IQ, Expectations, and Choice*

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Abstract

We match individual-level data on cognitive abilities (IQ), economic and financial expectations, and consumption, saving, and borrowing plans for a representative population. High-IQ men display forecast errors for inflation that are 50% lower than the forecast errors of other men. High-IQ men, but not others, have consistent inflation expectations over time and their inflation perceptions align with past expectations. Only high-IQ men decrease their saving propensity when expecting higher inflation, in line with the consumption Euler equation. Also, only high-IQ men increase their borrowing propensity at times in which nominal interest rates decrease, and decrease their borrowing propensiity at times when nominal interest rates increase. Heterogeneity in education, income, other expectations, and financial constraints do not explain these results. Our findings propose cognitive abilities as *human frictions* to the formation of economic expectations and the effectiveness of economic policy, and support models that accomodate heterogeneity in expectations formation.

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

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I Introduction

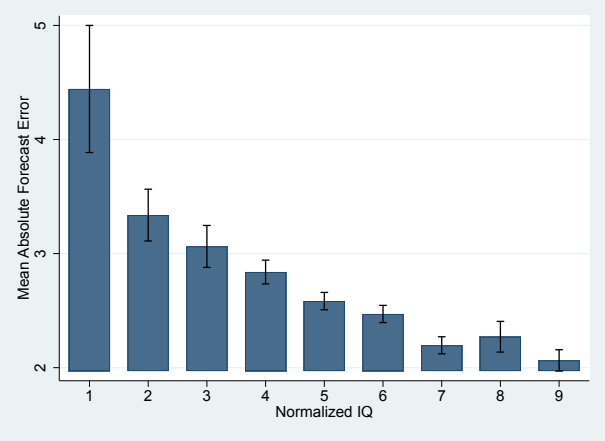
After the financial crisis, several governments around the world implemented unconventional policy measures to decrease household leverage and increase household spending so as to avoid a liquidity trap. Policies such as mortgage refinincing programs and unconventional monetary policy aimed to affect choice through managing households' beliefs about future macroeconomic conditions and hence stimulating consumption over savings. Unfortunately, these policies turned out to be much less effective than expected. A candidate explanation for such ineffectiveness is that many households' expectations might *not* react to policy announcement merely because households make mistakes in forming their expectations and have no understanding of economic mechanisms.

In this paper, we exploit unique data on cognitive abilities, economic expectations, and financial decisions for a representative population to study the extent to which limited cognitive abilities might help us understand households' inability to react to policies that aim to manage their expectations. Figure 1 plots the average absolute forecast error for inflation across bins by IQ-test scores for a representative sample of Finnish men. The average absolute forecast error of low-IQ individuals is 4.3%. The absolute forecast error decreases monotonically with IQ and is about 50% smaller for high-IQ individuals. This heterogeneity appears to be relevant for policy effectiveness. We find that only high-IQ men adjust their consumption propensity to changes in inflation expectations in line with the consumer Euler equation. High-IQ men are also twice as sensitive to changes in interest rates when making borrowing decisions compared to low-IQ men, at times of both increases and decreases of policy rates.

We base our analysis on confidential micro data from Finland. Around age 20, all Finnish men take a standardized cognitive test before entering the mandatory military service. We observe the test scores of Finnish male cohorts between 1982 and 2001. We match these test scores with the answers to the monthly harmonized European Commission consumer confidence survey (EU survey) from 1995 to 2015. This survey elicits inflation expectations, propensities to consume and borrow, as well as a rich set of demographics such as age, education, marital status, income, household size, and employment status for a set of repeated cross sections.

IQ is a standardized variable that follows a stanine distribution (integers from 1 to 9, with 9 being the highest). Regressing individual-level absolute forecast errors on a dummy

Figure 1: **Mean Absolute Forecast Error for Annualized Inflation by IQ**



This figure plots the average absolute monthly inflation forecast error across IQ levels. Forecast error is the difference between the numerical forecast for one-year-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 military entrance exam test for all men in Finland. IQ obtains integer values between 1 and 9. The sample period is from Januart 2001 to March 2015.

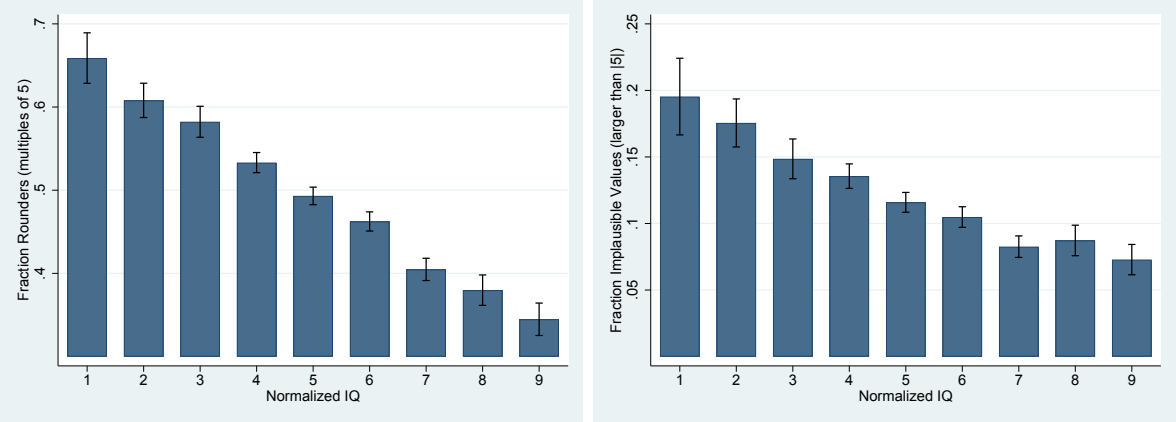
that equals 1 when the respondent has a IQ above 5 delivers a significantly negative coefficient whose size is 20% of the mean absolute forecast error in the sample. Each point increase in standardized IQ is associated with a decrease in absolute forecast errors of 0.2 percentage points. These cross-sectional results survive when we absorb time-varying economy-wide shocks at the monthly level as well as a rich set of demographics, including income, which in turn IQ might affect. Because IQ is measured around age 20 and survey respondents are typically older, reverse causality from income or other covariates is a barely relevant concern, as we argue further below. Crucially, we do not find any systematic patterns if we run the analysis across the distribution of education levels or income deciles.

