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Abstract

We compare the inflation expectations reported by consumers in a survey with their behavior in a financially incentivized investment experiment designed such that future inflation affects payoffs. The inflation expectations survey is found to be informative in the sense that the beliefs reported by the respondents are correlated with their choices in the experiment. Furthermore, most respondents appear to act on their inflation expectations showing patterns consistent (both in direction and magnitude) with expected utility theory. Respondents whose behavior cannot be rationalized tend to be less educated and to score lower on a numeracy and financial literacy scale. These findings are therefore the first to provide support to the microfoundations of modern macroeconomic models.

Key words: inflation expectations, surveys, experimental economics

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1. Introduction

Inflation expectations are at the center of modern macro-economic theory and monetary policy (Woodford 2005, Gali 2008, Sims 2009). Although the academic debate about expectations formation is still open,[1] virtually all macro-economic models are built on the assumption that agents maximize expected utility under a well defined distribution representing their inflation beliefs. Economic theory therefore predicts that inflation expectations should influence many economic decisions. For instance, households are expected to take future inflation into consideration when deciding on large durable purchases, mortgage (re)financing, taking on and managing debt, saving, or wage negotiations. Inflation expectations therefore possess a self-fulfilling property in macro-economic models: by affecting decisions in the real economy, inflation expectations impact realized inflation. This transmission effect is now well recognized both in academic and in central banking circles (Bernanke 2004, 2007). It is therefore generally agreed that one of the first steps to controlling inflation consists in actively managing the public's beliefs about future inflation (Woodford 2004, 2005).[2]

Because of the role played by inflation expectations, accurate measurements of the public's beliefs are important to academic economists and policy makers. In particular, macro-economists who do not fully adhere to the rational expectations hypothesis now use outside estimates of inflation expectations as an input to their models.[3] Central banks also need accurate measures of inflation expectations to calibrate monetary policy. In addition, to monitor the effectiveness of its communication, a central bank needs to regularly assess the consistency of the public's beliefs with policy objectives.[4]

Existing measures of inflation expectations may be partitioned into two broad categories depending on whether they are direct or indirect. Indirect measures are inferred from either financial instruments (such as TIPS, the Treasury Inflation-Protected Security), the term structure of interest rates, or past realizations of inflations rates. Direct measures are obtained from surveys in which consumers, businesses or professional forecasters are asked to self-report their subjective beliefs about future inflation. In the U.S., such surveys include the monthly Reuters/University of Michigan Survey of Consumers, the Livingston Survey, the Conference Board's Consumer Confidence Survey and the Survey

[1] Since Muth (1961) and Lucas (1972) inflation expectations have been mostly assumed to be formed rationally. Over the past twenty years, with mounting empirical evidence rejecting the rational expectations hypothesis, several variations have been introduced including adaptive learning (Sargent 1999, Evans and Honkapohja 2001), sticky information (Mankiw and Reis 2002), rational inattention (Sims 2003, 2006, Mackowiak and Wiederholt 2009), or asymmetric information (Capistran and Timmermann 2009). Regardless of how expectations formation is modeled, these models still assume that agents act on their inflation beliefs.

[2] In particular, Ben Bernanke (2004) argued that "an essential prerequisite to controlling inflation is controlling inflation expectations."

[3] Examples include Roberts (1995, 1997, 1998), Kozicki and Tinsley (2002), Erceg and Levin (2003), Carroll (2003), Mankiw et al. (2003), Nunes (2010), Adam and Padula (2011).

[4] Observe that what is needed for these purposes is not necessarily an accurate predictor of future inflation, but an accurate measure of the public's true beliefs. Of course, true beliefs are unbiased when the rational expectation hypothesis holds. Even when inflation expectations are biased, however, they may still be informative about the economic decisions the public makes.

of Professional Forecasters. In addition, several central banks around the world are now conducting inflation expectations surveys of individual consumers.[5] Each of these direct and indirect measures has potential weaknesses. While market based estimates rely on strong modeling assumptions (e.g. about risk and liquidity premia), surveys of professionals are often based on small samples.[6] Finally, because of the absence of direct financial consequences, inflation surveys of households may suffer from a "cheap talk" problem.[7]

Indeed, some consumers may not think constantly about inflation. As a result, they may not have well formed beliefs when they are asked about their inflation expectations. In the absence of direct incentives, these survey respondents may be reluctant to process the information necessary to come up with their best possible estimate. Moreover, respondents who do have well formed beliefs about future inflation have no explicit incentives to report these expectations accurately in a survey. Because of the lack of incentives for thoughtful and truthful responses, inflation surveys of consumers may suffer from noisy and possibly biased responses. In fact, most empirical studies find that the average (and median) expectation elicited from surveys of consumers is a biased estimate of actual inflation.[8] The presence of an aggregate bias, however, does not necessarily rule out the possibility that consumers accurately report the inflation beliefs on which they base their decisions. So the question remains: how informative are the survey responses of individual consumers about the choices they make?

Moreover, although several studies have recently looked at how individuals form and update their inflation beliefs,[9] the extent to which inflation expectations influence the behavior of consumers is still not well-understood. It has been argued (e.g. Nunes 2010) that, in part because of the high stakes involved, professional investors, firms and other large economic actors do take future inflation into consideration when making decisions. At a more micro-economic level, however, it is unclear how agents' behavior is affected

[5] Central banks that survey consumers about their inflation expectations include the Bank of England, the European Central Bank, the Bank of Australia, the Bank of Japan, the Reserve Bank of India, and the Sveriges Riksbank.

[6] For instance, the Survey of Professional Forecasters conducted by the Federal Reserve Bank of Philadelphia currently consists of 45 respondents on average. It has also been pointed out that, because of strategic and reputational considerations, professional forecasters may have incentives to misreport their beliefs (Ehrbeck and Waldmann 1996, Laster, Bennett and Geoum 1999, Lloyd 1999, Ottoviani and Sorensen 2006).

[7] For a discussion of this issue see e.g. Keane and Runkle (1990), Manski (2004, 2006), Pesaran and Weale (2006), or Inoue, Kilian and Kiraz (2009).

[8] Studies showing that surveys produce biased forecasts of inflation include Bryan and Gavin (1986), Pesaran (1987), Batchelor and Dua (1989), Baghestani (1992), Roberts (1997, 1998), Croushore (1998), Thomas (1999), Mehra (2002), Ball and Croushore (2003), Carroll (2003), Ang, Bekaert and Wei (2007), Nunes (2010) and Adam and Padula (2011). Capistran and Timmermann (2009) show theoretically that the bias in forecasted inflation may be explained by asymmetric costs of over- versus under-predicting future inflation. Nevertheless, Ang et al. (2007) find that surveys of consumers produce better estimates of inflation than other direct and indirect measures.

[9] Bryan and Venkatu, (2001a,b), Döhring and Mordonu (2007), Malmendier and Nagel (2009), Bruine de Bruin et al. (2010b).

by their beliefs about future inflation.[10] In particular, because of the delay between the decision and the realization of the random event, and because most households face far more significant risks (e.g. related to employment or health), it is unclear whether future inflation prospects are sufficiently salient to influence consumers' behavior. Furthermore, a series of incentivized laboratory experiments on "money illusion" suggest that subjects behave differently when an otherwise identical situation is framed in real or in nominal terms (Fehr and Tyran 2001, 2007). If these results extend to consumers outside the lab, then the role of inflation expectations in shaping economic decisions may be ambiguous.[11]

In this paper, we examine whether consumers act on the inflation expectations they report in a survey. To do so, we compare the behavior of consumers in a financially incentivized investment framed field experiment with the beliefs they self report in an inflation expectations survey. As further explained below, the survey was fielded twice with the same respondents at a five-months interval. Our analysis may be decomposed in two parts.

First, we evaluate the extent to which reported beliefs are informative about observed behavior. To do so, we simply examine how the inflation expectations the consumers report in the survey correlate with their decisions in the investment experiment. In essence, we are conducting what the survey literature refers to as a "construct validity" exercise, which is a key requirement to validate a survey question (Carmines and Zeller 1991). For instance, a question aimed at eliciting understanding of HIV risks is validated by examining how responses are correlated with risky sexual activities (Bruine de Bruin et al. 2007).[12] Because of possible confounds, identifying objective (real life) measures of behavior to validate responses to a consumer inflation expectations survey is not trivial. For instance, the timing of a durable good purchase could be influenced by the respondent's inflation expectations, but also by his time discounting or liquidity constraints (which may be difficult to measure). Such a methodological issue may explain why, although inflation expectations surveys of consumers are conducted around the world, questions aimed at eliciting inflation beliefs have not been formally validated (to the best of our knowledge). Instead, our controlled experiment provides a direct approach to test unambiguously whether the inflation expectations consumers report in a survey are informative about an actual financial decision whose payoffs depend on future inflation.[13]

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[10] For instance, Du Caju et al. (2008) report that wage bargaining is often driven by realized inflation rather than by expectations about future inflation.

[11] In addition, several lab experiments in which subjects play incentivized games (unrelated to inflation) suggest that, in contrast with standard economic theory, subjects do not necessarily act on their stated beliefs (e.g. Costa-Gomez and Weizsaker 2008).

[12] Likewise, Barsky et al. (1997) compare responses to a survey question aimed at eliciting risk attitudes with different behaviors such as smoking, drinking, not having insurance, choosing risky employment, and holding risky assets. They conclude that "Showing that our measure of risk tolerance predicts behavior in the way one would expect partially validates the survey measure."

[13] An alternative validation approach consists in comparing survey responses with an incentive compatible measure with real monetary payoffs. For instance, Dohmen et al. (2011) validate a self assessment measure of risk attitudes by examining how survey responses correlate with risk attitudes elicited from an incentive

Second, we subject the data to a stricter analysis by examining the extent to which inflation expectations and experimental decisions comply with expected utility theory. More precisely, we exploit the panel structure of the data to investigate whether or not survey respondents consistently act on their reported inflation beliefs in a way that satisfies expected utility theory. In other words, we conduct a simple yet formal test of one of the basic assumptions underlying most modern macro-economic models. To the best of our knowledge, this is the first time such a test of the micro-foundations of macro-economic models has been conducted in the literature. Let us make it clear, however, that our objective is not to assess how consumers generally account for future inflation when making decisions in their everyday life. Instead, we rely on a controlled experimental environment to isolate the possible influence of inflation expectations on a financial decision. Our study should therefore be considered a first step in establishing empirically the role played by inflations expectations in shaping the economic behavior of consumers.

The results reveal that the inflation expectations survey is informative. Indeed, stated beliefs and experimental decisions are found to be highly correlated and consistent, on average, with payoff maximization. There is, however, a substantial amount of heterogeneity across respondents. In particular, roughly 40% of the respondents behave as if risk averse, while one out of four respondents behave as if risk loving. These departures from risk neutrality are explained in large part by the respondents' self-reported risk tolerance. Our results also indicate that respondents who change their inflation expectations from one survey to the next, also tend to adjust their decisions in the experiment in a way consistent (both in direction and magnitude) with expected utility theory. Finally, we find that respondents whose behavior is difficult to rationalize share three characteristics: i) they score lower on a numeracy and financial literacy scale, ii) they are less educated and iii) they take significantly more time to complete the survey.

The remainder of the paper is organized as follows. The survey and the respondents are described in Section 2. The design of the experiment is presented in Section 3. The responses to the inflation expectations questions and the choices made in the experiment are analyzed separately in Section 4. In Section 5, we test whether stated beliefs about future inflation are informative about experimental choices. In Section 6, we exploit the panel structure of the data to study how respondents who change their predictions from one survey to the next adjust their experimental choices. Our final comments are provided in Section 7.

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compatible lottery experiment. Likewise, in addition to the survey question, we could have elicited the respondents' inflation expectations with a financially incentivized instrument such as a scoring rule. There is no guarantee, however, that such an approach is incentive compatible even when respondents are risk neutral. Indeed, the respondents' wealth is likely to depend on future inflation, which creates a stake in the event predicted. As shown by (e.g.) Karni and Safra (1995), incentivized beliefs elicitation techniques are only incentive compatible when the respondent has no stake in the event predicted (the so called "no stake" condition).

2. The Survey and the Respondents

The survey is part of an ongoing effort by the Federal Reserve Bank of New York, with support from academic economists, and psychologists at Carnegie Mellon University. The general goal of this initiative is to better understand how the public forms and updates beliefs about future inflation, and to develop better tools to measure consumers' inflation expectations (Bruine de Bruin 2010a). The survey consisted of two sets of questions. The first set of questions, which is analyzed in this paper, examines the link between self-reported beliefs and economic behavior. The second set of questions, which is analyzed separately in Armantier et al. (2011), investigates how individual consumers revise their inflation expectations after being exposed to new information.

2.1. The Respondents

The survey, which includes the experiment, was conducted over the internet with RAND's American Life Panel (ALP). Our target population consists of individuals 18 or older who participated in the Michigan Survey between November 2006 and July 2010 and subsequently agreed to participate in the ALP.[14] Out of a total sample of 972 individuals invited to participate in the survey, 771 did so, for a response rate of 79.3%. Those who completed the first survey were invited to participate in the second survey, of which 734 did so, implying a response rate of 95.2%. The first survey was fielded between July 20, 2010 and August 17, 2010. The second survey was fielded roughly five months later, between January 3rd, 2011 and February 9, 2011. Respondents received $20 for each completed survey. As explained in the next section, respondents were also eligible to earn extra money in each survey if they answered all the questions in the experiment. Although respondents were allowed to skip questions, those who tried to do so received a prompt encouraging them to provide an answer.

As indicated in Table 1 (column "All Data"), respondents reported an average age of 52.1, with a median of 53. In total, 57% of the respondents were female, 15% had no more than a high school diploma, while 21% possessed a post graduate degree (i.e. beyond a Bachelor degree). The median reported income range was $60-$75k, with 42% of the respondents reporting incomes over $75k. The average and median completion times were respectively 42 and 26 minutes with no notable differences between survey 1 and 2. There is, however, substantial heterogeneity across respondents. While fewer than 1% of the respondents completed the survey in less than 9 minutes, other respondents took a considerable amount of time between the moments they opened and finished the survey (more than a week for 5% of the respondents). As we shall see next, it is important to control for these differences in completion time when studying the link between reported beliefs and experimental choices.

[14] The Michigan survey is a monthly telephone survey with 500 respondents, consisting of a representative list assisted random-digit-dial sample of 300, and 200 respondents who were re-interviewed from the random-digit-dial sample surveyed six months earlier. Our target population is further restricted to active ALP members, defined as those who either participated in at least one ALP survey within the preceding year, or were recruited into the ALP within the past year.

2.2. *Procedure*

Both surveys had a similar structure.[15] As explained in more detail below, respondents first reported their expectations for future inflation. Then, they were asked to explain what information they used to form their reported inflation expectations (not analyzed here). The experiment was presented next. After answering questions about how they update their beliefs about future inflation (not analyzed here), respondents completed measures of numeracy, financial literacy, and willingness to take risk.

Three features of the design are worth noting. First, up to the experiment, the respondents were asked the same questions in the same order in both surveys. Second, at the time they reported their inflation beliefs, respondents were not told about the subsequent incentivized experiment in which payments depend on future inflation. Third, several questions separated the experiment from the inflation expectations questions. This delay, along with the substantial financial incentives involved in the experiment, therefore reduces experimental demand, which could have led respondents to make choices in the experiment, not as a reflection of their preferences, but simply to be consistent with their stated predictions.

2.3. *Reported Beliefs*

Each respondent was randomly assigned to one of two "expectation" treatments. In the "Inflation" treatment, respondents were asked directly about their expectations for the "rate of inflation." In the "Price" treatment, respondents were asked about their expectations for the "prices of the things I usually spend money on." Point predictions were elicited for two time horizons: between now and 12 months from now, and between 24 and 36 months from now. In addition to point estimates, the respondents in both expectation treatments were asked to report probabilistic beliefs for a range of inflation outcomes. More specifically, respondents were asked to state the percent chance that, over the next 12 months, the "rate of inflation" or "changes in prices" would be within the following intervals:]-12% or less], [-12%,-8%], [-8%,-4%],[-4%,-2%], [-2%,0%], [0%,2%], [2%,4%], [4%,8%], [8%,12%], [12% or more[. Respondents could press a button to see the sum of the probabilities entered so far in order to verify that their answers added to 100%. If it was not the case, they were prompted to go back and make the appropriate changes.

Following the approach developed by Engelberg, Manski and Williams (2009) (see also Bruine de Bruin et al. 2011), a generalized beta distribution is fitted to each respondent's stated probabilistic beliefs. We then generate two variables that will be used in the econometric analysis. The first, equal to the mean of the respondent's beta distribution, is an "Estimated Expected Prediction." The second, equal to the variance of the respondent's fitted distribution, captures the respondent's "inflation uncertainty."

[15] The complete list of questions asked in the first survey may be found in the supplemental material available online at https://sites.google.com/site/olivierarmantier/.

2.4. *Numeracy, Financial Literacy and Self-Reported Risk Tolerance*

Six questions were asked in the first survey to measure the respondent's numeracy and financial literacy. The numeracy questions were drawn from Lipkus, Samsa, and Rimer (2001), while the questions about financial literacy were slightly adapted from Lusardi (2007).[16] We created a variable taking integer values between zero and six depending on the number of correct answers the respondent gave to these questions. As indicated in Table 1 (column "All Data") respondents answered 4.5 questions correctly on average with a median of 5. There is, however, some heterogeneity across respondents: While 29.8% answered every question correctly, 11.0% got less than half of the answers right.

In each survey, respondents were also asked to assess their willingness to take risk regarding financial matters using a qualitative scale ranging from 1 (Not willing at all) to 7 (very willing). This instrument has been shown to produce meaningful measures of risk preferences. In particular, Dohmen et al. (2011) find that the risk tolerance self-reported on this qualitative scale is consistent with the risk preference elicited with a financially incentivized lottery-type experiment developed by Holt and Laury (2002). Other studies using a similar risk attitude measure include Bonin et al. (2007), Dohmen, Khamis and Lehman (2010), or Caliendo, Fossen and Kritikos (2010). As indicated in Table 1 (column "All Data") the average reported risk tolerance across the two surveys is 3.3 with a median of 3. One third of the respondents selected a rating of 1 or 2, thereby reflecting substantial aversion to risk, while one respondent out of four indicated a high tolerance toward risk by selecting a rating of 5, 6 or 7. This distribution is generally consistent with those obtained in previous work using the same measure. Furthermore, our risk attitude measure appears to be generally stable over time. Indeed, we find a correlation of 0.822 between the reported risk tolerances reported by the same respondents across the two surveys.[17]

[16] Here is an illustration of the type of questions we asked: "Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up as an even number?"; or "If you have $100 in a savings account, the interest rate is 10% per year and you never withdraw money or interest payments, how much will you have in the account after: one year? two years?". The rest of the numeracy and financial literacy questions may be found in the supplemental materials.

