Status Quo Bias under Uncertainty: An Experimental Study*

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Abstract

Individuals' tendency to stick to the current state of affairs, known as the status quo bias, has been widely documented over the past 30 years. Yet, the determinants of this phenomenon remain elusive. Following the intuition suggested by Bewley (1986), we conduct a systematic experiment exploring the role played by different types of uncertainty on the emergence of the bias. We find no bias when the status quo option and the alternative are both risky (gambles with known probabilities) or both ambiguous (gambles with unknown probabilities). The bias emerges under asymmetric presence of ambiguity, i.e., when the status quo option is risky and the alternative ambiguous, or vice versa. These findings are not predicted by existing models based on loss aversion (Kahneman and Tversky, 1979) or incomplete preferences (Bewley, 1986) and suggest a novel determinant of the status quo bias: the *dissimilarity* between the status quo option and the alternative.

Keywords: Status Quo Bias, Risk, Ambiguity, Reference Effects, Experiment.

JEL Codes: C91, D11, D81.

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1 Introduction

In their seminal work, Samuelson and Zeckhauser (1988) coined the term *status quo bias* to describe the tendency of decision makers to stick to the current state of affairs. In a series of field and lab experiments they showed that individuals choose to keep their status quo option more frequently than would be predicted by the classic model of choice. Following these original findings, the status quo bias has been established as a widespread phenomenon whose effects have been observed in many contexts, such as the markets for retirement plans (Madrian and Shea, 2001), electric services (Hartman et al., 1991), organ donations (Johnson and Goldstein, 2003), financial assets (Kempf and Ruenzi, 2006) and Medicare (Ericson, 2012). However, while heavily documented, the status quo bias is not universally present and its magnitude varies across domains and depending on decision makers' characteristics.[1]

One possible determinant of status quo bias is the ambiguity associated with the alternatives in the choice set. It stands to reason that when the environment is well known to the decision maker, he might not hesitate to trade one option for another. However, when there is uncertainty regarding the relative ranking of the options, the decision maker may prefer to act "cautiously" and stick to the current state of affairs.

This hypothesis was originally advanced by Bewley (1986). He introduces the "inertia" assumption (which is, in fact, a status quo bias assumption[2]) according to which the agent would not move away from his current position unless one of the alternative options dominates it, i.e., is unambiguously better. Bewley also suggests to experimentally test the inertia assumption in relation to the presence of ambiguity in the choice set. Surprisingly

[1]For example, List (2003, 2004) finds that individuals with more trading experience are less prone to the bias. The size of the choice set, on the other hand, has a positive effect on the bias (Samuelson and Zeckhauser, 1988; Dean, 2008; Kempf and Ruenzi, 2006; Redelmeier and Shafir, 1995).

[2]The terms status quo bias and inertia will be used interchangeably in this paper.

enough, in the 30 years that have passed since, no experiment has investigated how different types of uncertainty affect status quo bias. While numerous experiments have examined the endowment effect (Thaler, 1980) in the uncertainty domain[3], the status quo bias literature has mostly focused on everyday ordinary goods as in the well-known study by Knetsch (1989).[4]

In this paper we attempt to fill this gap by examining the relationship between inertia and uncertainty. For this purpose, we make use of ambiguous prospects, i.e., gambles for which the probabilities are not objectively specified, and non-ambiguous (but risky) prospects, i.e., gambles with specified probabilities (which we will also refer to as risky lotteries or, simply, lotteries). We construct a 2-by-2 design where the status quo option and the alternative may be either risky or ambiguous and test whether inertia arises in each case. In every treatment we perform an identical within-subject design: Subjects' preferences over gambles are initially elicited through pairwise comparisons without a status quo option. Subsequently, subjects receive an endowment and face the same choices again. This time around, questions are presented in the form of a switch from the endowment to the alternative. Comparing choices with and without an endowment allows us to assess the presence and magnitude of the status quo bias for each uncertainty structure.[5]

Our results are summarized in Table 1. We find no bias when the status quo option and the alternative are both risky or both ambiguous. The bias emerges under asymmetric presence of ambiguity, i.e., when the status quo option is risky and the alternative ambigu-

[3]Notice the difference between the status quo bias, a phenomenon reflected through choices between goods, and the endowment effect (Thaler, 1980), defined as the gap in the evaluations of a good when it is in the possession of the decision maker compared to when it is not.

[4]In Knetsch (1989), subjects were divided into 3 groups: group 1 receive an endowment of a mug, group 2 receive a candy and group 3 (control) do not receive any endowment. Subjects in all groups are asked to choose between the mug and the candy. Results show a significant increase in choices of the endowed good compared to the control.

[5]When referring to the experiment we use the term *endowment* to describe the prospect which was given to the participants. For all purposes of this paper, it is equivalent to the term *status quo option*.

Table 1

Summary of findings

		Alternative	
		Risky	**Ambiguous**
Status Quo	**Risky**	NO BIAS	BIAS
	Ambiguous	BIAS	NO BIAS

ous, or vice versa. Therefore, we find only partial support for Bewley's suggested driving force of inertia. As his theory predicts, choices are not biased towards the status quo when ambiguity is absent, i.e., when all alternatives in the choice set are risky lotteries. Further support comes from the two "asymmetric treatments", when one option is risky and the other ambiguous. In both treatments we find evidence for status quo biased behavior. However, surprisingly, when even more ambiguity is added to the problem, and both the status quo option and the alternative are ambiguous, we find that individuals behave as rational decision makers, and do not exhibit status quo bias, in contrast to Bewley's model.

Our findings are also difficult to reconcile with the loss aversion paradigm originally introduced by Kahneman and Tversky (1979). According to this approach, an individual evaluates outcomes relative to a reference point (which is typically taken to be his status quo option, if present) and weighs losses more severely than commensurate gains. While loss aversion accommodates many experimental irregularities, it does not predict our findings. We further discuss loss aversion in Section 4, but the intuition is that the two main forces at play, i.e., evaluation relative to a reference point and overweighting of losses, are present to the same extent in all of our treatments and therefore cannot explain the heterogeneity of our results.

The pattern we find is novel and it highlights a possible new determinant for the status quo bias which is the *dissimilarity* between the status quo and the alternative option. There are two reasons why dissimilarity may lead to status quo bias. The first is a shift of preferences, not necessarily towards the status quo option but rather towards options which are similar to it.[6] In our experiment, a risky endowment may shift preferences towards risky prospects and, similarly, an ambiguous endowment may shift preferences in the direction of ambiguous prospects. A shift of this sort may lead to status quo bias in choices between an ambiguous and a risky prospect, but not in choices within the same uncertainty type.

A second channel linking our findings to dissimilarity is *decision avoidance*, i.e., the tendency to avoid making an active choice and thus maintaining the status quo. This channel may be at play under the following two hypotheses: (i) active choices are more often avoided when comparisons are difficult, and (ii) dissimilar options are more difficult to compare than similar ones.[7] When options are easy to compare, the best one is readily identified. In these circumstances, choices reflect standard decision making and the endowment plays no role in the choice procedure. On the other hand, when comparisons are more difficult, sticking to the current situation could be a natural way to avoid the complications involved with identifying the best option.[8]

Both channels come to play in a recent model developed by Maltz (2016). He partitions

[6] Dean (2008) and Dean et al. (2017) find such preference shifts in choices between a risky and a riskless prospect. Sprenger (2015) shows that the propensity to take up risk increases if the status quo is risky, generating what he calls an *endowment effect for risk*. A similar mechanism may be at play in our experiment, where we observe a shift of preferences in the direction of the status quo's type of uncertainty.

[7] The idea that similar alternatives may be easier to compare than dissimilar ones has been suggested by Schwartz (2000). This intuition works particularly well in the context of our experiment, in which the risky options all share a similar risk profile (they are all binary lotteries paying different prizes with equal probabilities). Our ambiguous options are also all defined over a similar state space. Instead, the choice between risky and ambiguous options presents a complex asymmetry in terms of the uncertainty involved.

