What Are the Consequences of United States Government Slaughter Policies on Horse Prices?

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Abstract

As a result of several judicial rulings, the processing of horses for human consumption came to a halt in 2007. This article determines the impact horse prices suffered as a result of the elimination of horse processing facilities. A quantile regression approach is applied and is useful, as horses of varying quality were impacted differently. The authors acknowledge that the slaughter ban occurred alongside the U.S. economic downturn and attempts to account for the recession to adequately asses the policy effect.

Keywords: *horse processing, slaughter, quantile regression, price*

Introduction

The equine industry has been estimated to contribute $39 billion directly to the United States economy and is also responsible for over 1.4 million jobs (Deloitte Consulting 2005). The United States horse population is approximately 9.2 million (Lenz 2009). The equine industry provides a livelihood to millions and a significant economic impact in the United States, yet recent court decisions have halted the processing of horses for human consumption, an action which can lead to subsequent negative impacts on an economically productive industry.

In 2006, almost 105,000 horses were processed for human consumption, all in two foreign-owned Texas plants and a third foreign-owned plant in Illinois (Cowan 2010). Most U.S. and Canadian consumers view horses as performance and companion animals rather than food, and therefore the market for horse-meat lies abroad. The destination of the meat included markets such as France, Belgium, Switzerland, Italy, Japan, and Mexico. The United States exported more than 17,000 metric tons of horse meat at an estimated value of $65 million dollars in 2006. Several states have had long standing laws aimed at the prevention of the processing of horses for human consumption. In 2006, the owners of the two Texas processing plants, Beltex Corporation and Dallas Crown, Inc., sought to clarify the Texas state law initially passed in 1949 which banned the sale of horsemeat. The United States District Court for the Northern District of Texas had earlier agreed that the law had been repealed, was preempted by the Federal Meat Inspection Act (FMIA), and violated the dormant Commerce Clause of the United States Constitution. In January of 2007, a panel of the United States Court of Appeals for the Fifth Circuit rejected the previous conclusion, and declared the Texas law to be in force. This development cleared the way for the state attorney to prosecute the plant owners unless they ceased operation. The Illinois legislature passed a law banning horse processing in May 2007, and the Illinois plant ceased operation in September 2007 (Cowan 2010). An increasing number of horses were then transported to Mexico and Canada due to the legal actions which ended horse processing in the United States. In 2006, a little more than 11,000 horses were shipped to Mexico for processing. In 2008, the number shipped for processing rose to over 50,000 (Simon 2011). Legislation was introduced to the 111th Congress to make it illegal to knowingly possess, ship, transport, purchase, sell, deliver, or receive any horse, horseflesh, or carcass intended for human consumption (Cowan 2010). The legislation was referred to subcommittee in March of 2009. As the result of these legal actions, the problem of the unwanted horse has grown dramatically since 2007, and abandonment has become increasingly common (Dawson 2008). Previous to the slaughter ban, horses had a salvage value; horse owners are now faced with an unexpected disposal cost which many owners are unable to handle and could potentially lead to increased animal cruelty cases.

Economic research and analysis of the economics of the horse industry is uncommon. Few studies have been conducted analyzing horse prices, and even less research has estimated the economic impact of the slaughter ban on horse prices. The only other publication addressing horse processing is the Government Accountability Office Report to Congressional Committees on Horse Welfare published in June of 2011. Their results are similar to what is concluded here. In regards to the previous hedonic studies, several studies have been conducted to establish the determinants of horse prices. The horse industry as a whole covers a wide range of horse enthusiasts, each looking for a particular trait or appearance. From Thoroughbred race horses bred for speed, Arabians bred for endurance, and Quarter Horses used for a multitude of events, the industry as a whole demands a variety. Several studies have examined the racehorse industry. Lansford et al. (1998) used a semi-log hedonic pricing model to estimate the price of individual and ancestral characteristics of yearling Quarter Horses bred for racing. Maynard and Stoeppel (2007) conducted a hedonic price analysis of Thoroughbred broodmares in foal. Neibergs (2001) conducted a hedonic price analysis of Thoroughbred broodmares, and Neibergs (1997) estimated a supply and demand function of the Thoroughbred yearling market. Only a small amount of research has been conducted on other subsets of the horse industry. Taylor et.al. (2006) examined the price determinants of show quality Quarter Horses sold at auction, while Lange et al. (2010) applied a hedonic pricing model to ranch horses sold at auction in Texas. Freeborn (2008) conducted a hedonic price analysis to study the 'lower end' segment of the horse industry by examining recreational and pleasure horses sold and advertised online. These studies contributed to the small amount of economic literature identifying the determinants of horse prices outside of the Thoroughbred and Quarter Horse racing industries.

