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Public resource allocation, strategic behavior, and status quo bias in choice experiments

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Public Choice

Public Resource Allocation, Strategic Behavior, and Status Quo Bias in Choice Experiments *

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Public Resource Allocation, Strategic Behavior, and Status Quo Bias in Choice

Experiments *

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Public resource allocation, strategic behavior and status quo bias in choice experiments

Abstract

Choice experiments, a survey methodology in which consumers face a series of choice tasks requiring them to indicate their most preferred option from a choice set containing two or more options are used to generate estimates of consumer preferences to determine the appropriate allocation of public resources to competing projects or programs. The analysis of choice-experimental data typically relies on the assumptions that choices of the non-status quo option are demand-revealing and choices of the status quo option are not demand-revealing, but, rather, reflect an underlying behavioral bias in favor of the status quo. This paper reports the results of an experiment demonstrating that both of those assumptions are likely to be invalid. We demonstrate that choice experiments for a public good are vulnerable to the same types of strategic voting that affect other types of multiple-choice voting mechanisms. We show that owing to the mathematics of choice-set design, what actually is strategic voting often is misinterpreted as a behavioral bias for the status quo option. Therefore, we caution against using current choice-experimental methodologies to inform policy making about public goods.

Keywords: choice experiment, strategic voting, status quo bias, public goods experiment

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Public resource allocation, strategic behavior and status quo bias in choice experiments

1. Introduction

This paper cautions against the growing use and dominance of the choice experimental method to generate estimates of the benefits received from public policies and programs. “Choice experiments” (CEs), a survey method used to uncover consumer preferences, initially were developed and now are used widely in the context of private goods studied by scholars in marketing and transport to reveal consumer preferences and predict market shares for new products (e.g., Louviere and Woodworth 1983; Louviere 1984, 1988; Revelt and Train 1998; Brownstone and Train 1999; McFadden 2001; Hensher, Rose and Greene 2015). However, the methodology soon was applied to informing administrators of public programs and policies in the environmental and healthcare domains, whose outputs largely (or solely) are public goods (e.g., Australian Energy Market Operator 2014; Cameron and DeShazo 2013; Emmerson and Metcalfe 2013; Queen’s University Belfast and Perceptive Insight 2015). Choice-experiment mechanisms can take a variety of forms such as one-shot or repeated choice tasks. On each choice task, participants are presented with a choice set containing two or more options from which they must choose one. In order to be consistent with market settings in which consumers always have the option not to purchase anything, in most choice experiments, one of the options in each choice task always is a ‘no purchase’ (in CEs for private goods) or ‘status quo’ (in CEs for public goods) alternative. Figure 1 reports example choice tasks from choice experiment surveys used in three very different settings: to estimate the demand for quality-differentiated beef (Lusk and Schroeder 2004); to determine the public’s preferences for public lands’ use for endangered species protection versus military training (Smith and McKee 2007); and to estimate preferences for a cervical cancer screening program (Ryan and Wordsworth 2000). The common

[Insert Figure 1 about here]

features of the relevant experimental designs are (1) choice options described in terms of their characteristics, termed attributes, which vary across options; (2) the offer of more than two options from which respondents may choose; (3) information about a price or cost attribute for each option (which enables researchers to estimate willingness to pay); and (4) the presence of a no purchase/no policy change (status quo) option. Because of the gains in statistical efficiency of preference estimates that result from asking respondents to choose from more than two options and presenting respondents with more than one choice task (both of which generate more information about each respondent's preferences, resulting in greater statistical efficiency), most choice experiment surveys employ a repeated multiple choice mechanism, in which participants complete a series of choice tasks similar to those presented in Figure 1. As respondents proceed through the tasks, the characteristics of the purchase/non-status-quo options change, while the characteristics of the no purchase/status quo option remain the same. Using logit-based econometric techniques (McFadden 1986, 2001), researchers can use respondents' stated choices to estimate respondents' willingness to pay for a good or policy as well as their marginal willingness to pay for the attributes of a good or policy.

Although we might expect to obtain reliable preference estimates in the private goods domain, the application of the choice experiment domain to the public goods environment potentially is problematic. In particular, the possibility of strategically biased preference estimates in the public goods environment has been neglected in the literature to date. One of the most common biases in choice experiments that researchers have found is apparent over-selection of the no purchase/status quo option (e.g., Collins and Vossler 2009; Adamowicz et al. 2011), termed status quo bias. The apparent bias in favor of the status quo option can