Our baseline analysis exploits cross-sectional variation, but the consumer confidence survey contains a small panel dimension between 1995 and 1999. This small panel allows us to study the consistency of inflation expectations within individual over time and whether the perception of current inflation lines 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 rational expectations imply on average a positive correlation between past inflation forecasts and current inflation forecasts. Only for high-IQ men past inflation forecasts are positively associated with current inflation forecasts, both unconditionally and conditional on month fixed effects

and a rich set of demographics.

After forecast and perception errors, we move on to consider other features of expectations that earlier research has proposed as signs of inaccuracy in forecasting by households. In particular, we consider rounding – the tendency of households to respond with multiples of 5 when asked for a numerical forecast of future inflation – and the reporting of implausible values for the expected 12-month inflation rate. Figure 2 plots the average share of respondents that rounds (left panel) and the average share of respondents that provides implausible values (right panel) by IQ bins.[1]

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 that report forecasts for inflation larger than 5 in absolute value by IQ levels. We define rounders as survey participants that report multiples of 5 for the numeric inflation forecast. Vertical lines represent 95% confidence intervals around the estimated mean for each bin. 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 2 documents two evident monotonic patterns for the shares of rounders and those providing implausible inflation forecast values 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.

After documenting the heterogeneity in the formation of macroeconomic beliefs across IQ levels, we assess whether the heterogeneity matters for economic decision making. As a first step, we study whether individuals adjust their consumption plans in line with the consumption Euler equation. We thus ask whether IQ levels relate to Finnish

[1]In this figure, we consider forecasts whose absolute value is larger than 5 as implausible values, and the results are similar when we increase this threshold, as we describe below.

men's understanding of intertemporal substitution. We estimate a set of multinomial logit regressions to study the relationship between inflation expectations and willingness to spend on durable goods. The EU survey asks how respondents think consumer prices will evolve in the following 12 months compared to the previous 12 months.[2] When we split the sample into high-IQ and low-IQ respondents, we find high-IQ respondents who think inflation will increase are almost 4% more likely to state it is a good time to spend relative to other high-IQ men. For low-IQ men, instead, we detect a negative and statistically insignificant association between inflation expectations and readiness to spend. These results hold conditional on a rich set of demographics including education and income. Because low-IQ men do not react in line with the consumer Euler equation, these results suggest cognitive abilities could be a first-order impediment to the effectiveness of common fiscal and monetary policies.

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 household income does not affect any of our baseline results, and low-income households are plausibly more likely to be financially constrained than high-income households. We also confirm the baseline patterns when running our analysis separately for men above the median of the distribution by income.

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. We can rule our this alternative channel directly, because we observe households' income expectations elicited at the same time as their inflation expectations. We confirm our results when splitting the samples of high-IQ and low-IQ men into those reporting positive or negative income expectations.

Low-IQ men might not adjust their consumption plans to changing inflation expectations for at least three reasons: (i) they are not informed about current inflation; (ii) they are informed about current inflation but are uninformed about future inflation, and respond randomly to the survey questions; (iii) they are informed about both current inflation and future inflation but do not react because they do not understand intertemporal substitution. When we split our sample by the size of perception errors – the difference between the perception of current inflation and actual inflation – or by the

[2]For ease of interpretation, we follow D'Acunto, Hoang, and Weber (2018) and create a dummy variable that equals 1 when a household expects inflation to increase.

size of forecast errors – the difference between the forecast of future inflation and ex-post realized inflation – we find low-IQ men do not respond to changing inflation expectations for both low and high forecast errors, and for both low and high perception errors. These results suggest that men with low cognitive abilities might not fully understand economic incentives, irrespective of the extent to which they are informed about current and future macroeconomic variables.

A. Related Literature

The consumption Euler equation lies at the core of modern dynamic macroeconomics. Several policies central banks around the world implemented during the recent Great Recession relied at least implicitly on a positive association between inflation expectations and consumption. Forward guidance constitutes a recent vivid example. Promises to keep interest rates low until the end of the liquidity trap generate inflation in the future, and hence should increase households' inflation expectations today as well as consumption. The effect becomes more powerful the longer is the horizon of such promises. Yet, recent research questions the effectiveness of intertemporal substitution as a policy transmission mechanism: borrowing constraints paired with uninsurable income shocks and asset holdings of different liquidity limit the scope of forward guidance and intertemporal substitution more generally (see McKay, Nakamura, and Steinsson (2016), Del Negro, Giannoni, and Patterson (2015), Kaplan, Weidner, and Violante (2014), and Kaplan, Moll, and Violante (2018)). Another possibility why policy measures are less effective than rational expectations models predict are finite lifespans when decision makers plan only for a limited number of periods ahead (see Woodford (2018)). Gabaix (2018) develops a behavioral New Keynesian model in which a subset of agents is myopic which mutes the power of forward guidance.

