How Does Consumption Respond to News About Inflation? Field Evidence from a Randomized Control Trial*

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Abstract: We implement a survey of Dutch households in which random subsets of respondents receive information about inflation. The resulting exogenously generated variation in inflation expectations is used to assess how expectations affect subsequent monthly consumption decisions relative to those in a control group. The causal effects of reduced inflation expectations on non-durable spending are imprecisely estimated but there is a sharp positive effect on durable spending. We provide evidence that this is likely driven by the fact that Dutch households seem to become more optimistic about their real income as well as aggregate spending when they decrease their inflation expectations. There is little evidence to support the idea that the degree to which respondents change their beliefs or their spending in response to information treatments depends on their level of cognitive or financial constraints. (*JEL* E31, C83, D84)

This paper represents the first attempt to apply a randomized control trial (RCT) approach to determine how inflation expectations affect spending decisions of households in the economy. Specifically, we apply randomized information treatments about recent inflation to a nationally representative survey of households in the Netherlands.[1] These treatments lead to discernible and exogenously generated changes in the inflation expectations of the treated households relative to those in the (untreated) control group. Using follow-up surveys of these same households, we then determine whether these exogenous changes in inflation expectations affected the spending

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[1] This RCT is registered with the AEA Registry as described in Coibion et al. (2019).

decisions of households in subsequent months. Given the fact that the treatment was implemented during the period in which the European Central Bank's policy rate was around the effective lower bound (ELB), our results speak directly to the effect of changes in inflation expectations on economic outcomes. We find that inflation expectations do affect spending decisions but not in the way that is commonly predicted in macroeconomic models.

Standard theory underlying the predicted effects of changes in inflation expectations focuses on a household's willingness to reallocate its consumption across different periods in light of the real interest rate, which captures the relative price of consumption across periods, and the discount rate, which captures how individuals compare utility across periods. When applied to non-durable goods consumption[2], this framework yields the prediction that lower inflation expectations should lead to higher expected real interest rates at the zero bound, a higher return to saving, and a lower level of spending today. Consistent with this prediction, we find that spending on non-durable goods by Dutch households does seem to decline when they lower their inflation expectations, although the effects are too noisy to ascribe precise magnitudes.

However, we find that spending on *durable* goods *rises* sharply when these same households lower their inflation expectations. What drives this rise in spending on durables following exogenously reduced inflation expectations? When households lower their inflation expectations following our information treatments, they do not simultaneously reduce their expected future levels of nominal income, that is, households effectively predict their real incomes will rise. They also tend to anticipate higher spending at the aggregate level and even anticipate that other households will become more optimistic about aggregate spending. This supply-side view of inflation by Dutch households—which is in line with survey evidence for other countries (e.g., Kamdar 2019, Coibion, Gorodnichenko and Ropele 2020)—can therefore potentially explain why Dutch households choose to increase rather than decrease their spending on durable goods. In addition, learning that inflation has been lower than previously thought may lead households to infer that their real income and wealth is higher than they thought, justifying more purchases of large durable goods.

Our paper is the first to apply an RCT strategy to generate exogenous variation in households' inflation expectations and assess the resulting effects on their spending. This approach helps address a fundamental issue that has plagued prior work on this topic: the endogeneity of

[2] We use the term non-durable goods throughout the paper to refer to the total of non-durable goods and services.

expectations. Our randomized provision of information about recent inflation leads treated households in our sample to revise their inflation expectations downwards on average relative to the control group, consistent with Bayesian updating given that most Dutch households originally expected higher levels of inflation. This first stage builds on a rapidly growing literature that uses randomized information treatments to study the macroeconomic expectations of households and firms (e.g. Armantier et al. 2016, Cavallo et al. 2017, Armona et al. 2019, Roth and Wohlfart 2020, Binder and Rodrigue 2019, Coibion, Gorodnichenko and Weber 2021, Coibion, Gorodnichenko and Ropele 2020). This work has repeatedly found that simple information treatments involving publicly available information can have powerful albeit generally transitory effects on households' expectations, consistent with what we find in our survey of Dutch households.

The second stage of our approach then uses this exogenous variation in expectations to study the resulting effects on household spending: i.e., when households exogenously reduce their inflation expectations, what happens to their spending in subsequent months? An extensive literature has previously used survey data to try to address this important question. Launching this literature, Bachmann, Berg and Sims (2015) used the Michigan Survey of Consumers and found little evidence that U.S. households with higher inflation expectations had different perceptions of whether now was a good time to purchase big-ticket household items. Using inflation expectations from the New York Fed's Survey of Consumer Expectations, Crump et al. (2015) estimated a value of 0.8 for the intertemporal elasticity of substitution. Dräger and Nghiem (2018) found similar results for German households as did Ichiue and Nishiguchi (2013) for Japanese households during the ZLB period. Pooling survey data from seventeen European countries, Duca, Kenny and Reuter (2020) find that when households expect inflation to be higher, they report that they are more inclined to spend on consumer durables.[3] Burke and Ozdagli (2020) find little effect of inflation expectations on non-durable spending of U.S. households but some negative effect on durable goods purchases.

Relative to this prior work, our main contribution is that we are able to use *exogenously* generated variation in beliefs from our randomly assigned information treatments to characterize how these beliefs affect subsequent spending decisions, thereby addressing a fundamental

[3] Related work has studied how inflation expectations affect other decisions households face, for example the composition of their assets (Vellekoop and Wiederholt 2017).

identification problem in this literature.[4] However, RCTs are not a panacea for all econometric issues and some limitations exist. First, because Dutch households were relatively well-informed about inflation in the first place, the power of the information treatment in moving their expectations is more limited than in other recent work: our instrument is valid but not very powerful. This reduces the precision of the estimates. Second, the Dutch survey is of limited size, also limiting power and precision. Third, spending data are self-reported by households, which introduces further noise and imprecision into the estimates. However, subsequent work has replicated our approach in a U.S. survey with a much larger cross-section of households, external scanner level data on household spending, and more powerful information treatments and reached the same qualitative findings for how inflation expectations affect both durable and non-durable spending (Coibion, Gorodnichenko and Weber 2021).

Another potential concern is that the estimated coefficients do not necessarily map cleanly into structural parameters. Households can interpret information treatments in many ways, leading to different channels through which expectations affect spending responses. One channel is the standard intertemporal Euler equation intuition: if households anticipate higher prices in the future than before, this should lead them to move their spending forward. But treatments can work through other channels as well. For example, if households associate inflation with bad economic times, those who raise their inflation expectations may expect lower wages in the future or a higher probability of job loss. Or they could anticipate that the central bank would raise nominal interest rates more than inflation, leading to a rise in the perceived real rate and therefore face a larger incentive to save. With one information treatment, we have only one instrument available and we cannot distinguish between these different channels. Our approach therefore estimates the *combined* effect of all the channels through which a change in inflation expectations may affect spending. While we can provide evidence for the presence of different channels, we cannot disentangle them in a quantitative sense without a wider range of treatments.

[4] There a few papers providing causal identification of expectations on decisions. D'Acunto, Hoang and Weber (2016), for example, examine how an anticipated change in the VAT in Germany affected the expectations and readiness to spend of German households. Roth and Wohlfart (2020) assess how exogenous variation in beliefs about the likelihood of recession affects *desired* spending. One difference relative to these papers is that we measure both non-durable and durable monthly expenditures *directly* and separately in subsequent monthly waves following our baseline survey, rather than relying on qualitative measures of whether now is a good time to purchase goods or planned levels of future spending.

This combined effect can be useful along a number of dimensions. First, understanding how households interpret information about inflation can be helpful in the design and calibration of macroeconomic models of imperfect information. Acosta and Afrouzi (2019), for example, model agents who are provided signals about inflation and who then update their views about other economic variables based on their historical experience of what shocks drive economic dynamics. Our results on the joint formation of expectations and their resulting effects on spending can provide unique identifying moments for such models. Second, the combined effect that we estimate speaks directly to policy discussions and communications that focus particularly on inflation expectations. For example, the ECB uses brief explainers that aim to make complex central banking topics understandable for the public, and the Cleveland Fed is introducing cartoon videos about inflation that have an underlying message similar to our simple information treatments. The Central Bank of Jamaica has produced music videos for people to understand the inflation target. Our results speak directly to the first-round direct effects such policies might have on consumer spending before general equilibrium effects kick in. Follow-up work is exploring how more sophisticated and varied information treatments can be used to directly assess the potential effects of other policies such as forward guidance (Coibion, Georgarakos, Gorodnichenko and Weber 2020).

As is, our results also speak (at least indirectly) to the forward guidance puzzle: the fact identified in Del Negro, Giannoni and Patterson (2015) that forward guidance announcements have smaller effects in practice than in simple New Keynesian models. One potential source of the discrepancy is the consumption Euler equation, which implies that very distant changes in interest rates should have large effects on consumption. McKay, Nakamura and Steinsson (2016), for example, argue that incomplete markets imply heavier discounting in the Euler equation, thereby weakening the consumption response to announcements of future policy changes. Fahri and Werning (2019) instead emphasize limited higher-order thinking by agents, a feature which also dampens consumption responses to news.[5] A unique feature of our survey is that we introduce questions that measure the level of higher-order thinking that households engage in. This allows us to directly assess the potential importance of cognitive constraints in determining the strength of consumption responses. In addition, our survey includes questions that quantify financial

[5] Other potential solutions to the forward guidance include Angeletos and Lain (2018), who emphasize imperfect common knowledge, and Afrouzi and Yang (2019) who also attempt to explain the forward guidance puzzle through information frictions but do so by considering rational inattention in price-setting decisions rather than focusing on consumption decisions.

constraints. Our survey therefore allows us to directly test the importance of both cognitive and financial constraints. We find little support for either. Respondents who do higher orders of thinking do not reduce their spending more than those with lower orders of thinking when they expect lower inflation, which is the mechanism operating in Fahri and Werning (2019). Nor do we find that financially constrained households change their consumption by less than unconstrained households when their inflation expectations change, which is the mechanism operating in McKay, Nakamura and Steinsson (2016). Instead, the large increases in spending that we observe with lower inflation expectations happen primarily for respondents with *higher* levels of cognitive ability as well as higher levels of wealth and financial liquidity.

Our ability to measure the degree of higher-order thinking by households yields a number of novel results that speak to a growing literature on the role of cognitive constraints in the form of level-*k* thinking (e.g., Huo and Takayama 2015, Qiu 2019, Iovino and Sergeyev 2020) for macroeconomic dynamics. First, there is generally a strong positive correlation between the first-order and higher-order beliefs of households. Second, cross-sectional means of the two are similar, but the dispersion in higher-order beliefs is somewhat smaller. Third, the degree of higher-order thinking varies significantly across households, but does not appear to be strongly correlated with how they form or revise their higher-order beliefs about aggregate spending. However, we find little evidence that differences in higher-order thinking are important in explaining the effect of inflation expectations on consumption decisions. For example, there are few differences in how households respond to information treatments with respect to their degree of higher-order thinking, which suggests that the latter is not a primary source of differences in beliefs across households.

From a methodological point of view, we contribute to a small but budding literature that uses RCTs to address macroeconomic questions. Much of this work has focused on how information treatments lead to changes in inflation expectations (see Coibion et al. 2020 for a survey). We are consistent with this literature in using information treatments to generate exogenous variation in inflation expectations but go beyond it by then using this exogenous variation in beliefs to study how household spending decisions change thereafter. In this sense, we are much closer to more recent work that has focused on how exogenous changes in expectations from information treatments affect actual decisions of economic agents (e.g. Coibion, Gorodnichenko and Kumar 2018; Coibion, Gorodnichenko and Ropele 2020 for firms). To the best of our knowledge, we are the first to do so in the context of household consumption decisions

and their relation to macroeconomic expectations. RCTs allow for clearer exogenous variation and statements about causality than traditional identification strategies used in macroeconomic analysis. Our results highlight the potential usefulness of this approach in identifying how expectations translate into the economic decisions of households.

In Section I, we describe the survey of Dutch households that was used to measure expectations and outcomes. Section II discusses various household expectations measured by the survey. The information treatments are described in Section III, along with how they were implemented as well as their effects on inflation expectations. Section IV presents results on the causal effects of inflation expectations on spending decisions of households, while Section V discusses the possible channels underlying the spending responses. Section VI concludes.

I Survey Design

We use data from the CentER Internet panel, which is sponsored by the Dutch National Bank (DNB) and maintained by CentERdata at Tilburg University. The members of the panel are recruited through face-to-face or telephone interviews. CentERdata provides respondents who are selected for participation in the panel but who do not have a computer with Internet access with the necessary equipment (for more details on the CentERdata panel, see Teppa and Vis 2012). The baseline survey is conducted annually and collects detailed information on a range of demographic and economic characteristics for a representative sample of Dutch-speaking households. In addition to the baseline survey, respondents participate during the course of a year in special purpose surveys.

We designed such a special purpose survey providing random sub-groups of respondents with different information treatments about inflation and asking a number of questions (pre- and post-treatment) that are necessary for our analysis. We administered the special survey and the information experiment to every panel participant aged 18 and older in April 2018. Participants are invited to take the survey in the first week of each month. Those who do not respond receive a reminder invitation and can fill in the survey in the second week of the month. Given that the survey allows for contacting respondents at a high-frequency (i.e., monthly), we repeated (part of) the survey in May, June and July 2018 in order to track changes in expectations and behavior in

the post-treatment period. All surveys are done online. Our dataset includes 2,187 adult respondents from 1,843 households.[6]

The specific questions asked in each wave are in Appendix B. The first wave collected a range of households' expectations, both about the aggregate economy and their own economic situation. It also included a randomized information treatment, which was followed by a few additional questions. Subsequent waves targeted the behavior and expectations of the same respondents to assess whether and how the information treatments affected their beliefs and outcomes relative to the untreated control group. We describe the treatments in detail in Section III.

Descriptive statistics about respondents are provided in Table 1. The average respondent is 49 years old, and about half are women. Half of the respondents have either a college or vocational education degree. The average net monthly household income is approximately €2,500 with a net financial wealth of €38,000, although the variance across respondents is very large for both. Spending on durables is infrequent but large when it occurs: the average spending over three months conditional on buying a durable good is €2,500 while the median is €500.

In addition to standard demographics, we collect information on various household characteristics that can help us better understand the workings of forward guidance and other tools based on the management of expectations. Specifically, we ask respondents to report how much money they had in their checking and savings accounts and in cash on the day before their last regular paycheck arrived (excluding fixed term deposits, stocks, bonds, mutual funds, or retirement accounts, etc.). As discussed in Kaplan and Violante (2014), hand-to-mouth (liquidity constrained) consumers do not carry liquid assets from period to period and thus, a hand-to-mouth consumer should have zero liquid wealth just before receiving a paycheck. To the extent that liquidity constraints may be important in how people are able to smooth their consumption after changes in expectations (e.g., McKay, Nakamura and Steinsson 2016), we should observe heterogeneous responses in consumer spending for liquid and illiquid households. Table 1 reports three measures of liquid wealth just before receiving a paycheck: *i*) absolute amount in euro; *ii*) as a multiple of net monthly income; iii) as a multiple of monthly (average over the previous three months) spending on non-durable goods. The median amount is approximately €2,000, 0.88 of net monthly income, and 5 times their monthly spending on non-durable goods. There is considerable variation in liquid wealth across households

[6] Because we sometimes observe more than one respondent per household, we will cluster all standard errors at the household level. Our results are insensitive to restricting each household to one respondent.

(e.g., the interquartile range of liquid wealth is €11,800) and the distribution has a thick right tail. Approximately, six percent of households reported zero liquid wealth just before receiving a regular paycheck. Using high-frequency data generated by a financial aggregation and bill-paying computer/smartphone application, Gelman et al. (2016) report that approximately 20 percent of U.S. households have zero liquid wealth before receiving a regular paycheck. Kaplan and Violante (2014) report a similar magnitude for U.S. households in the Survey of Consumer Finances.

García-Schmidt and Woodford (2019) and Fahri and Werning (2019) suggest that constraints in cognitive reasoning can also influence the reaction of households to policy announcements. To quantify the importance of this potential channel, we construct two measures. First, we ask respondents to play a game as in Nagel (1995) which measures the ability of consumers to eliminate dominated strategies and thus allows us to quantify a level of reasoning for each respondent. We describe the game and the results in Section II.C below. Second, we ask three standard questions on financial literacy and take the count of correct responses as a measure of literacy.[7] On average, consumers get a score of 2 (out of 3) with 44 percent of respondents answering all question correctly and 16 percent of respondents answering all questions incorrectly. In their seminal work introducing this literacy scale, Lusardi and Mitchell (2011), report that 30 (12) percent of the adult US population answered all (no) questions correctly with an average of 1.8 (out of 3) correct answers.