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4 significantly reduce the estimated value of the public good (Adamowicz et al. 1998), possibly
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6 resulting in misallocations of public resources. Although multiple explanations for the source of
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8 the bias have been advanced in the literature,¹ as well as econometric methods (Adamowicz et al.
9
10 1998) to adjust benefit estimates for the presence of status quo bias, none of the existing studies
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12 considers the role that the underlying incentives of the choice mechanism in a public goods
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14 environment may play in generating bias. That neglect may be explained by the difficulties
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16 inherent in identifying strategic behavior in field survey data.
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21 This paper takes the choice experiment out of the field and into the laboratory in order to
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23 establish whether choice experiments can generate unbiased estimates of the benefits received
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25 from public goods. By taking such an approach, we are able to demonstrate unambiguously that
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27 choice experiments for public goods are vulnerable to the same type of strategic voting that
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29 occurs in multi-candidate elections. Strategic choices center on the second-best option, which,
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31 because of the mathematics of combinatorial choice set design,² is the status quo option in a
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33 disproportionate number of choice tasks. The experimental results demonstrate that it is
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35 inappropriate to interpret the results from choice experiments as either fully demand-revealing,
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37 or as demand-revealing with an adjustment for status quo bias. Both interpretations of choice
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39 experimental data can result in biased estimates of preferences for public goods and, thus,
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41 misallocations of public resources. Because of that potential problem, we argue that current
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43 choice experiment methods to value public goods should be used with caution.
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55 ¹ See, for example, List et al. (2006), Taylor et al. (2010), Carlsson et al. (2007), Bateman et al. (2008), Collins and
56 Vossler (2009), Day and Pinto-Prades (2010), Day et al. (2012) and Aravena et al. (2014).

57 ² By the “mathematics of combinatorial choice set design”, we mean the method by which individual choice options
58 with different levels of attributes are combined into groups of options, termed choice sets. During a choice
59 experimental survey, respondents are presented with a series of tasks, in which they are asked to choose one option
60 from each choice set. Their selection usually is interpreted to indicate the most preferred option in the set.
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We provide three forms of support for this argument: (1) well-known results from the theoretical and applied literature on strategic voting demonstrating voters' incentives to choose their second favorite option in races involving three or more candidates; (2) a model demonstrating how the mathematics of combinatorial choice set design can result in choice experiments in which a large fraction of choice tasks contain the status quo option as the second-best choice; and (3) evidence from an experiment based on three fractional factorial designs showing that behavior in such choice experiments is consistent with the predictions of voting theory. The remainder of this paper lays out the argument by presenting the theoretical and mathematical models in section 2, the experimental design in section 3, the results in section 4, and concluding remarks in section 5.

2. Theory and simulations

2.1 Voting in multi-candidate elections

As the theory of voting is well-known, we provide only a brief summary of it here. Farquharson (1969) provides a comprehensive overview of the topic. Consider a group of n agents voting on the choice of a public program or policy. Suppose that agents choose from three discrete public goods, $g \in \{A, B, C\}$. Each agent i has a complete, reflexive and transitive preference ordering over the three proposed programs, which can be represented by a utility function $u_i(g)$. In order to determine which program to provide, the public agency conducts a vote. Each agent i casts a vote $v_i(g)$. Under a plurality voting rule, the agency's decision is to provide the public program that receives the most votes, g^* . Thus, each agent's problem is to choose his or her vote $v_i(g)$ to maximize own-utility, $u_i(g)$, conditional on the distribution of votes of the other group members. In the case of uniform priors, in which agent i believes that the other group members' votes are distributed equally across the three outcomes, agent i 's best response is to vote for his or her

most preferred option. In that case, agent i 's vote is demand-revealing. However, if agent i has non-uniform priors about the distribution of others' votes, the voter may have incentive to vote for an option other than the one he or she most prefers. For example, if agent i 's preferences are such that $u_i(A) > u_i(B) > u_i(C)$, but her priors are

$$\sum_{j \neq i} v_j(C) > \sum_{j \neq i} v_j(B) > \sum_{j \neq i} v_j(A), \quad (1)$$

then agent i can potentially improve her utility by voting for her second most-preferred option rather than her most preferred option, in order to prevent the least-preferred option from winning. In such cases, agent i 's vote is not demand-revealing.

Strategic voting of that type is perhaps the most well-known result of voting theory. It has been demonstrated to occur in laboratory settings under conditions of full information about the distribution of the preferences of the other voters (Felsenthal et al. 1988; Forsythe et al. 1993; Meginnis et al. 2018) and in field settings wherein voters have only partial information about the distribution of other voters' preferences (Fujiwara 2011; Kawai and Watanabe 2013). Given that the incentive structure of each choice task in a choice experiment mechanism for a public good is identical to that of a multi-candidate election, it is reasonable to expect that a similar type of strategic voting might take place in choice experiment surveys. We demonstrate below that owing to the mathematics of combinatorial choice set design, strategic votes for the second-best option are likely to disproportionately favor the status quo option.

2.2. Combinatorial choice set design and the second-best option

We begin with a few definitions:

Definition 1: A *choice experiment* is a survey in which a respondent faces a series of choice tasks such as the ones illustrated in Figure 1. On each choice task, the respondent faces a choice set from which s/he must select one option.

