PRIORITIZATION OF SANITARY

RESTRICATIONS FACING US EXPORTS OF

BOVINE, PORCINE, AND OVINE

FOR DETERMINATION OF

SURVEILLANCE NEEDS

by

Philip L. Paarlberg, Purdue University
Ann Hillberg Seitzinger, CEAH/VS/APHIS/USDA
John G. Lee, Purdue University
Mildred M. Haley, ERS /USDA

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by
Philip L. Paarlberg
John G. Lee
Department of Agricultural Economics, Purdue University
403 W. State Street
West Lafayette, IN 47907
E-mail: paarlbep@purdue.edu, jlee1@purdue.edu

Ann Hillberg Seitzinger
USDA:APHIS:Veterinary Services
Centers for Epidemiology and Animal Health
2150 Centre Ave, Building B, Mailstop 2E7
Fort Collins, CO 80526
E-mail: Ann.H.Seitzinger@aphis.usda.gov

Mildred M. Haley
USDA:Economic Research Service
1800 M Street NW
Washington, DC 20036-5831
E-mail: MHALEY@ers.usda.gov

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Abstract

This research uses databases of sanitary regulations facing U.S. livestock exports to examine the frequency and cost of sanitary barriers. Many sanitary regulations potentially face livestock exports; however, relatively few apply to most animals. As a share of the export unit value, regulations costs for cattle and bovine semen exports are smaller than those for swine and sheep. Most of the sanitary regulations appear justified from an animal health standpoint. While the cost savings from reductions in regulations are not large, for those farms that do export animals and regions along the Canadian and Mexican borders the importance of potential cost savings are greater.

Keywords: sanitary restrictions, exports, trade

JEL Codes: Q17

The views expressed here are those of the authors, and may not be attributed to the Economic Research Service or the U.S. Department of Agriculture.

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Introduction

As a result of limits placed on the use of traditional trade barriers like tariffs, quotas, variable levies, and voluntary export restraints by the Uruguay Round, the expectation was that sanitary and phytosanitary barriers would play a larger role in restricting agricultural trade. Under Article XX nations have the right to use trade barriers to protect animal and plant health and safety. Prior to the Uruguay Round, Article XX required such trade barriers to be no higher than necessary and to not be disguised protection. Those conditions proved unworkable, so during the Uruguay Round additional conditions were developed. The new conditions added that barriers should be based on science, recognize risk, and be designed to be either harmonized with international standards or equivalent to those standards. For livestock, sanitary barriers were to be aligned with the guidelines established by the World Organization for Animal Health.

While seen as an improvement, observers express concern that the rules under Article XX remain sufficiently vague to allow nations to use them to substitute for traditional measures of protection capped in the Uruguay Round Agreement on Agriculture (Roberts). Negotiations attempting to bring the tangled behemoth of sanitary and phytosanitary trade regulations into line with these provisions have faltered and grown costly as the negotiations proceed on a country-by-country, pest-by-pest or disease-by-disease, and issue-by-issue basis. Hayes and Kerr propose application of the concept of fulfillment costs to these negotiations. They suggest fulfillment costs related to information needs, negotiations, and monitoring and enforcement can quickly exceed the benefits of reducing sanitary and phytosanitary barriers to trade. The difficulty of recognizing risk in trade barriers, harmonizing rules or of establishing equivalency is seen as evidence of the continued trade protection hidden within Article XX rules (Henson and Wilson).

Studies have compiled databases of sanitary and phytosanitary regulations which researchers have used to assess the trade reducing role the regulations play (Wilson; Fontagne, von Kirchbach, and Mimonu; Neven). Beghin and Bureau survey methods and analyses of non-tariff barriers with a focus on what these methods offer and the weaknesses they contain. A common approach is for a database to assign a binary value to a sanitary or phytosanitary regulation when the World Trade Organization (WTO) is notified by a nation that a rule exists. For example, if there is a regulation reported under the WTO notifications, the database assigns a value of 1. If no regulation is reported, then a value of 0 is assigned. Econometric estimation across commodities and countries is used to estimate the trade reducing effects of sanitary and phytosanitary regulations.

One problem with this approach is that because it is catholic it cannot ask the simple questions of whether the regulation or regulations are legitimate health based regulations (Wilson). In the context of animal health, the approach cannot assess whether the regulations established by a country are justified as a means of protecting the health of the national herd or whether they are a protectionist trade barrier. Nor can the aggregate approach determine the cost or additional cost of a set of regulations. Are the regulations a substantial added cost or is the cost minor?

This research addresses the question of whether sanitary regulations facing U.S. exports of bovine, porcine, and ovine represent trade barriers and their respective costs. That is, the regulations exist, but are they costly to U.S. exports? The research proceeds in three phases. Phase 1 uses searchable databases of regulations for bovine, ovine, and porcine to summarize regulations facing U.S. livestock exports. Sanitary barriers facing U.S. exports of live bovine, bovine products, and bovine germplasm were categorized by Seitzinger and Forde and Seitzinger and Grandmaison into a searchable MS Access database according to the type of requirement, the disease/agent/condition being addressed, and the level at which the requirement is applied. Phase 2 develops estimates of the cost of the regulations and works that information into the excess demands facing the United States which can then be used to determine the economic impacts of various regulations.

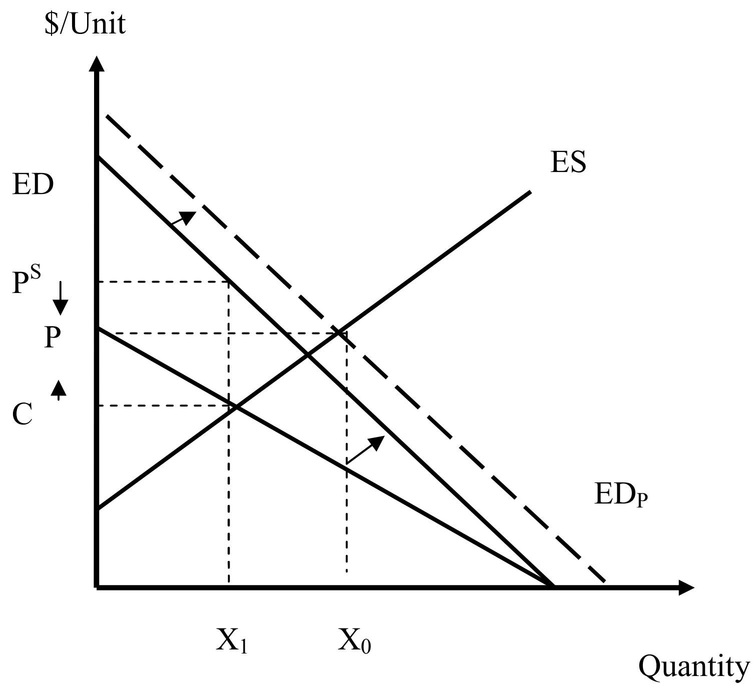
Conceptual Economic Models

A simplified economic framework for analyzing the effects of sanitary regulations facing U.S. livestock exports is depicted in Figure 1 which draws on the regulatory protection framework presented by Roberts, Josling, and Orden. Two departures from the Roberts, Josling, and Orden framework are introduced. One difference is that the importing country is not treated as a "small country," but rather faces a price responsive excess supply relationship. Another modification is the recognition that sometimes trade is banned and that there is a potential, or unrealized excess demand.

Abstracting from transportation and handling costs, if there are no regulatory costs, the common price to the buyer and seller is P in Figure 1 and the volume of trade is X_0. Sanitary regulations create two effects one is to shrink excess demand by imposing disease related bans. This is shown as the shift in excess demand in Figure 1 from the potential excess demand, ED_P, to the observed excess demand, ED. Further, as Roberts, Josling, and Orden demonstrate, the second effect of sanitary regulations is similar to that of a tariff since the cost of the regulations imposes a wedge between the price paid by the buyer, P^S, and the price received by the seller, C. The volume of exports falls to X_1.

The objective of this research is to use a searchable database of regulations to identify these gaps. One gap is that between potential excess demand facing U.S. and observed excess demand. Another gap is the cost of existing regulations. Once these

Figure 1: Impact of Reducing Sanitary Regulations



gaps are calculated, alternative surveillance scenarios examine reducing them so that the shifts shown by the arrows in Figure 1 can be determined. These shifts are used to prioritize surveillance efforts.

To determine the effects of livestock disease regulations on U.S. exports of bovine, porcine, and ovine several models are required because of differences in the products traded. One model is a U.S. agricultural model developed under a previous PREISM project. Since that model is focused on livestock for meat and milk, trade in breeding animals is treated as exogenous. Therefore, analysis of U.S. exports of breeding animals requires additional model development. Breeding animal trade reflects an investment decision which is a fundamentally different behavior than that represented by the excess demand shown in Figure 1 and will be discussed in a later section of the paper.

Effects of Import Regulations on the Excess Demands for Market Animals facing the United States

This section develops the conceptual framework for the research shown in Figure 1 in greater detail by recognizing the differences in motivating behavior for trade. The quarterly agricultural sector model developed under previous PREISM research relies on excess demands facing the United States for animals destined to be slaughtered. An alternative view must be developed for breeding animals and that requires a separate treatment.

The information needed consists of shifts and rotations in those demands that are tied to the import regulations for animal disease. For some endemic livestock diseases, import bans are imposed by some traders. For other diseases trade occurs, but costs are incurred in the form of certifications, quarantines and/or testing. Even with compliance, there always is a chance that a shipment is rejected and as Gallagher (1998) shows that risk affects the marketing margin and sales volume.

First consider the maximum potential excess demand. This is shown as ED_P in Figure 1. Let X_u be U.S. exports of an animal. Exports from the United States are the residual of total global imports less exports by rival exporting nations. There are n importing nations and m rival exporting nations. Let M_i denote imports by importer i and X_h be exports by exporter h. Thus, U.S. exports are:

(1) $X_u = \sum_i^n M_i - \sum_h^m X_h$.

Trade by each nation is the difference between domestic demand for animals and domestic supply of animals. Thus, these domestic relationships must be developed. Begin with domestic demand for market animals. Livestock export data indicate three broad categories of market animals are exported. Two types, those for immediate slaughter and those for feeding, are tied to the supply of meat. A third type of animal consists of dairy cows for milk production.

The derived demands for animals from the meat and milk industries are similar. Assume perfectly competitive firms producing a continuous flow output of good j at time t denoted $q_{j,t}$ where j can be meat or milk for sale at price $P_{j,t}$. The output of good j is given by a restricted production function $q_{j,t}(k_{j,f,t}, K_{j,t}, \zeta_{j,t})$ where $k_{j,f.t}$ indicates the use of factor of production f at time t in the production of good j. The existing capital stock in industry j at time t is $K_{j,t}$ while the technology used is denoted by $\zeta_{j,t}$. To simplify the presentation let f = a be the animal input and f = o be all other inputs. The firm pays $P_{a,t}$ for the animal and $W_{o,t}$ for the other input. Thus, profit for the firm at time t, π_t, is given as:

(2) $\pi_{j,t} = P_{j,t}q_{j,t}(k_{j,a,t}, k_{j,o,t}, K_{j,t}, \zeta_{j,t}) - P_{a,t}k_{j,a,t} - W_{o,t}k_{j,o,t}$.

Differentiating expression (2) assuming an interior solution gives the first-order conditions:

(3) $\partial\pi_{j,t}/\partial k_{j,a,t} = P_{j,t} \ (\partial q_{j,t}/\partial k_{j,a,t}) - P_{a,t} = 0$;

(4) $\partial\pi_{j,t}/\partial k_{j,o,t} = P_{j,t} (\partial q_{j,t}/\partial k_{j,o,t}) - P_{o,t} = 0$.

These conditions are recognized as the value of marginal product conditions and applying the implicit function theorem means the derived demand for animals can be written as:

(5) $D_{j,a,t} = D_{j,a,t}(P_{a,t}, P_{o,t}, P_{j,t}, K_{j,t}, \zeta_{j,t})$.

Trade is not only determined by the demands for animals, but also by the supply of animals. Expression (5) captures the demand. The supply of domestic market animals is treated as pre-determined since animals for market must be born and fed to market weight which means the short-run supply of market animals is effectively perfectly inelastic. Consider swine for example. Gestation takes roughly 114 days and the time to raise a market hog adds another 180 days. Thus, current period supply of market hogs are determined by decisions made some 300 days previously.

Thus, the endogenous variables driving trade decisions are demand determined. The demands for animals for slaughter and for feeding are the most transparent specifications so begin with those relationships. This research project focuses on bovine, porcine, and ovine trade restrictions so will assume a single good partial equilibrium model. The prices of other factors of production shown in equation (5) are treated as exogenous. The price of the meat output is treated as determined in global meat markets and is assumed given in order to simplify the discussion. To facilitate the manipulation of the expressions, assume excess supply and excess demand equations are linear. Excess demand equations are written as:

(6) $M_{a,t,i} = \alpha_i - \beta_{a,t,i} P_{a,t,i} + \beta_{o,t.i}P_{o,t} + \beta_{j,t,i}P_{j,t,i}$, $i = 1, 2,\ldots, n$.

Excess supply equations are written as:

(7) $X_{a,t,h} = a_h + b_{a,t,h}P_{a,t,h} - b_{o,t,h}P_{o,t,h} - b_{j,t,h}P_{j,t,h}$, $h = 1, 2,\ldots, m$.

Inserting equations (6) and (7) into the identity given by expression (1) yields the potential excess demand facing the United States:

(8) $X_{a,t,u} = \sum_i^n \{\alpha_i - \beta_{a,t,i}P_{a,t,i} + \beta_{o,t.i}P_{o,t,i} + \beta_{j,t,i}P_{j,t,i}\} - \sum_h^m \{a_h + b_{a,t,h}P_{a,t,h} - b_{o,t,h}P_{o,t,h} - b_{j,t,h}P_{j,t,h}\}$.

Some importing nations ban imports when there is a disease risk. To allow for this possibility assume that a subset of k importing nations accept imports from the United States. That is, n-k nations ban trade so actual U.S. exports are less than the potential exports. Thus, the observed excess demand, ED in Figure 1, can be given as:

(9) $X_{a,t,u} = \sum_i^k\{\alpha_i - \sum_i^k\beta_{a,t,i}P_{a,t,i} + \beta_{o,t.i}P_{o,t} + \beta_{j,t,i}P_{j,t,i}\} - \sum_h^m \{a_h + \sum_h^m b_{a,t,h}P_{a,t,h} - b_{o,t,h}P_{o,t,h} - b_{j,t,h}P_{j,t,h}\}$, where $k < n$.