II Unconditional Properties of Households' Expectations

A Household Income and Spending on Durables and Non-Durables

Respondents are asked a wide range of forward-looking questions, both about their own circumstances as well as their beliefs about aggregate economic conditions (translated survey questions from each wave are in Appendix B). For example, after being separately asked about the level of their spending on durable and non-durable goods over the previous three months, they are asked to provide point forecasts about how much they expect to spend on each over each of the following three months. This provides us with an anticipated level of monthly expenditures for

[7] The specific questions are:
a. "Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than €102, exactly €102, less than €102?"
b. "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account: more than today; exactly the same, less than today?"
c. "Do you think that the following statement is 'true' or 'false'? Buying a company stock usually provides a safer return than a stock mutual fund."

each type of spending. Households are then asked, using a distributional question, to characterize the likely path of their household's spending on non-durables as well as their income over the next twelve months.[8] As documented in Table 2, respondents report that they expect their spending on non-durable goods to rise by 1.33% on average over the next twelve months. There is significant cross-sectional variation in this planned level of spending, however, with many reporting that they expect their spending to rise or fall by much more than this. Respondents report expected changes in their household net income which are very much in line: the average rise in expected income is also about 1% with a similar amount of cross-sectional dispersion as for spending. There is a weak positive correlation ($\rho = 0.16$) in individuals' expectations of their future income and spending on non-durables. The permanent income hypothesis suggests that respondents interpret most of their income changes as transitory since spending on non-durables should primarily reflect permanent income changes.

Because the questions regarding twelve-month-ahead forecasts of non-durable spending and income are distributional, we can also measure the uncertainty associated with their forecasts. The average uncertainty of individuals with respect to these two economic variables is close to but somewhat smaller than the cross-sectional disagreement in each. Individuals who are more uncertain about their future income also tend to be more uncertain about their future non-durable spending, with a correlation of 0.55.

An unusual feature of the survey is that respondents were asked not only about their own expected change in consumption but also about what they expected spending on non-durables to be for the whole economy over the next twelve months, again via a distributional question. As reported in Table 2, the average expectation of aggregate spending on non-durables is very close to the average expectation across individuals of planned changes in personal non-durable spending: 1.65% vs. 1.33% respectively. The dispersion in forecasts about aggregate non-durable spending is somewhat lower than that for individual spending, as is uncertainty about each. Individuals who anticipate larger increases in their spending generally anticipate higher spending at the aggregate level as well, with a correlation of 0.54.

In addition to questions about expected aggregate spending, respondents were asked about what they thought *other households* expected would happen to aggregate non-durable spending,

[8] We fit generalized beta distributions to their reported distributions to measure mean and standard deviation of their forecasts.

thereby measuring their higher-order belief about this variable. The average higher-order belief is almost identical to the first-order belief at 1.79% vs. 1.65% respectively, but the former is associated with significantly lower disagreement (cross-sectional standard deviation of 1.95 vs. 2.20 respectively) but somewhat higher uncertainty. There is again a strong positive correlation across beliefs: individuals who expect themselves to spend more over the next twelve months also tend to think that other households expect others to spend more, with a correlation of 0.41.

B Inflation Expectations

After being asked about spending and income, respondents were asked about aggregate prices. First, they were presented with a question asking about the percentage change in consumer prices over the last twelve months. The median response was 2.0%, close to the actual rate of 1.2% in February 2018 (the most recent publicly available figure for inflation at the time of the first wave of the survey). At the same time, there is a thick right tail in the distribution of perceived inflation so that the mean response was 4.9%, with a cross-sectional dispersion of 10.0%. Approximately, five percent of respondents perceive inflation to be greater than 20% with some respondents reporting 100% perceived inflation over the previous twelve months. Because these extreme perceptions appear to be outliers, we also compute moments robust to extreme observations: Huber-robust mean and standard deviation are 2.2% and 1.3% respectively. This level of disagreement about recent inflation is relatively low compared to other recent surveys of households. For example, Coibion, Gorodnichenko and Weber (2021) report that the Huber-robust standard deviation of perceived inflation for U.S. households during the same period is 2.6% with the median inflation perception of 3.0% (actual inflation was 2.3%). The low level of disagreement about recent inflation as well as the fact that the median belief about recent inflation is so close to actual inflation suggests that Dutch households were relatively familiar with inflation dynamics compared to households in other countries.

Individuals were then presented with a distributional question about aggregate inflation over the next twelve months. The average forecast was just under 2%, very close to the European Central Bank's inflation target.[9] For comparison, the DNB was predicting inflation rates of 1.4% in 2018 and 2.3% in 2019 for the Netherlands. In contrast, average inflation forecasts of households in the U.S. at the time were well above those of professionals (Coibion, Gorodnichenko and Weber

[9] Moments of expected inflation for various subgroups are presented in Appendix Table 1.

2021). Disagreement about expected inflation across households was also comparably low, with a cross-sectional standard deviation of the same order of magnitude as for aggregate spending. Individuals report even less uncertainty about inflation than for aggregate spending. Not surprisingly, there is a strong positive relationship between individuals' perceived rates of inflation and their predicted rates of inflation, with a (Huber-robust) correlation of 0.61, consistent with other evidence for households (e.g., Jonung 1981).[10]

Unconditionally, there is little correlation between an individual's *perceived* rate of inflation and their predicted change in either personal non-durable consumption or aggregate non-durable consumption (Huber-robust correlations are 0.09 and 0.14 respectively). At the same time, the correlation between (pre-treatment) *expected* inflation and expected spending is stronger (column (3) in Table 2): 0.25 for personal spending on non-durable goods and 0.37 for aggregate spending on non-durable goods. Interestingly, expected inflation is only weakly correlated (0.12) with expected personal net income. Uncertainty about expected inflation is strongly correlated with uncertainty about income and spending variables (column (6) in Table 2).

One approach to estimating the effects of inflation expectations hews closely to these correlations. For example, Bachmann, Berg and Sims (2015) consider whether individuals in the Michigan Survey of Consumers are more likely to report that now is a good time to purchase big ticket items when they expect higher inflation and find little such correlation. In contrast, we go beyond this correlational approach and employ information treatments to generate *exogenous* variation in inflation expectations to assess how these affect spending decisions.

C Higher-Order Thinking

García-Schmidt and Woodford (2019) and Fahri and Werning (2019) among others emphasize that limited levels of reasoning may be an important determinant of weak consumption responses to changes in interest rates as economic agents may fail to appreciate the power of general-equilibrium effects. To explore whether the level of reasoning is related to the strength of consumer spending responses, we elicit respondents' level of thinking as well as their higher-order beliefs about consumer spending done by other Dutch households.

[10] Evidence for the Netherlands is reported in Christensen, van Els and van Rooij (2006).

Following the earlier experimental literature (e.g., Nagel 1995, Nagel and Duffy 1997, Camerer, Ho and Chong 2004), we ask households to participate in a "beauty contest" game. The specific survey question was:

> *Please choose a number from zero to 100.*
>
> *We will take your number as well as the numbers chosen by other participants to calculate the average number. The winning number will be the number that is closest to* ***two-thirds (2/3)*** *of the average number.*
>
> *The participant who filled in the winning number will receive 500 euro (if more participants have filled in the winning number, the 500 euro will be divided equally among the winners).*

A k^{th}-level thinker provides the following guess $g(k)$:

$$g(k) = \left(\frac{2}{3}\right)^k \times 50$$

As discussed in Nagel (1995) and subsequent literature, individuals with deeper levels of reasoning should do more rounds of eliminating dominated strategies and thus pick a lower value of $g(k)$. Figure 1 reports the distribution of guesses, with red vertical lines indicating values of k, blue line indicating responses one would observe if individuals pick $\left(\frac{3}{2}\right)^k \times 50$ (that is, people use (3/2) rather than (2/3)), and the green line indicating $\left(\frac{2}{3}\right) \times 100$. The average value of the reported guesses is 47 (standard deviation 22), which is a bit higher than the average reported in other experiments outside labs (e.g., Camerer 1997).

Consistent with experimental evidence, we find lumps at the points that correspond to various levels of thinking (50, 33, 22, etc.) but the distribution is not perfectly concentrated at these points. Indeed, there is considerable variation outside these points and many individuals pick dominated responses (e.g., anything that is greater than 66 is a dominated response). Usually, these suboptimal responses are interpreted as level-0 thinking in the sense that this level would capture a group of people who do not eliminate dominated strategies by failing to understand the rules of the game. For example, Nagel (1995) classifies respondents who pick 50 or a greater number as $k = 0$ thinkers. To differentiate this group from others, we classify a respondent as $k = 0^+$ if he or she reports a guess in the $(40,50]$ range and as $k = 0$ if he or she reports a guess in the $(50,100]$ range. $k = 1, 2, 3, 4$ includes everybody who reported a number in $(30,40]$, $(20,30]$, $(10,20]$ and $(0,10]$ ranges, respectively.

Nearly 50 percent of respondents are classified as $k = 0$ with another 15 percent classified as $k = 0^+$ (Table 3). We find that reported guesses differ by respondents' sociodemographic characteristics. For example, younger, more educated, more financially literate people tend to pick lower values for their guesses, which correspond to higher levels of thinking.

In addition to eliciting a numerical response, we ask respondents to report their beliefs about the distribution of numbers they think other participants are choosing. Specifically, the [0,100] interval is split into ten equally sizes bins (e.g., [0,10), [10, 20) and so on) and respondents are asked to assign a fraction of households who (they think) would provide a numerical response for each bin. This question informs us about whether a chosen numeric response is consistent with a respondent's belief about choices of other participants in the game. In other words, a person may pick 66 as his guess (a dominated strategy) because he believes that everybody else picks 100.

Panel A of Table 3 reports the perceived distribution of others' guesses by level of thinking. We observe that none of the levels correctly conjectures the true distribution of types. Consistent with Coibion, Gorodnichenko, Kumar and Ryngaert (2020), a typical respondent believes that: *i*) many other respondents have the same level of thinking as the respondent; *ii*) there are many types of respondents in terms of level-*k* thinking (including individuals with levels of thinking greater than the level of the respondent); *iii*) the quality of the perceived distribution about others' guesses does not improve discernably in the respondent's level of thinking.

While respondents may have wrong perceptions about others' guesses, the reported guesses may still be internally consistent: to win the prize, a respondent should report a guess of two-thirds of the believed average guess of other respondents.[11] To test the consistency, we estimate the following specification:

$$Guess_i^{Own} = b \times E_i[Guess^{HO}] + error_i$$

where $Guess_i^{Own}$ is the guess submitted by person i, $E_i[Guess^{HO}]$ is person i's average guess for others' guesses. We find (Panel B of Table 3) that the estimated b is generally close to one for respondents with low k, close to $\frac{2}{3}$ for respondents with $k = 1, 2$, and falls well below $\frac{2}{3}$ for $k \geq 3$.

Consistent with prevalence of $k = 0$ and $k = 0^+$ types, we find relatively small differences between low-order expectations of spending and higher-order expectations of spending

[11] It may be the case that when asked directly about other households, survey participants will engage in an additional level of reasoning that was not present when they formed their own guess or expectation.

(Appendix Table 2). In agreement with theoretical predictions, cross-sectional dispersion of beliefs is smaller for higher-order expectations than for low-order expectations. At the same time, we fail to find more confidence (smaller standard deviation implied by reported distribution) in higher-order expectations than in low-order expectations. In summary, while we observe considerable heterogeneity in levels of reasoning, the properties of the responses appear to pose a puzzle for popular models of limited reasoning.

III Effects of Information Treatments on Inflation Expectations

After answering baseline questions, each individual participant in the first wave of the survey was randomly assigned to one of three groups. One group was provided with the following statement:

> *"Before we proceed, we would like to share the following information with you. In a public release* ***available to all Dutchmen*** *at no charge, the Dutch Statistical Office recently reported that the percent increase in consumer prices in February compared to 12 months earlier in the Netherlands was 1.2%".*

The statement provides information about the most recent inflation rate at the time of the survey and describes it as something that is publicly available to all citizens. The second group was provided with the following statement:

> *"Before we proceed, we would like to share the following information* ***only with you*** *and a few other households. The Dutch Statistical Office recently reported that the percent increase in consumer prices compared in February to 12 months earlier in the Netherlands was 1.2%"*

This alternative statement provides the same information about recent inflation but is phrased in such a way that individuals should view this as information which is privately provided to them. We therefore refer to the first group (N=702) as having been treated with a public signal while the second group (N=744) was treated with a private signal. The third group (N=741) receives no such information and serves as a control group.

To assess whether respondents believe that the provided information is widely known, those in the treatment groups were immediately asked what fraction of Dutchmen they thought knew the provided information. The average fractions were 18.4% (standard deviation 18.9%) for the private treatment group and 17.9% (standard deviation 18.2%) for the public treatment group. Hence, the phrasing of the treatment did not lead respondents to interpret the information very differently in

terms of how well known it was to other households.[12] Consistent with this, we find no difference in how the two treatments shape household expectations (Appendix Table 2). As a result, we pool across the two treatment groups and simply refer to households being treated or not.

Following these information treatments (or lack thereof for the control group), respondents were asked a number of follow-up questions. These questions covered their expectations about inflation, expected income and non-durable consumption over the next twelve months and expected aggregate consumption in the Netherlands over the next twelve months. To avoid asking respondents the same question twice, follow-up questions were phrased as point estimates rather than distributional questions.

In this section, we characterize the average effects of information treatments on inflation expectations of respondents (we discuss the effects on other household expectations in Section V). To do so, we regress the change in individual inflation expectations in each wave relative to their pre-treatment belief on dummy variables equal to one if participants were treated with either the public or the private signal.[13] The resulting coefficient on the dummy treatment variable tells us the average effect of receiving either treatment on individual inflation expectations relative to the control group. We use Huber-robust regressions to systematically control for outliers in the data.

Because average inflation expectations are close to actual inflation (Table 2), regressing revisions in expectations on a treatment dummy variable may yield no materially important treatment effect, but this need not indicate that agents are not responding to the information. What one should expect to see, if respondents are responding to treatments as Bayesians, is that all agents should place some weight on their priors and some weight on the signal, leading to convergence in beliefs. We illustrate this point in Figure 2. For the control group and each treatment group separately, we present binscatter plots of agents' posterior beliefs (immediately after treatment) versus their prior beliefs about inflation. The slope of the relationship is less than one even for the control group, reflecting the different nature of the inflation expectation questions asked (i.e., distributional vs. point

[12] While the two treatments only provide information about recent inflation, Coibion, Gorodnichenko and Weber (2021) show that information treatments involving the central bank's inflation target or forecasts of inflation from either professionals or the central bank all lead to indistinguishable effects on inflation expectations. Coibion, Gorodnichenko and Kumar (2018) find a similar result for firms.

[13] Note that since inflation expectations in subsequent waves were measured in both distributional and point forecast versions, we can use both to assess how expectations respond over time. The prior belief is measured using the elicited distributional inflation forecast from wave 1 asked prior to information treatments.

forecasts)[14] and possibly some mean reversion in the responses. The figure also shows much flatter slopes for the treatment groups, suggesting that individuals in these groups placed less weight on their prior beliefs as they placed weight on the common signals they received. The fact that the two signals have approximately the same slope confirms that they affect expectations in the same way.

To assess this prediction more formally and across waves, we regress individuals' posterior expectations ($E_i^{post}\pi_{t+1}$) on their priors ($E_i^{prior}\pi_{t+1}$), a dummy variable for being treated ($Treat_i$) with either signal, and the interaction of the two:

$$E_i^{post}\pi_{t+1} = b_0 + b_1 \times E_i^{prior}\pi_{t+1} + b_2 \times E_i^{prior}\pi_{t+1} \times Treat_i + b_3 \times Treat_i + error_i. \quad (1)$$

Given that the control group is not receiving any information, we would expect to see non-treated respondents place a higher weight on their priors than those in the treatment groups, so the interaction term should be negative. We report estimates of this regression across waves in Table 4. Consistent with Figure 2, we find that contemporaneously, individuals in the treatment groups place significantly less weight on their priors than do those in the control group. The implied weight on the prior falls from 0.54 for the control group to 0.35 for the treatment group. This is consistent with agents' forecasts in the treatment group converging toward the signal received. The strong effect of the inflation treatment on inflation expectations is consistent with earlier work applying information treatments, such as Armantier et al. (2016), Cavallo, Cruces and Perez-Truglia (2017) or Coibion, Gorodnichenko and Weber (2021).

In addition, we find evidence that these effects on expectations dissipate rapidly: the average effects on beliefs have fully dissipated within one month of the treatment (i.e., coefficients b_2 and b_3 are not significant), irrespective of which measure of expectations we use (point or distribution). In subsequent waves, there are few differences in the weights assigned to prior beliefs between the treatment and control groups, confirming that the information about recent inflation in the treatments has no discernible long-lived effect on inflation expectations of Dutch

[14] Bruine de Bruin et al. (2017) document that the wording of questions may influence the response.

households.[15] Such short-lived effects are also consistent with other evidence documented for the inflation expectations of both households (e.g., Cavallo, Cruces and Perez-Truglia 2017, Coibion, Gorodnichenko and Weber 2021) and firms (Coibion, Gorodnichenko and Kumar 2018, Coibion, Gorodnichenko and Ropele 2020): information treatments about inflation have large effects on individual expectations that dissipate rapidly.

In short, we find that the information treatments have clear, albeit relatively small and transient, effects on the inflation expectations of Dutch households. Also, while there is some heterogeneity in the strength of the response, households revise their inflation expectations toward the treatment that they receive, if any, in much the same way as documented in other information experiments on households and firms. However, given that Dutch households were initially better informed about inflation than commonly found in other advanced economies, the resulting average revisions in expectations were smaller than found in prior work. The above suggest that the information treatments can serve as a valid source of exogenous variation in inflation expectations to study their causal effect on spending decisions of households.

