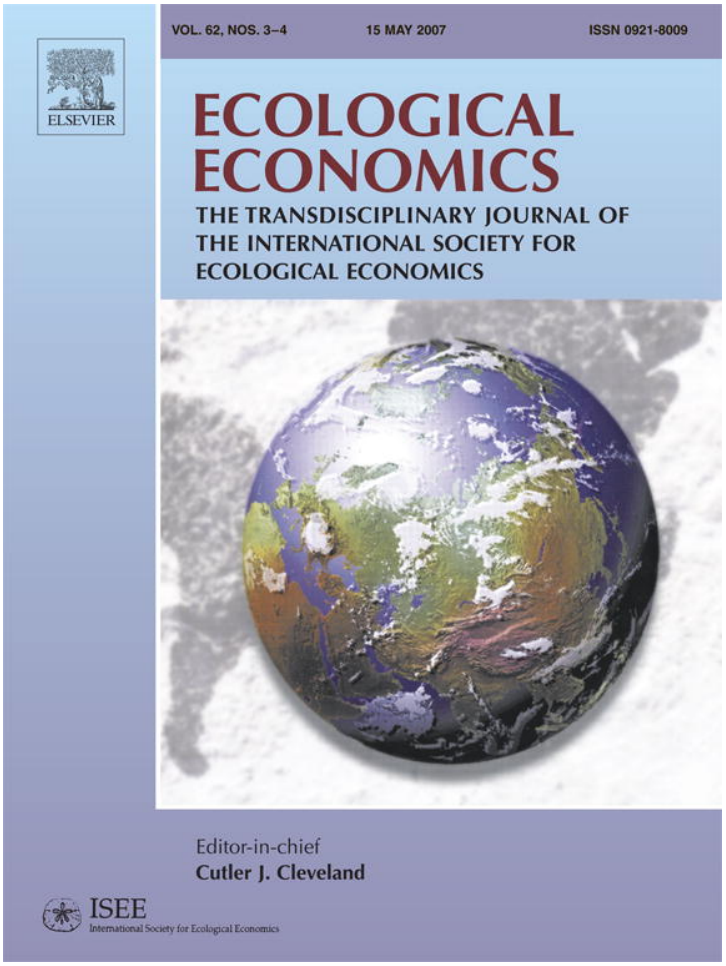

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ANALYSIS

Analysis of programs to reduce overpopulation of companion animals: Do adoption and low-cost spay/neuter programs merely cause substitution of sources? ☆

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ABSTRACT

Overpopulation of companion animal results in millions of deaths each year at shelters and spending in the billions of dollars. Major efforts are underway to reduce this problem, with one of the largest efforts being spearheaded by Maddie's Fund. Maddie's Fund programs focus on encouraging spay/neuter and adoptions through economic incentives and marketing. However, aggressive spay/neuter and adoption programs present economic questions regarding how much they simply lead to substitution of sources for these good and services rather than increasing total community adoption and spay/neuter levels. In addition, spay/neuter also presents an ecological question as to how effective it is at reducing population sizes and therefore shelter intake. Analysis of Maddie's Fund program results show that low-cost spay/neuter programs are effective at raising total community spay/neuter levels (i.e. they do not merely cause substitution in source of spay/neuter procedures). Similar results were found for adoptions, with animal control adoptions not being reduced by new adoption programs initiated by other organizations. However, no clear results were found demonstrating the impact of total spay/neuter procedures on shelter intake.

1. Introduction

Overpopulation of companion animals results in millions of deaths each year at shelters. There are three possible utility-based reasons for minimizing the number of unwanted companion animals. One would be to minimize the welfare loss to human beings from direct causes (such as dog bites, nuisance costs, etc.). A second would be to minimize the indirect welfare loss experienced by human beings who suffer sympathetically from the plight of companion animals. The third would be to minimize the direct suffering of the animals themselves. These three different costs are in increasing order of potential welfare impact. The costs are also increasing in their level of controversy.

