IQ, Expectations, and Choice*

Francesco D'Acunto,[†]Daniel Hoang,[‡]Maritta Paloviita,[§]and Michael Weber[¶]

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Abstract

We use administrative and survey-based micro data to study the relationship between cognitive abilities (IQ), the formation of economic expectations, and the choices of a representative male population. Men above the median IQ (high-IQ men) display 50% lower forecast errors for inflation than other men. High-IQ men, but not others, have consistent inflation expectations and perceptions over time. High-IQ men are also less likely to round and to forecast implausible values. In terms of choice, only high-IQ men increase their propensity to consumer when expecting higher inflation as the consumer Euler equation prescribes. High-IQ men are also forward-looking – they are more likely to save for retirement conditional on saving. Education levels, income, socio-economic status, and occupations, although important, do not explain the variation in expectations and choice by IQ. Our results have implications for heterogeneous-beliefs models of household consumption, saving, and investment.

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[†]Carroll School of Management, Boston College, Chestnut Hill, MA, USA. e-Mail: dacuntof@bc.edu

[‡]Department for Finance and Banking, Karlsruhe Institute of Technology, Karlsruhe, B-W, Germany. e-Mail: daniel.hoang@kit.edu

[§]Bank of Finland, Helsinki, Finland. e-Mail: Maritta.Paloviita@bof.fi

[¶]Booth School of Business, University of Chicago, Chicago, IL, USA and NBER. e-Mail: michael.weber@chicagobooth.edu.

After the rational-expectations revolution, researchers have largely stopped paying attention to how individuals form expectations, because subjective-expectations data display large cross-sectional variation and deviate from the rational benchmark (Coibion, Gorodnichenko, and Kamdar (2017)). Yet individuals' actual expectations are central to explain their saving, consumption, and investment choices and hence aggregate outcomes (Gennaioli and Shleifer (2018)), which motivates a recent revival of studying how individuals form, update, and act upon economic expectations.[1]

Because forming expectations and financial decision-making require the use of cognitive resources, cognitive ability is a natural candidate to help explain the cross-sectional variation of individual expectations (Falk, Becker, Dohmen, Enke, Huffman, and Sunde (2018)). Cognition might affect households' ability to gather information about economic variables, their ability to solve maximization and resource-allocation problems over time, as well as their ability to grasp basic economic reasoning and intuition (D'Acunto, Hoang, Paloviita, and Weber (2018)).

Assessing the extent to which cognitive abilities shape individual expectations and decisions faces a major empirical challenge. The econometrician needs to measure at the same time the cognitive abilities, economic expectations, economic decisions, and demographic characteristics of a representative population. To overcome this empirical hurdle, we match – to the best of our knowledge for the first time – individual-level administrative data on cognitive abilities (IQ) with survey-based information on a large set of macroeconomic expectations, as well as on the consumption, saving, and borrowing plans of a representative sample of men in Finland.

Finland provides a desirable laboratory to study the effects of cognition on beliefs and choice, because it is a culturally homogeneous society with essentially free access to schooling and with a low degree of labor-income inequality (see Grinblatt, Keloharju, and Linnainmaa (2011)). As we discuss below, in this setting, the cross-sectional variation in cognitive abilities is barely associated with the variation in labor income, and hence assuming low-IQ individuals are low-income individuals and vice versa would be misleading. Moreover, the ratio of debt to labor income is similar across the distribution of cognitive abilities, which suggests men with different levels of IQ have not only similar

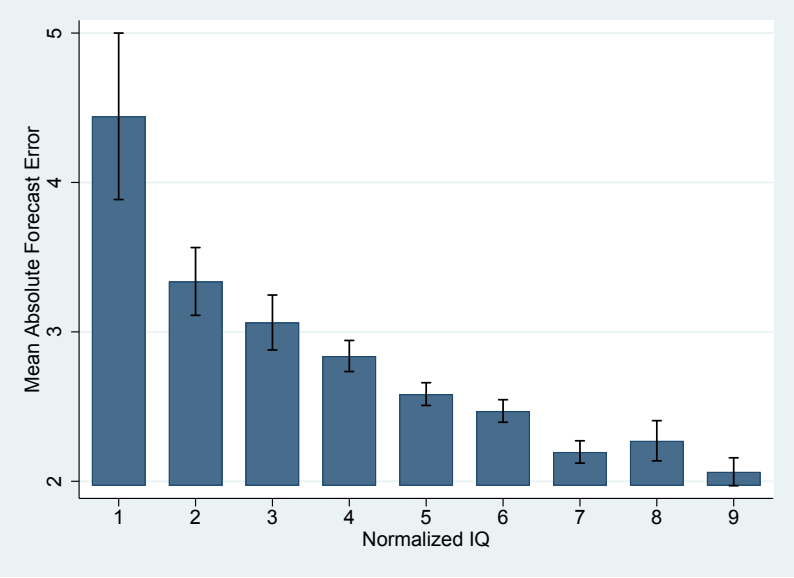
[1]See also Landier, Ma, and Thesmar (2018), Ben-David, Fermand, Kuhnen, and Li (2018), Malmendier and Nagel (2016), Das, Kuhnen, and Nagel (2017), D'Acunto, Malmendier, Ospina, and Weber (2018)), Bordalo, Gennaioli, and Shleifer (2018), and Gennaioli, Ma, and Shleifer (2018).

labor incomes, but also similar debt capacity and access to financing (D'Acunto et al. (2018)).

We use the Finnish setting to assess the extent to which cognitive abilities help explain the cross-sectional variation in individual-level economic expectations. In addition, we study the extent to which agents' economic and financial decisions react to their expectations based on heterogeneity in cognitive abilities.

In our baseline analysis, we focus on inflation expectations because in most macroeconomic models, inflation expectations drive the consumption, saving, and borrowing decisions of individuals, workers' wage bargaining with firms as well as managers' price-setting decisions, and the effectiveness of fiscal and monetary policy, among other outcomes (Bernanke (2007)).