IV Effects of Inflation Expectations on Household Spending

Inflation expectations are a frequent topic of discussion for policy-makers because, ultimately, they are perceived as affecting economic decisions. One channel through which these expectations may matter is the saving/spending decisions of households. But *causal* evidence on this channel remains limited due to the inherently endogenous nature of expectations and spending decisions. In this section, we overcome this issue by using the information treatments to identify exogenous variation in inflation expectations to characterize the effect of expectations on spending decisions.

A Identification Strategy

Our approach stems from the fact that we observe ex-post spending on non-durables and durables on the part of households, measured in follow-up surveys, as well as exogenous variation in

[15] We also find in our data that the effect of treatments on perceived inflation is short-lived: for waves 2 through 4, perceptions in the treatment group are similar to perceptions in the control group. These transient effects on perceptions suggest that changes in expectations are unlikely to influence how households think about their past holdings of financial wealth. Note that b_2 and b_3 estimated for wave 2 flip the sign relative to the estimates for wave 1. This pattern does not reflect a "reversal" in beliefs. Instead, these "reversal" estimates for wave 2 are simply an artifact of using a particular value of the tuning parameter of the Huber regression (default option in Stata) and discreteness of survey responses reporting high inflation. The results for wave 2 are in line with estimates for other waves when we use less aggressive values for the tuning parameter or use alternative methods (e.g., trimming data) to deal with outliers.

inflation expectations. To characterize the link between the two, we therefore rely on an instrumental variable (IV) strategy in which the treatments are used to identify exogenous variation in inflation expectations and ex-post measures of spending are regressed on these instrumented inflation expectations. To be clear, we do not estimate the Euler equation. Instead, the spirit of our analysis is to construct an impulse response function for consumer spending after an exogenous shock to inflation expectations.

This IV approach addresses the fact that causality can run from household spending to their inflation expectations. For example, households who increase their spending due to e.g. relaxed financial constraints could infer that other households would do the same and therefore that prices would rise more rapidly in the future. Another channel of simultaneity would be if households that experience higher prices (and therefore higher expenditures) use these observed prices to make inferences about broader price movements (as in Coibion and Gorodnichenko 2015 or D'Acunto, Malmendier, Ospina and Weber 2020), which would again lead to correlations between inflation expectations and spending that are not causally identifying the effect of inflation expectations on decisions. By generating exogenous variation in inflation expectations, our instrumental variable approach therefore addresses this type of endogeneity. As discussed in the next section, controlling for this endogeneity through our instrumental variable strategy has significant effects on the estimates relative to simple OLS regressions.

However, regressions of ex-post spending on inflation expectations, even those that identify exogenous variation in the latter, will not in general solely identify the intertemporal channel emphasized by e.g. the Euler equation. This is because providing information about inflation, an endogenous object, can lead households to draw inferences about the underlying shocks that drive not just inflation but other variables as well, as formalized in Acosta and Afrouzi (2019). As a result, they may change their other expectations as well and these may affect spending decisions above and beyond the intertemporal channel. Hence, regressions of ex-post spending on inflation expectations will identify the *combined* effect of these different channels. With only one instrument from our treatment, we cannot separately identify the different expectations channels through which spending changes. However, we can still test for the presence of different channels underlying our estimated effects, as discussed in Section V. It should be emphasized that the combined effect that we are identifying is the most relevant one from a policy-making point of view: when policy-makers try to change inflation expectations via communications about recent

inflation or inflation targets, how households change their consumption will reflect the multitude of channels that our estimates capture, not just the intertemporal substitution channel captured by the Euler equation.

B Estimation and Results

For non-durable spending, we regress ex-post non-durable expenditures (measured in waves 2-4) on post-treatment inflation expectations from wave 1. The econometric specification is given by the following equation:

$$S_{i,t+h}^{cat} = \alpha_h + \beta_h \times F_{i,t}\pi_{t+12} + \gamma_h \times F_{i,t-}S_{i,t+h}^{cat} + \delta_h \times F_{i,t-}\pi_{t+12} + \theta_h \times \boldsymbol{X}_{i,t} + error_{i,t+h} \quad (2)$$

where $S_{i,t+h}^{cat}$ denotes spending in category cat (non-durable/ durable) by household *i* in month *t*+*h* reported in survey at time *t*+*h*; $F_{i,t}\pi_{t+12}$ is the twelve-month-ahead inflation forecast of household *i* at the end of wave 1 (time *t*) after treatments while $F_{i,t-}\pi_{t+12}$ is the equivalent forecast prior to the treatment (time *t*-); $F_{i,t-}S_{i,t+h}^{cat}$ is the prediction prior to the treatment of household *i* in wave 1 (time *t*-) of what the level of spending on goods in category cat would be at time *t*+*h*; and $\boldsymbol{X}_{i,t}$ is a vector of household controls.[16] Note that $F_{i,t-}S_{i,t+h}^{cat}$ is measured prior to the information treatment and should therefore capture all of the relevant information available to household *i* at time *t* about what own spending would be at time *t*+*h* (e.g., expectations of future income). We instrument for the inflation expectations using a treatment dummy and the interaction of the treatment with households' prior inflation expectation. As documented in Table 5, the F-statistic for the first stage is generally higher than 10, indicating that the instruments are sufficiently strong for inference.[17] Nonetheless, we also provide 95% confidence intervals and *p*-values that are robust to weak instruments for all results. We also cluster standard errors at the household level to account for the fact that we sometimes observe more than one respondent per household.

We run these regressions for each individual post-treatment wave *h* (columns (1)-(3)) as well as pooled across waves (column (4)) and present the key estimated coefficient $\hat{\beta}_h$ for spending on

[16] The list of controls includes quadratic polynomial in age, log annual gross income, indicator variables for educational attainment and marital status.

[17] We describe our treatment of outliers and influential observations in Appendix C.

non-durables in Panel A of Table 5.[18] Looking across horizons $t+h$ effectively traces out the impulse response of spending levels to a change in inflation expectations at time t. In the first two months, the estimated effect on consumption is positive but insignificantly different from zero. In the third month, we detect a large positive effect, such that the average effect across the three months is positive and statistically significant at the 10 percent level. The implied magnitude is large: a 1 percent exogenous decrease in inflation expectations leads to an approximately 10 percent decrease in non-durable spending on average in the three months following our experiment. However, the standard errors are very large and we cannot reject the null of much smaller effects. We interpret this result as a reflection of the significant noise in self-reported data on non-durable spending and the relatively small number of participants in the survey.[19] In addition, the results suggest that the effects on non-durable goods spending may be delayed for some months, and we may be missing the brunt of the effects given that we only followed up with households for three months. Coibion, Gorodnichenko and Ropele (2020), for example, find that temporary exogenous increases in the inflation expectations of firms in Italy have contractionary effects on their employment decisions that build up over a year. Coibion, Gorodnichenko and Kumar (2018) similarly find that information treatments have large but transitory effects on New Zealand firms' inflation expectations, but the effects on their actions last at least six months. Finally, the weak response of spending on non-durable goods is also consistent with small variation of this spending category over the business cycle.

We then turn to the effects of inflation expectations on durable goods spending, which is much more cyclical. We focus on the extensive margin of durable goods purchases using questions in the survey. First, respondents were asked in wave 1 whether they planned to engage in any purchases of durable goods (including, for instance, cars, electronics, kitchen appliances, furniture, house maintenance and jewelries). In follow-up waves, all respondents were asked whether they had

[18] Because instruments could be weak for some specifications, the confidence intervals robust to weak instruments can include infinity with positive probability (see Andrews, Stock and Sun 2019).

[19] Consistent with this, follow-up work by Coibion, Gorodnichenko and Weber (2021) applies the same RCT approach involving inflation information treatments to a much larger survey of U.S. households for which external scanner data on spending is available and finds much more precise, smaller but statistically significant coefficients over several months following the treatment. When they use self-reported spending data from the survey instead, standard errors are much larger and closer to the ones observed here.

made any purchases of durable goods over the previous month.[20] These questions therefore allow us to determine whether ex-post surprise purchases (or lack thereof) of large durable goods are predictable using exogenous changes in inflation expectations.

To do so, we use the same empirical specification as for non-durable goods spending but replace the dependent variable with a dummy variable equal to one if they did a durable goods purchase in that month. We also replace the ex-ante forecast of their spending with a dummy variable for whether they had initially planned to do a durable good purchase that month. Applying the same IV strategy as before for inflation expectations yields estimated values of β_h shown in Panel B of Table 5 for each follow-up wave as well as pooled across all three follow-up waves. For each month, we find negative effects of inflation expectations on the probability of purchasing durable goods that month. The effects are economically large: a 1 percentage point exogenous decrease in inflation expectations increases the probability of purchasing durable goods by 21 percentage points on average. Unlike the estimated effects on non-durable goods, the estimated effects on the probability of purchasing durable goods are fairly precise and consistently imply large elasticities with respect to inflation expectations. However, given that we have follow-up surveys only over the next three months, we cannot determine whether households are simply delaying these purchases or whether they are cancelling them outright for the foreseeable future.

These results do not hinge on using ex-post reported spending of households. We can verify this using the fact that households were asked to report their monthly spending *plans* in each of the follow-up waves. We can therefore examine if the reaction of spending plans to information treatments is similar to the reaction of actual consumer spending. In particular, we estimate the following version of equation (2):

$$P^{cat}_{i,w,t+h} = \alpha_h + \beta_h \times F_{i,t}\pi_{t+12} + \gamma_h \times F_{i,t-}S^{cat}_{i,t+h} + \delta_h \times F_{i,t-}\pi_{t+12} + \theta_h \times \boldsymbol{X}_{i,t} + error_{i,t+h} \quad (2')$$

where $P^{cat}_{i,w,t+h}$ is spending for goods in category cat planned in wave w. We focus on the responses in the second wave of the survey since it gives us the largest number of observations (plans for spending in May and June) and it is closest to the treatment in the first wave of the survey. To

[20] The survey also included questions regarding the amount of spending on durables, thereby capturing the intensive margin as well. We present results using these measures in Appendix Table 4. However, given that very few households purchased large durable goods, the sample size is very small (329 observations). Furthermore, most of the effects of inflation expectations on durables goods purchases seem to be operating on the extensive margin, so we focus on these in Table 5.

maximize statistical power, we pool responses for planned spending in May and June. We find (column (5) of Table 5) that the estimated responses of planned spending, as expressed in these follow-up waves, are generally similar to the estimated responses of actual spending (column (4) of Table 5), although there is again considerable sampling uncertainty in the estimates. This helps confirm that the identified responses of each type of consumption are not an anomaly: they are reflected both in ex-post reports of actual spending as well as ex-ante predictions for the path of that spending.

It also provides a potential rationale for why transitory changes in expectations in general and inflation expectations in particular can appear to have longer-lived effects on actions. The temporary effect on inflation expectations is itself not surprising and in fact consistent with earlier RCT studies for the U.S. and other countries (e.g., Cavallo, Cruces and Perez-Truglia 2017, Coibion, Gorodnichenko and Weber 2020). Nor is the fact that transitory changes in expectations lead to persistent effects on actions unusual: Coibion, Gorodnichenko and Kumar (2018) document the same qualitative finding for firms in New Zealand, while Coibion, Gorodnichenko and Ropele (2020) find even more long-lasting effect on firms' decisions in Italy. If economic agents revise their plans for spending and other choices at the time of the treatment and then stick to these plans even after treatment effects on inflation expectations are worn out, then one would expect to find results like those above. Indeed, Chetty and Szeidl (2007) document that some types of consumer spending may be rather inflexible and households may cut spending on food (more generally small purchases) in response to large negative income shocks to stick to their consumption plans. Our result that plans for spending react to transitory shocks is consistent with this type of effect and is also consistent with the delayed effect of inflation expectations on firms' decisions documented in Coibion, Gorodnichenko and Ropele (2020).

C Implications and Limitations

RCTs are becoming increasingly common in macroeconomics to study how agents' beliefs respond to different types of information. But they have been much less used to study the effects of changes in beliefs on decisions. How should we interpret the resulting estimates?

The key advantage of randomized treatments is that they can, when successful, generate exogenous variation in beliefs, thereby addressing a fundamental identification issue faced in modeling forward-looking decisions. In our case, for example, the information treatments that

generate exogenous changes in inflation expectations are necessary to recover the resulting effects on spending. Appendix Table 5 documents equivalent regressions done by OLS, i.e., ignoring the potential endogeneity of inflation expectations with respect to spending decisions. The estimated effects of inflation expectations on spending decisions are all very small and generally insignificant, much as found by Bachmann, Berg and Sims (2015) using the Michigan Survey of Consumers. In contrast, we show that exploiting the exogenous variation in inflation expectations from the information treatments leads to large estimated effects of expectations on spending decisions, especially for durable goods purchases.

At the same time, RCTs do not remedy all econometric issues. First, to provide powerful enough instruments, information treatments must successfully move expectations by relatively large amounts. Our treatments are successful in moving expectations, but the fact that Dutch households were relatively well-informed about inflation in the first place limits their power as an instrument. This leads to less precise estimates. Second, because RCTs are commonly applied in surveys, external information on ex-post decisions are typically unavailable and the latter must generally be measured from self-reported answers in subsequent waves. This introduces additional measurement error and imprecision, which is visible in Table 5: estimates are imprecise even when statistically significant.

Having access to external information on spending can be helpful but may still be insufficient. One subsequent paper that uses an RCT to change inflation expectations of households in Malaysia has access to credit card spending data for households but still find insignificant effects of inflation expectations for spending on non-durable goods and services (Galashin, Kanz and Perez-Truglia 2020). However, their approach has a relatively small sample (less than 3,000 respondents), omits a control group, and captures only a small part of spending since in countries like Malaysia, cash payments account for more than 50 percent of transactions (Widjaja 2016). Another follow-up paper to ours is able to achieve much more precise (but qualitatively similar) estimates for the effect of inflation expectations on spending in the U.S. using the same RCT design but required a much larger sample of households in the survey (25,000), more powerful treatment effects (due to the U.S. population being less well-informed about inflation than Dutch households), and high-quality scanner level information on spending (Coibion, Gorodnichenko and Weber 2021). Being able to reach such a large number of survey respondents and combining it with external information on decisions will be a challenge for this line of research.

Furthermore, even when precise estimates are found, the interpretation of the results is not immediate. In our case, we estimate the total effect of exogenously changed inflation expectations on different types of spending over time, but this total effect can capture many different channels. One is the standard intertemporal channel arising in the Euler equation. But other channels include the fact that households may revise their views about their future real income, future nominal and therefore real interest rates, or the risk of job loss in the future. With only one instrument available from the information treatment, we are not able to distinguish between these channels. We can still speak to the potential presence of different channels and do so in section V, but we cannot quantify them separately. To do so, one would need multiple information treatments that generate different relative movements across different types of expectations, as done by Coibion, Georgarakos, Gorodnichenko, Kenny and Weber (2021) to separate the effects of first and second moments of expectations on spending. But again, this requires much larger samples.

The combined effect we identify here is still interesting. For example, it provides a first metric of the direct spending effect of households from e.g., central banks providing clearer information to the public about recent inflation or the inflation target, prior to general equilibrium effects kicking in. This can help speak to the numerous communication campaigns that different central banks are engaging, such as the Bank of Jamaica's musical approach to informing about the inflation target, the Bank of England's graphical approaches to inflation forecasts, or the Federal Reserve Bank of Cleveland's experimentation with cartoons to inform about inflation. It can also be used to differentiate between or calibrate models of imperfect information in which agents are uncertain about underlying fundamental shocks, as in Acosta and Afrouzi (2020). As models of imperfect information become increasingly prevalent, empirical moments that can help identify the nature of the expectations formation process and how those expectations affect decisions will become more and more important.

A final potential limitation is external validity. Unlike time series analysis on long samples that can test whether results vary across subperiods, RCTs like ours are done at one moment in time in a specific setting. In our case for example, the Netherlands was at the Effective Lower Bound (ELB) on interest rates. This is the case when effects of changes in inflation expectations on spending should be largest, since there should be no offsetting movements in expected interest rates. Indeed this mechanism can be so strong that negative supply side shocks can theoretically be expansionary in New Keynesian models at the ELB, since the persistent increase in inflation induced by the shock

leads to lower perceived real interest rates and therefore higher spending by households when central banks are unable or unwilling to raise rates. This prediction has received little empirical support (Wieland 2019, Garin, Lester and Sims 2019) and our results provide a possible rationale for this. However, due to the "one time" nature of the experiment, our results do not immediately carry over to other settings.

V Channels

We find robust evidence that inflation expectations affect spending on the part of households. While the evidence on non-durable spending is imprecise, the estimated effects on durable goods spending are much sharper and negative. In this section, we explore several potential channels for how information treatments influence consumption choices of Dutch households.

A Expectations of other variables

One interpretation of the observed spending responses on durable goods is that they reflect changing expectations of durable goods prices. Durable goods purchases depend not just on the perceived real interest rate but also on the expected path of prices of durable goods (e.g., consumers may expect a fall in the price of durables and thus they postpone purchases on durable goods until prices become more attractive). We do not observe price expectations for durable goods in the survey and so it is difficult for us to speak directly to this channel.