A more complicated structure for the excess demand facing the United States appears when an importing country does not ban imports from the United States, but instead insists on tests, quarantines, and the like as identified in Phase 1 of the research. These regulations impose additional costs on the U.S. exporting agent. Denote such costs $c_{a,i}(\gamma_{a,i})$ where $\gamma_{a,i}$ indicates the magnitude of import regulations for animals. Assume that $\partial c_{a,i}/\partial \gamma_{a,i} \geq 0$, or the cost of complying with import regulations is non-decreasing in the magnitude of regulation. A similar structure applies to other factors of production subscripted by "o" and to the output goods subscripted by "j." Importing nations also may impose traditional trade barriers such as *ad valorem* tariffs, $(1+t_{a,i})$, or specific tariffs, $T_{a,i}$. Since the excess demand and excess supply equations given by (6) and (7) represent behavior by importers and rival exporters, the role of exchange rates needs to be included. Let e_i and e_h be the exchange rate for importing and rival exporting nations, respectively.

With this structure it is time to consider the problem faced by U.S. exporters of the commodity. The U.S. exporting firm purchases quantity $q_{a,i}$ of the animal in the United States at a price in U.S. dollars of $P_{a,u}$ for sale to importer i in foreign currency at price $P_{a,i}$. To access the import market, the exporter has incurred disease test and quarantine costs in U.S. dollars of $c_{a,i}(\gamma_{a,i})$.

Nevertheless, there is uncertainty over whether the good can be sold in the import market. Tests prior to shipment or at the port of entry could reveal some pathogen or risk material even though tests at port of export show no pathogen or risk material as happened with beef shipped to Korea in 2006. Rules allowing export could have been ignored or applied in correctly as occurred with beef shipped to Japan in January 2006. The state of nature could have changed from disease-free to diseased. It is also possible that import authorities behave capriciously as has happened with U.S. poultry exports to Russia. Gallagher (1998) investigates a similar issue of the effect of random application of nontariff barriers that halt a fraction of shipments on marketing margins and finds that such administrative barriers reduce trade.

Let $\rho_{a,i}(\gamma_{a,i})$ be the probability of a completed sale to importer i and $(1-\rho_{a,i}(\gamma_{a,i}))$ be the probability of the imports being blocked. The probability of a completed import sale may be tied to the import regulations imposed on the exporting agent. As the regulations increase, the likelihood of a contaminated good arriving at the port of entry falls, so the probability of a successful entry rises; $\partial \rho_{a,i}/\partial \gamma_{a,i} \geq 0$.

A successful sale generates a profit, $\Pi s_{a,i}$, where sales revenue, $P_{a,i}q_{a.i}$, is balanced against the costs of moving the commodity into the import market. Costs include the purchase of the commodity in the United Sates, $P_{a,u}$, the costs complying with country i's regulations, $c_{a,i}(\gamma_{a,i})$, conversion into country i's currency, and the costs of *ad valorem* and specific tariffs, $(1+t_{a,i})$ and $T_{ia,i}$. Thus:

(10) $\Pi s_{a,i} = P_{a,i}q_{a,i} - [e_i(P_{a,u} + c_{a,i}(\gamma_{a,i}))(1+t_{a,i}) + T_{a,i}]q_{a,i}$.

An unsuccessful sale to country i, $\Pi u_{a,i}$, results in the exporting firm incurring the purchase and regulatory costs but receiving no revenue. An unsuccessful import also means the exporting agent pays no import duties. Thus, the return to an unsuccessful sale is:

$$(11)\ \Pi u_{a,i} = -[e_i(P_{a,u} + c_{a,i}(\gamma_{a,i}))]q_{a,i}.$$

Consequently the problem for a perfectly competitive exporting firm is to determine the export quantity purchased for shipment to importer i that maximizes the expected profit given the import price and the U.S. price, or:

$$(12)\ \underset{q_{a,i}}{\text{MAX}}\ E(\Pi_{a,i}) = \rho_{a,i}(\gamma_{a,i})\Pi s_{a,i} + (1-\rho_{a,i}(\gamma_{a,i}))\Pi u_{a,i}.$$

The first-order condition after some simplification is:

$$(13)\ [\rho_{a,i}(\gamma_{a,i})(P_{a,i} - T_{a,i}) - e_i(P_{a,u} + c_{a,i}(\gamma_{a,i}))(1 + \rho_{a,i}(\gamma_{a,i})t_{a,i})]q_{a,i} = 0.$$

Comparing the margin under uncertainty to that under certainty shows that the presence of import risk reduces the profit margin. The cost side of the problem is not much affected since the trading firm buys the commodity for export. But, the revenue side is strongly affected as sales revenue is lost when trade is blocked.

From (13) the price in each importing nation can be linked to the U.S. export price:

$$(14)\ P_{a,i} = [e_i(P_{a,u} + c_{a,i}(\gamma_{a,i}))(1 + \rho_{a,i}(\gamma_{a,i})t_{a,i})]/ \rho_{a,i}(\gamma_{a,i}) + T_{a,i},$$

and inserted into the excess demand facing the Untied States:

$$\begin{aligned}(15)\ X_{a,t,u} = \textstyle\sum_i^k \{&\alpha_i - \beta_{a,i}\{[e_i(P_{a,t,u} + c_{a,i}(\gamma_{a,i}))(1 + \rho_{a,i}(\gamma_{a,i})t_{a,i})]/ \rho_{a,i}(\gamma_{a,i}) + T_{a,i}\} \\ &+ \beta_{o,t.u}\ \{[e_i(P_{o,t,u} + c_{o,i}(\gamma_{o,i}))(1 + \rho_{o,i}(\gamma_{o,i})t_{o,i})]/ \rho_{o,i}(\gamma_{o,i}) + T_{o,i}\} \\ &+ \beta_{j,t,i}P_{j,t,i}\{[e_i(P_{j,t,u} + c_{j,i}(\gamma_{j,i}))(1 + \rho_{j,i}(\gamma_{j,i})t_{j,i})]/ \rho_{j,i}(\gamma_{j,i}) + T_{j,i}\} \\ &- \textstyle\sum_h^m \{a_h + b_h e_h P_u - b_{o,t,h}P_{o,t,h} - b_{j,t,h}P_{j,t,h}\}\ .\end{aligned}$$

From the excess demand given by (15) the impacts of change in regulations and entry conditions are apparent. If regulatory costs increase and nothing else is affected, then U.S. exports fall. If the probability of successful entry rises, there are two effects. One effect reduces U.S. exports because more *ad valorem* tariff is incurred. On the other hand, more sales are made so sales revenue is higher. The combined effect is non-negative since $\rho_{a,i} \leq 1$:

$$(16)\ \partial X_{a,u}/\partial\rho_{a,i} = \beta_i e_i \rho_{a,i}^{-2}(P_{a,u} + c_{a,i})(1 + t_{a,i} - \rho_{a,i}t_{a,i}) \geq 0.$$

Increased regulation, $\partial\gamma_{a,i} \geq 0$, has two conflicting effects with the combined effect ambiguous as shown in expression (17):

$$(17)\ \partial X_{a,u}/\partial\gamma_{a,i} = -\ \{\beta_{a,i}[e_i(1 + \rho_{a,i}(\gamma_{a,i})t_{a,i})]/\ \rho_{a,i}(\gamma_{a,i})\}\partial c_{a,i}/\partial\gamma_{a,i} + \{\beta_i e_i \rho_{a,i}^{-2}(P_{a,u} + c_{a,i})(1 + t_{a,i} - \rho_{a,i}t_{a,i})\}\partial\rho_{a,i}/\partial\gamma_{a,i}.$$

One effect is to raise the shipping cost which reduces U.S. exports. The other is to increase the probability of entry which as shown above boosts exports. If increased regulation increases cost but does not raise the probability of entry, U.S. exports fall. On the other hand, if the cost effect is small, but the probability of entry rises, U.S. exports can expand.

Expression (15) applies to animals that are slaughtered for meat, market animals. A quarterly model of U.S. agriculture described in Paarlberg, Hillberg Seitzinger, Lee, and Mathews Jr. uses similar specifications for excess demand to determine the economic market and welfare effects of a livestock disease outbreak. Thus, it focuses on the vertical and horizontal linkages among livestock products, livestock, and feeds. This means that while trade in breeding animals is included, that trade is exogenous. The model determines the price of market livestock but not breeding livestock. Thus, this model can be used to analyze how changes in regulations facing U.S. exports of stocker, feeder, grower, and finish animals affect market prices for meat animals and the associated welfare effects.

Model of Trade in Breeding Animals

Changes in sanitary regulations for breeding animals cannot be analyzed in the U.S. agricultural sector model because that model focuses on the price formation of market animals. Breeding animals must be handled in a fundamentally different way. In this case the livestock farm is buying improved genetics from the United States so is making investment decisions over the period t = 0 to t = T. The approach is to first determine a function for the flow of quasi-rents linked to time. Then consider the decision to replace a breeding animal at a point in time and finally to expand the number of time periods.

To obtain the function describing the quasi-rent stream define profit or the quasi-rent for the livestock producer at time t, $\pi_{a,t}$, as total revenue from animal sales less costs of raising the animals. Total revenue is the price of future progeny animals sold, $P_{a,t}$, multiplied by the quantity of animals sold, $q_{a,t}$. The quantity of animals sold depends on the genetics or technology given by $\zeta_{a,t}$. Variable costs like feed, veterinary costs, and so forth are indicated by $C_{a,t}$ and depend on $q_{a,t}$. Thus, the quasi-rent can be expressed as:

$$(18)\ \pi_{a,t} = P_{a,t}q_{a,t}(\zeta_{a,t}) - C_{a,t}(q_{a,t}(\zeta_{a,t})).$$

The livestock grower's decision is to select the genetics that maximizes quasi-rents from animal sales. Differentiating (18) with respect to $\zeta_{a,t}$ gives the optimality condition:

(19) $(P_{a,t} - \partial C_{a,t}/\partial q_{a,t})(\partial q_{a,t}/\partial \zeta_{a,t}) = 0$, or

the animal price equals the marginal cost of the genetics. From (19) the optimal $\zeta_{a,t}$ can be determined. Combining (18) and (19) links the optimal quasi-rent stream to time:

(20) $\pi_{a,t} = \pi_a(t)$.

This function indicates the maximum quasi-rent obtained by the livestock producer at each point of time from the genetics.

Next consider the decision to replace the breeding animal at a single time period. The present value of the profit from breeding animal 1, Z_1 , is the present value of the quasi-rent stream, $\int_0^T \pi_a(t)e^{-rt}dt$, where r is the interest rate, plus the present value of cull receipts, $S(T)e^{-rT}$, less the cost of the breeding animal purchased at time period 0, C_0:

(21) $Z_1 = \int_0^T \pi_a(t)e^{-rt}dt + S(T)e^{-rT} - C_0$.

Differentiating (20) with respect to time yields:

(22) $\pi_a(T) + \partial S(T)/\partial T = rS(T)$, where $\partial S(T)/\partial T < 0$;

which indicates animal 1 will be culled when the marginal quasi-rent less depreciation equals the interest return from investing the cull value in the bond market.

Allowing a chain of breeding animals over a succession of time periods is a more realistic formulation of the farmer's problem. Let subscript k index the animal in the chain sequence. The general form of the present value of profits from breeding animals 2 and higher is:

(23) $Z_k = [\int_0^T\pi_a(t)e^{-rt}dt + S(T)e^{-rT}-C_0]e^{-r(k-1)T}$.

Summing across an infinite number of breeding animals gives the present value of aggregate profits:

(24) $Z = \sum_1^\infty Z_k = [\int_0^T\pi_a(t)e^{-rt}dt + S(T)e^{-rT}-C_0]/(1-e^{-rt})$.

Differentiating with respect to T and rearranging gives:

(25) $(C_0/\theta) = \theta^{-1}[\int_0^T\pi_a(T)e^{-rt}dt + S(T)] - \pi_a(T) - \partial S(T)/\partial T$,

where $\theta = (1-e^{-rT})/r$ which is the present value of \$1 for T years. The right-hand side of expression (25) describes the net marginal benefit of replacing an old animal with a new one. The term $\theta^{-1}[\int_0^T\pi_a(T)e^{-rt}dt]$ describes the average annual return to a new breeding animal while the term θ^{-1} S(T) captures the cull value of the old animal, so indicates the value of the new animal. The last two right-hand side terms are the annual flow of quasi-rent from the old animal and its depreciation. The left-hand side of (25) is the annual investment cost. Thus, breeding animals are culled when the difference in the value of a new animal compared to the value of the old animal equals the cost of the new animal. If the net increase in rent flow is less than the cost, the old animal should not be culled. If the net benefit exceeds the cost, the cull decision should have occurred sooner.

The implicit function theorem allows specification of the demand for a breeding animal, D_b, as depending on the present value of the return to a new animal relative to the quasi-rent for an old animal, $\int_0^T \pi_a(T)e^{-rt}dt - \pi_a(T)$, the cull return, $S(T)$, the rate of depreciation, $\partial S(T)/\partial T$, and the cost of a new breeding animal, C_0:

(26) $D_b = D_b(\int_0^T \pi_a(T)e^{-rt}dt - \pi_a(T), S(T), \partial S(T)/\partial T, C_0)$.

Recall that the quasi-rent used in (18) is determined by the price of progeny sold plus the variable costs of raising the animals.

As discussed above, trade is not only determined by the demands for animals, but also by the supply of animals. In addition to the gestation time, a breeding animal must mature to be bred. Since animal production is time dependent and there is little flexibility, the supplies of the various types of animals available at a point in time are treated as predetermined.

The critical question is the appropriate modeling framework for breeding animals. The following discussion presents 4 alternative models for consideration. Three approaches are traditional elasticity approaches. The fourth framework relies on Nash bargaining game theory.

Figure 2 below shows the modeling framework for approach 1. The key features revolve about the elasticity in the markets. The left panel shows the United States while the right panel shows the world market. In the United States domestic demand for breeding animals is denoted D and domestic supply is denoted S. The difference between these schedules is excess supply. The excess supply, ES_0, reflects the situation if there are no regulation costs. The elasticity of the excess supply is a linear combination of the domestic demand and supply elasticities where the weights are the inverse trade shares. Estimated breeding inventory equations show very inelastic behavior for demand with estimates ranging from 0.107 for dairy cattle to 0.025 for swine (Paarlberg, Hillberg Seitzinger, Lee, and Mathews, Jr.). Beef cattle breeding inventories and ewe inventory elasticities are also estimated with that range. Because export animals for breeding need to be of a specified maturity and it takes time to grow the animal, supply elasticities should approach 0. Export quantity values range from a few hundred animals to a few thousand. Inventories for breeding animals number in the millions. For example, before the BSE case in December 2003, dairy bull exports were around 1,000 head per quarter while dairy cow exports were around 10,000 head per quarter. But the United States had a dairy cattle milking inventory of over 9 million head with 4 million heifer replacements and 500 thousand bulls. Beef bull exports were 3,000 head per quarter with beef cow export of 5,000-10,000 head per quarter. The breeding beef cattle inventory ran around 33 million head of which 5 million are replacements and 1.5 million bulls. Even allowing for elite breeding bulls being a smaller subset of all bulls suggests the magnitudes of the inverse trade shares used in the excess supply elasticity calculation are huge which translates into very elastic excess supply.