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



This figure plots the average absolute forecast error for inflation 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. 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 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 is 4.3 percentage points. The absolute forecast errors decrease monotonically with IQ. The difference in absolute forecast errors between men with median and the highest cognitive abilities is

0.6 percentage points, which is 30% of the 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. The average absolute forecast errors are large across the whole IQ distribution compared 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%.

These cross-sectional results survive when 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, which researchers have shown affect the inflation expectations of Americans (D'Acunto, Malmendier, Ospina, and Weber (2018)). Consistent with earlier research, we find these observables are important determinants of expectations and choice, but they barely help explain the relationship between IQ, expectations, and choice.

Our IQ measure derives from administrative micro data (Grinblatt, Keloharju, and Linnainmaa (2011)). Around age 20, all Finnish men take a standardized cognitive test immediately after starting their mandatory military service. IQ is a cohort-level standardized variable that follows a stanine distribution (integers from 1 to 9, with 9 being the highest) and summarizes the results of 120 cognitive-ability questions in the military cognitive test. The Finnish Defence Forces (FDF) perform this level of aggregation and standardization to allow comparisons across cohorts.[2] We observe this measure for all Finnish male cohorts between 1982 and 2001. We match IQ to the individual answers to the monthly harmonized European Commission Consumer Survey (EU survey), which covers repeated representative cross sections of Finns from 2001 to 2015. This survey elicits expectations of individual and aggregate economic outcomes, as well as propensities to consume, save, and borrow.

Regressing absolute forecast errors at the individual-level on a dummy that equals 1 when the respondent has an IQ above 5 (high IQ) and demographic observables delivers a significantly negative coefficient whose size is 20% of the mean absolute forecast error in the sample. Each point increase in standardized IQ is associated with a decrease in

[2]The standardization alleviates the Flynn effect of trending test scores over time.

absolute forecast errors of 0.2 percentage points.

Our baseline analysis exploits cross-sectional variation, but the EU survey also contains a small rotating panel dimension between 1995 and 1999 during which each individual is interviewed three times with a six-month lag between interviews. The panel allows us to study the consistency of inflation expectations within individuals over time and whether the perceptions of current inflation line up with past inflation forecasts. Only high-IQ men display a positive correlation between past forecasts and current perceptions of past inflation. Realized inflation is highly persistent, and hence rational expectations imply on average a positive correlation between past inflation forecasts and current inflation forecasts. This association should be especially detectable at times when no shocks or news about inflation are realized between adjacent interview periods. We find only high-IQ men display a positive association between past and current inflation forecasts. This association for high-IQ men is indeed higher across interview periods with stable inflation.

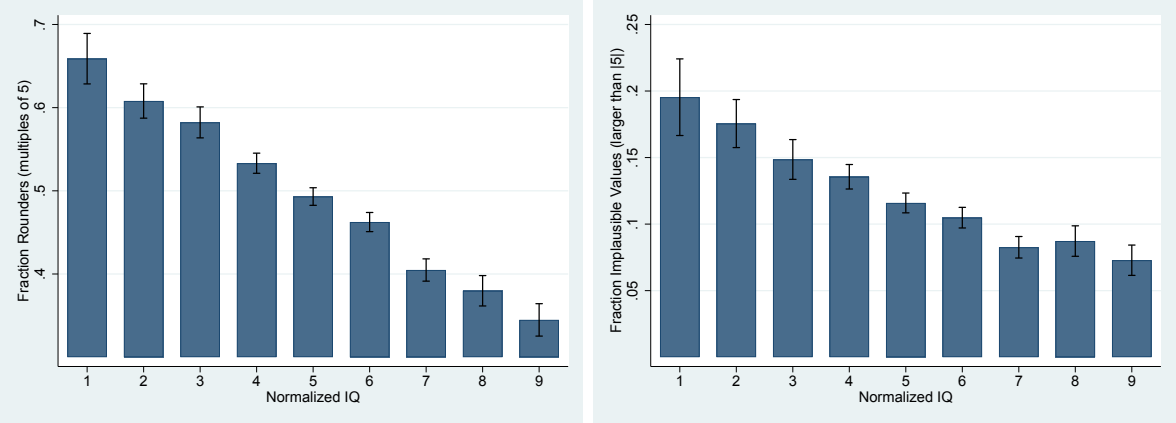
After studying forecast errors and the consistency of expectations over time, we move on to consider other features of expectations that earlier research in microeconomics, macroeconomics, and social psychology proposed as signs of inaccuracy in elicited individual economic beliefs. In particular, we consider rounding – the tendency of households to respond with multiples of 5 when asked for a numerical forecast of inflation – and the reporting of implausible values for expected inflation (see, e.g., Manski and Molinari (2010) and Binder (2015)).

Figure 2 plots the average share of respondents who round (left panel) and the average share of respondents who provide implausible values (right panel) by IQ bins.[3] The figure documents two evident monotonic patterns for the shares of rounders and those providing implausible inflation forecasts across IQ bins, despite the fact that these two phenomena affect individual respondents to different extents, ranging from 40% to 70% of respondents for rounding, and from 7% to 20% for the reporting of implausible values fo inflation. For both aspects of forecast inaccuracy, the monotonic patterns are similar to the one we documented in Figure 1 for forecast errors.

In the second part of the paper, we assess whether the heterogeneity of individual expectations by IQ levels matters for economic decision-making. As a first step,

[3]In this figure, we consider forecasts whose absolute value is larger than 5 as implausible values. As we show below, the results are similar when we change this threshold.

Figure 2: **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. IQ is the standardized test score from the Finnish Armed Forces. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

we assess whether IQ levels relate to Finnish men's understanding of intertemporal substitution. Specifically, we test whether individuals adjust their consumption plans to changing inflation expectations as the consumption 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, and many central banks relied on the Euler equation when implementing policies to raise inflation expecations during the Great Recession in the hope of stimulating consumption.[4] Because the numerical inflation expectations of low-IQ individuals are inaccurate and such individuals might be aware of their inability to forecast inflation precisely, one might expect these individuals to actively decide not to employ their numerical inflation expectations when forming consumption plans. We thus follow D'Acunto, Hoang, and Weber (2018) and create a qualitative measure of inflation expectations – a dummy variable that equals 1 when a household expects inflation to increase over the next 12 months relative to the previous 12 months. D'Acunto et al. (2018) show this qualitative measure tracks closely ex-post inflation rates even for households with low levels of sophistication. If low-IQ individuals were aware of their

[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."

biases and understood intertemporal substitution, we would thus expect that at least their accurate qualitative inflation expectations were related to their consumption plans.