[8] *Decision avoidance* has also been used to explain why the status quo bias is more frequent in larger choice sets (Dean, 2008; Dean et al., 2017).

the choice set into categories of goods which are similar to each other and studies the effect of the endowment within and across categories. According to his approach, the decision maker first focuses on the endowment's category and designates the best alternative within that set to act as his reference point. This step is in line with the first suggested explanation, i.e., a shift of preferences towards options which are similar to the endowment. At the second stage, this reference point induces a constrained set of feasible alternatives from which the agent makes his final choice. The constraint is a psychological construct which reflects decision avoidance - instead of making a choice between many alternatives or among alternatives that are difficult to compare, the decision maker simplifies his choice problem by excluding some options from further consideration. This model can rationalize our findings in all four treatments as we illustrate in Section 4.

To the best of our knowledge, our study is the first to comprehensively examine the role of different types of uncertainty on status quo bias. As far as we know, two of our treatments (Risky-Ambiguous and Ambiguous-Ambiguous) have never been run before. Indeed, only a handful of experiments have looked at the status quo bias in the uncertainty domain. Dean (2008) uses risky lotteries to measure the effect of the size of the choice set on the bias. His findings are complementary to ours as he reports low levels of status quo bias in small choice sets. In fact, just like in our study, he finds no bias in binary choices among risky lotteries. However, in his study, as the size of the choice set grows, the bias increases, possibly through the channel of decision avoidance which may be the common link between his findings and ours.

The closest experiment to ours is Roca et al. (2006), so far the only controlled experiment on status quo bias involving ambiguity that we are aware of. They document positive status quo bias when the endowment is an ambiguous gamble while the alternative is risky, a finding which is consistent with our results in the treatment studying the same uncertainty structure. Notice however, that their finding in isolation is also consistent with both the loss aversion approach and Bewley (1986). Varying the type of uncertainty of the status quo and the alternative, we are able to pinpoint precisely where the main existing theories fall short in explaining the data.

Our study is also related to the literature on the endowment effect which refers to individuals' higher valuation of a good when they own it compared to when they do not (Thaler, 1980) and can be interpreted as status quo bias in choices where one of the two options is money. Several studies provide evidence for the endowment effect for both risky and ambiguous gambles.[9] However, as one would expect, no effect shows up when trade involves only monetary payoffs (Kahneman et al., 1991). Combining these findings with ours, we find that status quo bias is absent in choices among monetary payoffs, risky lotteries and ambiguous gambles, but it does emerge in choices across the aforementioned categories. Thus, the findings of the endowment effect in the realm of uncertainty further strengthen the pattern of our results, emphasizing the role of dissimilarity among options in the choice set as a potential determinant of status quo bias (see Section 5 for a more elaborate discussion). The exploration of such hypothesis seems a worthwhile pursuit for future work, both within the domain of uncertainty and beyond it.

The paper is organized as follows: Section 2 describes the experimental design and in section 3 we highlight the main results. Section 4 discusses different theoretical models in light of our findings while Section 5 explores the findings alongside evidence from the endowment effect literature. Section 6 concludes.

[9]See for example Knetsch and Sinden (1984) and Eisenberger and Weber (1995).

2 Experimental Design

Experiment overview. We run four treatments corresponding to all combinations of a risky or ambiguous status quo option with risky or ambiguous alternatives. In each treatment we adopt a within-subject design where subjects make the same choices under two different frames. In the first part of the experiment subjects make a series of choices between a fixed gamble and different alternative gambles under a *neutral frame*: They are sequentially presented with pairs of gambles and for each pair are asked to choose their preferred option. In the second part, subjects receive the gamble which was fixed in the first part as their endowment and face the same comparisons. This time around, the questions are presented in a *status quo frame*, i.e., as a decision between keeping the endowment or switching to the alternative. In each treatment, status quo bias is observed if subjects choose the endowment more often in the second part, when they own it, compared to the first part when they do not. As elaborated later in this section, special aspects of the design ensure that the fixed alternative does not play the unintended role of a reference when choices are taken under the neutral frame. The experiment was pencil-paper based and conducted at the CESS lab in NYU. It involved 143 subjects among the NYU undergraduate population. All subjects received a show-up fee of $8 and earned on average a total of $16. The duration of the experiment was approximately 30 minutes.

Experimental procedure: The Risky-Ambiguous (R-A) Treatment. We outline the experimental procedure for treatment R-A, where the status quo option is risky and the alternative is ambiguous. Following this outline, we explain how the design is modified in the other three treatments. The instructions can be found in the online Appendix.

At the beginning of the experiment subjects are introduced with two bags. First, the *known bag* which consists of a known composition of poker chips - 50 white and 50 black. The second bag is the *unknown bag* and remains empty until all tasks have been completed. Subjects are told that at the payment stage this bag will be filled with X white chips and $100 - X$ black chips, where X equals the two decimals of the Dow Jones Industrial Average Index at the time of payment.[10] This mechanism ensures that subjects' beliefs regarding the composition of the unknown bag remain fixed throughout the experiment as we further explain later in this section.

Following this introduction, participants proceed to the first part of the experiment which entails 15 pairwise choices between a fixed gamble from the known bag and different gambles from the unknown bag. The fixed gamble from the known bag pays \$10 if a white chip is drawn and \$4 if the chip is black (henceforth the $(10, 4)$ gamble). Thus, a typical question compares the $(10, 4)$ gamble on the known bag, with a (w, b) gamble from the unknown bag, which pays \$$w$ if a white chip is drawn from that bag and \$$b$ if the chip is black. Table 2(b) lists the prizes of the 15 alternative gambles in treatment R-A (the prizes for the other treatments are shown in 2(a) and 2(c)). In the paper we will sometimes refer to these gambles as the *alternative set*. Nine additional questions not involving gamble $(10, 4)$ are interspersed in between the 15 questions listed in Table 2(b) (for a total of 24 questions) and are intended to reduce the salience of gamble $(10, 4)$.[11] Upon completion of part 1, subjects participate in a non-incentivized intermission in which they answer 8 questions presented in the same format as in part 1 but involving larger stakes. The intermission serves the purpose of separating the two main parts of the experiment and is discussed in the online Appendix.

[10]The value of the index was verified online with a volunteer subject at the payment stage.

[11]A typical additional question is a choice between a (p, q) gamble on the known bag (where $p \neq 10, q \neq 4$) and a gamble performed on the unknown bag. As the aim of part 1 is to elicit preferences in a *neutral* frame of choice, the 9 additional questions prevent the gamble $(10, 4)$ from accidentally playing the role of a reference which repeatedly appears in all questions. The full list of questions is available in the online Appendix.

Table 2

PAYOFFS OF THE GAMBLES IN THE ALTERNATIVE SET

(a) Treatment R-R and A-A

w-b	w-b
4-6	10-2
5-6	11-2
6-6	12-2
7-6	13-2
8-6	14-2
9-6	15-2
10-6	16-2
	17-2

(b) Treatment R-A

w-b	w-b
5-6	12-2
6-6	13-2
7-6	14-2
8-6	15-2
9-6	16-2
10-6	17-2
	18-2
	19-2
	20-2

(c) Treatment A-R

w-b	w-b
4-6	8-2
5-6	9-2
6-6	10-2
7-6	11-2
8-6	12-2
9-6	13-2
	14-2
	15-2
	16-2

NOTES: The table lists the payoffs of the gambles offered as alternatives to the status quo in each treatment. Each pair of numbers $w - b$ reports the payoff in US dollars of, respectively, a draw of a white chip and a black chip.

In part 2 each subject receives a card with a description of the $(10, 4)$ gamble on the known bag and is explicitly told he owns it. Subsequently, the subjects answer 24 questions. In each question they are asked whether they would like to keep their $(10, 4)$ gamble or switch to the alternative gamble to be performed on the unknown bag. Thus we explicitly induce a frame of maintaining the endowment or giving it up for the alternative. Of the 24 alternatives which appear sequentially, 15 coincide with the gambles presented in part 1 which are listed in Table 2(b). Thus, subjects compare the $(10, 4)$ gamble with the gambles in the alternative set twice, first under a neutral frame and then under a status quo frame.

The Gambles in the Alternative Set. The alternative gambles presented in Table 2(b) are divided into two columns (or subsets): Gambles that pay \$6 if a black chip is drawn and gambles that pay \$2 if a black chip is drawn. In each of these subsets the gambles are ordered in terms of first order stochastic dominance (determined by the varying prize of the white chip) and each subset contains both "attractive" gambles (high expected payoffs) and "non-attractive" gambles (low expected payoffs). As a result, most subjects choose the $(10, 4)$ gamble over the low expected payoff alternatives and switch at some threshold to choosing from the alternative set. The threshold at which the switch occurs depends on the individual's preferences. The presence of such a switching point in the interior of the range of available alternatives ensures that the magnitude of the status quo bias is correctly assessed. Subjects who do not exhibit an interior switching point are discussed in detail in Appendix C.

