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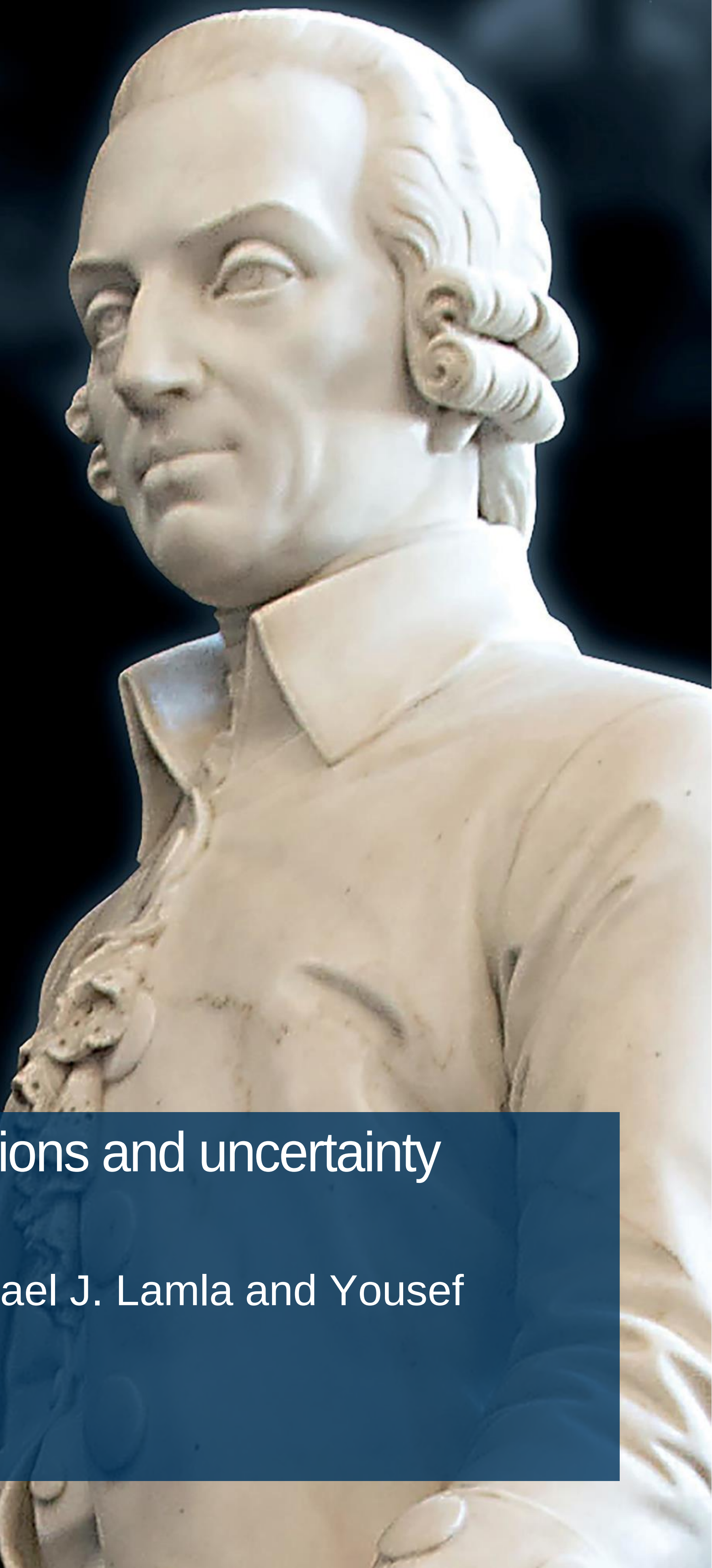

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Abstract

Pessimism is commonly associated with higher inflation expectations; however, raw survey data show the opposite. Theoretically, the true relationship may be obscured by a bias in survey responses: risk-averse respondents adjust low expectations upward (high expectations downward) to minimize the expected disutility from reporting errors; pessimism amplifies this effect. While the error-minimization objective is typically associated with professional forecasters, consumers are conventionally assumed to report expectations that inform everyday consumption decisions, and to have no incentives to misreport beliefs. Yet, in our surveys, risk aversion and pessimism reduce reported expectations on average, with opposite effects for low and high beliefs, unexplainable by personal finance, expertise, or macroeconomic conditions. These findings contradict the consumption-choice view but align well with the forecasting view. With the bias offset, pessimism raises expectations, and risk attitudes play no role.

Keywords: surveys, inflation expectations, risk aversion, ambiguity aversion, pessimism, bias.

JEL classification: E52; E58; D89.

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1 Introduction

Microeconomic axiomatizations of decisions in uncertainty imply that expectations with respect to *utility* are governed by attitudes toward risk and ambiguity. Ambiguity aversion (pessimism[1]) of consumers and firms receives growing attention in macroeconomic and monetary policy analysis[2]; however, no existing theoretical model of inflation expectations explicitly accounts for attitudes toward uncertainty.[3] Empirical studies of expected inflation typically associate pessimism with higher expectations (Pfajfar and Santoro, 2013; Ehrmann et al., 2017; Coibion et al., 2020; Baqaee, 2020; Bianchi et al., 2022); some assume that risk aversion may also play a role here (Goldfayn-Frank and Wohlfart, 2020; Armantier et al., 2022).[4] No clear evidence on either of the relationships exists thus far. Figure 1 plots the percentage of ambiguity-averse respondents in the consumer surveys of Lamla and Vinogradov (2019) for each reported value of expected inflation, suggesting a puzzling non-linearity in the relationship. We theoretically explain the inverse U-shaped relationship by a bias in survey-based expectations: instead of reporting true beliefs consistent with everyday consumption choices, respondents focus on providing a best-guess estimate, despite having no explicit incentives to do so, and therefore adjust beliefs to minimize the disutility from forecasting errors. For this reason, *reported* expectations depend on ambiguity and risk aversion, with opposite signs for low and high beliefs, as in Figure 1. While the relationship between uncertainty attitudes and *true* beliefs is therefore not directly observable in the raw data, we offer empirical evidence that ambiguity aversion indeed pushes true expectations upward while risk aversion plays no role.

A typical survey question on inflation expectations asks by how much prices in general would change over a certain period or how likely price changes of given magnitudes are. Many surveys explicitly ask for a "best-guess" point estimate (e.g., De Bruin et al., 2012; Bruine de Bruin et al., 2010; Stanisławska and Paloviita, 2021; Cavallo et al., 2017; Coibion et al., 2021; Crump et al., 2022). If respondents aim to provide the most precise forecast, those who are risk-averse hedge against large errors and misreport their true beliefs, avoiding extreme forecasts, which thus results in a bias in reported expectations relative to true

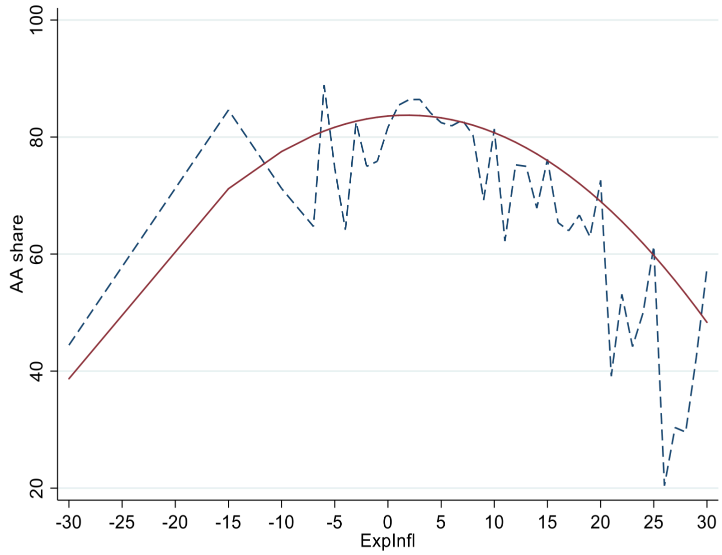
[1]Throughout the paper, we use the words "ambiguity aversion" and "pessimism" interchangeably.

[2]Recent developments include Michelacci and Paciello (2020); Baqaee (2020); Masolo and Monti (2021).

[3]Models of decision-making under uncertainty describe preferences with respect to uncertain consumption. Under a set of assumptions (axioms), these preferences can be described by an expectation functional, such as expected utility and its generalizations. Inflation or interest rates usually enter the decision problem as parameters of the budget constraint. Uncertainty about them implies uncertainty about future outcomes However, the expectation functional still describes future utility, not inflation or interest rates. To derive from here an expectation representation for inflation or interest rates, additional conditions must be imposed.

[4]In Goldfayn-Frank and Wohlfart (2020) and Armantier et al. (2022) being tolerant or intolerant of *financial* risks does not affect expectations, but whether and under what conditions risk aversion in a broader sense would affect them, remains unclear.

Figure 1: Percentage of ambiguity-averse respondents per reported value of expected inflation.



Note: Values of expected inflation are on the x-axis, the share of respondents classified as ambiguity-averse is on the y-axis. Data from the inflation expectations survey introduced by Lamla and Vinogradov (2019) is extended here to 15 000 observations in December 2015 - June 2019, quarterly, non-repeated representative samples of U.S. general public. The dashed line represents survey data (only data points with 10 observations or above), and the solid line - fitted values from a polinomial estimation of $y(x)$.

underlying beliefs.[5] Researchers have so far applied this argument to professional forecasters only, showing that incentives can be designed to avoid this bias (Winkler and Murphy, 1970; Allen, 1987; Blanco et al., 2010). On the one hand, these designs are hardly implementable in large-scale expectation surveys. On the other hand, whether the consumers surveyed indeed aim to minimize the forecasting error is unclear: after all, there are no explicit incentives for them to do so. The prevailing interpretation of survey responses is that respondents report expected inflation the way they perceive it in everyday consumption decisions (e.g. Bachmann et al., 2015; Vellekoop and Wiederholt, 2019; D'Acunto et al., 2023).[6] We formalize the link between reported beliefs and consumption decisions and explicitly model expectations within a consumption-choice framework. As an alternative, we model reported expectations as optimal forecasts ("best guesses") in the prediction task. These two views deliver contrasting implications, which we then confront with survey data.

[5] Adam et al. (2021) discuss a different rationale to misreport expectations: risk-averse respondents may adjust reported beliefs towards risk-neutral estimates; their empirical estimates strongly reject this view.

[6] Further research shows that survey-reported inflation expectations of firms affect their business decisions (Coibion et al., 2018) and that macroeconomic expectations (e.g., rates of return, gross domestic product growth) are reflected in investors' choices (Giglio et al., 2021). Armantier et al. (2015) show in an experiment that reported beliefs are consistent with investment decisions.

On the theoretical front, we employ the neo-additive Choquet expected utility (Chateauneuf et al., 2007), to encompass both risk and ambiguity aversion.[7] Our objective here is to construct two models of reported expectations within one decision-making framework, to highlight, in a tractable and comparable way, how the type of the task (best forecast vs. true reporting) affects values (of expected inflation) reported by in a consumer survey. This comparison formalizes key theoretical discrepancies between the two views. First, risk attitudes matter in the prediction task but are irrelevant for expectations in the consumption-choice view. Second, the ambiguity aversion effect in the best-guess view is explicitly conditional on the level of reported expectations, explaining the inverse U-shape in Figure 1. This effect is driven by the avoidance of large errors, and thus risk-averse respondents with high expectations understate them, while those with low expectations report values above their true beliefs. Ambiguity aversion (pessimism) amplifies both effects by overemphasizing the likelihood of large errors. By contrast, the consumption choice view implies that financial constraints and income of households determine preference for high or low inflation, with cohorts of different financial standings possibly differing in terms of the effect of ambiguity aversion on expectations. Third, the bias that arises from best-guessing (prediction task) does not depend on the nature of the forecast variable and, as such, equally applies to assessments of both the future (e.g. expected inflation) and the past (e.g. perceived current inflation), as well as to variables of different nature (e.g. inflation vs. interest rates). By contrast, if assessments of these variables are reported in line with the consumption-choice view, effects of uncertainty attitudes depend on the role of these variables in the intertemporal choice: for example, if current prices and interest rates are given, they are to a large extent independent of respondents' uncertainty attitudes, while assessments of the future heavily depend on respondents' pessimism or optimism.

Our empirical analysis relies on data from the survey of the US public first introduced in Lamla and Vinogradov (2019), extended herein to cover the low inflation period from December 2015 to June 2019 and the recent period of elevated inflation in March - September 2022, with approximately 15,000 complete responses in the former period and an additional 3,000 responses in the latter. To measure uncertainty attitudes independent of the economic context, we embedded abstract lottery choice questions in the survey. The willingness-to-accept (WTA) measure for a lottery with a 50% chance of winning is used to measure risk attitudes. In 2015-2019 surveys, the two-color Ellsberg (1961) task identifies ambiguity attitudes. In the 2022 surveys, instead, we ask respondents about their WTA for a lottery with

[7] The model is rich enough to encompass risk and ambiguity attitudes, while separating attitude to ambiguity from the degree of perceived ambiguity and offering a linear transformation of expected utility, which is convenient for our analysis. In Appendix A, we outline implications of the smooth model of decisions in ambiguity (Klibanoff et al., 2005) and discuss applicability of minmax (Gilboa and Schmeidler, 1989) and α-MEU (Ghirardato et al., 2004) approaches.

the same payoffs as the above 50-50 gamble, but with an unknown probability of winning.[8] The difference in WTAs between lotteries with known and unknown probabilities provides a continuous measure of ambiguity aversion, which we convert into binary characterizations to match the data from the Ellsberg tasks for comparison; we also use the continuous measure for robustness. To assess the current financial standing of households, we use data on respondents' household income and ask them how they would spend an extra $1000 - with options of depositing, investing in stocks, spending on durable consumption, or mortgage.

Unconditionally, ambiguity-averse respondents report approximately 2 percentage points *lower* inflation rates than the rest of the sample, against the conventionally assumed positive association between pessimism and inflation expectations. In addition, we detect a strong upward push of risk tolerance, which makes findings incompatible with the view that respondents report consumption-choice-consistent expectations. The difference in the ambiguity aversion effects between cohorts with low and high expectations cannot be explained by the financial position of households and is robust to the variations in the definition of cohorts with low and high expectation, to removal of suspected outliers, to using data from low or high inflation periods. To reduce the bias, we focus on expected changes in inflation and interest rates: if the reporting biases in expected and perceived variables are of the same magnitude, the difference between expectations and perceptions is nearly unbiased. The results for these constructed variables strongly support the idea that pessimists expect higher growth of inflation and interest rates while risk attitudes are irrelevant for beliefs, in line with the consumption choice view.

All empirical findings are novel, as previous studies on macroeconomic expectations do not focus on uncertainty attitudes. The potential bias in responses due to risk aversion has been theoretically predicted for professional forecasters since at least Winkler and Murphy (1970), while Offerman et al. (2009) extended this result to ambiguity; both studies focus on proper scoring rules for the elicitation of probabilities of events in surveys of professional forecasters. Instead, we focus on the elicitation of point estimates in consumer surveys. Conceptually, we differ by allowing consumers (who face no explicit incentives to make the best forecast) to be *behaviorally* inclined to provide the best guess, when faced with the survey question.[9] Theoretically, we model this behavioral inclination as a disutility from prediction errors. Strikingly, this modification of respondents' objective suffices to explain patterns in the data that are otherwise incompatible with the dominant consumption choice view. Further on the theoretical side, our particular interest is in the interactions of uncertainty attitudes with

[8] Eichberger et al. (2015), Butler et al. (2014), and Vinogradov and Makhlouf (2021) all use the former approach.. The latter approach is based on Dimmock et al. (2016).

[9] It is not unnatural to be willing to minimize the prediction error even when one lacks incentives to do so. Neuroscience and social cognition literature theorize the human brain as a prediction error minimizer (PEM, see, e.g. Hohwy, 2013, 2016; De Bruin and Michael, 2017).

macroeconomic conditions and individual financial standing of households, which have not been investigated so far.[10] Empirically, we quantify the bias as an approximately 2 percentage points downward shift in the sample average, with different qualifications for lower and upper quantiles.

Detection of the prediction bias in the consumer survey data leads us to conclude that unincentivized responses underestimate consumer beliefs about inflation. Respondents are aware of this: two-thirds report that they anticipate inflation to be above their reported value, while one in seven believe it will be lower than the reported expectation.[11] On the one hand, more sophisticated belief elicitation mechanisms may be required to avoid uncertainty aversion biases in survey responses. This is a necessary step to be able to further test the positive relationship between pessimism and inflation expectations in the unbiased data. In our data, such a relationship is evidenced by the effects of ambiguity aversion on expected changes in macroeconomic variables, but differencing is not a perfect remedy. Accounting for self-assessed biases in reported expectations also uncovers a positive relationship between ambiguity aversion and expected inflation. On the other hand, the bias itself may be informative about the degree of perceived economic uncertainty, which is a useful direction for further research.

2 Reported expectations

This section formalizes two views on survey-based expectations: in section 2.1, survey reports are best guesses, and in section 2.2 they are assessments stemming from everyday consumption decisions. Both models characterize the reported expected inflation at an individual level, with a focus on the effects of risk and ambiguity attitudes on reported beliefs.

To set the notation, consider a typical survey question "By about what percent do you expect prices to go up/down on the average, during the next 12 months?" with S answer options π_s, $s = 1..S$. Respondents then report some $\pi^e \in \{\pi_s\}_{s=1..S}$. We define s as an event corresponding to the realization of π_s, and $S = \{1, 2, ..S\}$ - the set of all conceivable inflation

[10] In regard to the impact of macroeconomic conditions on expectations, Andre et al. (2022) empirically demonstrate the heterogeneity of macroeconomic models that households and professional forecasters implicitly use when making predictions. They explain this heterogeneity by contextual cues and prior experiences. We further formalize the role of models in expectation formation and show how uncertainty attitudes may affect the way these implicit macroeconomic models shape expectations.