A second interpretation is that changes in inflation expectations also affect households' expectations of other economic variables and those then lead to offsetting effects on spending patterns. Coibion, Gorodnichenko and Ropele (2020), for example, find that firms in Italy interpret higher inflation as associated with worse economic outcomes, both at the aggregate level and at the level of their firm, which may explain why firms with exogenously higher inflation expectations choose to reduce their employment in a persistent fashion.

To assess this possibility, we continue to use the same IV strategy as with ex-post spending outcomes of households but instead replace the dependent variable with their expectations about their future spending, their future nominal income, aggregate future spending on non-durables, or what they think other households expect about future non-durable spending. These expectations are from wave 1 immediately after the information treatment (if any) was applied to households. We replace the ex-ante expectation of future spending on the right-hand side with the ex-ante belief about

the dependent variable measured prior to the treatment. We then instrument for post-treatment inflation expectations in the same way as before. Formally, we estimate the following specification

$$E_i^{post} X_{t+1} = b_0 + b_1 \times E_i^{post} \pi_{t+1} + b_2 \times E_i^{prior} \pi_{t+1} + b_3 \times E_i^{prior} X_{t+1} + \\ + controls + error_i. \quad (3)$$

where $E_i^{post} X_{t+1}$ is the post-treatment expectation for the variable of interest X, $E_i^{prior} X_{t+1}$ is the pre-treatment expectation for X, $controls$ include, as before, quadratic polynomial in a respondent's age, indicator variables for a respondent's educational attainment, log gross annual income of the household, and an indicator variable for marital status. The key coefficient in this regression is b_1. The first-stage regression for $E_i^{post} \pi_{t+1}$ is given by equation (1'). The results are presented in Table 6.

Households expect no change in their net nominal household income (column (1), Panel A) when their inflation expectations exogenously decrease, meaning that their perceived *real* income increases. Consistent with this, they predict a strong increase in their spending on non-durable goods (column (2), Panel A): a one percent decrease in inflation expectations leads to a 2.9 percent increase in anticipated spending on non-durables. The reaction of households' expectations for aggregate spending on non-durables (column (3), Panel A) and households' higher-order expectations for aggregate spending on non-durables (column (4), Panel A) are similarly strong, indicating that they perceive that broader economic activity will be stronger when they lower their inflation expectations. These positive revisions in anticipated spending to lower inflation expectations are consistent with correlations observed for U.S. households. Specifically, Kamdar (2019) documents that households in the Michigan Survey of Consumers and in the New York Fed's Survey of Consumer Expectations associate high inflation with high unemployment. Andre et al. (2019) find similar results conditional on structural shocks and argue that U.S. households use simple "good-bad" heuristics which lead them to associate higher inflation with bad outcomes. In other words, U.S. and Dutch consumers apparently subscribe to a stagflationary view of inflation, even though inflation and unemployment have largely been negatively correlated in the data since the 1970s. Kamdar (2019) uses rational inattention to explain this apparent contradiction. Intuitively, if consumers can have only a limited number of signals about shocks hitting the economy, they will focus on the shocks that shift the Phillips curve because these shocks are costliest for welfare. As a result, even if inflation and unemployment are uncorrelated in the

data generating process, inattentive consumers end up with a positive correlation between these variables because they concentrate on specific shocks. Coibion, Gorodnichenko and Ropele (2020) document equivalent results for firms in Italy.

Panel B in Table 6 reports the reaction of uncertainty in net household income expectations in waves 2 through 4 to post-treatment inflation expectations immediately after the treatment. Specifically, uncertainty about income expectations rises when inflation expectations fall. These responses suggest that uncertainty is unlikely to be a central channel of expected increases in future spending on non-durable goods (Panel A, Table 6) or actual increases in spending on durable goods (Table 5).

Jointly, these results provide one possible interpretation for why total spending as well as spending on durables falls sharply when inflation expectations rise while non-durable spending, if anything, rises. Assuming symmetrical effects for rising or falling inflation expectations, the decline in expected real income calls for a decrease in total spending, particularly if the decline in income is perceived to be persistent. Because nominal income is contemporaneously unchanged, meeting this necessary decline in total spending can be most easily accomplished by delaying and reducing durable goods purchases. The anticipated rise in prices is also likely to lead to some stocking up of storable goods, as documented elsewhere in D'Acunto, Hoang and Weber (2016) and Coibion, Gorodnichenko and Koustas (2017), which can explain why there may be an increase in non-durable goods spending while also pushing toward an additional reduction in durable goods spending to finance this stocking up behavior.

There are other, related, explanations that can help explain these results. One is that by observing the current inflation rate, households may be learning about their *current* real income. Specifically, a positive surprise in inflation can signal to households that their real income is lower than what they had thought and that therefore they may have overspent. Since adjustment of non-durable goods may be harder in the short-run than postponing or cancelling purchases of durable goods, households can decrease spending on durable goods and keep spending on non-durable goods relatively stable to balance their budgets. This can be reinforced if households realize that, through their overspending, they have accumulated an excessively large stock of durable goods. Another explanation relies on the relative prices of durables and non-durables. Learning about higher recent inflation would likely lead households to believe that the relative price of durables has gone up (since durable goods have much more flexible prices than non-durables). Barsky,

House and Kimball (2006) show that the marginal utility of non-durable consumption is uniquely pinned down by this relative price since the shadow price of consumption flow from durable goods is effectively constant. An increase in the relative price of durables should lead households to reallocate their spending toward non-durables and away from durable goods. Unfortunately, our survey data do not allow us to explicitly assess the strength of these additional channels, but jointly these can provide a powerful rationale for why households seem to respond the way they do to information that changes their inflation expectations.

B The Role of Cognitive and Financial Constraints

Other factors that could affect how spending responds to inflation expectations include financial constraints on households (e.g., McKay, Nakamura and Steinsson 2016) and cognitive constraints (Fahri and Werning 2019). To assess what role they play in driving our results, we verify to what extent households with different levels of financial or cognitive constraints respond to information treatments in the same way or whether these constraints lead to differential responses of expectations and actions.

We start by considering whether inflation expectations respond similarly to information treatments depending on individual characteristics. To maximize statistical power, we focus on the pooled treatment.[21] The econometric specification is given by:

$$\begin{aligned} E_i^{post}\pi_{t+1} = {} & b_0 + b_1 \times E_i^{prior}\pi_{t+1} + b_2 \times E_i^{prior}\pi_{t+1} \times Treat_i + b_3 \times Treat_i \\ & + b_4 \times E_i^{prior}\pi_{t+1} \times W_i + b_5 \times E_i^{prior}\pi_{t+1} \times Treat_i \times W_i \\ & + b_6 \times Treat_i \times W_i + b_7 \times W_i + error_i. \end{aligned} \quad (4)$$

where W_i is some characteristic (level of thinking, education, income, etc.) of respondent i. To measure cognitive constraints, we classify respondents based on their level-*k* of thinking. We also consider splits of respondents based on their education and their income. To identify financial constraints, we rely on whether respondents have enough liquid savings to cover three months of non-durable good spending and, as a separate measure, on whether their financial wealth is greater than €17,000 (the median financial wealth of households participating in the survey). Finally, we split households by their financial literacy. Variables used for sample splits are weakly correlated (Appendix Table 8). Note that, given the modest size of our sample, the splits are more demanding on our data and should be

[21] Results differentiating by treatment type are available in Appendix Table 3.

expected to yield less precise estimates. While we cannot increase the sample size in the DNB survey, future work using other surveys can address this issue by recruiting a greater number of households.

We find little evidence (Table 7) that the level of thinking has a discernable influence on how treatment affects inflation expectations.[22] In a similar spirit, liquidity positions of respondents do not alter reactions to the treatment much. However, financial wealth has more of an effect on how beliefs respond to treatments: higher wealth agents place more weight on their priors and therefore respond less than agents with lower wealth, on average. We also observe some differences by education and income: more educated individuals rely less on their priors when treated than less educated individuals, while the reverse is true for higher income respondents.

We then verify whether spending responses differ along observable characteristics of households. We do so by running separate IV regressions (2) for each subgroup of the population that we are interested in. Given the emphasis placed on cognitive constraints and financial constraints in Fahri and Werning (2019), we present these results in Table 8.[23] We find some role for level-k thinking in spending decisions (columns (1) and (2) of Table 8). With respect to spending on non-durables, $k = 0$ individuals decrease their spending while $k > 0$ individuals tend to increase their spending when their inflation expectations are lower although standard errors are large so that the difference is not statistically significant. Higher level thinkers also seem to increase their consumption of durable goods more than lower-level thinkers when they raise their inflation expectations. Notably, higher-level thinkers are therefore the ones who significantly raise their spending when inflation expectations are lower, which is the opposite of what one would expect from a simple consumption Euler equation logic. It is also the opposite of the effect required by Fahri and Werning (2019) to explain the forward guidance puzzle, since their proposal is that higher level thinkers will see their consumption rise more, not less, than lower-level thinkers when their inflation expectations increase.

[22] How the level of thinking influences treatment effects may depend on whether information in a treatment is public or private. We find that splitting the treatments does not yield statistical significance either (see column (1) of Appendix Table 3.

[23] Results broken down along other observable characteristics are in Appendix Table 6. We find little difference based on education or income, which suggests that the differences identified based on cognitive and financial constraints are indeed capturing those forces. Consistent with Bachmann, Berg and Sims (2015) and D'Acunto et al. (2019), we find that financially literate households respond more to inflation expectations than those who are less financially literate, although large standard errors again imply that differences are not statistically significant. Interactions of cognitive and financial constraints, as emphasized in Fahri and Werning (2019), similarly have no meaningful explanatory power.

Financial constraints also seem to be related to spending responses. As displayed in Table 8, we find that respondents who are more liquid (column (4)) tend to increase their durable spending relatively more compared to those who are less liquid (column (3)) when their inflation expectations fall. Appendix Table 6 documents a similar difference using a measure of financial wealth. While the small change in spending following changes in inflation expectations for liquidity-constrained individuals is to be expected (by definition, their ability to intertemporally substitute is limited), the fact that spending on durable goods changes more sharply for the unconstrained seems at odds with the logic in McKay, Nakamura and Steinsson (2016), although they focus on consumption of non-durables: facing a lower real interest rate, the unconstrained should spend more via intertemporal substitution given that they expect little change in their future nominal income.

We also provide evidence that cognitive and financial constraints have effects above and beyond those operating through expectations of future income or aggregate conditions. In Table 9, we consider how inflation expectations vary across different subgroups of the population. For different levels of thinking, for example, we find similar sensitivity of non-inflation expectations to inflation expectations for $k = 0$ and $k > 0$ thinkers although the limited number of observations makes precise conclusions difficult to draw. We find that financially constrained agents are somewhat more likely to take a supply-side view of inflation, but again the differences are not generally statistically significant.[24] This suggests that it is primarily the financial and cognitive constraints themselves which drive the differences in consumption behavior across sub-groups, not how these different groups interpret news about inflation, even though these constraints cannot themselves explain the observed average responses of different types of spending.

VI Conclusion

We provide new causal evidence on the effect of inflation expectations on households' spending decisions. To this end, we use a novel randomized control trial (RCT) design to identify exogenous variation in expectations and actions of households participating in a population representative survey. We find, consistently with recent research on firms and households in other countries, that our information treatments generate statistically significant, albeit small and transient, effects on

[24] Appendix Table 7 presents results for other sample splits.

household inflation expectations. These effects on expectations then translate into households' spending decisions, at least in the short run. The implied effects are pronounced for durable goods spending but less clearly so for non-durable spending. We view the strong positive response of durable spending to lower inflation expectations as reflecting a supply side view of inflation: households view low inflation periods as periods where the economy does better and their future real income is higher.

This result builds on a growing literature employing RCT methods to study microeconomic decisions underlying macroeconomic mechanisms but is the first to do so to characterize how household spending changes with inflation expectations. The RCT approach provides a unique ability to generate exogenous variation in the beliefs of actual agents, in a setting where the effects of those changing beliefs on actions can be measured frequently in consecutive months. This specific application, how inflation expectations affect household decisions, is a central one in macroeconomic models but it is just one of many settings where this approach can be applied. We hope that this application serves as a stepping stone for more extensive use of randomized information treatments (especially on large samples and with differential effects) to characterize how expectations feed into the decisions of households and other agents.

The main result documented here, namely that exogenously lower inflation expectations lead to higher, rather than lower, durable good spending on the part of households during the ELB has immediate policy implications. One is that policies that aim to affect expectations can work, in that exogenous changes in expectations clearly affect the decisions of households. But an immediate second implication is that doing so is rife with challenges. The way in which households interpret the information may be more complex than in the usual thought experiment. Changing inflation expectations, for example, can induce agents to also change their other economic expectations and, importantly, revise their consumption plans so that the ultimate effects on actions may differ from those intended. An implication is that communication of policies aimed to move inflation expectations should be nuanced. Perhaps, policy communication emphasizing goals rather than instruments as in Angeletos and Sastry (2018) could be more effective in avoiding misinterpretation and adverse information effects. Clearly, more research is needed to understand how agents make inferences about their own financial situation as well as the underlying state of the economy and how the economy functions.

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Table 1. Descriptive statistics for various socioeconomic characteristics.

	Mean	Percentiles			St.dev
		P25	P50	P75	
	(1)	(2)	(2)	(3)	(4)
Age	49.29	34.00	49.00	64.00	17.45
Female	0.49	0.00	0.00	1.00	0.50
Education: Post-secondary	0.29	0.00	0.00	1.00	0.45
Education: Secondary	0.41	0.00	0.00	1.00	0.49
Education: Less than secondary	0.30	0.00	0.00	1.00	0.46
Number of family members in the household	2.21	1.00	2.00	3.00	1.14
Number of children	0.50	0.00	0.00	1.00	0.90
Financial literacy score	2.01	1.00	2.00	3.00	1.10
Net financial wealth, '000 €	38.38	1.39	12.24	37.83	117.59
Household net income, €	2,647.40	1,690.00	2,500.00	3,510.00	1,571.36
Average monthly spending on non-durable goods over previous three months, €	627.57	200.00	480.00	800.00	678.65
Spending on durable goods over previous three months, €	2,498.79	160.00	500.00	2,000.00	5,771.94
Share of respondents reporting positive spending on durables goods over previous three months	0.51	0.00	1.00	1.00	0.50
Money in checking/saving accounts before receiving the last paycheck:					
'000 €	13.77	0.20	2.00	12.00	34.19
multiple of net monthly income	6.61	0.10	0.88	5.00	51.54
multiple of monthly spending on non-durable goods	45.80	0.50	5.00	26.67	225.29

Notes: The table reports descriptive statistics for various household characteristics of survey participants. None of the variables is winsorized, censored, etc. "Money in checking/saving accounts before receiving the last paycheck" is based on the following question: "How much money did you have in your checking and savings accounts and in cash on the day **before** your last regular paycheck arrived? Please do not include fixed term deposits, stocks, bonds, mutual funds, or retirement accounts, etc." The multiple of net monthly income is the ratio of "money in checking/saving accounts…" to net monthly income reported in another survey question. The multiple of monthly spending on non-durable goods is the ratio of "money in checking/saving accounts…" to the average monthly spending on non-durables goods over the previous three months. Moments for "Spending on durable goods over previous three months, €" are conditional on observing a positive spending.

Table 2. Descriptive statics for expectations.

	Implied mean			Implied uncertainty (standard deviation)		
Expectations (12-months ahead) for:	Average (1)	St.Dev. (2)	Corr. with inflation (3)	Average (4)	St.Dev. (5)	Corr. with inflation (6)
Inflation	1.98	2.14		1.55	1.49	
Growth rates						
Household spending on non-durable goods	1.33	2.51	0.25	1.95	1.45	0.57
Economy-level spending on non-durable goods	1.65	2.20	0.37	1.86	1.37	0.65
Higher-order expectations: Economy-level spending on non-durable goods	1.79	1.95	0.42	2.03	1.42	0.64
Household net income	0.95	2.95	0.12	1.18	1.20	0.66

Notes: The table reports moments of various expectations elicited before survey participants are treated. All moments are based on the probability distributions reported by survey participants. Means (columns (1)-(3)) are computed as means implied by the generalized beta distribution fitted to each respondent separately. Uncertainty (columns (4)-(6)) is computed as standard deviation implied by the generalized beta distribution fitted to each respondent separately. Column (1) reports cross-section averages for implied means. Column (2) reports cross-sectional standard deviation for implied means. Column (3) reports the correlation between implied mean inflation expectations and implied mean expectation for another variable. Column (4) reports cross-section averages for implied uncertainty (standard deviation). Column (5) reports cross-sectional standard deviation for implied uncertainty (standard deviation). Column (6) reports the correlation between implied uncertainty (standard deviation) for inflation expectations and implied uncertainty (standard deviation) for expectation for another variable. Inflation expectations for various demographics groups are reported in Appendix Table 1.

Table 3. Beliefs about distribution of other households' guesses.