We chose to present the questions in random order and sequentially on separate cards, rather than in an ordered list so as to allow subjects to treat each question and each part of the experiment in isolation. Presenting questions in this manner also allows us to mix in the 9 additional questions which were crucial for reducing the salience of the fixed $(10, 4)$ gamble in part 1. In pilot rounds, we validated our assumption that participants viewed the two parts as completely separate and that indeed, once they reached the second part of the experiment, did not think about the decisions they made in part 1.

A consequence of our approach compared to the list procedure is that more subjects switch back and forth between the $(10, 4)$ gamble and the alternative set, violating the combination of the assumptions of monotonicity and transitivity. These are most likely mistakes which arise when answering multiple questions of similar nature. However, of the 143 subjects, roughly 75 percent exhibit a single switching point or at most one "mistake" (i.e., changing their answer to one question leads to a single switching point). In analyzing the data we run a probit regression where the error term absorbs mistakes of this sort.

Payment. Subjects are paid according to one randomly selected question among the 48 they answer during the experiment. At the payment stage we invite a volunteer who assists in constructing the unknown bag using the Dow Jones Index. Next, he flips a coin that determines according to which part (1 or 2) subjects will be compensated. We then ask the volunteer to roll a 24-sided fair die which sets the exact question used for payoff. Finally, the volunteer draws a chip from each bag and subjects are paid according to their choices in that question.

The Dow Jones Index. The choice of the Dow Jones Index to determine the composition of the unknown bag was made to clarify to the subjects that the experimenters do not know and have no control over the distribution of chips in the unknown bag. It also ensures subjects do not alter their beliefs regarding the composition of the unknown bag throughout the experiment and allows for a *ceteris paribus* comparison of the two choice frames.[12] At the end of the experiment a non-incentivized questionnaire was distributed in which we asked whether the beliefs regarding the composition of the unknown bag changed throughout the experiment (and if so why and at which stage).[13] All but one subject answered that their beliefs did not change.[14]

We were concerned that subjects may perceive the distribution of the decimals of the Dow Jones as uniform and not view the unknown bag as genuinely ambiguous. Rather, they may view gambles performed on this bag as compound lotteries where at the first stage the bag's composition is determined and at the second stage a chip is drawn. We investigate this hypothesis in our questionnaire, where we ask: *Did you have any belief regarding how many white chips will be placed in the unknown bag?* Some typical answers

[12]Beliefs regarding the proportions of white and black chips could change when, in the second part, subjects receive a specific endowment whose value depends on the bag's composition.

[13]The questionnaire and a categorical distribution of the answers are available in the online Appendix.

[14]In a pilot session we used a typical two color Ellsberg Bag in which the bag was set up before the experiment and the composition left completely unspecified to subjects. This attempt was unsuccessful in maintaining the *ceteris paribus* requirement. From the questionnaire following the experiment we concluded that a significant percent of the subjects made inferences regarding the bag's composition based on the stakes of the gambles they faced during the experiment.

are: *I had no idea, I thought it would be 50-50, Had a feeling there will be more white.* There are also a few answers reporting more "extreme beliefs" (0-20 or 30 white chips). These responses suggest that the unknown bag was indeed perceived as ambiguous.

The Other Treatments. The same procedure outlined for the R-A treatment is adopted in the other three treatments, with the difference being the type of uncertainty (risk or ambiguity) characterizing the status quo and the alternative options. Thus, the payoffs of the status quo gamble remain $(10, 4)$ and the difference between treatments lies in the composition of the bags on which the status quo gamble and the alternative gambles are performed. The compositions of the bags are as follows:

– Treatment R-R (Risky - Risky): The $(10, 4)$ gamble and the alternative gambles are performed on two bags with known compositions of chips: one with 50 white chips and 50 black chips and the other with 50 green chips and 50 red chips.

– Treatment R-A (Risky - Ambiguous): As explained earlier, the $(10, 4)$ gamble is performed on a bag with 50 white chips and 50 black chips and the alternative gambles are performed on a bag with 100 chips, the exact composition of which is determined using the Dow Jones index.

– Treatment A-R (Ambiguous - Risky): The $(10, 4)$ gamble is performed on a bag with a composition determined by the Dow Jones index and the alternative gambles are performed on a bag with 50 white chips and 50 black chips.

– Treatment A-A (Ambiguous - Ambiguous): The $(10, 4)$ gamble and the alternative gambles are performed on two bags, each with an unknown proportion of black and white chips. Both compositions are determined according to the decimals of stock market indices (one using the Dow Jones and the other using the $S\&P$ 500).[15]

Another small difference between treatments lies in the range of prizes chosen for the alternative gambles, as can be seen in Table 2. In order to maintain an interior switching point from the $(10, 4)$ gamble to the alternatives, we adjusted the range of prizes of the alternative set to account for ambiguity aversion.[16] Pilot sessions were used to determine the range of prizes that would maximize the probability of observing an interior switching point in each treatment.

3 Results

Evidence for status quo bias is found if the status quo option (the gamble $(10, 4)$) is chosen more frequently when subjects own it compared to when they do not. We analyze the data using two methods. First, we run a random effects probit regression and test whether the $(10, 4)$ gamble is chosen significantly more often under the *status quo frame* compared to the *neutral frame*. Second, exploiting the within-subject design, we construct a subject specific status quo bias index and compare the distribution of the index across treatments. Both approaches lead to the same conclusions.

3.1 Regression analysis

A random effects probit model is estimated to test if the frame of choice has an effect on the likelihood that the status quo option is chosen. The probability that the $(10, 4)$ gamble is chosen in any question (as a function of the treatment, the frame and the prizes

[15] In all treatments we purposely use two distinct bags: one for the $(10, 4)$ gamble and the other for the alternative gambles. As a result the status quo gamble and the alternative gambles have independent outcomes in all treatments.

[16] For example the average payoffs of the alternative gambles in treatment R-A were higher than in treatment R-R to account for ambiguity aversion.

of the alternative gamble) is modeled as $\Phi(\tilde{Y})$ where Φ is the CDF of the standard normal distribution and $\tilde{Y}$ is specified as follows:

$$\tilde{Y_{i,k}} = \beta_1(T^{\text{R-R}}_{i,k} \cdot \text{SQ}_{i,k}) + \beta_2(T^{\text{R-A}}_{i,k} \cdot \text{SQ}_{i,k}) + \beta_3(T^{\text{A-R}}_{i,k} \cdot \text{SQ}_{i,k}) + \beta_4(T^{\text{A-A}}_{i,k} \cdot \text{SQ}_{i,k}) + \delta \mathbf{X}_{i,k} + \epsilon_{i,k}$$

where $T^j_{i,k}$ is a dummy variable that equals 1 if question i of subject k belongs to treatment j where $j \in \{\text{R-R, R-A, A-R, A-A}\}$ and $\text{SQ}_{i,k}$ is a dummy variable taking value 1 if question i of subject k belongs to part 2 of the experiment, i.e., to the *status quo frame*. $X_{i,k}$ is a vector of controls and $\epsilon_{i,k}$ is the error term. The status quo bias is captured by the coefficients of the interaction terms $T^j_{i,k} \cdot \text{SQ}_{i,k}$ which measure the effect of the status quo frame on the likelihood that the gamble $(10, 4)$ is chosen in treatment T^j. The results of the estimation are reported in Table 3. Specification (1) controls only for the treatment dummies, while specification (2) also controls for the prizes of the alternative gambles.

Under both specifications we find no significant status quo effect in the “symmetric treatments” R-R and A-A. We do find evidence of status quo bias in the “asymmetric treatments” R-A and A-R. After controlling for the payoffs of the alternative gambles, the status quo frame increases the likelihood that $(10, 4)$ is chosen by 12% in the R-A treatment and by 10% in the A-R treatment. Both results are significant at the 1% level.

