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Abstract

We study the effects of monetary policy on aggregate consumption combining a heterogeneous agent model with measured expectations under different policy counterfactuals. We express the consumption of non-hand-to-mouth households as a function of expectations only and elicit all expectations appearing in the consumption functions for alternative policy scenarios with tailored surveys. Feeding these individual-level expectations into the model illustrates that a modest forward guidance statement in March 2021 would have reduced aggregate consumption by 0.14 percent on impact and an interest rate hike of 40 basis points in March 2022 would have reduced aggregate consumption by 0.30 percent on impact.

JEL Classification: D12, D14, D83, D84, E32, G11
Keywords: Monetary Policy, Expectation Formation, Aggregate Consumption.

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1 Introduction

Expectations are central for the effectiveness of both conventional and unconventional monetary policy (Angeletos and Lian, 2018; Farhi and Werning, 2019; García-Schmidt and Woodford, 2019; Gabaix, 2020; McKay et al., 2016; Kaplan et al., 2018). Yet, modeling expectation formation in response to monetary policy is challenging, especially in settings with heterogeneous agents with limited cognitive abilities, which may disagree about the response of the economy to monetary policy shocks (Andre et al., 2022a).

In this paper, we propose an approach to identify the effects of monetary policy that feeds estimates of expectation differences across policies – measured in tailored surveys – into a heterogeneous agent model, and thus remains agnostic about the way expectations are formed.[1]

The main idea of this paper can be illustrated with a simple example. Many macroeconomic models imply equations of the form:

$$Y = \alpha E\left[X\left(Z\right)\right], \tag{1}$$

where Y is an outcome variable (e.g. consumption of an individual), X is an endogenous variable (e.g. lifetime income of the individual), and Z is a structural shock (e.g. a policy shock). Furthermore, α is a coefficient and E is the subjective expectation of the agent. The marginal effect of the structural shock on the outcome variable is

$$\frac{\partial Y}{\partial Z} = \alpha \frac{\partial E\left[X\left(Z\right)\right]}{\partial Z}.$$

To compute the derivative $\frac{\partial E[X(Z)]}{\partial Z}$, one usually makes assumptions about expectation formation. The most common assumption is that agents have full-information rational expectations: agents know the realization of the shock Z and are right about how the

[1] In a recent commentary, Monika Piazzesi calls for the use of subjective beliefs measured in surveys as an input in theoretical models (Brunnermeier et al., 2021). For an introduction to this "temporary equilibrium with measured expectations" approach see Piazzesi and Schneider (2016). Applications include Landvoigt et al. (2015) and Leombroni et al. (2020).

distribution of X moves with Z (Christiano et al., 2005; Smets and Wouters, 2007; Eggertsson and Woodford, 2003; McKay et al., 2016; Kaplan et al., 2018). One alternative is to assume that agents have incomplete information about the realization of Z, e.g. due to sticky information (Mankiw and Reis, 2002), exogenous noisy signals (Woodford, 2003), rational inattention (Sims, 2003; Mackowiak and Wiederholt, 2009), or sparsity (Gabaix, 2014). The other alternative is to assume that agents have distorted beliefs about the effect of Z on X, e.g. due to level-k thinking (Farhi and Werning, 2019), reflexive expectations (García-Schmidt and Woodford, 2019), diagnostic expectations (Bordalo et al., 2019), or adaptive learning (Evans and Honkapohja, 2012). In this paper, we take a different route. We directly elicit the expectation $E[X(Z)]$ for alternative policies and agents' attentiveness at the individual level. We can thereby compute the effect of the shock Z on the outcome variable Y without making assumptions about expectation formation.

We implement this idea in the context of a Heterogeneous Agent New Keynesian model. The assumptions about preferences, asset structure, and borrowing constraints are similar to the assumptions in McKay et al. (2016). Consider a household who is currently not borrowing constrained and holds the belief that it will not be borrowing constrained in the future. The log-linearized consumption function of this type of household has the following form: current consumption is a linear function of the expectation of lifetime income, the expectation of the discounted sum of current and future real interest rates, and the expectation of end-of-previous-period real liquid wealth (Angeletos and Lian, 2018). This is an example of equation (1) but with multiple terms on the right-hand side of the equation. In the survey, we elicit all expectations that appear on the right-hand side of this consumption function for a baseline policy and an alternative policy. Substituting the difference in expectations across policies into the consumption function we can assess the effect on consumption of implementing one policy instead of another policy. As part of the survey, we also elicit a household's subjective probability of becoming borrowing constrained in the future and whether the household is currently borrowing constrained. This allows us to substitute the expectation differences into the consumption function that is adequate for this type of household. Aggregating across households yields the differ-

ence in aggregate consumption across policies on impact. This approach captures both direct effects of monetary policy, which operate through the expected real interest rate path, and indirect effects of monetary policy, which operate through the expected income path. In sum, at a given point in time we feed the empirical joint distribution of hand-to-mouth status, subjective probability of becoming borrowing constrained, and expectation differences across policies into a standard consumption model to compute how aggregate consumption would vary across policy alternatives.

This approach can be used to study the effects of conventional and unconventional monetary policy. To illustrate this point, we elicited the expectations that appear in the consumption functions for alternative forward guidance statements in March 2021 and for alternative interest rate decisions in March 2022. The elicitation was done in the days before the FOMC meetings to capture the expectations in the relevant context. In March 2021, we studied the effects of unconventional monetary policy, since there appeared to be broad agreement at the Federal Reserve to keep the current interest rate close to zero. In March 2022, we examined the effects of conventional monetary policy, because FOMC members were publicly debating the timing and the size of an interest rate increase. We highlight our approach in detail for the unconventional monetary policy survey, and afterwards briefly describe our results from the conventional monetary policy survey.

In our forward guidance survey, conducted with more than 2,000 US households, we study household expectations under different Fed projections about the future federal funds rate. To do so, we leverage hypothetical vignettes, which provide us with tight control over our respondents' information sets. Respondents first complete a hypothetical scenario in which they are asked to imagine that at the next Fed meeting the projected federal funds rate for the year 2023 remains constant at 0.1 percent. They are then asked about their expectations about the federal funds rate, the inflation rate, and their nominal household income under this scenario. Second, respondents are asked to think of an alternative hypothetical scenario in which the projected federal funds rate for the year 2023 increases from 0.1 percent to 0.5 percent at the next Fed meeting. We then elicit our respondents' expectations about the federal funds rate, the inflation rate as well as their

income under this alternative scenario.

Respondents' expectations differ across the two forward guidance scenarios. First, the increase in the Fed's projection substantially increases respondents' expectations about the federal funds rate in the years after the announcement. The effect peaks at 0.19 percentage points for the rate in 2023 and then reverts back to close to zero in 2026 and 2030, consistent with the Fed's long-term projections remaining unchanged. Second, respondents reduce their inflation expectations in response to the increase in the projected federal funds rate in 2023. Expectations decrease by 0.25 percentage points for inflation in 2021, on impact of the announcement, and less strongly for later time periods. Third, there is a muted average response of nominal income expectations over all relevant time horizons.

To compute the model-based aggregate consumption responses to the change in Fed projections, we directly feed the estimated expectation counterfactuals of the relevant behavioral types into the model. Thus, we calculate the effects of adjustments in the Fed's projection on aggregate consumption based on how non-hand-to-mouth households actually adjust their expectations in response to changes in the Fed's projection. This approach yields a predicted reduction of aggregate consumption by 0.14 percent on impact of the announcement. The modest response reflects both that real income effects and intertemporal substitution effects work in opposite directions, and that the size of the expectation differences across policy scenarios is modest.

We also apply our approach to conventional monetary policy with a survey in March 2022 with a baseline scenario in which the Fed keeps the current federal funds rate at 0.1 percent and an alternative scenario in which the federal funds rate is increased to 0.5 percent. Respondents have higher inflation expectations in the alternative scenario, in line with respondents interpreting the interest rate hike as a signal about the Fed's private information of future inflationary pressures. As in our forward guidance survey, respondents' expectations about their nominal household income do not differ across the two scenarios. Based on the expectation differences measured in the survey, our model predicts that consumption would be 0.30 percent lower in the scenario featuring a rate

hike.

To validate our model-based consumption predictions, we conducted an additional survey in September 2022 in which – on top of expectations – we also measure differences in spending plans across the two hypothetical scenarios. The model-based estimates of consumption responses are strongly positively correlated with the survey-based measures of spending plans, corroborating the validity of our approach.

We contribute to a literature assessing the effects of conventional monetary policy (Kaplan et al., 2018) and unconventional monetary policy (Eggertsson and Woodford, 2003; Del Negro et al., 2012). To explain why forward guidance has more muted effects than suggested by standard models, previous work has proposed anticipated future credit constraints (McKay et al., 2016), a lack of common knowledge (Angeletos and Lian, 2018), level-k thinking (Farhi and Werning, 2019), reflexive expectations (García-Schmidt and Woodford, 2019), myopia (Gabaix, 2020), or inattention (Wiederholt, 2015) as reasons. Our paper offers a new methodological approach to assess the effectiveness of conventional and unconventional monetary policy that combines a parsimonious model with survey-based estimates of expectation differences across counterfactual policy scenarios. The key innovation is that instead of making assumptions about expectation formation, we use measured expectations as sufficient statistics in the model.

Our approach has a number of additional desirable features. First, the ex-ante nature of our approach opens a possibility for policymakers to use our method to predict effects of different policy options on aggregate outcomes before committee meetings. Second, a key advantage of our approach compared to models calibrated based on historical data is that it captures rich state-dependence in the consumption response to policy changes. Specifically, it predicts the effects of policy changes based on current expectation counterfactuals, current hand to mouth-status, current subjective probability of becoming credit constrained in the future and current attention to monetary policy across the population. Third, by measuring hypothetical full-information expectation differences for each respondent, policymakers can vary other model inputs, such as the fraction of the population that is attentive to the policy change. Finally, our approach can be flexibly tailored

to different kinds of policy counterfactuals, including new policy measures, for which no historical data are available.

We also contribute to a literature that empirically studies households' expectation formation in the context of monetary policy (Andre et al., 2022a,b; Coibion et al., 2020b; D'Acunto et al., 2021; Link et al., 2023). For instance, Coibion et al. (2022) and Coibion et al. (2020a) conduct information provision experiments to study how households' inflation expectations respond to different real-world pieces of communication about future inflation or policy rates. Our paper differs from the existing literature in three main ways: first, our measurement of expectations and behavioral types is directly guided by the insights of a macroeconomic model. Second, we use our estimated elasticities of expectations as inputs in our model to quantify the impact of monetary policy on consumption. Third, different to experiments providing actual pieces of information on monetary policy, our approach based on hypothetical policy changes can be used to predict the effects of specific future policy options ex-ante.

2 Theoretical framework

This section presents a model of consumption differences across policy announcements on interest rates. The assumptions about preferences, budget constraints and borrowing constraints are similar to the assumptions in McKay et al. (2016). In Section 3, we use this model together with our experimentally estimated expectation differences across policy scenarios to study the effects of forward guidance. In Section 4, we use the same approach to study the effects of conventional monetary policy announcements (i.e., announcements about the target for the current short-term interest rate).

2.1 Assumptions

The economy is populated by a unit continuum of households, indexed by $i \in [0,1]$, with preferences given by

$$E_{i,t}\left[\sum_{s=t}^{\infty}\beta^{s-t}\left(\frac{C_{i,s}^{1-\gamma}}{1-\gamma}-v_i\left(N_{i,s}\right)\right)\right], \tag{2}$$

where $C_{i,s}$ is consumption of household i at time s and $N_{i,s}$ is labor supply of household i at time s. The disutility of labor function $v_i : \mathbb{R}_+ \to \mathbb{R}$ is twice continuously differentiable, strictly increasing, and convex, and may differ across households. The preference parameters satisfy $\beta \in (0,1)$ and $\gamma > 0$.

Households can save, or borrow up to a borrowing limit. Households can save by holding a positive amount of a liquid asset (e.g., a nominal government bond) with gross nominal interest rate R_t between periods t and $t+1$. Households can borrow by holding a negative amount of the liquid asset with gross nominal interest rate R_t^{debt} between periods t and $t+1$. For now, we assume that $R_t = R_t^{debt}$.

There are firms in the economy that generate profit. Households therefore have dividend income. For now, we assume that households cannot trade their stakes in the firms.

The flow budget constraint of household i in period t reads

$$P_t C_{i,t} + B_{i,t} = R_{t-1}B_{i,t-1} + W_{i,t}N_{i,t} + D_{i,t} - T_{i,t}, \tag{3}$$

where $P_t C_{i,t}$ is the consumption expenditure of household i in period t, P_t is the consumer price index in period t, and $B_{i,t}$ are the household's holdings of the liquid asset between periods t and $t+1$. Turning to the right-hand side of the flow budget constraint, $W_{i,t}N_{i,t}$ is labor income, $D_{i,t}$ is dividend income, and $T_{i,t}$ are tax payments of household i in period t. The wage rate and the dividend income may differ across households. The tax payment can be any function of income and wealth, so long as it does not affect the consumption Euler equation.

The borrowing constraint of household i in period t reads

$$B_{i,t} \geq -L_{i,t} \tag{4}$$

where the borrowing limit $L_{i,t}$ may differ across households, can depend on the entire history of the economy, and is taken as given by household i. A special case is a borrowing limit of zero in every period and every state of the world.

So far we have made no assumptions about knowledge and beliefs. We now turn to those assumptions. We make three assumptions:

First, we assume that households understand the *structure* of the flow budget constraint, i.e., households understand that, in every period, savings equal the difference between total after-tax income and consumption expenditure.

Second, we assume that households understand that there *exists* a borrowing limit in every period. We do not restrict households' beliefs about the sequence of future borrowing limits, but we do assume that households believe that they cannot run a Ponzi scheme along any path.

Third, the expectations operator in equation (2) and in all following equations is the mathematical expectation computed with subjective probabilities. Formally, for any variable X_{t+h} that the household takes as given household i's period-t expectation of the variable X_{t+h} is defined as

$$E_{i,t}[X_{t+h}] = \sum_{s^{t+h} \in S^{t+h}} p_{i,t}(s^{t+h}) X_{i,t}(s^{t+h}). \tag{5}$$

Let s_t denote the vector of exogenous shocks that nature draws in period t. This vector contains all aggregate and idiosyncratic shocks. Let x_{-1} denote the vector of initial conditions that nature drew before period zero. Let $s^{t+h} = \{x_{-1}, s_0, s_1, \ldots, s_{t+h}\}$ denote the exogenous history of the economy up to and including period $t+h$. In equation (5), the household believes that s^{t+h} is drawn from some finite set S^{t+h}, $p_{i,t}\left(s^{t+h}\right)$ denotes household i's period-t subjective probability of the realization s^{t+h} given household i's

period-t information set, and $X_{i,t}\left(s^{t+h}\right)$ denotes household i's period-t subjective belief about the value of the variable X_{t+h} at history s^{t+h}. We impose no restrictions on the set of possible histories, S^{t+h}, the subjective probabilities, $p_{i,t}\left(s^{t+h}\right)$, and the subjective models, $X_{i,t}\left(s^{t+h}\right)$. The subscripts i and t indicate that these are the subjective probabilities and subjective models in period t and that they can differ across households.[2]

For ease of exposition, we make two additional assumptions:

First, we assume that households observe their current after-tax income and their current borrowing limit in period t.

Second, we assume that each household believes that it will observe the real gross return on its savings in future periods.

The first assumption avoids that households accidentally hit the borrowing limit in period t. The second assumption simplifies the derivation of the Euler equation. Both assumptions can be relaxed, at the cost of more complex terminology and notation. In fact, the first assumption is relaxed in Appendix A. The second assumption can be relaxed by assuming that households believe that they will observe the real gross returns with a certain probability, as in a sticky-information model, or by assuming that households believe that they will receive noisy signals about the real gross returns, as in exogenous noisy information or rational inattention models.

We assume that in period t, each household chooses consumption $C_{i,t}$ and hours worked $N_{i,t}$ so as to maximize its objective (2) subject to its knowledge of the structure of the flow budget constraint, its knowledge that there exists a borrowing limit in every period, and given its subjective beliefs about the future paths of all relevant variables. This decision problem is formally stated in Appendix A.

[2]In the special case of rational expectations, one imposes two restrictions on these objects: (i) the subjective probability $p_{i,t}\left(s^{t+h}\right)$ equals the objective probability of the history s^{t+h} given the information set of household i in period t, and (ii) the subjective model, $X_{i,t}\left(s^{t+h}\right)$, equals the equilibrium outcome of variable X_{t+h} at history s^{t+h}.

2.2 Terminology

Note that in period t, each household belongs to exactly one of the following three groups:

- Group 1: The household spends all of its available resources in period t (formally, $B_{i,t} = -L_{i,t}$). If the borrowing limit is strictly positive, the household borrows up to the borrowing limit; if the borrowing limit equals zero, the household carries zero liquid wealth between t and $t+1$. Following the literature, we will refer to households in group 1 as "hand-to-mouth" households (Kaplan et al., 2014).

- Group 2: The household does not spend all of its available resources in period t (formally, $B_{i,t} > -L_{i,t}$), and the household believes that it will not become "hand-to-mouth" in the future.

- Group 3: The household does not spend all of its available resources in period t (formally, $B_{i,t} > -L_{i,t}$), and the household believes that it will become "hand-to-mouth" in the future with strictly positive probability.

We distinguish between these three groups because households in different groups have different consumption functions, which we turn to next.

2.3 Consumption functions

The consumption of a household in group 1 (i.e., the consumption of a hand-to-mouth household) is given by the flow budget constraint and the borrowing limit:

$$C_{i,t} = \frac{1}{P_t}\left(R_{t-1}B_{i,t-1} + W_{i,t}N_{i,t} + D_{i,t} - T_{i,t} + L_{i,t}\right). \tag{6}$$

The household consumes all liquid wealth, all after-tax income, as well as all available credit.

The consumption function of a household in group 2 can be derived from the lifetime

budget constraint in real terms, which has to hold along any path,

$$\sum_{s=t}^{\infty} Q_{t,s} C_{i,s} = \frac{R_{t-1}}{\Pi_t} \tilde{B}_{i,t-1} + \sum_{s=t}^{\infty} Q_{t,s} \left(\tilde{W}_{i,s} N_{i,s} + \tilde{D}_{i,s} - \tilde{T}_{i,s} \right),$$

where $\tilde{B}_{i,t-1} \equiv \frac{B_{i,t-1}}{P_{t-1}}$, $\tilde{W}_{i,s} \equiv \frac{W_{i,s}}{P_s}$, $\tilde{D}_{i,s} \equiv \frac{D_{i,s}}{P_s}$, $\tilde{T}_{i,s} \equiv \frac{T_{i,s}}{P_s}$, $Q_{t,t} \equiv 1$, and $Q_{t,s} \equiv \prod_{k=t+1}^{s} \left(\frac{R_{k-1}}{\Pi_k} \right)^{-1}$, and the consumption Euler equation for all horizons $s - t = 1, 2, ...$

$$C_{i,t}^{-\gamma} = E_{i,t} \left[\beta^{s-t} \prod_{k=t+1}^{s} \left(\frac{R_{k-1}}{\Pi_k} \right) C_{i,s}^{-\gamma} \right].$$

Taking the subjective expectation on both sides of the lifetime budget constraint, log-linearizing the lifetime budget constraint and the consumption Euler equation around any point, where all variables are constant over time and $R/\Pi = 1/\beta$, and using the consumption Euler equation to substitute for the expectation of future consumption yields

$$\begin{aligned} c_{i,t} = & \quad \frac{\frac{1}{\frac{C_i}{\tilde{Y}_i}} (1-\beta) E_{i,t} \left[\sum_{s=t}^{\infty} \beta^{s-t} \tilde{y}_{i,s} \right]}{} \\ & + \left[\left(\frac{1}{\beta} - 1 \right) \frac{\tilde{B}_i}{\tilde{Y}_i} \frac{1}{\frac{C_i}{\tilde{Y}_i}} - \frac{1}{\gamma} \right] \beta E_{i,t} \left[\sum_{s=t}^{\infty} \beta^{s-t} \left(r_s - \pi_{s+1} \right) \right] \\ & + \left(\frac{1}{\beta} - 1 \right) \frac{\tilde{B}_i}{\tilde{Y}_i} \frac{1}{\frac{C_i}{\tilde{Y}_i}} E_{i,t} \left[r_{t-1} - \pi_t + \tilde{b}_{i,t-1} \right]. \end{aligned} \tag{7}$$

Here $\tilde{Y}_{i,t}$ denotes real labor income plus real dividend income minus real tax payments

$$\tilde{Y}_{i,t} \equiv \tilde{W}_{i,t} N_{i,t} + \tilde{D}_{i,t} - \tilde{T}_{i,t},$$

and lower-case letters denote log-deviations from the point around which we log-linearize household i's consumption function ($c_{i,t} = ln\left(C_{i,t}\right) - ln\left(C_i\right)$ and $\tilde{y}_{i,t} = ln\left(\tilde{Y}_{i,t}\right) - ln\left(\tilde{Y}_i\right)$).[3] The consumption of a household who is non-hand-to-mouth in period t and believes that it will not become hand-to-mouth in the future depends on three expectations: the expec-

[3]The definition of the variable $\tilde{b}_{i,t-1}$ is $\tilde{b}_{i,t-1} = ln\left(\tilde{B}_{i,t-1}\right) - ln\left(\tilde{B}_i\right)$ if $\tilde{B}_i > 0$, $\tilde{b}_{i,t-1} = ln\left(\left|\tilde{B}_{i,t-1}\right|\right) - ln\left(\left|\tilde{B}_i\right|\right)$ if $\tilde{B}_i < 0$, and $\tilde{b}_{i,t-1} = 0$ if $\tilde{B}_i = 0$.

tation of non-interest income (the first term in equation (7)), the income and substitution effect linked to expected real interest rates (the second term in equation (7)), and the perceived beginning-of-period real liquid wealth (the third term in equation (7)).

Combining the two interest income terms and the non-interest income term yields

$$\begin{aligned} c_{i,t} = & \frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}}(1-\beta) E_{i,t}\left[\sum_{s=t}^{\infty}\beta^{s-t}\left(\frac{1}{\beta}\frac{\tilde{B}_i}{\bar{Y}_i}(r_{s-1}-\pi_s)+\tilde{y}_{i,s}\right)\right] \\ & -\frac{1}{\gamma}\beta E_{i,t}\left[\sum_{s=t}^{\infty}\beta^{s-t}(r_s-\pi_{s+1})\right] \\ & +\frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}}(1-\beta)\frac{1}{\beta}\frac{\tilde{B}_i}{\bar{Y}_i}E_{i,t}\left[\tilde{b}_{i,t-1}\right]. \end{aligned} \tag{8}$$

Consumption of a household in group 2 depends on expected lifetime income, the intertemporal substitution term, and the perceived end-of-previous-period real liquid wealth. This equation is derived using the same steps, but more formal notation, in Appendix A.

Turning to the effect of implementing one policy announcement rather than another policy announcement on consumption in period t. Let $\triangle c_{i,t} = c_{i,t}^{PolicyA} - c_{i,t}^{PolicyB}$ denote the difference between consumption under policy announcement A and consumption under policy announcement B and let $\triangle E_{i,t}[X] = E_{i,t}^{PolicyA}[X] - E_{i,t}^{PolicyB}[X]$ denote the difference between the expectation of variable X under policy announcement A and the expectation of the same variable under policy announcement B. Equation (8) implies that

$$\begin{aligned} \triangle c_{i,t} = & \frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}}(1-\beta) \triangle E_{i,t}\left[\sum_{s=t}^{\infty}\beta^{s-t}\left(\frac{1}{\beta}\frac{\tilde{B}_i}{\bar{Y}_i}(r_{s-1}-\pi_s)+\tilde{y}_{i,s}\right)\right] \\ & -\frac{1}{\gamma}\beta \triangle E_{i,t}\left[\sum_{s=t}^{\infty}\beta^{s-t}(r_s-\pi_{s+1})\right] \\ & +\frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}}(1-\beta)\frac{1}{\beta}\frac{\tilde{B}_i}{\bar{Y}_i}\triangle E_{i,t}\left[\tilde{b}_{i,t-1}\right]. \end{aligned} \tag{9}$$

For a household in group 2, differences in consumption across policy announcements are determined by differences in expectations across policy announcements. The key idea of this paper is to elicit these differences in expectations with a survey and to compute the effect of policy announcements on consumption from equation (9).

