

# Explaining earnings variation of bovine veterinarians in private practice

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## Abstract

Bovine veterinarians are needed to protect food animal protein supplies, prevent losses due to disease, and protect public health: society needs these services. It is also important that economic incentives exist for, and are understood by, practitioners that serve the food animal industry. Surveys of American Association of Bovine Practitioners members were examined to explain variation in bovine veterinary earnings in private practice. We estimate the systematic variation in earnings due to practitioner characteristics. Results communicate expected earnings levels and variation across bovine veterinarians in private practice based on observable individual attributes and characteristics. These results communicate, in context of the survey questions, what the market for bovine veterinary services values. Bovine veterinarians are compensated more for specializing in a species within the food animal industries and owning their practice. The volume of animals seen is important, and bovine veterinarians should look to practice in areas with large concentrations of animals. Numbers of clients attained are not important, whereas numbers of animals serviced are. Further, gaining experience is more important than additional education or certifications beyond the doctor of veterinary medicine degree. However, there remains a large unexplainable variation in earnings models. This unexplained variation is likely due to unobserved and unmeasured ability/effort effects within each individual and it is thought, but not tested, that higher quality veterinarians earn more. Future salary surveys need to attempt to measure these deep human capital attributes.

**Key words:** veterinarians, bovine, earning, income, AVMA, AABP

## Résumé

Les vétérinaires bovins sont requis pour préserver les réserves de protéines provenant d'animaux de production, pour prévenir les pertes causées par la maladie et protéger la santé publique car la société requiert ces services. Il est aussi important que les vétérinaires qui travaillent dans le

secteur des animaux de production comprennent et bénéficient d'incitations économiques. Des sondages auprès des membres de l'*American Association of Bovine Practitioners* ont été examinés pour tenter d'expliquer la variation dans les revenus des vétérinaires bovins en pratique privée. Nous estimons la variation systématique dans les revenus causée par les caractéristiques des praticiens. Les résultats nous parlent des niveaux de revenus attendus et de la variation entre les vétérinaires bovins en pratique privée basée sur des attributs et des caractéristiques individuelles observables. Ces résultats indiquent, dans le contexte des questions du sondage, ce que le marché valorise au niveau des services en médecine vétérinaire bovine. Les vétérinaires bovins sont mieux rémunérés lorsqu'ils se spécialisent dans une espèce du secteur des animaux de production et lorsqu'ils sont propriétaires de la pratique. Le nombre d'animaux vus est important et les vétérinaires devraient penser à pratiquer dans des endroits avec de grandes densités animales. Le nombre de clients acquis n'est pas important tandis que le nombre d'animaux servis l'est. De plus, acquérir de l'expérience est plus important qu'une formation supplémentaire ou une certification au-delà du doctorat en médecine vétérinaire. Néanmoins, une grande proportion de la variation dans les revenus demeure inexpliquée. Cette variation inexpliquée est probablement reliée à des effets individuels non observés et non mesurés et on pense, sans l'avoir testé, que les vétérinaires de qualité supérieure gagnent plus. Des sondages futurs sur les salaires devraient tenter de mesurer ces attributs élémentaires du capital humain.

## Introduction

There are many economic issues important to veterinarians and to the industries that provide and support veterinary services. To name a few these include practice management, financial management, student debt, compensation gender equity, consumer trends, and public health. But a persistent issue of interest to current and future veterinarians is earnings: what are veterinarians paid? The American Veterinary Medical Association (AVMA) publishes regular reports on the economic state of the veterinary profession,

including the market for veterinarians.<sup>1</sup> The research discussed herein contrasts with this broader AVMA work in that we provide a unique focus on compensation for bovine practitioners in private practice.

Much like how production agriculture industries have undergone changes in past years, the agriculture service industries have also changed. One such industry is certainly veterinary services. In 1980, the veterinary industry was male dominated and large animal focused.<sup>14</sup> Today, food animal practice comprises just 9% of veterinarians and women are a majority of, especially new, veterinarians.<sup>13</sup> Nonetheless, food animal medicine remains important because of societal needs to respond to animal health crises, to protect public health, and to sustain the food supply through producers having access to veterinary care.<sup>7</sup> Veterinary colleges and professional organizations like the AVMA and the American Association of Bovine Practitioners (AABP) play a role in contributing to the assurance that food animal veterinarians are being trained and supplied.