We also contribute to a recent literature that uses micro-level data to study the relationship between inflation expectations and households' readiness to purchase consumption goods. Bachmann et al. (2015) start this literature using survey data from the Michigan Survey of Consumer (MSC). They find an economically small and statistically insignificant association between households' inflation expectations and their readiness to spend on durable consumption goods. Burke and Ozdagli (2014) confirm these findings using panel survey data from the New York Fed/ RAND-American Life

Panel household expectations survey for a period from April 2009 to November 2012. Ichiue and Nishiguchi (2015) find that Japanese households that expect higher inflation plan to decrease their future consumption spending, but have increased their spending in the past, whereas D'Acunto, Hoang, and Weber (2018) show households on average behave in line with the predictions from the consumer Euler equation in EU countries. They also use a salient policy, the unexpected announcement of a future VAT increase, as a natural experiment to causally identify the effect. Arioli et al. (2017) confirm these findings for quantitative inflation expectations in Europe. Vellekoop and Wiederholt (2017) find the inflation expectations of Dutch households are systematically related to the composition of households' financial portfolios. Using data from the same survey, Christelis et al. (2016) find trust in the ECB lowers uncertainty about inflation expectations. Coibion, Gorodnichenko, and Kumar (2015) advance this literature using experimental variation to study causally the effect on inflation expectations on economic decisions. Malmendier and Nagel (2009) show that personal experiences determine inflation expectations, D'Acunto, Malmendier, Ospina, and Weber (2017) use unique survey data on the AC Nielsen homescan sample to show shopping experiences shape inflation expectations and determine the gender bias in inflation expectations. Dräger and Lamla (2013) studies the anchoring of inflation expectations.

Our findings stress the importance of cognitive abilities to shape 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 (2015), who study mutual fund choice. Agarwal and Mazumder (2013) relate cognitive abilities to suboptimal use of credit cards and home equity loan applications. More recently, Aghion et al. (2017) use micro-level data on visiospatial 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.

II Data

Our analysis uses three micro data sets that include individual-level information on macroeconomic expectations, consumption and borrowing plans, cognitive abilities, as

well as administrative information on household-level income.

A. Cognitive Abilities Data

All Finnish men are required to participate in a mandatory military service during our sample period. Within the first weeks of the mandatory military service every Finnish men has to participate in a series of psychological tests around the age of 19-20. The Finnish Armed Forces (FAF) administer these tests. The FAF uses the test 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 in the test.[3]

The test consists of 120 questions which attempt to test cognitive abilities in three areas – logical, mathematical, and verbal cognitive abilities. The FAF aggregates those scores into a composite measure of cognitive abilities, which we label collectively as IQ. The FAF 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 of 1 and the 4% with the highest test scores a standardized IQ of 9. We have test results for all participants from January 1 1982 until December 31 2001.

Finland is a very homogeneous country in terms of cultural background and opportunities. Education opportunities, including college education, are accessible to residents virtually for free. The country is also racially homogeneous and our sample period does not cover the influxes of migrants that started around 2015 during the Syrian refugee crisis. Our setting is thus an ideal 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. 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

[3]Grinblatt et al. (2011) discuss the points in more detail. To the extent high-IQ men try to share their cognitive abilities in the test, all our results represent a lower bound on the importance of cognitive abilities on expectations and choice.

Consumer Climate survey of Statistics Finland.[4] Statistics Finland conducts the survey on behalf of the Directorate General for Economic and Financial Affairs (DG ECFIN) of the European Commission as part of the European Commissions' harmonized consumer survey program. Every month, they ask a representative repeated cross section of about 1,500 Finnish households 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. Our sample period includes large time variation in macroeconomic fundamentals as well as several policy interventions, which we exploit in the second part of our analysis.

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 3 times at 6-month intervals, and each month one third of the sample was replaced. Since January 2001, the survey employs random samples that change completely from month to month.[5] 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.

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 make major purchases such as furniture, electrical/ electronic devices, etc.?*

Question 6 *How will consumer prices evolve during the next twelve months compared to the previous twelve months?*

Households can answer, "Prices will increase more," "Prices will increase by the same," "Prices will increase less," "Prices will stay the same," or "Prices will decrease." We

[4]We discuss the data in more detail in the online appendix

[5]The data for 2000 is missing unfortunately.

create a dummy variable that equals 1 when households answer, "Prices will increase more," to get a measure of higher expected inflation.

On average, households' inflation expectations are highly correlated with their perception of past inflation (see Jonung (1981)). We also use the following survey question in our baseline analysis to disentangle the effects of inflation expectations from inflation perceptions:

Question 4 *What is your perception on how consumer prices evolved during the last twelve months?*

Households can answer, "Prices increased substantially," "Prices increased somewhat," "Prices increased slightly," "Prices remained about the same," or "Prices decreased."

The questions discussed above ask households to use qualitative scales to assess their expectations, perceptions, and spending plans. Statistics Finland also asks for point estimates of the perceived inflation rate – perceived inflation rate over the previous 12 months – and the expected inflation rate – expected inflation rate over the following 12 months. In addition, we use questions regarding expectations about general macroeconomic variables, personal income and unemployment, and a rich set of socio-demographics from the Statistics Finland survey, which include gender, age, marital status, household size, and education levels.

The online appendix contains all the original survey questions in Finnish.

C. Income and Wealth Data 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. On average, 20% of households say it is a good time to buy durables, 24% say it is a bad

time, and the others are indifferent. Fourteen percent of households expect higher inflation in the following 12 months. More than 80% of the respondents think prices in the previous 12 months increased substantially, somewhat, or slightly, with equal proportions for each answer. Only 13% think prices remained the same, and essentially nobody thinks prices decreased.