The consumption function of a household in group 3 looks different because of the

strictly positive subjective probability of becoming a hand-to-mouth household in the future. To illustrate the implications of beliefs about future binding borrowing constraints for current consumption, consider a household who believes that it will become borrowing constrained in the near future with a high probability. Specifically, suppose that the subjective probability of becoming borrowing constrained in the next period equals one. Since the household is non-hand-to-mouth in period t, the household's consumption Euler equation has to hold with equality in period t

$$C_{i,t}^{-\gamma} = E_{i,t}\left[\beta \frac{R_t}{\Pi_{t+1}} C_{i,t+1}^{-\gamma}\right].$$

The household's belief that it will become borrowing constrained in the next period with probability one implies that, in the previous equation, we have

$$C_{i,t+1} = \frac{R_t}{\Pi_{t+1}}\left(\frac{R_{t-1}}{\Pi_t}\tilde{B}_{i,t-1} + \tilde{Y}_{i,t} - C_{i,t}\right) + \tilde{Y}_{i,t+1} + \tilde{L}_{i,t+1}.$$

Using the last equation to substitute for next period's consumption in the previous equation yields a single equation that characterizes consumption of household i in period t. Log-linearizing this equation around any point where the real interest rate, real non-interest income and consumption are constant over time and $R/\Pi = 1/\beta$ yields

$$\begin{aligned} c_{i,t} = & \frac{\frac{1}{\bar{C}_i}}{\frac{1}{\bar{Y}_i}} \frac{1}{1+\beta} E_{i,t}\left[\sum_{s=t}^{t+1} \beta^{s-t}\left(\frac{1}{\beta}\frac{\tilde{B}_i}{\bar{Y}_i}\left(r_{s-1} - \pi_s\right) + \tilde{y}_{i,s}\right)\right] \\ & -\frac{1}{\gamma}\frac{\beta}{1+\beta} E_{i,t}\left[r_t - \pi_{t+1}\right] \\ & +\frac{\frac{1}{\bar{C}_i}}{\frac{1}{\bar{Y}_i}} \frac{1}{1+\beta} E_{i,t}\left[\frac{1}{\beta}\frac{\tilde{B}_i}{\bar{Y}_i}\tilde{b}_{i,t-1} + \beta\frac{\tilde{L}_i}{\bar{Y}_i}\tilde{l}_{i,t+1}\right], \end{aligned} \tag{10}$$

where lower-case letters denote log-deviations from the point at which we log-linearize household i's consumption function ($c_{i,t} = ln\left(C_{i,t}\right) - ln\left(C_i\right)$ and $\tilde{y}_{i,t} = ln\left(\tilde{Y}_{i,t}\right) - ln\left(\tilde{Y}_i\right)$).[4] Comparing equation (10) to equation (8) shows that the anticipation of a binding borrowing constraint in the next period has several implications. First, the relevant definition of

[4]Equation (10) is derived using the same steps, but more formal notation, in Appendix A.

expected income becomes the expected average income up to and including the period in which the borrowing constraint becomes binding. Second, the intertemporal substitution term depends only on the expected real interest rate up to the period in which the borrowing constraint becomes binding. Third, the expectation of the real value of the borrowing limit in the period in which the borrowing constraint becomes binding affects current consumption.

The difference in consumption across policy announcements then equals

$$\begin{aligned}\triangle c_{i,t} = & \frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}} \frac{1}{1+\beta} \triangle E_{i,t} \left[\sum_{s=t}^{t+1} \beta^{s-t} \left(\frac{1}{\beta} \frac{\tilde{B}_i}{\bar{Y}_i} \left(r_{s-1} - \pi_s \right) + \tilde{y}_{i,s} \right) \right] \\ & - \frac{1}{\gamma} \frac{\beta}{1+\beta} \triangle E_{i,t} \left[r_t - \pi_{t+1} \right] \\ & + \frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}} \frac{1}{1+\beta} \triangle E_{i,t} \left[\frac{1}{\beta} \frac{\tilde{B}_i}{\bar{Y}_i} \tilde{b}_{i,t-1} + \beta \frac{\tilde{L}_i}{\bar{Y}_i} \tilde{l}_{i,t+1} \right], \end{aligned} \tag{11}$$

where $\triangle c_{i,t}$ is the difference between consumption in period t under policy announcement A and consumption in period t under policy announcement B and $\triangle E_{i,t}[X]$ is the difference between the expectation of variable X under policy announcement A and the expectation of the same variable under policy announcement B.

For households in group 2 and households in group 3, differences in consumption across policy announcements are determined by differences in expectations across policy announcements. In other words, for households in groups 2 and 3, expectation differences across policies are sufficient statistics for consumption differences across policies. The key idea of the paper is to elicit these differences in expectations with a survey and to compute, for each household, the effect of implementing one policy announcement rather than another policy announcement on consumption from the consumption function of this type of household.

In the following sections, we assume that households do not switch group across policies at a given point in time. For the distinction between hand-to-mouth and non-hand-to-mouth households, this is the common assumption that hand-to-mouth households are households with a *binding* borrowing constraint and that small variations in policy do

not change their hand-to-mouth status. For the distinction between group 2 and group 3 households, this is the assumption that the subjective probability of becoming borrowing constrained in the future does not switch from zero to strictly positive across policies. In Section 3, we demonstrate empirically that the subjective probability of becoming borrowing constrained does not vary systematically across policies.

3 The effects of unconventional monetary policy

In this section we apply our approach to study the effects of unconventional monetary policy using data from the March 2021 survey. The full experimental instructions are provided in Appendix F.1.

3.1 Setting

For our main survey we collect a sample of 2,218 respondents that is representative of the US population in terms of education, gender, age, region, and household net income. The survey was conducted as an online survey in collaboration with the panel data provider Luc.id, which is commonly used in economic research (Haaland et al., 2021). The data collection took place shortly before the regular FOMC meeting on March 16/17 2021. At the time of the survey, the current federal funds rate was near zero and the annual inflation rate was 1.7 percent. There appeared to be broad agreement at the Federal Reserve to keep the federal funds rate near zero.

3.2 Experimental design

Demographics, definitions and introduction In the beginning of our survey, we elicit a set of demographic characteristics. Then, we provide our respondents with basic definitions of the inflation rate as well as the federal funds rate. In particular, we explain to our respondents that the Federal Reserve (Fed) controls the federal funds rate and that,

besides choosing the current rate, the Fed publishes projections of where this interest rate will be in the coming years.

Baseline scenario Respondents are then asked to imagine the following hypothetical scenario:

> Please imagine that at the next meeting of the Fed on March 16/17 2021, the Fed announces that the current federal funds rate will remain unchanged at 0.1 percent. Moreover, the Fed announces that its projection about the future federal funds rate at the end of 2023 remains unchanged at 0.1 percent. Note: Further imagine, that the Fed's projection of the federal funds rate at the end of 2030 remains unchanged at 2.5 percent.

We then elicit the respondents' own expectations under this hypothetical scenario, such as their expectations about the future federal funds rate at the end of the years 2021, 2022, 2023, 2026 and 2030, and their expectations about annual inflation in 2021, 2022 and 2023, as well as their average expected inflation rate for the years 2024-2026. We also elicit our respondents' expectations about their average annual household income in nominal dollar terms in 2021, 2022-2023, as well as 2024-2026. To make it clear to respondents that we are interested in their expectations conditional on learning about the Fed announcement we explicitly ask them about their expectations "if they learned about the Fed's announcement".

Alternative scenario Respondents are then asked to imagine an alternative scenario about the Fed's projections. Specifically, respondents receive the following instructions:

> We will now ask you to consider the following alternative hypothetical scenario. Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the current federal funds rate will remain unchanged at 0.1 percent. However, the Fed announces that its projection about the future federal funds rate at the end of 2023 increases from 0.1 percent to 0.5 percent.

Note: Further imagine, that the Fed's projection of the federal funds rate at the end of 2030 remains unchanged at 2.5 percent.

We then re-elicit respondents' own expectations regarding the federal funds rate, the inflation rate, and their net household income under this alternative hypothetical scenario using the same time horizons as in the baseline scenario.

Beliefs about the source of the change in projections To illustrate how our approach can be used to study the effects of different types of policy announcements, we cross-randomize respondents into four groups receiving different messages on the source of the change in the Fed projection. In the "no-reason" group, respondents are not provided with a reason for why the projection changes. In the "endogenous" group, respondents are told that the change in the projection is due to a change in the Fed's outlook on the broader development of the economy. In the "exogenous" group, participants are told that the change in the Fed's projection occurred because the composition of the committee changed before the meeting and is not due to a change in the Fed's outlook on the broader development of the economy. In the "exogenous-stock" group, respondents receive the same instructions as respondents in the "exogenous" group, but are additionally told that, in response to the Fed announcement, the S&P 500 stock market index falls by one percent.

Identifying behavioral types We also include questions measuring three dimensions of type heterogeneity that play an important role in our model: We measure households' (i) hand-to-mouth status, (ii) their subjective probability of becoming credit constrained in the future, and (iii) their level of attention to Fed announcements.

3.3 Sample restrictions and summary statistics

Sample restrictions We drop respondents in the top and bottom percentiles of response time, as very short or very long response times may indicate inattention to our survey,

reducing the sample size from 2,218 to 2,175 for the main survey.

Point forecasts of macroeconomic variables elicited in household surveys are known to include extreme outliers, which may reflect typos or inattention to the survey questions. These outliers could disproportionately affect predicted consumption responses according to our model featuring averages taken over individual survey responses, which are sensitive to outliers. We deal with this concern by excluding outliers in elicited point forecasts.

Specifically, we exclude responses predicting a federal funds rate higher than 20 percent for any horizon (corresponding to the 98th or 99th percentile in the main survey depending on the horizon), responses predicting an inflation rate higher than 20 percent for any horizon (98th or 99th percentile), and responses predicting cumulative income growth of less than -70 percent or higher than 200 percent for any horizon (first and 98th or 99th percentile). In addition, we set to missing those who predict extreme differences in beliefs across the two hypothetical scenarios, as such extreme differences likely indicate typos. Specifically, we set to missing those predicting absolute effects on the federal funds rate and on the inflation rate of more than 5 percentage points or absolute effects on cumulative income growth of more than 50 percentage points. Again, these cutoffs mostly correspond to the bottom first or second or top 98th or 99th percentiles across variables and horizons.

Even though these steps are not restrictive individually, and even though there is strong overlap of groups containing outliers across survey questions, our focus on a common sample implies that these procedures result in dropping 13.6 percent of responses in the main survey. None of our results are sensitive to the exact cutoffs used. We examine the robustness of the predicted consumption responses to winsorizing outliers instead of excluding them.

Summary statistics Appendix Table A.1 Panel A shows summary statistics of the remaining sample of 1,871 respondents for the main survey, including benchmarks from the 2019 American Community Survey. Our sample closely resembles the population ac-

cording to the targeted variables gender, age, education, income and region even after our sample restrictions.

3.4 Type heterogeneity

In this subsection, we provide descriptive evidence on the distributions of hand-to-mouth status, subjective probabilities of becoming credit constrained, and attention to Fed announcements in our sample.

Hand-to-mouth status We classify hand-to-mouth households with a series of questions on balance sheet variables using a similar procedure as Kaplan et al. (2014). We ask respondents about their household's liquid wealth in the last days before the main earner's last income receipt as well as their total revolving credit card debt and overall combined credit limit for all credit cards owned by the household. Among those who report having carried over positive credit card debt from the last billing cycle (27.4 percent), we classify those as hand-to-mouth who carried over credit card debt of more than 80 percent of their combined limit on all cards (8.5 percent of the full sample). Among those who report not to have carried over any credit card debt, we classify those as hand-to-mouth who report liquid wealth holdings before the last income receipt of the main earner of less than their monthly household net income (18.3 percent). Together, this procedure yields a fraction of 26.8 percent hand-to-mouth households, which is very close to previous findings (Kaplan et al., 2014).[5]

Anticipated credit constraints The subjective probability of becoming credit constrained plays a key role for the consumption response to Fed announcements among non-hand-to-mouth households according to our model and previous literature (McKay et al., 2016). To measure anticipated credit constraints we ask our respondents about the probability

[5] In the model, only households with a binding borrowing constraint are "hand-to-mouth", but in the empirical implementation we also assume that households at the zero kink are "hand-to-mouth" and thus do not respond to expectations.

that their household will be in a situation where it would like to borrow more money on its credit cards, but would be unable to do so. We elicit the subjective probabilities of becoming credit constrained at some point (i) until the end of 2021, (ii) until the end of 2022, and (iii) until the end of 2026. Figure 1 displays the distributions of the subjective percent chance of becoming credit constrained over different horizons among non-hand-to-mouth households in our sample. The figure highlights that a majority (60 percent) attach zero probability to becoming credit constrained at any point until the end of 2026.

Inattention to Fed announcements A key variable in the consumption response to Fed announcements is the fraction of households that are inattentive to such announcements, and may therefore not adjust their consumption in response to these events. To quantify the fraction of inattentive households, we ask our respondents to think of announcements by the Federal Reserve in general. We then ask them how long it would typically take until they hear of a Fed announcement on a scale ranging from "less than seven days" to "typically I would never hear of such an announcement".

Appendix Figure A.1 provides histograms of non-hand-to-mouth respondents' self-reported time until they typically hear about Fed announcements. 54 percent of respondents report that it typically takes at most seven days until they learn about Fed announcements.[6]

3.5 The effects of unconventional monetary policy on expectations

The first row of Table 1 illustrates the difference between federal funds rate expectations under the "rise" and under the "baseline" scenario among non-hand-to-mouth households.[7] It shows that respondents substantially update their federal funds rate expectations when going from the baseline to the rise scenario. While the average federal funds rate expectations increase by 0.05 percentage points for 2021 ($p < 0.01$) and by 0.08 per-

[6] Appendix Table A.6 uses survey data from March 2022 to show that this measure is correlated with alternative measures of attention to monetary policy.

[7] Our results on expectation differences are qualitatively similar if we instead use the full sample.

centage points for 2022 ($p < 0.01$), the effect peaks for 2023 with an increase by 0.19 percentage points ($p < 0.01$), and then reverts back to close to zero in 2026 and 2030, consistent with the Fed's longer-run projection being constant across the scenarios. The increase by 0.19 percentage points corresponds to approximately 50 percent of the difference in Fed projections across scenarios. This suggests that respondents attach positive probability to a state where the Fed will not increase the federal funds rate as projected.[8]

The second row of Table 1 highlights that the increase in the projected federal funds rate in 2023 is associated with lower inflation expectations. Inflation expectations decrease by 0.25 percentage points for 2021 ($p < 0.01$), by 0.17 percentage points for 2022 ($p < 0.01$), and somewhat less strongly for the later time periods. The size of the differences in inflation expectations is significant. These findings highlight that households expect most of the changes in inflation to occur early on after the announcement, while effects are less pronounced for 2023, when the effect on the federal funds rate expectations is highest. The size of the differences in inflation expectations is somewhat smaller than implied by benchmark models. Overall, the effects on federal funds rate and inflation expectations point to an important role for the intertemporal substitution mechanism in households' consumption responses.

The third row of Table 1 displays results on nominal income expectations. The table reveals a muted average response of income expectations over all relevant time horizons. These effects are very precisely estimated and the minimum detectable effect sizes for a power of 80 percent and a significance threshold of 5 percent are below 1 percentage point. This suggests a limited relevance of adjustments of nominal income expectations in response to the change in Fed projections.

Varying the source of the change in projections Appendix Table A.2 displays expectation differences between the two scenarios when the source of the change is described to be (i) endogenous to current economic conditions, (ii) exogenous to current conditions,

[8] Another potential reason for the less than one-to-one pass-through of projections to expectations is that a fraction of respondents may be inattentive to our survey and just quickly click through the questions.

or (iii) exogenous to current conditions and also reflected in stock market movements, or when (iv) no reason for the change is given. The measured expectation differences remain largely qualitatively similar when varying the source of the shock.

Robustness experiment In our model, we assume that the subjective probability of becoming credit constrained does not respond to changes in monetary policy. The model also abstracts from the effect of differences in home price expectations across scenarios on consumption. We assess the plausibility of these assumptions using a robustness experiment.

The robustness experiment (n=392) was conducted in March 2021 in collaboration with Luc.id with a sample representative of the US population in terms of education, gender, age, region, and household net income. Our design is identical to our main experiment except that we elicit a different set of expectations in the hypothetical scenarios. In the robustness experiment, we elicit expectations about the future federal funds rate, the probability that the household will be borrowing constrained in the future, and the value of the household's main residence under the baseline scenario of a constant Fed projection and under the alternative scenario of a rise in the projected fed funds rate. In Appendix F.2, we provide the full set of experimental instructions.[9]

The first row of Appendix Table A.3 shows similar effects on expectations about the federal fund rate in the robustness experiment as in the main survey. Rows 2 and 3 of Table A.3 show that neither respondents' subjective probability of becoming credit constrained nor their home price expectations change in response to the change in the Fed projection.

[9]We apply the same sample restrictions as in the main survey to our initial sample of 478 respondents in the robustness survey. This results in dropping 8 respondents in the top and bottom percentiles of response time, and dropping 78 respondents providing outlier responses. We define outliers according to respondents' predicted federal funds rate as in the main survey (described in Section 3.3), and according to whether they predict home price growth less than -90 or greater than 900 percent, or absolute differences in expected home price growth across scenarios of more than 150 percent.

3.6 Consumption counterfactuals with measured expectations

In this section, we use the measured expectation differences across policy scenarios from Section 3.5 as sufficient statistics in our model outlined in Section 2, and discuss the implied consumption differences across Fed announcements.

Consumption response of non-hand-to-mouth anticipating no borrowing constraints For a non-hand-to-mouth household who does not expect to be borrowing constrained in the future, the difference in consumption across policies equals

$$\triangle c_{i,t} = \begin{array}{c} \frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}} (1-\beta) \sum_{s=t}^{\infty} \beta^{s-t} \triangle E_{i,t} \left[\frac{1}{\beta} \frac{\tilde{B}_i}{\bar{Y}_i} (r_{s-1} - \pi_s) + \tilde{y}_{i,s} \right] \\ -\frac{1}{\gamma} \beta \sum_{s=t}^{\infty} \beta^{s-t} \triangle E_{i,t} \left[r_s - \pi_{s+1} \right] \\ + \frac{1}{\frac{\bar{C}_i}{\bar{Y}_i}} (1-\beta) \frac{1}{\beta} \frac{\tilde{B}_i}{\bar{Y}_i} \triangle E_{i,t} \left[\tilde{b}_{i,t-1} \right] \end{array} . \tag{12}$$

In the literature on Heterogeneous Agent New Keynesian (HANK) models, the effects of a change in the expected path of the nominal interest rate minus inflation on consumption are called direct effects of monetary policy, while the effects of a change in the expected paths of labor income, dividend income, and net tax payments on consumption are called indirect general equilibrium effects of monetary policy (Kaplan et al., 2018). Rather than computing the expectation differences across policies from a model, we take these from the survey that households complete a few days before the policy meeting.

The survey elicits each household's expected path for the federal funds rate, the inflation rate, and own, total, after-tax nominal income under the baseline policy announcement and under the alternative policy announcement.[10] The survey measures expectations about annual variables. The expectations appearing in equation (12) are about quarterly variables. In the case of inflation expectations, we proceed as follows. When a household reports that it expects x% inflation for a calendar year, we turn this answer into an expectation of $1/4$ x% inflation for each quarter of the year. A household might

[10] Appendix B provides a more detailed discussion of how the model inputs are derived from the survey responses.

expect all inflation to occur in the first quarter of the year and no inflation in the second to fourth quarter of the year, but with a quarterly discount factor of $\beta = 0.99$, it matters hardly at all how the inflation expectation for the year is translated into inflation expectations for the four different quarters of the year. For this reason, we decided to elicit expectations about annual inflation.[11] In the case of nominal income expectations, we proceed similarly. When a household reports that it expects $\$x$ nominal income for a calendar year, we turn this answer into an expectation of $1/4$ $\$x$ nominal income for each quarter of the year. Again, for a quarterly discount factor of $\beta = 0.99$, it matters hardly at all how the nominal income expectation for the calendar year is translated into nominal income expectations for the four different quarters of the year. We therefore chose to elicit expectations about annual income. In the case of nominal interest rate expectations, we interpolate the expected interest rate path. If a household reports that it expects a difference in the nominal interest rate across scenarios of 5 basis points at the end of 2021 and 10 basis points at the end of 2022, we assume that the difference in the expected nominal interest rate across scenarios equals zero in the quarters 2021:Q1-2021:Q3, 5 basis points in the quarters 2021:Q4-2022:Q3, and 10 basis points in the quarters 2022:Q4-2023:Q3. All expectations are elicited up to a certain horizon. We assume that expectation differences across scenarios decay at quarterly rate ρ beyond those horizons. In the main tables we present results for $\rho = 0.1$. In robustness checks we present results for different values of ρ (0.05, 0.2, 0.5, 0.9). The value of ρ turns out to matter barely for the consumption counterfactuals.

The left-hand side of equation (12) is the log difference in individual consumption across policies. The first line on the right-hand side is the real income effect of monetary policy. For a household with positive liquid wealth, the term $\frac{1}{\bar{\beta}} \frac{\tilde{B}_i}{\bar{Y}_i} (r_{s-1} - \pi_s)$ is interest

[11] When a household expects x% inflation for a calendar year and expects the price level to grow at a constant rate within the year, the discounted sum of expected quarterly inflation rates equals $\left(1 + \beta + \beta^2 + \beta^3\right) \frac{1}{4} x\%$. In the most extreme cases, where all inflation is expected to occur in the first quarter of the year or all inflation is expected to occur in the fourth quarter of the year, the discounted sum of expected quarterly inflation rates equals x% and $\beta^3 x$%, respectively. For conventional discount factors, these three numbers are very similar. For example, for $\beta = 0.99$ the three numbers equal $0.985 * x$%, $1 * x$%, and $0.97 * x$%.

income, the variable $\tilde{y}_{i,s}$ is non-interest income, and the term $\triangle E_{i,t}\left[\frac{1}{\beta}\frac{\tilde{B}_i}{\tilde{Y}_i}\left(r_{s-1}-\pi_s\right)+\tilde{y}_{i,s}\right]$ is the difference in the expectation of own, total, after-tax real income across the two policies, relative to the value at the point around which we log-linearized the consumption function, which we take to be household quarterly income in the year 2020. The survey measures the expectation of nominal income. To arrive at the expectation of real income, we deflate the household's expectation of nominal income with the household's expectation of inflation up to that point. Turning to a household with negative liquid wealth, the term $\frac{1}{\beta}\frac{\tilde{B}_i}{\tilde{Y}_i}\left(r_{s-1}-\pi_s\right)$ is interest expenses, the variable $\tilde{y}_{i,s}$ is income, and the first line on the right-hand side of equation (12) is the real income effect of monetary policy net of the real interest expense effect of monetary policy. For a household with negative liquid wealth, we write $\triangle E_{i,t}\left[\frac{1}{\beta}\frac{\tilde{B}_i}{\tilde{Y}_i}\left(r_{s-1}-\pi_s\right)+\tilde{y}_{i,s}\right]$ as $\triangle E_{i,t}\left[\frac{1}{\beta}\frac{\tilde{B}_i}{\tilde{Y}_i}\left(r_{s-1}-\pi_s\right)\right]$ plus $\triangle E_{i,t}\left[\tilde{y}_{i,s}\right]$. We refer to the first term as the interest expense effect.

The second line on the right-hand side of equation (12) is the intertemporal substitution effect of monetary policy. The variable $E_{i,t}\left[r_s\right]$ is the expectation of the log gross nominal interest rate, which approximately equals the expectation of the net nominal interest rate, which the survey elicits for both policy alternatives. The variable $E_{i,t}\left[\pi_{s+1}\right]$ is the expectation of the log gross inflation rate, which approximately equals the expectation of the inflation rate, which the survey measures for both policy scenarios.

The survey also elicits the own, total, after-tax nominal income, the household's nominal liquid wealth, and the household's saving rate in 2020, from which we compute $\frac{\tilde{B}_i}{\tilde{Y}_i}$ and $\frac{C_i}{\tilde{Y}_i}$. We set the quarterly discount factor, β, to 0.99 and the intertemporal elasticity of substitution, $\frac{1}{\gamma}$, to $\frac{1}{2}$.

The third line on the right-hand side of equation (12) is the effect on consumption of holding different beliefs about past real liquid wealth across policy announcements. In complete-information HANK models, this effect equals zero. The reason is that agents have complete information about the history of the economy and thus do not revise beliefs about the past after a policy announcement. Under incomplete information, households may revise beliefs about past real liquid wealth after a policy announcement, be-

cause they may revise beliefs about the past price level after a policy announcement.[12] In the main tables, we assume that households do not revise beliefs about the past price level after a policy announcement. As a robustness exercise, we assume that households revise beliefs about last year's inflation as much as they revise beliefs about current year's inflation after a policy announcement. We view this calculation as an upper bound on the size of this effect.

