

Designing socially acceptable stray animal management policies: evidence from a national survey in South Korea

Donggyu Yi

University of Seoul

Hocheol Jeon

Chungnam National University

Heesun Jang

heesun.jang86@korea.ac.kr

Korea University

Article

Keywords: Stray animal, choice experiment, discrete choice, non-market valuation, latent class model

Posted Date: September 17th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-9006265/v1>

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Additional Declarations: No competing interests reported.

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March 6, 2026

Abstract

Stray animal management has become a pressing societal challenge, highlighting the need for socially acceptable policy design and sustainable financing mechanisms. This study examines public preferences for alternative stray animal management strategies using a large-scale, nationally representative choice experiment in South Korea. The policy scenarios differed in terms of intervention type, implementing entity, expected effectiveness, and associated household tax contributions. The results show that policy acceptability varies substantially across governance structures and the magnitude of the associated tax burden. Individuals willing to pay higher taxes display stronger support for public implementation, while overall preferences suggest significant heterogeneity in attitudes toward taxation and policy responsibility. Companion animal owners—particularly those with higher related expenditures—show lower marginal resistance to increased tax contributions, suggesting that targeted financing mechanisms may generate broader public support. Overall, the findings indicate that socially acceptable policy design requires aligning governance arrangements with public perceptions of fairness and responsibility. Financing mechanisms that target relevant consumption activities, rather than imposing uniform registration fees, may reduce resistance and thereby improve social

welfare. More broadly, the study demonstrates how preference heterogeneity and perceived responsibility shape the societal feasibility of environmental and social management policies.

Keywords: Stray animal; choice experiment; discrete choice; non-market valuation; latent class model

JEL Classification: H41, Q51, Q57, Q58

1 Introduction

Companion animals have become an integral part of modern households, shaping daily life and contributing to emotional and physical health in many societies, including South Korea (Beck and Meyers, 1996; Virués-Ortega and Buéla-Casal, 2006; Cutt et al., 2007; Knight and Edwards, 2008). Approaches to estimating companion animal populations vary widely across countries and organizations, and no unified methodology exists, leaving the global number of companion animals unclear (Downes et al., 2013). Nevertheless, the literature documents that companion animals are already present in a substantial share of households across many countries around the world (Downes et al., 2009; Murray et al., 2015; Rowan, 2018). In Korea, it has been reported that approximately 5.91 million households—about 27 percent of all households—were raising companion animals in 2024, and this share has been increasing over the past decades (KB Financial Group, 2025; Ministry of Agriculture, Food, and Rural Affairs, 2025).¹ Gromek and Perek-Białas (2022) show that, despite the rapid global expansion of the companion animal related market driven by rising companion animal ownership, research on this topic remains concentrated largely outside economics, particularly in psychology and veterinary science. They emphasize that companion animal related areas remain largely unexplored within economics and argue that economists should devote greater attention to this growing sector. Recently, Liu et al. (2024) provide empirical evidence that companion animal ownership influences consumer behavior beyond animal related consumption,

¹This figure includes a wide range of companion animals, such as dogs, cats, goldfish, and turtles.

demonstrating structural impacts on broader consumption decisions.

As companion animals have become increasingly present in modern households, concerns have also grown regarding the darker aspects associated with this trend. Among the most serious concerns are the persistent problems of animal abuse and abandonment. In general, animal abuse and abandonment can be understood as behaviors in which owners intentionally or negligently inflict harm on animals or relinquish responsibility for their care, leaving them without adequate protection or supervision (Ascione, 2001). Such behaviors raise not only serious animal welfare concerns but also broader ecological and social implications. Abandonment or release of companion animals can facilitate the introduction of non-native species into local ecosystems, substantially increasing the risk of ecological disruption and biodiversity loss (Loss et al., 2013; Lockwood et al., 2019; Gippet and Bertelsmeier, 2021). Langlois et al. (2025) provide a bibliometric synthesis demonstrating that pet and stray dogs can contribute to zoonotic transmission pathways, emphasizing the importance of strengthened surveillance and disease monitoring systems for companion animals. Beyond zoonotic risks, stray animal overpopulation is linked to a wider set of public health, sanitation, ethical, and welfare challenges. Abdulkarim et al. (2021) offer a comprehensive review showing that unmanaged stray animal populations can impose substantial burdens on local environments and communities. Abdulkarim et al. (2021) offer a comprehensive review showing that unmanaged stray animal populations can impose substantial burdens on local environments and communities. Perdomo et al. (2021) highlight sterilization and other preventive measures as critical tools for mitigating stray animal overpopulation and reducing its ecological and societal impacts.

Recent works have also examined public perceptions. Azevedo et al. (2025) show that Portuguese residents view free roaming cats and dogs as contributing to ecological disruption, public health risks, and animal welfare issues, and they report broad support for policy and educational measures to address these challenges. Similarly, Munir et al. (2023) document that Malaysians view stray animals as a source of public health and safety concerns—including disease transmission, road accidents, and sanitation problems—and highlight the need for more systematic and coordinated

management efforts at both the community and local-government levels. In addition to understanding public perceptions, evaluating the effectiveness of management interventions is also important. Smith et al. (2019) conduct a systematic review of dog population management and demonstrate that integrated approaches, such as capture-neuter-return, community engagement, and adoption initiatives, can yield long-term reductions in free roaming dog populations. Bicalho et al. (2024) examine ethical population management programs on university campuses, identifying practical challenges and strategies for implementing humane and sustainable stray animal management systems.

This paper aims to provide empirical evidence on public preferences for alternative stray animal management policies in South Korea and to draw implications for designing publicly supported and fiscally acceptable stray animal management policies. South Korea introduced its first Comprehensive Animal Welfare Plan in 2015. Since then, the government has strengthened a range of preventive measures, including the expansion of the mandatory animal registration system and enhanced public education on responsible ownership. It has also reinforced regulatory actions, such as increased penalties for animal abandonment, and improved post-abandonment interventions, including rescue procedures and municipal shelter operations. Despite these efforts, more than 100,000 stray or abandoned animals are reported nationwide each year; a large proportion of rescued animals—estimated at around 60%—remain unregistered, and nearly half are euthanized, underscoring the persistent limitations of existing policy mechanisms (Ministry of Agriculture, Food, and Rural Affairs, 2025). As concerns remain about which management approaches and policy alternatives are most preferred by the public and considered acceptable for financial support, it is important to understand how the public evaluates alternative management approaches and their willingness to support them financially. In this paper, we employ a large-scale discrete choice experiment (DCE) to elicit individuals’ preferences for several policy attributes—such as type of policy intervention, implementing entity, expected effectiveness, and associated annual tax burdens—and to estimate their willingness to pay (WTP) for improvements in stray animal management. To the best of our knowledge, this is the first study in the literature to apply a nationally representative

DCE to evaluate public preferences and welfare impacts of stray animal management policies. By quantifying preference structures and WTP measures, this study offers important policy insights into which management approaches are socially valued, how much the public is willing to contribute financially, and how preferences differ across population subgroups. In doing so, the paper contributes to the emerging economic literature on companion- and stray-animal policy by providing novel and systematic evidence on societal support for stray animal management.

The results show that public preferences for stray animal management policies are not uniform and vary systematically across policy attributes and population subgroups. Across all model specifications, respondents exhibit the strongest preference for legal regulation relative to capture- or prevention-based interventions, indicating broad support for policies that mandate registration and strengthen enforcement against abandonment. Preferences regarding the implementing entity display substantial heterogeneity. While some respondents favor public-sector implementation, others prefer private provision, with these differences closely related to trust in government and willingness to bear additional tax burdens. Welfare analysis further reveals that a regulatory policy implemented by the public sector with a moderate tax increase generates the largest welfare gains, whereas more stringent regulation combined with a substantially higher tax yields smaller net benefits despite achieving greater reductions in stray animals. These patterns highlight the importance of jointly considering policy instruments, governance arrangements, and fiscal acceptability when designing effective stray animal management policies.

The remainder of this paper is organized as follows. Section 2 describes the choice experiment design and presents the survey data and summary statistics. Section 3 outlines the econometric models used to estimate the discrete choice experiment. Section 4 presents the estimation results. Section 5 discusses the policy implications and concludes the paper.

