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Horse Owner Preferences for Equine Veterinary Services

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THESIS

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ABSTRACT OF THESIS

Horse Owner Preferences for Equine Veterinary Services

The decline in the number of equine veterinarians creates significant challenges for the future of equine veterinary medicine. One crucial aspect of this issue is how the financial health of equine veterinary practices might be improved. Examining how horse owners respond to changes in the prices of veterinary services allows practices to determine whether adjusting prices can improve practices' financial standing. Using an online stated preference survey completed by 4,992 horse owners in the U.S., this study investigates horse owner preferences for equine veterinary services. First, horse owners' utilization of equine veterinary services and willingness to adapt to the changes in the provision of services are gathered. Next, horse owners' price sensitivity for three common equine veterinary services is estimated. Finally, the determinants of willingness-to-pay (WTP) for each service is explored. Results suggest that demand for routine vaccinations, lameness exams, and emergency colic surgeries is elastic. Many horse ownership and demographic attributes are statistically significant determinants of WTP; however, poor model fit suggests that additional factors outside of those measured may explain more of the variation in the responses.

KEYWORDS: Equine Veterinary Services, Stated Preferences, Price Elasticity of Demand, Willingness-To-Pay

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CHAPTER 1. INTRODUCTION

1.1 Motivation

American Association of Equine Practitioners (AAEP) membership data show that many young equine veterinarians do not renew their AAEP membership within five years of graduating veterinary school, a trend that has been steadily increasing and reached over 50% for 2017 – 2022 graduates (AAEP-AVMA, 2024). A survey conducted by the AAEP in 2016 asked respondents who were not currently in equine medicine to report how many years they worked as an equine veterinarian. Surprisingly, 67.4% had remained in the profession for only zero to five years after graduation (AAEP-AVMA, 2019). Many of these former equine veterinarians have transitioned to companion animal positions or left the profession all together (AAEP-AVMA, 2024). Both survey results illustrate the defection of equine veterinarians from clinical practice within five of after graduating. Many factors have been cited in this trend; each of these is briefly discussed below.

1.2 Number of Horses

Both the American Horse Council (AHC) and the United States Department of Agriculture (USDA) Census of Agriculture (COA) report that the number of horses in the U.S. has been decreasing for the past few decades. From 2005 to 2023, the AHC reports a 30% decrease (9.2 million to 6.4 million) in the population of equine across the U.S. In roughly the same time span, the USDA reports a decline of 33% (4.0 million to 2.6 million). Although there appears to be a declining horse population, there are more treatment options available for those with horses with growing numbers in jobs and expenditures (AHC, 2023).

1.3 Challenges in the Profession

Since 2014, between 5% and 8% of new veterinary school graduates have entered the equine practice through a full-time position or internship. Why are half of new veterinarians leaving the equine practice within 5 years? This section discusses challenges reported by equine veterinarians in the profession, including low salaries and high debt loads, poor work-life balance, and mental health.

1.3.1 Low Salaries and High Debt Loads

Companion animal veterinarians earn a significantly higher salary than equine veterinarians. The AAEP-AVMA Economic Report (2024) reported that in 2023, the average starting salary for equine practitioners in private practice is $94,389, while companion animal predominant practitioners start at an average of $133,521. As a student coming out of veterinary school, it may be hard to justify entering the equine sector with such a significant salary difference. However, it is promising to note that starting salaries for equine veterinarians have risen significantly since 2020; at that time the average starting salary for equine practitioners in private practice was $57,952.

Debt-to-income ratios have improved significantly since 2020 but are still relatively high at 1.7:1 for equine practitioners, while the debt-to-income ratio was 1.3:1 for all 2023 veterinary school graduates. Among new graduates, 1 in 3 equine practitioners had more than $200,000 in student debt. On the other hand, 20.1% of 2023 equine graduates reported 0 debt, compared to 16.7% for all other graduates. The average debt for veterinarians who accepted a full-time equine position was $154,048 for 2023 for veterinary school graduates (AAEP-AVMA, 2024).

1.3.2 Poor Work-Life Balance

Studies show declining numbers of equine veterinarians can be partially attributed to the number of work hours required. In a survey completed in 2020, 57.7% of respondents who had left the equine veterinary profession answered that their reason for leaving the profession was because of lifestyle and the number of hours worked (Grice, 2020). The common practice of veterinarians traveling to horses restricts the number of patients a veterinarian can see in a day. Almost half (47 percent) of AAEP respondents reported that they drove between 25,001 and 50,000 miles annually while practicing equine veterinary medicine (AVMA-AAEP, 2019). Though there is an ambulatory fee added to owners' bills, farm call rates typically vastly undervalue practitioners' time. In addition to long hours on the road, equine practitioners often find themselves on-call at the end of a normal work day. Almost one third (32.6 percent) of AAEP respondents working full time reported that they performed 26% to 50% of the total amount of on-call or emergency duty at their place of employment, and 24.9% reported that they were responsible for 100% of this duty (AVMA-AAEP, 2019). With a significant amount of time on-call, veterinarians find it difficult to apply a "hard stop" to their workdays.

1.3.3 Mental Health

On average, veterinarians have higher suicide rates than the general population. Tomasi et al. (2019) studied proportionate mortality rates (PMR) with an emphasis on suicide in the United States from 1979 to 2015. They reported that equine veterinarians had a PMR of 1.2 for both male and females, estimated to be higher than the general population. Clinical veterinarians have an estimated a PMR of 2.1 for males and 3.5 for females, supporting the hypothesis of higher rates of suicide for those in veterinary practice. The study attributes the rate of suicide partially to unmanaged occupational stressors such as burnout, psychological distress, and depression. One survey from 2020 reports that 44.5% of respondents left or considered leaving the equine veterinary profession due to mental health and stress (Grice, 2020). The AVMA-AAEP 2016 survey states that AAEP graduates from the last 10 years reported higher levels of negative effects of their mental health on their work and accomplishments in the four weeks prior to the survey than other cohorts (AVMA-AAEP, 2019). These levels of recognized mental health issues cause concern for not only the number of veterinarians leaving the profession, but the lives of those veterinarians.

1.4 “Shortage”?

Some in the industry have suggested there is a shortage of equine veterinarians. It is important to highlight that from an economist’s perspective, there is little economic literature supporting that the equine sector is experiencing a shortage. However, AVMA News (2023) has stated that there is a shortage in some aspects of veterinary medicine such as food animal, equine, academia, shelters, emergency practices, specialties, and public health. Additionally, there is some concern that there is a lack of care in specific areas, such as rural areas and/or areas farther away from veterinary colleges (Wang et al. 2012).

1.5 Rural Areas

Specifically in rural areas, equine owners are having more difficulty finding available veterinary care for their horses. It appears that veterinarians prefer to locate closer to a veterinary college and in less rural areas (Wang et al, 2012). This can be inferred as a business decision, as there may not be enough business in rural areas to support competitive salaries for veterinarians. With the large debts to pay off veterinary school, veterinarians may choose to locate where they feel they will have the highest opportunity to generate enough revenue to pay off those debts. Even if debt was eliminated as a factor of where veterinarians choose to reside, veterinarians still must factor in lifestyle preferences when choosing where to live after graduation. The AAEP-AVMA (2024) report shows that the majority of equine veterinarians reside in California, Texas, and Florida, which also happen to be the most populated states for both people and horses. According to AAEP, an average of 51% of veterinarians claim to live in rural areas. However, "rural" may be subjective unless well-defined. Rural classifications depend on the entity that defines it. For example, the Health Resources and Service Administration (HRSA) defines rural as any area with a population less than 50,000. On the contrary, the Census Bureau states that a rural area is open countryside with less than 2,500 people. This can cause confusion and discrepancies amongst study results, especially when respondents are allowed to self-define "rural".

One potential solution in the challenges of serving rural horse owners is using telehealth consultations. Using telehealth for nonemergency situations may increase revenue while providing services to horses in rural areas that would otherwise not be reached. Though this emerging technology opens new avenues for veterinary medicine, it does have challenges. First, telemedicine requires a Veterinarian – Client – Patient Relationship (VCPR) in person to gain accurate information about both the client and the patient. Even with an established VCPR, telemedicine does not allow veterinarians to provide an accurate and full examination of the horse, and it depends heavily upon the horse owner's ability to assess and communicate clinical signs, both of which can lead to misdiagnosis and lack of appropriate care. Accordingly, there are numerous liability concerns that must be addressed. Telehealth can provide information without the use of VCPR, in certain instances. For example, "teleadvice" does not require a VCPR and can aid in education and prevention for horse owners. Additionally, "teletriage" can be useful in determining urgency and does not require a VCPR (JAVMA News, 2023).

1.6 Research Objectives

The reasons for the recent decline in equine practitioners are multifactorial, and solving it will require a multi-pronged approach. In this research, we will consider one of the factors, non-competitive salaries, and explore an avenue to address the gap. If veterinary practices can generate additional profit revenue, salaries can be made more competitive. How might this be achieved? One approach depends on the price sensitivity of horse owners. If horse owners are relatively insensitive to price changes, veterinary practices may be able to generate more revenue by raising the price of its services. In order to determine the horse owners' price sensitivity, it is necessary to characterize demand for equine veterinary services.

Accordingly, the objective of this study is to characterize horse owners' demand for equine veterinary services and estimate the price elasticity of demand for three sample equine veterinary services. In addition, we explore the current use of services and willingness to adapt to future changes. Then, the determinants of horse owner willingness-to-pay (WTP) for different attributes of equine veterinary services are investigated. Gaining insight on the preferences of current horse owners can inform potential solutions for leaders in the equine veterinarian industry.

1.7 Thesis Structure

Chapter 2 presents the literature review of papers used as background for this study. Chapter 3 provides the survey design and data. Chapter 4 presents the empirical models for demand and willingness-to-pay. The results are shared in Chapter 5, and Chapter 6 includes discussion and conclusions drawn from the study.

CHAPTER 2. LITERATURE REVIEW

2.1 Veterinary Markets

Research in Veterinary Economics was originally focused on the economic impact of animal diseases, especially on concentrated animal feeding operations. More recently, most research has transitioned to issues surrounding the provision of veterinary care for companion animals. This research adds to a handful of studies that investigate the demand for veterinary services; to our knowledge, this is the first that focuses on the equine sector.

When considering the entire veterinary profession, the AVMA Capacity Report (2014) shows that the veterinary industry excess capacity was 12.5% in 2012, 7.7% in 2014, and was expected to decline to 5.7% by 2025. Excess capacity is affected by supply, demand, and price, and is defined as the unused portion of total capacity. This report estimated only around 5.2% of the excess capacity in the equine sector. Excess capacity can lead to a stagnant job market, decrease the profession's financial viability, and may cause some to leave equine practice (Dwyer, 2013).

When focusing on the equine sector, there has been a significant gender shift in the equine medicine industry. The AAEP Salary Survey Report (2022) reports that before 1976 96% of equine practitioners were male, and only 3% were female. Shifting to 2016 – 2021, only 13% of equine practitioners were male, while 87% were female. There is a wide gap in salaries between males and females, partially attributed to years of experience. The average salaries for males in the equine veterinary industry in 2022 was $210,873, while the average for females was $118,637. According to AVMA Veterinary Census Data (2023), of the total 127,131 veterinarians in the U.S., 3,972 are equine specific. Grice (2020) reports that about 1.5% of veterinary school graduates pursue the equine veterinary profession after graduation, and about 44% of the current equine veterinary profession will near retirement in the next decade. Around 50% of new veterinarians do not renew their AAEP membership and leave the profession within 5 years of graduation.

Wang et al. (2016) discusses the United States veterinary markets according to demand side change, rurality, and gender. This study provides an analysis on how veterinarian service type and price may be affected by these three factors. Results showed that as number of females rise in the veterinary industry, companion animal focus also rises, while farmed animal service prices drop. Female veterinarians are very sensitive to companion animal numbers and to an area's average per capita income (Wang et al., 2016). Both male and female veterinarians are shown to have a disinclination to reside in rural areas, and females are less likely to locate in rural areas.

2.2 Importance of Price Elasticity of Demand

From the perspective of the firm, price elasticity of demand is crucial to forecasting the impact of a price change on total revenue. Johnson and Kilkenny (2014) provide insight into the importance of understanding the price elasticity of demand for veterinarians. Veterinarians would benefit from price elasticity estimates for each of their products or services because it would help them understand how clients would likely react to a price change. In order for these effects to be accurately estimated, all of the other factors that could affect demand—such as changes in pet owners' employment status and income, changes in the numbers of pets clients own, and changes in clients' residential circumstances—must be documented and included in the statistical analysis of the quantities of veterinary services purchases at the fees charged (Johnson and Kilkenny, 2014). More generally, characteristics of the service, characteristics of the purchasers, location of practice, and substitute goods and services all influence price elasticity of demand.

Similarly, Knippenberg (2014) identified factors that shift the relationship between the price of veterinary services and the quantity demanded for those services. He proposed that market size, income level, tastes and preferences, the prices of complementary and substitute goods, and expectations about future changes in the prices, income, or wealth affect the quantity that consumers are willing to purchase at a given price. Little is known about the specific impact of each of these factors on veterinary services, but veterinarians should be aware of how changes in the composition of the consumer population can change the demand for veterinary services (Knippenberg, 2014).

2.3 Price Elasticity of Demand in Veterinary Medicine

The market conditions for veterinary services are contingent on supply and demand. Obtaining the data needed to estimate these relationships is challenging. The few studies that have reported demand estimates have faced challenges with data availability and distributional assumptions (Brown and Silverman 1999; Kilkenny et al. 2014; Shonkwiler, Kilkenny, and Johnson 2015). Neill et al. (2018) examined the current market conditions for companion animal veterinary services, measuring the aggregate demand for and supply of veterinarians. Aggregate demand was measured by the number of all types of veterinary services demanded, while supply was measured as a function of hours worked by the veterinarian. They found that in the aggregate, demand for both dog and cat services were price inelastic, which would suggest the potential for veterinary income growth if prices were increased.