Consumption response of non-hand-to-mouth with positive subjective probability of becoming constrained For a non-hand-to-mouth household who expects to be borrowing constrained with probability one in the next period, the difference in consumption across policies equals

$$\triangle c_{i,t} = \begin{array}{c} \frac{1}{\frac{C_i}{Y_i}} \frac{1}{1+\beta} \sum_{s=t}^{t+1} \beta^{s-t} \triangle E_{i,t} \left[\frac{1}{\beta} \frac{\tilde{B}_i}{Y_i} \left(r_{s-1} - \pi_s \right) + \tilde{y}_{i,s} \right] \\ -\frac{1}{\gamma} \frac{\beta}{1+\beta} \triangle E_{i,t} \left[r_t - \pi_{t+1} \right] \\ + \frac{1}{\frac{C_i}{Y_i}} \frac{1}{1+\beta} \left(\frac{1}{\beta} \frac{\tilde{B}_i}{Y_i} \triangle E_{i,t} \left[\tilde{b}_{i,t-1} \right] + \beta \frac{\tilde{L}_i}{Y_i} \triangle E_{i,t} \left[\tilde{l}_{i,t+1} \right] \right) \end{array} . \tag{13}$$

A positive subjective probability of a binding borrowing limit in the future shortens the horizon, raises the marginal propensity to consume, and makes consumption depend on the expectation of the real borrowing limit in the future (Kaplan et al., 2018; McKay et al., 2016). Otherwise equation (13) resembles equation (12). We assume that the expectation of the nominal credit limit is the same across policy announcements, implying $\triangle E_{i,t} \left[\tilde{l}_{i,t+1} \right] = -\triangle E_{i,t} \left[p_{t+1} \right]$.[13] The expectation of a higher price level then means the expectation of fewer real resources being available when the credit limit becomes binding, which depresses current consumption.

The survey includes a series of questions on hand-to-mouth status and elicits each household's subjective probability of becoming borrowing constrained in the current year,

[12] Recall that $\tilde{b}_{i,t-1} = b_{i,t-1} - p_{t-1}$, implying $E_{i,t} \left[\tilde{b}_{i,t-1} \right] = E_{i,t} \left[b_{i,t-1} \right] - E_{i,t} \left[p_{t-1} \right]$. Hence, revising up beliefs about the past price level implies revising down beliefs about past real liquid wealth.

[13] This assumption has a very limited quantitative influence on the predicted aggregate consumption response and could be easily relaxed through small adjustments in the survey design.

at some point over the next two years, and at some point over the next five years. For a non-hand-to-mouth household with a zero subjective probability of becoming borrowing constrained in the current year, we compute the consumption difference across policies from equation (12). For a non-hand-to-mouth household with a strictly positive subjective probability of becoming borrowing constrained in the current year, we take a parsimonious approach: We compute the consumption difference across policies from equation (13) if the subjective probability of becoming borrowing constrained in the current year exceeds 50 percent, while we compute the consumption difference across policies from equation (12) if this subjective probability is below 50 percent.[14] Figure 1 reports the distributions of answers to the subjective probability questions.

Consumption response of hand-to-mouth The consumption of a hand-to-mouth household equals its available resources. The household's consumption difference across policies is determined by the household's income difference across policies. We assume that the change in income for the hand-to-mouth households occurs with a delay under both policies. The reason is the following. For the income of the hand-to-mouth households to change, firms have to make decisions to adjust their factor inputs, which will presumably happen after they have observed a change in demand. In the meantime, firms can meet the reduced demand by adjusting inventories and/or factor utilization.

Aggregation We weight each household's consumption difference across policies by the household's overall spending in 2020. Formally, the aggregate consumption counterfactuals are computed from the equation

$$\triangle c_t = \sum_{i=1}^{I} \frac{PC_i}{PC} \triangle c_{i,t}, \tag{14}$$

[14] Empirically, the predicted aggregate consumption response remains similar if we use different cutoffs in this probability.

which follows from log-linearizing the definition of aggregate consumption, $C_t = \sum_{i=1}^{I} C_{i,t}$, around any point $\{C, C_1, \ldots, C_I\}$ with $C = \sum_{i=1}^{I} C_i$, yielding $c_t = \sum_{i=1}^{I} \frac{C_i}{C} c_{i,t}$, taking the difference across policies, and multiplying numerator and denominator of the ratio $\frac{C_i}{C}$ by the price level. Weighting each household's consumption difference across policies by the household's overall spending in 2020 can thus be interpreted as using as a point of log-linearization of equation (14) each household's consumption in 2020. This is also the point of log-linearization that we used for the individual consumption functions.[15]

Results Table 2 shows the model-implied consumption responses and their different components both aggregated and by group. Panel A shows consumption responses under the assumption that all households hear of the announcement. Non-hand-to-mouth households with a subjective probability of becoming borrowing constrained of zero reduce their consumption by 0.475 percent in response to the increase in the projected federal funds rate (Column 2). This reflects real income effects (increasing consumption by 0.273 percent) and intertemporal substitution effects (reducing consumption by 0.747 percent) working in opposite directions. The announcement leads to a 0.313 percent increase in consumption among non-hand-to-mouth households with a positive subjective probability of facing constraints that is at most 50 percent (Column 3), which are driven by positive real income effects outweighing negative effects from intertemporal substitution. Among non-hand-to-mouth households expecting constraints with a probability greater than 50 percent, the announcement leads to a 0.508 percent increase in consumption, which is mostly driven by a higher expected real credit limit due to lower expected inflation (Column 4). Aggregating across the different groups yields the following overall

[15]Household spending in 2020 is elicited by eliciting the after-tax, total income in 2020 and the saving rate in 2020. The saving rate in 2020 is elicited with a categorical question and allows for a negative saving rate.

response (Column 5):[16]

$$\begin{aligned}\triangle \bar{c}_t = & \underbrace{0.21}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{HTM}}} \times 0 + \underbrace{0.52}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{non-HTM}\\ \text{0\% constr.}}} \times (-0.475) \\ & + \underbrace{0.22}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{non-HTM}\\ \text{0\% } < \text{ constr. } \leq \text{ 50\%}}} \times 0.313 + \underbrace{0.06}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{non-HTM}\\ > \text{ 50\% constr.}}} \times 0.508 = -0.148\end{aligned} \tag{15}$$

Panel B presents consumption adjustments under the assumption that only attentive households adjust their expectations in response to the announcements. The average group-level consumption responses are somewhat attenuated under this assumption and yield an overall predicted consumption response of -0.143 percent.

Appendix Table A.4 provides a sensitivity analysis of the model-implied consumption responses to unconventional monetary policy. Specifically, the predicted consumption response varies only weakly with the value ρ at which expectation differences beyond the horizons measured in the survey are assumed to converge to zero (Panels B-E). When winsorizing extreme expectation differences instead of excluding the corresponding observations, the predicted consumption response is close to zero (Panel F). The statistical precision of the estimates decreases despite the larger sample size, suggesting that the outlier observations indeed reflect inattention to the survey. Allowing agents to update beliefs about inflation in the previous year has only negligible effects on the predicted consumption responses (Panel G). Finally, the predicted consumption responses vary somewhat across treatment arms that provide respondents with different reasons for the policy change (Panels H-K), although this should be viewed in light of the smaller underlying samples.

In sum, we elicit the joint distribution of hand-to-mouth status, subjective probability

[16]Since group-level averages are calculated weighting each household's consumption response by household spending in 2020, one needs to use the weighted fractions of households in the different groups to obtain the overall average consumption response.

of becoming borrowing constrained in the future, inattention to monetary policy, and expectation differences across policy alternatives ahead of a policy meeting. We use these data to compute the effect on consumption of implementing one monetary policy rather than another monetary policy, with a consumption model that is standard in the HANK literature. All data are collected in the days before the policy meeting; hence the aggregate consumption counterfactual is fully state contingent and available before the policy meeting. We find that, in March 2021, the announcement of a 40 basis points higher fed funds rate at the end of 2023 would have reduced aggregate consumption by 0.14 percent on impact. The main reasons for the modest power of forward guidance are that expectation differences across policies are of modest size (Table 1) and that intertemporal substitution and real income effects work in opposite directions (Table 2).

4 The effects of conventional monetary policy

In this section, we apply our approach to assess the effects of conventional monetary policy on aggregate consumption using our March 2022 survey.

Setting The survey was conducted shortly before the March 2022 meeting of the Federal Reserve. At the time of the survey, the current federal funds rate was still close to zero, but inflation had reached very high levels (7.9 percent in February 2022). FOMC members were publicly debating the timing and the size of an interest rate increase and dramatically increased interest rates over subsequent months.

Sample We recruit a sample broadly representative of the US population using Prolific, a commonly used online labor market for research studies. We apply the same sample restrictions with respect to extreme response times and outliers in expectations using the same cutoff values as in the main survey, which reduces the initial sample size of 838 observations to 692 observations. Again, none of our results are sensitive to the exact sample restrictions we apply or to whether we winsorize outliers in expectations instead

of excluding them from the sample.

Design The design of this survey closely resembles the design of the March 2021 experiment (described in Section 3.2). Specifically, we elicit expectations about the federal funds rate, inflation and household income under two policy scenarios. However, different to our March 2021 survey, the scenarios presented to respondents now feature differences in the current federal funds rate instead of the projected future rate. In the baseline scenario, the Fed announces at their meeting in March that it keeps the current federal funds rate unchanged near zero. In the alternative scenario, the Fed announces that it increases the current federal funds rate to 0.5 percent. In both scenarios we tell respondents that the Fed's projection of the federal funds rate in 2031 remains unchanged at 2.5 percent. As in the March 2021 survey, we collect rich data on attention to Fed announcements, hand-to-mouth status and anticipated credit constraints. In line with the core idea of our approach, we design the survey such that we can use the elicited expectation adjustments together with our model to calculate the implied impact of the policy announcement on aggregate consumption. In Appendix F.3 we provide the full experimental instructions.

The effects of conventional monetary policy on expectations We start by presenting the effects of the policy announcement on respondents' expectations. The first row of Table 3 presents the differences in respondents' expectations about the federal fund rate between the rise and the no-change scenario, respectively. In the rise scenario, participants increase their federal funds rate expectations by approximately 0.2 percentage points for 2022, 2023 and 2024 ($p < 0.01$) compared to the baseline scenario. For 2027, the expectation difference declines somewhat to 0.15 percentage points ($p < 0.01$), and for 2031 the expectation difference reverts back close to zero ($p = 0.25$). The increases in expectations about the federal funds rate in the initial years correspond to about half of the difference in the current federal funds rate across scenarios. This likely reflects that also under the baseline scenario respondents expect increases in the federal funds rate in later meetings in 2022.

The second row of Table 3 presents the differences in respondents' inflation expectations between the rise and the no-change scenario. It shows that households increase their inflation expectations by 0.16 percentage points for 2022 ($p < 0.01$), by 0.19 percentage points for 2023 ($p < 0.01$), by 0.29 percentage points for 2024 ($p < 0.01$) and by 0.21 percentage points for 2025-2027 ($p < 0.01$). These findings highlight that households expect the strongest changes in inflation to occur a few years after the announcement. The increase in inflation expectations suggests that respondents interpret the policy announcement as a signal about the Fed's private information of increased inflationary pressures. Thus, adjustments of inflation expectations differ from the adjustments we measured for the hypothetical forward guidance announcement in our March 2021 survey. Given the very different macroeconomic environment in March 2022, e.g., given the war in Ukraine, this suggests an important role for state-dependence in the effects of monetary policy announcements on inflation expectations. A key strength of our approach is that it flexibly accounts for such state-dependence in expectations adjustments and identifies it before policy meetings.

The third row of Table 3 presents the differences in respondents' nominal income expectations between the rise and the no-change scenario. The table reveals muted and statistically insignificant differences in expectations about cumulative nominal income growth. These effects are very precisely estimated and the minimum detectable effect sizes for a power of 80 percent and a significance threshold of 5 percent are close to 1 percentage point. Consistent with our main evidence presented in Section 4, this suggests a limited relevance of adjustments of nominal income expectations in response to monetary policy announcements.

Consumption counterfactuals with measured expectations We next feed the measured expectation differences into our model outlined in Section 2 and present the implied aggregate consumption counterfactual.

Table 4 presents the model-implied consumption responses for group 2 and group 3 households. Panel A of Table 4 shows results under the assumption that all households

react, while Panel B displays results under the assumption that only attentive households react. Assuming that all non-hand-to-mouth households react to the announcement, while hand-to-mouth households do not react, our model implies an aggregate consumption response of:

$$\begin{aligned}\triangle \bar{c}_t = & \underbrace{0.26}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{HTM}}} \times 0 + \underbrace{0.35}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{non-HTM}\\ \text{0\% constr.}}} \times (-1.225) \\ & + \underbrace{0.36}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{non-HTM}\\ \text{0\% } < \text{ constr. } \leq \text{ 50\%}}} \times (-1.292) + \underbrace{0.04}_{\substack{\text{Weighted}\\ \text{fraction}\\ \text{non-HTM}\\ > \text{ 50\% constr.}}} \times 0.015 = -0.883\end{aligned} \tag{16}$$

If only those non-hand-to-mouth households who report to typically hear about Fed announcements within seven days are assumed to react to the announcement, the overall consumption response to the policy announcement is reduced to -0.295.

Appendix Table A.7 provides a sensitivity analysis of the model-implied consumption responses to conventional monetary policy. The predicted responses hardly change when varying the value ρ at which expectation differences beyond the horizons measured in the survey are assumed to converge to zero (Panels B-E), when winsorizing extreme expectation adjustments instead of dropping the relevant observations from the sample (Panel F), or when allowing agents to update beliefs about inflation in the previous year (Panel G). Moreover, Appendix Table A.8 shows that the consumption responses predicted by the model when only households that are attentive to monetary policy react (Panel B of Table 4) do not vary meaningfully when alternative measures are used to identify attentive households.

In sum, in March 2022 we used our approach to study the effects of conventional monetary policy. At the time of the survey, inflation had reached very high levels, there was a public debate about whether inflation was here to stay, and FOMC members were publicly debating the timing and the size of an interest rate increase. We elicit the joint dis-

tribution of hand-to-mouth status, subjective probability of becoming credit constrained in the future, inattention to monetary policy, and expectation differences across policy alternatives ahead of the policy meeting. We find that a 40 basis point increase in the Fed funds rate in March 2022 would have raised household inflation expectations, consistent with a signalling channel of monetary policy. The rate hike would have reduced aggregate consumption by 0.88 percent if all households are attentive to the announcement or by 0.3 percent if only those households that usually hear about monetary policy announcements are attentive to the announcement.

5 Validation

We validate our model-based consumption predictions using an additional survey in which respondents directly report how they would adjust their consumption under the different scenarios. The survey was fielded approximately two weeks before the Fed meeting in September 2022 in an environment of elevated inflation (8.3 percent in August 2022). The federal funds rate was 2.4 percent before the meeting. We collected a sample of 1,106 US respondents with Prolific. Appendix Table A.9 provides summary statistics.

Design As in the main experiment on conventional monetary policy, we present our respondents with two scenarios: a no-change scenario where the Fed keeps the federal funds rate at 2.4 percent and a rise scenario where the Fed increases the federal funds rate from 2.4 percent to 3.1 percent. Our design is identical to the March 2022 experiment except that we additionally elicit differences in spending plans across the scenarios. Appendix F.4 provides the full set of experimental instructions.

Self-reported data on household spending is known to be subject to a high level of measurement error, even for recall of past spending levels (Browning et al., 2003; Bound et al., 2001).[17] This measurement challenge is further complicated by the need to elicit

[17] In the context of self-reported expectations of future spending, Galashin et al. (2021) document a very noisy relationship between spending plans and realized spending as measured in credit card data.

these plans for different hypothetical scenarios. In addition, the elicitation of quantitative spending plans would need to be in nominal dollar amounts, which will not only capture changes in expected real spending but also differences in expected prices across the two scenarios. This would complicate the interpretation of the elicited quantitative spending plans (if a household expects to spend more under one scenario, this could mean that the household expects higher consumption or that the household expects higher prices under that scenario). We take two steps to circumvent these challenges: (i) we elicit beliefs about quantities purchased rather than spending in nominal terms and (ii) we elicit consumption plans in the simplest possible way using qualitative questions.

After completing the two scenarios, we remind our respondents of the federal funds rate in the two scenarios. We then ask our respondents to assess under which scenario they would be more likely to make particular types of adjustments to their spending behavior over the next three months. The answer options are (i) in the no-change scenario, (ii) same in both scenarios and (iii) in the rise scenario. Specifically, we ask our respondents under which scenario their household would be more likely (i) to reduce purchases of items that they consider to be non-essential, (ii) to cut back on the quality of the goods and services consumed, e.g., to purchase store brands instead of name brands, (iii) to look for deals to obtain the goods and services needed, e.g., to look for sales or rebates or to make use of coupons. On top of this, we elicit a measure of adjustments to overall non-durable purchases by asking them under which scenario their household would make fewer purchases of non-durable goods and services, such as food, entertainment services or clothing.

Effects on expectations Appendix Table A.10 highlights qualitatively similar differences in expectations about the federal funds rate and inflation across scenarios as in the March 2022 survey. Different from the March 2022 survey, respondents now also expect lower nominal income growth in response to the federal funds rate increase.[18]

[18]At the Jackson Hole conference in August 2022, the Federal Reserve Chair emphasized that higher interest rates will also bring some pain to households and businesses. This speech by Federal Reserve Chair Jerome H. Powell was widely covered in the news media and may have affected households' views

Self-reported and model-implied consumption counterfactuals To validate our approach, we compare consumption differences across scenarios as predicted by our model with those reported by our respondents. Appendix Table A.11 displays relatively strong model-implied consumption responses to the rate hike, amounting to -2.8percent assuming that all non-hand-to-mouth households respond and amounting to -1.3 percent if only attentive non-hand-to-mouth households respond. Figure 2 shows the self-reported consumption responses, which provide a similar picture. 48.5 percent of respondents consider it more likely to reduce their overall non-durable purchases in the federal funds rate increase scenario, while 43 percent consider a reduction of non-durable purchases equally likely across the two scenarios. Only 8.5 percent report a higher likelihood of reducing non-durable purchases in the no-change scenario. The patterns are similar for our other measures of consumption behavior (reducing purchases of non-essential items, purchasing goods and services of lower quality, looking for sales or using more coupons).

Table 5 displays correlations between self-reported and model-implied consumption adjustments across respondents. Specifically, we regress dummy variables taking value one if a respondent reports a higher likelihood of making a specific type of downward adjustment to their consumption under the increase scenario on a dummy variable taking value one if the model-implied consumption response is negative. A negative model-implied consumption response is associated with a 12.9 percentage points greater tendency to report that the household is more likely to reduce non-durable purchases under the increase scenario (Column 1, Panel A, $p < 0.01$), which increases to 21.6 percentage points when restricting the sample to non-hand-to-mouth households (Column 1, Panel B, $p < 0.01$). Also our other self-reported consumption measures are strongly correlated with the model-implied response, although the coefficient estimates are somewhat smaller (Columns 2-4).

Summary Taken together, respondents' self-reported consumption responses provide a similar picture as the model-implied responses, and the two are strongly correlated with

ahead of the September 2022 FOMC meeting.

each other. These findings validate our approach of using a model combined with expectation differences across scenarios measured in surveys to predict the effects of policy changes on consumption.

Our model-based approach has a range of advantages compared to eliciting consumption responses in the survey. First, it allows us to circumvent the problems related to eliciting real vs nominal consumption and related to measurement error in self-reported spending data outlined above, enabling us to make quantitative predictions about consumption responses. Second, we can vary other model inputs, such as the degree of attention to Fed announcements or the degree of liquidity constraints, and examine how such changes affect predicted consumption responses. Finally, our approach circumvents a problem related to how respondents interpret questions about consumption in the context of our hypothetical vignettes. Specifically, it is not clear what the respondents "hold fixed". Do the responses reflect how much respondents' consumption would change if monetary policy was the *only* thing that changed? Or do the responses reflect how much their consumption would change after everybody else has also changed their consumption, leading to a change in output, income and inflation in the economy? By contrast, in our approach, direct and indirect effects of monetary policy on consumption of non-hand-to-mouth households are taken into account because they operate through the expectation of the interest rate path, the expectation of the inflation rate path, and the expectation of the net income path and these expectations are elicited for the two policy scenarios.

6 Conclusion

We propose an approach to assess the effects of policies on aggregate outcomes without making assumptions on expectation formation. Specifically, we combine a standard consumption model with expectation differences across policy scenarios elicited in a survey to study the effects of both unconventional and conventional monetary policy. We find that a 40 basis point forward guidance statement in March 2021 would have reduced aggregate consumption by 0.14 percent on impact and a 40 basis point increase in the

current policy rate in March 2022 would have reduced aggregate consumption by 0.30 percent on impact. We validate the consumption responses predicted by our approach using an additional survey eliciting self-reported measures of consumption responses to monetary policy announcements.

Our approach naturally lends itself to study the effects of policies in various other contexts. It is particularly useful in settings where expectation formation is likely highly state-dependent and where expectations of non-policy variables such as inflation and income play an important role. For instance, one could conduct surveys eliciting expectations across different fiscal policy scenarios to study the effects of such policies on consumption or investment behavior. Similarly, one could apply our approach to study the effects of macroprudential policies, e.g. in the context of bank runs.

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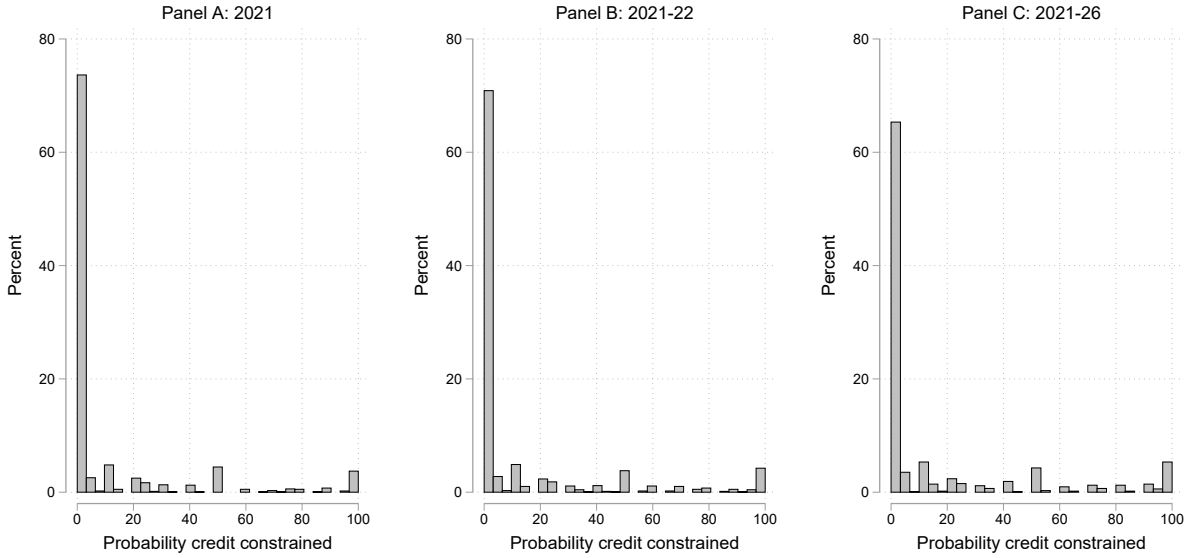
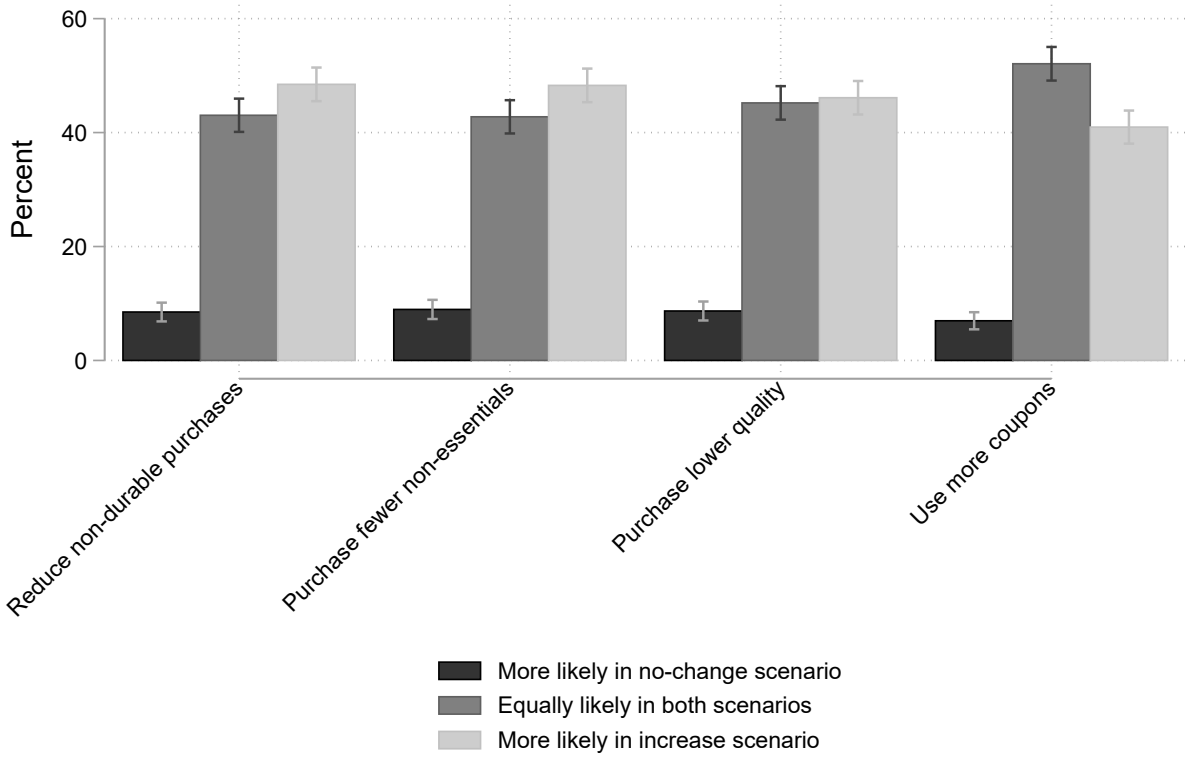
Main figures

Figure 1: Subjective probability of becoming credit constrained: March 2021 main survey



Notes: This figure displays histograms of respondents' subjective probability of becoming credit constrained at any point in time over the indicated horizons. The sample is restricted to non-hand-to-mouth households in our March 2021 main survey on the effects of unconventional monetary policy.

