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Abstract

Forecast errors for inflation decline monotonically with both verbal and quantitative IQ in a large and representative male population. Within individuals, inflation expectations and perceptions are autocorrelated only for men above the median by IQ (high-IQ men). High-IQ men's forecast revisions are consistent with the diagnostic-expectations framework, whereas anything goes for low-IQ men. Education levels, income, socioeconomic status, or financial constraints do not explain these results. Using ad-hoc tasks in a controlled environment, we investigate the channels behind these results. Low-IQ individuals' knowledge of the concept of inflation is low; they associate inflation with concrete goods and services instead of abstract economic concepts, and are less capable of forecasting mean-reverting processes. Differences in expectations formation by IQ feed into choice—only high-IQ men plan to spend more when expecting higher inflation as the consumer Euler equation prescribes. Our results have implications for heterogeneous-beliefs models of consumption, saving, and investment.

JEL classification: D12, D84, D91, E21, E31, E32, E52, E65

Keywords: Behavioral Macroeconomics, Heterogeneous Beliefs, Limited Cognition, Expectations Formation, Household Finance.

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Theoretically, deviations from the paradigm of rational choice have a long history in economics (Simon (1955)). Empirically, subjective expectations display large cross-sectional variation and deviate from the rational benchmark (Manski (2004); Coibion et al. (2018)). And, yet, after the rational-expectations revolution, most macroeconomists lost interest in understanding how individuals form expectations under the conviction that the standard model implies the expectations of the representative agent directly. But because subjective expectations are the ultimate drivers of individual saving and consumption choices at the micro level, and hence of aggregate outcomes (Gennaioli and Shleifer (2018)), macroeconomists have recently moved to understand how agents form, update, and act upon their own subjective economic expectations.[1]

Forming expectations and making economic decisions require the use of cognitive resources—cognition might affect individuals' ability to gather information about economic variables, the ability to solve resource-allocation problems over time, and the ability to grasp basic economic reasoning and intuition. Cognitive abilities are therefore a natural candidate to help explain subjective economic expectations and choice (Falk, Becker, Dohmen, Enke, Huffman, and Sunde (2018)).

Assessing how cognitive abilities shape consumers' economic expectations and choices faces a major empirical challenge. The econometrician needs to jointly measure the cognitive abilities, macroeconomic and individual subjective expectations, and the economic choices of a representative population. Most existing data sources that include proxies for cognitive abilities, such as the *Health and Retirement Study* (HRS) that produced important microeconomic research on the beliefs and decision-making of the elderly (e.g., see Manski (2018)), are not viable in this case. They only survey elderly populations, they are run every two years, which makes studying the process of updating expectations over time difficult, and they only include questions about individual expectations such as retirement age and longevity. Observing macroeconomic expectations is crucial to understanding whether any effects of limited cognition might

[1]See also Landier, Ma, and Thesmar (2018), Bordalo, Gennaioli, and Shleifer (2018), Gennaioli, Ma, and Shleifer (2018), Armantier, Bruine de Bruin, Topa, Klaauw, and Zafar (2015), Crump, Eusepi, Tambalotti, and Topa (2018), Bachmann, Berg, and Sims (2015), Glaeser and Nathanson (2017), Fuster, Perez-Truglia, Wiederholt, and Zafar (2018), Malmendier and Nagel (2016), Roth and Wohlfart (2018), D'Acunto, Hoang, and Weber (2019), Das, Kuhnen, and Nagel (2017), D'Acunto, Malmendier, Ospina, and Weber (2019), D'Acunto, Malmendier, and Weber (2019), Fuster, Kaplan, and Zafar (2018), Andre, Pizzinelli, Roth, and Wohlfart (2019), Vellekoop and Wiederholt (2017), and Ben-David, Fermand, Kuhnen, and Li (2018).

matter for aggregate outcomes and for the effectiveness of policies that operate through managing such expectations. Moreover, because the realizations of macroeconomic variables are observable and common to all consumers, they allow for studying the accuracy of expectations by comparing forecasts with subsequent realizations.

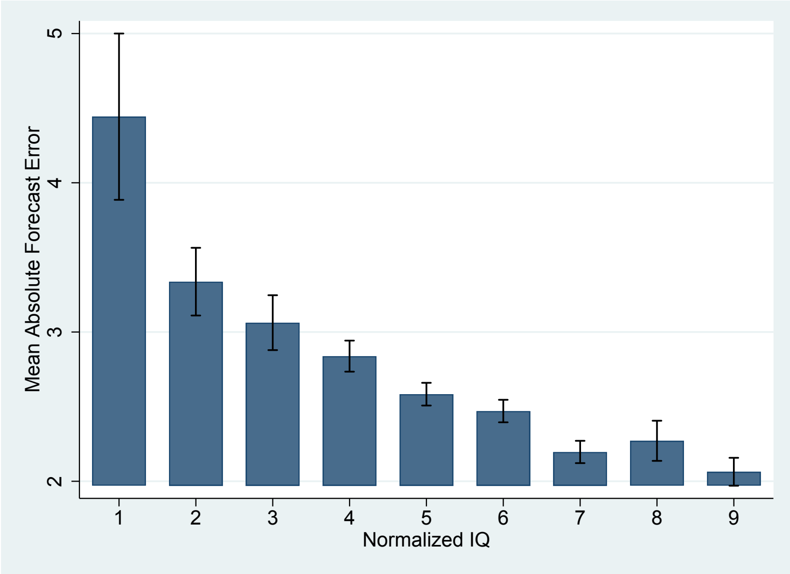
To overcome this empirical hurdle, we match—for the first time, to the best of our knowledge—individual-level administrative data on cognitive-ability tests administered to the quasi-universe of Finnish men, with survey-based information on macroeconomic forecasts, as well as on the consumption, saving, and borrowing plans of a representative sample of this population.

We use these unique data to first assess the extent to which cognitive abilities help explain the cross-sectional variation in subjective macroeconomic expectations. Because our data include a full-panel component that elicits numerical expectations every six months, we also assess how cognitive abilities relate to the process of updating macroeconomic expectations within individuals. Moreover, we study how agents' economic and financial plans react to their expectations based on cognitive abilities. To understand the possible channels that might explain the differences in expectations and choice by cognitive abilities, we recruited a large US population and elicit their cognitive abilities and have them perform a set of tasks in a controlled environment, as we discuss in detail below.

The majority of our analysis focuses on inflation expectations, because in most macroeconomic models, inflation expectations drive the consumption, saving, and borrowing decisions of individuals, workers' wage bargaining with firms, and managers' price-setting decisions. Ultimately, inflation expectations determine the effectiveness of fiscal and monetary policy (Bernanke (2007)). Inflation is also one of the few macroeconomic variables consumers recognize as important and relevant to their daily-life decision-making (Di Tella, MacCulloch, and Oswald (2001)).

Figure 1 plots the average absolute forecast error for inflation across bins by IQ-test scores. Forecast error is the difference between an individual's numerical forecast of 12-month-ahead inflation and actual inflation measured after 12 months. The average absolute forecast error for individuals with the lowest cognitive abilities (normalized score of 1) is 4.3 percentage points. The absolute forecast errors decrease monotonically with IQ. The difference in absolute forecast errors between men with median cognitive abilities and men with the highest cognitive abilities is 0.6 percentage points, which is 30% of the

Figure 1: **Mean Absolute Forecast Error for 12-Month-Ahead Inflation by IQ**



This figure plots the average absolute forecast error for inflation (in percentage points) across IQ levels. Forecast error is the difference between the numerical forecast for 12-month-ahead inflation and ex-post realized inflation. Vertical lines represent 95% confidence intervals around the estimated mean for each bin. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

forecast error of the highest-IQ individuals. Comparing 95% confidence intervals across IQ levels, we can statistically and economically reject the null hypothesis of identical forecast error across most adjacent IQ levels. Interestingly, the average absolute forecast errors are large across the *whole* IQ distribution relative to the average realized inflation rate of 1.66% during our sample period and the official inflation target of the European Central Bank (ECB) of close to, but below, 2%. Even consumers with the highest levels of IQ form inaccurate expectations about macroeconomic variables, on average.

The monotonic pattern by IQ is similar when we consider proxies for the uncertainty of respondents' inflation expectations, such as their tendency to report round numbers or implausible values (see, e.g., Manski and Molinari (2010); De Bruin et al. (2011); and Binder (2017)). The raw-data results do not change if we absorb time-varying economy-wide shocks at the monthly level, as well as a rich set of demographics that include age, income, education levels, socio-economic status, marital status, employment status, number of children, and rural versus urban residence. These demographics represent dimensions that earlier research has related to macroeconomic expectations, as well as potential determinants of households' consumption baskets that shape the inflation expectations of Americans (D'Acunto, Malmendier, Ospina, and Weber (2019)). Consistent with earlier research, we find these observables are important determinants of expectations and choice, but they barely help explain the relationship between IQ and expectations.

The field data are not comprehensive enough to delve into the channels that might explain these cross-sectional differences in inflation expectations by IQ. We thus fielded a survey instrument on Amazon Mechanical Turk (MTurk) to administer ad-hoc tests for a set of non-mutually-exclusive potential channels.[2] This controlled environment is also important because it allows us to recruit both men and women from a different population than Finns, which helps assess whether the facts we document are likely to generalize across genders and across space.

Several differences emerge in the ways in which individuals approach the problem of forming inflation expectations based on their cognitive abilities. First, we find that low-IQ individuals have lower knowledge of the concept of inflation, based on their answers to questions about the implications of inflation. Moreover, low-IQ individuals think about inflation differently than others—they think about the prices of concrete goods and services they experience in their daily lives, such as gas or purchases on Amazon. By contrast, high-IQ individuals are more likely to associate inflation with abstract and general economic concepts such as the overall price level, wages, and savings.

Beyond these differences in the knowledge and conceptualization of inflation, we find low-IQ individuals make larger errors when forecasting generic mean-reverting processes, especially for processes that have lower volatility and hence are easier to forecast (Landier et al. (2018)). This result likely reflects a lower ability to think in probabilistic terms by low-IQ individuals (McDowell and Jacobs (2017)), irrespective of their knowledge and understanding of economic concepts.

The last channel we consider is respondents' ability to map news about inflation into optimal economic decisions in scenario analyses. We find that low-IQ individuals have a lower ability to propose meaningful choices in these scenarios, whereas high-IQ individuals are more likely to choose the options that would arise in a standard dynamic

[2]We thank Andrei Shleifer for inspiring this analysis.

macro models, such as those the consumer Euler equation prescribes.[3]

After having assessed how and why cognitive abilities might help explain the cross-sectional differences in consumers' inflation expectations, we move on to study the formation and updating of inflation expectations within individuals by exploiting the panel component of our Finnish field data. Because realized inflation is highly persistent, under rational expectations, we would expect a positive correlation between a consumer's recent inflation forecast and her current inflation forecast, on average (Landier et al. (2018)). Whereas we do detect such positive correlation for high-IQ men, we fail to detect any correlation for low-IQ men. Moreover, past expectations of future inflation should be correlated with current perceptions of realized inflation if no major news about inflation occurred between the two interview periods. We find an economically and statistically significant association between past expectations and current perceptions of inflation for high-IQ men that is five times larger than the association for low-IQ men. The association for high-IQ men is higher across interview periods with stable inflation, whereas it drops across periods of volatile inflation, during which news about inflation intervened across subsequent interviews. Similar to the other tests, we do not detect any variation in the (low) consistency of inflation expectations for low-IQ men.

Despite the economic and statistical significance of the correlations for high-IQ men, the size of the estimated coefficients is significantly lower than 1, even at times of stable inflation, which suggests the rational-expectations framework does not accurately describe the expectations of high-IQ men either. Motivated by this observation, we test whether individuals' tendency to overreact or underreact to macroeconomic news might help describe the expectations-formation process of high-IQ men. To do so, we estimate the relationship between forecast errors and forecast revisions within individuals (see Coibion and Gorodnichenko (2012), Coibion and Gorodnichenko (2015), Bordalo, Gennaioli, Ma, and Shleifer (2018)). Consistent with the diagnostic-expectations framework (Bordalo, Gennaioli, Ma, and Shleifer (2018)), we do find evidence that high-IQ men overreact to macroeconomic news when forming inflation forecasts. The evidence for low-IQ men is mixed—they overreact to a lesser extent than high-IQ men, and over-reaction is not statistically significant within individuals.

[3]Scenario analyses are important because they completely rule out the possibility that MTurk respondents could find answers online during the limited time they had available for the survey. Although implausible given the response time, we cannot completely rule out this possibility for questions about the knowledge of the concept of inflation.

Overall, we interpret our evidence as suggesting that high-IQ men overreact to news when forming macroeconomic expectations but update their forecasts in the correct direction. For low-IQ men, instead, we do not find unambiguous evidence in support of any existing framework of expectations-formation. Low-IQ men's expectations are not adaptive, they are not rational, and they are barely consistent with the diagnostic-expectations framework. With low-IQ men—who in our sample represent 50% of the representative population we study—anything goes in terms of expectations formation and updating over time.

In the last part of the paper, we test whether the heterogeneity of individual expectations by cognitive abilities matters for economic decision-making. As a first step, we assess whether IQ levels relate to Finns' understanding of intertemporal substitution. Specifically, we test whether individuals adjust their durable consumption plans to their inflation expectations, as the consumer Euler equation prescribes, after keeping constant income expectations and other macroeconomic expectations (Bachmann, Berg, and Sims (2015)). The consumer Euler equation is at the core of all dynamic macro models. Several central banks relied on intertemporal substitution when implementing policies to raise inflation expectations during the Great Recession in the hope of stimulating consumption.[4]

Because the numerical inflation expectations of low-IQ men are inaccurate and such individuals might be aware of their inability to forecast inflation precisely, in principle, they might actively decide not to employ their numerical inflation expectations when forming spending plans. We thus follow D'Acunto, Hoang, and Weber (2019) and create a qualitative measure of inflation expectations—a dummy variable that equals 1 when a household expects inflation to increase over the following 12 months relative to the previous 12 months. D'Acunto et al. (2019) show that this qualitative measure tracks closely ex-post inflation rates even for individuals with low levels of sophistication. If low-IQ individuals were aware of their biases and understood intertemporal substitution, we would expect that at least their accurate qualitative inflation expectations would be associated with their purchasing plans.

Within high-IQ men, respondents who think inflation will increase going forward are

[4] Yellen (2016) is a good example: "With nominal short-term interest rates at or close to their effective lower bound in many countries, the broader question of how expectations are formed has taken on heightened importance. Under such circumstances, many central banks have sought additional ways to stimulate their economies, including adopting policies that are directly aimed at influencing expectations of future interest rates and inflation."

about 4% more likely to state it is a good time to purchase large-ticket items relative to other high-IQ men. Instead, when we consider the subsample of low-IQ men, we detect a small, negative, and statistically insignificant association between qualitative inflation expectations and willingness to spend. These results hold conditional on the rich set of demographics we discussed above and suggest that even if low-IQ men held plausible inflation expectations—for instance, because policymakers successfully anchored expectations or provided information about professional forecasts—low-IQ men might still not behave in line with the predictions of standard macroeconomic models.

We also consider respondents' saving and borrowing motives, even if we can only observe these dimensions for a restricted portion of our sample. We find high-IQ and low-IQ men do not differ based on their propensity to save part of their monthly income—if anything, high-IQ men are less likely to save in general. High-IQ men, though, are more likely to save for retirement relative to saving for current purposes. High-IQ men might thus understand the trade-off between current consumption and future consumption better than low-IQ men (Falk et al. (2018)). Moreover, high-IQ men are as likely as low-IQ men to borrow to finance current consumption, but high-IQ men are more likely to borrow to finance current or future education-related costs. Overall, we interpret these results as consistent with high-IQ men being more forward-looking than low-IQ men.

When assessing the channels that might explain the differences in mapping inflation expectations to economic choice, one might think low-IQ men are more likely to be financially constrained than high-IQ men, which would explain the insensitivity of their consumption plans to changes in real interest rates (see Zeldes (1989)). Note that income and IQ have a correlation of 0.15 only in our sample, and conditioning on income does not affect any of our results. We find that even low-IQ individuals in the top quarter of the population by income are insensitive to their inflation expectations when forming spending plans, which casts doubt on the ability of this channel to explain our results.

Another possibility is that expecting higher economic growth and hence higher household income might deliver a spurious positive relationship between the propensity to spend and inflation expectations. Because we can observe respondents' income expectations elicited at the same time as their inflation expectations, we can test for this channel directly in the data and we rule it out.

Demographic-based channels do not seem able to explain our results in full. We thus move on to propose field-data proxies for the non-mutually exclusive channels in the formation and updating of expectations we tested on MTurk. First, low-IQ men might be less informed about economic fundamentals like inflation than high-IQ men. The cognitive costs of gathering information about macroeconomic variables might be high for low-IQ men, who might thus behave rationally by deciding to not gather such information. We find that even the subset of low-IQ men whose perceptions about recent inflation rates is correct do not adjust their spending plans in response to their inflation expectations.

Because low-IQ men have more difficulty thinking in probabilistic terms and forecasting in general, even well-informed low-IQ men might have miscalibrated expectations about macroeconomic variables, which might in turn explain their non-reaction to inflation expectations when forming spending plans. In the data, however, we find that even low-IQ men who have accurate inflation expectations do not react to such expectations when forming consumption plans.

Finally, we consider consumers' inability to map future states of the world into optimal economic choice due to limited cognition, which Ilut and Valchev (2017) study theoretically. Under this framework, even low-IQ agents who have the right information about current inflation and are able to forecast future states of the world accurately might not understand basic economic concepts such as intertemporal substitution and hence not act accordingly.[5]

Although we do not have conclusive evidence in favor of this channel, we find the differences between high-IQ and low-IQ men drop substantially and almost disappear within the subsample of respondents who have an economics or business degree. In this subsample, the correlation between IQ and forecast errors almost disappears. Moreover, in this subsample even low-IQ individuals who expect higher inflation increase their readiness to spend as predicted by the consumer Euler equation.

We would like to stress the potential relevance of this channel analysis for policymaking. Because information about inflation has little effect in reducing the differences in economic plans and choice across individuals by cognitive ability, policies relying on managing households' expectations directly through communicating inflation targets might be less effective than predicted by the models policy institutions use. Even providing information about experts' forecasts of future macroeconomic variables might be ineffective in influencing low-IQ men's economic choices, because low-IQ men

[5]Note this channel could also explain the excess sensitivity of consumption to predictable income changes (see, e.g., Parker et al. (2013)).

who forecast accurately are still unable to map this information into optimal economic behavior. Ultimately, these policies based on communicating inflation targets might even increase wealth inequality through a redistribution from low-IQ individuals, who barely react and hence do not take advantage of the monetary incentives the policies create, to high-IQ individuals (D'Acunto et al. (2018)). Thus, providing information about future macroeconomic variables to manage consumers' expectations might not be enough to change consumers' economic plans. Instead, explaining *why* such information matters for choice and how consumers should change their consumption, saving, or investment decisions.