2 Choice experiment design and summary statistics

2.1 Choice experiment design

To examine public preferences for stray animal management policies, we collaborated with the Korea Institute of Public Finance (KIPF). We designed a choice experiment survey module on stray animal management, which KIPF incorporated into the 16th wave of the National Survey of Tax and Benefit (NaSTaB). NaSTaB is a nationwide annual panel survey administered by KIPF that collects comprehensive household- and personal-level information on taxes, expenditures, and government transfer programs. It also includes a broad set of socio-demographic variables, such as gender, age, education, consumption, and income. To enhance the accuracy of the survey, it is conducted face-to-face and respondents are asked to keep a household account book and answer the questionnaire based on this information. Additional compensation is provided for those who attach receipts. As part of its survey design, NaSTaB selects specific topics each year and incorporates corresponding modules as supplementary surveys. Our choice experiment was implemented as the supplementary module in 2023. The module consists of two parts. The first part is a perception and status survey that collects information on companion animal ownership, expenditures related to companion animals, and respondents' perceptions and attitudes toward stray animals. The second part is a choice experiment section comprising 12 choice sets, as described in detail below.

Table 1 summarizes the attributes and levels used in the choice experiment. In each choice set, respondents selected their most preferred option from three alternatives, two representing new policy interventions and one representing an opt-out alternative in which the status quo is maintained. Each alternative consists of four attributes: (1) type of policy intervention, (2) implementing entity, (3) expected effectiveness, and (4) annual household income tax contribution. The first two attributes, type of policy intervention and implementing entity, are discrete categorical variables. The type of policy intervention attribute consists of three categories.

First, capture refers to strengthening post-abandonment management once companion animals have become stray animals, such as capturing stray animals, performing sterilization procedures on captured animals, and arranging adoption placements or humane euthanasia when unavoidable. Second, prevention represents measures aimed at reducing the likelihood that companion animals become stray animals. Examples include pre-adoption education for prospective owners, initiatives to encourage compliance with the animal registration system, owner-surrender programs through which ownership can be transferred to a public shelter in unavoidable circumstances such as military enlistment, imprisonment, or severe illness, and public support programs that provide financial assistance for sterilization procedures. Third, legal regulation involves mandating the registration of companion animals and enforcing laws that prohibit abandonment or unregistered ownership, accompanied by fines or penalties for violations. The implementing entity attribute specifies whether the intervention would be administered by government ministries and public agencies (public) or by private organizations such as associations or non-governmental organizations (private). The expected effectiveness attribute is expressed as the percent reduction in stray animals based on the annual baseline of 100,000 stray animals and includes four levels, 20%, 30%, 50%, and 70% reduction. The price attribute consists of four levels, 5,000, 10,000, 50,000, and 100,000 KRW, representing the annual increase in household income tax.² The price levels were determined from a pilot survey of 1,002 respondents that included an open-ended willingness to pay question: “Given that approximately 100,000 animals are abandoned each year, how much would you be willing to contribute to reduce the number of abandoned animals by half?” The results show that the average willingness to pay among all respondents was 53,741 KRW. Excluding zero responses, the three most frequent values were 100,000 KRW (81 respondents), 10,000 KRW (66 respondents), and 50,000 KRW (46 respondents).

Based on the attributes and levels presented in Table 1, a full factorial design incorporating all possible combinations of the attributes and levels would generate a total of 96 distinct alternatives ($3 \times 2 \times 4 \times 4 = 96$). Evaluating such a large number

²Using the average exchange rate between 2022 and 2024, USD 1 = KRW 1,320.73, the four tax levels correspond approximately to USD 3.8, 7.6, 37.8, and 75.7, respectively.

of profiles is practically impossible for respondents due to cognitive limitations and the potential for response fatigue (Johnston et al., 2017). To construct a manageable survey instrument, we employed a fractional factorial design that reduces the number of combinations while maintaining orthogonality to estimate main effects.³ In addition, the design was restricted such that legal regulation was always paired with public sector implementation, as it cannot be implemented by private entities. Consequently, the selected profiles were paired to form 12 choice sets. Each choice set presented the respondent with two hypothetical policy alternatives and a status quo option. An example of a choice scenario is shown in Table 2.

2.2 Summary statistics

Table 3 presents the summary statistics for the respondents. The choice experiment was completed by a sample of 14,659 individuals from 8,619 households. The average age of respondents is approximately 56.4 years, with a relatively wide age distribution, as indicated by a standard deviation of 16.7 years. About 49 percent of the respondents is male. With respect to educational attainment, 47 percent hold a college degree or higher, while the rest have less than a college level education. Household income is measured on an 11-category scale ranging from 1 to 11 and shows an average value of 5.65, which corresponds to an average monthly household income of approximately 5 million KRW. Respondents also evaluated how serious they perceive the stray or abandoned animal problem to be on a five point scale. The average rating of 3.76 indicates that most respondents regard the stray or abandoned animal issue as moderately to highly severe. The survey also includes a question asking whether respondents would be willing to pay additional taxes if the government were to raise taxes to expand welfare spending.⁴ Approximately 35 percent indicated that they are willing to pay more than their current tax burden, whereas 65 percent reported

³While statistically efficient designs (e.g., D-efficient designs) are often utilized in modern stated preference studies to maximize estimation precision with smaller sample sizes, they require reliable priors regarding the parameters (Ngene, C., 2018). As this study is the first to empirically analyze public preferences for stray animal management policies in South Korea, such priors were unavailable.

⁴This question pertains to general welfare spending and is not specific to animal related policies.

that they are not willing to pay any additional taxes. Approximately 12 percent of respondents currently own a dog or a cat.⁵ Among those who own a dog or a cat, 74.4 percent reported that their companion animals were adopted, rescued, or obtained from acquaintances, whereas roughly one-quarter obtained their companion animals through commercial channels such as pet shops. Companion animal owning households spend an average of 63,000 KRW per month on animal related expenditures, though the large standard deviation of 97,000 KRW suggests substantial variation in the animal related expenditure behavior.

In Table 4, respondents are grouped into three behavioral categories based on their responses to the 12 choice tasks: *Never*, *Sometimes*, and *Always*. The *Never* group consists of respondents who selected the status quo option in all 12 choice tasks, indicating a consistent preference for maintaining current policies. The *Sometimes* group includes respondents whose choices varied across the three alternatives, reflecting mixed or context dependent preferences. The *Always* group comprises respondents who selected one of the two policy alternatives in every task—never choosing the status quo—demonstrating strong support for policy interventions rather than the current status. The sample sizes for the three groups are 3,746 respondents for *Never*, 7,036 for *Sometimes*, and 3,877 for *Always* group, respectively. Given that each respondent completed 12 choice sets and each set contained three alternatives, the constructed data consists of $14,659 \times 12 \times 3 = 527,724$ observations, of which 134,856 from *Never*, 253,296 from *Sometimes*, and 139,572 from *Always* respondents, respectively.

Table 4 reveals several interesting heterogeneity across the three groups. Average age is highest in the *Never* group (58.72 years), lower in the *Sometimes* group (56.02 years), and lowest in the *Always* group (54.77 years), indicating that respondents who favor policy interventions tend to be relatively younger. The *Always* group has a higher share of women compared with the other two groups. In terms of educational attainment, 40 percent of *Never* respondents hold a college degree or higher, compared with 47 percent in the *Sometimes* group and 54 percent in the *Always* group. Household income increases with policy support, with mean values of 5.32 for

⁵In Korea, dogs and cats are the two most common companion animals.

the *Never* group, 5.63 for the *Sometimes* group, and 6.01 for the *Always* group on the 11-category income scale. Differences also emerge in perceptions of the seriousness of the stray or abandoned animal issue. The *Always* group reports the highest average seriousness rating (3.86 on a five-point scale), followed by the *Never* group (3.76) and the *Sometimes* group (3.72). Willingness to pay a higher tax for expanding welfare spending varies substantially across groups, being highest in the *Always* group (40 percent), followed by the *Sometimes* group (36 percent), and lowest in the *Never* group (27 percent). Companion animal ownership exhibits considerable variation across the groups. Only 5 percent of *Never* respondents currently own a dog or a cat, compared with 13 percent in the *Sometimes* group and 15 percent in the *Always* group. Among dog or cat owners, the share of respondents who acquired their animals through non-commercial channels—such as adoption, rescue, or acquaintances—is highest in the *Never* group (78 percent) and lowest in the *Always* group (70 percent). However, companion animal related monthly expenditures display the opposite pattern. Respondents in the *Always* group spend the most on average (70,500 KRW), followed by those in the *Sometimes* group (61,500 KRW), while respondents in the *Never* group spend the least (48,800 KRW). The large standard deviations of the monthly expenditure suggest considerable heterogeneity in respondents’ expenditures on their own companion animals.