	Level of thinking						Average expected distribution	Actual distribution
	$k = 0$	$k = 0^+$	$k = 1$	$k = 2$	$k = 3$	$k \geq 4$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of respondents	42.3	15.2	16.1	15.1	7.5	3.9		
Panel A. Perceived distributions of others' guesses								
Range of Guesses								
From 0 to 9.99	5.7	5.6	5.5	6.3	11.6	22.2	6.7	3.7
From 10 to 19.99	6.7	7.3	7.5	10.4	16.9	10.1	8.3	7.0
From 20 to 29.99	8.5	9.8	11.8	19.0	12.3	9.3	11.0	13.4
From 30 to 39.99	10.3	12.5	21.8	17.3	12.6	11.4	13.7	16.8
From 40 to 49.99	12.1	18.4	14.1	11.9	10.1	8.6	13.1	11.8
From 50 to 59.99	15.3	17.3	12.6	11.6	10.5	10.3	14.1	11.3
From 60 to 69.99	14.9	10.7	9.4	7.7	8.0	7.2	11.6	15.9
From 70 to 79.99	11.9	7.5	7.1	6.0	6.6	8.3	9.2	14.0
From 80 to 89.99	8.0	5.7	5.4	5.0	5.7	6.3	6.6	4.5
From 90 to 100	6.6	5.3	4.8	4.7	5.9	6.3	5.8	1.4
Panel B. Consistency of responses								
Dependent variable: $Guess_i^{Own}$								
$E_i[Guess^{HO}]$	1.30	0.93	0.73	0.55	0.31	0.13		
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)		
Observations	739	254	282	226	118	61		
R^2	0.96	0.97	0.97	0.95	0.87	0.79		
p-value(slope=2/3)	0.00	0.00	0.00	0.00	0.00	0.00		

Notes: The table reports various moments for responses in the "beauty contest" game described in Section II.C. Because there are many responses not equal to 33, 22, etc., we group responses in level of thinking as follows. $k = 0$ includes everybody who reported a number greater than 50. $k = 0^+$ includes everybody who reported a number in (40,50] range. $k = 1$ includes everybody who reported a number in (30,40] range. $k = 2$ includes everybody who reported a number in (20,30] range. $k = 3$ includes everybody who reported a number in (10,20] range. $k \geq 4$ includes everybody who reported a number in (0,10] range. Panel B reports Huber-robust estimates of the slope in the following regression: $Guess_i^{Own} = b \times E_i[Guess^{HO}] + error_i$ where $Guess_i^{Own}$ is the guess submitted by person i, $E_i[Guess^{HO}]$ is person i's average guess for others' guesses.

Table 4. Posterior inflation expectations as a function of treatment and prior inflation expectations.

	Point prediction				Implied mean		
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 2	Wave 3	Wave 4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Prior	0.540	0.110	0.258	0.250	0.354	0.298	0.370
	(0.031)	(0.029)	(0.029)	(0.033)	(0.042)	(0.034)	(0.039)
Prior×Treatment	-0.187	0.161	0.032	-0.016	0.057	0.189	0.007
	(0.038)	(0.036)	(0.035)	(0.039)	(0.048)	(0.043)	(0.046)
Treatment	0.094	-0.357	-0.057	-0.010	-0.106	-0.370	-0.116
	(0.086)	(0.092)	(0.091)	(0.098)	(0.117)	(0.103)	(0.111)
Constant	1.272	2.151	1.765	1.760	1.544	1.580	1.454
	(0.071)	(0.077)	(0.077)	(0.082)	(0.101)	(0.085)	(0.095)
Observations	1,778	1,543	1,533	1,500	1,621	1,606	1,579
R-squared	0.339	0.112	0.170	0.126	0.210	0.269	0.238
F-stat for treatment	26.65	10.24	0.411	0.265	0.711	9.783	1.293

Notes: The table reports estimated coefficients for specification (1). Treatment variable pools across treatment with private information ("Before we proceed, we would like to share the following information **only with you** and a few other households. The Dutch Statistical Office recently reported that the percent increase in consumer prices compared in February to 12 months earlier in the Netherlands was 1.2%") and treatment with public information ("Before we proceed, we would like to share the following information with you. In a public release **available to all Dutchmen** at no charge, the Dutch Statistical Office recently reported that the percent increase in consumer prices in February compared to 12 months earlier in the Netherlands was 1.2%"). All coefficients are estimated using Huber-robust regressions. F-statistic for treatment is the F-statistic for the test of coefficients on treatment variables (levels and interactions) being equal to zero. Robust standard errors clustered by household are reported in parentheses.

Table 5. Consumption response to changes in inflation expectations.

Dep. var. is indicated in the title of the panel	Actual spending, horizon, month				Planned spending
	$\ln(C_1)$	$\ln(C_2)$	$\ln(C_3)$	Pooled	Pooled
	(1)	(2)	(3)	(4)	(5)
Panel A. Spending on non-durable goods, log(spending)*100.					
Posterior inflation expectations	6.91	6.74	26.34	11.33	-0.15
	(8.58)	(7.78)	(13.34)	(7.28)	(7.72)
	[-11.8, 28.0]	[-10.3, 26.8]	[-0.45, 99.6]	[-3.93, 44.8)	[-18.20, 15.45]
Observations	945	924	888	2,763	1,627
R-squared	0.34	0.40	0.25	0.33	0.36
1st stage F-stat	15.37	14.53	12.06	15.17	14.14
p-value (weak IV robust)	0.57	0.45	0.06	0.17	0.64
Panel B. Spending on durable goods, extensive margin, linear probability model.					
Posterior inflation expectations	-0.17	-0.29	-0.33	-0.21	-0.13
	(0.10)	(0.11)	(0.11)	(0.07)	(0.07)
	[-0.44, 0.02]	[-0.74, -0.09]	[-0.69, -0.14]	[-0.45, -0.08]	[-0.38, -0.01]
Observations	1,088	999	939	3,036	1,636
R-squared	0.00	-0.23	-0.34	-0.08	0.11
1st stage F-stat	10.62	8.136	10.10	12.07	8.83
p-value (weak IV robust)	0.09	<0.01	<0.01	<0.01	0.04

Notes: The table reports estimated coefficient β in specification (2) for various measures of consumer spending. Panel titles indicate which measure of consumer spending is used as an outcome variable. Columns (1)-(4) report estimates for actual spending. Column (5) reports results for spending planned in the second wave of the survey (specification (2')). All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). 1st stage F-stat report the F-test for the coefficients on instrumental variables being equal to zero. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors clustered by household are reported in parentheses. 95% confidence interval robust to weak IV is reported in square brackets, which can extend to positive or negative infinity. *p-value (weak IV robust)* is the p-value for coefficient β in specification (2) robust to weak IV. Inference robust to weak IV is based on conditional likelihood estimation.

Table 6. How inflation expectations translate into expectations about other variables.

	(1)	(2)	(3)	(4)
	Response of other expectations immediately after the treatment			
	Household net income	Household spending on non-durable goods	Economy-level spending on non-durable goods	Higher-order expectations: Economy-level spending on non-durable goods
Panel A. Point predictions				
$E_{it}^{post}\pi_{t+1}$	0.11	-2.93	-3.12	-3.46
	(1.10)	(1.29)	(1.52)	(1.63)
	[-2.20, 2.48]	[-9.15, -0.58]	[-17.6, -0.34]	[-13.7, -0.50]
Observations	1,175	1,157	1,093	1,018
R-squared	0.19	-0.05	-0.13	-0.08
1st stage F-stat	17.40	18.63	14.35	18.14
p-value (weak IV robust)	0.97	0.02	0.03	0.02
	Household income expectations in subsequent waves			
	Wave 2	Wave 3	Wave 4	Pooled
Panel B. Implied standard deviation (uncertainty)				
$E_{it}^{post}\pi_{t+1}$	-0.62	-0.01	-0.53	-0.28
	(0.25)	(0.15)	(0.24)	(0.13)
	[-1.53, -0.23]	[-0.36, 0.38]	[-1.29, -0.17]	[-0.79, -0.02]
Observations	974	960	966	2,886
R-squared	0.00	0.36	0.03	0.25
1st stage F-stat	8.27	8.70	7.79	9.90
p-value (weak IV robust)	<0.01	0.73	<0.01	0.03

Notes: The table reports estimated coefficient b_1 in specification (3). Outcome variables on Panel A are measured in the first wave immediately after the treatment. All outcome variables are measured as point predictions. Panel B reports results for implied uncertainty (standard deviation) of expected growth rate of household income over the next 12 months. Outcome variables in Panels B and C are based on probability distributions reported by respondents. All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). Treatments are pooled. 1st stage F-stat report the F-test for the coefficients on instrumental variables being equal to zero. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors clustered by household are reported in parentheses. 95% confidence interval robust to weak IV is reported in square brackets. *p-value (weak IV robust)* is the p-value for coefficient b_1 in specification (3) robust to weak IV. Inference robust to weak IV is based on conditional likelihood estimation.

Table 7. Heterogeneity in posterior inflation expectations as a function of treatment and prior inflation expectations.

	Respondents' characteristic W					
	Level of thinking k	College-level education	Log gross monthly income	Money in liquid accounts enough to cover 3 months on non-durable consumption	Financial wealth is greater than €17,000	Financially literate
	(1)	(2)	(3)	(4)	(5)	(6)
Prior	0.563	0.459	0.487	0.604	0.582	0.130
	(0.037)	(0.037)	(0.032)	(0.047)	(0.042)	(0.049)
Prior × Treatment	-0.139	-0.104	-0.117	-0.220	-0.299	-0.033
	(0.046)	(0.046)	(0.040)	(0.062)	(0.052)	(0.068)
W × Treatment	-0.001	0.310	-0.367	0.096	-0.467	-0.307
	(0.074)	(0.181)	(0.132)	(0.183)	(0.194)	(0.260)
Prior × W × Treatment	-0.015	-0.189	0.266	0.062	0.329	-0.140
	(0.034)	(0.083)	(0.058)	(0.082)	(0.085)	(0.080)
Prior × W	-0.061	0.174	-0.216	-0.046	-0.195	0.424
	(0.028)	(0.066)	(0.053)	(0.063)	(0.069)	(0.059)
Treatment	0.019	-0.057	-0.050	0.044	0.199	0.345
	(0.107)	(0.109)	(0.089)	(0.140)	(0.123)	(0.242)
W	0.077	-0.371	0.269	-0.029	0.384	0.216
	(0.063)	(0.149)	(0.122)	(0.146)	(0.164)	(0.202)
Observations	1,694	1,780	1,657	1,323	1,478	1,785
R-squared	0.352	0.324	0.366	0.392	0.328	0.335

Notes: The table reports estimated coefficients in specification (4). Posterior inflation expectations are measured in the first wave immediately after the treatment. The title of each column indicates which variable is used as W in specification (4). Log gross monthly income (column (3)) is normalized to have zero mean. Variables W in columns (2), (4), (5) and (6) are indicator variables. All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). Treatments are pooled. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors clustered by household are reported in parentheses.

Table 8. Heterogeneity in consumption response to changes in inflation expectations.

Dependent variable is indicated in the title of the panel	Sample split by:			
	Level of thinking		Money in liquid accounts enough to cover 3 months on non-durable consumption	
	$k = 0$	$k \geq 1$	No	Yes
	(1)	(2)	(3)	(4)
Panel A. Spending on non-durable goods, log(spending)×100.				
$E_{it}^{post}\pi_{t+1}$	10.41	-11.25	13.17	12.64
	(7.25)	(16.50)	(10.34)	(11.92)
	[3.1, 619]	[-418, 35.4]	[-8.9, 82.9]	[-13.2, 121]
Observations	1,607	1,083	995	1,563
p-value equality	0.23		0.97	
1st stage F-stat	11.56	3.828	7.01	5.91
p-value (weak IV robust)	0.02	0.63	0.24	0.34
Panel B. Spending on durable goods, extensive margin, linear probability model.				
$E_{it}^{post}\pi_{t+1}$	-0.23	-0.44	-0.19	-0.30
	(0.10)	(0.20)	(0.11)	(0.11)
	[-0.58, -0.10]	[-3.59, -0.18]	[-0.94, 0.30]	[-0.74, -0.14]
Observations	1,746	1,176	986	1,544
p-value equality	0.37		0.47	
1st stage F-stat	6.18	3.31	3.95	8.08
p-value (weak IV robust)	<0.01	<0.01	0.197	<0.01

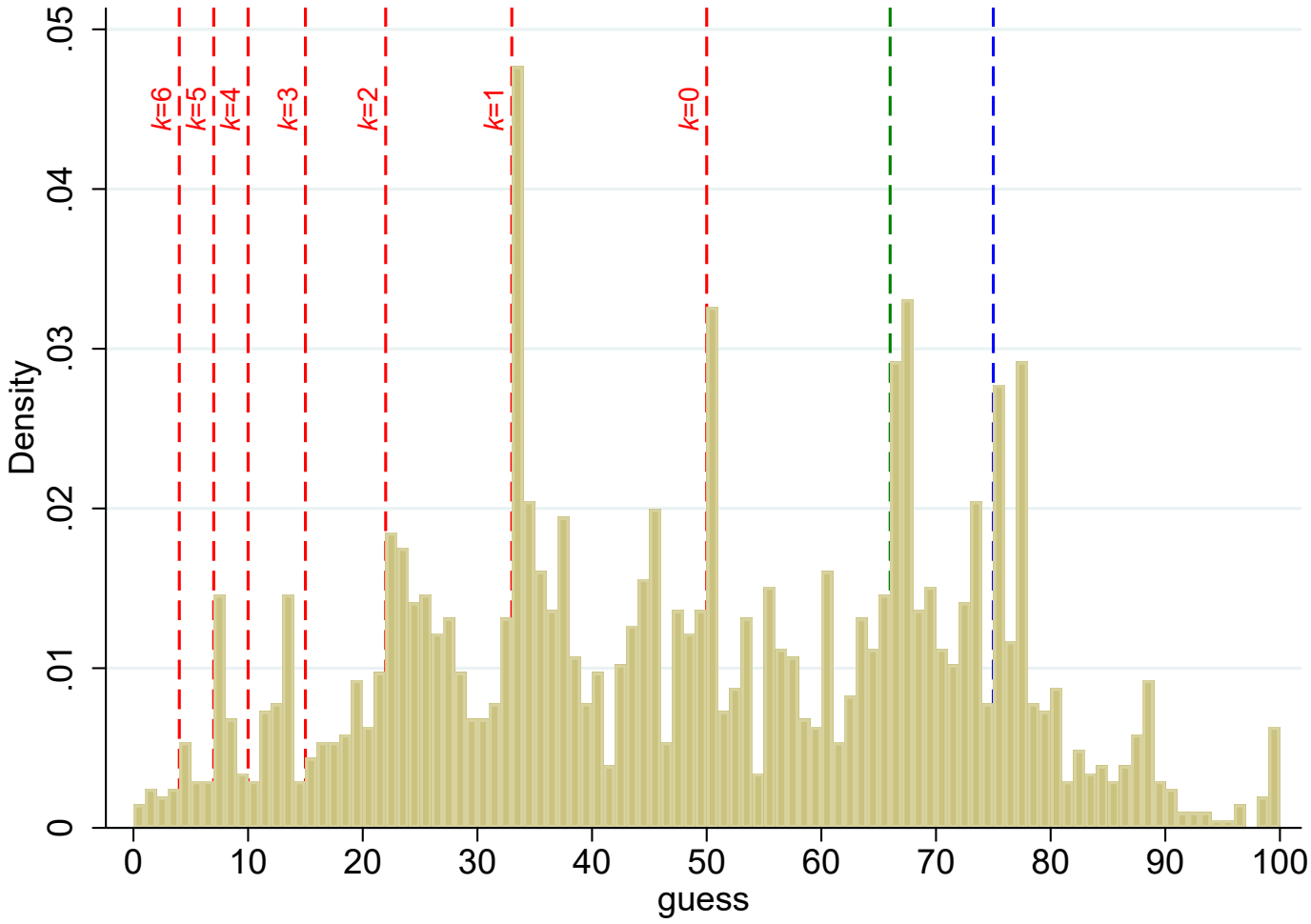
Notes: The table reports estimated coefficient β in specification (2) for various measures of consumer spending and various subsamples. Panel titles indicate which measure of consumer spending is used as an outcome variable. All results are for the case where data are pooled across waves (which corresponds to column (4) in Table 5). All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). *1st stage F-stat* reports the F-test for the coefficients on instrumental variables being equal to zero. *P-value equality* shows p-value for the test of equality of estimated coefficients β in each sample split. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors clustered by household are reported in parentheses. 95% confidence interval robust to weak IV is reported in square brackets. *p-value (weak IV robust)* is the p-value for coefficient β in specification (2) robust to weak IV. Inference robust to weak IV is based on conditional likelihood estimation.

Table 9. Heterogeneity in inflation expectation responses.