Figure 2: Self-reported consumption responses to conventional monetary policy: September 2022 survey



Notes: This figure displays the shares of respondents reporting that particular types of consumption adjustments to the hypothetical increase in the federal funds rate from 2.4 to 3.1 percent in September 2022 are more likely in the no-change scenario, equally likely in both scenarios, or more likely in the federal funds rate increase scenario, including error bands.

Main tables

Table 1: Expectation differences across unconventional monetary policy scenarios: March 2021 main survey

	Horizon				
	(1) 2021	(2) 2022	(3) 2023	(4) 2026	(5) 2030
Δ Expected federal funds rate	0.053***	0.076***	0.191***	0.032	0.001
	(0.013)	(0.014)	(0.019)	(0.024)	(0.028)
Δ Expected inflation rate	-0.248***	-0.165***	-0.038	-0.134***	
	(0.025)	(0.029)	(0.036)	(0.040)	
Δ Expected cumulative income growth	-0.072		0.047	-0.192	
	(0.161)		(0.172)	(0.198)	
Observations	1,370	1,370	1,370	1,370	1,370

Notes: This table shows the effect of the hypothetical increase in the Fed's projection of the future federal funds rate at the end of 2023 from 0.1 to 0.5 percent in March 2021 on respondent's own expectations about the federal funds rate, inflation and the cumulative growth of nominal household net income at different horizons. The sample is restricted to non-hand-to-mouth households in our March 2021 main survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 2: Model-based consumption responses to unconventional monetary policy: March 2021 main survey

	Group 1: HTM	Group 2: Non-HTM Prob. constr. = 0%	Group 3a: Non-HTM 0% < Prob. constr. ≤ 50%	Group 3b: Non-HTM Prob. constr. > 50%	All
	(1)	(2)	(3)	(4)	(5)
Panel A: All non-HTM react:					
Overall response		-0.475**	0.313	0.508	-0.148
		(0.191)	(0.357)	(0.444)	(0.128)
- Real income effects		0.273	1.681***	0.046	0.507***
		(0.269)	(0.477)	(0.363)	(0.175)
- Intertemporal substitution effects		-0.747***	-1.365***	-0.021**	-0.681***
		(0.158)	(0.300)	(0.009)	(0.105)
- Interest expense effects		-0.001*	-0.004	0.000	-0.001**
		(0.001)	(0.002)	(0.002)	(0.001)
- Effects from real credit limit				0.482	0.028
				(0.356)	(0.021)
Observations	501	937	340	93	1,871
Panel B: Only attentive non-HTM react:					
Overall response		-0.320**	0.102	-0.005	-0.143
		(0.157)	(0.196)	(0.348)	(0.094)
- Real income effects		0.147	0.536*	-0.045	0.189
		(0.225)	(0.298)	(0.339)	(0.134)
- Intertemporal substitution effects		-0.467***	-0.434**	-0.001	-0.334***
		(0.129)	(0.181)	(0.003)	(0.077)
- Interest expense effects		-0.001*	-0.000	0.002*	-0.000
		(0.000)	(0.001)	(0.001)	(0.000)
- Effects from real credit limit				0.039	0.002
				(0.071)	(0.004)
Observations	501	937	340	93	1,871

Notes: This table shows the immediate consumption responses to the hypothetical increase in the Fed's projection of the future federal funds rate at the end of 2023 from 0.1 to 0.5 percent in March 2021 according to the model, using the survey-based changes in expectations. We assume effects on expectations to converge to zero at a quarterly rate $\rho = 0.1$ for horizons beyond those measured in the survey. In Panel A all of the included non-HTM households are assumed to react. In Panel B only those included non-HTM households that report that they typically learn about Fed announcements within seven days (61 percent of non-HTM households) are assumed to react, while the consumption response is set to zero among those that report that it typically takes longer than seven days or that they typically never hear about Fed announcements (39 percent). We assume that households of group 3a behave as if they expected never to be constrained. We assume that households of group 3b behave as if they expected to be constrained with certainty in the next quarter. Each of the four terms of the consumption response is winsorized at -15 percent and 15 percent. The overall consumption response is the sum of the winsorized individual terms. All statistics are weighted by the respondents' total household spending in 2020. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 3: Expectation differences across conventional monetary policy scenarios: March 2022 survey

	Horizon				
	(1) 2022	(2) 2023	(3) 2024	(4) 2027	(5) 2031
Δ Expected federal funds rate	0.226***	0.227***	0.197***	0.145***	0.040
	(0.021)	(0.024)	(0.028)	(0.031)	(0.034)
Δ Expected inflation rate	0.155***	0.193***	0.293***	0.214***	
	(0.051)	(0.058)	(0.062)	(0.066)	
Δ Expected cumulative income growth	-0.242		0.297	-0.430	
	(0.335)		(0.368)	(0.450)	
Observations	462	462	462	462	462

Notes: This table shows the effect of the hypothetical increase in the federal funds rate from 0.1 to 0.5 percent in March 2022 on respondent's own expectations about the federal funds rate, inflation and the cumulative growth of nominal household net income at different horizons. The sample is restricted to non-hand-to-mouth households in our March 2022 survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 4: Model-based consumption responses to conventional monetary policy: March 2022 survey

	Group 1: HTM	Group 2: Non-HTM Prob. constr. $= 0\%$	Group 3a: Non-HTM $0\% <$ Prob. constr. $\leq 50\%$	Group 3b: Non-HTM Prob. constr. $> 50\%$	All
	(1)	(2)	(3)	(4)	(5)
Panel A: All non-HTM react:					
Overall response		-1.225***	-1.292***	0.015	-0.883***
		(0.388)	(0.402)	(0.719)	(0.198)
- Real income effects		-0.766	-1.425**	0.065	-0.770***
		(0.562)	(0.557)	(0.720)	(0.280)
- Intertemporal substitution effects		-0.459	0.134	0.004	-0.111
		(0.293)	(0.327)	(0.013)	(0.155)
- Interest expense effects		0.000	0.000	-0.007	-0.000
		(0.001)	(0.001)	(0.020)	(0.001)
- Effects from real credit limit				-0.047	-0.002
				(0.038)	(0.001)
Observations	230	205	222	35	692
Panel B: Only attentive non-HTM react:					
Overall response		-0.332	-0.501**	-0.058	-0.295***
		(0.247)	(0.205)	(0.037)	(0.113)
- Real income effects		-0.019	-0.407	-0.048	-0.153
		(0.382)	(0.336)	(0.038)	(0.178)
- Intertemporal substitution effects		-0.313	-0.094	-0.002	-0.142
		(0.223)	(0.197)	(0.004)	(0.105)
- Interest expense effects		-0.000	-0.000	-0.000	-0.000
		(0.000)	(0.001)	(0.003)	(0.000)
- Effects from real credit limit				-0.008	-0.000
				(0.006)	(0.000)
Observations	230	205	222	35	692

Notes: This table shows the immediate consumption responses to the hypothetical increase in the federal funds rate from 0.1 to 0.5 percent in March 2022 according to the model, using the survey-based changes in expectations. We assume effects on expectations to converge to zero at a quarterly rate $\rho = 0.1$ for horizons beyond those measured in the survey. In Panel A all of the included non-HTM households are assumed to react. In Panel B only those included non-HTM households that report that they typically learn about Fed announcements within seven days (41 percent of non-HTM households) are assumed to react, while the consumption response is set to zero among those that report that it typically takes longer than seven days or that they typically never hear about Fed announcements (59 percent). We assume that households of group 3a behave as if they expected never to be constrained. We assume that households of group 3b behave as if they expected to be constrained with certainty in the next quarter. Each of the four terms of the consumption response is winsorized at -15 percent and 15 percent. The overall consumption response is the sum of the winsorized individual terms. All statistics are weighted by the respondents' total household spending in 2021. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table 5: Validation of model-based consumption responses to conventional monetary policy with self-reported responses: September 2022 survey

	Reports higher likelihood of … in federal funds rate increase scenario			
	(1) reducing non-durable purchases	(2) purchasing fewer non-essentials	(3) purchasing lower quality	(4) using more coupons
Panel A: Full sample				
$\mathbb{1}$ (Model-based consumption response < 0)	0.129***	0.091**	0.090**	0.073**
	(0.036)	(0.037)	(0.036)	(0.036)
Observations	1,106	1,106	1,106	1,106
R-squared	0.02	0.01	0.01	0.01
Panel B: Non-HTM households				
$\mathbb{1}$ (Model-based consumption response < 0)	0.216***	0.186***	0.157***	0.140***
	(0.049)	(0.049)	(0.048)	(0.049)
Observations	790	790	790	790
R-squared	0.03	0.02	0.02	0.01

Notes: This table correlates immediate consumption responses to the hypothetical increase in the federal funds rate from 2.4 to 3.1 percent in September 2022 as reported by the respondents with consumption responses based on the model (using the survey-based changes in expectations). The outcome variables are dummy variables taking value one if the respondent reports that its household would be more likely to make a given type of consumption adjustment under the "increase scenario" than under the "no-change scenario". The independent variable is a dummy variable indicating whether the model-implied consumption response is negative. The model-implied responses are calculated as explained in the note to Appendix Table A.11. Panel A is based on the full sample, while Panel B focuses on non-HTM households. All correlations are weighted by the respondents' total household spending in 2021. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Online Appendix: The Effects of Monetary Policy: Theory with Measured Expectations

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A Proofs

In this Appendix, we introduce notation (Section A.1), formally state the decision problem of a household (Section A.2) and derive equations (8) and (10) in the paper (Section A.3).

A.1 Notation

Let s_t denote the vector of exogenous shocks that nature draws in period t. This vector s_t contains all aggregate and idiosyncratic shocks to the economy. Let x_{-1} denote the vector of initial conditions that nature drew before period zero. Let $s^t = \{x_{-1}, s_0, s_1, \ldots, s_t\}$ denote the exogenous history of the economy up to and including period t. Let z_i^t denote the information set of household i in period t. We assume that s^t is drawn from a finite set S^t and z_i^t is drawn from a finite set Z_i^t. Let $p_{i,\tau}\left(s^t, z_i^t\right)$ denote household i's period-τ subjective probability of the realization $\left(s^t, z_i^t\right)$. Finally, let $X_{i,\tau}\left(s^t\right)$ denote household i's subjective belief in period τ about the value of the endogenous variable X_t at history s^t.

This setup is extremely general. It imposes no restrictions on the exogenous histories, s^t, the information sets, z_i^t, the subjective probabilities, $p_{i,\tau}\left(s^t, z_i^t\right)$, and the subjective models, $X_{i,\tau}\left(s^t\right)$, apart from the finiteness of the set of possible realizations of $\left(s^t, z_i^t\right)$.

The standard procedure in DSGE models is to impose additional restrictions on these objects. For example, the assumption of rational expectations is nested as a special case by imposing two restrictions: (i) the *subjective* probability $p_{i,\tau}\left(s^t, z_i^t\right)$ equals the *objective* probability of the realization $\left(s^t, z_i^t\right)$ given information z_i^τ, and (ii) the *subjective model* $X_{i,\tau}\left(s^t\right)$ equals the *equilibrium outcome* of variable X_t at history s^t. The assumption of full-information, rational expectations (FIRE) is nested as a special case by imposing restriction (i), restriction (ii), and $z_i^t = s^t$. In this paper, we follow a different strategy. We avoid imposing restrictions on $p_{i,\tau}\left(s^t, z_i^t\right)$, $X_{i,\tau}\left(s^t\right)$, and z_i^t as much as we can.

A.2 Statement of the decision problem of a household

Before we formally state the decision problem of a household, we introduce three concepts: planned consumption, highest feasible consumption, and actual consumption.

Let $C\left(z_i^t\right)$ and $N\left(z_i^t\right)$ denote household i's period-zero plan for consumption and hours worked in period t at information set z_i^t. The two parentheses indicate that the household's actions in period t have to be measurable with respect to the household's information in period t.

The highest feasible consumption of household i in period t at history s^t and information set z_i^t, denoted $\bar{C}\left(s^t, z_i^t\right)$, is given by the flow budget constraint and the borrowing limit:

$$\bar{C}\left(s^t, z_i^t\right) = \frac{1}{P\left(s^t\right)}\left[W\left(s^t\right) N\left(z_i^t\right) + D\left(s^t\right) + R\left(s^{t-1}\right) B\left(s^{t-1}, z_i^{t-1}\right) - T\left(s^t\right) + L\left(s^t\right)\right]. \tag{17}$$

Here $W\left(s^t\right)$, $D\left(s^t\right)$, $T\left(s^t\right)$, and $L\left(s^t\right)$ denote the household's individual nominal wage rate, dividend income, tax payment, and borrowing limit at history s^t, $R\left(s^{t-1}\right)$ denotes the gross nominal interest rate on bond holdings between periods $t-1$ and t at history s^{t-1}, and $P\left(s^t\right)$ denotes the price level at history s^t. $N\left(z_i^t\right)$ are household i's hours worked in period t at information set z_i^t and $B\left(s^{t-1}, z_i^{t-1}\right)$ denotes household i's nominal bond holdings between periods $t-1$ and t at history s^{t-1} and information set z_i^{t-1}. The highest feasible consumption of household i in period t depends on the history s^t and the information set z_i^t, because all variables that the household takes as given are a function of the history s^t, the household's hours worked are a function of the information set z_i^t, and the household's nominal bond holdings between periods $t-1$ and t are a function of s^{t-1} and z_i^{t-1}.

The actual consumption of household i in period t at history s^t and information set z_i^t, denoted $C\left(s^t, z_i^t\right)$, is given by

$$C\left(s^t, z_i^t\right) = min\left\{C\left(z_i^t\right); \bar{C}\left(s^t, z_i^t\right)\right\}. \tag{18}$$

If planned consumption exceeds the highest feasible consumption, the credit card payment does not go through and actual consumption equals the highest feasible consumption. By contrast, if planned consumption does not exceed the highest feasible consumption, the credit card payment goes through and actual consumption equals planned consumption.

The expected utility of household i in period zero can be written as:

$$E_{i,0}\left[\sum_{t=0}^{\infty}\beta^{t}\left(\frac{C_{i,t}^{1-\gamma}}{1-\gamma}-v_{i}\left(N_{i,t}\right)\right)\right]=\sum_{t=0}^{\infty}\sum_{s^{t}\in S^{t}}\sum_{z_{i}^{t}\in Z_{i}^{t}}p_{i,0}\left(s^{t},z_{i}^{t}\right)\beta^{t}\left(\frac{C_{i,0}\left(s^{t},z_{i}^{t}\right)^{1-\gamma}}{1-\gamma}-v_{i}\left(N\left(z_{i}^{t}\right)\right)\right), \tag{19}$$

with

$$C_{i,0}\left(s^{t},z_{i}^{t}\right)=min\left\{C\left(z_{i}^{t}\right);\bar{C}_{i,0}\left(s^{t},z_{i}^{t}\right)\right\}. \tag{20}$$

Here $p_{i,0}\left(s^{t},z_{i}^{t}\right)$ denotes household i's period-zero subjective probability of the realization $\left(s^{t},z_{i}^{t}\right)$, $C_{i,0}\left(s^{t},z_{i}^{t}\right)$ denotes household i's period-zero belief about its actual consumption at history s^{t} and information set z_{i}^{t}, $C\left(z_{i}^{t}\right)$ denotes household i's period-zero plan for consumption in period t at information set z_{i}^{t}, and $\bar{C}_{i,0}\left(s^{t},z_{i}^{t}\right)$ denotes household i's period-zero belief about its highest feasible consumption at history s^{t} and information set z_{i}^{t}. Equation (20) states that the household is aware of the fact that, if it attempts to spend more than it can, its actual consumption will equal its highest feasible consumption. Finally, $N\left(z_{i}^{t}\right)$ denotes household i's period-zero plan for hours worked in period t at information set z_{i}^{t}.

We assume that each household knows the *structure* of the flow budget constraint. That is, each household understands that bond holdings between periods t and $t+1$ equal the difference between total after-tax income in period t and consumption expenditure in period t. Formally, household i's period-zero subjective belief about the value of its nominal bond holdings between periods t and $t+1$ at history s^{t} and information set z_{i}^{t}, denoted $B_{i,0}\left(s^{t},z_{i}^{t}\right)$, is given by:

$$B_{i,0}\left(s^{t},z_{i}^{t}\right)=W_{i,0}\left(s^{t}\right)N\left(z_{i}^{t}\right)+D_{i,0}\left(s^{t}\right)+R_{i,0}\left(s^{t-1}\right)B_{i,0}\left(s^{t-1},z_{i}^{t-1}\right)-T_{i,0}\left(s^{t}\right)-P_{i,0}\left(s^{t}\right)C_{i,0}\left(s^{t},z_{i}^{t}\right), \tag{21}$$

where $W_{i,0}\left(s^{t}\right)$, $D_{i,0}\left(s^{t}\right)$, and $T_{i,0}\left(s^{t}\right)$ denote household i's period-zero belief about its nominal wage rate, its dividend income, and its tax payment at history s^{t}, $P_{i,0}\left(s^{t}\right)$ denotes household i's period-zero belief about the price level at history s^{t}, $R_{i,0}\left(s^{t-1}\right)$ denotes household i's period-zero belief about the gross nominal interest rate at history s^{t-1}, $C_{i,0}\left(s^{t},z_{i}^{t}\right)$ denotes household i's period-zero belief about its actual consumption at history s^{t} and information set z_{i}^{t}, and $N\left(z_{i}^{t}\right)$ denotes household i's period-zero plan for hours worked at information set z_{i}^{t}.

It is important to emphasize that equation (21) is extremely general. To see this, consider the consequences of imposing additional assumptions. For example, imposing the assumption that

households have correct beliefs about the outcomes at history s^t and information set z_i^t, equation (21) reduces to

$$B\left(s^t, z_i^t\right) = W\left(s^t\right) N\left(z_i^t\right) + D\left(s^t\right) + R\left(s^{t-1}\right) B\left(s^{t-1}, z_i^{t-1}\right) - T\left(s^t\right) - P\left(s^t\right) C\left(s^t, z_i^t\right). \tag{22}$$

Furthermore, imposing the additional assumption that households have complete information (i.e., $z_i^t = s^t$), equation (22) reduces to

$$B\left(s^t\right) = W\left(s^t\right) N\left(s^t\right) + D\left(s^t\right) + R\left(s^{t-1}\right) B\left(s^{t-1}\right) - T\left(s^t\right) - P\left(s^t\right) C\left(s^t\right). \tag{23}$$

The last equation is the usual formulation of the flow budget constraint with history notation. Going from equation (23) to equation (22) one allows for the possibility that households have incomplete information. Going from equation (22) to equation (21) one, in addition, allows for the possibility that households have non-rational expectations.

We also assume that each household knows that there *exists* a borrowing limit. Let $L_{i,0}\left(s^t\right)$ denote household i's period-zero subjective belief about its borrowing limit in period t at history s^t. This formulation nests the possibility that the household has correct beliefs about the borrowing limit at history s^t ($L_{i,0}\left(s^t\right) = L\left(s^t\right)$); it also nests the possibility that the household has incorrect beliefs about the borrowing limit at history s^t ($L_{i,0}\left(s^t\right) \neq L\left(s^t\right)$).

Finally, we assume that households are capable of combining their knowledge of the *structure* of the flow budget constraint with their beliefs about the borrowing limit to arrive at beliefs about the highest feasible consumption in period t at history s^t and information set z_i^t, denoted $\bar{C}_{i,0}\left(s^t, z_i^t\right)$,

$$\bar{C}_{i,0}\left(s^t, z_i^t\right) = \frac{1}{P_{i,0}\left(s^t\right)}\left[W_{i,0}\left(s^t\right) N\left(z_i^t\right) + D_{i,0}\left(s^t\right) + R_{i,0}\left(s^{t-1}\right) B_{i,0}\left(s^{t-1}, z_i^{t-1}\right) - T_{i,0}\left(s^t\right) + L_{i,0}\left(s^t\right)\right]. \tag{24}$$

Equation (24) follows from equation (21) by setting $B_{i,0}\left(s^t, z_i^t\right)$ equal to $-L_{i,0}\left(s^t\right)$ and solving for consumption.

Statement of the decision problem of a household: In period zero, each household i makes a plan for consumption and hours worked $\left\{C\left(z_i^t\right), N\left(z_i^t\right)\right\}_{t=0}^{\infty}$, with $C\left(z_i^t\right) \in \mathbb{R}_{++}$ and $N\left(z_i^t\right) \in \mathbb{R}_{+}$,

so as to maximize the expected utility (19) subject to equations (20), (21) and (24).

Equation (19) is the equation for the expected utility of household i in period zero. Equation (20) characterizes household i's period-zero belief about its actual consumption at history s^t and information set z_i^t: the household is aware of the fact that, if it attempts to spend more than it can, its actual consumption will equal its highest feasible consumption. Equation (21) characterizes the household's period-zero belief about the evolution of bond holdings over time: the household understands that savings equal the difference between total after-tax income and consumption expenditure. Equation (24) characterizes the household's period-zero belief about its highest feasible consumption at history s^t and information set z_i^t: the household is capable of combining its knowledge of the structure of the flow budget constraint with its belief about the borrowing limit to arrive at beliefs about the highest feasible consumption. All four equations are based on household i's period-zero subjective beliefs. Hence, all variables have a subscript $i, 0$.

A.3 Consumption functions of different types of households

This subsection contains the derivations of equations (8) and (10) in the paper.

Definition 1: We say household i is "ex-ante non-hand-to-mouth for all periods $t = 0, 1, 2, \ldots$," if the solution to the decision problem of the household, $\left\{C^*\left(z_i^t\right), N^*\left(z_i^t\right)\right\}_{t=0}^{\infty}$, has the property $C^*\left(z_i^t\right) < \bar{C}_{i,0}\left(s^t, z_i^t\right)$ for all $t = 0, 1, 2, \ldots$ and for all $s^t \in S^t$ and $z_i^t \in Z_i^t$ with $p_{i,0}\left(s^t, z_i^t\right) > 0$.

For a household who is ex-ante non-hand-to-mouth for all periods $t = 0, 1, 2, \ldots$", the subjective probability of becoming hand-to-mouth (i.e., consuming all available resources) equals zero for any horizon under the optimal plan.

Proposition 1: Consider any household who is ex-ante non-hand-to-mouth for all periods $t = 0, 1, 2, \ldots$ and who believes that it cannot run a Ponzi scheme.

- The planned consumption of the household in period zero, $C\left(z_i^0\right)$, is given by two equations: the perceived lifetime budget constraint, equation (33), and the Euler equation based on subjective beliefs, equation (34).

