Inflation Disasters and Consumption

Jane Ryngaert*
Wake Forest University

September 2021

Abstract

This paper shows that consumers with longer-tailed subjective probability distributions of inflation anticipate tighter access to future credit and lower real consumption growth. I propose a model in which rare inflation disasters decrease in credit access by raising debt issuance costs. I then empirically examine the predictions of the model on readiness to buy durables and reported future MPC, showing that consumers with long-tailed distributions are more likely to purchase durables and more likely to spend out of an unexpected increase in future income.

JEL Classification: E21, E31, D84
Keywords: inflation expectations, expected consumption, issuance costs, tail risk

*Wake Forest University, Department of Economics, Box 7505, Winston-Salem, NC 27109; (e-mail: ryngaertjm@wfu.edu)

1 Introduction

As expected inflation rises, the expected real interest rate falls, thereby ecouraging consumers to increase their current consumption. With this central macroeconomic relationship as motivation, most surveys of inflation elicit expectations as point forecasts. Some of these surveys include density forecasts that allow researchers to fit subjective probability distributions over a range of inflation outcomes, providing additional information about subjective uncertainty and the weight respondents place in the tails of their distribution. Theory has little to say about how these tails should relate to consumption beyond their implications for the real interest rate. This paper examines this relationship empirically.

This paper uses expectations data from the Federal Reserve Bank of New York's Survey of Consumer Expectations to show that the length of the tails of consumer's inflation distribution are correlated with pessimism about future credit access. The correlation is the same for both perceived upside and downside risk. This means that consumers expect a credit crunch to accompany *any* failure to maintain price stability, whether inflationary or disinflationary. Consistent with this perceived reduction in credit, longer tails also lower the consumers expected real consumption growth. If consumers expect difficulty borrowing in the future, they will plan to consume less in the future. Increased debt costs in the future also encourage the household to move borrowing and durables purchases to the present rather than pay the cost later. This reduces the household's inclination to consumption smooth by savingand further reduces expected consumption growth.

To match these facts, I introduce a model of *rare inflation disasters* in expectations. These events severely limit consumers' ability to borrow by increasing debt issuance costs. Disasters can cause extreme inflation, disinflation, or deflation. The tails of the expected inflation distribution therefore simultaneously indicate an expectation of disaster and consequently more expensive credit. When consumers anticipate higher debt issuance costs tomorrow, they want to move borrowing to the present to avoid paying these higher costs. This in turn shifts consumption - inclusive of durable goods - from the future to the present, explaining the reduction in consumption growth for consumers reporting long-tailed distributions.

I next derive additional theoretical implications and use questions from the SCE Household Spending Survey to investigate whether the data supports additional model predictions. I show that households with longer-tailed distributions are more likely to report positive probabilty of durable purchase. Intuitively, a consumer who is worried about obtaining debt in the future should "stock up" on debt today and purchase durables. Durable goods last into the following period and provide a service flow of utility and - barring irreversibilities - the option to sell to finance non-durable consumption when credit is tight. I find an economically significant relationship between the tails of the distribution and spending attitudes towards durables. Increasing the length of the right tail by a percentage point increases the probability of inclination towards spending on durables by 3.6%. The corresponding number for the left tail is 3%. The effect of an increase of one percentage point in the median of the distribution on spending is an order of magnitude lower. This implies that an appropriate examination of the effect of inflation expectations on consumption should take the expectations of tail outcomes into account.

I consider how a future disaster and its associated issuance cost may influence a consumer's future marginal propensity to consume. Consumers in the household spending supplement are asked to allocate a hypothetical increase in future income between future spending, saving, and debt repayment. Consumers who anticipate more difficulty accessing credit in the future should allocate more of this future increase to consumption. I find evidence both in the model and in the data that the consumers that I hypothesize have these beliefs about the future - those with longer tailed distributions - plan to spend more of the hypothetical increase.

This paper contributes to a literature on how expected inflation affects household spending. Much of this literature focuses on the response of readiness to spend on durables: Bachmann, Berg, and Sims 2015, Coibion, Georgarakos, Gorodnichenko, and van Rooij 2021, Duca-Radu, Kenny, and Reuter 2019, Burke and Ozdagli 2021, D'Acunto, Hoang, and Weber 2016, and D'Acunto, Hoang, and Weber 2018. These papers differ from each other in the measured sign of the effect of inflation expectations on durables consumption. All consider the response of durables to point forecast or implied mean forecast and so do not account for the nonlinearities noted in this paper. Ichiue and Nichiguchi 2015 finds that consumption increases with expected inflation while planned consumption decreases. Dräger and Nghiem 2021 and Crump, Eusepi, Tambalotti, and Topa 2015 use exepcted inflation to estimate the consumption Euler equation. Other papers document that higher increases savings (Armantier et al. 2021) and decreases readiness to purchase durables (Binder 2017). I control for uncertainty using the interquartile range of the subjective inflation distribution and find results consistent with these two findings. I consider the tails of the distribution in addition to uncertainty and show that increased weight in the tails and increased uncertainty produce opposite predictions for expected consumption behavior.

I also contribute to a literature considering tail risks in individual's inflation expectations. García and Manzanares 2007, for example, model inflation risks and their assymmetries in density forecasts, showing that these aggregates of these perceived risks vary over the business cycle. Andrade, Ghysels, and Idier 2012 proposes a measure of the level of left and right tail outcomes, Inflation-at-Risk, and notes that movements in the aggregated assymmetry of these tail risks predicts both inflation itself and the target policy rate.

The paper proceeds as follows. Section 2 discusses inflation expectations. Section 3 shows the effect of components of density forecasts of inflation on forecasted real consumption growth and the ease of accessing credit. Section 4 describes utility maximization with disaster-induced debt issuance costs. Section 5 discusses the implications of the model for durables spending and the future MPC and the support for these implications in the data.

2 Inflation Expectations

I utilize the inflation expectations data from the Federal Reserve Bank of New York's Survey of Consumer Expectations. The survey is conducted monthly over the internet and includes a nationally representative survey set of rotating household heads who stay in the survey for up to twelve months.[1] Households provide their inflation expectations in two formats, first as a point estimate and then as probabilities that inflation may fall in a set of ranges. They are first asked:

What do you expect the rate of [inflation/deflation][2] *to be* ***over the next 12 months****? Please give your best guess. (Q8v2)*

Respondents provide this answer as a percentage. The distribution of point estimates includes many extreme forecasts of inflation, with more than 10% of responses forecasting 15% inflation or higher. The New York Fed accordingly elicits density forecasts of inflation and uses the distribution-implied means to track consumer inflation expectations.[3] The next question asks respondents to consider several possible outcomes for inflation.

Now we would like you to think about the different things that may happen to inflation over the ***next 12 months****. We realize that this question may take a little more effort. (Q9)*

In your view, what would you say is the percent chance that, ***over the next 12 months...***

The respondent is then presented with a set of ranges for the rate of inflation or deflation, where deflation is defined for them as the opposite of inflation. The ranges are a rate of inflation 12% *or higher*, *between* 8% *and* 12%, *between* 4% *and* 8%, *between* 2% *and* 4%, between 0% *and* 2%, and the same set of bins for the rate of deflation.

[1] A household head is defined as the owner or renter of the household home.

[2] This selection is based on the answer to a previous question.

[3] This New York Fed's headline measure of inflation expectations the survey-weighted interpolated median of this series.

Measuring the mean and subjective uncertainty implied by the density forecasts requires fitting a probability distribution to the histogram. The SCE (see Armantier, Topa, van der Klaauw, and Zafar 2016) uses a modified version of the approach of Engelberg, Manski, and Williams 2009, who fit isoceles triangle distributions to distributions filling only one or two bins and a generalized beta distribution to distributions filling three or more bins.[4] The mean implied by these distributions is used as the measure of consumers' inflation expectations in many existing studies using SCE data: Armantier, Topa, van der Klaauw, and Zafar 2016, Armantier et al. 2021, Crump, Eusepi, Tambalotti, and Topa 2015, Armantier, Nelson, Topa, van der Klaauw, and Zafar 2016, Ben-David, Fermand, Kuhnen, and Li 2018. The subjective distributions in this paper are formed using a modification of this approach that equates the subjective probability's mode to the reported point forecast. For more details on this method, see Ryngaert 2021.

The sample runs from from June 2013 to September 2020. There are an average of 13,010 observations per periodand the sample contains a total of 115,300 person-month observations. I Winsorize continuous variables at the 1% level at each date and all subsequent analysis is survey weighted.

Much of the previous work on the effect of inflation expectations on spending focuses on either the point forecast (Bachmann, Berg, and Sims 2015, Coibion, Georgarakos, Gorodnichenko, and van Rooij 2021) or the mean implied by the density forecast (Crump, Eusepi, Tambalotti, and Topa 2015, Armantier et al. 2021), often controlling for subjective uncertainty (Burke and Ozdagli 2021, Binder 2017). I extend the discussion of the effect of inflation expectations on consumer spending by testing the effect of the lengths of the tails of the subjective distribution on spending behavior. The right tail is defined as the difference between the 95th quantile and the 75th quantile. The left tail is the difference between the 25th quantile and the 5th quantile. The tails reflect the consumers' beliefs over extreme outcomes, such as high inflation or deflation.[5] Consumers with longer tails place positive weight on a larger range of extreme realizations of inflation. The longer the tail, the more extreme the potential risk in that direction.