The supply of food animal veterinarians is a concern of livestock industry associations, food animal producers, and governments. In a study of small-scale livestock operations earning less than \$500,000 a year, a category that makes up over 90% of all US farms, researchers found that there was likely a shortage of rural food animal veterinarians available to these operations.<sup>2</sup> The authors conclude that the biggest reason livestock producers did not use a veterinarian was because the distance to the closest veterinarian was too great. There are also other indications that there may not be enough food animal veterinarians. When compared to all types of veterinarians, AABP members work, on average, 10 more hours per week.<sup>15</sup> This is not likely due to the high demand for services as these practitioners usually have more travel time to see clients when compared to companion animal practitioners who practice more often in suburban or urban clinics and hospitals. Nonetheless, high travel times could indicate that there may not be enough veterinarians in some areas.

Further, with the rising cost and declining net present value of the doctor of veterinary medicine (DVM) degree, economic incentives may play an important role in the decision to become a food animal veterinarian.<sup>11</sup> Income for food animal veterinarians in private practice varies greatly. In a 2007 survey of their members, the AVMA found that food animal-exclusive practices had the greatest percentage of veterinarians in the highest income bracket.<sup>16</sup> At the same time, this was not true of food animal-predominant (food animal-only practices or mixed animal practices that mainly serve food animals) practices.<sup>16</sup> These sorts of differences make it important to understand what factors influence the levels and variation in bovine veterinarian income.

The objective of this study is to explain the factors that are important in determining bovine veterinarian income and thereby assist veterinarians in understanding sources of economic reward. What characteristics of bovine veterinarians contribute to their income and economic success? What can

bovine veterinarians do and where can they locate that will contribute to their income? Attributes and characteristics of veterinarians and their practices were identified through responses of 2 AVMA surveys of AABP members and the data are used to explain veterinarian income through statistical regression. It was hypothesized that factors such as experience, practice ownership status, geographic location, gender, and the species of food animals and volume of animals seen would influence veterinarian income. We explain the conditional mean of income and thereby show the contribution of different individual attributes or characteristics to annual earnings across bovine veterinarians in private practice.

Details of the surveys are reported in the document American Association of Bovine Practitioners Economic Report 2016.<sup>4</sup> The surveys were a substantial effort by AVMA in conjunction with AABP to understand employment conditions, work environments, and compensation. Survey respondents were also asked to self-report on background, education, skills, and their current employment details. Details were also asked about compensation amounts and practices. The AVMA report summarizes the responses and compares responses of bovine practitioners to a sample of general veterinarians. One piece of the report was an income or earnings model. Annual earnings were explained as a function of characteristics of the survey respondents. The fit of that model was an R-squared of 38.3%. The purpose of the research reported herein was an exploratory exercise to make improvements on that model. Could the model's explanatory power be improved? Could income for bovine veterinarians be better explained? And thus, could better information be provided to, both established and new, bovine veterinarians on determinants of income and ways to improve financial wellbeing through better earnings? These are the goals of this research and the purpose of this paper.

## Materials and Methods

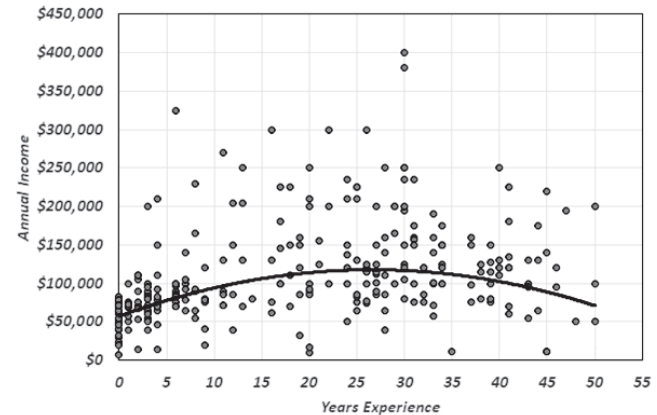
The AVMA with the AABP conducted an employment survey with the population of 2,138 AABP members in private practice in March 2015. The survey asked about unemployment, job satisfaction and perceptions of future work outlook, competition pressures, perceived self-competence, internships, revenue shares of certain services, and different quantity measures associated with client visits in 2014. A second survey was conducted with same AABP members in June 2015 regarding annual 2014 compensation. It collected information on salary and benefits, practice ownership, compensation type, and community type where the respondent lived. AVMA collected and combined the survey data, and the final response rate of usable surveys was just under 30%.

