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The Potential Impact of a Proposed Ban on the Sale of U.S. Horses for Slaughter and Human Consumption

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Both federal and state governments in the United States are being asked to enact laws that would make slaughtering of horses for human consumption illegal. In the past, the United States was one of the principal exporters of horsemeat to Europe. This paper examines the impacts of a proposed ban on the U.S. horse industry and the U.S. export market for horsemeat. Findings indicate a loss of approximately $300 per horse in the United States as a result of such a ban. The supply of U.S. exported horsemeat has declined during the past decade. The results suggest that the most significant factors influencing this decline are lower real prices and competing imports.

Key Words: horse slaughter, horsemeat, meat exports

During the past decade, the practice of slaughtering horses to produce meat for human consumption has been challenged in the United States even though virtually all of the meat is exported to foreign (mostly European) consumers. Horsemeat consumption in Europe is fairly common, but European supplies are insufficient to meet demand (Grunder, 2003). Consequently, importing horsemeat, including horsemeat from North America, is an important business in Europe, and slaughtering horses for human consumption has been a method used to dispose of many U.S. horses. The value of U.S. horses sold for slaughter in 2002 was about $26 million [U.S. Department of Agriculture/Foreign Agricultural Service (USDA/FAS), 2003].

Horse enthusiasts and animal welfare activists have lobbied the federal and state governments in the United States to ban the slaughter of horses for human consumption. For example, Texas state courts have held since 1949 that it is illegal to slaughter Texas horses for human consumption (Texas Humane Legislation Network, 2003). In spite of this, the only two remaining equine slaughtering plants in the United States are located in Texas. In 1998, the California legislature voted to

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ban the slaughter of horses in California. Many other states have considered enacting similar laws. At the federal level, the U.S. House of Representatives has been lobbied to enact legislation banning the slaughter of horses for human consumption. In February 2003, Representatives John Sweeny of New York and John Spratt of North Carolina, together with 60 co-sponsors, introduced legislation, titled "The American Horse Slaughter Prevention Act" (H.R. 857), to ban the slaughter of horses in the United States (Sweeny and Spratt, 2003).

The reasons supporters give for attempting to enact H.R. 857 fall into four general categories: (*a*) horses have not traditionally been raised or intended as a foreign consumable product in the United States, (*b*) animal welfare issues, (*c*) food safety issues, and (*d*) lack of market transparency[1] (Sweeny and Spratt, 2003). The status of the bill has not changed since its introduction. The proposed law has been referred to the House Agriculture, the House International Relations, and the House Ways and Means Committees. No hearings have been scheduled as of this writing.

The proposed federal ban on horse slaughter has the potential to impact both the horse industry in the United States as well as the horsemeat industry in the European Union (EU) because the EU is the principal customer for U.S. horsemeat. Accordingly, the objective of this research was to determine the potential economic impact the proposed ban might have on the $112 billion U.S. horse industry (American Horse Council, 2003a) and the potential impact of the ban on the supply of horsemeat in Europe.

Overview of the Horsemeat Market and State Legislation in the United States

Unwanted horses include aged horses, horses deemed dangerous, injured horses, breeding failures, and horses birthed for premarin[2] production. The methods used to dispose of unwanted horses include slaughter, rendering, incineration (cremation), unprocessed animal feed, burial, or removal to a landfill.

Horses in the United States sold for slaughter are transported to the slaughter facility in one of two ways. First, the horses could be sold at auction to a horse dealer who typically picks up enough horses to fill a trailer. The trailer is then transported directly to a slaughter facility, commonly located hundreds of miles from where the horses were sold. The second method is much the same as the first. However, rather than having the animals pass through an auction, the owner simply transports the animals directly to the slaughter facility (Potter, 2003).

There are currently only two equine processing plants in the United States that export horsemeat for human consumption. Both are located in Texas—one in Fort

[1] When horses are sold, especially at auction, there is no requirement to inform the seller that the horse may be sold for slaughter. Consequently, sellers do not have full information about how the horse will be used or disposed of.

[2] Premarin is a hormone replacement used by menopausal women. The hormone is extracted from the urine of pregnant mares. Male foals in these operations are viewed as a by-product and are often sold for slaughter (Humane Society of the United States, 2003; see the HSUS online website at http://www.hsus.org/ace/11788).

Worth and the other in Kaufman.[3] Four equine slaughter facilities are located in Canada—one in Owen Sound, Ontario; one in Yamachiche, Quebec; one in Massueville, Quebec; and one in Fort Mcleod, Alberta.