Figure 1 plots the survey-weighted average of each of the tails as well as the implied medians and interquartile ranges of the subjective probability distributions over time. All variables move over time, but there is a noticeable downward trend in the average subjective median into 2015. This timing is consistent with increasing credibility Bernanke's January 2012 announcement of a 2 percent inflation target. Binder and Verbrugge 2016 note similar timing in the leveling off of longer-term inflation expectations. The average IQR and tails also move around over time. The most distinct pattern in these variables

[4]The SCE deviates only slightly from the Engelberg, Manski, and Williams 2009 approach, fitting a uniform distribution to one-bin forecasts rather than a triangular distribution.

[5]Scharnagl and Stapf 2015 notes increased concern about such tailsf in European options-implied inflation expectations.

occurs at the outset of the the COVID-19 crisis in early 2020, when all three sharply increased before beginning to fall again.

Table 1 gives the survey weighted means and standard deviations of the implied mean, implied median, IQR, and tails of the subjective probability distributions for the full sample and for samples excluding the years before 2015 - before the median expectation leveled off, excluding the COVID period, and excluding both. The average implied median ranges from roughly 3.7 to 4, with the mean in a similar range and the correlation between the two high. The average IQR is roughly 5.3 and the the average left and right tails roughly 2.9 and 2.7, respectively. These numbers are large compared to a series that is targeted to 2 % for the entirety of the sample period. While consumers report dispersed subjective distributions over inflation, often missing or assigning minimal weight to its true value, the components of these distributions still correlate significantly with consumers' spending attitudes.

3 Results

This section presents results on the impact of inflation expectations on the anticipated availability of credit and expected consumption growth.

3.1 Inflation Expectations and Expected Credit Availability

Consumers in the SCE report subjective inflation distributions with substantial tails. This section shows that these tails are associated with a belief that credit will be harder to access in the future.

The Survey of Consumer Expectations includes questions about the ease of accessing credit. These questions are:

Compared to 12 months ago*, do you think it is generally harder or easier these days for people to obtain credit or loans (including credit and retail cards, auto loans, student loans, and mortgages)?* (Q28)

And looking ahead, do you think that ***12 months from now*** *it will generally be harder or easier for people to obtain credit or loans (including credit and retail cards, auto loans, student loans, and mortgages) than it is these days?* (Q29)

The possible responses for both questions are:

1. *Much harder*,

2. *Somewhat harder*,

3. *Equally easy/hard*,

4. *Somewhat easier*,

5. *Much easier*.

The average response over this sample is 2.8 for both Q28 and Q29, implying that the average household expects credit to conditions to deteriorate slightly and at a constant rate.

The majority of survey responses contain the same value for Q28 and Q29. Because survey respondents tend to report a constant rate of change in the credit access conditions, I measure the household's beliefs about the future availablility of credit in terms of the deceleration of credit conditions. Consider, for example, two households reporting that they believe it is "Equally easy/hard" to borrow these days than it was 12 months ago. A household responding that conditions will be "Equally easy/hard" next year expects a constant rate of deterioration in credit conditions. Conversely, a household that reports thinking credit will be harder to find next year, expects the rate at which credit is becoming harder to find to increase.

Table 2 shows the results of a probit regression where the dependent variable is equal to 1 if they the respondent believes the deterioration of credit availability is accelerating (Q29 $<$ Q28) and 0 otherwise. The marginal effects on the left and right tails are statistically significant and positive, indicating that an increase in the length of either tail will increase the probability of a negative outlook. A one percentage point increase in the right tail increases this probability by 0.33% while a one percentage point increase in the left tail increases the probability by 0.49%. The probability of a negative outlook also increases with the consumer's reported probabilities that unemployment and interest rates will increase in the next year and decreases with the reported probability that stock prices will increase.

These results suggest that consumers anticipate a tightening of their access to credit at relatively high and relatively low levels of inflation. At low levels of inflation or in deflation, repsondents may expect recession and difficulty finding credit. They may expect these things at particularly high levels of inflation as well. There is growing evidence that households view inflation as stagflationary (Kamdar 2018, Coibion, Georgarakos, Gorodnichenko, and van Rooij 2021, Coibion, Gorodnichenko, and Ropele 2020, and Candia, Coibion, and Gorodnichenko 2020) and may therefore assume negative macroeconomic and borrowing conditions will accompany particularly high realizations of inflation.

3.2 Inflation Expectations and Consumption Growth

I next consider the impact of the components of the subjective inflation distribution on expected real consumption growth. The SCE collects information on the household's anticipated change in spending:

Now think about your total household spending, including groceries, clothing, personal care, housing (such as rent, mortgage payments, utilities, maintenance, home improvements), medical expenses (including health insurance), transportation, recreation and entertainment, education, and any large items (such as home appliances, electronics, furniture, or car payments).

Over the next 12 months*, by about what percent do you expect your total household spending to [increase/decrease]? Please give your best guess.* (Q26v2)

This variable tracks nominal spending. I put it into real terms by subtracting the implied inflation density median, and I regress of the resulting forecast of real consumption on the components of the density inflation forecast.[6] This exercise is similar to that of Crump, Eusepi, Tambalotti, and Topa 2015, who provides an empirical estimate of the intertemporal elasticity of substitution by estimating the response of expected consumption growth on expected inflation. However, their paper uses the first-order approximation of the Euler equation to recover structural parameters. I am interested in how different parts of the subjective probability distribution over inflation outcomes, including information about perceived upside and downside risks, predict consumption plans.

I include several variables to control for the households' expectations of other macroeconomic and idiosyncratic outcomes. These include questions about the household's current financial situation as it relates to a year ago (Q1) and its expected future financial situation (Q2). I control for the forecasted change in the household's real income, defined as their reported expected change in nominal income (Q25v2) less the median of their subjective inflation distribution. I include the indicator described in the previous section, which takes on a value of 1 if the consumer expects credit negative acceleration in access to credit.[7] The household reports the probability that unemployment, nominal interest

[6] I use the median rather than the mean as the mean of a potentially asymmetric distribution will be sensitive to the lengths of the tails. Including the mean in calculation of the dependent variable may mean that we pick up this sensitivity in the coefficients on the tails.

[7] The regression still produces significant results on the tails of the inflation distribution, despite controlling for the mechanism I argued for in Section 3.1. The indicator for accelerating beliefs in deteriorating conditions is a rough measure of beliefs about future cost of credit. As a dependent variable, it can show us something about the types of consumers who are pessimistic about future credit. As an independent control variable in estimations of consumption plans, it is an imperfect measure of the anticipated cost of credit.

rates, and stock prices will increase in the following year (Q4new, Q5new, and Q6new respectively). I also include date fixed effects and a number of additional demographic controls: household income category, census region, education category, numeracy, others living in the household, indicators for race, gender, marital status, homeownership and debt status, and a full set of controls for the labor force situation of the respondent and spouse. Noting that forecasts in the SCE often improve with length of time in the survey as found in Binder and Kim 2021, I control for forecaster tenure. The set of controls is described in detail in Appendix A.

Table 3 shows the results of this regression. The coefficient on the median is -0.50, almost identical to the estimate of the intertemporal elasticity of consumption estimated in Crump, Eusepi, Tambalotti, and Topa 2015 after controlling for excess sensitivity. This coefficient is statistically significant and consistent with theory as it implies that a decrease in the real interest rate should causes consumers to increase consumption today. The IQR, a measure of subjective uncertainty, has the opposite sign coefficient as the tails. More uncertain consumers increase their consumption growth, potentially through precautionary savings. Consumers with longer-tailed distributions decrease their consumption growth. The coefficient on the right tail is roughly -.50, and on the left tail -0.22; both are statistically significant. This means that a one percentage point increase in the right (left) tail decreases consumption growth by 0.50 (0.22) percentage points. The average consumption growth is 5.80%, meaning longer tails can generate a substantial reduction.

A longer right tail causing a shift of consumption from the future to the present has a Fisherian interpretation. As expected inflation increases, the real interest rate decreases. This should prompt consumers to move consumption from the future to the present, reducing growth. The left tail is harder to explain as left tail inflation beliefs should be associated with a high expected real interest rate. This high interest rate penalizes consumption in the present period and should therefore encourage consumption growth. The next section will explain this result in terms of an increase in the cost of credit that materializes at tail outcomes of the inflation distribution.

4 Theory

The model that matches the empirical facts set forward has two main components. The first is a cost associated with future borrowing that encourages consumers to move borrowing and consumption to the present period, reducing consumption growth from t to $t+1$. I model this as an expected debt issuance cost. When consumers expect this cost to be high in the future, they will move their borrowing to the present. The second is a feature of expectations that causes the consumer to expect this cost to be higher in the tails of her subjective inflation distribution than at the center. This is consistent with the evidence provided in Section 3.1 that the lengths of both tails of the inflation distribution increase the probability of having a negative outlook about future credit availability.

