The Nature of Demand For Companion Pet Health Care

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Abstract

More than 49 percent of American households own companion animals and spend nearly five billion dollars annually for veterinary care. This paper examines the demand for cat and dog health care. The estimated price and income elasticities for overall demand are -0.12 and +0.80, respectively. However, cat owners show more sensitivity to both price and income than do dog owners. In addition, these sensitivities vary with the location and the practice composition of veterinarian firms.

Introduction

Americans spent nearly five billion dollars in 1987 for veterinary care. Veterinarians provided care for an estimated 126.5 million companion animals at a forty dollar annual health care expenditure per animal. Given that about 49 percent of households (44.8 million) had at least one companion animal, the average annual veterinary expenditure per household was about $111. About 91.9 percent of these expenditures were for feline and canine veterinary care.[1]

According to two studies by the American Veterinary Medical Association, AVMA, (see footnote 1) conducted during the 1983-1987 period, veterinary care expenditure and pet health care utilization (number of veterinary visits) increased by approximately 31 and 8 percents, respectively. Furthermore, these studies reveal significant changes in pet ownership preferences and health care utilizations which have important economic ramifications for about 49,000 practicing veterinarians. These changes include: an increasing trend in cat ownership, a declining trend in dog ownership, and a much faster increase in health care utilization rate for cats than for dogs (13 and 4 percents, respectively). A plausible explanation for some of these changes maybe shifts in labor market participation rates and the home-ownership trends. For example, as the number of multiple wage-earner families continues to increase while the home-ownership rate declines, cats maybe more suitable pets to own, given their greater independence than dogs.

The importance of pet health care is also reflected in the recent emergence of the pet health insurance market. Pet health insurance has been available for cats and dogs for the last ten years. One firm has underwritten about 250,000 policies during this period.[2] In addition, a recently formed health care plan, Preferred Pets Company, has expanded coverage to include all pets from elephants to mice.

While a good deal of empirical research has advanced our general understanding of the nature of demand for human health care, to our knowledge, no study of the demand for pet health care has been completed to date. By linking consumer behavior towards their pets to the literature on human health care, price and income elasticities of the demand for pet health care (cats and dogs only) are estimated in this paper. These estimates are from a national survey sample of 493 veterinarians. The results have important implications for veterinarians, pet health insurance companies, and consumers.

Empirical Specification of Demand for Pet Health Care

The most commonly used analytical framework for the study of the market for human health care is the traditional model of supply and demand. This model rests on consumer maximization of expected utility, given prices, income, and market characteristics of goods and services, including health care services. The optimizing behavior of individuals determines the overall market demand for health care services. Given the overall demand, and the service provider's marginal cost of production, the individual provider determines the quantity of services to offer.

Based on the above framework, a number of studies have estimated price and income elasticities of demand for physician services for adults or children. Yet, the data used in these studies differ by level of aggregation. Some used state or metropolitan area data. Others have used either households or physician firms as the unit of observation. Moreover, most studies have used a single-equation approach. The results, in general, indicate that

the demand for physician visits is both price and income inelastic. The price and income elasticities vary from -.08 to -.2 and from .25 to .85, respectively (Manning et al. 1981; Newhouse and Phelps 1976; Wedig 1988; Newhouse 1981).

Human attitudes towards the health care of their pets is not different from those towards the health care of themselves and their children. Indeed, a body of literature has shown that the well-being of pet owners is influenced by their pets. Keddies (1977) found that in some cases people mourn the loss of a pet in a similar fashion as to the loss of a limb. Robin and Bensel (1985) found that pets are instrumental to the self-identification process during the transition from childhood to adulthood. Fogle (1981) observed that pets can be used as therapy in self-expansion of children, hospital patients, and the elderly. Horm and Meer (1984) report that pet owners have a greater feeling of well-being than non-owners. Sussman (1985) reported that about eighty percent of pet owners regarded their pets as a family member. Belk (1988) explains peoples behavior with respect to their pets by linking it to the relationship between self-identification and possessions. Thus, pets are a unique area of consumer behavior, affected by the process of self-extension.

Given the observations of the above literature, it is reasonable to argue that people care almost as much about the health care of their pets as that of themselves. Indeed, pet owners act as agents for their pets. Consequently, the provision of pet health care will follow the same principle as that of the health care of children. Thus, we expect that the theory of consumer behavior is applicable to pets, and that the price and income elasticities for veterinary services show similar patterns as those of human health care.