[11] An argument can be made that for the expectation-elicitation question, respondents report the mean value, while the question "Do you think the actual rate in the future will be higher or lower than your prediction?" induces a median or modal framing, thus the difference . To rule this out, we also test the relationship between answers to the latter question and the risk and ambiguity attitudes of respondents. The results, reported in Section 4.5, reject this explanation, and therefore we interpret relevant responses as a self-assessed bias.

events.[12] For convenience, events are ordered so that values of inflation increase in s with step 1, $\pi_{s+1} = \pi_s + 1$, a realistic feature of inflation surveys.

2.1 Best-guess report

Assume that the respondent's utility u from reporting π^e decreases in the squared error $(\pi_s - \pi^e)^2$, realized when actual inflation takes a value of π_s. Let the state-contingent utility be $u_s(\pi_s, \pi^e) = u\left((\pi_s - \pi^e)^2\right)$, with $u' < 0$. Risk-neutrality holds if $u' = const$; risk-aversion holds if $u'' > 0$; that is the Arrow-Pratt measure of risk aversion is positive: $-u''/u' > 0$.

Respondents maximize Choquet expected utility with NEO-additive capacities (NEO-additive CEU, Chateauneuf et al., 2007)[13]: they overestimate the likelihood of extreme (the best and the worst) outcomes and solve

$$\max_{\pi^e} (1-\delta) \sum_{s\in S} p_s \cdot u\left((\pi_s - \pi^e)^2\right) + \delta \cdot (\alpha \cdot u_{max} + (1-\alpha) \cdot u_{min}), \tag{1}$$

where $p = \{p_s\}_{s=1..S}$ is the probability distribution over π_s, δ stands for the degree of ambiguity, and α is the degree of the respondent's optimism: an optimistic view overvalues the likelihood of achieving the highest feasible utility u_{max}, while a pessimistic view overvalues the likelihood of obtaining the lowest feasible utility u_{min}. Note that the highest utility $u_{max} = u(0)$ is realized in state s, where $\pi_s = \pi^e$, while the lowest utility u_{min} is achieved either in state $s = 1$ or in $s = S$, depending on the distance $|\pi_s - \pi^e|$.

For compactness, we can re-write (1) as

$$\max_{\pi^e} \sum_{s\in S} w(p_s, \pi^e) \cdot u\left((\pi_s - \pi^e)^2\right), \tag{2}$$

where $w(p_s, \pi^e)$ is the probability weighting function[14]

$$w(p_s, \pi^e) = \begin{cases} (1-\delta)\cdot p_s + \delta \cdot \alpha & \text{if } \; s : \pi_s = \pi^e \\ (1-\delta)\cdot p_s + \delta\cdot(1-\alpha) & \text{if } \; s = 1 \text{ and } \pi^e \geq \frac{\pi_1 + \pi_S}{2}, \text{ or } s = S \text{ and } \pi^e < \frac{\pi_1+\pi_S}{2} \\ (1-\delta)\cdot p_s & \text{otherwise.} \end{cases} \tag{3}$$

We can now characterize the solution to (1).

[12] Event s is a set of all states of nature in which inflation takes a value π_s. If states differ only in the rate of inflation, each event contains one and only one state, and thus the two terms are interchangeable.

[13] Appendix A discusses applications of other models of decisions in ambiguity.

[14] As the value $\pi^e = (\pi_1 + \pi_S)/2$ is equidistant from π_1 and π_S, we break the tie by assuming $w(p_s, \pi^e)$ assigns higher weight to state $s = 1$. This assumption allows us to remove additional uncertainty with respect to probability weighting, and, thus, to focus only on uncertainty about the inflation rate. The original formulation (1) is free from this tiebreaking issue as its focus is on utility values. Instead, our focus is on distortions to the probability distribution.

Proposition 1 *A respondent with a NEO-additive CEU and state-contingent utility* $u\left((\pi_s - \pi^e)^2\right)$ *reports expected inflation* π^e *that meets*

$$\pi^e = \sum_{s \in S} w\left(p_s, \pi^e\right) \cdot \rho_s\left(\pi^e\right) \cdot \pi_s, \tag{4}$$

where $w\left(p_s, \pi^e\right)$ *is given by (3) and reflects attitude toward ambiguity and* $\rho_s\left(\pi^e\right) = \frac{u'\left((\pi_s - \pi^e)^2\right)}{\sum_{s' \in S} w(p_{s'}, \pi^e) \cdot u'\left((\pi_{s'} - \pi^e)^2\right)} > 0$ *reflects the risk attitude.*

Note that for a risk-neutral respondent holds $\rho_s\left(\pi^e\right) \equiv 1$; for any two states s and t such that $\pi_s < \pi_t \leq \pi^e$ or $\pi_s > \pi_t \geq \pi^e$, risk-aversion implies $\rho_s\left(\pi^e\right) < \rho_t\left(\pi^e\right)$, while risk-seeking implies $\rho_s\left(\pi^e\right) > \rho_t\left(\pi^e\right)$. If there is no ambiguity ($\delta = 0$), ambiguity attitude does not matter, $w\left(p_s, \pi^e\right) = p_s$, and a risk-neutral respondent reports

$$\pi^e = \sum_{s \in S} p_s \cdot \pi_s, \tag{5}$$

which is the benchmark bias-free case.

The recursive characterization of π^e in Proposition 1 is instructive for empirical applications: when a value of π^e is observed from a survey, equation (4) judges the extent of the biases due to ambiguity and risk aversion contained in this reported value, for an individual with known risk and ambiguity attitudes. For example, if the observed value is low, $\pi^e < \frac{\pi_1 + \pi_S}{2}$, and the respondent is a risk-neutral ($\rho_s\left(\pi^e\right) = 1$) pessimist ($\alpha = 0$), the proposition implies that the underlying true distribution $\{p_s\}_{s=1..S}$ has been distorted by overemphasizing the likelihood of extremely high inflation π_S, and thus the reported value π^e is higher than that which would have been implied by p. This upward bias arises from the error minimization; as we show in Section 2.2, it differs from the traditional effect of pessimism in consumer behavior. Similarly, if such a low value of π^e has been reported by a risk-averse respondent, Proposition 1 implies that higher values of inflation have been overweighted, and thus again, the reported value is biased upward. [15] Ambiguity aversion and risk aversion thus work in the same direction, with one amplifying the other, as in Offerman et al. (2009). Characterizing the risk aversion bias through $\rho_s\left(\pi^e\right)$ requires, at a minimum, knowing whether the individual is averse or neutral to risk. Characterizing ambiguity aversion bias requires knowing the perceived degree of ambiguity δ and attitude toward ambiguity α, both of which enter the probability weighting $w\left(p_s, \pi^e\right)$.

[15] Let the reported value be $\pi^e = \pi_{s^e}$. By symmetry of $(\pi_s - \pi^e)^2$, inflation values $\pi_1..\pi_{s^e-1}$ below π^e and an equal number of other values $\pi_{s^e+1}..\pi_{2s^e-1}$ above π^e receive weights $\rho_{s^e-k}\left(\pi^e\right) = \rho_{s^e+k}\left(\pi^e\right)$, $k = 1..(s^e - 1)$; therefore, for all values $\pi_1..\pi_{2s^e-1}$, the upward and downward biases perfectly offset each other because $\pi_{s+1} = \pi_s + 1$. By assumption $\pi^e = \pi_{s^e} < \frac{\pi_1 + \pi_S}{2}$, the set of admissible values $\{\pi_{2s^e+1}, .., \pi_S\}$ is not empty. By proposition 1, $\rho_{2s^e-1}\left(\pi^e\right) < \rho_{2s^e}\left(\pi^e\right) < \rho_{2s^e+1}\left(\pi^e\right) < .. < \rho_S\left(\pi^e\right)$; that is, higher weights have been applied to values of inflation $\pi_{2s^e}..\pi_S$, all of which are above π^e, thus the upward bias.

Finally, $w(p_s, \pi^e)$ is based on probability distribution p. To explicitly separate the effects of uncertainty attitudes from those dictated by the probability distribution, and to derive a non-recursive implication of (4), we now allow respondents to use model $\mathbf{P}(\mathbf{M})$ to derive probability distribution p: $\mathbf{P}(\mathbf{M}) = \{p_s(M_1, ..M_N)\}_{s=1..S}$, where $\mathbf{P}(\mathbf{M})$ is an S-dimensional vector-valued function and $\mathbf{M}$ is an N-dimensional vector of macroeconomic and individual parameters.[16] The following proposition is an implication of representation (4) for the case of linear forecasting model $\mathbf{P}(\mathbf{M})$. Denote ρ_{min} and ρ_{max} the lowest and highest values of the weighting coefficients, respectively, which correspond to the best outcome (inflation rate $\pi_{best} = \pi^e$) and to the worst outcome ($\pi_{worst} = \pi_1$ or π_S).[17]

Proposition 2 *If $p_s(\mathbf{M}) = a_s + \mathbf{b}_s\mathbf{M}, \forall s \in S$, then reported expected inflation can be represented as*

$$\pi^e = (1-\delta)\sum_{s\in S} a_s \cdot \rho_s(\pi^e) + (1-\delta)\sum_{n=1}^{N}\left(\sum_{s\in S} b_s^n \cdot \rho_s(\pi^e)\right)\cdot M_n + \\ +\delta\cdot\alpha\left(\pi_{best}\cdot\rho_{min} - \pi_{worst}\cdot\rho_{max}\right) + \delta\cdot\pi_{worst}\cdot\rho_{max} \tag{6}$$

Corollary 1 *Expected inflation reported by ambiguity-neutral ($\alpha = \frac{1}{2}$) respondents meets*

$$\pi^e = (1-\delta)\sum_{s\in S} a_s\rho_s(\pi^e) + (1-\delta)\sum_{n=1}^{N}\sum_{s\in S} b_s^n\rho_s(\pi^e)M_n + \delta\cdot\frac{\pi_{best}\rho_{min} + \pi_{worst}\rho_{max}}{2}. \tag{7}$$

Corollary 2 *Expected inflation reported by risk-neutral ($\rho_s \equiv 1, \forall s$) respondents meets*

$$\pi^e = (1-\delta)\sum_{s\in S} a_s + (1-\delta)\sum_{n=1}^{N}\sum_{s\in S} b_s^n \cdot M_n + \delta\cdot\alpha\left(\pi_{best} - \pi_{worst}\right) + \delta\cdot\pi_{worst}. \tag{8}$$

Proposition 2 establishes that risk aversion affects each term in equation (6) and, in particular, the effect of ambiguity attitude α and the effects of macroeconomic factors M_n. For a respondent who reports low expected inflation, the worst-case scenario is $\pi_{worst} = \pi_S > \pi_{best} = \pi^e$, thus $\pi_{best}\cdot\rho_{min} - \pi_{worst}\cdot\rho_{max} < 0$ due to $\rho_{min} < \rho_{max}$, and higher pessimism (lower α) implies an upward bias in the reported value. For those who report high inflation values, $\pi_{worst} = \pi_0$. As long as deflation or zero inflation cannot be ruled out, $\pi_0 \leq 0$; thus

[16] In this section we consider an individual decision-maker. For regression specifications in Section 2.3 we will distinguish between macroeconomic factors, common for all respondents, and individual demographic factors.

[17] The proof of Proposition 1 in Appendix B specifies that ρ_s is proportional to $-u'\left((\pi_s - \pi^e)^2\right) > 0$. Concavity of the utility function ($u'' > 0$) implies that the lowest absolute value of $u'\left((\pi_s - \pi^e)^2\right)$, and therefore of $\rho_s(\pi^e)$, is obtained at a minimum error, and the highest value at the highest possible error.

$\pi_{best} \cdot \rho_{min} - \pi_{worst} \cdot \rho_{max} > 0$, which implies a downward bias in reported beliefs due to pessimism (low α).

Assuming ambiguity neutrality in Corollary 1 indicates that even without ambiguity effects, risk aversion may lead to different implications for expectations of cohorts reporting low and high inflation: as π_{worst} and π_{best} differ for them (their definition does not require ambiguity aversion or seeking), and $\rho_{min} < \rho_{max}$, the non-recursive last term in (7) also differs across these cohorts, affecting the level of reported expectations.

In Corollary 2, characterization (8) for risk-neutral respondents is non-recursive and explicitly emphasizes opposite effects of pessimism on beliefs of respondents who report low and high values: for the former, $\pi_{worst} - \pi_{best} = \pi_S - \pi^e \geq 0$, and for the latter, $\pi_{worst} - \pi_{best} = \pi_1 - \pi^e \leq 0$.

2.2 Consumption-choice-consistent report

In a general case, expected inflation does not enter the consumption choice problem explicitly. In some special cases, the optimal consumption choice may be shown to explicitly depend on expected inflation through the Euler equation (e.g., Dräger and Nghiem, 2021). The following concept of consistency directly connects expected inflation with consumption decisions:

Definition 1 *If the consumption choice problem can be represented as* $\max \sum_{s=1}^{S} \hat{p}_s \cdot v_s(\mathbf{c})$*, where* $v_s(\mathbf{c})$ *is the utility of consumption bundle* $\mathbf{c}$ *in state* s *and* $\hat{p}_s$ *are weights assigned to states of the world* $s = 1..S$*, then reported expected inflation* π^e *is **consistent** with the consumption choice if* $\pi^e = \sum_{s=1}^{S} \hat{p}_s \cdot \pi_s$*.*

Definition 1 requires that expectations about inflation use the same set of states of the world, expectation formation operator and weights assigned to states of the world, as those used in consumption decisions. If weights $\hat{p}_s$ are probabilities of the states of the word s, the expectation formation operator is the traditional expected value $\sum_{s=1}^{S} \hat{p}_s \cdot \pi_s = \mathbb{E}^{\hat{p}}$, as in Dräger and Nghiem (2021) and Adam et al. (2021). Our formulation allows for generalizations to non-expected utility cases, requiring only that the consumption choice objective function is additive in decision weights $\sum_{s=1}^{S} \hat{p}_s \cdot v_s(\mathbf{c})$. NEO-additive CEU (2) and prospect theory are examples of non-expected utility functionals that meet this condition.

Consider a consumer endowed with nominal wages W_1 and W_2 in periods 1 and 2 who chooses savings/borrowing B in period 1 to maximize utility of consumption C_1 and C_2 in the same respective periods. The consumer may invest in debt instruments B, which pay interest i, not inflation-indexed, and real assets R that perfectly hedge against inflation. Both investments are in nominal terms, as is income W_T in periods $T = 1, 2$. The consumer faces the following budget constraints for period 1 (consumption price normalized to unity) and S state-contingent budget constraints for period 2:

$$C_1 = W_1 - B - R, \tag{9}$$

$$(1+\pi_s) \cdot C_2^s = W_2 + (1+i) \cdot B + (1+\pi_s) \cdot R, \text{ for all } s = 1, .., S. \tag{10}$$

The consumer maximizes the NEO-additive CEU

$$\max_{B,R} \sum_{s=1}^{S} w(p_s, B, R) \cdot v\left(W_1 - B - R, R + \frac{W_2 + (1+i) \cdot B}{1+\pi_s}\right), \tag{11}$$

where $w(p_s, B, R)$ is

$$w(p_s, B, R) = \begin{cases} (1-\delta) \cdot p_s + \delta \cdot \alpha & \text{if } \; v\left(C_1, C_2^s\right) = v_{max}\left(B, R\right) \\ (1-\delta) \cdot p_s + \delta \cdot (1-\alpha) & \text{if } \; v\left(C_1, C_2^s\right) = v_{min}\left(B, R\right) \\ (1-\delta) \cdot p_s & \text{otherwise,} \end{cases} \tag{12}$$

with v_{min} and v_{max} being the worst and the best feasible utilities, respectively,

$$v_{min}\left(B, R\right) := \min_{\pi_s} v\left(W_1 - B - R, R + \frac{W_2 + (1+i) \cdot B}{1+\pi_s}\right),$$
$$v_{max}\left(B, R\right) := \max_{\pi_s} v\left(W_1 - B - R, R + \frac{W_2 + (1+i) \cdot B}{1+\pi_s}\right).$$

Three observations stand out. First, the weighting function $w(p_s, B, R)$ is different from that in Proposition 4. Second, utilities from consumption differ across individuals with different income streams (W_1, W_2) and financial constraints reflected in their position in B and R. Third, expected inflation does not appear explicitly in the decision problem (11). However, Definition 1 implies the following result:

Proposition 3 *Reported expected inflation π^e consistent with consumption choice (11) meets*

$$\pi^e(p) = \sum_{s=1}^{S} w(p_s, B, R) \cdot \pi_s. \tag{13}$$

Comparison of (13) and (4) shows that truly reported beliefs consistent with the consumption choice are governed by ambiguity attitudes, which shape the distribution $w(p_s, B, R)$, but unaffected by risk attitudes, which were present in (4) through weights ρ_s.[18] Although the utility index appears in the definition of $w(p_s, B, R)$ in (12), the latter is affected by the

[18]NEO-additivity may be viewed as a restrictive assumption. In a more general second-order expected utility (SOEU) framework, the irrelevance result for risk attitudes obtains under ambiguity neutrality (Appendix A.1). Ambiguity-neutrality is thus a crucial model-free benchmark for empirical estimates.

minimum and maximum attainable values of utility but not by the curvature of the utility function, which defines the risk attitude.

The effect of the ambiguity attitude, given here by the degree of optimism α, is again determined by the difference between the best and the worst outcome, $\pi_{best} - \pi_{worst}$. The latter is positive (i.e. high inflation is preferred to low inflation) only if consumption in period 2 increases in inflation, i.e. if $W_2 + (1+i) \cdot B < 0$. A strictly positive investment in real assets $R > 0$ hedges against inflation and ensures $C_2^s > 0$ as long as $W_2 + (1+i) \cdot B > -R$. These considerations lead to the following observation:

Proposition 4 *If* $R > -W_2 - (1+i) \cdot B > 0$, *then* $\pi_{best} > \pi_{worst}$. *Otherwise* $\pi_{best} \leq \pi_{worst}$.