4.1 Utility Maximization

I model changing credit conditions with a period-specific debt issuance fee associated with initiating new loans. This fee is proportional to the size of the loan. The household generates flow utility through consumption and comes into a period with nominal assets A_t. These assets provide a gross return R_t. Including the debt issuance fee, a household has the following flow budget constraint:

$$P_tC_t + A_{t+1} - \iota_t(A_{t+1} - A_t)\mathbf{1}(A_{t+1} - A_t < -A_t) \leq P_tY_t + R_tA_t \tag{1}$$

Note that the variable describing forecasted real spending growth Section 3.1 included both durable and non-durable goods. We should therefore consider durable goods to be a part of C_t. I will consider durable goods separately in Section 5.1. The consumer may costlessly dissave up to the limit of her current assets, A_t. After this point, she must intiate new debt and pay the issuance fee. The first order conditions for A_{t+1} and C_t are:

$$\lambda_t[1 - \iota_t\mathbf{1}(A_{t+1} - A_t < -A_t)] = \lambda_{t+1}[R_{t+1} - \iota_{t+1}\mathbf{1}(A_{t+2} - A_{t+1} < -A_{t+1})] \tag{2}$$

where λ_t is the Lagrange multiplier on the time-t budget constraint.

$$\beta^t u'(C_t) = \lambda_t P_t \tag{3}$$

Combining Equations 2 and 3 gives the intertemporal Euler equation:

$$u'(C_t)[1 - \iota_t\mathbf{1}(A_{t+1} - A_t < -A_t)] = \beta u'(C_{t+1})[R_{t+1} - \iota_{t+1}\mathbf{1}(A_{t+2} - A_{t+1} < -A_{t+1})]\frac{1}{(1 + \pi_{t+1})} \tag{4}$$

The interpretation of Equation 4 will depend on the household's borrowing plans for both periods. If, however, we consider a household that plans to borrow in both periods, the left hand side is the marginal utility gained by financing consumption through borrowing in period t. The consumer cannot use the entirety of the loan to finance consumption as she must pay fee ι_t. The right hand side represents the discounted marginal utility that is foregone due to borrowing, namely the gross interest rate to be repaid. Importantly, the future debt issuance cost reduces the cost of borrowing as taking a loan today reduces the future loan amount and its associated fee.

Assuming log utility, Equation 4 gives the following ratio $\frac{C_{t+1}}{C_t}$:

$$\frac{C_{t+1}}{C_t} = \frac{\beta(R_{t+1} - \iota_{t+1}\mathbf{1}(A_{t+2} - A_{t+1} < -A_{t+1}))}{(1+\pi_{t+1})(1 - \iota_t\mathbf{1}(A_{t+1} - A_t < -A_t))} \tag{5}$$

Consumption growth is decreasing in inflation. Setting ι_{t+1} and ι_t equal to zero causes the fraction on the right-hand side to collapse to the gross real interest rate. As inflation increases, the real return to savings decreases. This encourages consumption today and reduces planned consumption growth. Debt issuance costs in the present, ι_t, increase consumption growth by increasing the cost of borrowing and reducing current consumption. Increasing ι_{t+1} has the opposite effect. Increasing the future cost of borrowing encourages the consumer to stock up on debt in the present and increase current consumption.

4.2 Expectations

The empircal evidence in Section 3.2 indicates that the lengths of both the left and right tails of the subjective inflation distribution predict a reduction in real consumption growth. It further shows that the tails of the distribution are positively associated with belief in worsening credit access. This can potentially explain the why both tails predict the same consumption response, even though this is inconsistent with the Fisher relation. To match this feature of the data, I introduce an expectation of *rare inflation disasters* into expectations. Disaster states lead to an increased likelihood in particularly high or particularly low inflation but, regardless of realized inflation, the disaster causes an increased debt issuance fee.

I allow inflation and the future issuance cost to be unknown. Furthermore, I allow the consumer to condition her expectation of ι_{t+1} on the rate of inflation. Assume that the consumer forms expectations of the inflation rate as a Gaussian mixture of expectations in two states, one of which is a disaster state. The mixture has five parameters: the means and standard deviations of the two normal distributions - μ_t^D, $\mu_{it}^{\neg D}$, σ_t^D, $\sigma_t^{\neg D}$- and a mixing probability γ_t that gives the consumer's unconditional probability of realizing the disaster state. The disaster (D) is defined by an increase in the future cost of credit relative to other state ($\neg D$), i.e. $\iota^D > \iota^{\neg D}$. In order to concentrate expected disasters in the tails of the expected inflation distribution, I also assume that uncertainty is higher in the disaster state, that is $\sigma_t^D > \sigma_t^{\neg D}$.[8] Given the two distributions, the consumer can use

[8]Inflation uncertainty and general macroeconomic uncertainty tend to be higher in recessions: Bloom 2014, Binder 2017, Chan and Song 2018. There is also evidence that crises generate macroeconomic

Bayes' Rule to find her expected probability of the disaster state conditional on a level of inflation:

$$Pr_t[D|\pi_{t+1}] = \frac{\gamma \times f_\pi^D(\pi_{t+1})}{f_\pi(\pi_{t+1})} \tag{6}$$

I assume, that $\iota_t = 0$, $\iota^{\neg D} = 0$, and $\iota^D > 0$. At a given inflation rate, the expected cost of future credit is therefore $Pr_t[D|\pi_{t+1}] \times \iota^D$ and we can rewrite the ratio of future consumption to current consumption for a borrower as:

$$\frac{C_{t+1}}{C_t} = \frac{\beta(R_{t+1} - Pr_t[D|\pi_{t+1}] \times \iota^D)}{1 + \pi_{t+1}} \tag{7}$$

Note that the variation in this cost comes from the expected probability of the disaster rather than the issuance cost realized in the disaster, which is constant. Figure 2 shows an example of inflation expectations with a disaster state. In this case, both distributions have the same mean, but the uncertainty about inflation is higher under D, that is $\sigma_t^D > \sigma_t^{\neg D}$. The first panel of the figure shows the two distributions and a mixture. The second panel shows the consumer's expected probability of the economy being in the disaster state conditional on the realization of inflation. As inflation is further from the mean of the distribution, it becomes more likely that this rate of inflation is occuring under the disaster state. The third panel shows the Euler equation plotted against the inflation rate along with the Euler equation in a model without disasters. As the conditional probability of the disaster increases, the expected future debt issuance cost increases as well. This drives consumption towards the present and makes the ratio of future to present consumption lower than it would be otherwise.

The disaster state can also be modeled to have a different mean than the normal state. Figure 3 shows the distributions, conditional probability of disaster, and Euler equations for a consumer who believes that the disaster state will have both higher uncertainty and a higher mean, $\mu_t^D > \mu_t^{\neg D}$. This spreads the expected inflation distribution (the mixture between the two states) and gives it a long tail on the right side. The probability of disaster is now close to 0 for a wider range of outcomes than in Figure 2. The portion of the distribution near the center of the non-disaster state distribution and in the tail of the disaster state distribution gives inflation realizations that are almost certainly produced by the non-disaster state. This also means that there will be a range of outcomes for which the Euler equation is very close to the non-disaster Euler equation. There is also,

uncertainty (Bloom 2009), most recently in the Coronavirus crisis, see Leduc and Liu 2020. Binder 2020 notes this uncertainty in inflation expectations in a survey conducted in March 2020.

however, a long tail in which the planned consumption growth falls below the growth sans disaster.

This theory offers an explanation for the negative relationship between consumption growth and a consumer's perceived upside and downside inflation risks. The next section considers empirically the implications of this theory for other aspects of spending plans.

5 Additional Discussion and Results

Thus far, I have shown evidence that household's expected consumption growth falls as the tails of their subjective probability distribution over inflation get longer. I further propose a model of inflation outcomes as an indication that the cost of borrowing has increased. This section introduces additional evidence to support this theory, drawing from the SCE Household Spending Survey. This supplement is administered in addition to the core module of the survey in April, August and December, starting in December of 2019. I include all publically available microdata, through August 2019. This provides 16,742 person-month observations. I look at two particular aspects of consumer spending that provide testable implications for my theory: the likelihood of purchasing durable and larger goods and the future marginal propensity to consume.

5.1 Buying Attitudes Towards Durables

The model in Section 4 suggests that the primary mechanism for moving consumption from the future to the present is the incentive to stock up on debt before a disaster occurs and increases the issuance costs for new debt. It therefore makes sense to consider the effect of the tails of the subjective inflation distribution on the purchases of durable goods that provide utility in multiple periods and may require debt to finance.

There are several papers considering the effect of inflation expectations on durable spending, providing mixed evidence on the direction of the relationship between expected inflation and durables spending. Bachmann, Berg, and Sims 2015 find a negative relationship between inflation expectations and reported readiness to spend on durables in the Michigan Survey of Consumers at the zero lower bound. Coibion, Georgarakos, Gorodnichenko, and van Rooij 2021 provide experimental evidence that exogenous changes in the inflation expectations of Dutch households cause declines in their plans to spend on durables. Burke and Ozdagli 2021 finds a positive impact of inflation on durables consumption among American households, but only for college educated consumers. On the other hand, Duca-Radu, Kenny, and Reuter 2019 finds a positive relationship between inflation expectations and readiness to spend at the zero lower bound for a large survey of European consumers. D'Acunto, Hoang, and Weber 2016 and D'Acunto, Hoang, and Weber 2018 note an increase in willingness to spend on durables among German and Polish consumers, respectively, following exogenous increases in inflation expectations generated by unexpected tax announcements.