[17] Reporting different risk tolerance in each survey is not necessarily a violation of standard economic theory. Indeed, the qualitative measure reflects both the respondents risk preference and the nature of the risks they face. While standard theory assumes that the former is stable over the time, the latter may have evolved in the five months separating the two surveys.

3. The Financially Incentivized Framed Field Experiment

3.1. Experimental Design

As shown in Appendix A where the experimental instructions are reported, the experiment consists of 10 questions with real monetary consequences.[18] For each question the respondent is asked to choose between two investments. Each investment produces a specific revenue payable 12 months later.[19] Investment B is a fixed dollar amount while investment A is indexed on future inflation. More specifically, the respondent's revenue under investment A depends on what the realization of the annual rate of inflation will be over the next 12 months. The possible revenue as a function of realized inflation were presented to the respondents as in Table 2, where the "rate of inflation" was explicitly defined as the official annual U.S. CPI (Consumer Price Index) rounded to the nearest percentage point. As indicated in Appendix A, investment A remains the same in each of the 10 questions. In contrast, the revenue produced by investment B varies across questions.

We conducted two treatments by changing the order in which investment B was presented to respondents. In the "Ascending" treatment, the earnings of investment B increase in increments of $50 from $100 in question 1 to $550 in question 10. In the "Descending" treatment the earnings of investment B decrease in increments of $50 from $550 in question 1 to $100 in question 10. While the analysis conducted in the subsequent sections includes the data collected in both treatments, we only refer to the "Ascending" treatment for the remainder of this section in order to simplify the description of the experiment.

Observe that the structure of the experiment is akin to the now classic experiment designed by Holt and Laury (2002) to measure risk attitudes. In their experiment, respondents are presented with a series of 10 questions asking them to choose between two lotteries A and B. The probability of the high payoff is the same for the two lotteries, but the terminal payoffs are more unequal under Lottery B (which therefore has a higher variance). The number of questions after which a respondent switches from one lottery to the other therefore provides an estimate of the respondent's degree of risk aversion. Similarly, in our ascending scale treatment, an expected payoff maximizer with an inflation expectation within [0%,9%], say 5%, should first select investment A for the first 4 or 5 questions (the respondent is indifferent between the two investments in question 5 as they both produce $300 in expectation), and then switch to investment B for the remaining questions. Hence, a rational respondent should switch investments at most once and in a specific direction.

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[18] According to the taxonomy established by Harrisson and List (2004) our experiment belongs to the class of "framed field experiment."

[19] Observe that, regardless of the investment selected, a respondent can only receive additional money 12 months after filling the survey. As a result, time preference should not influence the choice between the two investments.

The analysis conducted in the next section focuses a respondent's "switching point." We only define this switching point for respondents whose behavior may be rationalized, that is for respondents who switch at most once from investment A to investment B in the ascending scale treatment and from investment B to investment A in the descending scale treatment. For these respondents, the switching point is set equal to the number of questions for which the respondent selected investment A. So, for both experimental treatments, the switching point can take integer values between 0 (i.e. the respondent always selects investment B) and 10 (i.e. the respondent always selects investment A).[20]

In each of the two surveys, the participants were informed that two respondents would be paid according to their choices in the experiment. Once a survey was completed, we randomly picked one of the ten questions, and two survey participants who completed the experiment. Twelve months later, these two participants were paid according to the investment choice they made for the selected question. Although the amounts a respondent could earn were substantial compared to traditional lab experiments (i.e. up to $600), the random mechanism used to pay respondents created small expected incentives. In addition, since the exact number of participants was unknown at the time the experiment was conducted, the respondents were not able to calculate exactly their odds of being selected for payment. Paying randomly a subset of respondents has been adopted in several lab experiments (Armantier 2006, Kobberling, Schwieren and Wakker 2007, Bettinger and Slonim 2007), and in particular in large field experiments similar to the one conducted here (e.g. Harrison, Lau, and Williams 2002, Harrisson, Lau and Rustrom 2006, Dohmen et al. 2011).

Finally, note that each respondent was randomly assigned to one of the four possible treatment combinations (i.e. either the "Price" or the "Inflation" treatment, and either the "Ascending" or the "Descending" treatment). Once assigned to a treatment, a respondent remains in the same treatment in the two surveys.

3.2. Economic Considerations

Although presented in terms of terminal payoffs to facilitate the respondents' comprehension, investments A and B both have an economic interpretation. Indeed, investment A corresponds to the following scenario: "an agent borrows $5,000 for 12 months at a rate equal to the inflation rate, and invests the $5,000 for 12 months in an account that earns a fixed annual rate of 11%." Investment B corresponds to the following scenario: "an agent borrows $5,000 for 12 months at a rate equal to the inflation rate, and invests the $5,000 for 12 months in an inflation protected account that earns an annual rate equal to the inflation rate plus k %, where k varies in increments of 1% from 2% in question 1 to 11% in question 10. "

[20] Unlike Holt and Laury (2002), the switching point does not have a direct interpretation here. Indeed, our experiment was not designed as an incentive compatible instrument aimed at eliciting risk attitude or inflations expectations. Instead, it was designed to reflect an investment scenario.

In nominal terms, investment B earns $\$5{,}000 * k$ while investment A earns $\$5{,}000 * (0.11 - i)$, where i denotes the inflation rate over the next 12 months. If expressed in real terms, investment B earns $X = \$5{,}000 * k/(1 + i)$, while investment A earns $\$5{,}000 * (0.11 - i)/(1 + i) = \alpha X - \beta$, where $\alpha = 1.11/k > 1$ and $\beta = \$5{,}000$. It is then easy to see that the variance of the earnings with respect to inflation is always lower with investment B whether one expresses earnings in nominal or in real terms. We can then derive three propositions that will help us assess whether the behavior observed in the experiment is consistent with standard economic theory. To do so we consider an expected utility framework and we assume that the agent's utility function over income, denoted $U(.)$, is thrice differentiable, strictly increasing, and satisfies the von Neumann Morgenstern axioms.

> ***Proposition 1:*** *If investment A and investment B have the same expected return then a risk-averse agent prefers investment B to investment A.*[21]

The proposition therefore shows that, all else equal, and in particular for the same set of beliefs, a risk-averse (respectively risk-loving) agent has a lower (respectively, higher) switching point than a risk neutral agent. For instance, consider a respondent who believes that the inflation rate will 4% over the next 12 months. In question 6 the two investments produce the same expected return of \$350. If this respondent is risk averse (respectively risk loving) then he should select the safer (respectively riskier) option in question 6, that is, he should select investment B (respectively investment A).

We now generalize Proposition 1 by showing that, all else equal, a more risk-averse agent has a lower switching point.

> ***Proposition 2:*** *If a risk averse agent is indifferent between investment A and investment B, then, all else equal, a more risk averse agent (in the classical sense of Pratt 1964) prefers investment B to investment A.*

Proposition 2 therefore allows us to rationalize differences in behavior observed in the experiment. Consider for instance two agents who share the same beliefs about future inflation and report a point prediction of 4%. Furthermore, assume the first agent selects a switching point of 5 while the second agent selects a switching point of 3. Under expected utility, we can rationalize this difference in behavior by a difference in risk aversion, whereby the second agent is more risk averse than the first.

For Proposition 3, we restrict our attention to HARA (hyperbolic absolute risk aversion) utility functions. This class of utility functions is considered to be quite general as it encompasses CRRA (constant relative risk aversion) and CARA (constant absolute risk aversion) utility functions. In particular, virtually all the utility functions used in practice (e.g. exponential, logarithmic, power) belong to the HARA family.

> ***Proposition 3:*** *If a risk-averse agent with a HARA utility function is indifferent between investment A and investment B, then the agent prefers investment B to investment A for any increase in risk (in the classical sense of Rothschild and Stiglitz 1970).*

[21] The proofs of all the propositions are provided in Appendix B.

Proposition 3 therefore shows that if a risk-averse agent is indifferent between the two investments for a given belief distribution, then the agent should strictly prefer the safer investment (here investment B) for any mean preserving changes of his belief distribution. In other words, all else equal, a risk averse agent should switch from investment A to investment B earlier when the investment risk increases.

4. Responses to the Survey

Out of the 771 respondents who answered at least one of the two surveys, a total of 115 respondents (57 in survey 1 and 58 in survey 2) failed to report a point prediction and/or to provide an answer for the 10 questions in the experiment. Out of the 1,364 remaining respondents, 88.9% (598 in Survey 1 and 615 in survey 2) switched at most once from investment A to investment B during the course of the 10 questions. This ratio of rationalizable responses is consistent with those obtained in the literature on measuring risk attitude using the Holt and Laury's instrument. In particular, Holt and Laury (2002) report that 25% of their respondents had non-rational answers, while this ratio was 15% in Eckel and Wilson (2004). Finally, note that 82.8% (1,004 out of 1,213) of the rationalizable answers are due to the same 502 repeat respondents who provided rationalizable answers to both surveys.

Perhaps not surprisingly, the respondents with missing data and multiple switching points have specific characteristics. Indeed, a comparison of the columns "Group 1" and "Group 2" with the columns "Group 3" and "Group 4" in Table 1 indicates that the first two groups score significantly lower on our scale of numeracy and financial literacy, are more likely to be a female, they have lower income and lower education, and they provide higher and more volatile point predictions. As indicated in the last column of Table 1, a probit regression in which the dependent variable is equal to 1 when a respondent provides rationalizable answers in both surveys reveals that only the measure of numeracy and financial literacy remains significant after controlling for other respondent's characteristics. More specifically, we find that for each additional numeracy and financial literacy questions respondent's answer correctly, they are 6% more likely to make rationalizable choices in both surveys.

Before examining the possible link between the respondents' inflation expectations and their behavior in the experiment, we look separately at the responses to the inflation expectations questions and the choices made in the experiment.

4.1. Responses to the Point Predictions Questions

In Figure 1, we plot for each survey the distribution of point predictions combined across the "Inflation" and the "Price" treatments. As we can see, both distributions have similar shapes with the same mode (2% to 4%), the same median (3%) and the same interquartile range (3%). Observe, however, that the distribution of point predictions for both treatments shifts to the right in survey 2, thereby indicating an increase in inflation expectations between the five months that separate the two surveys. A Mann-Whitney test confirms that the average point prediction in survey 1 (4.1%) is significantly lower (P-value=0.03) than the average point prediction in survey 2 (4.8%). Finally, note that the shape of the point prediction distributions is similar to those obtained in recent inflation expectation surveys we conducted with similar respondents (Bruine de Bruin et al. 2010b).

We plot in Figure 2 the distribution of the individual differences in point predictions across the two surveys. To do so we calculate for each of the 502 repeat respondents with rationalizable answers in both surveys the difference between the point prediction she/he made in survey 2 and the point prediction she/he made in survey 1. Although the mode of the distribution is centered on zero, it is not the case that the majority of respondents make the same predictions in both surveys. In fact, between the five months that separate the two surveys, 74% of the respondents revised their point prediction by at least ±0.5%, and 27% by more than ±4.0%. Finally, note that, consistent with the increase in average point prediction observed in Figure 1, the distribution reported in Figure 2 has more weight in the positive domain. In fact, only 28% of the respondents revised their point prediction downward in survey 2.

Finally, we explore whether the responses to the point prediction question are affected by the "price" versus "inflation" treatment to which a respondent is assigned. Recall that roughly half of the respondents are asked about their expectations for the "prices of things I usually spend money on", while the other half is asked about the "rate of inflation". We plot in Figure 3 the distribution of responses for the two expectation treatments. In both surveys, the different distributions exhibit a similar pattern. Note, however, that consistent with previous studies we conducted (e.g. Bruine de Bruin et al. 2010b), the question about the "prices of things I usually spend money on" yields higher average predictions than the question about the "rate of inflation" question. More specifically, the average point prediction for the "prices of things I usually spend money on" is 4.29% in survey 1 and 4.91% in survey 2, while the average point prediction for the "rate of inflation" question is 3.80% in survey 1 and 4.58% in survey 2. These differences, however, are well within one standard deviation (between 5% and 6% across expectation treatments) and a Mann-Whitney test fails to identify a significant difference between expectation treatments (P-value equals 0.18 in survey 1 and 0.25 in survey 2).

4.2. Choices Made in the Experiment

The distribution of switching points in each survey is plotted in Figure 4. We can see that although respondents make use of all possible switching points, most choices (61% in survey 1 and 55% in survey 2) are concentrated between 4 and 7. Note also that the distribution of switching points shifts to the left in survey 2. A Mann-Whitney test confirms that this difference across surveys is in fact highly significant (P-value = 3.4E-4). As we shall see next, this shift toward lower switching points is consistent with the fact that respondents reported higher point predictions in the second survey.

We plot in Figure 5 the distribution of individual differences in switching points for the 502 respondents who made rationalizable experimental choices in both surveys. As with the point predictions, we can see that 78% of respondents chose a different switching point in each survey. Furthermore, note that 48% of the 502 respondents who made rationalizable choices in both surveys selected a strictly lower switching point in survey 2. In the next section, we will therefore be able to exploit the fact that most respondents change their predictions and switching points across the two surveys to test whether the direction and the magnitude of those changes are consistent with expected utility theory.

Finally, we explore whether the choice of switching point is influenced by the treatment combination to which a respondent is assigned. Recall that our sample is segmented in four groups depending on which expectation treatment (i.e. “Price” or “Inflation”) and which experimental treatment (i.e. “Ascending” or “Descending”) a respondent is assigned to. We plot in Figure 6 the distribution of switching points for each treatment combination. None of these distributions seems to exhibit a specific pattern. This absence of treatment effect is confirmed by a series of Mann-Whitney tests (the P-values range from 0.21 to 0.77).

5. The Link between Beliefs and Behavior

5.1. Are Point Predictions Informative about Experimental Choices?

We now turn our attention to the correlation between respondents’ point predictions and their switching points. In Figure 7, we plot for each switching point between 0 and 10 the average point prediction across the respondents who selected that switching point. For instance, we can see that the respondents who always selected investment B, and who therefore have a switching point equal to 0, reported an average point prediction of 9.3% in survey 1 and 10.2% in survey 2. Observe first in Figure 7 that there is a generally monotonic decreasing relationship between the reported beliefs and the switching points. Furthermore, note that this relationship is very similar in both treatments. This result therefore supports the hypothesis that inflation expectations surveys are informative in the sense that the beliefs the respondents reported correlate well, on average, with their choices in the financially incentivized experiment.

We also plot in Figure 7 a risk-neutral band indicating the range of beliefs that would rationalize each switching point under risk neutrality. For instance, if a risk-neutral agent selects a switching point equal to 5, then his point prediction should belong to the interval [3.5%, 5.5%]. As shown in Proposition 1, switching points below (respectively, above) the risk-neutral band may be rationalized under risk aversion (respectively, risk loving). We can see in Figure 7 that, on average, respondents exhibited behavior consistent with risk neutrality, although a number of switching point and average prediction combinations are close to the risk averse frontier.

This does not imply, however, that most of respondents behaved as if risk-neutral. In fact, the box plot in Figure 8 reveals that most respondents are outside the risk-neutral band. More precisely, we find that in survey 1 (respectively in survey 2) 41%, 32% and 27%

(respectively 37%, 41% and 22%) of the respondents behaved as if risk averse, risk neutral, and risk loving. This finding therefore provides some evidence against the hypothesis that respondents, driven by a desire for internal consistency, simply chose a switching point within the risk-neutral band in order to match their inflation prediction. Furthermore, we will see in section 5.2, that these departures from risk neutrality are explained in large part by the respondents' self reported risk tolerance.

The general trends observed in Figure 7 seem to be robust. In particular, instead of the average point prediction, we plot in Figures A1 and A2 (reported in Appendix 2) the median point prediction in one case, and the "estimated expected prediction" (calculated with the respondents reported probabilistic beliefs) in the other case. Although slightly flatter, these two additional figures display a similar relationship between point predictions and switching points in both surveys. In Figures A3 to A6 (reported in Appendix C) we reproduce Figure 7 with the data collected in each of the four treatment combinations. Although the average point predictions are somewhat more volatile across switching points than in Figure 7, as can be expected given the reduction in sample sizes, the general trend does not vary substantially across treatment combinations.

To confirm these observations statistically, we estimate a series of ordered probit models in which the dependent variable is the respondents' switching points. Table 3 shows the results of these estimations for each survey.[22] In Model 1, the parameter associated with the variable "Point prediction" is highly significant and negative.[23] This result therefore confirms that the respondents' reported beliefs are informative about their decisions in the incentivized experiment. We also find that the parameter associated with the self-reported measure of risk attitude is positive and significant. In other words, consistent with Proposition 2, respondents who report being more risk-averse tend to select lower switching points, while respondents who report being more risk-loving have higher switching points. Furthermore, the parameter associated with inflation uncertainty is significant and negative. Respondents with more diffuse beliefs, therefore, tend to switch investment earlier. According to Proposition 3, this result may be rationalized under expected utility if respondents exhibit risk aversion (which is the case for many respondents). Finally, note that none of the treatment dummies is significantly different from zero in Model 1, thereby supporting the absence of treatment effects.

In Model 2 of Table 3, we augment the specification by including demographic variables. Observe that the parameters estimated in Model 1 remain essentially unchanged. In addition, none of the demographic variables seems to play a role in explaining when a

[22] Alternatively, we could have estimated each of the four models in Table 3 jointly with the data collected in both surveys. The panel structure of our data, however, is not long enough to estimate a joint model properly. Indeed, since we have at most two set of observations per respondents (i.e. one from survey 1 and one from survey 2), we are not able to control effectively for individual specific effects. We therefore defer to Section 6 where we conduct a formal comparison of a respondent's predictions and experimental choices across surveys.

[23] We do not report the marginal effects from the ordered probit regressions because, unlike simple probit models, they are not directly interpretable. Instead, we report in Appendix D the outcome of simple linear regressions. These additional regressions not only confirm the robustness of the results presented in this section, but they also provide a sense of the relative effect of each explanatory variable.

respondent switches from investment A to investment B. In Model 3 of Table 3, we replace the point prediction by the "estimated expected prediction." Once again the parameters previously estimated remain essentially unchanged. The parameter associated with the "estimated expected prediction" in Model 3 is similar, both in sign and magnitude, to the parameter associated with the point prediction variable in Model 1. In fact, a log-likelihood ratio test reveals that the two parameters are statistically indistinguishable at the usual significance levels (the P-value is 0.182 in survey 1 and 0.354 in survey 2).