Following the theoretical determinants of the demand for human health care and using veterinarian firms as the unit of observation, the demand schedule for pet health is specified as:

$$Q = f(P, Y, PS, AT, DEM) \quad (1)$$

where Q is the average daily quantity of visits, P is the veterinarian's fee, Y is the income of potential customers, PS is the price of substitute for veterinary services, and AT and DEM are sets of variables representing attributes of the veterinarian (AT) and the characteristics of the veterinarian's market area (DEM) affecting demand. This single equation model includes variables measuring characteristics of both buyers and sellers. Accordingly, the model specifies supply shifts while demand is assumed stable. This follows from the price setting behavior of veterinarian services. That is, consumers respond to prices on a take it or leave it basis. As such, there is no reason to believe that the visit of a household depends on the quantity of services supplied by a given veterinarian. Thus, a single equation model is an appropriate representation of behavior.

In view of the information available (described below), equation (1) represents the demand curve for all services rather than the demand for a given type of medical or surgical procedure. Literature on human health care indicates that patients are likely to select a physician based on his or her overall costliness and performance, and not based on charges for specific procedures (Sloan 1976). Consequently, one might expect pet owners to demonstrate similar selection behavior for their pet health care. Indeed, most pet owners have a regular veterinarian for their animals.[3] Thus, we aggregated overall services and specified the quantity of veterinary service demanded (Q) as dependent on the mean fee (P). This averaging approach controls for differential levels of care per visit, and was adopted by Sloan (1975) and Wedig (1988). Since we are estimating the demand for an individual veterinarian and not the market demand, the fee variable is treated as exogenous.[4]

Five variables represent veterinarian attributes. The first variable is years since graduation from veterinary school. This variable and its square account for the relative experience in the practice and the accumulation of patient contact.[5] As such, it is expected to have a positive impact on demand. However, it is also possible that more recent graduates have obtained a more technologically advanced education than the older veterinarian. This might influence the composition of the practice and the size of the clientele. In addition, there is some evidence that physicians hours of work decline with age (Sloan, 1975). That is, older practitioners (more experienced) place a higher value on leisure. These last two considerations imply a negative impact on the number of clients. Thus, the net impact of the experience variable needs to be determined empirically.

The second veterinarian attribute variable is the distinction between group and solo practices. In recent years there has been a rapid increase in group medical practices, perhaps a result of potential economies of scale resulting from a more efficient use of non-physician personnel and equipment. This efficiency improvement can reduce the marginal cost and increase quantity per practitioner within the group. In addition, group practice can be perceived by pet-owners as a "differentiated" product, in that it reduces time spent for obtaining multiple services such as, physical examinations, vaccinations, x-rays, or blood tests.[6] Group practice is represented by a dichotomous variable in our model and is expected to have a positive impact on demand.

Three other variables representing veterinarian attributes are used. They are the percent of practice

allocated to large animals (horses and cows), the percent of practice allocated to pet birds and other small animals, and the availability of a periodical payment plan for services. The first two variables reflect the impact of "production mix" or "animal specialty" of an individual veterinarian and the impact of this specialty on the demand for cat and dog health care services. We expect that a practice that specializes in large animals would have fewer visits per day. On the other hand, the practice of "other" small animals may be perceived as a complement to cats and dogs practice, as such, it would have a positive impact on the dependent variable. The availability of a payment plan (represented by a binary variable) is expected to have a positive impact on demand. That is, ceteris paribus, veterinarians who accept monthly or periodic payments, rather than payment at time of service, would attract more clients.

Characteristics of the veterinarian's market area is also represented by three measures: the veterinarian-pet ratio, and two dummy variables for the location of the practice. These variables may partially control for the effects of veterinarian supply on observed demand. One would expect that higher veterinarian-pet ratios would reduce the demand for individual practitioner. However, it can also be argued that higher ratios may induce a higher per capita utilization of pet health care due to the availability and accessibility of a veterinarian. In this case, the ratio may have a positive impact on demand. Literature on human health care also provides mixed results on this issue (Feldstein 1970, 1971; Newhouse 1970; Sloan 1976). Thus, we anticipate possible contradictory impacts for this variable.