I extend the baseline model in Section 4 to include utility from consumption of both durable and non-durable goods and durables purchases in the consumer's budget constraint and:

$$P_tC_t + P_tI_t^X + A_{t+1} - a_t(A_{t+1} - A_t)\mathbf{1}(A_{t+1} - A_t < -A_t) \leq P_tY_t + R_tA_t \tag{8}$$

Durables depreciate at rate δ and the stock of durables in a period is equal to:

$$X_t = I_t^X + (1 - \delta)X_{t-1} \tag{9}$$

Combining Equations 8 and 9 gives:

$$P_tC_t + P_t(X_t - (1 - \delta)X_{t-1}) + A_{t+1} - \iota_t(A_{t+1} - A_t)\mathbf{1}(A_{t+1} - A_t < -A_t) \leq P_tY_t + R_tA_t \tag{10}$$

The first order condition for durables spending is:

$$u_X(C_t, X_t) = \lambda_tP_t - \lambda_{t+1}P_{t+1}(1 - \delta) \tag{11}$$

Combining this with Equations 2 and 3 (and making the appropriate adjustments to the marginal utilities in those equations) gives:

$$u_X(C_t, X_t) = \beta u_C(C_{t+1}, X_{t+1})\left[\frac{R_t - \iota_{t+1}}{(1 - \iota_t)(1 + \pi_{t+1})} - (1 - \delta)\right] \tag{12}$$

This condition and the intertemporal Euler equation in Equation 4 imply that the optimal ratio of the marginal utility of durables consumption to non-durable consumption should be:

$$\frac{u_X(C_t, X_t)}{u_C(C_t, X_t)} = 1 - (1 - \delta)\frac{(1 - \iota_t)(1 + \pi_{t+1})}{R_t - \iota_{t+1}} \tag{13}$$

I assume log-log utility. I further set $\iota_t = 0$ and incorporate the expectations of ι_{t+1} as relying on the probability of disaster conditional on a level of inflation, $Pr_t[D|\pi_{t+1}] \times \iota^D$. The optimal ratio of durable to non-durable consumption is:

$$\frac{X_t}{C_t} = \frac{1}{1-(1-\delta)\frac{1+\pi_{t+1}}{R_t - Pr_t[D|\pi_{t+1}]\times\iota^D}} \tag{14}$$

Figures 4 shows the optimal durable to non-durable consumption with and without disasters when $\mu^D = \mu^{\neg D}$. Figure 5 shows the same when $\mu^D > \mu^{\neg D}$. The optimal ratio is increasing in inflation. At inflation rates where the conditional probability of disaster is low, the ratio of durables to non-durables is similar to the optimal ratio from the model without disasters. In the tails of the inflation distribution, where the conditional probability of disaster and expected future debt issuance cost is high, the ratio is higher than would be optimal without these costs. The expected issuance costs incentivize borrowers to move borrowing from $t+1$ to t. The consumer therefore "overaccumulates" durables relative to a model without these costs. The durables provide two benefits to the consumer beyond utility in time-t. Undepreciated durables provide future flow utility and can also be sold to finance non-durable consumption, C_{t+1}, when borrowing is costly. In the tails of a distribution with disasters, consumers therefore shift spending from the future to the present more than they otherwise would and spend more on durables relative to consumption in time-t. This implies that durables purchases should be particularly high for consumers' with longer-tailed distributions.

The SCE Household Spending Survey includes questions about the likelihood of buying durable goods. These questions have the respondent report the probability that they will make a purchase in a particular good category in the next four months. I consider the categories: *Appliances*, *Electronics*, *Furniture*, *Cars and Vehicles*, and *House or Apartment*. Table 4 shows the average probability assigned to each of these questions. To test the effect of subjective inflation distributions on the willingness to purchase larger goods, I define respondents that report positive probability in a category as *potential buyers*. This is a dummy variable that is equal to 1 if respondents provide positive probability in this category and 0 otherwise and is similar to the "readiness to spend" variable employed by Bachmann, Berg, and Sims 2015. I combine appliances, electronics, and furniture into one durables category.[9] Potential buyers of durables may assign positive probability to purchasing any of the three goods in the category. Table 4 also provides the proportion of potential buyers in each category.

I estimate probit regressions separately for each category using the *potential buyer*

[9] This provides a parallel to the Michigan Surveys questions asking if now is a good time to buy durables, a car, or a house.

dummy as the dependent variable. The main variables of interest are the median and tails of the subject inflation distribution, though I include the full set of controls as well as an indicator equal to 1 if the respondent reports making a purchase in that category in the last four months. As the model predicts increased purchases of durables at higher expected inflation and higher probability of disaster, we should see a positive effect of the median and the tails on the probability that a consumer reports positive probability of purchase. Table 5 reports the coefficients and marginal effects. The inflation distribution variables have highly significant effects. The coefficients on both tails are positive and significant for all three goods categories. Holding all other variables at their means, an increase of one percentage point in the right tail leads to a 3.56%, 4.61%, and 3.81% increase in the probability that a consumer reports positive probability of durables, car, and home purchase, respectively. The corresponding increases for an increase of one percentage point in the left tail are 3.01%, 2.13%, and 2.41%.[10] These effects are economically significant. A one standard deviation in the increase of either tail increases the probability of being a potential buyer by roughly 6 to 13 percent, depending on the tail and category.

These results should be considered an extension of exisiting results on this topic, rather than a negation. Indeed, the marginal effects on the implied median of the respondents distribution indicate that an increase in the central tendency of the expected inflation distribution decreases the probability of being a potential buyer for durables, cars and homes. This is consistent with Coibion, Georgarakos, Gorodnichenko, and van Rooij 2021 and Bachmann, Berg, and Sims 2015 at the ZLB, meaning the inclusion of the tails of the distribution does not bring this particular result in line with theory. The coefficient on the IQR is negative, consistent with Binder 2017, who finds that the probability of a favorable buying attitude decreases as uncertainty increases.

5.2 Future Marginal Propensity to Consume

The model predicts that households with a greater expectation of disaster should assign larger shares of unexpected future income to future consumption. I test this prediction with the following question from the SCE household spending module:

*Suppose next year you were to find your household with **10 % more income** than you currently expect. What would you do with the extra income?*

Respondents are then given the option to allocate this income (in percentages) between *Save or invest*, *Spend or donate*, and *Pay down debts*. Households plan to spend 17.95% on average, with 53.33% planning to spend at least some of the hypothetical increase. We

[10] These results are robust to increasing the probability threshhold for a potential buyer up to 15%.

can interpret the percentage the household would choose to spend as a future marginal propensity to consume. The intuition that consumers with higher expected future debt issuance costs will have a higher future MPC combined with the results in Section 3.2 imply that those with longer-tailed inflation distributions will spend more out of an unexpected change in future income.

Table 6 shows the results of a regression of the percentage households plan to spend on the median, inter-quartile range, and left and right tails of the subjective inflation distributions. The regression includes the controls described in Section 3.2. The coefficient on the right tail is positive and statistically significant, prediciting an extra 1.26% of a surprise increase in future income allocated to consumption for each one percentage point increase in the length of the tail. The coefficient on the left tail implies a 0.37% increase in consumption for each one percentage point increase in length, but is not statistically significant. As a further investigation, I run a probit regression on the indicator variable that is equal to 0 if the respondent reports that they would spend none of an unexpected increase and 1 otherwise. The results of this show that, all else equal, increasing the length of the left or right tail of the subjective probability distribution increases the probability that a household will report a positive spending share.[11] In both the linear regression and probit analyses, the coefficients on median inflation is economically small and either not statistically significant or only weakly so. The coefficient from the linear regression indicates that consumers will spend 0.008% less out of an income increase for each percentage point increase in the median. This is consistent with the predictions of the model, where implications for the future MPC are driven by the costs of borrowing implied by tail outcomes of inflation rather than inflation itself.

This result is akin to that of Zeldes 1989, though with a different interpretation on the limitations on household credit. Zeldes 1989 observes that the ratio between the marginal utility of consumption today to consumption tomorrow is higher in the presence of binding borrowing constraints than it is in a model without borrowing constraints. Increasing income today relaxes the borrowing constraint, bringing her optimal feasible bundle closer to the unconstrained bundle. We therefore expect a constrained household to spend more out of a change in current income than an unconstrained household would, ceteris parabis.

The consumer in Section 4.1 can borrow as much as they would like, but at a cost. The Euler equation for a for a consumer facing issuances costs in time-t only - removing the distinction between durables and non-durables for simplicity - is:

[11] This result is robust to increasing the cutoff for coding the dependent variable as 1 to 5%.

$$u'(C_t) - \iota_t \mathbf{1}(A_{t+1} - A_t < -A_t)u'(C_t) = \beta \frac{R_{t+1}}{1 + \pi_{t+1}} U'(C_{t+1}). \tag{15}$$

The value of additional income in t (which reduces the need to borrow) equals the marginal utility lost to debt issuance costs. Holding all else constant, as Y_t increases, we would expect to see this household consume more, reducing $u'(C_t)$ as well as the utility loss from borrowing. If income increases enough that the household no longer needs to borrow ($A_{t+1} - A_t \geq 0$), the indicator function is set to 0 and borrowing costs do not affect the consumer's Euler equation between time-t and time-$t+1$.