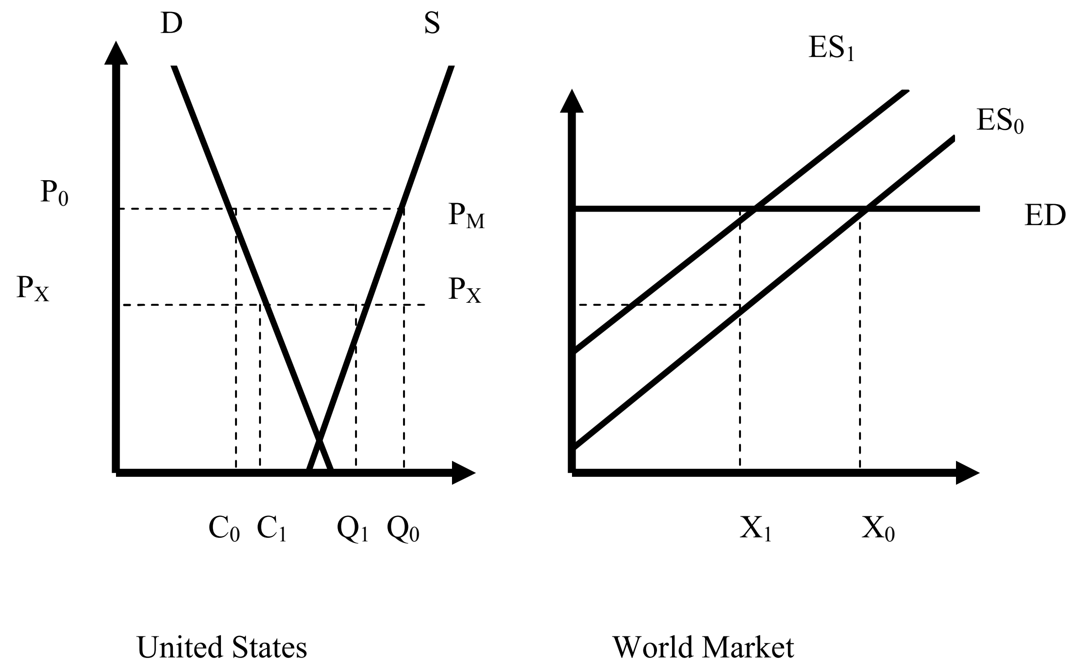
Considering potential importers and rival exporters suggests that the excess demand elasticity facing the United States would be large in absolute value. Thus, the excess demand faced by the United States, ED, in approach 1, is treated as perfectly elastic and the United States is a "small country" price taker. If there were no regulation costs, the equilibrium quantity of exports would be X_0 and the price would be P_0. Domestic quantities consumed and produced would be C_0 and Q_0.

Roberts, Josling, and Orden argue that regulation costs acts like a tariff, but without the tariff revenue. Instead the wedge between the prices reflects compliance cost. This is shown by drawing a perceived excess supply, ES_1, left of the original that includes the cost of regulation. The quantity of exports of breeding animals is X_1 which is less than the quantity that would prevail in the absence of the regulations. The price paid by the importer is P_M and the price received by the exporter is P_X with the gap being the cost of the regulations. Because the excess demand facing the United States is perfectly elastic by assumption, the price paid by the importer matches the original price, $P_0 = P_M$. The price received by the exporter falls by the full cost of the regulations, from P to P_X. That is, all changes in sanitary cost are absorbed by U.S. exporters of breeding animals. The quantities demanded and supplied in the United States adjust accordingly.

An alternative approach is to introduce elasticity into the excess demand facing the United States. This is depicted in figure 3 below. This means the United States is a "large country" in world breeding animal trade and its export volume affects the level of world price. As drawn, the excess demand is less elastic (more inelastic) than the excess supply. The major difference with the situation shown in Figure 1 is that now the price paid by the importing nation is affected by the regulations. Earlier that price was unchanged, but now it rises from P without the regulations to P_M in the presence of the regulations. The price received by the exporter falls from P to P_X because of the sanitary regulations and the quantity of breeding animals exported from the United States falls from X_0 to X_1. The gap between P_M and P_X is the cost of the sanitary regulations.

The incidence of the changes is governed by the relative elasticities; just like for tariffs and export subsidies. Because the excess demand is drawn to be relatively less elastic than the excess supply, the adjustment falls on the price paid in the importing country. The price received by the exporter falls little and the quantity of exports is slightly lower. Had the figure been drawn with more balanced slopes, the adjustments would have been more evenly shared.

Figure 2: Sanitary Regulations on U.S. Livestock Exports with a Perfectly Elastic Excess Demand



The third approach again varies the assumed elasticity of excess demand for breeding animals facing the United States. The argument made is that foreign buyers of breeding animals are actually buying unique genetics tied to individual U.S. animals which cannot be found in other animals. Therefore, buyers are not willing to forego a purchase once those genetic traits have been located and hence the quantity of breeding animals exported by the United States is not sensitive to price. That is, the excess demand facing the United States for breeding animals is perfectly inelastic as depicted in Figure 4.

The implications of this excess demand elasticity are that the price charged to the importer, P_M, rises to fully cover the cost of sanitary regulations. The price received by the U.S. exporter, P_X, is unchanged by the cost of sanitary regulations and remains at P because U.S. breeding animal exports remain at X_0. In this scenario, the U.S. exporter does not care about the cost incurred in exporting animals because they are fully passed through to the foreign buyers.

In the fourth approach a Nash bargaining solution from game theory is applied. The excess demand-excess supply equilibrium approaches previously described assumes multiple transactions occur in a market environment. The quarterly export data show discrete, small, occasional exports. Export unit values vary greatly across destinations while the values to specific destinations are often stable across time. This suggests transactions occur as individual negotiations between a buyer and seller. Shipment data supports the hypothesis that many of these are single transactions between a single seller

Figure 3: Sanitary Regulations on U.S. Livestock Exports with a Less Elastic Excess Demand

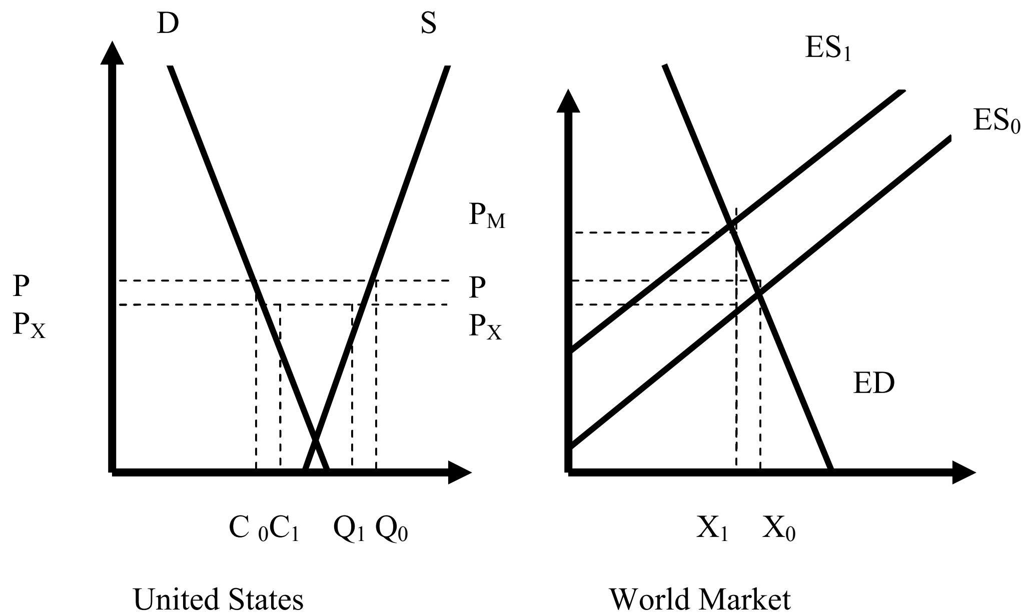
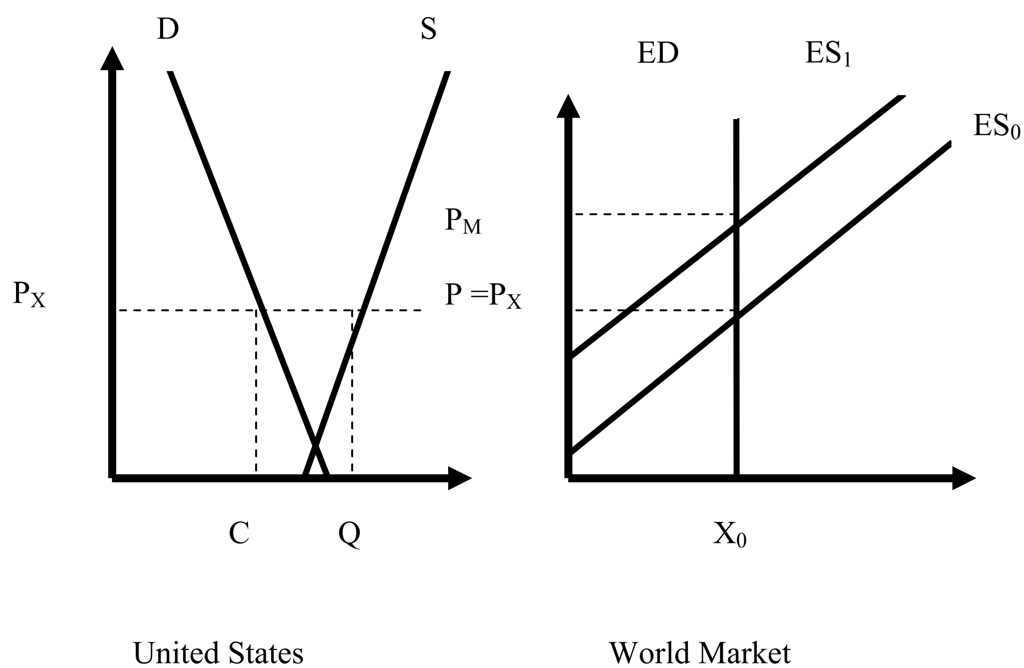


Figure 4: Sanitary Regulations on U.S. Livestock Exports with a Perfectly Inelastic Excess Demand



and buyer. In that situation a bargaining game framework would be the correct framework.

The situation assumed is that there are two players involved in a cooperative game. That is, the players must agree to a solution or there is no payoff to either player – there is no sale. There are 4 key assumptions. One assumption is Pareto-efficiency, or that no player will agree to a solution that does not increase or leave unchanged their payoff. Second, the game is independent of the labeling of players. Third, if new outcomes are added to the game, then either one of the new outcomes is a new solution or the welfare (payoffs) of the new outcomes are lower than those of the initial solution. Fourth, the payoffs are linear in the strategic variable.

The critical aspect is to define the strategic variable. An animal sale is treated as a two part negotiation. The first part sets a price for the animal, P, paid by the buyer to the seller. Because P is assumed to equal the buyer's marginal utility for the animal and the seller's marginal cost, there is no change in welfare among the players. In the second part of the transaction, the buyer and seller must determine the allocation of export regulation costs. To simplify the illustration normalize the export regulation cost at 1. The payoff to the seller of breeding animals, V, is a non-negative linear function of the proportion of the export regulation cost paid by the buyer (importer), R, or:

(1) $V = R$.

The payoff to the buyer of breeding animals (importer), U, is a non-positive function of the strategic variable, R, or:

(2) $U = 1 – R$.

As the share of the regulation cost paid by the buyer rises, the buyer's payoff (economic welfare) falls.

When $R = 0$ the buyer pays none of the regulation cost, then $U=1$ and $V = 0$, or the importer (buyer) captures all of the cost saving. When $R = 1$ the buyer pays all costs, so $U = 0$ and $V = 1$. The exporter (seller) gains all of the benefit.

Let the bituple (V^T, U^T) give the payoffs to the threat strategies of each player. If the Nash axioms are satisfied, then there exists an equilibrium bargaining solution determined by:

(3) $\text{MAX } (U-U^T)(V-V^T)$
Subject to: (U, V) feasible.

This situation is illustrated in figure 5. Let U_M and V_M denote the maximum payoff to the buyer and seller, respectively. The linear relationship between V_M and U_M establishes the boundary of the feasible set. The linearity reflects assumption number 4.

Since Pareto-optimality is assumed, the equilibrium must lie on the boundary of the feasible set.

Substituting expression (1) and (2) into expression (3) and maximizing with respect to R gives:

(4) $R = (1 - U^T + V^T)/2$.

The threat payoffs occur if no bargain is reached and control the division of the cost. When $U^T > V^T$, the importer has the stronger bargaining position and the share of the cost paid by the exporter rises. When $U^T < V^T$, the exporter has the stronger bargaining position and the payoff to that player rises.

This case is structured such that a failed bargain generates no cost saving and no payoff to either player. That is, if the players cannot agree on how to share the regulatory cost, there is no animal sale. Thus, $(V^T, U^T) = (0, 0)$ and is indicated in figure 4 as the origin.

The equilibrium point is shown as N in Figure 4 where the parabola is tangent to the boundary of the feasible set. This solution is known as "split-the-difference" solutions with each player paying ½ of the export regulation cost. This means that when there is a reduction in the regulatory cost of exporting breeding animals the buyer and seller equally split the cost saving.

Of the four approaches, the Nash bargaining model appears to be the framework most consistent with the institutional structure of the market. International trade in breeding animals is conducted by specialized farms, transactions are infrequent and often limited to a few animals, and the reported export unit values show some rigidity across time. In contrast, the excess demand frameworks are based on consistently large numbers of animals being traded in open markets with many buyers and sellers. Such characteristics do not appear to match U.S. trade in breeding animals so the Nash bargaining framework is used where it is assumed that each player has equal bargaining strength.

Numerical Analysis

Using information from Phase 1 on the nature of the regulations, plus cost information allows parameterization of the effects in the excess demands facing the United States. The frequency of regulations faced can be determined. Solving the U.S. agricultural sector model with alternative shifts identifies the economic costs of the regulatory environment faced by U.S. market animal exports. For breeding animals the cost savings split between buyers and sellers from changes in regulations can be identified.

The numerical analysis begins with U.S. trade data. It then compiles information on regulations to which costs are applied. Finally export shocks are determined and introduced into a quarterly U.S. agricultural sector model developed under an earlier PREISM cooperative agreement (Paarlberg, Hillberg Seitzinger, Lee, and Mathews Jr.).