Most of the meat from U.S. horses slaughtered for human consumption is exported to the EU, and all of these horses are slaughtered in Texas. France is the principal buyer of U.S. horsemeat, followed by Belgium; Mexico, Argentina, Eastern Europe, and Australia are also major horsemeat exporters (USDA/FAS, 2003). The only U.S. demand for horsemeat comes from zoos where the meat is fed to carnivores.

Texas state representative Betty Brown, and state Senator Bob Deuell, proposed a state bill to make the Texas processing plants and horse slaughter legal (H.B. 1324 and S.B. 1413). On May 30, 2003, the Texas Senate failed to pass H.B. 1324, and it is now considered a "dead" bill. Consequently, it is still illegal to slaughter horses in Texas. In response to the failure of H.B. 1324 to pass the Texas Senate, a federal judge ruled that the two plants could continue to operate until a lawsuit against one of the Texas facilities is settled (Brooks, 2003; Drosjack, 2003).

Proposition Six, titled "The Prohibition of Horse Slaughter and Sale of Horsemeat for Human Consumption Act of 1998," was passed by California voters in 1998. Proposition Six makes slaughtering California horses for human consumption illegal. It prohibits anyone from possessing, buying, selling, or exporting from California any part of a horse for human consumption (Save the Horses, 1998). Interviews of people associated with California's horse industry revealed that, even though the law had been in place for five years, little or no enforcement of Proposition Six is taking place (e.g., Bake, 2003; Schonholtz, 2003). No research has been conducted, of which we are aware, to examine the economic impact of Proposition Six on the California horse industry.

Anecdotal evidence suggests some horse owners in California have simply abandoned their horses[4] as a result of Proposition Six rather than paying to dispose of these animals (Warren, 2003). According to an anonymous California Horse Racing Board member, in some of these cases, the horses become malnourished and die before help is rendered. Based on additional anecdotal evidence provided by an anonymous California horse trader, there has been an increase in the number of thin and crippled horses at auctions in California since the implementation of Proposition Six. The horses most affected by California's slaughter horse ban are low-value horses. At one time, a sound 1,100-pound horse was worth \$0.40/pound, or \$440. Today, the same horse is worth only \$0.10–\$0.20/pound (1,100 pounds × \$0.15/pound = \$165), a difference of \$275 (Warren, 2003).[5]

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[3] An additional plant slaughters horses in North Platte, Nebraska. But this meat is used for domestic zoo animals, and none is currently exported for human consumption.

[4] The belief is that some horse owners become desperate and abandon their horses in a manner similar to a cat or dog, leaving the animal in the field or in a neighbor's yard.

[5] This information is offered as one opinion from a person close to the horse industry. One cannot tell definitively from this example what the effect of Proposition Six has been, since there could be other unknown contributing factors.

Many landfills will not accept dead livestock, and it is illegal to bury horses in many California counties. This creates additional costs for horse owners who must pay to have horses transported to be euthanized or disposed of in some other way. The cost of disposal becomes an important factor when one considers that without a ban, horse sellers could sell an unwanted horse. But with a ban, they must either pay to have the horse disposed of or must find someone else willing to care for the animal.

Estimated Impact on U.S. Horse Prices of the Proposed Slaughter Ban

An estimated net present value (NPV) model was used to approximate the change in U.S. horse prices that might be expected after a horse slaughter ban. Eliminating slaughter as a disposal method would eliminate the possibility of obtaining a positive salvage value for any unwanted horses in the United States and would add a disposal cost for each horse at the end of its life. The following formula was used to calculate the NPV (Robinson and Barry, 1996, p. 55):

(1) $$\frac{Prevalue \ \& \ Postvalue}{(1 \ \% \ i)^x},$$

where *Prevalue* is the current value for cull horses in the United States, *Postvalue* is the cost to dispose of the horse following the implementation of the slaughter ban, i is the discount rate, and x is the lifespan of the horse. The disposal methods considered in this analysis include (*a*) euthanasia followed either by cremation, rendering, burial, or disposal at a landfill; or (*b*) the owner could pay to have the horse cared for until its natural death. Table 1 displays the expected costs of disposal using each of these methods. The costs of care or disposal vary from approximately $170 to euthanize and bury an animal to an estimated $24,570 ($2,340 per year) to care for the animal until its natural death. The estimate of the cost to care for the horse until death is documented in table 2. Another potential method for dealing with unwanted horses is through adoption. The only cost estimates for horse adoption available are provided by the price charged by the federal government to adopt a horse through the Bureau of Land Management's (BLM's) National Wild Horse and Burro Program. This cost is $185 per horse but, according to Godfrey (2004), does not come close to recovering BLM's cost to operate the program.[6]

An estimated NPV for equation (1) can be calculated assuming that the foregone sale of the horse for slaughter (i.e., the *Prevalue*) is $350 for a horse weighing 1,000 pounds (455 kg) (Palmer, 2003). Assuming a discount rate of 5% (i = 5%), and that the average lifespan for a horse is 11 years (x = 11),[7] the estimated decrease in the

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[6] Interested readers are referred to BLM's online program information at http://www.wildhorseandburro.blm.gov/requirements.htm.