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4 Definition 2: A *choice set* is a collection of two or more *choice options*. The number of options
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6 in the choice sets illustrated in Figure 1 ranges from three (for the land use and health studies) to
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8 six (for the beef study). In most choice experiment surveys, including the ones illustrated in
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10 Figure 1, one of the choice options typically is the no purchase/status quo option.
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14 Definition 3: A *choice option* is a version of the good that the respondent may choose. Each
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16 choice option is described in terms of the quantity of each *attribute* it possesses. Choice options
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18 in Figure 1 include five different types of steak and a no purchase option, two alternative land
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20 use policies along with a keep current policy (status quo) option, and two alternative cancer
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22 screening program options along with a no screening option.
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26 Definition 4: An *attribute* is a characteristic of a good. The amount of an attribute that a good
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28 possesses may be described using discrete or continuous numerical values. The cost or price of
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30 an option usually is one of the attributes in order to facilitate the estimation of a respondent's
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32 willingness to pay. In Figure 1, the attributes of the steaks are limited to their prices and a
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34 descriptor of their qualities (e.g., "Guaranteed Tender"). The attributes of the land use policy
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36 include the cost of each policy per household and the impact of the policy on species survival
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38 and soldiers' readiness (both of which can take on levels of low, medium, or high). Attributes of
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40 the cancer screening program include the time between Pap smears, the time to obtain results, the
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42 chance of being recalled, the chance of an abnormality being discovered, the chance of dying
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44 from cervical cancer, and the cost.
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51 In the derivation that follows, we consider fundamental principles of attribute-balanced
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53 choice set design applied to experiments eliciting preferences for public goods. An attribute
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55 balanced choice set is a choice set in which every choice option is described using the same
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57 number of attributes, and each attribute has the same number of possible levels. In Figure 1, the
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choice sets in the land use study are attribute-balanced. The mathematical results below generalize easily to choice sets in which different attributes have different numbers of possible levels.³ In choice sets in which each of m attributes has n levels, n^m possible choice options can be combined into choice sets. One of more of those options are combined with the status quo/no purchase option (whose attributes are fixed) to create a choice set. To illustrate the effect of such a choice set design process, we let π represent the proportion of the non-status-quo choice options that are preferred by the voting public to the status quo. We make the simplifying assumption that all voters have the same value of π . The result generalizes to the more realistic assumption that the values of π are distributed non-uniformly across the voting population. Therefore, given the values of n , m , and π , πn^m choice options are preferred to the status quo option, and $(1 - \pi)n^m$ choice options are not preferred to the status quo.

A choice experiment in which respondents face a sufficient number of options that they choose from all possible combinations in choice sets of a given size is termed a full factorial choice experiment. We consider a full factorial choice experiment in which on each choice task, respondents must choose from a three-option choice set consisting of two options plus the status quo. We focus our analysis on that type of choice experiment both because it is the simplest choice experimental design in which the choice tasks contain more than two options, and because such choice experimental designs are adopted frequently in applied public goods settings (Ferrini and Scarpa 2007). In a full factorial choice experiment in which each choice set contains two options plus the status quo, the total number of possible choice sets is $n^m(n^m - 1)$. In $(\pi n^m)(\pi n^m - 1)$ of those choice sets, the status quo will be the least-preferred option. In $[(1 - \pi)n^m][(1 - \pi)n^m - 1]$ of these choice sets, the status quo will be the most-preferred option.

³ A proof of the generalized result is available from the authors.

Those considerations yield

$$n^m(n^m - 1) - \{\pi n^m(\pi n^m - 1) + [(1 - \pi)n^m][(1 - \pi)n^m - 1]\} \quad (2)$$

choice sets in the full factorial design in which the status quo option is the second-best option. In the limit (as either $n \rightarrow \infty$ or $m \rightarrow \infty$), the ratio of this number to the total number of choice sets is $2\pi(1 - \pi)$. Furthermore, the limiting fraction of total possible choice sets in the full factorial design in which the status quo is either the most-preferred or second-most-preferred option is $(1 - \pi^2)$.

[Insert Table 1 about here.]

2.3. Calculations and simulation results

The derivation above demonstrates that the status quo is likely to be the first-best or second-best position in a large fraction of choice sets. In a full factorial choice experiment in which half the options are preferred to the status quo and half are not ($\pi = 0.50$), the status quo will be the first-best or second-best position in $(1 - (0.5)^2) = 75\%$ of the choice sets. That result is for large values of n or m and all possible choice sets. Table 1 reports the proportion of choice sets in which the status quo option is first-best or second-best for small values of n or m when $\pi = 0.5$. Table 1 shows that the limiting case is reached very quickly.

Typically, field choice experiments do not adopt full factorial designs, as they would require respondents to complete an inordinate number of choice tasks. Choice experiments using a subset of the choice sets from the full factorial design are termed fractional factorial choice experiments. We apply three techniques to derive fractional factorial choice experiment designs from the full factorial design to examine the extent to which the predictions of the mathematical model for the latter hold for the former. We derive designs for choice experiments containing 12 choice tasks in which the choice sets are either utility balanced (Huber and

[Insert Table 2 about here.]

[Insert Table 3 about here.]