Sample split			Dependent variable: post-treatment expectations (point predictions)			
			Household net income	Household spending on non-durable goods	Economy-level spending on non-durable goods	Higher-order expectations: Economy-level spending on non-durable goods
			(1)	(2)	(3)	(4)
Level of thinking	$k = 0$	$E_{it}^{post}\pi_{t+1}$	-0.28 (1.65) [-5.4, 3.7]	-2.56 (1.39) [-6.9,0.03]	-3.80 (2.05) [-20.0, -0.45]	-3.08 (1.92) [-21.9, -0.13]
		Observations	694	676	652	602
		1st stage F-stat	8.077	11.47	8.833	9.923
		p-value (weak IV robust)	0.98	0.06	0.03	0.05
	$k > 0$	$E_{it}^{post}\pi_{t+1}$	-0.09 (1.70) [-4.8, 3.2]	-3.12 (2.57) [-55.2, 1.3]	-1.61 (2.49) [-202, 3.4]	-3.07 (3.32) [-53.1, 3.7]
		Observations	462	462	424	402
		1st stage F-stat	8.987	6.509	4.665	5.821
		p-value (weak IV robust)	0.726	0.216	0.766	0.321
	p-value equal.		0.94	0.85	0.50	0.99
Money in liquid accounts enough to cover 3 months on non-durable consumption	No	$E_{it}^{post}\pi_{t+1}$	-2.07 (1.97) [-7.5, 1.6]	-4.98 (2.66) [-20.2, -0.13]	-7.63 (3.44) [-34.6, -2.4]	-5.98 (3.83) [-97.2, 0.7]
		Observations	405	409	385	349
		1st stage F-stat	8.638	8.672	6.459	5.980
		p-value (weak IV robust)	0.23	0.05	<0.01	0.09
	Yes	$E_{it}^{post}\pi_{t+1}$	2.44 (1.79) [-1.1, 8.4]	-1.40 (1.53) [-6.2, 1.3]	-1.33 (1.96) [-12.6, 2.4]	-2.81 (1.96) [-9.6, 1.0]
		Observations	643	629	606	569
		1st stage F-stat	6.644	9.287	6.363	9.358
		p-value (weak IV robust)	0.159	0.286	0.527	0.155
	p-value equal.		0.10	0.24	0.11	0.46

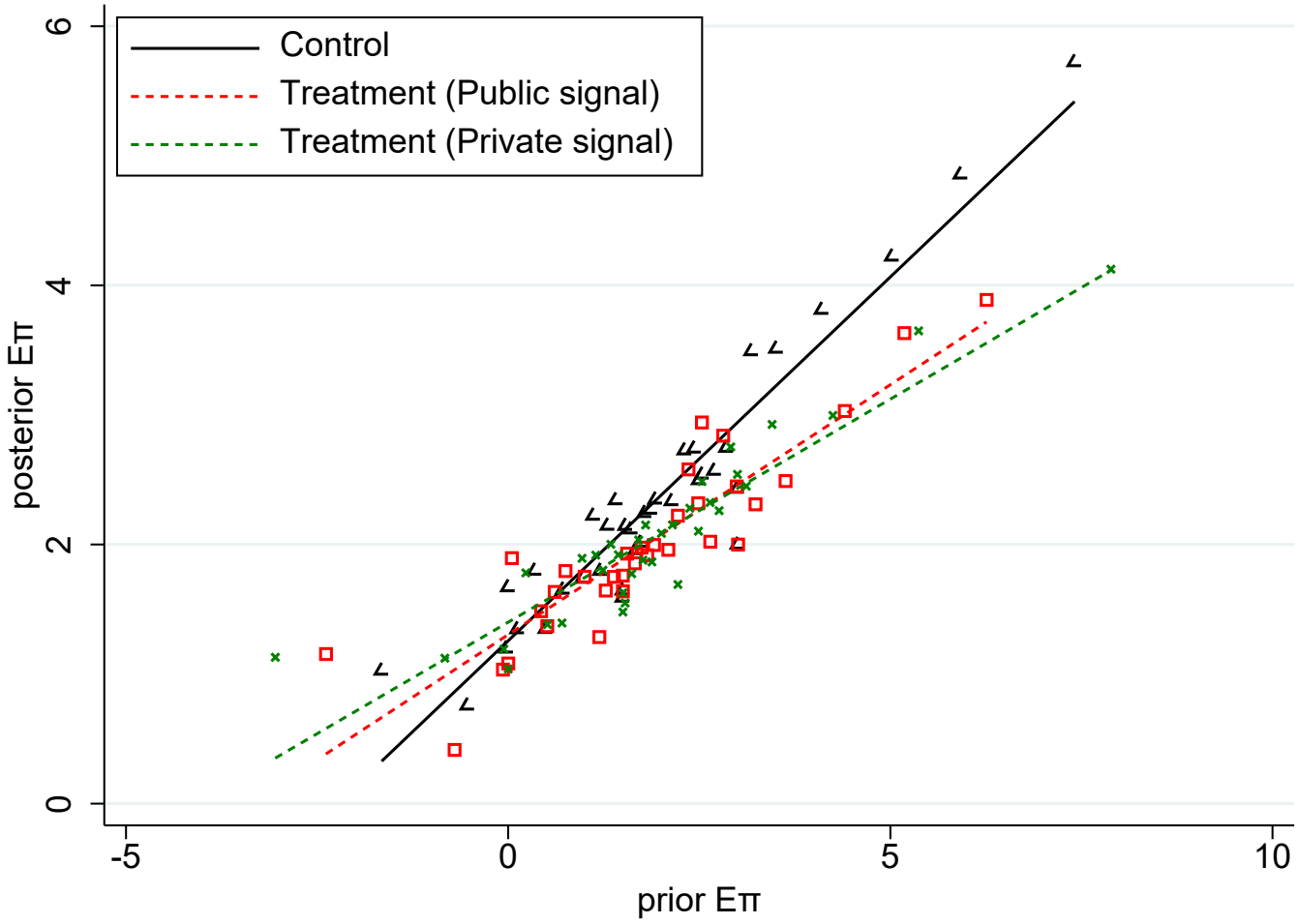
Notes: The table reports estimated coefficient b_1 in specification (3). All outcome variables are measured in the first wave immediately after the treatment. The two left columns indicate which sample is used for estimation. All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). Treatments are pooled. 1st stage F-stat report the F-test for the coefficients on instrumental variables being equal to zero. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1, 5 and 10 percent levels. *P-value equality* shows p-value for the test of equality of estimated coefficients b_1 in each sample split. Robust standard errors clustered by household are reported in parentheses. 95% confidence interval robust to weak IV is reported in square brackets. *p-value (weak IV robust)* is the p-value for coefficient b_1 in specification (3) robust to weak IV. Inference robust to weak IV is based on conditional likelihood estimation.

Figure 1. Level-k responses.



Notes: The figure reports the distribution of responses in the "beauty contest" game described in Section II.C. Red vertical lines indicate values of k, blue lines indicate responses one would observe if individuals pick $(3/2)^k \times 50$ (that is, people use (3/2) rather than (2/3)), and the green line indicates $(2/3) \times 100$.

Figure 2. Relationship between prior and posterior beliefs for control/treatment groups.



Notes: The figure presents a binscatterplot of post-treatment inflation expectations (point prediction immediately after treatment) and pre-treatment inflation expectations (implied mean from the reported distribution) by treatment group. The lines show fitted linear relationships for each group. Each bin represents approximately 20 observations.

APPENDIX A

ADDITIONAL FIGURES AND TABLES

Appendix Table 1. Inflation expectations by respondents' characteristics.

	Implied mean		Implied uncertainty (standard deviation)	
	Average	St.Dev.	Average	St.Dev.
	(1)	(2)	(3)	(4)
Level of thinking				
$k = 0$	2.09	2.14	1.54	1.47
$k = 1$	1.96	1.75	1.36	1.20
$k = 2$	1.59	1.95	1.57	1.45
$k = 3$	1.94	2.31	1.57	1.60
$k \geq 4$	2.19	2.33	1.95	1.86
Gender				
Male	2.13	1.91	1.35	1.29
Female	1.89	2.34	1.66	1.59
Education				
Less than secondary	2.15	2.21	1.66	1.71
Secondary	1.97	2.37	1.71	1.50
Post-secondary	1.87	1.54	1.20	1.08
Liquidity constraint				
Hand-to-mouth	2.01	2.03	1.58	1.48
Not hand-to-mouth	2.07	1.65	1.24	1.08
Financial literacy score				
0	1.23	3.42	2.92	2.09
1	2.14	2.22	1.99	1.78
2	2.02	2.31	1.62	1.43
3	2.08	1.55	1.12	1.00
Gross monthly income above mean				
No	2.00	2.36	1.75	1.60
Yes	1.97	1.96	1.42	1.39
Financial wealth above €17,000				
No	1.91	2.35	1.73	1.59
Yes	2.11	1.82	1.20	1.16

Notes: Hand-to-mouth is defined as a household that has liquid wealth smaller than three months of average monthly spending on non-durable goods. Inflation expectations are for 12-month-ahead horizon.

Appendix Table 2. Posterior inflation expectations as a function of treatment and prior inflation expectations.

	Point prediction				Implied mean		
	Wave 1	Wave 2	Wave 3	Wave 4	Wave 2	Wave 3	Wave 4
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Prior	0.538	0.108	0.257	0.251	0.355	0.297	0.369
	(0.031)	(0.030)	(0.030)	(0.033)	(0.041)	(0.034)	(0.039)
Prior×Treatment (public)	-0.156	0.212	0.039	0.004	0.036	0.120	-0.000
	(0.046)	(0.047)	(0.043)	(0.047)	(0.056)	(0.050)	(0.053)
Treatment (public)	0.022	-0.450	0.030	0.015	-0.023	-0.198	-0.080
	(0.100)	(0.115)	(0.110)	(0.119)	(0.135)	(0.120)	(0.127)
Prior×Treatment (private)	-0.210	0.136	0.027	-0.025	0.075	0.312	0.015
	(0.043)	(0.039)	(0.039)	(0.042)	(0.053)	(0.048)	(0.052)
Treatment (private)	0.148	-0.313	-0.132	-0.042	-0.179	-0.627	-0.150
	(0.098)	(0.101)	(0.101)	(0.105)	(0.129)	(0.115)	(0.123)
Constant	1.279	2.160	1.771	1.760	1.541	1.579	1.455
	(0.071)	(0.078)	(0.077)	(0.083)	(0.100)	(0.085)	(0.095)
Observations	1,778	1,545	1,534	1,500	1,621	1,603	1,579
R-squared	0.337	0.114	0.170	0.129	0.212	0.297	0.238
F-stat for treatment	13.61	5.775	1.932	0.875	0.795	11.19	0.769

Notes: The table reports estimated coefficients for specification (1) in Panel A. Panel A distinguishes treatments with private information ("Before we proceed, we would like to share the following information **only with you** and a few other households. The Dutch Statistical Office recently reported that the percent increase in consumer prices compared in February to 12 months earlier in the Netherlands was 1.2%") and with public information ("Before we proceed, we would like to share the following information with you. In a public release **available to all Dutchmen** at no charge, the Dutch Statistical Office recently reported that the percent increase in consumer prices in February compared to 12 months earlier in the Netherlands was 1.2%"). Panel B pools treatments into one. All coefficients are estimated using Huber-robust regressions. F-statistic for treatment is the F-statistic for the test of coefficients on treatment variables (levels and interactions) being equal to zero. Robust standard errors clustered by household are reported in parentheses.

Appendix Table 3. Heterogeneity in posterior inflation expectations as a function of treatment and prior inflation expectations.

	Respondents' characteristic X					
	Level of thinking k	College-level education	Log gross monthly income	Money in liquid accounts enough to cover 3 months on non-durable consumption	Financial wealth is greater than €17,000	Financially literate
	(1)	(2)	(3)	(4)	(5)	(6)
Prior	0.567	0.458	0.487	0.599	0.581	0.130
	(0.036)	(0.038)	(0.032)	(0.048)	(0.043)	(0.049)
Prior × Treatment (Pub)	-0.132	-0.007	-0.089	0.001	-0.260	0.169
	(0.053)	(0.055)	(0.046)	(0.068)	(0.065)	(0.091)
Prior × Treatment (Pri)	-0.158	-0.159	-0.128	-0.362	-0.325	-0.145
	(0.051)	(0.050)	(0.044)	(0.065)	(0.057)	(0.085)
W × Treatment (Pub)	-0.099	0.464	-0.210	0.677	-0.330	-0.358
	(0.084)	(0.204)	(0.142)	(0.198)	(0.224)	(0.302)
W × Treatment (Pri)	0.049	0.218	-0.353	-0.429	-0.611	-0.508
	(0.080)	(0.209)	(0.135)	(0.217)	(0.221)	(0.324)
Prior × W × Treatment (Pub)	0.022	-0.359	0.150	-0.227	0.202	-0.328
	(0.040)	(0.095)	(0.062)	(0.090)	(0.102)	(0.104)
Prior × W × Treatment (Pri)	-0.017	-0.072	0.291	0.283	0.452	-0.038
	(0.036)	(0.095)	(0.054)	(0.095)	(0.096)	(0.098)
Prior × W	-0.058	0.176	-0.218	-0.025	-0.194	0.423
	(0.027)	(0.067)	(0.053)	(0.065)	(0.070)	(0.060)
Treatment (Pub)	0.028	-0.186	-0.099	-0.385	0.147	0.357
	(0.121)	(0.125)	(0.103)	(0.148)	(0.144)	(0.281)
Treatment (Pri)	0.035	0.006	-0.022	0.379	0.235	0.575
	(0.120)	(0.121)	(0.101)	(0.155)	(0.140)	(0.307)
W	0.073	-0.377	0.270	-0.067	0.380	0.215
	(0.063)	(0.150)	(0.122)	(0.151)	(0.166)	(0.203)
Observations	1,688	1,783	1,661	1,323	1,483	1,789
R-squared	0.362	0.332	0.372	0.405	0.332	0.337

Notes: see notes to Table 4 and Table 7.

Appendix Table 4. Consumption response to changes in inflation expectations, additional results.

Dep. var. is indicated in the title of the panel	Actual spending, horizon, month				Planned spending
	$\ln(C_1)$	$\ln(C_2)$	$\ln(C_3)$	Pooled	Pooled
	(1)	(2)	(3)	(4)	(5)
Panel A. Spending on durable goods, intensive margin, log(spending).					
Posterior inflation expectations				-60.31	
				(35.81)	
				[-187.3, 28.71]	
Observations				329	
R-squared				0.19	
1st stage F-stat				12.05	
p-value (weak IV robust)				0.14	
Panel B. Spending on durable goods, IV Tobit, log(spending)*100.					
Posterior inflation expectations	-3.90	-5.77	-8.26	-4.90	-6.58
	(2.02)	(2.36)	(2.23)	(1.43)	(2.51)
	[-9.06, -0.32]	[-13.03, -1.54]	[-15.00, -4.30]	[-7.45, -2.85]	[-12.48, -2.55]
Observations	1,087	999	940	3,036	1,634
R-squared	21.74	15.50	24.15	26.92	18.09
1st stage F-stat	0.04	0.01	<0.01	<0.01	<0.01
p-value (weak IV robust)	0.09	<0.01	<0.01	<0.01	0.04

Notes: The table reports estimated coefficient β in specification (2) for various measures of consumer spending. Panel titles indicate which measure of consumer spending is used as an outcome variable. Columns (1)-(4) report estimates for actual spending. Column (5) reports results for spending planned in the second wave of the survey (specification (2')). All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). Panel B reports coefficients in the IV Tobit regression. 1st stage F-stat report the F-test for the coefficients on instrumental variables being equal to zero. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors clustered by household are reported in parentheses. 95% confidence interval robust to weak IV is reported in square brackets, which can extend to positive or negative infinity. *p-value (weak IV robust)* is the p-value for coefficient β in specification (2) robust to weak IV. Inference robust to weak IV is based on conditional likelihood estimation.

Appendix Table 5. Consumption response to changes in inflation expectations, OLS estimates.

Dep. var. is indicated in the title of the panel	Actual spending, horizon, month				Planned spending
	$\ln(C_1)$	$\ln(C_2)$	$\ln(C_3)$	Pooled	Pooled
	(1)	(2)	(3)	(4)	(5)
Panel A. Spending on non-durable goods, log(spending)*100.					
Posterior inflation expectations	-1.31	0.62	1.57	0.18	-1.21
	(2.05)	(1.88)	(2.51)	(1.58)	(1.84)
Observations	945	924	888	2,763	1,627
R-squared	0.35	0.40	0.32	0.35	0.37
Panel B. Spending on durable goods, extensive margin, linear probability model.					
Posterior inflation expectations	-0.01	-0.03	-0.02	-0.02**	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	1,088	999	939	3,036	1,636
R-squared	0.10	0.05	0.05	0.06	0.20
Panel C. Spending on durable goods, intensive margin, log(spending).					
Posterior inflation expectations				-5.48	
				(7.70)	
Observations				329	
R-squared				0.28	
Panel D. Spending on durable goods, IV Tobit, log(spending)*100.					
Posterior inflation expectations	-0.28	-0.53	-0.52	-0.43	0.07
	(0.25)	(0.25)	(0.28)	(0.18)	(0.31)
Observations	1,087	999	940	3,036	1,634

Notes: The table reports OLS estimated coefficient β in specification (2) for various measures of consumer spending. Panel titles indicate which measure of consumer spending is used as an outcome variable. Columns (1)-(4) report estimates for actual spending. Column (5) reports results for spending planned in the second wave of the survey (specification (2')). Panel D reports coefficients in the Tobit regression. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors clustered by household are reported in parentheses.

Appendix Table 6. Heterogeneity in consumption response to changes in inflation expectations, additional results.