Again, we allow decision-makers to use model $\mathbf{P}(\mathbf{M})$ to derive probability distribution p. Equation (13) then implies:

Proposition 5 *If* $p_s(\mathbf{M}) = a_s + \mathbf{b}_s\mathbf{M}, \forall s \in S$, *then expected inflation consistent with (11) is*

$$\begin{aligned}\pi^e =&(1-\delta)\sum_{s\in S} a_s + (1-\delta)\sum_{n=1}^{N}\left(\sum_{s\in S} b_s^n\right) \cdot M_n + \\ &+\delta \cdot \alpha\left(\pi_{best}(W_1, W_2, B, R) - \pi_{worst}(W_1, W_2, B, R)\right) + \delta \cdot \pi_{worst}(W_1, W_2, B, R).\end{aligned} \tag{14}$$

Proposition 5 stipulates that if respondents report expectations consistent with their everyday consumption choices, π^e does not depend on risk attitudes. In particular, and in contrast with Proposition 2, risk aversion does not moderate the effect of macroeconomic factors M_n. As risk aversion plays no role, representation (14) is similar to the risk-neutral representation (8) in the error-minimizing "best-guess" approach, except for the terms $\pi_{best}(W_1, W_2, B, R)$ and $\pi_{worst}(W_1, W_2, B, R)$, which now depend on the financial standing of the respondent instead of the level of reported beliefs.

2.3 Empirical implications

Table 1 summarizes the main implications of the two views on reported expectations are summarized in . The clear distinction between predictions of the best-guess and consumption-choice models with respect to effects of uncertainty attitudes serves a basis for the empirical discrimination between the two views. For the cross-sectional regression analysis, to reflect the respondent-level heterogeneity, we augment the probability model $p_s(\mathbf{M})$ with individual demographic factors $\mathbf{D}_i$, in addition to systemic macroeconomic factors $\mathbf{M}$: $p_s(\mathbf{M}) = a_s + \mathbf{b}_s\mathbf{M} + \mathbf{d}_s\mathbf{D}_i$. This was previously not necessary as we focused on an individual decision-maker.

Table 1: Empirical implications of the best-guess and consumption-choice views on reported beliefs.

	Best guess	Consumption choice
1. Risk aversion affects reported π^e	Yes	No
2. Effects of risk aversion differ for high and low π^e	Yes	No
3. Effects of risk aversion and ambiguity aversion interact	Yes	No
4. Effects of ambiguity aversion differ for high and low π^e	Yes	Only if reported π^e positively correlates with income and borrowings
5. Effect of ambiguity aversion depends on financial constraints	Only if effect of financial constraints on p overrides error-minimization effects	Yes
6. Risk aversion moderates effects of macroeconomic factors on π^e	Yes	No

Now consider equation (8), which holds for risk-neutral respondents, and equation (14), which holds for consumption-choice-consistent reports independent of risk attitudes. Both imply the following (baseline) linear regression equation:

$$\pi_i^e = a + b^{AA} AA_i + \sum_{n=1}^{N} b_n^M M_n + \sum_{n=1}^{D} b_n^D D_{n,i} + \epsilon_i, \tag{15}$$

where π_i^e is the reported expectation of respondent i; $a = \sum_{s \in S} a_s + \delta \cdot \pi_{worst}$ is the constant term; $b^{AA} = \delta\left(\pi_{best} - \pi_{worst}\right)$ is the sensitivity of expectations to ambiguity attitudes; AA_i represents ambiguity aversion, a counterpart of $1 - \alpha_i$ in the NEO-additive CEU; and $b_n^M = \sum_{s \in S} b_s^n$ are coefficients for macroeconomic factors M_n. As our surveys are quarterly, we capture quarterly macroeconomic conditions by survey fixed effects, except when our focus is on macroeconomic conditions specifically. Demographic controls are included as $D_{n,i}$. For a clean identification, we estimate regression (15) separately on a risk-neutral subsample, in line with (8). If the estimates on the risk-averse subsample are different from those on the risk-neutral subsample, we cannot reject the reporting bias due to risk aversion. The same applies to risk seeking versus risk neutrality.

Alternatively, we capture both types of uncertainty attitudes without splitting the sample by augmenting (15) with risk attitude controls in a linear fashion, similarly to Armantier et al. (2022) and Goldfayn-Frank and Wohlfart (2020):

$$\pi_i^e = a + b^{AA} AA_i + b^{RA} RA_i + b^{RS} RS_i + \sum_{n=1}^{N} b_n^M M_n + \sum_{n=1}^{D} b_n^D D_{n,i} + \epsilon_i, \tag{16}$$

where RA_i is the risk-aversion dummy and RS_i is the risk-seeking dummy. In estimates with a continuous measure of risk aversion, we drop the terms with RS_i. To control for potential joint effects of risk and ambiguity attitudes, we also estimate the same with interaction terms:

$$\begin{aligned} \pi_i^e = a &+ b^{AA} AA_i + b^{RA} RA_i + b^{AA\times RA} AA_i \times RA_i + b^{RS} RS_i + b^{AA\times RS} AA_i \times RS_i \\ &+ \sum_{n=1}^{N} b_n^M M_n + \sum_{n=1}^{D} b_n^D D_{n,i} + \epsilon_i, \end{aligned} \tag{17}$$

To control for the effects of the economic/financial standing of households and their understanding of financial and economic conditions, we estimate the following specification:

$$\begin{aligned} \pi_i^e = a + b^{AA} AA_i + b^{RA} RA_i + b^{RS} RS_i + \sum_{n=1}^{X} \left[b^{X_n} X_{n,i} + b^{AA\times X_n} AA_i \times X_{n,i} \right] + \\ + \sum_{n=1}^{N} b_n^M M_n + \sum_{n=1}^{D} b_n^D D_{n,i} + \epsilon_i, \end{aligned} \tag{18}$$

where $X_{n,i}$ is one of the relevant respondent-specific variables, such as financial constraints or the level of financial literacy of respondent i.

Finally, to ensure that our results do not hinge on the NEO-additive specification, we estimate the following on a subsample of ambiguity-neutral respondents:

$$\pi_i^e = a + b^{RA} RA_i + \sum_{n=1}^{N} b_n^M M_n + \sum_{n=1}^{D} b_n^D D_{n,i} + \epsilon_i, \tag{19}$$

where RA_i captures the risk attitudes of respondents. Including this term helps distinguish between equation (7), in which the first term explicitly depends on risk attitudes, and equation (14), in which risk attitudes play no role. If reported expectations are consumption-choice-consistent, we should observe $b^{RA} = 0$. Observing $b^{RA} \neq 0$ instead would reject the null of no bias.

3 Survey design and data

We extend the survey first reported in Lamla and Vinogradov (2019) by an extra year in the low inflation pre-pandemic period and by an extra year in the high inflation (post-2021) regime. Here, we make use of the core questions on current and expected inflation ("prices in general") and interest rates (the survey asks about the interest rate on a car loan of $10 000), as well as the previously unused data on respondents' uncertainty attitudes.

The uncertainty attitude questions confront respondents with hypothetical situations of choice between a risky and a safe option (for risk attitudes) and between an option with a 50-50 chance of success and an option with an unknown probability of success (for ambiguity attitudes). The answer to the question "Consider a lottery ticket with a 50% chance of winning $ 100,000 and 50% chance of getting nothing. What is the lowest amount of money you would accept in exchange for this lottery ticket?" is the certainty equivalent (CE) measured as the willingness to accept (WTA). If CE is below (above) the expected value of the lottery, we classify respondents as risk-averse (risk-seeking), which we code as $RA_i = 1$ ($RS_i = 1$) and zero otherwise. If the reported CE equals the lottery mean, we classify the respondent as risk-neutral.

We use the two-color Ellsberg task as a simple test of ambiguity aversion: we deem respondents who prefer the 50/50 urn when the prize is conditioned on one color and the same urn when the prize is conditioned on another color, ambiguity-averse, coded by dummy $AA_i = 1$, zero otherwise.[19] We classify respondents who choose the 50/50 urn when the prize is conditioned on one color and the urn with an unknown distribution when the prize is conditioned on the other color, as ambiguity-neutral ($AN_i = 1$, otherwise zero); respondents who always prefer the ambiguous source are ambiguity-seekers. In our 2022-2023 surveys, instead of the Ellsberg task, we ask respondents about their willingness to accept (CE_A) a lottery with an unknown probability of success: "Consider a similar lottery ticket, except that the chance of winning $100,000 is unknown. What is the lowest amount of money you would accept in exchange for this lottery ticket?" Ambiguity-averse respondents underweight the probability of success[20], and thus their WTA is lower for the lottery with the unknown probability of success. To binarize, we assign $AA_i = 1$ if respondent i reports $CE_{A,i} < CE_i$ and zero otherwise;

[19] This follows Eichberger et al. (2015), Butler et al. (2014) and Vinogradov and Makhlouf (2021).

[20] Chew and Sagi (2006) show the existence of subjective probabilities for ambiguous lotteries. Abdellaoui et al. (2011) develop a source method, in which prospect-theory style weights for subjective probabilities differ across sources of uncertainty. Dimmock et al. (2016) introduce matching probability: if a respondent is indifferent between two binary lotteries with identical payoffs, one with known and one with unknown probabilities, the known probability is the matching probability for the latter ambiguous lottery. According to their Theorem 1, the matching probability captures the difference in decision weights for unknown and known probabilities (i.e. ambiguity attitudes). It follows that the difference in CEs for lotteries with known and unknown probabilities also captures ambiguity attitudes.

for ambiguity-neutrality, $AN_i = 1$ if respondent i reports $CE_{A,i} = CE_i$ (zero otherwise). We also compute a continuous measure of ambiguity aversion, $AmbPremium_i = CE_i - CE_{A,i}$.

Financial standing comes from the question asking how respondents would allocate an extra $1000 if they received it now. Respondents can allocate this amount among stocks, safe assets, deposits, mortgage repayment, or consumption, with a possibility to choose "other," generating respective dummies $Deposit_i$, $Stocks_i$ and so on, that take the value of 1 if the amount allocated respectively is strictly positive and zero otherwise.

We assess financial literacy by asking how many of the four statements (equivalent to QK4 b and QK5 a, b and c in INFE (2011)) are true. All four statements shown in the question are true, thus giving us a measure of financial literacy on a scale from 0 to 4. In the 2022-2023 sample, instead, we ask respondents to self-assess their expertise in economic and business issues. The full questionnaire is available in Appendix C.

We collect data via SurveyMonkey, an online platform to adminster surveys and recruit respondents. SurveyMonkey incentivize respondents by an opportunity to make a donation to a charity of their choice upon completion of the survey. Pre-registered users (only users over 18 years old) are invited to participate in the survey. Sample selection is random, stratified to represent general US population. The provider also supplies data on age, gender, household income, US region and the device type respondents use. These serve as the source of our demographics variables. Data collection is quarterly, in a time window of four days around a Federal Reserve (Fed) monetary policy announcement event. Having data collected within a short window each quarter allows us to control for quarterly economic conditions by including a survey fixed effect in the model.

Table 2 reports the summary statistics. The difference between the levels of beliefs reported in 2015-2019 and 2022 is due to the inflation surge and the Fed rate response in 2022. Shares of risk-averse and risk-neutral respondents in the two samples are close to each other. The difference in the shares of ambiguity-averse and ambiguity-neutral respondents is due to the change in the classification method: when the question explicitly mentions probabilities, some respondents may hypothesize a 50-50 probability for the lottery with an unknown probability of success, whereby the Ellsberg task does not mention probabilities. While the Ellsberg task offers a stricter criterion of ambiguity neutrality, the method with two lottery tickets is more restrictive in the selection of ambiguity-averse respondents. Demographic variables show that the compositions of the two samples are well comparable in terms of age, gender, and income.

Table 2: Summary Statistics

	2015-2019 sample			2022-2023 sample		
	Obs.	Mean	SD	Obs.	Mean	SD
Beliefs						
PastInfl	17803	7.821	8.452	3487	19.767	9.264
ExpInfl	16738	6.984	7.742	3461	13.984	11.148
PastRate	17105	7.757	5.94	3468	8.328	6.651
ExpRate	16529	8.754	6.261	3455	9.051	6.782
Attitudes toward uncertainty						
Certainty equivalent., *CE*	14958	300005	22253	3442	33533	21501
RA	9058	0.605		2005	0.582	
RN	3610	0.241		744	0.216	
Ambiguity premium				3448	11822	19819
AA	11962	0.799		1921	0.557	
AN	1065	0.069		1069	0.310	
Demographics						
Age	14816	2.627	1.057	3417	2.499	1.054
18-29	2,587	0.175		745	0.218	
30-44	4,317	0.291		948	0.277	
45-59	3,947	0.266		997	0.292	
60+	3,965	0.268		727	0.213	
Female	14816	0.543	0.498	3417	0.542	0.498
Top income	17808	0.055	0.229	3133	.084	.277
Expertise						
Finliteracy	15,296	3.068	1.126			
BusEcon				3215	3.328	1.144
Marginal propensity to invest/repay/consume (spending extra $1000)						
Stocks	17808	96.808	247.794			
Deposits	17808	59.167	194.055			
Mortgage	17808	120.933	274.414			
Safe	17808	115.3	255.579			
Durable	17808	151.791	293.218			
Other	17808	314.941	401.254			

Notes: AA and AN are dummies for ambiguity aversion and ambiguity neutrality respectively, identified by the Ellsberg task in 2015-2019 and by the sign of Ambiguity premium in 2022. Ambiguity premium is the difference between WTAs for lotteries with known and unknown probabilities. Certainty equivalent is WTA for a lottery with a 50% probability of success. RA and RN are dummies for risk aversion and risk neutrality respectively, identified by CE above or equal to the mean payoff. Age mean is the average of the indicators 1, 2, 3 and 4 of falling in groups 18-29, 30-44, 45-59 and 60+, respectively. For age groups, the mean is the share of respondents in each group. Finliteracy is the score between 0 and 4 of correct answers to four financial literacy test questions (not tested in 2022). BusEcon is self-reported expertise in business and economics issues on a scale from 1 to 5. Stocks, Deposits, Mortgage, Safe, Durable, and Other are indicated allocations of a hypothetical unexpected income of $1000. Age, Gender, and income are provided by the survey collector. Top income = 1 if the annual household income is above $175K.

4 Results

We begin by testing the predictions from Table 1 for respondents' assessments of current and future inflation. Distinguishing between past (perceived) values and future values is instructive for two reasons. First, if assessments of current inflation are based on observed prices, there is less uncertainty about them and therefore less scope for uncertainty aversion effects. Second, as current and past prices are explicitly observed in everyday consumption, respondents may be more likely to report consumption-choice-consistent values for past inflation. We then proceed with the analysis of assessments of current and future interest rates, with the purpose of capturing effects of a greater perceived ambiguity δ relative to inflation measures: respondents likely face more ambiguity with respect to interest rates than to inflation, because they are more exposed to information about prices and their movements (e.g. through everyday shopping and news), while financial contracts are signed less frequently, and a household would not often come across information about a specific financial contract in the question (in our case it is a car loan). After establishing main results for this set of variables, we test their robustness by considering an ambiguity-neutral benchmark for a cleaner identification of risk-aversion effects and by considering a high inflation period in 2022-2023, to contrast with our benchmark results from the low-inflation 2015-2019 period. We conclude this section by discussing approaches to offset or control for the bias we detect.

4.1 Expectations and perceptions of inflation

Estimates of the baseline equation (15) separately for subsamples of risk-neutral, risk-averse, and risk-seeking respondents are in Table 3: in columns 1-2, ambiguity-averse respondents report on average 2% lower inflation expectations and 2.7% lower current inflation than the rest of the risk-neutral subsample. While the coefficients slightly differ across the subsamples, differences are not statistically significant (except for the effects of ambiguity aversion on expected inflation in risk-neutral and risk-seeking cohorts, which is significant at $p < 0.1$, suggesting some interaction between risk attitudes and ambiguity attitudes.)

Table 4 estimates the effects of uncertainty attitudes on reported beliefs by controlling for risk attitudes in a linear fashion as in equations (16) and (17). First, we find that ambiguity aversion is again associated with lower inflation expectations and assessments of current inflation, on average. Second, columns 1 - 2 highlight the lack of the risk-aversion effect (only significant at $p < .05$ for PastInfl, but almost 10 times smaller in magnitude than the ambiguity aversion effect; this effect becomes statistically insignificant if measured without controlling for ambiguity attitudes, as shown in Appendix A.2, Table A.2.) and a striking

Table 3: Effect of ambiguity aversion on expectations and perceptions of inflation and interest rates in cohorts of risk-neutral, risk-averse, and risk-seeking respondents.

	(1)	(2)	(3)	(4)	(5)	(6)
	Risk-neutral		Risk-averse		Risk-seeking	
	PastInfl	ExpInfl	PastInfl	ExpInfl	PastInfl	ExpInfl
AmbAverse	-2.671***	-1.994***	-2.677***	-2.297***	-3.317***	-3.013***
	(-6.63)	(-5.35)	(-11.31)	(-10.05)	(-6.44)	(-6.08)
Constant	8.296***	6.674***	7.461***	6.717***	13.133***	10.771***
	(7.73)	(7.04)	(10.81)	(11.10)	(7.71)	(6.35)
Survey	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.063	0.043	0.057	0.052	0.062	0.057
N	3546	3546	8837	8837	2238	2238

Notes: Low inflation regime (sample 2015-2019). t-statistics are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Effects of ambiguity and risk attitudes on expectations and perceptions of inflation.