In total, 638 responses from individual bovine practitioners were available. However, not all responses were complete, thereby decreasing the overall sample size usable in any statistical analysis. For example, the question rather frequently not answered in the compensation survey was the

question about income. Other potential explanatory variables were also not answered by respondents. For example, some respondents did not provide information on their gender or age. Also dropped from the sample were observations where the majority of income was from equine, swine, or companion animal practice. The resulting data allow the effort to focus on veterinarians where  $\geq 50\%$  of income is from bovine veterinary practice. Further, 5 influential observations were removed from the sample. One individual reported income 3 times the next largest income. This observation created a very high leverage point in the OLS models. Four other observations were similarly high leverage points due to very small numbers of animals seen and were dropped. These observations had impacts on the means and estimated coefficients if used. In the end, there were 272 responses in the final model reported, with the number of observations changing depending on the candidate explanatory variables used.

Because of the wide range of questions and data obtained from the survey, factors that might be important in determining income were grouped and selected based in part on a literature review. There were a very large number of candidate explanatory variables for the model. For a study of AVMA members, experience, gender, ownership status, type of practice (small, mixed, food, equine, etc.), and geographic location were important factors to explaining income.<sup>10</sup> Another study compared the net present value of different veterinary career tracks and found that becoming a full-time specialist or practice owner were more valuable when compared to general practice or a part-time specialist.<sup>6</sup> A study of laboratory animal veterinarians found geographic region, employer type, job title, and different levels of experience useful in explaining income.<sup>5</sup> While none of these studies looked at just food animal veterinarians, all help identify potentially important variables or groups of variables and provide candidates to consider for bovine veterinarians.

Literature suggested that experience would be important.<sup>10</sup> After viewing income versus experience as in Figure 1, a squared experience variable was included to account for the changing rate at which experience affects income. The regression line in Figure 1 makes use of the final model coefficients for experience and all other variables are held at their means and combined with the intercept. Salary and experience are plotted on the figure as well. Due to the wide range in the number of animals seen and the hours worked per week, a similar effect as seen in Figure 1 was observed in these variables. Increasing any 1 of these 3 factors implied increasing income at a decreasing rate and then were ultimately associated with decreased income. Squared variables were considered for any explanatory variable that were continuous and were not included in the final model if insignificant. Interaction variables were also considered between the continuous variables, between continuous variables and discrete variables, and between discrete variables. Thus, we considered nonlinear relationships between explanatory variables and income.



**Figure 1.** Illustrating the nonlinear relationship between years of experience and bovine practitioner income.

Examining the highest-earning veterinarians led to a better understanding of an additional factor affecting income. Most of these high-earning veterinarians earned a large percentage of their income from a single species within the food animal sectors. Thus, species specialization appears to be important. A species specialist was defined as someone who earned more than 50% or 75% of their income from 1 species. We examined the impact of varying this threshold percentage. The specialist effect was included in the model and found to be significant.

Variables from the literature and variables tested in candidate models were used in the final model. The explanatory variables included region, business size, hours worked per week, minutes per ambulatory call, the type (cow-calf, stocker, feeding, dairy) of animal operations seen, the number of animals seen, gender, having an MBA or PhD, completing a residency, board certification, ownership status, compensation type, experience level, and average herd size seen. There were 46 veterinarians who graduated in 2014 in the final model sample. Because they may not have worked for the entire year, a new veterinarian variable was included. This allows us to measure new veterinarian salary relative to established veterinarians. Many of the attributes or characteristics associated with individuals are of this discrete yes-or-no structure.

A “testing down” method of model building approach was used with the base candidate model starting with the expected-important variables discussed above.<sup>9</sup> Starting with a large model and then removing unimportant variables ensures that the test statistics for the model retain independence or that the test statistics become increasingly more restrictive.<sup>3</sup> Essentially, the model has a broad initial specification, and explanatory variables are removed until only the relevant and significant variables are included. Candidate models were estimated and included over 50 variables that are not reported here. There are a very large number of potential variables or groups of variables available within the surveys relative to the number of observations, and many are

simply statistically insignificant. The final model reported here is robust to alternative specifications. The reported explanatory variables are those that are statistically significant, and they do not become important due to the removal of other variables. There are simply many variables that are not important; these are dropped and variables that are important across the alternative models are included in the final specification. Further, a few insignificant variables were kept to demonstrate their insignificance.