[7] The average lifespan of horses in the United States is estimated to be 10.5 years (Thomson's Veterinary Healthcare Communications, 2003b). Consequently, for this study, x was assumed to be equal to 11.

Table 1. Estimated Costs Associated with Horse Disposal

Cost Item	Cost Range	Average	Total Cost of Euthanasia, Hauling, and Disposal
Euthanasia +	\$71–\$90 [a]	\$80	
Transportation: 50 miles @ \$0.35/mile		\$18	
Cremation/Incineration	\$1,000 [b]	\$1,000	\$1,098
Rendering	\$75–\$100 [b]	\$88	\$186
Burial	\$200–\$350 [b]	\$275	\$373
Landfill	\$100 [b]	\$100	\$198
Care until natural death [c]	\$195/month [d]	\$195 × 12 × 10.5 years	\$24,570

Note: Selling for slaughter is considered as revenue, not a cost, and therefore is not listed.
[a] *Source:* Thomson's Veterinary Healthcare Communications (2003a, p. 107).
[b] *Source:* Endersby (2003).
[c] Disposal at death is not calculated into the horse's maintenance costs.
[d] For breakdown of care costs, refer to table 2 below.

Table 2. Estimated Horse Maintenance Costs for Care Until Death

Description	Average Cost/Horse/Month (\$)	Average Cost/Horse/Year (\$)
Board (own facility) [a]	20	240
Hay consumption (16.5–20 lbs./horse/day)	80	960
Grain @ 4 lbs./day	24	288
Shoeing (seven times/year)	48	576
Deworming (six times/year)	6	72
Vaccinations (two times/year)	9	104
Float teeth (once annually)	8	100
Average Cost:	\$195/month	\$2,340/year

Notes: Horse maintenance costs are the average calculated among three online sources:
< http://www.petplace.com/Articles/artShow.asp?artlD=786
< http://www.easyhorsesearch.com/horse-costs.html#(5)
< http://www.horsekeeping.com/horse_management/cost_of_keeping_a_horse.htm
Averages were calculated on an annual basis from the three sources cited above. Monthly figures are calculated from the annual amount divided by 12.
[a] Board is considered as overhead, and therefore decreases through economies of scale; board varied considerably from state to state.

NPV for a horse in the United States after the implementation of a ban on slaughtering horses would average $304, i.e.,

$$\frac{\$350 - (-\$170)}{(1 + 0.05)^{11}} = \$304.$$

The American Horse Council estimates the 2003 U.S. horse inventory to be approximately 6.9 million animals (Owens, 2003). Annual horse mortality in the United States can be calculated by taking 6.9 million horses and dividing that number by the average lifespan of a horse (10.5 years), which yields an estimate of 657,142 horse deaths in the United States each year (6,900,000/10.5 years = 657,142). Approximately 65,000 to 95,000 of the 657,142 U.S. horses dying each year are disposed of by slaughter [American Quarter Horse Association (AQHA), 2003; Cordes, 2003].

Multiplying the number of U.S. horses slaughtered per year by the estimated loss in NPV for each of these horses following the implementation of a slaughter ban, yields an estimated impact on the U.S. horse industry, in terms of lost value, of $20–$29 million annually (i.e., 65,000 or 95,000 horses × $304 = $19,760,000 or $28,880,000, respectively). This estimation should be considered a lower bound for the impact on costs because it considers only the cheapest method for disposal (euthanasia) and only the direct impact on horses that would have been slaughtered. It seems reasonable to assume that potential additional costs might have at least some expanded negative impact on all horse prices, but data are not available to measure the magnitude of such an expanded impact.

Modeling Supply and Demand for Horsemeat Exports

A simultaneous econometric model was developed and estimated to identify the determinants of U.S. horsemeat supply and European demand for U.S. horsemeat because it was assumed that supply and demand are jointly determined. The structural model should include variables determined by economic theory and was specified as:

$$(2) \qquad Supply\ Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 C_t + \alpha_3 Q_{t-1} + \alpha_4 MID90_t + \varepsilon_t,$$

$$(3) \qquad Demand\ P_t = \beta_0 + \beta_1 Q_t + \beta_2 BSE_t + \beta_3 Q_{B_t} + \beta_4 INCOME_t + \beta_5 IMPORTS_{t-1} + \xi_t,$$

$$(4) \qquad Supply = Demand,$$

where P_t is the exchange-rate adjusted value of U.S. exports measured in real Euros at time t. Q_t is the annual quantity of horsemeat exported from the United States, and BSE_t is a binary variable used to test if the BSE crisis in Europe affected U.S.