	(1)	(2)	(3)	(4)
	PastInfl	ExpInfl	PastInfl	ExpInfl
AmbAverse	-2.785***	-2.372***	-2.651***	-1.907***
	(-14.60)	(-12.99)	(-6.63)	(-5.13)
RA	-0.332**	-0.134	-0.314	0.213
	(-2.29)	(-1.02)	(-0.71)	(0.51)
RS	1.478***	1.657***	2.028***	2.604***
	(6.51)	(7.82)	(3.38)	(4.55)
AmbAverse × RA			-0.015	-0.41
			(-0.03)	(-0.94)
AmbAverse × RS			-0.708	-1.196*
			(-1.10)	(-1.95)
Constant	8.350***	7.344***	8.238***	6.959***
	(21.42)	(20.44)	(16.47)	(15.05)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
R^2	0.065	0.056	0.065	0.057
N	14621	14621	14621	14621

Low inflation regime (sample 2015-2019). t-statistics are in parentheses. AmbAverse is a dummy equal to 1 if ambiguity-averse, and 0 otherwise. RA is a dummy equal to 1 if risk averse, and 0 otherwise. RS is a dummy equal to 1 if risk seeking, and 0 otherwise. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

positive impact of risk seeking.[21] It follows that risk attitudes work in the same direction as ambiguity attitudes: the less respondents tolerate uncertainty (both risk and ambiguity), the more they shift their reported beliefs downward, on average. The observed effects indicate best-guessing, primarily because of the visible effect of risk attitudes, which is against the consumption-choice model (prediction 1 in Table 1). This holds for both the expected and past inflation. The predicted interaction between risk and ambiguity attitudes (prediction 3 in Table 1) finds no strong support using the crude binary classification of respondents by risk attitudes. The lack of joint effects in columns 3 and 4 in Table 4 is good news as it validates controlling for risk attitudes in a linear fashion, a more tractable and compact approach than splitting the samples as in Table 3, which we will follow hereafter.

Table 5: Effects of ambiguity and risk attitudes on expectations and perceptions of inflation in cohorts with low (below or equal to median) and high (above median) beliefs.

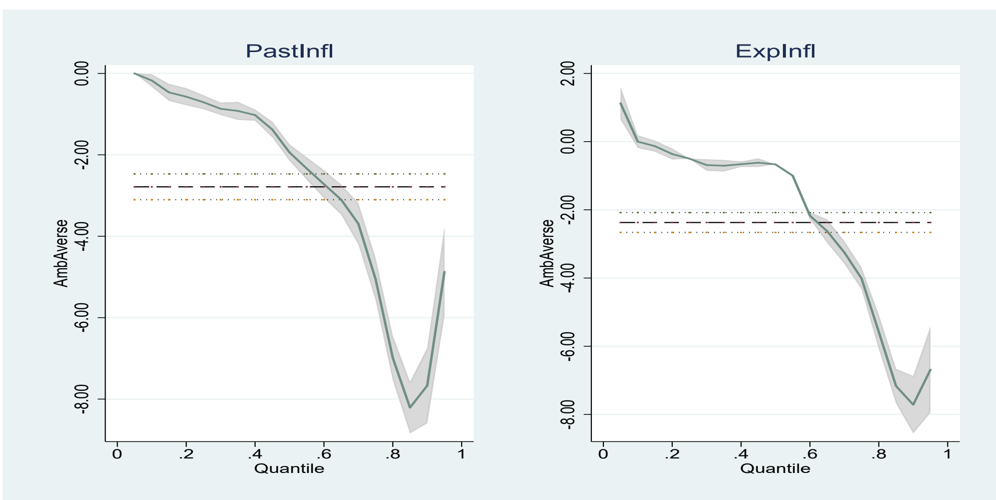
	(1)	(2)	(3)	(4)
	Below median		Above median	
	PastInfl	ExpInfl	PastInfl	ExpInfl
AmbAverse	0.367***	0.462***	-2.683***	-2.940***
	(3.04)	(3.94)	(-11.81)	(-12.23)
RA	-0.002	-0.116	-0.452**	-0.279
	(-0.02)	(-1.60)	(-2.16)	(-1.26)
RS	-0.173	-0.253**	1.293***	1.219***
	(-1.30)	(-1.98)	(4.50)	(4.06)
Constant	1.963***	2.445***	15.193***	13.778***
	(9.37)	(11.08)	(28.37)	(25.16)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
R^2	0.032	0.020	0.085	0.115
N	8325.000	9315.000	6296.000	5306.000

Low inflation regime (sample 2015-19). t-statistics in parentheses. AmbAverse is dummy equal to 1 if ambiguity averse, zero otherwise. RA is dummy equal to 1 if risk averse, zero otherwise. RS is dummy equal to 1 if risk seeking, zero otherwise. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[21] This approach aligns with having a binary measure for ambiguity attitudes and draws attention to average differences between respondents classified as risk-averse and those classified as risk-seeking, with risk-neutrality serving a the base for comparison. Similarly, binary classification of respondents by risk tolerance is used in Goldfayn-Frank and Wohlfart (2020) and Armantier et al. (2022). An alternative would be to use a continuous measure (CE, given by the WTA response for a lottery with known probabilities), which would emphasize differences between high and low risk aversion and high and low risk seeking, while relatively downplaying the difference between moderately risk-averse, moderately risk-seeking, and risk-neutral respondents. As we are interested in the sign of the effects, we report the results of the binary classification. Estimates with the continuous measure qualitatively confirm our findings and are reported in Table A.1 in Appendix A.2.

Table 5 estimates equation (16) separately for cohorts with below (or equal to) and above median beliefs, confirming the reversal of the effects of uncertainty attitudes on beliefs. This result is robust to the definition of cohorts with low and high expectations and to the measurement of risk attitudes.[22] Quantile regressions in Figure 2 provide further evidence of heterogeneity in ambiguity aversion effects at different levels of expectations. These results confirm predictions 2 and 4 from Table 1 for the "best-guess" model. However, in the consumption-choice view, the effect of ambiguity aversion also can lack homogeneity, as it is determined by respondents' economic and financial standing. If high earners and top borrowers have high inflation expectations, the consumption-choice view might offer an alternative explanation to the aforementioned pattern, because for respondents with large net borrowings and high inflation-protected income, ambiguity aversion may have a negative effect on inflation expectations (Proposition 4).

Figure 2: Effects of ambiguity aversion on perceptions and expectations of inflation: quantile regressions



Note: dashed line = OLS estimate with 95% confidence intervals (dotted lines).

We now turn to the financial standing of the households. Estimates of equation (18) with $X_{n,i}$ measuring income and marginal propensities to consume/save are in Table 6. Columns 1-2 show that being a top earner is negatively associated with perceived and expected inflation, in line with D'Acunto et al. (2023). Although the variable itself does not specify whether income is inflation protected, it is not unreasonable to assume that top earners are better protected from inflation than those with a lower income. This relationship works against

[22]Tables A.5-A.6 and Figure A.1 in Appendix A.2 show similar results on subsamples with various thresholds for low and high expectations. Table A.7 confirms these results using a continuous measure of risk tolerance (CE).

Table 6: Financial standing of households, uncertainty attitudes, and perceptions and expectations of inflation.

	(1) PastInfl	(2) ExpInfl	(3) PastInfl	(4) ExpInfl
AmbAverse (AA)	-2.837***	-2.401***	-1.343***	-1.276***
	(-13.81)	(-12.36)	(-3.54)	(-3.54)
RA	-0.362**	-0.162	-0.363**	-0.163
	(-2.33)	(-1.16)	(-2.34)	(-1.17)
RS	1.369***	1.527***	1.370***	1.528***
	(5.66)	(6.81)	(5.66)	(6.82)
Stocks	-0.539**	-0.192	2.535***	2.082**
	(-2.03)	(-0.75)	(3.20)	(2.53)
Deposit	0.127	0.629**	2.385**	2.801***
	(0.36)	(2.05)	(2.08)	(2.80)
Mortgage	-0.295	-0.237	1.021	1.669**
	(-1.19)	(-1.10)	(1.40)	(2.42)
Safe	-0.215	-0.291	1.379*	0.614
	(-0.85)	(-1.30)	(1.85)	(0.91)
Durable	-0.406*	-0.312	1.508**	0.532
	(-1.75)	(-1.46)	(2.13)	(0.81)
Top Income	-1.913***	-1.338***	-2.948***	-2.247***
	(-8.39)	(-6.72)	(-3.72)	(-2.93)
AA × Stocks			-3.811***	-2.820***
			(-4.57)	(-3.30)
AA × Deposit			-2.748**	-2.644**
			(-2.30)	(-2.53)
AA × Mortgage			-1.577**	-2.301***
			(-2.04)	(-3.18)
AA × Safe			-1.925**	-1.088
			(-2.44)	(-1.53)
AA × Durable			-2.307***	-1.006
			(-3.10)	(-1.46)
AA × Top Income			1.240	1.083
			(1.51)	(1.38)
Constant	8.933***	7.825***	7.727***	6.922***
	(20.42)	(19.73)	(14.90)	(14.31)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
R^2	0.070	0.061	0.073	0.063
N	12754	12754	12754	12754

Notes: Low inflation regime (sample 2015-2019). Stocks, Deposits, Mortgage, Safe, Durable, and Other are amounts allocated from a hypothetical extra $ 1000. Top income = 1 if income above $ 175,000. t-statistics are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

a possible explanation of the negative association between ambiguity aversion and beliefs within the consumption-choice view.

Marginal propensities to consume, invest and repay debt (the willingness to spend the hypothetical extra \$1000) characterize liquidity constraints (Misra and Surico, 2014; Bunn et al., 2018; Bartzoka et al., 2022) and indebtedness (in Koşar et al., 2023, high levels of debt generate a high marginal propensity to repay it). These exhibit rather weak correlations with perceived and expected inflation (Table 6, columns 1-2). For the financial constraint channel to be able to explain the negative effect of ambiguity aversion on beliefs, high indebtedness should be positively correlated with beliefs, which is not what we observe. In columns 3-4 of Table 6, the focus is on the interaction between economic and financial standing and ambiguity aversion, as in equation (18). The consumption-choice view implies a strong interaction, as financial position of households determines the best and the worst outcome. We do observe significant interactions, whose signs agree with the average ambiguity aversion effect; that is, ambiguity aversion effect on expected and perceived inflation is stronger for those respondents who are less financially constrained (vs. the base category choosing response option "Other," which effectively includes current consumption, energy bills.). On the one hand, theoretically, households with high levels of debt might consider high inflation a good outcome, in which case ambiguity aversion shifts their expectations downward, as we observe. On the other hand, this does not reject the reporting bias that we claim to be due to error minimization: from the "best-guess" perspective, financial circumstances still may define the underlying probability p, which is then distorted by the error-minimization objective. Moreover, for households that prefer to spend the extra \$1000 on current consumption and thus allocate low amounts to investments and mortgage repayments, there is still a negative association between ambiguity aversion and expectations (see the AmbAverse term in Table 6), unexplainable within the consumption choice framework.

Finally, according to equation (6) in Proposition 2, risk aversion moderates the effects of macroeconomic factors M_n if reported values are best guesses; if they are consumption-choice-consistent, risk aversion has no effect, as in equation (14) in Proposition 5. To test this prediction, we include three-month T-bill rates, current inflation, and unemployment rates (at the time of the respective survey wave) to proxy for macroeconomic factors that may affect households' expectations (this follows, e.g., Mankiw et al., 2004). Controlling for the survey fixed effects then captures all remaining macroeconomic, political, and other relevant factors common for respondents of each respective wave. As Table 7 reveals, the three isolated macroeconomic factors show reasonable relationships to perceived and expected inflation in the cohort with below-median expectations: current inflation and interest rates positively contribute to expectations, while unemployment is negatively related to perceived inflation. However, this does not hold for the above-median beliefs. This suggests that either the latter are driven by macroeconomic considerations to a lesser extent or the heterogeneity of macroeconomic models used by households to form expectations (Andre et al., 2022) is too high in this subsample. For the subsample with below-median perceived and expected inflation, where we observe substantial commonality in the effects of macroeconomic factors, the table also shows significant interaction between risk-seeking and macroeconomic factors, contradicting the consumption-choice view.

Table 7: Uncertainty attitudes, macroeconomic factors, and assessments of inflation.

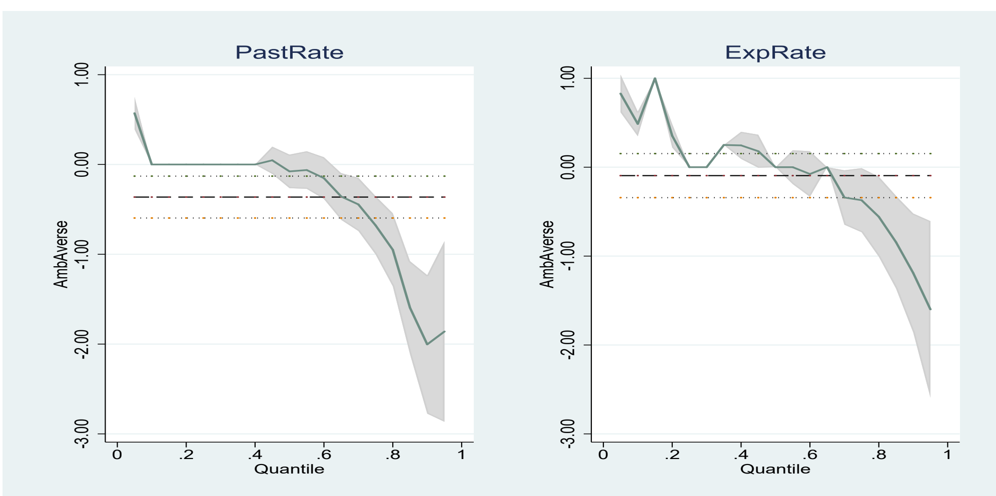
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Below or equal to median				Above median			
	PastInfl	ExpInfl	PastInfl	ExpInfl	PastInfl	ExpInfl	PastInfl	ExpInfl
AmbAverse	0.354***	0.461***	0.353***	0.460***	-2.694***	-2.938***	-2.701***	-2.943***
	(2.94)	(3.93)	(2.93)	(3.92)	(-11.87)	(-12.22)	(-11.89)	(-12.22)
RA	0.005	-0.119*	0.663	1.576	-0.432**	-0.253	1.220	3.869
	(0.07)	(-1.65)	(0.40)	(0.99)	(-2.07)	(-1.15)	(0.27)	(0.80)
RS	-0.174	-0.264**	-3.715	5.760**	1.325***	1.271***	-0.451	3.437
	(-1.30)	(-2.06)	(-1.18)	(2.32)	(4.62)	(4.25)	(-0.07)	(0.54)
TB3MS	0.276***	0.214**	0.244	0.492***	0.053	0.308	-0.186	0.435
	(2.79)	(2.26)	(1.46)	(2.71)	(0.21)	(1.18)	(-0.38)	(0.82)
RA × TB3MS			-0.018	-0.309			0.318	-0.158
			(-0.09)	(-1.43)			(0.54)	(-0.25)
RS × TB3MS			0.342	-0.640*			0.294	-0.178
			(0.87)	(-1.92)			(0.37)	(-0.21)
INFL	0.374**	0.352**	0.460	0.117	-0.088	0.292	0.753	1.095
	(2.29)	(2.50)	(1.58)	(0.45)	(-0.22)	(0.69)	(0.96)	(1.30)
RA × INFL			0.129	0.402			-1.134	-1.056
			(0.36)	(1.28)			(-1.21)	(-1.05)
RS × INFL			-1.227**	-0.196			-0.919	-0.973
			(-1.97)	(-0.35)			(-0.72)	(-0.73)
UNEMPL	-0.391**	0.107	-0.401	0.464*	-0.506	-0.149	-0.326	0.430
	(-2.41)	(0.74)	(-1.42)	(1.75)	(-1.26)	(-0.35)	(-0.41)	(0.52)
RA × UNEMPL			-0.153	-0.326			-0.425	-0.867
			(-0.45)	(-1.03)			(-0.46)	(-0.89)
RS × UNEMPL			0.789	-1.214**			0.375	-0.407
			(1.25)	(-2.41)			(0.30)	(-0.31)
Constant	3.060***	1.551**	3.124**	-0.269	17.635***	14.084***	16.992***	11.286***
	(3.91)	(2.13)	(2.23)	(-0.20)	(8.89)	(6.74)	(4.40)	(2.75)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.026	0.016	0.028	0.017	0.083	0.112	0.083	0.113
N	8325	9315	8325	9315	6296	5306	6296	5306

Notes: Low inflation regime (sample 2015-2019). TB3MS = three-month T-bill rate; INFL = current inflation, not seasonally adjusted; UNEMPL = current unemployment rate, not seasonally adhjusted. t-statistics are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.2 Expectations and perceptions of interest rates

Although our theoretical models assume that respondents report expected inflation, biases in reported beliefs may extend from inflation expectations to other beliefs if reported values are driven by the objective of error minimization. A key difference between assessments of inflation and interest rates is in the perceived degree of ambiguity. While respondents observe prices on a daily basis, they less frequently come across interest rates, especially across the specific car loan rate used in our survey question; thus, they are likely to face more uncertainty about interest rates than prices. Higher degree of perceived ambiguity δ in equation (1) puts less weight on expected utility (which reflects risk attitudes) and more weight on pessimistic/optimistic distortions to the underlying probability distribution. As a consequence, equation (6) implies dampened effects of risk attitudes on reported interest rates. For the same reason, equations (6) and (14) imply a dampened effect of macroeconomic parameters on reported values. With respect to ambiguity attitudes, according to equations (6) and (14), in addition to perceived ambiguity δ, the difference between the best and the worst outcomes, $(r_{best} \cdot \rho_{min} - r_{worst} \cdot \rho_{max})$ and $(r_{best}(W_1, W_2, B, R) - r_{worst}(W_1, W_2, B, R))$, respectively[23] moderates the effect of optimism α. If these are smaller for interest rates (for example, because the range of conceivable interest rates that the household might face is limited), the effect of ambiguity aversion on beliefs would be smaller than for inflation.

Figure 3: Effects of ambiguity aversion on perceptions and expectations of interest rates: quantile regressions



Note: dashed line = OLS estimate with 95% confidence intervals (dotted lines).