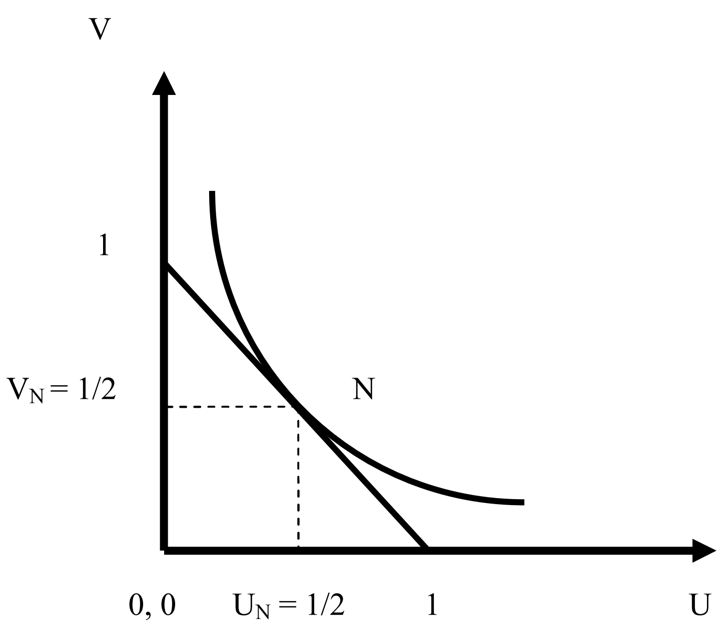
Data

The following sections describe the data and regulations information used to determine the export shocks. It begins with the U.S. export data for livestock and then covers the regulations. The process of applying costs to the regulations is described.

Trade Data

The export data is from the U.S. International Trade Commission (USITC) which compiles export data from the U.S. Customs Service and makes that data available through its trade data web (USITC). The data recorded are the monthly quantity, value, and free-along-side (FAS) unit value of exports from 1989 through 2007. Since the U.S. agricultural sector model is quarterly, quarterly data is used for this project. Bovine data is divided into HTS sub categories of purebred male dairy for breeding, purebred female dairy for breeding, purebred male non-dairy for breeding, purebred female non-dairy for breeding, and not elsewhere specified or otherwise included (NESOI). Porcine are divided into purebred for breeding, NESOI 50 kg and heavier, NESOI 50 kg and lighter. Ovine are not further divided.

Figure 5: Nash Bargaining Model of Trade in Breeding Animals



Cases of bovine spongiform encephalopathy (BSE) in the United States and Canada affect the export data. The initial cases occurred in late May 2003 for Canada and in late December 2003 for the United States. Thus, the export destinations and levels before 2003 differ from those after because many nations restricted imports of bovine from the United States and Canada. Even after 2003 exports remained affected as restrictions were ended by various export destinations at different times. Thus, the analysis needs to recognize the disruption of exports from the BSE cases by considering trade regulations and volumes prior to 2003 as well as after 2003.

The USITC data report quarterly totals for each destination. Some costs are not incurred on a per head basis, but rather on a per shipment basis. In order to allocate costs incurred on a per shipment basis, a shipment size must be determined for each destination. Internal data collected by USDA/APHIS does record the number of animals in each shipment. Based on that data, the assumption is that except for Canada and Mexico, each quarterly observation for the number of head going to a destination is one shipment. For Mexico and Canada average shipment sizes are calculated from the USDA/APHIS data.

Regulations Data

Regulations for bovine, porcine, and ovine trade as of January 2008 as reported on the USDA:APHIS:Veterinary Services IREGS website are included in a searchable database compiled by the Animal and Plant Health Inspection Service, U.S. Department of Agriculture (Seitzinger and Forde; Seitzinger and Grandmaison). Trade regulations by export destination can be divided in many alternative ways. The process here is to separate the regulations by species, then according to type (general or disease specific) and then by requirement (test, treatment, quarantine, etc.) and the level at which it is applied (individual animal, regional, state, national, etc.).

For example, U.S. bovine exports may be required to be tested for Enzootic Bovine Leukosis (EBL). Countries requiring an EBL test for cattle include among others: Korea, South Africa, Saudi Arabia, Japan, Egypt, Bermuda, Taiwan, Cayman Islands, Honduras, Cuba, China, and Vietnam. Korea and Egypt require 2 tests; most require only a single test. Some nations specify only one type of test. Algeria specifies an Agar-Gel Immunodiffusion (AGID) test. Other nations allow options. Bermuda allows exporters to use the AGID test or an ELISA test.

Thus, the databases are first searched for tests, treatments, quarantine rules, paperwork, and any other requirements by importing country. These lists are compared to USITC data of actual U.S. exports by quarter from 1989 through 2007. Database coverage of export destinations varies by species. For cattle 11-16% of export destinations are excluded from the database. For swine the share of export destinations not recorded in the database ranges from 19.2% for NESOI swine 50 kg and over to 44.4% for breeding swine. Ovine destinations excluded represents 28.6% of U.S. exports.

The database information can be separated in two ways. One method for examining the data is according to frequency of regulations from nations that imported U.S. animals from the first quarter of 1989 through the fourth quarter of 2007. That is, for each HTS category how many of the nations recorded in the database that actually have imported U.S. animals require a specific test, treatment, or other regulation. This method measures the frequency of regulations by export destination. Another way to examine the data is to calculate the number of animals exported by the United States in each HTS category affected by the various regulations in 2007. This method identifies which regulations are encountered most often and weights the regulations in favor of those imposed by the largest U.S. trading partners like Canada and Mexico.

The frequency of regulations by country importing U.S. animals for the first quarter of 1989 through the fourth quarter of 2007 are categorized into very infrequent (10% or less of the destination countries), infrequent (11-25% of destinations), common (26-50% of destinations), frequent (51-75% of destinations), and very frequent (76% or more of the destinations). The results are shown in Tables 1-9. There is a clear and consistent pattern across species. U.S. cattle exports face a large variety of regulations with the majority of regulations appearing in the very infrequent and infrequent categories. Regulations facing U.S. swine exports show a bi-modal distribution. The ovine data is distributed more uniformly. There are many regulations for ovine that appear very infrequently with the frequency of regulations in the infrequent, common, and frequent categories showing roughly the same number of regulations.

Although all HTS cattle classifications show a pattern where very infrequent regulations dominate, there are some differences among the cattle that reflect the pattern of recorded U.S. export destinations (Tables 1-5). Exports of purebred dairy cattle for breeding face a slightly greater number of regulations than other cattle classifications and this bias occurs in the very infrequent category. For example, the database records 38 regulations for exports of purebred female dairy cattle for breeding whereas 35 regulations of the same type apply to exports of purebred non-dairy females for breeding. Thus, among the nations importing U.S. dairy female cattle there are additional costs of tests for Blackleg, clostridial disease, and the requirement of being in a herd registered by the Dairy Herd Improvement Association.

Most export destinations for U.S. cattle require inspection of outgoing animals along with a health certificate and an embarkation certificate. There are some shifts among categories. Both dairy and non-dairy males show a Vesicular Stomatitis Virus (VSV) test or treatment required in 10% or less of the export destinations, but females show the test or treatment required in 11-25% of destinations. Infectious Bovine Rhinotracheitis (IBR) and Enzootic Bovine Leukosis (EBL) test regulations change frequency category. For exports of purebred dairy males for breeding the IBR test requirement falls in the very infrequent category but for all other cattle HTS classifications that requirement is in the infrequent classification. The requirement for EBL appears in the common category for purebred dairy females for breeding, but in the infrequent category for all other HTS classifications. In the common category (26-50% of destinations in the database), there are generally 3 regulations. A Brucellosis test and a test for bovine Tuberculosis are required by nearly 40% of the destinations. More than one-third of the destinations to which the United States has shipped cattle adopted a ban on imports of cattle from the United States because of either Bovine Spongiform Encephalopathy (BSE) or Bluetongue as of January 1, 2008. These bans are in place even though the World Organization for Animal Health (OIE) classifies the United States as a Controlled Risk country and Bluetongue can be regionalized to the U.S. Southeast as Canada has done.

For U.S. swine exports the database indicates no regulations in the very frequent category (Tables 6-8). That is, no regulation appeared in 76% or more of the nations to which the United States exported swine. In the infrequent category, the only regulation appearing is for Vesicular Stomatitis Virus (VSV). Thus, regulations for swine appear in the very infrequent, common, or frequent categories. Although the very infrequent category has the most regulations, there is a greater balance than seen for cattle and the pattern varies by HTS classification because the destinations vary. The regulations categorized as very infrequent are the same except for inspection of incoming animals for NEOSI swine and one case of an animal registration requirement for NESOI swine over 50 kg weight. The regulations categorized as common and infrequent vary between breeding animals and NESOI swine. The frequency of a Pseudorabies test requirement, of a required health certificate, quarantine requirements, of rules on transport and a disease free origin are less frequent for purebred breeding swine than for NESOI swine. These comparisons reflect differences in the nations making purchases. That is, of the nations actually importing U.S. swine from 1989 through 2007 a greater percentage importing NESOI swine had a disease free origin requirement than did nations importing breeding swine. In all cases, swine usually face tests for Brucellosis, Tuberculosis, Pseudorabies, Porcine Reproductive and Respiratory Syndrome (PRRS), parasites, and Transmissible Gastroenteritis (TGE).

Table 9 gives the regulation frequency for ovine. Most rules fall into the very infrequent category while none are included in the very frequent category. Other categories are roughly equally balanced. Tests or treatments for Leptospirosis, Ovine Progressive Pneumonia (OPP), and paratuberculosis – Johne's disease fall into the infrequent category with between 11% and 25% of destination having a regulation. Tests or treatments for Bluetongue, ovine Tuberculosis, and parasites are required by more destinations so are categorized as common. A Brucellosis test is the most common with 51% of the countries listed in the database requiring a test.

An alternative method of examining the regulations is to count the number of animals affected by each regulation. Tables 10-18 show these values using 2007 annual U.S. animal exports by HTS category. One general observation is that this method means that regulations on animal trade by Canada and Mexico dominate in most cases. Since those nations impose few regulations, the proportion of U.S. animal exports facing heavy regulation is small. The most frequent regulations based on 2007 annual U.S. animal exports are embarkation and health certificates. For example, Table 11 shows that of the 8452 head of purebred dairy female cattle exported in 2007, 7054 head required an embarkation certificate and 5957 required a health certificate. Another feature of the regulations is that the most common tests required are for Brucellosis and bovine Tuberculosis. Treatment for ectoparasites is also frequent for most HTS categories.

For U.S. swine exports regulations additional to the Brucellosis and Tuberculosis tests occurring very frequently require animals to be sourced in disease free regions, to adhere to rules on animal transport, as well as to the required days in quarantine. For sheep exports by the United States transport rules are common.

Beyond the regulations generally applied to exports of most animal categories, there are some variations for additional regulations applied by HTS category. For purebred dairy males, few animals were exported in 2007 and few additional regulations experienced (Table 10). Purebred dairy female cattle exports in 2007 faced more regulations, especially tests for BVD, Campylobacterosis, Leptospirosis, Parainfluenza 3, and Trichomonasis (Table 11). These animals often were required to be treated for endoparasites as well as ectoparasites. The database also indicates rules on transportation were encountered often in 2007. Purebred male non-dairy cattle exported by the United States in 2007 were subject to additional tests for BVD, IBR, EBL, Leptospirosis, Trichomonasis (Table 12). Quarantine rules and transport rules were also important for this group. Non-dairy female cattle exports (Table 13) reflect the additional tests required by Honduras. The additional regulations frequency for Not Elsewhere Specified cattle reflected the large sale in 2007 to Thailand (Table 14). Thus, many of these animals were subject to tests for Bluetongue and Paratuberculosis (Johne's). Sourcing these cattle in disease free regions was also a common requirement.

Tables 15-17 show that U.S. swine exports in 2007 were subjected to more regulations than were cattle. The most common regulations beside embarkation and health certificates were days in quarantine, sourcing swine in disease free regions, and transport rules. Tests for Brucellosis and Pseudorabies were applied in most instances. Common tests applied included tests for PRRS, TGE, Plueroneumonia, and tuberculosis.

Sheep regulations imposed in 2007 are reported in Table 18. Since Mexico and Canada dominate U.S. exports, the embarkation certificate and transport rules dominate. The few other destinations for U.S. sheep are in Latin American and Caribbean nations which bought small numbers of animals in 2007. These nations imposed tests for OPP, Blackleg, Paratuberculosis, Entertoxemia, and ovine Tuberculosis. Treatments for both ectoparasites and endoparasites were often required.

Sanitary Regulations Affecting U.S. Bovine Semen Exports

As is true for live bovine trade, testing and treatment requirements for US bovine semen exports line up reasonably well with diseases which are present in the United States, although the frequency of required tests raises some questions. Table 19 shows testing and treatment requirements for individual diseases according to how many importing countries present in the database apply them to donor animals. For example, less than 10 percent of countries which imported semen from the United States during 2008 required testing for vesicular stomatitis virus (VSV), Vibriosis, or Q Fever, or treatment for Leptospirosis. Between 11 and 25 percent of importing countries required testing for Akabane, Bluetongue, Epizootic Hemorrhagic Disease (EHD), Bovine Leukosis (BLV), Leptospirosis, Johnes, or Bovine Tuberculosis (TB). The highest percentage of countries, between 26 and 50 percent, required bovine viral diarrhea (BVD), Brucellosis, Campylobacterosis, Infectious Bovine Rhinotracheitis (IBR)/Infectious Pustular Vulvoginitis (IPV), and Trichomoniasis testing. The smaller number of diseases addressed by the semen testing and treatment requirements when compared to live animal regulations indicates the lower disease risk associated with semen shipments.

When viewed from another perspective of percent of 2008 trade volume affected by the testing and treatment requirements, a stronger impression of which requirements are most important to US bovine semen exports emerges (Table 20). Over half of the volume traded is subject to donor animal testing for Bovine Tuberculosis, Campylobacteriosis, IBR/IPV, and Trichomoniasis, while more than 80 percent must document the results of brucellosis testing. Donors of between one-quarter and one-half of bovine semen exports must be tested for Bluetongue, Bovine Viral Diarrhea (BVD), Enzootic Hemorrhagic Disease (EHD), Bovine Leukosis (EBL), Leptospirosis, and Johnes Disease. Less than 25 percent of US bovine semen exports require donor animals to be tested for Akabane, Q Fever, VSV, and Vibriosis and treated for Leptospirosis.