3.2 The Status Quo Bias Index

The within-subject design allows us to construct a status quo bias index for each subject by comparing his choices under the two frames. The index is constructed as follows: Starting off with a status quo bias index of 0, if a subject chooses an alternative over the $(10, 4)$ gamble under the neutral frame, but prefers to keep the $(10, 4)$ gamble after it is given to him as an endowment, one point is added to the index. If the opposite behavior takes place, one point is subtracted. Thus, subjects choosing the $(10, 4)$ gamble more often when

Table 3

Probit Regression: Marginal Probability Effects

	(1)	(2)
$SQ \times T^{\text{R-R}}$	0.03	0.04
	(.264)	(.24)
$SQ \times T^{\text{R-A}}$	0.09***	0.12***
	(.003)	(.004)
$SQ \times T^{\text{A-R}}$	0.07***	0.10***
	(.01)	(.009)
$SQ \times T^{\text{A-A}}$	0.01	0.01
	(.761)	(.755)
White prize		−0.17***
		(.000)
Black prize		−0.31***
		(.000)
No. obs.	4287	4287

NOTES: Both specifications include treatment dummies. P-values in parenthesis. Standard errors are clustered at the subject level. *** Significant at the 1% level.

Table 4

MEAN AND MEDIAN OF THE STATUS QUO BIAS INDEX

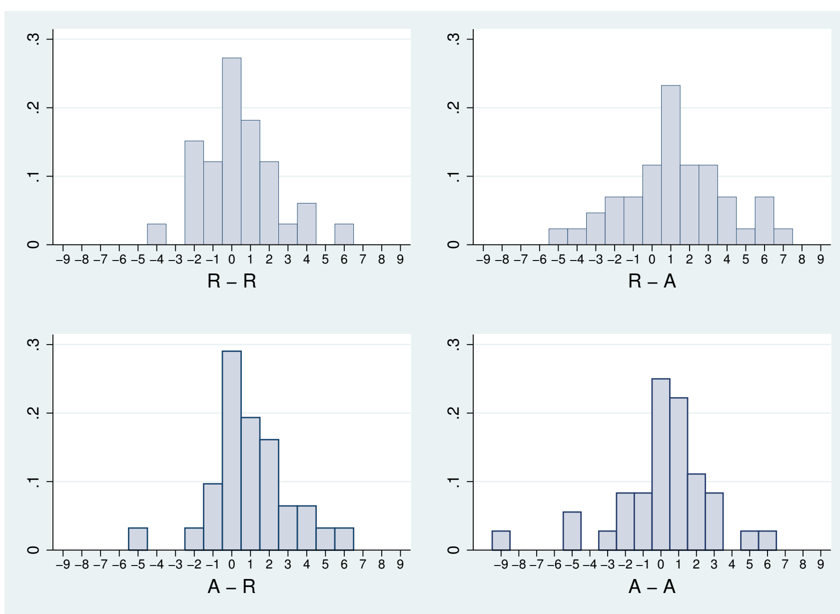
	R-R	R-A	A-R	A-A
Mean	0.4	1.2***	1.0**	0.1
	(.277)	(.005)	(.015)	(.764)
Median	0	1	1	0
No. obs	33	43	31	36

NOTES: P-values of a two sided t-test in parenthesis. *** Significant at 1% level. ** Significant at 5% level.

it serves as the status quo option have a positive index while those exhibiting the opposite behavior have a negative index. Subjects who make the exact same choices in both parts of the experiment receive an index of 0.

Figure 1

DISTRIBUTION OF THE STATUS QUO BIAS INDEX



In Table 4 we report the mean and median level of the status quo bias index across treatments. The mean is not significantly different from 0 in the symmetric treatments. The median in these treatments is also 0. We find a positive and significant mean index in the two asymmetric treatments. The median in these treatments is 1. In Figure 1 we report the full distribution of the status quo bias index across treatments. Consistently with the aggregate statistics, we observe that the distribution of the index is centered around 0 in the symmetric treatments while it is shifted to the right in the two asymmetric treatments.

The status quo bias can also be quantified in terms of forgone payoffs. The average premium required to give up the $(10, 4)$ gamble after receiving it as an endowment is 3.5% of expected payoffs in treatment A-R and 4% of expected payoffs in treatment R-A. This means that if a subject is indifferent between options x and y absent an endowment, then, if x becomes his status quo, in order to restore indifference, the payoff of y has to increase by 3.5% and 4% respectively.[17]

4 Discussion of the Theoretical Literature

One approach to status quo bias associates the emergence of the bias to the incompleteness of the preference relation (Bewley, 1986) and predicts that the status quo bias may emerge only in the presence of ambiguity. As stated in the introduction, our study has been motivated by this approach and more in general by the intriguing potential relationship

[17]The quantification is derived from the status quo bias index as follows. In treatment A-R subjects choose the gamble $(10, 4)$ in one more question on average under the status quo frame compared to their choice in the neutral frame. Since the subjects are presented with two sets of ordered alternatives they typically exhibit two switching points. Hence the premium required by the average subject is equal to half the difference in expected payoff of two subsequent gambles. There is a \$1 difference in the prize associated with a white chip between two successive gambles, or in other words, \$0.5 in expectation (assuming a uniform prior over states for the ambiguous gambles). As our average gamble in the experiment pays \$7 in expectation we roughly estimate the premium to be $\frac{\frac{0.5}{2}}{7} \approx 0.035$ in treatment A-R. In treatment R-A the average status quo bias index is equal to 1.2 which, following a similar calculation, leads to an estimate for the bias equal to 4% of expected payoffs.

between ambiguity and status quo maintenance. In the setting of Bewley (1986), the agent faces outcomes which depend on states of the world, the probability of which may not be objectively defined. The agent acts as if he has a set of priors over the possible states of the world. Facing alternatives which do not dominate the status quo option for every prior in that set, the agent exhibits *inertia*, that is, he sticks to the status quo option.

The decision maker may be thought of as acting "cautiously": When the ranking of alternatives is ambiguous (i.e., it changes depending on the prior under consideration), he keeps his endowment to avoid making a mistake. Ortoleva (2010) provides axiomatic foundations for such behavior by imposing behavioral postulates on the preferences of the agent (this model is discussed formally in Appendix B).

The common theme of these models is that inertia may arise only when the ranking of alternatives depends on the prior under which they are evaluated. Hence, the decision maker may exhibit inertia only in the presence of ambiguous prospects. Consequently, these models correctly predict no bias in the R-R treatment. In the two asymmetric treatments involving ambiguity there is scope for the emergence of the bias, as confirmed by our findings. However the models fail to predict the absence of status quo bias in the A-A treatment. Using the representation proposed by Ortoleva (2010) and under a natural assumption on the set of priors that the agent holds, treatment A-A is, in fact, the most prone to status quo biased behavior (we show this in Appendix B). More precisely, if status quo bias is observed in the asymmetric treatments, then according to this model, it should also be present in the A-A treatment, contrary to our findings.

In a similar spirit, Mihm (2016) models a decision maker whose ambiguity attitude is affected by his reference point. While able to explain the findings of Roca et al. (2006), this model predicts the absence of status quo bias in all cases where the endowment is non-ambiguous, hence it is at odds with the presence of status quo bias in the R-A treatment, where the status quo is a risky lottery.

A second strand of the literature views the status quo bias as stemming from loss aversion (Kahneman and Tversky, 1979). The two features which generate the status quo bias as a prediction of the loss aversion model are: (i) The decision maker evaluates outcomes in terms of gains and losses with respect to a reference point (typically chosen as the status quo option if it exists, or set to 0 if it is absent); and (ii) losses loom larger than gains. A recent non-parametric method by Abdellaoui et al. (2016) estimates the parameters of this model and finds that the utility and the loss aversion parameter are the same under risk and ambiguity. Thus, given our controlled design across treatments in terms of odds and payoffs, loss aversion predicts a positive status quo bias in all of our treatments. Hence, this approach does not explain the heterogeneity of our findings, i.e., why status quo bias is observed only in the asymmetric treatments.[18]

One concern is that the reason for the absence of the bias in the symmetric treatments is the fact that we can only observe choices over a finite set of alternatives. If the loss aversion parameter is small, setting the difference in expected value between two consecutive gambles at 50 cents may be too large an interval and impair our ability to detect a preference reversal across the two frames of choice. We address this point in Appendix A using the version of the loss aversion model suggested by Koszegi and Rabin (2006) and with a standard loss aversion parameter found in Sprenger (2015) which is also in line with previous studies (Kahneman and Tversky, 1992; Pope and Schweitzer, 2011; Gill and Prowse, 2012).[19] We show that our experimental setup is well calibrated: The adopted

[18]Some theoretical papers have already raised the concern that loss aversion may be at odds with the status quo bias phenomenon. Masatlioglu and Ok (2014) show that loss aversion may actually lead to anti-status quo bias predictions. They illustrate that an agent abiding to loss aversion may choose x over y in the absence of an endowment, but reverse his choices, and choose y over x when endowed with x. Their example is a development of comments regarding the loss aversion model made even earlier, by Munro and Sugden (2003) and Sagi (2006).