Table 8 estimates (16) for assessments of interest rates as the dependent variable, and, as such, is the counterpart of Table 4: while it reveals a strong effect of risk seeking on

[23] Here notation r refers to interest rates, replacing the inflation notation in the original equations

Table 8: Effects of ambiguity and risk attitudes on expectations and perceptions of interest rates.

	(1) PastRate	(2) ExpRate	(3) PastRate	(4) ExpRate
AmbAverse	-0.363***	-0.095	-0.157	0.019
	(-2.71)	(-0.68)	(-0.55)	(0.07)
RA	0.094	0.016	0.229	0.032
	(0.88)	(0.14)	(0.75)	(0.10)
RS	0.806***	0.827***	1.292***	1.294***
	(4.86)	(4.75)	(3.09)	(3.05)
AmbAverse × RA			-0.158	-0.014
			(-0.48)	(-0.04)
AmbAverse × RS			-0.616	-0.601
			(-1.36)	(-1.29)
Constant	6.895***	7.422***	6.724***	7.327***
	(24.05)	(24.39)	(18.64)	(19.72)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
R^2	0.047	0.049	0.047	0.049
N	14621	14621	14621	14621

Low inflation regime (sample 2015-2019). t-statistics are in parentheses. AmbAverse is a dummy equal to 1 if ambiguity-averse, and 0 otherwise. RA is a dummy equal to 1 if risk-averse, and 0 otherwise. RS is a dummy equal to 1 if risk-seeking, and 0 otherwise. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

reported values, the interaction between risk attitudes and ambiguity aversion is undetectable in statistical terms.[24] With respect to the difference in observed effects for cohorts with low and high reported beliefs, Figure 3 plots quantile regressions for interest rate measures. Table A.4 in Appendix A presents the ordinary least squares (OLS) estimates for interest rates on subsamples below and above median beliefs. Effects of risk and ambiguity aversion on reported assessments of interest rates have opposite signs for cohorts with low and high beliefs, same as for the inflation measures above. Finally, estimating a counterpart of Table 7 for interest rates produces no significant effects or interactions of macroeconomic factors and risk attitudes, and thus we do not report them here. This lack of significant effects is in line with a higher level of ambiguity for the assessment of interest rates and a smaller perceived range of feasible interest rate values, as discussed in the beginning of this subsection.

[24]Estimates of (15) are in Table A.3 in Appendix A: ambiguity aversion shows no significant effects in the risk-neutral cohort and substantially reduced and less significant effects in the risk-averse and risk-seeking cohorts. Nevertheless, the latter effects are negative, in line with our results for the inflation measures.

4.3 Robustness

Thus far, we have revealed a bias in reported inflation expectations and reported perceived inflation. A similar bias, albeit to a lesser extent, holds for reported perceptions and expectations of interest rates. In what follows, for all four types of reported beliefs, we test whether the results are robust to variations in the identification of ambiguity-neutral respondents, to controlling for respondents' understanding of economic and business information, and to moving from the low inflation regime of 2015-2019 to a high inflation in 2022.

4.3.1 Ambiguity-neutral benchmark

Our predictions are based on the NEO-additive CEU model, which offers a linear representation of expectations. In non-linear models, the effects of risk aversion may have a complex interaction with ambiguity aversion; however, the linear representation holds for ambiguity-neutral respondents. To robustify our main results, Table 9 explores the effects of risk attitudes on the subsample of respondents classified as ambiguity-neutral. This gives us a benchmark that does not depend on the choice of the underlying model of decisions under ambiguity. The table reports both the binarized measures and the continuous (CE) measure of risk attitudes. For the former, risk-seeking exhibits the same positive effect (Panel A, columns 1- 4) as in our baseline findings in Table 4, though with lesser significance, which is due to the size of the ambiguity-neutral subsample (recall, respondents are classified as ambiguity-neutral by the Ellsberg task). For the continuous measure the significance drops even further, revealing the same positive effect only for expected inflation.

We complement these results with an alternative definition of ambiguity aversion used in our 2022 sample,[25] where respondents are considered ambiguity-neutral if they show exactly the same WTA for a lottery with unknown probabilities as for a similar 50-50 lottery. In this sample, risk-seeking again exerts a positive effect on beliefs, though it is significant only for interest rate measures (Panel B of Table 9, columns 1-4), while the continuous measure of risk tolerance is significant for all beliefs except the perceptions of the current interest rates (Panel B, columns 5-8).

Despite the drastically reduced number of observations in the ambiguity-neutral subsample, we cannot reject the effect of risk attitudes on reported beliefs. This conclusion is robust to the variation in the identification of ambiguity-neutral respondents.

4.3.2 Understanding the context

Ambiguity attitudes play a role in belief formation because of the uncertainty about future values of variables. Having more information and being able to better understand available

[25] We analyze this sample further in Section 4.3.3.

Table 9: Effect of risk attitudes on reported beliefs: ambiguity-neutral only.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Binary risk attitudes				Continuous risk attitudes			
	PastInfl	ExpInfl	PastRate	ExpRate	PastInfl	ExpInfl	PastRate	ExpRate
Panel A: *Ambiguity neutrality defined by the Ellsberg task (sample 2015-2019, low inflation)*								
RA	0.195	0.558	0.087	0.068				
	(0.23)	(0.67)	(0.15)	(0.12)				
RS	1.915*	2.132**	1.501**	2.033***				
	(1.74)	(1.96)	(1.97)	(2.66)				
CE					2.269	2.961**	0.978	1.293
					(1.48)	(1.97)	(0.93)	(1.17)
Constant	9.399***	7.235***	6.203***	7.444***	9.358***	8.535***	5.418***	5.409***
	(5.31)	(4.07)	(4.74)	(5.67)	(3.75)	(3.57)	(3.52)	(3.38)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.067	0.078	0.046	0.048	0.065	0.078	0.041	0.038
N	1007.000	1007.000	1007.000	1007.000	1007.000	1007.000	1007.000	1007.000
Panel B: *Ambiguity neutrality defined by equality of WTA for risky and ambiguous lotteries (sample 2022, high inflation)*								
RA	-1.059	0.090	0.165	0.171				
	(-1.24)	(0.08)	(0.25)	(0.26)				
RS	0.347	1.390	1.567**	1.703**				
	(0.38)	(1.17)	(2.11)	(2.28)				
CE					3.527***	3.622**	1.266	1.948**
					(2.98)	(2.57)	(1.40)	(2.09)
Constant	19.552***	13.518***	9.631***	10.663***	15.463***	13.995***	7.517***	8.750***
	(12.35)	(7.14)	(7.34)	(8.19)	(7.09)	(6.63)	(5.26)	(6.04)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.081	0.064	0.065	0.066	0.085	0.068	0.059	0.062
N	980.000	980.000	980.000	980.000	980.000	980.000	980.000	980.000

Notes: AmbAverse is a dummy equal to 1 if ambiguity averse, and 0 otherwise. CE = WTA for a lottery with a known probability of success (Prob = 0.5). RA is a dummy, equal to 1 if CE is below the expected value of the lottery, and 0 otherwise. RS is a dummy, equal to 1 if CE is above the expected value of the lottery, and 0 otherwise. *t*-statistics are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Understanding of financial issues and the effect of ambiguity aversion on reported beliefs.

	(1) PastInfl	(2) ExpInfl	(3) PastRate	(4) ExpRate	(5) PastInfl	(6) ExpInfl	(7) PastRate	(8) ExpRate
AmbAverse	-3.891***	-3.616***	-0.085	0.387	-1.641***	-1.996***	-0.326	-0.460
	(-11.11)	(-10.57)	(-0.35)	(1.55)	(-3.92)	(-4.01)	(-1.08)	(-1.49)
RA	-0.317**	-0.118	0.094	0.013	-0.629*	0.079	0.196	-0.127
	(-2.19)	(-0.90)	(0.88)	(0.11)	(-1.77)	(0.18)	(0.79)	(-0.49)
RS	1.508***	1.690***	0.810***	0.823***	0.900**	1.714***	1.213***	1.081***
	(6.65)	(7.99)	(4.88)	(4.72)	(1.99)	(3.09)	(3.55)	(3.02)
FinLit	-2.954***	-2.798***	-0.386	-0.078				
	(-7.73)	(-7.53)	(-1.49)	(-0.30)				
BusEcon					1.560***	3.154***	0.855**	0.546
					(3.26)	(5.54)	(2.39)	(1.48)
AmbAverse × FinLit	1.678***	1.887***	-0.458	-0.758**				
	(4.02)	(4.69)	(-1.58)	(-2.53)				
AmbAverse × BusEcon					0.577	0.605	-0.820*	-0.837*
					(0.98)	(0.86)	(-1.90)	(-1.88)
Constant	10.884***	9.620***	7.396***	7.728***	16.530***	7.935***	7.791***	9.023***
	(23.21)	(21.76)	(22.20)	(21.91)	(18.95)	(7.86)	(12.50)	(14.00)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.065	0.057	0.046	0.049	0.067	0.067	0.031	0.030
N	14621.000	14621.000	14621.000	14621.000	3877.000	3877.000	3877.000	3877.000

Notes: Low inflation regime (sample 2015-19) except BusEcon (high inflation, sample 2022). FinLit is a dummy = 1 if 3 or 4 correct answers out of 4 financial literacy questions, zero otherwise. BusEcon is a dummy = 1 if self-assessed proficiency in business and economics is 4 or 5 on 5-point scale. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

information may reduce uncertainty and, through that, limit the scope for ambiguity aversion. Table 10 estimates (18) with $X_{1,i} = FinLit_i$ being the measure of financial literacy and $X_{2,i} = BusEc_i$ being the self-assessed proficiency in business and economics (dummy = 1 if respondents believe their understanding of these issues is at levels 4 or 5 on a 5-point scale). As the two may be collinear, we estimate their effects separately. Better understanding of finance basics indeed adjusts the impact of ambiguity aversion on inflation measures upward, though it does not suffice to remove its overall negative effect on reported expected and perceived inflation. For interest rates, the joint effect of ambiguity aversion and financial literacy is strikingly negative (though non-significant for assessments of the current rate), suggesting that better understanding of finance basics induces a stronger downward bias in reported beliefs about interest rates. The effects of proficiency in business and economics are in columns 5-8. The negative contribution of this measure to the ambiguity aversion effect is similar to that of financial literacy.

Complementing Table 10, Table A.8 in Appendix A.2 replaces financial literacy and proficiency in business and economics with attentiveness to information. While being interested in general economic conditions does not alter the effect of ambiguity aversion, being particularly attentive to Fed news does, though it adds even more to the negative effect of ambiguity aversion on reported beliefs about inflation.

It follows that the main result is not driven by the poor understanding of economic matters or the lack of interest in economic issues. Respondents who are financially literate, more proficient in business and economics, or interested in specialized economics and monetary policy news also exhibit an ambiguity aversion bias and, in some respects, an even stronger bias than the remainder of the sample.

4.3.3 High inflation regime

Our 2015-2019 sample covers the period of historically low inflation rates, when messages from the Fed often emphasized the zero-bound problem and the need to increase inflation. In such circumstances, hypothetically, the reversal of the best and worse outcomes might occur not because of individual financial circumstances but because of the framing induced by messages of this type. As we highlighted previously, information and knowledge do not suffice to reverse the negative ambiguity aversion effect. We now explicitly focus on the recent period of accelerated inflation and higher inflation expectations.

Panel B of Table 9 shows similarity of effects of risk aversion in high and low inflation regimes on the subsample of ambiguity-neutral respondents. Table 11 explores the effects of both types of uncertainty attitudes on the whole 2022 sample: the negative effect of ambiguity aversion on reported beliefs does not disappear (see Panel A; columns 1-4 report effects for a binary measure of ambiguity aversion, similar to that used in our main sample). As the

Table 11: Effects of uncertainty attitudes on reported beliefs: high inflation regime.

	(1) PastInfl	(2) ExpInfl	(3) PastRate	(4) ExpRate	(5) PastInfl	(6) ExpInfl	(7) PastRate	(8) ExpRate
Panel A: *binary measures of risk attitude*								
AmbAverse	-1.327***	-1.524***	-0.606**	-0.765***				
	(-4.05)	(-3.88)	(-2.46)	(-3.04)				
RA	-0.452	0.192	0.232	0.020	-1.024**	-0.573	-0.130	-0.191
	(-1.16)	(0.41)	(0.86)	(0.07)	(-2.47)	(-1.15)	(-0.44)	(-0.63)
RS	0.834*	1.174*	1.252***	1.348***	0.778	1.067*	1.187***	1.363***
	(1.67)	(1.94)	(3.35)	(3.46)	(1.56)	(1.78)	(3.18)	(3.51)
AmbPremium					-4.579***	-5.859***	-2.653***	-1.971***
					(-5.42)	(-5.49)	(-4.34)	(-3.10)
Constant	19.974***	15.773***	9.070***	9.276***	20.115***	16.066***	9.258***	9.211***
	(22.82)	(15.66)	(13.47)	(13.88)	(23.02)	(16.14)	(13.82)	(13.91)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.077	0.083	0.038	0.032	0.080	0.088	0.041	0.032
N	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000
Panel B: *continuous measure of risk attitude*								
AmbAverse	-1.748***	-2.748***	-0.691	-0.495				
	(-2.86)	(-3.88)	(-1.58)	(-1.12)				
CE	3.491***	3.127**	0.506	1.807**	2.868***	3.200***	0.135	0.837
	(3.31)	(2.46)	(0.61)	(2.15)	(3.65)	(3.48)	(0.23)	(1.42)
CE × AmbAverse	0.322	2.353	-0.091	-1.302				
	(0.21)	(1.30)	(-0.08)	(-1.12)				
Constant	14.104***	7.340***	7.184***	7.660***	13.308***	6.137***	6.863***	7.397***
	(13.99)	(6.37)	(10.23)	(10.50)	(13.85)	(5.59)	(10.10)	(10.54)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.081	0.088	0.034	0.028	0.074	0.081	0.031	0.023
N	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000

Notes: High inflation regime (sample 2022). AmbPremium is the nominal difference in WTA for lotteries with known (Prob = 0.5) and unknown probabilities, divided by 1000. AmbAverse is a dummy equal to 1 if ambiguity-averse and 0 otherwise. CE = WTA for a lottery with known probabilities (Prob = 0.5). RA is a dummy, equal to 1 if CE is below expected value of the lottery and 0 otherwise. RS is a dummy, equal to 1 if CE is above expected value of the lottery and 0 otherwise. t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2022 waves of the survey measured ambiguity aversion by a difference in WTAs for lotteries with known and unknown probabilities, we are now able to compute a continuous ambiguity attitude measure given by this difference, which we label *AmbPremium*: the results with this continuous measure are the same (Table 11, Panel A, columns 5-8).

4.4 Offsetting the bias

The theoretical mechanism of the bias we discuss is in the adjustment of the underlying probability distribution by underweighting probabilities of extreme values and overwheighting probabilities in the mid-range. Under this mechanism, variables viewed by respondents as drawn from similar underlying distributions would induce biases of a similar magnitude for each respondent. In our main sample period, inflation and interest rates did not change significantly. With this in mind, taking the difference between expected and perceived inflation, $DiffInfl_i = ExpInfl_i - PastInfl_i$, for individual respondent i, (at least partially) offsets the bias contained in $ExpInfl_i$ by a similar bias contained in $PastInfl_i$. The difference has an intuitive meaning of an expected change in inflation. Similarly, $DiffRate_i = ExpRate_i - PastRate_i$ reflects the expected change in the interest rate.

Uncertainty about perceived values $PastInfl_i$ and $PastRate_i$ stems from the lack of clarity on the extent to which the prices and interest rates the respondent observes relate to "prices in general" and interest rate for an "average" consumer. The same uncertainty affects expected values $ExpInfl_i$ and $ExpRate_i$, which, on top of that, also relate to uncertainty about future economic developments. It follows that differences $DiffInfl_i$ and $DiffRate_i$ reflect mainly uncertainty about the future, accommodated in expectations $ExpInfl_i$ and $ExpRate_i$. Theoretically, from a consumption-choice perspective, pessimists would expect a higher change in the variable, while risk attitudes should play no role. We now estimate the baseline equations (15) and (16) with *DiffInfl* and *DiffRate* on the left-hand side. The results in Table 12 evidence the positive effect of pessimism (ambiguity aversion) on beliefs and a zero effect of risk attitudes (measured both by a continuous measure and more traditionally as dummies), as well as the non-significant interaction between the two.

However, as highlighted previously, offsetting the bias by differencing is based on a rather strong assumption that the probability distributions governing the two variables are close enough. In the low inflation period of our main sample, this assumption is likely met: inflation has been low and rather stable since long before our sample period begins. By contrast, the recent high inflation period is a rather new phenomenon for consumers after a long period of low inflation and interest rates. The effects of uncertainty attitudes on *DiffInfl* and *DiffRate* estimated on our 2022 sample and reported in Appendix A.2 (Table A.9) lack

Table 12: Effects of ambiguity and risk attitudes on expected changes in inflation and interest rates.

	(1) DiffInfl	(2) DiffRate	(3) DiffInfl	(4) DiffRate	(5) DiffInfl	(6) DiffRate	(7) DiffInfl	(8) DiffRate
AA	0.404**	0.269***	0.431	0.323**	0.414**	0.268***	0.743**	0.176
	(2.28)	(2.88)	(1.38)	(2.15)	(2.33)	(2.87)	(2.14)	(0.93)
CE	-0.061	0.124	0.010	0.266				
	(-0.22)	(0.87)	(0.01)	(0.67)				
AA × CE			-0.090	-0.179				
				(-0.11)	(-0.42)			
RA					0.197	-0.077	0.527	-0.197
					(1.47)	(-1.20)	(1.36)	(-0.92)
RS					0.179	0.021	0.576	0.002
					(0.86)	(0.19)	(1.08)	(0.01)
AA × RA							-0.395	0.145
							(-0.95)	(0.65)
AA × RS							-0.488	0.015
							(-0.84)	(0.05)
Constant	-0.645	0.414*	-0.667	0.371	-1.007***	0.528***	-1.279***	0.603**
	(-1.40)	(1.68)	(-1.30)	(1.38)	(-2.78)	(2.81)	(-2.84)	(2.55)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demogr.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reg.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
N	14621.000	14621.000	14621.000	14621.000	14621.000	14621.000	14621.000	14621.000

Low inflation regime (sample 2015-2019). AA is a dummy equal to 1 if ambiguity- averse and 0 otherwise. CE = WTA for a lottery with known probabilities (Prob = 0.5). RA is a dummy, equal to 1 if CE is below expected value of the lottery and 0 otherwise. RS is a dummy, equal to 1 if CE is above expected value of the lottery and 0 otherwise. t-statistics are in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

consistency and indicate that the offsetting method fails to remove the bias from the high inflation period data.