When focusing on high-IQ men, we find respondents who think inflation will increase in the following 12 months are almost 4% more likely to state it is a good time to purchase large-ticket items relative to other high-IQ men. Instead, when limiting the sample to low-IQ men, we detect a small, negative, and statistically insignificant association between qualitative inflation expectations and readiness to spend. These results hold conditional on the rich set of demographics discussed above, and suggest that even if low-IQ men held plausible expectations about future inflation – for instance, because policymakers informed them about the inflation rate expected by professional forecasters – low-IQ men might still not behave in line with the predictions of standard macroeconomic models.

One might worry 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)). Conditioning on labor income does not affect any of our baseline results, and low-income individuals are plausibly more likely to be financially constrained than high-income individuals. Another potential concern 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. D'Acunto et al. (2018) directly show financial constraints and income expectations elicited at the same time as inflation expectations cannot explain the non-response in the consumption plan of low-IQ men to their inflation expectations.

In the last part of the paper, we consider households' saving and borrowing motives, even if we can only observe these dimensions for a restricted portion of our sample. We find that high-IQ and low-IQ men do not differ in 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 instead of purchasing specific large-ticket items or paying for holidays. These results suggests high-IQ men might 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.

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 et al. (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 (2015), who study mutual fund choice. Agarwal and Mazumder (2013) relate cognitive abilities to suboptimal use of credit cards and home-equity loan applications. Aghion et al. (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.

I Data

Our analysis uses three micro data sets 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 that 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.[5] Within the first weeks of the mandatory military service, Finnish men have to participate in a series of tests typically around the age of 19-20. The FDF administers these tests and uses 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

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

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 nine-point standard scale with a mean of five and a standard deviation of two. 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. We have test results for all participants from 1982 until 2001.

Finland is a homogeneous country in terms of cultural background and opportunities. 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 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.[6] 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 about households' 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 as opposed to repeated cross sections. 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.[7]

[6] D'Acunto et al. (2018) use the micro data for several European countries and discuss in detail the survey design and data properties.

[7] The data for 2000 are missing unfortunately.

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 II.*B.* in which we exploit the panel dimension to study variation 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:

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.

The online appendix contains the original survey questions in Finnish.

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 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. The annual administrative data set covers the period between 1988 and 2013.

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, but 77.6% have kids. 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. 15% 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 forecasts 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 analysis 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.

II IQ and Expectations

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, and we study the association between past forecasts of inflation, current forecasts of future inflation, and current inflation perceptions exploiting the panel component of the survey.

A. Cross-sectional Expectations and 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. The forecast error for inflation is a proxy for the accuracy of households' inflation expectations – the higher the forecast error, the lower the accuracy of forecasts.

A.1 First Moment of Expectations

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 in inflation expectations 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% higher 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 3 reports the results for the alternative definition of forecast errors, and replicates all the patterns in Figure 1, although the association is slightly flatter for levels of IQ above the median.

A relevant concern with the univariate association between IQ bins and forecast errors is that IQ might be a 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 Table **??** shows the correlation between IQ and income levels, despite being positive, is quite low (0.15).

To assess the extent to which this concern is relevant, we first repeat the univariate

analysis of Figure 1, plotting average forecast errors across categories of income and education level. In Panel A of Figure 4, we split our sample into nine equal-sized bins of taxable 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 percentile, for which the mean forecast error is the lowest – than for the income levels below the median, but the differences appear to be small and insignificant. These results underscore the desirability of the Finnish setting which allows us to disentangle the variation in cognitive abilities from the variation in labor income.

Panel B of Figure 4 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.[8] We fail to detect a negative association as stark as the one by the IQ bins between education levels and average forecast error, although the association is slightly negative. These results suggest variation in IQ levels exist among individuals that obtain the same formal degree. The overall amount of learning of individuals holding the same degree but different levels of IQ might differ, but at least in terms of observable levels of education we do not detect substantial differences in expectations.

Our analysis of the raw data suggests the concerns about observed characteristics might be relevant, even though we do not detect any negative associations nearly as strong as the ones with IQ bin. To directly assess the extent to which observable characteristics might explain the variation in forecast errors by IQ levels, 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 zero 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 the respondent has at least one child and 0 otherwise, a dummy that equals 1 if the respondent lives in a urban

[8]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).

area and 0 otherwise, and a dummy that equals 1 if the respondent lives in Helsinki and 0 otherwise. For the sample splits, we exclude from the right-hand side the demographic variable that we use to split the sample. On average, the mean absolute forecast error is lower by a quarter percentage points for high-IQ men relative to low-IQ men conditional on year-month fixed effects and the whole set of demographics (untabulated).

To further investigate which observables might be relevant to explain the relationship between IQ and expectations, we perform the multivariate analysis across a set of sample splits in Table 3. The first splits we consider 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 households' expectations about general inflation; that is, households tend to extrapolate from their personally experienced price changes in their shopping bundle to overall inflation expectations (D'Acunto et al. (2018)). We therefore compare the size of the association between IQ and absolute forecast errors for inflation separately for single and married respondents (column 1), respondents below and above age 35 (column (2), urban and rural respondents (column (3)), and respondents earning more than the median labor income in the sample (column (4)).

Across the board, we find IQ is economically and statistically negatively associated with the 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 that result, one potential explanation could be cognitive abilities deteriorate with age. We observe IQ around age 20 for all respondents and we might expect that within our sample of old men 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.

The second set of splits we consider refer to proxies for the extent to which households might find it easy to obtain information about inflation and the extent to which households understand basic economic concepts. Specifically, we estimate the baseline specification for respondents with or without a college degree (column (5)), and respondents with a

degree in the areas of economics, business, law, or information, and other respondents (column (6)). In columns (5) and (6), 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.