Finally, three of the four treatment combination dummies were interacted with the point prediction in Model 4. As indicated in Table 3, none of the corresponding parameters is found to be significantly different from zero at the usual significance levels. In other words, we do not find statistical evidence that the slope of the relationship between the point predictions and the switching points varies significantly across treatments. This absence of treatment effect may seem somewhat surprising. Indeed, the payments in the experiment depend on a measure of inflation (the CPI), while respondents in the "price" treatment are asked to make a prediction about the "prices of things I usually spend money on." As a result, one could have expected a weaker relationship between point predictions and experimental choices in the "price" treatment than in the "inflation" treatment (where respondents are asked to state their beliefs about inflation). Note, however, that the lack of a treatment effect identified in this section is consistent with the fact that we failed to find significant differences between the point predictions (respectively the switching points) reported in the "inflation" and "prices" treatments.[24]

5.2. Deviations from Risk Neutrality and Reported Risk Tolerance

Although the estimates in Table 3 confirm that reported beliefs and experimental decisions are correlated, they fail to assess the extent to which choices in the experiment may be explained by risk attitude. In theory, an experimental decision deviating from risk neutrality should be explained entirely by the respondent's i) risk attitude and ii) subjective belief about the investment's riskiness, as determined by the shape of the respondent's inflation distribution.

To test this hypothesis, we calculate each respondent's pair of "risk neutral switching points," that is, the pair of switching points the respondent should have selected if risk neutral given his stated point prediction. For instance, consider a respondent in the

[24] We also estimated several alternative models not reported here. For instance, we estimated a model in which i) a "price" and "increasing" dummy variable were introduced instead of interactions between the "expectation" and "experimental" treatment variables, ii) the reported risk aversion is defined as a set of 7 seven dummy variables, iii) respondents with extreme switching points (i.e. 0 or 10) are excluded, iv) the reported risk attitude was interacted with other explanatory variable (e.g. the estimated variance), v) the time taken to complete the survey enters non-linearly in order to test the hypothesis that the respondents with the shortest completion time did not answer the survey with as much attention as other respondents, vi) the sample is limited to the 502 respondents that made rationalizable choices in both surveys. These models produced similar conclusions to the ones we present in this section.

ascending scale treatment who made a point prediction of 3%. If risk neutral, this respondent should switch to investment B after selecting investment A in the first 5 or 6 questions (note that the respondent is indifferent between the two investments in question 5 as they both earn $400). In that case, the respondent's pair of "risk neutral switching points" is {5,6}. We then define a new variable for the respondent, the "deviation from risk neutrality," as the difference between the respondent's actual switching point and his pair of risk neutral switching points. For instance, if in the example above the respondent selected a switching point of 4 (respectively 8), then her deviation from risk neutrality is -1=Max{4-5,4-6} (respectively 2=Min{8-5,8-6}). The deviation from risk neutrality is therefore an integer between -10 and 10.

We can then classify respondents depending on their "revealed risk attitude." In what follows, we will refer to respondents as exhibiting risk aversion, risk loving, or risk neutrality when their deviation from risk neutrality is respectively strictly negative, strictly positive or equal to zero. A respondent's revealed risk attitude should be distinguished from his/her reported risk tolerance. The former is fully characterized by the respondent's choices in the experiment, while the latter is the respondent's self assessment about his general willingness to take risk when it comes to financial matters.

To get a complete picture of the factors that influence the deviations from the risk neutral choices, we report in Table 4 the estimates produced by four ordered probit models. The dependent variable is a respondent's "deviation from risk neutrality" in Model 1, and the absolute value of this deviation in Model 2. In the last two models, the dependent variable is a respondent's deviation from risk neutrality, but we restrict the sample to respondents with revealed risk aversion in Model 3, and to respondents with revealed risk loving in Model 4. The last two models will help us gauge whether the same factors influence respondents who exhibit risk aversion and risk loving.

Since the theory predicts that non risk neutral choices are due to a combination of the respondent's risk attitude and the investment's risk, the hypothesis that will be tested with these models is:

> *H_0 : The reported risk tolerance and the inflation uncertainty are the only two explanatory variables with statistical power to explain the deviation from risk neutrality.*

The results reported in Table 4 (Model 1) reveal a strong positive relationship between a respondent's reported risk tolerance and his/her deviation from risk neutrality. As indicated in Model 3 and 4, this effect applies both to respondents that exhibit risk aversion and risk loving. In other words, we find that, all else equal, respondents who report being more risk averse (respectively, risk loving) select lower (respectively, higher) switching points in the experiment thereby revealing higher levels of risk aversion (respectively, risk loving). This result is confirmed in Model 2, as the effect of reported risk tolerance on the absolute deviation from risk neutrality is now identified to be U shaped. Consistent with H_0, we therefore find that reported risk tolerance plays a substantial role in explaining why a respondent did not behave as if risk neutral in the experiment.

Inflation uncertainty does not appear to affect choices in Model 1. This result, however, is misleading. Indeed, observe in Model 2 that inflation uncertainty has a strong positive impact on the absolute deviation from risk neutrality. The difference between the results obtained in Model 1 and Model 2 may be explained by the fact that inflation uncertainty has an opposite effect on respondents depending on whether their experimental choices reveal risk aversion or risk loving (see Model 3 and 4). Indeed, in line with Proposition 3, we find that, all else equal, respondents who exhibit risk aversion (respectively, risk loving) have a lower (respectively, higher) switching point when their inflation uncertainty is higher. Consistent with H_0, we therefore find that deviations from risk neutrality may be explained in large part by the respondents' reported risk tolerance and their subjective uncertainty about future inflation.

In contrast with H_0, however, other variables also have explanatory power. In particular, observe in the last three models in Table 4 that the parameters associated with the respondent's numeracy and financial literacy, as well as education level are highly significant. Furthermore, the results from Model 3 and 4 indicate that these variables have an opposite effect on respondents who behave as if risk averse and those who behave as if risk loving. In other words, it seems that, all else equal, the experimental choices of respondents with lower numeracy, financial literacy, and education level tend to deviate further away from those of a payoffs maximizer. This finding has several possible interpretations. Respondents with lower numeracy, financial literacy or education i) may be more likely to make optimization errors when they try to select a strategy consistent with their beliefs, ii) they may not fully understand the experiment (although their experimental choices are rationalizable), iii) they may report point predictions (respectively risk tolerance) in the survey that are not a true reflection of their inflations beliefs (respectively risk attitude), or iv) they may not act on their beliefs.

Finally, we find that, all else equal, respondents who took longer to complete the survey have a behavior in the experiment that is more likely to deviate from that of a risk neutral optimizer. This result also has several possible interpretations. It could reflect the fact that, when these respondents finally reach the experiment, the predictions they made in at the beginning of the survey do not accurately represent their beliefs anymore (some respondents took more than 10 days between the time they started and completed the survey). Alternatively, it is possible that respondents who took a long time to complete the survey did not make predictions and choices in the experiment with the same attention as the other respondents. Finally, it could reflect a lack of comprehension, as these respondents may have needed more time to complete the survey because it was more difficult for them to understand and answer the questions.

6. Changes in Predictions and Changes in Experimental Choices across Surveys

We now exploit the panel structure of the data to look at the predictions and experimental choices of the same respondent across the two surveys. To do so we concentrate on the

502 repeat respondents who made rationalizable choices in both surveys. Our general objective in this section is to address the following question: When a respondent reports different inflation expectations in survey 2 than in survey 1, does this respondent also adjust his experimental choices in a way that is consistent with expected utility theory? We decompose the analysis in two parts: First we look at whether the *direction* of the adjustments across surveys may be rationalized; then we study whether the *magnitude* of the adjustments is consistent with a simple expected utility model.

6.1. Is the Direction of Adjustments Consistent with Theory?

6.1.1 Changes in Revealed Risk Attitudes

The first test we conduct is based on the standard assumption that an agent's preferences are invariant over time. As a result, a respondent should not act as if risk averse in one survey and as if risk loving in the other survey. If a respondent exhibits such behavior, then we say that the respondent's revealed risk attitudes are inconsistent across the two surveys. In contrast, switches from revealed risk neutrality to revealed risk aversion or risk loving will not be considered inconsistent with theory. Indeed, given the fact that experimental choices are discrete, we cannot exclude the possibility that a respondent who makes a decision consistent with risk neutrality is in fact slightly risk averse or risk loving.

We report in Figure 9 the distributions of revealed risk attitudes in both surveys. In more than 50% of the cases a respondent with a specific revealed risk attitude in survey 1 (i.e. risk averse, risk loving or risk neutral) exhibits the same revealed risk attitude in survey 2. Furthermore, note that only 6% of the repeat respondents have inconsistent revealed risk attitudes. More precisely, 16 out of the 214 (respectively 14 out of the 123) respondents who made experimental choices consistent with risk aversion (respectively risk loving) in survey 1, behaved as if risk loving (respectively risk averse) in survey 2.

To identify whether these respondents have specific characteristics, we estimate a probit model in which the dependent variable is equal to one when a respondent's revealed risk attitudes are inconsistent across the two surveys. In addition to demographic variables we control for the absolute difference between the risk tolerance reported in surveys 1 and 2. Thus, we can test whether inconsistent revealed risk attitudes are accompanied by large variations in reported risk tolerance. Similarly, we control for the difference in inflation uncertainty across surveys and the total time the respondent took to complete both surveys.

The results reported in Table 5 (Model 1) indicate that inconsistent revealed risk attitudes are driven by three factors: the respondent's i) financial literacy and numeracy, ii) education level and iii) completion time. In particular, we find that respondents with at most a high school diploma are 15.3% more likely to exhibit inconsistent revealed risk attitudes than respondents with some college but no more than a Bachelor degree. Likewise, respondents who answer correctly half of the numeracy and financial literacy questions are 14.4% more likely to exhibit inconsistent revealed risk attitudes than respondents who answer all six questions correctly. Finally, observe that variations across surveys in reported risk tolerance or in inflation uncertainty do not explain changes in revealed risk attitudes.

6.1.2 Correlation between Changes in Point Predictions and Changes in Switching Points

As illustrated in Figure 7, there should be a negative correlation between inflation expectations and switching points: All else equal, a respondent with a higher (lower) point prediction should select a lower (higher) switching point. Intuitively, the same correlation should apply to a respondent's predictions and switching points across surveys. In other words, we expect an increase in point prediction from one survey to the next to be accompanied by a decrease in switching points. For instance, consider a risk neutral agent with a point prediction equal to 3% who selects a switching point of 7 in survey 1. If five months later the inflation expectation of this agent increases to 6%, then he should select a switching point of 4 or 5 in survey 2. We call this first order effect, the "expectation effect."

There is, however, a second order effect, a "risk effect," for respondents who are not risk neutral. Indeed, all else equal, and in particular if expected inflation remains the same, an agent may be led to select a different switching point if the shape of his beliefs distribution changes from one survey to the next. Consider for instance a risk-averse agent. If her inflation uncertainty increases (decreases), then, as shown in Proposition 3, the agent will be led to select a smaller (higher) switching point. The first order "expectation effect" and the second order "risk effect" can therefore go in the same or in opposite directions. In the latter case, the exact correlation between changes in predictions and changes in switching points depends on the relative strength of the two effects. Simulations, however, indicate that the "expectation effect" almost always dominates.[25]

Taking these two effects into consideration, we now define a new variable to study how changes in switching points across surveys respond to changes in point predictions. Let $\{S_1;S_2\}$ and $\{P_1;P_2\}$ denote a respondent's pairs of switching points and point predictions in surveys 1 and 2. We say that this respondent has an "inconsistent correlation" when the following three conditions are all satisfied:

1) $(S_2-S_1) * (P_2-P_1) \geq 0$
2) $\{S_1;S_2\} \neq \{1;1\}$ and $\{S_1;S_2\} \neq \{11;11\}$
3) $|S_2-S_1| > 1$ or $|P_2-P_1| > 1\%$

The first condition reflects a violation of the first order "expectation effect" just described (e.g. an increase in point prediction should result in a decrease in switching points). Condition 2 excludes respondents who pick the same switching point either equal to 1 or equal to 11 in both surveys. Indeed, it is always possible to find a specific risk attitude to

[25] The simulations are based on the expected utility model presented in Section 6. For almost all levels of risk aversion, they suggest that the "risk effect" only dominates when the expected inflation remain virtually unchanged across the two surveys, while the distribution of the beliefs is extremely concentrated in one survey and nearly uniform in the other survey.

rationalize the behavior of respondents who consistently pick the same extreme choice. Note, however, that only 3.2% of the 502 repeat respondents exhibit such behavior.

The last condition characterizes an "indifference zone" in which changes in point predictions and changes in switching points do not exceed respectively $\pm 1\%$ and ± 1. Respondents with inconsistent correlations should fall outside this indifference zone. In contrast, three types of respondents fall within the indifference zone. First, the 8.4% (42 out of 502) respondents who provide exactly the same prediction and the same switching points in both surveys. Second, the respondents with about the same predictions in both surveys who make slight changes in switching points because of the second order "risk effect." Finally, the indifference zone reflects the discreteness of the experiment. Indeed, recall that the choice of a switching point may be rationalized by a range of predictions. For instance, a risk neutral agent could have the same inflation expectation of 4% in both surveys, but select a switching point of 6 in one survey and a switching point of 7 in the other survey. Likewise, a risk neutral agent could select the same switching point of 6 in both surveys, and change his predictions from 4% to 5%. Note, however, that the way in which the indifference zone is defined may be considered somewhat conservative. Indeed, under risk neutrality, we could have a respondent with $S_2=S_1$ and $|P_2-P_1|=2\%$ or $|S_2-S_1|=2$ and $P_2=P_1$. Such a respondent would therefore fall outside our indifference zone.

To illustrate the adjustments across surveys, we plot in Figure 10 the difference between a respondent's point predictions across the two surveys (X-axis) and the difference between the respondent's switching points across surveys (Y-axis). The area of each bubble in Figure 10 reflects the number of respondents at that point. In addition, the indifference zone defined above is indicated in Figure 10.

As mentioned earlier, we generally expect a negative correlation between the adjustment in predictions and the adjustment in switching points. If this is the case, then respondents have consistent correlations and they should be located either in the upper left or bottom right quadrants of Figure 10. As we can see, this is overwhelmingly the case. More precisely, a total of 102 out of 502 repeat respondents (20.3%) exhibit inconsistent correlations. Furthermore, we find that the correlation coefficient between the adjustment in predictions and the adjustment in switching points is -0.49. Note, however, that this correlation is not expected to be perfectly linear because the difference in switching points across surveys is bounded between -10 and 10.

To identify whether respondents with inconsistent switching points have specific characteristics, we again estimate a probit model in which the dependent variable is equal to 1 when the respondent exhibits an inconsistent correlation. The results reported in Table 5 (Model 2) reveal that respondents with lower education, respondents who scored low on our numeracy and financial literacy scale, and respondents who took more time to complete the survey are more likely to exhibit inconsistent correlations. More specifically, we find that, compared to a respondent with the highest possible numeracy and financial literacy score, a respondent who answered half the questions correctly is 16% more likely to exhibit an inconsistent correlation. Furthermore, compared to a respondent who went to college up to a Bachelor degree, a respondent without a college education (respectively with a post graduate education) is 15% more likely (respectively 10% less likely) to exhibit an inconsistent correlation.

6.2. Is the Magnitude of Adjustments Consistent with Theory?

We have just established that when respondents change their predictions from one survey to the next, most of them also adjust their experimental choices in a direction consistent with the theory. In this section, we explore whether the magnitude of the behavior adjustments may be rationalized under a simple expected utility model.

6.2.1 Methodology

To simplify, we concentrate on a specific respondent *i* who selects a switching point $S_{i,1}$ in survey 1 and $S_{i,2}$ in survey 2. We assume that this respondent possesses a specific power utility function over income of the form $U(x,\theta_i) = x^{\theta_i}$, with $\theta_i > 0$. The parameter θ_i, which is assumed to be time invariant, therefore characterizes the agent's risk attitude. When $0 < \theta_i < 1$ the agent is risk averse with a constant relative risk aversion parameter equal to $(1-\theta_i)$. The agent is risk neutral when $\theta_i = 1$ and risk loving when $\theta_i > 1$. Finally, we assume that the generalized beta distribution fitted to the respondent's reported probabilistic beliefs in a given survey accurately represents the respondent's true inflation beliefs at the time. The expectation operator with respect to the distribution elicited in survey 1 (respectively survey 2) is then denoted $E_{i,1}[.]$ (respectively $E_{i,2}[.]$). Our approach to evaluate the magnitude of the behavior adjustments proceeds in three steps.

<u>Step 1</u>: The first step consists of inferring a range of risk attitude parameters $[\overline{\theta}_i, \underline{\theta_i}]$ that rationalizes the switching point $S_{i,1}$. More specifically, denote $E_{i,1}[U(A,\theta_i)]$ the respondent's expected utility under investment A. Recall that the payments under investment B increase in increment of \$50 from \$100 in question 1 to \$550 in question 10. We therefore denote $R(S) = \$50 * (1+S)$ the revenue (in nominal terms) generated by investment B in question $S \in \{1, \ldots, 10\}$ of the experiment. Furthermore, we assume that $R(0) = \$50$ and $R(11) = \$600$.[26]

In this framework, the switching point $S_{i,1}$ actually selected by the agent should satisfy:

$$E_{i,1}\left[U\left(R\left(S_{i,1}\right),\theta_i\right)\right] \leq E_{i,1}[U(A,\theta_i)] \leq E_{i,1}\left[U\left(R\left(S_{i,1}+1\right),\theta_i\right)\right].$$

In other words, given his probabilistic beliefs and his risk attitude parameter, the respondents should have no strict incentive to switch earlier or later than he actually did in the experiment. To illustrate, consider a respondent who opts for investment A in the first question and then switches to investment B for the remaining nine questions. In that case, we have $S_{i,1} = 1$, and this decision is rational in our framework if θ_i is such that

$$E_{i,1}[U(100,\theta_i)] \leq E_{i,1}[U(A,\theta_i)] \leq E_{i,1}[U(150,\theta_i)].$$

[26] Assuming that $\$0 \leq R(0) < \$50$ and $R(11) > \$600$ does not affect the results meaningfully.

We can then define the pair $\left\{\underline{\theta_i}, \overline{\theta}_i\right\}$ that satisfies:

$$E_{i,1}\left[U\left(R\left(S_{i,1}\right), \underline{\theta_i}\right)\right] = E_{i,1}\left[U\left(A, \underline{\theta_i}\right)\right] \quad \text{and} \quad E_{i,1}\left[U\left(R\left(S_{i,1}+1\right), \overline{\theta_i}\right)\right] = E_{i,1}\left[U\left(A, \overline{\theta_i}\right)\right]$$

It must then be the case that, given the probabilistic beliefs expressed by the respondent, any risk attitude parameter $\theta \in \left[\underline{\theta_i}, \overline{\theta}_i\right]$ can rationalize the choice of switching point $S_{i,1}$. Finally, we denote $\hat{\theta}_i = \left(\underline{\theta_i} + \overline{\theta}_i\right)/2$ the midpoint of the range of risk attitude parameters.