3 Econometric model

Discrete choice experiment is based on the random utility model that maps observed characteristics to preferences (McFadden, 1974). The random utility model decomposes the utility function into a deterministic component specifying a function of measured attributes of the alternatives, and a stochastic component representing the unobservable random variables (Baltas and Doyle, 2001). We begin by specifying the utility a person i receives from alternative j during choice situation c as

$$V_{ijc} = \beta' X_{ijc} + \epsilon_{ijc} \quad (1)$$

where β' is a vector of utility function parameters, X_{ijc} is a vector that includes characteristics of the choice alternative, and ϵ_{ijc} is a random variable that has a structural interpretation. It is a part of the utility function whose value is known to the person i and hence affects his choices, but unobserved by the researcher. ϵ_{ijc} is often referred to as unobserved heterogeneity, since it accounts for drivers of decisions not accounted for by the measured variables. If we assume that ϵ_{ijc} is distributed independent and identical type I extreme value, the conditional logit model emerges. Under this assumption for the error terms, the probability of observing person i choosing alternative j during choice situation c is

$$Pr_{ijc} = \frac{\exp(\beta' X_{ijc})}{\sum_{k=1}^J \exp(\beta' X_{ikc})} \quad (2)$$

where J is the number of choice alternatives. Maximum likelihood estimation based on these probabilities allows us to recover estimates of β' , given a functional form for X_{ijc} .

The conditional logit model imposes a common utility function across all respondents, which leads to homogeneous utility coefficient estimates. Moreover, the model relies on the assumption that the unobserved components of utility are uncorrelated across alternatives, known as the independence of irrelevant alternatives (IIA), meaning that the ratio of the choice probabilities for any two alternatives is unaffected by the presence or attributes of other alternatives (Burton et al., 2024). However, previous studies have shown that heterogeneity is a defining feature of non-market valuation due to both observed and unobserved factors driving heterogeneous individual characteristics and preferences (Phaneuf, 2013; Zhang and Sohngen, 2018). In recent years, discrete choice models have increasingly incorporated unobserved preference heterogeneity through several extended approaches, among which the mixed logit model and the latent class model are the most widely used. Both approaches allow for the parameter heterogeneity across individuals and relax the IIA property. The motivating idea behind the mixed logit model is that utility is given by

$$V_{ijc} = \beta'_i X_{ijc} + \epsilon_{ijc} \quad (3)$$

where β'_i is a vector of utility function parameters specific to person i . Aside from the subscript on the parameter vector, it is identical to the conditional logit model. While the distribution for β_i can be anything, a common assumption is that $\beta_i \sim N(b, \Omega)$, where b is a vector of mean marginal utilities associated with the variables in X_{ijc} , and the variance matrix Ω describes how much preferences for attributes vary in the population. Therefore, in the mixed logit model unobserved heterogeneity enters the model both via β'_i and ϵ_{ijc} .

$$Pr_{ijc} = \int \frac{\exp(\beta'_i X_{ijc})}{\sum_{k=1}^J \exp(\beta'_i X_{ikc})} f(\beta_i) d\beta_i \quad (4)$$

where $f(\beta_i)$ is the probability density function for β_i . In the mixed logit model, we are interested in obtaining estimates for b and Ω so as to measure both mean preferences via b and how variable preferences are via Ω .

Recent studies note potential gains from specifying a discrete instead of normal distribution (Green and Hensher, 2003; Shen, 2009). Latent class model models the parameter heterogeneity across individuals with a discrete distribution that is a function of individual characteristics. The individuals are grouped into a few discrete classes that remain latent for the researcher, where the preferences are homogeneous within each class n (Zhang and Sohngen, 2018).

$$V_{ijc} = \beta'_n X_{ijc} + \epsilon_{ijc} \quad (5)$$

where n denotes membership in one of $n = 1, \dots, N$ latent preference classes. Since we do not know the specific classes to which each person belongs, class memberships are latent, and need to be estimated as part of the model. We assume that the probability that person i belongs to latent class n is determined as follows.

$$Pr_{in} = \frac{\exp(\alpha_n + \gamma'_n Z_i)}{\sum_{k=1}^N \exp(\alpha_k + \gamma'_k Z_i)} \quad (6)$$

where α_n is a scalar, Z_i is a vector of individual characteristics that influence class membership, and γ'_n is a vector of coefficients associated with Z_n . The probability of observing person i choosing alternative j on choice occasion c is

$$Pr_{ijc} = \sum_{n=1}^N \left(\frac{\exp(\alpha_n + \gamma'_n Z_i)}{\sum_{k=1}^N \exp(\alpha_k + \gamma'_k Z_i)} \frac{\exp(\beta'_n X_{ijc})}{\sum_{k=1}^J \exp(\beta'_n X_{ikc})} \right) \quad (7)$$

The log-likelihood function for a sample of I individuals can be written as

$$\ln L = \sum_{i=1}^I \sum_{c=1}^C \sum_{j=1}^J y_{ijc} \ln Pr_{ijc}, \quad (8)$$

where y_{ijc} denotes an indicator variable that equals 1 if individual i chooses alternative j in choice occasion c and 0 otherwise.

4 Results

4.1 Model estimation results

Table 5 presents the conditional logit model estimates for the full sample and for subgroups distinguished by whether respondents currently own a dog or cat. Columns (1)–(3) show the baseline models without interaction terms. Across all three specifications, respondents tend to prefer legal regulation over prevention or capture, and favor higher levels of % reduction, while experiencing disutility from additional tax payments. The results are mixed with respect to respondents' preferences for public versus private implementation. In column (1), all attributes are statistically significant, indicating that policy design and expected outcomes (% reduction) significantly influence stated choices. Columns (2) and (3) compare respondents who currently own a dog or cat with those who do not. Since respondents who do not own a dog or cat account for approximately 88 percent of the sample, their estimates in column (2) closely mirror the full sample results. In contrast, column (3) reveals distinctive patterns for dog or cat owners. Specifically, among respondents who currently own a dog or cat, the coefficient on the public attribute is not statistically significant, indicating that dog or cat owners do not express a clear preference between public- and private-sector implementation. Dog or cat owners also place substantially higher

value on increased % reduction, as reflected in the larger coefficient on this attribute. Finally, the price coefficient is more negative for dog or cat owners, implying a larger marginal utility of income in the context of the policy choice—that is, each additional unit of tax reduces their utility more sharply than it does for non-owners. Importantly, dog or cat owners also exhibit a significantly more negative coefficient on the status quo alternative, suggesting a markedly lower preference for maintaining the current policy relative to non-owners. This implies that companion animal owners are more dissatisfied with the status quo and more inclined to support the introduction of new policy interventions. Columns (4)–(6) incorporate interaction terms to capture additional heterogeneity, and the interaction between the public attribute and Willing Tax indicates that respondents who are willing to pay additional taxes exhibit stronger support for public-sector implementation across all specifications.

Column (7) further conducts the analysis for respondents who own a dog or cat, allowing for a more detailed examination of heterogeneity, by incorporating interactions with both adoption source and monthly companion animal related expenditures. The baseline coefficient for the public attribute is positive and statistically significant at 0.17, indicating a general preference for public-sector implementation among dog or cat owners. However, this preference varies considerably depending on whether the respondent adopted their dog or cat and whether they are willing to pay additional taxes. For individuals who adopted their dogs or cats and are willing to pay additional taxes, the combined effect of the interaction terms produces a positive coefficient ($0.17 + 0.21 - 0.31 = 0.07$), meaning they generally prefer public implementation over private implementation. In contrast, adopters who are not willing to pay additional taxes exhibit a negative combined coefficient on the public attribute ($0.17 - 0.31 = -0.14$), implying that this group prefers private-sector implementation. A plausible explanation is that individuals who adopted or rescued their pets often have substantial prior exposure to private rescue organizations, through which trust and familiarity are formed. As a result, they may already hold a considerable degree of trust in private organizations based on their prior adoption or rescue experiences. Among owners who acquired their companion animals from commercial sources, for example, breeders or pet shops, the preference for public implementation

becomes stronger when they are willing to pay additional taxes ($0.17 + 0.21 = 0.38$), whereas those who are not willing to pay additional taxes maintain the baseline tendency to favor the public sector (0.17). It is also worth noting that the interaction terms between adoption source and the other policy attributes—such as prevention and % reduction—are generally insignificant, suggesting that adoption source affects preferences primarily through preferences regarding the implementing entities, rather than through other channels. Finally, the interaction between the price attribute and monthly companion animal related expenditures is positive and statistically significant at 0.002. This implies that respondents who spend more on their companion animals exhibit lower sensitivity to additional tax burdens. In other words, as monthly expenditure on companion animals increases, the marginal disutility of higher policy costs decreases, indicating that higher spending households are less constrained by tax related price increases in the policy context.