Table 1: Frequency of Export Regulations for U.S. Exports of Purebred Dairy Males for Breeding

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Frequent >76%
Anaplasmosis	Bluetongue	Brucellosis	Health Cert.	Inspect on Export
Babesiosis	Campylobacteriosis	Bovine TB		Ramp Fee
BVD	EBL	Ban		Embark. Cert.
IBR	Leptospirosis			
Chlamydiosis	Paratuberculosis			
VSV	Trichomonasis			
IBR & IPV	Endoparasites			
Clostridial Disease	Ectoparasites			
Fascioliasis	Transport Rules			
Anthrax	Disease Free Origin			
Blackleg	Quarantine			
BRSV				
Malignant Edema				
Parainfluenza 3				
Pasteurellosis				
Shipping Fever				
Inspect on arrival				
DHIA Member				

Table 2: Frequency of Export Regulations for U.S. Exports of Purebred Dairy Females for Breeding

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Frequent >76%
Anaplasmosis	Bluetongue	Brucellosis		Inspect on Export
Babesiosis	Campylobacteriosis	Bovine TB		Ramp Fee
BVD	IBR	EBL		Embark. Cert.
Mastitis	VSV	Ban		Health Cert.
Chlamydiosis	Leptospirosis			
IBR & IPV	Paratuberculosis			
Clostridial Disease	Trichomonasis			
Fascioliasis	Endoparasites			
Anthrax	Ectoparasites			
Blackleg	Transport Rules			
BRSV	Disease Free Origin			
Malignant Edema	Quarantine			
Parainfluenza 3				
Pasteurellosis				
Shipping Fever				
Inspect on arrival				
DHIA Member				

Table 3: Frequency of Export Regulations for U.S. Exports of Purebred Non-Dairy Males for Breeding

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Frequent >76%
Anaplasmosis		Brucellosis	Health Cert.	Inspect on Export
Babesiosis	Campylobacteriosis	Bovine TB		Ramp Fee
BVD	EBL	Bluetongue		Embark. Cert.
Chlamydiosis	IBR	Disease Free Origin		
VSV	BRSV	Quarantine		
IBR & IPV	Leptospirosis	Ban		
Clostridial Disease	Paratuberculosis			
Fascioliasis	Trichomonasis			
Anthrax	Endoparasites			
Malignant Edema	Ectoparasites			
Parainfluenza 3	Transport Rules			
Pasteurellosis	Quarantine			
Shipping Fever				
Inspect on arrival				

Table 4: Frequency of Export Regulations for U.S. Exports of Purebred Non-Dairy Females for Breeding

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Frequent >76%
Anaplasmosis	Bluetongue	Brucellosis	Health Cert.	Inspect on Export
Babesiosis	Campylobacteriosis	Bovine TB		Ramp Fee
BVD	IBR	Ban		Embark. Cert.
Mastitis	EBL			
Chlamydiosis	VSV			
IBR & IPV	Leptospirosis			
Clostridial Disease	Paratuberculosis			
Fascioliasis	Trichomonasis			
Anthrax	Endoparasites			
Blackleg	Ectoparasites			
BRSV	Transport Rules			
Malignant Edema	Disease Free Origin			
Parainfluenza 3	Quarantine			
Pasteurellosis				
Shipping Fever				
Inspect on arrival				

Table 5: Frequency of Export Regulations for U.S. Exports of Not Elsewhere Specified or Included Cattle

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Frequent >76%
Anaplasmosis	Bluetongue	Brucellosis	Health Cert.	Inspect on Export
Babesiosis	Campylobacteriosis	Bovine TB		Ramp Fee
BVD	IBR	Ban		Embark. Cert.
Mastitis	EBL			
Chlamydiosis	Leptospirosis			
VSV	Paratuberculosis			
IBR & IPV	Trichomonasis			
Clostridial Disease	Endoparasites			
Fascioliasis	Ectoparasites			
Anthrax	Transport Rules			
BRSV	Disease Free Origin			
Malignant Edema	Quarantine			
Parainfluenza 3				
Pasteurellosis				
Shipping Fever				
Inspect on arrival				

Table 6: Frequency of Export Regulations for U.S. Exports of Swine Not Elsewhere Specified or Included over 50 kg

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Infrequent >76%
Atrophic Rhinitis	VSV	Ectoparasites	Brucellosis	
Erysipelas		Endoparasites	Pseudorabies	
Influenza		Leptospirosis	Inspect on Export	
Mycoplasmosis		PRRS	Ramp Fee	
Plueroneumonia		TGE	Embark. Cert.	
Coronavirus		TB	Health Cert.	
Parvovirus			Transport Rules	
Swine Dysentery			Disease Free Origin	
Toxoplasmosis			Quarantine	
Shipping Fever				
Inspect on arrival				
Animal Registration				
Ban				

Table 7: Frequency of Export Regulations for U.S. Exports of Swine Not Elsewhere Specified or Included under 50 kg

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Infrequent >76%
Atrophic Rhinitis	VSV	Ectoparasites	Brucellosis	
Erysipelas		Endoparasites	Pseudorabies	
Influenza		Leptospirosis	Inspect on Export	
Mycoplasmosis		PRRS	Ramp Fee	
Plueroneumonia		TGE	Embark. Cert.	
Coronavirus		TB	Health Cert.	
Parvovirus			Transport Rules	
Swine Dysentery			Disease Free Origin	
Toxoplasmosis			Quarantine	
Shipping Fever				
Inspect on arrival				
Ban				

Table 8: Frequency of Export Regulations for U.S. Exports of Live Purebred Breeding Swine

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Infrequent >76%
Brucellosis suis	VSV	Ectoparasites	Brucellosis	
Atrophic Rhinitis		Endoparasites	Inspect on Export	
Erysipelas		Leptospirosis	Ramp Fee	
Influenza		PRRS	Embark. Cert.	
Mycoplasmosis		TGE		
Plueroneumonia		TB		
Coronavirus		Pseudorabies		
Parvovirus		Health Cert.		
Swine Dysentery		Transport Rules		
Toxoplasmosis		Disease Free Origin		
Shipping Fever		Quarantine		
Ban				

Table 9: Frequency of Export Regulations for U.S. Exports of Ovine

Regulation\Frequency Category

Very Infrequent <10%	Infrequent 11-25%	Common 26-50%	Frequent 51-75%	Very Frequent >76%
Blackleg	Leptospirosis	Bluetongue	Brucellosis	
Anthrax	OPP	Ectoparasites	Inspect on Export	
Campylobacterosis	Paratuberculosis	Endoparasites	Ramp fee	
Chlamydosis	Disease Free Origin	Ovine TB	Embark. Cert.	
C. pustular ermatitis	Ban	Transport Rules	Health Cert.	
Ethyma		Quarantine		
Entertoxemia				
Miyagawanella				
Fasciola hepatico				
Hem. septicemia				
IBR				
Ovine epididymitis				
Malignant edema				
Q-fever				
VSV				
Inspect on arrival				
Shipping fever				

Table 10: Number of U.S. Purebred Dairy Male Bovine affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Anaplasmosis	1	Endoparasites	0
Babesiosis	0	Ectoparasites	1
Brucellosis	10	Fascioliasis	0
Bluetongue	1	Anthrax	0
Bovine Tuberculosis	10	Blackleg	0
BVD	0	BRSV	0
Campylobacteriosis	1	Malignant Edema	0
Chlamydiosis	0	Parainfluenza 3	0
EBL	1	Pasteurellosis	0
IBR	1	Shipping Fever	0
Leptospirosis	1	Quarantine	10
Paratuberculosis	1	Embarkation Cert.	28
Trichomonasis	1	Health Cert.	28
VSV	1	Herd Registration	9
IBR & IPV	0	Transport Rules	10
Clostridial Disease	0	Disease Free Region	1
		Total Animals Shipped	35

Table 11: Number of U.S. Purebred Dairy Female Bovine affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Anaplasmosis	0	Endoparasites	4156
Babesiosis	0	Ectoparasites	6255
Brucellosis	5944	Fascioliasis	2
Bluetongue	41	Anthrax	4
Bovine Tuberculosis	5944	Blackleg	0
BVD	4156	BRSV	0
Campylobacteriosis	4152	Malignant Edema	0
Chlamydiosis	0	Parainfluenza 3	4154
EBL	4156	Pasteurellosis	0
IBR	4156	Shipping Fever	0
Leptospirosis	4154	Quarantine	6
Paratuberculosis	0	Embarkation Cert.	7054
Trichomonasis	4156	Health Cert.	5957
VSV	2	Herd Registration	1745
IBR & IPV	2	Transport Rules	1751
Clostridial Disease	4156	Disease Free Region	6
		Total Animals Shipped	8452

Table 12: Number of U.S. Purebred Non-dairy Male Bovine affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Anaplasmosis	1	Endoparasites	96
Babesiosis	0	Ectoparasites	799
Brucellosis	118	Fascioliasis	0
Bluetongue	22	Anthrax	0
Bovine Tuberculosis	118	Blackleg	96
BVD	117	BRSV	96
Campylobacteriosis	97	Malignant Edema	96
Chlamydiosis	0	Parainfluenza 3	96
EBL	118	Pasteurellosis	0
IBR	117	Shipping Fever	0
Leptospirosis	118	Quarantine	118
Paratuberculosis	22	Embarkation Cert.	812
Trichomonasis	118	Health Cert.	130
VSV	21	Herd Registration	0
IBR & IPV	97	Transport Rules	22
Clostridial Disease	96	Disease Free Region	704
		Total Animals Shipped	812

Table 13: Number of U.S. Purebred Non-dairy Female Bovine affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Anaplasmosis	0	Endoparasites	80
Babesiosis	0	Ectoparasites	80
Brucellosis	767	Fascioliasis	0
Bluetongue	0	Anthrax	0
Bovine Tuberculosis	767	Blackleg	80
BVD	80	BRSV	80
Campylobacteriosis	80	Malignant Edema	80
Chlamydiosis	0	Parainfluenza 3	80
EBL	80	Pasteurellosis	0
IBR	80	Shipping Fever	0
Leptospirosis	80	Quarantine	80
Paratuberculosis	0	Embarkation Cert.	779
Trichomonasis	80	Health Cert.	699
VSV	0	Herd Registration	0
IBR & IPV	80	Transport Rules	0
Clostridial Disease	80	Disease Free Region	80
		Total Animals Shipped	992

Table 14: Number of U.S. Not Elsewhere Specified Bovine affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Anaplasmosis	66	Endoparasites	2250
Babesiosis	0	Ectoparasites	43848
Brucellosis	13698	Fascioliasis	0
Bluetongue	2316	Anthrax	0
Bovine Tuberculosis	13698	Blackleg	0
BVD	66	BRSV	0
Campylobacteriosis	44	Malignant Edema	0
Chlamydiosis	0	Parainfluenza 3	0
EBL	120	Pasteurellosis	0
IBR	2316	Shipping Fever	0
Leptospirosis	2272	Quarantine	66
Paratuberculosis	2316	Embarkation Cert.	65253
Trichomonasis	22	Health Cert.	65253
VSV	22	Herd Registration	0
IBR & IPV	0	Transport Rules	43848
Clostridial Disease	0	Disease Free Region	43848
		Total Animals Shipped	65253

Table 15: Number of U.S. U.S. Exports of Swine Not Elsewhere Specified or Included over 50 kg affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Brucellosis	119923	Ectoparasites	0
Atrophic Rhinitis	0	Endoparasites	0
Erysipelas	0	Leptospirosis	247
Influenza	0	PRRS	1987
Mycoplasmosis	0	TGE	1740
Plueroneumonia	1740	TB	1987
Coronavirus	0	PRCV	0
Parvovirus	0	Shipping fever	0
Parvovirus	0	Quarantine	2936
Swine Dysentery	1740	Embarkation Cert.	119923
Toxoplasmosis	0	Health Cert.	2936
VSV	247	Transport Rules	118183
Pseudorabies	118676	Disease Free Region	1196
		Total Animals Shipped	119923

Table 16: Number of U.S. U.S. Exports of Swine Not Elsewhere Specified or Included less than 50 kg affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Brucellosis	3643	Ectoparasites	296
Atrophic Rhinitis	0	Endoparasites	0
Erysipelas	0	Leptospirosis	296
Influenza	0	PRRS	296
Mycoplasmosis	0	TGE	296
Plueroneumonia	0	TB	296
Coronavirus	0	PRCV	0
Parvovirus	0	Shipping fever	0
Parvovirus	0	Quarantine	3085
Swine Dysentery	0	Embarkation Cert.	3643
Toxoplasmosis	0	Health Cert.	3643
VSV	296	Transport Rules	3643
Pseudorabies	3643	Disease Free Region	3085
		Total Animals Shipped	3964

Table 17: Number of U.S. U.S. Exports of Swine for breeding affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Brucellosis	11596	Ectoparasites	795
Atrophic Rhinitis	0	Endoparasites	794
Erysipelas	0	Leptospirosis	2044
Influenza	0	PRRS	7185
Mycoplasmosis	0	TGE	2712
Plueroneumonia	5272	TB	7486
Coronavirus	0	PRCV	0
Parvovirus	0	Shipping fever	0
Parvovirus	0	Quarantine	9588
Swine Dysentery	5272	Embarkation Cert.	11596
Toxoplasmosis	51	Health Cert.	10552
VSV	1621	Transport Rules	6225
Pseudorabies	10911	Disease Free Region	6982
		Total Animals Shipped	13045

Table 18: Number of U.S. U.S. Exports of Ovine affected in 2007 by Export Regulations

Regulation	Head	Regulation	Head
Brucellosis	674	Leptospirosis	22
Bluetongue	0	OPP	304
Blackleg	282	Paratuberculosis	282
Anthrax	0	Ectoparasites	674
Campylobacterosis	0	Endoparasites	304
Chlamydosis	0	Ovine TB	392
C. pustular ermatitis	0	VSV	0
Ethyma	0	Q-fever	0
Entertoxemia	282	Shipping fever	
Miyagawanella	0	Quarantine	22
Fasciola hepatico	0	Embarkation Cert	136538
Hem. septicemia	0	Health Cert.	65097
IBR	0	Transport Rules	65097
Ovine epididymitis	0	Disease Free Region	392
Malignant edema	0	Total Animals Shipped	136538

Table 19: Percent of Importing Countries Applying Bovine Semen Regulations, 2008

Very Infrequent	Infrequent	Common	Frequent	Very Frequent
<10%	11-25%	26-50%	51-75%	>76%
Q Fever	Akabane	BVD		
VSV	Bluetongue	Brucellosis		
Leptospirosis Treatment	EHD	Campylobacteriosis		
	Bovine Leukosis	IBR/IPV		
	Leptospirosis Test	Trichomoniasis		
	Johnes			
	Bovine TB			

Table 20: Bovine Semen Quantity Affected Category, 2008, Percent of Trade

Very Infrequent	Infrequent	Common	Frequent	Very Frequent
<10%	11-25%	26-50%	51-75%	>76%
	Akabane (21%)	Bluetongue (30%)	Bovine TB (59%)	Brucellosis (83%)
	Q Fever (11%)	BVD (49%)	Campylobacteriosis (71%)	
	VSV (15%)	EHD (31%)	IBR/IPV (67%)	
	Lepto Treatment (11%)	Bovine Leukosis (29%)	Trichomoniasis (70%)	
		Leptospirosis Test (44%)		
		Johnes (42%)		

Cost Data

Cost information is difficult to obtain and to use. Thus, for each type of cost information many assumptions are required to estimate the cost of any particular restriction.

Test Costs

Test cost information for 2007 is collected from 10 animal diagnostic laboratories from across the United States. The laboratory websites giving test costs and fees are listed in the References. Test coverage by these laboratories varies. Of the laboratories examined those in Ohio and Texas offer the greatest range of test coverage. Other laboratories like those in the western high plains tend to specialize in cattle and sheep tests and may not offer tests for swine diseases like Porcine Reproductive and Respiratory Syndrome (PRRS). Laboratories in the Midwest may focus on swine diseases and offer less coverage of cattle or sheep diseases. While full coverage by all laboratories did not occur for some tests, multiple cost information is obtained for most tests.