Related Literature. Our findings stress the importance of cognitive abilities in shaping individual economic decision-making. Papers that document the role of IQ in financial decision-making are Grinblatt, Keloharju, and Linnainmaa (2011), who study the effect on stock market participation, Grinblatt, Keloharju, and Linnainmaa (2012), who study the effect on trading behavior, and Grinblatt, Ikäheimo, Keloharju, and Knüpfer (2016), who study mutual fund choice. Agarwal and Mazumder (2013) relate cognitive abilities to suboptimal use of credit cards and home-equity loan applications. Aghion, Akcigit, Hyytinen, and Toivanen (2017) use micro-level data on visuospatial IQ to study the effects of cognitive abilities, education, and parental income on inventiveness. Dal Bo, Finan, Folke, Persson, and Rickne (2017) relate IQ to the likelihood individuals enter political careers in Sweden. In a broad, comprehensive, and representative study of global preferences, Falk et al. (2018) document the relationship between survey respondents' self-reported cognitive abilities and their economic preferences. More broadly, a large literature has studied the role of cognition as well as the deterioration of cognitive abilities with aging on a several features of economic preferences and beliefs about personal outcomes.[6] Our paper contributes to this strand of literature by linking cognitive abilities to macroeconomic expectations and subsequent choices, which allows the measurement of forecast errors based on objective and common realization to all consumers. Moreover, we investigate how cognitive abilities relate to consumers' view of the economy and the ways in which they conceptualize economic concepts. The large variation by cognitive abilities

[6]For instance, see Frederick (2005); Heckman et al. (2006); Chabris et al. (2008); Hanushek and Woessmann (2008); Agarwal, Driscoll, Gabaix, and Laibson (2009); Oechssler et al. (2009); Borghans et al. (2009); Burks et al. (2009); Banks et al. (2010); Dohmen et al. (2010); McArdle et al. (2011); Benjamin et al. (2012); Benjamin et al. (2013); Agarwal and Mazumder (2013); Choi et al. (2014); Kautz et al. (2014); Gerardi et al. (2013).

we uncover speaks to the relevance of considering subjective models of the macroeconomy both under the research and policy perspectives (Andre et al. (2019)).

In our paper, we use a test-based measure of cognitive abilities because such a measure is available for a large population of men in a developed country through administrative sources. We do not claim that the measure we use is the best possible measure of cognitive abilities, or that producing one single measure of cognitive abilities is the best way to assess individuals' intelligence and other potentially related traits.[7] In the ideal test, we would have produced a set of measures for several traits related to intelligence and cognition by contacting directly the population of interest and using elicitation methods aligned with the most recent state of the art in this area. Unfortunately, producing these types of measures might be feasible for a limited population under study but not for a large, representative population, whose analysis is the main contribution of our paper.

We focus our study on how individuals form inflation expectations and whether they adjust their consumption, savings, and borrowing plans to their inflation expectations. Other recent contributions studying the formation and updating of expectations and the relationship with economic behavior are Zafar (2011), who studies the formation of expectations by college students, Malmendier and Nagel (2016) and Kuchler and Zafar (2018), who study the effect of personal experiences on expectations about aggregate outcomes, Fuster, Perez-Truglia, Wiederholt, and Zafar (2018), who study how agents acquire and process information for national home price expectations, Coibion, Gorodnichenko, and Kumar (2018), who study how firms form inflation expectations, Bachmann et al. (2015), who are the first to study the consumer Euler equation at the micro level, Crump et al. (2018), who study the consumer Euler equation using the microdata from the novel Survey of Consumer Expectations from the New York Fed, D'Acunto et al. (2019) and D'Acunto et al. (2018), who use preannounced consumption tax changes to causally relate inflation expectations to consumption plans, D'Acunto et al. (2019) and Cavallo, Cruces, and Perez-Truglia (2017), who show individuals extrapolate from the realized inflation experienced in their shopping bundle to overall inflation expectations, Rozsypal and Schlafmann (2017), who document an overpersistence bias in income expectations and study how it relates to consumption plans, and Coibion et al. (2019), who study how different forms of monetary-policy communications causally change

[7] For detailed summaries and for the evolution of this long-standing debate over time, see Weinberg (1989) and Stanovich (2009), among others.

individuals' inflation expectations. These papers do not focus on the heterogeneity in how agents form expectations by cognitive abilities.

I Data

Our analysis uses three micro datasets that include individual-level information on macroeconomic expectations, consumption and borrowing plans, and cognitive abilities, as well as administrative information on household-level income.

A. Data on Cognitive Abilities

Finland has general conscription for men, which means all Finnish men between the ages of 18 and 60 are liable for military or non-military service. The share of men who do non-military service is only about 3% of all men who start military service.[8] Within the first weeks of the mandatory military service, Finnish men typically around the age of 19-20 have to participate in a series of tests. The Finnish Defence Forces (FDF) administer these tests and use the results to select candidates for possible officer training. Because ranking well in the IQ test provides a set of advantages in terms of quality of training and access to elite social networks, men have an incentive to perform as well as possible on the test (Grinblatt et al. (2011)).

The cognitive-ability test consists of 120 questions that focus on three areas – visuospatial, mathematical, and verbal. The FDF aggregates those scores into a composite measure of cognitive abilities, which we label collectively as IQ. The FDF standardizes IQ to follow a stanine distribution. Stanine (STAndard NINE) is a method of scaling test scores on a 9-point standard scale with a mean of 5 and a standard deviation of 2, approximating a normal distribution. The respondents with the lowest 4% of test scores are at least 1.75 standard deviations from the mean and are assigned a standardized IQ score of 1, and the 4% with the highest test scores are assigned a standardized IQ score of 9. Hence, most of the mass of our observations is around the median bin, whereas the extreme bins account for only a small part of the sample. We have test results for all participants from 1982 until 2001.

Finland is a homogeneous country in terms of cultural background and opportunities.

[8]Please see https://puolustusvoimat.fi/en/conscription for these and additional details.

Access to education, including college education, is virtually for free. The country is also racially homogeneous (Grinblatt et al. (2011)). These features make the Finnish setting a desirable laboratory because our measures of IQ are unlikely to proxy for differences in cultural or environmental factors, which individuals could manipulate, but are more likely to reflect differences in innate abilities across individuals.

B. Data on Expectations, Spending, and Borrowing Plans

Our main source of information on individual-level macroeconomic expectations and consumption and borrowing propensities are the confidential micro data underlying the Consumer Survey of Statistics Finland. Statistics Finland conducts the survey on behalf of the Directorate General for Economic and Financial Affairs of the European Commission as part of the European Commission's harmonized consumer survey program.[9] Every month, it asks a representative repeated cross section of approximately 1,500 Finns questions about general and personal economic conditions, inflation expectations, and willingness to spend on consumption goods. Statistics Finland also collects additional information through supplementary questions on plans to save and borrow.

We obtained access to the micro data underlying the survey for the period starting in March 1995 and ending in March 2015. Until December 1999, Statistics Finland ran the survey using rotating panels. In the rotating panels, the same person within a household answered the survey three times at six-month intervals, and each month one-third of the sample was replaced. Since January 2001, the survey has employed random samples that change completely from month to month.[10] The samples are drawn from the total population of 4.4 million individuals and 2.6 million households residing in Finland. The survey is run through phone interviews. In advance of the phone interview, Statistics Finland notifies all target individuals with a letter that contains information about the contents and logistics of the survey. Our analysis employs the purely cross-sectional data starting in 2001, with the exception of section IV, in which we exploit the panel dimension to study variation in expectations within individual over time.

We use the answers to the following two questions in the survey to construct the variables capturing spending plans and inflation expectations in our baseline analysis:

[9] D'Acunto et al. (2019) use the micro data for several European countries and discuss in detail the survey design and data properties.

[10] The data for 2000 are missing, unfortunately.

Question 10 *In view of the general economic situation in Finland, do you think that now it is the right moment for people to buy durable goods such as furniture, home appliances, cars, etc.?*

Respondents can answer, "It's neither a good nor a bad time," "No, it's a bad time," or "Yes, it's a good time."

Question 7 *By what percentage do you think consumer prices will change over the next 12 months?*

Respondents can answer numbers between -100 and 100 with one decimal point.

In addition, we use qualitative questions regarding expectations about general macroeconomic variables, personal income and unemployment, and a rich set of socio-demographics from Statistics Finland, which include gender, age, marital status, household size, and education levels.

C. Data on Income from Tax Returns

We also have access to administrative income and debt data for all Finnish full-time residents at the end of each calendar year through Statistics Finland. The data contain information on individuals' labor and business incomes, received and paid income transfers, as well as overall household taxable assets and liabilities. The information is collected from underlying sources across various agencies (Tax Administration, National Institute for Health and Welfare, Statistics Finland, Kela), administrative registers, and statistical repositories.

D. Descriptive Statistics

Table 1 contains the descriptive statistics for the main variables in our analysis. Mean inflation expectations during our cross-sectional sample are 2.5% with large cross-sectional dispersion of 3.76%. Mean household income is EUR 22,500 and the average age is 30.7 years. 5.8% are unemployed in our sample, 60% are single, and 77.6% have children. In our running sample, 35.6% of men live in urban areas, with 27.8% living in Helsinki, and 34% have a college degree.

On average, 51% of respondents say it is a good time to buy durables, 20% say it is a bad time, and the others are indifferent. On average, 72% of men save in general and 29.5% save for retirement. Fifteen percent of Finns borrow money for education and 31.3% borrow for consumption.

Table 2 reports average inflation expectations and standard deviations within each stanine of the distribution by IQ. Both the mean and the cross-sectional dispersion in inflation expectations are higher for low-IQ men than for high-IQ men and decrease monotonically in IQ. Note the number of observations is not symmetric around bin 5, but we observe systematically lower mass in the left tail of the distribution than in the right tail. In some of our analyses, we split our sample between groups 1 to 5 (low-IQ mean) and groups 6-9 (high-IQ men) to obtain subsamples of similar size.

The asymmetry of the distribution of the survey responses by IQ might raise concerns about sample selection,[11] because the underlying distribution of IQ we obtain from the FDF is symmetric around 5. Only after merging the IQ data with the consumer-expectations survey do we observe the asymmetry. Conversations with survey experts at Statistics Finland suggest a nonnegligible fraction of Finns who are contacted to complete the survey decline to do so. Low-IQ men might be more likely to decline to participate in the survey relative to high-IQ men. If the low-IQ men who decline are those who have severe cognitive problems or know they have a limited knowledge of their surroundings, we would expect these men would perform even worse, on average, than the surveyed low-IQ men in forecasting inflation and making economic choices. In this case, the empirical effects we estimate in this paper might be a lower bound of the actual effects we would expect if everybody in the population provided expectations and plans.

II IQ and Expectations across Individuals

The first part of our analysis tests whether any systematic heterogeneity exists in the precision and consistency with which economic agents form their inflation expectations based on cognitive abilities. We also assess the potential heterogeneity in the relationship between expectations and IQ by demographic splits.

[11]We thank Kathrin Schlafmann for emphasizing this point.

A. Forecast Errors

We start by analyzing the association between IQ levels and the precision and accuracy of inflation expectations in the raw data. First, we compute the forecast error for inflation at the individual level as the difference between the numerical forecasts for 12-month-ahead inflation and ex-post realized inflation.

In Figure 1 in the Introduction, we compute the average of the absolute values of the individual forecast errors within each stanine of normalized IQ scores. The graph documents a monotonic negative association between forecast errors for inflation and cognitive abilities. Men in the lowest IQ stanine have an average absolute forecast error of about 4.4%, whereas men in the highest stanine have an absolute forecast error of about 2%, which is more than 50% smaller. Two patterns are worth noticing. First, the monotonic relationship between absolute forecast errors and cognitive abilities is non-linear, and cognitive abilities display a decreasing marginal improvement on forecast errors. Second, respondents with the lowest cognitive abilities are not the only drivers of the patterns in the data. In fact, Figure 1 shows that individuals just below the median stanine (4) display forecast errors that are more than 40% larger than individuals in the top stanine.

We repeat the analysis for the bias in forecasts—the mean forecast error. In this alternative definition, we allow for positive and negative deviations of inflation expectations from ex-post realized inflation to wash away. Figure 2 reports the results, and replicates all the patterns in Figure 1, although the association is slightly flatter for levels of IQ above the median.

A.1 Forecast Errors by Income and Education

The univariate association between IQ bins and forecast errors might proxy for other individual-level characteristics, and especially for income or education levels. In fact, IQ bins and taxable income might be positively associated, but we find the correlation between IQ and income levels, despite being positive, is quite low (0.15).[12]

To assess the extent to which this interpretation might be relevant in our setting, we first repeat the univariate analysis of Figure 2, plotting average forecast errors across

[12] D'Acunto et al. (2018) show average income by IQ stanine is monotonically increasing similar to the pattern in Grinblatt et al. (2011). Large idiosyncratic variation in income at the individual level seems to result in the low correlation at the individual level.

categories of income and education level. In Panel A of Figure 3, we split our sample into nine bins of income and report the average forecast errors for individuals in each bin. Notably, we fail to detect any monotonic association between the average forecast error and income levels. If anything, average errors are higher for the income levels above the median—with the notable exception of the top bin—than for the income levels below the median.[13] These results underscore the desirability of the Finnish setting, which allows us to disentangle meaningfully the variation in cognitive abilities from the variation in labor income to explain the cross section of expectations.

Panel B of Figure 3 reports a similar analysis for splitting the sample into six groups based on education levels. We follow the *International Standard Classification of Education* to construct the six groups.[14] We fail to detect a negative association as stark as the one by the IQ bins between education levels and average forecast errors, although the association is slightly negative. These results suggest variation in IQ levels exist among individuals that obtain the same formal degree. Note the overall amount of learning of individuals holding the same degree might differ across IQ levels,[15] but at least in terms of observable levels of education, we do not detect differences in forecast errors as large as the differences across the IQ distribution. In our multivariate analysis below, we will partial out education-level fixed effects to only exploit variation in forecast errors not explained by different education levels.

Our analysis of the raw data suggests the potential of observed characteristics to explain the association between forecast errors and IQ is low. For a direct test, we perform a multivariate analysis in which we regress individual-level forecast errors on a dummy variable that equals 1 if the individual belongs to the top four stanines of the normalized IQ distribution (6 to 9), and 0 otherwise, year-month fixed effects, and a rich set of demographics. Demographics include age, age^2, a dummy that equals 1 if the respondent is single, and 0 otherwise, log of income, a dummy that equals 1 if the respondent has a college degree, and 0 otherwise, an unemployment dummy, a dummy that equals 1 if

[13] This result does *not* imply that labor income and IQ are not correlated, because correlation is not transitive. Indeed, we detect a positive correlation between IQ and labor income, although the correlation coefficient is not high (0.15). If we average income across IQ bin, we detect a monotonic association between these two variables.

[14] The classification includes eight categories, with the first two categories not present in our sample. The categories are: primary education (1), lower secondary education (2), upper secondary education (3), post-secondary non-tertiary education (4), short-cycle tertiary education (5), bachelor (6), master (7), and doctoral (8).

[15] We thank Basit Zafar for stressing this point.

the respondent has at least one child, and 0 otherwise, a dummy that equals 1 if the respondent lives in a urban area, and 0 otherwise, and a dummy that equals 1 if the respondent lives in Helsinki, and 0 otherwise. On average, the mean absolute forecast error is 0.24 percentage-points lower for high-IQ men than for low-IQ men (see column (1) of Table 3).

A.2 Forecast Errors by IQ: Demographic Splits

To further investigate the role of observables in shaping the relationship between IQ and expectations, we perform a multivariate analysis across a set of sample splits in Table 3. We first aim to capture the potential differences in households' consumption baskets related to observables. Household consumption baskets, and especially the price changes households observe for the goods they typically purchase, are important determinants of expectations about general inflation (D'Acunto et al. (2019)). We compare the size of the association between IQ and absolute forecast errors for inflation separately for single and married respondents (column (2)), respondents below and above age 35 (column (3)), urban and rural respondents (column (4)), and respondents earning more than the median labor income in the sample (column (5)).

Across the board, we find IQ is economically and statistically negatively associated with absolute forecast errors for inflation within each sample split. In terms of heterogeneity across groups, some differences in the association between IQ and forecast errors are noteworthy, even though we typically fail to reject the null hypothesis that the point estimates across splits are equal. High IQ is associated with a larger reduction in forecast errors within young respondents than within old respondents. Even though our paper is agnostic about the driving force behind the result, one potential explanation could be that cognitive abilities deteriorate with age. We observe IQ around age 20 for all respondents, and we might expect that within our sample, some men that were in the top part of the IQ distribution when they took the test have lower cognitive abilities at the time of the survey. We also observe a stronger effect of IQ on forecast errors within high-income men and men living in rural areas.

The second set of splits we consider refer to proxies for the extent to which households might easily obtain information about inflation and the extent to which households understand basic economic concepts. We estimate the baseline specification for respondents with or without a college degree (column (6)), and respondents with a degree in the areas of economics, business, law, or information, and other respondents (column (7)). We find the association between IQ and absolute forecast error for inflation is about half the size for college-educated respondents and respondents with economic-related degrees than for others. This result suggests the ability to process information or the grasping of basic economic concepts might be a substitute for cognitive abilities when forming expectations about inflation. At the same time, IQ is still economically and statistically significantly negatively associated with absolute forecast errors for inflation even for respondents who are more educated or have economics-related degrees.

A concern with our analysis so far is that cognitive abilities and macroeconomic expectations were elicited at different points in time for the men in our sample. IQ is measured for all men at the beginning of the military service—around age 19. Expectations, instead, are elicited at different ages for different men. One might worry that IQ measured at age 19 is not a good proxy for cognitive abilities at different points in one's life cycle, and especially might be a bad proxy for men who appear in our survey at elderly ages. To address this issue, we split our sample into three groups based on the time between the date the IQ test was taken and the date at which the individual participated in the expectations survey, and test if our results differ across these three groups. Table A.1 in the online appendix shows the baseline association between IQ and forecast errors does not change across groups. Moreover, the results are not different if we interact the dummy for an IQ bin above 6 with respondents' age, which suggests that potential deterioration of cognitive abilities over time does not interfere with the explanatory power of our proxy for IQ for forecast errors.

Overall, the association between IQ and forecast errors for inflation is a stable feature of the data. Some heterogeneity exists by demographic splits, which is why the subsequent analysis partials out these variables to ensure they do not drive any results.

A.3 Forecast Errors by IQ: Types of Cognitive Abilities

Our data do not only include a composite score for the cognitive abilities of men based on their overall test performance, but also separate measures of performance across three types of cognitive abilities, that is, visuospatial, verbal, and arithmetic abilities. In principle, each of these types of cognitive abilities might help explain the cross-sectional variation in forecast errors we detect in the data. Indeed, forecasting requires that agents have an understanding of the relationship between quantitative variables, that they read and understand information about macroeconomic variables, and that they understand the causal relationships across events in space and in time. The extent to which each of these features is more or less relevant to explain forecast errors in the cross section is an empirical question.