Step 2: In step 2, we use the pair $\left\{\underline{\theta_i}, \overline{\theta}_i\right\}$ inferred in step 1 and the probabilistic beliefs expressed by the respondent in survey 2 to predict a range of possible switching points $\left[\underline{S_{i,2}}, \overline{S}_{i,2}\right]$. These predicted switching points are defined by the pair of inequalities:

$$E_{i,2}\left[U\left(R\left(\underline{S_{i,2}}\right), \underline{\theta_i}\right)\right] \le E_{i,2}\left[U\left(A, \underline{\theta_i}\right)\right] < E_{i,2}\left[U\left(R\left(\underline{S_{i,2}}+1\right), \underline{\theta_i}\right)\right]$$
$$E_{i,2}\left[U\left(R\left(\overline{S}_{i,2}\right), \overline{\theta}_i\right)\right] \le E_{i,2}\left[U\left(A, \overline{\theta}_i\right)\right] < E_{i,2}\left[U\left(R\left(\overline{S}_{i,2}+1\right), \overline{\theta}_i\right)\right]$$

As we shall see, $\left(\underline{S_{i,2}}, -\overline{S}_{i,2}\right)$ may be equal to 0, 1 or 2 in our experiment depending on the values taken by the pair $\left\{\underline{\theta_i}, \overline{\theta}_i\right\}$ and by the respondent's reported belief distribution in survey 2.

Step 3: The last step consists of comparing the predicted range of switching points $\left[\underline{S_{i,2}}, \overline{S}_{i,2}\right]$ to $S_{i,2}$, the respondent's actual choice of switching point in survey 2. More precisely, we calculate a new variable, the "adjustment precision," as the minimum difference between $S_{i,2}$ and $\left[\underline{S_{i,2}}, \overline{S}_{i,2}\right]$. The adjustment precision is therefore an integer between -10 and 10. Observe that an adjustment precision equal to 0 does not simply imply that the respondent choice of switching point in survey 2 is consistent with our model. Instead, it implies that the magnitude of all adjustments the respondent made are consistent with our model. In other words, an adjustment precision equal to 0 requires the distribution of beliefs expressed in survey 1 and 2, as well the experimental choices made in survey 1 and 2, to all be consistent with our simple expected utility model.

6.2.2 Results

Step 1 of our methodology produces a specific risk attitude parameter $\hat{\theta}_i$ for each of the 502 repeat respondents. We find that the distribution of these risk attitude parameters has a mean of 0.975 and a standard deviation of 0.342. The average $\hat{\theta}_i$ is therefore close to 1, thereby reflecting the fact that, on average, respondents in survey 1 behaved as if risk neutral (see Figure 7). Furthermore, the relatively large standard deviation of $\hat{\theta}_i$ reflects the substantial heterogeneity in behavior illustrated in Figure 8.

Our methodology also produces a range of predicted switching points $\left[\underline{S_{i,2}}, \overline{S}_{i,2}\right]$ for each respondent. The width of this range is equal to either 0, 1 or 2 for respectively 30%, 64%

and 6% of the respondents. Now imagine the respondents in survey 2 made their choices in the experiment randomly by assigning the same probability to each possible switching point. In that case, we would find that on average 16% of the switching points chosen randomly fall within the range of predicted switching points. This statistic will therefore serve as a benchmark to evaluate how well our simple model explains the respondents' experimental choices in survey 2.

We plot in Figure 11 the distribution of adjustment precision in survey 2. This distribution is highly concentrated around 0. In fact, 41.2% of our respondents have an adjustment precision of 0, therefore clearly exceeding the 16% benchmark. Accounting for possible noise (e.g. in reported inflation expectations, risk tolerance or in making experimental choices) we find that 63.7% (respectively 78.8%) of the respondents have an adjustment precision in the interval [-1,1] (respectively [-2,2]). In other words, for most of our respondents, the magnitude of behavior adjustment across surveys is consistent, or nearly consistent, with our simple expected utility model. For the remaining respondents with large differences between predicted and actual switching points, their behavior in the experiment cannot be explained by our simple expected utility model or they incorrectly report their inflation expectations.

To identify the characteristics of respondents whose prediction and switching point adjustments cannot be explained by our model, we estimate an ordered probit model in which the dependent variable is the absolute value of the adjustment precision. As we can see in Table 5 (Model 3), the usual three variables seem to have statistical power in explaining deviations from the pair of predicted switching points: low numeracy and financial literacy, lower education, and high completion time. We also find that respondents with an income greater than $75k are better able to adjust their behavior across surveys. This result may be explained in part by the fact that these respondents are also more likely to report the same prediction and the same switching points across surveys.

7. Discussion

In this paper, we compare the inflation expectations individual consumers reported in a survey with their choices in a financially incentivized investment experiment. Our results reveal that, on average, there is a relatively tight correspondence between stated beliefs and behavior in the experiment. Across respondents, we find a substantial amount of heterogeneity in behavior that can be explained to a large extent by the respondents' self reported risk tolerances. Furthermore, when considering changes in beliefs for the same individual over time, we find the adjustments in experimental behavior to be mostly consistent (both in direction and magnitude) with expected utility theory. Finally, the respondents whose behavior is difficult to reconcile with standard economic theory tend to exhibit specific characteristics: they are less educated, they score lower on a numeracy and financial literacy scale, and they take longer to complete the survey. We now conclude with a brief discussion about the extent to which our results can be generalized.

By showing that stated inflation beliefs are informative about an economic decision, our analysis provides some support to the empirical validity of inflation expectation surveys. To the best of our knowledge, this is the first time that such a "construct validity" exercise has been carried out for a survey question aimed at eliciting inflation expectations. Our results, however, do not prove that the survey respondents accurately report their true inflation expectations. Since subjective beliefs are not observable, this proposition is by definition not directly testable. Our results simply suggest that inflation expectation surveys of individual consumers are informative in the sense that the beliefs elicited are generally consistent with the decisions of the respondents in a financially incentivized experiment. This construct validity criterion is consistent with the survey design literature and with Manski (2004) who argues that to gauge the information content of expectations surveys, one needs to investigate the extent to which responses are correlated with relevant behavior.

Perhaps more importantly, by showing that most respondents acted on their stated inflation beliefs in a way consistent with expected utility theory, we provide some evidence to support one of the key assumptions underlying macro-economic models whereby forward looking agents make economic decisions that are influenced by their beliefs about future inflation. Again, to the best of our knowledge, this is the first time such formal evidence has been put forward. To be clear, however, we have not shown that the decisions made by individual consumers in their daily life are influenced by the beliefs they hold about future inflation. Indeed, the behaviors observed in our experiment do not necessarily imply that individual consumers take into consideration future inflation when making investment, saving, wage, or large purchase decisions. It is quite difficult to observe and study real life behavior that is directly related to inflation expectations without other confounding factors playing a role. What we have shown is that, when presented with an opportunity to act on their inflation beliefs, most consumers responding to a survey make decisions consistent with the expectations they report. Our results may therefore be considered a first step in establishing whether future inflation prospects affect the actual behavior of individual consumers.

This paper fits in a broader research agenda aimed at collecting new survey data to better measure and understand how agents form and update their subjective expectations about inflation and other macroeconomic variables of interest. Heterogeneity in expectations plays an increasingly large role in macro-economic models that analyze labor, housing and credit market dynamics, and links between financial markets and real economic activity. More importantly, we wish to understand how expectations affect behavior in a variety of contexts. For example, the decision of households to default on their home mortgages may depend crucially on their expectations of future house price appreciation or declines. Job search effort in the labor market may also be affected by workers' expectations about their ability to find jobs in various occupations or locations, as well as their expectations for wage growth on a current job. As discussed earlier, this paper provides the first direct evidence at the individual level on the link between inflation expectations and financial decisions involving future payoffs, which is part of the micro-foundations of modern macro-economic models.

Finally, our finding that consumers with low financial literacy and numeracy are less likely to act on their reported beliefs in accordance with expected utility theory is relevant in the context of a growing literature on the role of financial literacy and education in economic decisions.[27] For instance, Lusardi and Mitchell (2008) show that women who are less financially literate are less likely to plan for retirement, which may lead to under-saving for retirement. Other work has looked at the role of financial literacy in portfolio choice and in household mortgage decisions.[28] Our findings could help shed light on some of the mechanisms that underlie these linkages, by suggesting a possible breakdown of the expected connection between inflation expectations and financial decisions for financially illiterate individuals.

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[27] See Lusardi and Mitchell (2007) for a brief introduction to the literature.

[28] See for instance Hilgert, Hogarth and Beverly (2003), Campbell (2006), Bucks and Pence (2008).

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Table1: Descriptive Statistics						
	All Data	Group 1 Missing Data for Point Prediction or Experiment	Group 2 Non-Rationalizable [b] Experimental Choices	Group 3 Rationalizable Experimental Choices	Group 4 Rationalizable Choices in Both Surveys	Probit [a] Probability to be in Group 4
Age	52.126 (14.049)	51.765 (16.794)	51.291 (13.657)	52.519 (13.736)	52.592 (13.422)	-0.001 (0.001)
Gender (female)	57.3%	73.0%	68.2%	54.4%	52.6%	-0.043 (0.032)
Education: No more than High School	15.1%	17.4%	18.6%	14.0%	12.8%	0.051 (0.048)
Education: More than Bachelor	20.9%	23.5%	13.25%	21.6%	22.5%	0.017 (0.038)
Income greater than $75k	41.8%	23.5%	29.1%	44.9%	47.4%	0.032 (0.031)
Numeracy and Financial Literacy [c]	4.502 (1.481)	3.3487 (1.692)	3.629 (1.553)	4.746 (1.335)	4.986 (1.234)	0.058*** (0.010)
Reported Risk Tolerance [c]	3.335 (1.586)	3.601 (1.823)	3.308 (1.745)	3.368 (1.567)	3.403 (1.548)	0.011 (0.010)
Point prediction	5.382 (6.903)	9.394 [e] (12.842)	8.705 (6.387)	4.777 (3.190)	4.563 (3.167)	—
Number of Observations	1,479 (100%)	115 (7.8%)	151 (10.2%)	1,213 (82.0%)	1,004 (67.9%)	1,479

[a] Marginal effects are reported. The endogenous variable equals one when a respondent is in group 4. The log Likelihood is -269.79. The pseudo R^2 is 0.080.
[b] A respondent is said to make non rationalizable choices when he switches more than once from investment A to investment B in the ascending scale treatment and from investment B to investment A in the descending scale treatment.
[c] The variable takes integer values between 0 and 6 depending on the number of correct answers the respondent gave to the six questions asked to measure the respondent's numeracy and financial literacy.
[d] Self reported willingness to take risk regarding financial matters on a scale from 1 (Not willing at all) to 7 (very willing).
[e] This statistic is based on 85 observations.

Table 2: Earnings under investment A											
Rate of inflation	-1% or less (deflation)	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10% or more
Earnings	$600	$550	$500	$450	$400	$350	$300	$250	$200	$150	$100	$50

Table 3: Factors Influencing the Choice of the Switching Point

Outcomes of ordered probit estimations where the dependent variable is the switching point (an integer between 0 and 10) for each respondent

	Model 1		Model 2		Model 3		Model 4	
	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2
Point prediction	-0.108*** (0.009)	-0.104*** (0.008)	-0.108*** (0.009)	-0.104*** (0.009)	—	—	-0.065*** (0.017)	-0.091*** (0.016)
Estimated Expected Prediction [c]	—	—	—	—	-0.090*** (0.012)	-0.096*** (0.010)	—	—
Reported Risk Tolerance [a]	0.188*** (0.029)	0.183*** (0.028)	0.191*** (0.030)	0.184*** (0.029)	0.163*** (0.030)	0.165*** (0.028)	0.193*** (0.030)	0.183*** (0.029)
Numeracy and Financial Literacy Score [b]	0.003 (0.035)	0.005 (0.032)	-0.002 (0.035)	0.001 (0.032)	-0.001 (0.035)	0.011 (0.032)	-0.002 (0.035)	-0.001 (0.031)
Inflation Uncertainty [c]	-0.007*** (0.002)	-0.004*** (0.001)	-0.007*** (0.002)	-0.004*** (0.001)	-0.005** (0.002)	-0.007*** (0.001)	-0.007*** (0.002)	-0.004** (0.001)
Log of Time Taken to Complete the Survey	0.007 (0.024)	-0.012 (0.019)	0.008 (0.024)	-0.008 (0.019)	0.009 (0.024)	-0.014 (0.019)	0.008 (0.024)	-0.007 (0.019)
Age	—	—	0.003 (0.003)	0.001 (0.003)	0.004 (0.003)	0.001 (0.003)	0.003 (0.003)	0.001 (0.003)
Gender (female)	—	—	-0.060 (0.089)	-0.094 (0.088)	-0.101 (0.088)	-0.126 (0.088)	-0.063 (0.089)	-0.094 (0.088)
Income greater than $75k	—	—	-0.027 (0.106)	-0.095 (0.087)	0.046 (0.089)	-0.059 (0.087)	-0.035 (0.089)	-0.099 (0.088)
Education: No more than High School	—	—	0.124 (0.125)	0.052 (0.127)	-0.001 (0.124)	0.036 (0.128)	0.128 (0.125)	0.070 (0.127)
Education: More than Bachelor			0.078 (0.106)	0.147 (0.105)	0.043 (0.106)	0.081 (0.105)	0.077 (0.107)	0.177 (0.105)
“Prices” * “Increasing”	-0.130 (0.119)	-0.108 (0.120)	-0.129 (0.119)	-0.108 (0.120)	-0.146 (0.121)	-0.069 (0.121)	-0.022 (0.152)	0.045 (0.170)
“Prices” * “Decreasing”	0.050 (0.119)	0.026 (0.118)	0.053 (0.116)	0.033 (0.118)	-0.013 (0.116)	0.034 (0.118)	0.150 (0.157)	0.031 (0.152)
“Inflation” * “Decreasing”	-0.007 (0.118)	0.104 (0.116)	-0.011 (0.118)	0.091 (0.119)	0.039 (0.118)	0.096 (0.119)	0.056 (0.148)	0.199 (0.165)
Point prediction * “Prices” * “Increasing”	—	—	—	—	—	—	-0.028 (0.025)	-0.033 (0.026)
Point prediction * “Prices” * “Decreasing”	—	—	—	—	—	—	0.025 (0.024)	-0.002 (0.022)
Point prediction * “Inflation” * “Decreasing”	—	—	—	—	—	—	-0.018 (0.027)	-0.026 (0.023)
N	589	607	589	607	589	607	589	607
Log Likelihood	-1,227.0	-1,266.9	-1,225.5	-1,265.3	-1,232.9	-1,265.2	-1,224.4	-1,277.7

The standard deviations are robust and clustered at the treatment combination level. Significance: * = 10%, ** =5%, *** = 1%.

[a] Self reported willingness to take risk regarding financial matters on a scale from 1 (Not willing at all) to 7 (very willing).

[b] The variable takes integer values between 0 and 6 depending on the number of correct answers the respondent gave to the six questions asked to measure the respondent’s numeracy and financial literacy.

[c] As explained in Section 2, these variables are calculated using the probabilistic beliefs reported by the respondent.

Table 4: Explaining the Deviations from Risk Neutrality

Ordered Probit estimations based on the difference between a respondent switching point and her/his pair of "risk neutral switching points."

	Model 1 [a]		Model 2 [b]		Model 3 [c]		Model 4 [d]	
	Dependent = Deviation		Dependent = Absolute Deviation		Dependent = Deviation when Deviation < 0		Dependent = Deviation when Deviation > 0	
	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2
Reported Risk Tolerance [e]	0.247***	0.196***	-0.550***	-0.543***	0.258***	0.220***	0.356***	0.217***
	(0.030)	(0.028)	(0.128)	(0.124)	(0.056)	(0.053)	(0.059)	(0.059)
Square of Reported Risk Attitude	—	—	0.077***	0.071***	—	—	—	—
			(0.017)	(0.017)				
Inflation Uncertainty [g]	0.002	0.001	0.004**	0.004***	-0.011***	-0.003**	0.010***	0.008***
	(0.002)	(0.011)	(0.002)	(0.001)	(0.004)	(0.002)	(0.003)	(0.003)
Numeracy and Financial Literacy Score [f]	-0.034	-0.057*	-0.146***	-0.118***	0.234***	0.191***	-0.175***	-0.239***
	(0.035)	(0.031)	(0.036)	(0.033)	(0.059)	(0.054)	(0.068)	(0.067)
Log of Time Taken to Complete the Survey	-0.036	-0.029	0.075***	0.070***	-0.097**	-0.064**	0.087*	0.091**
	(0.025)	(0.019)	(0.024)	(0.020)	(0.036)	(0.031)	(0.048)	(0.041)
Gender (female)	0.101	0.011	0.043	0.007	0.206	-0.071	-0.014	0.236
	(0.087)	(0.088)	(0.091)	(0.093)	(0.148)	(0.152)	(0.184)	(0.206)
Age	0.004	0.001	-0.001	0.004	0.001	0.006	0.005	0.011
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.007)	(0.007)
Income greater than $75k	-0.092	-0.143	-0.125	-0.048	0.185	0.306**	-0.131	-0.106
	(0.088)	(0.087)	(0.092)	(0.092)	(0.149)	(0.152)	(0.184)	(0.205)
Education: No more than High School	0.298**	0.085	0.535***	0.591***	-0.467**	-0.666***	0.820***	0.950***
	(0.125)	(0.126)	(0.128)	(0.129)	(0.218)	(0.203)	(0.217)	(0.244)
Education: More than Bachelor	0.019	0.102	-0.273**	-0.350***	0.463**	0.487**	-0.575**	-0.831***
	(0.105)	(0.105)	(0.112)	(0.116)	(0.187)	(0.198)	(0.257)	(0.287)
"Prices" * "Increasing"	0.003	-0.039	0.106	0.086	-0.110	-0.115	0.088	0.330
	(0.121)	(0.122)	(0.127)	(0.128)	(0.206)	(0.211)	(0.255)	(0.284)
"Prices" * "Decreasing"	0.180	0.164	0.022	-0.001	-0.086	-0.066	0.021	-0.286
	(0.120)	(0.119)	(0.127)	(0.126)	(0.216)	(0.214)	(0.251)	(0.270)
"Inflation" * "Decreasing"	-0.138	-0.173	0.002	-0.084	-0.141	-0.078	-0.230	-0.422
	(0.118)	(0.118)	(0.123)	(0.125)	(0.194)	(0.197)	(0.268)	(0.310)
N	589	607	589	607	242	134	161	134
Log Likelihood	-1,295.6	-1,259.7	-1,030.1	-1,008.2	-369.8	-204.1	-255.4	-213.9

The standard deviations are robust and clustered at the treatment combination level. Significance: * = 10%, ** =5%, *** = 1%.