The location of veterinary practice is expected to have an impact on demand. For example, as the distances between customers' residence and the veterinary office increase, per capita utilization may decline, due to higher travel costs to obtain the services. In addition, owners of indoor pets may be more sensitive to their pets' health care and visit a veterinarian more often than owners of outdoor pets. As a consequence, pets owned by rural and farm families (which are more likely to be outdoor pets and located further from the veterinary office) would receive fewer services than those in metropolitan areas. We measure the influence of location using two dichotomous variables, veterinarian location in cities of 100,000 or less and in urban areas with more than 100,000 population. The location reference group is rural areas.

Income should, in general, have a positive impact on pet health care utilization. Price of substitutes are expected to have a positive impact also. However, in the case of companion animals, euthanasia decisions may be the major substitute available in the event of major health care expenditures. Data on the actual prices of a major health care expenditure and euthanasia are not available. Thus, as a proxy, we include the percent of clients who choose euthanasia because of high health care cost.[7]

Data Source

The data used in the empirical work is from a national survey that was conducted during February 1990. A list of veterinarians by state was obtained from the AVMA directory. The questionnaire was sent to about 3000 veterinarians, according to the state's share of the total number of veterinarian. Four hundred and ninety-three practicing veterinarians returned the questionnaire, a return rate of about 16 percent. This sample constitutes more than one percent of the entire veterinary population in the U.S. The correlation coefficient between the number of responses from each state and the total number of veterinarians in the state was 0.68. Data on state level per capita income, the number of veterinarians and pets in each state were obtained to supplement the survey responses.[8]

The mean fee for the sample is $92.00 and the average number of daily veterinary visits is 24.1.[9] Group practice mean fee and average daily visit are about 61 percent and 20 percent higher than those for solo practice. Both mean fees and visits are substantially lower in rural areas than cities and urban areas. The sample means for these and other variables are summarized in Table 1.

Empirical Results

Based upon the discussion above, the average daily quantity of visits for the combined cats and dogs was estimated by ordinary least squares (OLS). The results are reported in Table 2. All the explanatory variables have the expected signs. In this regard, group practice, city location, and urban location have a significant impact on the quantity of practice. The coefficients of the variables reflecting veterinarian "animal specialty" (the percentage of practice in large animals and the percentage of practice in "other" small animals) are negative and positive. Both are statistically significant. This suggests that providing health care to large animals, and "other" small animals are, respectively, substitutes and complements to providing health care to cats and dogs. Coefficients of the variables experience, experience squared, payment plans, percent of clients choosing euthanasia, and the veterinarian-pet ratio have the expected signs, but they are not statistically significant from zero.

Both price and income variables conform to a priori expectations and are statistically significant at 5 and 1 percent levels, respectively.[10] The calculated price and income elasticities at the mean values are -0.12 and +0.80. While the lack of previous research makes the

Table 1
Sample Means and Standard Deviations

Variables	Mean	Std. Dev.
Mean Fees ($):		
Overall Sample	92.00	54.99
Group Practice	98.88	58.36
Solo Practice	82.15	48.25
Location: Rural	73.08	35.96
City	110.18	67.26
Urban	94.10	48.68
Average Daily Visits:		
Overall Sample: Cats	9.56	8.42
Dogs	14.54	11.07
Group Practice	28.45	20.65
Solo Practice	17.65	11.74
Location: Rural	16.76	10.38
City	29.24	21.74
Urban	27.59	18.68
Years Since Graduation	17.09	9.89
Percent of Practice: Large Animals	9.30	20.45
Other Animals	3.89	8.29
Percent of Client Choosing Euthanasia	19.76	24.67
Group Practice (%)	59.77	*
Location (%): Rural	38.18	*
City	39.32	*
Urban	22.50	*
Offer Payment Plans (%)	80.90	*
Per Capita Income (.000)[a]	13.30	1.85
Number of Veterinarian per Thousand:[a] Cats	0.88	0.27
Dogs	0.94	0.28

*Dummy variable.
[a]Indicate state level data. Per capita income is obtained from the Statistical Abstract of U.S., 1989. Veterinary-Pet ratios for each state are calculated by dividing the number of veterinarian in the state by the state's pets population (for cats and dogs separately). The number of veterinarians is obtained from the American Veterinary Medical Association Directory, 1989. Pet population is taken from Troutman (1988a).

check for accuracy of these estimates impossible, the existing literature on human health care suggests the reasonableness of our results.