### Empirical Model and Statistical Tests

All models were estimated using SAS 9.4. Individual t-tests were performed on each parameter as well as joint F-tests for groups of variables and on the entire regression. Variables were considered initially statistically significant if *P*-values were at or below the 10% significance level and were a candidate for the final model. *P*-values for each variable in the final model are reported. White's test detected heteroscedasticity, and therefore robust standard errors are reported. Heteroscedasticity implies that different places in the sample have higher or lower residual error variances. OLS assumes a single value. The more general variance-covariance matrix is preferred in this situation. The final model is specified where the annual income is explained as a function of veterinarian characteristics including experience, gender, ownership status, education, compensation type, hours/week, minutes per call, specialty (defined here as practice emphasis on type of production unit, i.e., dairy, cow-calf, feedlot, and not board certification), and number of animals seen, and a vector of practice characteristics including whether or not the practice is rural, and the practice region.

Table 1 defines the final variables, and Table 2 presents the summary statistics for the variables used. The mean income for the final sample is \$112,814.65. Many of independent variables are zero-one. These variables control for that individual having that characteristic or not. The resulting estimate measures the average impact of that attribute or characteristic being present on annual income compared to it not being present. The mean of these variables is the percentage of the sample with that attribute or characteristic. For example, about 70% of the final sample are male, 47% are compensated through salary alone, and 9.9% are located in Region 6 (Iowa and Minnesota; Table 4).

### Results and Discussion

The final statistical model results are reported in Table 3. There are 3 broad conclusions from the model. The first is that there are important determinants of mean income. There are characteristics across bovine veterinarians that result in higher or lower income. This indicates there are things bovine veterinarians can do to improve their income. Second, there are many individual characteristics that have no impact on average income. Most of the survey questions re-

**Table 1.** Definition of variables used in final income model.

Variable	Survey response measurements
Veterinary income (\$2014)	Annual dollars
Number of animals seen	Annual animals
Experience	Calculated years from graduation year
Hours worked/week	Typical week
Minutes per call	Typical ambulatory call time in minutes
Gender	1=male & 0=female
Ownership	1=owner & 0=non-owner
New veterinarian	1=2014 graduate & 0=before 2014
Rural	1= practice in rural area & 0=practice in non-rural area
MBA	1=yes & 0=no
PhD	1=yes & 0=no
Residency	1=yes & 0=no
Board certification	1=yes & 0=no
<b>Compensation type:</b>	
Salary	1=yes & 0=no
Salary & production bonus	1=yes & 0=no
Production-only	1=yes & 0=no
Hourly	1=yes & 0=no
<b>Region:</b>	
Region 0	1=yes & 0=no
Region 1	1=yes & 0=no
Region 2	1=yes & 0=no
Region 3	1=yes & 0=no
Region 4	1=yes & 0=no
Region 5	1=yes & 0=no
Region 6	1=yes & 0=no
Region 7	1=yes & 0=no
Region 8	1=yes & 0=no
Region 9	1=yes & 0=no
<b>Single Species Specialist:</b>	
One species ≥75% or ≥50% of income	Calculated: 1 if true & 0 if false

sulted in information that was insignificant when attempting to explain income. So, there are few simple actions that can result in more income for the bovine veterinarian. Questions from the survey that were not important are not in the final model – with some exceptions. Third, there remains a large amount of unexplained variation in individual incomes that cannot be attributed to characteristics asked in these surveys.

The amounts reported are in 2014 dollars and in annual income. Inflation should be considered to interpret the results in more current dollars. The US Department of Labor Bureau of Labor Statistics reports earnings for Professional and Business Services. The Veterinary Services industry has a NAICS Code of 54194. Earnings and costs of services between 2014 and 2019 increased by 10% to 18% for the alternative measures of earnings and services. Services provided in areas with urban pressure, such as the east and west coasts, had the highest inflation. Rural regions in the central US were