Table 6 presents the mixed logit model estimates. In contrast to the conditional logit model, which imposes homogeneous coefficients across respondents, the mixed logit model allows for random taste variation and explicitly captures unobserved heterogeneity in preferences, under the assumption that the coefficients follow a normal distribution. Several notable differences emerge. First, the estimated coefficient on the public attribute becomes positive and statistically significant across all specifications, indicating that once unobserved preference heterogeneity is accounted for, respondents on average favor public-sector over private-sector implementation. This stands in contrast to the conditional logit model results, where the corresponding coefficient was negative for the full sample and for respondents who do not own a dog or cat, and statistically insignificant for those who own a dog or cat. Second, the estimated standard deviation for the public attribute is large—substantially larger than those of the other attributes—suggesting pronounced heterogeneity in respondents’ views toward public-sector implementation. This implies that while some respondents strongly prefer public-sector implementation, others hold strong preferences for private-sector implementation, leading to wide dispersion around the mean coefficient. The large standard deviation highlights that attitudes toward implementing entities are diverse and cannot be characterized by a single representative coefficient.

Third, relative to the conditional logit model estimates, in the mixed logit model, the coefficients on prevention, price, and opt-out become more strongly negative, indicating that respondents exhibit a stronger aversion to these policy options or cost components than implied by the homogeneous coefficient specification. By contrast, the coefficient on legal regulation becomes smaller in magnitude, suggesting that the degree of respondents' positive preference for legal regulation is reduced, even though the attribute remains positive and significant. Finally, the coefficient on % reduction increases, implying that respondents place greater value on policy effectiveness when heterogeneity in preferences is explicitly modeled. The interaction effects in Columns (4)–(7) are broadly consistent with the conditional logit results, with both the sign and statistical significance of the interaction terms exhibiting consistent patterns across the two models.

Table 7 reports the latent class model estimates, which identify three distinct preference classes within the sample. Unlike the mixed logit model which estimates continuous preference heterogeneity, the latent class model captures discrete heterogeneity by grouping respondents into a few latent classes that differ systematically in their underlying preference structures. The model also requires specifying which individual characteristics parameterize the probabilities of class membership, and the set of demographic and behavioral variables included for this purpose—age, gender, education, income, perceived seriousness of stray animal issues, and dog or cat ownership—are shown in the lower panel of the table. The three latent classes exhibit clearly differentiated patterns of attribute valuations. Class 1, comprising 26 percent of respondents, shows disutility for prevention policies but positive preferences for legal regulation and public-sector implementation. This class also displays strong aversion to the opt-out option, indicating support for new policy intervention relative to the status quo. Class 2, comprising 37 percent of respondents, exhibits strong negative preferences for prevention, legal regulation, and public implementation, coupled with a positive and significant coefficient on the opt-out alternative. These patterns suggest that respondents in Class 2 tend to favor maintaining the current policy environment and are skeptical of new policy interventions. In contrast, Class 3, also accounting for 37 percent of respondents, strongly favors legal regula-

tion and displays the smallest price coefficient among the three classes, indicating the lowest sensitivity to policy costs. This group also prefers private-sector implementation, as reflected in the negative coefficient on the public attribute, and shows a positive and marginally significant preference for prevention relative to capture at the 10 percent level. Across all classes, the interaction term between Willing Tax and public is positive and statistically significant, indicating that regardless of latent class membership, respondents who show a willingness to pay additional taxes systematically prefer public-sector implementation. The class membership coefficients provide additional insights into the determinants of class assignment. Higher education and income levels significantly reduce the likelihood of belonging to Class 1 or Class 2, with the negative coefficients indicating these respondents are more likely to belong to Class 3, the group most supportive of regulatory interventions and least sensitive to costs. Respondents who currently own a dog or cat are significantly more likely to belong to Class 1 and significantly less likely to belong to Class 2, consistent with the earlier results showing greater policy engagement among companion animal owners. Overall, the result highlights that demographic and behavioral characteristics systematically influence how respondents are grouped into preference classes.

Table 8 summarizes how the three behavioral categories—*Never*, *Sometimes*, and *Always*—defined in Table 4 based on respondents’ choices across the 12 tasks align with the three latent classes, where individuals are assigned to the class with the highest posterior probability of membership. Table 8 reveals clear behavioral patterns across the latent classes. All respondents in the *Never* group are assigned to Class 2, consistent with this class’s strong preference for maintaining the status quo and general resistance to new policy interventions. Class 1 consists exclusively of respondents in the *Sometimes* group, suggesting that these individuals switch between the two policy alternatives and the opt-out option depending on the specific attribute combinations presented. Finally, all respondents in the *Always* group are assigned to Class 3, indicating strong and consistent support for adopting new policy alternatives.

Table 9 reports the summary statistics of the membership variables across the three latent classes, providing further insight into the types of individuals who are

most likely to belong to each class based on their highest posterior probability. Several patterns emerge. Class 2, identified as the group strongly favoring the status quo, tends to include older respondents and a higher proportion of men—although age and gender are not statistically significant predictors of class membership in Table 7. This class also includes individuals with lower levels of education and income, lower perceived seriousness of stray animal issues, lower willingness to pay additional taxes, and the lowest rate of dog or cat ownership. In contrast, Class 3, which represents respondents who consistently choose new policy alternatives, exhibits higher levels of education and income and, among companion animal owners, higher monthly expenditures on companion animals. Class 1, composed entirely of *Sometimes* respondents, lies between the other two groups on most characteristics, showing moderate levels of income and education. Interestingly, Class 1 has the highest willingness to pay additional taxes and the highest rate of companion animal ownership, which are consistent with its positive preference for public-sector implementation in Table 7. These differences suggest that systematic variation in membership variables is consistent with the behavioral patterns observed across the latent classes.

4.2 Willingness to pay estimates and welfare analysis

Table 10 presents the marginal willingness to pay (MWTP) estimates derived from the conditional logit, mixed logit, and latent class models, and the corresponding MWTP patterns are illustrated in Figure 1. For the conditional logit and mixed logit model specifications, the MWTP are computed using the estimated coefficients from columns (4)–(6) in Tables 5 and 6, which include the interaction term between the public attribute and the indicator for respondents who are willing to pay additional taxes. This allows the MWTP for public implementation to differ between respondents who are and are not willing to pay additional taxes. Across all model specifications, respondents consistently assign the highest MWTP to legal regulation relative to prevention or capture, indicating strong support for policy interventions that mandate registration, impose penalties, or strengthen enforcement mechanisms. MWTP for % reduction is also positive and statistically significant in all models, sug-

gesting that respondents derive meaningful welfare gains from policies that achieve larger reductions in stray animals. This preference is particularly pronounced among dog or cat owners and members of Class 3, both of whom exhibit substantially higher valuations for increased % reduction, as shown in Figure 1.

The pattern of MWTP for public implementation varies depending on model and respondent characteristics. In the conditional logit model, respondents who are not willing to pay additional taxes show negative MWTP for public implementation, whereas those willing to pay additional taxes show positive MWTP, reflecting heterogeneous trust in the public sector conditional on respondents' willingness to incur additional tax burdens. The mixed logit model produces overall more favorable MWTP for public implementation, especially among dog- or cat-owning households, and also reveals that these households place considerably greater value on % reduction.

The latent class model further highlights distinct sources of preference heterogeneity. Class 1, characterized by sometimes choosing new policy alternatives, shows moderate MWTP across attributes. Class 2, the strongly status-quo oriented group, exhibits uniformly negative MWTP for prevention, legal regulation, and public implementation, indicating broad aversion to policy changes. Class 3, in contrast, displays very large positive MWTP—particularly for legal regulation—revealing a segment of respondents who strongly favor policy interventions over maintaining the current situation. As shown in Table 7, the absolute value of the price coefficient in Class 3 is small, which produces much larger MWTP values and reflects this group's very low marginal disutility of additional tax payments. Finally, the weighted average reported in the last row of Table 10 summarizes overall population-level MWTP by aggregating class-specific MWTP estimates using the estimated latent class shares.