Though there is no research on price elasticity of demand for specific equine veterinary services, Neill and Holcomb (2016) compare own price and cross price elasticity of demand are compared for companion animals, food animals, and equine. The Poisson model was utilized to estimate service demand for the three different veterinary disciplines. The results showed that while own price elasticity of demand was estimated to be inelastic across all three animal categories, equine veterinary services were over four times more elastic than those of companion animal services. While causality cannot be inferred, lower incomes for equine veterinarians as compared to companion animal could be a result of a more elastic demand function (Neill & Holcomb, 2016).

2.4 Stated Preferences and Elasticity Methodology

The studies in the previous section utilized data from industry studies. To our knowledge, there is no research in economic literature using a stated preferences approach to estimate demand for equine veterinary services. However, this approach has been commonly utilized to estimate demand in other sectors. Some related studies are summarized below.

Cirillo et al. (2017) used a stated preference approach to derive determinants of WTP for attributes of new and used vehicles. The results from this study were used to describe consumer preferences and estimate market elasticities. The choice experiment provided a time sensitive hypothetical scenario where consumers were asked to keep their current vehicle or purchase a new one, including battery electric vehicles (BEV) and hybrid electric vehicles (HEV). The results suggested that consumers are more price sensitive to HEV (price elasticity of -1.45 to -1.80) and BEV (price elasticity of -1.32 to -1.60). Demand for gas vehicles was price inelastic (-0.6 in the short run and -0.7 to -0.95 in the long run). The determinants of WTP included vehicle size, fuel economy of the vehicle, purchasing price, and fuel prices.

Similar to Cirillo et al. (2017), Zuo et al. (2016) also used a stated preference approach to measure price elasticities of supply and demand for various types of water entitlements through survey data. The authors utilized a Tobit model to allow for censored data and compared price elasticities for water entitlements using linear-linear models and linear-log models. For high security water entitlements, price elasticity of supply and demand were both estimated to be price inelastic, with supply being more inelastic than demand. General security water entitlements had a relatively similar price elasticity of supply to high security water entitlements and was found to be price inelastic. Low reliability water entitlements had a price elasticity of supply that was extremely inelastic, and a price elasticity of demand that was more inelastic than high security water entitlements.

In the context of a situational approach, Hossinger et al., (2017) estimated the price elasticity of demand for fuel. Three discreet choice models (car ownership, daily trips, and holiday trips) were used to identify the determinants of demand. Fuel price and car travel costs were statistically significant at the 1% level in all three models. Other determinants such as trip purpose, trip duration, existence of car passengers, and number of car passengers were also statistically significant. The short-term price elasticity of demand ranged from -0.12 to -0.35 and long-term elasticity estimates ranged from -0.25 to -0.69.

Following the same methodology as the previous literature, Sipes and Mendelsohn (2001) used survey data to study the price elasticity of demand and the determinants that drive demand for gasoline taxation. They also used a hypothetical situation approach; they mention that respondents may find it difficult to place themselves in a hypothetical scenario, which can lead to discrepancies in the data. This is a common limitation of hypothetical survey methods; consumers may respond differently if the situation actually arose in their daily lives (Sipes & Mendelsohn, 2001).

2.5 Summary of Literature Review

Similar to these studies, this research utilizes a stated preference approach to estimate demand and determinants of willingness-to-pay for equine veterinary services. In contrast to earlier studies, this project uses three sample veterinary services rather than aggregating all services. Finally, this study solely focuses on the equine veterinary discipline.

CHAPTER 3. SURVEY DESIGN AND DATA

3.1 Survey Design

An online survey, developed in Qualtrics, was used to collect data for the study. The target audience was U.S. residents ages 18+ who were financially responsible for at least one horse, pony, mule, or donkey. This survey was designed to gain knowledge regarding horse owners' current experiences with equine veterinary services along with how they might react to changes in the equine veterinary profession. A focus group of 7 horse owners gathered to pilot test the survey and provide input on the survey questions. The survey was approved by the University of Kentucky's Office of Research and Integrity (protocol #88436). The link to the online survey was distributed through participating organizations' social media and email lists. The participating organizations included: University of Kentucky Ag Equine Programs, American Horse Publications, and the State Horse Council Advisory. The authors shared the invitation to participate and the survey link on their personal social media pages. The survey opened August 15, 2023, and closed September 11, 2023.

The survey had a total of 4,992 responses, 4,915 of which were usable responses. Due to our chosen distribution method, a response rate cannot be calculated.

The survey consisted of five sections. The first section focused on basic horse ownership questions. These questions included the number of years working with horses, purpose(s) of the horse(s), and where the horse(s) reside. Another set of questions focused on financial considerations of equine heath care. Caretakers of multiple horses were asked to select one horse when responding to the willingness – to – pay questions, and they reported that horse's age, breed, sex, and estimated value.

The second section of the survey focused on respondents' previous experiences with and preferences for equine veterinary services. This included some basic information, like whether the respondent had a primary veterinarian and how far they must travel to the veterinary clinic, and if they have transportation for their horse(s). The survey inquired about frequency of veterinary care and payment for veterinary services. Usage of telemedicine was also assessed.

In the next section, respondents were presented with three willingness-to-pay (WTP) questions. The WTP questions addressed three common services: annual spring vaccinations, a lameness exam, and colic surgery. These services were selected as examples of routine, elective, and emergency services, respectively, spanning various price ranges. Respondents were asked to choose the maximum amount they would be willing to pay for each service. WTP options ranged from $0 - $500 for annual spring vaccinations (in increments of $50), $0 - $1000 for lameness exam (in increments of $100), and $0 – $30,000 for colic surgery (in increments of $2,500). If respondents selected $0, they were prompted to select an explanation. In addition, if respondents' WTP exceeded the maximum of the price range, they were able to select "whatever it takes."

The fourth section collected demographic information. This included state, zip code, age, household income, gender, race/ethnicity, highest level of education, and number of dependents. Respondents were also asked to indicate the state and zip code where the horse resided and current cost of services, if known.

In the final section, respondents were asked to evaluate their awareness of the equine veterinary shortage prior to the survey, their concern for the current shortage, and difficulty in obtaining veterinary care in the last six months. Respondents were also asked to indicate how accurately they felt they answered the questions in the survey. The last question of the survey gave respondents the opportunity to leave comments and concerns.

3.2 Supplemental Sources

Supplemental data sources augmented the survey data. These supplemental sources came from the United States Department of Agriculture (USDA) and industry studies.

The United States Department of Agriculture (USDA) Economic Research Service (ERS) provided Rural-Urban Commuting Area Codes (RUCA Codes) at the zip code level using data from the United States Postal Service in 2010. These codes classify all zip codes in the U.S. according to rurality using 11 different area types.[1] Codes 1-3 classified three levels of metropolitan areas with populations of 50,000 or greater. Codes 4-6 classified three levels of micropolitan areas with a population range of 10,000 to 49,999. Codes 7-9 were classified as small-town areas with a population range of 2,500

[1] RUCA Code 1 indicates Metropolitan area core: primary flow within an urbanized area (UA). RUCA Code 2 indicates Metropolitan area high commuting: primary flow 30% or more to a UA. RUCA Code 3 indicates Metropolitan area low commuting: primary flow 10% to 30% to a UA. RUCA Code 4 indicates Micropolitan area core: primary flow within an Urban Cluster of 10,000 to 49,999 (large UC). RUCA Code 5 indicates Micropolitan high commuting: primary flow 30% or more to a large UC. RUCA Code 6 indicates Micropolitan low commuting: primary flow 10% to 30% to a large UC. RUCA Code 7 indicates Small town core: primary flow within an Urban Cluster of 2,500 to 9,999 (small UC). RUCA Code 8 indicates Small town high commuting: primary flow 30% or more to a small UC. RUCA Code 9 indicates Small town low commuting: primary flow 10% to 30% to a small UC. RUCA Code 10 indicates Rural areas: primary flow to a tract outside a UA or UC. RUCA Code 99 indicates Not coded: Census tract has zero population and no rural-urban identifier information.

to 9,999. RUCA Code 10 indicated a rural area with populations below 2,499. RUCA 99 was not coded and indicated the area had no identifying population data.

The American Horse Council Foundation 2023 Economic Impact Study of the U.S. Horse Industry (AHC 2024) and the 2021 American Horse Publications Equine Industry Study (AHP 2021), along with the 2022 USDA Census of Agriculture (COA), were used to assess the representativeness of our sample.

CHAPTER 4. EMPIRICAL METHODS

This study uses two empirical models. First, the demand for each of the three equine veterinary services is estimated. Second, the determinants of WTP for equine veterinary services are explored.

4.1 Elasticity of Demand for Equine Veterinary Services

To calculate the demand for different services, we assume a constant own-price elasticity of demand function:

$$Q_i = bP_i^c$$

where Q_i and P_i are the quantity demanded and price of service i, respectively. The scalar $b > 0$, and $c < 0$ represents the own-price elasticity of demand, ε_p. Own-price elasticity of demand measures the responsiveness of consumer demand for a good or service in relation to changes in its price. It is calculated as is the percentage change in quantity demanded divided by the percentage change in price, or $\varepsilon_p = \left(\frac{dQ_i}{dP_i}\right) \cdot (\frac{P_i}{Q_i})$. Demand is said to be elastic if $\varepsilon_p < -1$, indicating consumers are highly price-sensitive, and price increases will likely lead to decreased total revenue. When demand is unit elastic ($\varepsilon_p = -1$), changes in price and demand are proportional, resulting in constant total revenue. If demand is inelastic $\left(-1 < \varepsilon_p < 0\right)$, consumers are less sensitive to price changes, and price increases might actually boost total revenue.

In order to estimate the demand relationship using ordinary least squares (OLS), consider a natural log transformation of the demand function:

$$\ln Q_i = \beta_0 + \beta_1 \ln P_i + \varepsilon_i \qquad (1)$$

where the β_1 corresponds to the own-price elasticity of demand. It is assumed that $\varepsilon_i \sim iid\ N(0, \sigma^2)$.

For each equine veterinary service analyzed, a demand schedule was derived according to the number of respondents who were willing to pay various prices as indicated by their survey choices. In addition to an aggregate demand schedule for each service, multiple demand schedules were generated according to income category, horse value, and geographic classification determined by respondent zip code.

Table 4.1 presents each demand schedule for annual spring vaccinations. Table 4.2 provides the demand schedules for lameness exams, and Table 4.3 presents each demand schedule for emergency colic surgery.

Table 4.1 Demand Schedules for Annual Spring Vaccinations

	Aggregate	Income				Horse Value				Geographic Classification				
	Q_D	< $50,000	$50,000 - $99,999	$100,000 - $149,999	$150,000+	< $5,000	$5,000 - $9,999	$10,000 - $24,999	$25,000+	Metro 1	Metro 2	Metro 3	Micro	Rural
	(n = 3,496)	(n = 591)	(n = 1,125)	(n = 799)	(n = 798)	(n = 1,026)	(n = 888)	(n = 1,002)	(n = 580)	(n = 1,271)	(n = 939)	(n = 82)	(n = 556)	(n = 479)
$50	3422	570	1106	777	790	1000	875	978	569	1250	924	79	538	465
$100	3181	521	1023	735	744	928	816	909	528	1190	863	74	498	405
$150	2439	385	748	561	618	710	622	684	423	965	661	54	372	297
$200	1519	219	461	337	414	444	407	407	261	612	415	35	223	174
$250	851	110	266	173	249	246	229	235	141	356	233	21	113	91
$300	462	57	147	94	143	140	115	132	75	210	113	9	68	50
$350	197	24	64	32	65	65	41	60	31	94	46	3	29	18
$400	113	15	28	19	41	37	22	36	18	53	24	2	20	7
$450	50	5	14	7	19	19	8	15	8	19	10	1	10	5
$500	35	3	9	7	11	11	5	13	6	12	8	0	5	5

Table 4.2 Demand Schedules for Lameness Exams

	Aggregate	Income				Horse Value				Geographic Classification				
	Q_D (n = 3,642)	< $50,000 (n = 599)	$50,000 - $99,999 (n = 1,184)	$100,000 - $149,999 (n = 845)	$150,000+ (n = 841)	< $5,000 (n = 1,073)	$5,000 - $9,999 (n = 938)	$10,000 - $24,999 (n = 1,041)	$25,000+ (n = 590)	Metro 1 (n = 1,372)	Metro 2 (n = 994)	Metro 3 (n = 87)	Micro (n = 572)	Rural (n = 488)
$100	3629	595	1182	843	837	1066	936	1037	590	1369	992	86	569	485
$200	3256	497	1058	774	774	950	828	937	541	1260	882	75	496	429
$300	2236	321	721	517	557	637	568	652	379	904	601	47	321	280
$400	1411	186	443	324	383	393	351	424	243	580	372	34	195	179
$500	1016	124	314	239	287	281	257	303	175	414	270	22	138	137
$600	472	49	153	108	141	130	112	146	84	209	121	10	60	56
$700	321	28	102	74	106	83	83	99	56	140	82	8	48	36
$800	228	19	72	50	79	58	63	66	41	100	61	5	34	23
$900	130	10	43	27	47	35	29	39	27	55	35	4	21	13
$1,000	113	7	37	23	43	30	25	35	23	48	32	3	19	9

Table 4.3 Demand Schedules for Emergency Colic Surgery

	Aggregate	Income				Horse Value				Geographic Classification				
	Q_D (n = 3,952)	< $50,000 (n = 636)	$50,000 - $99,999 (n = 1,270)	$100,000 - $149,999 (n = 922)	$150,000+ (n = 945)	< $5,000 (n = 1,176)	$5,000 - $9,999 (n = 1,018)	$10,000 - $24,999 (n = 1,130)	$25,000+ (n = 628)	Metro 1 (n = 1,503)	Metro 2 (n = 1,087)	Metro 3 (n = 96)	Micro (n = 628)	Rural (n = 516)
$2,500	3334	494	1053	786	842	875	866	998	595	1288	915	80	519	425
$5,000	2597	342	774	606	741	560	660	833	544	1036	719	56	380	318
$7,500	1554	167	421	357	527	265	358	525	406	659	427	37	218	162
$10,000	1095	110	280	250	398	163	242	373	317	487	301	27	150	99
$12,500	458	42	98	98	192	63	88	159	148	218	119	11	60	37
$15,000	314	23	64	68	140	38	63	102	111	143	90	9	39	25
$17,500	128	15	15	28	59	17	26	40	45	56	39	4	15	11
$20,000	110	14	12	23	51	15	19	35	41	50	33	3	14	9
$22,500	35	8	5	9	11	4	11	7	13	15	7	0	6	6
$25,000	29	6	5	7	9	3	11	5	10	12	5	0	6	5
$27,500	18	4	5	4	3	2	8	4	4	10	2	0	3	2
$30,000	17	4	5	3	3	2	8	4	3	10	1	0	3	2

Using each of the demand schedules above, demand for each service was estimated using the ln-ln transformation of the constant own price elasticity of demand function in (1) using Stata BE 18 (64-bit). Post-estimation tests, described next, were used to test normality and homoskedasticity of residuals.