- Log-linearizing these two equations at a point, where all variables are constant over time and $R/\Pi = 1/\beta$, yields the log-linear consumption function

$$c\left(z_i^0\right) = \begin{array}{c} (1-\beta)\,\frac{\tilde{Y}}{\tilde{C}} E_{i,0}\left[\sum_{t=0}^{\infty}\beta^t\left(\tilde{y}_{i,t}+\frac{\frac{1}{\beta}\tilde{B}}{\tilde{Y}}\tilde{r}_t\right)\right] \\ -\frac{1}{\gamma}E_{i,0}\left[\sum_{t=1}^{\infty}\beta^t\tilde{r}_t\right] \\ +(1-\beta)\,\frac{\frac{1}{\beta}\tilde{B}}{\tilde{C}}E_{i,0}\left[\tilde{b}_{i,-1}\right] \end{array}. \tag{25}$$

Proof: First, we derive household i's period-zero belief about its lifetime budget constraint from equation (21) and from the household's belief that it cannot run a Ponzi scheme. Household i's period-zero belief about the value of its nominal bond holdings between periods t and $t+1$ at history s^t and information set z_i^t is given by equation (21):

$$B_{i,0}\left(s^t, z_i^t\right) = W_{i,0}\left(s^t\right) N\left(z_i^t\right) + D_{i,0}\left(s^t\right) + R_{i,0}\left(s^{t-1}\right) B_{i,0}\left(s^{t-1}, z_i^{t-1}\right) - T_{i,0}\left(s^t\right) - P_{i,0}\left(s^t\right) C_{i,0}\left(s^t, z_i^t\right). \tag{26}$$

Dividing both sides of the equation by $P_{i,0}\left(s^t\right)$ yields household i's period-zero belief about the value of its real bond holdings between periods t and $t+1$ at history s^t and information set z_i^t:

$$\tilde{B}_{i,0}\left(s^t, z_i^t\right) = \tilde{Y}_{i,0}\left(s^t, z_i^t\right) + \tilde{R}_{i,0}\left(s^t\right)\tilde{B}_{i,0}\left(s^{t-1}, z_i^{t-1}\right) - C_{i,0}\left(s^t, z_i^t\right), \tag{27}$$

where

$$\begin{array}{c} \tilde{B}_{i,0}\left(s^t, z_i^t\right) = \frac{B_{i,0}\left(s^t, z_i^t\right)}{P_{i,0}\left(s^t\right)} \\ \tilde{Y}_{i,0}\left(s^t, z_i^t\right) = \frac{W_{i,0}\left(s^t\right)N\left(z_i^t\right)+D_{i,0}\left(s^t\right)-T_{i,0}\left(s^t\right)}{P_{i,0}\left(s^t\right)} \\ \tilde{R}_{i,0}\left(s^t\right) = \frac{R_{i,0}\left(s^{t-1}\right)P_{i,0}\left(s^{t-1}\right)}{P_{i,0}\left(s^t\right)}. \end{array} \tag{28}$$

Here $\tilde{B}_{i,0}\left(s^t, z_i^t\right)$ is household i's period-zero belief about its real bond holdings between periods t and $t+1$, $\tilde{Y}_{i,0}\left(s^t, z_i^t\right)$ is household i's period-zero belief about its real non-interest income in period t, and $\tilde{R}_{i,0}\left(s^t\right)$ is household i's period-zero belief about the real interest rate between periods $t-1$ and t. Solving equation (27) for $\tilde{B}_{i,0}\left(s^{t-1}, z_i^{t-1}\right)$ yields

$$\tilde{B}_{i,0}\left(s^{t-1}, z_i^{t-1}\right) = \frac{1}{\tilde{R}_{i,0}\left(s^t\right)}\left[C_{i,0}\left(s^t, z_i^t\right) - \tilde{Y}_{i,0}\left(s^t, z_i^t\right)\right] + \frac{1}{\tilde{R}_{i,0}\left(s^t\right)}\tilde{B}_{i,0}\left(s^t, z_i^t\right). \tag{29}$$

Solving this equation forward from period zero onwards and using the fact that the household believes that it cannot run a Ponzi scheme along any path yields the lifetime budget constraint:

$$\tilde{B}_{i,0}\left(s^{-1}, z_i^{-1}\right) = \sum_{t=0}^{\infty}\frac{1}{\prod_{k=0}^{t}\tilde{R}_{i,0}\left(s^k\right)}\left[C_{i,0}\left(s^t, z_i^t\right) - \tilde{Y}_{i,0}\left(s^t, z_i^t\right)\right]. \tag{30}$$

Multiplying both sides of the last equation by $\tilde{R}_{i,0}\left(s^0\right)$ yields

$$\tilde{R}_{i,0}\left(s^0\right)\tilde{B}_{i,0}\left(s^{-1},z_i^{-1}\right)=\sum_{t=0}^{\infty}\frac{1}{\prod_{k=1}^{t}\tilde{R}_{i,0}\left(s^k\right)}\left[C_{i,0}\left(s^t,z_i^t\right)-\tilde{Y}_{i,0}\left(s^t,z_i^t\right)\right]. \tag{31}$$

This equation says that, along any path, the present value of consumption minus the present value of income has to equal real liquid wealth at the beginning of period zero. Using the fact that the household is ex-ante non-hand-to-mouth for all periods $t=0,1,2,\ldots$, and thus expects to be able to implement its consumption plan at each point in time, $C_{i,0}\left(s^t,z_i^t\right)=C\left(z_i^t\right)$, yields

$$\tilde{R}_{i,0}\left(s^0\right)\tilde{B}_{i,0}\left(s^{-1},z_i^{-1}\right)=\sum_{t=0}^{\infty}\frac{1}{\prod_{k=1}^{t}\tilde{R}_{i,0}\left(s^k\right)}\left[C\left(z_i^t\right)-\tilde{Y}_{i,0}\left(s^t,z_i^t\right)\right]. \tag{32}$$

Finally, since the last equation holds along any path, it also has to hold in expectations across paths, yielding

$$\sum_{s^0\in S^0}p_{i,0}\left(s^0\right)\tilde{R}_{i,0}\left(s^0\right)\tilde{B}_{i,0}\left(s^{-1},z_i^{-1}\right)=\sum_{t=0}^{\infty}\sum_{s^t\in S^t}\sum_{z_i^t\in Z_i^t}p_{i,0}\left(s^t,z_i^t\right)\frac{1}{\prod_{k=1}^{t}\tilde{R}_{i,0}\left(s^k\right)}\left[C\left(z_i^t\right)-\tilde{Y}_{i,0}\left(s^t,z_i^t\right)\right], \tag{33}$$

where $p_{i,0}\left(s^0\right)$ is household i's period-zero subjective probability of the realization s^0. In the special case, where the household believes to have complete information about the history of the economy in period zero, we have $p_{i,0}\left(s^0\right)=1$ for one element of S^0 and $p_{i,0}\left(s^0\right)=0$ for all other elements of S^0 on the left-hand side of equation (33). In the special case, where the household believes to have perfect foresight about the future of the economy in period zero, the triple sum on the right-hand side of equation (33) reduces to a single sum, because $p_{i,0}\left(s^t,z_i^t\right)=1$ for one element of $S^t\times Z_i^t$ and $p_{i,0}\left(s^t,z_i^t\right)=0$ for all other elements of $S^t\times Z_i^t$.

Second, an optimal plan has to satisfy the following optimality condition, for all $t=1,2,\ldots$:

$$C\left(z_i^0\right)^{-\gamma}=\sum_{s^t\in S^t}\sum_{z_i^t\in Z_i^t}p_{i,0}\left(s^t,z_i^t\right)\beta^t\left(\prod_{k=1}^{t}\tilde{R}_{i,0}\left(s^k\right)\right)C\left(z_i^t\right)^{-\gamma}. \tag{34}$$

If a plan $\left\{C\left(z_i^t\right),N\left(z_i^t\right)\right\}_{t=0}^{\infty}$ violates this condition, then there exists a deviation from the plan that raises the expected utility of household i in period zero. If the left-hand side of equation (34) is strictly smaller than the right-hand side of equation (34) for some $t=1,2,\ldots$, the household can raise expected utility through the following deviation: in period zero, consume marginally less

and, in period t, consume the ex-post, cumulative, real gross return ($\prod_{k=1}^{t} \tilde{R}_{i,0}\left(s^k\right)$) on the additional saving. To implement this deviation, the household only has to observe the cumulative, real gross return. Hence, we assume that the household believes that it will observe that cumulative return. If the left-hand side of equation (34) is strictly larger than the right-hand side of equation (34) for some $t = 1, 2, \ldots$, the household can raise expected utility through a similar deviation: in period zero, consume marginally more and, in period t, reduce consumption by the ex-post, cumulative, real gross return on the missing saving.

Third, we log-linearize the perceived lifetime budget constraint, equation (33). Expressing this equation in terms of log-deviations from a point, where all variables are constant over time and $\tilde{R} = 1/\beta$, yields:

$$\begin{array}{c} \sum_{s^0 \in S^0} p_{i,0}\left(s^0\right) \frac{1}{\beta} \tilde{B} e^{\tilde{r}_{i,0}\left(s^0\right) + \tilde{b}_{i,0}\left(s^{-1}, z_i^{-1}\right)} \\ = \sum_{t=0}^{\infty} \sum_{s^t \in S^t} \sum_{z_i^t \in Z_i^t} p_{i,0}\left(s^t, z_i^t\right) \beta^t e^{-\sum_{k=1}^{t} \tilde{r}_{i,0}\left(s^k\right)} \left[C e^{c\left(z_i^t\right)} - \tilde{Y} e^{\tilde{y}_{i,0}\left(s^t, z_i^t\right)} \right], \end{array} \tag{35}$$

where

$$\begin{array}{c} c\left(z_i^t\right) = ln\left(C\left(z_i^t\right)/C\right) \\ \tilde{y}_{i,0}\left(s^t, z_i^t\right) = ln\left(\tilde{Y}_{i,0}\left(s^t, z_i^t\right)/\tilde{Y}\right) \\ \tilde{b}_{i,0}\left(s^{-1}, z_i^{-1}\right) = ln\left(\tilde{B}_{i,0}\left(s^{-1}, z_i^{-1}\right)/\tilde{B}\right) \\ \tilde{r}_{i,0}\left(s^k\right) = ln\left(\tilde{R}_{i,0}\left(s^k\right)/\tilde{R}\right) \end{array} \tag{36}$$

for some (household-specific) C, $\tilde{Y}$, and $\tilde{B}$. In the empirical implementation, $\tilde{Y}$ and $\tilde{B}$ will be the non-interest income and the liquid wealth of the household in the previous year. A first-order Taylor approximation of equation (35) at zero yields

$$\begin{array}{c} \sum_{s^0 \in S^0} p_{i,0}\left(s^0\right) \frac{1}{\beta} \tilde{B} \left(\tilde{r}_{i,0}\left(s^0\right) + \tilde{b}_{i,0}\left(s^{-1}, z_i^{-1}\right) \right) \\ = \sum_{t=0}^{\infty} \sum_{s^t \in S^t} \sum_{z_i^t \in Z_i^t} p_{i,0}\left(s^t, z_i^t\right) \beta^t \left[C\left(-\sum_{k=1}^{t} \tilde{r}_{i,0}\left(s^k\right) + c\left(z_i^t\right) \right) - \tilde{Y}\left(-\sum_{k=1}^{t} \tilde{r}_{i,0}\left(s^k\right) + \tilde{y}_{i,0}\left(s^t, z_i^t\right) \right) \right], \end{array} \tag{37}$$

which can also be written as

$$c\left(z_i^0\right) + E_{i,0}\left[\sum_{t=1}^{\infty} \beta^t \left(-\sum_{k=1}^{t} \tilde{r}_k + c_{i,t} \right) \right] = \frac{\frac{1}{\beta}\tilde{B}}{C} E_{i,0}\left[\tilde{r}_0 + \tilde{b}_{i,-1} \right] + \frac{\tilde{Y}}{C} E_{i,0}\left[\tilde{y}_{i,0} + \sum_{t=1}^{\infty} \beta^t \left(-\sum_{k=1}^{t} \tilde{r}_k + \tilde{y}_{i,t} \right) \right]. \tag{38}$$

Equation (38) states that the expected present value of consumption equals the perceived beginning-of-period-zero real financial wealth plus the expected present value of real non-interest income.

Fourth, we log-linearize the optimality condition, equation (34). Expressing this equation in terms of log-deviations from a point, where all variables are constant over time and $\tilde{R} = 1/\beta$, yields:

$$e^{-\gamma c\left(z_i^0\right)} = \sum_{s^t \in S^t} \sum_{z_i^t \in Z_i^t} p_{i,0}\left(s^t, z_i^t\right) e^{\sum_{k=1}^{t} \tilde{r}_{i,0}\left(s^k\right) - \gamma c\left(z_i^t\right)}. \tag{39}$$

A first-order Taylor approximation of the last equation at zero yields

$$-\gamma c\left(z_i^0\right) = \sum_{s^t \in S^t} \sum_{z_i^t \in Z_i^t} p_{i,0}\left(s^t, z_i^t\right) \left[\sum_{k=1}^{t} \tilde{r}_{i,0}\left(s^k\right) - \gamma c\left(z_i^t\right)\right]. \tag{40}$$

This equation can also be written as

$$-\gamma c\left(z_i^0\right) = E_{i,0}\left[\sum_{k=1}^{t} \tilde{r}_k - \gamma c_{i,t}\right], \tag{41}$$

or equivalently

$$E_{i,0}\left[c_{i,t}\right] = \frac{1}{\gamma} E_{i,0}\left[\sum_{k=1}^{t} \tilde{r}_k\right] + c\left(z_i^0\right). \tag{42}$$

Fifth, we combine equations (38) and (42). Using equation (42) to substitute for $E_{i,0}\left[c_{i,t}\right]$ in equation (38) yields

$$\frac{1}{1-\beta} c\left(z_i^0\right) + \left(\frac{1}{\gamma} - 1\right) \sum_{t=1}^{\infty} \beta^t E_{i,0}\left[\sum_{k=1}^{t} \tilde{r}_k\right] = \frac{\frac{1}{\beta}\tilde{B}}{C} E_{i,0}\left[\tilde{r}_0 + \tilde{b}_{i,-1}\right] + \frac{\tilde{Y}}{C} E_{i,0}\left[\tilde{y}_{i,0} + \sum_{t=1}^{\infty} \beta^t \left(-\sum_{k=1}^{t} \tilde{r}_k + \tilde{y}_{i,t}\right)\right]. \tag{43}$$

This equation can also be written as

$$\frac{1}{1-\beta} c\left(z_i^0\right) + \left(\frac{1}{\gamma} + \frac{\tilde{Y} - C}{C}\right) \frac{1}{1-\beta} \sum_{t=1}^{\infty} \beta^t E_{i,0}\left[\tilde{r}_t\right] = \frac{\frac{1}{\beta}\tilde{B}}{C} E_{i,0}\left[\tilde{r}_0 + \tilde{b}_{i,-1}\right] + \frac{\tilde{Y}}{C} E_{i,0}\left[\sum_{t=0}^{\infty} \beta^t \tilde{y}_{i,t}\right], \tag{44}$$

since

$$\sum_{t=1}^{\infty} \beta^t E_{i,0}\left[\sum_{k=1}^{t} \tilde{r}_k\right] = \frac{1}{1-\beta} \sum_{t=1}^{\infty} \beta^t E_{i,0}\left[\tilde{r}_t\right]. \tag{45}$$

Multiplying both sides of equation (44) by $(1-\beta)$ and moving the interest rate term on the right-hand side of equation (44) yields

$$c\left(z_i^0\right) = \begin{array}{c} (1-\beta)\,\frac{\tilde{Y}}{C}E_{i,0}\left[\sum_{t=0}^{\infty}\beta^t\tilde{y}_{i,t}\right] \\ -\left(\frac{1}{\gamma}-\frac{C-\tilde{Y}}{C}\right)E_{i,0}\left[\sum_{t=1}^{\infty}\beta^t\tilde{r}_t\right] \\ +(1-\beta)\,\frac{\frac{1}{\beta}\tilde{B}}{C}E_{i,0}\left[\tilde{r}_0+\tilde{b}_{i,-1}\right] \end{array}. \tag{46}$$

Finally, we log-linearized equations (33) and (34) at a point, where all variables are constant over time, which requires the following relationship across variables in that point: $C = \tilde{Y} + \left(\frac{1}{\beta}-1\right)\tilde{B}$. Using this equation to substitute for $C-\tilde{Y}$ in the last equation and rearranging yields the log-linear consumption function, equation (25).

Next, we turn to the consumption function of a household who is ex-ante non-hand-to-mouth in the current period and who expects to become hand-to-mouth in the next period with a high probability.

Definition 2: We say household i is "ex-ante non-hand-to-mouth in period $t=0$," if the solution to the decision problem of the household, $\left\{C^*\left(z_i^t\right), N^*\left(z_i^t\right)\right\}_{t=0}^{\infty}$, has the property $C^*\left(z_i^0\right) < \bar{C}_{i,0}\left(s^0, z_i^0\right)$ for all $s^0 \in S^0$ and $z_i^0 \in Z_i^0$ with $p_{i,0}\left(s^0, z_i^0\right) > 0$.

For a household who is "ex-ante non-hand-to-mouth in period zero", the subjective probability of becoming hand-to-mouth (i.e., consuming all available resources) in the current period equals zero under the optimal plan.

Proposition 2: Consider any household who is ex-ante non-hand-to-mouth in period zero and believes that it will become hand-to-mouth in period one with probability one.

- The planned consumption of the household in period zero, $C\left(z_i^0\right)$, is given by two equations: the household's period-zero belief about its highest feasible consumption at history s^1 and information set z_i^1, equation (53), and the Euler equation based on subjective beliefs, equation (55).

- Combining these two equations yields the following equation for the planned consumption of the household in period zero:

$$C\left(z_i^0\right)^{-\gamma} = \sum_{s^1 \in S^1}\sum_{z_i^1 \in Z_i^1} p_{i,0}\left(s^1, z_i^1\right)\beta\tilde{R}_{i,0}\left(s^1\right)\left[\tilde{X}_{i,0}\left(s^1, z_i^1\right) - \tilde{R}_{i,0}\left(s^1\right)C\left(z_i^0\right)\right]^{-\gamma}, \tag{47}$$

with

$$\tilde{X}_{i,0}\left(s^1, z_i^1\right) = \tilde{R}_{i,0}\left(s^1\right)\left[\tilde{Y}_{i,0}\left(s^0, z_i^0\right) + \tilde{R}_{i,0}\left(s^0\right)\tilde{B}_{i,0}\left(s^{-1}, z_i^{-1}\right)\right] + \tilde{Y}_{i,0}\left(s^1, z_i^1\right) + \tilde{L}_{i,0}\left(s^1\right). \tag{48}$$

- Log-linearizing the consumption function (47) at a point, where all variables are constant over time and $R/\Pi = 1/\beta$, yields the log-linear consumption function

$$c\left(z_i^0\right) = \begin{array}{c} \frac{1}{\frac{\bar{C}}{\bar{Y}}}\frac{1}{1+\beta}E_{i,0}\left[\sum_{t=0}^{1}\beta^t\left(\tilde{y}_{i,t} + \frac{1}{\beta}\frac{\tilde{B}}{\bar{Y}}\left(r_{t-1} - \pi_t\right)\right)\right] \\ -\frac{1}{\gamma}\frac{\beta}{1+\beta}E_{i,0}\left[r_0 - \pi_1\right] \\ +\frac{1}{\frac{\bar{C}}{\bar{Y}}}\frac{1}{1+\beta}E_{i,0}\left[\frac{1}{\beta}\frac{\tilde{B}}{\bar{Y}}\tilde{b}_{i,-1} + \beta\frac{\tilde{L}}{\bar{Y}}\tilde{l}_{i,1}\right] \end{array}. \tag{49}$$

Proof: First, household i's period-zero belief about the highest feasible consumption in period one at history s^1 and information set z_i^1 is given by equation (24):

$$\bar{C}_{i,0}\left(s^1, z_i^1\right) = \frac{1}{P_{i,0}\left(s^1\right)}\left[W_{i,0}\left(s^1\right)N\left(z_i^1\right) + D_{i,0}\left(s^1\right) + R_{i,0}\left(s^0\right)B_{i,0}\left(s^0, z_i^0\right) - T_{i,0}\left(s^1\right) + L_{i,0}\left(s^1\right)\right]. \tag{50}$$

Household i's period-zero belief about the value of its nominal bond holdings between periods zero and one at history s^0 and information set z_i^0 is given by equation (21):

$$B_{i,0}\left(s^0, z_i^0\right) = W_{i,0}\left(s^0\right)N\left(z_i^0\right) + D_{i,0}\left(s^0\right) + R_{i,0}\left(s^{-1}\right)B_{i,0}\left(s^{-1}, z_i^{-1}\right) - T_{i,0}\left(s^0\right) - P_{i,0}\left(s^0\right)C_{i,0}\left(s^0, z_i^0\right). \tag{51}$$

Using the fact that the household is ex-ante non-hand-to-mouth in period zero implies that the household expects to be able to implement its consumption plan in period zero:

$$C_{i,0}\left(s^0, z_i^0\right) = C\left(z_i^0\right). \tag{52}$$

Combining the last three equations yields the following equation for household i's period-zero belief about the highest feasible consumption at history s^1 and information set z_i^1:

$$\bar{C}_{i,0}\left(s^1, z_i^1\right) = \tilde{X}_{i,0}\left(s^1, z_i^1\right) - \tilde{R}_{i,0}\left(s^1\right)C\left(z_i^0\right), \tag{53}$$

with

$$\tilde{X}_{i,0}\left(s^1, z_i^1\right) = \tilde{R}_{i,0}\left(s^1\right)\left[\tilde{Y}_{i,0}\left(s^0, z_i^0\right) + \tilde{R}_{i,0}\left(s^0\right)\tilde{B}_{i,0}\left(s^{-1}, z_i^{-1}\right)\right] + \tilde{Y}_{i,0}\left(s^1, z_i^1\right) + \tilde{L}_{i,0}\left(s^1\right). \quad (54)$$

Here $\tilde{Y}_{i,0}\left(s^0, z_i^0\right)$ is household i's period-zero belief about its real non-interest income in period zero at history s^0 and information set z_i^0. See equation (28).

Second, an optimal plan has to satisfy the following optimality condition:

$$C\left(z_i^0\right)^{-\gamma} = \sum_{s^1 \in S^1} \sum_{z_i^1 \in Z_i^1} p_{i,0}\left(s^1, z_i^1\right)\beta\tilde{R}_{i,0}\left(s^1\right)\left[\bar{C}_{i,0}\left(s^1, z_i^1\right)\right]^{-\gamma}. \quad (55)$$

If a plan violates this condition, then there exists a deviation from the plan that raises the expected utility of household i in period zero. If the left-hand side of equation (55) is strictly smaller than the right-hand side of equation (55), the household can raise expected utility by consuming marginally less in period zero and consuming the ex-post real gross return on the extra saving in period one. If the left-hand side of equation (55) is strictly larger than the right-hand side of equation (55), the household can raise expected utility by consuming marginally more in period zero and reducing consumption in period one by the ex-post real gross return on the missing saving. The value of consumption on the right-hand side of equation (55) equals the highest feasible consumption at every history s^1 and information set z_i^1, because of the condition that the household believes that it will become hand-to-mouth in period one with probability one.

Third, we combine equations (53) and (55). Using equation (53) to substitute for $\bar{C}_{i,0}\left(s^1, z_i^1\right)$ in equation (55) yields the following equation for the planned consumption of the household in period zero:

$$C\left(z_i^0\right)^{-\gamma} = \sum_{s^1 \in S^1} \sum_{z_i^1 \in Z_i^1} p_{i,0}\left(s^1, z_i^1\right)\beta\tilde{R}_{i,0}\left(s^1\right)\left[\tilde{X}_{i,0}\left(s^1, z_i^1\right) - \tilde{R}_{i,0}\left(s^1\right)C\left(z_i^0\right)\right]^{-\gamma}, \quad (56)$$

where $\tilde{X}_{i,0}\left(s^1, z_i^1\right)$ is given by equation (54).

Fourth, log-linearizing equation (56) at a point, where all variables are constant over time and $\tilde{R} = 1/\beta$, yields

$$c\left(z_i^0\right) = \frac{1}{1+\beta}E_{i,0}\left[\frac{\tilde{Y}}{C}\left(\tilde{y}_{i,0} + \beta\tilde{y}_{i,1}\right) + \frac{\tilde{B}}{C}\frac{1}{\beta}\left(\tilde{b}_{i,-1} + \tilde{r}_0 + \beta\tilde{r}_1\right) + \frac{\tilde{L}}{C}\beta\tilde{l}_{i,1}\right] - \frac{1}{\gamma}\frac{1}{1+\beta}E_{i,0}\left[\beta\tilde{r}_1\right]. \quad (57)$$

Here C, $\tilde{Y}$, $\tilde{B}$, and $\tilde{L}$ denote consumption, real non-interest income, real bond holdings, and real borrowing limit at the point around which we log-linearize, and small roman letters denote log-deviations from this point:

$$\begin{aligned} \tilde{y}_{i,0} &= ln\left(\tilde{Y}_{i,0}/\tilde{Y}\right) \\ \tilde{y}_{i,1} &= ln\left(\tilde{Y}_{i,1}/\tilde{Y}\right) \\ \tilde{b}_{i,-1} &= ln\left(\tilde{B}_{i,-1}/\tilde{B}\right) \\ \tilde{r}_0 &= ln\left(\tilde{R}_0/\tilde{R}\right) \\ \tilde{r}_1 &= ln\left(\tilde{R}_1/\tilde{R}\right) \\ \tilde{l}_{i,1} &= ln\left(\tilde{L}_{i,1}/\tilde{L}\right) \\ c\left(z_i^0\right) &= ln\left(C\left(z_i^0\right)/C\right). \end{aligned} \tag{58}$$

Rearranging the right-hand side of equation (57) and using $\tilde{R}_t = \frac{R_{t-1}}{\Pi_t}$, $\Pi_t = \frac{P_t}{P_{t-1}}$, and $\tilde{r}_t = r_{t-1} - \pi_t$ with $r_{t-1} = ln\left(R_{t-1}/R\right)$ and $\pi_t = ln\left(\Pi_t/\Pi\right)$ yields the log-linear consumption function, equation (49).