The survey sample appears to be balanced between women and men. The modal education level is the completion of high school studies without reaching a college degree. The mean household's size is 2.5 and the majority of households live in cities with fewer than 50,000 inhabitants.

III IQ and Expectations

Most existing models studying fiscal and monetary policies 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 plans and inflation expectations. In the textbook New Keynesian model, monetary policy affects real quantities through the dynamic IS equation, hence, intertemporal substitution.

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. Detecting such heterogeneity would cast doubt on the ability of representative-agent models to represent a valid empirical benchmark. We also aim to dig deeper into the potential channels that explain any systematic variation in economic behavior based on cognitive abilities. To this aim, we assess the patterns of reaction by levels of cognitive abilities for different subcomponents of IQ, and we study the association between forecasts of past inflation, current forecasts of future inflation, as well as current inflation perceptions.

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 have any bite in the data.

A. Expectations and Ex-post Realizations: Forecast and Perception 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 is the forecast error, the lower is the accuracy of forecasts.

First moment. 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 negative monotonic association between inflation expectations and cognitive abilities. Households in the lowest IQ stanine have an average absolute forecast error of about 4.4%, whereas households 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 error and cognitive abilities is non-linear, and cognitive abilities display 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 40% higher than individuals in the top stanine.

We repeat the analysis for an alternative definition of forecast error, in which we do not compute the absolute values of all individual errors within each IQ group. In this alternative definition, we thus allow for positive and negative deviations of inflation expectations from ex-post realized inflation to wash away. Panel A of 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.

In addition to forecast errors, we also consider perception errors for inflation. We define perception error as the difference between an individual's perception of inflation over the previous 12 months and actual realized inflation over the previous 12 months. Panel B of Figure 3 plots the average perception error by levels of IQ. Perception errors follow the same qualitative pattern as forecast errors, whereby low-IQ individuals have

larger perception errors and the association between perception error and IQ level is negative and monotonic.

A relevant concern with the univariate association between IQ levels and forecast and perception errors is that IQ might be a proxy for other individual-level characteristics, and especially for income or education levels. In fact, IQ levels and taxable income might be positively associated but Table 3 shows that 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 and Panel B of Figure 4, we split our sample in 9 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 or the average perception error and income levels. If anything, both 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. Panel C and Panel D of Figure 4 report a similar analysis for splitting the sample into 6 groups based on education levels. We follow the *International Standard Classification of Education* to construct the 6 groups.[6] Even in this case, we fail to detect a negative association as stark as the one by the IQ bins between education levels and average forecast error or average perception error, although the association is definitely negative.

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 levels. To tackle this concern, we first regress absolute forecast errors on IQ as well as a full set of monthly fixed effects and demographic characteristics. Table 4 reports the results of this analysis. In column 1, we regress individual-level forecast errors on a dummy variable that equals 1 if the individual belongs to the top 4 stanines of the normalized IQ distribution (6 to 9), and zero otherwise. Being in the top part of the distribution by IQ is associated with a 0.54 drop in the forecast error. In

[6]The classification follows an eight scale distribution 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), doctoral (8).

columns (2)-(4), we use the nine values of IQ as the main covariate, and add time fixed effects (column (3)) and demographics (column (4)). Controlling for time effects reduces the baseline association by about 40%, but the association stays negative and statistically significant. Adding demographic characteristics reduces the association by another 15%, but the negative association stays economically and statistically large.

To further assess the extent to which observable characteristics might explain the variation in IQ levels, we repeat our multivariate analysis across a set of sample splits in Table 5. The first set of covariates 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 their price change perceptions based on individual baskets to the price of the basket of the representative agent in the economy (D'Acunto et al. (2017)). We therefore compare the size of the association between IQ and absolute inflation forecast error 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 that IQ is economically and statistically negatively associated with the absolute inflation forecast error.

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 a college degree or no college degree (column (5)), respondents that have a degree in the areas of Economics, Business, Law, or Information, and other respondents (column (6)), and respondents with white collar jobs and other respondents (column (7)). In columns (5) and (6) we find that the association between IQ and absolute inflation forecast error is about half the size for college-educated respondents and respondents with economic-related degrees than for others. This result suggests that 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 inflation forecast error even for categories that are more educated or have economics-related degrees. Finally, we consider respondents'

occupation, and in particular, whether the respondent has a white-collar occupation or not. We find the association between IQ and absolute inflation forecast error is similar across these two groups.

Second moment. All the results we have discussed so far refer to the first moment of the distribution of inflation expectations and inflation perception across IQ levels. Intuitively, one might ask whether the second moment of these two variables also vary 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 compared to high-IQ bins. Higher dispersion of expectations and perceptions 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 reported inflation forecasts (Panel A) and reported inflation perceptions (Panel B) 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.

B. Consistency of Expectations and Perceptions

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 small rotating 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 inflation perceptions relate to past inflation expectations within individuals.

Realized inflation is highly persistent, and hence rational expectations suggest a positive correlation of inflation expectations within individuals over time. This correlation should be especially high in periods in which inflation changes are minimal, and hence it is unlikely that news about inflation or economic shocks happened between the two periods in which the respondent provided his forecast. Table 14 investigates this consistency of inflation expectations by cognitive abilities. Columns (1) and (2) document the association between past inflation expectations and current expectations for high-IQ and low-IQ men when we condition on demographics and time effects. We see that,

whereas an economically and statistically significant correlation exists for high-IQ men, this association is close to zero for low-IQ men. The size of the estimated coefficient for the low-IQ sample is one fifth of the size of the coefficient we estimates for high-IQ men.