Overall, we find the association between IQ and forecast errors for inflation is a stable feature of our data. Some heterogeneity exists by demographic splits but in our subsequent analysis we directly partial out these variables to ensure they do not drive any results.

A.2 Second Moment of Expectations

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 and inflation perceptions are 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, disagreeing more, or less capable of providing precise estimates than high-IQ respondents. In Figure 5, we report the average standard deviation of the forecasts errors for inflation across IQ bins. Indeed, we detect a negative monotonic relationship between the dispersion of each of these variables and IQ levels that mimics the pattern for the first moment of both distributions. 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 small compared to the variation in expectations across men.

B. Consistency of Expectations 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 current inflation expectations, as well as how perceptions of the current inflation rate, which the EU survey also elicits, relate to past inflation expectations within individuals.

In the standard model, agents have forward-looking expectations and many central banks aim to anchor inflation expectations. Hence, under rational expectations we should expect on average a positive correlation of inflation expectations within individuals over time. Columns (1) and (2) Table 4 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 zero (2.5%) for low-IQ men.

Under rational expectations, we would also expect, on average, past inflation expectations should be consistent with current perceptions of inflation. The panel dimension allows us to assess directly whether a positive association between current perceptions and past expectations exists within individual respondents. For this test, we regress current inflation perceptions on past inflation expectations at the individual level. In columns (3) and (4), we absorb time-varying economy-wide shocks and control for demographics. 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%).

Under rational expectations, the correlation between current perceptions of inflation and past expectations should be lower in periods with shocks to realized inflation.[9] To corroborate our interpretation of this result, we split the 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) and (6) of Table

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

4, we repeat the analysis only for periods of low changes in inflation, whereas in columns (7) and (8) we study periods with larger changes in inflation. Comparing columns (5) and (7), in line with the arguments above, we find the positive association between past inflation forecasts and current perceptions of inflation is higher during periods of stable inflation than during other periods for high-IQ men. To the contrary, columns (6) and (8) show that no differences exists in the economically small association for low IQ men. If anything, the association appears slightly larger during periods of changing inflation which seems hardly consistent with rational expectations.

We interpret these within-individual results as suggesting that the dynamics of expectations of high-IQ men are more consistent with the rational benchmark than those of low-IQ men.

C. Rounding and Implausible Values

In the last part of the analysis on how IQ shapes the expectation formation of individuals, we consider two dimensions that earlier research related to the quality of forecasts.

The first dimension is rounding, that is, individuals' tendency to report values that are multiples of 5 when asked to provide numerical forecasts. Previous research has argued reporting round numbers conveys uncertainty about future inflation (e.g., see Binder (2017) and Manski and Molinari (2010)).

C.1 Rounding and Inflation Uncertainty

Figure 2 in the introduction plots the fraction of respondents who report multiples of 5 in their numerical forecasts across the 9 bins of IQ. Similar to the baseline association of forecast errors for inflation with IQ, we document a monotonic negative association between the fraction of rounders and IQ bin. This fraction ranges from 65% for respondents in the lowest IQ bin to 35% for respondents in the highest IQ bin. Also similar to the forecast errors, Figure 2 shows we can reject the null hypothesis that the fractions of rounders 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 association.

In Table 5, we run this analysis in a multivariate setting, in which we regress a dummy variable that equals 1 if the respondent provided a round number in his inflation

forecast (columns (1)-(2)), and zero otherwise. The main covariate of interest is the dummy variable that equals 1 if the respondent obtained an IQ score of 6 or above.

Column (1) reports the raw correlation and column (2) controls for the baseline demographics and year-month fixed effects. Consistent with the patterns described above, we find that respondents in the top half of the distribution by IQ are 7.4 percentage points less likely to report round numbers in the multivariate analysis. Because log of income and a dummy for college education are among our controls, socioeconomic status does not drive the association between IQ and rounding we document (Ben-David et al. (2018)). In untabulated results, we also repeat the analysis after excluding all inflation forecasts that equal zero. Although a value of zero is also rounded, one might argue that other considerations lead respondents to provide this number. Our results are similar when we exclude all zeros from the analysis.

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 (D'Acunto et al. (2018)). To the extent that the expectations of high-IQ men are more consistent with the rational benchmark, we might expect they have a higher propensity to round in times of high objective uncertainty about inflation. Instead, low-IQ men might round due to subjective uncertainty about inflation, irrespective of the extent of objective uncertainty.

We propose a simple test for whether the propensity to round by high-IQ and low-IQ men varies at times of high and low objective uncertainty about inflation. Based on the argument above, when inflation rates fluctuate substantially, both high-IQ and low-IQ respondents might be uncertain and prone to rounding. Instead, when inflation uncertainty is low, high-IQ respondents might be less prone to rounding than low-IQ men.

To test this hypothesis, we consider the standard deviation of monthly inflation rates within each year as a proxy for the objective inflation uncertainty in that year. In Figure 6, we report the standard deviation 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. According to our conjecture, the difference between low-IQ rounders and high-IQ rounders should be high when inflation rates do not vary much, whereas it is low when inflation rates vary substantially. Figure 6 is consistent with this pattern. The fraction of low-IQ rounders is substantially higher in years of low objective inflation uncertainty, such as 2006, 2007, and 2013. Instead, the

fractions of low-IQ and high-IQ rounders are similar at times of high objective inflation uncertainty, such as 2001, 2003, and 2009. These patterns are consistent with rounding capturing objective forecast uncertainty among high-IQ men but not among low-IQ men.

C.2 Implausible Values

The second dimension of quality of expectations we consider is the tendency of respondents 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 European Central Bank has an inflation target of close to but below 2% in the medium run. We consider several thresholds for implausible forecasts. The thresholds are 5%, 7%, 10%, and 12%. For instance, for the 5% threshold, we would categorize an inflation forecast above 5% or below -5% as implausible.