horsemeat exports. The variable Q_{B_t} is per capita beef consumption in France at time t. $INCOME_t$ is the household income in France at time t. $IMPORTS_{t-1}$ are horsemeat imports in Europe from countries other than the United States in the previous time period. Q_t and P_t applied to the supply equation (2) are the same variables used in the demand equation (3). C_t in the supply equation is input costs, in this case, U.S. cull horse price at time t. Q_{t-1} is Q lagged one time period and is a partial adjustment or adaptive expectations mechanism (Nerlove, 1958). The estimated coefficient for Q_{t-1} (α_3) must be between zero and one in absolute value (lie in the unit interval) to meet the requirements for a stable system (Greene, 2003, p. 573).

From 1990 to 1994, and from 1996 to 2002, the U.S. horsemeat market was in a free fall (see figure 1). For reasons we are not completely able to explain with our models, U.S. horsemeat exports stabilized somewhat during 1994–1996. Thus, $MID90_t$ is a dummy variable that accounts for this apparent anomaly in the data and is equal to one for 1994–1996, inclusive, and zero otherwise.[8]

Total EU demand for horsemeat is presented in figure 2. As can be seen from figures 1 and 2, U.S. horsemeat exports have become a small proportion of EU horsemeat imports over time. The observations for the variables described here and used in the model were taken from a variety of sources, described below.

The value and quantity of U.S. horsemeat exports is gathered and reported by the USDA/FAS (2003) in its *Foreign Agricultural Trade of the U.S.* (FATUS) report. FATUS reports the total value of U.S. horsemeat exports in nominal U.S. dollars per metric ton (MT) and also the MT exported. The price of horsemeat exports (P_t) used in the regression analysis was calculated by dividing the total value of U.S. horsemeat exports by the total quantity measured in MT of horsemeat exported. This price was deflated using the U.S. consumer price index (CPI) and then converted to Euros using the PACIFIC commerce exchange rate table [Policy Analysis Computing and Information Facility in Commerce (PACIFIC), 2003]. The result was an exchange-rate adjusted, real price for U.S. horsemeat exports. The data are an annual time series beginning in 1990 and ending in 2002, inclusive.

For this analysis, France was chosen as a proxy to represent European demand for U.S. horsemeat because France is the largest single purchaser of U.S. horsemeat. The annual quantity of beef produced (Q_{B_t}) in France was used to test the effect of a potential complement or a substitute (beef) for horsemeat in France (USDA/FAS, 2003). Annual beef production in France was taken from the Food and Agriculture Organization (FAO) of the United Nations (2003) online database.[9]

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[8] Results discussed later will show that given other market conditions considered in the models (especially prices), slaughter was actually lower than expected during 1994–1996. While precipitation in the United States was near average and hay prices below average during this time period, feed costs were not determined to be a "statistical" determinant of U.S. horse slaughter [the sign was correct (positive effect on supply), but not statistically significant]. Changes in exports from other North American countries (Canada and Mexico) also could not explain this phenomenon.

[9] Per capita consumption was estimated by dividing total production by the estimated population of France. France is not a major beef exporter, so this was considered to be a reasonable estimate.