Another complication is the lack of uniformity in fee structure. Some laboratories have separate application/administrative fees in addition to test fees. For example, the Ohio laboratory charges a $10 application fee while the laboratory at Purdue University charges $7. Ohio waives the application fee for residents. Purdue waives the application fee for serology tests. Other laboratories do not separate the fees and apply a single charge. In many cases residents and non-residents pay different fees. Ohio test fees for non-residents are 1.5 times the resident fee. In the Purdue laboratory the non-resident fee is twice that paid by residents. There can also be bundling of fees for multiple tests and number of samples. For example, where there is an application fee, that fee is the same whether there are 1 or 10 test samples so the per unit cost falls. Some laboratories charge a minimum fee so that a test fee of $3.50 costs $5.00 for 1 sample but $7.00 when 2 samples are tested ($3.50X2).

Further problems are introduced because importing nations have various requirements and the test costs differ. Using the case of EBL described previously, the AGID test fee reported for one laboratory is $3.50 while the ELISA fee is $5.00. Also a molecular test (polymerase chain reaction or PCR) could be used, although these are very expensive, $15-$30. An animal going to Algeria is subject to the AGID test at $3.50 while an animal going to Armenia is subject to the ELISA fee of $5.00. An animal going to Bermuda could pay either fee depending on the test administered.

There is no means of precisely costing the tests administered. Which animals were subject to which test at which laboratory is unknown. Further, whether the tests were resident or non-resident is also unknown. The method used in this analysis creates a range from the lowest possible cost to the highest possible cost for each destination, excluding molecular (PCR) test fees unless explicitly required. To illustrate, consider Bluetongue tests. The test fees overlap. The lowest fee is the Serum Neutralization (SN) test for residents at $3.00 and the most costly is the Complement Fixation (CF) test for non-residents at $22.75. For the AGID tests the range is a low of $3.50 for a resident test and a high of $15.25 for a non-resident test. For the ELISA test the range is $5.00-$17.50. When any test is allowed the range is $3.00 to $22.75. If the CF test is not allowed the highest cost drops to the ELISA cost. If the ELISA is disallowed, the SN cost is the highest. In the case of anaplasmosis the lowest test fee is $4.00 (resident) and the highest cost is $21.25 (non-resident) if a Complement Fixation test is allowed. But if an ELISA test is required the lowest cost is $4.50 and the highest is $17.00. Thus, for each test for each importing nation a range from the lowest possible cost to the highest possible cost is constructed.

Treatment Costs

Various treatments are required for animals for export. These treatments differ by destination. The searchable database identifies the specific treatments required and the prices are available from websites selling animal pharmaceuticals (Listed in References).

One complication is that a single vaccine often treats multiple diseases, that is, there is a bundling issue. For example, Cattlemaster 4 Plus VL5® covers 7 diseases while Bovi-Shield 4® covers 4 diseases and Bovi-Shield IBR® only treats Infectious Bovine Rhinotracheitis (IBR). Thus, for each export destination a list of required treatments is made and the prices for products that most closely correspond to the required treatments are used. Cuba requires treatments for Endoparasites, Ectoparasites, Leptospriosis, and IBR so prices for IVOMEC, Tri Vib 5L®, and Bovi-Shield IBR® are used. Honduras Requires treatments for all of the disease Cuba requires plus 5 more so Cattlemaster 4 Plus VL5® replaces the Bovi-Shield IBR® and Tri Vib 5L®.

Prices are quoted for bottles capable of supplying multiple doses. One way to determine the treatment cost is to convert the price to dollars per ml and multiply by the number of ml required. In other cases, the number of doses in a bottle is given and so the price per dose is determined. In cases where two or more treatments are required, the cost is adjusted to reflect the multiple treatments.

Since producers treat these diseases for most animals during the course of normal production, it could be argued that such costs should be excluded from the cost of exporting an animal. But importing nations specifying disease treatments usually require that the animal be treated within a specific time frame before export. Thus, earlier treatments for the same diseases are not recognized and the export treatments are additional.

Who administers the treatment is a problem for allocating costs. Most commercial producers do their own treatments. Larger operations may have veterinarians on staff or on a retainer. Depending on the length of pre-export quarantine, treatments may be administered during that period. The procedure used in this analysis is to use the cost of a veterinarian at $53 per visit. That cost is obtained from a 1995 analysis of TB treatment costs inflated to 2008 dollars using the GDP deflator. The per-visit cost is scaled by animal numbers per shipment. In the case of large shipments additional days and visits are incorporated. Thus, there are scale economies to the veterinarian costs.

Quarantine Costs

Quarantine costs for an individual animal showed considerable differences. At an APHIS facility the cost for an incoming animal are $102 for cattle and $27 for swine and sheep (USDA/APHIS, Financial Management Division, 9CFR 130.2). Export pen fees reported by the Texas Department of Agriculture are considerably lower. The fees are separated by animal species, type of quarantine, and purpose as well as by method of shipment. Breeding animals cost more than slaughter animals. For example, breeding cattle in pens are charged $5 for day 1 and $8 for each additional day. Slaughter cattle pay a set $3 per animal per day. Breeding hogs in a pen are charged $3 for the first day and $4.50 per day from day two on while slaughter hogs are charged $2 per day. Sheep for breeding in pens pay $2 on day 1 and $3.50 per day for each added day. Sheep for slaughter are charged $1 per day. Animals in stalls are charged a flat rate of $20 per day. Fees are higher if the shipment is by air out of Houston. Cattle in pens are charged $10 per day while cattle in stalls are charged $40. Hogs and sheep are charged $5 per day.

With the complicated fee structure assumptions are needed to assign quarantine costs. Shipments of more than one animal are treated as held in pens while shipments of 1 animal are charged the stall fee. Unless specified in the regulations, very large shipments are assumed to go by ship and small shipments by air. Further, shipments to Asia, South Africa, and Russia are assumed to go by air. Shipments to Mexico and Canada are treated as truck shipments. Maximum shipment size per truck is based on trailer weight assuming an average of 50 500-pound cattle. In the case of hogs a truck accident in Iowa reported the load size of 156 animals so a load of 150 animals is assumed (Des Moines KCCI8). All other destinations are treated as moving by ship. With a few exceptions, like air shipments of single cattle to Korea, there is little cost variation.

These costs exclude feed which is provided by the shipper. Feed costs are calculated from the daily feed intake of each animal type multiplied by market prices for the feedstuffs from the spring of 2007 (USDA/ERS, *Livestock and Poultry Situation and Outlook*). The resulting feed costs are small relative to the user fees. The largest feed cost is for dairy heifers of $2.33 per day. Lambs for backgrounding have the lowest daily feed cost of $0.10 per day.

Ramp Fees

For most export destinations a ramp fee is imposed to cover the costs of setting up loading. The exceptions are Canada and Mexico where animals are assumed to move by truck instead of by airplane or ship. The ramp fee for the APHIS facility at Miami International airport is reported to be $151 (USDA/APHIS, Financial Management Division, 9CFR 130.2). That charge is adjusted by the number of animals in a shipment. The labor charge for supervising the loading is included in the inspection costs.

Shipment sizes for Canada and Mexico are discussed above. For other countries animals move by air or sea. For most other countries 2007 quarterly export data show exports occurring is a single quarter and those are treated as the shipment size. When the export data record exports in multiple quarters shipment size is the most frequent flow size. For cattle, this situation occurred twice. Shipment size of purebred dairy females to Saudi Arabia is set at 1500 head. Shipment size for purebred non-dairy males to Guatemala is set at 3 head. More frequent multiple quarters of exports occur for breeding swine. In these cases the shipment size is set by averaging the quarterly flows.

Inspection Costs

Inspection costs are separated into outgoing costs and incoming costs incurred on arrival. Outgoing inspection costs are incurred on virtually all shipments and embarkation certificates generally contain a statement confirming that a veterinarian has inspected the animals. Outgoing inspection costs include inspecting the facility, the means of transport, and animals, plus supervising loading and rest periods. User fees are based on the time required, hence, shipment size, and when the inspection occurs. This analysis applies the standard fee schedule reported by USDA/APHIS, Financial Management Division, 9CFR 130.30. Inspection fees are divided into quarter hour segments. The hourly charge is $84 with quarter hour charges of $21 and a minimum charge of $25. A special charge is applied to U.S.-Mexico shipments of $3.75 per head for slaughter animals and $9 per head for other ruminants (USDA/APHIS, Financial Management Division, 9CFR 130.6).

It is assumed that the inspection tasks for each animal take 3 minutes and charges are calculated in discrete quarter hour increments. For example, a 3 minute inspection of a single animal is charged the $25 minimum as is a 12 minute inspection of a 4 head shipment. A 7 animal shipment would take 21 minutes so would be charged as 2 quarter hours at $21 per quarter hour for a total charge of $42. Thus, the inspection of single head shipment costs $25 per head, the 4 head shipment costs $6.25, and the 7 head shipment inspection cost is $6.00 per head. Using this method gives scale economies to inspection with the minimum cost of $4.20 per head.

Some buyers of U.S. animals require additional inspection upon arrival. Charges for such inspection are set at $2-$4 per head based on the information reported in the regulations database.

Embarkation Certificate Costs

User fees for endorsing export certificates are reported by USDA/APHIS, Financial Management Division, 9CFR 130.20. The fees are separated according to whether tests or vaccinations are required or not and number of animals. Once the total cost for the export certification for each shipment to each destination is calculated, per animal cost can be determined using the shipment sizes as discussed previously.

Export destinations fall into 1 of 5 classifications. Slaughter animals moving to Canada and Mexico are charged $35 per certificate. Exports of ruminants, except slaughter animals to Canada and Mexico, are charged $33 for endorsing an export certificate. Swine that are not tested appear to fall into the "other" category, a charge of $24 per certificate. Fees for certificates to importing nations that report test or vaccination requirements are scaled by the number of tests and vaccinations required as well as the number of animals record on the certificate. Animals going to importers with 1-2 required tests or vaccinations pay $76 for the first animal and $4.25 for each additional animal. Requirements of 3-6 tests or vaccinations mean a fee of $94 for the first animals and $7.25 for each additional animal. When 7 or more tests or vaccinations are required the initial charge jumps to $109 with each additional animal costing $8.50. There are also shipments to importers that are not listed in the regulations database. Shipments to those destinations are charged the fee structure for 1-2 tests or vaccinations.

Health Certificate

Many importing nations require a health certificate accompany each shipment of animals. Certificates are often bilingual and are issued by a veterinarian authorized by the USDA and endorsed by a Veterinary Services (VS) veterinarian. The certificate contains the name and address of the consignor and consignee, and complete identification of the animals to be exported. It is assumed that each certificate requires 10 minutes to complete and process. The hourly rate is $60, so the minimum to cover the time and paperwork costs required to issue the certificate is $10.

Other Costs

There are a number and variety of additional costs that some destinations impose. Some nations require an import permit. Thailand, for example, requires that an import permit be presented to a veterinarian prior to inspection for export. There may be rules on transportation, such as not allowing intermediate stops, prohibitions against re-provisioning, forbidding including other ruminants or swine in the shipment. China requires Chinese veterinarians to be at the farms of export cattle, related isolation premises, testing laboratories, and quarantine facilities to cooperate with U.S. veterinarians in making inspections and quarantine. Some nations restrict entry of new animals onto farms before export. The Philippines requires that cattle be of U.S. origin and traceability. There are also regional restrictions focused on Bluetongue free areas. For dairy cattle for breeding Mexico requires the herd to be registered with the Dairy Herd Improvement Association.

In these cases small additional per head charges are included. The charges range from $1 to $5 per head.

Cost of Exporting

The costs of exporting animals are reported in Tables 21—29. These tables indicate the quantity of U.S. exports by quarter for 2007, the FAS export unit value per head, and the regulation cost per head.

There are few exports of purebred dairy males for breeding (Table 21). The largest individual trade flow is 18 head to Guatemala in the third quarter. Mexico shows 9 animals bought. Export unit values have a wide range from $800 per head on the trade to Guatemala to $220,000 for the 1 animal exported to Korea. Regulation costs also vary greatly. Costs per head to Guatemala are estimated to be $25. The lowest cost to Korea is $1,670 per head while the high cost estimate is $1,843 per head. The high cost to Korea occurs because of the small shipment, 1 animal, the days in quarantine, and the number of tests or treatments required. Exporting a single animal means forfeiting economies of scale. For example, the entire ramp fee of $151 is incurred by the single animal. So too is the inspection fee of $109. For Korea the length of the quarantine period is 30 days. That is long compared to some other destinations, although not the longest. Korea also requires many tests and treatments, such as that for Anaplasmosis, not required by other export destinations. Nevertheless, the costs for Korea are less than 1% of the FAS export unit value which is lower than for Mexico (5%) and Saudi Arabia (8%).

U.S. exports of purebred dairy females for breeding occur more often in 2007 than do exports of males (Table 22). The export unit values are consistent with most between $2,000 and $2,500 per head. The largest export unit value is $3,566 on exports to Turkey. Regulation costs separate into 3 groups. The lowest costs range from $24 to $140 per head which are 1.1-5.1% of the FAS unit export value. This group includes the largest export flow, that to Canada. Regulation costs on exports to Trinidad & Tobago are $315 per head (11.7% of the FAS export unit value) and the costs to Costa Rica are $415-$429 per head, or 20.47-21.2% of the FAS unit export value. The highest regulation costs are incurred in trade with Egypt. The low cost estimate is $1,056 and the high cost estimate is $1,196 and these cost range from 45.3 to 51.4% of the FAS export unit value. A substantial cause of the high cost is the 78 days in quarantine. Also contributing are rules requiring several lower frequency tests, EBL, VSV, Trichomonasis, and Vibriosis.

Table 23 reports the export and regulation costs for purebred non-dairy males. Most U.S. exports in 2007 go to Canada with export unit values ranging from$1,875-$3,455 per head. Regulations on this trade relationship are few so the total cost is estimated to be low at $10 per head or 0.4% of the FAS unit value. Korea is again an outlier with 1 animal purchased at a price of $203,000 and regulation costs estimated to be between $1,661 and $1,817 per head which is 0.8-0.9% of the FAS export unit value. For the other destinations, the costs range from $108 to $493 per head which are between 5% and 26% of the export unit value.

The remaining two HTS classifications for bovine tell much the same story. U.S. exports of purebred non-dairy females for breeding are few (Table 24). Export unit values are around $2,000 per head with regulation costs estimated to lie from $25 - $475 per head, or 1-31.7% of the FAS export unit value. U.S. exports of Not Elsewhere Specified or Included bovine are more frequent (Table 25). Canada and Mexico dominate with sporadic sales to other destinations. Export unit values, from $151-$860 per head, are lower than for the other bovine classifications, suggesting lighter weight animals or animals not for breeding. Lower FAS export unit values means that as a percent the regulation costs are greater because the test costs, treatment costs, and other costs are not sensitive to animal weight. For Canada and Mexico, the percent regulation costs remain relatively low at 2.4-6.2% of the FAS export unit value. The same occurs for the United Kingdom and Bermuda. However, other destinations have relatively high regulation costs so the percent of export unit values are high, ranging from 24.3% for Japan under the low cost scenario to 143.6% of FAS export unit value for Hong Kong under the high cost scenario.