Figure 2 in the introduction shows that, similar to the patterns for forecast errors for inflation and the extent of rounding, the share of respondents who report implausible values for the 5% threshold declines monotonically with IQ, ranging from 20% of respondents in the lowest IQ bin to 7% of respondents in the highest bin.

Because the 5% threshold is arbitrary, in Figure 7, we report the fraction of respondents providing implausible values across all thresholds we consider by IQ bin. In particular, we consider a 5% threshold (solid line), a 7% threshold (long-dashed line), a 10% threshold (short-dashed line), and a 12% threshold (dash-dotted line). The Figure confirms the monotonic negative association between the fraction of respondents reporting implausible values for inflation forecasts and IQ levels for all the thresholds.

Another interesting pattern we observe in Figure 7 is the differential changes in the slopes of the curves at the lowest and highest IQ levels across different thresholds. Consider first the 5% threshold (top line). The curve is essentially flat for the 3 highest IQ bins suggesting no increasing marginal returns to IQ in terms of improving the quality of forecasts for the highest levels of IQ. Instead, for low levels of IQ, the curve is downward sloping and is steepest across the 3 lowest IQ bins, suggesting increasing marginal returns to IQ in terms of improving the quality of forecasts for the lowest levels of IQ. Interestingly, these two patterns are more pronounced when we consider more implausible thresholds. For instance, consider the 12% threshold (bottom line). In this case, the curve is even flatter across the intermediate and highest IQ bins, whereas it is even steeper for the

lowest IQ bins. This qualitative pattern suggests the marginal returns to IQ in terms of improving the quality of forecasts are especially high the lower the quality of forecasts.

In columns (3) and (4) of Table 5, we run a multivariate analysis similar to the one for rounding described above. We regress a dummy variable that equals 1 if the respondent provided an implausible value for his inflation forecast, and zero otherwise. We use the threshold of 5% in this table, but all results are similar for the other thresholds. The main covariate of interest is a dummy variable that equals 1 if the respondent obtained an IQ score of 6 or above. Even columns report raw correlations, whereas odd columns control for demographics year-month fixed effects. Again, consistent with the results for the other features of expectations, we find high-IQ men are 2 percentage points less likely to report implausible values for inflation forecasts when we condition on observables and time-varying economic shocks.

Overall, we confirm the patterns by IQ we documented for forecast errors for inflation when we consider other potential proxies for the quality of inflation forecasts, such as rounding and reporting implausible values.

III IQ and Choice

Most existing models studying fiscal and monetary policy are based on a representative agent with rational expectations that reacts fully and immediately 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 second 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.

Our analysis so far suggests individuals with low cognitive abilities display larger forecast errors for inflation than individuals with high cognitive abilities. Low-IQ individuals display inflation expectations that are less consistent with their perceptions than do high-IQ individuals, and they are more prone to rounding and reporting

implausible values for inflation expectations than high-IQ individuals. But do expectations of different quality transmit to individual choice, and especially consumption and saving decisions?

In particular, we could think of three possible situations, each of which would have different implications in terms of the interpretation and relevance of our results. One possibility is low-IQ individuals ultimately make consumption and saving decisions as if they held accurate inflation expectations even if they report expectations and perceptions of lower quality once asked in a survey. Note that, different from other surveys used in earlier research such as the Michigan Survey of Consumers or the NY Fed Survey of Consumer Expectations, the survey we use asks households about changes in consumer prices, not inflation or changes in prices of things people typically purchase. The fact low-IQ households might not know the term "inflation" thus cannot drive our results. Instead, differences in cognitive abilities might capture different abilities of households to express their beliefs in numerical terms, but households might hold accurate and unbiased beliefs irrespective of their cognitive abilities. If this conjecture were true, the inaccurate expectations of low-IQ individuals would not have substantial implications for household-level or aggregate outcomes.

A second possibility is low-IQ individuals understand the main prescriptions of intertemporal substitution in terms of consumption and saving decisions, even if they rely on their inaccurate expectations when optimizing intertemporally. In this case, we would observe individuals' choices deviate 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, a third case is low-IQ individuals might not only have inaccurate expectations, but might also not know or understand the concept of intertemporal substitution. This case would be the most disruptive for an economist who tried to predict the choices of households in the economy. Even if one observed the beliefs of every agent in the economy, the prescriptions of the consumption Euler equation would not apply. Moreover, if low-IQ households did not grasp the concept of intertemporal substitution, providing them with accurate information about inflation or professional forecasts alone would not help, because low-IQ households would not use such expectations in their decision-making process as prescribed by most models.

As we discuss below, the third case is the one that appears most consistent with our

results.

A. IQ and Intertemporal Substitution

As documented in the previous section, low-IQ households 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 (2015) and D'Acunto et al. (2018)). If we correlated numerical values of inflation expectations with choice, we would be unable to disentangle the case in which low-IQ households 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 et al. (2018) 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 (unbiased) inflation expectations meaningfully in numerical terms, 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 about inflation.

This qualitative measure of inflation expectations is a dummy variable that equals 1 if the respondent declares he expects a higher inflation rate in the following 12 months, compared to the prevailing inflation rate over the past 12 months, and zero otherwise. D'Acunto et al. (2018) 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-based 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 (2015)). 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. The random variable may take three values, $y \in \{0, 1, 2\}$: 0 denotes it is neither a good nor a bad time to purchase durable goods; 1 denotes it is a bad time to purchase durable goods; and 2 denotes it is a good time to purchase durable goods.

We define the response probabilities as $P(y = t|X)$, where $t = 0, 1, 2$, and X is an $N \times K$ vector where N is the number of survey participants. The first element of X is a unit vector, and the other $K - 1$ columns represent a rich set of household-level observables, including demographics and expectations.

We assume the distribution of the response probabilities is

$$P(y = t|X) = \frac{e^{X\beta_t}}{1 + \sum_{z=1,2} e^{X\beta_z}} \tag{1}$$

for $t = 1, 2$, and β_t is a $K \times 1$ vector of coefficients. The response probability for the case $y = 0$ is determined, because the three probabilities must sum to unity.