D'Acunto, Hoang, Paloviita, and Weber (2019) show that, unconditionally, all three types of cognitive abilities predict systematic differences in forecast errors across individuals. We first verify that the unconditional results in D'Acunto et al. (2019) survive once we absorb individual demographic characteristics as well as year-month fixed effects. Columns (1)-(3) of Table 4 confirm all three types of cognitive abilities are negatively associated with forecast errors. Scoring above 5 in visuospatial IQ is associated with a 0.15-percentage-point-lower forecast error, whereas scoring 6 or higher in verbal and arithmetic IQ is related to a 0.22 and 0.25-percentage-point-lower forecast error.

D'Acunto et al. (2019) also detect a large positive correlation among the scores in different categories of IQ. In this paper, we therefore also ask whether any of the three categories are more or less relevant to explain forecast errors, by performing a horse race among them. Column (4) of Table 4 reports this result. Once all three scores enter the same specification, verbal and arithmetic IQ retain an autonomous association with forecast errors. By contrast, the association between the visuospatial IQ score and forecast errors drops in magnitude by almost 75% and loses statistical significance.

Overall, we conclude empirically verbal and arithmetic cognitive abilities seem to be equally important in explaining the cross section of forecast errors in our representative male population.

B. Rounding, Uncertainty, and Implausible Values

We move on to study two proxies for the quality of individuals' forecasts that earlier research proposes. The first is rounding—individuals' tendency to report values that are multiples of 5 when asked to provide numerical forecasts. Reporting round numbers conveys uncertainty about future inflation (e.g., see Binder (2017) and Manski and Molinari (2010)). We also consider respondents' tendency to provide implausible forecasts for inflation. Implausible forecasts are values that would be very unlikely to materialize over a period of 12 months based on historical inflation rates and the fact the ECB has an inflation target of close to but below 2% in the medium run.

Similar to the baseline association between forecast errors for inflation and IQ, Figure 4 documents that the fraction of rounders as well as the fraction of respondents reporting implausible values both decline monotonically by IQ bins. The fraction of rounders ranges from 65% in the lowest IQ bin to 35% in the highest IQ bin. The fraction of those reporting implausible forecasts ranges from 20% in the lowest IQ bin to 7% in the highest bin when we consider the 5% threshold for implausible values. For the 5% threshold, we categorize an inflation forecast above 5% or below -5% as implausible. In Figure A.1 in the Online Appendix, we confirm this monotonic negative association for several other thresholds for implausible forecasts.

Note we can reject the null hypothesis that the fractions of rounders and those reporting implausible values are the same across almost all adjacent IQ bins, which suggests respondents in the lowest or highest IQ bins are not the outliers driving the negative associations. In untabulated results, we also confirm the analysis after excluding all inflation forecasts that equal zero.[16]

In Table 5, we run this analysis in a multivariate setting. We regress a dummy variable that equals 1 if the respondent forecast a round number (columns (1)-(2)) or if he forecasts an implausible value (columns (3)-(4)), and 0 otherwise. Columns (1) and (3) report the raw correlations, whereas columns (2) and (4) control for demographics and year-month fixed effects. The main covariate of interest is the dummy variable that equals 1 if the respondent obtained an IQ score of 6 or above.

Respondents with an IQ score of 6 or above are 7.4 percentage points less likely to report round numbers. Because we control for income and college education, socioeconomic status does not explain the association between IQ and rounding (Ben-David, Fermand, Kuhnen, and Li (2018)), which is a proxy for inflation uncertainty. High-IQ men are also about 2 percentage points less likely to report implausible values for inflation forecasts when we condition on observables and time-varying economic shocks.

Rounding to salient thresholds might reflect objective uncertainty, for example, due to high fluctuations in realized inflation, or subjective uncertainty about future states of the world and macroeconomic conditions. We thus assess how the relationship between

[16] Although a value of zero is rounded and not implausible, one might argue that other considerations lead respondents to provide this number. No patterns change when we exclude all zeros from the analysis.

IQ and rounding varies across periods when inflation rates fluctuate or not. In Figure 5, we report the yearly standard deviation of monthly inflation rates in the form of gray bars, and measure it on the left y-axis. The black line plots, for each year, the difference in the average fraction of rounders between low-IQ men and high-IQ men. This difference is higher in years in which inflation rates do not vary much—for example, 2001, 2003, and 2009—whereas it is lower in years in which inflation rates vary substantially—for example, 2006, 2007, and 2009. Overall, Figure 5 is consistent with the possibility that high-IQ men are more likely to round at times of high objective inflation uncertainty relative to low-IQ men.

C. Forecast Dispersion

All the results we have discussed so far refer to the first moment of the distribution of inflation expectations across IQ levels. Research in economics and finance suggests dispersion in forecasts might proxy for differences in opinions across forecasters (Roth and Wohlfart (2018) and Diether, Malloy, and Scherbina (2002)). Hence, one might ask whether the second moment of inflation expectations also varies across levels of IQ, that is, whether the standard deviation of the reported inflation forecasts is systematically higher within low-IQ bins than within high-IQ bins. Higher dispersion of expectations for low-IQ respondents would be consistent with low-IQ respondents being less certain, more confused, more disagreeable, or less capable of providing precise estimates than high-IQ respondents.

In Figure 6, we report the average standard deviation of the forecast errors for inflation across IQ bins. Indeed, we detect a negative monotonic relationship between the dispersion in forecast errors and IQ levels that mimics the pattern for the first moment of the distribution. As expected, the pattern we detect for the cross-sectional dispersion in forecast errors by IQ is similar to the pattern in the standard deviation of forecasts by IQ (Table 2), because the time-series variation in realized inflation is smaller than the variation in expectations across men.

III Channels Explaining Heterogeneity in Expectations by IQ

Several non-mutually exclusive channels might help explain the systematic differences in high- and low-IQ men's abilities to forecast inflation. Disentangling these channels using our field data would be difficult given the expectations survey was not designed to this aim.

A. Survey to Disentangle Potential Channels

To assess the potential scope of alternative channels to explain our results so far, we designed an ad-hoc survey instrument, in which we elicit proxies for respondents' cognitive abilities and dig deeper into the extent to which respondents understand the concept of inflation, how they differ in their forecast ability, and possible differences in economic reasoning. We fielded two sessions of this survey on MTurk in August 2019. The survey contained 69 questions, including questions about demographics, and the average response time in the first session was 28 minutes and 39 seconds, and 28 minutes and 21 seconds in the second session. To avoid any systematic bias in the recruited online sample based on the time or day of the week, we fielded the first session during a weekend afternoon in the US East Coast and the second session during a weekday evening. In each session, we recruited 500 respondents, for a total of 1,000 respondents.[17]

Despite the advantage of the survey design in allowing us to disentangle the scope for alternative potential channels driving our baseline results, the main drawback is that the population on which we can run the survey (US respondents of both sexes on MTurk) is not the same population for which we observe the administrative data for our results so far (Finnish men contacted by Statistics Finland). We show the MTurk survey responses uncover similar patterns as the ones we document in Finland, which if anything speaks to the external validity of those results even to settings outside Finland.

In terms of the incentivization scheme, we offered participants a base payment of \$1.50 as well as the possibility to earn a bonus of up to \$5.65. The maximal payment respondents could earn was thus \$7.15, and the average payment was \$3.41.

[17]Below, we discuss the filtering process of certain responses that, based on our questions, we could identify as bots or as individuals who could not speak any English, and hence could not meaningfully respond to the survey questions.

The survey started with five questions about respondents' preferences and beliefs, which we designed based on Falk et al. (2018). First, we elicited respondents' risk tolerance, generalized trust, self-reported mathematical abilities, reciprocity, and willingness to take revenge against peers. In all cases, respondents would use sliders to scale the extent to which statements about these characteristics described them accurately on a scale between 0 and 10.

Second, we elicited a set of features related to cognitive abilities using the three cognitive-reflection test questions in Frederick (2005). We slightly modified these questions by changing the context as well as the correct answers to ensure respondents, who could access the internet, would not be able to obtain the correct answers from any sources. We also added four questions about logical associations and numerical patterns. We presented these questions with the label of "brain teasers" to respondents. To make the answering to the questions about cognitive abilities incentive-compatible, respondents earned a bonus payment of $0.05 for each correct answer. Following our analysis of the administrative data discussed above, we construct our baseline proxy for cognitive abilities as a dummy variable, *High IQ*, which equals 1 if the respondent provided at least five correct answers to the seven questions about cognition, and 0 otherwise. The results are virtually identical if we define this variable adding or subtracting one correct answer.

Third, we asked respondents to assess whether a set of six statements about inflation we obtained from the survey in Leiser and Drori (2005) were true or false. These questions aimed at determining respondents' knowledge and understanding of the concept of inflation and its implications. Out of six questions, four referred to theoretical statements about inflation, whereas two presented respondents with hypothetical scenarios based on their concrete choices in daily life. Respondents earned a bonus payment of $0.05 for each correct answer

Fourth, we asked respondents to play an "association game" based on Leiser and Drori (2005). In this association game, respondents had to choose three words out of a list of seven words they thought were most related to the term "Inflation," and for each word, they had to explain briefly in their own words why the association had come to their mind. Three of the words were abstract concepts (prices, wages, and savings), three were concrete concepts (gas, Amazon, and stocks), and one was not as directly related to inflation (elections). Asking for respondents' motivations in their own words was important not only to assess whether the associations were meaningful or not, but also to identify any potential bots as well as subjects who were not able to perform our survey meaningfully, for instance, because their English language skills were subpar. To evaluate the answers to these questions, an answer that is generally true received a score of 1, an answer that could be true under certain conditions received a score of 0.5, and a wrong answer received a score of 0. Two of the authors rated the answers independently, and we used the average of the two ratings to create a final score at the respondent level.

Fifth, respondents engaged in a forecasting task, which we designed following Landier, Ma, and Thesmar (2018). We asked respondents to provide their best forecast for two random processes in each of 15 periods after observing the first 40 realizations of the processes. To incentivize this task, we followed Landier, Ma, and Thesmar (2018) and computed a bonus as the maximum between \$0 and the forecast error in the respondent assessment, scaled by the standard deviation of each process. Importantly, the processes to be forecasted were completely unrelated to any economic variables, and the instructions clearly stated the processes were created at random for the purpose of the survey.

The survey included other questions asking respondents to write in a few words their understanding of the relationship between inflation and a set of other economic concepts, whose design also followed Leiser and Drori (2005).

Sixth and last, we concluded with a set of questions about demographic characteristics including respondents' age, gender, income bracket, education level, as well as whether the respondent was the main financial decision-maker in his/her household (Dï¿½Acunto et al. (2019)) and whether he/she was the main grocery shopper for the household (D'Acunto et al. (2019), D'Acunto et al. (2019)).

B. Understanding the Concept of Inflation

High- and low-IQ men might understand the concept of inflation differently. For instance, Leiser and Drori (2005) conducted detailed one-on-one surveys with a sample of Israelis employed in different jobs (psychology students, high-school students, grocers, and school teachers), and found these groups differed systematically in their knowledge about the concept of inflation as well as the extent to which they thought inflation related to other macroeconomic variables. In our application, low-IQ individuals might have a worse understanding of the concept of inflation, and might therefore have a harder time providing plausible forecasts for inflation.

To assess the relevance of this channel, we consider respondents' answers to the six true-false statements about inflation. The top panel of Figure 7 reports univariate results for sample averages and 95% confidence intervals around the sample mean for the number of correct answers across respondents with different levels of IQ. Consistent with the conjecture that low-IQ respondents know the concept of inflation less, on average, they answer 4.05 questions correctly, whereas high-IQ respondents provide on average 4.82 correct answers, and this difference is statistically significant.

Low-IQ respondents might be worse at answering questions about inflation for two reasons. On the one hand, they might lack a formal and theoretical understanding of the concept of inflation and the relationship between inflation and other economic variables. In this case, they would be worse at answering questions about inflation similar to the common questions asked in surveys about consumer sentiment by central banks and statistical offices around the world, which assume that respondents understand the definition of inflation and the relationship between inflation and other macroeconomic variables. On the other hand, low-IQ respondents might possess an intuitive understanding of the concept of inflation, and even if they did not know the formal definition of inflation, they might be able to grasp this concept in questions based on concrete-scenario hypotheses that mimic daily situations.

Panel B and Panel C of Figure 7 show low-IQ respondents are less likely than high-IQ respondents to answer questions about inflation correctly irrespective of whether the questions refer to the definition of inflation and its theoretical relationship with other macroeconomic variables or whether considering daily-life scenarios about the consequences and implications of inflation.

Overall, we find low-IQ respondents have a worse understanding of the concept of inflation relative to high-IQ men, both in terms of theoretical and practical understanding of this concept. At the same time, we note that, despite the statistical significance of the differences across IQ levels, the economic magnitude of these differences is not large. On average, high-IQ men provide 0.77 more correct answers to seven questions in total.

The fact that low-IQ men seem to be less correct about inflation, but not by a substantial amount, suggests other channels might also be relevant to explain the differences in inflation forecasts by cognitive abilities.

C. Ability to Forecast Mean-Reverting Processes

A second channel we consider is agents' ability to think in probabilistic terms and hence to produce plausible forecasts for the future values of a stochastic process, irrespective of whether the process relates to an economic variable.

In the Finnish data we use in our main analysis, we cannot disentangle this channel from respondents' knowledge about inflation. Indeed, providing plausible forecasts for inflation requires not only the ability to think in probabilistic terms, but also the ability to assess plausible potential values and potential probabilities attached with future states of the world in the domain of inflation.

To tackle this challenge, we analyze the forecasting task in our survey, which asks individuals to forecast two alternative mean-reverting processes that do not relate to inflation or other economic variables. The tasks builds on Landier et al. (2018).[18] We first explain to survey participants that they will be shown a random process that partially relies on the last realization and partially on randomness. We show individuals the first 40 realizations of the process and then ask them to forecast the process for 15 periods. After each forecast, individuals see the current realization before they make the next forecast. The data-generating process follows a zero-mean AR(1) process with coefficient 0.9. Individuals have to forecast two processes with error-term standard deviations of 5 and 20.[19] We randomize the order of the two processes individuals have to forecast, but conditional on the process, each survey participant sees the same realizations.[20]

The incentive payment is a decreasing function of the absolute forecast error (Δ) and the error-term volatility (σ):

$$S = 100 \times max(0, 1 - |\Delta|/\sigma). \tag{1}$$

We convert the overall score into dollar payments using a conversion factor of 600. Landier et al. (2018) discuss that under the loss function in equation (1), a rational agent would choose the rational-expectations forecast.

[18] Note we do not aim to assess whether agents over-extrapolate from observed realization in our case, which creates a difference between our test and the one in Landier et al. (2018).

[19] The latter specification follows Landier et al. (2018) and the former is closer to the actual process of inflation.

[20] Because of this task, we ensured that the same respondent could not answer the survey more than once. We double check the automatic MTurk worker ID check by searching for duplicates among respondents' IP addresses.

We consider processes with different volatilities, because in the Finnish field results, we find high-IQ men provide better forecasts for inflation especially in times of low inflation volatility, relative to times of volatile inflation.

Figure 8 reports the univariate results for comparing the average within-individual mean forecast error (Panel A) and absolute forecast error (Panel B) across 15 rounds for low-IQ and high-IQ respondents. Two patterns emerge, which are consistent with our results in the field. First, for both the mean and the absolute forecast errors, high-IQ men display lower forecast errors than low-IQ men in terms of both economic and statistical significance. Second, the difference in average forecast errors is large when respondents assess the more stable process, but this difference drops substantially when respondents assess the more volatile process and especially for the absolute forecast errors.

Several individual observable characteristics that correlate with cognitive abilities might explain these patterns. For this reason, in Table A.2, we propose a multivariate analysis in which we regress the within-individual average forecast errors on the *High IQ* dummy as well as the set of individual preferences and beliefs we elicited and the individual demographic characteristics. Both patterns we uncovered in Figure 8 are confirmed in this multivariate setting.

D. Mapping Knowledge about Inflation into Economic Choices

Ilut and Valchev (2017) discuss the third channel we consider. Intuitively, because of different ways of thinking about the concept of inflation, high- and low-IQ individuals might display a differential ability to forecast inflation and map news about inflation into their optimal consumption and savings decisions. For instance, D'Acunto et al. (2019) find many individuals think about the price changes of goods they purchase frequently in their daily lives when forming expectations about aggregate inflation. Moreover, Leiser and Drori (2005) show that, due to different features of inflation that are salient to individuals employed in different industries, the understanding of the implications of inflation for other macroeconomic variables varies systematically across individuals.

To study this last channel, we first ask individuals to pick three words from a list of seven words based on what they think is most related to the word "Inflation," and to explain in their own words the reasons they picked each word. This "association game" is based on the questions in Leiser and Drori (2005). We picked the seven words in the list so that three of these words refer to abstract concepts in the form of macroeconomic variables (prices, wages, and savings), and three words refer to concrete concepts respondents might think of when asked to provide an inflation forecast (gas, Amazon, and stocks), and one word has no direct association with inflation (elections). A priori, meaningful reasons to relate each of these words with inflation are possible.

Before moving on to considering the motivations respondents provided, we compare the frequencies with which low-IQ and high-IQ respondents reported each of the six words among the three words they associate more with inflation. Figure 9 reports these frequencies for each word across the two groups defined above—concrete words (Panel A) and abstract words (Panel B).

The results in Figure 9 deliver two consistent patterns. On the one hand, low-IQ individuals are more likely than high-IQ individuals to pick concrete concepts in the association game, and this likelihood holds both economically and statistically for each of the three concrete concepts. By contrast, high-IQ individuals are more likely than low-IQ individuals to pick abstract concepts, a result that is also true both economically and statistically for each of the three abstract concepts.

We move on to consider whether individuals with high and low IQ levels provided meaningful explanations for the words they associated with inflation, irrespective of whether they picked concrete or abstract concepts. Assessing whether statements respondents provided are meaningful is subjective, and any method to evaluate these statements has pros and cons. We decided to proceed as follows. Two of the authors of the paper rated independently each of the short motivations respondents provided on a three-value scale between 0 and 1.[21] A value of 0 means the explanation is wrong; a value of 0.5 means the explanation could have been correct had the respondent specified specific conditions under which such an explanation would hold; and a value of 1 means that the explanation is correct. Because of potential subjectivity in interpreting answers, as well as in the interpretation of statements about economic variables non-expert respondents make, which often do not use a precise terminology, we take the average of the two ratings, which thus results in five potential outcomes in the analysis of this task—0, 0.25, 0.5, 0.75, and 1.

The left plot of Panel A of Figure 10 reports the univariate results for comparing

[21] We also have answers that are not meaningful sentences or words. We exclude these cases from the analysis, which might refer to robots or individuals who cannot write in English.

the average ratings across respondents with low and high IQ levels. High-IQ individuals are, on average, statistically more likely than low-IQ individuals to report meaningful explanations for the associations. As was the case for the questions about inflation, though, the difference is not economically large, because the average rating equals 0.62 for low-IQ respondents and 0.74 for high-IQ respondents.

The third way we propose to assess the ability of the mapping channel exploits three specific questions among the incentivized questions about inflation, which relate directly to the consequences of higher unexpected inflation for other macroeoconomic variables.