[a] In Model 1 the dependent variable is the difference between a respondent actual switching point and his/her pair of "risk neutral switching points."

[b] In Model 2 the dependent variable is the absolute value of the difference between a respondent actual switching point and his/her pair of "risk neutral switching points."

[c] In Model 3 the dependent variable is the difference between a respondent actual switching point and his/her pair of "risk neutral switching points," but the sample is restricted to respondents who behaved as if risk averse (i.e. the deviations from risk neutrality is strictly negative).

[d] In Model 4 the dependent variable is the difference between a respondent actual switching point and his/her pair of "risk neutral switching points," but the sample is restricted to respondents who behaved as if risk loving (i.e. the deviations from risk neutrality is strictly positive).

[e] Self reported willingness to take risk regarding financial matters on a scale from 1 (Not willing at all) to 7 (very willing).

[f] The variable takes integer values between 0 and 6 depending on the number of correct answers the respondent gave to the six questions asked to measure the respondent's numeracy and financial literacy.

[g] As explained in Section 2, these variables are calculated using the probabilistic beliefs reported by the respondent.

Table 5: Are Changes in Predictions and Changes in Switching Points across Surveys Consistent with Theory?			
	Model 1 [a] Probit (Marginal Effects) Dependent = Inconsistent Revealed Risk Attitudes	Model 2 [b] Probit (Marginal Effects) Dependent = Inconsistent Correlation	Model 3 [c] Ordered Probit Dependent = Absolute value of Adjustment Precision
Absolute Difference in Reported Risk Tolerance across Surveys [d]	-0.009 (0.014)	0.032 (0.022)	-0.027 (0.060)
Absolute Difference in Inflation Uncertainty across Surveys [e]	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Numeracy and Financial Literacy Score [f]	-0.048*** (0.014)	-0.054*** (0.014)	-0.153*** (0.042)
Log of Total Time Taken to Complete the two Surveys	0.013** (0.005)	0.027*** (0.007)	0.054** (0.021)
Gender (female)	-0.026 (0.024)	-0.062 (0.073)	0.089 (0.100)
Age	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.004)
Income greater than $75k	-0.009 (0.025)	-0.054 (0.036)	-0.203** (0.101)
Education: No more than High School	0.153*** (0.060)	0.150*** (0.064)	0.722*** (0.148)
Education: More than Bachelor	-0.052 (0.027)	-0.096** (0.038)	-0.353*** (0.125)
"Prices" * "Increasing"	-0.026 (0.021)	-0.054 (0.047)	-0.146 (0.144)
"Prices" * "Decreasing"	0.025 (0.032)	-0.035 (0.049)	0.098 (0.141)
"Inflation" * "Decreasing"	-0.028 (0.035)	-0.020 (0.048)	-0.105 (0.137)
N	495	495	495
Log Likelihood	-88.5	-222.1	-791.5

The standard deviations are robust and clustered at the treatment combination level. Significance: * = 10%, ** =5%, *** = 1%.

[a] A respondent is said to have "inconsistent revealed risk attitudes" when he behaves as if risk averse in one survey and as if risk loving in the other survey.

[b] A respondent is said to have an "inconsistent correlation" when his pair of switching points and his pair of point predictions satisfy all the conditions described in Section 6.1.2.

[c] The "adjustment precision" is the difference between a respondent switching point in survey 2 and his pair of predicted switching points (see Section 6.2).

[d] Self reported willingness to take risk regarding financial matters on a scale from 1 (Not willing at all) to 7 (very willing).

[e] As explained in Section 2, these variables are calculated using the probabilistic beliefs reported by the respondent.

[f] The variable takes integer values between 0 and 6 depending on the number of correct answers the respondent gave to the six questions asked to measure the respondent's numeracy and financial literacy.

Figure 1: Distribution of Point Predictions

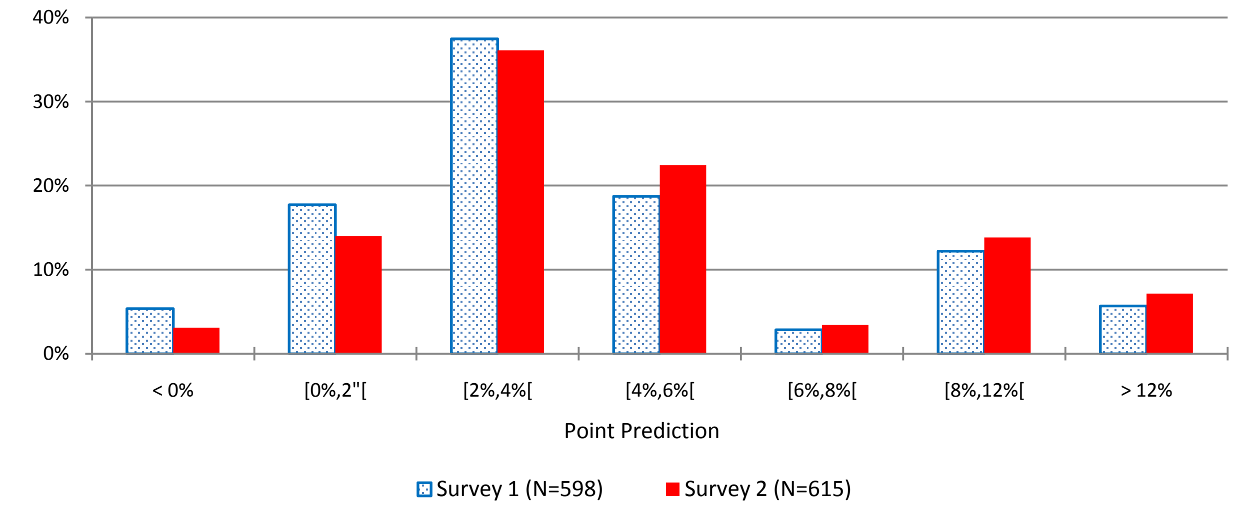


Figure 2: Distribution of Individual Differences in Point Predictions (N=502)

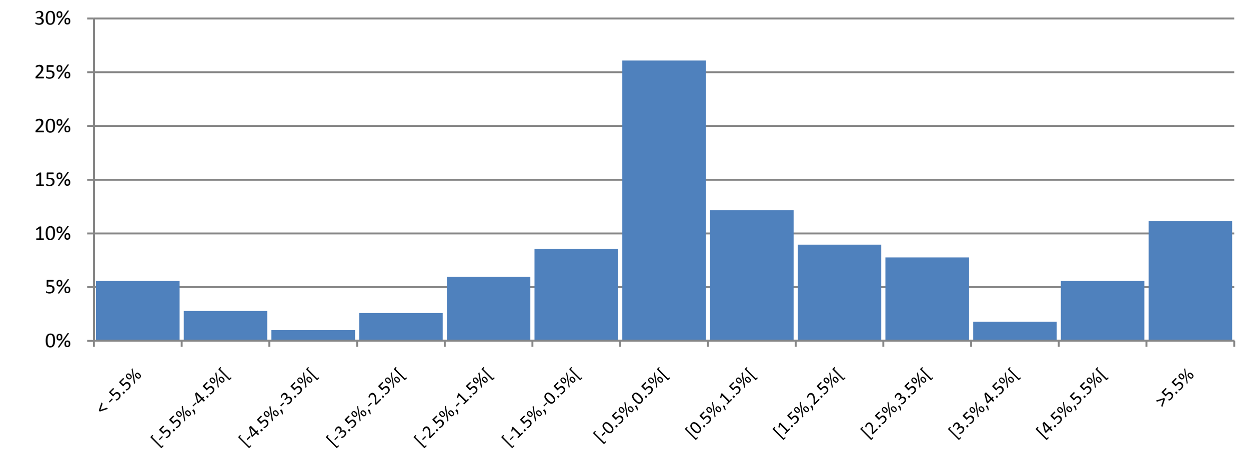
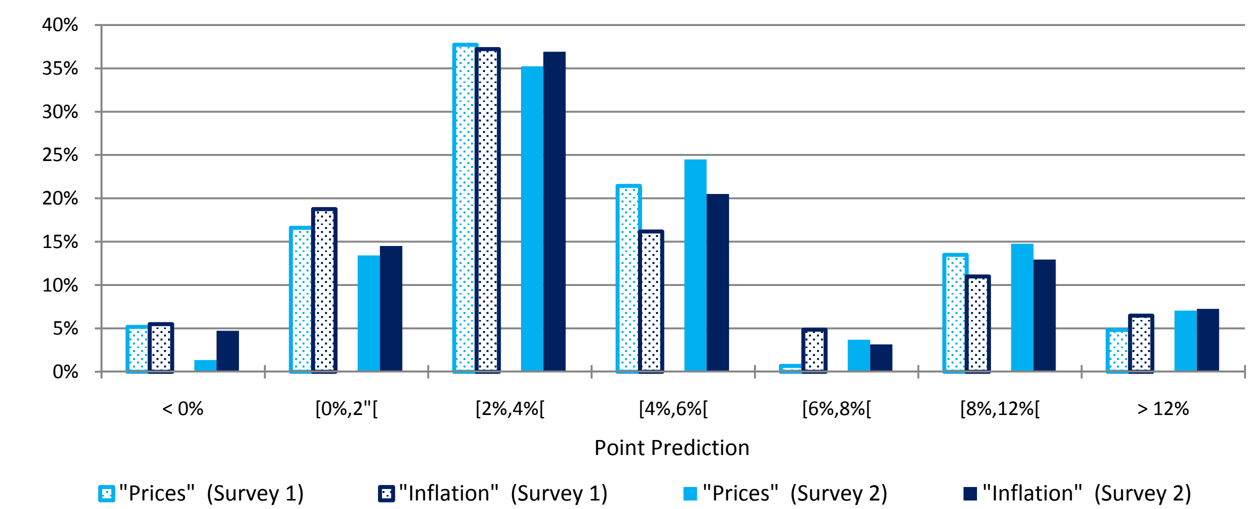


Figure 3: Histogram of Point Predictions for each Survey Treatment



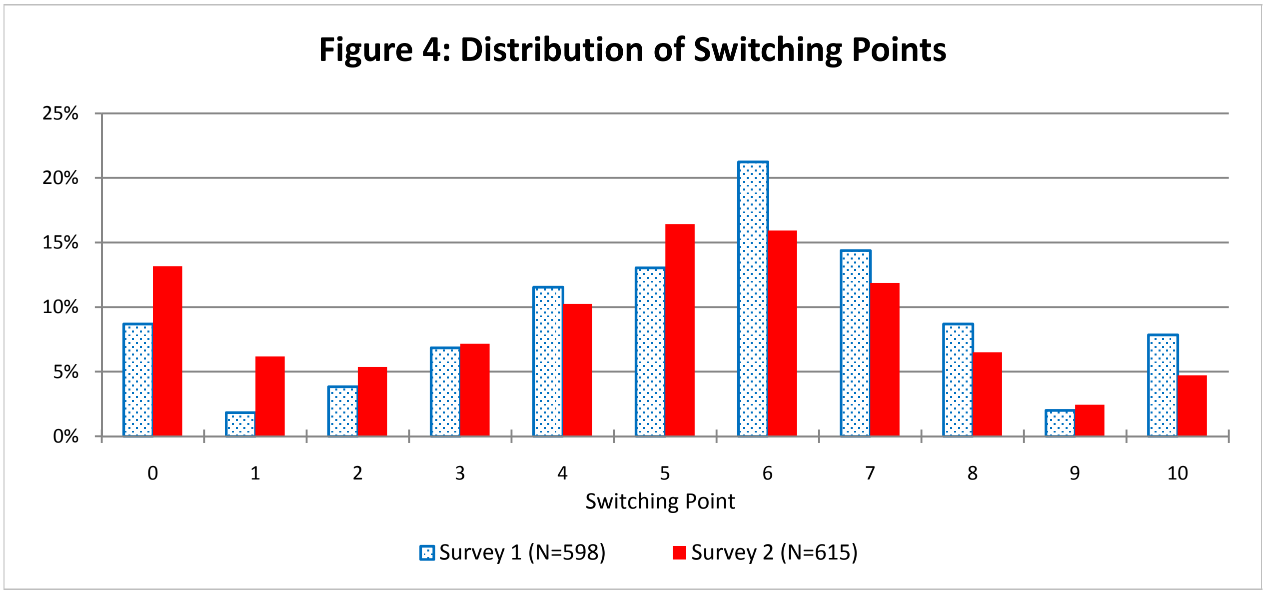


Figure 4: Distribution of Switching Points
25%
20%
15%
10%
5%
0%
0
1
2
3
4
5
6
7
8
9
10
Switching Point
Survey 1 (N=598)
Survey 2 (N=615)

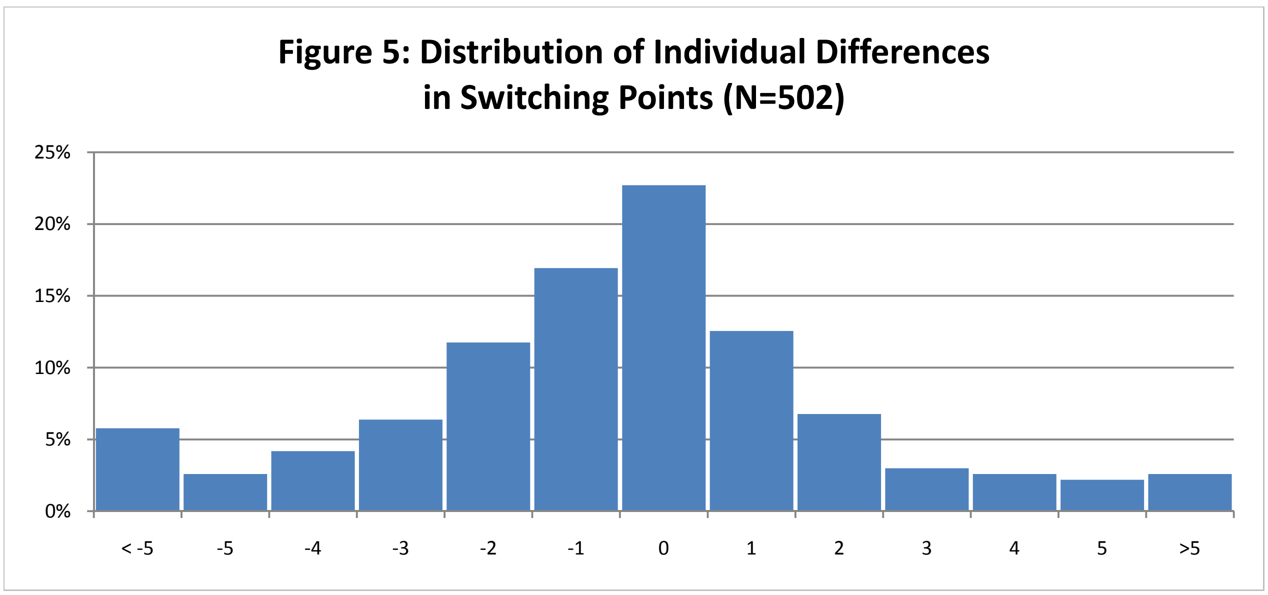


Figure 5: Distribution of Individual Differences in Switching Points (N=502)
25%
20%
15%
10%
5%
0%
< -5
-5
-4
-3
-2
-1
0
1
2
3
4
5
>5

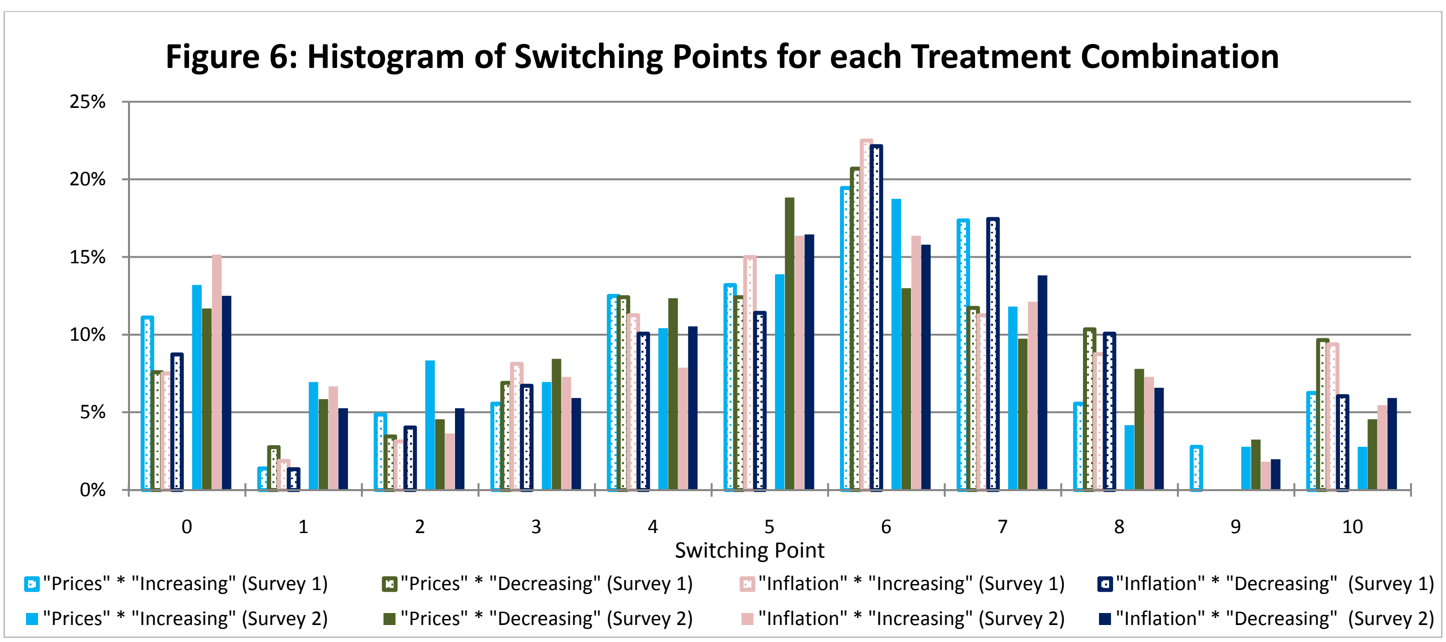


Figure 6: Histogram of Switching Points for each Treatment Combination
25%
20%
15%
10%
5%
0%
0
1
2
3
4
5
6
7
8
9
10
Switching Point
"Prices" * "Increasing" (Survey 1)
"Prices" * "Decreasing" (Survey 1)
"Inflation" * "Increasing" (Survey 1)
"Inflation" * "Decreasing" (Survey 1)
"Prices" * "Increasing" (Survey 2)
"Prices" * "Decreasing" (Survey 2)
"Inflation" * "Increasing" (Survey 2)
"Inflation" * "Decreasing" (Survey 2)