4.1.1 Post Estimation Testing

The Shapiro-Wilk post-estimation test was used to examine normality of residuals, while the Breusch-Pagan post-estimation test was used to test for homoskedasticity of residuals.

4.1.1.1 Shapiro – Wilk

The Shapiro Wilk post estimation tests for the normality of residuals in the data. In Stata, this is accomplished using the *swilk* command, which was adapted from (Shapiro and Wilk, 1965) and Royston (1982, 1992, 1993). This command can accommodate $4 < n < 2000$ observations.

The standard Shapiro Wilk model from Royston (1992) suggests that for size n, $y_1 < y_2 < \cdots < y_n$ is an ordered sample that is tested for non-normality. The test statistic, W, is defined as

$$W = (\sum a_i y_i)^2 / \sum (y_i - \bar{y})^2$$

For this model, $\boldsymbol{a} = (a_1, . . . , a_n)^T$ such that $(n-1)^{1/2} \sum a_i y_i$ is the best linear unbiased estimate for the standard deviation of the y_i while assuming normality for the data. The exact value of $\boldsymbol{ax}$ is estimated as the following:

$$\boldsymbol{a} = (m^T V^{-1} V^{-1} m)^{-\frac{1}{2}} m^T V^{-1}$$

In this equation, *V* is the covariance matrix of the order statistics. These order statistics are of sample *n*, standard normal random variables, which have an expectation of vector *m* (Royston, 1992).

Using the *swilk* command in Stata allowed for the estimation of the *p*-value of each *W* statistic for all models tested. The null hypothesis, H_0, presumes that the residuals from the regression are normally distributed. If the *p*-value is less than 0.05, the null hypothesis was rejected, suggesting that normality of residuals is rejected.

4.1.1.1 Breusch-Pagan

The Breusch-Pagan post estimation test tests for heteroskedasticity of residuals in a linear regression model. The standard Breusch-Pagan test is as follows:

$$\sigma_t^2 = \sigma^2 h(z_t'\alpha)$$

In this equation, *h* is unknown and a continuously differential function that is not dependent on t. α is a $(p \times 1)$ vector with unrestricted parameters, and the first element in z_t is unity. $z_t\alpha = \alpha_1$ so that $\sigma_t^2 = h(\alpha_1) = \sigma^2$ is constant (Breusch and Pagan, 1979). The null hypothesis presumes that the error variances are all equal, or that the residuals are homoskedastic. Rejecting the null hypothesis means that the variances are a multiplicative function of one or more variables in the equation, or heteroskedasticity. This test was run in Stata 18 using the command *estat hettest*, using a 0.05 critical value to determine if the null hypothesis is rejected (Breusch and Pagan, 1979).

4.1.2 Specific Models Estimated for Demand for Annual Spring Vaccinations

The following models estimate demand for annual spring vaccinations. The first model estimates the aggregate demand for annual spring vaccinations. Models 2 (a) – (d) estimate demand within different household income levels, 3 (a) – 3 (d) within different horse values, and 4 (a) – 4 (e) within different geographic locations.

Model 1 estimates the overall demand for annual spring vaccinations using the entire sample.

<u>Model 1</u>: $ln(Q_{VAX}) = \beta_0 + \beta_1 \, ln(P_{VAX}) + \varepsilon$

Models 2 (a) – 2 (d) estimate demand for annual spring vaccinations by annual household income. Model 2 (a) is restricted to respondents with income levels less than $50,000, Model 2 (b) is restricted to income levels $50,000 - $99,999, Model 2 (c) is restricted to income levels $100,000 - $149,999, and Model 2 (d) is restricted to income levels of at least $150,000.

<u>Model 2 (a – d):</u> $ln(Q_{VAX}) = \beta_0 + \beta_1 \, ln(P_{VAX}) + \varepsilon$

Models 3 (a) – 3 (d) estimate demand for annual spring vaccinations by horse value. Model 3 (a) is restricted to horse values less than $5,000, Model 3 (b) is restricted to horse values $5,000 - $9,999, Model 3 (c) is restricted to horse values $10,000 - $24,999, and Model 3 (d) is restricted to horse values at least $25,000.

<u>Model 3 (a – d):</u> $ln(Q_{VAX}) = \beta_0 + \beta_1 \, ln(P_{VAX}) + \varepsilon$

Finally, Models 4 (a) – (e) estimate demand for annual spring vaccinations by geographic location as defined by RUCA Codes. Model 4 (a) is restricted to geographic location of RUCA 1, Model 4 (b) is restricted to geographic location RUCA 2, Model 4 (c) is restricted to geographic location RUCA 3, Model 4 (d) is restricted to geographic location RUCA Micropolitan, and Model 4 (e) is restricted to geographic location RUCA Rural[2].

Model 4 (a – e): $ln(Q_{VAX}) = \beta_0 + \beta_1 \, ln(P_{VAX}) + \varepsilon$

4.1.3 Specific Models to be Estimated for Lameness Exams

A similar set of models are used to estimate demand for lameness exams. Model 5 estimates the aggregate demand for lameness exams. Models 6 (a) – 6 (d) estimate demand within different household income levels, 7 (a) – (d) within different horse values, and 8 (a) – (e) within different geographic locations.

Model 5 estimates the overall demand for lameness exams.

Model 5: $ln(Q_{LE}) = \beta_0 + \beta_1 \, ln(P_{LE}) + \varepsilon$

Models 6 (a) – (d) estimates demand for lameness exams by annual household income. Model 6 (a) is restricted to respondents with income levels less than $50,000, Model 6 (b) is restricted to income levels $50,000 - $99,999, Model 6 (c) is restricted to income levels $100,000 - $149,999, and Model 6 (d) is restricted to income levels of at least $150,000.

Model 6 (a – d): $ln(Q_{LE}) = \beta_0 + \beta_1 \, ln(P_{LE}) + \varepsilon$

Models 7 (a) – 7 (d) estimates demand for lameness exams by horse value. Model 7 (a) is restricted to horse values less than $5,000, Model 7 (b) is restricted to horse

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[2] The population distribution is presented using RUCA Codes 1, 2, and 3 as individual densities, RUCA Micropolitan (RUCA Codes 4-6 combined), and RUCA Rural (RUCA Codes Small-Town 7-9 and RUCA Code Rural 10 combined).

values \$5,000 - \$9,999, Model 7 (c) is restricted to horse values \$10,000 - \$24,999, and Model 7 (d) is restricted to horse values of at least \$25,000.

Model 7 (a – d): $ln(Q_{LE}) = \beta_0 + \beta_1\, ln(P_{LE}) + \varepsilon$

Model 8 (a) – 8 (e) estimates the price elasticity of demand for lameness exams by geographic location as defined by RUCA Codes. Model 8 (a) is restricted to geographic location of RUCA 1, Model 8 (b) is restricted to geographic location RUCA 2, Model 8 (c) is restricted to geographic location RUCA 3, Model 8 (d) is restricted to geographic location RUCA Micropolitan, and Model 8 (e) is restricted to geographic location RUCA Rural.

Model 8 (a – e): $ln(Q_{LE}) = \beta_0 + \beta_1\, ln(P_{LE}) + \varepsilon$

4.1.4 Specific Models to be Estimated for Emergency Colic Surgery

Finally, a similar approach is used to estimate demand for emergency colic surgery. Model 9 estimates the aggregate demand for lameness exams. Models 10 (a) – 10 (d) estimate demand within different household income levels, 11 (a) – 11 (d) within different horse value levels, and Models 12 (a) – (e) within different geographic locations.

Model 9 estimates the overall demand for emergency colic surgery.

Model 9: $ln(Q_{CS}) = \beta_0 + \beta_1\, ln(P_{CS}) + \varepsilon$

Models 10 (a) – 10 (d) estimates demand for emergency colic surgery by annual household income. Model 10 (a) is restricted to respondents with income levels less than \$50,000, Model 10 (b) is restricted to income levels \$50,000 - \$99,999, Model 10 (c) is restricted to income levels $100,000 - $149,999, and Model 10 (d) is restricted to income levels of at least $150,000.

Model 10 (a – d): $ln(Q_{CS}) = \beta_0 + \beta_1\, ln(P_{CS}) + \varepsilon$

Models 11 (a) – 11 (d) estimates demand for emergency colic surgery by horse value. Model 11 (a) is restricted to horse values less than $5,000, Model 11 (b) is restricted to horse values $5,000 - $9,999, Model 11 (c) is restricted to horse values $10,000 - $24,999, and Model 11 (d) is restricted to horse values of at least $25,000.

Model 11 (a – d): $ln(Q_{CS}) = \beta_0 + \beta_1\, ln(P_{CS}) + \varepsilon$

Models 12 (a) – 12 (e) estimates demand for emergency colic surgery by geographic location (RUCA Codes). Model 12 (a) is restricted to geographic location of RUCA 1, Model 12 (b) is restricted to geographic location RUCA 2, Model 12 (c) is restricted to geographic location RUCA 3, Model 12 (d) is restricted to geographic location RUCA Micropolitan, and Model 12 (e) is restricted to geographic location RUCA Rural.

Model 12 (a – e): $ln(Q_{CS}) = \beta_0 + \beta_1\, ln(P_{CS}) + \varepsilon$

4.2 WTP for Equine Veterinary Services

Next, the determinants of individual horse owners' WTP for each service type is explored. Initially, a Tobit model was considered to account for censored data. However, the Tobit model proved to be more difficult when log transforming the dependent variable. In addition, the number of censored observations was small. The Tobit model yielded very similar results to the standard Ordinary Least Squares (OLS) approach. Accordingly, an OLS model is more appropriate.

OLS is a linear regression model that estimates a linear relationship between two or more variables. To explain the variation in the dependent variable, one or more independent variables can be used. OLS estimates regression coefficient that minimize the sum of squared residuals.

The general OLS regression model is represented by:

$$y = \beta_0 + \beta_1 x_1 + \cdots \beta_p x_n + \varepsilon_0$$

In this equation, y represents the dependent variable and β_0 represents the constant. β_i is shown to be the slope coefficient for the independent variable x_i (i = 1, 2, …). ε_0 is the error term (Gross & Grobb, 2004). It is assumed that $\varepsilon_0 \sim iid\ N(0, \sigma^2)$. These models were estimated using the *reg* command in Stata 18.

4.2.1 WTP Models

For each of the three service types, general specification of the equation to be estimated is:

$$WTP_i = \beta_{0i} + X\beta_{1i} + \varepsilon$$

where *i* is the service type and *X* is the set of explanatory variables. This set of variables includes the following demographic, horse ownership, and veterinary characteristics: income, zip code, number of horses, primary veterinarian, horse value, payment in an emergency, insurance, colic reimbursement program, savings account, veterinary travel, distance from the veterinarian, access to transportation, horse gender, frequency of veterinary visits, age, education, dependents, and RUCA code. The dependent variable is each respondent's maximum WTP for service *i*.

For Model 13 (a), an OLS model was estimated for annual spring vaccinations using the general specifications above. Model 13 (b) uses a natural log of the dependent variable.

For Model 14 (a), an OLS model was estimated for lameness exams using the general specifications above. Model 14 (b) uses a natural log transformation the dependent variable.

Finally, for Model 15 (a), an OLS model was estimated for emergency colic surgery using the general specifications above, and Model 15 (b) uses a natural log transformation of the dependent variable.

4.3 WTP for Equine Veterinary Services

Next, Tables 4.1 – 4.4 provide descriptions of key variables for demographics, horse ownership, financial, and veterinary preferences.