There are a variety of direct costs caused by companion animal overpopulation. There are mitigation costs, with Rowan (1992) estimating that shelters spend approximately $1 billion every year to deal with unwanted companion animals. The cost of strays in human society includes the cost of dog bites. According to Sosin et al. (1986) dog bites are

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among the top 12 causes of non-fatal injury in the United States. In 1994, there were approximately 18 dog bites per 1000 people in the United States, with 757,000 of these bites requiring medical attention (Sacks et al., 1996). Other direct costs include the nuisance costs of strays; Bancroft (1974) found that the most common complaint received by municipal leaders involves animal control. More recently, for the state of Ohio it was found that there were 300,000 animal care and control complaints in 1996 (Lord et al., 1996). Another estimate is that there are roughly 1.5 to 4.5 animal control complaints per 1000 people in major United States cities (Clifton, 2002). Stray dogs and cats also present ecosystem costs with feral cat deaths to birds and other wildlife being considered a serious issue by some and with Baetz (1992) estimating the cost of livestock loss due to dogs at $10 million. Stray dogs and cats can also present other human costs including motor vehicle accidents and acting as a vector for the spread of disease.

The second level of cost from companion animal overpopulation is the utility lost by people due to the suffering and death of animals. This can be estimated by the amount people are willing to pay to protect animals. According to Jasper and Nelkin (1992), 20% of Americans have contributed money to an animal protection organization, and 10–15 million Americans belong to at least one animal welfare group. Congress also receives more letters about animal welfare than any other topic (Fox, 1990).

If the direct suffering of animals were taken as a legitimate economic cost, the suffering of the animals themselves would quite possibly be the greatest cost of all from companion animal overpopulation. However, there is more than a little controversy over whether this should be accepted as a real cost. Traditional economic theory only considers the costs and benefits received by humans. Philosophers such as Regan (1983) and Singer (1975) would find this to be an arbitrary and incorrect separation. However, even if the well-being of animals is considered to be intrinsically valuable, there still remains the important question of estimating nonhuman utility. For example, if strays are assumed to have positive utility even if they never find a human home, then sterilization efforts may be utility-decreasing for the animals. On the other hand, if the suffering of these strays is assumed to outweigh any positive utility they may experience, then sterilization efforts that reduce the birth of strays is utility-increasing in aggregate for these animals.

Progress has been made in reducing the death of companion animals at shelters. There are no national surveys of shelter animal deaths that have been conducted long-term (i.e. across many decades) on a consistent basis. However, there are a few studies looking at a particular community. Looking just at New York City data from the late 1800s on, Zawistowski et al. (1998) show a peak in the shelter death rate per person at around the time of the depression followed by a steep decline to about a tenth of the peak rate in the 1990s. Savesky (2001) provides long-term data from a California shelter which similarly shows a sharp decline between 1970 and 1998, with particularly sharp drops being seen in the 1970s and 1990s. Shelter deaths by 1997 were about one-seventh of the number of animals euthanized in 1970. Between 1984 and 1997, New Jersey shelter deaths were cut almost in half (Clancy and Rowan, 2003).

An important component in the reduction of shelter deaths has by most accounts been an increase in the number of people who sterilize (or spay/neuter) their dog and cats. A tremendous amount of money and effort has been put into spay/neuter programs nationwide. This is based on a seemingly reasonable population ecology assumption that decreased fertility will lead to decreased birth rates which will in turn lead to fewer unwanted companion animals. Fewer unwanted animals should lead to reduced animal intake at shelters, which in turn leads to fewer animals killed at shelters. A dynamic mathematical ecological/economic model that demonstrates these relationships in theory was formulated by Frank (2004). Unplanned births can increase the dog and cat population above the level that the public can absorb, both by causing unwanted animals who are turned in to a shelter shortly after birth and by generally increasing the population of animals available, reducing adoptions from shelters and increasing the number of animal turned in to shelters later in life. Reduced intake at shelters and less competition for adoptions from unplanned births leads to shelters being able to reduce the number of animals that they euthanize. Spay/neuter efforts have been pushed both through public education that focuses on health and behavioral benefits as well as the societal benefits of the procedure and by low-cost sterilization programs. Increased spay/neuter levels may be responsible for at least part of the decline in shelter deaths (Hodge, 1976; Clancy and Rowan, 2003) although low-cost spay/neuter programs have been subject to some controversy, particularly among private veterinarians. Some in the field have argued that low-cost spay/neuter do not work, often arguing that it simply caused a substitution effect: consumers would simply switch sources for the procedure rather than raising the number of procedures (Beck, 1983; Schneider, 1975). More recently, data from some programs, such as New Hampshire's statewide spay/neuter program suggest that low-cost spay/neuter can in fact work when targeted properly (Marsh, 2004). However, even in these cases the success stories are anecdotal, with self-selected success stories that possibly are not representative of all efforts receiving the attention.