**Table 2.** Summary statistics of variables used in final income model.

Variable	Mean	Std dev	Min	Max
Veterinary income (\$2014)	112,814.65	64,865.06	6536	400,000
Number of animals seen	10,112.48	27,515.17	0	250,000
Experience, years	19.20	14.66	0	50
Hours worked/week	51.79	13.99	2	90
Minutes per call	76.58	69.49	0	480
Gender	0.6985	0.4597	0	1
Ownership	0.6544	0.4764	0	1
New veterinarian	0.0772	0.2674	0	1
Rural	0.8162	0.3881	0	1
MBA	0.0221	0.1471	0	1
PhD	0.0110	0.1046	0	1
Residency	0.0368	0.1885	0	1
Board certification	0.1213	0.3271	0	1
<b>Compensation type:</b>			0	1
Salary	0.4706	0.5001		
Salary & production bonus	0.3051	0.4613	0	1
Production-only	0.1912	0.3940	0	1
Hourly	0.0331	0.1792	0	1
<b>Region:</b>				
Region 0	0.0257	0.1586	0	1
Region 1	0.1360	0.3435	0	1
Region 2	0.0404	0.1974	0	1
Region 3	0.0404	0.1974	0	1
Region 4	0.0956	0.2946	0	1
Region 5	0.3566	0.4799	0	1
Region 6	0.0993	0.2996	0	1
Region 7	0.0625	0.2425	0	1
Region 8	0.0478	0.2137	0	1
Region 9	0.0956	0.2946	0	1
<b>Single Species Specialist:</b>				
One species $\geq$ 75% or $\geq$ 50% of income	0.3676	0.4831	0	1

the lowest. Inflating the results reported here by this range reasonably converts the 2014 dollars to 2019 dollars.

### Important Income Determinants

The most important characteristics that increased bovine veterinarian income include years of experience, the number of animals seen, hours worked per typical work week, and owning a practice. These 4 variables contribute the most to model goodness-of-fit. Gaining experience, building a strong animal base, and working long weeks are more important than, for example, pursuing additional education beyond the DVM degree.

Experience and experience squared were both statistically significant. Experience increases earnings at a decreasing rate, and is eventually associated with decreases in earnings. This is not due to retirement as hours worked per week, numbers of animals, and all other characteristics in the final model are controlled for. The result was, however, expected from literature.<sup>10</sup> Those individuals in the sample

with the mean level of experience, 19.2 years, tend to observe an additional \$1,266 of average annual income with an additional year of experience. Individuals with 10 years of experience could expect an additional \$2,836 of average annual income the following year. Early career veterinarians on average see the largest pay increases. The years of experience associated with peak earnings is 26.62 years. We caution the reader to not think of increasing experience as causing increases in income. Rather, bovine veterinarians are adding value to the private practice in which they work. They are delivering services to clients, producing earnings for their business, and appear to be able to do this more successfully or productively each year that they practice prior to the peak year. The market for services is requiring that individuals be compensated at higher levels on average with more experience. The age of the respondent was also asked in the survey. However, age and experience are highly correlated, and including both in the modeling was less useful than either individual variable. Experience was more significant, and more frequently provided from the survey than age.

**Table 3.** Final regression model to explain bovine veterinarian income.

Variable	Parameter estimate	Robust SE	P-value	Percent of mean
Number of animals seen	\$0.7888	0.3288	0.0172	0.6%
Number animals squared	-\$0.00000333	0.000000167	0.0472	
Experience	\$4,542.15	947.7007	<0.0001	1.1%
Experience squared	-\$85.31	21.3956	<0.0001	
Hours worked/week	\$2,934.67	1,142.71	0.0108	2.2%
Hours/week squared	-\$25.30	10.3295	0.0150	
Minutes per call	\$120.74	67.7324	0.0759	1.1%
Gender	\$18,636	6,969.25	0.0080	16.5%
Ownership	\$28,293	7,438.06	0.0002	25.1%
New veterinarian	-\$1,124.87	9,339.64	0.9042	-1.0%
Rural	-\$6,842.81	7,796.13	0.3810	-6.1%
MBA	-\$5,032.04	15,767	0.7499	-4.5%
PhD	\$34,868	23,088	0.1323	30.9%
Residency	-\$33,625	13,034	0.0105	-29.8%
Board certification	-\$1,951.06	8,776.29	0.8243	-1.7%
Salary	\$18,744	8,539.53	0.0291	16.6%
Salary & production bonus	\$27,640	9,252.79	0.0031	24.5%
Production-only	Omitted			
Hourly	\$17,839	22,169	0.4218	15.8%
Region 0	-\$17,009	26,809	0.5264	-15.1%
Region 1	-\$2,906.16	25,983	0.9110	-2.6%
Region 2	Omitted			
Region 3	-\$13,883	29,350	0.6366	-12.3%
Region 4	-\$14,612	26,476	0.5942	-13.0%
Region 5	-\$10,821	25,418	0.6707	-9.6%
Region 6	\$6,423.17	26,878	0.8113	5.7%
Region 7	-\$16,970	28,349	0.5500	-15.0%
Region 8	\$29,191	33,884	0.3898	25.9%
Region 9	-\$616.23	26,355	0.9814	-0.5%
Single Species Specialist	\$17,879	6,955.44	0.0108	15.8%
Constant	-\$61,657	37,794	0.1041	
F-statistic	7.26		<0.0001	
R-squared	0.4555			
Square root error variance	50545			
Observation total	272			