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 forecast and the inflation rate at the time of the second forecast is in the top third of the distribution and all other periods. The rationale for this sample split is that at times in which inflation changes substantially, it is more likely that (unobserved) shocks or news about inflation arose in the periods between the two forecasts, and hence under rational expectations the correlation between the two forecasts should be low or non-existent than in other periods. In columns (3) and (4) of Table 14 , we repeat the analysis only for forecast in periods of low changes in inflation. As expected, the positive association across subsequent forecast for high-IQ men is larger in these periods than in the full-sample analysis (column (1)). In columns (5) and (6), instead, we only consider periods of changing inflation, that is, periods for which the change in inflation between the first and second forecast is in the top third of the distribution of changes. Consistent with our conjecture, we find that the estimated coefficient for high-IQ men is substantially smaller than in other periods, and we fail to reject the null that the coefficient equals zero statistically. Instead, the small positive association we detect for low-IQ individuals is, if anything, higher in periods of large changes of inflation compared to periods of flat inflation, which seems inconsistent with the rational expectations hypothesis.

Under rational expectations, we would also expect the *perception* of current inflation matches up with ex-post realized inflation and, on average, past 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. Because we observe three consecutive observations per individual, we consider both 6-month-ahead and 12-month-ahead inflation expectations. Table 15 reports the results for this analysis. In columns (1)-(4), we only absorb time-varying economy-wide shocks, whereas in columns (5)-(8), we additionally control for demographics. In all cases, we detect a positive and statistically significant association between current inflation perceptions and past inflation expectations for high-IQ men. The association is lower for low-IQ respondents. In all but

one of the other specifications, the association for low-IQ men is an order of magnitude lower than the association for high-IQ men, and not statistically different from zero.

Overall, current inflation perceptions appear to be consistent with past inflation expectations, both at a 6-month and 12-month horizon, only for high-IQ men, whereas we fail to detect any systematic positive association and hence consistency between inflation perceptions and past expectations for low-IQ men.

C. Quality of Expectations: Rounding and Implausible Values

In the last part of the analysis of IQ and households' expectations-formation processes, we consider two dimensions that earlier research related to the quality of household forecasts.

The first dimension is rounding, that is, individuals' tendency to report numerical values that are multiple of 5 when asked to provide a forecast of future inflation. Previous research has related rounding to respondents' uncertainty about the future prevailing inflation rate (for instance, see Binder (2017) and Manski and Molinari (2010)). In Figure 2 in the introduction, we report the fraction of respondents that reports 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 in each bin and IQ levels. 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 that respondents in the lowest or highest IQ bins are not the outliers driving the negative association.

In Panel A of Table 8, 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)) or inflation perception (columns (3)-(4)), and zero otherwise. The main covariate of interest is the dummy variable that equals 1 if the respondent obtained a score or 6 or above in IQ. Even columns report baseline regressions, whereas even columns control for the same set of demographics as in the baseline analysis. Consistent with the patterns described above, we find that respondents in the top half of the distribution by IQ are less likely to report round numbers for both inflation forecasts and inflation perceptions. In untabulated results, we also repeat the

analysis after excluding all inflation forecasts and perceptions that equal zero. Although a value of zero is also rounded, one might argue that other considerations bring respondents to provide this number. Our results are similar when we exclude all zeros from the analysis.

Because earlier research related rounding to uncertainty about future inflation, we propose a simple test for whether high-IQ and low-IQ respondents vary in the extent to which they round based on whether they are interviewed in periods of high- or low-inflation uncertainty. Intuitively, at times in which inflation rates vary substantially, both high-IQ and low-IQ respondents might be prone to rounding, whereas at times in which inflation uncertainty is low high-IQ respondents might be less prone to rounding, because they might be less uncertain about future inflation.

For this test, we consider the standard deviation of realized inflation within each year as a proxy for the inflation uncertainty in that year. In Figure 6, we report the yearly standard deviation of 12-month inflation rates in the form of gray bars, and measure this standard deviation on the left y-axis. On top of the yearly standard deviations, we impose a black line that represents, for each year, the difference in the average fraction of rounders for low-IQ men (IQ values of 5 or below) and high-IQ men (IQ values of 6 or above). If our conjecture is correct, we should observe that the difference between low-IQ rounders and high-IQ rounders is high at times in which inflation rates do not vary much, and hence uncertainty about inflation should be low, whereas it is low at times in which inflation rates vary substantially, and hence even high-IQ men are uncertain about future inflation. Figure 6 is consistent with this pattern. The fraction of low-IQ rounders is substantially higher in years of low inflation uncertainty, such as 2006, 2007, and 2013. Instead, the fractions of low-IQ and high-IQ rounders are closer at times of high inflation uncertainty, such as 2001, 2003, and 2009.

The second dimension we consider in relation to the quality of the expectations-formation process is the tendency of respondents to provide implausible values for numerical inflation forecasts. Implausible values are values that would be very unlikely (although not impossible) to realize over a period of 12 months based on historical inflation rates. For the analysis in the paper, we consider several thresholds in absolute value beyond which the inflation forecast are considered implausible. 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 inflation

forecast errors, inflation perception, and rounding, the share of respondents that report implausible values around the 5% threshold declines monotonically with the levels of IQ of respondents, 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). Panel A of Figure 7 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 Panel A of Figure 7 refers to the evolution of the share of implausible respondents across bins as we consider higher and higher thresholds, that is, more and more implausible values. We can see that the negative relationships flattens out for the higher levels of IQ as the threshold increases, that is, as implausiblity increases the fraction of implausible respondents decreases proportionally more for respondents in the center of the IQ distribution. Instead, we observe that for the first two bins by IQ – lowest levels of IQ – if anything the size of the negative association increases with the thresholds, because the line becomes steeper as the threshold increases. Panel B of Figure 7 shows that the same patterns are present when we consider the values respondents report for their perception of inflation rates over the last 12 months.