As previously mentioned, a factor which has received very little attention, is the impact the slaughter ban has had on horse prices. The primary objective of this research is to determine the impact of the slaughter ban on horse prices. The equine industry is rarely examined in economic literature, yet it is a multi-billion dollar industry which can suffer from judicial issues much similar to other agricultural industries, and therefore merits further investigation. With the processing market eliminated, what was once a product with a market demand has now been transformed into an, often costly, burden. Application of a quantile regression approach to the determinants of horse prices, allows for a more precise and clear picture of the resulting impacts following the processing closure. Lower quality horses were likely impacted to a greater extent due to fewer alternative uses, while horses with a larger monetary value are likely to be impacted less as they are more likely to have value outside of the processing market.

Theory

The horse industry is dynamic and diverse. Within each segment, whether it is show horses, ranch horses, or racing stock, the quality and subsequent price can vary greatly. The value of specific characteristics likely vary depending on the quality of the horse. Specific characteristics might be valued less or more on horses of a lower or higher monetary value. An analogous situation is the housing market. In an effort to better communicate the underlying motivational theory behind the quantile regression approach a brief discussion of the quantile regression approach to the housing market is discussed.

Over a hundred hedonic regression studies of house prices have been conducted and often the results disagree not only in magnitude, but also in direction of the effect of certain characteristics. These misleading and often inconclusive results are confounding, and led to the belief that housing characteristics are not valued the same across a given distribution of house prices (Zietz, Zietz, and Sirmans 2007). Malpezzi (2003) noted that different consumers may value housing characteristics differently. This led Zietz, Zietz, and Sirmans (2007) to use a quantile regression approach for the housing market, where they show that particular housing characteristics are valued differently for houses in the upper-price range as compared to houses in the lower-price range. Much like the segments of consumers in the housing market are the buyers of horses. Depending on the level of involvement in the industry, whether strictly for leisurely weekend recreation or the fierce competition of winning, owning, or riding a world champion horse, the valuation of characteristics vary. Likewise, it is hypothesized that the effect of a slaughter ban would differ across the different points in the distribution of horse prices. Horses at the upper-end of the market would most likely suffer a price decrease, but the impact could potentially be less than the impact felt at lower segments of the market.

As an alternative to the ordinary least squares (OLS) regressions previously mentioned, this study uses quantile regression to identify the implicit prices of horse characteristics for different points in the distribution of horse prices. By using the quantile regression approach, higher-priced horses are allowed to have a different implicit price for a characteristic than lower-priced horses. Quantile regression employs the entire sample, therefore the problem of truncation is avoided (Heckman 1979). It should also be noted that by using quantile regression rather than applying ordinary least squares to sub-sets of the data, the problem of biased estimates (created in applying OLS to sub-sets of data) is eliminated (Newsome and Zietz 1992).

Hedonic Pricing Methodology

The value of a horse is determined by the genetic and physical characteristics it possesses along with its genetic production capabilities in the case of mares and stallions. A hedonic model is an 'indirect' valuation method in which the value of the characteristic cannot be directly estimated; however it can be indirectly valued from the observed market transactions. By observing market transactions of heterogeneous individuals, the implicit price of one of the characteristics can then be estimated. Each horse's value is a reflection of the specific characteristics it possesses (Rosen 1974). Physical characteristics of a horse, such as conformation, demeanor, and general appearance, are not easily recorded in a sale catalog, and therefore were not included in the model.

Also included in the hedonic regression were specific variables of interest in terms of how the horse was described in the sale catalog. As determined by Levitt and Dubner (2005), through an analysis of the language used in real-estate ads, specific terms are correlated with higher house prices while other descriptive terms are related to lower house prices. The majority of terms found to be correlated with a higher sales price were physical descriptions of the house itself, while terms like 'fantastic,' yielded the opposite result. Included in the hedonic regression were indicator variables for descriptive language commonly used in describing horses in this market. A complete description of the independent variables and associated descriptions are included in table 1. Terms such as ‘beautiful,’ ‘nice,’ ‘lots of cow,’ ‘finished,’ and ‘100% sound’ are a few examples of the descriptive characteristics measured. The general specification of the hedonic pricing model is

(1) $price = f(physical\ traits, slaughter, unemployment, catalog\ description\ variables)$.