Zwerina 1996), orthogonal on the attribute level differences (Kanninen 2002; Street et al. 2005), or randomly drawn from the full factorial design. Each option in each choice set has three attributes, one of which is the cost, and each attribute has two possible levels. The status quo option contains baseline levels of each attribute at no cost. Table 2 illustrates a sample choice set used in the simulation. In order to generate a simulated voter's rank-ordering of the options in a choice set, we assume the following utility function:

$$\text{Utility} = (\text{Marginal value of attribute A} \times \text{Units of A}) + (\text{Marginal value of attribute B} \times \text{Units of attribute B}) - \text{Cost.} \quad (3)$$

By varying a voter's marginal valuations of the attributes in equation (3), we can vary the value of π and calculate a voter's simulated utility for each choice option, as well as their rank-ordering of each choice option in each choice set. Table 3 reports the results of the simulations, and demonstrates that the mathematical predictions based on the value of π applied to a full factorial design are reasonable estimates of the fraction of choice sets in a fractional factorial design that will contain the status quo as the second-best or first-best or second-best option.

Although the status quo option is likely to be the second-best position in a large percentage of choice sets, voters have incentive to cast non-demand revealing votes for the second-best option only if they hold non-uniform priors on the distribution of other voters' preferences. In order to examine whether the second condition is satisfied, we employ the orthogonal on the attribute level differences choice experiment design from the simulations in Table 3, and ask what the distribution of preferences over choice options in each choice set would be if the distribution of π were uniform. Table 4 reports the results of that exercise.

[Insert Table 4 about here.]

Uniform distributions of voter preferences over choice options clearly are not the norm, which means that it may not be reasonable to assume that voters have uniform priors about the distribution of votes. Thus, the conditions necessary for strategic voting appear to be present in choice experiments and, as a result of the mathematics of combinatorial choice set design, many of the strategic votes are likely to be for the status quo option, which will frequently fall in the second best position in a choice set.

3. Experimental design

3.1 Rules of the game

The experiment reported below is designed to simulate a field choice experiment. In the experiment, subjects in groups of nine, which remain the same for the entire experimental session, vote on a series of 12 ballots for a public good, which for the purposes of the experiment is characterized as a group investment for which earnings vary across subjects. Each ballot contains a choice set containing three options. Each option has two attributes and a cost. We reserve additional details about the choice sets for the following section on induced values.

The order of ballots is randomized across subjects. Subjects complete each ballot one by one and submit them to the experimental moderator. All ballots are cast privately; each subject sees the information only on his or her own ballot. After the 12 rounds of voting are completed, one ballot is selected randomly from the 12 to be binding using the roll of a 12-sided die. The votes on the binding ballot are counted and a plurality voting rule is applied, so that the choice option on the binding ballot with the most votes wins. Two-way ties are resolved using the toss of a fair coin, and three-way ties are resolved by rolling a fair six-sided die. The winning option is announced, and subjects compute their earnings for the winning option using the formula:

[Insert Figure 2 about here.]

$$\text{Earnings} = 6 + (\text{Marginal value of attribute A} \times \text{Units of attribute A}) + (\text{Marginal value of attribute B} \times \text{Units of attribute B}) - \text{Cost} \quad (4)$$

Subjects know all of the rules of the game at the beginning of the experiment. Each subject knows that other members of the group may face a different set of choice options on any given ballot and that other subjects also may have different marginal values for each attribute, but no subject knows the overall distribution of marginal values or possible choice options. Figure 2 presents a sample ballot.

3.2. Choice set designs

Each choice option contains three attributes (A, B and Cost) with two levels. Attribute A has possible levels of 1 or 2, Attribute B has possible levels of 1 or 3, and the Cost is either 5 or 10. This design is the simplest possible design that mimics a field choice experiment. A full factorial choice experiment design contains $2^3 = 8$ possible choice options which can be combined into 56 possible multiple-choice sets containing two different options and the status quo option. The status quo option contains 1 unit of attribute A, 1 unit of attribute B, and is available at zero cost.

In order to test whether behavior differs in different types of choice experiment designs, we employ three methods to reduce the number of choice sets from the full factorial: orthogonality on the attribute level differences (Kanninen 2002; Street et al. 2005), utility balance (Huber and Zwerina 1996) and random. In an orthogonal choice set in which each attribute has only two levels, if one attribute of one option in the set has the high level, that same attribute in the other option in the choice set will be assigned the low level. Thus, the smallest possible choice experiment that results from a 2^3 factorial design is one containing 12 choice

sets. For consistency, choice experiments designed using the random and utility balanced methodologies also contain 12 choice sets. Normally, to create utility-balanced choice sets, the designer would have to make assumptions regarding the choice options that are likely to be considered better or worse by respondents in order to generate the property of utility balance. In an induced-value setting, subjects' induced utility for each choice option is known in accordance with earnings equation (4). Thus, we create a different set of utility-balanced choice sets for each set of induced values. All choice set designs are reported in the supplemental materials.

[Insert Table 5 about here.]

3.3. *Induced values*

The experimental design incorporates three sets of induced values, corresponding to π values of 0.125, 0.50 and 0.75. Table 5 reports the marginal values of attributes A and B associated with each value of π .