Zeldes 1989 would interpret $\iota_t \mathbf{1}(A_{t+1} - A_t < -A_t)u'(C_t)$ as the Langrange multiplier on a borrowing constraint, θ_t. The parallel to Equation 15 for the borrowing-constrained consumer is:

$$u'(C_t) - \theta_t = \beta \frac{R_{t+1}}{1 + \pi_{t+1}} U'(C_{t+1}) \tag{16}$$

When the constraint does not bind, $\theta_t = 0$ and the Euler equation is satisfied between time-t and time-$t+1$. A consumer who does not pay any issuance costs - $\iota_t \mathbf{1}(A_{t+1} - A_t < -A_t)u'(C_t) = 0$ will have the same Euler equation as an unconstrained consumer. Otherwise, $\theta_t > 0$ and is equal to the value of being able to borrow an additional unit, that is the marginal utility gained from spending that unit today less the discounted marginal utility lost paying it back. . For a consumer with $\theta_t > 0$, an additional unit of income today relaxes the constraint by allowing the consumer to increase C_t without borrowing. This reduces the $u'(C_t)$ and θ_t. Constrained households should spend more out of an increase in Y_t than unconstrained households.[12]

The SCE question asks about an allocation of an increase in *future* income. To match the wording of this question, we can rewrite Equation 15 as the Euler equation between times $t+1$ and $t+2$ for a consumer who faces issuance costs in $t+1$ but not in t or $t+2$:

$$u'(C_{t+1}) - \iota_{t+1} \mathbf{1}(A_{t+2} - A_{t+1} < -A_{t+1})u'(C_{t+1}) = \beta \frac{R_{t+2}}{1 + \pi_{t+2}} U'(C_{t+2}) \tag{17}$$

The marginal propensity to consume out of ΔY_{t+1} should be higher for consumers who anticipate paying higher issuance costs in $t+1$. As outlined in Section 4.2, ι_{t+1} is

[12] More constrained households do tend to have higher MPCs: Jappelli and Pistaferri 2014, Flavin 1985. MPCs may be high even for consumers who seem like they should not be constrained but have illiquid wealth (Kaplan and Violante 2014) or the need to reserve liquid assets for a large future expense (Campbell and Hercowitz 2019).

expected to be high in the tails of the inflation distribution. Consumers with longer tails should therefore have a higher MPC in $t+1$, as suggested by the results in Table 6.

6 Conclusion

I provide evidence that beliefs in extreme inflation outcomes are a significant predictor of households' consumption plans. Households with long-tailed subjective probability distributions over inflation believe that credit access is declining at an accelerating rate, have lower forecasted growth in real consumption, are more likely to report positive spending attitudes towards durables, and are more likely to plan to spend out of an unexpected increase in future income. I further show that these results are consistent with *rare inflation disasters* that materialize in the tails of inflation expectations and increase the cost of borrowing.

Jointly, these results suggest that the relationship between inflation expectations and anticipated consumption goes beyond the well-known Fisher relationship. Indeed, households seem to view inflation not only as a component of real interest rates but also as a barometer of financial market access. Failures to achieve price stability reduce consumers' confidence in their ability to borrow, with implications for consumption-savings plans. Future research may further explore this new proposed link between inflation expectations and consumption.

References

Andrade, Philippe, Eric Ghysels, and Idier (2012). “Tails of Inflation Forecasts and Tales of Monetary Policy”.

Armantier, Oliver et al. (Sept. 2021). “How economic crises affect inflation beliefs: Evidencve from the Covid-19 pandemic”. In: *Journal of Economic Behavior Organization*.

Armantier, Olivier, Scott Nelson, Giorgio Topa, Wilbert van der Klaauw, and Basit Zafar (2016). “The Price is Right: Updating Inflation Expectations in a Randomized Price Information Experiment”. In: *Review of Economics and Statistics* 98.3, pp. 506–523.

Armantier, Olivier, Giorgio Topa, Wilbert van der Klaauw, and Basit Zafar (2016). “An Overview of the Survey of Consumer Expectations”. In: *Federal Reserve Bank of New York Staff Report* 800.

Bachmann, Rüdiger, Tim O. Berg, and Eric R. Sims (2015). “Inflation Expectations and Readiness to Spend: Cross-Sectional Evidence”. In: *American Economic Journal: Economic Policy* 7.1, pp. 1–35.

Ben-David, Itzhak, Elyas Fermand, Camelia M. Kuhnen, and Geng Li (2018). “Expectations Uncertainty and Household Economic Behavior”.

Binder, Carola (2017). “Measuring Uncertainty Based on Rounding: New Method and Application to Inflation Expectations”. In: *Journal of Monetary Economics* 90, pp. 1 –12.

— (2020). “Coronavirus Fears and Macroeconomic Expectations”. In: *The Review of Economics and Statistics* 102.2, pp. 721–730.

Binder, Carola and GwangMin Kim (2021). “Learning-through-Survey in Inflation Expectations”.

Binder, Carola and Randall J. Verbrugge (2016). “Digging into the Downward Trend in Consumer Inflation Expectations”.

Bloom, Nicholas (2009). “The Impact of Uncertainty Shocks”. In: *Econometrica* 77 (3), pp. 623 –685.

— (2014). “Fluctuations in Uncertainty”. In: *Journal of Economic Perspectives* 28 (2), pp. 153 –176.

Burke, Mary and Ali Ozdagli (2021). “Household Inflation Expectations and Consumer Spending: Evidence from Panel Data”.

Campbell, Jeffrey R. and Zvi Hercowitz (2019). “Liquidity Constraints and the Middle Class”. In: *American Economic Journal: Economic Policy* 11.2, pp. 130–155.

Candia, Bernardo, Olivier Coibion, and Yuriy Gorodnichenko (2020). “Communication and the Beliefs of Economics Agents”.

Chan, Joshua C. C. and Yong Song (2018). "Measuring Inflation Expectations Uncertainty Using High-Frequency Data". In: *Journal of Money, Credit and Banking* 50 (6), pp. 1139 –1166.

Coibion, Olivier, Dimitris Georgarakos, Yuriy Gorodnichenko, and Maarten van Rooij (2021). "How Does Consumption Respond to News about Inflation? Field Evidence from a Randomized Control Trial".

Coibion, Olivier, Yuriy Gorodnichenko, and Tiziano Ropele (Feb. 2020). "Inflation Expectations and Firm Decisions: New Causal Evidence". In: *Quarterly Journal of Economics* 135 (1), pp. 165 –219.

Crump, Richard K., Stefano Eusepi, Andrea Tambalotti, and Giorgio Topa (2015). "Subjective Intertemporal Elasticity". In: *Federal Reserve Bank of New York Staff Report* 734.

D'Acunto, Francesco, Daniel Hoang, and Michael Weber (2016). "The Effect of Unconventional Fiscal Policy on Consumption Expenditure".

— (2018). "Unconventional Fiscal Policy".

Dräger, Lena and Giang Nghiem (2021). "Are Consumers' Spending Decisions in Line with A Euler Equation?" In: *The Review of Economics and Statistics* 103.3, pp. 580–596.

Duca-Radu, Iona, Geoff Kenny, and Andreas Reuter (2019). "Inflation expectations, consumption and the lower bound: Micro evidence from a large multi-country survey". In: *American Economic Journal: Economic Policy* 11.2, pp. 130–155.

Engelberg, Joseph, Charles Manski, and Jared Williams (2009). "Macroeconomic Expectations of Households and Professional Forecasters". In: *Journal of Business and Economic Statistics* 27.1, pp. 30 –41.

Flavin, Marjorie A. (1985). "Inflation expectations, consumption and the lower bound: Micro evidence from a large multi-country survey". In: *The Canadian Journal of Economics* 18.2, pp. 117–136.

García, Juan Angel and Andrés Manzanares (2007). "What Can Probability Forecasts Tell Us About Inflation Risks?" In: *European Central Bank Working Paper Series* 825.

Ichiue, Hibiki and Shusaku Nichiguchi (2015). "Inflation Expectations and Consumer Spending at the Zero Lower Bound: Micro Evidence". In: *Economic Inquiry* 53.2, pp. 1086 –1107.

Jappelli, Tullio and Luigi Pistaferri (2014). "Fiscal Policy and MPC Heterogeneity". In: *American Economic Journal: Macroeconomics* 6.4, pp. 107–136.

Kamdar, Rupal (2018). "The Inattentive Consumer: Sentiment and Expectations".

Kaplan, Greg and Giovanni L. Violante (2014). "A Model of the Consumption Response of Fiscal Stimulus Payments". In: *Econometrica* 82.4, pp. 1199–1239.

Leduc, Sylvain and Zheng Liu (2020). "The Uncertainty Channel of the Coronavirus".

Ryngaert, Jane (2021). "A New Approach to Subjective Probability Distributions".