The quantile regression approach is based on the minimization of weighted absolute deviations to estimate conditional quantile functions (Koenker and Bassett 1978 ; Koenker and Hallock 2001). Quantiles, other than the median quantile, employs asymmetric weights(i.e. 0.2, 0.4, 0.6, and 0.8). In comparison to the ordinary least squares method where the explanations are limited to the mean of the dependent variable, quantile regression can explain the determinants of the dependent variable at any point of the distribution of the dependent variable. OLS regression estimates the linear conditional mean function $E(Y|X = x) = x'\beta$, by solving for,

$$(2) \qquad \hat{\beta} = \arg\min_{\beta \in R^p} \sum_{i=1}^{n} (y_i - x_i'\beta)^2 .$$

The estimated parameter $\hat{\beta}$ minimizes the sum of squared residuals in the same way that the sample mean $\hat{\mu}$ minimizes the sum of squares:

$$(3) \qquad \hat{\mu} = \arg\min_{\mu \in \boldsymbol{R}} \sum_{i=1}^{n} (y_i - \mu)^2 .$$

Likewise, quantile regression estimates the linear conditional quantile function, $Q(\tau|X = x) = x'\beta(\tau)$, by solving:

$$(4) \qquad \hat{\beta}(\tau) = \arg\min_{\beta \in R^p} \sum_{i=1}^{n} \rho_\tau(y_i - x_i'\beta),$$

for any quantile $\tau \in (0,1)$. The quantity $\hat{\beta}(\tau)$is the τth regression quantile. For example, τ=0.5 which minimizes the sum of absolute residuals, corresponds to the median regression (SAS 2008). The standard errors, confidence intervals and associated p-values are computed with the Markov Chain Marginal Bootstrap (MCMB) resampling method of He and Hu (2002).

Data

Sale prices and final bids were collected from the a large regional horse auction company in Oklahoma. Although the company conducts several sales per year, the largest sale was selected for evaluation and use in this study. Horses entered in the sale are consigned by the seller. The seller pays a catalog fee ranging from $150-$250 for each horse entered and agrees to pay 8% of the final sale price of each horse as a commission to the auction company. The seller is responsible for providing information regarding the horse and can submit a picture to be included in the catalog. The summary statistics are included in table 2. It is important to note that the data used in this study represent horses of a greater quality and value than horses directly intended for processing. Detailed data on processing or 'killer' horses is not readily available. This sale was selected for numerous reasons including: the geographical location, detailed attributes of horses sold, and range in sale price. The sale primarily includes horses for the following disciplines: cutting, reining, working cow horse, speed events, roping, ranch work, breeding stock, halter, western pleasure/hunter under saddle/all-around events, and general leisure or recreation (trail riding) horses. The sale data included 6,951 observations from the January sales for the period 2001-2010. The sale prices were adjusted for inflation and all results are in 2010 dollars. As described in table 1, the indicator variable for slaughter is included. Horses which sold from 2001-2007 are given a zero, as slaughter was still allowed, and horses which sold from 2008-2010 are given a one as horses were no longer processed in the United States for human consumption. To account for the state of the U.S. economy the most current unemployment rate for the West South Central division (TX, OK, AR, LA) was used. For example, the January 2002 sale used the December 2001 unemployment rate as a measure of the economy. Further, each horse's sale catalog description was individually examined and an associated discipline was assigned to the horse. The description was also examined for the inclusion of specific language which, as previously discussed, is related to sale price.