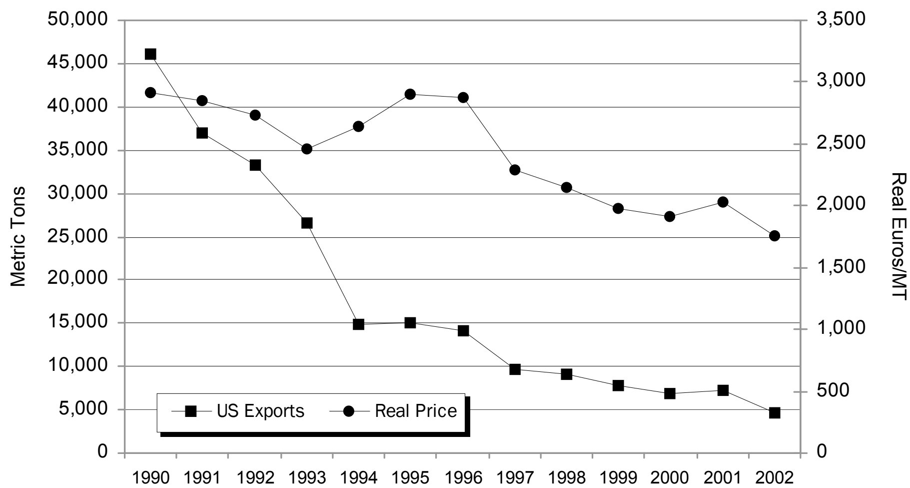
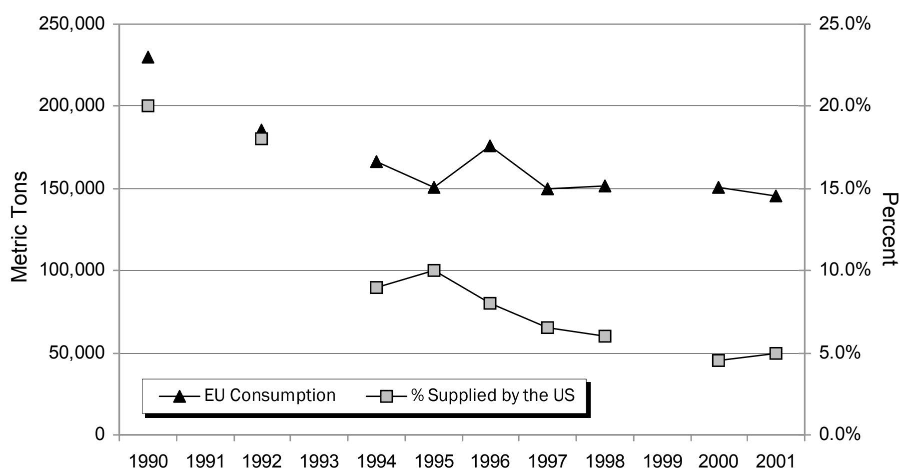


Figure 1. U.S. horsemeat exports and export prices, 1990–2002



Source: MHR Viandes (2003).

Figure 2. European horsemeat consumption from 1990–2001 (broken) and percentage of EU consumption supplied by the United States

The income measure ($INCOME_t$) is annual per capita income in France (INSEE, 2003). The PACIFIC commerce exchange rate tables were used to convert French income figures into U.S. dollars, and the CPI then was applied to maintain the income measure in real dollars. The import variable ($IMPORTS_{t-1}$) examines how increases in European imports of horsemeat during the previous year from non-U.S. countries affected U.S. horsemeat prices in the current year. Italy imports much of its horsemeat from non-U.S. countries, including eastern and central Europe. Because of this and the fact that a more comprehensive time series for EU imports was not available, Italy was used as a proxy for Europe's non-U.S. sources for horsemeat. Data from ISMEA (2003) and ISTAT (2003) gave the volume of horsemeat imports for Italy, reported in kilograms per year between 1990 and 2001, and converted to MT for our regression analysis. Because the 2002 value for Italian horsemeat imports was unavailable, it was interpolated using a semi-log growth model (Gujarati, 1999).

A binary variable was used to test the effect of the bovine spongiform encephalopathy (BSE, or mad-cow disease) crisis on the demand for horsemeat in Europe. Some believe that Europe's BSE crisis changed some European consumers' preferences from beef to horsemeat (Helm, 2000; Heyde, 2002). This dummy variable (*BSE*) was used to test whether BSE changed European preferences toward consuming horsemeat. The value for the *BSE* variable was 1 for 1996–1999 inclusive, the height of Europe's BSE crisis, and 0 otherwise.

The same prices and quantities of U.S. horsemeat exports used in the demand equation were also used in the supply equation. The price of cull horses was used in the supply equation to represent input costs since it is the principal input cost in horse processing and because a time series for processing costs was not available. The data for culled horse prices were gathered from an Idaho horse dealer who purchased and sold over 15,000 cull horses for slaughter between 1990 and 2002 (Palmer, 2003).

Results for Supply and Demand Model

Because the supply and demand for U.S. horsemeat are jointly determined, a simultaneous model of supply and demand is used to estimate the parameters of the supply and demand system specified by equations (2)–(4). Both the demand and supply equations are over-identified, indicating that a two-stage least squares (2SLS) procedure is the appropriate method for estimating the parameters of the system (Ferris, 1998). Because of the small sample size (n = 13) and the assumed asymptotic characteristics of 2SLS, ordinary least squares (OLS) estimates are also provided as a comparison for the 2SLS results.