A.4 The actual consumption of a household in period zero

The actual consumption of household i in period zero at history s^0 and information set z_i^0 equals the minimum of planned consumption of the household at information set z_i^0 and highest feasible consumption:

$$C\left(s^0, z_i^0\right) = min\left\{C\left(z_i^0\right); \bar{C}\left(s^0, z_i^0\right)\right\}. \tag{59}$$

See equation (18). Equation (59) is simply equation (18) for the special case of $t = 0$. If planned consumption exceeds the highest feasible consumption, the credit card payment does not go through and actual consumption equals the highest feasible consumption, $C\left(s^0, z_i^0\right) = \bar{C}\left(s^0, z_i^0\right)$. By contrast, if planned consumption does not exceed the highest feasible consumption, the credit card payment goes through and actual consumption equals planned consumption, $C\left(s^0, z_i^0\right) = C\left(z_i^0\right)$.

In the main body of the paper, we assume that households know their available resources in period zero. In this case, each household knows its highest feasible consumption in period zero. Hence, no household *accidentally* hits the borrowing limit in period zero and actual consumption equals planned consumption in period zero. If households do not all know their available resources in period zero, there is a change in the interpretation of the object that we compute. In that

case, we classify households as *ex-ante* non-hand-to-mouth in period zero based on their answers to the balance sheet questions (Section 3.4) and we compute *planned* consumption from equations (8) and (10). Some of these households may ex-post *accidentally* hit the borrowing limit, because they are wrong about their balance sheet or their credit limit, and for this subset of households actual consumption will be smaller than planned consumption.

B Expectations across policies: Deriving model inputs from survey responses

The survey elicits each household's expected path for the federal funds rate, the inflation rate, and own income under the baseline policy announcement and under the alternative policy announcement.

Let $E_{i,t}[r_s]$ denote household i's expectation in period t of the federal funds rate in period s. Let $\triangle E_{i,t}[r_s] = E^a_{i,t}[r_s] - E^b_{i,t}[r_s]$ denote the difference between the expectation under the alternative policy announcement and the expectation under the baseline policy announcement. The survey elicits each household's expectation in quarter t=2021:Q1 of the federal funds rate at the end of five years (2021, 2022, 2023, 2026, and 2030) under the two policy announcements.[1] Hence, from the survey, one can directly compute $\triangle E_{i,t}[r_{2021:Q4}]$, $\triangle E_{i,t}[r_{2022:Q4}]$, $\triangle E_{i,t}[r_{2023:Q4}]$, $\triangle E_{i,t}[r_{2026:Q4}]$, and $\triangle E_{i,t}[r_{2030:Q4}]$. We interpolate the answers for those quarters s that we do not ask about with the following formula:

$$\triangle E_{i,t}[r_s] = \begin{cases} 0 & s = t, t+1, t+2 \\ \triangle E_{i,t}[r_{2021:Q4}] & s = t+3, \ldots, t+6 \\ \triangle E_{i,t}[r_{2022:Q4}] & s = t+7, \ldots, t+10 \\ \triangle E_{i,t}[r_{2023:Q4}] & s = t+11, \ldots, t+22 \\ \triangle E_{i,t}[r_{2026:Q4}] & s = t+23, \ldots, t+38 \\ (1-\rho)^{s-(t+39)} \triangle E_{i,t}[r_{2030:Q4}] & s \geq t+39 \end{cases}. \tag{60}$$

[1] The survey elicits an annualized rate. We turn this annualized rate into a rate for a quarter by dividing it by four.

This formula contains two assumptions. First, the difference in the expectation under the two policy announcements starts in the quarter for which it is expressed for the first time. Second, the effect of the announcement in 2021:Q1 on the expected federal funds rate in quarter s converges to zero at rate ρ from quarter 2030:Q4 onwards.

Turning to inflation, let $E_{i,t}\left[\pi_s\right]$ denote household i's expectation in period t of the inflation rate in period s. Let $\triangle E_{i,t}\left[\pi_s\right] = E^a_{i,t}\left[\pi_s\right] - E^b_{i,t}\left[\pi_s\right]$ denote the difference between the expectation under the alternative policy announcement and the expectation under the baseline policy announcement. The survey elicits each household's expectation in quarter t=2021:Q1 of the annual inflation rate over the year 2021, over the year 2022, over the year 2023, and over the period 2024-2026. We compute the expected quarterly inflation rates with the following formula:

$$\triangle E_{i,t}\left[\pi_s\right] = \begin{cases} \frac{1}{4}\triangle E_{i,t}\left[\pi_{2021}\right] & s = t, \ldots, t+3 \\ \frac{1}{4}\triangle E_{i,t}\left[\pi_{2022}\right] & s = t+4, \ldots, t+7 \\ \frac{1}{4}\triangle E_{i,t}\left[\pi_{2023}\right] & s = t+8, \ldots, t+11 \\ \frac{1}{4}\triangle E_{i,t}\left[\bar{\pi}_{2024-2026}\right] & s = t+12, \ldots, t+23 \\ (1-\rho)^{s-(t+23)}\frac{1}{4}\triangle E_{i,t}\left[\bar{\pi}_{2024-2026}\right] & s \geq t+24 \end{cases} . \tag{61}$$

This formula contains two assumptions. First, the household expects the price level to grow at a constant rate within a year and within the period 2024-2026. The expected quarterly inflation rate thus equals (1/4) times the expected annual inflation rate. Second, the effect of the policy announcement in quarter t=2021:Q1 on the expected inflation rate in quarter s converges to zero at rate ρ from quarter 2026:Q4 onwards.

Turning to own nominal income, let $E_{i,t}\left[y^{total}_{i,s}\right] = E_{i,t}\left[\frac{Y^{total}_{i,s} - Y^{total}_{i,t-1}}{Y^{total}_{i,t-1}}\right]$ denote household i's expectation in period t of the percentage difference between total nominal income in period s and total nominal income in period $t-1$. Assuming that households know their own past nominal income, we have $E_{i,t}\left[y^{total}_{i,s}\right] = \frac{E_{i,t}\left[Y^{total}_{i,s}\right] - Y^{total}_{i,t-1}}{Y^{total}_{i,t-1}}$. Let $\triangle E_{i,t}\left[y^{total}_{i,s}\right] = E^a_{i,t}\left[y^{total}_{i,s}\right] - E^b_{i,t}\left[y^{total}_{i,s}\right]$ denote the difference between the expectation under the alternative policy announcement and the expectation under the baseline policy announcement. The survey elicits each household's expectation in quarter t=2021:Q1 of own nominal income in the year 2021, average own nominal income in the years 2022-2023, and average own nominal income in the years 2024-2026 under the two policy

announcements. Hence, from the survey, one can directly compute $\triangle E_{i,t}\left[y^{total}_{i,2021}\right] = \frac{\triangle E_{i,t}\left[Y^{total}_{i,2021}\right]}{Y^{total}_{i,2020}}$, $\triangle E_{i,t}\left[\bar{y}^{total}_{i,2022-2023}\right] = \frac{\triangle E_{i,t}\left[\bar{Y}^{total}_{i,2022-2023}\right]}{Y^{total}_{i,2020}}$, and $\triangle E_{i,t}\left[\bar{y}^{total}_{i,2024-2026}\right] = \frac{\triangle E_{i,t}\left[\bar{Y}^{total}_{i,2024-2026}\right]}{Y^{total}_{i,2020}}$. To arrive at expectations of quarterly own nominal income, we use the following formula:

$$\triangle E_{i,t}\left[y^{total}_{i,s}\right] = \begin{cases} \triangle E_{i,t}\left[y^{total}_{i,2021}\right] & s = t, \ldots, t+3 \\ \triangle E_{i,t}\left[\bar{y}^{total}_{i,2022-2023}\right] & s = t+4, \ldots, t+11 \\ \triangle E_{i,t}\left[\bar{y}^{total}_{i,2024-2026}\right] & s = t+12, \ldots, t+23 \\ (1-\rho)^{s-(t+23)} \triangle E_{i,t}\left[\bar{y}^{total}_{i,2024-2026}\right] & s \geq t+24 \end{cases}. \tag{62}$$

This formula contains two assumptions. First, if the household expects *annual* nominal income in 2021 to be x% higher in the year 2021 than in the year 2020, then the household expects *quarterly* nominal income to be x% higher in each quarter of the year. Second, the effect of the policy announcement in quarter t=2021:Q1 on the expected own nominal income in quarter s converges to zero at rate ρ from quarter 2026:Q4 onwards.

Finally, the expectation of own real income is determined by the expectation of own nominal income and the expectation of the rate of inflation

$$E_{i,t}\left[\tilde{y}^{total}_{i,s}\right] = E_{i,t}\left[y^{total}_{i,s}\right] - \sum_{k=t}^{s} E_{i,t}\left[\pi_k\right],$$

where $E_{i,t}\left[\tilde{y}^{total}_{i,s}\right]$ is the expectation of household i in period t=2021:Q1 of the percentage difference between own real income in quarter s and own real income per quarter in 2020. The last equation implies

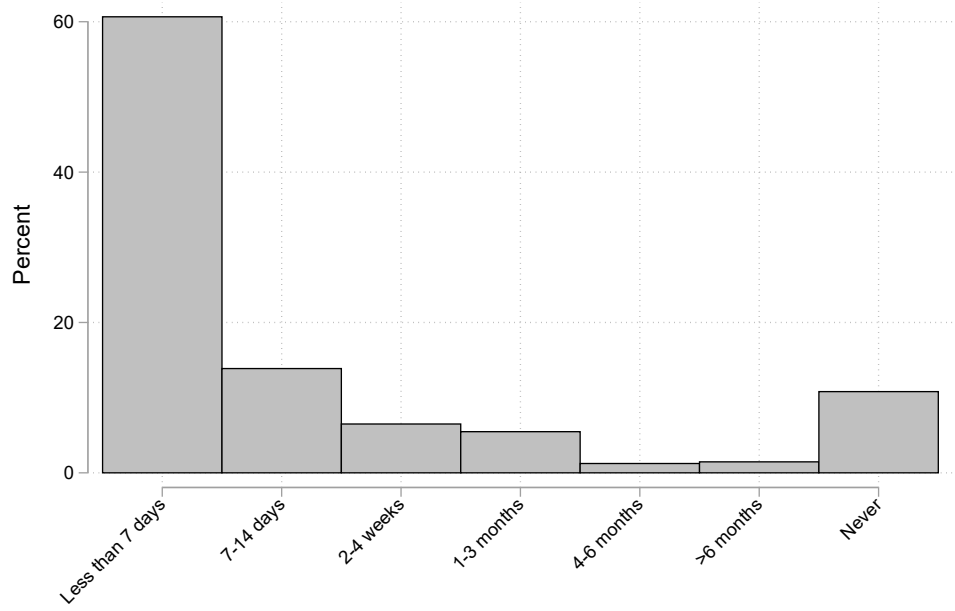
$$\triangle E_{i,t}\left[\tilde{y}^{total}_{i,s}\right] = \triangle E_{i,t}\left[y^{total}_{i,s}\right] - \sum_{k=t}^{s} \triangle E_{i,t}\left[\pi_k\right], \tag{63}$$

where $\triangle E_{i,t}\left[\tilde{y}^{total}_{i,s}\right]$ is the difference between the real income expectation under the alternative policy announcement and the real income expectation under the baseline policy announcement.

The variable $\triangle E_{i,t}\left[\tilde{y}^{total}_{i,s}\right]$ is the empirical measure of $\triangle E_{i,t}\left[\frac{1}{\beta}\frac{\tilde{B}_i}{\bar{Y}_i}\left(r_{s-1} - \pi_s\right) + \tilde{y}_{i,s}\right]$ for a household with positive liquid wealth and of $\triangle E_{i,t}\left[\tilde{y}_{i,s}\right]$ for a household with negative liquid wealth.

C Additional exhibits: March 2021 surveys

Figure A.1: Time until learned about Fed announcements: March 2021 main survey



Notes: This figure displays a histogram of respondents' estimates of the time it typically takes until they hear about Fed announcements. The sample is restricted to non-hand-to-mouth households in our March 2021 main survey on the effects of unconventional monetary policy.

Table A.1: Summary statistics: March 2021 surveys

	ACS 2019	Online Sample					
	(1) Mean	(2) Mean	(3) Median	(4) SD	(5) p25	(6) p75	(7) Observations
Panel A: March 2021 main survey							
Female	0.51	0.50	1.00	0.50	0.00	1.00	1,871
Age	47.78	52.49	60.00	15.20	40.00	70.00	1,871
At least bachelor's degree	0.31	0.41	0.00	0.49	0.00	1.00	1,871
Log(Household net income)	11.06	11.07	11.13	0.81	10.55	11.65	1,871
Northeast	0.17	0.19	0.00	0.40	0.00	0.00	1,871
Midwest	0.21	0.28	0.00	0.45	0.00	1.00	1,871
South	0.38	0.31	0.00	0.46	0.00	1.00	1,871
West	0.24	0.22	0.00	0.41	0.00	0.00	1,871
Main earner employed		0.63	1.00	0.48	0.00	1.00	1,871
Log(Household liquid wealth)		9.60	9.77	2.85	7.47	12.07	1,871
Log(Household credit card debt)		2.15	0.00	3.63	0.00	5.17	1,871
Prob. credit constrained 2021		13.93	0.00	28.22	0.00	10.00	1,871
Panel B: March 2021 robustness survey							
Female	0.51	0.52	1.00	0.50	0.00	1.00	392
Age	47.78	51.60	50.00	15.79	40.00	70.00	392
At least bachelor's degree	0.31	0.31	0.00	0.47	0.00	1.00	392
Log(Household net income)	11.06	10.77	10.98	1.41	10.37	11.51	392
Northeast	0.17	0.20	0.00	0.40	0.00	0.00	392
Midwest	0.21	0.20	0.00	0.40	0.00	0.00	392
South	0.38	0.40	0.00	0.49	0.00	1.00	392
West	0.24	0.20	0.00	0.40	0.00	0.00	392
Main earner employed		0.56	1.00	0.50	0.00	1.00	392
Log(Household liquid wealth)		9.26	9.77	2.89	7.13	11.23	392
Log(Household credit card debt)		2.46	0.00	3.69	0.00	6.44	392

Notes: This table shows summary statistics for the March 2021 main survey (Panel A) and for the March 2021 robustness survey (Panel B).

Table A.2: Expectation differences across unconventional monetary policy scenarios by reason for the policy change: March 2021 main survey

	Horizon				
	(1) 2021	(2) 2022	(3) 2023	(4) 2026	(5) 2030
Panel A: Change endogenous					
Δ Expected federal funds rate	0.055**	0.092***	0.174***	0.069	0.034
	(0.025)	(0.026)	(0.030)	(0.043)	(0.051)
Δ Expected inflation rate	-0.193***	-0.141***	-0.038	-0.096	
	(0.044)	(0.053)	(0.072)	(0.077)	
Δ Expected cumulative income growth	0.271		0.413	0.284	
	(0.316)		(0.366)	(0.433)	
Observations	369	369	369	369	369
Panel B: Change no explanation					
Δ Expected federal funds rate	0.013	0.023	0.154***	-0.010	-0.007
	(0.024)	(0.028)	(0.038)	(0.044)	(0.052)
Δ Expected inflation rate	-0.326***	-0.222***	-0.097	-0.169**	
	(0.051)	(0.057)	(0.071)	(0.081)	
Δ Expected cumulative income growth	-0.791***		-0.802**	-1.057***	
	(0.301)		(0.318)	(0.388)	
Observations	326	326	326	326	326
Panel C: Change exogenous					
Δ Expected federal funds rate	0.071***	0.108***	0.234***	0.099**	0.107*
	(0.023)	(0.029)	(0.041)	(0.050)	(0.058)
Δ Expected inflation rate	-0.224***	-0.106*	-0.022	-0.173**	
	(0.047)	(0.060)	(0.078)	(0.084)	
Δ Expected cumulative income growth	0.475		0.656*	0.166	
	(0.352)		(0.342)	(0.400)	
Observations	312	312	312	312	312
Panel D: Change exogenous stocks					
Δ Expected federal funds rate	0.070**	0.080**	0.203***	-0.025	-0.117*
	(0.029)	(0.031)	(0.042)	(0.052)	(0.061)
Δ Expected inflation rate	-0.255***	-0.188***	0.002	-0.107	
	(0.053)	(0.059)	(0.069)	(0.077)	
Δ Expected cumulative income growth	-0.247		-0.086	-0.206	
	(0.320)		(0.338)	(0.347)	
Observations	363	363	363	363	363

Notes: This table shows the effect of the hypothetical increase in the Fed's projection of the future federal funds rate at the end of 2023 from 0.1 to 0.5 percent in March 2021 on respondent's own expectations about the federal funds rate, inflation and the cumulative growth of nominal household net income at different horizons, across the four survey arms providing respondents with different reasons for the change in the Fed's projections. Arm "Change endogenous" (Panel A) attributes the change in the Fed's projections to a change in the Fed's broader economic outlook. Arm "Change no explanation" (Panel B) does not give an explanation for the change in projections. Arm "Change exogenous" (Panel C) attributes the change in the Fed's projections to a change in the composition of the Fed's committee before the next meeting. Arm "Change exogenous stocks" (Panel D) features the same explanation as "Change exogenous" and in addition explains that the stock market drops by 1 percent in response to the Fed's projections. The sample is restricted to non-hand-to-mouth households in our March 2021 main survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.3: Expectation differences across unconventional monetary policy scenarios: March 2021 robustness survey

	Horizon				
	(1) 2021	(2) 2022	(3) 2023	(4) 2026	(5) 2030
Δ Expected federal funds rate	0.064**	0.066*	0.176***	0.022	-0.024
	(0.027)	(0.033)	(0.037)	(0.049)	(0.059)
Δ Subjective probability credit constrained	0.240	0.025		0.516	
	(0.527)	(0.659)		(0.811)	
Δ Expected cumulative home value growth			0.284		
			(1.217)		
Observations	298	298	298	298	298

Notes: This table shows the effect of the hypothetical increase in the Fed's projection of the future federal funds rate at the end of 2023 from 0.1 to 0.5 percent in March 2021 on respondent's own expectations about the federal funds rate, the probability of becoming credit constrained, and the cumulative growth of the nominal value of their main residence at different horizons. The sample is restricted to non-hand-to-mouth households in our March 2021 robustness survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

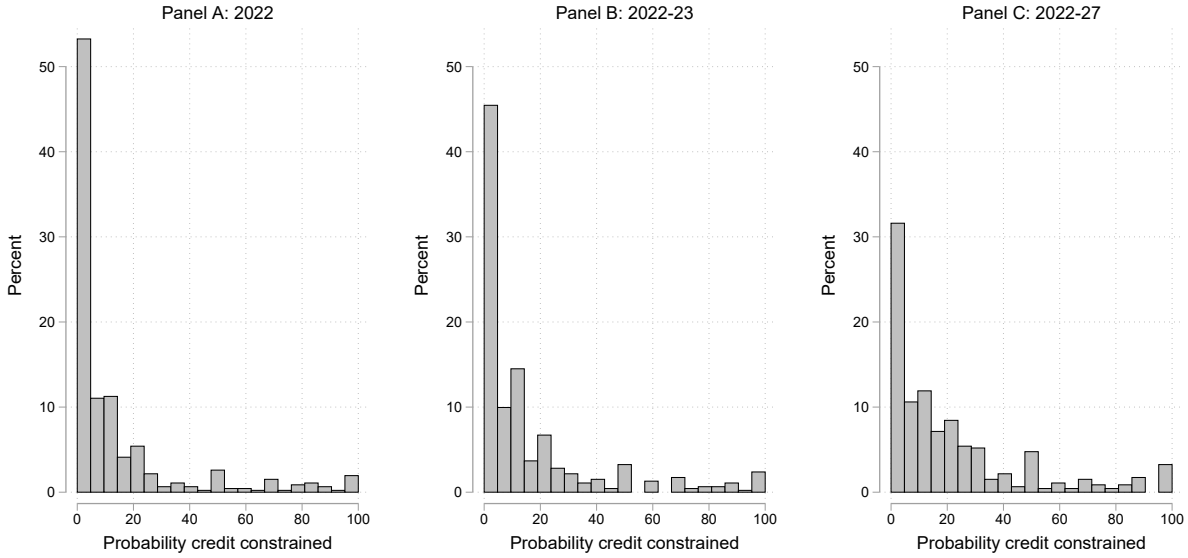
Table A.4: Sensitivity analysis of model-based consumption responses to unconventional monetary policy: March 2021 main survey

	Group 2: Non-HTM Prob. constr. = 0%	Group 3a: Non-HTM 0% < Prob. constr. ≤ 50%	Group 3b: Non-HTM Prob. constr. > 50%	All
	(1)	(2)	(3)	(4)
Panel A: Baseline				
Model-based consumption response	-0.475**	0.313	0.508	-0.148
	(0.191)	(0.357)	(0.444)	(0.128)
Panel B: $\rho = 0.9$				
Model-based consumption response	-0.384**	0.350	0.508	-0.093
	(0.160)	(0.290)	(0.444)	(0.107)
Panel C: $\rho = 0.5$				
Model-based consumption response	-0.390**	0.341	0.508	-0.098
	(0.164)	(0.298)	(0.444)	(0.110)
Panel D: $\rho = 0.2$				
Model-based consumption response	-0.423**	0.316	0.508	-0.120
	(0.175)	(0.325)	(0.444)	(0.118)
Panel E: $\rho = 0.05$				
Model-based consumption response	-0.562***	0.302	0.508	-0.195
	(0.212)	(0.389)	(0.444)	(0.141)
Panel F: Outliers winsorized				
Model-based consumption response	-0.391*	0.935**	0.431	0.048
	(0.204)	(0.427)	(0.713)	(0.147)
Panel G: Updating about past inflation				
Model-based consumption response	-0.455**	0.330	0.893	-0.112
	(0.192)	(0.358)	(0.572)	(0.131)
Panel H: Change endogenous				
Model-based consumption response	-0.604*	1.199**	1.416	0.000
	(0.317)	(0.492)	(0.933)	(0.206)
Panel I: Change no explanation				
Model-based consumption response	-0.131	-0.074	0.570	-0.045
	(0.442)	(0.797)	(1.327)	(0.297)
Panel J: Change exogenous				
Model-based consumption response	-0.128	-0.387	0.218	-0.129
	(0.368)	(1.209)	(0.472)	(0.304)
Panel K: Change exogenous stocks				
Model-based consumption response	-0.969**	0.291	-0.142	-0.408*
	(0.400)	(0.436)	(0.179)	(0.228)

Notes: This table shows a sensitivity analysis of the immediate consumption responses to the hypothetical increase in the Fed's projection of the future federal funds rate at the end of 2023 from 0.1 to 0.5 percent in March 2021 according to the model, using the survey-based changes in expectations. The model-implied responses are calculated as explained in the note to Table 2, with a few differences. Panel A shows the baseline estimates, which assume effects on expectations to converge to zero at a quarterly rate $\rho = 0.1$ for horizons beyond those measured in the survey, which exclude observations with extreme expectations, and which uses the pooled sample across all four arms. The estimates in Panels B-E assume different values of ρ (0.9, 0.5, 0.2, and 0.05). Panel F does not exclude observations with extreme levels or extreme changes in expectations across scenarios but instead winsorizes extreme changes in expectations across scenarios. Panel G allows for changes in beliefs about past inflation, assuming that respondents update beliefs about inflation in the previous year as much as beliefs about inflation in the current year. Panel H focuses on the arm "Change endogenous", which attributes the change in the Fed's projections to a change in the Fed's broader economic outlook. Panel I focuses on the arm "Change no explanation", which does not give an explanation for the change in projections. Panel J focuses on the arm "Change exogenous", which attributes the change in the Fed's projections to a change in the composition of the Fed's committee before the next meeting. Panel K focuses on the arm "Change exogenous stocks", which features the same explanation as "Change exogenous" and in addition explains that the stock market drops by 1 percent in response to the Fed's projections. All statistics are weighted by the respondents' total household spending in 2020. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

D Additional exhibits: March 2022 survey

Figure A.2: Subjective probability of becoming credit constrained: March 2022 survey



Notes: This figure displays histograms of respondents' subjective probability of becoming credit constrained at any point in time over the indicated horizons. The sample is restricted to non-hand-to-mouth households in our March 2022 survey on the effects of conventional monetary policy.

Table A.5: Summary statistics: March 2022 survey

	ACS 2019	Online Sample					
	(1) Mean	(2) Mean	(3) Median	(4) SD	(5) p25	(6) p75	(7) Observations
Female	0.51	0.53	1.00	0.50	0.00	1.00	692
Age	47.78	38.54	40.00	13.86	30.00	50.00	692
At least bachelor's degree	0.31	0.31	0.00	0.46	0.00	1.00	692
Log(Household net income)	11.06	10.78	10.82	0.81	10.31	11.35	692
Northeast	0.17	0.20	0.00	0.40	0.00	0.00	692
Midwest	0.21	0.19	0.00	0.39	0.00	0.00	692
South	0.38	0.40	0.00	0.49	0.00	1.00	692
West	0.24	0.21	0.00	0.41	0.00	0.00	692
Main earner employed		0.83	1.00	0.38	1.00	1.00	692
Log(Household liquid wealth)		8.52	8.74	2.55	6.77	10.53	692
Log(Household credit card debt)		2.81	0.00	3.79	0.00	6.78	692
Prob. credit constrained 2022		19.54	5.00	29.29	0.00	25.00	692

Notes: This table shows summary statistics for the March 2022 survey.