The combination of three methods to create fractional factorial choice experimental designs and three sets of induced values results in nine experimental conditions. Within an experimental session, which could contain up to 27 participants, subjects are assigned randomly to a group of nine that play either the orthogonal, utility-balanced or random version of the choice experiment.⁴ Within a group of nine, each subject is assigned randomly an induced value. Subjects are blinded to the method by which their choice sets were created, the induced values of the other individuals in their group, and the overall distribution of induced values. Moderators also are blinded to the distribution of induced values in the group. Two-hundred-and-seventy student volunteers from a US university participated in the experiment, resulting in a sample of

⁴ If the number of subjects who showed up was not divisible by nine, the unassigned subjects were invited to participate in a different experimental session at a later time. Prior to starting the experiment, all subjects completed an informed consent process. Subjects were free to leave at any time.

30 subjects for each choice experiment design-induced value combination. Since each subject votes 12 times, a total of 360 observations per choice experiment design-induced value combination were collected, or 1080 total observations for each choice experiment design methodology. The experiment takes 40 to 45 minutes to complete, and average experimental earnings ranged from \$15 to \$20.⁵

4. Results and discussion

The results to be reported demonstrate that (1) strategic voting occurs in choice experiments for public goods; (2) strategic votes for the status quo option happen a predictable percentage of the time; and (3) most choices of the status quo option are not examples of status quo bias, but rather, are demand-revealing. As a consequence, it is inappropriate to interpret the data from choice experiments as either fully demand-revealing, or as subject to a behavioral bias in favor of the status quo. Public policy choices informed by analyses based on either of those two interpretations may result in inefficient allocations of public resources. In the discussion that follows, all p-values are calculated using standard errors clustered at the individual subject level to account for within-subject correlation of errors.⁶

4.1 Result 1: Strategic voting occurs in choice experiments for public goods.

One-hundred-fourteen subjects (42% of all subjects) cast at least one vote for the second-best option in a choice set during the experiment. As reported in Table 6, votes for the second-best option constitute over 70% of all non-demand revealing votes. Conditional on a vote being non-

⁵ The experiment was conducted under the oversight of the university's Institutional Review Board (IRB). All experimental instructions are available in the online supplementary materials. Experimental data are available from the corresponding author upon request.

⁶As a check, we re-calculated all standard errors and p-values by controlling for clustering at the group level instead of at the subject level. Generally speaking, standard errors and p-values when controlling for clustering at the group level are the same or smaller than when controlling for non-independence at the individual subject level. Controlling for non-independence at the group level does not change any of the conclusions reported below.

[Insert Table 6 about here.]

demand revealing, no significant differences are found in the fractions of votes for the second-best alternative across choice experiment design treatments ($0.55 \leq p \leq 0.90$). Subjects with low values of π are significantly more likely than other subjects to vote for the second-best option ($p < 0.01$). No other significant differences are evident in the nature of non-demand revealing behavior across subject types.

[Insert Figure 3 about here.]

[Insert Figure 4 about here.]

Figure 3 reports the frequency of the total number of second-best votes cast by individual subjects. The vast majority of subjects who cast second-best votes cast one or two votes for the second-best option out of a possible 12. Subjects tend to vote for the second-best option when a very bad third option is offered in a choice set. Including the status quo option, nine possible choice options can be combined into choice sets. Figure 4 reports the ranking out of nine of the worst option in each choice set for those ballots for which non-demand revealing votes were cast for the second-best alternative. When subjects cast a non-demand revealing vote for the second-best alternative, 65% of the time the ballot contained a third option that ranked 7th, 8th, or 9th out of the possible nine alternatives. Seventy-nine percent of those ballots contained a third alternative that fell in the bottom half of the ranking. Most non-demand revealing votes are for the second-best option, tend to occur when a bad third option is included in the choice set and tend to be cast more often by the $\pi = 0.125$ subjects (who have many more bad options in their choice sets). The combination of these three results demonstrates that non-demand revealing behavior is not random, but rather follows a pattern consistent with a model of strategic voting.

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4 The overall rate of strategic voting in the experiment is 8%. That frequency of strategic
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6 voting is well within the range of rates of strategic voting observed previously in the laboratory
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8 (as high as 50%, as reported in Felsenthal et al. 1988; Forsythe et al. 1993) and in the field
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10 (1.2%, as reported in Kawai and Watanabe 2013). In most laboratory studies of strategic voting,
11
12 subjects have complete information about the distribution of other voters' preferences, providing
13
14 full information about non-uniform priors and making the incentives for strategic voting
15
16 completely transparent. Obviously, such information is not available to voters in the field. In
17
18 the experiment at hand, subjects have complete information about their own preferences (as in
19
20 other laboratory studies), but must form their own priors about the distribution of preferences of
21
22 other members of the group (as in field studies). Given that the experimental design contains
23
24 elements of both the lab and the field, it is not surprising to observe rates of strategic voting that
25
26 are consistent with and within the range of results reported previously from the lab and the field.
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33 [Insert Table 7 about here.]
34
35

36 *4.2. Result 2: Strategic votes for the status quo option happen a predictable percentage of the*
37
38 *time.*
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40