Adoption efforts by organizations outside of animal control have also generated similar controversy. Some animal control managers have argued that adoption programs by other organizations (such as smaller no-kill shelters in the same region) compete for the limited number of potential adopters and cause substitution of sources rather than an increase in total community-wide adoptions. However, in the case of both the adoption and the low-cost spay/neuter controversies, there is little empirical evidence to support or refute the possibility of cannibalization occurring.

Although progress has been made long-term in reducing the number of animals killed in shelters, 4.4–4.6 million dogs and cats are still killed every year in shelters in the United States (Clancy and Rowan, 2003). Furthermore, additional shelter deaths reductions can be difficult to achieve without renewed efforts or new, innovative programs. Fortunately, there are major efforts currently underway to reduce shelter deaths, with one of the largest efforts being spearheaded by Maddie's Fund.

Maddie's Fund is a private foundation created by the founders of PeopleSoft. Although it is a relatively young organization in the animal welfare arena, in terms of financial assets, the organization is the largest animal welfare non-profit organization in existence in the United States. The

Foundation funds animal welfare efforts around the country, focusing on community-wide coalitions and with aggressive program goals (such as reducing the death of all healthy companion animals in a community in five years).

The two main tools used in Maddie's Fund programs to reduce companion animal overpopulation are increasing spay/neuter levels (primarily through economic incentives) and increasing adoptions. These programs present important economic questions which to this date have received very little attention from economists (Frank, 2002). The size, scope, and rigorous data collection standards of Maddie's Fund programs present an unprecedented opportunity to analyze the impact of subsidized spay/neuter and adoption programs from an economic perspective. Maddie's Fund grant communities vary widely demographically, and although they may share certain characteristics (such as a desire and the potential in the grantor's opinion to reach specific aggressive community goals), testing these communities is unbiased in the sense that it is not known a priori how successful the programs will be in each community and communities are not excluded from the analysis because they do or do not succeed in reaching goals.

In addition to obtaining shelter and low-cost spay/neuter program data, Maddie's Fund programs are unusual in that they try to get the participation of a minimum of 70% of community veterinarians. This allows over all spay/neuter levels in the community to be quantified rather than just discount spay/neuter program surgeries. Private veterinarians have a motivation to cooperate in providing these statistics because Maddie's Fund provides funding for surgeries to private veterinarians and often works in cooperation with the region's Veterinary Medical Association. Although 100% veterinary participation would be ideal and there are doubtless some errors in record keeping, the data obtained from veterinarians is unusually large in its scope and level of detail.

This study statistically analyzes some of these impacts. More specifically this research examines how discount spay/neuter surgeries affect non-discount spay/neuter surgeries, how adoption programs from non-animal control organizations affect animal control adoptions, and how total spay/neuter levels affect shelter intake. The primary focus of this study is on shedding some light through new empirical data on the two controversial issues of possible substitution effects in adoption and low-cost spay/neuter programs.