The first question asks whether, after news of future higher inflation, a household should save more. This question is inspired by the consumer Euler equation in a standard New-Keynesian framework, based on which news of higher future inflation in times of stable nominal interest rates should reduce perceived real rates and hence decrease households' propensity to save. The right plot of Panel A of Figure 10 shows high-IQ respondents are less likely to state that households should save more when news about higher future inflation intervenes, which is consistent with the consumer Euler equation. An anecdotal assessment of the motivations respondents reported in the association game suggests low-IQ respondents are more likely than high-IQ respondents to confound news of future higher inflation with negative news about future economic growth and wage levels, which might trigger a precautionary saving motive in this group of households.

Two other questions we consider in Panel B of Figure 10 are whether inflation mainly benefits savers, which should not be the case given savings are mainly in nominal values, and whether a condition of persistent deflation is desirable for the economy. In both cases, low-IQ respondents are more likely to provide an answer that differs from the most plausible answer based on standard macroeconomic models.

Considering all three questions, the answers of low-IQ survey participants seem to portray an understanding of the consequences of inflation on other macroeconomic variables that does not conform with standard macroeconomic models. Rather, low-IQ individuals, on average, seem to think that periods of higher inflation (irrespective of the level of inflation) are bad times, that they are times in which households should save, and that, to the contrary, periods of sustained drops in prices and deflation are desirable. This result casts doubt on the effectiveness of most fiscal- and monetary-policy measures, which are in most cases justified in a representative-agent model of the economy that seems far from the actual interpretation and understanding of the economy by a large fraction of households, which is consistent with findings in Andre, Pizzinelli, Roth, and Wohlfart (2019).

Ideally, we would want to assess whether the mapping channel has a separate role in explaining low-IQ respondents' consumption and savings plans relative to low-IQ respondents being informed about inflation and being able to forecast inflation in a meaningful way. We attempt to disentangle these three channels in Table A.3 in the Online Appendix. In this table, we regress four dummies that equal 1 if the respondent has higher knowledge of inflation or provided the wrong answer for each of the questions discussed above, and 0 otherwise. Crucially, in this table, we restrict the sample to respondents who provided plausible values for their perception of current inflation and expectations about 12-month-ahead inflation, and hence respondents who are likely to be informed about the prevailing level of inflation as well as about inflation forecasts, irrespective of their IQ level.[22] We see that even within this subsample, and after absorbing the preferences, beliefs, and demographic characteristics we observe, high-IQ individuals are still more likely to have more correction answers and are still less likely to provide the wrong answers about inflation's consequences on other macroeconomic variables relative to low-IQ individuals.

Taken together, the results in this section suggest low-IQ individuals are more likely to associate inflation with the prices of specific goods, are worse in thinking in probabilistic terms and making forecasts in general, but also that they are less able to map news about inflation into the optimal consumption decisions relative to high-IQ survey participants, consistent with the mechanism Ilut and Valchev (2017) propose theoretically.

IV IQ and the Process of Expectations Formation within Individuals

Our results so far exploited cross-sectional variation in cognitive abilities and inflation expectations for individuals we observe only once. Between 1995 and 1999, though, Statistics Finland administered the survey with a panel component. In this section, we use the panel component to study how past inflation expectations are associated with

[22]Following Bachmann et al. (2019), we consider values of inflation perceptions and expectations between 0 and 4 as plausible.

current inflation expectations, how perceptions of the current inflation rate, which the EU survey also elicits, relate to past inflation expectations within individuals, and we study the association between forecast errors and forecast revisions to study whether individuals over- or underreact to news.

A. Are Current Expectations and Perceptions Consistent with Past Expectations?

In the standard model, agents have forward-looking expectations; that is, only news relevant for future inflation should result in forecast revisions. Moreover, many central banks aim to anchor inflation expectations. Hence, under rational expectations, we would expect, on average, a positive correlation of inflation expectations within individuals over short periods of time. Columns (1)-(2) of Table 6 investigate this auto-correlation of inflation expectations for high-IQ and low-IQ men when we condition on demographics and year-month fixed effects. An economically and statistically significant correlation of 23% exists for high-IQ men. This partial autocorrelation is statistically insignificant and close to 0 (2.5%) for low-IQ men.

Under rational expectations, we would also expect that past inflation expectations are positively correlated with current perceptions of inflation unless major news or shocks to inflation are realized between the times of the elicitation of expectations and perceptions.

To assess whether the correlation between past expectations and current perceptions varies across IQ levels, we regress current inflation perceptions on past inflation expectations at the individual level. In columns (3)-(4) of Table 6, we detect a positive and statistically significant association of 24% between current inflation perceptions and past inflation expectations for high-IQ men. The association for low-IQ men is statistically significant but an order of magnitude lower than the association for high-IQ men (5%).

For both tests in Table 6, high-IQ men display statistically significant positive associations, but the magnitude of these associations is not large, which might suggest even high-IQ men form expectations in a way that departs from the standard rational model.[23]

Note, though, that under rational expectations, the correlation between current

[23] Attenuation bias due to measurement error might help explain this low association in part. Note, though, that expectations and perceptions were elicited consistently across survey waves, and the question asks for a precise numerical value, which alleviates concerns about potential measurement error.

perceptions of inflation and past expectations should be lower in periods with shocks to realized inflation.[24] We thus split our sample into periods in which the difference between the inflation rate at the time of the first and subsequent interview is in the top third of the distribution, and all other periods. In columns (5)-(6) of Table 6, we repeat the analysis only for periods of low changes in inflation between elicitations, whereas in columns (7)-(8), we study periods with large changes in inflation.

Comparing columns (5) and (7), we see that for high-IQ men, the positive association between past inflation forecasts and current perceptions of inflation is higher in periods of stable inflation relative to other periods, even though the association is nowhere close to 1 even in periods of stable inflation. Columns (6) and (8) show that no differences exist in the economically small association for low-IQ men. If anything, the association appears slightly larger during periods of changing inflation, which is barely consistent with the standard rational model.

B. Do Individuals Learn about the Relationship between Expectations and Perceptions over Time?

The results in Table 6 suggest the dynamics of expectations of high-IQ men are more consistent with the rational benchmark than those of low-IQ men. High-IQ men, however, seem to form expectations in a way that is not fully consistent with the rational benchmark, because the size of the estimated coefficient is lower than 1.[25]

Because perceptions and expectations are elicited three times for the same individual in the panel component of our data, we can test whether individuals learn about the relationship between inflation expectations over time and hence whether they get closer to the rational benchmark as they make inflation forecasts over time.

To this aim, in Table 7, we estimate the specifications of Table 6 separately for the expectations and perceptions elicited between the first and second survey wave (columns (1)-(2) and (5)-(6)) relative to the expectations and perceptions elicited across all three waves (columns (3)-(4) and (7)-(8)). If agents learnt over time, we would find the size of the estimated coefficients are higher when we consider all waves combined relative to

[24]We should not expect an attenuating effect of shocks to realized inflation on the autocorrelation of inflation expectations to the extent that expectations are fully forward-looking and shocks to realized inflation do not affect long-run inflation.

[25]Under rational expectations, we would expect a coefficient of 1 to the extent that shocks to inflation are not uni-directional over time and that the sample period is not too short.

only the correlation between the expectations and perceptions across wave 1 and wave 2.

We fail to detect any substantial differences in the size or significance of the estimated coefficients across groups of waves either for low-IQ or high-IQ respondents, which suggests that agents barely learn over time when forming expectations across subsequent periods.

C. Overreaction or Underreaction to News by Cognitive Abilities?

Motivated by the fact that not only low-IQ men, but also high-IQ men seem to not form expectations in a way that is fully consistent with the rational benchmark, we move on to assess whether other potential processes of expectations formation might be consistent with our data.

Mounting evidence suggests consumers, professional forecasters, and managers form expectations that deviate from the rational benchmark because of underreaction or overreaction to news. We build on the framework in Coibion and Gorodnichenko (2012) and Coibion and Gorodnichenko (2015), who propose a simple test for whether individuals over- or underreact to news. Note the econometrician does not observe changes in agents' information sets, but he can observe changes in forecasts, and hence whether agents react to (unobservable) news they received across two forecast elicitations. We can thus regress the forecast errors of agent i, the differences between the realized value of a variable, x_{t+1}, minus the forecast at time t, $x_{i,t+1|t}$, on the forecast revision, $FR_{i,t,1} = x_{i,t+1|t} - x_{i,t+1|t-1}$:

$$x_{t+1} - x_{i,t+1|t} = \alpha + \beta FR_{i,t,1} + \varepsilon_{i,t}. \tag{2}$$

The full-information rational-expectations benchmark implies a coefficient estimate of 0 for β. A positive point estimate instead suggests the agent did not update the expectations sufficiently to news. To see the intuition, imagine the agent revised upwards the forecast for inflation. A positive coefficient implies the agent, on average, did not update the expectations enough, because the ex-post realized value was above the predicted value. Following a similar intuition, a negative point estimate for β instead implies the agent overreacted to news; that is, he forecasted a value that was too high given the ex-post realization.

Bordalo, Gennaioli, Ma, and Shleifer (2018) test this framework on the individual macroeconomic expectations underlying the Survey of Professional Forecasters and find professional forecasters, on average, overreact to news for most macroecnomic time series, which is in contrast to the results for consensus forecasts in Coibion and Gorodnichenko (2015). They rationalize their findings in a model of diagnostic expectations along the lines of Bordalo et al. (2016), Bordalo et al. (2018), and Bordalo et al. (2017).

We follow Bordalo et al. (2018) and test for overreaction versus underreaction at the individual level by pooling high- and low-IQ men separately:[26]

$$x_{t+1} - x_{i,t+1|t} = \alpha^{IQ} + \beta FR^{IQ}_{i,t,1} + \varepsilon_{i,t}. \tag{3}$$

Table 8 reports the results for estimating equation (3). In columns (1)-(2), we only absorb year-month fixed effects, whereas columns (3)-(4) add demographic characteristics. In columns (5)-(6), we restrict the variation within individuals and hence eliminate any systematic time-invariant differences across individuals in the two groups by IQ levels. Because of differences in prior beliefs or other reasons, some respondents might be consistently overly optimistic or pessimistic, which would affect the estimate of β.

Similar to Bordalo et al. (2018), the results with and without individual fixed effects are quite similar for high-IQ men. The economically and statistically negative estimate of β implies overreaction to news. If anything, the magnitude of the estimated coefficient increases as we absorb systematic time-invariant differences across high-IQ men. Moving on to low-IQ men, we also estimate a negative β across specifications, but the coefficient is lower in economic magnitude than for high-IQ men, and becomes statistically insignificant once we absorb time-invariant individual characteristics.

Taken together, our results for the accuracy of expectations and the process of expectations formation suggest high-IQ men overreact to news but make plausible inflation forecasts. Low-IQ men instead do not seem to form expectations in a way that is in line with the standard model or recent models of expectations formation.

[26] Our tests differ slightly from Bordalo et al. (2018), because in our sample, individuals always forecast 12-month-ahead inflation instead of inflation for a fixed forecast period, such as the year 2020. Because realized inflation is highly persistent and close to a random walk, we can still interpret the coefficients as in Bordalo et al. (2018).

V IQ and Choice

Do expectations of different quality transmit to individual choice, and especially consumption and saving decisions? Most existing models studying fiscal and monetary policy are based on a representative agent with rational expectations who reacts to changing economic incentives. Based on these premises, the Euler equation predicts a positive association between consumption expenditure and inflation expectations. In the textbook New Keynesian model, monetary policy affects real quantities through the dynamic IS equation, and hence, intertemporal substitution. In the last part of our analysis, we aim to test whether low-IQ and high-IQ individuals differ in the extent to which they update their consumption, saving, and borrowing plans to changing inflation expectations. This analysis is important because households' understanding of intertemporal substitution and its implications for consumption plans is crucial for any intertemporal-substitution-based channels to affect behavior.

Different mechanisms exist through which expectations might transmit to choice differently between high- and low-IQ men. One possibility is low-IQ individuals ultimately make consumption and saving decisions as if they held accurate inflation expectations even if they report expectations of lower quality once asked in a survey. Note the survey we use asks households about changes in consumer prices. The fact that low-IQ individuals might not know the term "inflation" thus cannot drive our results. Yet, everyone might hold accurate and unbiased beliefs and make choices as representative-agent models prescribe, but low-IQ men might be unable to express their beliefs in numerical terms. If this conjecture were true, the inaccurate expectations of low-IQ individuals would not have substantial implications for individual-level or aggregate outcomes.

A second possibility is that low-IQ individuals understand the concept of intertemporal substitution, but they rely on their inaccurate expectations when making choices. In this case, we would observe individuals' decisions deviating from the choices of the representative agent, but conditional on observing individual beliefs, one could predict how the individual would allocate his resources between current consumption and future consumption.

Finally, low-IQ individuals might not only have inaccurate expectations, but also might not know or understand the concept of intertemporal substitution.

A. IQ and Intertemporal Substitution

Low-IQ individuals provide numerical values for inflation expectations that are often inaccurate, implausible, or rounded. This fact is consistent with the common concern with survey-based numerical values of inflation expectations (e.g., see Binder (2017) and D'Acunto et al. (2019)). If we correlated numerical values of inflation expectations with choice, we would be unable to disentangle the case in which low-IQ individuals were unable to articulate their expectations in numerical terms from the case in which they were unable to understand intertemporal substitution, because in both cases, we would observe that reported numerical inflation expectations do not relate to consumption plans.

To address this concern, we follow D'Acunto, Hoang, and Weber (2019) and construct a measure of high inflation expectations based on survey respondents' *qualitative* expectations. The rationale is that, even if low-IQ households were not able to express their numerical inflation expectations meaningfully, they should be able to report whether they expect inflation to increase, stay the same, or decrease over the following 12 months. If not, they would either not understand the concept of inflation or would hold incorrect beliefs.

This qualitative measure of inflation expectations is a dummy variable that equals 1 if the respondent answers in the European Commissions survey that he expects a higher inflation rate in the following 12 months, compared to the prevailing inflation rate over the past 12 months, and 0 otherwise. D'Acunto, Hoang, and Weber (2019) show this measure tracks closely ex-post realized inflation across several samples in different countries and different time periods. A rationale for why this qualitative measure might track ex-post realized inflation more closely than quantitative measures is that respondents might have a clear idea for the directional changes in inflation they perceive and expect, but might be uninformed about the *level* of inflation prevailing at the time they are interviewed, consistent with evidence in Vellekoop and Wiederholt (2017).

We follow the recent literature in macroeconomics using micro data and study the association between the qualitative measure of inflation expectations and different choices (Bachmann et al. (2015) and Crump, Eusepi, Tambalotti, and Topa (2018)). Our first outcome variable of interest, households' readiness to purchase durable goods, derives from discrete, non-ordered choices in a survey. We therefore model the response probabilities in a multinomial-logit setting. We assume the answer to the question on the readiness to spend is a random variable representing the underlying population.

We estimate the model via maximum likelihood to obtain the vector of coefficients and compute the marginal effects of changes in the covariates on the probability that individuals choose any of three answers in the survey, and report them in the tables.

In columns (1) and (2) of Table 9, we report the average marginal effects for whether respondents think it is a good time to purchase durable goods on the dummy that equals 1 if the respondent thinks inflation will be higher in the following 12 months than it was in the previous 12 months. We cluster standard errors at the quarter level to allow for correlation of unknown form in the residuals across contiguous months. Both specifications include the full set of demographic controls we observe, as well as controls for perceived past inflation (Jonung (1981)). The results in column (1) refer to the full sample of high-IQ men, and those in column (2) include the full sample of low-IQ men. In column (1), high-IQ men who expect inflation to increase are, on average, 3.6% more likely to answer it is a good time to buy durables than are high-IQ men who expect constant or decreasing inflation. Instead, column (2) documents no economically or statistically significant association between the inflation expectations and the readiness of low-IQ men to purchase durable goods. If anything, the estimated coefficient is negative, although small in size and not statistically distinguishable from zero.

These baseline results are consistent with the possibility that low-IQ men do not understand the concept of intertemporal substitution because they do not adjust their consumption plans to their inflation expectations. Recall we use the dummy variable for expected inflation from a qualitative question that measures the change in expected inflation and tracks actual realized inflation well both for high-IQ and low-IQ men (D'Acunto, Hoang, and Weber (2019)). Hence, these results are barely consistent with the idea of low-IQ men being sophisticated – knowing their quantitative inflation expectations are inaccurate and deciding not to react to them when forming purchasing plans. If they were sophisticated, they would follow their expected directional change in inflation and adjust upward their consumption propensity when expecting higher inflation.

In the rest of Table 9, we consider the sample splits we proposed in the analysis of the association between IQ and expectations in Table 3 to assess whether similar patterns arise for the case of purchasing plans. For each sample split reported at the top of the columns, we report four marginal effects: for those high-IQ and low-IQ men who belong to the reported category (Panel A) and for those who do not belong to the category (Panel

B).

We emphasize a set of patterns from these sample splits. First, for most of the splits we consider, high-IQ men who expect higher inflation are systematically more likely to respond it is a good time to purchase durable goods irrespective of whether they belong to the demographic group of interest. Columns (3), (5), (7), (9), (11), and (13) show this higher propensity is economically large irrespective of whether high-IQ men are single, live in urban areas, are above the median of the distribution by income, have a college degree, or have an economics or business degree. Note we fail to detect statistical significance at conventional levels for the coefficients associated with high-IQ men above 35, high-IQ men below the median of the income distribution, and high-IQ men with an economics or business degree, but even in these cases, the point estimates are positive and large.

Second, we fail to reject the null that the marginal effect equals 0 for low-IQ respondents across most demographic splits, irrespective of the sample size, both economically and statistically (see columns (4), (6), (8), (10), and (12)).

Third, low-IQ men with an economics or business degree are the *only* group of low-IQ men for whom we can detect an economically and statistically positive association between expecting higher inflation and answering it is a good time to purchase durable goods, as the consumer Euler equation implies (0.1109, see column (14), Panel A).[27] This result might suggest providing economics and business knowledge to low-IQ men might be a relevant substitute for cognitive abilities in determining economic choice.

B. IQ, Borrowing Motives, and Saving Motives

Next, we assess whether low-IQ men differ from high-IQ men even along other forward-looking choices. To this aim, we exploit a limited set of questions in the survey regarding households' motives to save and borrow. These questions are conditional on saving and borrowing, and hence, we observe smaller and varying sample sizes. The structure is such that individuals are asked whether they plan to save (borrow), and if they respond yes, various subquestions regarding the motives of saving (borrowing) follow.

High-IQ men might understand the trade-off between present and future consumption

[27]Note the coefficient is also positive and nonnegligible in size for low-IQ men with any college degree (see column (12), Panel A), but we fail to reject the null that this coefficient is 0 statistically. Because this group also includes economics and business college degrees, the association is unlikely to be positive and large for low-IQ respondents with other types of college degrees.

better than low-IQ men or might be more patient (Falk et al. (2018)). In both cases, we should observe high-IQ men saving more for retirement than low-IQ men.