[19]The Koszegi and Rabin (2006) model of reference dependence is well suited when gambles serve as reference points as in our experiment.

grid of alternatives is fine enough to detect a bias if one is present.

A third modeling approach to the status quo bias has been proposed by Masatlioglu and Ok (2014). Their decision maker acts as a "constrained maximizer". In the absence of a status quo option he is a standard rational agent. The presence of a status quo option induces a psychological constraint set from which the agent chooses the best alternative according to his utility. The status quo bias is captured by the fact that some alternatives which are utility improving compared to some alternative x, may be excluded from x's constraint set and therefore will not be chosen when x serves as the endowment. While the model accommodates status quo bias in general, it does not provide ex-ante predictions as to which treatments in our experiment should give rise to it. As the constraint set has no specific structure, the model is compatible with our findings but would also be compatible with the opposite findings.

Our results show a novel pattern of choice where status quo bias appears only in choices between a risky and an ambiguous gamble. This pattern highlights the *dissimilarity* between the status quo and the alternative option as a possible determinant for the status quo bias. There are two reasons why this may happen. First, the status quo may shift preferences towards objects with similar characteristics. In the realm of uncertainty, evidence of such preference shifts has been documented by Dean (2008) and Dean et al. (2017) who find that a risky status quo increases the chances that a risky alternative is chosen over a certain monetary payoff. More evidence can be found in Sprenger (2015) who reports an endowment effect for risk, i.e., the higher tendency to take up risk when the endowment is risky. A preference shift towards the endowment's type of uncertainty may explain why we find status quo bias in choices between a risky and an ambiguous option, but not when all options are risky or all are ambiguous.

The second reason supporting the idea of dissimilarity-based status quo bias is that similar options may be easier to compare.[20] This seems very plausible in the context of our experiment where all risky alternatives share the same risk profile and the ambiguous gambles share a similar source of ambiguity. When options are easily compared, it stands to reason that the agent will have a clear ranking of alternatives and choose according to it, and irrespectively of the frame of choice. On the other hand, sticking to the status quo may be appealing when the ranking is more difficult or impossible to determine. This hypothesis in fact echoes the original idea of Bewley, namely, that inertia is a behavioral phenomenon that helps resolve indecisiveness in favor of the status quo when preferences are incomplete.

A recent paper by Maltz (2016) formalizes the idea of a dissimilarity-based status quo bias. Adopting the Masatlioglu and Ok (2014) framework, his set up specifies a partition structure on the space of alternatives, interpreted as categories of goods similar to each other (such as risky or ambiguous gambles in our experiment). In his representation, the decision maker has an (endowment-free) utility function and he settles his choice problem according to the following procedure: First, he identifies the best alternative which is similar to his endowment, i.e., in the same category as the endowment, and that alternative serves as his reference point. Next, this reference point induces a constraint set from which the decision maker chooses the best feasible alternative according to his utility.

An important feature of this model is that it predicts rational choice in the presence of alternatives which belong to a single category. This is due to the first stage, in which the agent identifies the best alternative in his endowment's category to serve as the reference point. If no goods from other categories are available for choice, this stage, in fact, identifies the best alternative overall. In other words, in these contexts, the constraint set plays no

[20] As noted by Schwartz (2000): "Within each category, it may be relatively easy to express preferences. Between categories, however, expressing preferences is more problematic." Schwartz uses the term categories to refer to goods of similar nature (or, "similar kind of things" using Schwartz's words).

role. Only when alternatives from different categories are available, the constraint set may rule out utility improving alternatives, leading to reference effects. To summarize, the model by Maltz (2016) predicts no status quo bias in choices among options that belong to the same category, while it allows for status quo bias (and more generally a bias towards the status quo option's category) when available options belong to more than one category. If one accepts the categorization of gambles into risky and ambiguous, this model explains all of our findings.

5 Status quo bias, Endowment Effect and Dissimilarity

In this section we provide further evidence for the conjecture that dissimilarity plays a role in explaining the status quo bias. We do this by adding the dimension of degenerate lotteries, i.e. fixed monetary payoffs, to the domain of alternatives. While our experiment provides no evidence for the case where either the endowment or the alternative is a monetary payoff, we can turn to the findings of the endowment effect literature to fill this gap as explained below.

The endowment effect phenomenon refers to subjects' increased valuation of a good when they own it compared to their valuation of it when they do not (Thaler, 1980). The studies documenting this effect report the existence of a gap between the willingness to accept (WTA) and the willingness to pay (WTP) values for a given good. The WTA is the amount of money the subject is willing to receive for giving up a good that is currently in his possession. The WTP is the amount of money the subject is willing to give up for the same good in order to acquire it. Hence the WTA-WTP gap may be interpreted as indirect evidence of status quo bias in choices between money and the good under assessment.

As a simple illustration, suppose that the decision maker is willing to pay a maximum of \$10 for a good, but when endowed with the same good, he is willing to sell it only at a price equal to, or above \$15. This means that if any amount lying within the interval \$10 – \$15, say \$12, is offered in comparison to the good, the decision maker would choose as follows: He keeps the \$12 when endowed with the money, while he chooses to keep the good when endowed with it.[21]

This gap has been consistently found and reported for a wide range of ordinary goods (see Horowitz and McConnell, 2002 for a survey). More relevant to our context is the fact that the gap is observed also in the case of risky lotteries (Knetsch and Sinden, 1984) and ambiguous gambles (Eisenberger and Weber, 1995). However, as one would expect, the gap does not arise for tokens of specified monetary value as shown by Kahneman et al. (1991). In Table 5 we add the money dimension alongside the risky and ambiguous gambles and combine the findings from our experiment (highlighted in bold) alongside the WTA-WTP evidence (in italics).

The pattern of our results generalizes to the expanded domain and it further highlights the possible role played by *dissimilarity* as a determinant of the status quo bias. When the endowment and the alternative are of *similar* nature, i.e., they are both monetary payoffs, risky lotteries or ambiguous gambles, no bias arises. However, when the endowment is *dissimilar* to the alternative the bias emerges.

[21] We have to be slightly careful in interpreting a WTA-WTP gap for a good as evidence for status quo bias. The reason is that WTA-WTP elicitations compare the two status-quo frames (money as an endowment or the good as an endowment). They do not provide information regarding a neutrally framed choice between a sum of money and the good. Hence we may only conclude that there is status quo bias in at least one of the two frames. In fact, according to Kahneman et al. (1991) the gap is mostly (though not only) due to a higher evaluation of the owners of the good rather than a lower evaluation of those who may purchase it. In table 5 we give a summary of the findings assuming that some disparity arises for both types of endowment frames (purchasing or selling) compared to the neutral choice frame.

Table 5

OUR FINDINGS COMBINED WITH WTA-WTP EVIDENCE

		Alternatives		
		Money	**Risky gamble**	**Ambiguous gamble**
	Money	*NO BIAS*	*BIAS*	*BIAS*
Status Quo	**Risky gamble**	*BIAS*	**NO BIAS**	**BIAS**
	Ambiguous gamble	*BIAS*	**BIAS**	**NO BIAS**

6 Conclusions

Our experiment examines the status quo bias phenomenon under uncertainty. We find no bias when the endowment and alternatives are both risky or both ambiguous prospects. A significant bias emerges when the endowment is a risky gamble and the alternative is ambiguous as well as when the endowment is ambiguous and the alternative risky. In these cases the magnitude of the bias equals to $3.5\% - 4\%$ of expected payoffs.