In Panel B of Table 8, 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 (columns (1)-(2)) or inflation perception (columns (3)-(4)), 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 a score or 6 or above in IQ. Even columns report baseline regressions, whereas old columns control for demographicss. Again, consistent with the results for the other features of expectations, we do find across the board that high-IQ men are less likely to report implausible values for inflation forecasts.

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

IV IQ and Choice

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

A natural question to ask is the extent to which expectations and perceptions of different quality transmit into individual choice, and especially consumption and saving decisions. This question is important, because households' optimal behavior in terms of intertemporal substitution of consumption expenditure is at the basis of all modern macroeconomic models.

In particular, we could think about three possible situations, each of which would have different implications in terms of the interpretation and relevance of our results. One possibility is that 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, and inflation or changes in prices people typically purchase. The fact that low-IQ households might not know the work "inflation" or not know this concept thus cannot drive our results. Instead, differences in cognitive abilities might capture different abilities of households to elaborate their beliefs in numerical terms, but households might hold accurate and unbiased beliefs in their mind irrespective of their cognitive abilities. If this were true, the inaccurate expectations and perceptions of low-IQ households would not have substantial implications for household-level or aggregate outcomes, because ultimately households would behave in line with the prescriptions of theory.

A second possibility is low-IQ households 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 that households' choices deviate from the choices of the representative agent, but yet after 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 households might not only have inaccurate expectations and perceptions, 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 information about accurate or professional forecasts of inflation 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. (2017)). 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, Hoang, and Weber (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, Hoang, and Weber (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-based 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.

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.

To corroborate the accuracy of our data, we first estimate the relationship between inflation expectations and readiness to purchase durable goods in the overall sample, which includes both men and women. If the Euler equation logic holds, we should observe a positive association between households' inflation expectations and their readiness to purchase durable goods. Table 9 reports the average marginal effects computed from the

multinomial logit regressions of whether it's 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. In column (1), the inflation-increase dummy is the only explanatory variable. Individuals that expect inflation to increase are on average 1.4% more likely to answer it is a good time to buy durables compared to individuals that expect constant or decreasing inflation.

Perceptions of past inflation shape households' expectations about future inflation (Jonung (1981)). Controlling for past inflation perceptions increases the marginal effect of inflation expectations on the willingness to buy durables to about 2% (see column (2)). High perceptions of past inflation, instead, decrease the marginal propensity to consume durables, which is consistent with the consumption Euler equation.

Apart from different perceptions of past inflation, households differ by purchasing propensity (see, e.g., Attanasio and Weber (1993)). Household characteristics that determine both purchasing propensities and inflation expectations might be systematically related, and hence controlling for the observed heterogeneity across households is important to verify the associations we documented so far are not spurious. In column (3) of Table 9, we add a rich set of demographics as covariate in the baseline specification. The baseline positive association between inflation expectations and readiness to purchase durable goods is unchanged.

After having established that the baseline positive association between inflation expectations and readiness to consume holds for the average household in the full sample, we move on to consider the subset of male respondents for whom we observe cognitive abilities. This subsample amounts to about 17% of the overall sample. When we repeat the specification of column (3) within this restricted subsample, we find a positive marginal effect of inflation expectations on consumption propensities, which is not statistically significant.

To understand whether cognitive abilities might be relevant to explain if household consumption propensity reacts to changes in inflation expectations, we split the whole sample into men with IQ above 5 and other men. In columns (5) and (6) of Table 9, we repeat the analysis of column (4) separately for each of the two groups. Column (5)

shows that in the subsample with high cognitive abilities, men are 3.7% more likely to say it is a good time to purchase durables when they expect inflation to increase relative to other men. This result is consistent with the conjecture that high-IQ men understand intertemporal substitution as well as the consumption Euler equation logic, and hence their consumption plans react to changes in inflation expectations. When we move on to consider men with lower levels of IQ (column (6)) we do find a negative but statistically insignificant marginal effect of inflation expectations on consumption propensities. Note that a statistical power issue can barely explain this lack of reaction of the consumption plans of low-IQ men to changes in inflation expectations, because the size of the samples in column (5) and column (6) are almost identical.

Overall, the results in Table 9 suggest that men with high cognitive abilities, but not other men, adjust their consumption plans to changes in inflation expectations in line with intertemporal substitution.

B. Which IQ Subcomponents Matter?

Standardized IQ scores are a summary statistic derived from aggregation of three different IQ subcategories, which include a verbal, a logical, and an arithmetic cognitive component. Table 3 shows that the three subcomponents of normalized IQ scores are positively correlated, but the correlation coefficients range from 0.56 to point 0.66, and hence different subcomponents seem to be capturing alternative sources of variation in cognitive abilities.

We have no conjecture about whether any of the standardized IQ subcomponents should matter more or less than the others in the relationship between inflation expectations and consumption propensities. One might argue that arithmetic and computational cognitive abilities are crucial for households to link quantitative dimensions such as inflation expectations and willingness to purchase durable goods. At the same time, verbal cognition should also be important, because it allows households to follow the financial news and understand the effects of policies on the economy. Finally, logical cognition should also be important, because households might understand notions like the consumption Euler equation and intertemporal substitution through thought examples and scenarios. Overall, assessing whether any of the IQ subcomponents is more relevant that the others is an empirical question.