We estimate the model via maximum likelihood to obtain the vector β_t of coefficients for $t = 1, 2$, and set the category $y = 0$ as the baseline response. We compute the marginal effects of changes in the covariates on the probability that households choose any of three answers in the survey, and report them in the tables.

In Table 6, we report the average marginal effects computed from the multinomial logit regressions of whether 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. In all columns, we report the marginal effect of the inflation-increase dummy on the likelihood that individuals respond it is a good time to buy durables. All the specifications include the full set of demographic controls we observe, as well as controls for past realized inflation (Jonung (1981)). Throughout the table, odd columns report the marginal effects within the subsample of high-IQ men (IQ variable equals 6 or more), whereas even columns report the marginal effects within the complementary subsample 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 do high-IQ individuals 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.

B. IQ, Borrowing Motives, and Saving Motives

Our analysis of households' choice so far focused on consumption plans to test for the extent to which households understand intertemporal substitution, a fundamental tenet of most macroeconomic models. The analysis suggests low-IQ men's consumption plans do not react to their inflation expectations, irrespective of the quality of such expectations, and hence they might be unable to think and plan for the future.

In the last part of this section, we assess whether low-IQ men differ from high-IQ men even based on other features of their planning for the future. 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.

Our first test aims to assess whether high-IQ men might be more forward-looking than low-IQ men, that is, whether high-IQ men save more for the future conditional on saving at all compared to low-IQ men. We already know high-IQ men have a better understanding of the relationship between future and present outcomes, because they behave in ways that suggest they understand intertemporal substitution, whereas low-IQ men do not. At the same time, high-IQ men might also understand the difference between present-day consumption and future consumption better than low-IQ men, and might know they should save for the long-run, such as for retirement. Alternatively, high-IQ men might be more patient and hence save more for retirement (Falk et al. (2018)).

We first assess whether individuals differ – based on cognitive abilities – in their propensity to save. Column (1) of Table 7 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 is consistent with a reduced precautionary savings motive 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 size 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 the high-IQ individuals in our sample are, if anything, less likely to save in general, but they are more likely to save for retirement than low-IQ individuals, which we interpret as evidence consistent with the notion that high-IQ individuals are more forward-looking than low-IQ individuals.

We move on to consider borrowing motives. In this analysis, we compare respondents' likelihood of answering that they plan to borrow with the intention of financing current or future consumption with the likelihood of answering that they plan to borrow with the intention of financing current or future education-related expenses. Column (3) of Table 7 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-return investment such as education and human capital.

One might argue that low-IQ individuals might think investing in education doesn't make sense for them because the returns to education, or even the ability to obtain a degree, might be low. At the same time, because obtaining education at any level is cheap in Finland, most education-related expenses would refer to additional tutorial lectures or lectures for topics not covered by the national curriculum. In any case, as long as additional tutorial hours are substitutes for individuals' IQ, low-IQ individuals should plan to spend more than high-IQ individuals on education-related expenses if they are forward-looking and realize the positive long-run return of investments in human capital.

IV Conclusion

Substantial variation exists in economic expectations across individuals and over time, and expectations often deviate from the full-information rational-expectations benchmark. We document cognitive abilities play a central role for forecast errors of inflation, uncertainty in forecasts, and for forecasting implausible values in a large, representative population. We also show cognitive abilities are systematically related to individuals' allocation of resources between current and future consumption, their understanding of intertemporal substitution, and their forward-looking behavior, such as the choice of saving for retirement or the choice of borrowing to finance education-related expenses and not only current consumption.

Future research in economics, finance, and cognitive science should investigate the specific cognitive 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?

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 and borrowing choices. 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.

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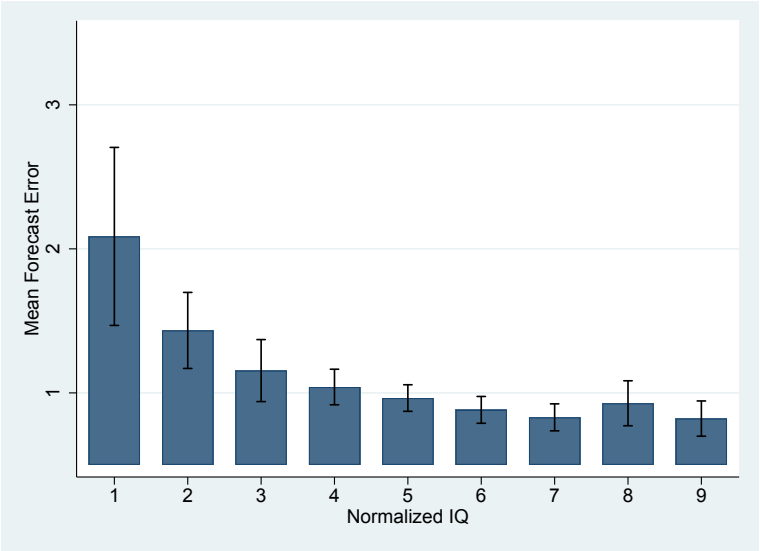
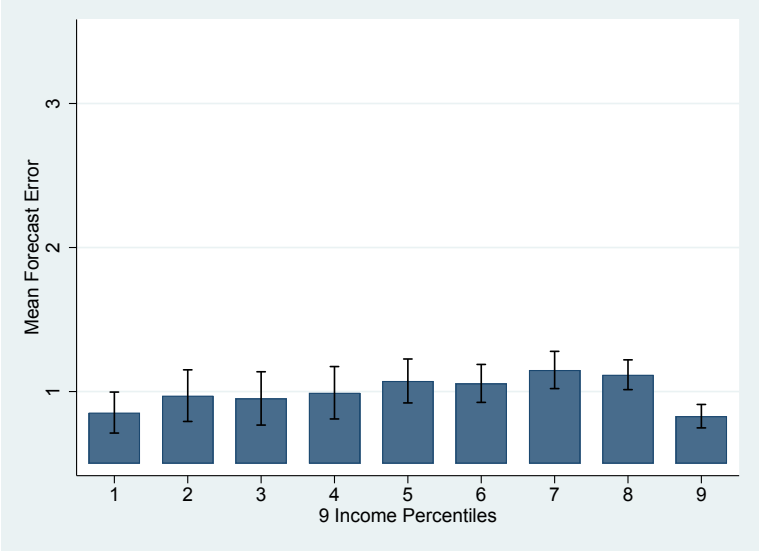
Figure 3: **Average Forecast Error by IQ**