Table 4.4 Key Demographic Variables

Variable Name	Description
Income < 25k	Household income of less than $25,000 *omitted variable*
Income 25k to 49k	Household income of $25,000 to $49,999 annually
Income 50k to 74k	Household income of $50,000 to $74,999 annually
Income 75k to 99k	Household income of $75,000 to $99,999 annually
Income 100k to 149k	Household income of $100,000 to $149,999 annually
Income 150k to 249k	Household income of $150,000 to $249,999 annually
Income 250k plus	Household income greater than $250,000 annually
Zip code region 0	Respondents that reside in zip codes beginning with 0
Zip code region 1	Respondents that reside in zip codes beginning with 1
Zip code region 2	Respondents that reside in zip codes beginning with 2

Table 4.4 continued

Zip code region 3	Respondents that reside in zip codes beginning with 3
Zip code region 4	Respondents that reside in zip codes beginning with 4 *omitted variable*
Zip code region 5	Respondents that reside in zip codes beginning with 5
Zip code region 6	Respondents that reside in zip codes beginning with 6
Zip code region 7	Respondents that reside in zip codes beginning with 7
Zip code region 8	Respondents that reside in zip codes beginning with 8
Zip code region 9	Respondents that reside in zip codes beginning with 9
Age 18-24	Respondents age 18 to 24 *omitted variable*
Age 25-34	Respondents age 25 to 34
Age 35-44	Respondents age 35 to 44
Age 45-54	Respondents age 45 to 54
Age 55-64	Respondents age 55 to 64
Age 65 plus	Respondents age 65 plus
Education HS	Respondent completed high school or less *omitted variable*
Education BS	Respondent has a bachelor's degree
Education MS	Respondent has a master's or graduate degree
Education PhD	Respondent has a Professional degree
Dependents 0	The respondent has no dependents in their household *omitted variable*
Dependents 1-3	The respondent has 1 to 3 dependents in their household
Dependents 4	The respondent has 4 dependents in their household
Dependents > 4	The respondent has more than dependents in their household
RUCA 1	The respondent resides in geographic location of RUCA 1 *omitted variable*
RUCA 2	The respondent resides in geographical location of RUCA 2
RUCA 3	The respondent resides in geographical location of RUCA 3
RUCA Micropolitan	The respondent resides in geographical location of RUCA Micropolitan
RUCA Rural	The respondent resides in geographical location of RUCA Rural

Table 4.5 Key Horse Ownership Variables

Variable Name	Description
1 to 5 Horses	Respondents are financially responsible for 1 to 5 horses *omitted variable*
6 to 10 Horses	Respondents are financially responsible for 6 to 10 horses
11 to 25 Horses	Respondents are financially responsible for 11 to 25 horses
26 to 50 Horses	Respondents are financially responsible for 26 to 50 horses
51 to 100 Horses	Respondents are financially responsible for 51 to 100 horses
>100 Horses	Respondents are financially responsible for greater than 100 horses
Horse value	Specified value of one chosen horse that the respondent is financially responsible for
Horse gender Stallion	Respondents chosen horse is a stallion *omitted variable*
Hore gender Gelding	Respondents chosen horse is a gelding
Horse gender Mare	Respondents chosen horse is a mare

Table 4.6 Key Financial Variables

Variable Name	Description
Pay $1,000 or less in emergency	Respondent would pay $1,000 or less in a horse related emergency
Pay $1,001 - $5,000 in emergency	Respondent would pay $1,001 to $5,000 in a horse related emergency
Pay $5,001 - $10,000 in emergency	Respondent would pay $5,001 to $10,000 in a horse related emergency
Pay $10,001 - $20,000 in emergency	Respondent would pay $10,001 to $20,000 in a horse related emergency
Pay > $20,000 in emergency	Respondent would pay greater than $20,000 in a horse related emergency *omitted variable*
Yes, this horse is enrolled in colic reimbursement	The respondent's chosen horse is enrolled in a colic reimbursement program
No, this horse is not enrolled in colic reimbursement	The respondent's chosen horse is not enrolled in a colic reimbursement program *omitted variable*
Yes - Insured	The respondent's chosen horse is insured
No – Not insured	The respondent's chosen horse is not insured *omitted variable*
Yes - horse savings account	Respondents have a savings account dedicated to horse related emergencies
No - horse savings account	Respondents do not have a savings account dedicated to horse related emergencies *omitted variable*

Table 4.7 Key Veterinary Preference Variables

Variable Name	Description
Yes, I have a primary vet	Respondents have a primary veterinarian
No, I do not have a primary vet	Respondents do not have a primary veterinarian *omitted variable*
Yes - horse transportation	Respondent has quick access to transportation (such as a truck and horse trailer) to haul their horse to a veterinarian especially in emergency
No - horse transportation	Respondent does not have quick access to transportation (such as a truck and horse trailer) to haul their horse to a veterinarian especially in emergency *omitted variable*
Vet is < 10 miles	The veterinarian respondent would take their horse to is less than 10 miles away *omitted variable*
Vet is 10-49 miles	The veterinarian respondent would take their horse to is 10 to 49 miles away
Vet is > 50 miles	The veterinarian respondent would take their horse to is greater than 50 miles away
I don't know distance to vet	The respondent does not know the distance to the veterinarian
Vet comes to my property	The veterinarian travels to the respondent's property
I travel to vet	The respondent hauls the horse to the veterinarian *omitted variable*
Vet sees horse daily	The veterinarian sees the respondent's horse close to a daily basis *omitted variable*
Vet sees horse once a week	The veterinarian sees the respondent's horse once a week
Vet sees horse once a month	The veterinarian sees the respondent's horse once a month
Vet sees horse 2-4 a year	The veterinarian sees the respondent's horse 2 to 4 times a year
Vet sees horse 6 times a year	The veterinarian sees the respondent's horse 6 times a year
Vet sees horse once a year	The veterinarian sees the respondent's horse once a year
Vet sees horse < once a year	The veterinarian sees the respondent's horse less than once a week
Vet sees horse never	The veterinarian never sees the respondent's horse

All of the key variables in Tables 4.1, 4.3, and 4.4 are dummy variables. All variables in Table 4.2 are dummy variables except for horse value. The omitted category for each dummy variable is indicated in the tables above.

CHAPTER 5. **RESULTS**

This chapter presents the summary statistics for the survey responses, followed by the results from the demand elasticities and the determinants of individual WTP.

5.1 Summary Statistics

First, the summary statistics for each section of the survey are presented.

5.1.1 Horse Ownership

Respondents first provided basic horse ownership information. This section discusses the percentages of responses for horse ownership questions from the survey.

Table 5.1

Number of Horses Owned (N=4915)	
1 to 5 Horses	77.64%
6 to 10 Horses	13.12%
11 to 25 Horses	5.94%
26 to 50 Horses	1.99%
51 to 100 Horses	0.41%
>100 Horses	0.12%
No Horses	0.77%

Table 5.2

Number of Years Working with Horses (N=4840)	
< 1 Year	0.21%
2 to 5 Years	4.65%
6 to 10 Years	8.29%
11 to 20 Years	20.08%
> 20 Years	66.78%

Table 5.3

Purpose(s) of Horse(s) [select all that apply] (N=4840)	
English-Style	52.38%
Western-Style	49.69%
Horses are Idle or Retired	39.92%
Breeding Stock	11.84%
Working Horses (Ranch, Police, etc.)	11.16%
Other	10.10%
Gaited-Horse	9.61%
Driving-Related	6.53%
Equine-Assisted Activities and Therapies	5.56%
Racing (All Breeds)	3.26%

Table 5.4

Do you: [Select all that apply] (N=4835)	
Keep your horses at home	61.68%
Board your horses elsewhere	34.77%
Keep your horses on a property you control or manage	14.91%
Board other peoples horses on your property	8.02%

Table 5.1-5.4 show the distribution of responses from the horse ownership section of the survey. Most respondents own 1-5 horses (77.6%) and have been working with horses for more than 20 years (66.8%). There are nearly equal responses from respondents who participate in English and Western disciplines, and nearly 40% have at least one horse that is idle or retired. Most horse owners keep their horses at home (61.7%).

Table 5.5

Sex of horse (N=4706)	
Gelding	42.63%
Mare	39.44%
Stallion	1.91%

Table 5.6

Estimated worth of horse (N= 4703)	
$0	1.98%
< $1,000	3.95%
$1,000 - $5,000	34.51%
$5,001 - $10,000	24.30%
$10,001 - $15,000	10.33%
$15,001 - $20,000	6.61%
$20,001 - $30,000	7.12%
$30,001 - $50,000	6.06%
$50,001 - $100,000	3.83%
> $100,000	7.44%

Respondents were asked to select one of their horses to consider when answering a specific set of questions in the survey. Tables 5.5 and 5.6 show that most horses were geldings (42.6%) and were estimated to be worth $1,000 - $5,000 (34.5%); nearly 65% had an estimated market value of $10k or less.

Table 5.7

Do you have a dedicated equine health savings account to cover emergencies? (N=4829)	
No	86.37%
Yes	13.63%

Table 5.8

Highest medical cost you would finance without insurance (N=4694)	
$1,000 or less	7.46%
$1,001 - $5,000	40.41%
$5,001 - $10,000	31.66%
$10,001 - $20,000	14.87%
> $20,000	5.60%

Table 5.9

Is this horse covered by an equine mortality policy and/or medical/health insurance? (N=4689)	
No	81.74%
Yes	17.96%
I don't know	0.30%

Table 5.10

Is this horse enrolled in a colic surgery reimbursement program? (N=4686)	
No	88.99%
Yes	10.54%
I don't know	0.47%

Tables 5.6 – 5.10 report summary statistics for questions related to financial considerations for equine health care. 86.4% of respondents reported that they do not have a savings account dedicated to equine medical emergency costs. The most common medical cost respondents would pay without insurance in an emergency is $1,001 - $5,000 (40.41%). Most horse owners reported that their horses are not covered by insurance (81.7%) and are not enrolled in a colic surgery reimbursement program (89%).

5.1.2 Current Veterinary Care

One contribution of this study is to provide basic information on horse owners' utilization of equine veterinary services.

Table 5.11

Do you have a primary veterinarian? (N=4686)	
Yes	94.92%
No	5.08%

Table 5.12

What type of practice does your primary veterinarian work in? (N=4441)	
Equine-specific practice	67.26%
Mixed-species practice	32.49%
I don't know	0.25%

Table 5.13

Is your primary veterinarian a sole practitioner, part of a small practice, or part of a large practice? (N=4439)	
Part of a small practice (2-4 veterinarians)	45.62%
Sole practitioner	33.27%
Part of a large practice (5 or more veterinarians)	20.70%
I don't know	0.41%

Tables 5.11 – 5.13 report the percentage of responses for the current veterinary care of horses. 94.9% of respondents have a primary veterinarian. For respondents that have a primary veterinarian, 67.26% have a veterinarian who works in an equine-specific practice, and 45.6% of veterinarians are a part of a small practice (2-4 veterinarians).

Table 5.14

Do you have quick access to transportation (such as a truck and horse trailer) for your horse(s) to get veterinary care, especially in case of emergency? (N=4661)	
Yes	91.10%
No	8.90%

Table 5.15

Distance from veterinarian (N=4661)	
< 10 miles	20.19%
10 - 49 miles	58.01%
50 or more miles	20.49%
I don't know	1.31%

Tables 5.14 and 5.15 report results regarding access to transportation and distance from the veterinary clinic. Most respondents do have access to transportation, such as a truck and horse trailer (91.1%). The veterinary clinic where the most respondents would take their horse(s) is 10 – 49 miles from their property (58%).

Table 5.16

For a typical (non-emergency) vet visit: (N=4601)	
A veterinarian travels to the property where your horse(s) are located	79.90%
Your horse(s) is (are) transported to the vet clinic	20.10%

Table 5.17

(If transported to the clinic) Is this clinic equine-specific or mixed-practice? (N=925)	
Equine-specific	49.62%
Mixed-species	49.62%
I don't know	0.76%

Unlike companion animal practice, equine practice is largely ambulatory. Most respondents' veterinarians travel to the property where their horse(s) are located for non-emergency calls (80%). For respondents who transported their horse(s) to the clinic, the results were split between whether this clinic was equine-specific or mixed-species clinics (Table 5.17).

Table 5.18

How long does it take to get an appointment for a non-emergency visit? (N=4653)	
Same day	4.43%
1-2 days	18.98%
3-4 days	24.61%
5-7 days	24.99%
More than one week	26.99%

Table 5.19

In a typical year, how frequently does a veterinarian see your horse(s)? (N=4651)	
Close to a daily basis	0.41%
About once a week	0.86%
About once a month	5.25%
2-4 times per year	59.08%
6 times per year	8.26%
About once a year	22.06%
Less than once a year	3.70%
Never	0.39%

Table 5.18 suggests a relatively uniform distribution across the categories capturing the length of time it takes to get an appointment with a veterinarian for a non-emergency visit. About one-quarter each responded 3-4 days (24.6%), 5-7 days (25%), and more than one week (27%) with nearly 20% reporting 1-2 days. Table 5.19 shows how often a veterinarian sees the respondents' horse, with respondents' horses being seen by their veterinarian about 2 – 4 times per year (59%).

5.1.3 Willingness to Adapt to New Practices

The next set of questions assessed horse owners' willingness to adapt to new practices which may be under consideration as the profession addresses challenges.

Table 5.20

How willing are you to have your horse(s) seen for a non-emergency visit by the veterinarian on-call rather than your primary veterinarian? (N=4631)	
Not willing at all	5.16%
Somewhat Willing	28.83%
Mostly willing	30.49%
Very willing	32.76%
Undecided	2.76%

Table 5.20 reports that over 63% of respondents would be mostly or very willing to see the on-call veterinarian rather than their primary veterinarian for a non-emergency visit.

Table 5.21

Do you currently pay for veterinary services at the time they are provided? (N=4630)	
Yes	65.16%
No, but I would be willing	19.59%
No, I prefer to be billed on a monthly basis	14.45%
Undecided	0.80%

Table 5.22

(If no, I prefer monthly billing) Why do you prefer to be billed monthly? [select all that apply] (N=663)	
That's just the way my veterinarian handles billing.	49.47%
Paying monthly bill is more efficient for my operation.	34.99%
I might not have the money to pay at the time that services are provided.	26.85%
If I am unable to pay the entire bill at once, it is more cost-effective to carry a balance at my vet clinic instead of on my credit card.	21.12%

Tables 5.21 and 5.22 summarize billing practices. Most respondents currently pay for services at the time that they are provided (65.2%). For respondents who do not pay

for services at the time they are provided, 49.5% reported that the primary reason for this is the way that their veterinarian handles billing.

Table 5.23

How willing would you be to leave a deposit or credit card number with the veterinarian for emergency care?		
	Current client of veterinarian (N=4614)	New client of veterinarian (N=4417)
Not Willing	5.55%	10.37%
Somewhat Unwilling	5.31%	12.47%
Neutral	10.16%	17.23%
Somewhat Willing	17.79%	23.14%
Very Willing	59.54%	30.84%
Not Applicable	1.65%	5.95%

Table 5.23 reports the results when respondents were asked to report their willingness to leave a deposit or credit card number on file with the veterinarian for emergency care. For current clients, 59.5% reported they would be very willing, but only 30.8% would be very willing to leave a deposit or credit card number on file if they were new clients of a practice.