41 The first five rows of Table 7 report the predicted fractions of votes for the second-best option
42
43 when that option is the status quo. The last three rows of Table 7 show the observed fraction of
44
45 second-best votes for the status quo. By comparing the last three rows to the rows above them, it
46
47 is possible to examine the extent to which strategic votes for the status quo are consistent with
48
49 the mathematical predictions based on the value of π .
50
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52

53
54 Subjects may deviate from those predictions by casting a second-best vote for the status
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56 quo more or less often than predicted by the model, depending on when they choose to cast votes
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58 for a second-best option. If they are casting second-best votes more often in choice tasks in
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4 which the status quo is not in the second-best position, the observed fraction of second-best votes
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6 for the status quo option will be less than predicted by the value of π . If they are casting second-
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8 best votes more often on choice tasks when the status quo is in the second-best position, then the
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10 observed fraction of second-best votes for the status quo will be greater than predicted by the
11
12 value of π . Both outcomes are observable in Table 7. The choice tasks on which subjects may
13
14 choose to cast second-best votes depends on a subject's priors and how bad the third alternative
15
16 is for them, which varies across choice sets and by values of π . The exceptions to that
17
18 conclusion are the orthogonal choice sets for $\pi = 0.50$ subjects. Since all of the orthogonal
19
20 choice sets contain the status quo in the second-best position, all second-best votes necessarily
21
22 are cast for the status quo alternative. The key message of Table 7 is, with the exception of the
23
24 utility-balanced treatment, that the fraction of second-best votes for the status quo generally is
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26 consistent with the mathematical predictions based on the value of π . Thus, strategic votes for
27
28 the status quo as the second-best option happen a predictable percentage of the time.
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37 [Insert Table 8 about here.]
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40 *4.3. Result 3: Most choices of the status quo option are not examples of status quo bias, but*
41
42 *rather, are demand-revealing choices.*
43

44 Table 8 reports the overall rates of demand revelation by choice experiment design methodology
45
46 and π . Although some differences in rates of demand revelation by choice experiment design are
47
48 evident,⁷ the main message of the table is about how demand revelation differs by value of π .
49
50 Overall, subjects who have low values of π are significantly less likely to cast a demand-
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52 revealing vote than other subjects ($p = 0.03$ for $\pi = 0.125$ versus 0.50 ; $p = 0.02$ for $\pi = 0.125$
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54
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58 ⁷ The overall rate of demand revelation is significantly less in the UBAL treatment than the OOD treatment ($p =$
59 0.02). No other significant differences in rates of demand revelation are evident across methods to create fractional
60 factorial choice experiment designs.
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versus 0.75). Such subjects prefer the status quo to most of the other available choice options and have many bad options in the choice sets that they face. They are precisely the subjects whom voting theory predicts are likely to vote strategically, which is what we observe in Table 8.

[Insert Table 9 about here.]

Although the results demonstrate that strategic votes for the second-best option are cast for the status quo option in a predictable fraction of choices, it likewise is the case that most votes for the status quo option are not strategic, but rather are demand-revealing. Table 9 reports the fraction of status quo votes that are demand revealing. That fraction differs significantly ($p < 0.01$ for all differences) by a subject's value of π in exactly the direction predicted by the mathematics of combinatorial choice set design. Those subjects who have very few choice options that are better than the status quo (those with $\pi = 0.125$) cast demand-revealing votes frequently for the status quo, while those who have many choice options that are better than the status quo ($\pi = 0.75$) cast demand-revealing votes for the status quo much less often. Of 1031 total votes for the status quo, 954 are demand-revealing. Of the 77 votes that remain, 54 (70%) are strategic votes for the status quo when it is the second-best option in the choice set. Thus, only 23 votes for the status quo, of a total of 1031 status quo votes cast, appear to exhibit what we might term "status quo bias". Thus, when the incentives of the choice mechanism are accounted for, status quo bias appears to be a rare phenomenon in choice experiments for a public good.

5. Conclusion

Moving from the laboratory to the field, the results reported herein have clear implications for any application of choice experimental data to public decision-making. When choice experiment

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4 data are analyzed to generate estimates of consumer preferences for use in determining the
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6 appropriate allocation of public resources to competing projects or programs, normally the data
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8 analysis hinges on two assumptions: (1) choices of the non-status quo option are demand-
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10 revealing; and (2) choices of the status quo-option are not true reflections of underlying
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12 preferences, but rather reflect an underlying behavioral bias in favor of the status quo. The
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14 experimental results reported here, which are robust to the types of choice experiment design
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16 methodologies tested, demonstrate that both assumptions are likely to be invalid. The only
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18 reason that non-demand revealing choices center more often on the status quo option is because
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20 the status quo option appears in every choice set, and owing to the mathematics of combinatorial
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22 choice set design, is likely to rank in first-best or second-best position in a choice set a large
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24 percentage of the time. Because it is easier to distinguish choices of the status quo from other
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26 choices in the data, the apparent over-selection of the status quo has been interpreted to reflect
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28 behavioral bias on the part of consumers. The experiment in this paper demonstrates that it is far
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30 more likely that consumers are making either a demand-revealing choice of their favorite option
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32 in the choice set, or a strategic choice of the second-best option in order to prevent a very bad
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34 third option from winning. Failure to account for the incentive structures inherent in the
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36 multiple-choice voting mechanism for public goods is likely to result in mis-estimation of
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38 preferences and, hence, misallocation of public resources. Thus, we caution against the use of
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40 the choice experiment methodology as currently practiced as a way of informing public policy
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42 decisions.
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53 Based on the results, we recommend that, in the future, researchers focus their attention
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55 on developing new mechanism designs that are free of the incentive properties that we describe
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herein or use alternative methods to analyze choice data that exploit the information that is present in a respondent's choice of the second-best option.