Scharnagl, Michael and Jelena Stapf (2015). "Inflation, deflation, and uncertainty: What drives euro-area option-implied inflation expectations, and are they still anchored in the sovereign debt crisis". In: *Economic Modeling* 48, pp. 248–269.

Zeldes, Stephen P. (Apr. 1989). "Consumption and Liquidity Constraints: An Empirical Investigation". In: *Journal of Political Economy* 97.2, pp. 305–346.

Table 1: Inflation Expectations: Descriptive Statistics

Panel A: Full Sample			$N = 112,300$
Variable	Mean	Stand. Dev.	Corr. with $E[\pi_{t+1}]$
$E[\pi_{t+1}]$	3.978	4.914	-
Median	3.997	4.888	0.9943
IQR	5.334	5.604	0.069
$p95 - p75$	2.746	2.493	0.105
$p25 - p5$	2.873	3.032	0.073
Panel B: 2015 and later			$N = 87,504$
$E[\pi_{t+1}]$	3.729	4.782	-
Median	3.746	4.760	0.9936
IQR	5.300	5.625	0.062
$p95 - p75$	2.729	2.507	0.094
$p25 - p5$	2.849	3.034	0.068
Panel C: Before 2020			$N = 101,407$
$E[\pi_{t+1}]$	3.988	4.840	-
Median	4.007	4.807	0.9936
IQR	5.304	5.616	0.071
$p95 - p75$	2.730	2.489	0.114
$p25 - p5$	2.861	3.034	0.071
Panel D: 2015 - 2019			$N = 76,161$
$E[\pi_{t+1}]$	3.701	4.661	-
Median	3.724	4.630	0.9935
IQR	5.253	5.644	0.064
$p95 - p75$	2.705	2.504	0.1030
$p25 - p5$	2.830	3.037	0.063

Notes: The table provides summary statistics of the subjective inflation distribution variables for the full sample period as well as relevant subsamples.

Table 2: Credit Access Expectations

	(3) Coeff.	ME
Median	0.0027	0.0005
	(0.0019)	(0.0004)
IQR	-0.0142*	-0.0028*
	(0.0074)	(0.0015)
$p95 - p75$	0.0205**	0.0041**
	(0.0095)	(0.0019)
$p25 - p5$	0.0250***	0.0049***
	(0.0089)	(0.0018)
Prob. unemployment increases, (0-100)	0.0045***	0.0009***
	(0.0003)	(0.0001)
Prob. interest rates increase, (0-100)	0.0011***	0.0002***
	(0.0003)	(0.0001)
Prob. stock prices increase, (0-100)	-0.0026***	-0.0005***
	(0.0004)	(0.0001)
Observations	74549	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The table shows the coefficients and marginal effects of a probit regression that is equal to 1 if they the respondent believes the deterioration of credit availability is accelerating (Q29 < Q28) and 0 otherwise.

Table 3: Change in Real Consumption

	Expected Change in Real Consumption
Median	-0.504***
	(0.019)
IQR	0.455***
	(0.061)
$p95 - p75$	-0.447***
	(0.082)
$p25 - p5$	-0.216***
	(0.078)
Δ real income	0.294***
	(0.009)
Prob. unemployment increases, (0-100)	0.003
	(0.003)
Prob. interest rates increase, (0-100)	0.004
	(0.003)
Prob. stock increase, (0-100)	0.000
	(0.003)
Current financial status	0.486***
	(0.099)
Expected financial status	-1.362***
	(0.111)
Constant	5.799***
	(2.197)
Observations	74706
R^2	0.236

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The table shows the response of expected real consumption growth to variables characterizing the subjective inflation distribution as well as households' macroeconomic expectations.

Table 4: Descriptive Statistics: Probability of Purchase

Category		Mean Response	Proportion > 0
Durables	*Appliances*	9.773	
		(0.191)	
	Electronics	16.206	0.593
		(0.250)	(0.005)
	Furniture	11.163	
		(0.212)	
Cars or Vehicles		9.039	0.376
		(0.203)	(0.004)
House or Apartment		5.239	0.216
		(0.170)	(0.005)

Notes: The table shows the average probability assigned to the likelihood of purchase in that category in the next four months as well as the proportion of respondents who respond with positive probability.

Table 5: Purchasing Attitudes for Durables, Cars, and Houses

	Durable Goods		Cars and Vehicles		Houses and Apartments	
	Coeff.	ME	Coeff.	ME	Coeff.	ME
Median	-0.0086**	-0.0030**	-0.0192***	-0.0067***	-0.0165***	-0.0044***
	(0.0043)	(0.0015)	(0.0043)	(0.0015)	(0.0047)	(0.0013)
IQR	-0.0645***	-0.0225***	-0.0586***	-0.0203***	-0.0749***	-0.0200***
	(0.0167)	(0.0058)	(0.0157)	(0.0054)	(0.0168)	(0.0045)
$p95 - p75$	0.1023***	0.0356***	0.1329***	0.0461***	0.1422***	0.0381***
	(0.0230)	(0.0080)	(0.0214)	(0.0073)	(0.0227)	(0.0060)
$p25 - p5$	0.0863***	0.0301***	0.0613***	0.0213***	0.0901***	0.0241***
	(0.0202)	(0.0070)	(0.0187)	(0.0065)	(0.0204)	(0.0054)
$E[\Delta$ real income$]$	0.0022*	0.0008*	0.0021*	0.0007*	0.0028**	0.0007**
	(0.0012)	(0.0004)	(0.0012)	(0.0004)	(0.0013)	(0.0003)
Prob. unemployment increases, (0 - 100)	0.0022***	0.0008***	0.0028***	0.0010***	0.0022**	0.0006**
	(0.0008)	(0.0003)	(0.0008)	(0.0003)	(0.0009)	(0.0002)
Prob. interest rates increase, (0 - 100)	0.0039***	0.0014***	0.0036***	0.0013***	0.0037***	0.0010***
	(0.0007)	(0.0003)	(0.0007)	(0.0002)	(0.0008)	(0.0002)
Prob. stock prices increase, (0 - 100)	0.0014*	0.0005*	0.0010	0.0003	0.0024***	0.0006***
	(0.0008)	(0.0003)	(0.0008)	(0.0003)	(0.0009)	(0.0002)
Current Financial Situation	0.0732***	0.0255***	0.0530**	0.0184**	0.0697***	0.0187***
	(0.0244)	(0.0085)	(0.0239)	(0.0083)	(0.0252)	(0.0067)
Expected Financial Situation	0.0269	0.0094	0.0027	0.0010	0.0097	0.0026
	(0.0262)	(0.0091)	(0.0254)	(0.0088)	(0.0276)	(0.0074)
Observations	11236		11221		11184	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table shows the results of a probit regression where the dependent variable is equal to 1 if the survey respondent reports a positive probability of buying in that category in the next four months. The durables category combines appliances, electronics, and furniture. The marginal effects are the change in the probability of identifying as a potential buyer for a one percentage point increase in each of the inflation distribution statistics, a one percentage point increase in the probability from 0 to 100 of a macroeconomic outcome increasing and a one unit increase in optimism about the household's current or future financial situation.

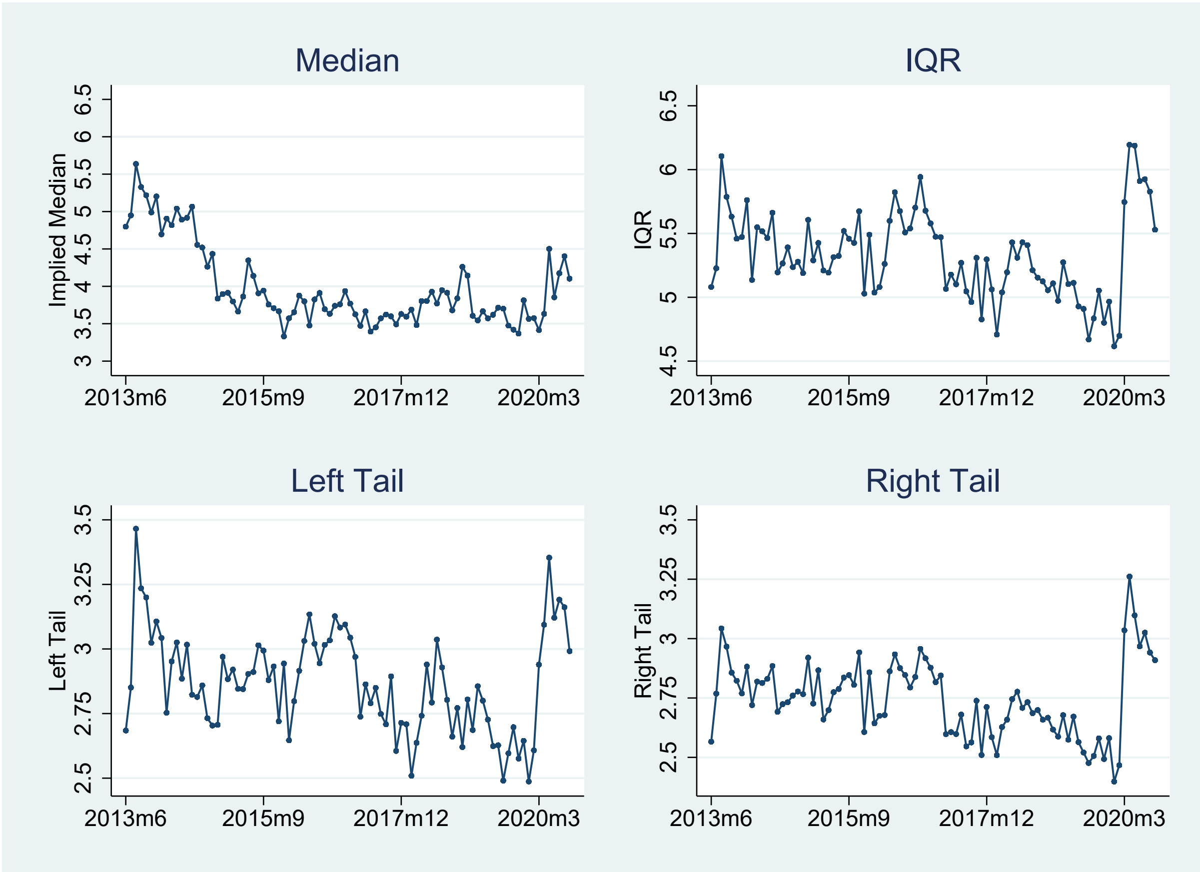
Table 6: Effect of Surprise Income on Future Spending