Procedure

The quantile regression was estimated and evaluated on a set of variables at the 0.2, 0.4, 0.6, 0.8 and the median (0.5) quantiles. In addition, the ordinary least squares regression was also evaluated. The inflation adjusted log of the sale price was shown to be a better fit to the data and therefore is included as the dependent variable in the estimated models which will be discussed. The hedonic pricing model takes the form

$$(5) \qquad \ln p_i = \alpha + \sum_i \beta_i X_i + \varepsilon_i,$$

where selling price, p_i, is expressed in logged form, α is the intercept term, β_i is the regression coefficient for the *i*th horse characteristic, X_i, and ε_i is the error term. More specifically, the estimated model can be specified as,

$$(6) \qquad \ln p_i = \alpha + \sum_{b=1}^{3} \beta_b\, breed_{ib} + \sum_{c=1}^{16} \beta_c\, color_{ic} + \sum_{g=1}^{2} \beta_g\, gender_{gi} + \sum_{d=1}^{14} \beta_d\, description_{di} + \beta_l lines_i + \beta_a geldage_i + \beta_s geldage2_i + \beta_m mareage_i + \beta_n mareage2_i + \beta_t studage_i + \beta_u studage2_i + \beta_p slaughter_i + \beta_e unemployment_i + \varepsilon_i,$$

where $\ln p_i$ is the inflation adjusted natural log price for horse *i* sold at auction, α is the intercept for price, β_b is the effect of breed on natural log of price, $breed_{ib}$ is the variable for breed *b* (where 1 is Paint, 2 is grade, 3 is other breeds, and the intercept reflects Quarter Horse), β_c is the effect of color on natural log price, $color_{ic}$ is the variable for color *c* (full color descriptions are included in table 1, the intercept reflects sorrel), β_g is the effect of gender on natural log price,

$gender_{gi}$ is the variable for gender g (where 1 indicates a stallion, 2 indicates a gelding, and the intercept reflects a mare), β_d is the effect of description on natural log price, $description_{di}$ is the variable for the *i*th description indicator variable, β_l is the effect of the number of lines, $lines_{li}$, in the catalog description on natural log price, β_a and β_s are the effects of gelding's age and gelding's age squared on natural log price respectively, β_m and β_n are the effects of mare's age and mare's age squared on natural log price respectively, β_t and β_u are the effects of stallion's age and stallion's age squared on natural log price respectively, β_p is the indicator variable for slaughter effect on natural log price, $slaughter_{si}$ is the variable for slaughter *s* (where 1=slaughter is banned, 0=slaughter is allowed), β_e is the effect of the United States unemployment rate the December prior to the January Sale, $unemployment_i$, on natural log price, and ε_i is the error term. The quantile models were estimated using the quantreg procedure in statistical analysis software (SAS), while the OLS model was estimated using the reg procedure.

Results

The complete quantile and ordinary least squares values are reported in table 3. Since the dependent variable is the natural log of horse price, the interpretation of the coefficient estimate is the approximate percentage change in price when the indicator variable characteristic in question is present. It is an approximation because the coefficients estimated for the indicator variables are transformations of the percentage effect, a small calculation is required. For a coefficient estimate, *b*, the percentage effect, g, is given by $100 * g = 100(\mathrm{e}^b - 1)$(Taylor 2003). This calculation was applied to the significant variables of the models estimated, and the results are included in table 4.

Several variables of interest significantly impact horse prices. Horses which are not registered are discounted in both the OLS model as well as all four (0.2, 0.4, 0.6, 0.8) of the quantiles examined. Grade horses have a relatively small breeding value as any offspring cannot be easily registered with a breed organization. Although many times hypothesized to be of little effect on price, color was shown to positively impact the lower quantiles (Q.2 and Q.4) most frequently. Palomino,red roan, blue roan, and buckskin horses received anywhere from a 13% to a 25% premium over sorrel horses in the Q.2 and Q.4 models. Color was least influential on horses in the upper quantiles (Q.6 and Q.8). This result is hypothesized to be due to the fact that upper end horses have training or significant high quality proven bloodlines which give them value, while horses in the lower quantiles (Q.2 and Q.4) are likely from unproven bloodlines, and do not have extensive training, therefore a unique, rare, or ‘flashy’ coat color is desired over a more common coat color (sorrel). Geldings are discounted approximately 18% in the lower-end (Q.2) model and 31% in the upper-end (Q.8) model. Also of a significance is the *general* variable. Each horse, based on their description and breeding, was assigned to a discipline category, and horses which did not designate a specific discipline or were recommended for general recreation or trail riding were assigned to the general category. Intuitively horses with no specialized training or genetic relation to proven discipline performers (sire/dam or grandsire/granddam) would not receive a premium at market.