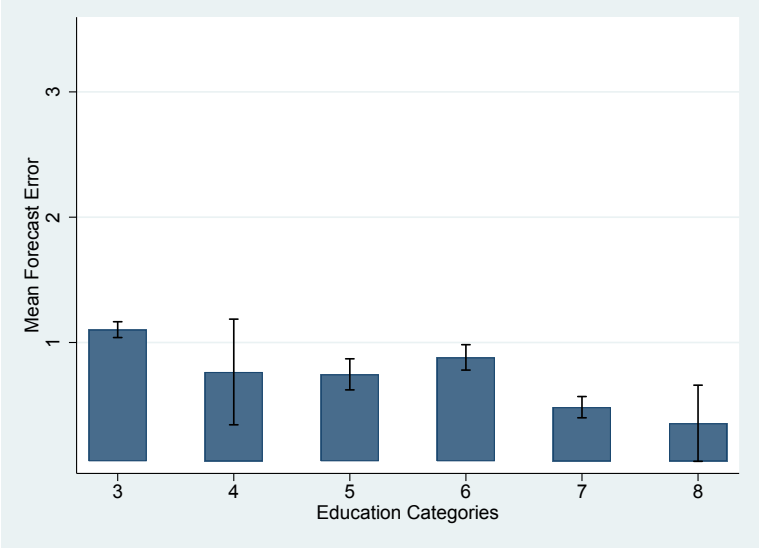
This figure plots the average forecast error for inflation as a function of normalized IQ in Finland. Forecast errors is the difference between inflation expectations and ex-post realized inflation. Perception error is the difference between perceived inflation over the previous 12 months and actual inflation over the same period. 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 households how consumer prices will evolve in the next 12 months. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is January 2001 to March 2015.

Figure 4: **Average Forecast Error by Income and Education Levels**

Panel A. Average Forecast Error by Income

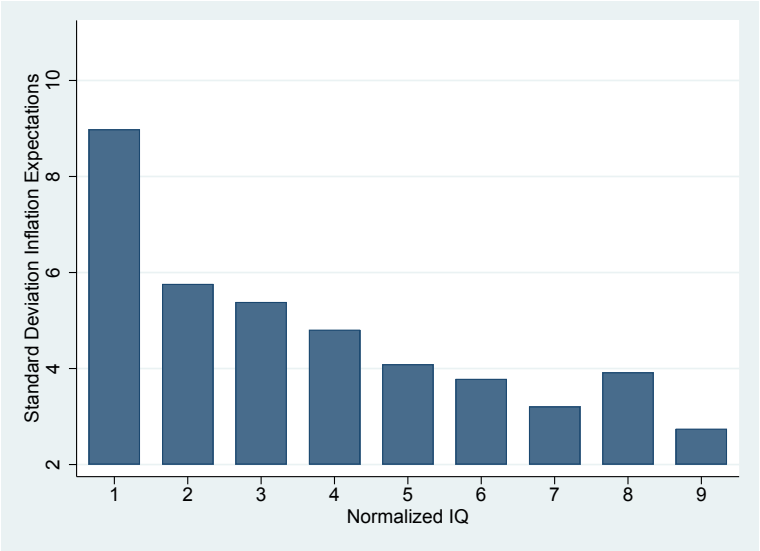


Panel B. Average Forecast Error by Education



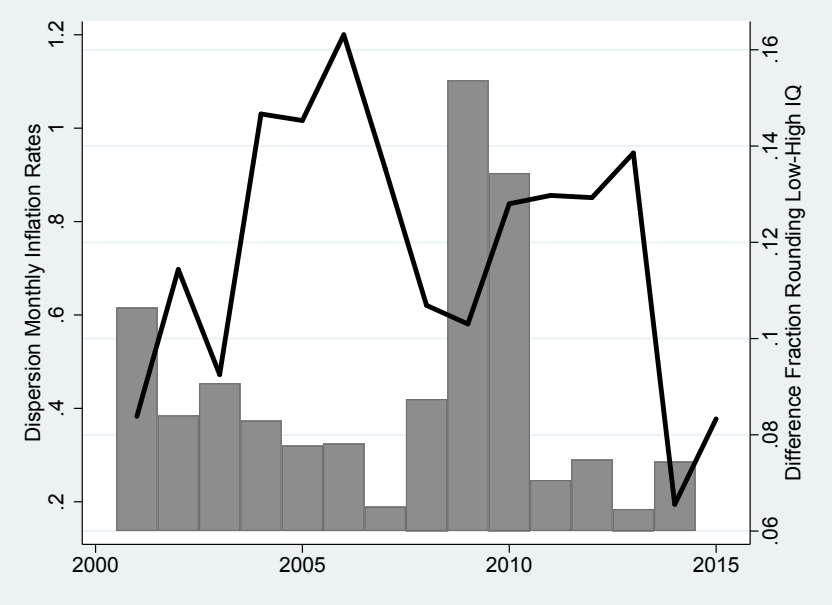
Panel A of this figure plots the average inflation forecast error as a function of 9 income percentiles in Finland. Panel B plots the average inflation forecast error across 6 education categories. Education levels are based on the International Standard Classification of Education. We define forecast 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 households how consumer prices will evolve in the next 12 months. The sample period is January 2001 to March 2015.