5.1.4 Telemedicine

The final set of questions in this section asked horse owners to report their attitude toward and experience using telemedicine for non-emergency services.

Table 5.24

How willing are you to utilize telemedicine consults for non-emergency veterinary services? (N=4608)	
Not willing at all	1.58%
Somewhat Willing	11.78%
Mostly willing	17.56%
Very willing	68.01%
Undecided	1.06%

Table 5.25

Have you been charged for a telemedicine consult from your equine veterinarian? (N=4585)	
No, I have not utilized telemedicine consults with my veterinarian.	53.44%
I have utilized telemedicine consults before, but I have not been charged.	43.66%
Yes, I have been charged for a telemedicine consult.	2.90%

Table 5.24 shows that over 85% of respondents reported to be mostly willing or very willing to utilize telemedicine in non-emergency situations. However, Table 5.25 shows that 53.4% reported that they have not yet utilized telemedicine consultations with their veterinarian, and 43.6% have utilized telemedicine consultations but have not been charged. Only 2.9% had been charged for a telemedicine consultation.

5.1.5 WTP

Respondents were asked to report the most they would be willing to pay for three equine veterinary services; annual spring vaccinations, lameness exam, and emergency colic surgery, using a payment card approach. This section displays the distribution of respondents' choices as well as reasons for selecting a WTP of $0.

Table 5.26

WTP for Annual Spring Vaccinations (N=3496)		
Price	**Quantity**	**Quantity %**
$0	74	2.12%
$50	241	6.89%
$100	742	21.22%
$150	920	26.32%
$200	668	19.11%
$250	389	11.13%
$300	265	7.58%
$350	84	2.40%
$400	63	1.80%
$450	15	0.43%
$500	35	1.00%

Table 5.27

If you wouldn't pay for annual spring vaccinations, why? [Select all that apply] (N=74)	
I give my own vaccines	60.81%
Don’t believe they are necessary	31.08%
Other	12.16%
My horse never leaves the property	10.81%
Health condition	9.46%
Too old	1.35%
Too expensive	0.00%

Most respondents selected their maximum WTP for vaccinations to be $150 (26.3%). Most respondents that were not willing to pay anything for annual spring vaccinations reported that they give their own vaccinations (60.8%).

Table 5.28

WTP for Lameness Exams (N=3642)		
Price	**Quantity**	**Quantity %**
$0	13	0.36%
$100	373	10.24%
$200	1020	28.01%
$300	825	22.65%
$400	395	10.85%
$500	544	14.94%
$600	151	4.15%
$700	93	2.55%
$800	98	2.69%
$900	17	0.47%
$1,000	113	3.10%

Table 5.29

If you wouldn't pay for a lameness exam, why? [Select all that apply] (N=13)	
Won't tell me anything new	46.15%
Other	46.15%
See if it resolves on its own	23.08%
Treatment will not help	15.38%
Semi or fully retired horse	15.38%
Putting money in this horse may mean I cant replace him/her	15.38%
I won't be able to afford treatment after diagnosis	7.69%
Too expensive	7.69%

Table 5.30

Which further diagnostic would you be willing to utilize if recommended by the veterinarian? (N=3625)	
X-Rays	98.81%
Ultrasound	89.16%
CT scan	35.83%
MRI	34.15%
Bone scan	29.21%

Most respondents (28.0%) were willing to pay a maximum of $200 for lameness exams. Only 13 respondents chose $0; most reported that they were not willing to pay for a lameness exam because it would not tell them anything new. If the respondents' practitioner recommended further diagnostics, most respondents would be willing to utilize radiographs and ultrasounds.

Table 5.31

WTP for Emergency Colic Surgery (N=3952)		
Price	**Quantity**	**Quantity %**
$0	618	15.64%
$2,500	737	18.65%
$5,000	1043	26.39%
$7,500	459	11.61%
$10,000	637	16.12%
$12,500	144	3.64%
$15,000	186	4.71%
$17,500	18	0.46%
$20,000	75	1.90%
$22,500	6	0.15%
$25,000	11	0.28%
$27,500	1	0.03%
$30,000	17	0.43%

Table 5.32

If you wouldn't pay for emergency colic surgery, why? [Select all that apply] (N=617)	
Don't want to put my horse through it	61.59%
Can't handle post-op	16.53%
Too old	42.95%
Concerned about post-op complications	42.46%
Too expensive	40.68%
Not sure horse will return to prev. level of performance	17.83%
Want to invest in a new horse	13.45%
No clinics close enough	10.21%
A previous colic surgery didn't end well	6.81%
Other	5.51%

Most respondents are willing to pay a maximum of $5,000 for emergency colic surgery (26.4%). In addition, just over 60% reported a maximum WTP of $5,000 or less; this is noteworthy because nearly all colic surgeries will cost more than $5,000. Most respondents that would not pay anything for the colic surgery reported that they would not want to put their horse through the surgery and recovery.

5.1.6 Geographic Classification

Tables 5.33 and 5.34 provide the reported geographic location where the horse(s) reside by zip code region and Rural-Urban Commuting Area (RUCA) codes. The population distribution is presented using RUCA Codes 1, 2, 3, RUCA Micropolitan, and RUCA Rural.

Table 5.33

Zip code regions (by first number) (N=4371)	
0 (CT, MA, ME, NH, NJ, RI, VT)	5.97%
1 (DE, NY, PA)	6.93%
2 (MD, NC, SC, VA, WV)	14.44%
3 (AL, FL, GA, MS, TN)	11.71%
4 (IN, KY, MI, OH)	21.23%
5 (IA, MN, MT, ND, SD, WI)	7.60%
6 (IL, KS, MO, NE)	5.06%
7 (AR, LA, OK, TX)	7.57%
8 (AZ, CO, ID, NM, NV, UT, WY)	7.34%
9 (AK, CA, HI, OR, WA)	12.15%

Table 5.34

Population density where horse resides (by RUCA code) (N=4370)	
RUCA 1	40.50%
RUCA 2	27.57%
RUCA 3	2.38%
RUCA Micro	16.27%
RUCA Rural	13.27%

Most respondents (21.2%) have horses located in zip code region (states: IN, KY, MI, and OH). Just over 70% of respondents had horses in one of three metropolitan designations (RUCA 1, 2, and 3). 40.5% were classified as RUCA code 1 by their zip codes.

5.1.7 Respondent Demographics

Tables 5.35 – 5.40 display the results for basic respondent demographics.

Table 5.35

Age (N=4312)	
18 to 24	5.33%
25 to 34	17.21%
35 to 44	20.85%
45 to 54	21.38%
55 to 64	21.57%
65 plus	13.66%

Table 5.36

Annual household income (N=4312)	
Less than 25k	3.55%
25k to 49k	13.22%
50k to 74k	15.86%
75k to 99k	16.54%
100k to 149k	23.96%
150k to 249k	17.56%
250k plus	9.32%

Table 5.37

Gender (N=4312)	
Male	2.13%
Female	96.20%
Genderqueer	0.46%
Prefer not to say	1.21%

Table 5.38

Race (N=4303)	
American Indian	1.16%
Asian	0.56%
African American	0.42%
Hispanic	1.65%
Pacific Islander	0.21%
White	96.44%
Other	1.81%

Table 5.39

Highest level of education completed (N=4303)	
High school	6.74%
College degree	56.98%
Graduate Degree	19.17%
Professional degree	17.10%

Table 5.40

Number of dependents in your household (N=4303)	
0	54.61%
1	18.31%
2	17.76%
3	5.00%
4	2.65%
More than 4	1.67%
Other	1.81%

Most respondents were white (96.4%), female (96.2%), age 55-64 (21.6%) and have zero dependents (54.6%). Most respondents had obtained a college degree (56.9%) and reported $100,000-$149,999 in annual household income (24.0%).

5.1.8 Reflection Questions

The last section of the survey asked respondents to reflect upon the current status of the equine veterinary profession. Tables 5.41 – 5.43 present the responses about the level of difficulty getting care, awareness of the shortage, and concern for the shortage.

Table 5.41

Level of difficulty getting veterinary care (N=4192)	
Low (0-3)	64.36%
Avg (4-7)	26.53%
High (8-10)	9.11%

Table 5.42

Awareness of veterinary shortage (N=4276)	
Not aware	5.43%
Somewhat aware	21.07%
Very aware	73.50%

Table 5.43

Level of concern for the shortage (N=4277)	
Not concerned	1.87%
Somewhat concerned	29.46%
Very concerned	68.67%

The majority of survey respondents reported little difficulty getting veterinary care (64.4%), but close to 10% reported a high degree of difficulty. 73.5% of respondents were very aware of the shortage and only 5% were not aware. Finally, 68.7% reported that they are very concerned about the provision of care.

5.2 Demand for Equine Veterinary Services

This section presents the results for estimated demand curves for three representative equine veterinary services: annual spring vaccinations, lameness exams, and emergency colic surgery. In addition to aggregate demand, we also estimate demand by income category, horse value, and geographic classification.

5.2.1 Annual Spring Vaccinations

First, we analyze demand for annual spring vaccinations. Model 1 presents the aggregate demand. Models 2 (a – d) estimate demand for annual spring vaccinations according to income levels. Models 3 (a – d) estimate demand for annual spring vaccinations by to horse value categories, and Models 4 (a – e) restricted to geographic location.

Table 5.44 Estimated Price Elasticity of Demand for Annual Spring Vaccinations

DV: *ln*(Quantity Demanded)

	Aggregate	Income				Horse Value				Geographic Classification				
	Model 1	Model 2a	Model 2b	Model 2c	Model 2d	Model 3a	Model 3b	Model 3c	Model 3d	Model 4a	Model 4b	Model 4c	Model 4d	Model 4e
		< $50,000	$50,000 - $99,999	$100,000 - $149,999	$150,000+	< $5,000	$5,000 - $9,999	$10,000 - $24,999	$25,000+	Metro 1	Metro 2	Metro 3	Micro	Rural
*ln*PRICE	-2.092***	-2.340***	-2.175***	-2.259***	-1.878***	-2.016***	-2.307***	-2.021***	-2.108***	-2.041***	-2.210***	-2.026***	-2.068***	-2.249***
constant	17.513***	16.816***	16.755***	16.791***	15.128***	15.930***	17.167***	15.913***	15.800***	16.335***	16.753***	13.362***	15.518***	16.143***
n	10	10	10	10	10	10	10	10	10	10	10	9	10	10
F-stat	31.22	31.77	30.42	30.79	27.30	32.35	26.36	34.01	31.00	25.87	29.79	23.72	34.76	35.73
Adj. R^2	0.7771	0.7737	0.7658	0.7680	0.7450	0.7770	0.7381	0.7858	0.7692	0.7343	0.7619	0.7396	0.7895	0.7942
Swilk *p*-val	0.255	0.175	0.172	0.326	0.195	0.277	0.191	0.226	0.315	0.089	0.276	0.202	0.303	0.281
BP *p*-val	0.498	0.547	0.566	0.451	0.618	0.497	0.645	0.448	0.456	0.703	0.498	0.681	0.460	0.388

*** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level, and * indicates statistical significance at the 10% level.

5.2.1.1 Aggregate Demand for Annual Spring Vaccinations

The first column in Table 5.44 reports the results for demand for annual spring vaccinations using the entire sample, and the coefficient estimates for *ln*PRICE correspond to the price elasticity of demand in each model. In Model 1, the results suggest the aggregate price elasticity of demand for annual spring vaccinations is –2.09. This estimate, which suggests that demand is elastic, is statistically significant at the 1% level. For every 1% increase in price of vaccinations, quantity demanded for vaccination decreases by 2.09%, ceteris paribus. The adjusted R^2 value indicates that 77.71% of the variation in quantity demanded is described by the variation in price of vaccinations. Post-estimation tests were conducted to test for normality and heteroskedasticity of residuals. The *p*-value in the Shapiro-Wilk test statistic, which tests for normality in the data, was 0.255 for vaccinations. At this value, the null hypothesis that the residuals are normally distributed cannot be rejected at the 5% level. The Breusch-Pagan test, which tests for heteroskedasticity, resulted in a *p*-value of 0.498 for vaccinations. The null hypothesis for homoskedasticity of residuals fails to be rejected.

5.2.1.2 Demand for Annual Spring Vaccinations by Household Income

The second through fifth columns of Table 5.44 present the results for demand for annual spring vaccinations by household income categories. The coefficient estimates for *ln*PRICE in Models 2(a) – (d) in Table 5.44 represent the estimated price elasticity of demand for annual spring vaccinations by annual household income categories. Since all coefficients are less than -1, demand is elastic across all income categories. In general, as income increases, coefficient values decrease; this suggests that demand becomes less elastic as income increases. All post-estimation tests fail reject the null hypotheses of normally distributed errors and homoskedasticity of residuals at the 5% level.

5.2.1.3 Demand for Annual Spring Vaccinations by Horse Value

Next, the 6th – 10th columns of Table 5.44 present the results for demand for annual spring vaccinations by the reported value of the horse. Although demand is elastic across all three models (all estimates < -1), there appears to be no consistent trend across horse value ranges. Respondents with horses valued in the $5,000-$9,999 category (Model 3 (b)) have the most elastic demand with a coefficient of –2.307. All elasticity estimates are statistically significant at the 1% level. Post-estimation tests fail to reject null hypotheses of normality and homoskedasticity of residuals.

5.2.1.4 Demand for Annual Spring Vaccinations by Geographic Classification

Finally, the 11th – 14th columns of Table 5.44 present the results for the demand for annual spring vaccinations by the classification of the respondents' rurality. In Table 5.44, going from Model 4 (a) to Model 4 (e) represents increasing rurality. RUCA codes 1, 2, and 3 are metropolitan classifications. Once again, demand is elastic across all RUCA code regions. Respondents in rural areas had the most elastic demand with an estimated price elasticity of –2.25; this estimate is statistically significant at the 1% level.