4.5 Self-assessed bias

In the 2023 round of the survey ($N = 537$), we asked respondents "Do you think the actual rate in the future will be higher or lower than your prediction?" with the answer options "higher", "lower," or "neither." The dominant choice was "higher" (63% for future inflation and 49% for the interest rate). We interpret this as an indication that respondents recognize their reported forecast understates expected inflation and interest rate, relative to the true beliefs. In addition, 22% respondents make no conscious adjustment of reported inflation expectations (32% for expected interest rate), according to this interpretation.

Do answers to this question characterize how conscious respondents are about the bias in their reported beliefs? It could be argued that when reporting expectations, respondents think of an expected value; this value may differ from the median of which respondents may think when the answer the question from the previous paragraph. If this is the case, a negatively skewed underlying probability distribution would imply a higher likelihood to observe realized inflation in the future above the expected value than below it (or higher likelihood to observe the realized rate below expectation, if the underlying distribution is positively skewed.) According to this alternative interpretation, the percentages of answers "above" and "below" and "neither" thus indicate the fractions of respondents with negatively and positively skewed or symmetric distributions.

To discriminate between these two interpretations, note that theoretically, the error of consumption-choice-consistent expectations is not predictable if the expectation operator for the error is also consumption-choice-consistent:

$$\text{Expected error} = \sum_{s=1}^{S} w(p_s, B, R, \alpha, \delta) \cdot \left[\pi_s - \sum_{s'=1}^{S} w(p_{s'}, B, R, \alpha, \delta) \cdot \pi_{s'} \right] = 0.$$

From the best-guess perspective, the expected error is predictable and depends on both risk aversion and ambiguity aversion:

$$\text{Expected error} = \sum_{s=1}^{S} \pi_s \cdot \left[w\left(p_s, \pi^e, \alpha, \delta\right) \cdot \rho_s\left(\pi^e\right) - w(p_s, B, R, \alpha, \delta) \right].$$

As our previous analysis rules out consumption-choice-consistent reporting, having a large part of respondents who are conscious of their overstatement or understatement of expectations is not surprising. If, however, these answers are skewness-driven, understatement is

Table 13: Effects of uncertainty attitudes on responses to the question "Do you think the actual rate in the future will be higher or lower than your prediction?"

	Understate		Overstate	
	ExpInfl	ExpRate	ExpInfl	ExpRate
AmbAverse	-0.085*	-0.062	-0.036	-0.039
	(-1.73)	(-1.05)	(-0.39)	(-0.56)
RA	0.118*	0.046	0.069	0.027
	(1.72)	(0.62)	(0.69)	(0.32)
RS	0.148*	0.157*	-0.046	0.004
	(1.81)	(1.81)	(-0.37)	(0.04)
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
N	301	292	121	183

Notes: High inflation regime (sample 2022-2023). Dummies Understate and Overstate from responses to question "Do you think the actual rate in the future will be higher or lower than your prediction?": Understate = 1 if response is "higher," Overstate = 1 if response is "lower," and zero otherwise if not missing. t-statistics are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

more likely for ambiguity-averse respondents.[26] Moreover, risk attitudes are irrelevant for the explanation of the expected error under this explanation. Table 13 shows that this is not the case.

Furthermore, if the answers are skewness-driven, the cohort of respondents who are unable to conclude whether the future actual rate would be higher or lower than their expected value likely forms expectations based on a symmetric distribution of probabilistic weights assigned to future states of the world. In this case, ambiguity attitudes hardly play a role for their expectations. Table 14 detects a positive effect of ambiguity aversion for this cohort (see the AA coefficient in columns 2 and 4.) We conclude that the error of expectations is predictable, and consumers are aware they understate or overstate beliefs in a survey. For the subsample of respondents who neither knowingly overstate nor understate beliefs, we detect a positive relationship between ambiguity aversion and expected inflation, as anticipated for unbiased beliefs.

5 Discussion

The detected risk aversion effect in reported expectations is consistent with the view that respondents forecast the "correct" value and minimize the error of forecasting. Unlike risk attitudes, ambiguity attitudes may shift beliefs even if they truly represent considerations

[26]Consumption-choice-consistency implies that the majority of ambiguity-averse respondents dislike inflation and thus their underlying distribution overemphasizes higher values of inflation (i.e. it is negatively skewed). Therefore, the median exceeds the mean, and thus reported belief is below the likely future realization.

Table 14: Expectations and conscious overstatement/understatement.

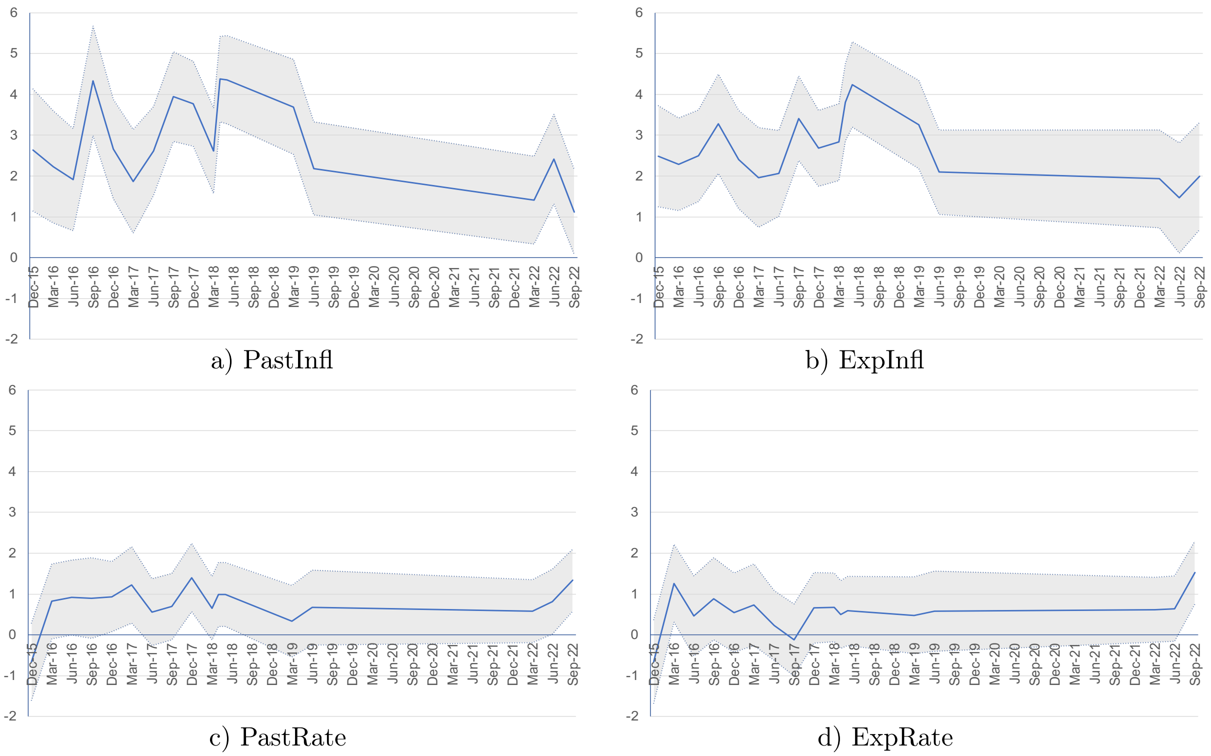
	(1) ExpInfl	(2) ExpInfl	(3) ExpRate	(4) ExpRate
AmbAverse	-3.589***	3.591*	-3.204**	0.893
	(-3.11)	(1.70)	(-2.58)	(0.46)
Understate	5.831***	11.662***	4.258***	8.488***
	(4.54)	(5.66)	(3.31)	(4.02)
Overstate	-1.680	3.699	2.344	4.323
	(-0.84)	(1.06)	(1.35)	(1.48)
AmbAverse × Understate		-9.068***		-7.515***
		(-3.60)		(-2.95)
AmbAverse × Overstate		-8.171*		-3.263
		(-1.94)		(-0.92)
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
R^2	0.182	0.206	0.114	0.136
N	348.000	348.000	346.000	346.000

Notes: High inflation regime (sample 2022-23). Dummies Understate and Overstate from responses to question, "Do you think the actual rate in the future will be higher or lower than your prediction?": Understate = 1 if the response is "higher," Overstate = 1 if the response is "lower," and zero otherwise if not missing. t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

made in everyday consumption decisions. We document a strong negative effect of ambiguity aversion on reported beliefs and its conditionality on the level of beliefs. To be able to explain these patterns from the perspective of true reporting consistent with consumption decisions, there must be a particular relationship between the financial standing of respondents and the level of beliefs they report. The data, however, reject this relationship. Knowledge, information and macroeconomic conditions also fail to explain this pattern within a true reporting view. HBy contrast, the best-guessing (forecasting view) well explains the pattern, and as such, the average ambiguity aversion effect we detect witnesses a reporting bias: inflation expectations reported by ambiguity-averse respondents are approximately 2% lower than those of the remainder of the sample. Given that ambiguity-averse respondents constitute a majority (55%-80% in our samples and in the studies reviewed by Oechssler and Roomets (2015)), survey-measured inflation expectations are underestimated.

The literature has extensively documented an upward bias in consumers' inflation expectations, relative to actual realizations or professional forecasts (e.g. Weber et al., 2022). Adam et al. (2021) show that expectations of rates of returns reported by market respondents are systematically above the risk-free rate (risk-neutral benchmark). Our results imply that both biases may be even larger on average due to downward adjustments of beliefs induced by error minimization. Similarly, the disagreement in expectations (Mankiw et al., 2004; Weber

Figure 4: Ambiguity aversion bias 2015-22



Note: Solid line = difference between average beliefs of ambiguity-neutral and ambiguity-averse respondents per survey round. Shaded area between the dotted lines = 95% confidence interval.

et al., 2022) is likely underestimated, as error minimization implies (and data confirm) that respondents with lower beliefs adjust them upward and those with higher beliefs adjust them downward, an effect driven by risk aversion and amplified by ambiguity aversion.

A simple way to reduce the reporting bias could be to frame questions so that respondents focus on their personal views instead of optimal forecasts. As we reviewed in the Introduction section, indeed surveys often explicitly ask respondents to provide a best guess of current or expected inflation. By contrast, in our surveys the emphasis was on personal views: the preamble explicitly emphasizes "No special knowledge is required. There is no right or wrong answer to our questions. In fact, any answer is correct as long as it truly reflects your opinion." The questions re-iterate this point by using "From your perspective" and "you think." It follows that such a simple framing does not really help overcome the bias.

Should this be a concern? First, surveys help track changes in expectations over time. If the reporting bias remained constant in time, it would vanish through differencing. Figure 4 shows the difference in beliefs between ambiguity-neutral and ambiguity-averse respondents in our samples over time. As true beliefs of ambiguity-averse respondents are presumably higher than those of ambiguity-neutrals, the difference is a conservative estimate of the sample-average reporting bias. For interest rate measures, it is rarely significantly different from zero, while for inflation measures, it exhibits noteworthy fluctuations between 2% and

4% in 2015-2019, spiking in August and plummeting in March. Unfortunately, to date there are no long enough series of inflation expectations that simultaneously measure ambiguity and risk attitudes, to derive a deeper insight into these fluctuations. However, if this apparent seasonality holds, it may affect conclusions on seasonal fluctuations of inflation expectations as well.

Second, moving from a low inflation period to a high inflation period seems to reduce the average ambiguity aversion bias for perceived and expected inflation and somewhat increase it for interest rates. One possible explanation for this could be the reduced uncertainty about inflation when it is high (e.g. "if it is already high, what else can happen?"), while uncertainty about interest rates increases, especially in the beginning of the inflationary period when inflation is already high but interest rates are still kept at a low level. Notwithstanding the explanation, potential shifts in the reporting bias when the economy moves from a low inflation regime to a high inflation regime, and in the opposite direction, also need to be taken into account and investigated further. Again, longer macroeconomic expectation series with uncertainty attitudes are necessary to better understand these shifts and their explanations.

6 Conclusions

In surveys, we detect a strong negative effect of ambiguity aversion on reported beliefs and a remarkable conditionality of this effect on the level of beliefs themselves, both contradicting the widely hypothesized positive relationship between pessimism and expected inflation. We considered two views on reported expectations: (1) respondents report their best guess about future price changes and minimize forecasting error, and (2) respondents report expectations consistent with their daily consumption choices. The two models differ in implications with respect to the role of uncertainty attitudes: risk aversion only matters if respondents report their best guess, while ambiguity aversion shifts expectations in both models, but with qualitative differences. Under error minimization, high beliefs are biased downward and low beliefs are biased upward, to reduce the expected error, while in the consumption choice the ambiguity aversion effect is determined by financial constraints and does not directly depend on the level of beliefs.

The data evidence that reported beliefs are best guesses. First, we detect a strong effect of risk attitude on reported values. Second, while income and financial constraints do affect the level of expectations, the signs of these relationships are opposite to those needed to explain why ambiguity aversion effects differ for high and low expectations. Third, financial constraints amplify the negative ambiguity aversion effect, against the consumption-choice view. By contrast, observed patterns are well compatible with and find explanation in the forecasting (best-guessing) view on reported beliefs. The observed ambiguity aversion effect is therefore a bias inherent in the majority of unincentivized expectations surveys. To better understand this bias and its variation in time, longer expectation series with measures of risk and ambiguity attitudes are required. For unbiased estimates of uncertainty aversion effects on expectations from survey data, relevant survey methods need to be developed to elicit beliefs free of the reporting bias. We call for further research in this direction.

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FOR ONLINE PUBLICATION

Appendix

A Auxiliary results

Probability weighting $w(p_s, \pi^e)$ in (2) can be viewed as a linearized source function from Abdellaoui et al. (2011). Maxmin model (Gilboa and Schmeidler, 1989) can be accommodated by defining $w(p_s, \pi^e) = p_s^{\min}$ where $p_s^{\min} = 1$ if either $s = 1$ and $\pi^e \geq \frac{\pi_1 + \pi_S}{2}$, or $s = S$ and $\pi^e < \frac{\pi_1 + \pi_S}{2}$ and zero otherwise, because the lowest expected utility is generated by distribution p that delivers the highest error with certainty. Similarly, the α-MEU model (Ghirardato et al., 2004) is accommodated through $w(p_s, \pi^e) = \alpha p_s^{\max} + (1-\alpha) p_s^{\min}$ (here we preserve the notation α for the degree of optimism) with $p_s^{\min}$ as above and $p_s^{\max} = 1$ if $\pi_s = \pi^e$ and zero otherwise, because the highest expected utility is generated by a distribution that delivers exactly the reported expected value with certainty. These cases correspond to (3) with $\delta = 1$ (and, in the case of maxmin, $\alpha = 0$).

A.1 Second-order expected utility representation

The second-order expected utility (SOEU, Klibanoff et al., 2005) is free of the assumption that the probability distribution p that governs the inflation process is unique. Here we demonstrate that this assumption does not change main conclusions with respect to biases in reported expectations. The SOEU-maximizer solves

$$\max_{\pi^e} \sum_{k=1}^{K} \mu_k \cdot \phi \left(\sum_{s \in S} p_s^k \cdot u\left((\pi_s - \pi^e)^2 \right) \right), \tag{A.1}$$

where $\mu = \{\mu_k\}_{k=1..K}$ is the probability distribution over K conceivable probability distributions $p^k = \left\{p_s^k\right\}_{s=1..S}$ governing the expected utility function $\sum_{s \in S} p_s^k \cdot u_s$, and $\phi : \mathbb{R} \to \mathbb{R}$ reflects ambiguity attitudes of subjects: it is concave for ambiguity-averse subjects, convex for ambiguity-seekers and linear for ambiguity-neutrals.

Proposition 6 *If DM maximizes SOEU of $u_s(\pi_s, \pi^e) = u\left((\pi_s - \pi^e)^2\right)$ then reported expected inflation can be represented as*

$$\pi^e = \sum_{s \in S} \pi_s \cdot \hat{w}_s(\pi^e) \cdot \sum_{k=1}^{K} \hat{\nu}_k(\pi^e) \cdot \mu_k \cdot p_s^k, \tag{A.2}$$

where $\hat{w}_s(\pi^e)$ reflects the risk attitude, and $\hat{\nu}_k(\pi^e)$ reflects the ambiguity attitude of the DM.

While the terms $\mu_k \cdot p_s^k$ in (A.2) determine the probability value for a particular state s based on information embedded in μ_k, terms $\hat{w}_s(\pi^e)$ and $\hat{\nu}_k(\pi^e)$ reflect the distortion of this information through respondent's risk and ambiguity attitudes respectively.