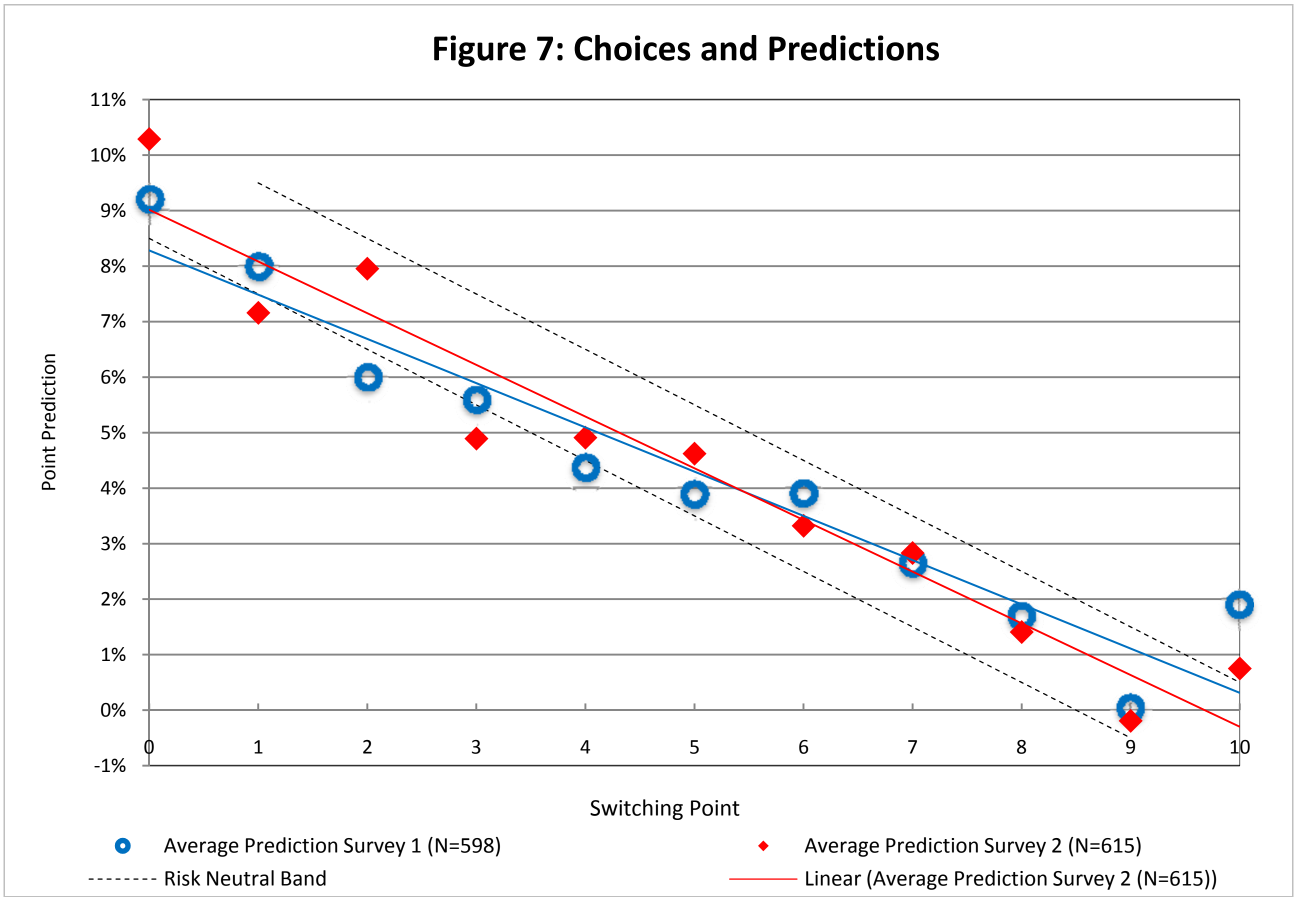


Figure 7: Choices and Predictions
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
Point Prediction
0 1 2 3 4 5 6 7 8 9 10
Switching Point
Average Prediction Survey 1 (N=598)
Average Prediction Survey 2 (N=615)
Risk Neutral Band
Linear (Average Prediction Survey 2 (N=615))

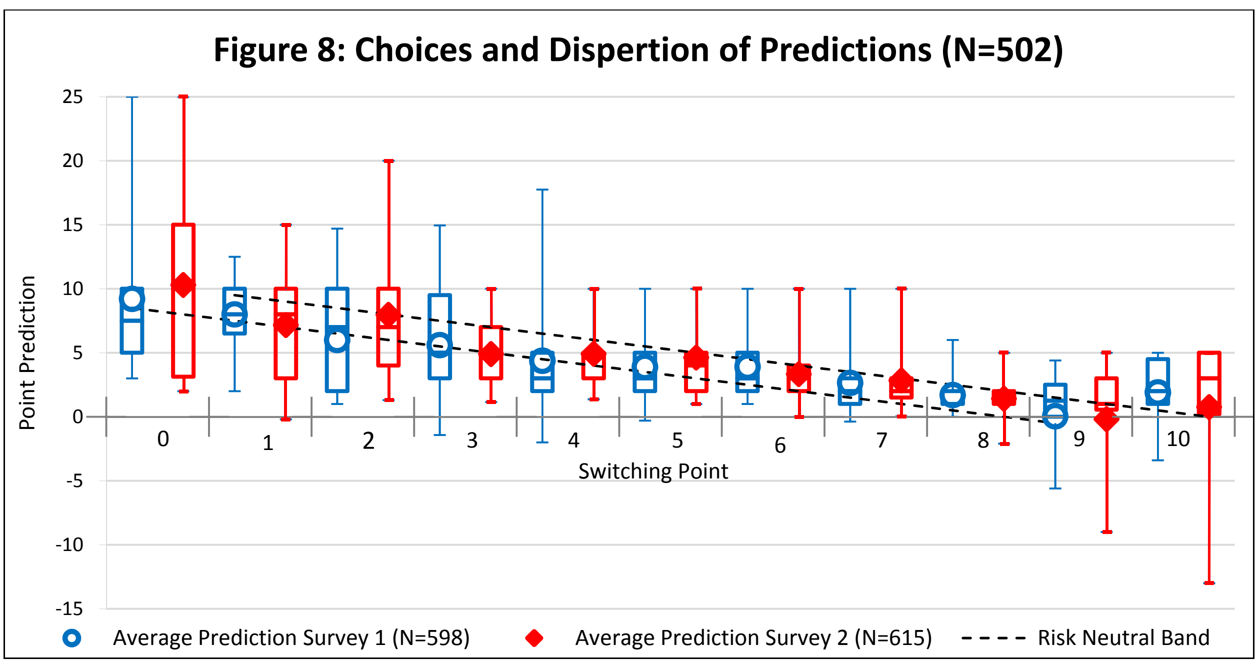


Figure 8: Choices and Dispertion of Predictions (N=502)
25
20
15
10
5
0
-5
-10
-15
Point Prediction
0 1 2 3 4 5 6 7 8 9 10
Switching Point
Average Prediction Survey 1 (N=598)
Average Prediction Survey 2 (N=615)
Risk Neutral Band

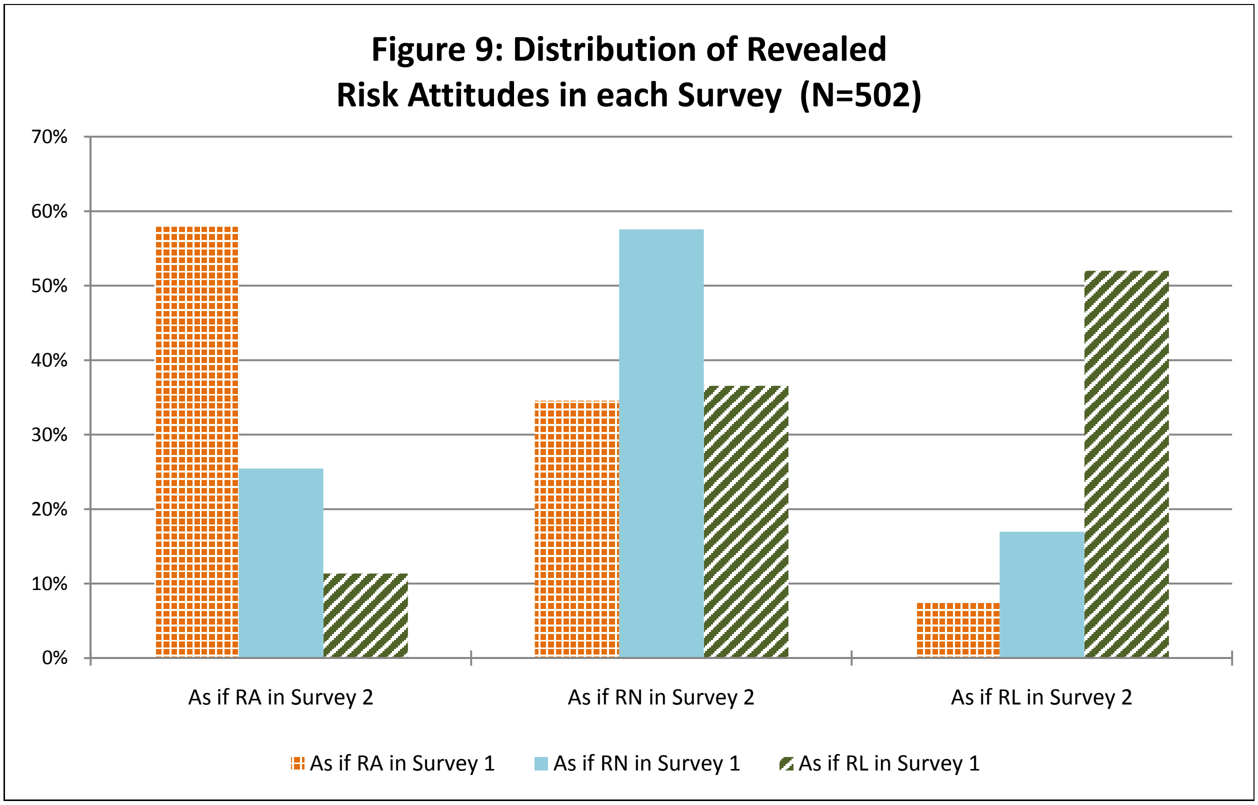


Figure 9: Distribution of Revealed
Risk Attitudes in each Survey (N=502)
70%
60%
50%
40%
30%
20%
10%
0%
As if RA in Survey 2
As if RN in Survey 2
As if RL in Survey 2
As if RA in Survey 1
As if RN in Survey 1
As if RL in Survey 1

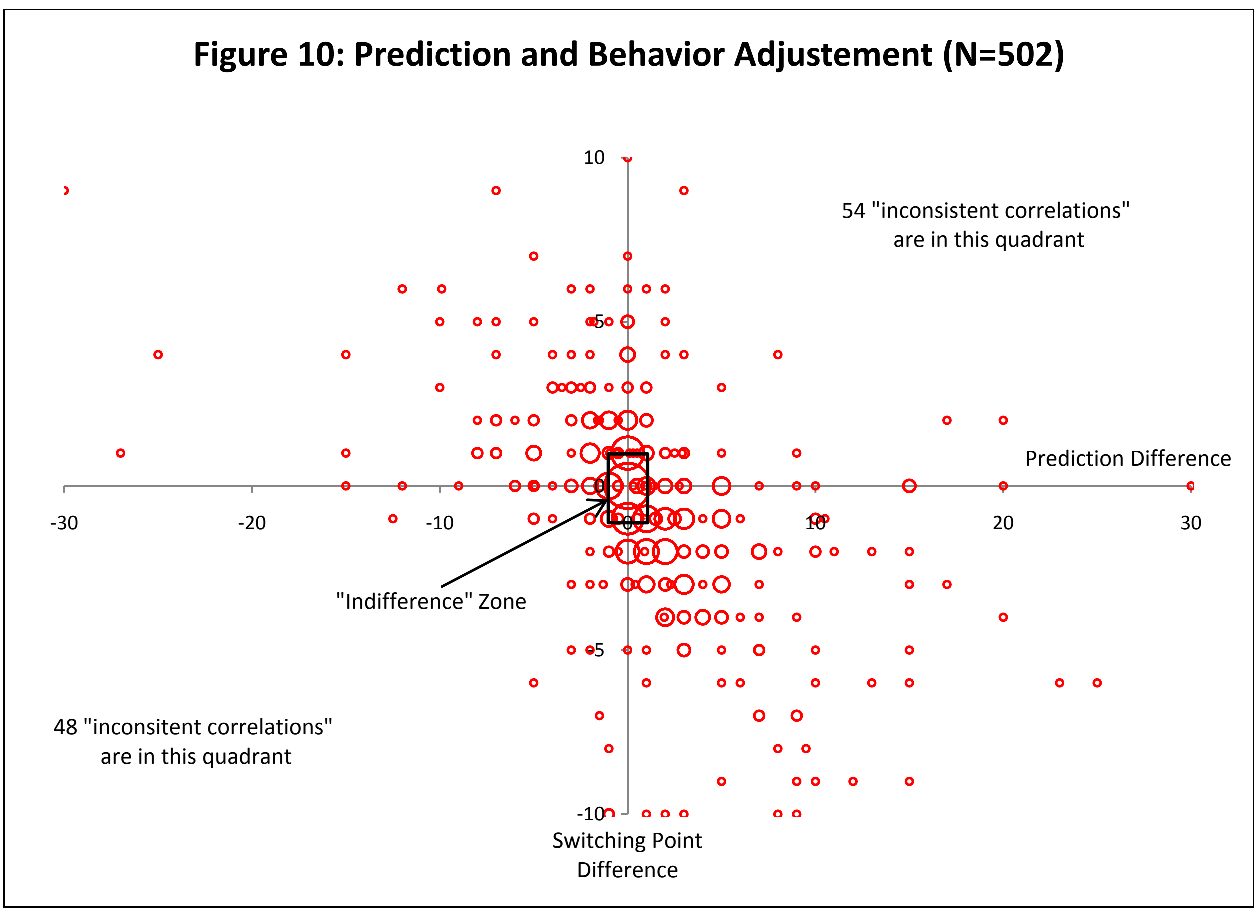
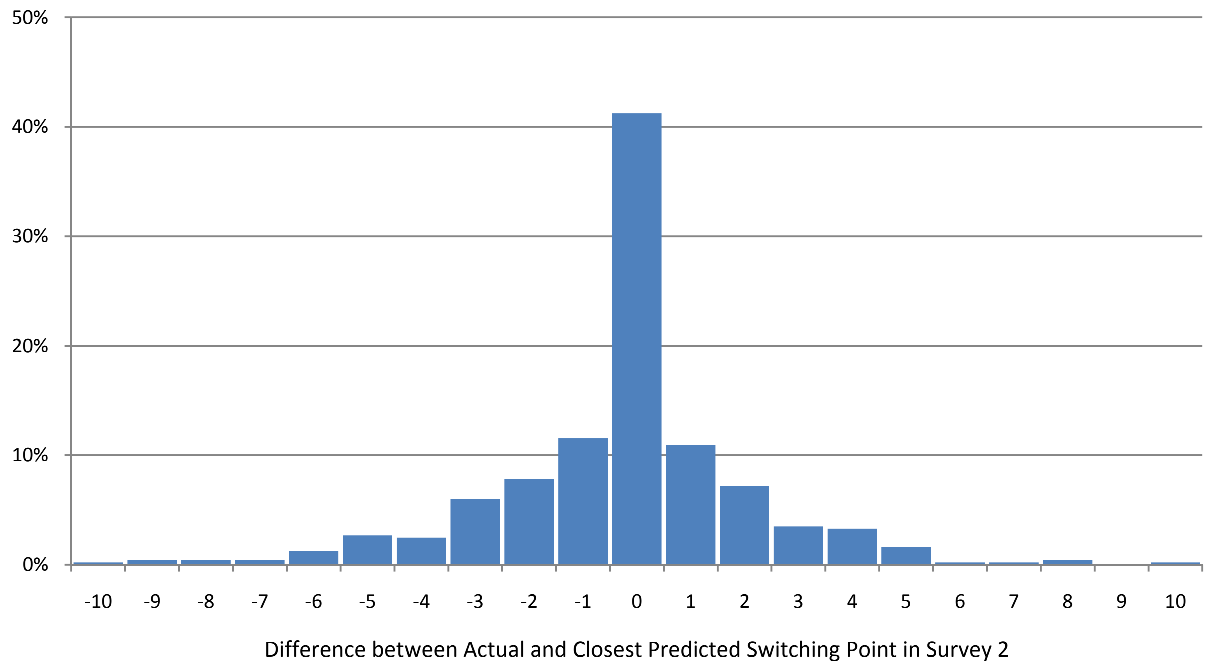


Figure 10: Prediction and Behavior Adjustement (N=502)
54 "inconsistent correlations"
are in this quadrant
Prediction Difference
"Indifference" Zone
48 "inconsitent correlations"
are in this quadrant
Switching Point
Difference
10
5
-5
-10
-30
-20
-10
0
10
20
30

Figure 11: Adjustment Precision in Survey 2



Appendix A: Experimental Instruction (Ascending Scale Treatment)

You can earn extra money by answering the following 10 questions. In each question, you are asked to choose between 2 investments, investment **A** and investment **B**.

- If you choose investment **A**, then how much you earn depends on what the rate of inflation will be over the next 12 months. Your earnings under investment **A** depending on the rate of inflation are summarized in the table below:

Earnings under investment **A**												
Rate of inflation	-1% or less (deflation)	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10% or more
Earnings	$600	$550	$500	$450	$400	$350	$300	$250	$200	$150	$100	$50

For example, we can see in the table that your earnings under investment **A** will be $50 if the rate of inflation over the next 12-months is 10% or more. Alternatively, your earnings under investment **A** will be $600 if the rate of inflation over the next 12-months is -1% or less (deflation).

- If you choose investment **B**, then how much you earn will not depend on the rate of inflation. Exactly how much you earn under investment **B** will be specified in each of the 10 questions below.

Once the survey is completed, we will randomly pick 1 of the 10 questions, and 2 survey participants. Twelve months from now, these 2 participants will be paid extra money according to the investment choice they made for the selected question. So answer every question carefully, as you may earn up to several hundred dollars. For investment **A**, the inflation rate over the next 12 months will be based on the official U.S. CPI index (Consumer Price Index) and it will be rounded to the nearest percentage point.

Earnings under investment **A**												
Rate of inflation	-1% or less (deflation)	0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10% or more
Earnings	$600	$550	$500	$450	$400	$350	$300	$250	$200	$150	$100	$50

For every question, please choose between investment **A** and investment **B**.