The indicator variables examined in the horse catalog descriptions also yielded interesting results. Consistent with Levitt and Dubner (2005), an ambiguous description such as ‘nice’ is shown to negatively impact prices across models. The inclusion of ‘nice’ is related to a 6% to 11% discount. A more descriptive variable such as ‘finished’ was significant in several of the quantiles examined as well as the OLS model. Including the word ‘finished’ in the horse’s description was associated with increased prices from 27% to 61%. This result is also intuitive as it indicates the horse has specialized training and will be ready to show in the specified discipline. Another descriptive and informative variable as ‘100% sound’ significantly impacts prices from 11% to 15%, while ‘athletic’ and ‘quiet/gentle’ negatively impacted upper-end prices by 12% and 8% respectively.

The slaughter variable was also one of the independent variables associated with a larger impact on price. As shown in table 4., the slaughter variable was associated with a larger negative effect on horses in the lower-end (Q.2). It is important to note, the horses sold at this sale are unlikely to go straight to a processing plant, however, they would be the closest horses (of the horses at this auction) to the bottom segment of the industry. Horses in the .20 quantile which were sold when processing plants were operating were linked to prices 44% higher than horses in the same quantile which sold after the processing plants were closed. The impacts of the processing ban were felt throughout the industry; however it is also important to acknowledge that the United States (U.S.) economy was also suffering setbacks at this time and the unemployment variable is significant and inversely related to horse prices in the upper-end models (Q.6 and Q.8). As hypothesized horses in the upper-end (Q.8) were impacted by the slaughter ban (-29%), however not to the extent as those in the lower quantiles (Q.2 and Q.4). Table 5 includes the parameter estimate, standard error, 95% confidence limits, t-value, and associated p-value for the slaughter variable across the quantile models estimated. This result validates the hypothesis that the effects of closing processing facilities did not impact all horses equally and although all horse prices declined, horses in a lower quantiles were impacted more and therefore in order to attain a more realistic and valid picture of the economic impacts a quantile approach is justified.

Conclusion

Economic research commonly overlooks the equine industry. Previous empirical research has primarily focused on the racing industry. The results from this study show that the effect of horse characteristics on selling price can be better explained by estimating a quantile regression across price categories, further the results show that the impact of the elimination of horse processing facilities can be associated with a significant impact on all horse prices.

Of particular importance is the fact that the court decisions which led to the closure of horse processing facilities, did not have a uniform percentile impact on all horse prices. Horses included in a lower quantile were more dramatically impacted by the processing plant closures than horses in the upper-end quantile, yet it should be noted the processing plant closures did negatively impact all horse prices. Although horse processing is a topic of great debate, very little economic studies have been conducted to determine the economic impacts the industry is suffering as a result of court proceedings and decisions. As our nation continues to battle the ever growing population of unwanted horses, this research can provide a valid economic argument as to the fiscal loss suffered to the industry.

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Table 1. Variable Definitions

Variable	Definition
Price	Sale price
AdjPrice	Inflation adjusted sale price (2010 dollars); $\ln(p_i)$=dependent variable
Quarter	1 if breed is Quarter Horse, 0 otherwise, (base variable)
Paint	1 if breed is Paint, 0 otherwise
Grade	1 if breed is grade (not registered), 0 otherwise
Other breed	1 if breed is other (Appaloosa, Thoroughbred, pony), 0 otherwise
Sorrel	1 if color is sorrel, 0 otherwise, (base variable)
Palomino	1 if color is palomino, 0 otherwise
Red roan	1 if color is red roan, 0 otherwise
Bay	1 if color is bay, 0 otherwise
Grey	1 if color is grey, 0 otherwise
Blue roan	1 if color is blue roan, 0 otherwise
Buckskin	1 if color is buckskin, 0 otherwise
Red roan	1 if color is red roan, 0 otherwise
Dun	1 if color is dun, 0 otherwise
Grulla	1 if color is grulla, 0 otherwise
Black	1 if color is black, 0 otherwise
Chesnut	1 if color is chesnut, 0 otherwise
Brown	1 if color is brown, 0 otherwise
Other	1 if color is other (appaloosa color patterns), 0 otherwise
Tobiano/Overo/ Tovero	1 if color is tobiano, overo, or tovero, 0 otherwise
Solid	1 if color is solid (indicates a solid Paint horse), 0 otherwise