2. Methodology

The dataset used consists of five Maddie's Fund community programs. The programs were for the state of Utah (all large counties), the state of Alabama (all large counties), Maricopa County in Arizona, Lodi, California, and Alachua County in Florida. All data was broken down at the county level. However, counties with very small populations tended to have very large annual variations in the studied variables and were therefore excluded. The Maddie's Fund community programs being studied were established with a grant period of five years. The programs were in different stages of progress, with between three and five years of data being available for each program included in the sample. Data was also divided by species (i.e. dogs or cats) for all programs except Alabama. Data by species was not available for Alabama. Therefore all analyses were run two ways—first with data broken down by species and with Alabama excluded, and second with data including Alabama and with dogs and cats combined for all counties in the dataset into one data point per county. Adoptions for each county were also broken down in the data by the type of shelter—"animal control" or a "no-kill organization" (currently known by the less controversial term "adoption guarantee organizations" in Maddie's Fund terminology). Animal control organizations generally have a contractual obligation to continue taking in all animals from the community they serve and kill excess animals when they reach capacity. No-kill/adoption guarantee organizations in these programs only kill animals they consider to be "non-rehabilitatable" and transfer some of the excess animals out of the region's animal control facility. There were also a very small number of open admission shelters (shelters that generally admit all animals but also kill healthy or treatable animals at times) without animal control responsibilities in the sample which were categorized as animal control organizations for purposes of analysis. Spay/neuter data for each county was broken down into regular spay/neuter procedures performed by veterinarians, and subsidized spay/neuter procedures given at a reduced cost or for free either through a veterinarian participating in Maddie's Fund's program or through another discount program.

After eliminating counties with very small populations or insufficient data (for example, counties without any no-kill/adoption guarantee adoption organizations when analyzing adoptions) and the loss of one time period for the calculation of growth rates, there were 212 observations used for analysis of spay/neuter procedures for cats and dogs combined and 404 observations used for analysis of spay/neuter procedures of cats and dogs separately while for analysis of adoptions there were 62 observations for dogs and cats combined and 102 observations used for analysis of dogs and cats separately.

To examine how the change in no-kill/adoption guarantee organization adoptions affects the change in animal control adoptions and how low-cost spay/neuter programs impact regular spay/neuter procedures, the year-to-year growth in levels were compared using a linear mixed effects model (PROC MIXED, Sas Institute, Inc. 1999). The data analysis was a combined time series/cross sectional analysis. Therefore, multiple data points were obtained from the same programs for different time periods which can cause the error terms to be correlated. The mixed effects model can be an appropriate tool for situations where repeated measurements are taken from the same experimental unit and these repeated measurements may be correlated (Littell et al., 1996; Olofsen et al., 2004).

To determine if discount spay/neuter procedures had the effect of crowding out regular spay/neuter procedures, the growth rates in the two types of procedures for a given year were compared first for combined species and then for dogs and cats separately using the following two mixed effects models:

$$RSN_{it} = \alpha + \beta_1 DSN_{it} + \gamma_1 C_i + \gamma_2 T_t + \varepsilon_{it} \quad (1)$$

$$RSN_{its} = \alpha + \beta_1 DSN_{its} + \gamma_1 C_i + \gamma_2 T_t + \gamma_3 D_s + \varepsilon_{its} \quad (2)$$

where RSN is the growth in regular spay/neuter procedures, DSN is the growth in discount spay/neuter procedures, C is the county or location of the observation, T is the program year of the observation and D is a species indicator. In the mixed effect model framework, DSN is a fixed effect parameter, while C, T, and D are random effects parameters.

If $\beta_1<0$ in Eqs. (1) and (2), this would be evidence that the two types of spay/neuter procedures are substitutes, though even a negative coefficient does not necessarily imply that there is complete cannibalization. In other words, discount spay/neuter can still cause some increase in total procedures even if there is a partial reduction in regular procedures as a result. If the null hypothesis that $\beta_1=0$ is not rejected, this would be evidence consistent with no substitution of sources occurring and that all the discount procedures performed are a net gain in total spay/neuter levels. There is also a third possibility; a coefficient for $\beta_1>0$ would be evidence that the two types of spay/neuter procedures are complements. This could be caused by spillover effects from marketing/publicity efforts promoting low-cost spay/neuter or by social positive feedback between consumers in the desire to purchase spay/neuter procedures. It could also be caused by private veterinarians, feeling threatened by the competition from subsidized spay/neuter programs, stepping up their own spay/neuter efforts.