The estimated costs of regulations range from $16-$135 per head with two exceptions. One exception is Japan. The data for that destination reports export of 22 animals at a unit export value of $836 per head. The estimated regulation costs are from $203 per head to $439 per head. Japan requires several tests for these animals which are potentially very costly depending on which test is used. Thus, the regulation cost estimates are high with a large range. Much the same occurs for Hong Kong. That destination also requires several potentially costly tests. Another boost to the estimated regulation costs is the 30 day quarantine requirement by Hong Kong. In comparison, Japan only requires 7 days in quarantine.

A much different pattern emerges for swine. U.S. exports are greater, export unit values are lower, and estimated regulations costs are higher relative to the export unit value. Table 26 gives this information for Swine Not Elsewhere Specified or Included weighing over 50 kilograms. Exports to Mexico dominate ranging from 10,821 head in quarter 2 of 2007 to 38,099 head in quarter 4. The export unit values are around $100 per head. The estimated regulation costs are $30 and $54 per head, so between 30 and 54% of the FAS export unit value. Relative to the export unit vales, the regulations costs are higher than for cattle. Hong Kong is the next largest market with 1,740 animals and an export unit value of $137 per head. The estimated regulation costs are $194 and $283 per head so 141.6 to 206.6% of the FAS export unit value.

U.S. exports of swine Not Elsewhere Specified or Included weighing less than 50 kilograms are small (Table 27). Canada is the major destination. Export unit values are low which reflect the light weight of the animals traded. The level of regulation costs is similar to the larger hogs so the relative importance is greater with a few exceptions. Korea has the highest cost relative to export value at between 389.1 and 581.9 percent. Both Canada and Mexico show large costs of regulation relative to the FAS export unit value, ranging from 17.9% to 84.3%. One noticeable exception is the fourth quarter shipment to Canada where the export unit value is much higher at $302 per head than those values in other quarters. A first quarter shipment to Mexico also shows a large export unit value. For Australia, the export unit value is $52 per head, but the regulations database shows few regulations so the cost is estimated at only $4 per head or 2.7-7.7% of FAS unit export value.

The United States is consistently selling breeding swine to several destinations (Table 28). Mexico and Hong Kong dominate this trade. Export unit values exceed those for other swine and vary greatly which suggests differences in the weight of breeding swine being exported as well as differences in the genetics. The estimated regulation costs are consistent with those for the other swine classifications and the range of variation is narrower than that for cattle. The lowest estimated regulation cost is $39 per head on exports to Vietnam while the largest estimated cost is $323 per head on exports to Korea. Since the export unit values are $500 per head and higher, up to $4,016 per head, the regulations costs as a percent of the export unit value are lower. The largest regulation cost as a percent of the FAS export unit value occurs for Mexico, 55.8-63.8%, because the unit export values for breeding swine sold to Mexico are low. For most destinations, the regulations costs as a percent of the export unit value are between 16 and 50%. Vietnam has the lowest relationship, 2.8-6.5%, because the regulation costs are low and the export unit value is high.

Ovine data and regulation costs are in Table 29. Mexico and Canada dominate with small occasional shipments to other destinations. Export unit values to Canada and Mexico are around $70 per head. Estimated regulation costs on export to Canada are $5 per head and $25 per head on export to Mexico. Since the FAS unit export values are similar, the regulation cost for Mexico is 34.2% of the export unit value while that for Canada is 7.8% of the export unit value. Ecuador and St. Vincent & Grenada show export values of about $50 per head. Regulation costs for St. Vincent & Grenada are estimated at only $25-$42 per head while estimated costs on exports to Ecuador run $78-$102 per head. That means the regulation costs for Ecuador range between 156% and 204% of the export unit value while those for Grenada range from 51% to 85.7%. Guyana shows a high export unit value and a low estimated total regulation cost, 5.6%. In the information in Table 27, the Bahamas is the different pattern. The unit export value of $185 per head is on a par with the estimated regulation costs of $173 and $232 per head.

Using the individual testing, treatment, inspection, and health certificate costs assembled for live animal export work and additional estimates for collection and quarantine costs, a range of total costs associated with exporting bovine semen from the United States was calculated (Table 30). While the testing costs estimates spanned a wide range for each country, their 5 to 10 percent share of the total cost of sanitary requirements for bovine semen exports was greatly overshadowed by the costs associated with collection of semen under Certified Semen Services Inc. (CSS) guidelines which apply to all bovine semen exports. Typically, donor animals must reside in certified centers for 60 days before collection begins and then remain for 45 days afterwards at a cost of $10 per day. Semen collection itself costs $40 per day and 25 days of collections for export are assumed to occur per year for an average bull during the residence period. These two charges add approximately $2000 per head to the cost of meeting sanitary requirements for export.

Table 31 records the total cost per dose of semen for the major importing countries assuming each donor animal produces an average of 1000 doses of semen for export. When compared to the 2008 unit export values, these costs average 26.9 percent but range from 15.6 to 52.1 percent of the export value where the variation is explained almost entirely by the unit export values. For example, a relatively low Argentine unit export value of $4.11 per dose leads to sanitary regulations costs averaging more than 50 percent of the semen export shipment value. In contrast, the higher average unit export value of $13.61 for Japan yields sanitary regulations costs averaging only 15.6 percent of the semen trade value. Across all of the importing countries found in the regulations database and representing destinations for over 90 percent of US bovine semen export volume, the sanitary regulations added an average 26.9 percent to the value of the exports. This leads to estimated total costs incurred to comply with sanitary measures required of US bovine semen exports ranging from $25.7 million to $58.3 million, annually.

Table 21: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Bovine, Purebred Dairy Males for Breeding

Country	Head by Quarters				FAS Unit Export Value				Regulation Cost			
	1	2	3	4	1	2	3	4	Low	High	Low	High
	-- Number--				--2007 $/head --						Percent	
Mexico		9				1257			65	89	5.2	7.1
Guatemala			18				800		25	25	3.1	3.1
Korea		1				220000			1670	1843	0.8	0.8
Saudi Arabia		5				1424			110	204	7.7	14.3
Fr. Polynesia		2				1550			NR[1]	NR[1]		

[1]Not recorded in database.

Table 22: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Bovine, Purebred Dairy Females for Breeding

Country	Head by Quarter				FAS Unit Export Value				Regulation Cost			
	1	2	3	4	1	2	3	4	Low	High	Low	High
	-- Number --				-- 2007 $/head --						Percent	
Mexico				1745				2469	45	68	1.8	2.8
Canada	282	408	241	166	2047	2025	2044	2573	54	54	2.5	2.5
Saudi Arabia	2298			1856	2470			2599	47	140	1.8	5.5
Egypt			2				2329		1056	1196	45.3	51.4
Costa Rica			4				2025		415	429	20.4	21.2
Trinidad & Tobago				1				2686	315	315	11.7	11.7
Panama				12				1939	33	33	1.7	1.7
Turkey				1395				3566	NR[1]	NR[1]		
Nicaragua			1			3056			NR[1]	NR[1]		

Barbados			2			2220			NR[1]	NR[1]		
Jamaica			33	6		2056	2147		24	50	1.1	2.4

[1] Not recorded in the database.

Table 23: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Bovine, Purebred Non-Dairy Males for Breeding

Country	Head by Quarters 1	2	3	4	FAS Unit Export Value 1	2	3	4	Regulation Cost Low	High	Low	High
	-- Number--				--2007 $/head --						Percent	
Canada	301	201	78	102	2518	2228	1875	3455	10	10	0.4	0.4
Honduras		96				1897			357	493	18.8	26.0
Taiwan			21				1700		266	381	15.7	22.4
Korea				1				203000	1661	1817	0.8	0.9
Guatemala	3		9		2000		2200		108	108	4.9	4.9
Guyana			22				1977		NR[1]	NR[1]		

[1]Not recorded in database.

Table 24: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Bovine, Purebred Non-Dairy Females for Breeding

Country	Head by Quarter 1	2	3	4	FAS Unit Export Value 1	2	3	4	Regulation Cost Low	High	Low	High
	-- Number --							-- 2007 $/head --			Percent	
Honduras		80				1500			381	475	25.4	31.7
Mexico			109	578			2500	2484	26	39	1.0	1.6
Guatemala	12				2000				25	25	1.2	1.2
Guyana		15				2567			NR[1]	NR[1]		
Turkey				198				2600	NR[1]	NR[1]		

[1]Not recorded in database.

Table 25: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Bovine, Not Elsewhere Specified or Included

Country	Head by Quarter 1	2	3	4	FAS Unit Export Value 1	2	3	4	Regulation Cost Low	High	Low	High
	-- Number --					-- 2007 $/head --					Percent	
Canada	8568	14231	7790	9977	151	417	297	176	16	16	6.2	6.2
Mexico			344	10994			820	820	20	43	2.4	5.2

Japan				22				836	203	439	24.3	52.5
U.K.				9				860	41	41	4.8	4.8
Hong Kong		44				816			442	669	54.2	81.9
Thailand	2250				94				52	135	55.3	143.6
Bermuda		44				812			37	75	4.6	9.2

Table 26: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Swine Not Elsewhere Specified or Included weighing 50 KG or more

Country	Head by Quarter				FAS Unit Export Value						Regulation Cost	
	1	2	3	4	1	2	3	4	Low	High	Low	High
	-- Number --				-- 2007 $/head --						Percent	
Japan		247				137			81	149	59.1	108.8
Canada	474		356	119	156		158	188	87	111	52.1	66.5
Mexico	31287	10821	38099	36780	105	99	107	90	30	54	30.0	54.0
Hong Kong	1740				137				194	283	141.6	206.6

Table 27: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Swine Not Elsewhere Specified or Included weighing 50 KG or less

Country	Head by Quarter				FAS Unit Export Value						Regulation Cost	
	1	2	3	4	1	2	3	4	Low	High	Low	High
	-- Number --				-- 2007 $/head --						Percent	
Mexico	558				323				90	114	27.9	35.3
Canada	1037	806	906	40	52	83	71	302	83	107	65.4	84.3
Korea			296				55		214	320	389.1	581.4
Australia				61				52	4	4	2.7	7.7

Table 28: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost Swine for Breeding

Country	Head by Quarter 1	2	3	4	FAS Unit Export Value 1	2	3	4	Regulation Cost Low	High	Low	High
	-- Number --				-- 2007 $/head --						Percent	
Mexico	1050	285	282	1874	270	364	339	232	168	192	55.8	63.8
Japan				266				500	86	153	17.2	30.6
Korea	34	120	435	222	1416	2114	1002	807	217	323	16.2	24.2
Taiwan				51				805	135	218	16.8	27.1
Philippines	137		156		1039		502		203	287	26.4	37.2
Venezuela		1231				500			NR[1]	NR[1]		
Dom. Rep.	239	327	104		747	960	499		214	274	29.1	37.3
Costa Rica				7				474	181	235	38.1	49.6
Indonesia				1				4016	NR[1]	NR[1]		
Honduras				10				493	182	234	36.9	47.5
Canada	162	75	180	81	723	738	473	489	164	187	27.1	30.9
Germany				33				178	NR[1]	NR[1]		
N. Antilles		11	15	20		515	517	489	NR[1]	NR[1]		
Hong Kong	175	572	3385	205	499	500	500	500	52	142	10.4	28.4
China		738		213		596		1431	216	306	21.3	30.2
Vietnam	34		45		1422		1336		39	90	2.8	6.5
Trinidad & Tobago	33	12	30	44	497	492	492	499	49	89	9.9	18.0
Aruba			21	21			508	495	141	202	28.2	40.3
Haiti				9				367	NR[1]	NR[1]		
El		37	5	76		501	544	499	NR	NR		

Salvador									[1]	[1]		
Guyana				36				261	NR[1]	NR[1]		
Sweden		1				2723			NR[1]	NR[1]		

[1]Not recorded in database.

Table 29: U.S. Export Data 2007 and Estimated Sanitary Regulation Cost for Ovine

Country	Head by Quarter				Export Value				Regulation Cost			
	1	2	3	4	1	2	3	4	Low	High	Low	High
	-- Number --				-- 2007 $/head --						Percent	
Mexico	17084	19392	12675	15924	78	73	71	71	25	25	34.2	34.2
Canada	10450	7744	16838	15737	52	64	71	67	5	5	7.8	7.8
Ecuador	232				50				78	102	156.0	204.0
Bahamas			22				185		173	232	93.5	125.4
Guyana			20				359		20	20	5.6	5.6
St. Vincent & Grenada				370				49	25	42	51.0	85.7

Table 30: Calculated Costs of Sanitary Requirements for US Exports of Bovine Semen. Major Markets

	Testing Costs		Treatment & Collection Costs	Quarantine Costs	Inspection & Health Certificate Costs	Total Requirement Costs	
	Low	High				Low	High
	$/head						
Argentina	79	404	1000	1050	14	2143	2468
Brazil	54	181	1000	1050	14	2118	2245
Canada	70	269	1000	1050	14	2134	2333
Japan	64	235	1000	1050	14	2128	2299
Mexico	29	98	1000	1050	14	2093	2162
United Kingdom	37	177	1000	1050	14	2102	2241

Table 31: Cost of Sanitary Requirements Relative to Unit Export Value, 2008

	Lower Bound Cost*	Unit Export Value	Lower Bound Cost Relative to Unit Export Value
	$/dose		
Argentina	2.14	4.11	.521
Brazil	2.12	7.23	.293
Canada	2.13	7.35	.290
Japan	2.13	13.61	.156
Mexico	2.09	7.59	.276
United Kingdom	2.10	9.65	.218
Average all Importers	2.11	7.85	.269
* Assumes 1000 doses collected per animal tested for export			

Bans

Several nations that formerly purchased livestock from the United States have imposed bans on imports of animals from the United States. Thus, there are potential unrealized U.S. livestock exports because of such regulations.

Incorporating such regulations into the framework and estimating the economic impacts is not straightforward. One issue is that import decisions by individual nations are lumpy with irregular purchases. Also just because a ban is removed by a trading partner does not mean that the former trade is restored. A clear example of that is the end of the import ban on U.S. beef imposed by Japan following the discovery of a dairy cow with Bovine Spongiform Encephalopathy (BSE) in December 2003. Even though beef sales to Japan were allowed, trade did not returned to former levels until several quarters later. Further, there is no way to determine what growth might or might not have occurred without the ban.

The procedure used to determine the shift in the excess demand facing the United States is based on historical, quarterly trade flows from the first quarter of 1989 through the fourth quarter of 2003. Imports from the United States by nations with bans on trade from the United States for each type of livestock are summed for the quarters. Those sums are compared to total U.S. exports to determine the percent reduction in U.S. exports. For example, quarterly exports of purebred dairy females averaged 4,828 head. Of that total, on average 332 animals, representing 7.5 percent of trade, were imported by nations that ban bovine imports for the United States after December 2003. That reduction in trade is introduced into the model to estimate the gain from ending such bans.