Table 1. Continued

Variable	Definition
Broodmare	1 if mare has previously foaled or is in-foal (pregnant), 0 otherwise
Mare	1 if gender is mare, 0 otherwise (base variable)
Stallion	1 if gender is stallion, 0 otherwise
Gelding	1 if gender is gelding, 0 otherwise (base variable)
General	1 if no specific training, no discipline is recommended or general recreation horse, 0 otherwise
Number of lines	Measured as the number of lines in the horses description in the sale catalog
Exclamation	1 if an exclamation mark (!) was used in the horse description, 0 otherwise
Nice	1 if the term 'nice' was used in the horse description, 0 otherwise
Sound	1 if the term '100 % sound' was used in the horse description, 0 otherwise
Beautiful	1 if the term 'beautiful' was used in the horse description, 0 otherwise
Pretty	1 if the term 'pretty' was used in the horse description, 0 otherwise
Cute	1 if the term 'cute' was used in the horse description, 0 otherwise
Quiet/Gentle	1 if the term 'quiet' and/or the term 'gentle' was used in the horse description, 0 otherwise
Finished	1 if the term 'finished' was used in the horse description, 0 otherwise
Lots of cow	1 if the term 'lots of cow' or 'cowy' was used in the horse description, 0 otherwise
Athletic	1 if the term 'athletic' was used in the horse description, 0 otherwise
Incentive Fund	1 if the horse is enrolled in the incentive fund program, 0 otherwise
Picture	1 if a picture was included in the sale catalog, 0 otherwise

Table 1. Continued

Variable	Definition
GeldAge	Gelding and age (sale year less year foaled) interaction term
GeldAge2	Gelding and age of horse squared interaction term
MareAge	Mare and age (sale year less year foaled) interaction term
MareAge2	Mare and age of horse squared interaction term
StudAge	Stallion and age (sale year less year foaled) interaction term
StudAge2	Stallion and age of horse squared interaction term
Slaughter	0 if sale year is 2001-2007 (slaughter allowed), 1 if sale year is 2008-2010 (slaughter banned)
Unemployment	December unemployment rate for West South Central division (TX, OK, LA, and AR) from Bureau of Labor Statistics

Table 2. Summary Statistics (N=6951)

Variable	Frequency	Mean	Std. Dev.	Min. Value	Max. Value
Price	6951	4,327.06	5,189.36	75.00	75,000.00
AdjPrice	6951	4,818.25	5,795.85	92.25	92,250.92
Quarter	5882	0.85	0.36	0	1
Paint	993	0.14	0.35	0	1
Grade	46	0.01	0.08	0	1
Other breed	30	0.00	0.07	0	1
Sorrel	1946	0.28	0.45	0	1
Palomino	450	0.06	0.25	0	1
Red roan	302	0.04	0.20	0	1
Bay	1025	0.15	0.35	0	1
Grey	387	0.06	0.23	0	1
Blue roan	196	0.03	0.17	0	1
Buckskin	393	0.06	0.23	0	1
Dun	416	0.06	0.24	0	1
Grulla	73	0.01	0.10	0	1
Black	211	0.03	0.17	0	1
Chesnut	412	0.06	0.24	0	1
Brown	110	0.02	0.12	0	1
Other	24	0.00	0.06	0	1
Tobiano/Overo/ Tovero	814	0.12	0.32	0	1
Solid	192	0.03	0.16	0	1
Stallion	1810	0.26	0.44	0	1
Gelding	1420	0.20	0.40	0	1
Mare	3721	0.54	0.50	0	1
Broodmare	1255	0.18	0.38	0	1
General	1928	0.28	0.45	0	1
Number of lines	6951	4.43	1.77	1	16
Exclamation	322	0.05	0.21	0	1
Nice	1707	0.25	0.43	0	1
Sound	872	0.13	0.33	0	1
Beautiful	738	0.11	0.31	0	1
Pretty	949	0.14	0.34	0	1
Cute	151	0.02	0.15	0	1
Quiet/Gentle	1189	0.17	0.38	0	1
Finished	170	0.02	0.15	0	1
Lots of cow	288	0.04	0.20	0	1
Athletic	626	0.09	0.29	0	1
Incentive Fund	637	0.09	0.29	0	1
Picture	520	0.07	0.26	0	1

Table 2. Continued

Variable	Frequency	Mean	Std. Dev.	Min. Value	Max. Value
GeldAge	6951	1.10	2.60	0	20
GeldAge2	6951	7.97	27.91	0	400
MareAge	6951	3.18	4.53	0	25
MareAge2	6951	30.67	71.38	0	625
StudAge	6951	0.97	2.36	0	22
StudAge2	6951	6.51	29.30	0	484
Slaughter	2016	0.29	0.45	0	1
Unemployment	10	5.49	1.06	4.1	7.9