The pattern highlighted by our results is not predicted by models which are based on the loss aversion approach of Kahneman and Tversky (1979) or by models inspired by Bewley (1986). Our findings suggest an important potential role of *dissimilarity* in generating the status quo bias. A recent model by Maltz (2016) is able to accommodate our findings by relating choice behavior to a similarity structure on the space of alternatives.

Appendix A Predictions of the Loss Aversion model

The aim of this section is to show that loss aversion would predict status quo bias in our experiment. Since our objects of choice are gambles, we utilize the stochastic reference model suggested by Koszegi and Rabin (2006) (KR), which accommodates a stochastic reference point. As the loss aversion parameter, we use an estimate found by Sprenger (2015) and widely supported in the literature (Kahneman and Tversky, 1992; Gill and Prowse, 2012; Pope and Schweitzer, 2011).

Following KR, Let r represent the referent drawn according to measure G. Let x be a consumption outcome drawn according to measure F. Then the KR utility formulation is:

$$U(F|G) = \int\int u(x|r)dG(r)dF(x)$$

with

$$u(x|r) = m(x) + \mu(m(x) - m(r))$$

The function $m()$ represents consumption utility and $\mu()$ represents gain-loss utility relative to the reference r. We adopt the same specification of Sprenger (2015): Following Koszegi and Rabin (2006, 2007) small stakes decisions are considered such that consumption utility, $m()$, can plausibly be taken as linear, and a piecewise linear gain-loss utility function is adopted:

$$\mu(y) = \begin{cases} \eta \cdot y & \text{for } \; y \geq 0 \\ \eta \cdot \lambda \cdot y & \text{for } \; y < 0 \end{cases}$$

where λ is the parameter of loss aversion which Sprenger (2015) finds to be equal to 3.4. We also follow the literature (and Sprenger, 2015) in setting $\eta = 1$ for our small stakes. We are now ready to show that status quo bias arises in treatment R-R, for which we can use the objectively specified probabilities. To this end, we consider gamble $(10, 4)$, which is the reference gamble in the second part of the experiment, and confront it with gamble $(7, 6)$. We show that using the above restrictions alongside the estimated parameter of loss aversion leads to a preference reversal across the two frames of choice.

We start by evaluating the utilities of the two gambles in part 1 of the experiment. In this part, no endowment is given to the subjects and it is not immediately clear which gamble should be used as the reference point. Two natural candidates are the degenerate gamble paying the average expected value of the gambles in our experiment (which is \$7) in all states and the degenerate gamble that pays \$0 in all states. We carry the exercise using \$7 as the reference point.[22] Under the neutral frame, the two gambles have utility given by the following:

$$U((10,4)|7) = 0.5u(10|7) + 0.5u(4|7) = 0.5[10 + (10 - 7)] + 0.5[4 + 3.4(4 - 7)] = 3.4$$

$$U((7,6)|7) = 0.5u(7|7) + 0.5u(6|7) = 0.5[7 + (7 - 7)] + 0.5[6 + 3.4(6 - 7)] = 4.8$$

Thus, the agent described by the KR model will choose the gamble $(7, 6)$ over $(10, 4)$ in part 1 of the experiment. We now turn to part 2, where the gamble $(10, 4)$ serves as the agent's endowment and is therefore used as the reference point. The evaluations of the two gambles are as follows:

$$U((10,4)|(10,4)) = 0.25u(4|4) + 0.25u(10|10) + 0.25u(4|10) + 0.25u(10|4) = 3.4$$

$$U((7,6)|(10,4)) = 0.25u(7|10) + 0.25u(6|10) + 0.25u(7|4) + 0.25u(6|4) = 1.8$$

Thus, in the second part of the experiment the agent would choose $(10, 4)$ over $(7, 6)$

[22] A similar exercise shows that if \$0 is used as a reference the model predicts two choice reversals (in this case, for the gambles (13, 2) and (14, 2)).

exhibiting a preference reversal. Under the same assumptions, gamble $(8, 6)$ is preferred to $(10, 4)$ in part 1 and is indifferent to it in part 2. Assuming ties are broken evenly, and according to the loss aversion model of KR the average subject in our experiment will therefore exhibit a status quo bias index equal to 1.5, contradicting our finding of no bias in the R-R treatment.[23]

Appendix B Predictions of Bewley's Model

According to Bewley's inertia hypothesis, the presence of ambiguity is a necessary condition for status quo biased behavior. Therefore it correctly predicts the absence of status quo bias in the R-R treatment. However this model is not well suited to explain the absence of ambiguity in the A-A treatment together with the presence of ambiguity in the asymmetric treatments A-R and R-A. Intuitively, if inertia stems from ambiguity, it stands to reason that the more ambiguity there is, the more likely it is to observe the bias. In this appendix we show this intuition formally under a fairly mild assumption on the set of priors and using the axiomatic development of Bewley's approach taken by Ortoleva (2010).[24]

The Model

We briefly summarize the model developed in Ortoleva (2010).[25] Using the standard Anscombe-Aumann framework, there is a finite set S of possible states of the world and a set X of consequences, which is assumed to be a convex and compact subset of a Banach space. Let $\Delta(X)$ stand for the set of all Borel probability measures (lotteries) on X. By

[23]Using a lower degree of loss aversion of $\lambda = 3$, which has often been used as a benchmark (Koszegi and Rabin 2006, 2007), the model would still predict the same 1.5 points of reversal.

[24]We adopt the model by Ortoleva (2010) rather than the original formulation by Bewley (1986) because the former adopts a complete preference relation in the absence of an endowment. This allows to derive precise predictions for choices under the neutral frame.

[25]We specifically make use of Theorem 1 of an earlier version of the paper given at http://gtcenter.org/Archive/Conf07/Downloads/Conf/Ortoleva498.pdf.

$\mathcal{F}$ we denote the set of all acts, that is, the set of all functions $f : S \rightarrow \Delta(X)$ where $f(s)$ denotes the consequence (lottery) of act f in state $s \in S$.

Within this set up and under the axioms imposed in Ortoleva (2010) the agent may be thought of as if he has a utility function $u : X \rightarrow \mathbb{R}$ and a set Π of possible priors over the states of the world. In addition, he has a single prior ρ which he uses when choosing absent an endowment. According to the model, we have that $\rho \in \Pi$. Facing acts absent an endowment, the agent evaluates them on the basis of their subjective expected utilities (by using the single prior ρ and utility function u), just like a standard Savagean agent. However, when the agent is endowed with an act f he does not act as an expected utility maximizer anymore. Rather, he becomes uncertainty averse and may be described as a constrained utility maximizer. His maximization takes place over a constrained set of alternatives. The constrained set comprises only the options that carry higher utility than the endowment according to all priors in the set Π. We follow Ortoleva (2010) and denote the constrained set by $\mathcal{D}_{\Pi,u}(f)$. Formally it takes the form:

$$\mathcal{D}_{\Pi,u}(f) := \left\{ g \in \mathcal{F} | \sum_{s \in S} \pi(s) E_{g(s)}(u) > \sum_{s \in S} \pi(s) E_{f(s)}(u), \quad \text{for all } \pi \in \Pi \right\}$$

where E is the expectation operator. The agent's choices can be summarized formally as follows. When facing a choice set A without an endowment he maximizes:

$$\arg\max_{g \in A} \sum_{s \in S} \rho(s) E_{g(s)}(u)$$

When facing a choice set A with an endowment $f \in A$ (denoted by (A, f)) the agent chooses as follows:

$$c(A,f) = \begin{cases} \{f\} & \text{if } \mathcal{D}_{\Pi,u}(f) \cap A = \emptyset \\ \arg\max_{g \in A \cap \mathcal{D}_{\Pi,u}(f)} \sum_{s \in S} \rho(s) E_{g(s)}(u) & \text{otherwise} \end{cases}$$

Such agent has a prior ρ which he trusts absent an endowment and is a standard Savagean agent in these contexts. However, when he is endowed with some act f he becomes uncertainty averse. That is, he considers as potential alternatives only those acts that generate a higher expected payoff than his endowment according to every prior he has in mind. If no feasible act satisfies this condition, he keeps his status quo option. If there are any acts which satisfy this requirement, i.e., belong to $A \cap \mathcal{D}_{\Pi,u}(f)$, the agent chooses among them in the final stage using the prior ρ.