To determine if no-kill/adoption guarantee organization adoptions acted as a substitute for regular adoptions, the growth rates in the two types of adoptions for a given year were compared first for combined species and then for dogs and cats separately using the following two mixed effects models:

$$AC_{it} = \alpha + \beta_1 NK_{it} + \gamma_1 C_i + \gamma_2 T_t + \varepsilon_{it} \quad (3)$$

$$AC_{its} = \alpha + \beta_1 NK_{its} + \gamma_1 C_i + \gamma_2 T_t + \gamma_3 D_s + \varepsilon_{its} \quad (4)$$

where AC is the growth in animal control adoptions, NK is the growth in no-kill/adoption guarantee organization adoptions, and the other variables are the same as described in Eqs. (1) and (2).

If $\beta_1<0$ in Eqs. (3) and (4), this would be evidence that the two sources for adoptions are substitutes, though even a negative coefficient does not necessarily imply that there is complete cannibalization. If the null hypothesis that $\beta_1=0$ is not rejected, this would be evidence consistent with no substitution of sources occurring and that all the no-kill/adoption guarantee organization adoptions are a net gain in total adoption levels. A coefficient for $\beta_1>0$ would be evidence that the two adoption sources are complements, possibly due to spillover effects from marketing/publicity efforts or social positive feedback.

Attempts were also made to analyze the effect of spay/neuter levels on shelter intake. Using growth in intake as the dependent variable and total spay/neuter growth as an explanatory variable, the relationship between the two variables was examined using a mixed effects model similar to Eqs. (1)–(4) above. However, it was anticipated that no negative relationship might be found for several reasons. First, the regions with the strongest spay/neuter programs also tend to be stronger in other aspects of Maddie's Fund community programs such as promoting adoptions. All other things being equal, there is a tendency for intake to go up when a community makes an announcement they are planning to commit to a goal of eliminating the killing of all healthy companion animals (Frank and Carlisle-Frank, 2003). This may be due to the public feeling more comfortable turning in animals or animal control field staff being more willing to pick up animals in marginal conditions. In addition, the impact of spay/neuter programs may be diffused over many years, with no single year necessarily getting the brunt of the impact. In fact, prior research suggests that the full impact of an increase in spay/neuter levels on intake may be spread over more than ten years, even if the spay/neuter increase takes place immediately (Frank, 2001, 2004).

An alternative is to analyze the level of spay/neuter procedures rather than the change in spay/neuter procedures. Since the size of the communities analyzed varied considerably, the spay/neuter procedures per thousand people is more appropriate for analysis than the raw spay/neuter level. However, even after adjusting for population, there are still problems with using levels. The spay/neuter procedures per thousand people can be broken mathematically into the number of cats and dogs in homes times the percentage of dogs and cats that are sterilized or:

$$\text{Spay/neuter procedures per 1000 people} = \text{animals per 1000 people} \times \text{percent sterilized} \quad (5)$$

Similarly, the intake rate per thousand people is equal to the number of cats and dogs in homes times the percentage of dogs and cats that are relinquished to shelters or that become homeless (assuming all homeless animals are picked up) or:

$$\text{Intake rate} = \text{animals per 1000 people} \times \text{percent relinquished or lost to street} \quad (6)$$

As Eqs. (5) and (6) show, the intake rate and the spay/neuter procedures per 1000 people have a common factor—namely the animal ownership/guardianship rate per 1000 people. This common factor would cause a positive relationship between the two variables, possibly countering the negative expected causal relationship of spay/neuter on intake. In aggregate for the United States over the long-term, it appears that this negative causal link between spay/neuter and intake may have overpowered the positive relationship from Eqs. (5) and (6), with spay/neuter rates generally rising over time while intake at United States shelters has simultaneously declined. However, when looking at smaller regions over shorter time periods, the positive relationship might still overpower the negative relationship.