Table 3. Coefficient Estimates of Ordinary Least Squares and Quantile Regression Models Estimated

Variable	Q.2	Q.4	Q.6	Q.8	OLS
Intercept	6.90***	7.47***	7.88***	8.29***	7.65***
	(0.08)[a]	(0.09)	(0.08)	(0.10)	(0.07)
Paint	-0.01	-0.33	-0.14	-0.13	-0.11
	(0.43)	(0.22)	(0.25)	(0.31)	(0.22)
Grade	-0.42***	-0.49***	-0.51***	-0.49***	-0.44***
	(0.13)	(0.14)	(0.15)	(0.14)	(0.12)
Other breed	-0.30	-0.45**	-0.43	-0.36	-0.39***
	(0.30)	(0.18)	(0.28)	(0.27)	(0.15)
Palomino	0.18***	0.13**	0.01	-0.03	0.07*
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)
Red roan	0.14	0.17***	0.09*	0.07	0.16***
	(0.09)	(0.05)	(0.05)	(0.07)	(0.05)
Bay	0.02	0.02	-0.01	-0.02	0.00
	(0.04)	(0.04)	(0.03)	(0.04)	(0.03)
Grey	0.01	0.08	-0.00	0.04	0.00
	(0.06)	(0.06)	(0.05)	(0.07)	(0.04)
Blue roan	0.12	0.14*	0.01	-0.07	0.04
	(0.09)	(0.07)	(0.06)	(0.06)	(0.06)
Buckskin	0.23***	0.21***	0.11**	0.05	0.14***
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
Dun	0.01	-0.05	-0.07	-0.07	-0.06
	(0.05)	(0.04)	(0.05)	(0.07)	(0.04)
Grulla	0.10	0.19	0.00	-0.05	0.06
	(0.13)	(0.13)	(0.10)	(0.10)	(0.09)
Black	-0.06	-0.01	-0.08	-0.11	-0.05
	(0.07)	(0.08)	(0.07)	(0.09)	(0.06)
Chesnut	-0.13**	-0.13**	-0.08	-0.07	-0.13***
	(0.06)	(0.06)	(0.06)	(0.07)	(0.04)
Brown	-0.10	-0.02	-0.12*	-0.08	-0.06
	(0.14)	(0.09)	(0.07)	(0.15)	(0.07)
Other	0.19	-0.05	-0.02	0.13	0.09
	(0.25)	(0.20)	(0.29)	(0.34)	(0.17)
Tobiano/Overo/Tovero	-0.38	-0.08	-0.34	-0.34	-0.35
	(0.42)	(0.23)	(0.25)	(0.30)	(0.22)
Solid	-0.77*	-0.37	-0.61**	-0.53*	-0.63**
	(0.43)	(0.22)	(0.24)	(0.31)	(0.23)
Stallion	-0.11	-0.07	0.05	0.08	-0.00
	(0.10)	(0.08)	(0.07)	(0.09)	(0.05)
Gelding	-0.20*	-0.35***	-0.39***	-0.38***	-0.34***
	(0.11)	(0.09)	(0.10)	(0.10)	(0.08)
General	-0.49***	-0.53***	-0.55***	-0.60***	-0.59***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Broodmare	-0.20***	-0.16***	-0.20***	-0.20***	-0.17***
	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)