Hours worked per week and hours squared were both statistically significant. Working additional hours will increase income to a point, and beyond that point veterinarians may become overextended, leading to inefficiency or the result may be due to extensive travel times. A person working the mean number of hours per week, 51.8 hours, could expect an additional \$314 of average annual income by working an additional hour per week. A veterinarian working 45 hours per week could expect an additional \$658 of average annual income by working an additional hour per week. Working additional hours when starting well below the mean hours substantially increases income. Hours worked per week associated with peak earnings is 58 hours per week.

The number of clients and average herd size in the respondent's area were examined in the analysis, but are not important. Numbers of animals seen are what is important.

A similar quadratic response was observed for numbers of animals seen. Increasing the number of animals seen is associated with increased earnings, but at a decreasing rate. A veterinarian seeing the mean number, 10,112 animals, could expect an additional \$721 of average annual income by seeing an additional 1,000 animals. A veterinarian seeing 50,000 animals and seeing an additional 1,000 could expect an additional \$456 of average annual income. The number of animals seen associated with peak average earnings is 118,438 animals per year. Building a strong animal-client base, as opposed to person-client base, is economically worthwhile.

In Table 3, in addition to regression coefficients, their standard errors and *P*-values, percent changes to mean income are reported across the explanatory variables. For example, an additional year of experience for an individual with the mean level of experience is associated with a 1.1%

**Table 4.** US regional designations used by the AVMA and identified with AABP survey participants.

Region	States
1	Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York
2	Pennsylvania, Maryland, New Jersey, Delaware, Virginia
3	North Carolina, South Carolina, Georgia, Florida, Tennessee, Mississippi, Alabama
4	Michigan, Ohio, West Virginia, Kentucky
5	Wisconsin, Indiana, Illinois
6	Minnesota, Iowa
7	Missouri, Kansas, Oklahoma
8	Texas, Arkansas, Louisiana
9	North Dakota, South Dakota, Nebraska, Wyoming, Colorado, New Mexico, Utah
10	California, Nevada, Arizona
11	Washington, Oregon, Idaho, Montana

increase in mean income. Similarly, seeing an additional 1,000 animals when the individual sees the mean number of animals is associated with the mean income increasing 0.6%. Finally, working an additional 4 hours per typical work week when the individual currently works the average number of hours is associated with a 2.2% increase in mean income. These relationships are nonlinear in that all increase at a decreasing rate and eventually turn negative. The percent changes for nonlinear continuous variables are for an individual at the mean of the underlying explanatory variable. For the remaining continuous linear variable, the percent change is in mean income given a 10% increase in number of minutes per call. For the discrete variables, the percent changes to mean income are if the underlying attribute or characteristic becomes present.

### Income Determinants and Younger Practitioners

Education levels beyond the DVM degree were included. Having a PhD, MBA, and being board certified were all insignificant in the model. It could be due to few bovine practitioners in private practice having these degrees. Individuals that completed a residency have average income that was about \$33,625 lower than those that did not. This is 29.8% of the mean salary. One reason for this result is that younger veterinarians are more likely to participate in residencies. But experience is controlled for as was whether the respondent was a new veterinarian. Participating in a residency clearly involves sacrificing income and income growth. We were not comfortable reporting the interaction effect between experience and residency, as this dimension of the sample is small. Nonetheless, the result indicates that for bovine veterinarians in private practice, obtaining working experience and building an animal-client base is more important for earnings than additional education, certifications, or completing a residency.

Compensation type was significant as well. Being on salary or on salary with production bonuses both increased annual income on average when compared to production-only compensation. Having a production bonus increased

income slightly more. Hourly pay was not significant, and again this is relative to production-only compensation. Salaried and salaried with bonuses bovine veterinarians earn about \$18,744 and \$27,640 on average more per year than production-only personnel. These are 16.6% and 25.1% of the average salary; the \$8,896 difference is itself statistically significant.

Young veterinarians should seek employment that builds experience, work to build their animal base, and consider investing in their own practice. Practice ownership was statistically significant, and veterinarians who owned their practice on average earned about \$28,000 more per year. This is 25.1% of the average salary. Caution is warranted when interpreting this result, as knowing the amount of time the practice has been owned jointly with the amount of experience might be important, but this effect cannot be ascertained from the survey. The increase in earnings needs to be considered in the context of how long the business was owned.