As stated there are some differences in ownership performance, health care utilization rate, and veterinary care expenditure between cat-owners and dog-owners. As a result, adding cat and dog visits may produce inconsistent estimates.[11] Thus, it seems more appropriate to estimate separate demand equations for each type of companion animal. To obtain unbiased and consistent estimates with improved efficiency, separate health care demand equations were specified for cats and dogs. The two-equation system was estimated by Zellner's Seemingly Unrelated Regressions (SUR) method. Whenever, there is a possibility that the random components of a system of equations are correlated (e.g. due to an omitted independent variable from the equations), the estimation of SUR equations reduces the variance of the estimators and improves efficiency. In the estimation process, the knowledge of the errors in one equation provides some information about the errors of the other equation. Through the iterating procedure this information is utilized until the variance of the coefficients converge.

Table 2
Regression Results: Demand for Veterinary Services
(Dependent Variable: Number of Clients Per Day)[a]

Variables	OLS Total β	OLS Total t	SUR Cats β	SUR Cats t	SUR Dogs β	SUR Dogs t
Constant	-.490	0.07	-2.734	0.79	6.456	1.48
Price	-.032	2.27	-0.017	2.57	-0.016	1.81
Per Capita Income ($000)	1.444	3.51	0.846	4.30	0.470	1.81
% of Clients Choosing Euthanasia	-0.32	1.04	-0.013	0.86	-0.017	0.87
Veterinary Attributes:						
Experience	0.161	0.64	0.036	0.31	0.139	0.87
Experience Square	-0.004	0.59	-0.001	0.19	-0.003	0.87
Group Practice	11.114	7.20	4.676	6.44	6.760	6.90
Percent of Practice:						
Large Animals	-0.165	3.82	-0.061	3.04	-0.098	3.54
Other Animals	0.267	2.75	0.111	2.46	0.140	2.29
Offer Payment Plans	0.838	0.43	0.802	0.89	0.232	0.19
Characteristics of Market Area:						
Veterinary - Pet Ratio:						
Total	-0.900	0.63	*	*	*	*
Cats	*	*	-2.469	2.06	*	*
Dogs	*	*	*	*	-2.267	1.42
Location:						
City	8.469	4.24	3.64	3.88	4.495	3.56
Urban	6.189	2.98	3.77	3.81	2.558	1.92
OLS R^2	.32		.31		.27	

[a]See text for a description of the sample. The critical t values are 2.576, 1.960, and 1.645 for 1, 5, and 10 percent level of significance. *Indicates not applicable.

Table 2 includes the SUR results. Again, all coefficients have the expected signs. However, there are substantial differences across the two equations, both in terms of the significance levels and the magnitude of the coefficients. For example, the income coefficient in the cat equation is significant at 1 percent, and at the 10 percent level in the dog equation. Moreover, this coefficient is almost twice as large as that of the dog equation. Comparing the SUR results to those of the aggregate OLS, the most noticeable difference is the significance of the veterinarian-pet ratio coefficient, which is insignificant in OLS results. The coefficients of the veterinarian-pet ratios from the SUR analysis are significant in both the cat and dog equations. This change is consistent with the claim for higher efficiency resulting from accounting for across-equation error corrections by the SUR method.

Given the price and income coefficients in the SUR equations, respective elasticities were calculated at the mean values of each variable for cats and dogs separately. Price elasticities are -0.16 and -0.10 and income elasticities are 1.18 and 0.43 for cats and dogs, respectively. These results suggest that the demand for cat health care is more price and income sensitive than that of dog health care.[12] This is consistent with AVMA's report that most people believe that cats need less veterinary care than do dogs. The lower perceived need will induce higher income and price sensitivities on the part of consumers. This perception, however, may be the result of the more "independently-natured" behavior of cats and not the result of less health care needs.