Table 3. Continued

Variable	Q.2	Q.4	Q.6	Q.8	OLS
Number of lines	0.03***	0.03***	0.03***	0.04***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Exclamation	0.06	0.05	0.07	0.10*	0.05
	(0.06)	(0.08)	(0.07)	(0.06)	(0.04)
Nice	-0.07**	-0.10***	-0.11***	-0.12***	-0.09***
	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)
Sound	0.14***	0.11***	0.14***	0.12***	0.13***
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
Beautiful	0.15***	0.13***	0.15***	0.20***	0.16***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)
Pretty	0.10***	0.09***	0.11***	0.15***	0.11***
	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
Cute	-0.02	-0.05	-0.02	0.04	-0.00
	(0.07)	(0.07)	(0.10)	(0.07)	(0.06)
Quiet/Gentle	0.01	-0.00	-0.02	-0.09***	-0.05**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Finished	0.48***	0.35***	0.24***	0.10	0.30***
	(0.08)	(0.06)	(0.05)	(0.06)	(0.06)
Lots of cow	0.14**	0.10**	0.05	0.04	0.08*
	(0.06)	(0.04)	(0.05)	(0.07)	(0.05)
Athletic	-0.02	-0.04	-0.12***	-0.13***	-0.08**
	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)
Incentive Fund	0.02	0.01	-0.03	-0.05	-0.06*
	(0.05)	(0.04)	(0.04)	(0.04)	(0.03)
Picture	0.39***	0.47***	0.42***	0.39***	0.44***
	(0.06)	(0.04)	(0.04)	(0.05)	(0.04)
GeldAge	0.29***	0.30***	0.28***	0.27***	0.28***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.02)
GeldAge2	-0.02***	-0.02***	-0.02***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
MareAge	0.17***	0.17***	0.17***	0.19***	0.16***
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
MareAge2	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
StudAge	0.31***	0.30***	0.29***	0.30***	0.28***
	(0.05)	(0.03)	(0.02)	(0.03)	(0.02)
StudAge2	-0.02***	-0.01***	-0.01***	-0.01***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table 3. Continued

Variable	Q.2	Q.4	Q.6	Q.8	OLS
Slaughter	-0.58***	-0.48***	-0.36***	-0.35***	-0.45***
	(0.03)	(0.03)	(0.02)	(0.03)	(0.02)
Unemployment	0.01	-0.01	-0.02*	-0.03**	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Quantile upper bound/ OLS mean ln *adjprice*	7.26	7.79	8.24	8.80	8.48
Quantile upper bound/ OLS mean *adjprice*	1,419.75	2,409.64	3,789.47	6,666.67	4,818.25

* Significance levels where α=0.1.
** Significance levels where α=0.05.
*** Significance levels where α=0.01.
[a] Numbers in parentheses are standard errors.

Table 4. Percentage Effect of Explanatory Indicator Variables on Price from Estimated OLS and Quantile Regression Models

Variable	Q.2	Q.4	Q.6	Q.8	OLS
Grade	-34.30	-38.74	-39.95	-38.74	-35.60
Other breed	-	-36.24	-	-	-32.29
Palomino	19.72	13.88	-	-	7.25
Red roan	-	18.53	9.42	-	17.35
Blue roan	-	15.03	-	-	-
Buckskin	25.86	23.37	11.63	-	15.03
Chesnut	-12.19	-12.19	-	-	-12.19
Solid	-53.70	-	-45.66	-	-46.74
Gelding	-18.13	-29.53	-32.29	-31.61	-28.82
General	-38.74	-41.14	-42.31	-45.12	-44.57
Broodmare	-18.13	-14.79	-18.13	-18.13	-15.63
Exclamation	-	-	-	10.52	-
Nice	-6.76	-9.52	-10.42	-11.31	-8.61
Sound	15.03	11.63	15.03	12.75	13.88
Beautiful	16.18	13.88	16.18	22.14	17.35
Pretty	10.52	9.42	11.63	16.18	11.63
Quiet/Gentle	-	-	-	-8.61	-4.88
Finished	61.61	41.91	27.12	-	34.99
Lots of cow	15.03	10.52	-	-	8.33
Athletic	-	-	-11.61	-12.19	-7.69
Incentive Fund	-	-	-	-	-5.82
Picture	47.70	60.00	52.20	47.70	55.27
Slaughter	-44.01	-38.12	-30.23	-29.53	-36.24
Unemployment	-	-	-1.98	-2.96	-

Note: Values are percents, calculated by: $100(e^{b} - 1)$, b=coefficient estimate (table 3), only variables found to be significant are included in this table.

Table 5. Slaughter Variable: Parameter Estimate, Confidence Interval, t-Value, p-Value

Model	Slaughter Parameter Estimate	Standard Error	Lower 95%CI	Upper 95% CI	t-value	p-value
Q.2	-0.58	0.03	-0.64	-0.52	-18.50	<.001
Q.4	-0.48	0.03	-0.53	-0.43	-18.53	<.001
Q.6	-0.36	0.02	-0.41	-0.31	-14.78	<.001
Q.8	-0.35	0.03	-0.41	-0.30	-12.37	<.001