### Specialization and Geography

Being a specialist within a food animal industry species was significant to the model, and on average earns an additional \$17,879. This is 15.8% of the average salary. Figure 2 compares the average income by species specialists as well as the average for the AABP member sample in the final model. Cow-calf and dairy cattle specialists were considered so if they earned more than 75% of their income from that species. Stocker cattle and feedlot cattle specialists were considered so if they earned more than 50% of their income from that practice emphasis. This in part was because there were not enough observations to determine an average with confidence from those who earned more than 75% from those food animal species industry sectors alone. We examined the percent of income associated with categorizing someone as a specialist, and these percentages have explanatory power. Certain specialties will have higher returns than others. Dairy specialists have the greatest income while practitioners with cow-calf interests may be better served by being also a general practitioner as cow-calf specialists earned lower



**Figure 2.** Average income across single species specialists including the number of specialists in each group. AABP membership average income includes a majority of general practitioners.

income than their other specialist peers. Finally, although it is more difficult to specialize in feedlot cattle, there are fewer of these individuals. It may have a higher payoff if one can determine the right clients and number of animals to serve.

Geographical location was not as significant to bovine veterinary income, in contrast to studies of other types of veterinarians. The regional estimates compare all regions to the base region: Region 2. Geographical regions are multi-state and defined by the AVMA. Table 4 lists the regions and member states. The concentration of bovine animals explains why there was higher income in Regions 6 and 8. But again, these are not statistically significant. It may be important for veterinarians to go where the animals are, but it is far more important for them to see large numbers of animals. The rural nature of many livestock operations could make it difficult to identify areas to practice with a relatively high concentration of animals. This may explain the shortages of veterinarians in certain areas.<sup>2,19</sup> Furthermore, the above industry average hours worked per week could be due to extended travel time needed to reach certain types of operations and contribute to why the regional variables are not important.

### Gender

On average, with all else held constant, income was higher by \$18,636 per year on average for males. This is 16.5% of the mean salary. This is the difference that persists after controlling for experience, numbers of animals seen, hours worked, practice ownership, and all the other variables in the model. We find the gender-related result that is common in veterinary compensation research. The bovine-practice sector of veterinary medicine has long been male dominated, although this may change with the increasing number of females in the profession. But this is not yet in our sample.

We examined interaction terms between gender and the continuous variables, and between gender and other discrete variables. This effectively splits the sample into

men and women. The main significant difference between men and women was in experience, ownership, and being a new veterinarian. The impact of number of animals, minutes per call and all other variables are not significant in explaining men versus women bovine veterinarian income. Young women veterinarians earn less than young men veterinarians. However, the income gain for women is greater than that for men as similar experience is earned. Salary coaching for new women bovine veterinarians may help redress a portion of the gender pay difference. However, men owners clearly pay themselves substantially more than women owners do. So, the difference will likely persist. It is encouraging from a gender equity perspective that once the attribute measures are allowed to be different across men and women, then the impact of most of those attributes on income are not statistically significant. However, we are concerned with the sample size. Splitting the sample into men and women makes 2 rather different samples, with more being different than just gender.

### Much is Unknown and Future Research Needs

The regression model was significant on the whole, but  $R^2$  is 45.55%. There are clearly other factors determining approximately half of the income variation across bovine practitioners other than the variables used in this model and asked through the survey. The remaining variation in income could in part be due to the quality of the individual practitioner and the amount of effort the individual devotes to their work. This may actually be a “good news” story for bovine veterinarians. Only 45 to 50% of the variation in reported income can be explained by the available variables or treatment effects. Results for some candidate models had goodness-of-fit measures of upwards to 50% but never above, and these candidates contained many insignificant variables. A portion of the remaining variation in earnings is likely quality and effort of the person receiving the income. To see this variation, for example, using the means of all the explanatory variables, then the regression model will predict the mean compensation: \$112,815. But the 75% confidence interval for that individual is between \$54,423 to \$171,206. Any single veterinarian could have substantial variation in income due to factors not in our model and not measured in the surveys. We think this is due to a variety of things: effort, skill, quality, knowledge – and possibly luck, serendipity, or simply asking for more money. We have a casual observation that being willing to move, interview, and take new jobs can result in higher compensation. But this factor, and the others listed prior, is not asked in or can otherwise not be constructed from the survey data.