5.2.2 Lameness Exam

Next, we turn to demand for lameness exams. Model 5 presents the aggregate demand. Models 6 (a) – (d) estimate demand for lameness exams by income levels. Models 7 (a) – (d) estimate demand for lameness exams by horse value categories, and Models 8 (a) – (e) are restricted to geographic location.

Table 5.45 Estimated Price Elasticity of Demand for Lameness Exams

DV: *ln*(Quantity Demanded)

	Aggregate	Income				Horse Value				Geographic Classification				
	Model 5	Model 6a	Model 6b	Model 6c	Model 6d	Model 7a	Model 7b	Model 7c	Model 7d	Model 8a	Model 8b	Model 8c	Model 8d	Model 8e
		< $50,000	$50,000 - $99,999	$100,000 - $149,999	$150,000+	< $5,000	$5,000 - $9,999	$10,000 - $24,999	$25,000+	Metro 1	Metro 2	Metro 3	Micro	Rural
***ln*PRICE**	-1.646***	-2.053***	-1.648***	-1.695***	-1.417***	-1.703***	-1.684***	-1.616***	-1.558***	-1.581***	-1.651***	-1.589***	-1.640***	-1.818***
constant	16.579***	16.838***	15.455***	15.387***	13.954***	15.636***	15.417***	15.186***	14.318***	15.301***	15.293***	12.487***	14.630***	15.470***
n	10	10	10	10	10	10	10	10	10	10	10	10	10	10
F-stat	49.56	48.17	52.64	46.44	47.77	51.47	47.17	47.49	51.15	45.28	52.56	60.32	63.15	43.07
Adj. R^2	0.8436	0.8398	0.8516	0.83.47	0.8386	0.8487	0.8369	0.8378	0.8478	0.8311	0.8514	0.8683	0.8735	0.8238
Swilk *p*-val	0.435	0.480	0.380	0.421	0.478	0.465	0.246	0.442	0.424	0.303	0.507	0.690	0.415	0.610
BP *p*-val	0.255	0.310	0.220	0.300	0.259	0.228	0.351	0.272	0.272	0.293	0.217	0.175	0.151	0.399

*** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level, and * indicates statistical significance at the 10% level.

5.2.2.1 Aggregate Demand for Lameness Exams

The first column in Table 5.45 presents the results for demand for lameness exams using the entire sample; again, the coefficient of *ln*PRICE corresponds to the price elasticity of demand. When considering the entire sample, the results indicate that demand for lameness exams is elastic, with the price elasticity of demand estimated to be –1.65; this estimate is statistically significant at the 1% level. This value means that for every 1% increase in price of lameness exams, quantity demanded decreases by 1.65%, ceteris paribus. The adjusted R^2 value indicates that 84.36% of the variation in quantity demanded is explained by the variation in price of lameness exams. The *p*-value in the Shapiro-Wilk test statistic, which tests for normality in the data, was 0.435; accordingly, the null hypothesis that the residuals are normally distributed cannot be rejected at the 5% level. The Breusch-Pagan test, which tests for heteroskedasticity, resulted in a *p*-value of 0.255. This shows that the post-estimation test fails to reject homoskedasticity of residuals.

5.2.2.2 Demand for Lameness Exam by Household Income

Next, we consider demand for lameness exams by household income categories. The results appear in the 2nd – 5th columns of Table 5.45. The coefficient estimates for *ln*PRICE in Models 6 (a) - (d) represent the estimated price elasticity of demand for lameness exams across different household income levels. Since all estimates are < -1, demand is elastic across each income category, and in general, demand becomes less elastic as income increases. While a lameness exam is considered an elective service, demand appears to be less elastic than vaccines, which can be considered a routine service. Post-estimation tests fail to reject the null hypotheses of normality and heteroskedasticity of residuals.

5.2.2.3 Demand for Lameness Exams by Horse Value

The 6th – 10th columns of Table 5.45 (Models 7 (a) – (d)) correspond to demand for lameness exams by horse value categories. Though demand in each horse value category is elastic, demand becomes less elastic as horse value increases. The adjusted R^2 for the models range from 83.69% to 84.87%, which shows the percentage of variation in quantity demanded of lameness exams at the horse value level described by the price. Both post estimation tests fail to reject the respective null hypotheses in all models.

5.2.2.4 Demand for Lameness Exam by Geographic Classification

Finally, the last five columns of Table 5.45 provide estimates of demand for lameness exams by geographic location classification. Similar to the previous models for this service, demand in each category is elastic, with demand in rural areas being the most elastic (ε_p = -1.818). Demand in RUCA 1 areas is the least elastic with a price elasticity of –1.58. All coefficient estimates are statistically significant at the 1% level. Both the Shapiro-Wilk and the Breusch-Pagan post estimation tests fail to reject their respective null hypotheses.

5.2.3 Emergency Colic Surgery

Last, we consider the demand for emergency colic surgery. Model 9 presents the aggregate demand. Models 10 (a) – (d) estimate demand for emergency colic surgery across income levels. Models 11 (a) – (d) estimate demand for emergency by horse value categories, and Models 12 (a) – (e) are defined by geographic location classification.

Table 5.46 Estimated Price Elasticity of Demand for Emergency Colic Surgery

	DV: *ln*(Quantity Demanded)													
	Aggregate	**Income**				**Horse Value**				**Geographic Classification**				
	Model 9	**Model 10a**	**Model 10b**	**Model 10c**	**Model 10d**	**Model 11a**	**Model 11b**	**Model 11c**	**Model 11d**	**Model 12a**	**Model 12b**	**Model 12c**	**Model 12d**	**Model 12e**
		< $50,000	**$50,000 - $99,999**	**$100,000 - $149,999**	**$150,000+**	**< $5,000**	**$5,000 - $9,999**	**$10,000 - $24,999**	**$25,000+**	**Metro 1**	**Metro 2**	**Metro 3**	**Micro**	**Rural**
***ln*PRICE**	-2.406***	-2.194***	-2.646***	-2.447***	-2.450***	-2.764***	-2.230***	-2.583***	-2.246***	-2.295***	-2.776***	-1.611***	-2.349***	-2.389***
constant	28.197***	24.21***	28.914***	27.090***	27.462***	29.644***	25.197***	28.602***	25.404***	26.350***	30.160***	17.543***	25.745***	25.815***
n	12	12	12	12	12	12	12	12	12	12	12	8	12	12
F-stat	69.37	161.91	81.83	72.59	36.84	96.42	113.35	51.88	39.09	63.63	43.88	40.46	91.55	112.17
Adj. R^2	0.8614	0.9360	0.8802	0.8668	0.7652	0.8966	0.9108	0.8222	0.7759	0.8506	0.7958	0.8493	0.8917	0.9100
Swilk *p*-val	0.465	0.994	0.908	0.670	0.129	0.261	0.871	0.233	0.248	0.515	0.090	0.371	0.954	0.758
BP val	0.168	0.015	0.091	0.157	0.157	0.162	0.025	0.277	0.470	0.168	0.655	0.713	0.081	0.058

*** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level, and * indicates statistical significance at the 10% level.

5.2.3.1 Aggregate Demand for Emergency Colic Surgery

The first column in Table 5.46 presents the results for demand for emergency colic surgery using the entire sample. Overall, demand for colic surgery appears to be elastic; the aggregate price elasticity of demand for colic surgery is –2.41. The coefficient estimate is statistically significant at the 1% level. This estimate means that for every 1% increase in the price of colic surgery, quantity demanded decreases by 2.41%, ceteris paribus. The adjusted R^2 value indicates that 86.14% of the variation in quantity demanded is described by the variation in the price of colic surgery. The *p*-value in the Shapiro-Wilk test statistic, which tests for normality in the data, was 0.465, which means the null hypothesis cannot be rejected at the 5% level. The Breusch-Pagan test resulted in a *p*-value of 0.168, which fails to reject the null hypothesis of homoskedasticity of residuals.

5.2.3.2 Demand for Emergency Colic Surgery by Household Income

Next, the 2^{nd} – 5^{th} columns of Table 5.45 (Models 10 (a) – (d)) focuses on demand for emergency colic surgery by household income levels. Again, all estimates suggest that demand in each income category is price elastic. No consistent trends are apparent; demand is least elastic for income greater than $150,000 but most elastic for income $50,000 - $100,000. For post estimation testing, the Shapiro-Wilk test fails to reject the null hypothesis at the 5% confidence level for each model. The Breusch-Pagan test rejects homoskedasticity of residuals for Model 6 (a), meaning that heteroskedasticity cannot be ruled out. For Models 6 (b) - (d), however, the test fails to reject homoskedasticity.

5.2.3.3 Demand for Emergency Colic Surgery by Horse Value

The 6th – 10th columns of Table 5.46 (Models 11 (a) – (d)) consider demand for emergency colic surgery by various horse value categories, and the *ln*PRICE coefficients in those models represent the price elasticity of demand. Again, each of the four models show that demand is elastic across all categories. There are no apparent trends, although respondents with the most elastic demand were those with horses in the lowest income category. The Shapiro-Wilk test fails to reject the null hypothesis of normally distributed residuals for all four models. For three of the four models, the Breusch-Pagan test also fails to reject the null hypothesis of homoskedasticity. However, the Breusch-Pagan test for Model 11 (b) rejects the null hypothesis, meaning that heteroskedasticity cannot be ruled out.

5.2.3.4 Demand for Emergency Colic Surgery by Geographic Classification

Finally, the 11th – 14th columns of Table 5.46 describe demand for emergency colic surgery by geographic location. The *ln*PRICE coefficients represent the price elasticity of demand for colic surgery. Similar to previous models, demand is elastic in all categories. Demand in RUCA 2, a metropolitan area, was estimated to be the most elastic (-2.77), while demand in RUCA 3, another metropolitan area, was the least elastic (-1.61). The post estimation testing for Shapiro-Wilk fails to reject the null hypothesis across all models, and the Breusch-Pagan test fails to reject homoskedasticity for all Models 12 (a) – (e).

5.2.4 Summary

Demand for all three services was estimated to be elastic; in the aggregate, demand was the least elastic for lameness exams, and most elastic for emergency colic surgery. Examining demand by segments of respondents showed that some variation in price sensitivity can be attributed to household income, horse value, geographic classification, and type of service.

5.3 Determinants of WTP

Next, we turn to identify determinants of WTP for equine veterinary services. Horse ownership characteristics, sociodemographic, and utilization of veterinary services are used as covariates.

5.3.1 WTP for Annual Spring Vaccinations

Table 5.47 provides the coefficient estimates from two OLS models to determine WTP for annual spring vaccinations. The dependent variable in Model 13 (a) is maximum WTP, while the dependent variable in Model 13 (b) is *ln* (Maximum WTP +1).

Table 5.47 Willingness-To-Pay for Annual Spring Vaccinations

DV: Max WTP for Vaccination (a) and *ln* (Max WTP for Vaccination) (b)						
	Model 13 (a)			Model 13 (b)		
	Coefficient	Std. err.	VIF	Coefficient	Std. err.	VIF
Income 25k to 49k	-7.989	7.482	3.170	0.001	0.043	3.140
Income 50k to 74k	6.192	7.576	3.770	0.047	0.043	3.800
Income 75k to 99k	5.196	7.602	3.910	0.063	0.043	3.920
Income 100k to 149k	5.550	7.486	4.880	0.085**	0.043	4.870
Income 150k to 249k	21.789***	7.905	4.120	0.152***	0.045	4.140
Income 250k plus	27.521***	9.018	2.610	0.167***	0.051	2.640
Zip code region 0	48.117***	7.041	1.210	0.231***	0.040	1.210
Zip code region 1	11.602*	6.508	1.220	0.052	0.037	1.220
Zip code region 2	10.478**	5.107	1.440	0.059**	0.029	1.440
Zip code region 3	-2.648	5.221	1.390	-0.025	0.030	1.390
Zip code region 5	-3.980	6.054	1.290	-0.039	0.035	1.290
Zip code region 6	-3.243	7.106	1.190	-0.038	0.041	1.190
Zip code region 7	1.401	6.175	1.310	0.007	0.035	1.310
Zip code region 8	-21.838***	6.110	1.290	-0.111***	0.035	1.280
Zip code region 9	-6.861	5.166	1.420	-0.030	0.030	1.420
6 to 10 Horses	-22.725***	4.232	1.080	-0.113***	0.024	1.070
11 to 25 Horses	-36.855***	6.102	1.080	-0.247***	0.035	1.080
26 to 50 Horses	-51.355***	10.445	1.100	-0.408***	0.060	1.110
51 to 100 Horses	-87.657***	22.475	1.070	-0.641***	0.132	1.070
>100 Horses	-92.973	61.231	1.060	-0.499	0.346	1.060
Yes, I have a primary vet	12.340*	6.965	1.290	0.064	0.041	1.270
Horse value	0.000	0.000	1.170	0.000	0.000	1.170
Yes - Insured	0.130	4.226	1.190	0.001	0.024	1.190
Yes - horse savings account	10.444**	4.312	1.030	0.048**	0.024	1.030
Yes - horse transportation	-7.370	5.238	1.080	-0.044	0.030	1.080
Vet is 10-49 miles	-6.691*	3.834	1.750	-0.032	0.022	1.750
Vet is > 50 miles	-5.700	4.671	1.790	-0.020	0.027	1.780
I don't know distance to vet	-16.946	13.092	1.100	-0.081	0.076	1.090
Vet comes to my property	17.755***	3.744	1.240	0.111***	0.021	1.230
Vet sees horse once a week	-33.339	31.494	3.480	-0.173	0.179	3.400

Table 5.47 Continued

Vet sees horse once a month	-48.131*	27.086	15.450	-0.249	0.153	15.180
Vet sees horse 2-4 a year	-53.576**	26.305	83.000	-0.304**	0.148	80.970
Vet sees horse 6 times a year	-50.946*	26.776	23.600	-0.312**	0.151	23.490
Vet sees horse once a year	-68.172***	26.376	62.770	-0.392***	0.149	61.220
Vet sees horse < once a year	-91.262***	27.227	15.800	-0.517***	0.154	14.100
Vet sees horse never	-94.986***	35.579	2.320	-0.636***	0.214	2.030
Age 25-34	-3.046	7.107	3.490	-0.018	0.040	3.480
Age 35-44	-17.130**	7.165	4.150	-0.098**	0.041	4.120
Age 45-54	-21.733***	7.145	4.100	-0.127***	0.041	4.070
Age 55-64	-29.860***	7.071	3.870	-0.168***	0.040	3.810
Age 65 plus	-23.435***	7.357	2.920	-0.125***	0.042	2.880
Education BS	8.356	5.346	3.500	0.028	0.031	3.560
Education MS	14.262**	6.091	2.740	0.067*	0.035	2.780
Education PhD	17.223***	6.361	2.610	0.078**	0.036	2.650
Dependents 1-3	-8.306***	3.151	1.170	-0.047***	0.018	1.170
Dependents 4	-7.591	8.965	1.060	-0.041	0.051	1.060
Dependents > 4	0.982	11.052	1.070	0.025	0.063	1.070
RUCA 2	-2.726	3.650	1.290	-0.015	0.021	1.290
RUCA 3	-5.563	9.678	1.060	-0.018	0.056	1.060
RUCA Micropolitan	-2.072	4.384	1.270	-0.005	0.025	1.260
RUCA Rural	-5.152	4.810	1.350	-0.046*	0.028	1.350
_cons	230.730***	28.313		5.367***	0.160	
n	3,492			3,419		
F-stat	10.36			10.13		
Adj. R^2	0.1203			0.1199		
Mean VIF	5.750			5.630		

*** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level, and * indicates statistical significance at the 10% level.