Table A.6: Validation of measure of attention to monetary policy announcements: March 2022 survey

	Heard Fed news at least once last month	Typically hears Fed news at least monthly	Fed news quiz correct	Date last rate change correct
	(1)	(2)	(3)	(4)
Panel A: Full sample				
Typically hears about Fed announcements within a week	0.346***	0.329***	0.147***	-0.017
	(0.035)	(0.037)	(0.032)	(0.036)
Observations	692	692	692	692
R-squared	0.12	0.11	0.03	0.00
Panel B: Non-HTM households				
Typically hears about Fed announcements within a week	0.359***	0.316***	0.152***	-0.026
	(0.042)	(0.045)	(0.038)	(0.044)
Observations	462	462	462	462
R-squared	0.13	0.10	0.04	0.00

Notes: This table correlates several alternative measures of attention to monetary policy with our main measure – a dummy variable indicating whether a respondent reports to typically hear about Fed announcements within a week or less. The outcome variables are dummy variables indicating whether the respondent heard news about the Fed at least once within the last month (Column 1), whether the respondent typically hears news about the Fed at least once per month (Column 2), whether the respondent identified the true news item among a set of true and false news items about the Fed (Column 3), or whether the respondent correctly identified the date of the last change of the fed funds target rate (Column 4). The sample is the full sample of our March 2022 survey (Panel A) or the subsample of non-HTM households (Panel B). Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.7: Sensitivity analysis of model-based consumption responses to conventional monetary policy: March 2022 survey

	Group 2: Non-HTM Prob. constr. $= 0\%$	Group 3a: Non-HTM $0\% <$ Prob. constr. $\leq 50\%$	Group 3b: Non-HTM Prob. constr. $> 50\%$	All
	(1)	(2)	(3)	(4)
Panel A: Baseline				
Model-based consumption response	-1.225***	-1.292***	0.015	-0.883***
	(0.388)	(0.402)	(0.719)	(0.198)
Panel B: $\rho = 0.9$				
Model-based consumption response	-1.199***	-1.239***	0.015	-0.855***
	(0.320)	(0.337)	(0.719)	(0.166)
Panel C: $\rho = 0.5$				
Model-based consumption response	-1.205***	-1.253***	0.015	-0.862***
	(0.327)	(0.345)	(0.719)	(0.170)
Panel D: $\rho = 0.2$				
Model-based consumption response	-1.218***	-1.273***	0.015	-0.874***
	(0.353)	(0.368)	(0.719)	(0.182)
Panel E: $\rho = 0.05$				
Model-based consumption response	-1.185***	-1.296***	0.015	-0.871***
	(0.434)	(0.455)	(0.719)	(0.223)
Panel F: Outliers winsorized				
Model-based consumption response	-1.149***	-1.200***	0.051	-0.809***
	(0.369)	(0.384)	(0.736)	(0.187)
Panel G: Updating about past inflation				
Model-based consumption response	-1.231***	-1.286***	-0.078	-0.887***
	(0.389)	(0.403)	(0.712)	(0.199)

Notes: This table shows a sensitivity analysis of the immediate consumption responses to the hypothetical increase in the federal funds rate from 0.1 to 0.5 percent in March 2022 according to the model, using the survey-based changes in expectations. The model-implied responses are calculated as explained in the note to Table 4, with a few differences. Panel A shows the baseline estimates, which assume effects on expectations to converge to zero at a quarterly rate $\rho = 0.1$ for horizons beyond those measured in the survey and which exclude observations with extreme expectations. The estimates in Panels B-E assume different values of ρ (0.9, 0.5, 0.2, and 0.05). Panel F does not exclude observations with extreme levels or extreme changes in expectations across scenarios but instead winsorizes extreme changes in expectations across scenarios. Panel G allows for changes in beliefs about past inflation, assuming that respondents update beliefs about inflation in the previous year as much as beliefs about inflation in the current year. All statistics are weighted by the respondents' total household spending in 2021. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.8: Sensitivity analysis of model-based consumption responses to conventional monetary policy to using different measures of attention: March 2022 survey

	Group 2: Non-HTM Prob. constr. $= 0\%$	Group 3a: Non-HTM $0\% <$ Prob. constr. $\leq 50\%$	Group 3b: Non-HTM Prob. constr. $> 50\%$	All
	(1)	(2)	(3)	(4)
Panel A: Hears about Fed news within a week (baseline)				
Model-based consumption response	-0.332	-0.501**	-0.058	-0.295***
	(0.247)	(0.205)	(0.037)	(0.113)
Panel B: Heard Fed news at least once last month				
Model-based consumption response	-0.500	-0.342	0.004	-0.295*
	(0.307)	(0.289)	(0.709)	(0.150)
Panel C: Typically hears Fed news at least monthly				
Model-based consumption response	-0.366	-0.407**	0.128	-0.267**
	(0.300)	(0.193)	(0.232)	(0.124)
Panel D: Fed news quiz correct				
Model-based consumption response	-0.510***	-0.289	0.527	-0.259***
	(0.172)	(0.202)	(0.462)	(0.095)
Panel E: Date last rate change correct				
Model-based consumption response	-0.299	-0.265	-0.271	-0.208*
	(0.262)	(0.227)	(0.512)	(0.123)

Notes: This table shows a sensitivity analysis of the immediate consumption responses to the hypothetical increase in the federal funds rate from 0.1 to 0.5 percent in March 2022 according to the model, using the survey-based changes in expectations, to using different measures of attention to monetary policy. The model-implied responses are calculated as explained in the note to Table 4, but vary which proxy is used to identify households that are attentive to monetary policy. Panel A shows the estimates from Table 4 Panel B, in which only those non-HTM households that report that they typically learn about Fed announcements within seven days (41 percent of non-HTM households) are assumed to react. In Panel B, only those non-HTM households that report to have heard news about the Fed at least once within the last month are assumed to react (59 percent of non-HTM households). In Panel C, only those non-HTM households that report to typically hear news about the Fed at least once per month are assumed to react (42 percent of non-HTM households). In Panel D, only those non-HTM households that identified the true news item among a set of true and false news items about the Fed are assumed to react (18 percent of non-HTM households). In Panel E, only those non-HTM households that correctly identified the date of the last change of the fed funds target rate are assumed to react (33 percent of non-HTM households). All statistics are weighted by the respondents' total household spending in 2021. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

E Additional exhibits: September 2022 survey

Table A.9: Summary statistics: September 2022 survey

	ACS 2019	Online Sample					
	(1) Mean	(2) Mean	(3) Median	(4) SD	(5) p25	(6) p75	(7) Observations
Female	0.51	0.51	1.00	0.50	0.00	1.00	1,106
Age	47.78	39.12	40.00	13.79	30.00	50.00	1,106
At least bachelor's degree	0.31	0.47	0.00	0.50	0.00	1.00	1,106
Log(Household net income)	11.06	10.90	10.98	0.78	10.43	11.39	1,106
Northeast	0.17	0.19	0.00	0.39	0.00	0.00	1,106
Midwest	0.21	0.20	0.00	0.40	0.00	0.00	1,106
South	0.38	0.43	0.00	0.50	0.00	1.00	1,106
West	0.24	0.18	0.00	0.38	0.00	0.00	1,106
Main earner employed		0.85	1.00	0.36	1.00	1.00	1,106
Log(Household liquid wealth)		8.71	8.74	2.59	7.13	10.53	1,106
Log(Household credit card debt)		3.07	0.00	3.96	0.00	7.47	1,106
Prob. credit constrained 2022		17.38	0.00	28.64	0.00	20.00	1,106

Notes: This table shows summary statistics for the September 2022 survey.

Table A.10: Expectation differences across conventional monetary policy announcements: September 2022 survey

	Horizon				
	(1) 2022	(2) 2023	(3) 2024	(4) 2027	(5) 2031
Δ Expected federal funds rate	0.626***	0.645***	0.609***	0.546***	0.474***
	(0.023)	(0.025)	(0.026)	(0.028)	(0.032)
Δ Expected inflation rate	0.442***	0.378***	0.388***	0.254***	
	(0.040)	(0.045)	(0.047)	(0.049)	
Δ Expected cumulative income growth	-0.536**		-0.359	-0.772**	
	(0.253)		(0.297)	(0.348)	
Observations	790	790	790	790	790

Notes: This table shows the effect of the hypothetical increase in the federal funds rate from 2.4 to 3.1 percent in September 2022 on respondent's own expectations about the federal funds rate, inflation and the cumulative growth of nominal household net income at different horizons. The sample is restricted to non-hand-to-mouth households in our September 2022 survey. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

Table A.11: Model-based consumption responses to conventional monetary policy: September 2022 survey

	Group 1: HTM	Group 2: Non-HTM Prob. constr. = 0%	Group 3a: Non-HTM 0% < Prob. constr. ≤ 50%	Group 3b: Non-HTM Prob. constr. > 50%	All
	(1)	(2)	(3)	(4)	(5)
Panel A: All non-HTM react:					
Overall response		-3.865***	-3.418***	-1.629**	-2.751***
		(0.296)	(0.344)	(0.711)	(0.176)
- Real income effects		-2.328***	-1.606***	-1.528**	-1.546***
		(0.420)	(0.464)	(0.707)	(0.233)
- Intertemporal substitution effects		-1.535***	-1.807***	-0.016	-1.200***
		(0.270)	(0.296)	(0.012)	(0.147)
- Interest expense effects		-0.002*	-0.004***	0.001	-0.002
		(0.001)	(0.002)	(0.042)	(0.002)
- Effects from real credit limit				-0.086	-0.004
				(0.095)	(0.004)
Observations	316	414	319	57	1,106
Panel B: Only attentive non-HTM react:					
Overall response		-2.165***	-1.246***	-0.558*	-1.329***
		(0.258)	(0.250)	(0.292)	(0.138)
- Real income effects		-1.433***	-0.260	-0.509*	-0.719***
		(0.339)	(0.358)	(0.285)	(0.183)
- Intertemporal substitution effects		-0.730***	-0.982***	-0.020**	-0.607***
		(0.210)	(0.194)	(0.010)	(0.108)
- Interest expense effects		-0.002**	-0.005***	-0.011	-0.003
		(0.001)	(0.001)	(0.037)	(0.002)
- Effects from real credit limit				-0.019	-0.001
				(0.084)	(0.003)
Observations	316	414	319	57	1,106

Notes: This table shows the immediate consumption responses to the hypothetical increase in the federal funds rate from 2.4 to 3.1 percent in September 2022 according to the model, using the survey-based changes in expectations. We assume effects on expectations to converge to zero at a quarterly rate $\rho = 0.1$ for horizons beyond those measured in the survey. In Panel A all of the included non-HTM households are assumed to react. In Panel B only those included non-HTM households that report that they typically learn about Fed announcements within seven days (54 percent of non-HTM households) are assumed to react, while the consumption response is set to zero among those that report that it typically takes longer than seven days or that they typically never hear about Fed announcements (46 percent). We assume that households of group 3a behave as if they expected never to be constrained. We assume that households of group 3b behave as if they expected to be constrained with certainty in the next quarter. Each of the four terms of the consumption response is winsorized at -15 percent and 15 percent. The overall consumption response is the sum of the winsorized individual terms. All statistics are weighted by the respondents' total household spending in 2021. Robust standard errors are in parentheses. * denotes significance at 10 pct., ** at 5 pct., and *** at 1 pct. level.

F Instructions

F.1 Instructions: March 2021 main survey

F.1.1 Attention check

The next question is about the following problem. In questionnaires like ours, sometimes there are participants who do not carefully read the questions and just quickly click through the survey. This means that there are a lot of random answers which compromise the results of research studies. **To show that you read our questions carefully, please choose both "Very strongly interested" and "Not at all interested" as your answer in the below question**

Given the above, how interested are you in politics?

- ☐ Very strongly interested
- ☐ Very interested
- ☐ A little bit interested
- ☐ Almost not interested
- ☐ Not at all interested

→

F.1.2 Demographics

In this survey we will ask you various times about things related to your **household**, such as the total income of your household. By household we mean all family members living with you in your main residence, but excluding roommates and renters.

Which of these describes you more accurately?

- ○ Male
- ○ Female

What is your age?

- ○ 18 - 24
- ○ 25 - 34
- ○ 35 - 44
- ○ 45 - 54
- ○ 55 - 64
- ○ 65 or older

In which region do you currently reside?

- ○ Northeast (CT, ME, MA, NH, RI, VT, NJ, NY,PA),
- ○ Midwest (IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD)
- ○ South (DE, DC, FL, GA,MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX)
- ○ West (AZ, CO, ID, NM, MT, UT,NV, WY, AK, CA, HI, OR, WA)

What is the highest level of education you have completed?

- ○ 12th grade or less
- ○ Graduated high school or equivalent
- ○ Some college, no degree
- ○ Associate degree
- ○ Bachelor's degree
- ○ Post-graduate degree

What was your total household net income in **2020** in US dollars after taxes and deductions?

Note: Your household's total net income includes your household's total income from all sources, including e.g. labor income, financial income and income from transfers, net of taxes.

What was your total household net income in **2020** in US dollars after taxes and deductions?
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

F.1.3 Definitions

About this study

This study is about your **beliefs about the future development of the US economy, as well as your own economic situation.** Your task will be to report your expectations about the future development of both the US economy and your personal economic situation under different hypothetical scenarios.

On the next page, we will provide you with a brief definition. Please read it carefully!

→

Definition

The **inflation rate** measures how much prices in the economy rise from year to year. It is defined as the yearly growth of the general level of prices of goods and services (Consumer Price Index). For instance, an inflation rate of 2% means that, on average, prices for goods and services rise by 2% over 12 months. That is, a typical bundle of goods and services that costs $1,000 at the beginning of a year costs $1,020 at the end of that year. If the inflation rate is negative, it is referred to as deflation. This means that goods and services become less expensive from one year to the next.

→

The main part of the survey begins when you press on the next button. Please try to **make your responses as accurate as possible**.

It is very important for the success of our research that you answer to the best of your knowledge and read the questions very carefully before answering.

→

The federal funds rate

The **federal funds rate** is the most important interest rate in the economy, and is frequently discussed in the news. The value of the rate influences how "costly" it is for banks to acquire money, thereby influencing interest rates on important financial products, such as savings accounts, consumer loans, mortgages, or loans to firms.

The **Federal Reserve (Fed)** controls the federal funds rate. Besides choosing the current rate, the Fed publishes **projections** of where this interest rate will be in the coming years.

We will now ask you about your own expectations under two different hypothetical scenarios about the Fed's projections on the future federal funds rate.

Currently, the federal funds rate stands at **0.1 percent**. According to the projection by the Fed, the rate will remain at **0.1 percent** until the end of **2023**.

→

F.1.4 Baseline scenario

Baseline scenario: Projected federal funds rate stays constant

We now would like to ask you to imagine the following hypothetical scenario.

Please imagine that at the next meeting of the Fed on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

Moreover, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023** remains **unchanged at 0.1 percent**.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

Your predictions

Imagine that on March 18 2021, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, the inflation rate, and your net household income.

Under this hypothetical scenario, what would be **your own expectations** about the **future federal funds rate?**

Note: As an example, for an expected federal funds of 0.1%, please enter 0.1.

Federal funds rate at the end of **2021** (in %):
Federal funds rate at the end of **2022** (in %):
Federal funds rate at the end of **2023** (in %):
Federal funds rate at the end of **2026** (in %):
Federal funds rate at the end of **2030** (in %):

And what would be your expectations about **the future rate of inflation** under the hypothetical scenario if you learned about the Fed's announcement?

Note: As an example, if you think inflation will be 2%, please enter 2.

Reminder: Respond under the assumption that the Fed's projection of the end-2023 federal funds rate remains at 0.1 percent in their meeting on March 17, 2021.

Inflation over the year **2021** (in %):
Inflation over the year **2022** (in %):
Inflation over the year **2023** (in %):
Average annual inflation over the years **2024-2026** (in %):

And what would be your expectations about your **households' future total net income (after taxes and deductions)** under the hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that the Fed's projection of the end-2023 federal funds rate remains at 0.1 in their meeting on March 17, 2021.

Total household net income in the year **2021**:

Total household net income in the year **2021** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly total household net income in the years **2022-2023**:

Average yearly total household net income in the years **2022-2023** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly total household net income in the years **2024-2026**:

Average yearly total household net income in the years **2024-2026** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

→

F.1.5 Transition between baseline and rise scenario

Important!

On the next page, you will read a scenario that describes a change in the Fed's projections. We will ask you how the change in the Fed's projections would affect your expectations about the future federal funds rate, the US inflation rate and your household's income.

→

F.1.6 Between-subject variation in sources of change in the Fed Projection

Exogenous

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario.

Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023 increases from 0.1 percent to 0.5 percent**.

The Fed explains that the change in the Fed's projection about the future federal funds rate occurred because the **composition** of the committee **changed** before the meeting on March 16-17 2021. In particular, some more "dovish" members, whose terms ended, left the Fed, and some more "hawkish" members joined the Fed. The change in the projection is **not** due to a change in the Fed's outlook on the broader development of the economy.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

Exogenous with stocks

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario.

Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the future federal funds rate at the end of 2023 increases from 0.1 percent to 0.5 percent.

The Fed explains that the change in the Fed's projection about the future federal funds rate occurred because the **composition** of the committee **changed** before the meeting on March 16-17 2021. In particular, some more "dovish" members, whose terms ended, left the Fed, and some more "hawkish" members joined the Fed. The change in the projection is **not** due to a change in the Fed's outlook on the broader development of the economy.

In response to the Fed annoucement, the **S&P 500 stock market index falls** by 1 percent.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

Endogenous

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario. Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023 increases from 0.1 percent to 0.5 percent**.

The Fed explains that the change in the Fed's projection about the future federal funds rate is due to **a change** in the Fed's outlook on **the broader development of the economy**.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

No reason

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario. Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023 increases from 0.1 percent to 0.5 percent**.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

F.1.7 Rise scenario

Your predictions

Imagine that on March 18, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement and the response of the S&P 500 stock market index. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, the inflation rate and your net household income.

Under the alternative hypothetical scenario (the Fed's projection of the end-2023 federal funds rate increases from 0.1 to 0.5 percent), what would be **your own expectations** about the **future federal funds rate?**

Federal funds rate at the end of **2021** (in %):
Federal funds rate at the end of **2022** (in %):
Federal funds rate at the end of **2023** (in %):
Federal funds rate at the end of **2026** (in %):
Federal funds rate at the end of **2030** (in %):

And what would be your expectations about **the future rate of inflation** under the alternative hypothetical scenario if you learned about the Fed's announcement?
Reminder: Respond under the assumption that the Fed's projection of the end-2023 federal funds rate increases from 0.1 to 0.5 percent in their meeting on March 17, 2021.

Inflation over the year **2021** (in %):
Inflation over the year **2022** (in %):
Inflation over the year **2023** (in %):
Average annual inflation over the years **2024-2026** (in %):

And what would be your expectations about your **households' future total net income (after taxes and deductions)** under the alternative hypothetical scenario if you learned about the Fed's announcement?
Reminder: Respond under the assumption that the Fed's projection of the end-2023 federal funds rate increases from 0.1 to 0.5 percent in their meeting on March 17, 2021.

Household net income in the year **2021**:

Household net income in the year **2021** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2022-2023**:

Average yearly household net income in the years **2022-2023**: (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average household net income in the years **2024-2026**:

Average yearly household net income in the years **2024-2026** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

→

F.1.8 Inattention to Fed announcements

Announcements by the Fed

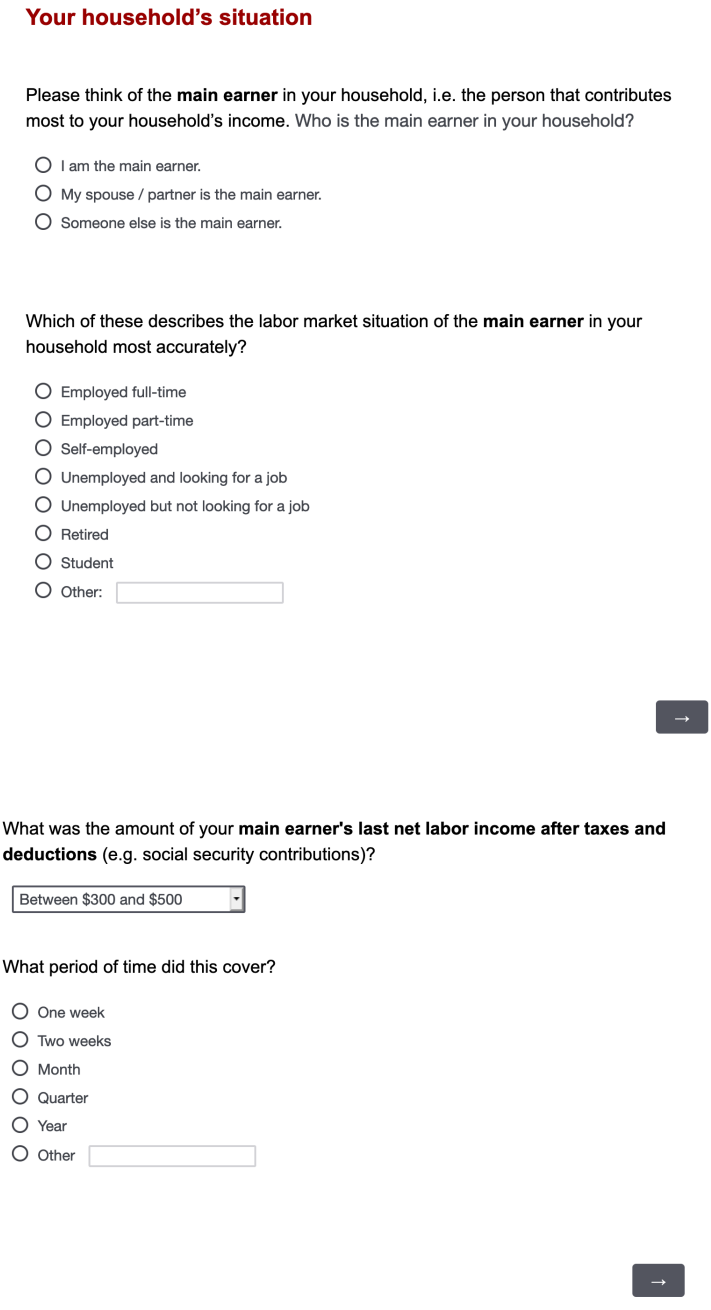
Now please think of **announcements by the Federal Reserve in general**. When the Fed makes an announcement, how long would you say does it typically take until you hear of such an announcement?

- ○ Less than seven days
- ○ Seven to 14 days
- ○ Two to four weeks
- ● One to three months
- ○ Four to six months
- ○ Longer than six months
- ○ Typically I would never hear of such an announcement.

Now please think of **movements of the stock market in response to announcements by the Federal Reserve**. When the stock market moves in response to a Fed announcement, how long would you say does it typically take until you hear of such a movement?

- ○ Less than seven days
- ○ Seven to 14 days
- ○ Two to four weeks
- ○ One to three months
- ○ Four to six months
- ○ Longer than six months
- ○ Typically I would never hear of such a movement.

F.1.9 Hand-to-mouth module



Your household's situation

Please think of the **main earner** in your household, i.e. the person that contributes most to your household's income. Who is the main earner in your household?

- ○ I am the main earner.
- ○ My spouse / partner is the main earner.
- ○ Someone else is the main earner.

Which of these describes the labor market situation of the **main earner** in your household most accurately?

- ○ Employed full-time
- ○ Employed part-time
- ○ Self-employed
- ○ Unemployed and looking for a job
- ○ Unemployed but not looking for a job
- ○ Retired
- ○ Student
- ○ Other:

→

What was the amount of your **main earner's last net labor income after taxes and deductions** (e.g. social security contributions)?

Between $300 and $500

What period of time did this cover?

- ○ One week
- ○ Two weeks
- ○ Month
- ○ Quarter
- ○ Year
- ○ Other

→

What were your household's holdings of **liquid wealth** on the **last days before** the **main earner** in your household received his or her **last income**? By liquid wealth we mean **cash, bank accounts or other easily accessible savings**, such as mutual funds, stocks and bonds that can be sold within a few days.

→

Did your household **pay** all its credit card bills in full **at the end of the last billing cycle**? That is, did your household start the new billing cycle with a **zero credit card balance** on all cards?

- ○ Yes
- ○ No

→

If you think of all credit cards your household owns, what is the **maximum combined amount your household could borrow** on credit cards (in $)?