We first assess whether individuals differ – based on cognitive abilities – in their propensity to save. Column (1) of Table 10 reports the marginal effect attached to the high-IQ dummy when the outcome variable of a probit specification is a dummy that equals 1 if the individual claims he saves at least part of his monthly labor income. High-IQ individuals, if anything, are *less* likely to save than low-IQ men. This fact could be consistent with a reduced precautionary savings motive for high-IQ men, among other potential explanations.

We then consider a second question that digs deeper into the saving motives and asks respondents whether they save for retirement. In column (2), we report the marginal effect on the high-IQ dummy for a similar specification as column (1), but in this case, the outcome variable is a dummy that equals 1 if the respondent claims he saves for retirement. The sign of the association flips, and the association with high IQ becomes positive and statistically different from zero. Overall, then, the analysis of saving motives suggests high-IQ men are, if anything, less likely to save in general, but they are more likely to save for retirement than low-IQ men. We interpret this evidence as consistent with the notion that high-IQ men are more forward-looking than low-IQ men.

After having assessed whether any differences exist in the average association between being in the top of the IQ distribution and saving for retirement, in Figure 11, we provide evidence that the association between IQ bins and the fraction of households that declare they save for retirement increases monotonically – it is lowest for the first IQ bin and highest for the top IQ bins. Because the sample size is smaller than in our baseline analysis, statistical significance is sparse and we cannot reject the null hypothesis that fractions are the same across all adjacent bins.

We move on to consider borrowing motives. In this analysis, we compare respondents' likelihood of answering that they plan to borrow to finance current or future consumption with the likelihood of answering that they plan to borrow to finance current or future education-related expenses. Column (3) of Table 10 shows high-IQ men do not differ from low-IQ men in their likelihood of borrowing to finance consumption, whereas we see in column (4) high-IQ men are substantially more likely than low-IQ men to plan to borrow to finance education-related costs. We interpret this evidence as also consistent with high-IQ individuals being more forward-looking than low-IQ individuals, because they plan to borrow to finance a long-term investment in human capital. This interpretation assumes formal education and IQ are at least in part substitutes.

C. Which Channels Mediate the Differences in Choice by IQ?

After documenting that high-IQ men have lower forecast errors, update expectations in a way that seem consistent with the diagnostic-expectations framework, and act on their expectations in economic decisions in a way that is consistent with the Euler equation logic, whereas low-IQ men do not, we investigate the channels that might mediate the relationship between IQ, expectations, and choice in field data.

Because the question we use to measure consumption propensities asks respondents if they think it is a good time to purchase durable goods, one might wonder whether low-IQ men display systematic characteristics that make their consumption plans insensitive to inflation expectations. For instance, low-IQ men might be more financially constrained or have negative income expectations relative to high-IQ men. At the same time, low-IQ men might interpret the survey question as referring to their own purchasing decisions instead of the decision of the average household in the economy. In our sample, income and IQ have a correlation of 0.15 only, and D'Acunto et al. (2018) show financial constraints and income expectations do not differ systematically across high- and low-IQ men, which suggests a different economic outlook or financial situations are an unlikely explanation for our results.

We therefore move on to assess three channels based on the potential cognitive costs of gathering information about economic variables, of forming expectations about future states of the world, and of mapping expectations into economic decision-making in line with the channels we studies in the controlled MTurk environment.

First, low-IQ men might be less informed than high-IQ men about economic fundamentals, including the current state, potentially because gathering information about macroeconomic variables is more cognitively costly to them. In this case, low-IQ men would have miscalibrated perceptions about current inflation, resulting in miscalibrated beliefs about future macroeconomic variables. As long as low-IQ men understand their expectations are biased, they would not rely on them when forming purchasing plans.

To assess this channel directly, we focus on the subsamples of high-IQ men and low-IQ men with perception errors below the median and below the 25^{th} percentile. These men represent individuals who are likely to be informed about the prevailing inflation rate at the time of the interview given their perception error is low, irrespective of whether their IQ is high or low.

A concern is that this split merely captures low-IQ men who provided values for the inflation rate at random and ended up being close to the actual realization ex post. Panel A of Figure A.2 in the online appendix suggests this concern is not material, because it shows that even if low-IQ men, on average, have less accurate perceptions about inflation than high-IQ men, still a large fraction of low-IQ men proposes values for inflation close to the actual inflation rate at the time they were interviewed. If all low-IQ men were merely providing values for inflation randomly, the distribution of perceived inflation in Figure A.2 would be uniform instead of displaying a mode close to the actual inflation rate.

In Panel A of Table 11, we regress consumption propensities on inflation expectations for men with low perception errors, across levels of IQ. In column (1), we find high-IQ men within the group of men with low perception errors for contemporaneous inflation display a large positive and significant association between their inflation expectations and consumption propensities. The size of this association is higher than the size of the baseline association we detected in Table 9. In column (2) of Table 11, the point estimate is positive and economically non-negligible, but we fail to detect a significant association between inflation expectations and consumption propensities for low-IQ men with low perception errors for contemporaneous inflation. The results are similar if we restrict the samples even more and only consider men whose perception error is below the 25^{th} percentile (columns (3)-(4)). Even in this case, low-IQ men whose perceptions about inflation are quite accurate do not display any significant positive association between inflation expectations and consumption propensity.

The fact that low-IQ men do not behave in line with the consumer Euler equation even when they seem accurately informed about the prevailing inflation rate suggests that informing consumers about the level of current inflation might not be sufficient to affect the economic plans or choices of low-IQ men.

The second channel we consider states that low-IQ men might be unable to think in probabilistic terms and about future states of the world (McDowell and Jacobs (2017)). This channel could explain the non-response in the Euler equations only if low-IQ men were sophisticated about their bias; that is, they knew that they should not rely on their faulty expectations when making consumption and saving plans.

To assess the relevance of this channel, we focus on the subsample of men with forecast errors for 12-month-ahead inflation below the median and below the 25^{th} percentile. Similar to above, because the distribution of both low-IQ and high-IQ men has a mode at plausible values for inflation forecasts and is not uniform (see Panel B of Figure A.2 in the online appendix), the two subsamples are likely to include individuals who are able to think probabilistically and to come up with plausible assessments of future states of the world, irrespective of their IQ levels.

Panel B of Table 11 reports the results for estimating the marginal effect of expecting higher inflation on the propensity to consume across groups based on the size of their forecast errors. High-IQ men increase their spending propensities when they expect higher inflation and their inflation forecasts are accurate (columns (1) and (3)). Low-IQ men, instead, are still unresponsive, both economically and statistically, even if their expectations about future inflation are close to the ex-post realization.

In terms of policy implication, these results could imply that purely providing the broader population with plausible forecasts of future inflation might not be enough to align their consumption and saving plans to what the consumer Euler equation predicts.

A third channel we consider is that low-IQ men might not understand basic economic concepts such as intertemporal substitution. This channel suggests that even if low-IQ men were perfectly informed about current inflation and about plausible forecasts of future inflation, still they would not be able to map this information into optimal consumption and saving plans. Ilut and Valchev (2017) provide a theoretical foundation for this channel, because they model agents with limited knowledge of the optimal action even conditional on knowledge of the current and future economic state. This channel would be consistent with all the evidence in the paper and could also rationalize other puzzles in the literature, such as the excess sensitivity of consumption to predictable income changes (see, e.g., Parker et al. (2013)).

Although we cannot provide a direct test for this channel in our data, we propose suggestive evidence by focusing on two subsamples. First, we consider only high-IQ men and low-IQ men with a college degree in economics and business. Intuitively, both of these two groups should understand intertemporal substitution and should know how inflation expectations map into optimal action, because they should have been trained on these concepts extensively during their college studies. Columns (1)-(2) of Panel C of Table 11 estimate the marginal effect of expecting higher inflation on the propensity to spend on durable goods for this subsample. We find that, indeed, within the group of men with an economics or business degree, *both* high-IQ and low-IQ men increase their propensity to consume when expecting higher inflation, which is consistent with the consumer Euler equation.

To further assess whether the split by economics/business degree is likely to capture knowledge of basic economic concepts as opposed to the effects of a quantitative college degree, in columns (3)-(4) of Panel C of Table 11, we consider the subsample of high-IQ men and low-IQ men with a college degree in engineering. Men trained in engineering obtained college education, irrespective of their IQ levels, and if anything were trained more in quantitative skills than men who earned an economics or business degree. At the same time, these men were not trained specifically in economic concepts such as intertemporal substitution. We see that for this group, low-IQ men do not display a positive association between expecting higher inflation and willingness to purchase durable goods. If anything, the estimated coefficient is large and negative, although statistically insignificant.[28]

Overall, we interpret the results in Panel C of Table 11 as broadly consistent with the possibility that low-IQ men do not understand basic economic concepts and hence cannot map their macroeconomic expectations into optimal choice.

VI Conclusion

We show that cognitive abilities play a central role in understanding forecast errors for inflation both across and within individuals in a unique representative male sample that uses administrative data on IQ. Cognitive abilities are also relevant to individuals' plans for current and future consumption, their understanding of intertemporal substitution, and their forward-looking behavior.

Exploiting variation within individual, we find that high-IQ men overreact to macroeconomic news when forming inflation forecasts, but update their forecasts in the right direction (Bordalo, Gennaioli, Ma, and Shleifer (2018)). For low-IQ men,

[28]Note that for this group, high-IQ men display no association between inflation expectations and willingness to consume, which emphasizes that education per se does not explain our results.

instead, we fail to find unambiguous evidence in support of an existing framework of expectations-formation. Low-IQ men's expectations are not adaptive, are not rational, and are barely consistent with the diagnostic-expectations framework. Overall, with low-IQ men—who in our sample represent more than 50% of the representative population we study—anything goes in terms of expectations formation and updating over time.

We study a set of potential channels that might explain these results, and find that low-IQ individuals have lower knowledge of the concept of inflation, are more likely to think about concrete goods rather than prices in general, have a lower ability to forecast generic random processes unrelated to economic variables, and have a harder time choosing the optimal economic decision conditional on new information. We study these channels in a controlled environment for a US population that includes both genders.

Future research in economics, finance, and cognitive science should build on these results to investigate in more detail the specific mechanisms that explain the role of cognitive abilities in the formation of economic expectations. For instance, do cognitive abilities matter for the gathering of information, the processing of information, and the mapping of processed values into economic decisions? Or are they only driving choice through a subset of these channels? Distinguishing between these mechanisms is crucial not only to inform the development of new heterogeneous-agent models across fields of economics, but also to inform policymakers on the policy actions that might or might not help low-IQ individuals make optimal decisions based on the incentives policies create.

The lack of forward-looking attitudes in low-cognitive-ability individuals might result in a lower sensitivity of their choices to policy shocks that operate through forward-looking savings, consumption, and borrowing decisions, and might help explain why some policies are less effective than a representative-agent full-information model predicts, such as forward guidance. Limited reaction to policy interventions by many households would be detrimental for governments that aim to change aggregate consumption and saving patterns throughout the business cycle (D'Acunto et al. (2018)). Future research could thus investigate the extent to which cognitive abilities interact with the reaction to policy interventions and quantify their effect on aggregate outcomes.

References

Agarwal, S., J. C. Driscoll, X. Gabaix, and D. Laibson (2009). The age of reason: Financial decisions over the life cycle and implications for regulation. *Brookings Papers on Economic Activity 2009*(2), 51–117.

Agarwal, S. and B. Mazumder (2013). Cognitive abilities and household financial decision making. *American Economic Journal: Applied Economics 5*(1), 193–207.

Aghion, P., U. Akcigit, A. Hyytinen, and O. Toivanen (2017). The social origins of inventors. *NBER Working Paper 24110*.

Andre, P., C. Pizzinelli, C. Roth, and J. Wohlfart (2019). Subjective models of the macroeconomy: Evidence from experts and a representative sample. *Unpublished Manuscript*.

Armantier, O., W. Bruine de Bruin, G. Topa, W. Klaauw, and B. Zafar (2015). Inflation expectations and behavior: Do survey respondents act on their beliefs? *International Economic Review 56*(2), 505–536.

Bachmann, R., T. O. Berg, and E. Sims (2015). Inflation expectations and readiness to spend: Cross-sectional evidence. *American Economic Journal: Economic Policy 7*(1), 1–35.

Bachmann, R., B. Born, E. Sims, and M. Weber (2019). Are households neo-fisherian? *Unpublished Manuscript*.

Banks, J., C. o'Dea, and Z. Oldfield (2010). Cognitive function, numeracy and retirement saving trajectories. *The Economic Journal 120*(548), F381–F410.

Ben-David, I., E. Fermand, C. Kuhnen, and G. Li (2018). Expectations uncertainty and household financial choices. *Working Paper*.

Benjamin, D. J., S. A. Brown, and J. M. Shapiro (2013). Who is "behavioral"? cognitive ability and anomalous preferences. *Journal of the European Economic Association 11*(6), 1231–1255.

Benjamin, D. J., D. Cesarini, M. J. Van Der Loos, C. T. Dawes, P. D. Koellinger, P. K. Magnusson, C. F. Chabris, D. Conley, D. Laibson, M. Johannesson, et al. (2012). The genetic architecture of economic and political preferences. *Proceedings of the National Academy of Sciences 109*(21), 8026–8031.

Bernanke, B. S. (2007). Inflation expectations and inflation forecasting. Speech 306, Board of Governors of the Federal Reserve System (U.S.).

Binder, C. (2017). Measuring uncertainty based on rounding: New method and an application to inflation expectations. *Journal of Monetary Economics 90*, 1–12.

Bordalo, P., K. Coffman, N. Gennaioli, and A. Shleifer (2016). Stereotypes. *The Quarterly Journal of Economics 131*(4), 1753–1794.

Bordalo, P., N. Gennaioli, Y. Ma, and A. Shleifer (2018). Over-reaction in macroeconomic expectations. Technical report, National Bureau of Economic Research.

Bordalo, P., N. Gennaioli, R. L. Porta, and A. Shleifer (2017). Diagnostic expectations and stock returns. Technical report, National Bureau of Economic Research.

Bordalo, P., N. Gennaioli, and A. Shleifer (2018). Diagnostic expectations and credit cycles. *The Journal of Finance 73*(1), 199–227.

Borghans, L., J. J. Heckman, B. H. Golsteyn, and H. Meijers (2009). Gender differences in risk aversion and ambiguity aversion. *Journal of the European Economic Association 7*(2-3), 649–658.

Burks, S. V., J. P. Carpenter, L. Goette, and A. Rustichini (2009). Cognitive skills affect economic preferences, strategic behavior, and job attachment. *Proceedings of the National Academy of Sciences 106*(19), 7745–7750.

Cavallo, A., G. Cruces, and R. Perez-Truglia (2017). Inflation expectations, learning, and supermarket prices: Evidence from survey experiments. *American Economic Journal: Macroeconomics 9*(3), 1–35.

Chabris, C. F., D. Laibson, C. L. Morris, J. P. Schuldt, and D. Taubinsky (2008). Individual laboratory-measured discount rates predict field behavior. *Journal of risk and uncertainty 37*(2-3), 237.

Choi, S., S. Kariv, W. Müller, and D. Silverman (2014). Who is (more) rational? *American Economic Review 104*(6), 1518–50.

Coibion, O. and Y. Gorodnichenko (2012). What can survey forecasts tell us about information rigidities? *Journal of Political Economy 120*(1), 116–159.

Coibion, O. and Y. Gorodnichenko (2015). Information rigidity and the expectations formation process: A simple framework and new facts. *American Economic Review 105*(8), 2644–78.

Coibion, O., Y. Gorodnichenko, and R. Kamdar (2018). The formation of expectations, inflation, and the phillips curve. *Journal of Economic Literature 56*(4), 1447–1491.

Coibion, O., Y. Gorodnichenko, and S. Kumar (2018). How do firms form their expectations? New survey evidence. *American Economic Review 108*(9), 2671–2713.

Coibion, O., Y. Gorodnichenko, and M. Weber (2019). Monetary policy communications and their effects on household inflation expectations. *Working Paper*.

Crump, R. K., S. Eusepi, A. Tambalotti, and G. Topa (2018). Subjective intertemporal substitution. *FRB of New York Staff Report* (734).

D'Acunto, F., D. Hoang, M. Paloviita, and M. Weber (2018). Human frictions to the transmission of economic policy. *Working Paper*.

D'Acunto, F., D. Hoang, M. Paloviita, and M. Weber (2019). Cognitive abilities and inflation expectations. In *AEA Papers and Proceedings*, Volume 109, pp. 562–66.

D'Acunto, F., D. Hoang, and M. Weber (2018). Unconventional fiscal policy. In *AEA Papers and Proceedings*, Volume 108, pp. 519–23.

D'Acunto, F., D. Hoang, and M. Weber (2019). Managing households' expectations with simple economic policies. *Working Paper*.

D'Acunto, F., U. Malmendier, J. Ospina, and M. Weber (2019). Exposure to daily price changes and inflation expectations. *Unpublished manuscript, University of Chicago Booth School of Business*.

D'Acunto, F., U. Malmendier, and M. Weber (2019). Gender roles distort women's economic outlook. *Unpublished Manuscript*.

Dï¿½Acunto, F., M. Prokopczuk, and M. Weber (2019). Historical antisemitism, ethnic specialization, and financial development. *The Review of Economic Studies 86*(3), 1170–1206.

Dal Bo, E., F. Finan, O. Folke, T. Persson, and J. Rickne (2017). Who becomes a politician? *Quarterly Journal of Economics 132*(4), 1877–1914.

Das, S., C. Kuhnen, and S. Nagel (2017). Socioeconomic status and macroeconomic expectations. *Working Paper*.

De Bruin, W. B., C. F. Manski, G. Topa, and W. Van Der Klaauw (2011). Measuring consumer uncertainty about future inflation. *Journal of Applied Econometrics 26*(3), 454–478.

Di Tella, R., R. J. MacCulloch, and A. J. Oswald (2001). Preferences over inflation and unemployment: Evidence from surveys of happiness. *American Economic Review 91*(1), 335–341.

Diether, K. B., C. J. Malloy, and A. Scherbina (2002). Differences of opinion and the cross section of stock returns. *The Journal of Finance 57*(5), 2113–2141.

Dohmen, T., A. Falk, D. Huffman, and U. Sunde (2010). Are risk aversion and impatience related to cognitive ability? *American Economic Review 100*(3), 1238–60.

Falk, A., A. Becker, T. Dohmen, B. Enke, D. Huffman, and U. Sunde (2018). Global evidence on economic preferences. *Quarterly Journal of Economics 133*(4), 1645–1692.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic perspectives 19*(4), 25–42.

Fuster, A., G. Kaplan, and B. Zafar (2018). What would you do with usd500? spending responses to gains, losses, news and loans. Technical report, National Bureau of Economic Research.

Fuster, A., R. Perez-Truglia, M. Wiederholt, and B. Zafar (2018). Expectations with endogenous information acquisition: An experimental investigation. Technical report, National Bureau of Economic Research.

Gennaioli, N., Y. Ma, and A. Shleifer (2018). Over-reaction in macroeconomic expectations. *NBER Working Paper No. 24932*.

Gennaioli, N. and A. Shleifer (2018). A crisis of beliefs: Investor psychology and financial fragility. *Princeton University Press*.