Question 1: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$100**?

Question 2: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$150**?

Question 3: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$200**?

Question 4: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$250**?

Question 5: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$300**?

Question 6: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$350**?

Question 7: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$400**?

Question 8: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$450**?

Question 9: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$500**?

Question 10: Which one of these two investments do you choose?
( ) Investment **A**: your earnings are determined by the table above.
( ) Investment **B**, your earnings are exactly **$550**?

Appendix B: Demonstrations of the Propositions in Section 2

> ***Proposition 1:*** *If investment A and investment B have the same expected return then a risk-averse agent prefers investment B to investment A.*

Proof: We consider a standard expected utility framework. The agent's utility function over income, denoted $U(.)$, is thrice differentiable, strictly increasing, and satisfies the von Neumann Morgenstern axioms. Assume that the agent's beliefs are such that the two investments have the same expected returns, so that $E[A] = E[B]$ or equivalently $E[\alpha X - \beta] = E[X]$. In that case, we have $\beta = (\alpha - 1)E[X]$ and the earnings under investment A are then $X + (\alpha - 1)(X - E[X])$.

Let $g(\delta) = E\big[U\big(X + (\delta - 1)(X - E[X])\big)\big]$ with $\delta > 0$. Observe that $E[U(A)] = g(\alpha)$ while $E[U(B)] = g(1)$. Note also that

$$\begin{aligned} g'(\delta) &= E\big[(X - E[X])U'\big(X + (\delta - 1)(X - E[X])\big)\big] \\ &= E\big[XU'\big(X + (\delta - 1)(X - E[X])\big)\big] - E[X]E\big[U'\big(X + (\delta - 1)(X - E[X])\big)\big] \\ &= COV\big[X, U'\big(X + (\delta - 1)(X - E[X])\big)\big] \quad . \end{aligned}$$

Now, let $h(x) = U'\big(x + (\delta - 1)(x - E[X])\big)$ so that $h'(x) = \delta U''\big(x + (\delta - 1)(x - E[X])\big)$. When $U(.)$ is strictly concave, $h'(x) < 0$, which implies that $g'(\delta) < 0$ for all risk averse agents. Then, because $\alpha > 1$, we have $g(1) > g(\alpha)$ or equivalently $E[U(A)] < E[U(B)]$. Conversely, $h'(x) > 0$ when $U(.)$ is strictly convex, so that $g'(\delta) > 0$ for all risk loving agents, in which case $g(1) < g(\alpha)$ or equivalently $E[U(A)] > E[U(B)]$. ■

> ***Proposition 2:*** *If a risk averse agent is indifferent between investment A and investment B, then, all else equal, a more risk averse agent (in the classical sense of Pratt 1964) prefers investment B to investment A.*

Proof: Consider two risk-averse agents, the first with a utility function $U(.)$ and the second with a utility function $V(.)$. The second agent is more risk-averse (in the classical sense of Pratt 1964) if his utility function verifies $V(.) = \Phi\big(U(.)\big)$ with $\Phi'(.) > 0$ and $\Phi''(.) \leq 0$. Assume the two agents share the same beliefs about the distribution of the random variable X defined above. Let us also denote $F_A(.)$ and $f_A(.)$ (respectively $F_B(.)$ and $f_B(.)$) the cumulative and probability distribution functions associated with investment A (respectively investment B). To simplify, we assume that the support of investments A and B is the real line.

Proposition 2 may then be written

$$E[U(A)] = E[U(B)] \;\Rightarrow\; E[V(A)] \leq E[V(B)]\,. \tag{2.1}$$

Based on Theorem 1 of Jewitt (1989), the implication in (2.1) is satisfied when $F_A(.)$ and $F_B(.)$ satisfy the single crossing property:

$$F_A(x_0) = F_B(x_0) \;\Rightarrow\; f_A(x_0) \geq f_B(x_0) \;. \tag{2.2}$$

Observe that

$$F_A(y) = Pr[Y \le y] = Pr[\alpha X - \beta \le y] = Pr\left[X \le \frac{y+\beta}{\alpha}\right] = F_B\left(\frac{y+\beta}{\alpha}\right) \ .$$

Thus, when $F_A(x_0) = F_B(x_0)$ we have $F_B(x_0) = F_B\left(\frac{x_0+\beta}{\alpha}\right)$, or equivalently $x_0 = \frac{\beta}{\alpha-1}$. Thus x_0 exists and $x_0 > 0$ because $\alpha > 1$ and $\beta > 0$. Now observe that

$$f_A(x_0) = \frac{1}{\alpha} f_B\left(\frac{x_0+\beta}{\alpha}\right) = \frac{1}{\alpha} f_B(x_0) \ .$$

Because $\alpha > 1$ we have $f_A(x_0) < f_B(x_0)$. The cumulative distributions $F_A(.)$ and $F_B(.)$ therefore satisfy the single crossing property in (2.2), which implies that the implication in (2.1) is also satisfied. ■

> ***Proposition 3:*** *If a risk-averse agent with a HARA utility is indifferent between investment A and investment B, then the agent prefers investment B to investment A for any increase in risk (in the classical sense of Rothschild and Stiglitz 1970).*

Proof: Consider a risk-averse agent with a utility function $U(.)$. The agent initially believes that investments A and B are characterized by a random variable X. For this distribution of beliefs, assume that the agent is indifferent between investment A and investment B, so that $E[U(A)] = E[U(B)]$ or equivalently $E[U(\alpha X - \beta)] = E[U(X)]$. Now, assume that the agent faces an increase in risk *(in the classical sense of Rothschild and Stiglitz 1970)*, that is, he now believes that investments A and B are characterized by a random variable $\tilde{X} = X + \epsilon$, where ϵ is a mean zero random variable.

Let us denote $\tilde{A}$ and $\tilde{B}$ the investments that earn respectively $\alpha\tilde{X} - \beta$ and $\tilde{X}$. Proposition 3 may then be written

$$E[U(A)] = E[U(B)] \ \Rightarrow \ E\big[U(\tilde{A})\big] \le E\big[U(\tilde{B})\big] \, . \tag{3.1}$$

Let us also denote A' the investment that earns $\alpha X - \beta + \epsilon$. To prove Proposition 3, let us first show that $E[U(A')] > \ E\big[U(\tilde{A})\big]$.

Let $g(\delta) = E[U(\alpha X - \beta + \delta\epsilon)]$ with $\delta > 0$. Observe that $E\big[U(\tilde{A})\big] = \ g(\alpha)$ and $E[U(A')] = g(1)$. Furthermore, note that

$$g'(\delta) = E[\epsilon U'(\alpha X - \beta + \delta\epsilon)] = COV[\epsilon, U'(\alpha X - \beta + \delta\epsilon)]$$

Now, let $h(\epsilon) = U'(\alpha X - \beta + \delta\epsilon)$ so that $h'(\epsilon) = \delta U''(\alpha X - \beta + \delta\epsilon)$. When $U(.)$ is strictly concave then $h'(\epsilon) < 0$, which implies that $g'(\delta) < 0$ for all risk averse agents. Then, because $\alpha > 1$, we have $g(1) > g(\alpha)$ or equivalently $E[U(A')] > \ E\big[U(\tilde{A})\big]$.

Next, consider the following implication:

$$E[U(A)] = E[U(B)] \ \Rightarrow \ E[U(A')] \le E\big[U(\tilde{B})\big] \, . \tag{3.2}$$

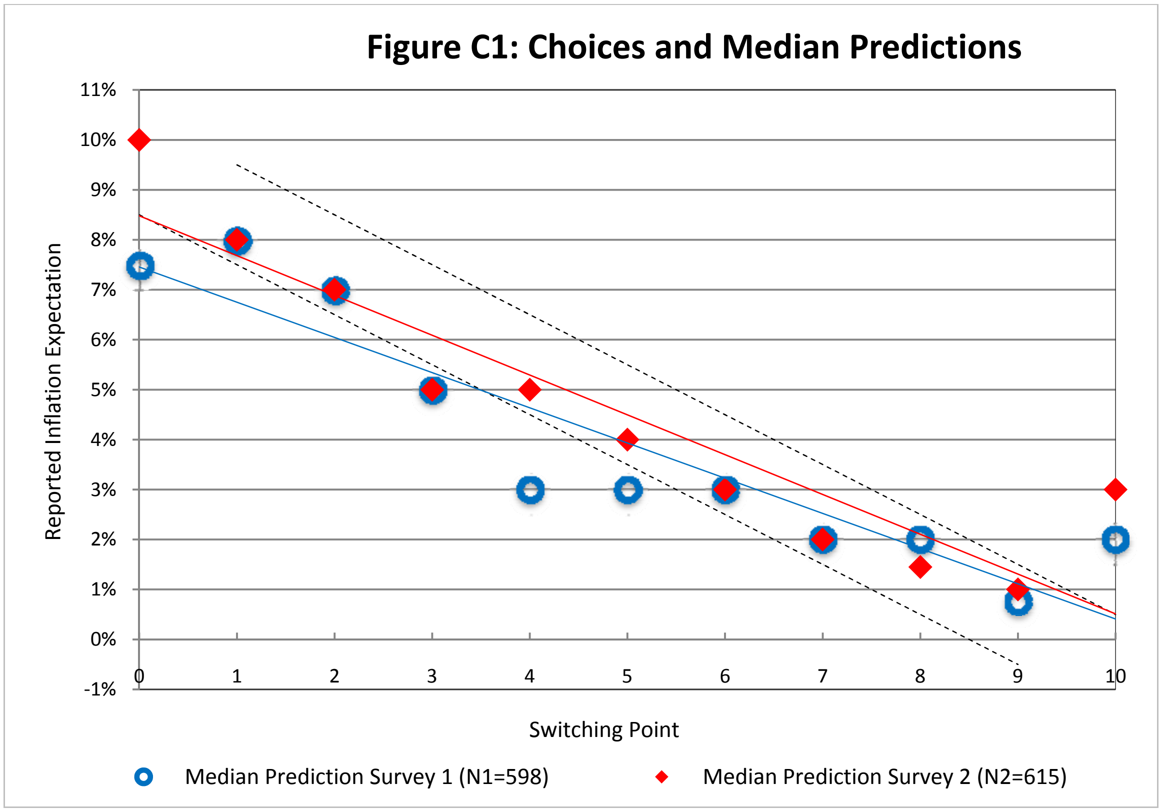
Because $E[U(A')] > E\big[U(\tilde{A})\big]$, it is sufficient to verify that the implication in (3.2) is satisfied in order to demonstrate Proposition 3 as stated in (3.1).

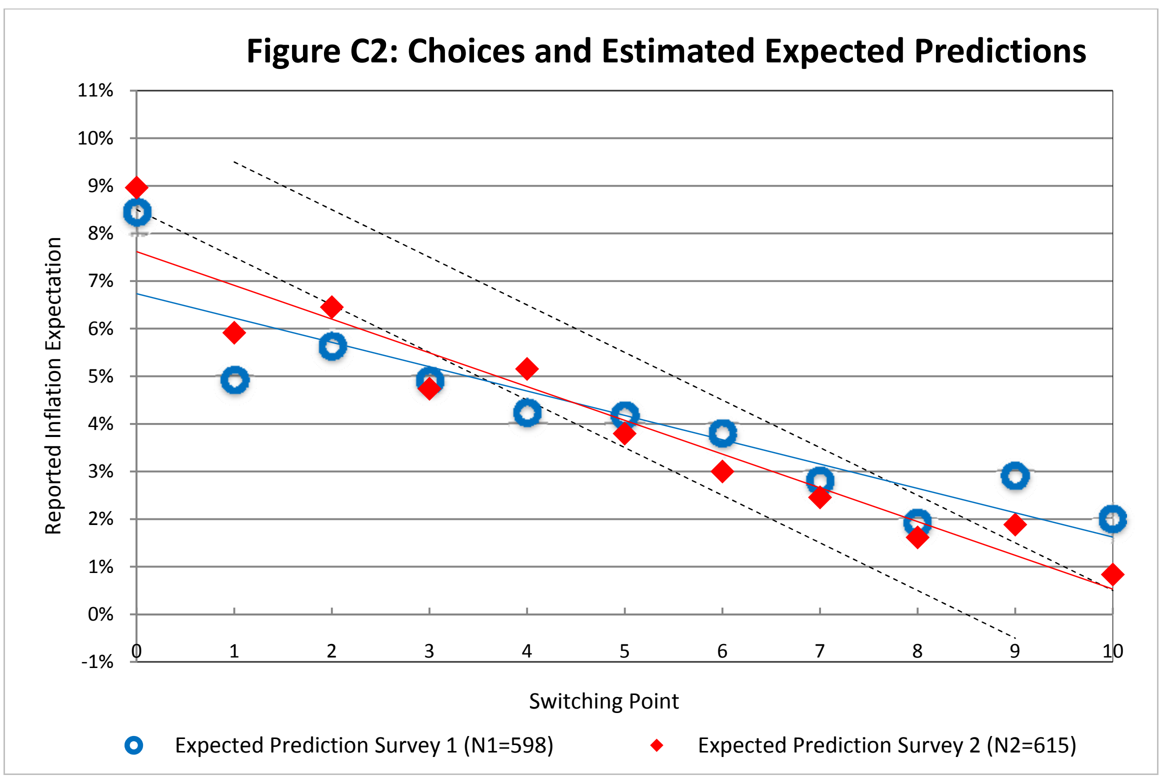
Let us denote the indirect utility function $V(X) = E_\epsilon[U(x+\epsilon)]$. The implication in (3.2) can then be written

$$E[U(A)] = E[U(B)] \;\; \Rightarrow \; E[V(A)] \leq E[V(B)]\,. \tag{3.3}$$

From Proposition 2 we know that the implication in (3.3) is satisfied when $V(.)$ is more risk averse than $U(.)$, that is, $V(.) = \Phi\big(U(.)\big)$ with $\Phi'(.) > 0$ and $\Phi''(.) \leq 0$. From Gollier and Pratt (1996), $V(.)$ is more risk averse than $U(.)$ if $V(.)$ satisfies the "vulnerability condition." This condition, which imposes constraints up to the fourth derivative, is not satisfied by every risk averse utility function. Nevertheless, Gollier and Pratt (1996) show that the vulnerability condition is satisfied by the family of HARA utility functions. ■

Appendix C: Additional Figures





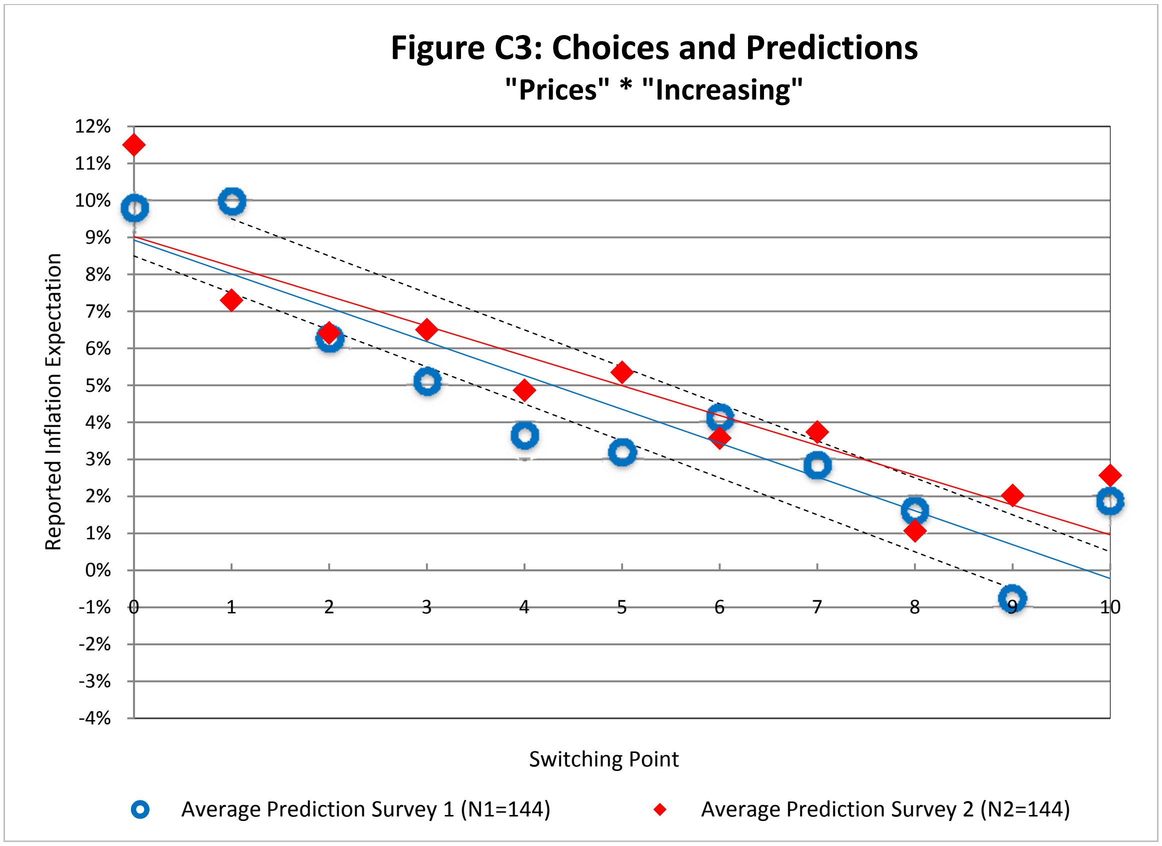


Figure C3: Choices and Predictions
"Prices" * "Increasing"
12%
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
0
1
2
3
4
5
6
7
8
9
10
Reported Inflation Expectation
Switching Point
Average Prediction Survey 1 (N1=144)
Average Prediction Survey 2 (N2=144)