To attempt to compensate for the positive effect caused by animal ownership/guardianship rates, variables were added

Table 1 – Fixed effect results for regular spay/neuter procedures combined species

	Coefficient estimate	*DF*	Standard error	T value	Pr >t
Intercept	0.8472	82	0.3797	2.23	0.0284
DSN	0.6656	57	0.1127	5.91	<0.0001

Table 2 – Fixed effects results for regular spay/neuter procedures separate species

	Coefficient estimate	DF	Standard error	T value	Pr >t
Intercept	0.6330	1	0.2453	2.58	0.2353
DSN	0.4925	161	0.06308	7.81	< 0.0001

that may explain the animal ownership rate per thousand people. In theory, if the number of animals per thousand people can be fully explained statistically by other variables, then including those variables in a regression as independent variables would remove this confounding relationship when analyzing the impact of spay/neuter procedures on intake. Relevant demographic factors were added in some versions of the analysis, including: population growth, percent of population under 5, percent of population over 65, percentage of the population that is white, percent that are college graduates, percent that are high school graduates, percent below poverty threshold, median household income, employment change, employment relative to population size, population density, home ownership rate, and household size.

3. Results

Table 1 shows the fixed effect results of a linear mixed effects model for Eq. (1), where the effect of growth in discount spay/neuter on regular spay/neuter procedures is studied with species combined. As indicated, there is a significant relationship ($p<0.0001$) between the two types of spay/neuter procedures. However this is a positive relationship, indicating the two types of procedures complement each other rather than crowding each other out.

Table 2 shows the same relationship with data for dogs and cats separated (i.e. Eq. (2)). Once again, there is a significant relationship ($p<0.0001$) between the two types of spay/neuter procedures and the relationship between them is positive.

Table 3 shows the fixed effect results of a linear mixed effects model for Eq. (3), where the effect of growth in no-kill/adoption guarantee organization adoptions on animal control adoptions is studied with species combined. As indicated, there is a positive but not statistically significant relationship between the two types of adoption.

Table 4 shows the same adoption relationship with data for dogs and cats separated (i.e. Eq. (4)). Once again, there is a positive but not statistically significant relationship between the two types of adoption.

Although a number of specifications were examined to analyze the effect of spay/neuter procedures on shelter intake, no statistically significant inverse relationship could be found between these two variables. This included examining both levels of intake and spay/neuter per 1000 as well as growth rates and logged differences. Although a number of demographic factors were found to be significantly related to intake, the inclusion of these variables did not change the result with respect to spay/neuter's relationship to intake.

Table 3 – Fixed effects results for animal control adoptions combined species

	Coefficient estimate	DF	Standard error	T value	Pr >t
Intercept	0.2626	29	0.1633	1.61	0.1186
NK	0.00156	12	0.02062	0.08	0.9410

Table 4 – Fixed effects results for animal control adoptions separate species

	Coefficient estimate	DF	Standard error	T value	Pr >t
Intercept	0.9627	18	0.2750	3.50	0.0025
NK	0.00990	43	0.02497	0.40	0.6937

4. Discussion

Even if private spay/neuter procedures did decline from low-cost spay/neuter programs, the program can still be beneficial if there is less than 100% substitution. This would indicate that even though some cannibalization of procedures occurred, at least some customers brought in by discount programs were on the margin in terms of that decision and would not have otherwise sterilized their animal. However, not only was there no substitution (i.e. no negative relationship) seen between the two types of spay/neuter procedures, there was in fact a highly significant positive relationship observed in both models. On its surface, it may seem counterintuitive that offering a discount spay/neuter program would increase regular spay/neuter procedures performed in a community. Arguably, the best result that could be hoped for is no loss of regular spay/neuter clients due to the presence of a discount spay/neuter program. This would be the case if these markets are totally segmented. Some low-cost spay/neuter programs such as those sponsored by Maddie's Fund are designed to segment the market by having stringent income requirements, excluding all but low-income households from the program.