As discussed previously the nature of demand may differ by type and market area of practice. In Table 3 the price and income elasticities of demand are broken out by type of practice (solo versus group) and by location of practice (rural, cities, and urban areas). The equations used to calculate these elasticities are specified the same way as those reported under SUR in Table 2, except for the addition of interaction terms between price and income on the one hand, and the type and market area of practice on the other. Elasticities within each category use coefficients of the relevant

Table 3
Price and Income Elasticities of Demand for Pet Health Care by Type of Veterinary Practice and Location[a]

Measures	Price Elasticities Cats	Price Elasticities Dogs	Income Elasticities Cats	Income Elasticities Dogs
Type of Practice:				
Solo	-0.28	-0.21	1.21	0.13
Group	-0.06	-0.13	1.18	0.57
Location of Practice:				
Rural Areas	-0.10	-0.04	0.91	-0.23
Cities	-0.13	-0.08	1.18	0.43
Urban	-0.28	-0.18	1.24	0.39
Overall Sample	-0.16	-0.10	1.18	0.43

[a]See text for a description of the elasticities calculation.

interaction terms and are computed at the mean values within the category in question.

Turning to the results in Table 3, note that in all cases but one the magnitudes and signs of the estimated elasticities are reasonable. In this regard, the price elasticities have negative signs and the income elasticities have positive signs, suggesting that health care of a small companion animal is considered a "normal" and a "superior" service.[13] In addition, except for the price elasticity of demand associated with group practice, cat health care demand shows more price and income sensitivity than dog health care demand. The relative price elasticities along with the relative income elasticities (greater and smaller than one for cats and dogs, respectively) indicate that, in general, pet owner perceive cat's health care as a "luxury" or "superior" service and that of dogs as a "necessity" service.

In general, clients of group practices are less price sensitive than those of solo practices. This result along with the higher mean fees charged by group practices (see Table 2) lend support to the product differentiation hypothesis discussed earlier. Finally, price sensitivity increases with population density, perhaps reflecting the effect of veterinarian supply on observed demand, that is, the impact of a higher degree of competition in more densely populated areas.

Conclusion

This paper is the first attempt in understanding the consumers behavior with respect to their demand for pet health care. By incorporating an economic model of human health care and the psychology of human attitudes towards pets, we develop and test hypotheses about the price and income elasticities of demand for pet health care. The empirical results suggest that pet health care is considered a normal service by pet owners. Although the results in general conform our a priori expectations, the demand for pet health care seems to be somewhat more price and income sensitive than that of human health care.

However, price and income elasticities of demand for health care are by no means uniform between cat and dog owners. In this regard, cat owners show more sensitivity to both price and income than do dog owners. The differential behavior is perhaps a reflection of the perceived relative health care needs of the type of pets by the consumers. In addition, the elasticities are positively related to population density. These elasticities also depend upon the composition of the veterinary firms. In general, pet owners differentiate the mix of services provided by group practices from that provided by solo practices.

Our results from the veterinarian sample, as well as the results from pet-owners samples by AVMA, reveal that dog owners' health care utilization is currently higher than that of cat owners. However, as the AVMA studies report, not only the health care utilization rate of cat owners is increasing much faster than that of dog owners, but also the ownership preferences of house-

holds are changing in favor of cats. These trends, along with our findings of elasticities, imply a changing nature of overall demand for veterinary services.

Given the higher elasticities of demand for cat health care, and if the current trends of ownership and utilization continues, veterinarians will face more price-and-income sensitivity to demand for their overall services. In addition, pet owners should experience a higher degree of both price and non-price competition among veterinarians in the future. Also, our results imply that an appropriate policy by pet health care insurance providers should consider different cost sharing formulas (premium and deductibility) for dogs and cats.

Suggestions for Future Research

This paper reveals significant differences between cat and dog owners with respect to their demand for pet health care. It also reveals significant changes in pet ownership preferences and health care utilization. These differences and changes have important economic ramifications for the practicing veterinarians. Thus, a formal modeling and an empirical knowledge of the cost and market structures under which veterinarians operate would be a fruitful reach area.

Furthermore, the increasing veterinary care utilization nd expenditure have given raise to a newly created market for pet health care insurance with a substantial growth potential. The extent of pet owners' participations in pet health insurance market as well as an analysis of policy formulation by insurance providers seems appropriate for future research. Finally, the finding of this paper can be enhanced by future empirical analysis based on data from individual pet-owners. ❧