Finally, to evaluate the welfare implications of alternative stray-animal management policies, we construct four policy scenarios relative to the status quo, which represents maintaining the current situation with no new policy intervention. Scenario 1 reflects a capture-based policy implemented by private sector that achieves a 30% reduction in stray animals at an annual household tax contribution of 10,000 KRW. Scenario 2 replaces capture with prevention while keeping the implementing

entity, % reduction, and tax payment constant, thereby isolating the welfare effects of shifting from capture to preventive measures. Scenario 3 instead considers a regulatory policy implemented by the public sector, again with a 30% reduction and an annual household tax contribution of 10,000 KRW, allowing assessment of how preferences for legal regulation and public provision translate into welfare changes. Scenario 4 strengthens the regulatory intervention by increasing % reduction from 30% to 50% at a higher annual tax of 30,000 KRW, capturing the trade-off between greater reductions in stray animals and the higher tax burden imposed on households.

Table 11 reports the estimated welfare changes for the four policy scenarios, with the corresponding welfare patterns across scenarios illustrated in Figure 2. For the conditional logit and mixed logit models, the welfare changes are computed from the coefficients in columns (4)–(6) of Tables 5 and 6, which incorporate the interaction between the public attribute and the indicator for respondents who are willing to pay additional taxes. These specifications allow the estimated welfare changes to differ depending on respondents’ willingness to incur additional tax burdens. The latent class welfare changes are calculated using the class-specific coefficients for each class. Across all models, a clear and consistent pattern emerges. Households that own a dog or cat and are willing to pay additional taxes experience the largest welfare gains from the new policy interventions related to stray animals. Moving from Scenario 1 (capture) to Scenario 2 (prevention) generally reduces welfare, as respondents place lower value on prevention relative to capture at the same level of % reduction and tax burden. However, welfare increases sharply when moving from Scenario 2 to Scenario 3, driven by the strong positive valuation of legal regulation. Scenario 3 yields the largest welfare gains in nearly all models and subgroups. Scenario 4, despite the highest % reduction, produces smaller welfare gains than Scenario 3, indicating that the higher tax burden offsets the benefits from improved % reduction. The mixed logit model confirms these patterns, producing larger overall welfare changes and especially strong welfare gains among dog- or cat-owning households. The latent class model further highlights systematic heterogeneity. Class 1 shows moderate gains, with welfare decreasing when moving from Scenario 1 to Scenario 2 and then increasing when moving from Scenario 2 to Scenario 3. Class 2 experiences

welfare losses across all scenarios, consistent with its preference for the status quo. In contrast, Class 3 exhibits exceptionally large welfare gains, and this group continues to display the same pattern in which welfare gains reach their highest level under Scenario 3 before declining in Scenario 4. The weighted average welfare change reported in the final rows of Table 11 aggregates class-specific welfare changes using the estimated latent class shares, providing an overall population-level measure that accounts for preference heterogeneity.

5 Conclusion and policy implication

This paper has examined public preferences for alternative stray animal management policies in South Korea using a large-scale discrete choice experiment. By estimating several discrete choice models, the results have provided quantitative evidence on how households evaluate different types of policy interventions (capture, prevention, and legal regulation), implementing entities (public versus private), expected % reduction, and associated annual household income tax, and how these preferences translate into marginal willingness to pay and welfare changes under alternative policy scenarios.

Several findings emerge. First, across all models, respondents consistently assign the highest value to legal regulation relative to capture or prevention. This indicates strong support for policies that mandate the registration of companion animals and enforcing laws that prohibit abandonment or unregistered ownership, accompanied by fines or penalties for violations. Second, preferences regarding the implementing entity exhibit substantial heterogeneity, with divergence in support for public-versus private-sector implementation. In the conditional logit model, the coefficient on the public attribute is either insignificant or suggests a preference for private implementation. However, once unobserved heterogeneity is incorporated into the mixed logit model, the average preference shifts toward public-sector implementation. The large estimated standard deviation for the public attribute further indicates pronounced dispersion in preferences. While some respondents strongly prefer public-sector implementation, others favor private-sector implementation. The latent class

model confirms this heterogeneity. The sign of the public coefficient differs across latent classes, revealing systematically varying preferences for governance structures. Meanwhile, across all model specifications, the interaction term between willingness to pay additional taxes and public implementation is positive and statistically significant. This finding indicates that respondents who are willing to bear higher tax burdens consistently exhibit stronger support for public-sector implementation. Furthermore, differences in preferred governance between respondents unwilling to pay additional taxes and those willing to do so suggest that policies that promote tax compliance may differ from those preferred by the general public. In addition, the latent class model results show that demographic and behavioral characteristics systematically shape how respondents evaluate policy attributes, underscoring the importance of accounting for population heterogeneity in policy design. Finally, the welfare analysis of policy scenarios reveals that a regulatory policy with public implementation and a moderate tax increase generates the largest welfare gains, whereas further strengthening of legal regulation combined with a substantial tax increase provides smaller welfare gains, despite achieving a higher % reduction in stray animals. Across all models, companion animal owners—particularly those who report greater trust in the public sector—experience the largest welfare improvements from new policy interventions.

These findings provide several policy implications. First, the robust public support for legal regulation suggests that policy interventions should prioritize mandating the registration of companion animals and strictly enforcing laws that prohibit abandonment or unregistered ownership, accompanied by fines, penalties, and systematic enforcement mechanisms. At the same time, the welfare analysis of policy scenarios indicates that introducing more stringent regulations must be carefully balanced against the potential financial burden on the public. Second, the results highlight the importance of implementation arrangements and governance design. The finding that respondents exhibit markedly different preferences for public- versus private-sector implementation indicates that a uniform policy design may be inefficient in the presence of heterogeneous preferences. A governance arrangement that differentiates or appropriately assigns roles between public and private entities may

enhance policy acceptance and improve the welfare implications of alternative policy designs. Functions that rely heavily on public trust and coercive authority—such as regulation, compliance monitoring, and enforcement—are likely to be more efficiently performed by public agencies, whereas those requiring operational efficiency, flexibility, or specialized expertise—such as service provision, education, outreach, and field-level operations—may be better supplied through collaboration with private entities.

Finally, to enhance financing acceptability and reduce inefficiencies in social welfare, an excise tax may be more appropriate than a universal levy. Given that a substantial share of respondents are unwilling to pay additional taxes while others express a willingness to contribute more, a universal taxation scheme is likely to face lower public acceptability. Our results show that companion animal owners who are willing to pay additional taxes experience the largest welfare gains, and that individuals with higher monthly expenditures on companion animals exhibit lower marginal disutility from increased tax burdens. These findings suggest that taxing companion animal-related goods through an *ad valorem* tax may be both more realistic and more publicly acceptable than a registration-based tax. A universal registration tax is likely to face substantial public resistance and may even induce avoidance of companion animal registration, thereby undermining efforts to manage stray animals effectively. In particular, prior studies indicate that companion animal-related products tend to be price inelastic (Daneshvary and Schwer, 1993; Brown and Silverman, 1999; Hobbs Jr, 2023). Accordingly, under Ramsey’s inverse elasticity rule (Ramsey, 1927), taxing goods and services for companion animals could reduce deadweight loss and represent an efficient means of revenue generation.

We conclude by discussing the limitations of this study and suggesting directions for future research. First, although the choice experiment incorporates four attributes—type of policy intervention, implementing entity, expected effectiveness, and annual tax payment—the actual policy environment surrounding stray animal management is far more complex. Future work could incorporate additional attributes and allow for more realistic and sophisticated trade-offs to better capture the multi-dimensional nature of policy design. Second, related to the first point,

the welfare analysis in this study examines only four simplified policy scenarios. In practice, a much wider range of policy combinations is possible—for example, sterilization-intensive programs, various forms of public–private partnership models, or integrated packages that combine strengthened registration and enforcement with preventive measures. Future research should explore such richer and more realistic policy configurations to support more detailed policy design. Finally, this study is based on stated preferences elicited through a discrete choice experiment, rather than revealed behavioral data. Because respondents do not face actual tax burdens or real policy consequences when making hypothetical choices, their stated preferences may diverge from real-world behavior. Future research would benefit from using administrative or behavioral data to validate and extend the findings.

Declaration of competing interest

The authors declare no competing interests.

Data statement

All data and estimation code necessary to replicate the results of this study are included in the supplementary files submitted with the manuscript.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors. The research utilized secondary data from the 16th wave of the National Survey of Tax and Benefit (NaSTaB), a nationwide panel survey administered by the Korea Institute of Public Finance (KIPF). As the study involved the analysis of a de-identified and anonymized dataset provided for research purposes, it was deemed exempt from institutional review board (IRB) approval. The original NaSTaB survey was conducted by KIPF following established ethical protocols for

national statistics collection.