For instance, let's say your household owns three credit cards. Then, the maximum combined amount your household could borrow on credit cards is the sum of the three credit limits.

→

What would you say is the probability that --- at any point in the next years -- your household will be in a situation where your household would like to **borrow more money** on its credit cards, but would be **unable** to do so (i.e. to be borrowing constrained)?

Probability of being borrowing constrained in **2021**:

Probability of being borrowing constrained in **2021** or **2022**:

Probability of being borrowing constrained at any point in time **until the end 2026**:

→

We now would like you to think about your households' **spending behavior in recent years**. Which of the following four types **describes your household most accurately**?

- ○ My household usually spends its entire income, and does not put aside any money to save or to pay back debt, but also does not increase debt through new borrowing.
- ○ My household usually does not spend its entire income, but puts aside some money to save or to pay back debt.
- ○ My household usually spends more than its income by increasing its debt through new borrowing.
- ○ My household usually spends more than its income by reducing its savings.

In case of an unexpected decline in income or increase in expenses, does your household have at least two months of income available in cash, bank accounts, or easily accessible funds?

- ○ Yes
- ○ No

→

F.1.10 Additional characteristics

Additional characteristics

In general, how willing or unwilling are you to **take risks**, using a scale from 0 to 10, where 0 means you are "completely unwilling to take risks" and 10 means you are "very willing to take risks." You can also use any number between 0 and 10 to indicate where you fall on the scale.

0 - completely unwilling to take risks	1	2	3	4	5	6	7	8	9	10 - very willing to take risks
○	○	○	○	○	○	○	○	○	○	○

In comparison to others, are you a person who is generally willing to **give up something today** in order to **benefit from that in the future** or are you not willing to do so? Please use a scale from 0 to 10, where a 0 means you are "completely unwilling to give up something today" and a 10 means you are "very willing to give up something today". You can also use any number between 0 and 10 to indicate where you fall on the scale.

0 - completely unwilling to give up something today	1	2	3	4	5	6	7	8	9	10 - very willing to give up something today
○	○	○	○	○	○	○	○	○	○	○

To what extent do you agree with the following statement?

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
A recession would adversely affect the financial situation of my household.	○	○	○	○	○	○	○

→

Next we would like to ask you three questions to see how people use numbers in everyday life. Please answer the following questions by filling in the blank.

Let's say you have $200 in a savings account. The account earns ten percent interest per year. Interest accrues at each anniversary of the account. If you never withdraw money or interest payments, how much will you have in the account at the end of two years (in $)?

Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After one year, how much would you be able to buy with the money in this account?

- ○ More than today
- ○ Exactly the same
- ○ Less than today

Please tell me whether this statement is true or false: Buying a single company's stock usually provides a safer return than a stock mutual fund.

- ○ True
- ○ False

What was your household's **savings rate** in 2020 (in percent)?

Note: This refers to the fraction of your household's net income that your household put aside to save.
For instance, if your household spent 95 percent of its net income and saved 5 percent of its net income, then your household's savings rate was 5 percent.
If your household spent 10 percent more than its net income, then your household's savings rate was -10 percent.

→

Next we would like to ask you **which member** of your household has the **best overview** of the household's finances. By that we mean things such as income, savings and checking accounts, pensions, real estate. Who among the household members living in your household **knows the most** about the household's finances?

- ○ I know most about the household's finances.
- ○ My spouse knows most about the household's finances.
- ○ Someone else.

Does your household own or rent its current main residence?

- ○ Own
- ○ Rent
- ○ Other

What do you estimate is the current value of your household's total holdings of **stocks in publicly held corporations and stock mutual funds, including holdings in retirement accounts?**

- ○ Less than $1,000
- ○ Between $1,000 and $3,000
- ○ Between $3,000 and $5,000
- ○ Between $5,000 and $10,000
- ○ Between $10,000 and $15,000
- ○ Between $15,000 and $20,000
- ○ Between $20,000 and $30,000
- ○ Between $30,000 and $40,000
- ○ Between $40,000 and $50,000
- ○ Between $50,000 and $75,000
- ○ Between $75,000 and $100,000
- ○ Between $100,000 and $150,000
- ○ Between $150,000 and $200,000
- ○ Between $200,000 and $300,000
- ○ Between $300,000 and $500,000
- ○ Between $500,000 and $1,000,000
- ○ Between $1,000,000 and $2,000,000
- ○ More than $2,000,000

How many people usually live in your current primary residence, including yourself and those who are temporarily away, but excluding non-relatives like roommates or renters?

What was your household's total net income in **2019** in US dollars after taxes and deductions?

What was your household's total net income in **2019** in US dollars after taxes and deductions?
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

→

We will now ask you some questions on how you are personally affected by the coronavirus pandemic.

What influence does the coronavirus crisis exert on the **economic situation** of your household?

- ○ Very negative influence
- ○ Negative influence
- ○ No influence
- ○ Positive influence
- ○ Very positive influence

Do you worry about your **health** or the health of other household members because of the coronvirus crisis?

- ○ No worries at all
- ○ Little worries
- ○ Moderate worries
- ○ Big worries
- ○ Very big worries

→

F.2 Instructions: March 2021 robustness survey

F.2.1 Baseline scenario

Baseline scenario: Projected federal funds rate stays constant

We now would like to ask you to imagine the following hypothetical scenario.

Please imagine that at the next meeting of the Fed on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

Moreover, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023** remains **unchanged at 0.1 percent**.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

Your predictions

Imagine that on March 18 2021, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, unemployment rate, your borrowing and the value of your residence.

Under this hypothetical scenario, what would be **your own expectations** about the **future federal funds rate?**

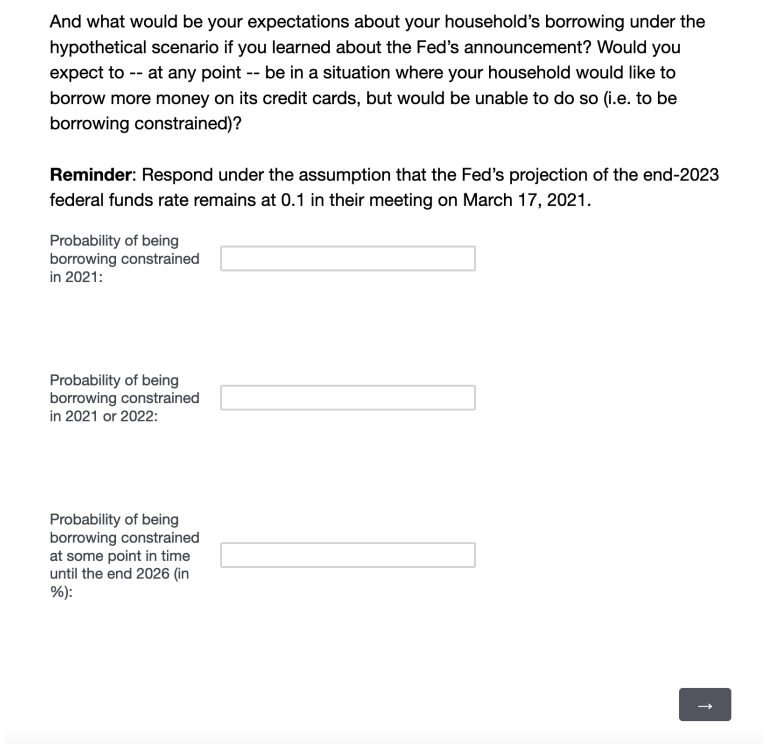
Note: As an example, for an expected federal funds of 0.1%, please enter 0.1.

Federal funds rate at the end of **2021** (in %):
Federal funds rate at the end of **2022** (in %):
Federal funds rate at the end of **2023** (in %):
Federal funds rate at the end of **2026** (in %):
Federal funds rate at the end of **2030** (in %):

Please think of your household's current main residence (which you may own or rent).

What would be your expectations about the **value** of this residence in the year **2023** under the hypothetical scenario if you learned about the Fed's announcement?
Reminder: Respond under the assumption that the Fed's projection of the end-2023 federal funds rate remaints at 0.1 in their meeting on March 17, 2021.

What would be your expectations about the **value** of this residence in the year **2023** under the hypothetical scenario if you learned about the Fed's announcement?
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.



F.2.2 Transition between baseline and rise scenario

Important!

On the next page, you will read a scenario that describes a change in the Fed's projections. We will ask you how the change in the Fed's projections would affect your expectations about the future federal funds rate, the value of your residence and your borrowing.

F.2.3 Between-subject variation in sources of change in the Fed Projection

Exogenous

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario.

Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023 increases from 0.1 percent to 0.5 percent**.

The Fed explains that the change in the Fed's projection about the future federal funds rate occurred because the **composition** of the committee **changed** before the meeting on March 16-17 2021. In particular, some more "dovish" members, whose terms ended, left the Fed, and some more "hawkish" members joined the Fed. The change in the projection is **not** due to a change in the Fed's outlook on the broader development of the economy.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

Exogenous with stocks

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario.

Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the future federal funds rate at the end of 2023 increases from 0.1 percent to 0.5 percent.

The Fed explains that the change in the Fed's projection about the future federal funds rate occurred because the **composition** of the committee **changed** before the meeting on March 16-17 2021. In particular, some more "dovish" members, whose terms ended, left the Fed, and some more "hawkish" members joined the Fed. The change in the projection is **not** due to a change in the Fed's outlook on the broader development of the economy.

In response to the Fed annoucement, the **S&P 500 stock market index falls** by 1 percent.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

Endogenous

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario. Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023 increases from 0.1 percent to 0.5 percent**.

The Fed explains that the change in the Fed's projection about the future federal funds rate is due to **a change** in the Fed's outlook on **the broader development of the economy**.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

No explanation

Hypothetical scenario: Federal funds rate projection for 2023 increases

We will now ask you to consider the following alternative hypothetical scenario. Please imagine that at their next meeting on March 16/17 2021, the Fed announces that the **current** federal funds rate will remain **unchanged at 0.1 percent**.

However, the Fed announces that its projection about the **future** federal funds rate at the **end of 2023 increases from 0.1 percent to 0.5 percent**.

Note: Further, imagine that the Fed's projection of the federal funds rate at the end of 2030 remains **unchanged** at 2.5 percent.

F.2.4 Rise scenario

Your predictions

Imagine that on March 18, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, your borrowing and the value of your residence.

Under the alternative hypothetical scenario (the Fed's projection of the end-2023 federal funds rate increases from 0.1 to 0.5 percent), what would be **your own expectations** about the **future federal funds rate?**

Federal funds rate at the end of **2021** (in %):
Federal funds rate at the end of **2022** (in %):
Federal funds rate at the end of **2023** (in %):
Federal funds rate at the end of **2026** (in %):
Federal funds rate at the end of **2030** (in %):

Please think of your household's current main residence (which you may own or rent).

What would be your expectations about the **value** of this residence in the year **2023** under the alternative hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that the Fed's projection of the end-2023 federal funds rate increases from 0.1 to 0.5 percent in their meeting on March 17, 2021.

What would be your expectations about the **value** of this residence in the year **2023** under the alternative hypothetical scenario if you learned about the Fed's announcement?

Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

And what would be your expectations about your household's borrowing under the hypothetical scenario if you learned about the Fed's announcement? Would you expect to -- at any point -- be in a situation where your household would like to borrow more money on its credit cards, but would be unable to do so (i.e. to be borrowing constrained)?

Reminder: Respond under the assumption that the Fed's projection of the end-2023 federal funds rate increases from 0.1 to 0.5 percent in their meeting on March 17, 2021.

Probability of being borrowing constrained in 2021:

Probability of being borrowing constrained in 2021 or 2022:

Probability of being borrowing constrained at some point in time until the end 2026 (in %):

→

F.3 Instructions: March 2022 survey

F.3.1 Baseline scenario

The federal funds rate

The **federal funds rate** is the most important interest rate in the economy, and is frequently discussed in the news. The value of the rate influences how "costly" it is for banks to acquire money, thereby influencing interest rates on important financial products, such as savings accounts, consumer loans, mortgages, or loans to firms.

The **Federal Reserve (Fed)** controls the federal funds rate. Besides choosing the current rate, the Fed publishes projections of where this interest rate will be in the coming years.

We will now ask you about your own expectations under two different hypothetical scenarios about the Fed's decision about the current federal funds rate.

Currently, the federal funds rate stands at **0.1 percent**. According to the projection by the Fed, the rate will increase to 2.5 percent until the end of 2031.

→

Baseline scenario: Federal funds rate stays constant

We now would like to ask you to imagine the following hypothetical scenario.

Please imagine that at the next meeting of the Fed on March 15/16 2022, the Fed decides to keep the current federal funds rate **unchanged at 0.1 percent**.

Note: Further imagine that the Fed's projection for the federal funds rate at the end of 2031 remains **unchanged** at 2.5 percent.

Your predictions

Imagine that on March 17 2022, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, the inflation rate and your net household income.

Under this hypothetical scenario, what would be **your own expectations** about the **future federal funds rate?**

Note: As an example, if you think the federal funds rate will be at 0.1%, please enter 0.1

Federal funds rate at the end of **2022** (in %):
Federal funds rate at the end of **2023** (in %):
Federal funds rate at the end of **2024** (in %):
Federal funds rate at the end of **2027** (in %):
Federal funds rate at the end of **2031** (in %):

And what would be your expectations about **the future rate of inflation** under the hypothetical scenario if you learned about the Fed's announcement?
Note: As an example, if you think inflation will be 2%, please enter 2.

Reminder: Respond under the assumption that in the Fed meeting on March 15/16 2022 the Fed decides to keep the federal funds rate at 0.1 percent.

Inflation over the year **2022** (in %):
Inflation over the year **2023** (in %):
Inflation over the year **2024** (in %):
Average annual inflation over the years **2025-2027** (in %):

And what would be your expectations about your **household's future total net income (after taxes and deductions)** under the hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that in the Fed meeting on March 15/16 2022 the Fed decides to keep the federal funds rate at 0.1 percent.

Household net income in the year **2022**:

Household net income in the year **2022** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2023-2024**:

Average yearly household net income in the years **2023-2024** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2025-2027**:

Average yearly household net income in the years **2025-2027** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

→

F.3.2 Transition between baseline and rise scenario

Important!

On the next page, you will read a scenario that describes a change in the Fed's fund rate. We will ask you how the change in the current federal funds rate would affect your expectations about the future federal funds rate, the US inflation rate and your household's income.

F.3.3 Rise scenario

Hypothetical scenario: Federal funds rate increases

We will now ask you to consider the following alternative hypothetical scenario.

Please imagine that at the next meeting of the Fed on March 15/16 2022, the Fed **increases** the current federal funds rate **from 0.1 to 0.5 percent**.

Note: Further imagine that the Fed's projection for the federal funds rate at the end of 2031 remains **unchanged** at 2.5 percent.

Your predictions

Imagine that on March 17 2022, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, the inflation rate and your net household income.

Under the alternative hypothetical scenario (the current federal funds rate increases from 0.1 to 0.5 percent), what would be **your own expectations** about the **future federal funds rate?**

Federal funds rate at the end of **2022** (in %):

Federal funds rate at the end of **2023** (in %):

Federal funds rate at the end of **2024** (in %):

Federal funds rate at the end of **2027** (in %):

Federal funds rate at the end of **2031** (in %):

And what would be your expectations about **the future rate of inflation** under the alternative hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that in the Fed meeting on March 15/16 2022 the Fed decides to increase the federal funds rate from 0.1 to 0.5 percent.

Inflation over the year **2022** (in %):
Inflation over the year **2023** (in %):
Inflation over the year **2024** (in %):
Average annual inflation over the years **2025-2027 (in %):**

And what would be your expectations about your **household's future total net income (after taxes and deductions)** under the alternative hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that in the Fed meeting on March 15/16 2022 the Fed decides to increase the federal funds rate from 0.1 to 0.5 percent.

Household net income in the year **2022**:

Household net income in the year **2022** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2023-2024**:

Average yearly household net income in the years **2023-2024**: (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average household net income in the years **2025-2027**:

Average yearly household net income in the years **2025-2027** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

→

F.3.4 Inattention to Fed announcements

Announcements by the Fed

How often have news about the Federal Reserve come to your attention in the **last four weeks**?

- ○ Never
- ○ Once
- ○ 2 times
- ○ 3 times
- ○ 4 times
- ○ More than 5 times

How often do you **typically** hear news about the Federal Reserve?

- ○ Daily
- ○ Weekly
- ○ Between 2 and 3 times per month
- ○ About once per month
- ○ Between 1 and 2 times per quarter
- ○ Less frequently than once per quarter
- ○ Never

Think of the news **over the last three months**. The next four statements describe different pieces of news. One or more of these statements describe actual pieces of news, while the rest are made up. Which one(s) is/are actual pieces of news? Please click on all that apply.

- ☐ There was an international meeting of central bankers in San Francisco followed by a speech by the chairman of the Federal Reserve
- ☐ The Federal Reserve increased its main interest rate, the federal funds rate
- ☐ Jerome Powell was renominated as chairman of the Federal Reserve
- ☐ The Federal Reserve put in place new lending facilities to fight the recession

When do you think was the last time the Federal Reserve changed its main interest rate, the federal funds rate?

- ○ August 2012
- ○ September 2018
- ○ March 2020
- ○ March 2021
- ○ November 2021

Now please think of **announcements by the Federal Reserve in general**. When the Fed makes an announcement, how long would you say does it typically take until you hear of such an announcement?

- ○ Less than seven days
- ○ Seven to 14 days
- ○ Two to four weeks
- ○ One to three months
- ○ Four to six months
- ○ Longer than six months
- ○ Typically I would never hear of such an announcement.

F.4 Instructions: September 2022 survey

F.4.1 Baseline scenario

The federal funds rate

The **federal funds rate** is the most important interest rate in the economy, and is frequently discussed in the news. The value of the rate influences how "costly" it is for banks to acquire money, thereby influencing interest rates on important financial products, such as savings accounts, consumer loans, mortgages, or loans to firms.

The **Federal Reserve (Fed)** controls the federal funds rate. Besides choosing the current rate, the Fed publishes projections of where this interest rate will be in the coming years.

We will now ask you about your own expectations under two different hypothetical scenarios about the Fed's decision about the current federal funds rate.

Currently, the federal funds rate stands at **2.4 percent**. According to the projection by the Fed, the rate will increase to 2.5 percent until the end of 2031.

→

Baseline scenario: Federal funds rate stays constant

We now would like to ask you to imagine the following hypothetical scenario.

Please imagine that at the next meeting of the Fed on September 20/21 2022, the Fed decides to keep the current federal funds rate unchanged at **2.4 percent**.

Note: Further imagine that the Fed's projection for the federal funds rate at the end of 2031 remains **unchanged** at 2.5 percent.

Your predictions

Imagine that on September 22 2022, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, the inflation rate and your net household income.

Under this hypothetical scenario, what would be **your own expectations** about the **future federal funds rate?**

Note: As an example, if you think the federal funds rate will be at 0.1%, please enter 0.1

Federal funds rate at the end of **2022** (in %):
Federal funds rate at the end of **2023** (in %):
Federal funds rate at the end of **2024** (in %):
Federal funds rate at the end of **2027** (in %):
Federal funds rate at the end of **2031** (in %):

And what would be your expectations about **the future rate of inflation** under the hypothetical scenario if you learned about the Fed's announcement?
Note: As an example, if you think inflation will be 2%, please enter 2.

Reminder: Respond under the assumption that in the Fed meeting on September 20/21 2022 the Fed decides to keep the federal funds rate at 2.4 percent.

Inflation over the year **2022** (in %):
Inflation over the year **2023** (in %):
Inflation over the year **2024** (in %):
Average annual inflation over the years **2025-2027** (in %):

And what would be your expectations about your **household's future total net income (after taxes and deductions)** under the hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that in the Fed meeting on September 20/21 2022 the Fed decides to keep the federal funds rate at 2.4 percent.

Household net income in the year **2022**:

Household net income in the year **2022** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2023-2024**:

Average yearly household net income in the years **2023-2024** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2025-2027**:

Average yearly household net income in the years **2025-2027** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

→

F.4.2 Transition between baseline and rise scenario

Important!

On the next page, you will read a scenario that describes an increase in the federal funds rate. We will ask you how the increase in the current federal funds rate would affect your expectations about the future federal funds rate, the US inflation rate and your household's income.

F.4.3 Rise scenario

Hypothetical scenario: Federal funds rate increases to 3.1 percent

We will now ask you to consider the following alternative hypothetical scenario.

Please imagine that at the next meeting of the Fed on September 20/21 2022, the Fed **decides to increase** the current federal funds rate **from 2.4 to 3.1 percent**.

Note: Further imagine that the Fed's projection for the federal funds rate at the end of 2031 remains **unchanged** at 2.5 percent.

Your predictions

Imagine that on September 22 2022, i.e. **on the day after the Fed meeting**, you learn about the Fed's announcement. Imagine that we would then ask you about **your own expectations** regarding the federal funds rate, the inflation rate and your net household income.

Under the alternative hypothetical scenario (the current federal funds rate increases from 2.4 to 3.1 percent), what would be **your own expectations** about the **future federal funds rate?**

Federal funds rate at the end of **2022** (in %):
Federal funds rate at the end of **2023** (in %):
Federal funds rate at the end of **2024** (in %):
Federal funds rate at the end of **2027** (in %):
Federal funds rate at the end of **2031** (in %):

And what would be your expectations about **the future rate of inflation** under the alternative hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that in the Fed meeting on September 20/21 2022 the Fed decides to increase the federal funds rate from 2.4 to 3.1 percent.

Inflation over the year **2022** (in %):
Inflation over the year **2023** (in %):
Inflation over the year **2024** (in %):
Average annual inflation over the years **2025-2027 (in %):**

And what would be your expectations about your **household's future total net income (after taxes and deductions)** under the alternative hypothetical scenario if you learned about the Fed's announcement?

Reminder: Respond under the assumption that in the Fed meeting on September 20/21 2022 the Fed decides to increase the federal funds rate from 2.4 to 3.1 percent.

Household net income in the year **2022**:

Household net income in the year **2022** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2023-2024**:

Average yearly household net income in the years **2023-2024** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

Average yearly household net income in the years **2025-2027**:

Average yearly household net income in the years **2025-2027** (in $):
Note: We would now ask you to enter an exact dollar amount which lies in the bracket specified above.

→

F.4.4 Spending plans

You just now completed two scenarios about the Fed meeting on September 20/21 2022:

- **No-change Scenario**: In the Fed meeting on September 20/21 2022 the Fed decides to keep the federal funds rate at **2.4 percent**.
- **Rise Scenario**: In the Fed meeting on September 20/21 2022 the Fed decides to **increase** the federal funds rate **from 2.4 percent to 3.1 percent**.

We will now ask you to assess under which scenario each of the following statements that describe your **spending plans over the next 3 months** is more likely to be true.

Under which scenario would your household …

	No-change scenario (**no change** in the current federal funds rate)	Same in both scenarios	Rise scenario (**increase** in the current federal funds rate from **2.4 percent to 3.1 percent**)
… be more likely to **reduce purchases of items** that you consider to be **non-essential**?	○	○	○
… be more likely to **cut back** on the **quality** of the goods and services consumed, e.g., to purchase store brands instead of name brands?	○	○	○
… be more likely to **look for deals** to obtain the goods and services needed, e.g., to look for sales or rebates or to make use of coupons?	○	○	○
... make fewer purchases of **nondurable goods** and **services**, such as food, entertainment services or clothing?	○	○	○

→

F.4.5 Inattention to Fed announcements

Announcements by the Fed

How often have news about the Federal Reserve come to your attention in the **last four weeks**?

- ○ Never
- ○ Once
- ○ 2 times
- ○ 3 times
- ○ 4 times
- ○ 5 times or more often

How often do you **typically** hear news about the Federal Reserve?

- ○ Daily
- ○ Weekly
- ○ Between 2 and 3 times per month
- ○ About once per month
- ○ Between 1 and 2 times per quarter
- ○ Less frequently than once per quarter
- ○ Never

Think of the news **over the last three months**. The next four statements describe different pieces of news. One or more of these statements describe actual pieces of news, while the rest are made up. Which one(s) is/are actual pieces of news? Please click on all that apply.

- ☐ There was an international meeting of central bankers in San Francisco followed by a speech by the chairman of the Federal Reserve
- ☐ The Federal Reserve increased its main interest rate, the federal funds rate
- ☐ Jerome Powell was renominated as chairman of the Federal Reserve
- ☐ The Federal Reserve put in place new lending facilities to support the economy

When do you think was the last time the Federal Reserve changed its main interest rate, the federal funds rate?

- ○ July 2022
- ○ March 2022
- ○ November 2021
- ○ March 2021
- ○ March 2020

Now please think of **announcements by the Federal Reserve in general**. When the Fed makes an announcement, how long would you say does it typically take until you hear of such an announcement?

- ○ Less than seven days
- ○ Seven to 14 days
- ○ Two to four weeks
- ○ One to three months
- ○ Four to six months
- ○ Longer than six months
- ○ Typically I would never hear of such an announcement.