In the first column of Table 5.47, Model 13 (a) presents the results for estimating the determinants of maximum WTP for annual spring vaccinations. The sign and magnitude of coefficients of the significant variables describe the increase or decrease in maximum WTP compared to that of the omitted variable in each category.

For income, the omitted category was respondents earning less than $25,000. Consumers who reported $250,000 or more in household income would be willing to pay an average of $27.52 more for annual spring vaccinations for one horse than those who reported less than $25,000 in household income, ceteris paribus. Higher willingness to pay for those in the highest income category may be attributed to the Respondents who had a household income of $150,000 – $249,999 would pay an average of $21.79 more than the less than $25,000 category, holding all else constant. These results show that higher salaries allow horse owners to have a higher WTP for annual spring vaccinations.

For zip code category, zip code region 4 was the omitted category. Horse owners in zip code regions 0, 1, and 2 would pay an average of $48.12, $11.60, and $10.48 more, respectively, than horse owners in zip code region 4, while those in zip code region 8 would be willing to pay an average of $21.84 less, holding all else constant. Geographic location may shift the maximum WTP for horse owners' subject to the cost of living in their area.

For number of horses owned, the omitted category was 1 – 5 horses. The more horses the respondent owns, the less they are willing to pay: $22.73 for 6 – 10 all the way up to $87.66 for 51 – 100 horses, ceteris paribus. This trend may be attributed to the high cost of vaccinating larger numbers of horses; it is much more expensive to vaccinate more horses rather than just a few. Another notable reason may be the increase in horse owners choosing to self-vaccinate as an alternative to save costs.

Horse owners with a savings account dedicated to horse related expenses would be willing to pay an average of $10.44 more per horse than those without, holding all else constant.

Horse owners whose veterinarians come to their property for care are willing to pay an average of $17.76 more than those who haul their horses to the clinic, ceteris paribus. Although the trend is not entirely linear, horse owners are willing to pay less for vaccinations the less frequently their horses see the veterinarian. At its greatest, horse owners who reportedly never see a veterinarian are willing to pay an average of $94.99 less than those whose horses reportedly see a veterinarian daily, ceteris paribus. This trend could be attributed to the VCPR that has been built from spending time with the veterinarian. Horse owners may believe that the more time the veterinarian spends with their horse, the better the care provided will be.

Respondents age 55 – 64 are willing to pay $29.86 less on average than horse owners ages 18 – 25, holding all else constant. Horse owners who has been in the industry longer may have a harder time adapting to the higher costs of veterinary services today. Those who reported to have a professional degree are willing to pay an average of $17.22 more than those who have a high school education, ceteris paribus.

In the second column of Table 5.47 Model 13 (b) presents the results when the dependent variable is *ln* transformed. Where the dependent variable is *ln*-transformed, the coefficient estimates are interpreted as percentage changes in WTP relative to the omitted variables. The variables omitted from Model 13 (a) are also omitted in Model 13 (b) for consistency of comparisons. Most of the variables from Model 13 (a) still show significance after the *ln* transformation of the dependent variable. In Model 13 (b), horse owners who resided in zip code region 1 was no longer statistically significant. On the other hand, horse owners who reside in rural areas are now statistically significant at the 10% level and are estimated to have a maximum willingness to pay that is an average of 4.60% lower than those who live in RUCA 1 areas (the most metropolitan area), ceteris paribus.

The Adjusted R^2 is low in both models (0.12 and 0.12, respectively), meaning that a fraction of the variation in maximum WTP for annual spring vaccinations is explained by the independent variables.

5.3.2 WTP for Lameness Exams

Table 5.48 presents the results from two OLS models which explore the determinants of willingness-to-pay for lameness exams.

Table 5.48 Willingness-To-Pay for Lameness Exams

DV: Max WTP for Lameness Exam (a) and *ln* (Max WTP for Lameness Exam) (b)						
	Model 14 (a)			Model 14 (b)		
	Coefficient	Std. err.	VIF	Coefficient	Std. err.	VIF
Income 25k to 49k	30.002*	17.54799	3.11	0.082*	0.049	3.14
Income 50k to 74k	60.087***	17.709	3.72	0.176***	0.049	3.76
Income 75k to 99k	65.493***	17.718	3.9	0.196***	0.049	3.93
Income 100k to 149k	65.561***	17.378	4.8	0.205***	0.048	4.84
Income 150k to 249k	91.873***	18.385	3.98	0.263***	0.051	4.01
Income 250k plus	81.958***	20.617	2.61	0.245***	0.057	2.63
Zip code region 0	78.124***	16.059	1.21	0.209***	0.045	1.21
Zip code region 1	18.987	14.823	1.22	0.070*	0.041	1.22
Zip code region 2	22.977**	11.699	1.42	0.069**	0.032	1.42
Zip code region 3	-6.533	12.308	1.36	-0.019	0.034	1.36
Zip code region 5	3.755	14.372	1.27	0.020	0.040	1.27
Zip code region 6	13.418	16.476	1.19	0.071	0.046	1.19
Zip code region 7	-10.961	14.686	1.3	-0.031	0.041	1.3
Zip code region 8	10.533	14.711	1.26	0.044	0.041	1.26
Zip code region 9	39.318***	12.154	1.4	0.133***	0.034	1.4
6 to 10 Horses	-28.788***	9.940	1.06	-0.080***	0.028	1.06
11 to 25 Horses	-44.371***	14.226	1.05	-0.109***	0.040	1.05
26 to 50 Horses	-18.530	24.326	1.04	-0.044	0.067	1.04
51 to 100 Horses	-79.345	54.438	1.01	-0.171	0.151	1.01
>100 Horses	86.605	101.660	1.01	0.266	0.282	1.01
Yes - primary vet	40.158***	15.027	1.06	0.081*	0.042	1.06
Horse value	0.000	0.000	1.25	0.000	0.000	1.25
< $1,000 in emerg.	-84.841***	22.460	3.4	-0.238***	0.062	3.36
$1,001 - $5,000 in emerg.	-39.981**	19.505	8.36	-0.104*	0.054	8.34
$5,001 - $10,000 in emerg.	-16.854	19.386	7.24	-0.029	0.054	7.22
$10,001 - $20,000 in emerg.	5.441	20.387	4.09	0.023	0.057	4.08
Yes – insurance	3.186	10.316	1.28	0.018	0.029	1.28
Yes - colic reimbursement	16.202	12.660	1.16	0.045	0.035	1.16
Yes - savings account	22.613**	10.040	1.02	0.050*	0.028	1.02
Vet comes to my property	6.891	8.862	1.21	0.060**	0.025	1.21
Age 25-34 years	-52.529***	16.342	3.38	-0.165***	0.046	3.39
Age 35-44 years	-65.237***	16.501	3.97	-0.216***	0.046	3.99

Table 5.48 Continued

Age 45-54 years	-61.522***	16.483	3.93	-0.200***	0.046	3.95
Age 55-64 years	-43.552***	16.294	3.75	-0.169***	0.045	3.77
Age 65 or more years	-56.816***	17.010	2.84	-0.163***	0.047	2.85
1-3 dependents	-19.898***	7.407	1.17	-0.052***	0.021	1.17
4 dependents	12.278	20.844	1.06	0.002	0.058	1.06
> 4 dependents	-14.479	26.085	1.07	-0.052	0.072	1.07
RUCA 2	-11.088	8.482	1.27	-0.039*	0.024	1.27
RUCA 3	-18.018	22.530	1.06	-0.063	0.063	1.06
RUCA Micropolitan	-16.093	10.273	1.25	-0.056**	0.029	1.25
RUCA Rural	-4.558	11.139	1.29	-0.012	0.031	1.28
_cons	332.796***	28.310		5.651***	0.079	
n	3,638			3,624		
F-stat	5.84			6.42		
Adj. R^2	0.0529			0.0591		
Mean VIF	2.26			2.27		

*** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level, and * indicates statistical significance at the 10% level.

In the first column of Table 5.48, Model 14 (a) presents the results for estimating the determinants of maximum WTP for lameness exams. Nearly all income categories have a significant coefficient estimate relative to household income less than $25,000; owners with an annual household income of $150,000 – $249,999 have a maximum WTP that is an average of $91.87 higher than those who reported a household income of less than $25,000, ceteris paribus. Again, higher household income results in the ability to pay more for lameness exams.

Horse owners that reside in zip code region 0, which is in the eastern most part of the U.S., are willing to pay an average of $78.12 more than those in zip code region 4, which is in the Mideast U.S., ceteris paribus.

Horse owners who own 6 – 10 and 11 – 25 horses are willing to pay an average of $28.79 and $44.37 less for a lameness exam than those who own one to five horses, ceteris paribus.

Consumers that reported that they do have a primary veterinarian are willing to pay an average of $40.16 more on average than consumers who do not have a primary veterinarian, ceteris paribus. Horse owners who are able to pay less than $1,000 out-of-pocket in a horse related emergency are willing to pay an average of $84.84 less than owners who would pay more than $20,000 in a horse related emergency, ceteris paribus. Those who have a horse dedicated savings account would be willing to pay an average of $22.61 more for a lameness exam than those who do not have a horse dedicated savings, ceteris paribus. Those who have savings accounts dedicated to horse related emergencies are prepared to pay more out-of-pocket than those who do not have a horse dedicated savings account.

All coefficients for respondent age are statistically significant at the 10% level or better, but there is no trend discernable across age categories. Horse owners in the age category 35–44 have a maximum WTP that is an average of $65.24 lower than those under 25, ceteris paribus. Horse owners who have one to three dependents in their household are willing to pay an average of $19.90 less than those who reported that they have zero dependents, holding all else constant. Those who have dependents in their household may be willing to pay less because they are financial responsible for those dependents, where as those with no dependents may have more financial freedom to dedicate to their horse(s).

In Model 14 (b), results from a *ln*-transformation of the dependent variable in Model 14 (a) indicates percentage changes in maximum WTP with respect to omitted variables. When comparing Model 14 (a) and Model 14 (b), there is a change in significance of several variables. The maximum WTP of respondents whose income is $150,000 - $249,999 is 26.30% greater than those whose income is less than $25,000. One new zip code region become statistically significant at the 10% level. Horse owners who are in RUCA Code 2 are willing to pay an average of 3.90% less than those located in RUCA Code 1, ceteris paribus, with a coefficient that is now statistically significant at 10% level. Respondents located in micropolitan RUCA regions are willing to pay an average of 5.60% less than those located in RUCA Code region 1, ceteris paribus. This result is statistically significant at the 5% level. Micropolitan areas typically have a lower cost of living than metropolitan areas, therefore this result is unsurprising.

Again, the Adjusted R^2 is low in both models (0.05 and 0.06, respectively). Consequently, only a fraction of variation in maximum WTP for lameness exams is explained by the independent variables in the model.

5.3.3 WTP for Emergency Colic Surgery

Table 5.49 provides the results from two OLS models to estimate the determinants of WTP for emergency colic surgery.