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*****Footnotes*****

1. These are some of the summary results of two descriptive research studies based on 40,000 American households, sponsored by the American Veterinary Medical Association in 1983 and 1987. Reports of these studies appear in Troutman (1988a, 1988b). Table A1 in Appendix A summarizes some of the information contained in these reports by type of animal, as well as for all animals, for 1987.
2. Veterinary Pet Insurance (VPI) of Santa Ana, California and the American Health Insurance Agency of Danbury, Connecticut offer pet health care insurance. VPI offers insurance with an annual premium ranging from about $30 to about $150 with payments between $750 and $1,000 on each diagnosis, and with annual maximum medical benefits between $5,000 to $7,500.
3. The previously mentioned study by AVMA found that more than 84 percent of pet owners have a regular veterinarian.
4. During the initial estimation, we used the instrumental variable method and performed Hausman's test for price exogeneity. Different variables and combination of variables, including weekly wages of veterinary workers and nurses, were tried as the instrument. In all cases the hypothesis of exogeneity was not rejected. For details of this test, see Maddala (1988, pp. 331 and 437-439).
5. The aforementioned study by AVMA reports that most companion animal owners have an attachment to a veterinarian, and that about 90 percent have expressed satisfaction with their veterinarian.
6. Our measure of price does not reflect this "external" benefit of group practice to the buyers of services. However, as Sloan (1974) points out, group practitioners may internalize this benefit and charge higher fees. In the case of physicians, Sloan (1976) finds a negative significant effect on fees and a positive significant effect on average revenue for group practices comprising of 3 to 10 physicians. A variable reflecting more than 10 physicians in the group has a positive but insignificant impact on both fees and average revenues. In our empirical estimation, reported below, we include an interaction term between price and group practice. This variable has a positive impact on quantity. However, the issue cannot be further investigated without a knowledge of the cost and market structures under which veterinarians operate.
7. Omission of a price variable for euthanasia, with an expected positive sign, may produce a positive bias and, therefore, an underestimation of the health care price coefficient. On the other hand, including the percent of clients choosing euthanasia as a proxy variable for price of euthanasia, if irrelevant, has no effect on the bias of estimated health care price. Thus, there is a possibility of downward bias in our estimated elasticities.
8. Per capita income was from the *Statistical Abstract of U.S.;* the number of veterinarians and the pet population were taken from the AVMA directory and Troutman (1988a), respectively.
9. Every veterinarian reported the average quantities of cats and dogs visited per day and the percent distribution of charges per visit of practice. The mean fee was calculated by utilizing this information.
10. In several preliminary estimations we have included price square and/or price-income interaction terms. The coefficients of neither variables were significant. So the hypotheses that demand is linear in price and that price elasticity is independent from income

Appendix Table A1
Summary Information on Companion Animal Ownership in the U.S.: 1987

Variable	Type of Companion Animal: Cats	Dogs	Birds and Others	Horses	All Companion Animals
Number of Companion[a] Animals (millions)	54.6	52.4	12.9	6.6	126.5
Percent of U.S. Households Owning Companion Animals[b]	30.5	38.2	5.7	2.7	49.4[c]
Percent of Pet Owner Households That Obtained Veterinary Care During 1987 (At Least Once)	59.5	77.6	7.6	47.4	N/A
Average Number Owned per Household	2.0	1.5	2.5	2.8	N/A
Veterinary Care Expenditures (billion)	1.573	3.012	.072	.330	4.987
Average Expenditure ($) Among Household who obtained Veterinary Care in 1987	96	112	183	284	N/A

Source: "Veterinary Services Market for Companion Animals: Summary Report," See Troutman (1988b)
[a]Excludes pets in animal shelters or other such places.
[b]Based on our estimated total of 90.7 million households in 1987.
[c]Because of multiple species ownership by households, a precise estimate of this figure is not possible. However, almost all bird and horse owners also have cats and/or dogs. In addition, 36.7 percent of cat owning households were exclusively cat-owners. Given these information, a lower bond estimate was obtained by adding 37.7% of cat-owners to the total number of dog-owners.

could not be rejected.

11. In another demand estimation, impact of cat visits and dog visits on price was tested separately (i.e., two quantities along with other control variables). The coefficients of quantity variables were statistically different from each other at the 5 percent level.
12. Given that computed elasticities are a product of mean price-mean quantity ratio and the estimated coefficients, they do not have a known statistical distribution. As such, a statistical test of significance of the difference in these elasticities cannot be performed.
13. The exception is the case of income elasticity of demand for dog health care in rural areas, which has a negative sign. A plausible explanation for this unexpected outcome is that our measure of the income variable (state level per capita) does not appropriately reflect income differentials across the rural areas of low and high income states. That is, the pattern of companion animal ownership and the demand for health care may differ among the rural areas for high and low-income states.

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