Dependent variable is indicated in the title of the panel	Sample split by: College-level education		Gross monthly income is greater than the mean		Financially literate		Financial wealth is greater than €17,000	
	No	Yes	No	Yes	No	Yes	No	Yes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Spending on non-durable goods, log(spending)×100.								
$E_{it}^{post}\pi_{t+1}$	10.05	6.23	-0.14	15.86	7.88	6.79	13.19	-0.60
	(7.97)	(12.31)	(10.84)	(8.96)	(10.29)	(8.92)	(8.09)	(12.87)
	[-4.4, 95.6]	[-23, 36]	[-∞ ,-61] ∪ [-33, ∞]	[-1.8, 46.26]	[-∞ ,-125] ∪ [-15, ∞]	[-11, 72]	[-3.3, 93]	[-35, 47]
Observations	1,562	1,173	1,074	1,661	951	1,784	1,048	1,372
p-value equality	0.79		0.23		0.94		0.36	
1st stage F-stat	8.87	10.22	4.42	12.33	5.26	11.16	9.93	5.28
p-value (weak IV robust)	0.17	0.83	0.94	0.08	0.29	0.53	0.94	0.08
Panel B. Spending on durable goods, extensive margin, linear probability model.								
$E_{it}^{post}\pi_{t+1}$	-0.29	-0.20	-0.29	-0.22	-0.17	-0.29	-0.16	-0.28
	(0.10)	(0.12)	(0.14)	(0.10)	(0.10)	(0.10)	(0.07)	(0.16)
	[-0.74, -0.14]	[-0.66, 0.06]	[-∞, -0.15] ∪ [55.9, ∞]	[-0.54, -0.06]	[-∞, -0.1] ∪ [1.1, ∞]	[-0.50, -0.30]	[-0.54, -0.06]	[-1.50, -0.02]
Observations	1,793	1,221	1,249	1,765	1,222	1,792	1,210	1,424
p-value equality	0.58		0.68		0.40		0.47	
1st stage F-stat	6.38	7.13	2.86	10.71	2.681	9.348	7.21	3.46
p-value (weak IV robust)	<0.01	0.18	<0.01	0.02	0.10	<0.01	0.02	0.05

Notes: The table reports estimated coefficient β in specification (2) for various measures of consumer spending and various subsamples. Panel titles indicate which measure of consumer spending is used as an outcome variable. All results are for the case where data are pooled across waves (which corresponds to column (4) in Table 5). All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). Panel C reports coefficients in the IV Tobit regression. *1st stage F-stat* reports the F-test for the coefficients on instrumental variables being equal to zero. *P-value equality* shows p-value for the test of equality of estimated coefficients β in each sample split. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors clustered by household are reported in parentheses. 95% confidence interval robust to weak IV is reported in square brackets. *p-value (weak IV robust)* is the p-value for coefficient β in specification (2) robust to weak IV. Inference robust to weak IV is based on conditional likelihood estimation.

Appendix Table 7. Heterogeneity in inflation expectation responses, additional results.

Sample split			Dependent variable: post-treatment expectations (point predictions)			
			Household net income	Household spending on non-durable goods	Economy-level spending on non-durable goods	Higher-order expectations: Economy-level spending on non-durable goods
			(1)	(2)	(3)	(4)
College-level education	No	$E_{it}^{post}\pi_{t+1}$	-0.28	-3.62	-5.68	-5.03
			(1.22)	(1.69)	(2.56)	(2.56)
			[-3.4, 2.5]	[-17.9, -0.9]	[-41, -2.1]	[-42, -0.7]
		Observations	682	665	628	586
		1st stage F-stat	10.44	10.07	6.485	8.341
		p-value (weak IV robust)	0.96	0.01	<0.01	0.02
	Yes	$E_{it}^{post}\pi_{t+1}$	0.91	-1.66	1.33	-0.85
			(2.38)	(1.94)	(1.81)	(1.71)
			[-5.2, 6.1]	[-14.5, 2.7]	[-7.5, 5.8]	[-7.4, 3.1]
		Observations	493	492	465	432
		1st stage F-stat	9.172	11.79	12.94	15.06
		p-value (weak IV robust)	0.746	0.731	0.278	0.873
	p-value equal.		0.656	0.440	0.0242	0.171
Gross monthly income is greater than the mean	No	$E_{it}^{post}\pi_{t+1}$	0.53	-3.74	-4.31	-3.39
			(1.63)	(2.09)	(2.63)	(2.54)
			[-3.6, 30.7]	[-60, -0.5]	[-126, 0.03]	[-1323, -1.4]
		Observations	477	471	439	401
		1st stage F-stat	6.468	6.594	5.152	6.921
		p-value (weak IV robust)	0.670	0.0296	0.0567	0.00777
	Yes	$E_{it}^{post}\pi_{t+1}$	-0.32	-2.31	-1.54	-2.65
			(1.59)	(1.68)	(1.73)	(2.26)
			[-9.7, 3.8]	[-8.9, 1.1]	[-14.9, 1.8]	[-10.3, 1.9]
		Observations	698	686	654	617
		1st stage F-stat	11.51	12.57	9.498	11.79
		p-value (weak IV robust)	0.564	0.209	0.465	0.289
	p-value equal.		0.708	0.595	0.380	0.827
Financial wealth is greater than €17,000	No	$E_{it}^{post}\pi_{t+1}$	-1.82	-2.18	-3.25	-3.81
			(1.19)	(1.32)	(1.65)	(1.86)
			[-4.8, 0.1]	[-6.1, 0.3]	[-11.5, -0.2]	[-15.3, -0.1]
		Observations	449	446	410	384
		1st stage F-stat	15.59	18.13	12.84	17.17
		p-value (weak IV robust)	0.0670	0.0849	0.0384	0.0541
	Yes	$E_{it}^{post}\pi_{t+1}$	4.81	-3.31	-4.55	-2.88
			(3.59)	(3.25)	(3.62)	(3.98)
			[-∞,-13.1] ∪ [-.3, ∞]	[-50, 4.0]	[-∞, .75] ∪ [364, ∞]	[-919, 6.7]
		Observations	574	551	540	508
		1st stage F-stat	2.811	3.419	3.125	3.404
		p-value (weak IV robust)	0.0585	0.336	0.0936	0.407
	p-value equal.		0.0796	0.747	0.745	0.831
Financially literate	No	$E_{it}^{post}\pi_{t+1}$	-0.24	-3.05	-3.89	-1.86
			(1.18)	(2.22)	(2.81)	(2.42)
			[-3.3, 2.6]	[-27.4, 1.4]	[-∞ , -1.4] ∪ [50.6, ∞]	[-110, 1.3]
		Observations	413	404	372	344
		1st stage F-stat	9.283	5.534	3.504	7.664
		p-value (weak IV robust)	0.909	0.148	0.00845	0.220
	Yes	$E_{it}^{post}\pi_{t+1}$	1.52	-3.03	-2.13	-3.64
			(1.98)	(1.61)	(1.73)	(2.11)
			[-2.8, 8.2]	[-10.7, 0.2]	[-10.5, 1.6]	[-12.9, -0.2]
		Observations	762	753	721	674
		1st stage F-stat	9.888	15.16	12.62	12.84
		p-value (weak IV robust)	0.648	0.0831	0.385	0.0401
	p-value equal.		0.445	0.994	0.594	0.580

Notes: The table reports estimated coefficient b_1 in specification (3). All outcome variables are measured in the first wave immediately after the treatment. The two left columns indicate which sample is used for estimation. All specifications are estimated using treatment and treatment interacted with prior inflation beliefs as instrumental variables (IV). Treatments are pooled. 1st stage F-stat report the F-test for the coefficients on instrumental variables being equal to zero. Outliers and influential observations are identified and removed according to the procedure described in footnote 17. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1, 5 and 10 percent levels. *P-value equality* shows p-value for the test of equality of estimated coefficients b_1 in each sample split. Robust standard errors clustered by household are reported in parentheses. 95% confidence interval robust to weak IV is reported in square brackets. *p-value (weak IV robust)* is the p-value for coefficient b_1 in specification (3) robust to weak IV. Inference robust to weak IV is based on conditional likelihood estimation.

Appendix Table 8. Correlation matrix for variables used for sample splits.

		(1)	(2)	(3)	(4)	(5)	(6)
Level of thinking k	(1)	1.0000					
College-level education	(2)	0.0437	1.0000				
Log gross monthly income	(3)	0.0487	0.2686	1.0000			
Money in liquid accounts enough to cover 3 months on non-durable consumption	(4)	-0.0103	0.0793	0.1129	1.0000		
Financial wealth is greater than €17,000	(5)	-0.0641	0.1478	0.2305	0.2741	1.0000	
Financially literate	(6)	-0.0010	0.0977	0.0513	0.0679	0.0696	1.000

Notes: The variables are defined as follows. "Level of thinking k" is an indicator variable equal to one if $k \geq 1$ and zero otherwise. College-level education is an indicator variable equal to one if a respondent has a college degree and zero otherwise. Log gross monthly income is a continuous variable. Money in liquid accounts … is an indicator variable equal to one if a household has liquidity enough to cover 3 months of spending on non-durable consumption and zero otherwise. Financial wealth … is an indicator variable equal to one if a household has financial wealth greater than €17,000 (approximately the median value) and zero otherwise. Financially literate is a dummy variable is a respondent answers all questions measuring financial literacy correctly and zero otherwise.

APPENDIX B

QUESTIONNAIRES

Wave 1: QUESTIONNAIRE (to be fielded: March 30, 2018)

PROGRAMMING INFORMATION

QUESTION BLOCK

12. This question is being asked to all participants in this survey. These participants are representative of the Dutch population.

    Please choose a number from zero to 100.

    We will take your number as well as the numbers chosen by other participants to calculate the average number. The winning number will be the number that is closest to **two-thirds (2/3) of** the average number.

    The participant who filled in the winning number will receive 500 euro (if more participants have filled in the winning number, the 500 euro will be divided equally among the winners).

    Please take your time to answer this question.

Your chosen number is: ……
[ ] I do not want participate

13. Like you, other participants in this survey are asked to choose a number from zero to 100, with the goal of making their choice as close as possible to **two-thirds (2/3) of** the average choice of all participants. What percentage of other participants do you think chooses a number that falls in the listed ranges in the table below?

Chosen numbers	**Percentage of other participants**
From 0 to 9.99	…… %
From 10 to 19.99	…… %
From 20 to 29.99	…… %
From 30 to 39.99	…… %
From 40 to 49.99	…… %
From 50 to 59.99	…… %
From 60 to 69.99	…… %
From 70 to 79.99	…… %
From 80 to 89.99	…… %
From 90 to 100	…… %
Total (the percentages should sum to 100):	100 **%**

[ ] I do not know

1. How much did your household spend in **total** on purchases of **durable goods** in the last three months (January 2018 to March 2018)?
   Durable goods are goods that last in time, including for instance cars, electronics, kitchen appliances, furniture, house maintenance, jewelries, etc. (please exclude purchases of houses, apartments, etc.). Please provide an answer in euros.

Answer:…… euros
… I did not buy any durables
… I do not know

2. What do you think your household's spending on purchases of **durable goods** will be per month in the next three months (April, May and June)? Please provide an answer in euros.

April: …… euros
… I do not have plans to buy durables in this month
… I do not know

May: …… euros
… I do not have plans to buy durables in this month
… I do not know

June: …… euros
… I do not have plans to buy durables in this month
… I do not know

3. What was your households' **average** monthly spending on **nondurable goods and services** in the last three months (January 2018 to March 2018)?
Nondurable goods and services include for instance food, tobacco, alcohol, gasoline, clothing, haircuts, transportation, and other small services and nondurable goods that do not last in time. Please provide an answer in euros.

Answer: …… euros per month
… I do not know

4. What do you think your household's spending on **nondurable goods and services** will be per month in the next three months (April, May and June)? Please provide an answer in euros.

April: …… euros
… I do not know

May: …… euros
… I do not know

June: …… euros
… I do not know

5. How much higher or lower do you think **your household's** spending on **nondurable goods and services** will be in the next twelve months compared to the past twelve months?

Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the points in the column should sum to 100)

	Points
Spending increases 8% or more	……
Spending increases 4% or more, but less than 8%	……
Spending increases 2% or more, but less than 4%	……
Spending increases 1% or more, but less than 2%	……
Spending increases or decreases less than 1%	……
Spending decreases 1% or more, but less than 2%	……
Spending decreases 2% or more, but less than 4%	……

Spending decreases 4% or more, but less than 8%	……
Spending decreases 8% or more	……
Total (the points should sum to 100)	100

[ ] I do not know

6. How much higher or lower do you think total spending on **nondurable goods and services** will be for the Dutch economy (that is, **all households in the Netherlands**) in the next twelve months compared to the last twelve months.

   Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the points in the column should sum to 100)

	Points
Spending increases 8% or more	……
Spending increases 4% or more, but less than 8%	……
Spending increases 2% or more, but less than 4%	……
Spending increases 1% or more, but less than 2%	……
Spending increases or decreases less than 1%	……
Spending decreases 1% or more, but less than 2%	……
Spending decreases 2% or more, but less than 4%	……
Spending decreases 4% or more, but less than 8%	……
Spending decreases 8% or more	……
Total (the points should sum to 100)	100

[ ] I do not know

7. **The previous question was also asked to other households in the Netherlands.** We would like to know what your opinion is about what **other** households think will happen to total spending on **nondurable goods and services** in the Dutch economy in the next twelve months compared to the last twelve months.

   Please allocate 100 points in the table below indicating how likely you think it is that other households in the Netherlands indicated the listed changes. (Note that the points in the column should sum to 100)

	Points
Spending increases 8% or more	……
Spending increases 4% or more, but less than 8%	……
Spending increases 2% or more, but less than 4%	……
Spending increases 1% or more, but less than 2%	……
Spending increases or decreases less than 1%	……
Spending decreases 1% or more, but less than 2%	……
Spending decreases 2% or more, but less than 4%	……
Spending decreases 4% or more, but less than 8%	……
Spending decreases 8% or more	……
Total (the points should sum to 100)	100

[ ] I do not know

8. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months?

   Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the points in the column should sum to 100)

	Points
Net income increases 8% or more	……
Net income increases 4% or more, but less than 8%	……
Net income increases 2% or more, but less than 4%	……
Net income increases 1% or more, but less than 2%	……
Net income increases or decreases less than 1%	……
Net income decreases 1% or more, but less than 2%	……
Net income decreases 2% or more, but less than 4%	……
Net income decreases 4% or more, but less than 8%	……
Net income decreases 8% or more	……
Total (the points should sum to 100)	100

   [ ] I do not know

9. How much higher or lower do you think **consumer prices** in general in the Netherlands are now compared to **twelve months earlier**? Please provide a change in percentage terms. If you think prices on average decreased, please fill in a negative percentage (insert a minus sign for the number). If you think prices on average increased, please fill in a positive percentage. If you think prices on average did not change, please fill in 0 (zero).

Answer: …… %

10. How much do you think **consumer prices** in general will change in the **next twelve months** in the Netherlands? Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the probabilities in the column should sum to 100)

	Points
Consumer prices increase 8% or more	……
Consumer prices increase 4% or more, but less than 8%	……
Consumer prices increase 2% or more, but less than 4%	……
Consumer prices increase 1% or more, but less than 2%	……
Consumer prices increase or decreases less than 1%	……
Consumer prices decrease 1% or more, but less than 2%	……
Consumer prices decrease 2% or more, but less than 4%	……
Consumer prices decrease 4% or more, but less than 8%	……
Consumer prices decrease 8% or more	……
Total (the points should sum to 100)	100

11. How much money did you have in your checking and savings accounts and in cash on the day **before** your last regular paycheck arrived? Please do not include fixed term deposits, stocks, bonds, mutual funds, or retirement accounts, etc.

Answer: ……. euros … I do not know

If value: Don't Know
Please provide an estimate of the money you had in your checking and savings accounts and in cash on the day **before** your last regular paycheck arrived, using the categories listed below. Please do not include fixed term deposits, stocks, bonds, mutual funds, or retirement accounts, etc.

[ ] 0 – 249 euro
[ ] 250 – 499 euro
[ ] 500 – 999 euro
[ ] 1,000 – 2,499 euro
[ ] 2,500 – 4,999 euro
[ ] 5,000 – 9,999 euro
[ ] 10,000 – 14,999 euro
[ ] 15,000 - 19,999 euro
[ ] 20,000 – 29,999 euro
[ ] 30,000 - 39,999 euro
[ ] 40,000 - 49,999 euro
[ ] 50,000 - 59,999 euro
[ ] 60,000 - 69,999 euro
[ ] 70,000 – 79,999 euro
[ ] 80,000 – 89,999 euro
[ ] 90,000 – 99,999 euro
[ ] 100,000 – 149,999 euro
[ ] 150,000 – 199,999 euro
[ ] 200,000 – 249,999 euro
[ ] 250,000 – 299,999 euro
[ ] 300,000 – 399,999 euro
[ ] 400,000 – 499,999 euro
[ ] 500,000 euro or more

[ ] I do not know

EXPERIMENT & Follow-up

3 groups of respondents (~900 each, randomly selected).

a) Group A is the control group. Skip straight to "Follow-up questions" below.
b) Group B is first treatment group. They are read INFORMATION 1 below, then are asked follow-up questions below.
c) Group C is second treatment group. They are read INFORMATION 2 below, then are asked follow-up questions below.