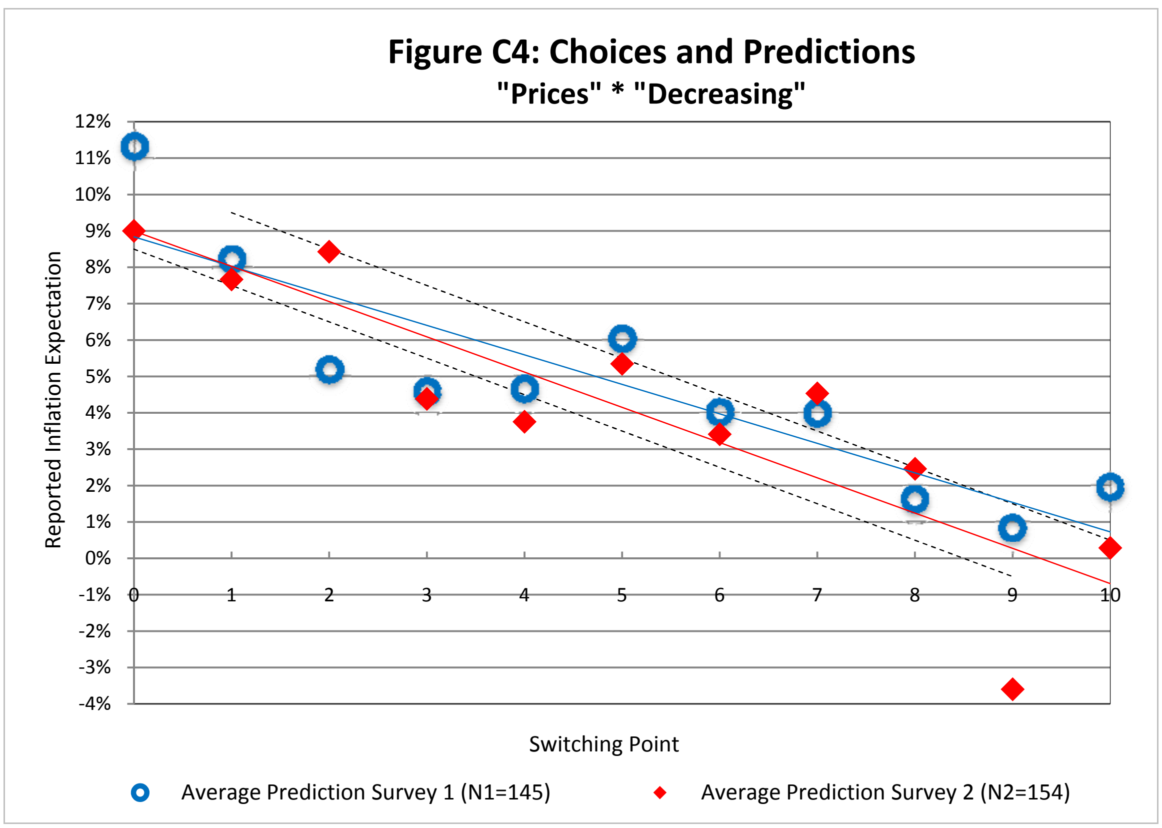


Figure C4: Choices and Predictions
"Prices" * "Decreasing"
12%
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
0
1
2
3
4
5
6
7
8
9
10
Reported Inflation Expectation
Switching Point
Average Prediction Survey 1 (N1=145)
Average Prediction Survey 2 (N2=154)

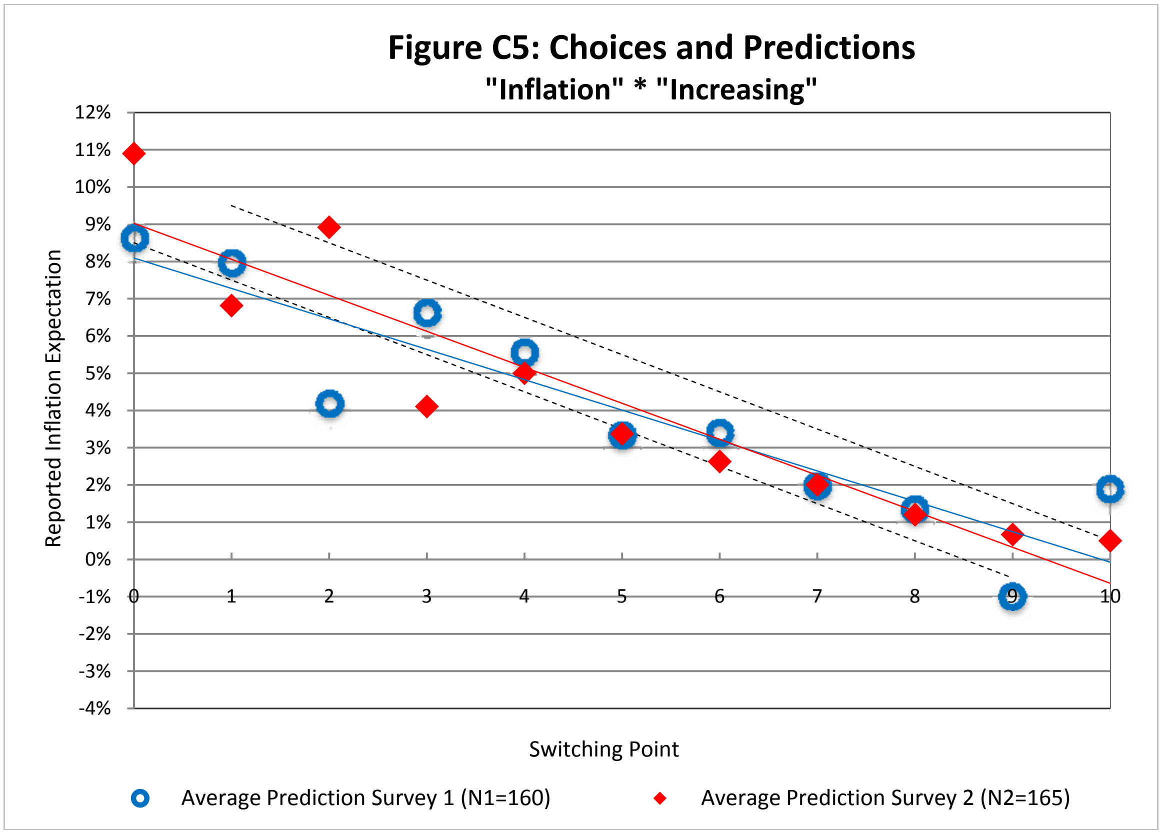
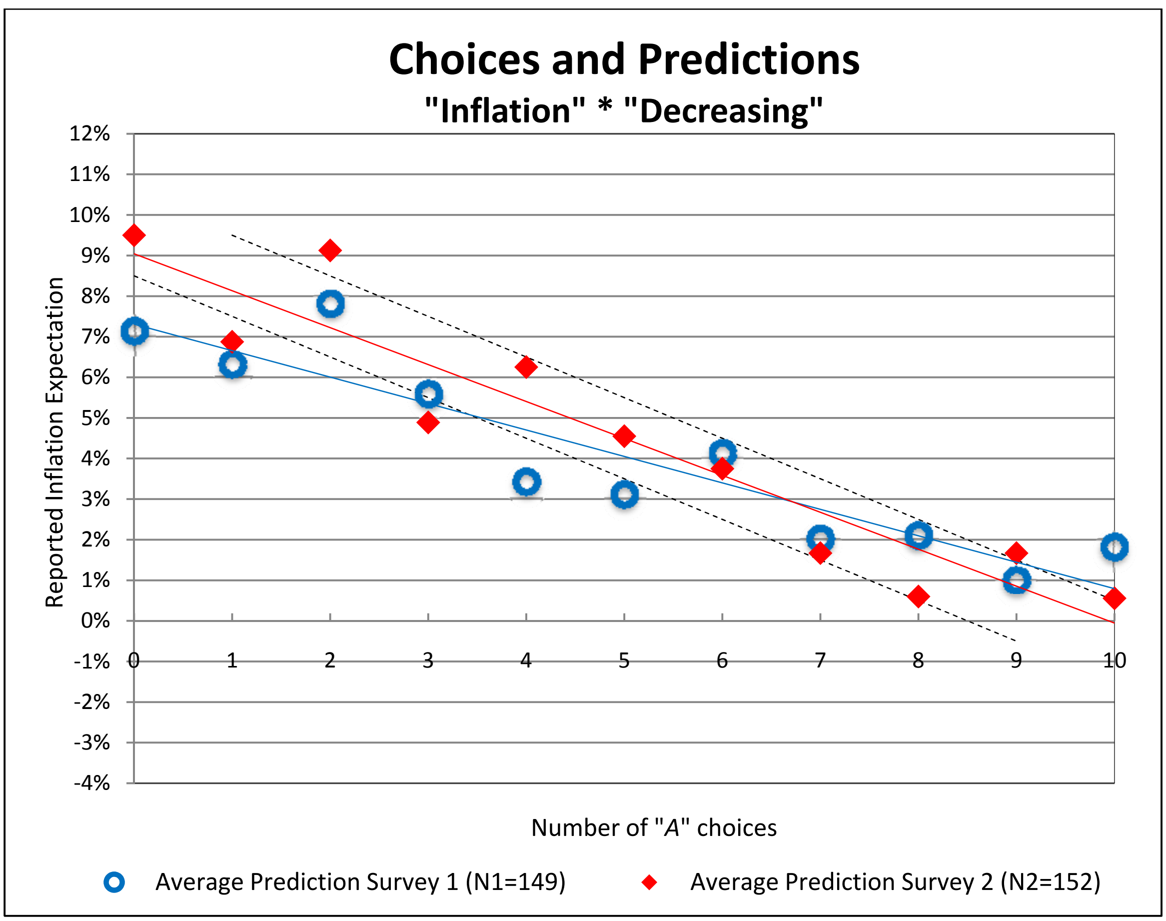


Figure C5: Choices and Predictions
"Inflation" * "Increasing"
Reported Inflation Expectation
12%
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
0 1 2 3 4 5 6 7 8 9 10
Switching Point
Average Prediction Survey 1 (N1=160)
Average Prediction Survey 2 (N2=165)


Choices and Predictions
"Inflation" * "Decreasing"
Reported Inflation Expectation
12%
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
0 1 2 3 4 5 6 7 8 9 10
Number of "A" choices
Average Prediction Survey 1 (N1=149)
Average Prediction Survey 2 (N2=152)

Appendix D: Linear Regressions

Table D.3: Factors Influencing the Choice of the Switching Point

Outcomes of linear regressions where the dependent variable is the switching point (an integer between 0 and 10) for each respondent

	Model 1		Model 2		Model 3		Model 4	
	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2
Point prediction	-0.182*** (0.020)	-0.213*** (0.017)	-0.182*** (0.020)	-0.213*** (0.018)	—	—	-0.188*** (0.024)	-0.180*** (0.031)
Estimated Expected Prediction [c]	—	—	—	—	-0.199*** (0.025)	-0.226*** (0.019)	—	—
Reported Risk Tolerance [a]	0.436*** (0.065)	0.417*** (0.061)	0.435*** (0.067)	0.417*** (0.064)	0.379*** (0.068)	0.376*** (0.064)	0.403*** (0.072)	0.418*** (0.064)
Numeracy and Financial Literacy Score [b]	0.012 (0.078)	0.042 (0.080)	0.010 (0.079)	0.029 (0.072)	0.017 (0.081)	0.040 (0.072)	0.023 (0.085)	0.026 (0.071)
Inflation Uncertainty [c]	-0.015*** (0.004)	-0.009*** (0.003)	-0.014*** (0.004)	-0.009*** (0.003)	-0.011*** (0.004)	-0.013*** (0.003)	-0.019*** (0.004)	-0.010** (0.003)
Log of Time Taken to Complete the Survey	0.025 (0.054)	-0.025 (0.043)	0.029 (0.054)	-0.017 (0.043)	0.031 (0.055)	-0.032 (0.044)	-0.006 (0.060)	-0.014 (0.044)
Age	—	—	0.005 (0.007)	-0.001 (0.007)	0.006 (0.007)	-0.001 (0.007)	0.003 (0.008)	0.001 (0.007)
Gender (female)	—	—	-0.172 (0.201)	-0.180 (0.200)	-0.284 (0.203)	-0.307 (0.202)	-0.325 (0.208)	-0.179 (0.201)
Income greater than $75k	—	—	-0.056 (0.202)	-0.197 (0.198)	-0.122 (0.204)	-0.117 (0.200)	-0.116 (0.208)	-0.203 (0.199)
Education: No more than High School	—	—	0.245 (0.284)	0.065 (0.288)	0.017 (0.287)	0.074 (0.290)	0.160 (0.310)	0.092 (0.289)
Education: More than Bachelor			0.172 (0.241)	0.437 (0.239)	0.088 (0.246)	0.248 (0.241)	0.263 (0.246)	0.426* (0.239)
"Prices" * "Increasing"	-0.288 (0.269)	-0.294 (0.272)	-0.288 (0.270)	-0.292 (0.273)	-0.354 (0.274)	-0.208 (0.276)	0.063 (0.375)	0.021 (0.371)
"Prices" * "Decreasing"	0.101 (0.269)	0.017 (0.268)	0.109 (0.273)	0.038 (0.269)	0.060 (0.274)	0.032 (0.270)	-0.249 (0.329)	0.128 (0.341)
"Inflation" * "Decreasing"	-0.052 (0.268)	0.182 (0.268)	-0.063 (0.279)	0.153 (0.270)	-0.036 (0.272)	0.161 (0.272)	-0.073 (0.331)	0.459 (0.343)
Point prediction * "Prices" * "Increasing"	—	—	—	—	—	—	-0.078 (0.084)	-0.057 (0.050)
Point prediction * "Prices" * "Decreasing"	—	—	—	—	—	—	0.038 (0.035)	-0.022 (0.045)
Point prediction * "Inflation" * "Decreasing"	—	—	—	—	—	—	-0.033 (0.040)	-0.068 (0.047)
Constant	5.659*** (0.534)	5.327*** (0.478)	5.450*** (0.719)	5.450*** (0.672)	5.594*** (0.732)	5.714*** (0.680)	5.934*** (0.778)	5.295*** (0.686)
N	589	607	589	607	589	607	589	607
Adjusted R^2	0.221	0.287	0.218	0.287	0.192	0.277	0.240	0.287

The standard deviations are robust and clustered at the treatment combination level. Significance: * = 10%, ** =5%, *** = 1%.

[a] Self reported willingness to take risk regarding financial matters on a scale from 1 (Not willing at all) to 7 (very willing).

[b] The variable takes integer values between 0 and 6 depending on the number of correct answers the respondent gave to the six questions asked to measure the respondent's numeracy and financial literacy.

[c] As explained in Section 2, these variables are calculated using the probabilistic beliefs reported by the respondent.

Table D.4: Explaining the Deviations from Risk Neutrality

Linear regressions based on the difference between a respondent switching point and her/his pair of "risk neutral switching points."

	Model 1 [a]		Model 2 [b]		Model 3 [c]		Model 4 [d]	
	Dependent = Deviation		Dependent = Absolute Deviation		Dependent = Deviation when Deviation < 0		Dependent = Deviation when Deviation > 0	
	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2
Reported Risk Tolerance [e]	0.651*** (0.074)	0.497*** (0.069)	-1.029*** (0.221)	-1.086*** (0.213)	0.361*** (0.073)	0.335*** (0.816)	0.495*** (0.080)	0.294*** (0.081)
Square of Reported Risk Attitude	—	—	0.146*** (0.029)	0.143*** (0.030)	—	—	—	—
Inflation Uncertainty [g]	0.015*** (0.004)	-0.001 (0.003)	0.008*** (0.003)	0.008*** (0.002)	-0.016*** (0.005)	-0.007** (0.003)	0.014*** (0.005)	0.011*** (0.004)
Numeracy and Financial Literacy Score [f]	-0.085 (0.088)	-0.115 (0.077)	-0.262*** (0.062)	-0.239*** (0.056)	0.307*** (0.080)	0.346*** (0.086)	-0.212** (0.099)	-0.322*** (0.092)
Log of Time Taken to Complete the Survey	-0.072 (0.060)	-0.071* (0.047)	0.139*** (0.043)	0.130*** (0.034)	-0.119** (0.049)	-0.102** (0.050)	0.131** (0.073)	0.107* (0.057)
Gender (female)	0.271 (0.220)	0.052 (0.217)	0.074 (0.156)	0.009 (0.175)	0.161 (0.201)	-0.004 (0.241)	0.121 (0.268)	0.241 (0.286)
Age	0.009 (0.008)	-0.001 (0.008)	-0.001 (0.006)	0.004 (0.003)	0.001 (0.008)	-0.007 (0.009)	0.007 (0.010)	0.013 (0.010)
Income greater than $75k	-0.201 (0.222)	-0.295 (0.215)	-0.246 (0.175)	-0.097 (0.157)	0.273 (0.205)	0.458** (0.242)	-0.142 (0.268)	-0.217 (0.285)
Education: No more than High School	0.805** (0.312)	0.250 (0.311)	1.120*** (0.222)	1.217*** (0.226)	-0.705** (0.310)	-1.013*** (0.332)	1.236*** (0.317)	1.249*** (0.344)
Education: More than Bachelor	-0.008 (0.266)	0.251 (0.258)	-0.477** (0.189)	-0.588*** (0.189)	0.593** (0.250)	0.851** (0.305)	-0.819** (0.357)	-0.990*** (0.368)
"Prices" * "Increasing"	0.009 (0.308)	-0.140 (0.301)	0.240 (0.217)	0.213 (0.218)	0.078 (0.282)	-0.210 (0.332)	0.218 (0.372)	0.431 (0.396)
"Prices" * "Decreasing"	0.425 (0.306)	0.322 (0.295)	0.086 (0.216)	0.059 (0.214)	0.033 (0.297)	-0.102 (0.340)	0.190 (0.363)	-0.344 (0.375)
"Inflation" * "Decreasing"	-0.282 (0.287)	-0.427 (0.292)	-0.049 (0.210)	-0.077 (0.212)	0.292 (0.263)	-0.009 (0.313)	-0.168 (0.386)	-0.523 (0.429)
Constant	-2.768*** (0.787)	1.121 (0.718)	4.012*** (0.654)	3.391*** (0.595)	-5.016*** (0.747)	-4.694 (0.836)	0.868 (0.910)	1.632 (0.791)
N	589	607	589	607	242	134	161	134
Adjusted R^2	0.140	0.083	0.172	0.204	0.252	0.270	0.331	0.309

The standard deviations are robust and clustered at the treatment combination level. Significance: * = 10%, ** =5%, *** = 1%.

[a] In Model 1 the dependent variable is the difference between a respondent actual switching point and his/her pair of "risk neutral switching points."

[b] In Model 2 the dependent variable is the absolute value of the difference between a respondent actual switching point and his/her pair of "risk neutral switching points."

[c] In Model 3 the dependent variable is the difference between a respondent actual switching point and his/her pair of "risk neutral switching points," but the sample is restricted to respondents who behaved as if risk averse (i.e. the deviations from risk neutrality is strictly negative).

[d] In Model 4 the dependent variable is the difference between a respondent actual switching point and his/her pair of "risk neutral switching points," but the sample is restricted to respondents who behaved as if risk loving (i.e. the deviations from risk neutrality is strictly positive).

[e] Self reported willingness to take risk regarding financial matters on a scale from 1 (Not willing at all) to 7 (very willing).

[f] The variable takes integer values between 0 and 6 depending on the number of correct answers the respondent gave to the six questions asked to measure the respondent's numeracy and financial literacy.

[g] As explained in Section 2, these variables are calculated using the probabilistic beliefs reported by the respondent.