Table 10 performs our baseline analysis using the scores in the three IQ subcategories to split low-IQ and high-IQ men. For each subcategory, we define the dummy for high-IQ men as we did for the overall IQ score, that is, we define high-IQ respondents those respondents who scored a 6 or higher in the stanine scale for the subcategory. To make the comparison of the subcategory results with the baseline results easier, columns (1) and (2) of Table 10 report the same coefficients we estimate in columns (5) and (6) of Table 9 when using the overall IQ scores. In columns (3), (5), and (7) of Table 10, we find that across all IQ subcategories men that score high in the IQ test display a positive and statistically significant association between inflation expectations and willingness to consume. Not only are the estimated marginal effects all positive, but the sizes of the estimated effects are very similar across subcategories. In columns (4), (6), and (8), instead, we detect no association between inflation expectations and willingness to spend among men with low cognitive abilities.

Overall, we conclude that all three subcategories tested in the IQ questions – verbal, logical, and arithmetic cognitive abilities – help explain the sensitivity of the propensity to consume to changes in inflation expectations.

C. Financial Constraints and Individual-level Shocks

Binding financial constraints are a compelling alternative interpretation to our results. If low-IQ men are systematically more likely to be financially constrained than high-IQ men, low-IQ men's consumption plans might be insensitive to inflation expectations not because they do not understand intertemporal substitution, but because they cannot easily substitute their consumption expenditure intertemporally. To assess the relevance of this alternative interpretation, we repeat our baseline analysis limiting the sample to respondents that are unlikely to be financially constrained. To proxy for the lack of financial constraints, we consider subsamples of respondents whose income is in the higher part of the distribution. The rationale for this test is that financially-unconstrained respondents can substitute intertemporally if they realize it is convenient for them to do so.

Table 11 reports the marginal effects of expecting higher inflation on the willingness to purchase durable goods for respondents whose income is above the median income of men with IQ data (columns (2) and (3)) and whose income is above the 25^{th} percentile

(columns (4) and (5)). In both cases, we replicate the baseline positive association between inflation expectations and readiness to spend on durable goods for high-IQ men. To the contrary, the consumption plans of low-IQ men appear to be insensitive to changes in inflation expectations even for those that are unlikely to be financially constrained.

A second relevant concern with our baseline results is that low-IQ men might have more negative expectations regarding *other* dimensions of their future personal outlook and/or macroeconomic variables, which might mute their willingness to adjust future consumption plans to changes in inflation expectations. For instance, low-IQ men that expect higher inflation might also be more likely to expect a job loss over the following 12 months compared to high-IQ men. In this case, a negative expected income shock might counteract the effect of higher inflation expectations on consumption plans. To assess the relevance of this concern, we exploit the richness of our expectations data. The survey asks about individuals' expectations regarding any changes in their own income over the following 12 months, which should capture any potential household-level or macro-level shocks that are likely to produce a negative or positive income effect at the household level.

Table 12 replicates our baseline analysis using individual income expectations. In columns (1)-(2) of Table 12, we only focus on respondents that expect their household income will increase over the following 12 months. Within this group, the consumption plans of high-IQ men react to changing inflation expectations, whereas the consumption plans of low-IQ men are insensitive to inflation expectations – if anything, the statistically insignificant association is negative. This result is direct evidence that even low-IQ men who do not expect any negative income shocks do not adjust their consumption plans to inflation expectations. In columns (3)-(4) of Table 12, we move on to consider only respondents who expect their household income will decrease over the following 12 months. Again, we detect the same patterns as in the baseline analysis, whereby high-IQ men adjust their consumption plans to inflation expectations, whereas the consumption plans of low-IQ men are insensitive to changing inflation expectations. The results for high-IQ men suggest the consumption Euler equation plausibly explains our baseline results, wheres income effects based on a Phillips-curve logic are an unlikely explanation. Finally, for the results in columns (5)-(6) of Table 12 we construct a dummy variable that equals 1 if respondents have a negative outlook regarding their household income going forward and we add this dummy directly as a control in our specifications. This test allows us

to run our multinomial logit regressions for the full sample, and hence avoid the concern that statistical power might drive the non-results. We confirm all our results.

D. 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 that low-IQ individuals' consumption plans do not react to their changing inflation expectations, irrespective of the quality or such expectations, and hence they might be unable to think and plan for the future as lifecycle agents would do.

In the last part of this section, we assess whether low-IQ individuals differ from high-IQ individuals 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. One drawback of this analysis is that the the questions we can access in this part of the survey have varying response rates, and respondents only overlap marginally across questions, which are asked in different parts of the questionnaire. 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 individuals might be more forward-looking than low-IQ individuals, that is, whether high-IQ households save more for the future conditional on saving at all compared to low-IQ households. We already know that high-IQ households have a better understanding of the relationship between future and present outcomes as they behave in ways that suggest they understand intertemporal substitution whereas low-IQ households do not. At the same time, high-IQ households might also understand the difference between present-day consumption and future consumption better than low-IQ households, and might know they should save for the long-run, such as for retirement.