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Number of attributes (m)				
Number of attribute levels (n)		2	3	4
	2	0.833	0.786	0.767
	3	0.781	0.760	0.753
	4	0.767	0.754	0.751

Table 1. Proportion of choice sets with status quo as first-best or second-best option when

$$\pi = 0.5$$

<u>Option 1</u>	<u>Option 2</u>	<u>Option 3 (current portfolio)</u>
1 unit of A	2 units of A	1 unit of A
3 units of B	1 unit of B	1 unit of B
Cost = 5	Cost = 10	Cost = 0

Table 2. Sample choice set from a simulation exercise

	Fraction of choice sets in which the status quo is second-best			Fraction of choice sets in which the status quo is first- or second-best		
	$\pi = 0.125$	$\pi = 0.50$	$\pi = 0.75$	$\pi = 0.125$	$\pi = 0.50$	$\pi = 0.75$
Full factorial prediction: $n = 2, m = 3$	0.25	0.57	0.43	1.00	0.79	0.46
Full factorial prediction: limiting case	0.22	0.50	0.38	0.98	0.75	0.44
Orthogonal fractional factorial choice experiment design	0.25	1.00	0.50	1.00	1.00	0.50
Utility-balanced fractional factorial choice experiment design	0.08	0.33	0.33	1.00	0.75	0.42
Random fractional factorial choice experiment design	0.17	0.67	0.42	1.00	0.75	0.50

Table 3. Full-factorial predictions of fractions of choice sets containing status quo as second-best or first- or second-best option versus actual results for fractional factorial choice experiment designs

Choice set	Share preferring Option 1	Share preferring Option 2	Share preferring the status quo
1	0%	57%	43%
2	86%	0%	14%
3	86%	0%	14%
4	0%	57%	43%
5	71%	0%	29%
6	14%	29%	57%
7	0%	86%	14%
8	29%	14%	57%
9	0%	71%	29%
10	29%	14%	57%
11	0%	71%	29%
12	57%	0%	43%

Table 4. Distribution of voter preferences assuming a uniform distribution of π

π	Marginal value of attribute A	Marginal value of attribute B
0.125	3	2
0.50	3	7
0.75	11	7

Table 5. Induced values

	Mean	Robust std. error	95% conf. int.
By method to create fractional factorial choice set designs			
Orthogonal	0.79	0.051	[0.69, 0.89]
Utility-balanced	0.82	0.050	[0.72, 0.92]
Random	0.83	0.046	[0.74, 0.92]
By fraction of choice options preferred to the status quo (π)			
$\pi = 0.125$	0.87	0.035	[0.80, 0.94]
$\pi = 0.50$	0.79	0.048	[0.70, 0.89]
$\pi = 0.75$	0.73	0.064	[0.61, 0.86]

Table 6. Fraction of non-demand revealing votes for the second-best alternative

	Fraction of choice sets in which the status quo is second-best		
	$\pi = 0.125$	$\pi = 0.50$	$\pi = 0.75$
Full factorial prediction: $n = 2, m = 3$	0.25	0.57	0.43
Full factorial prediction: limiting case	0.22	0.50	0.38
Orthogonal fractional experimental design	0.25	1.00	0.50
Utility-balanced fractional experimental design	0.08	0.33	0.33
Random Fractional Experimental Design	0.17	0.67	0.42
Experimentally observed fraction of second-best votes for the status quo			
Observed: Orthogonal experimental results (Robust standard error)	0.03 (0.04)	1.00 (N/A)	0.40 (0.15)
Observed: Utility-balanced experimental results (Robust standard error)	0.04 (0.03)	0.07 (0.03)	0.47 (0.18)
Observed: Random experimental results (Robust standard error)	0.02 (0.02)	0.80 (0.16)	0.39 (0.10)

Table 7. Predicted and observed votes for second-best options that are the status quo option

	Mean	Robust std. error	95% Conf. int.
By method to create fractional factorial choice experiments			
Orthogonal	0.93	0.015	[0.90, 0.95]
Utility-balanced	0.87	0.019	[0.83, 0.91]
Random	0.90	0.019	[0.86, 0.93]
By fraction of choice options preferred to the status quo (π)			
$\pi = 0.125$	0.85	0.024	[0.81, 0.90]
$\pi = 0.50$	0.92	0.015	[0.89, 0.95]
$\pi = 0.75$	0.92	0.016	[0.89, 0.95]