Attempts at measuring both practitioner effort, quality, and entrepreneurial spirit should be considered in future income surveys. This is an important conclusion from the analysis. As discussed earlier, improved measurement of hours worked or billed is also part of what is needed. Fee



schedules and more detailed survey questions about how veterinarians spend their time will help explain the variation in incomes. However, respondents to future surveys may need to be linked to third-party, and not self-reported, measures of veterinarian quality. For example, linking client surveys to an individual might be illustrative. Further, questions related to the survey respondent's business acumen need to be considered. But more detailed surveys also increase the likelihood of unanswered questions and unusable surveys. Interestingly, practitioner quality or effort does not appear to be proxied by the presence of other degrees or board certification. Measuring and sorting out the impact of practitioner effort on income would be a useful exercise and provide useful information to future veterinarians. What is it that some bovine veterinarians do that results in high income – and conversely low income – higher or lower than their peers?

Earnings variation has been an important interest to the field of labor economics for some time. Much has been analyzed regarding different levels of education, gender differences, college major, and other different measures of human capital. We know that earnings inequality has been increasing over time and that the most skilled workers continue to pull further and further away both within and across groups.<sup>8</sup> The Bureau of Labor Statistics reports on this inequality; at the 10<sup>th</sup> percentile veterinarians earn \$52,530, and at the 90<sup>th</sup> percentile they earn \$157,390.<sup>17</sup> They suggest that skill, job task, and performance could be causing this inequality beyond experience, education, and location. One study called the difference an “unobserved ability” where labor demand favors the most skilled, and increasing returns to skill has led to higher salaries for some.<sup>8</sup> A focus group of successful veterinarians determined that there were technical and non-technical factors associated with success. These non-technical factors consist of personality traits, abilities and core interests, values, and motivations (whereas technical factors are similar to what are in the survey: experience, numbers of animals, etc.).<sup>12</sup> These measures of the type and quality of work indicate that more determines salary than just individual characteristics. Questions about practice management also need to be asked. One study found 8 business practices accounted for as much as 15% of income variation. These included business orientation, frequency of financial data review, employee development, negotiating skill, client loyalty, leadership, client retention, and new-client development.<sup>18</sup> In the end, these are not easy dimensions for future survey work to address but certainly have appeal to bovine veterinarians and teachers of these future veterinarians.

Future work might compare fixed effects within different groups of veterinarians (general practitioners vs specialists, low income vs high income, owners vs non-owners, etc.) and may yield higher levels of explained variation. There may be different factors influencing the income of these groups. It might be worthwhile to identify whether or not there are thresholds of where veterinarians begin earning more. Further, it is likely a good idea to delve into measuring the

effect of an individual's effort and quality of practice on that individual's income. Last, this study only compared income for 1 year. Variation in income across different years will likely improve the reliability and explanatory power of the model. There is much left to explain what makes a veterinarian economically successful over their career, which will be crucial for ensuring a supply of veterinarians to meet the world's protein and food safety demand in the future. However, this work does contribute to understanding causes of the variation in bovine practitioner earnings.

## Conclusions

Characteristics of bovine veterinarians that are associated with increased income include experience, the number of animals seen, and owning a practice. Hours worked per typical work week are also important. Young veterinarians should take all this into consideration when making career decisions. They should seek opportunities to gain experience and consider investing in their own practice. Building a strong animal-client base, especially within a certain species sector, is worthwhile. Certain specialties will also have higher returns than others. Dairy specialists will likely increase income the most. Cow-calf specialists might also need to be a general practitioner. Finally, although it is more difficult to specialize in feeder and stocker cattle, it may have a high payoff if one can determine the right clients and numbers of animals to serve.

The rural nature of many livestock operations could make it difficult to practice in an area with a relatively high concentration of animals. Furthermore, the above industry average hours worked per week could be due to high travel time needed to reach certain livestock operations. We suspect these could differ by region and the type of practice.

Finally, there is a lot of variation in bovine practitioner income to still be explained. It may also be necessary to compare effects within different groups of veterinarians (general practitioners vs specialists, low income vs high income, owners vs non-owners, etc.). There may be different factors influencing the income of these groups. Further, it is likely a good idea to delve into measuring the effect of an individual's effort and quality of practice on that individual's income. Last, this study only compared income for 1 year. Variation in income across different years would be a worthy avenue of future research. There is much left to explain what makes a veterinarian economically successful over their career, which will be crucial for ensuring a supply of veterinarians to meet the world's protein and food safety demand in the future.

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