The 2SLS procedure is accomplished in two steps. First, each of the endogenous variables in the system, in this case P_t and Q_t, are separately regressed on all of the exogenous variables in the system, in this case *BSE*, Q_B, *INCOME*, *IMPORTS*, *C*, Q_{t-1}, and *MID90*, to obtain OLS estimates for P_t and Q_t that are not contemporaneously correlated, or $\hat{P}_t$ and $\hat{Q}_t$. The equations used for the first step of the procedure are also called the reduced-form equations and are specified as follows:

$$(5) \qquad \hat{Q}_t = \theta_0 + \theta_1 BSE_t + \theta_2 Q_{B_t} + \theta_3 INCOME_t + \theta_4 IMPORTS_{t-1} + \theta_5 C_t + \theta_6 Q_{t-1} + \theta_7 MID90_t ,$$

$$(6) \qquad \hat{P}_t = \phi_0 + \phi_1 BSE_t + \phi_2 Q_{B_t} + \phi_3 INCOME_t + \phi_4 IMPORTS_{t-1} + \phi_5 C_t + \phi_6 Q_{t-1} + \phi_7 MID90_t .$$

The second step in 2SLS is to estimate the parameters of the original model but substituting the predicted (uncorrelated) values for P and Q on the right-hand side of their respective equations [i.e., predicted values from equations (5) and (6)]. Consequently, the 2SLS parameter estimates are obtained by using OLS estimates for the parameters of the following equations:

$$(7) \qquad Q_t = \delta_0 + \delta_1 \hat{P}_t + \delta_2 C_t + \delta_3 Q_{t-1} + \delta_4 MID90_t + \phi_t ,$$

$$(8) \qquad P_t = \gamma_0 + \gamma_1 \hat{Q}_t + \gamma_2 BSE_t + \gamma_3 Q_{B_t} + \gamma_4 INCOME_t + \gamma_5 IMPORTS_{t-1} + \psi_t .$$

The 2SLS parameter estimates for equations (7) and (8), together with OLS parameter estimates for equations (2) and (3), are presented in table 3.

Results for both the 2SLS and OLS procedures were virtually identical for the supply equation. However, diagnostics for the 2SLS estimates indicate it is the superior model for the demand equation—i.e., standard errors tended to be smaller, and a slightly better fit in terms of the adjusted R^2 ($\bar{R}^2$) was achieved. The Durbin-Watson (DW) test for first-order autocorrelation for the demand equation indicated no decision could be reached concerning the presence or absence of autocorrelation in that equation (see Greene, 2003, p. 270). Because the supply equation includes a lagged dependent variable (Q_{t-1}),[10] Durbin's *h*-test for autocorrelation was performed (Greene, 2003, p. 270) and indicated no autocorrelation was present in the supply equation residuals (table 3).

The signs for the variables included in the supply equation were all as expected and indicate a relatively well-behaved supply schedule for the supply of horsemeat exports from the United States. That is, price and supply are strongly positively correlated with only a temporary leftward shift during the mid-1990s.[11] Consequently, these results suggest that the huge reductions in U.S. horsemeat exports can be largely explained by reductions in the exchange rate-adjusted real price for U.S.

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[10] A lagged dependent variable (P_{t-1}) could have been included in the demand equation also. However, pre-testing indicated that a lagged dependent variable in the demand equation yielded an insignificant parameter estimate for that variable. Consequently, to preserve degrees of freedom, a lagged dependent variable was not included in the demand equation.

[11] Pre-tests for trends in the location of both the supply and demand curves during the study period yielded insignificant results.

Table 3. 2SLS and OLS Parameter Estimates for the Supply and Demand for U.S. Horsemeat Exported to Europe

	2SLS		OLS	
Variable	Parameter Estimate	*t*-Statistic	Parameter Estimate	*t*-Statistic
Supply Equation:				
Intercept	!28,160.667**	!3.665	!24,487.010**	!3.642
$\hat{P}$ or P [a]	19.955**	3.409	16.850**	3.412
C	!17,408.076	!1.539	!12,795.954	!1.242
$Q_{t!1}$	0.613***	5.473	0.613***	4.161
MID90	!10,422.763***	!3.740	!9,170.342***	!3.696
$\bar{R}^2$	0.971		0.971	
Durbin *h*	!1.091		!0.191	
Demand Equation:				
Intercept	!1,613.707*	!2.406	!1,499.506	!1.963
$\hat{Q}$ or Q [b]	!0.020 [c]	!1.810	!0.012	!1.053
BSE	!140.027*	!2.045	!130.209	!1.668
Q_B	195.672***	4.386	141.507**	3.429
INCOME	0.084**	2.860	0.097**	2.947
IMPORTS	!13.296***	!6.832	!12.332***	!5.695
$\bar{R}^2$	0.957		0.944	
Durbin-Watson	2.291		2.237	

Note: Single, double, and triple asterisks (*) denote statistically different than zero at the 10%, 5%, and 1% levels of confidence, respectively.

[a] For 2SLS = $\hat{P}$, and for OLS = P.

[b] For 2SLS = $\hat{Q}$, and for OLS = Q.