Gerardi, K., L. Goette, and S. Meier (2013). Numerical ability predicts mortgage default. *Proceedings of the National Academy of Sciences 110*(28), 11267–11271.

Glaeser, E. L. and C. G. Nathanson (2017). An extrapolative model of house price dynamics. *Journal of Financial Economics 126*(1), 147–170.

Grinblatt, M., S. Ikäheimo, M. Keloharju, and S. Knüpfer (2016). IQ and mutual fund choice. *Management Science 62*(4), 924–944.

Grinblatt, M., M. Keloharju, and J. Linnainmaa (2011). IQ and stock market participation. *The Journal of Finance 66*(6), 2121–2164.

Grinblatt, M., M. Keloharju, and J. T. Linnainmaa (2012). IQ, trading behavior, and performance. *Journal of Financial Economics 104*(2), 339–362.

Hanushek, E. A. and L. Woessmann (2008). The role of cognitive skills in economic development. *Journal of economic literature 46*(3), 607–68.

Heckman, J. J., J. Stixrud, and S. Urzua (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor economics 24*(3), 411–482.

Ilut, C. and R. Valchev (2017). Economic agents as imperfect problem solvers. *Unpublished Manuscript, Boston College*.

Jonung, L. (1981). Perceived and expected rates of inflation in Sweden. *The American Economic Review 71*(5), 961–968.

Kautz, T., J. J. Heckman, R. Diris, B. Ter Weel, and L. Borghans (2014). Fostering and measuring skills: Improving cognitive and non-cognitive skills to promote lifetime success. Technical report, National Bureau of Economic Research.

Kuchler, T. and B. Zafar (2018). Personal experiences and expectations about aggregate outcomes. *Journal of Finance, Forthcoming*.

Landier, A., Y. Ma, and D. Thesmar (2018). New experimental evidence on expectations formation. *Working Paper*.

Leiser, D. and S. Drori (2005). Naïve understanding of inflation. *The Journal of Socio-Economics 34*(2), 179–198.

Malmendier, U. and S. Nagel (2016). Learning from inflation experiences. *Quarterly Journal of Economics 131*(1), 53–87.

Manski, C. and F. Molinari (2010). Rounding probabilistic expectations in surveys. *Journal of Business Economics and Statistics 28*(2), 219–231.

Manski, C. F. (2004). Measuring expectations. *Econometrica 72*(5), 1329–1376.

Manski, C. F. (2018). Survey measurement of probabilistic macroeconomic expectations:

progress and promise. *NBER Macroeconomics Annual 32*(1), 411–471.

McArdle, J. J., J. P. Smith, and R. Willis (2011). Cognition and economic outcomes in the health and retirement survey. In *Explorations in the Economics of Aging*, pp. 209–233. University of Chicago Press.

McDowell, M. and P. Jacobs (2017). Meta-analysis of the effect of natural frequencies on bayesian reasoning. *Psychological bulletin 143*(12), 1273.

Oechssler, J., A. Roider, and P. W. Schmitz (2009). Cognitive abilities and behavioral biases. *Journal of Economic Behavior & Organization 72*(1), 147–152.

Parker, J. A., N. S. Souleles, D. S. Johnson, and R. McClelland (2013). Consumer spending and the economic stimulus payments of 2008. *American Economic Review 103*(6), 2530–53.

Roth, C. and J. Wohlfart (2018). How do expectations about the macroeconomy affect personal expectations and behavior? *Working Paper*.

Rozsypal, F. and K. Schlafmann (2017). Overpersistence bias in individual income expectations and its aggregate implications.

Simon, H. A. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics 69*(1), 99–118.

Stanovich, K. E. (2009). *What intelligence tests miss: The psychology of rational thought.* Yale University Press.

Vellekoop, N. and M. Wiederholt (2017). Inflation expectations and choices of households: Evidence from matched survey and administrative data. *Unpublished Manuscript, University of Frankfurt*.

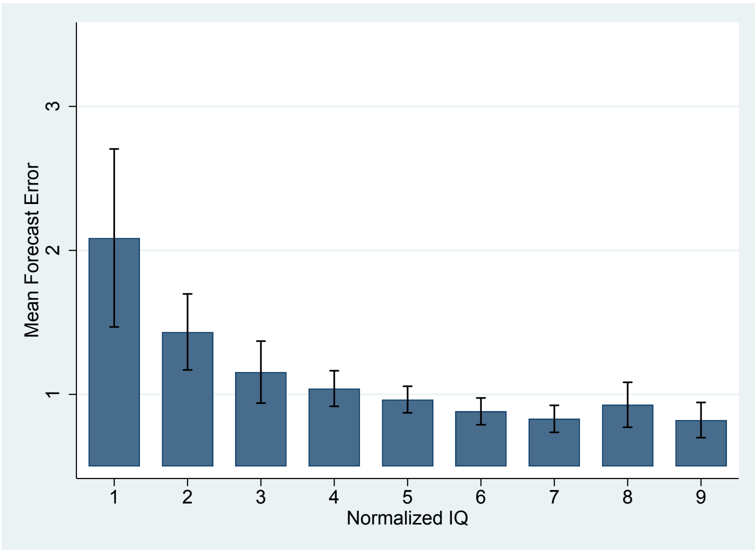
Weinberg, R. A. (1989). Intelligence and IQ: Landmark issues and great debates. *American psychologist 44*(2), 98.

Yellen, J. (2016). Macroeconomic research after the crisis. *Speech at the 60th annual economic conference sponsored by the Federal Reserve Bank of Boston*.

Zafar, B. (2011). How do college students form expectations? *Journal of Labor Economics 29*(2), 301–348.

Zeldes, S. P. (1989). Consumption and liquidity constraints: An empirical investigation. *The Journal of Political Economy 97*(2), 305–346.

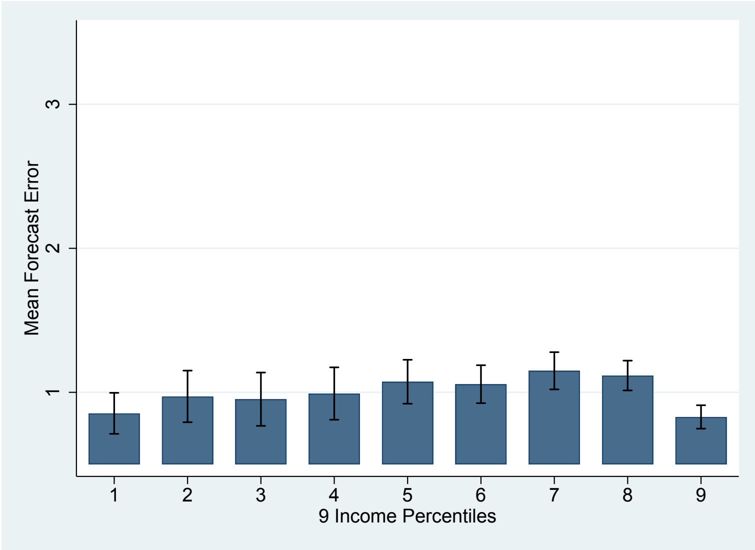
Figure 2: **Average Forecast Error by IQ**



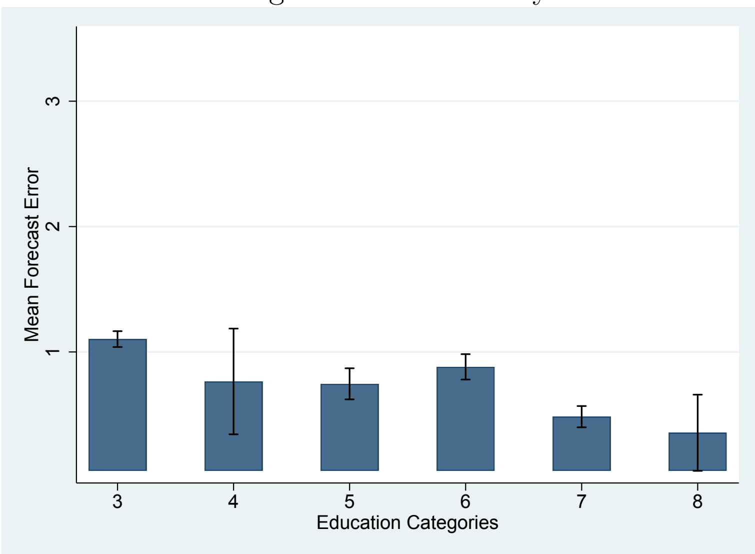
This figure plots the average forecast error for inflation (in percentage points) across IQ levels. Forecast error is the difference between the numerical forecast for 12-month-ahead inflation and ex-post realized inflation. Vertical lines represent 95% confidence intervals around the estimated mean for each bin. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

Figure 3: **Average Forecast Error by Income and Education Levels**

Panel A. Average Forecast Error by Income

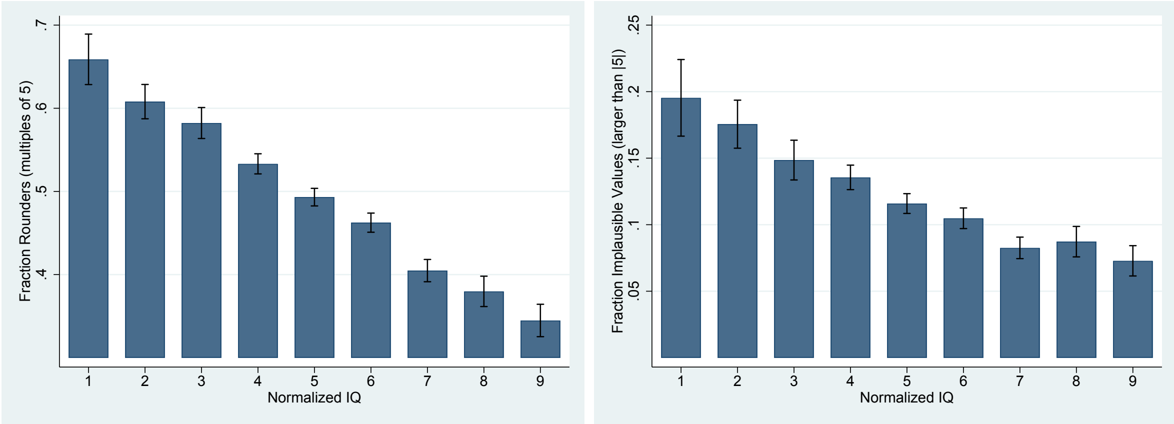


Panel B. Average Forecast Error by Education



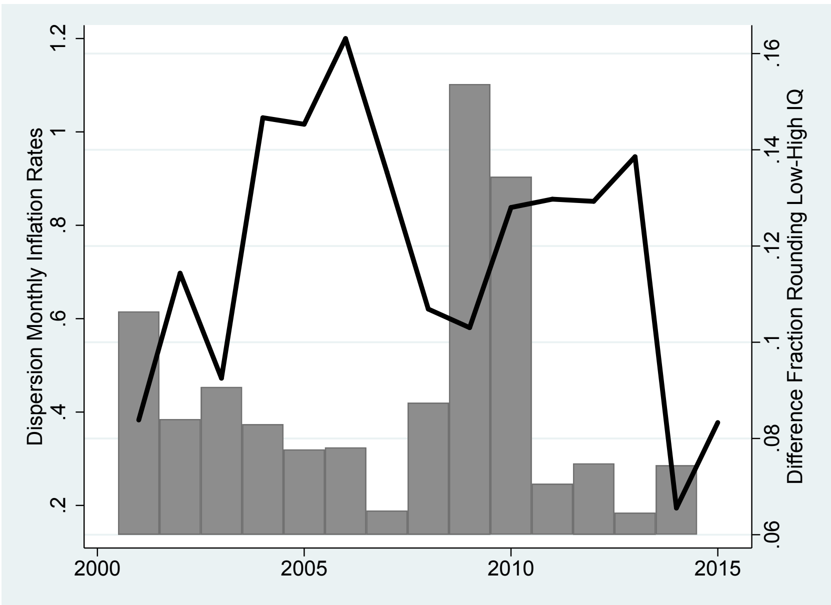
Panel A of this figure plots the average forecast error for inflation (in percentage points) as a function of 9 income percentiles. Panel B plots the average forecast error for inflation across 6 education categories. Education levels are based on the International Standard Classification of Education. Forecast error is the difference between the numerical forecast for 12-month-ahead inflation and ex-post realized inflation. Vertical lines represent 95% confidence intervals around the estimated mean for each bin. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

Figure 4: **Rounding and Implausible Values for Inflation Expectations by IQ**



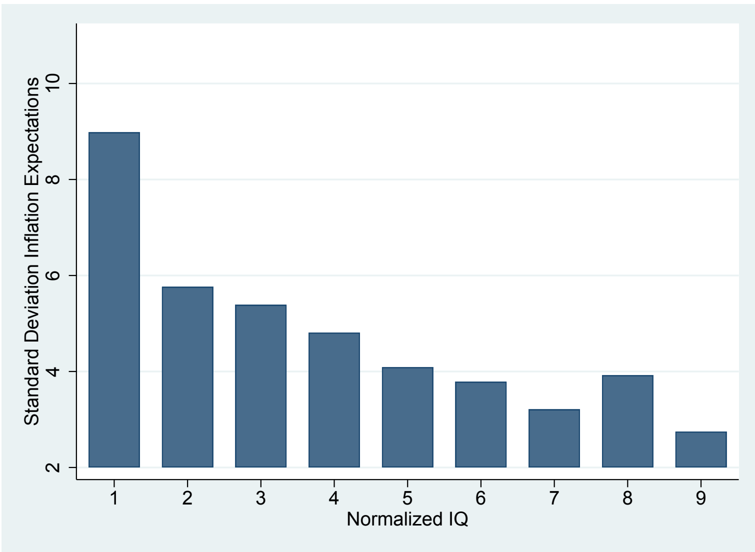
This figure plots the share of rounders (left panel) and the share of survey respondends who report forecasts for inflation larger than 5 in absolute value across IQ levels. We define rounders as survey participants who report multiples of 5 for the numerical forecast for 12-month-ahead inflation. Vertical lines represent 95% confidence intervals around the estimated mean for each bin. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

Figure 5: **Yearly Standard Deviation of Monthly Inflation Rates and Fraction of Rounders**



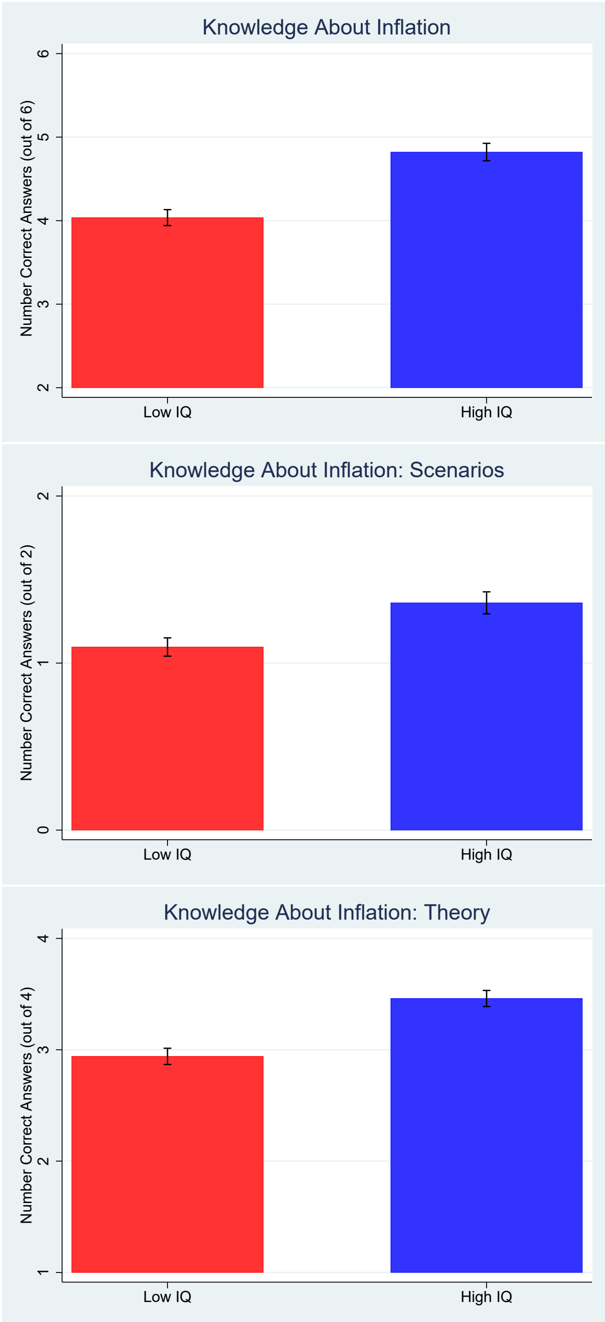
This figure plots the standard deviation of realized inflation within a year on the left y-axis and the differences in the fraction of rounders between low- and high-IQ men. We define rounders as survey participants who report multiples of 5 for the numeric inflation forecast. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. We define high-IQ men as survey participants with normalized IQ larger than 5. The sample period is from January 2001 to March 2015.

Figure 6: **Dispersion of Forecasts of Inflation by IQ**



This figure plots the standard deviation for inflation (in percentage points) across IQ levels. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

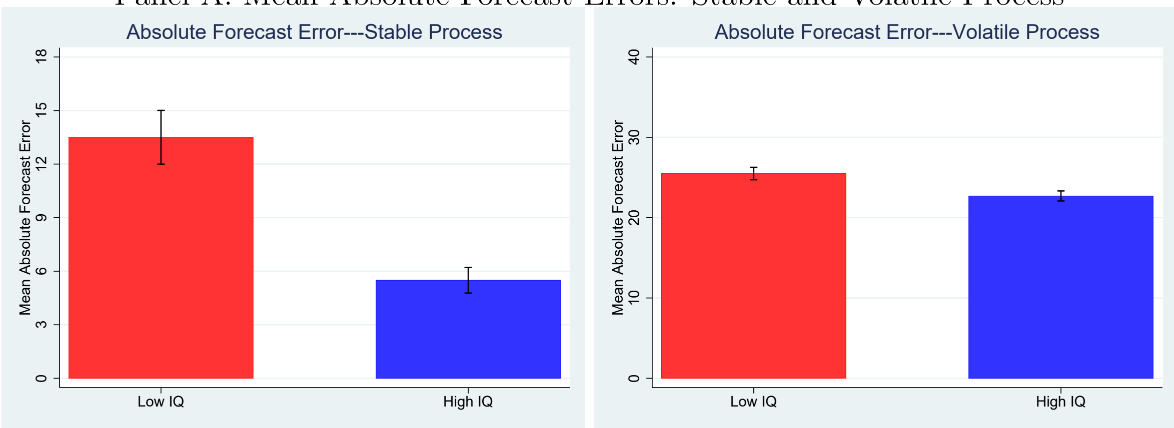
Figure 7: **Knowledge about Inflation by IQ**



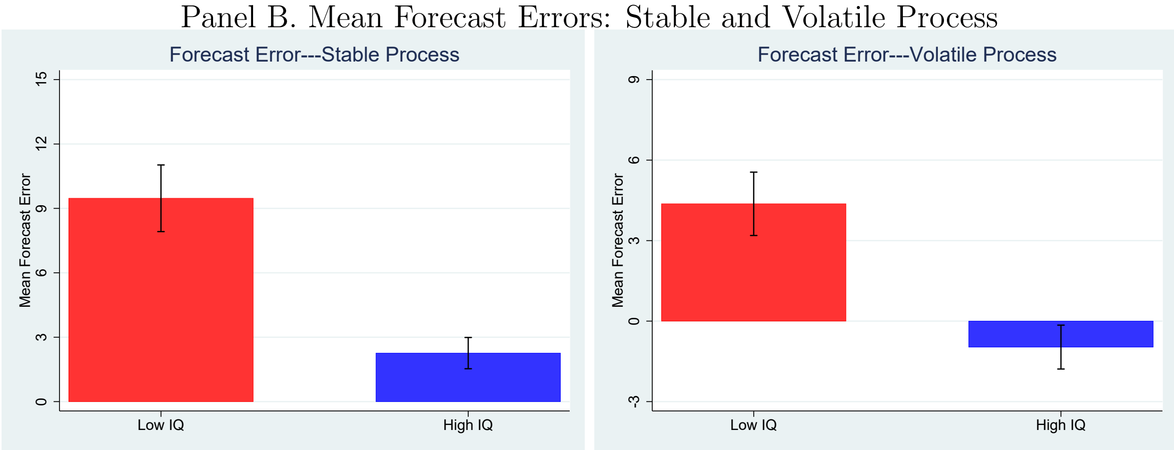
This figure plots the number of correct answers about the concept of inflation by low and high IQ. We fielded six questions on MTurk about inflation and split the sample by IQ using the number of correct answers in a cognitive reasoning test. Low-IQ survey participants correctly answered on average 4 and high-IQ survey participants 4.8. We fielded two waves of the survey in August 2019 with 500 respondents per wave.