The status quo act f, thus, affects choice in two ways: (1) The agent will choose it if no other act dominates it for all priors (that is, when $\mathcal{D}_{\Pi,u}(f)$ does not contain any feasible act); and (2) by restricting the set of acts which the agent considers for choice.

Predictions of the model within the experimental set up

We now apply the model within our experimental set up to derive the prediction of interest. The two *ambiguous* bags used in our experiment, the Dow-Jones (DJ) and Standard & Poor's (SP), contain 100 poker chips with an unspecified amount of whites and blacks. A state of the world is any possible joint composition of the two bags. States are indicated by $s_{i,j}$, $i,j \in \{0,1,...,99\}$ where i is the number of white chips in bag DJ and j is the number of white chips in bag SP.

We denote by $\mathcal{R}$ the set of all constant acts, i.e., acts that deliver the same lottery in every state of the world. Let F_{DJ} denote the set of all acts whose outcomes only depend on the realization of the Dow Jones Index. Similarly let F_{SP} be the set of acts whose outcomes only depend on the Standard & Poor's realization. We are now ready to show that if a decision maker exhibits status quo biased behavior in choices between an act $f \in F_{DJ}$ (in the experiment - the $(10, 4)$ act played on the DJ bag) and some constant act $r \in \mathcal{R}$ (in the experiment - a risky lottery on the known bag) then, according to the above representation, he must also be biased in choices between f and another act $g \in F_{SP}$. In other words, the presence of status quo bias in treatment A-R implies status quo bias in treatment A-A. We start by formally defining status quo biased behavior in our set up.

Definition. We say that the choice between two acts, f and g, *exhibits status quo bias in favor of* f, if absent an endowment the DM chooses g but not f from the set $\{f, g\}$, but chooses f over g from the same set when f serves as the endowment.[26]

Next, we introduce an assumption regarding the set of priors that the individual holds. This assumption roughly states that his subjective distributions over the composition of one ambiguous bag are independent of the subjective distributions over the possible compositions of the other bag.[27] We start with some simple notation. For any joint probability $\pi \in \Pi$ denote by π_{DJ} and π_{SP} the marginal probability distributions induced by π. Formally, for every $i, j \in \{0, ..., 99\}$, define $\pi^i_{DJ} \equiv \sum_j \pi(s_{ij})$, $\pi^j_{SP} \equiv \sum_i \pi(s_{ij})$. Now, define $\Pi_{DJ} \equiv \{p \in \mathbb{R}^{100} | p = \pi_{DJ} \text{ for some } \pi \in \Pi\}$ and $\Pi_{SP} \equiv \{q \in \mathbb{R}^{100} | q = \pi_{SP} \text{ for some } \pi \in \Pi\}$. Finally, for every $\pi \in \Pi$, define $\pi_{DJ} \otimes \Pi_{SP} \equiv \left\{\tilde{\pi} \in \mathbb{R}^{100} \times \mathbb{R}^{100} | \tilde{\pi} = \pi^T_{DJ} \cdot \bar{\pi}_{SP} \text{ for some } \bar{\pi}_{SP} \in \Pi_{SP}\right\}$ (where $\cdot$ is matrix multiplication, and v^T stands for the transpose of v for any row vector v) and similarly $\Pi_{DJ} \otimes \pi_{SP} \equiv \left\{\tilde{\pi} \in \mathbb{R}^{100} \times \mathbb{R}^{100} | \tilde{\pi} = \bar{\pi}^T_{DJ} \cdot \pi_{SP} \text{ for some } \bar{\pi}_{DJ} \in \Pi_{DJ}\right\}$

[26] This definition is a strict version of the weak status quo bias (WSQB) axiom introduced in Masatlioglu and Ok (2014).

[27] This assumption is very natural in our set up given the construction of the ambiguous bags according to the decimals of two different stock market indices.

We are now ready to state our assumption.

Assumption 1: For any $\pi \in \Pi$ we have $\pi_{DJ} \otimes \Pi_{SP} \subseteq \Pi$ and $\Pi_{DJ} \otimes \pi_{SP} \subseteq \Pi$.

Proposition 1 *According to the representation given in Ortoleva (2010) and under Assumption 1, if there exist acts $f \in F_{DJ}$ and $r \in \mathcal{R}$ such that the choice between f and r exhibits status quo bias in favor of f, then there exists an act $g \in F_{SP}$ such that the choice between f and g also exhibits status quo bias in favor of f.*

Proof. Let f and r be as in the Proposition. If the decision maker exhibits status quo bias in favor of f then the following must be true:

$$\textstyle\sum_{s\in S} \rho(s) E_{f(s)}(u) < E_r(u) \tag{1}$$

$$\textstyle\sum_{s\in S} \tilde{\pi}(s) E_{f(s)}(u) > E_r(u), \quad \text{for some } \tilde{\pi} \in \Pi \tag{2}$$

According to inequality (1), act f evaluated at the prior ρ, i.e., without an endowment, delivers lower expected utility than r. However there is one prior in Π according to which f carries strictly higher expected utility than r; f is therefore chosen when it serves as the status quo. Now let $g \in F_{SP}$ be such that:

$$\sum_{s\in S} \rho(s) E_{g(s)}(u) = E_r(u). \tag{3}$$

Continuity of the utility function alongside monotonicity guarantee that such a g exists.[28] From (1) and (3) it follows that $\sum_{s\in S} \rho(s) E_{g(s)}(u) > \sum_{s\in S} \rho(s) E_{f(s)}(u)$, hence g is chosen

[28]The act g is not only a theoretical construct. In our experiment, we find implicit evidence for the existence of such g as in all treatments we observe switching points in part 1 for the vast majority of subjects.

over f absent a status quo. We are left to show that when f serves as the endowment, it is chosen over g, that is, it carries higher expected utility than g according to some prior in Π.

Recall $\tilde{\pi}_{DJ} \equiv (\tilde{\pi}^1_{DJ}, \tilde{\pi}^2_{DJ}, ..., \tilde{\pi}^{100}_{DJ})$ and $\rho_{SP} \equiv (\rho^1_{SP}, \rho^2_{SP}, ..., \rho^{100}_{SP})$. Define $\hat{\pi} \equiv \tilde{\pi}^T_{DJ} \cdot \rho_{SP}$. Assumption 1 ensures that $\hat{\pi} \in \Pi$. By construction, $\hat{\pi}$ evaluates gambles on the DJ bag using $\tilde{\pi}$, and evaluates gambles on the SP bag using ρ. It follows that $\sum_{s\in S} \hat{\pi}(s) E_{f(s)}(u) = \sum_{s\in S} \tilde{\pi}(s) E_{f(s)}(u)$ and $\sum_{s\in S} \hat{\pi}(s) E_{g(s)}(u) = E_r(u)$ which together with (2) completes the proof.

■

Appendix C Corners

Due to the limited number of questions asked in an experimental session, some subjects did not exhibit an *interior* switching point from the endowment to the alternative set, a situation we dub as a "corner". A corner is the case where a subject always chooses the $(10, 4)$ gamble or always chooses the alternative gambles in one or both subsets of ordered alternatives. To understand the role of corners, the reader could imagine extending the range of alternative options. It is conceivable that if we keep decreasing the expected payoff of the alternative gambles all subjects would eventually prefer the $(10, 4)$ gamble. Similarly, all subjects would eventually switch to the alternative gamble if the expected payoffs of the latter are made large enough. Hence we interpret corners as cases in which a subject's switching point is not captured by the selected range of alternative gambles. Corners have the potential to generate a bias in our estimate of the status quo effect. Luckily we can exploit the pattern of choice exhibited in proximity to the end of the range of questions to assess whether a certain corner is more likely to induce an overestimation or underestimation of status quo bias.

In this section we give an account of the emergence of corners across treatments. We show that in each treatment the bias is affected to a similar extent by instances of potential overestimation and underestimation. If anything, underestimation is slightly more likely in the two asymmetric treatments, which are the two cases where we do observe a statistically significant status quo bias. Thus, it seems that adjusting for corners would only strengthen the pattern of our findings.