Informed consent

This article does not contain any studies with human participants performed by any of the authors. Informed consent was obtained by the Korea Institute of Public Finance (KIPF) from all participants during the original administration of the 16th wave of the National Survey of Tax and Benefit (NaSTaB). For the present study, additional informed consent was not required as the research relied exclusively on the analysis of anonymized secondary data. No personally identifiable information was accessed or used, ensuring the strict confidentiality of the survey respondents.

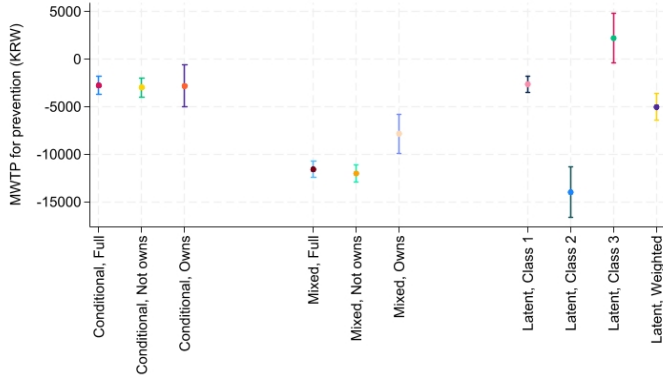
Funding

This work was supported by the 2025 sabbatical year research grant of the University of Seoul.

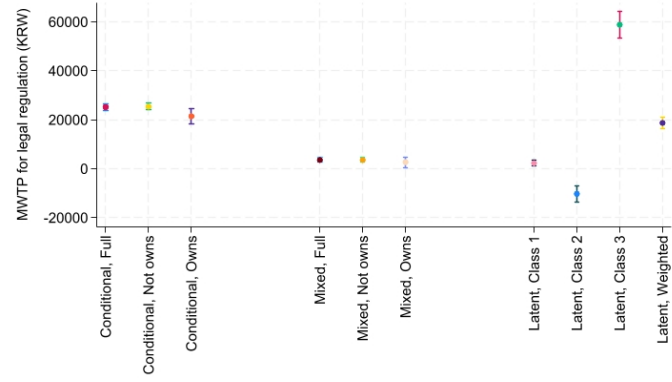
Declaration of generative AI in scientific writing

During the preparation of this work the authors used Chat GPT in order to improve the readability and language of the manuscript. After using this service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

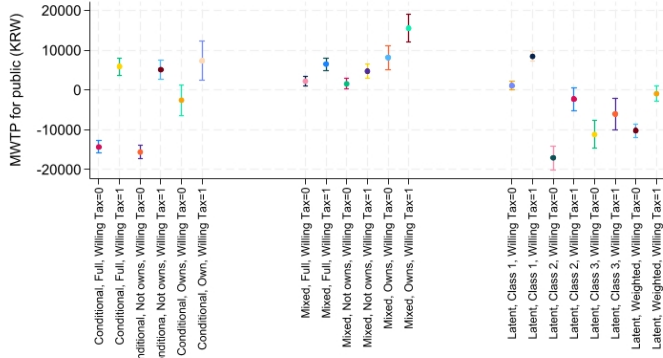
Figure 1: Marginal willingness to pay estimates



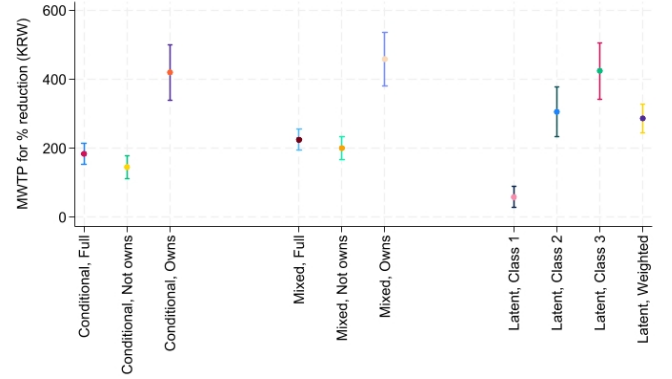
(a) MWTP for prevention



(b) MWTP for legal regulation

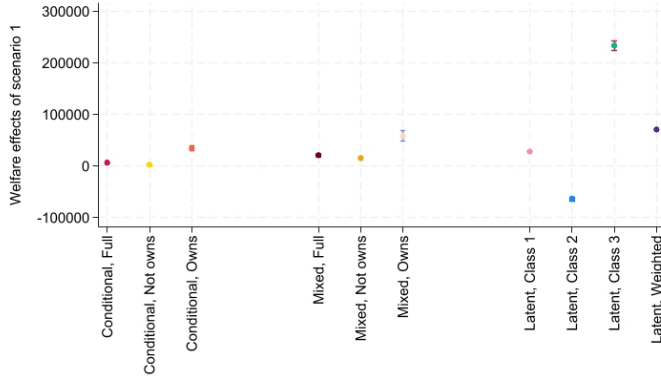


(c) MWTP for public

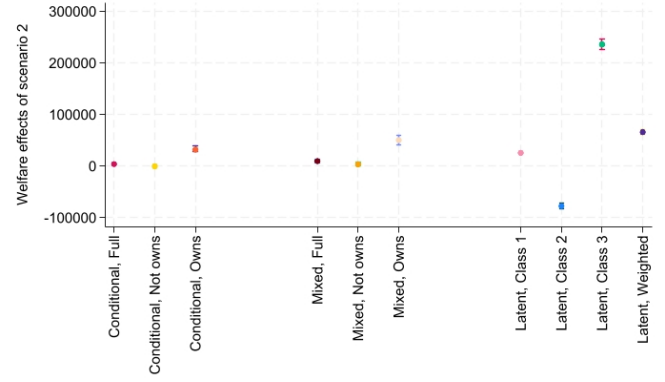


(d) MWTP for % reduction

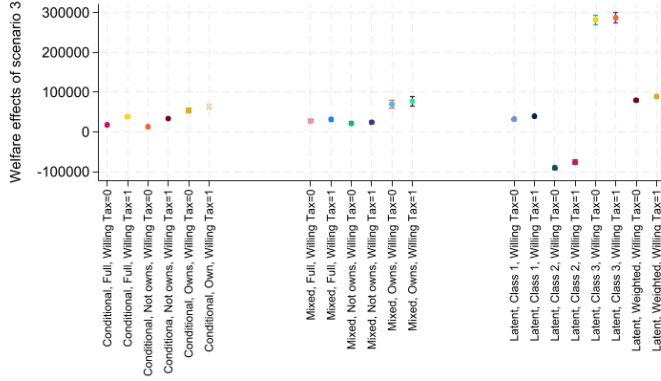
Figure 2: Welfare effects across scenarios



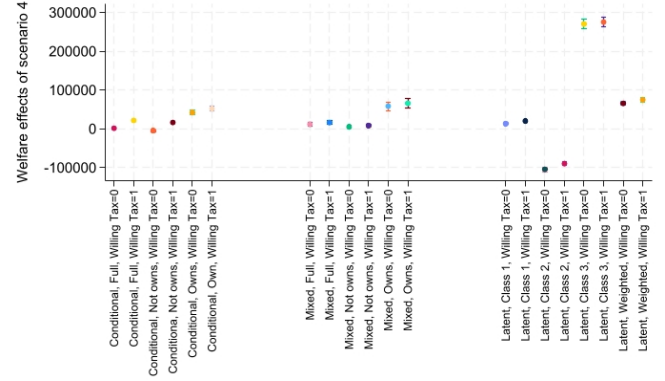
(a) Scenario1



(b) Scenario2



(c) Scenario3



(d) Scenario4

Welfare effects scenarios:

Scenario 1: Capture + Private + 30% reduction + 10,000 KRW

Scenario 2: Prevention + Private + 30% reduction + 10,000 KRW

Scenario 3: Regulation + Public + 30% reduction + 10,000 KRW

Scenario 4: Regulation + Public + 50% reduction + 30,000 KRW

Table 1: Attributes and levels for the choice experiment

Attribute	Description	Levels
Type of policy	Strengthening post-management measures after companion animals become stray animals	Capture
	Strengthening preventive measures to reduce the likelihood of companion animals becoming stray animals	Prevention
	Mandating the registration of companion animals, and imposing fines or penalties for illegal abandonment or unregistered ownership	Legal regulation
Implementing entity	Government ministries and public agencies	Public
	Private organizations such as associations or non-governmental organizations	Private
% reduction	Expected percentage reduction in stray animals based on 100,000 stray animals annually	20%
		30%
		50%
		70%
Price	Increase in annual income tax per household	5,000 KRW
		10,000 KRW
		50,000 KRW
		100,000 KRW

The average exchange rate from 2022 to 2024 was approximately USD 1 = KRW 1320.73.