Table 5.49 Willingness-To-Pay for Emergency Colic Surgery

DV: Max WTP for Colic Surgery (a) and *ln* (Max WTP for Colic Surgery) (b)						
	Model 15 (a)			Model 15 (b)		
	Coefficient	Std. err.	VIF	Coefficient	Std. err.	VIF
Income 25k to 49k	201.697	327.770	3.2	0.002	0.045	3.15
Income 50k to 74k	-48.973	331.188	3.87	-0.036	0.045	4.01
Income 75k to 99k	168.183	331.104	4.06	-0.004	0.045	4.25
Income 100k to 149k	290.188	323.521	5	0.012	0.044	5.29
Income 150k to 249k	367.428	339.548	4.23	0.045	0.046	4.56
Income 250k plus	1112.830***	381.639	2.69	0.116**	0.051	2.9
Zip code region 0	214.896	285.921	1.23	0.054	0.038	1.25
Zip code region 1	249.913	272.072	1.23	0.038	0.037	1.23
Zip code region 2	153.391	212.433	1.45	0.013	0.028	1.46
Zip code region 3	212.144	226.561	1.36	0.008	0.030	1.36
Zip code region 5	253.492	261.659	1.28	0.016	0.035	1.28
Zip code region 6	606.671**	301.200	1.19	0.040	0.039	1.21
Zip code region 7	494.499*	268.671	1.3	0.036	0.035	1.31
Zip code region 8	213.698	269.767	1.26	0.035	0.036	1.26
Zip code region 9	760.657***	224.482	1.41	0.076***	0.030	1.44
6 to 10 Horses	-287.758	183.911	1.07	-0.019	0.024	1.07
11 to 25 Horses	-758.642***	264.196	1.06	-0.087**	0.036	1.06
26 to 50 Horses	-475.493	440.892	1.04	-0.002	0.059	1.05
51 to 100 Horses	-2040.252**	969.612	1.01	-0.077	0.136	1.02
>100 Horses	2116.578	1937.543	1.01	0.259	0.236	1.02
Yes - primary vet	236.600	282.178	1.06	-0.028	0.040	1.04
Horse value	0.0049316*	0.003	1.29	0.000000725*	0.000	1.28
< $1,000 in emerg.	-10864.720***	471.579	4.32	-1.196***	0.064	2.74
$1,001 - $5,000 in emerg.	-9181.207***	422.923	11.75	-0.992***	0.053	10.28
$5,001 - $10,000 in emerg.	-5681.386***	420.695	10.34	-0.467***	0.052	9.52
$10,001 - $20,000 in emerg.	-1782.044***	433.787	5.89	-0.094*	0.054	5.77
Yes, this horse is insured	67.215	192.074	1.3	-0.034	0.024	1.29
Yes - colic reimbursement	529.604**	231.920	1.16	0.025	0.029	1.15
Yes - savings account	655.479***	183.946	1.02	0.076***	0.024	1.02
Horse gender Gelding	242.461	174.892	1.99	0.040*	0.023	2
Horse gender Mare	177.278	175.155	1.97	0.017	0.023	1.98

Table 5.49 Continued

Yes - horse transportation	263.019	218.989	1.07	0.065**	0.030	1.07
Vet comes to my property	112.336	163.552	1.21	0.036	0.022	1.22
Age 25-34 years	-741.792**	312.243	3.59	-0.047	0.041	3.54
Age 35-44 years	-743.337**	312.408	4.2	-0.055	0.041	4.22
Age 45-54 years	-1334.987***	313.176	4.29	-0.107***	0.041	4.23
Age 55-64 years	-971.375***	309.972	4.18	-0.080**	0.041	4.13
Age 65 or more years	-1435.432***	318.991	3.17	-0.083**	0.043	2.95
RUCA 2	126.056	154.540	1.27	0.015	0.020	1.26
RUCA 3	438.861	408.206	1.06	-0.001	0.054	1.06
RUCA Micropolitan	-126.279	186.815	1.24	-0.043*	0.025	1.24
RUCA Rural	-123.687	205.975	1.29	-0.038	0.028	1.29
_cons	12660.870***	622.042		9.296***	0.081	
n	3,947			3,331		
F-stat	63.99			55.2		
Adj. R^2	0.4013			0.406		
Mean VIF	2.59			2.51		

*** indicates statistical significance at the 1% level, ** indicates statistical significance at the 5% level, and * indicates statistical significance at the 10% level.

In the first column of Table 4.49, Model 15 (a) presents the results for estimating the determinants of maximum WTP for colic surgery. The coefficient estimates for each significant variable indicate the dollar amount that horse owners would be willing to pay more or less for colic surgery than the variable that was omitted. Respondents who reported a household income of over $250,000 have a maximum WTP that is an average of $1,112.83 higher than those who reported an annual income under $25,000, holding all else constant.

Horse owners who reside in zip code region 6 are willing to pay an average of $606.67 more, zip code region 7 an average of $494.50 more, and zip code region 9 an average of $760.66 more than those who reside in zip code region 4, ceteris paribus.

There is some evidence that the more horses that are owned, the lower the WTP, although this is not a consistent trend. Respondents who own 11 – 25 horses are willing to pay an average of $758.64 less than those who own one to five horses, while those who own 51 – 100 horses are willing to pay an average of $2,040.25 less, ceteris paribus.

There is a trend that WTP declines according to the ability to tolerate a medical emergency; owners who could pay less than $1,000 in case of emergency have a maximum WTP that is an average of $10,864.72 less, $1,000 - $5,000 have a maximum WTP that is an average of $9,181.21 less, and $10,000 - $20,000 have a maximum WTP that is an average of $1,782.04 less than owners who would pay over $20,000 in a horse-related emergency, holding all else constant. Horse owners who are able to financially tolerate a medical emergency have an increasingly higher maximum WTP. Horse owners enrolled in a Colic Reimbursement program have a maximum WTP that is an average of $529.60 higher than those not enrolled, ceteris paribus. Respondent age is a significant determinant, but the magnitude of the estimates do not show a consistent trend across the age category. Respondents over 65 years of age are willing to pay an average of $1,435.43 less than those under 25, ceteris paribus.

In the second column of Table 5.49, Model 15 (b) presents the results of a *ln*-transformation of the dependent variable in Model 15 (a). The coefficient estimates for this transformation capture percentage changes in maximum WTP with respect to omitted variables. Some variables were no longer statistically significant through the transformation: those residing in zip code regions 6 and 7, 51 – 100 horses owned, respondents enrolled in a Colic Reimbursement program, owners ages 25 – 34, and ages 35 – 44. Horse owners who have a trailer to haul their horses became statistically significant at the 5% level, with a coefficient estimate of 0.065. These respondents have a maximum WTP that is an average of 6.50% higher than those who do not have a trailer, ceteris paribus.

The Adjusted R^2 is higher in Model 15 (a) (0.40) but is the highest for the three services in Model 15 (b) (0.41). This means that the most variation is explained in Model 15 (b), but there is significant variation in WTP for colic surgery left to explain.

5.3.4 Summary of WTP

Some horse ownership, sociodemographic, and veterinary service utilization variables explain the difference in WTP for the three services, but a large amount of the variation is left unexplained, suggested by the low Adjusted R^2 in Models 13 (a) – 15 (b).

CHAPTER 6. DISCUSSIONS AND CONCLUSIONS

First, this chapter presents the representativeness of the sample. Second, the discussions and conclusions are presented.

6.1 Representativeness of Sample

Figure 6.1 Age Comparison

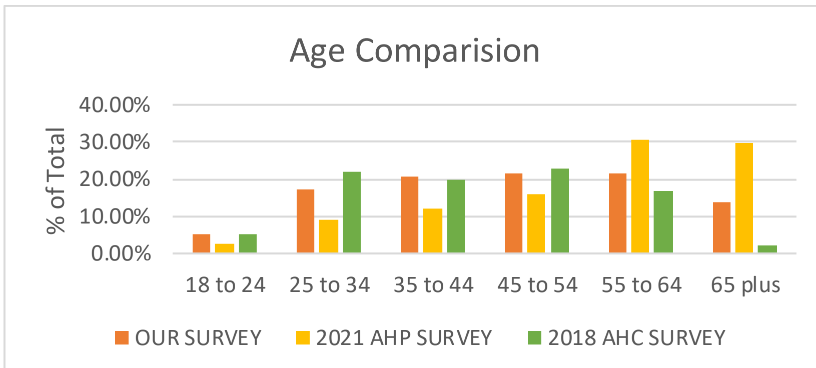
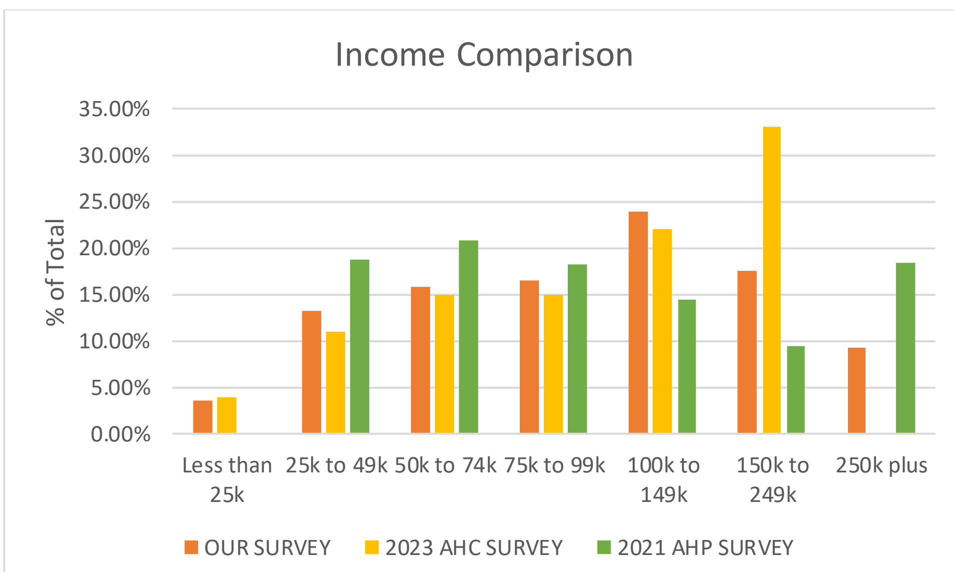


Figure 6.2 Income Comparison



The extent to which results from this study can be extrapolated to the entire population of U.S. horse owners depends on the representativeness of our sample. While there is no comprehensive measure of the horse owning population like the one that exists for the human population, the US Census, we can compare demographic information to those of a few recent national studies.

Figure 6.1 and Figure 6.2 illustrate the comparison of horse owner age and income between the 2018 AHC economic report, the AHP 2021 equine industry study, the AHC 2023 economic report, and this study. Age is compared between AHC 2018, AHP 2021, and this study (2023). Income is compared between AHP 2021, AHC 2023, and this study (2023). The AHP study had a greater percentage of older respondents. The percentage across age groups for our study and AHC 2018 are similar, except for the oldest age category. Our study and the 2023 AHC study had similar income distribution and had a greater percentage of high income respondents than the AHP 2021. This study shows that most respondents were aged 55-64 and reported \$100,000 – \$149,999 in household income. Respondents from 2023 AHC did not record age, but the majority reported \$150,000 – \$249,999 in household income. Most respondents from 2021 AHP were ages 55-64 and reported \$50,000 – \$74,999 in household income. These studies show that horse owners are increasing in household income over time but remain relatively steady in age.

Table 6.1: Distribution of Respondents by State Compared to Distribution of Horses

	Our % Total	% AHC Total 2023	% COA Total 2022
1	Kentucky (7.26%)	Texas (10.33%)	Texas (12.48%)
2	Indiana (5.78%)	California (6.59%)	Kentucky (4.58%)
3	California (5.31%)	Florida (4.62%)	Oklahoma (4.33%)
4	North Carolina (5.12%)	Ohio (3.44%)	Ohio (3.70%)
5	Florida (4.78%)	Oklahoma (3.44%)	California (3.69%)
6	Virginia (4.74%)	Kentucky (3.10%)	Florida (3.44%)
7	Texas (4.65%)	Pennsylvania (2.97%)	Pennsylvania (3.30%)

Data collected from the COA 2022, AHC 2023, and the survey results from this study were used to compare the geographic distribution of respondents. The greatest percentage of respondents from this study had horse(s) residing in Kentucky (7.26%). This was not the case for the other two reports which both reported that the largest equine population was found in Texas. Because this research originated in Kentucky, respondents from Kentucky are likely oversampled.

6.2 Conclusions

This study offers an introductory outlook on horse owners' preferences for equine veterinary services based on three service types: annual spring vaccinations, lameness exams, and emergency colic surgery. The results suggest that horse owners' demand for each of the three specific veterinary services are price elastic, therefore raising prices of these services would be counterproductive in increasing equine veterinarian's salaries.

Because demand is elastic, an increase in price would result in a proportionally greater decrease in quantity demanded. This would mean that the total revenue generated by that particular service would fall. However, since quantity demanded would decrease, the practitioner would perform fewer services. This would lead to a decrease in costs. If the decline in costs exceeded the decline in revenue, profits would increase. We are unsure of the extent to which costs would decline, but this would be interesting to examine in future studies.

While Neill and Holcomb (2016) found aggregate demand for equine veterinary services to be inelastic, we found demand for each individual service to be elastic. This raises a few interesting questions as to why. Certainly, the two approaches measured demand very differently. Is there some theoretical basis that can explain why individual services are elastic but aggregated demand is inelastic? Or have things changed since their study? In any event, is it something that deserves further exploration.

In addition, the significant determinants of WTP for equine veterinary services were estimated. While a number of demographic, horse ownership, and veterinary experience variables were statistically significant, the low Adjusted R^2 in each model suggests that other outside factors not included in the survey may explain more of the variation in the data. However, in Models 15 (a) and (b) the ability of horse owners to financially tolerate a medical emergency appeared to have a large impact on WTP. This information can be used to educate horse owners about the importance of creating "horse spending savings accounts."

There are limitations to this study and the research that was conducted. Some of these limitations include the inability to capture every factor that may affect the respondent's willingness to pay for a service. Another limitation may be having horse owners choose a specific horse. Respondents may have been willing to pay more or less when keeping a different horse in mind. Another limitation is that this study originated in Kentucky. Kentucky respondents were oversampled, so statistical inference must be pursued with care. Other limitations may be the selection of the three specific services we chose. Geographically, service prices may differentiate resulting in responses that may not be applicable to all veterinarians. Last, hypothetical bias may not reflect how respondents would react if the situation arose in their everyday lives.

Solving the challenges in the equine veterinary industry, including raising the salaries for veterinarians will require a multi-pronged approach. Our study suggests that raising prices would be counterproductive. It also suggests that increasing educational efforts for horse owners to be financially prepared for emergencies would be beneficial. Last, our study suggests that the equine veterinary profession should consider how telemedicine can be used to operate more efficiently and/or reach underserved areas.

Further research may include choosing different service types or more ways to increase revenue for veterinarians that are not related to price change within their service lists. Additionally, other alternatives to traditional ambulatory models could be considered to allow veterinarians to expand the number of patients seen each day.

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