Figure 8: **Forecasting Errors of Random Process by IQ**

Panel A. Mean Absolute Forecast Errors: Stable and Volatile Process

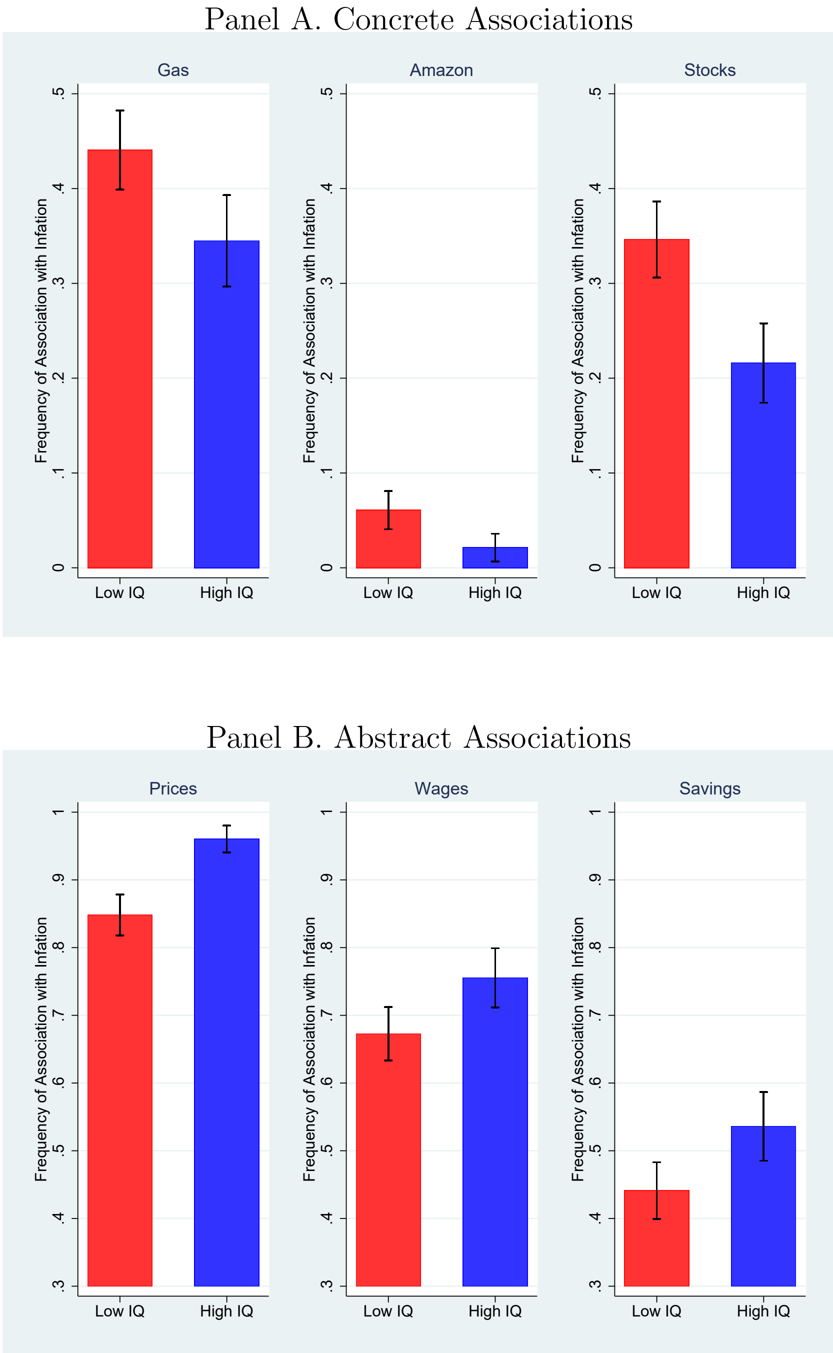


Panel B. Mean Forecast Errors: Stable and Volatile Process



This figure plots the average mean absolute forecast error (Panel A) and the average mean forecast error (Panel B) across two groups of individuals based on cognitive abilities. Low-IQ respondents scored 4 or less in our cognitive ability measure, whereas high-IQ respondents scored between 5 and 7 in the test. We produced these data through a forecasting task inspired by Landier et al. (2018). We asked respondents to forecast two zero-mean AR(1) processes for 15 periods with coefficients of mean reversion of 0.9. The left figures plot the statistics for a process with a volatility of 5 and the right figures plot the statistics for a process with a volatility of 20. The forecasting were part of a survey on MTurk we fielded in August 2019. The survey consisted of two sessions with 500 respondents each.

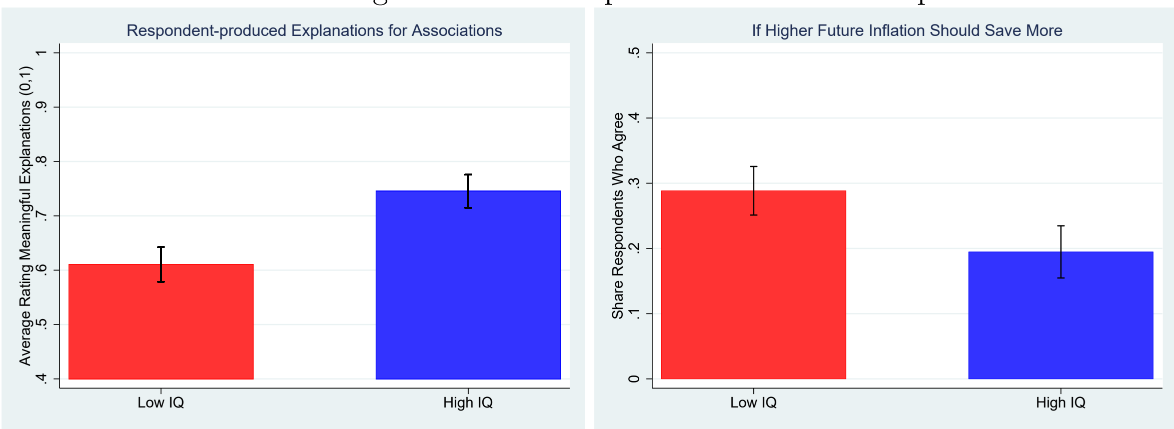
Figure 9: **Concrete versus Abstract Associations with Inflation by IQ**



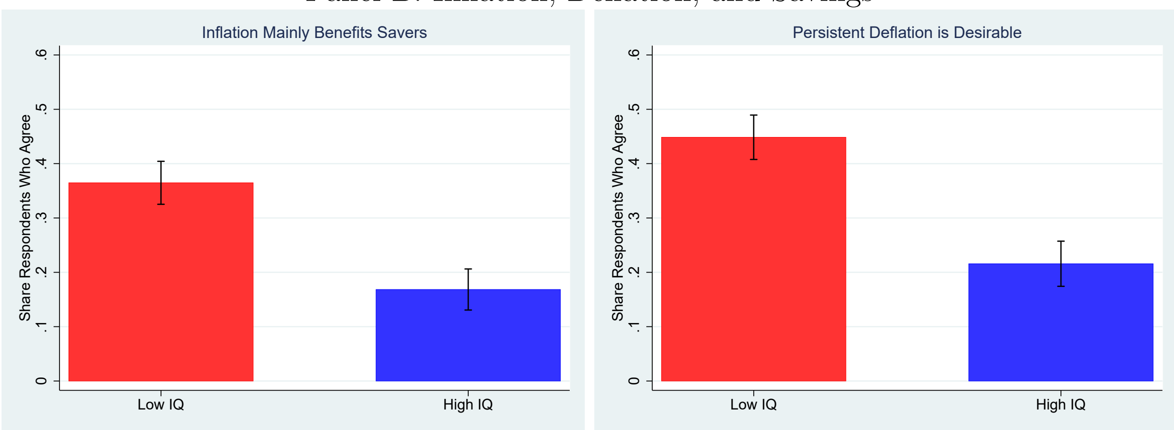
This figure plots the frequency with which individuals mention each of 6 available words with inflation when picking the first 3 words from the list they think are most related with the concept of "inflation." Frequencies are reported as average share of respondents mentioning each word across two groups—low-IQ respondents, who score 4 or less in our cognitive ability measure, and high-IQ respondents, who score between 5 and 7 in the test. Panel A refer to the 3 words in the list that constitute concrete concepts, whereas Panel B refer to the 3 words that constitute abstract concepts. We produced these results through an association game task á la Leiser and Drori (2005), which was part of a survey on MTurk we fielded in August 2019. The survey consisted of two sessions with 500 respondents each.

Figure 10: **Economic Reasoning by IQ**

Panel A. Rating of Provided Explanation and Euler Equation

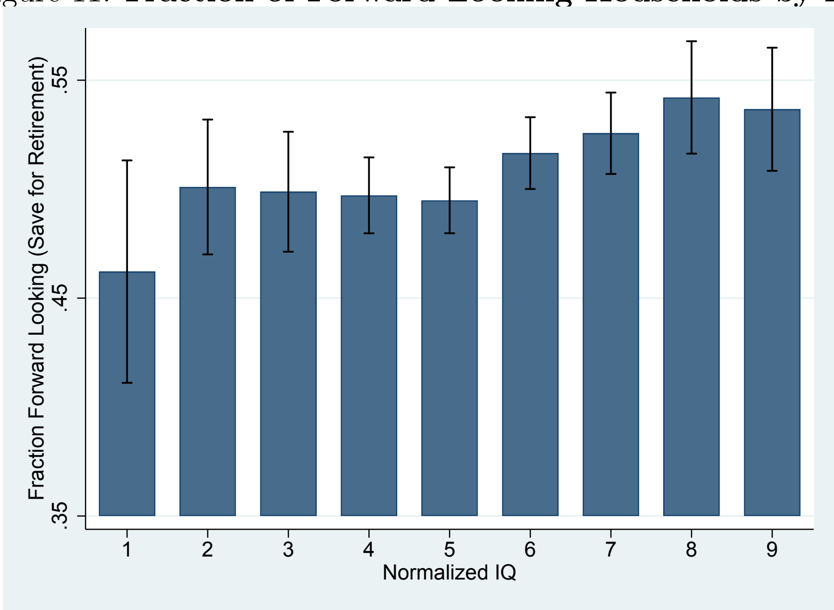


Panel B. Inflation, Deflation, and Savings



This figure plots mean absolute forecast error in Panel A and the mean forecast error in Panel B separately by low and high IQ. Individuals had to forecast two zero-mean AR(1) processes for 15 periods with coefficients of mean reversion of 0.9. The left figures plot the statistics for a process with a volatility of 5 and the right figures plot the statistics for a process with a volatility of 20. We fielded these forecasting tasks on MTurk and split the sample by IQ using the number of correct answers in a cognitive reasoning test. We fielded two waves of the survey in August 2019 with 500 respondents per wave.

Figure 11: **Fraction of Forward-Looking Households by IQ**



This figure plots the share of households that report they save for retirement (conditional on saving in general) as a function of normalized IQ in Finland. We use the confidential micro data underlying the official European Commission consumer confidence survey to savings for retirement. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

Table 1: **Descriptive Statistics**

This table reports descriptive statistics for the variables we use in the paper. We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is January 2001 to March 2015.

Statistic	Inflation Perception	Inflation Expectation	Total Debt [EUR]	IQ Dummy	Age	Income [EUR]
Nobs	27,184	27,568	27,540	27,568	27,568	27,568
Mean	3.00	2.47	38,591	0.50	30.70	22,541
Std	4.63	3.76	53,806	0.50	6.94	14,301
p1	-5.00	-5.00	0	0	19	900
p10	0.00	0.00	0	0	21	6,700
p25	0.00	0.00	0	0	25	13,100
p50	2.00	2.00	14,400	1	30	21,000
p75	5.00	3.50	62,300	1	36	28,900
p90	7.00	5.00	102,200	1	40	38,300
p99	20.00	15.00	242,400	1	46	74,400
Single	no	38.93%	Urban		no	64.41%
	yes	61.07%			yes	35.59%
Unemployed	no	94.17%	Helsinki		no	72.19%
	yes	5.83%			yes	27.81%
Kids	no	22.41%	College		no	65.67%
	yes	77.59%			yes	34.33%
Rounders	no	59.00%	Save		no	27.70%
	yes	41.00%			yes	72.30%
Implausible	no	89.80%	Save		no	70.53%
Values	yes	10.20%	Retirement		yes	29.47%
Durables	Good time	50.94%	Borrow		no	85.04%
	Neutral	28.67%	Education		yes	14.96%
	Bad time	20.40%				
			Borrow		no	68.66%
			Consumption		yes	31.34%

Table 2: **Numerical Inflation Expectations by IQ**

This table reports the average and standard deviation of inflation expectation by IQ category. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

	Low-IQ Men					High-IQ Men			
IQ	1	2	3	4	5	6	7	8	9
Mean	3.46	2.80	2.58	2.42	2.40	2.36	2.28	2.30	2.26
Std	8.70	5.93	5.52	4.66	4.66	4.16	3.47	4.13	3.31
Nobs	928	2,221	2,860	7,011	9,528	8,099	6,030	3,213	2,688

Table 3: **Absolute Forecast Errors and IQ: Splits by Demographic Groups**

This table reports the coefficient estimates from a linear regression of absolute forecast errors on normalized IQ and individual demographics. For each demographic category listed above a column, we perform the analysis separately for respondents who belong to the category (Panel A) and respondents who do not belong to the category (Panel B). We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015. High IQ is a dummy that equals 1 if normalized IQ is larger than 5. Standard errors are clustered at the quarter level. The sample period is January 2001 to March 2015.

	(1) Full Sample	(2) Single	(3) Below 35	(4) Urban	(5) Top 50% Income	(6) College Degree	(7) Econ/Business Degree
		Panel A. Respondent within Category					
High IQ	$-0.2388***$	$-0.2451***$	$-0.2728***$	$-0.1837***$	$-0.2586***$	$-0.1243***$	$-0.1530*$
	(0.0472)	(0.0534)	(0.0704)	(0.0597)	(0.0688)	(0.0508)	(0.0884)
Demographics	X	X	X	X	X	X	X
Year-Month FE	X	X	X		X	X	X
Adj. R^2	0.0608	0.0509	0.0457	0.0467	0.0446	0.0758	0.0093
Nobs	27,568	16,837	11,231	9,812	10,713	9,463	2,949
		Panel B. Respondent outside Category					
High IQ		$-0.2100***$	$-0.1915***$	$-0.2745***$	$-0.1760***$	$-0.2830***$	$-0.2563***$
		(0.0618)	(0.0481)	(0.0537)	(0.0500)	(0.0552)	(0.0441)
Demographics		X	X	X	X	X	X
Year-Month FE		X	X		X	X	X
Adj. R^2		0.0663	0.0682	0.0566	0.0626	0.0447	0.0528
Nobs		10,731	16,337	17,756	16,855	18,105	24,619

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

Table 4: **Absolute Forecast Errors and IQ: Types of Skills**

This table reports the coefficient estimates from a linear regression of absolute forecast errors on normalized IQ and individual demographics. We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. We also use IQ measures for different subcategories: visuospatial, verbal, and arithmetic. The sample period is from January 2001 to March 2015. High IQ is a dummy that equals 1 if normalized IQ is larger than 5. Standard errors are clustered at the quarter level. The sample period is January 2001 to March 2015.

	(1)	(2)	(3)	(4)
High IQ visuospatial	−0.1510***			−0.0393
	(0.0391)			(0.0434)
High IQ verbal		−0.2228***		−0.1385***
		(0.0400)		(0.0447)
High IQ arithmetic			−0.2473***	−0.1743***
			(0.0401)	(0.0462)
Demographics	X	X	X	X
Year-Month FE	X	X	X	X
Adj. R^2	0.0549	0.0555	0.0557	0.0561
Nobs	27,484	27,484	27,484	27,484

Standard errors in parentheses

$*p < 0.10, **p < 0.05, ***p < 0.01$

Table 5: **Rounding and Implausible Values by IQ**

This table reports the coefficient estimates from a linear regression of a dummy variable that equals 1 if the respondent reported a multiple of 5 as his inflation forecast (columns (1)–(2)) and if he reported a number larger than 5 in absolute value as his inflation forecast (columns (3)–(4)). We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. High IQ is a dummy that equals 1 if normalized IQ is larger than 5. Standard errors are clustered at the quarter level. The sample period is from January 2001 to March 2015.

	Rounding		Implausible Values	
	(1)	(2)	(3)	(4)
High IQ	−0.1195***	−0.0735***	−0.0446***	−0.0194***
	(0.0051)	(0.0061)	(0.0036)	(0.0044)
Demographics		X		X
Year-Month FE		X		X
Adj. R^2	0.0142	0.0482	0.0049	0.0417
Nobs	38,289	28,807	31,841	24,345

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

Table 6: **Current Perceptions and Expectations and Past Inflation Expectations and IQ**

This table reports the coefficient estimates from a linear regression of inflation expectations (columns (1)–(2)) and inflation perceptions (columns (3)–(8)) on inflation expectations 6 months ago for men with high and low IQs. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. We define High IQ as the sample of men with normalized IQ larger than 5. The sample period is March 1995 to December 1999.