Table 2: An example of choice scenario in choice experiment

	①	②	③
Type of policy	Stray prevention	Stray animal capture	No preferred option
Implementing entity	Public	Private	(status quo)
Expected effect	70% reduction	30% reduction	
Annual household cost	10,000 KRW	5,000 KRW	

The average exchange rate from 2022 to 2024 was approximately USD 1 = KRW 1320.73.

Table 3: Summary statistics of respondents

Variable	Value	Description
Age	56.38 (16.68)	Age of respondent
Gender	0.49 (0.50)	1 = Male, 0 = Otherwise
Education	0.47 (0.49)	1 = College graduate or above, 0 = Otherwise
Income	5.65 (3.02)	Average monthly household income during the past year: 1 = Less than 1; 2 = 1.0–1.99; 3 = 2.0–2.99; 4 = 3.0–3.99; 5 = 4.0–4.99; 6 = 5.0–5.99; 7 = 6.0–6.99; 8 = 7.0–7.99; 9 = 8.0–8.99; 10 = 9.0–9.99; 11 = 10 million KRW or more
Serious	3.76 (0.82)	Perception of seriousness of stray/abandoned animal problems: 1 = Not serious at all, 5 = Very serious
Willing tax	0.35 (0.47)	Self-reported willingness to bear additional tax burden: 1 = Willing to pay more, 0 = Not willing to pay more
Owns dog or cat	0.12 (0.32)	1 = Currently owns a dog or a cat, 0 = Otherwise
<i>For dog or cat owners only</i>		
Adopt source	0.74 (0.43)	1 = Adopted, rescued, or obtained from acquaintances; 0 = Purchased through commercial channels such as pet shops
Monthly expenditure	6.3 (9.7)	Average monthly amount of pet-related expenditure (10,000 KRW)
Number of respondents	14,659	
Number of households	8,619	

Standard deviations are in the parentheses.

Table 4: Summary statistics of demographic characteristics by choices

Variable	<i>Never</i>	<i>Sometimes</i>	<i>Always</i>
Age	58.72 (17.37)	56.02 (16.53)	54.77 (16.03)
Gender	0.50 (0.49)	0.50 (0.49)	0.48 (0.49)
Education	0.40 (0.48)	0.47 (0.49)	0.54 (0.49)
Income	5.32 (3.01)	5.63 (3.01)	6.01 (3.02)
Serious	3.76 (0.85)	3.72 (0.80)	3.86 (0.82)
Willing tax	0.27 (0.48)	0.36 (0.48)	0.40 (0.49)
Owns dog or cat	0.05 (0.22)	0.13 (0.34)	0.15 (0.35)
<i>For dog or cat owners</i>			
Adopt source	0.78 (0.41)	0.75 (0.43)	0.70 (0.45)
Monthly expenditure	4.88 (7.63)	6.15 (9.62)	7.05 (10.4)
Number of respondents	3,746	7,036	3,877
Number of observations	134,856	253,296	139,572

Standard deviations are in the parentheses.

Table 5: Conditional logit model results

Variable	(1) Full sample	(2) Not owns dog or cat	(3) Owns dog or cat	(4) Full sample	(5) Not owns dog or cat	(6) Owns dog or cat	(7) Owns dog or cat
Prevention	-0.05** (0.008)	-0.05** (0.009)	-0.06** (0.02)	-0.05** (0.008)	-0.05** (0.009)	-0.06** (0.02)	-0.06 (0.05)
Legal regulation	0.45** (0.01)	0.44** (0.01)	0.47** (0.03)	0.45** (0.01)	0.44** (0.01)	0.47** (0.03)	0.37** (0.07)
Public	-0.12** (0.01)	-0.15** (0.01)	0.03 (0.03)	-0.26** (0.01)	-0.27** (0.01)	-0.05 (0.04)	0.17** (0.08)
% reduction	0.003** (0.0002)	0.002** (0.0003)	0.009** (0.0008)	0.003** (0.0002)	0.002** (0.0003)	0.009** (0.0008)	0.01** (0.002)
Price	-0.18** (0.002)	-0.17** (0.002)	-0.22** (0.006)	-0.18** (0.002)	-0.17** (0.002)	-0.22** (0.006)	-0.24** (0.007)
Optout	-0.20** (0.02)	-0.15** (0.02)	-0.71** (0.06)	-0.20** (0.02)	-0.15** (0.02)	-0.71** (0.006)	-0.72** (0.006)
<i>Interaction variables</i>							
Willing Tax $\times$ Public				0.36** (0.02)	0.36** (0.03)	0.22** (0.07)	0.21** (0.07)
Adopt source $\times$ Prevention							0.001 (0.06)
Adopt source $\times$ Legal regulation							0.14** (0.08)
Adopt source $\times$ Public							-0.31** (0.08)
Adopt source $\times$ % reduction							-0.0003 (0.002)
Price $\times$ Monthly expenditure							0.002** (0.001)
Log-likelihood	-172855.49	-152112.7	-19509.06	-172396.86	-151711.83	-19490.17	-19422.81
# of respondents	14,659	12,942	1,717	14,659	12,942	1,717	1,717
# of observations	527,724	465,912	61,812	527,724	465,912	61,812	61,812

Robust standard errors clustered at respondent level in parentheses.

** Significant at 5 percent or greater; * Significant at 10 percent.

Table 6: Mixed logit model results

Variable	(1) Full sample	(2) Now owns dog or cat	(3) Owns dog or cat	(4) Full sample	(5) Not owns dog or cat	(6) Owns dog or cat	(7) Owns dog or cat
Prevention	-0.40** (0.01)	-0.41** (0.01)	-0.31** (0.04)	-0.40** (0.01)	-0.41** (0.02)	-0.31** (0.04)	-0.31** (0.08)
Legal regulation	0.12** (0.02)	0.12** (0.02)	0.11** (0.04)	0.12** (0.02)	0.12** (0.02)	0.11** (0.04)	-0.04 (0.10)
Public	0.13** (0.02)	0.09** (0.02)	0.45** (0.05)	0.08** (0.02)	0.05** (0.02)	0.33** (0.06)	0.62** (0.11)
% reduction	0.008** (0.0005)	0.007** (0.0006)	0.02** (0.002)	0.007** (0.0005)	0.007** (0.0006)	0.02** (0.001)	0.02** (0.003)
Price	-0.35** (0.004)	-0.34** (0.004)	-0.39** (0.01)	-0.35** (0.004)	-0.34** (0.004)	-0.39** (0.01)	-0.42** (0.02)
Optout	-0.85** (0.07)	-0.66** (0.07)	-2.17** (0.21)	-0.86** (0.07)	-0.67** (0.07)	-2.17** (0.19)	-2.17** (0.18)
<i>Standard deviation</i>							
Prevention	0.71** (0.02)	0.69** (0.03)	0.82** (0.07)	0.71** (0.03)	0.69** (0.03)	0.83** (0.07)	0.86** (0.06)
Legal regulation	0.57** (0.04)	0.53** (0.05)	0.46** (0.18)	0.57** (0.04)	0.53** (0.05)	0.45** (0.19)	0.64** (0.11)
Public	1.27** (0.03)	1.28** (0.03)	1.22** (0.07)	1.27** (0.03)	1.28** (0.03)	1.22** (0.07)	1.23** (0.07)
% reduction	0.03** (0.001)	0.03** (0.001)	0.03** (0.003)	0.03** (0.001)	0.03** (0.001)	0.04** (0.004)	0.03** (0.003)
Optout	4.95** (0.08)	5.12** (0.07)	3.65** (0.19)	4.95** (0.07)	5.12** (0.07)	3.63** (0.18)	4.07** (0.17)
<i>Interaction variables</i>							
Willing Tax $\times$ Public				0.15** (0.04)	0.11** (0.04)	0.29** (0.09)	0.23** (0.09)
Adopt source $\times$ Prevention							-0.04 (0.09)
Adopt source $\times$ Legal regulation							0.21* (0.12)
Adopt source $\times$ Public							-0.41** (0.11)
Adopt source $\times$ % reduction							0.001 (0.003)
Price $\times$ Monthly expenditure							0.003** (0.001)
Log-likelihood	-110023.91	-95750.672	-14093.37	-110013.43	-95745.95	-14087.52	-14016.75
# of respondents	14,659	12,942	1,717	14,659	12,942	1,717	1,717
# of observations	527,724	465,912	61,812	527,724	465,912	61,812	61,812

Robust standard errors clustered at the respondent level in parentheses.