Figure 5: **Dispersion of Forecasts of Inflation by IQ**



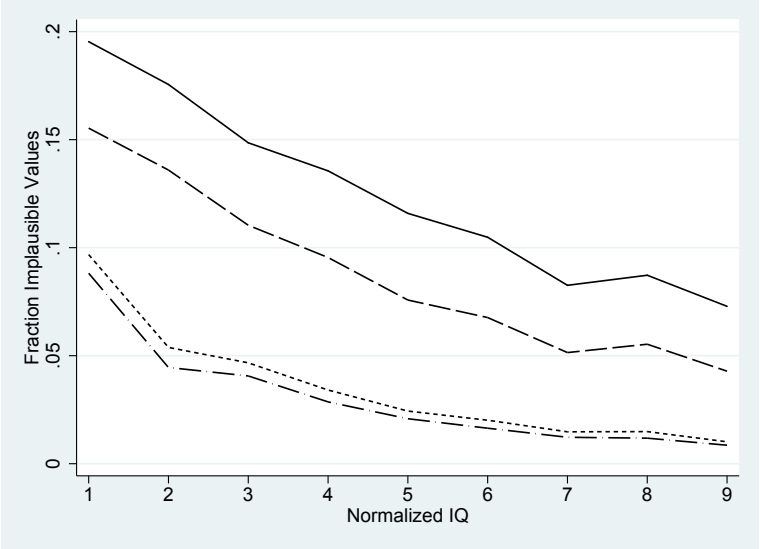
This figure plots the standard deviation of inflation forecasts as a function of normalized IQ in Finland. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation forecasts and perception. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is January 2001 to March 2015.

Figure 6: **Yearly Standard Deviation of Monthly Inflation Rates and Fraction of Rounders**



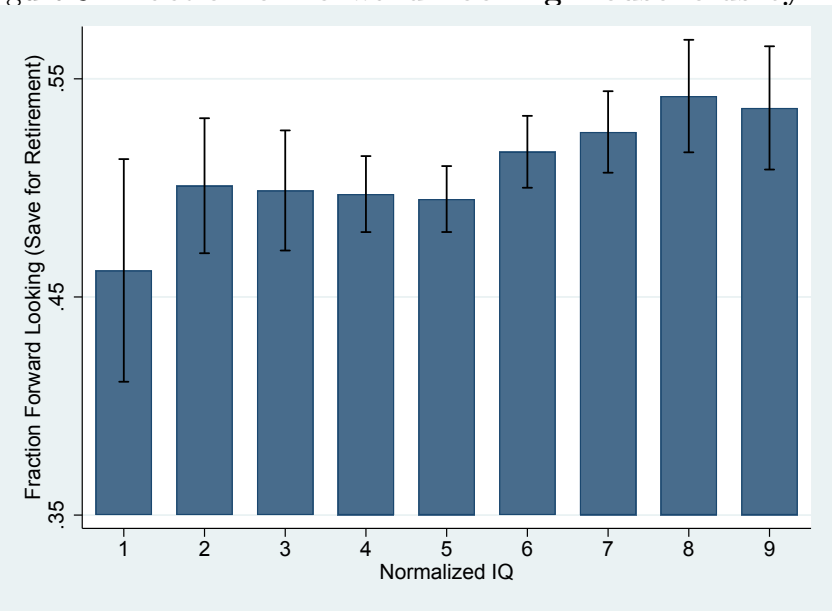
This figure plots the standard deviation of realized inflation within a year on the left y-axxis and the differences in the fraction of rounders between low- and high-IQ men. We define rounders as survey participants who report multiples of 5 for the numeric inflation forecast. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation forecasts and perception. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is a standardized variabls between 1 and 9. High IQ reflects a normalized IQ larger than 5. The sample period is January 2001 to March 2015.

Figure 7: **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). IQ is the standardized test score from the military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9. The sample period is from January 2001 to March 2015.

Figure 8: **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 consider saving for retirement conditional on saving to be a proxy for whether households are forward-looking. 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 households how consumer prices will evolve in the next 12 months. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is 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. We measure normalized IQ using data from the official military entrance exam in Finland. 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. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is 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 household 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 construct these variables. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is a standardized variable between 1 and 9. IQ dummy 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.

	Single	Below 35	Urban	Top 50% Income	College Degree	Econ/Business Degree
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Respondent within Category					
High IQ	−0.2451 ∗ ∗∗	−0.2728 ∗ ∗∗	−0.1837 ∗ ∗∗	−0.2586 ∗ ∗∗	−0.1243 ∗ ∗∗	−0.1530∗
	(0.0534)	(0.0704)	(0.0597)	(0.0688)	(0.0508)	(0.0884)
Demographics	X	X	X	X	X	X
Year-Month FE	X	X		X	X	X
Adj. R^2	0.0509	0.0457	0.0467	0.0446	0.0758	0.0093
Nobs	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

Table 4: **Current Perceptions and Expectations and Past Inflation Expectations and IQ**

This table reports the coefficient estimates from a linear regression of inflation expectations 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 construct these variables. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is a standardized variables between 1 and 9. High IQ reflects a normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is March 1995 to December 1999.

	Inflation Expectations		**Inflation Perceptions**					
			All Periods		Periods of Stable Inflation		Periods of Changing Inflation	
	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
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 5: **Rounding, Implausible Values, and Cognitive Abilities**

This table reports the coefficient estimates from a linear regression of a dummy variable that, for men with high and low IQs, equals 1 if the respondent reported a multiple of 5 as his inflation forecast and if he reported a number larger than 5 in absolute value as his inflation forecast. We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. We measure normalized IQ using data from the official military entrance exam in Finland. IQ is a standardized variable between 1 and 9. High IQ reflects a normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is 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: **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 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 households on a monthly basis whether it is a good time to purchase durables given the current economic conditions. Households 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. 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	
			High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ	High IQ	Low IQ
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
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**	−0.02	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 7: **Saving and Borrowing Motives and Cognitive Abilities**

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 respondent agrees with the statement. We use the confidential micro data underlying the official European Commission consumer confidence survey to construct these variables. We measure normalized IQ using data from the official military entrance exam in Finland. Standard errors are clustered at the quarter level. The sample period is 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
$*p < 0.10, **p < 0.05, ***p < 0.01$

Online Appendix:

IQ, Expectations, and Choice

Francesco D'Acunto, Daniel Hoang, Maritta Paloviita, and Michael Weber

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