[c] Significant at 10% level of confidence for a one-tailed test of $H_0: \gamma_1 < 0$.

horsemeat exports (see figure 1). The short-run supply elasticity calculated at the means is 0.255, and the long-run supply elasticity is calculated as 0.889[12] (Nerlove, 1958). The coefficient for lagged supply (α_3) lies in the unit interval, indicating it satisfies the stability conditions. Costs for inputs (cull horses), while statistically insignificant, display the expected negative sign (*C*).

Results for the demand equation (table 3) provide some additional insights regarding factors affecting the market for U.S. horsemeat. Demand and the quantity of U.S. horsemeat exports are negatively correlated, as expected.[13] The results for the demand equation also indicate that U.S. horsemeat exports have suffered because of a shift

[12] Using the means and the estimated coefficients for α_1 and α_3, the long-run elasticity was calculated as 0.255/(1 ! 0.713). Note the elasticity for the lagged dependent variable, $Q_{t!1}$, also is between zero and one in absolute value and satisfies the stability condition.

[13] This is based on a one-tailed test for a positive coefficient for $\hat{Q}$ in table 3.

away from red meat in Europe. For example, the BSE crisis in the last half of the 1990s had a small negative effect on horsemeat, suggesting European consumers were exhibiting some reluctance to eat red meat in general and not just beef (parameter estimate for *BSE* in table 3). This is illustrated perhaps more dramatically by the significant positive sign for Q_B, a result showing that horsemeat and beef are complements to each other. An examination of the data reveals that per capita beef consumption[14] in France fell by over 17% during the study period (from 33.6 kg in 1990 to 27.8 kg in 2002); at the same time, U.S. horsemeat exports fell by over 90% (from 46,066 MT in 1990 to 4,592 MT in 2002). These results suggest a general shift away from red meat during the study period, which would explain the positive sign for beef consumption (table 3).

As observed from table 3, *INCOME* has a positive and statistically significant coefficient, indicating U.S. horsemeat exports are a normal good—i.e., demand increases with positive changes in French income. This finding is consistent with information from interviews conducted in France and Switzerland which suggested that income and consumption of horsemeat in Europe are positively related (Grunder, 2003). Perhaps most importantly, competing European imports were found to be significant substitutes for U.S. horsemeat, as expected, because *IMPORTS* had a negative and statistically significant coefficient. These results indicate that U.S. horsemeat exports have not been competitively priced with other competitors. Freer trade with central Europe and an increase in horsemeat production by South American countries appear to have placed significant downward pressure on horsemeat prices in Europe.[15] Consequently, the demand for U.S. horsemeat in Europe has continued to slide downward.

One might speculate U.S. horsemeat exports have simply shifted to Canada and/or Mexico as a result of political pressure to eliminate horse slaughter for human consumption in the United States. Goydon and Kindel (2003) report that the number of horses slaughtered in both Canada and the United States declined dramatically during the study period, but has increased in Mexico, resulting in fairly stable total slaughter numbers for North America since 1994 (table 4).[16] Based on data from the U.S. International Trade Commission, Goydon and Kindel (2003) note that exports of live horses from the United States to Canada and Mexico averaged only 23,000–30,000 and 1,000 head, respectively, in the seven years prior to their study. If this is true, it would provide little evidence that the huge decline in the number of U.S. horses being slaughtered can be explained by increased shipments for slaughter

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[14] Beef production per capita in France is actually used in the analysis. Assuming that most beef produced in France is consumed domestically, this should make domestic production a reasonable estimate for domestic French consumption.

[15] Goydon and Kindel (2003) reported that Brazil increased horsemeat exports by four-fold in the decade preceding 2003 to 15,000 metric tons, and Poland and Uruguay also increased horsemeat exports during the same period. Unfortunately, annual data for these countries were not available for this analysis.

[16] A pre-test for the impact of shifts in slaughter number within North America on U.S. horsemeat exports did not produce statistically significant results, and consequently was not included in the regression model in order to preserve degrees of freedom.

Table 4. Annual North American Horse Slaughter (head), 1990–2001

Year	Canada	Mexico	United States	Total
1990	129,900	575,000	348,400	1,053,300
1991	113,800	590,000	276,900	980,700
1992	88,800	606,000	246,400	941,200
1993	85,200	610,000	167,300	862,500
1994	59,700	618,000	107,000	784,700
1995	59,600	626,000	109,200	794,800
1996	63,500	630,000	103,700	797,200
1997	64,500	630,000	87,100	781,600
1998	65,400	630,000	72,000	767,400
1999	62,300	626,000	61,700	750,000
2000	60,900	626,000	50,400	737,300
2001	66,300	626,000	62,000	754,300

Source: Goydon and Kindel (2003).

to other North American locations.[17] Whether or not U.S.-origin horses are being slaughtered elsewhere, the fact remains that the horsemeat industry appears to be shifting to low-cost providers who are able to sell horsemeat at lower prices than the United States. This has resulted in a dramatic decline in U.S. horsemeat exports.