Corollary 3 *Expected inflation reported by ambiguity-neutral subjects depends on their risk attitudes:*

$$\pi^e = \sum_{s \in S} \pi_s \cdot \hat{w}_s(\pi^e) \cdot p_s, \text{ with } p_s = \sum_{k=1}^{K} \mu_k \cdot p_s^k. \tag{A.3}$$

For the consumption choice case, consumers maximize the following SOEU:

$$\max_b \sum_{k=1}^{K} \mu_k \cdot \phi \left(\sum_{s \in S} p_s^k \cdot v \left(W_1 - B, \frac{W_2 + (1+i) \cdot B}{1 + \pi_s} \right) \right), \tag{A.4}$$

with the same notation as before. In a general case, the consistency assumption cannot be applied, as nonlinearity of ϕ prevents transforming (A.4) in a form that would allow us to identify an analogue of probability distribution $p = \{p_s\}_{s=1..S}$ governing the states of the world in the consumption choice problem. However, for ambiguity-neutral subjects ϕ is linear, which helps yield the following result:

Proposition 7 *For ambiguity-neutral DMs, expected inflation π^e consistent with (A.4) does not depend on risk attitudes:*

$$\pi^e = \sum_{s=1}^{S} \pi_s \cdot \hat{p}_s = \sum_{s \in S} \pi_s \cdot \sum_{k=1}^{K} \mu_k \cdot p_s^k. \tag{A.5}$$

A.2 Additional empirical estimates

Table A.2 gives estimates on the main sample 2015-19 of baseline specification (15) for ambiguity aversion AA_i, and a similar specification for risk attitudes where AA_i is replaced with the linear combination of RA_i and RS_i for risk-aversion and risk-seeking dummies correspondingly,

$$B_i^e = a + b^{RA} RA_i + b^{RS} RS_i + \sum_{n=1}^{N} b_n^M M_n + \sum_{n=1}^{D} b_n^D D_{n,i} + \epsilon_i, \tag{A.6}$$

and a specification where the main independent instead of AA_i is the continuous measure of risk tolerance given by the certainty equivalent CE_i:

$$B_i^e = a + b^{CE} CE_i + \sum_{n=1}^{N} b_n^M M_n + \sum_{n=1}^{D} b_n^D D_{n,i} + \epsilon_i. \tag{A.7}$$

Table A.1 summarizes effects of uncertainty attitudes on reported beliefs as in equation (16), using a continuous measure of risk aversion (CE) and estimated with $b^{AA\times CE} = 0$ in Panel A (without interaction terms) and without this restriction in Panel B (with interaction terms). Coefficients for CE show an upward shift in all beliefs due to risk tolerance. Note that an increase in CE either reflects a reduction in risk-aversion (if CE is below the expected payoff of the lottery) or an increase in risk-seeking (if CE is above the expected payoff). Hence the risk attitudes effect works in the same direction as that of ambiguity attitude: the less respondents tolerate uncertainty (both risk and ambiguity), the more they shift their reported beliefs downwards, on average. Joint effects of ambiguity and risk attitudes are significant for inflation measures.

Table A.3 estimates (15) for interest rates as the dependent variable, on subsamples of risk-neutral, risk-averse and risk-seeking respondents. As such, it is the interest rates counterpart of Table 3.

Table A.4 is a counterpart of Table 5, with the inclusion of interest rate measures on top of inflation measures reported in the main text, showing the difference in observed effects for cohorts with below median and above median reported beliefs. Table A.5 estimates (15) for bottom two-thirds versus top third expectations. Table A.6 estimates the same for bottom 80% expectations versus top 20%. For an overarching perspective, we create nested subsamples of subjects i with $B_i^e \leq T$, for each threshold $T = 4..30$ (B_i^e is either PastInfl, ExpInfl, PastRate, or ExpRate). For each subsample we estimate coefficients b^{AA} in (15), which gives us a mapping $b^{AA}(T)$, depicted in Figure A.1. The higher the average belief in the subsample, the lower the effect of ambiguity aversion detected in that subsample. Remarkably, the effect of ambiguity aversion on expected values (inflation and interest rates) is always above that on current (perceived) values, while the effect on inflation measures has a wider variation than that on interest rates.

Table A.7 is a counterpart of Table 5 with a continuous measure of risk tolerance (certainty equivalent, CE) instead of binary classification of respondents into risk-averse (RA), -neutral (RN) and -seeking (RS). The differential effect of ambiguity and risk attitudes for high and low expectations remains, although risk tolerance shows insignificant (or weakly positive, for expected interest rates) effect for low expectations.

Table A.1: Effects of ambiguity and risk attitudes on expectations and perceptions of inflation and interest rates.

	(1) PastInfl	(2) ExpInfl	(3) PastRate	(4) ExpRate
***Panel A**: full effects*				
AmbAverse	-2.821***	-2.416***	-0.388***	-0.119
	(-14.78)	(-13.21)	(-2.90)	(-0.86)
CE	2.071***	2.010***	0.419*	0.543**
	(6.98)	(7.28)	(1.90)	(2.33)
Constant	7.453***	6.808***	6.277***	6.692***
	(14.09)	(14.31)	(16.74)	(16.94)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
R2	0.062	0.053	0.045	0.047
N	14621	14621	14621	14621
***Panel B**: with interaction*				
AmbAverse	-2.060***	-1.628***	-0.268	0.055
	(-6.60)	(-5.39)	(-1.21)	(0.24)
CE	4.075***	4.085***	0.736	1.002*
	(5.01)	(5.21)	(1.30)	(1.74)
AmbAverse × CE	-2.518***	-2.607***	-0.398	-0.576
	(-2.90)	(-3.13)	(-0.65)	(-0.92)
Constant	6.836***	6.169***	6.180***	6.550***
	(11.90)	(11.83)	(15.31)	(15.52)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
R2	0.062	0.054	0.045	0.047
N	14621	14621.	14621	14621

Low inflation regime (sample 2015-19). t-statistics in parentheses. AmbAverse is dummy equal to 1 if ambiguity averse, zero otherwise. CE = willingness to accept for a lottery with known probabilities. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.2: Uncertainty attitudes and reported expectations and perceptions of inflation and interest rates.

	(1) PastInfl	(2) ExpInfl	(3) PastRate	(4) ExpRate
Panel A: *ambiguity attitudes*				
AmbAverse	-2.822***	-2.417***	-0.388***	-0.119
	(-14.74)	(-13.18)	(-2.90)	(-0.86)
Constant	8.067***	7.404***	6.401***	6.853***
	(15.40)	(15.68)	(17.27)	(17.56)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
r2	0.058	0.049	0.045	0.047
N	14621	14621	14621	14621
Panel B: *risk attitudes (binary)*				
RA	-0.231	-0.049	0.107	0.020
	(-1.58)	(-0.37)	(1.00)	(0.17)
RS	1.646***	1.800***	0.828***	0.833***
	(7.18)	(8.42)	(4.99)	(4.79)
Constant	5.871***	5.233***	6.572***	7.338***
	(16.75)	(16.32)	(25.30)	(26.57)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
r2	0.046	0.040	0.046	0.049
N	14621.000	14621.000	14621.000	14621.000
Panel C: *risk attitudes (continuous)*				
CE	2.075***	2.013***	0.420*	0.543**
	(6.93)	(7.25)	(1.90)	(2.33)
Constant	5.220***	4.895***	5.970***	6.597***
	(10.20)	(10.80)	(16.64)	(17.44)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
r2	0.042	0.035	0.044	0.047
N	14621.000	14621.000	14621.000	14621.000
N	14621	14621	14621	14621

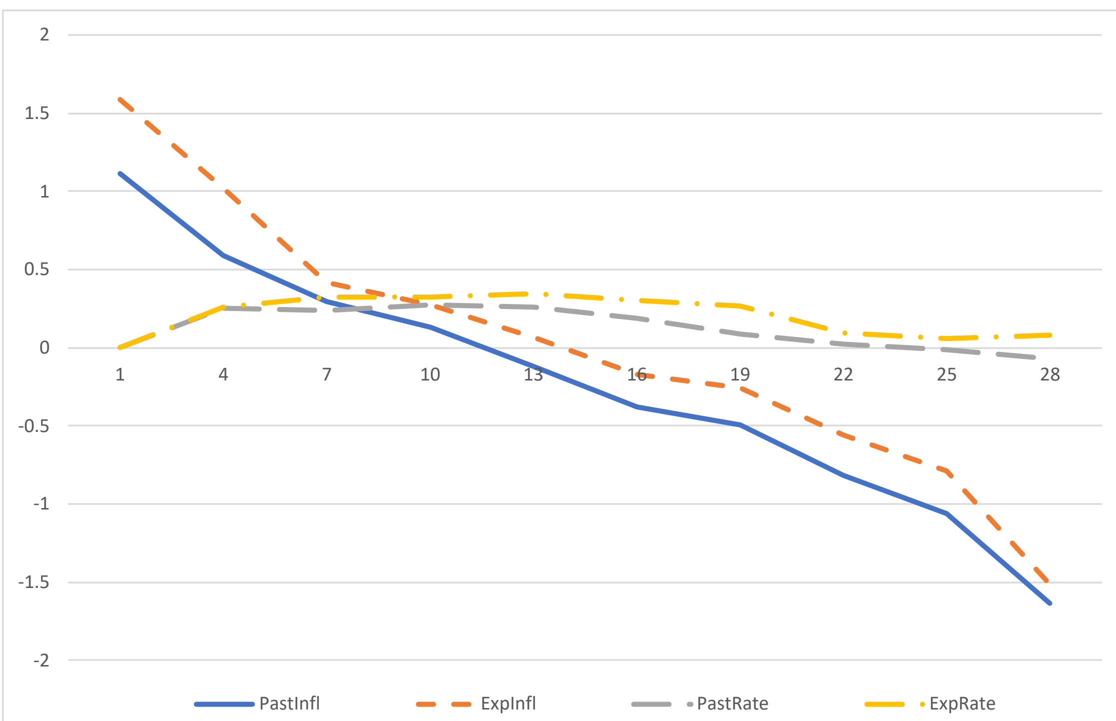
Notes: Low inflation regime (sample 2015-19). t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.3: Effect of ambiguity aversion on expectations and perceptions of interest rates in cohorts of risk-neutral, risk-averse and risk-seeking subjects.

	(1)	(2)	(3)	(4)	(5)	(6)
	Risk-neutral		Risk-averse		Risk-seeking	
	PastRate	ExpRate	PastRate	ExpRate	PastRate	ExpRate
AmbAverse	-0.146	0.016	-0.279*	0.021	-0.887**	-0.621*
	(-0.51)	(0.06)	(-1.68)	(0.12)	(-2.45)	(-1.67)
Constant	6.584***	7.584***	7.293***	7.702***	7.564***	7.375***
	(8.59)	(9.50)	(14.94)	(14.64)	(5.94)	(5.80)
Survey	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.05	0.05	0.048	0.048	0.039	0.048
N	3546	3546	8837	8837	2238	2238

Notes: Low inflation regime (sample 2015-19). t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure A.1: Ambiguity aversion effect in subsamples with restricted beliefs ($Belief \leq T$).



Note: Coefficients β (vertical axis) in $y_i = \alpha + \beta AA_i + \epsilon$ for $y \in \{PastInfl, ExpInfl, PastRate, ExpRate\}$ and $i \in \{i : y_i \leq T\}$. Values of threshold T on the horizontal axis.

Table A.4: Effects of ambiguity and risk attitudes on expectations and perceptions of inflation in cohorts with low (below median) and high (above median) expectations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Risk attitudes				Ambiguity attitudes			
	PastInfl	ExpInfl	PastRate	ExpRate	PastInfl	ExpInfl	PastRate	ExpRate
Panel A: *below median beliefs*								
RA	-0.010	-0.127*	-0.044	-0.051				
	(-0.13)	(-1.75)	(-1.15)	(-1.20)				
RS	-0.188	-0.267**	-0.170***	-0.137**				
	(-1.41)	(-2.08)	(-2.98)	(-2.12)				
AmbAverse					0.371***	0.467***	0.239***	0.339***
					(3.06)	(3.97)	(5.19)	(6.47)
Constant	2.283***	2.857***	4.506***	5.094***	0.836***	2.150***	3.232***	3.701***
	(12.65)	(15.05)	(48.52)	(47.89)	(2.78)	(7.35)	(19.60)	(19.18)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.03	0.017	0.022	0.023	0.032	0.019	0.024	0.028
N	8325	9315	8304	8152	8325.000	9315.000	8304.000	8152.000
Panel B: *above median beliefs*								
RA	-0.304	-0.119	-0.106	0.083				
	(-1.43)	(-0.53)	(-0.62)	(0.49)				
RS	1.482***	1.447***	1.069***	1.181***				
	(5.11)	(4.77)	(4.33)	(4.83)				
AmbAverse					-2.702***	-2.975***	-1.143***	-0.758***
					(-11.88)	(-12.38)	(-5.78)	(-3.88)
Constant	12.775***	11.214***	10.153***	11.312***	17.316***	14.441***	11.938***	12.486***
	(25.66)	(22.21)	(26.21)	(28.59)	(23.09)	(18.93)	(18.32)	(21.72)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.061	0.085	0.066	0.071	0.077	0.109	0.066	0.069
N	6296.000	5306.000	6317.000	6469.000	6296.000	5306.000	6317.000	6469.000

Low inflation regime (sample 2015-19). t-statistics in parentheses. AmbAverse is dummy equal to 1 if ambiguity averse, zero otherwise. CE = willingness to accept for a lottery with known probabilities. RA is dummy, equal to 1 if CE below expected value of the lottery, zero otherwise. RS is dummy, equal to 1 if CE above expected value of the lottery, zero otherwise. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.5: Effects of ambiguity aversion on expectations and perceptions of inflation and interest rates, for cohorts with beliefs below and above 33rd percentile.

	(1) PastInfl	(2) ExpInfl	(3) PastRate	(4) ExpRate
***Panel A:** bottom 66.6%*				
AmbAverse	-0.033	0.400***	0.290***	0.324***
	(-0.29)	(3.61)	(5.60)	(5.58)
Constant	3.342***	1.914***	3.976***	4.989***
	(10.72)	(5.19)	(21.04)	(28.73)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
r2	0.033	0.016	0.016	0.018
N	11858.000	10296.000	10470.000	9994.000
***Panel B:** top 33.3%*				
AmbAverse	-1.650***	-2.866***	-1.044***	-0.755***
	(-6.41)	(-11.39)	(-4.55)	(-3.41)
Constant	21.116***	16.640***	13.623***	14.323***
	(22.57)	(19.85)	(20.60)	(21.86)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
r2	0.082	0.104	0.045	0.046
N	2763.000	4325.000	4151.000	4627.000

Low inflation regime (sample 2015-19). t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.6: Effects of ambiguity aversion on expectations and perceptions of inflation and interest rates, for cohorts with beliefs below and above 20th percentile.

	(1) PastInfl	(2) ExpInfl	(3) PastRate	(4) ExpRate
Panel A: *bottom 80%*				
AmbAverse	-0.123	0.159	0.213***	0.350***
	(-1.07)	(1.44)	(3.49)	(5.06)
Constant	3.237***	2.961***	4.738***	5.726***
	(10.39)	(7.60)	(21.72)	(26.62)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
r2	0.031	0.017	0.011	0.010
N	12132.000	12428.000	11837.000	11935.000
Panel B: *top 20%*				
AmbAverse	-1.587***	-1.727***	-1.209***	-0.449*
	(-6.32)	(-6.16)	(-4.70)	(-1.81)
Constant	22.877***	23.389***	16.265***	17.238***
	(23.81)	(22.47)	(21.32)	(21.91)
Survey	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes
r2	0.075	0.100	0.045	0.040
N	2489.000	2193.000	2784.000	2686.000

Low inflation regime (sample 2015-19). t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.7: Effects of ambiguity and risk attitudes on expectations and perceptions of inflation and interest rates in cohorts with low (below median) and high (above median) expectations: continuous measure of risk tolerance.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Below median expectations				Above median expectations			
	PastInfl	ExpInfl	PastRate	ExpRate	PastInfl	ExpInfl	PastRate	ExpRate
	PastInfl	ExpInfl	PastRate	ExpRate	PastInfl	ExpInfl	PastRate	ExpRate
Panel A: total effects								
AmbAverse	0.372***	0.466***	0.239***	0.339***	-2.700***	-2.961***	-1.139***	-0.756***
	(3.07)	(3.96)	(5.18)	(6.47)	(-11.91)	(-12.34)	(-5.76)	(-3.87)
CE	-0.120	0.164	0.066	0.155*	2.165***	1.763***	0.790**	0.621*
	(-0.70)	(1.00)	(0.86)	(1.76)	(5.43)	(4.19)	(2.36)	(1.86)
Constant	0.867***	2.105***	3.213***	3.658***	16.647***	13.859***	11.707***	12.291***
	(2.82)	(7.15)	(19.33)	(18.79)	(22.05)	(17.92)	(17.65)	(21.05)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.032	0.019	0.024	0.029	0.081	0.112	0.067	0.070
N	8325	9315	8304	8152	6296	5306	6317	6469
Panel B: joint effects								
AmbAverse	0.594***	0.684***	0.200***	0.347***	-2.169***	-2.614***	-0.990***	-0.440
	(2.80)	(3.21)	(2.61)	(3.88)	(-5.80)	(-6.50)	(-3.04)	(-1.36)
CE	0.525	0.796	-0.036	0.177	3.428***	2.564***	1.170	1.432*
	(0.92)	(1.43)	(-0.19)	(0.80)	(3.90)	(2.76)	(1.48)	(1.87)
CE × AmbAverse	-0.772	-0.763	0.128	-0.028	-1.687*	-1.077	-0.485	-1.032
	(-1.30)	(-1.32)	(0.61)	(-0.12)	(-1.72)	(-1.04)	(-0.56)	(-1.21)
Constant	0.675*	1.929***	3.243***	3.651***	16.276***	13.584***	11.585***	12.033***
	(1.91)	(5.63)	(18.56)	(17.86)	(20.73)	(16.61)	(16.57)	(19.34)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.032	0.019	0.024	0.029	0.082	0.112	0.067	0.070
N	8325	9315	8304	8152	6296	5306	6317	6469

Notes: Low inflation regime (sample 2015-19). AA is ambiguity aversion from the two-color Ellsberg task. CE is the willingness to accept a lottery with known probabilities. t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.8 is the counterpart of Table 10 where instead of measures of financial literacy and proficiency in business and economics we use attentiveness to economic and monetary policy news.