	Inflation Expectations		**Inflation Perceptions**					
			All Periods		Periods of Stable Inflation		Periods of Changing Inflation	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ
Past expectations	0.231***	0.025	0.243***	0.053***	0.300***	0.047*	0.141	0.061**
	(0.0661)	(0.0476)	(0.047)	(0.021)	(0.054)	(0.028)	(0.090)	(0.024)
Demographics	X	X	X	X	X	X	X	X
Year-Month FE	X	X	X	X	X	X	X	X
Adj. R^2	0.03	0.02	0.03	0.02	0.04	0.02	0.03	0.04
Nobs	1,082	774	1,367	1,185	922	782	445	403

Standard errors in parentheses

$*p < 0.10, **p < 0.05, ***p < 0.01$

Table 7: **Current Perceptions and Expectations and Past Inflation Expectations and IQ: by Wave**

This table reports the coefficient estimates from a linear regression of inflation expectations (columns (1)–(4)) and inflation perceptions (columns (5)–(8)) on inflation expectations 6 months ago for men with high and low IQs. Columns (1)–(2) and (5)–(6) regress answers during the second participation on the answers during the first participation in the survey and columns (3)–(4) and (7)–(8) do so for answers in the third and second participation. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. We define High IQ as the sample of men with normalized IQ larger than 5. The sample period is March 1995 to December 1999.

	Inflation Expectations				**Inflation Perceptions**			
	Only Wave 2 and Wave 1		**All Waves**		**Only Wave 2 and Wave 1**		**All Waves**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ
Past expectations	0.2620***	0.0258	0.2305***	0.0253	0.2646***	0.0357*	0.2823***	0.0292
	(0.0347)	(0.0363)	(0.0661)	(0.0476)	(0.0362)	(0.0183)	(0.0530)	(0.0291)
Demographics	X	X	X	X	X	X	X	X
Year-Month FE	X	X	X	X	X	X	X	X
Adj. R^2	0.1308	0.0335	0.0253	0.0189	0.1332	0.0753	0.0359	0.0316
Nobs	633	443	1,082	774	619	432	1,064	760

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

Table 8: **Forecast Errors on Forecast Revisions by IQ**

This table reports the coefficient estimates from the following linear specification of forecast errors for inflation on forecast revisions for men with high and low IQs. We define forecast errors as ex-post realized inflation minus on expected inflation. We define forecast revision as the change in forecast for 10-month ahead inflation from six month before. We thus estimate the following specifications (see Coibion and Gorodnichenko (2015) and Bordalo, Gennaioli, Ma, and Shleifer (2018)):

$$x_{t+1} - x_{i,t+1|t} = \alpha^{IQ} + \beta FR^{IQ}_{i,t,1} + \varepsilon_{i,t},$$

where the forecast errors of agent i is the difference between the realized value of a variable, x_{t+1}, minus the forecast at time t, $x_{i,t+1|t}$. The forecast revision, $FR_{i,t,1} = x_{i,t+1|t} - x_{i,t+1|t-1}$. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. We define High IQ as the sample of men with normalized IQ larger than 5. The sample period is March 1995 to December 1999.

	(1) High IQ	(2) Low IQ	(3) High IQ	(4) Low IQ	(5) High IQ	(6) Low IQ	(7) High IQ	(8) Low IQ
Forecast revision	−0.7612***	−0.5235***	−0.7771***	−0.5257***	−0.8533***	−0.6333***	−0.8739***	−0.5191
	(0.0979)	(0.1516)	(0.0910)	(0.1519)	(0.0634)	(0.1653)	(0.1114)	(0.4191)
Year-Month FE			X	X	X	X	X	X
Demographics					X	X	X	X
Individual FE							X	X
Pseudo R^2	0.6545	0.4817	0.7284	0.5207	0.8193	0.6362	0.9581	0.9426
Nobs	1,377	1,203	1,377	1,203	1,082	774	1,082	774

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

Table 9: **Inflation Expectations and Readiness to Spend: Splits by Demographic Groups**

This table reports the average marginal effects of a multinomial logit regression. Households' readiness to purchase durables is the dependent variable. Inflation increase is a dummy variable that equals 1 when a survey participant replies that inflation will increase. For each demographic category listed above a column, we perform the analysis separately for respondents who belong to the category (Panel A) and respondents who do not belong to the category (Panel B). We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. Statistics Finland asks a representative sample of 1,500 individuals each month whether it is a good time to purchase durables given the current economic conditions. Individuals can reply that it is a good time, it is a bad time, or it is neither a good time nor a bad time. In this table, we study the "it is a good time" outcome. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. We define High IQ as the sample of men with normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is January 2001 to March 2015.

	Full Sample		Single		Below 35		Urban		Top 50% Income		College Degree		Econ/Business Degree	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ
Panel A. Respondent within Category														
Expects Higher	0.0358∗∗∗	−0.0096	0.0377∗∗	−0.0183	0.0614∗∗∗	−0.004	0.0391∗∗	−0.0131	0.0723∗∗∗	−0.0288	0.0390∗∗	0.0254	0.0459	0.1109∗∗
Inflation	(0.0119)	(0.0138)	(0.0167)	(0.0177)	(0.0221)	(0.0201)	(0.0192)	(0.0239)	(0.0207)	(0.0233)	(0.0174)	(0.0260)	(0.0309)	(0.0458)
Demographics	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Year-Month FE	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pseudo R^2	0.0108	0.0091	0.0098	0.0069	0.0097	0.0054	0.0109	0.0109	0.0094	0.0064	0.0131	0.0156	0.0148	0.0276
Nobs	16,606	16,256	10,109	11,107	6,499	7,469	7,070	4,644	6,593	6,703	7,512	3,051	2,024	1,398
Panel B. Respondent outside Category														
Expects Higher			0.0356∗∗	0.0067	0.0211	−0.0152	0.0333∗∗	−0.0061	0.0121	0.0016	0.0354∗∗	−0.0200	0.0341∗∗∗	−0.0225∗
Inflation			(0.0163)	(0.0211)	(0.0158)	(0.0187)	(0.0169)	(0.0168)	(0.0150)	(0.0178)	(0.0173)	(0.0152)	(0.0129)	(0.0135)
Demographics			X	X	X	X	X	X	X	X	X	X	X	X
Year-Month FE			X	X	X	X	X	X	X	X	X	X	X	X
Pseudo R^2			0.0145	0.0171	0.0131	0.0127	0.0107	0.0092	0.0146	0.0122	0.0097	0.008	0.0111	0.0085
Nobs			6,497	5,149	10,107	8,787	9,536	11,612	10,013	9,553	9,094	13,205	14,582	14,858

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

Table 10: **Saving and Borrowing Motives by IQ**

This table reports the average marginal effects of individuals' saving and borrowing motives. Individuals' saving and borrowing motives are the dependent variables that equal dummy variables that equal 1 if the survey participant agrees with the statement. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. High IQ is a dummy that equals 1 if normalized IQ is larger than 5. The sample period is from January 2001 to March 2015.

	Saving Motives		**Borrowing Motives**	
	for any purpose	for retirement	for consumption	for education
	(1)	(2)	(3)	(4)
High IQ	−0.1069***	0.1045***	0.0632	0.3157***
	(0.0200)	(0.0287)	(0.0454)	(0.0459)
Demographics	X	X	X	X
Year-Month FE	X	X	X	X
Pseudo R^2	0.0046	0.0482	0.0795	0.0259
Nobs	33,456	13,886	4,153	4,155

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

Table 11: **Inflation Expectations and Readiness to Spend: Channels**

This table reports the average marginal effects of a multinomial logit regression. Individuals' readiness to purchase durables is the dependent variable. Inflation expectation is a dummy variable which equals 1 when a household replies that inflation will increase. We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. The surveys ask representative samples of individuals on a monthly basis whether it is a good time to purchase durables given the current economic conditions. Individuals can reply that it is a good time, it is a bad time, or it is neither a good time nor a bad time. In this table we study the "it is a good time" outcome. We measure normalized IQ using data from the official military entrance exam in Finland. Demographics controls are age, age^2, sex, marital status, log of income, employment status, number of children, urban versus rural classification, college dummy, and a dummy that equals 1 if the respondent lives in Helsinki. We cluster standard errors at the quarter level. The sample period is from January 2001 to March 2015.

	(1)	(2)	(3)	(4)
Panel A	**Abs Perception Error <= Q50$_t$**		**Abs Perception Error <= Q25$_t$**	
	High IQ	Low IQ	High IQ	Low IQ
Expects Higher Inflation	0.0472***	0.0209	0.0587**	0.0149
	(0.0153)	(0.0165)	(0.0239)	(0.0250)
Demographics	X	X	X	X
Year-Month FE	X	X	X	X
Nobs	10,115	8,984	4,800	4,007
Panel B	**Abs Forecast Error <= Q50$_t$**		**Abs Forecast Error <= Q25$_t$**	
	High IQ	Low IQ	High IQ	Low IQ
Expects Higher Inflation	0.0401**	0.0069	0.0409	0.0112
	(0.0184)	(0.0243)	(0.0254)	(0.0298)
Demographics	X	X	X	X
Year-Month FE	X	X	X	X
Nobs	9,699	8,694	5,869	5,262
Panel C	**Economics Major**		**Engineering Major**	
	High IQ	Low IQ	High IQ	Low IQ
Expects Higher Inflation	0.0619*	0.1059**	−0.0220	−0.2886
	(0.0330)	(0.0475)	(0.0964)	(0.2782)
Demographics	X	X	X	X
Year-Month FE	X	X	X	X
Nobs	1,751	1,228	273	52

Standard errors in parentheses

$*p < 0.10, **p < 0.05, ***p < 0.01$

Online Appendix:

IQ, Expectations, and Choice

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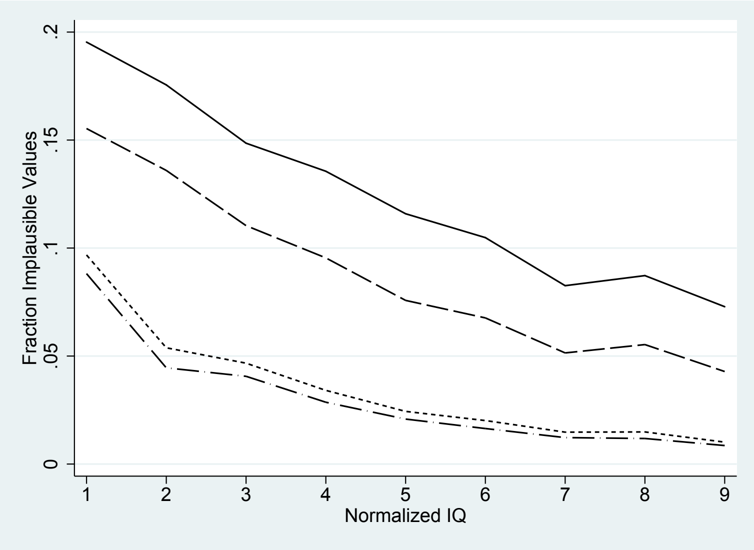
Not for Publication

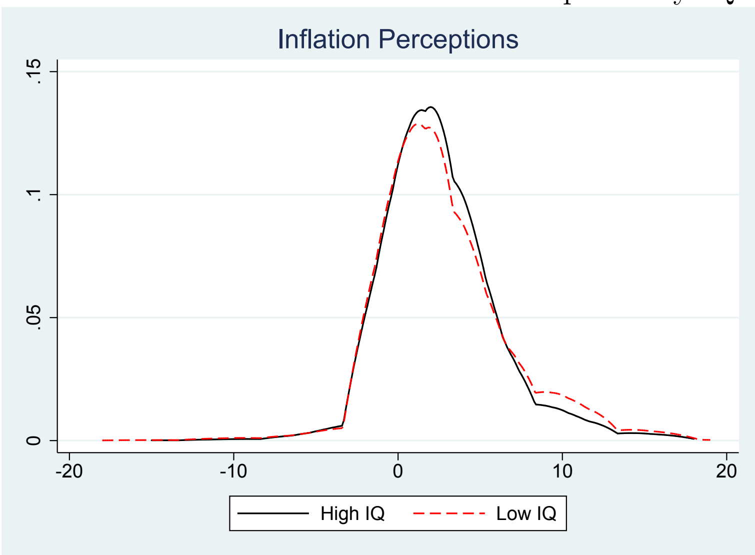
Figure A.1: **Implausible Values for Inflation Expectations by IQ**



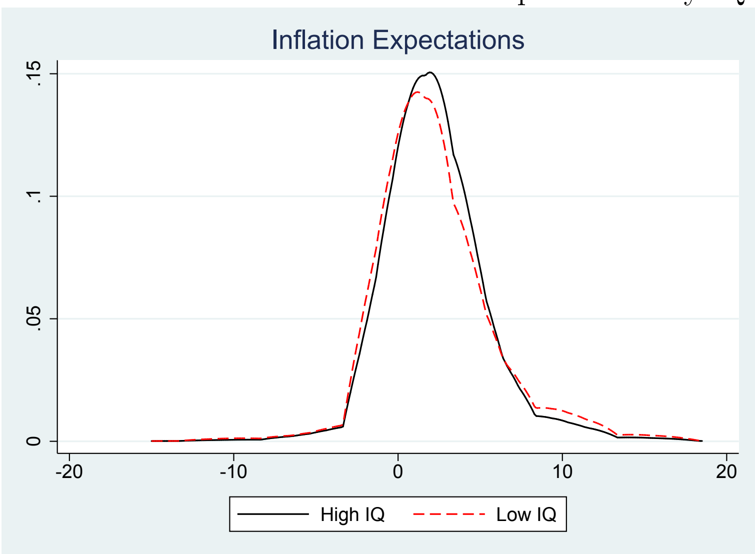
This figure plots the share of survey respondents who report forecasts for inflation larger than a threhold in absolute value by IQ levels. The thresholds we consider are 5% (solid line), 7% (long-dashed line), 10% (short-dashed line), and 12% (dash-dotted line). We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. We define high-IQ men as survey participants with normalized IQ larger than 5. The sample period is from January 2001 to March 2015.

Figure A.2: **Distribution of Inflation Perceptions and Expectations by IQ**

Panel B. Distribution of Inflation Perceptions by IQ



Panel A. Distribution of Inflation Expectations by IQ



This figure plots the density of numerical inflation perceptions (Panel A) and numerical inflation expectations (Panel B) across men with IQ levels between 1 and 5 ("Low IQ") and between 6 and 9 ("High IQ"). IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. To measure numerical inflation perceptions and expectations, we use the confidential micro data underlying the official European Commission consumer confidence survey. Statistics Finland asks a representative sample of 1,500 individuals each month. The sample period is from January 2001 to March 2015. The densities are estimated using an Epanechnikov kernel with a bandwidth of 1.5 in both Panels.

Table A.1: **Absolute Forecast Errors and IQ: Time Since Test**

This table reports the coefficient estimates from a linear regression of absolute forecast errors on normalized IQ and several interaction terms of IQ with dummy variables and age. $\mathbb{1}_{long\ ago}$ equals 1 for individuals that are in the top third of the distribution of the time gap between when they took the IQ test and the survey on inflation expectations, $\mathbb{1}_{medium\ ago}$ equals 1 for individuals that are in the middle third, and $\mathbb{1}_{pre\ test}$ equals 1 for individuals that answered the survey on inflation expectations before the IQ test. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,500 individuals each month. IQ is the standardized test score from the Finnish Defence Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015. High IQ is a dummy that equals 1 if normalized IQ is larger than 5. Standard errors are clustered at the quarter level. The sample period is January 2001 to March 2015.

	(1)	(2)	(3)	(4)
High IQ	−0.2467***	−0.2969***	−0.2467***	−0.3644**
	(0.0503)	(0.0852)	(0.0406)	(0.1754)
High IQ × $\mathbb{1}_{long\ ago}$	0.0022	0.0528		
	(0.0787)	(0.1059)		
High IQ × $\mathbb{1}_{medium\ ago}$		0.0721		
		(0.1045)		
High IQ × $\mathbb{1}_{pre\ test}$			0.0785	
			(0.4126)	
High IQ × age				0.0039
				(0.0056)
Demographics	X	X	X	X
Year-Month FE	X	X	X	X
Pseudo R^2	0.0556	0.0558	0.0557	0.0556
Nobs	27,568	27,568	27,568	27,568

Standard errors in parentheses

$*p < 0.10, **p < 0.05, ***p < 0.01$

Table A.2: **(Absolute) Forecast Errors and IQ: MTurk Evidence**

This table reports the coefficient estimates from a linear regression of mean (absolute) forecast errors on an IQ dummy and several demographic covariates. Individuals had to forecast two zero-mean AR(1) processes for 15 periods with coefficients of mean reversion of 0.9. *Stable* columns report the statistics for a process with a volatility of 5 and *Volatile* columns report the statistics for a process with a volatility of 20. We fielded these forecasting tasks on MTurk. High IQ is a dummy that takes a value of 1 if individuals answered more than four out of seven cognitive reasoning questions correctly. We fielded two waves of the survey in August 2019 with 500 respondents per wave. Covariates include dummy variables for risk tolerance, general trust, reciprocity, willingness to take revenge, gender, four age group dummies, five income group dummies, four education group dummies, as well as dummies that take the value of one if the survey respondent is in charge of financial decision and is the main grocery shopper within household.

	Mean Forecast Errors		Mean Absolute Forecast Errors	
	Stable (1)	Volatile (2)	Stable (3)	Volatile (4)
High IQ	−6.318***	−4.671***	−7.057***	−2.642***
	(0.996)	(0.822)	(0.971)	(0.560)
Demographics	X	X	X	X
Pseudo R^2	0.065	0.059	0.080	0.036
Nobs	922	922	922	922

Standard errors in parentheses

$*p < 0.10, **p < 0.05, ***p < 0.01$

Table A.3: **Economic Reasoning by IQ: Plausible Expectations**

This table reports the coefficient estimates from a linear regression of the average rating of the provided reasoning behind associating inflation with different words on a scale from 0 to 1 in column (1), whether survey participants think persistent inflation is desirable in column (2), on whether survey participants think inflation benefits savers on average in column (3), and whether they would increase their savings propensity to unexpected news about inflation in column (4) on an IQ dummy and several demographic covariates for the subsample of individuals that have reasonable inflation perceptions and expectations. We define reasonable when perceptions and expectations between 0% and 4%. High IQ is a dummy that takes a value of 1 if individuals answered more than four out of seven cognitive reasoning questions correctly. We fielded two waves of the survey in August 2019 with 500 respondents per wave. Covariates include dummy variables for risk tolerance, general trust, reciprocity, willingness to take revenge, gender, four age group dummies, five income group dummies, four education group dummies, as well as dummies that take the value of one if the survey respondent is in charge of financial decision and is the main grocery shopper within household.

	Knowledge (1)	Deflation (2)	Saver (3)	Saving (4)
High IQ	0.0902**	−0.128**	−0.110**	−0.0958*
	(0.0318)	(0.0405)	(0.0415)	(0.0414)
Demographics	X	X	X	X
Pseudo R^2	0.0250	0.0550	0.0600	0.0170
Nobs	403	412	412	412

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