To capture the range of potential trade shocks the average, high, and low trade for each type of animal is evaluated. In the example given above for purebred dairy females, average quarterly export loss is 332 head while the minimum of quarterly imports from the United States is 0 and the maximum is 2,779 head. These values represent percent shock ranging from 0 to 52.1 percent with the average of 7.5 percent.

Scenarios and Results

Based on the data discussed above several scenarios are identified where regulations could be costly to U.S. exports of bovine, porcine, and ovine. This section examines and estimates the economic impacts of these key regulations.

<u>Loss of Exports resulting from Disease related Bans</u>

The regulations database identifies three diseases as causing bans on exports of U.S. livestock as of January 1, 2008. One disease listed as the cause for a ban on exports of U.S. cattle and sheep is Bovine Spongiform Encephalopathy (BSE). Bluetongue is listed as the reason European nations ban U.S. cattle. Finally, Argentina bans imports of

U.S. swine because the U.S. swine herd is infected with Porcine Reproductive and Respiratory Syndrome (PRRS).

Determining the economic effects requires determining the loss in potential U.S. exports. That is, how far to the right does the potential excess demand shown in Figure 1 lie? Two methods are used to estimate this potential. In the case of slaughter cattle exported to Mexico, they are explicitly included in the U.S. agricultural sector model discussed above. Thus, the model can be solved assuming a ban is imposed and the outcomes compared to observed data. For breeding animals, the impacts are measured at the minimum, average, and maximum losses.

Slaughter Cattle

In August 2004 Mexico adopted a ban on feeder and slaughter cattle. The losses from the ban are estimated using the U.S. agricultural sector model by halting slaughter cattle exports. The period of the analysis is the 12 quarters from the first quarter of 2001 through the fourth quarter of 2003. Thus, the baseline is constructed using observed data that contain slaughter cattle exports to Mexico and the scenario consists of removing those exports and comparing the results to the observed baseline.

The average per quarter changes in returns to capital and management and changes in consumer surplus are given in Table 32. The impacts are concentrated in the beef and beef cattle sectors. Spillover effects to other sectors are small. The largest change in average quarterly returns to capital and management occurs for beef cattle, a decline of $20.1 million. Beef packers and processors experience a small increase in quarterly returns to capital and management of $2.9 million. Beef consumers experience a gain in consumer surplus of $30.9 million each quarter. These changes in economic welfare are driven by the change in the prices of cattle and beef. The ban on U.S. exports of slaughter cattle means more cattle are slaughtered in the United States. The price of market cattle falls which causes the loss in returns to beef cattle producers. The beef price also falls with more slaughter so there is a gain in consumer surplus. The beef price falls by slightly less than does the cattle price and more cattle are slaughtered so returns to capital and management in the packing and processing sector rise slightly.

For other meats, the fall in the beef price causes their price to fall as well. The lower meat prices generate small gains in consumer surplus. Lower meat prices decrease returns to capital and management in meat packing. As the meat prices fall, there is a magnified downward pressure on livestock growers whose returns to capital and management fall by more. The results for dairy and milk include the entire supply chain. In this market fewer cattle exports and lower cattle prices means increased feeding which raises feed costs. As a result, milk output falls and the milk price rises. Both producers and consumers experience declines in economic welfare.

Breeding Animals

The impacts of bans due to BSE and Bluetongue are reported in Table 33. For these animals the estimated minimum loss, the estimated average loss, and the estimated maximum loss using observed quarterly trade flows are shown. The largest quarterly losses in export value are for purebred dairy females, ranging from 0 to $5.9 million. Average quarterly losses for the other types of cattle range from $74,300 to $107,200 . Export losses for sheep exhibit a wider range as trade quantities fluctuate more. The average quarterly export loss for lambs and sheep is $26,900 with the maximum quarterly loss of $610,600. Total estimated quarterly U.S. export losses for breeding animals as a result of bans range from $1.1 million to $9.1 million.

Changes in Treatment and Test Costs

Test and treatment costs are major components of the cost of exporting animals. Thus, several scenarios examine the role those cost can play. In order to develop a manageable set of scenarios some basic decision rules are applied. One rule is to concentrate on cost reduction in major markets for U.S. livestock. The rationale is that although small markets may have significantly greater costs for tests and treatments, the additional gains in trade are likely to be small compared to reductions in costs for larger markets. A second decision rule is to concentrate on tests and/or treatments that appear unnecessary given the disease history of the United States. For example, several nations require a test for Vesicular Stomatitis Virus which appears sporadically in the United States. A third decision rule is to concentrate on the largest cost categories.

Brucellosis and Bovine Tuberculosis Tests on Breeding Cattle Exports to Mexico

Applying the three decision rules to the 2007 export data for cattle suggests a scenario which applies more uniformity to North America cattle trade. While Mexico prohibits the importation of U.S. feeder and slaughter cattle, breeding animals are permitted. Unlike Canada, Mexico requires tests for Brucellosis and for Bovine Tuberculosis. The cost for a Brucellosis test ranges from $1 to $21.25 per head. The bovine Tuberculosis test costs $8.45 to $11.30 per head. Thus, one scenario considers requiring the same set of tests for U.S. breeding cattle exports to Canada and Mexico by sequentially lowering the test costs. Initially, only the Brucellosis test on shipments to Mexico is eliminated. Then only the Bovine Tuberculosis test on breeding cattle exports to Mexico is ended. The third option considered is to end both tests.

Quarterly results for 2007 sales are reported in Table 34. The magnitudes of cost saving vary depending on cattle purchases by Mexico. During quarter 1 the data report no purchases in 2007 so no benefits are gained. The largest purchases occur in the fourth quarter. Using the lowest test cost the benefits range from $13,317 when only the Brucellosis test is ended, to $427,833 when both test requirements are dropped. When the larger test cost values are used, the greater are the benefits. The smallest benefits occur when only the low cost Brucellosis test is eliminated. The results for the elimination of the Bovine Tuberculosis test show larger benefits than do the results for the Brucellosis test elimination for the low test cost, but smaller benefits for the Bovine Tuberculosis high test cost. That pattern reflects the test costs where the range for costs is narrower for the Bovine Tuberculosis test. The greatest benefits, ranging from $125,846 to $427,833, occur when both tests are ended.

Eliminating Test for Vesicular Stomatitis Virus

Vesicular Stomatitis Virus (VSV) appears occasionally in isolated U.S. cattle herds and some nations require a test even when a VSV outbreak is not occurring. Test costs can range from $5 for a virus isolation test to $26 for a serum neutralization test depending on whether application fees are applied and residency. Export data for 2007 shows sporadic, small sales to the nations that test for VSV. During the first quarter of 2007 no sales to these markets are reported while the second quarter reports a sale of 1 purebred dairy bull. Thus, the cost savings in the second quarter is $10 and $26 which are the cost of the serum neutralization test. Larger, but still small, cost savings are shown for the third and fourth quarters, ranging from $220 to $583 (Table 35). Again the small cost savings reflect the small number of cattle exported to the market that test for VSV.

Table 32: Quarterly Changes in Economic Welfare resulting from a Ban on Exports of U.S. Slaughter Cattle to Mexico[1]

Sector	Changes in Returns to Capital and Management	Changes in Consumer Surplus
	--- thousand $ --	
Beef	2899	30905
Market Beef Cattle	-20105	
Pork	-35	349
Market Hogs	-1397	
Lamb & Sheep Meat	-5	64
Market Lambs & Sheep	-206	
Dairy & Milk	-973	-12775
Poultry Meat	-914	-974
Eggs	-66	-524
Coarse Grains	50	-1197
Wheat	-109	-950
Rice	1	-92
Soybeans	-52	
Soybean Oil		-2
Soybean Processing	-143	
Total	-18851	14804

[1]Estimated by removing observed exports to Mexico from 2001 quarter 1 – 2003 quarter 4.

Table 33: Estimated Quarterly Losses in U.S. Exports of Breeding animals from Disease Related Bans

Animal		Losses in U.S. Export Value Minimum	Average	Maximum
		-- thousand 2007 dollars --		
Bovine				
	Purebred Dairy Males	0	93	735
	Purebred Dairy Females	0	702	5883
	Purebred Non-dairy Males	0	107	1022
	Purebred Non-dairy Females	0	74	516
	Not Elsewhere Specified	0	82	303
Ovine[1]		0	27	611
Porcine[2]		0	0	0
Total		0	1085	9069

[1] Canada reports a ban on sheep for breeding. Export flows declined prior to the BSE case and show no impact of BSE.

[2]The only nation reporting a ban on swine is Argentina which made a 1-time purchase of 32 head in the fourth quarter of 1990.

Regionalization of U.S. Cattle because of Bluetongue

Bluetongue is a disease confined to the U.S. South. Some nations ban imports of cattle sourced in states with Bluetongue. Others subject U.S. cattle being exported to a Bluetongue test. Such tests can be quite costly depending on the test, ranging from $3 per head for a serum neutralization test for a resident to $55 per head for a polymerase chain reaction (PCR) test. For non-residents, most tests cost between $15 and $22 per head. If nations requiring a test for Bluetongue eliminated the test in favor of requiring imports of U.S. cattle be sourced outside of the U.S. south, quarterly cost savings using 2007 data range from nothing when no exports occurred to $51, 188 (Table 35).

Changes in Quarantine Rules

Quarantine requirements vary greatly across destinations and species. Japan consistently requires the fewest days an animal must remain in quarantine, 7 days. All other destinations require more days with some destinations requiring more than 2 months of isolation and quarantine. This scenario calculates the cost savings using 2007 U.S. animal exports if all destinations set quarantine requirements at 14 days while Japan keeps its 7 day rule.

For 2007, the cost savings from the uniform quarantine requirements is $615,125 (Table 36). The bulk of that cost savings occurs for swine. The cost saving for purebred swine for breeding is $289,611. Cost savings are also generated on shipments to Canada and China as the days in quarantine fall from 30 days to 14 days. There are also cost savings on a number of other small flows to other markets around the world. For NESOI swine weighing over 50 kg the cost saving using the 2007 exports is $164,354 on exports to Canada and Hong Kong. For NESOI swine weighing less than 50 kg the cost savings is $140,693 on U.S. exports to Canada and Korea. The cost saving for sheep is small since the major export destinations of Mexico and Canada do not quarantine U.S. sheep. The cost savings shown in Table 23 is on a shipment of 22 head to the Bahamas in the 3rd quarter of 2007. The small cost savings for cattle arise from reduced quarantine time for small shipments to Korea and Honduras. Mexico either has a ban (feeder and slaughter cattle) or no quarantine requirement (heifers). The exception is for dairy bulls which must be isolated in Mexico for their lifetime.

The data in the cattle database for Saudi Arabia illustrates a limitation of the analysis. U.S. export data show exports of about 4,000 purebred female dairy cattle to Saudi Arabia, but the database reports the days in quarantine as unknown which is translated in the analysis as 0 days. A similar situation occurs for swine trade with Mexico. The database shows no quarantine for feeder pigs while reporting a quarantine requirement for breeding swine. However, the length of the quarantine period is not given so a value of 0 is assumed. Given the size of U.S. exports of swine to Mexico, this assumption is important to the magnitude of the cost savings.

Table 34: Cost Savings from Ending Brucellosis and Bovine Tuberculosis Tests on Breeding Cattle Exports to Mexico using 2007 U.S. Export Data

Quarter		End Brucellosis Test Only	End Bovine Tuberculosis Test Only	End Both
		-- 2007 dollars --		
1	Low Test Cost	0	0	0
	High Test Cost	0	0	0
2	Low Test Cost	9	76	85
	High Test Cost	191	102	293
3	Low Test Cost	453	3828	4821
	High Test Cost	8563	5119	13682
4	Low Test Cost	13317	112529	125846
	High Test Cost	277351	159482	427833

Table 35: Cost Savings from Ending Tests for Selected Cattle Diseases using 2007 U.S. Export Data

Test Ended	Quarter 1 Low	Quarter 1 High	Quarter 2 Low	Quarter 2 High	Quarter 3 Low	Quarter 3 High	Quarter 4 Low	Quarter 4 High
	-- 2007 dollars --							
VSV	0	0	10	26	230	557	220	583
Bluetongue	7875	51188	144	719	336	1626	202	609

Table 36: Cost Savings from Establishing a Uniform 14 Day Quarantine Length using 2007 Data

Animal	Cost Saving
	2007 dollars
Purebred dairy males[1]	900
Purebred dairy females	1972
Purebred non-dairy males	14914
Purebred non-dairy females	12428
NESOI Cattle	8314
NESOI Swine 50+ kg	164354
NESOI Swine 50- kg	121319
Purebred Swine for breeding	289611
Sheep	1313
Total	615125

[1] Excludes cost for lifetime isolation in Mexico

Conclusions

Rules limiting the use of traditional barriers to trade negotiated during the Uruguay Round focused attention on non-tariff barriers like sanitary rules. Econometric analyses estimating the trade contraction effects of such barriers often rely on databases that simply count the existence of a sanitary regulation. This research uses searchable databases of sanitary regulations facing U.S. livestock exports to examine the frequency and cost of sanitary barriers.

There are a large number of sanitary regulations potentially faced by U.S. livestock exports. However, given the pattern of U.S. livestock trade with most shipments moving to Canada and Mexico, relatively few regulations apply to most animals. The regulations that most frequently impact U.S. animal exports include embarkation and health certificates, Brucellosis tests, Tuberculosis tests, ectoparasite treatments, and for swine Psuedorabies tests as well as quarantine rules.

As a share of the FAS export unit value, the regulations costs for cattle exports are generally less than 25 percent. The regulations costs as a percent of the FAS export unit value for swine and sheep are larger because the unit export values are smaller than those for cattle while the regulations costs are of similar magnitude.

Most of the sanitary regulations facing U.S. livestock exports appear justified from an animal health standpoint. There are few instances where a sanitary regulation appears to be disguised protection. In some cases, such as requiring a Bluetongue test, sourcing U.S. animals in disease free regions could result in cost savings. The most frequent and costly sanitary regulations that could be seen as excessive are the bans on imports of cattle from the United States because of BSE. Such bans have caused millions of dollars in economic losses each year. For U.S. swine exports, the length of quarantine set by some importing countries results in several hundreds of thousands of dollars of added costs. Reductions in other costs examined here do not generate large cost savings given the pattern of U.S. animal exports.

While the cost savings from reductions in the sanitary regulations considered are not large compared to the total value of trade, there is a regional and farm dimension to consider. Most animals exported by the United States are shipped to Canada and Mexico and that is more common for regions along the borders with those two nations. Furthermore, exporting animals is a specialized process and a subset of farms engages in that activity. For those farms that do export animals and those regions that are along the Canadian and Mexican borders the importance of cost savings are greater.

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