However, the results show a positive relationship, not just the lack of a negative one. This is reasonable if there are offsetting positive effects both from marketing/publicity and from social positive reinforcement. Low-cost sterilization programs do not get clients by simply providing a discount. People would not be aware of the low-cost program without marketing efforts which typically not only inform people of the low-cost service, but also sell its benefits. Spay/neuter is a service that some people surveyed simply do not see to be of benefit, so they would not spay/neuter their animal regardless of the price (Frank, 2001). Therefore, programs promoting spay/neuter must sell the benefits as well as the cost and they will typically heavily market their service by promoting the benefits of spay/neuter. These benefits include reduced risk for some health problems, a reduction in behavioral problems such as aggression, elimination of the possibility of a "surprise" litter, and the social benefits (or "warm glow" benefit) of helping to address animal overpopulation. The marketing/publicity campaigns can also address misconceptions people commonly have regarding the risks or downsides of the spay/neuter procedure. Some of these marketing campaigns not

only educate on benefits and costs, they also attempt to exert social pressure to position spay/neuter as the socially proper thing to do. The programs often include television ads, radio spots, billboards, and brochures/print material. To the extent that these messages are received by the public at large, this can create a positive externality for private veterinarians, encouraging customers to spay/neuter at their practices as well.

In addition to a positive effect from marketing, there can be social positive reinforcement, or what has been termed a "bandwagon effect" (Leibenstein, 1950). People tend to spay/neuter more often when they see it as a socially accepted or socially required behavior for people who have pets. This also may lead low-cost spay/neuter programs to positively effect private-practice spay/neuter procedures. The results are consistent with positive social feedback and the positive effects of marketing more than compensating for any loss of customers by private-practice veterinarians from substitution of sources.

Of course, the effect of discount spay/neuter programs could easily depend on how those programs are designed. Although Maddie's Funds spay/neuter program parameters are determined and managed by a lead organization in each region, they all generally have strong limitations to keep the programs focused on financially needy pet guardians. A more loosely defined program that allows financially-able persons to participate may have more of a tendency to cannibalize regular procedures in the region. The relationship found would also be affected by the maturity of the market for spay/neuter services. In a fully mature market for spay/neuter services, evidence of cannibalization would be more likely to be found.

As with low-cost spay/neuter programs, adoption programs at no-kill/adoption guarantee organizations were not found to reduce animal control adoptions through a substitution effect. Once again, both models instead showed a positive relationship; however in this case the adoption relationship was not significant and quite likely was due to random chance. If there is a real positive relationship, it could once again be due both to a bandwagon effect and a publicity effect. Marketing the adoption option over animal purchases by no-kill/adoption guarantee organizations may boost adoptions from all sources. This marketing may make people aware that adoption is an alternative source for an animal or serve as a reminder for those considering purchasing an animal. The sight of appealing animals needing a home could also inspire the desire to adopt. Advertisements could also subtly exert social pressure to suggest that adoption is the "right" choice for getting an animal since it helps to save an animal's life. In addition to these spillover effects from marketing, there can be positive social feedback as adoption becomes a more fashionable source for obtaining animals.

5. Conclusion

The data across community programs demonstrates that economic incentives to promote spay/neuter and adoption programs can work to increase total spay/neuter procedures and adoptions, rather than crowding out other procedures and programs. The statistical analysis was not able to demonstrate an inverse relationship between spay/neuter level and intake rates. Due to confounding relationships between variables and the diffusion of the impact of spay/neuter, it is not surprising that this relationship is difficult to establish in practice. However, since this relationship has never empirically been demonstrated other than anecdotally, it would be beneficial to find evidence supporting this assumption at some point. At the same time, it is important to note that the negative relationship between intake and spay/neuter levels is the least controversial portion of this study. There have been no known scientific papers or credible cases presented, either theoretical or empirical, that argue against a negative relationship between shelter intake and total spay/neuter levels.

On the other hand, as previously discussed, there are a number of people who have argued that low-cost spay/neuter programs merely cannibalize regular spay/neuter procedures rather than increasing total spay/neuter levels as well as a number of people who have argued that aggressive no-kill/adoption guarantee organization adoption programs primarily cannibalize from animal control programs rather than increasing total adoptions. The results of this study present strong evidence that neither of these cannibalization or substitution effects take place, or at least if they occur, they are more than compensated for by positive spillover effects (i.e. a complement effect) in adoption and spay/neuter efforts. The evidence is particularly strong in the case of spay/neuter procedures, where discount programs appear to significantly promote regular spay/neuter procedures.

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