Table 6

TYPES OF CORNERS

(a) Right corner in part 2

	a_1	a_2	a_3		a_N
Part 1	0	0	1	...	1
Part 2	0	0	0	...	0

(b) Right corner in part 1

	a_1	a_2	a_3		a_N
Part 1	0	0	0	...	0
Part 2	0	0	1	...	1

(c) Left corner in part 1

	a_1	a_2	a_3		a_N
Part 1	1	1	1	...	1
Part 2	0	0	1	...	1

(d) Left corner in part 2

	a_1	a_2	a_3		a_N
Part 1	0	0	1	...	1
Part 2	1	1	1	...	1

Table 6 provides examples of corners. The 0 entry represents a choice of the $(10, 4)$ gamble in the question comparing the $(10, 4)$ gamble to alternative a_j. An entry of 1 represents the choice of the alternative gamble. The alternatives are monotonically ordered, that is, a_j first order stochastically dominates a_{j-1}. As mentioned earlier, most subjects exhibit an interior switching point. That is, if they choose gamble a_j over the $(10, 4)$ gamble they also prefer gamble a_{j+1} over the $(10, 4)$ gamble. This means that for most subjects all the 0 entries (if any) are located to the left of the 1 entries. This observation allows us to group corners into two categories, right and left corners. A right corner is represented by a full line of 0 entries. In this case the subject would eventually switch to the alternative gamble if offered an attractive enough alternative gamble. However, our finite grid of alternatives does not capture the switching point. Similarly a left corner occurs when, under a certain frame, a subject always chooses gambles from the alternative set. In this case the switching point is located to the left of the grid of alternatives and all entries are 1. Right and left corners may lead to overestimation or underestimation of the bias depending on the frame under which they occur. To see this, consider the case described in table 6(a). The subject exhibits an interior switching point in part 1 and a right corner in part 2. Under a monotonicity assumption, if we were to add an additional gamble to the right of the grid it would turn either into an additional choice exhibiting status quo bias, or into a switch to the alternative gamble in part 2. In the former case, our findings would underestimate the true level of the bias while in the latter it would be accurate. For this reason we say that, in example 6(a), the truncation of the grid is more likely to have produced an underestimation of the bias, rather than an overestimation. Using a similar reasoning the truncation represented in Table 6(b) led more likely to an overestimation of the bias. The list below outlines all possible cases of underestimation and overestimation due to corners.

- Left corner in part 1 and/or right corner in part 2: Potential underestimation.
- Right corner in part 1 and/or left corner in part 2: Potential overestimation.
- Left corner hit in both part 1 and part 2: Neutral.
- Right corner hit in both part 1 and part 2: Neutral.

Table 7 categorizes corners into instances of overestimation and underestimation and reports the occurrence of corners in all treatments. Notice that percentages of potential overestimation and underestimation are fairly balanced in each treatment. Underestimation appears slightly more prominent than overestimation in the two asymmetric treat-

Table 7

CORNERS BY TREATMENT

	R-R	R-A	A-R	A-A
Underestimation	4.55 (3)	19.7 (17)	12.9 (8)	6.9 (5)
Overestimation	3 (2)	16.2 (14)	4.8 (3)	6.9 (5)
Difference	1.55	3.5	8.1	0
No. obs.	33	43	31	36

Percentages of occurences of subjects hitting corners which lead to overestimation or underestimation in each treatment (the number of occurences is reported in parenthesis).

ments (especially in treatment A-R). This implies that if we were to correct our analysis to account for corners, our main result would only be strengthened.

References

Bewley, T. F. (1986): "Knightian Decision Theory. Part I," *Cowles Foundation discussion paper*, 807.

Dean, M. (2008): "Status Quo Bias in Large and Small Choice Sets," *Working Paper.*

Dean, M., O. Kibris, and Y. Masatlioglu (2017): "Limited Attention and Status Quo Bias," *Journal of Economic Theory, Forthcoming.*

Eisenberger, R. and M. Weber (1995): "Willingness-to-pay and willingness-to-accept for risky and ambiguous lotteries," *Journal of Risk and Uncertainty*, 10(3), 223–233.

Ericson, K. (2012): "Market Design When Firms Interact with Inertial Consumers: Evidence from Medicare Part D," *Working Paper.*

Gill, D. and V. Prowse (2012): "A Structural Analysis of Disappointment Aversion in a Real Effort Competition," *American Economic Review*, 102(1), 469–503.

Hartman, R. S., M. J. Doane, and C.-K. Woo (1991): "Consumer Rationality and the Status Quo Bias," *Quarterly Journal of Economics*, 106(1), 141–162.

Horowitz, J. K. and K. E. McConnell (2002): "A Review of WTA/WTP Studies," *Journal of Environmental Economics and Management*, 44(3), 426–447.

Johnson, E. J. and D. G. Goldstein (2003): "Do Defaults Save Lives?" *Science*, 302, 1338–1339.

Kahneman, D., J. L. Knetsch, and R. H. Thaler (1991): "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias," *Journal of Economic Perspectives*, 5(1), 193–206.

Kahneman, D. and A. Tversky (1979): "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, 47(2), 263–292.

——— (1992): "Advances in prospect theory: Cumulative representation of uncertainty," *Journal of Risk and Uncertainty*, 5(4), 297–323.

Kempf, A. and S. Ruenzi (2006): "Status Quo Bias and the Number of Alternatives: An Empirical Illustration from the Mutual Fund Industry," *Journal of Behavioral Finance*, 7(4), 204–213.

Knetsch, J. L. (1989): "The Endowment Effect and Evidence of Nonreversible Indifference Curves," *American Economic Review*, 79(5), 1277–1284.

Knetsch, J. L. and J. Sinden (1984): "Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value," *Quarterly Journal of Economics*, 99(3), 507–521.

Koszegi, B. and M. Rabin (2006): "A Model of Reference-Dependent Preferences," *The Quarterly Journal of Economics*, 121(4), 1133–1165.

——— (2007): "Reference-Dependent Risk Attitudes," *American Economic Review*, 97(4), 1047–1073.

List, J. A. (2003): "Does Market Experience Eliminate Market Anomalies?" *Quarterly Journal of Economics*, 118(1), 47–71.

——— (2004): "Neoclassical Theory Versus Prospect Theory: Evidence From the Marketplace," *Econometrica*, 72(2), 615–625.

Madrian, B. C. and D. F. Shea (2001): "The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior," *Quarterly Journal of Economics*, 116(4), 1149–1187.

Maltz, A. (2016): "Exogenous Endowment - Endogenous Reference Point," *Working Paper*.

Masatlioglu, Y. and E. A. Ok (2014): "A Canonical Model of Choice with Initial Endowments," *The Review of Economic Studies*, 81(2), 851–883.

Mihm, M. (2016): "Reference dependent ambiguity," *Journal of Economic Theory*, 163, 495–524.

Munro, A. and R. Sugden (2003): "On the Theory of Reference-Dependent Preferences," *Journal of Economic Behavior and Organization*, 50(4), 407–428.

Ortoleva, P. (2010): "Status quo bias, multiple priors and uncertainty aversion," *Games and Economic Behavior*, 69(2), 411–424.

Pope, D. G. and M. E. Schweitzer (2011): "Is Tiger Woods Loss Averse? Persistent Bias in the Face of Experience, Competition, and High Stakes," *American Economic Review*, 101(1), 129–157.

Redelmeier, D. A. and E. Shafir (1995): "Medical Decision Making in Situations that Offer Multiple Alternatives," *The Journal of the American Medical Association*, 273(4), 302–305.

Roca, M., R. M. Hogarth, and A. J. Maule (2006): "Ambiguity seeking as a result of the status quo bias," *Journal of Risk and Uncertainty*, 32(3), 175–194.

Sagi, J. S. (2006): "Anchored preference relations," *Journal of Economic Theory*, 130(1), 283–295.

Samuelson, W. and R. Zeckhauser (1988): "Status Quo Bias in Decision Making," *Journal of Risk and Uncertainty*, 1(1), 7–59.

Schwartz, B. (2000): "Self-determination: The tyranny of freedom," *The American psychologist*, 55(1), 79–88.

Sprenger, C. (2015): "An Endowment Effect for Risk: Experimental Tests of Stochastic Reference Points," *Journal of Political Economy*, 123(6), 1456–1499.

Thaler, R. (1980): "Toward a positive theory of consumer choice," *Journal of Economic Behavior and Organization*, 1(1), 39–60.