** Significant at 5 percent or greater; * Significant at 10 percent.

Table 7: Latent class model results

Variable	(1) Class 1	(2) Class 2	(3) Class 3
Prevention	-0.18** (0.03)	-0.50** (0.04)	0.02* (0.01)
Legal regulation	0.16** (0.04)	-0.37** (0.06)	0.61** (0.02)
Public	0.08** (0.04)	-0.61** (0.05)	-0.11** (0.02)
Willing Tax $\times$ Public	0.51** (0.04)	0.53** (0.05)	0.05** (0.02)
% reduction	0.004** (0.001)	0.01** (0.001)	0.004** (0.0004)
Price	-0.70** (0.007)	-0.36** (0.01)	-0.10** (0.002)
Optout	-2.58** (0.05)	2.25** (0.05)	-2.37** (0.03)
<i>Class membership variables</i>			
Age	-0.002 (0.001)	0.002 (0.001)	-
Gender	0.04 (0.04)	0.04 (0.041)	-
Education	-0.21** (0.05)	-0.34** (0.05)	-
Income	-0.01* (0.008)	-0.02** (0.007)	-
Serious	0.01 (0.02)	-0.05** (0.02)	-
Owens dog or cat	0.17** (0.06)	-0.84** (0.07)	-
Constant	-0.14 (0.16)	0.41** (0.14)	-
Latent class share	0.26	0.37	0.37
Log-likelihood		-108838.64	
# of respondents		14,659	
# of observations		527,724	

Robust standard errors are in parentheses clustered at respondent.

** Significant at 5 percent or greater; * Significant at 10 percent.

Table 8: Summary of latent classes by choices

	Class 1	Class 2	Class 3	Total
<i>Never</i>	0	134,856	0	134,856
<i>Sometimes</i>	135,396	60,588	57,312	253,296
<i>Always</i>	0	0	139,572	139,572
Total	135,396	195,444	196,884	527,724

Table 9: Summary of latent classes by characteristics

Variable	Class 1	Class 2	Class 3
Age	55.71 (16.78)	58.09 (17.09)	55.13 (16.05)
Gender	0.50 (0.49)	0.51 (0.49)	0.48 (0.49)
Education	0.47 (0.49)	0.41 (0.49)	0.53 (0.49)
Income	5.67 (3.05)	5.38 (2.98)	5.91 (3.03)
Serious	3.79 (0.78)	3.72 (0.83)	3.79 (0.84)
Willing tax	0.39 (0.48)	0.29 (0.45)	0.37 (0.48)
Owens dog or cat	0.16 (0.36)	0.06 (0.24)	0.14 (0.34)
<i>For dog or cat owners</i>			
Adopt source	0.76 (0.42)	0.77 (0.42)	0.71 (0.45)
Monthly expenditure	5.95 (10.22)	4.94 (7.19)	7.17 (10.23)
# of respondents	3,761	5,429	5,469
# of observations	135,396	195,444	196,884

Standard deviations are in the parentheses.

Table 10: Marginal willingness to pay estimates

		Prevention	Legal regulation	Public	% reduction
<i>Conditional logit model</i>					
Full sample	Willing Tax=0	-2771.22** (473.95)	25197.01** (651.67)	-14300.78** (804.31)	184.37** (15.72)
	Willing Tax=1			5922.73** (1095.73)	
Not owns dog or cat	Willing Tax=0	-2974.16** (520.95)	25414.09** (716.14)	-15607.43** (877.17)	145.89** (17.04)
	Willing Tax=1			5138.11** (1205.18)	
Owns dog or cat	Willing Tax=0	-2837.28** (1120.06)	21469.75** (1529.84)	-2543.11 (1983.00)	420.68** (41.34)
	Willing Tax=1			7365.60** (2488.01)	
<i>Mixed logit model</i>					
Full sample	Willing Tax=0	-11588.54** (420.78)	3617.10** (488.52)	2220.49** (633.06)	225.08** (15.32)
	Willing Tax=1			6510.78** (779.57)	
Not owns dog or cat	Willing Tax=0	-12023.26** (462.73)	3632.93** (540.11)	1568.17** (689.49)	200.82** (16.66)
	Willing Tax=1			4754.02** (868.67)	
Owns dog or cat	Willing Tax=0	-7842.18** (1041.35)	2730.66** (1110.21)	8161.67** (1490.51)	459.00** (39.32)
	Willing Tax=1			15539.61** (1791.41)	
<i>Latent class model</i>					
Class 1	Willing Tax=0	-2649.67** (451.51)	2289.27** (648.80)	1130.18** (557.52)	58.76** (15.54)
	Willing Tax=1			8454.92** (606.05)	
Class 2	Willing Tax=0	-13992.11** (1372.14)	-10228.24** (1694.76)	-17052.51** (1510.60)	306.13** (36.34)
	Willing Tax=1			-2270.03 (1487.93)	
Class 3	Willing Tax=0	2195.97* (1326.91)	58869.65** (2753.28)	-11167.64** (1778.48)	425.09** (41.85)
	Willing Tax=1			-6036.15** (2051.82)	
Weighted average	Willing Tax=0	-5044.10** (713.66)	18747.96** (1210.91)	-10198.09** (873.47)	287.17** (20.77)
	Willing Tax=1			-928.42** (956.82)	

Standard errors are in parentheses clustered at respondent.

** Significant at 5 percent or greater; * Significant at 10 percent.

The average exchange rate from 2022 to 2024 was approximately USD 1 = KRW 1320.73.

Table 11: Welfare effects across scenarios

		Scenario 1	Scenario 2	Scenario 3	Scenario 4
<i>Conditional logit model</i>					
Full sample	Willing Tax=0	6828.99** (902.93)	4057.77** (929.37)	17725.22** (1114.43)	1412.68 (1157.49)
	Willing Tax=1			37948.73** (1312.61)	21636.19** (1385.82)
Not owns dog or cat	Willing Tax=0	2838.23** (997.79)	-135.93 (1030.77)	12644.89** (1220.07)	-4437.22** (1264.18)
	Willing Tax=1			33390.43** (1445.79)	16308.31** (1523.83)
Owns dog or cat	Willing Tax=0	34898.94** (2075.84)	32061.66** (2078.31)	53825.57** (2685.38)	42239.17** (2856.62)
	Willing Tax=1			63734.29** (3073.48)	52147.89** (3278.29)
<i>Mixed logit model</i>					
Full sample	Willing Tax=0	21457.72** (2054.19)	9869.18** (2092.10)	27295.32** (2154.89)	11797.06** (2203.68)
	Willing Tax=1			31585.61** (2273.19)	16087.35** (2328.64)
Not owns dog or cat	Willing Tax=0	15898.66** (2043.90)	3875.41* (2073.64)	21099.76** (2161.29)	5116.18** (2220.43)
	Willing Tax=1			24285.61** (2297.85)	8302.03** (2362.40)
Owns dog or cat	Willing Tax=0	58421.04** (5012.97)	50578.85** (5098.17)	69313.37** (5373.81)	58493.37** (5653.55)
	Willing Tax=1			76691.31** (5628.19)	65871.31** (5922.12)
<i>Latent class model</i>					
Class 1	Willing Tax=0	28454.23** (377.41)	25804.55** (554.17)	31873.69** (678.91)	13048.97** (740.94)
	Willing Tax=1			39198.42** (746.24)	20373.71** (810.48)
Class 2	Willing Tax=0	-63408.79** (2007.47)	-77400.90** (2748.15)	-90749.54** (3132.40)	-104627** (2955.82)
	Willing Tax=1			-75967.06** (2871.56)	-89844.49** (2727.16)
Class 3	Willing Tax=0	234087.2** (4930.49)	236283.2** (5407.41)	281789.2** (6183.77)	270291.1** (6398.73)
	Willing Tax=1			286920.7** (6350.29)	275422.6** (6561.01)
Weighted average	Willing Tax=0	71168.48** (1975.86)	66124.38** (2251.69)	79718.35** (2581.85)	65461.69** (2625.60)
	Willing Tax=1			88988.02** (2594.15)	74731.36** (2645.36)

Standard errors are in the parentheses.

** Significant at 5 percent or greater; * Significant at 10 percent.

The average exchange rate from 2022 to 2024 was approximately USD 1 = KRW 1320.73.

Welfare effects scenarios:

Scenario 1: Capture + Private + 30% reduction + 10,000 KRW

Scenario 2: Prevention + Private + 30% reduction + 10,000 KRW

Scenario 3: Regulation + Public + 30% reduction + 10,000 KRW

Scenario 4: Regulation + Public + 50% reduction + 30,000 KRW

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