	Percentage Exp. Spending	Percentage Exp. Spending > 0	
		Coeff.	ME
Median	-0.0080	-0.0085*	-0.0032*
	(0.0804)	(0.0045)	(0.0017)
IQR	-0.8002***	-0.0526***	-0.0200***
	(0.2567)	(0.0163)	(0.0062)
$p95 - p75$	1.2619***	0.0834***	0.0316***
	(0.3733)	(0.0223)	(0.0084)
$p25 - p5$	0.3726	0.0416**	0.0158**
	(0.3262)	(0.0196)	(0.0074)
$E[\Delta$ real income$]$	0.0520**	0.0032**	0.0012**
	(0.0220)	(0.0013)	(0.0005)
Prob. unemployment increases,	0.0114	0.0004	0.0002
	(0.0138)	(0.0008)	(0.0003)
Prob. interest rates increase,	0.0347***	0.0017**	0.0006**
	(0.0130)	(0.0007)	(0.0003)
Prob. stock prices increase,	0.0152	0.0016*	0.0006*
	(0.0151)	(0.0008)	(0.0003)
Current Financial Situation	1.5282***	0.0790***	0.0300***
	(0.4182)	(0.0236)	(0.0089)
Expected Financial Situation	-1.0057**	0.0036	0.0014
	(0.4698)	(0.0260)	(0.0099)
Observations	10463	10446	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

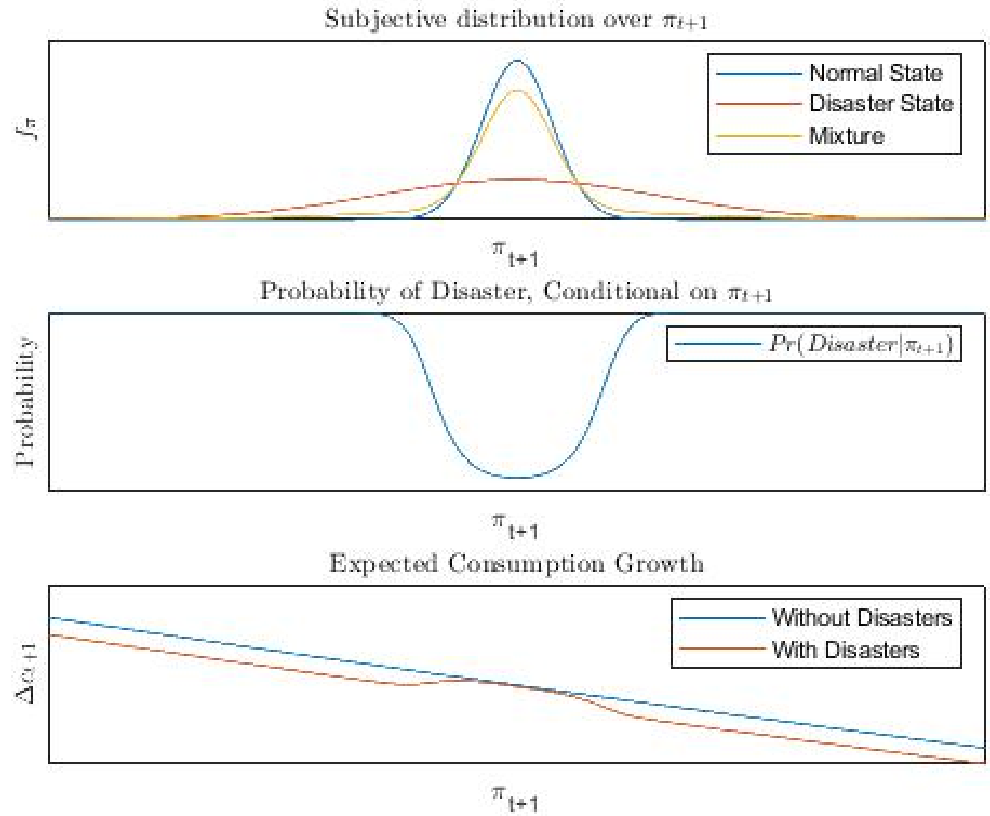
Notes: This table shows effects of inflation expectation on the share of a hypothetical increase in future income that a consumer expects to spend. The first column is a simple regression using the reported probability as the dependent variable. The second and third columns give the coefficient and marginal effects from a probit regression where the dependent variable is equal to 1 if the respondent expects to spend at least something out of the hypothetical increase.

Figure 1: Time-Variation in Inflation Variables



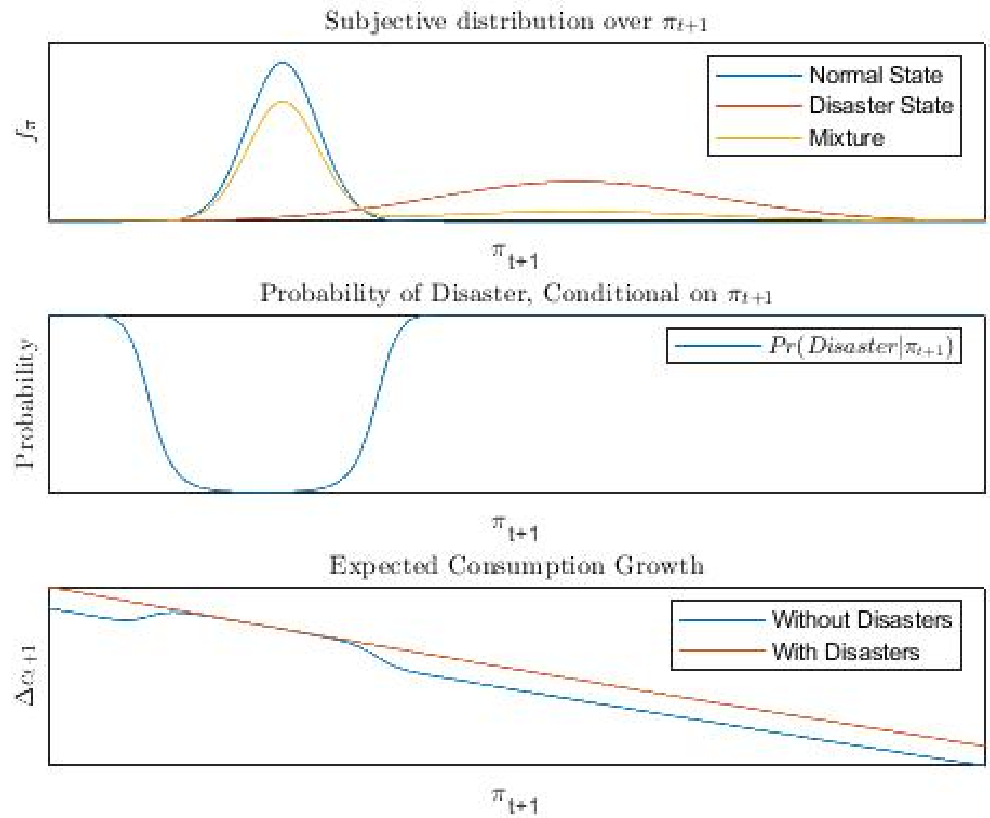
Notes: This figure plots the survey-weighted means of the implied median, interquartile range, and right and left tails from the subjective probability distributions over inflation. The left and right tails are defined as the differences between the 25th and 5th percentiles and the 95th and 75th percentiles, respectively. All variables show time-variation as well as some trends to note. The average subjective median is declining for the first part of the survey, leveling out going into 2015. The average IQR and tails increase at the onset of the COVID crisis, peaking in April 2020 and then coming back down. The average median also increased slightly at the onset of the COVID crisis.