The results for the demand equation suggest that a movement away from red meat, especially beef, and an increase in low-priced competing imports, probably from central Europe and South America, have combined to dramatically reduce the demand for U.S. horsemeat since 1990. Results for the system of supply and demand indicate that increasing competition and changes in consumer preferences for red meat have combined to reduce both the quantity and price of U.S. horsemeat exports. Continuing pressure from U.S. policy makers and the opening of freer trade within Europe and between Europe and South America all foreshadow a difficult future in the United States for the horse slaughter industry for human consumption.

Conclusions

U.S. exports of horsemeat to Europe have declined throughout the past decade. This is a result of two major factors. First, the number of slaughtering facilities located in the United States has decreased to only two plants, both of which are located in Texas. Second, horsemeat imports to Europe from countries other than the United States are increasing. This has the effect of reducing horsemeat prices in the United States, as was observed in the regression model results.

[17] The results provide strong evidence that changes in U.S. exports have been driven by lower prices rather than by shifting U.S. supply to either Canada or Mexico.

A ban on slaughtering horses will cause the U.S. horse industry to experience both an immediate negative impact as a result of the closure of the export market, and a permanent increase in expenses due to increased disposal costs. A ban on slaughtering horses will almost certainly cause the value of both U.S. horses and horsemeat to decrease to some degree. For example, the value of live U.S. horses that would have gone to slaughter is estimated to decline by an average of $304 per horse following a slaughter ban. This figure was calculated using the net present value method. Horses currently have a salvage value. Following a ban on selling horses for slaughter, the salvage value of a horse would become zero or negative, where the horse owner will incur the expense of having the animal disposed of using another method. This estimate ($304/horse) should be considered a lower bound on costs given that it assumes the least costly method for disposal is used rather than selling the horse for slaughter. However, the direct economic impact on the horse industry would be in the neighborhood of $50 million annually ($26 million in lost export revenue and $20–$29 million in increased disposal costs). This represents a real, but perhaps relatively small, direct cost to the industry.[18] However, it also fails to measure any potential extended impact on the price of horses that are not slaughtered, since increasing costs for one segment of the industry will likely have at least some "ripple" effect on the entire industry.

Aside from the immediate monetary impact, money will be needed to care for or dispose of unwanted horses that cannot be slaughtered and are not disposed of. H.R. 857 does not contain language as to what to do with unwanted horses. The bill simply bans slaughtering, selling, and consuming horses. It does not answer the questions "What is to be done with unwanted horses?" and "Where are these horses going to go?" Logically, the bill infers that unwanted horses will be euthanized and discarded through other disposal methods. But there is no guarantee this will be the case. There are currently no data on how many horses are being disposed of by burial, rendering, or incineration. Consequently, no one knows if these other methods of disposal are capable of increasing production to fulfill the increased disposal needs if slaughtering is banned.

There are presently insufficient rescue or Humane Society facilities to house every unwanted horse (Cordes, 2003; Warren, 2003). For the United States to absorb the effects from a ban on slaughtering horses, an increase in rescue facilities would need to occur. Programs that find new careers for unwanted horses will need to be developed in order to address the numbers expected on horse rescue farms.

If these horses are not euthanized, caring for each of them will cost rescue facilities approximately $2,340 per year, depending on location (table 2). Thus, based on the AQHA (2003) estimate that approximately 65,000 to 95,000 U.S. horses are disposed of by slaughter each year, caring for unwanted horses until natural death could cost as much as $152 million to $222 million per year (i.e., 65,000 horses × $2,340 per year = $152,100,000; 95,000 horses × 2,340 per year = $222,300,000). A less expensive

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[18] Other industries, such as the feed and veterinarian services industries, would benefit from a ban on livestock slaughter, but these benefits are not estimated as part of this study.

method than caring until death would be to euthanize and dispose of unwanted horses, at an estimated annual cost of $11 million to $16 million (i.e., 65,000 horses × $170 for euthanasia, hauling, and rendering = $11,050,000; 95,000 horses × $170 for euthanasia, hauling, and rendering = $16,150,000).

Prior to placing a ban on the slaughter of horses, policy makers and horse owners should seriously consider cost-effective and humane alternatives for disposal. The equine industry should understand the potential monetary impact of the proposed ban and consider methods to cover these additional costs. Plans need to be in place to provide funds to increase the number of equine rescue facilities and the number of people trained to handle large animals. A strategy to move horses quickly through rescue facilities and into new homes should also be established.

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