Table 8. Rates of demand revelation

By method to create fractional factorial choice experiments			
Orthogonal	0.89	0.037	[0.81, 0.96]
Utility-balanced	0.95	0.026	[0.90, 1.00]
Random	0.93	0.027	[0.87, 0.98]
By fraction of choice options preferred to the status quo (π)			
$\pi = 0.125$	0.99	0.003	[0.99, 1.00]
$\pi = 0.50$	0.84	0.048	[0.75, 0.94]
$\pi = 0.75$	0.56	0.079	[0.41, 0.72]

Table 9. Fraction of status quo votes that are demand revealing

Sample choice task for quality-differentiated beef steaks (Lusk and Schroeder 2004, p. 469).^a

Scenario 11	Steaks					None of These
	Generic \$6.75	Guaranteed Tender \$7.88	Natural \$9.00	USDA Choice \$5.63	Certified Angus Beef \$7.88	
I would choose . . .	☐	☐	☐	☐	☐	☐

Sample choice task for use of public land for endangered species protection versus military training (Smith and McKee 2007, p. 232).^b

Question 5

Suppose the following three options were the only options available for managing the balance between endangered species encroachment and the DOD training mission. Please indicate which option you prefer by placing an "X" in one of the boxes below.

Feature	Option A	Option B	Option C: Current Status
Payment per household	\$50	\$75	None
Impact on species survival	High	Medium	Low
Impact on soldiers' readiness	Medium	Low	High

☐ I would choose A

☐ I would choose B

☐ I would choose C

Sample choice task for a cervical cancer screening program (Ryan and Wordsworth 2000, p. 511).^c

• Choice 1	Option A	Option B
Time between smears (years)	3	1
Time for results (days)	28	10
Chance of being recalled	11 %	20 %
Chance of abnormality	10 %	10 %
Chance of dying from cervical cancer	2 %	0.8 %
Cost of each smear (£)	5	20

Prefer Option A Prefer Option B Prefer no screening

Which Option would you prefer? (tick one box only)

☐ ☐ ☐

^aLusk, J. & Schroeder, T. (2004). Are choice experiments incentive compatible? A test with quality-differentiated beef steaks. *American Journal of Agricultural Economics*, 86(2), 467-482. By permission of Oxford University Press. ^bSmith, J. & McKee, M. (2007). 'People or prairie chickens' revisited: stated preferences with explicit non-market trade-offs. *Defence and Peace Economics*, 18(3), 233-244. Taylor & Francis Ltd. Reprinted by permission of the publisher. ^cRyan, M. & Wordsworth, S. (2000). Sensitivity of willingness to pay estimate to the level of attributes in discrete choice experiments. *Scottish Journal of Political Economy*, 47(5), 504-524. © Scottish Economic Society 2000. John Wiley & Sons. Reprinted with permission of the publisher.

Figure 1. Sample choice tasks from choice experiment surveys (Lusk and Schroeder 2004, Smith and McKee 2007, Ryan and Wordsworth 2000)

Your value of A is: 3
Your value of B is: 7

Option 1

1 unit of **A**
3 units of **B**
Cost = 5

Option 2

2 units of **A**
1 unit of **B**
Cost = 10

Option 3 (current portfolio)

1 unit of **A**
1 unit of **B**
Cost = 0

Please select which option you wish to vote for below:

☐

Option 1

☐

Option 2

☐

Option 3

Figure 2. Sample experimental ballot

Figure 3. Frequency of number of second-best votes per subject

Figure 4. Ranking (out of 9) of the worst option in a choice set when a non-demand revealing vote for the second-best option was cast

Sample choice task for quality-differentiated beef steaks (Lusk and Schroeder 2004, p. 469).^a

Scenario 11	Steaks					
	Generic \$6.75	Guaranteed Tender \$7.88	Natural \$9.00	USDA Choice \$5.63	Certified Angus Beef \$7.88	None of These
I would choose ...	↓ ☐	↓ ☐	↓ ☐	↓ ☐	↓ ☐	↓ ☐

Sample choice task for use of public land for endangered species protection versus military training (Smith and McKee 2007, p. 232).^b

Question 5

Suppose the following three options were the only options available for managing the balance between endangered species encroachment and the DOD training mission. Please indicate which option you prefer by placing an "X" in one of the boxes below.

Feature	Option A	Option B	Option C: Current Status
Payment per household	\$50	\$75	None
Impact on species survival	High	Medium	Low
Impact on soldiers' readiness	Medium	Low	High

☐ I would choose A

☐ I would choose B

☐ I would choose C

Sample choice task for a cervical cancer screening program (Ryan and Wordsworth 2000, p. 511).^c

• Choice 1

	Option A	Option B
Time between smears (years)	3	1
Time for results (days)	28	10
Chance of being recalled	11 %	20 %
Chance of abnormality	10 %	10 %
Chance of dying from cervical cancer	2 %	0.8 %
Cost of each smear (£)	5	20

Prefer

Option
A

Prefer Option B

Prefer no
screening

Which Option would you
prefer? (tick one box only)

☐
☐
☐

Figure 3

Figure 4

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