Figure 2: Expectations and Consumption Growth with a Disaster State



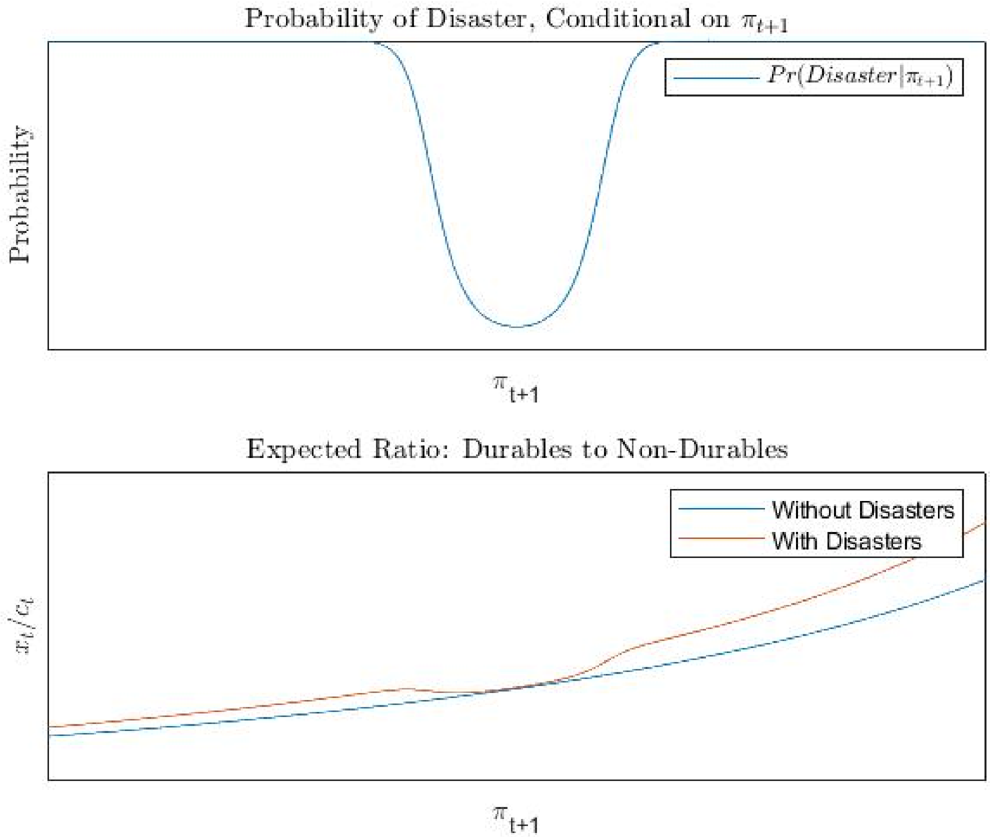
Notes: This figure shows the model of inflation expectations as a mixture of two normal distributions over possible inflation outcomes. One of these distributions gives the distributions over inflation in a disaster. Future debt issuance costs increase in the disaster state The first panel shows the two normals and their mixture. The mixture gives the agent's expectations over possible inflation outcomes. The second panel applies Bayes Rule to find the expected probability of being in the disaster state conditional on a realization of inflation. The third panel shows optimal consumption growth plotted against the rate of inflation. The blue line shows that consumption growth should decline as inflation increases and the real interest rate decreases, causing the consumer to shift consumption from the future to the present. The red line shows consumption growth plotted against inflation when anticipated disasters factor into the consumer's behavior. The possibility of a disaster drives up the expected future loan issuance fee, which drives borrowing and consumption towards the present. As the probability of disaster is higher in the tails of the distribution, consumption growth is further from the disaster-free prediction at these inflation rates than it is at inflation rates at the middle of the distribution.

Figure 3: Disaster State with Higher Mean



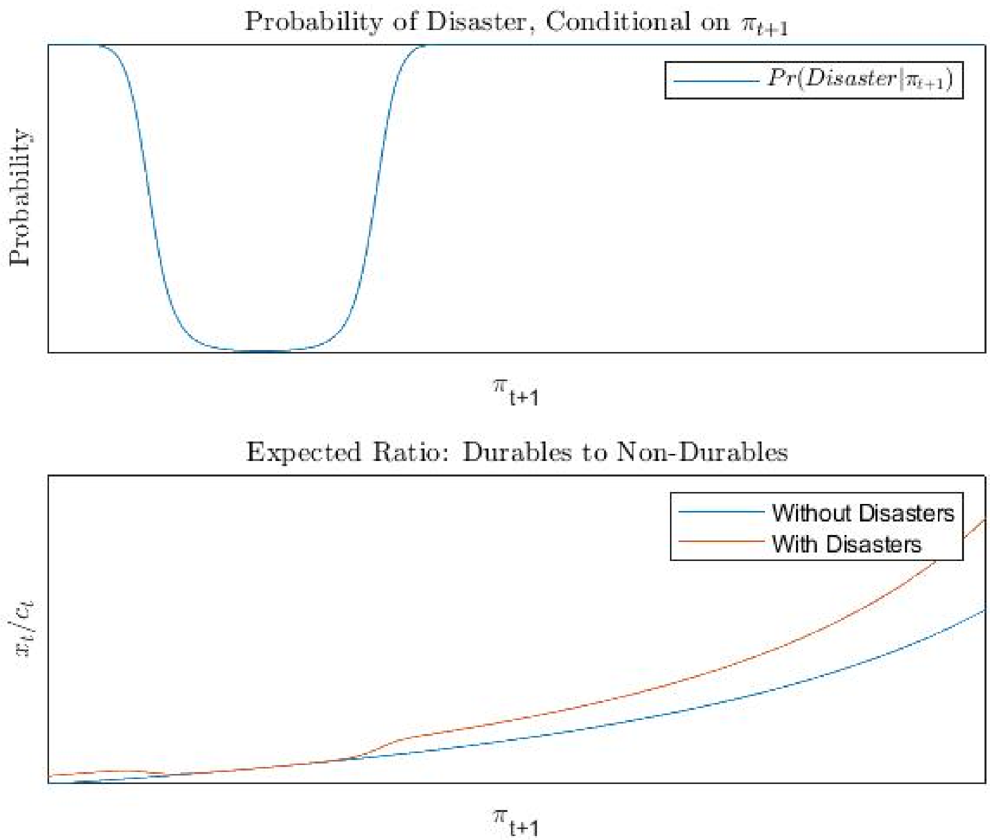
Notes: This figure shows the model of inflation expectations with expected disasters when the disaster state has a higher mean as well as higher uncertainty than the non-disaster state. The probability of disaster is now close to 0 across a broader range of outcomes - in the portions of the distribution where non-disaster state probability is concentrated. Consumption growth is similar to the disaster-free consumption growth for these outcomes. In the tails of the distribution, consumption growth in the disaster-free state is higher than in the model with disasters.

Figure 4: Durables Consumption with Disasters



Notes: This figure shows the expected probability of disaster conditional on a realization, π_{t+1} as well as the expected ratio of durable to non-durable consumption for the model in Figure 2 model where the disaster and non-disaster states have the same mean. In the tails of the distribution, the ratio of durable to non-durable consumption is higher in the model with disasters than in the model without disasters.

Figure 5: Durables with a Disaster with a Higher Mean



Notes: This figure replicates Figure 4 but with a disaster state with a higher mean than the non-disaster state, corresponding to the expectations in Figure 3. The primary difference in this model is that there is an larger range of inflation outcomes where the expected probability of disaster is low and the optimal durable to non-durable ratio looks similar across the two models.

APPENDICES

A Description of Control Variables

- Age
- Age^2
- Age^3
- Married (Indicator)
- Female (Indicator)
- Hispanic (Indicator)
- Census Region (Categorical): Midwest; Northeast; South; West
- Race (Categorical): White; Black; American Indian; Asian; Hawaiian/Pacific Islander; Other
- Education (Categorical): No College; Some College/Associate's Degree; Bachelor's Degree
- Household Income (Categorical): Less than 50K; 50K to 100K; More than 100K
- Spouse (Indicator): 0 if no spouse living in residence; 1 if one or more spouse/partner living in residence
- Children Under 18 (Categorical): 0 if no children under 18 in residence; 1 if one child under 18; 2 if two children under 18; 3 if three or more children under 18
- Children Over 18 (Indicator): 0 if no children over 18 in residence; 1 if one or more children over 18
- Non-Relatives (Indicator): 0 if no non-relatives in residence; 1 if one or more non-relatives
- Other Relatives - e.g. Parents/Spouses Parents (Indicator): 0 if no other relatives in residence; 1 if one or more other relatives
- Household Size: This variable includes the number of all those living in the household, the sum of all subcategories listed above

- Labor Force Status: This variable takes on values of all of the possible combinations of these job statuses for the respondent and spouse (where No=0, Yes=1): Working full-time; Working part-time; Not working, but would like to work; Temporarily laid off; Self-employed; On sick or other leave; Permanently disabled or unable to work; Retiree or early retiree; Student; Homemaker
- Multiple Jobs (Indicator): 0 if no job or 1 job; 1 if more than one job
- Numeracy (Indicator): 0 if low numeracy; 1 if high numeracy
- Debt (Indicator): 0 if no loans reported; 1 if has at least one loan. This variable comes from the SCE Consumer Credit Access Module. The value of debt is the value reported in the most recent previous survey that included the debt module.
- Home Ownership (Indicator): 0 if does not own primary residence; 1 if owns primary residence