Table A.9 shows effects of ambiguity and risk attitudes on expected changes in inflation and interest rates in 2022. The results lack consistency. As explained in the main text, due to a shift in the inflation regime in 2022, differencing is not suitable to reduce the bias in reported beliefs. The positive effect of risk tolerance (CE) confirms that the bias has not been removed.

B Proofs

Proof of Proposition 1. A DM with a NEO-additive CEU and state-dependent utility $u\left((\pi_s - \pi^e)^2\right)$ solves

$$\max_{\pi^e} (1-\delta) \sum_{s \in S} p_s \cdot u\left((\pi_s - \pi^e)^2\right) + \delta \cdot \left(\alpha \cdot u_{max} + (1-\alpha) \cdot u_{min}\right), \tag{B.1}$$

where $u_{max} = u\left((\pi^e - \pi^e)^2\right) = u(0)$ and $u_{min} = u\left((\pi_1 - \pi^e)^2\right)$ if reported value π^e is above the mid-range of possible inflation values, or $u_{min} = u\left((\pi_S - \pi^e)^2\right)$ if π^e is below mid-range. The first-order condition is then

$$\begin{aligned} &(1-\delta) \sum_{s \in S} p_s \cdot u'\left((\pi_s - \pi^e)^2\right) \cdot 2\left(\pi_s - \pi^e\right) \\ &+ \delta \cdot \Big(\alpha \cdot u'\left((\pi_\xi - \pi^e)^2\right) \cdot 2\left(\pi_\xi - \pi^e\right) + (1-\alpha) \cdot 0\Big) = 0, \end{aligned} \tag{B.2}$$

where $\xi = 1$ if $\pi^e \geq \frac{\pi_1 + \pi_S}{2}$ and $\xi = S$ if $\pi^e < \frac{\pi_1 + \pi_S}{2}$. Noting that $0 \equiv u'\left((\pi^e - \pi^e)^2\right) \cdot 2\left(\pi^e - \pi^e\right)$, we can write the first-order condition as

$$\sum_{s \in S} w(p_s, \pi^e) \cdot u'\left((\pi_s - \pi^e)^2\right) \cdot 2\left(\pi_s - \pi^e\right) = 0, \tag{B.3}$$

where $w(p_s, \pi^e)$ is

$$w(p_s, \pi^e) = \begin{cases} (1-\delta) \cdot p_s + \delta \cdot \alpha & \text{if} \quad s : \pi_s = \pi^e \\ (1-\delta) \cdot p_s + \delta \cdot (1-\alpha) & \text{if} \quad s = 1 \text{ and } \pi^e \geq \frac{\pi_1 + \pi_S}{2}, \text{ or } s = S \text{ and } \pi^e < \frac{\pi_1 + \pi_S}{2} \\ (1-\delta) \cdot p_s & \qquad \text{otherwise.} \end{cases} \tag{B.4}$$

Table A.8: Attentiveness to economic news and the effect of ambiguity aversion on reported beliefs.

	(1) PastInfl	(2) ExpInfl	(3) PastRate	(4) ExpRate	(5) PastInfl	(6) ExpInfl	(7) PastRate	(8) ExpRate
AmbAverse	-2.747***	-2.349***	-0.359***	-0.087	-2.710***	-2.308***	-0.380***	-0.113
	(-14.28)	(-12.75)	(-2.65)	(-0.62)	(-14.20)	(-12.63)	(-2.83)	(-0.81)
RA	-0.330**	-0.133	0.094	0.017	-0.327**	-0.129	0.093	0.015
	(-2.27)	(-1.01)	(0.89)	(0.15)	(-2.25)	(-0.98)	(0.87)	(0.14)
RS	1.481***	1.658***	0.806***	0.828***	1.471***	1.654***	0.810***	0.830***
	(6.52)	(7.83)	(4.86)	(4.75)	(6.49)	(7.82)	(4.88)	(4.77)
AmbAverse × SearchEC					-5.013**	-5.246**	0.720	0.776
					(-2.18)	(-2.39)	(0.51)	(0.58)
AmbAverse × SearchFED					7.805***	5.933***	-2.125*	-2.092*
					(3.86)	(2.91)	(-1.67)	(-1.80)
Constant	8.285***	7.336***	6.988***	7.454***	8.094***	7.189***	6.983***	7.507***
	(20.78)	(20.01)	(23.71)	(23.99)	(20.78)	(19.91)	(24.21)	(24.46)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.065	0.057	0.047	0.049	0.067	0.058	0.047	0.049
N	14621.000	14621.000	14621.000	14621.000	14621.000	14621.000	14621.000	14621.000

Notes: Low inflation regime (sample 2015-19). SearchEC = 1 if respondent reports having searched for economic news in the week before survey wave, zero otherwise. SearchFED = 1 if respondent reports having searched for news on Fed in the week before survey wave, zero otherwise. t-statistics in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A.9: Effects of ambiguity and risk attitudes on expected changes in inflation and interest rates: high inflation regime.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	DiffInfl	DiffRate	DiffInfl	DiffRate	DiffInfl	DiffRate	DiffInfl	DiffRate
AmbAverse	-0.269	-0.145					-1.000	0.196
	(-0.71)	(-0.79)					(-1.43)	(0.64)
AmbPremium			-1.620*	0.781*				
			(-1.67)	(1.76)				
CE					0.332	0.702*	-0.364	1.302**
					(0.36)	(1.73)	(-0.28)	(2.37)
AmbAverse × CE							2.031	-1.211
							(1.12)	(-1.51)
Constant	-6.911***	0.829	-6.790***	0.607	-7.170***	0.534	-6.764***	0.476
	(-6.87)	(1.62)	(-6.79)	(1.20)	(-7.09)	(1.04)	(-6.33)	(0.91)
Survey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.040	0.006	0.040	0.006	0.039	0.006	0.040	0.007
N	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000	3152.000

High inflation regime (sample 2022). t-statistics in parentheses. AmbAverse is dummy equal to 1 if respondent is ambiguity averse, zero otherwise. CE = willingness to accept for a lottery with known probabilities. AmbPremium = difference in willingess to accept for lotteries with known and unknown probabilities. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

It follows that the forecasting error is minimized and the utility of forecasting is maximized if and only if the reported value of π^e is

$$\sum_{s\in S} w(p_s,\pi^e)\cdot u'\left((\pi_s-\pi^e)^2\right)\cdot \pi_s = \pi^e \cdot \sum_{s\in S} w(p_s,\pi^e)\cdot u'\left((\pi_s-\pi^e)^2\right), \tag{B.5}$$

i.e.

$$\pi^e = \sum_{s\in S} \pi_s \cdot w\left(p_s,\pi^e\right)\cdot \rho_s\left(\pi^e\right), \tag{B.6}$$

where the system of weights $\rho_s\left(\pi^e\right)$ reflects the DM's risk attitude:

$$\rho_s\left(\pi^e\right) = \frac{u'\left((\pi_s-\pi^e)^2\right)}{\sum_{s'\in S} w\left(p_{s'},\pi^e\right)\cdot u'\left((\pi_{s'}-\pi^e)^2\right)} > 0. \tag{B.7}$$

For risk-neutral DMs, linearity of u implies $u'\left((\pi_s-\pi^e)^2\right) = const$, which together with $\sum_{s'\in S} w\left(p_{s'},\pi^e\right) = 1$ yields $\rho_s\left(\pi^e\right) \equiv 1$. ■

Proof of Proposition 2. The proof is by substituting for $p_s\left(\mathbf{M}\right) = a_s + \mathbf{b}_s\mathbf{M}$ in equation (4) and re-arranging. ■

Proof of Proposition 5. The proof is by substituting $p_s\left(\mathbf{M}\right) = a_s + \mathbf{b}_s\mathbf{M}$ in the definition of $w(p_s,B,R)$ in (12) and subsequently in (13), and re-arranging. ■

Proof of Proposition 6. The first-order condition is

$$\sum_{k=1}^{K} \mu_k \cdot f_k \cdot \sum_{s\in S} p_s \cdot u'\left((\pi_s-\pi^e)^{-2}\right)\cdot 2\left(\pi_s-\pi^e\right) = 0, \tag{B.8}$$

where

$$f_k = \phi'\left(\sum_{s\in S} p_s^k \cdot u\left((\pi_s-\pi^e)^{-2}\right)\right).$$

Note that for any k the term $\sum_{s\in S} p_s^k \cdot u\left((\pi_s-\pi^e)^{-2}\right)$ is a function of the decision variable π^e. For ambiguity-neutral subjects it is a positive real number, independent of π^e.

By definition of ϕ, the vector of f_k reflects ambiguity attitudes: for lower values of expected utility $\sum_{s\in S} p_s^k \cdot u\left((\pi_s-\pi^e)^{-2}\right)$ concavity of ϕ implies higher values of f_k, i.e. the decision-maker overemphasises worse expected outcomes and places less weight on better expected outcomes.

From (B.8), we obtain

$$\pi^e \cdot \sum_{k=1}^{K} \mu_k \cdot f_k \cdot \sum_{s\in S} p_s^k \cdot u'\left((\pi_s-\pi^e)^{-2}\right) = \sum_{k=1}^{K} \mu_k \cdot f_k \cdot \sum_{s\in S} \pi_s \cdot p_s^k \cdot u'\left((\pi_s-\pi^e)^{-2}\right).$$

Multiply both sides with $\left(\sum_{k'=1}^{K}\mu_{k'}\cdot f_{k'}\right)^{-1} > 0$ (positivity follows from strictly positive f_k and definition of μ_k as probabilities) and re-arrange:

$$\begin{aligned}\pi^e\cdot\frac{1}{\sum_{k'=1}^{K}\mu_{k'}\cdot f_{k'}}\cdot\sum_{s\in S}\sum_{k=1}^{K}\mu_k\cdot f_k\cdot p_s^k\cdot u'\left((\pi_s-\pi^e)^{-2}\right) = \\ = \frac{1}{\sum_{k'=1}^{K}\mu_{k'}\cdot f_{k'}}\cdot\sum_{s\in S}\sum_{k=1}^{K}\pi_s\cdot\mu_k\cdot f_k\cdot p_s^k\cdot u'\left((\pi_s-\pi^e)^{-2}\right).\end{aligned} \tag{B.9}$$

Note that

$$\sum_{k=1}^{K}\mu_k\cdot\frac{f_k}{\sum_{k'=1}^{K}\mu_{k'}\cdot f_{k'}} = 1.$$

We can define probabilistic weights $\nu_k = \mu_k\cdot\frac{f_k}{\sum_{k'=1}^{K}\mu_{k'}\cdot f_{k'}}$, $0\le\nu_k\le 1$, so that the values $p_s = \sum_{k=1}^{K}\nu_k\cdot p_s^k$ have an interpretation of "expected" probability values. With this notation, (B.9) yields

$$\pi^e\cdot\sum_{s\in S}p_s\cdot u'\left((\pi_s-\pi^e)^{-2}\right) = \sum_{s\in S}\pi_s\cdot p_s\cdot u'\left((\pi_s-\pi^e)^{-2}\right), \tag{B.10}$$

and hence

$$\pi^e = \sum_{s\in S}\pi_s\cdot\frac{p_s\cdot u'\left((\pi_s-\pi^e)^{-2}\right)}{\sum_{s\in S}p_s\cdot u'\left((\pi_s-\pi^e)^{-2}\right)} = \sum_{s\in S}\pi_s\cdot p_s\cdot\hat{w}_s. \tag{B.11}$$

Equation (B.11) leads to the result in (A.2), where $\hat{\nu}_k = \frac{f_k}{\sum_{k'=1}^{K}\mu_{k'}\cdot f_{k'}}$.

■

Proof of Proposition 7. For ambiguity-neutral DMs, the consumption choice problem (A.4) takes the form:

$$\max_b\sum_{s\in S}\sum_{k=1}^{K}\mu_k\cdot p_s^k\cdot v\left(W_1-B,\frac{W_2+(1+i)\cdot B}{1+\pi_s}\right). \tag{B.12}$$

By Definition 1, expected inflation π^e consistent with (A.4) is

$$\pi^e = \sum_{s\in S}\pi_s\cdot\sum_{k=1}^{K}\mu_k\cdot p_s^k, \tag{B.13}$$

or, denoting $\hat{p}_s = \sum_{k=1}^{K}\mu_k\cdot p_s^k$, it is $\pi^e = \sum_{s=1}^{S}\pi_s\cdot\hat{p}_s$. By construction, none of the terms depends on risk attitudes. ■

C Survey questionnaire

Thank you for participating in our survey. We are interested in your view on current and future prices, inflation and interest rates in the United States.

The survey consists of 15 questions. It usually takes less than 5 minutes to answer them (most participants do this in 3 minutes). No special knowledge is required. There is no right or wrong answer to our questions. In fact, any answer is correct as long as it truly reflects your opinion. All responses are anonymous.

If you decide to quit the survey at any stage, please let us know why, by using a special comment field available at each page. You will also be able to give us some general feedback in the end.

Thank you for your help, and welcome to the survey!

1. From your perspective, by how much did prices in general change during the past 12 months? Please use the drop-down menu below. For example, if you think prices on average have decreased by about 5%, choose "down by 5%"; if you think they have risen by 5%, choose "up by 5%".

Answer options: dropdown scrollable menu with options from "up by 30%" to "down by 30%".

2. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

3. What annual interest rate do you think an average US citizen would be charged, if they take a car loan of $ 10,000 this week? Please use the drop-down menu below.

Answer options: dropdown scrollable menu with options from "0%" to "30% and above".

4. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

5. By how much do you think prices in general will change during the next 12 months? Please use the drop-down menu below. For example, if you think prices on average will decrease by about 5%, choose "down by 5%"; if you think they will rise by 5%, choose "up by 5%".

Answer options: dropdown scrollable menu with options from "up by 30%" to "down by 30%".

6. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

7. What annual interest rate do you think an average US citizen will be charged, if they take a car loan of $ 10,000 in a year from now? Please use the drop-down menu below.

Answer options: dropdown scrollable menu with options from "0%" to "30% and above".

8. How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

9. [Only in 2015-19 surveys] If you had an extra $ 1,000 now, how much of this amount, in dollars, you would spend in the current situation on the following (you can also allocate the whole amount to just one option):

- Stocks (mutual funds)
- Safe assets (401k, pension funds, treasury bills)
- Term deposit for 3 months or more
- Mortgage contribution (raise mortgage deposit or make an extra payment)
- Buy a car, holiday trip, jewellery or durable goods like a fridge/freezer
- Other household expenses

Answer options: free text box for each option with control that the input content is a number and the sum of all numbers equals 1000.

9. [Only in 2022 surveys] By how much do you think prices in general will change during a 12-months period in 5 years from now? Please use the drop-down menu below. For example, if you think prices on average will decrease by about 5%, choose "down by 5%"; if you think they will rise by 5%, choose "up by 5%".

10. [Only in 2015-19 surveys] In your opinion, how many of the following four statements are true?

a) An investment with a high return is likely to be high risk.

b) High inflation means that the cost of living is increasing rapidly.

c) It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks and shares.

d) If you put $ 100 into a no fee savings account with a guaranteed interest rate of 2% per year, at the end of five years there will be over $ 110.

Answer options: - none of them is true - 1 is true - 2 are true - 3 are true - all 4 of them are true

10. [Only in 2022 surveys] How confident are you in this answer?

Answer options: Absolutely sure, Rather sure; Neither sure, nor unsure; Rather unsure; Absolutely unsure.

11. Consider a lottery ticket with a 50% chance of winning $ 100,000 and 50% chance of getting nothing. What is the LOWEST AMOUNT of money you would accept in exchange for this lottery ticket? We assume that you would also be happy to swap the lottery ticket for any amount higher than the one you indicate.

Answer options: from $ 60,000 to $ 5,000 with step $ 5,000, and additional two options of $ 1,000 and $ 500.

12. [Only in 2015-19 surveys] Consider two urns, each containing 100 balls coloured either red or blue.

Urn A contains red and blue balls in an unknown proportion. Urn B contains 50 red balls and 50 blue balls.

You will get a prize if you draw a RED ball. From which urn would you draw - from urn A or B?

Answer options: - Urn A (unknown proportion) - Urn B (50/50)

12. [Only in 2022 surveys] Consider a similar lottery ticket, except that the chance of winning $100,000 is UNKNOWN. What is the LOWEST AMOUNT of money you would accept in exchange for this lottery ticket? We assume that you would also be happy to swap the lottery ticket for any amount higher than the one you indicate.

Answer options: from $ 60,000 to $ 5,000 with step $ 5,000, and additional two options of $ 1,000 and $ 500.

13. [Only in 2015-19 surveys] Consider the same two urns as above, again each containing 100 balls coloured either red or blue.

Urn A contains red and blue balls in an unknown proportion. Urn B contains 50 red balls and 50 blue balls.

You will get a prize if you draw a BLUE ball. From which urn would you draw - from urn A or B? w

Answer options: - Urn A (unknown proportion) - Urn B (50/50)

13. [Only in 2022 surveys] How would you rank your understanding of economic and business issues? (1 star = I understand very little, 5 stars = I am an expert)

14. During the last week, have you heard any news about the monetary policy of the Federal Reserve (Fed)? What did you hear?

Answer options:

- I have NOT heard any news about the Fed policy
- I have heard that the Fed would raise interest rates
- I have heard that the Fed would keep interest rates at the current level
- I have heard that the Fed would lower interest rates
- I have heard some other news about the Fed, namely:

15. During the last week, what were your main sources of information on economic and business conditions? Please choose up to three options.

Answer options:

- Official sources (like the webpages of the White House, the Government, statistical agencies or the Fed)
- Articles in specialised newspapers (like Financial Times, The Wall Street Journal, The Economist) - online or in print
- Articles in general interest newspapers - online or in print
- Other Internet sources (for example, blogs, discussion forums, etc.)
- News programmes on television and radio
- Other programmes on television and radio
- Employer and colleagues

- Friends and relatives
- I did not come across any information on economic and business conditions
- Other sources of information (please specify) - [open text box]

Thank you for taking part in our survey!