INFORMATION 1 (for respondents in Group B): "Before we proceed, we would like to share the following information with you. In a public release **available to all Dutchmen** at no charge, the Dutch Statistical Office recently reported that the percent increase in consumer prices in February compared to 12 months earlier in the Netherlands was 1.2%".

INFORMATION 2 (for respondents in Group C): "Before we proceed, we would like to share the following information **only with you** and a few other households. The Dutch Statistical Office recently reported that the percent increase in consumer prices compared in February to 12 months earlier in the Netherlands was 1.2%".

Follow-up Questions:

Instructions: (Question 14 is skipped by respondents in group A, but asked to respondents in groups B and C)

14. What percentage of Dutchmen (aged 18 and older) do you think knows this information?

Answer: …… %
… I do not know

15. How much higher or lower do you think **your household's** spending on **nondurable goods and services** will be in the next twelve months compared to the last twelve months?

    Please provide an answer in percentage terms. If you think your household's spending on nondurable goods and services on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think your household's spending on nondurable goods and services on average will increase, please fill in a positive percentage. If you think your household's spending on nondurable goods and services on average will not change, please fill in 0 (zero).

Answer: …… %
… I do not know

16. How much higher or lower do you think total spending on **nondurable goods and services** will be for the Dutch economy (that is, **all households in the Netherlands**) in the next twelve months compared to the last twelve months.

    Please provide an answer in percentage terms. If you think total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero)

Answer: …… %
…I do not know

17. **The previous question was also asked to other households in the Netherlands.** We would like to know what your opinion is about what **other** households think will happen to total spending on **nondurable goods and services** in the Dutch economy in the next twelve months compared to the last twelve months.

Please provide an answer in percentage terms. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero).

Answer: …… %
…I do not know

18. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months? Please provide an answer in percentage terms.

    Please provide an answer in percentage terms. If you think that your household's total net income will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that your household's total net income will increase, please fill in a positive percentage. If you think that your household's total net income will not change, please fill in 0 (zero).

Answer: …… %
… I do not know

19. How much do you think **consumer prices** in general will change in the next twelve months in the Netherlands?

    Please provide an answer in percentage terms. If you think consumer prices on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think consumer prices on average will increase, please fill in a positive percentage. If you think consumer prices on average will not change, please fill in 0 (zero).

Answer: …… %

20. Finally, the last three questions. Suppose you had €100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than €102, exactly €102, less than €102

    [ ] More than €102
    [ ] Exactly €102
    [ ] Less than €102
    [ ] I do not know

21. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account: more than today; exactly the same, less than today?

    [ ] More than today
    [ ] Exactly the same
    [ ] Less than today
    [ ] I do not know

22. Do you think that the following statement is 'true' or 'false'? Buying a company stock usually provides a safer return than a stock mutual fund.

    [ ] True
    [ ] False
    [ ] I do not know

WAVE 2: QUESTIONNAIRE (to be fielded in May 2018)

1. How much did your household spend on purchases of **durable goods** in the month April 2018?
   Durable goods are goods that last in time, including for instance cars, electronics, kitchen appliances, furniture, house maintenance, jewelries, etc. (please exclude purchases of houses, apartments, etc.). Please provide an answer in euros.

Answer:…… euros … I did not buy any durables… I do not know

2. What do you think your household's spending on purchases of **durable goods** will be per month in the next two months (May and June)? Please provide an answer in euros.

May: …… euros … I do not have plans to buy durables in this month … I do not know June: …… euros … I do not have plans to buy durables in this month … I do not know

3. What was your households' spending on **nondurable goods and services** in the month April 2018?
   Nondurable goods and services include for instance food, tobacco, alcohol, gasoline, clothing, haircuts, transportation, and other small services and nondurable goods that do not last in time. Please provide an answer in euros.

April: …… euros … I do not know

4. What do you think your household's spending on **nondurable goods and services** will be per month in the next two months (May and June)? Please provide an answer in euros.

May: …… euros … I do not know June: …… euros … I do not know

15. How much higher or lower do you think **your household's** spending on **nondurable goods and services** will be in the next twelve months compared to the last twelve months?

    Please provide an answer in percentage terms. If you think your household's spending on nondurable goods and services on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think your household's spending on nondurable goods and services on average will increase, please fill in a positive percentage. If you think your household's spending on nondurable goods and services on average will not change, please fill in 0 (zero).

Answer: …… % … I do not know

16. How much higher or lower do you think total spending on **nondurable goods and services** will be for the Dutch economy (that is, **all households in the Netherlands**) in the next twelve months compared to the last twelve months.

Please provide an answer in percentage terms. If you think total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero)

Answer: …… % …I do not know

17. **The previous question was also asked to other households in the Netherlands.** We would like to know what your opinion is about what **other** households think will happen to total spending on **nondurable goods and services** in the Dutch economy in the next twelve months compared to the last twelve months.

Please provide an answer in percentage terms. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero).

Answer: …… % …I do not know

18. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months? Please provide an answer in percentage terms.

Please provide an answer in percentage terms. If you think that your household's total net income will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that your household's total net income will increase, please fill in a positive percentage. If you think that your household's total net income will not change, please fill in 0 (zero).

Answer: …… % … I do not know

8. Now we are interested in how likely you think your income will change. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months?

Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the points in the column should sum to 100)

	Points
Net income increases more than 8%	……

Net income increases more than 4%, but less than 8%	……
Net income increases more than 2%, but less than 4%	……
Net income increases more than 1%, but less than 2%	……
Net income increases or decreases no more than 1%	……
Net income decreases more than 1%, but less than 2%	……
Net income decreases more than 2%, but less than 4%	……
Net income decreases more than 4%, but less than 8%	……
Net income decreases more than 8%	……
Total (the points should sum to 100)	100

[ ] I do not know

9. How much higher or lower do you think **consumer prices** in general in the Netherlands are now compared to **twelve months earlier**? Please provide a change in percentage terms. If you think prices on average decreased, please fill in a negative percentage (insert a minus sign for the number). If you think prices on average increased, please fill in a positive percentage. If you think prices on average did not change, please fill in zero.

Answer: …… %

19. How much do you think **consumer prices** in general will change in the next twelve months in the Netherlands?

    Please provide an answer in percentage terms. If you think consumer prices on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think consumer prices on average will increase, please fill in a positive percentage. If you think consumer prices on average will not change, please fill in 0 (zero).

Answer: …… %

10. Now we are interested in how likely you think consumer prices will change. How much do you think **consumer prices** in general will change in the **next twelve months** in the Netherlands? Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the probabilities in the column should sum to 100)

	Points
Consumer prices increase more than 10%	……
Consumer prices increases more than 5%, but less than 10%	……
Consumer prices increases more than 3%, but less than 5%	……
Consumer prices increases more than 1%, but less than 3%	……
Consumer prices increases or decreases no more than 1%	……
Consumer prices decreases more than 1%, but less than 3%	……
Consumer prices decreases more than 3%, but less than 5%	……
Consumer prices decreases more than 5%, but less than 10%	……
Consumer prices decreases more than 10%	……
Total (the points should sum to 100):	100

WAVE 3: QUESTIONNAIRE (to be fielded in June 2018)

1. How much did your household spend on purchases of **durable goods** in the month May 2018?
   Durable goods are goods that last in time, including for instance cars, electronics, kitchen appliances, furniture, house maintenance, jewelries, etc. (please exclude purchases of houses, apartments, etc.). Please provide an answer in euros.

Answer:…… euros … I did not buy any durables… I do not know

2. What do you think your household's spending on purchases of **durable goods** will be in June? Please provide an answer in euros.

June: ……..…… euros … I do not have plans to buy durables in this month … I do not know

5. What was your households' spending on **nondurable goods and services** in the month May 2018?
   Nondurable goods and services include for instance food, tobacco, alcohol, gasoline, clothing, haircuts, transportation, and other small services and nondurable goods that do not last in time. Please provide an answer in euros.

May: …… euros … I do not know

6. What do you think your household's spending on **nondurable goods and services** will be in June? Please provide an answer in euros.

June: …… euros … I do not know

20. How much higher or lower do you think **your household's** spending on **nondurable goods and services** will be in the next twelve months compared to the last twelve months?

    Please provide an answer in percentage terms. If you think your household's spending on nondurable goods and services on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think your household's spending on nondurable goods and services on average will increase, please fill in a positive percentage. If you think your household's spending on nondurable goods and services on average will not change, please fill in 0 (zero).

Answer: …… % … I do not know

21. How much higher or lower do you think total spending on **nondurable goods and services** will be for the Dutch economy (that is, **all households in the Netherlands**) in the next twelve months compared to the last twelve months.

Please provide an answer in percentage terms. If you think total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero)

Answer: …… %
…I do not know

22. **The previous question was also asked to other households in the Netherlands.** We would like to know what your opinion is about what **other** households think will happen to total spending on **nondurable goods and services** in the Dutch economy in the next twelve months compared to the last twelve months.

Please provide an answer in percentage terms. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero).

Answer: …… %
…I do not know

23. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months? Please provide an answer in percentage terms.

Please provide an answer in percentage terms. If you think that your household's total net income will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that your household's total net income will increase, please fill in a positive percentage. If you think that your household's total net income will not change, please fill in 0 (zero).

Answer: …… %
… I do not know

10. Now we are interested in how likely you think your income will change. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months?

Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the points in the column should sum to 100)

	Points
Net income increases more than 8%	……
Net income increases more than 4%, but less than 8%	……
Net income increases more than 2%, but less than 4%	……
Net income increases more than 1%, but less than 2%	……
Net income increases or decreases no more than 1%	……
Net income decreases more than 1%, but less than 2%	……

Net income decreases more than 2%, but less than 4%	……
Net income decreases more than 4%, but less than 8%	……
Net income decreases more than 8%	……
Total (the points should sum to 100)	100

[ ] I do not know

11. How much higher or lower do you think **consumer prices** in general in the Netherlands are now compared to **twelve months earlier**? Please provide a change in percentage terms. If you think prices on average decreased, please fill in a negative percentage (insert a minus sign for the number). If you think prices on average increased, please fill in a positive percentage. If you think prices on average did not change, please fill in zero.

Answer: …… %

24. How much do you think **consumer prices** in general will change in the next twelve months in the Netherlands?

    Please provide an answer in percentage terms. If you think consumer prices on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think consumer prices on average will increase, please fill in a positive percentage. If you think consumer prices on average will not change, please fill in 0 (zero).

Answer: …… %

11. Now we are interested in how likely you think consumer prices will change. How much do you think **consumer prices** in general will change in the **next twelve months** in the Netherlands? Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the probabilities in the column should sum to 100)

	Points
Consumer prices increase more than 10%	……
Consumer prices increases more than 5%, but less than 10%	……
Consumer prices increases more than 3%, but less than 5%	……
Consumer prices increases more than 1%, but less than 3%	……
Consumer prices increases or decreases no more than 1%	……
Consumer prices decreases more than 1%, but less than 3%	……
Consumer prices decreases more than 3%, but less than 5%	……
Consumer prices decreases more than 5%, but less than 10%	……
Consumer prices decreases more than 10%	……
Total (the points should sum to 100):	100

WAVE 4: QUESTIONNAIRE (to be fielded in July 2018)

1. How much did your household spend on purchases of **durable goods** in the month June 2018?
   Durable goods are goods that last in time, including for instance cars, electronics, kitchen appliances, furniture, house maintenance, jewelries, etc. (please exclude purchases of houses, apartments, etc.). Please provide an answer in euros.

Answer:…… euros … I did not buy any durables … I do not know

3. What was your households' spending on **nondurable goods and services** in the month June 2018?
   Nondurable goods and services include for instance food, tobacco, alcohol, gasoline, clothing, haircuts, transportation, and other small services and nondurable goods that do not last in time. Please provide an answer in euros.

Answer: …… euros … I do not know

15. How much higher or lower do you think **your household's** spending on **nondurable goods and services** will be in the next twelve months compared to the last twelve months?

    Please provide an answer in percentage terms. If you think your household's spending on nondurable goods and services on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think your household's spending on nondurable goods and services on average will increase, please fill in a positive percentage. If you think your household's spending on nondurable goods and services on average will not change, please fill in 0 (zero).

Answer: …… % … I do not know

16. How much higher or lower do you think total spending on **nondurable goods and services** will be for the Dutch economy (that is, **all households in the Netherlands**) in the next twelve months compared to the last twelve months.

Please provide an answer in percentage terms. If you think total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero)

Answer: …… % …I do not know

17. **The previous question was also asked to other households in the Netherlands.** We would like to know what your opinion is about what **other** households think will happen to total spending on **nondurable goods and services** in the Dutch economy in the next twelve months compared to the last twelve months.

    Please provide an answer in percentage terms. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will increase, please fill in a positive percentage. If you think that other households in the Netherlands believe that total spending on nondurable goods and services for the Dutch economy on average will not change, please fill in 0 (zero).

Answer: …… %
…I do not know

18. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months? Please provide an answer in percentage terms.

    Please provide an answer in percentage terms. If you think that your household's total net income will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think that your household's total net income will increase, please fill in a positive percentage. If you think that your household's total net income will not change, please fill in 0 (zero).

Answer: …… %
… I do not know

8. Now we are interested in how likely you think your income will change. How much higher or lower do you think **your household's total net income** will be over the next twelve months compared to the last twelve months?

    Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the points in the column should sum to 100)

	Points
Net income increases more than 8%	……
Net income increases more than 4%, but less than 8%	……
Net income increases more than 2%, but less than 4%	……
Net income increases more than 1%, but less than 2%	……
Net income increases or decreases no more than 1%	……
Net income decreases more than 1%, but less than 2%	……
Net income decreases more than 2%, but less than 4%	……
Net income decreases more than 4%, but less than 8%	……
Net income decreases more than 8%	……
Total (the points should sum to 100)	100

[ ] I do not know

9. How much higher or lower do you think **consumer prices** in general in the Netherlands are now compared to **twelve months earlier**? Please provide a change in percentage terms. If you think prices on average decreased, please fill in a negative percentage (insert a minus sign for the number). If you think prices on average increased, please fill in a positive percentage. If you think prices on average did not change, please fill in zero.

Answer: …… %

19. How much do you think **consumer prices** in general will change in the next twelve months in the Netherlands?

    Please provide an answer in percentage terms. If you think consumer prices on average will decrease, please fill in a negative percentage (insert a minus sign for the number). If you think consumer prices on average will increase, please fill in a positive percentage. If you think consumer prices on average will not change, please fill in 0 (zero).

Answer: …… %

10. Now we are interested in how likely you think consumer prices will change. How much do you think **consumer prices** in general will change in the **next twelve months** in the Netherlands? Please allocate 100 points in the table below indicating how likely the listed changes are. (Note that the probabilities in the column should sum to 100)

	Points
Consumer prices increase more than 10%	……
Consumer prices increases more than 5%, but less than 10%	……
Consumer prices increases more than 3%, but less than 5%	……
Consumer prices increases more than 1%, but less than 3%	……
Consumer prices increases or decreases no more than 1%	……
Consumer prices decreases more than 1%, but less than 3%	……
Consumer prices decreases more than 3%, but less than 5%	……
Consumer prices decreases more than 5%, but less than 10%	……
Consumer prices decreases more than 10%	……
Total (the points should sum to 100):	100

APPENDIX C

TREATMENT OF OUTLIERS AND INFLUENTIAL OBSERVATIONS

Because of significant noise in both expectations and consumption data, we use the following approach to minimize the effect of outliers. In the first stage, we use the Huber-robust regression to identify influential observations (Huber-robust regression is an M-estimator). At the first stage, a simple OLS regression is fitted to calculate Cook's *D* statistic. Observations with $D > 1$ are excluded. Then the estimator works iteratively: i) run a regression to compute residuals; ii) compute weights from absolute residuals (larger residuals lead to lower weights); iii) run a regression with weights; iv) iterate between ii) and (iii) until the change in weights is below a threshold (see help for STATA's `rreg` command for more details.) In the process of running Huber-robust regressions, we generate a weight ω that quantifies the influence of each observation. In this step, Huber-robust regressions effectively eliminate (i.e., assign weight $\omega = 0$) observations with extreme predictions for future inflation (e.g., 100 percent inflation in the next 12 months). In the second stage, we use jackknife to identify influential observations. That is, we run IV regressions (which use weights ω) by dropping one observation at a time and recording the resulting coefficient β. We identify observation i as influential if it moves β by a magnitude greater than a certain threshold. To ensure that we apply the same threshold across specifications, we normalize estimated βs by the standard error of β estimated on the full sample. Belsley, Kuh and Welsch (1980, p. 28) identify influential observations as those that move the coefficient of interest by more than $2/\sqrt{\#\ obs}$ (given the number of observations per wave, this would mean that the threshold is approximately 0.05), but it is also common practice to use a threshold of 1 (Bollen and Jackman 1990, p. 267). We use a threshold of 0.1 for specifications estimated on a single wave and 0.05 for specifications estimated on data pooled across waves. These thresholds eliminate less than 1 percent of the sample.

Belsley, A. David, Edwin Kuh, and Roy E. Welsch. 1980. *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*. New York: Wiley.

Bollen, A. Kenneth, and Robert W. Jackman. 1990. Regression diagnostics: An expository treatment of outliers and influential cases. In *Modern Methods of Data Analysis*, ed. J. Fox and J. S. Long, 257–291. Newbury Park, CA: Sage.