For the first test, we consider households' saving plans. We first assess whether individuals differ in their stated likelihood to save any part of their labor income based on cognitive abilities. Column (1) of Table 13 reports the marginal effect attached to the dummy for IQ levels of 6 or above when the outcome variable is a dummy that equals 1 if the individual claims he saves at least part of their monthly labor income. We can see

that high-IQ individuals, if anything, are *less* likely to save than low-IQ people possibly due to a reduced precautionary savings motive. We then consider a second question that digs deeper in saving motives and asks respondents whether they save for retirement or not. 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 suggest that 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 then move on to consider households' borrowing motives. In this analysis, we compare respondents' likelihood of claiming the household plans to borrow to finance current or future consumption with the likelihood of claiming the household plans to borrow to finance current or future education-related expenses. Column (3) of Table 13 shows that high-IQ households do not differ from low-IQ households in their likelihood to plan to borrow to finance consumption, whereas in column (4) high-IQ households are substantially more likely to plan to borrow to finance education-related costs compared to low-IQ households. We interpret this evidence as also consistent with high-IQ households being more forward-looking than low-IQ individuals, because they plan on borrowing to finance a long-term-return investments like education and human capital.

One might argue that low-IQ households might think it makes no sense for them to invest in education 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 the level of IQ of individuals, low-IQ households should plan on spending more than high-IQ households on education-related expenses if they were forward looking and realized the positive return to human capital investment in the long run.

V Channels

In our previous discussion, we provided arguments for why channels like households' financial constraints or expectations about future economic conditions are unlikely to explain our findings. In this section, we further discuss a set of channels that could help explain why low-IQ men might be less responsive to policy changes than high-IQ men.

First, low-IQ men might less informed about economic fundamentals than high-IQ men. In this case, low-IQ men would have miscalibrated beliefs about future macroeconomic variables and would be unlikely to adjust their consumption plans to changing economic conditions in line with the aims of policy interventions.

To assess this channel directly, we exploit a unique feature of our survey – the fact the survey asks households directly about their perception of current inflation on top of their expectations about future inflation. Based on this question, we compute an inflation-perception error at the individual level as the difference between the numerical response for perceived inflation and the actual current rate of inflation. Consistent with the low-information channel, Panel B of Figure 3 shows that low-IQ men have higher perception errors about contemporaneous inflation than high-IQ men. Panel B and Panel D of Table 4 show that, even for the case of perception errors, variation in income levels or education levels across men with different levels of IQ do not drive the baseline pattern.

To dig deeper into the low-information channel, Table 17 splits our sample into men with perception errors below the median (columns (1)-(2)) and men with perception errors above the median (columns (3)-(4)). In column (1), we find that 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), instead, we fail to detect any significant association between inflation expectations and consumption propensities for low-IQ men with low perception errors for contemporaneous inflation. This non-result suggests that even low-IQ men that are well informed about macroeconomic variables do not display a behavior consistent with the Euler equation. In columns (3) and (4) of Table 17, we fail to detect any association between the inflation expectations and consumption propensities of either high-IQ men or low-IQ men. For low-IQ men the association is even negative, although not statistically different from zero.

On the normative side, these results suggest that a mere policy of educating consumers about the level of current inflation might not be sufficient to increase the effectiveness of policy interventions.

An alternative channel that might help explain why low-IQ men display no reaction to changing economic incentives is that low-IQ men have too large forecast errors. To assess the relevance of this channel, in Table 18 we split our sample in two groups based on the size of the forecast error for future inflation. Columns (1)-(2) of Table 18 only consider low- and high-IQ men below the median forecast errors for inflation. Within this subsample, only high-IQ men increase their spending propensities when their inflation expectations increase. Low-IQ men are still unresponsive, even if their expectations about future inflation are close to the ex-post realization. Once we focus on men with high inflation forecast errors (columns (3)-(4) of Table 18), we still find a positive association between inflation expectations and consumption propensity for high-IQ men, whereas again we detect no significant association for low-IQ men.

These results also have normative implications. Educating the population only about expected inflation rates in the future – e.g., by stating the central bank follows a specific inflation target – is likely insufficient to obtain a reaction to policy interventions by the whole population, because low-IQ consumers are still unlikely to react.

VI Conclusion

Expectations deviate from the full information rational expectations benchmark and substantial variation exists in the cross section of individuals and over time. We document cognitive abilities play a central role for forecast and perception errors of inflation, uncertainty in forecasts, and for reporting round and implausibly large values, which earlier research relates to the inability of individuals to form accurate expectations about the future. We also show that cognitive abilities are systematically related with households' planned choices in the allocation of resources between current and future consumption, households' understanding of intertemporal substitution, as well as households' forward-looking behavior such as the choice of saving for retirement and the choice of borrowing to finance education-related expenses instead of current consumption.

These qualitative differences in expectations quality and choice by cognitive abilities are large in magnitude. Low-cognitive abilities men have forecast and perception errors

for inflation that are more than twice as large then the errors for high IQ men; 70% of low IQ men round their forecasts to multiples of 5 relative to only 40% for high IQ men which is an indication of uncertainty; low IQ men are 10% less likely to save for retirement compared to high IQ men; are substantially less likely to borrow for education and are as likely to borrow for consumption; and low IQ men do not adjust their consumption plans to their inflation expectations contrary to a consumption Euler equation.

These facts, which we document for the first time, imply that the non-responsiveness of low-cognitive-ability individuals in their consumption plans to inflation expectations might result in an implicit redistribution from low- to high-cognitive abilities men when central banks or government implement policies to stimulate demand via policies that aim to raise inflation expectations. The lack of forward-looking attitudes in low-cognitive-ability individuals might also determine a lower sensitivity to policy shocks aiming to favor forward-looking saving and borrowing choices. Hence, cognitive abilities might contribute to changes in wealth inequality over time. Limited reaction to policy interventions by many households would also be detrimental for governments that aim to change aggregate consumption and saving patterns throughout the business cycle. Future research should investigate the extent to which cognitive abilities interact with the reaction to policy interventions.

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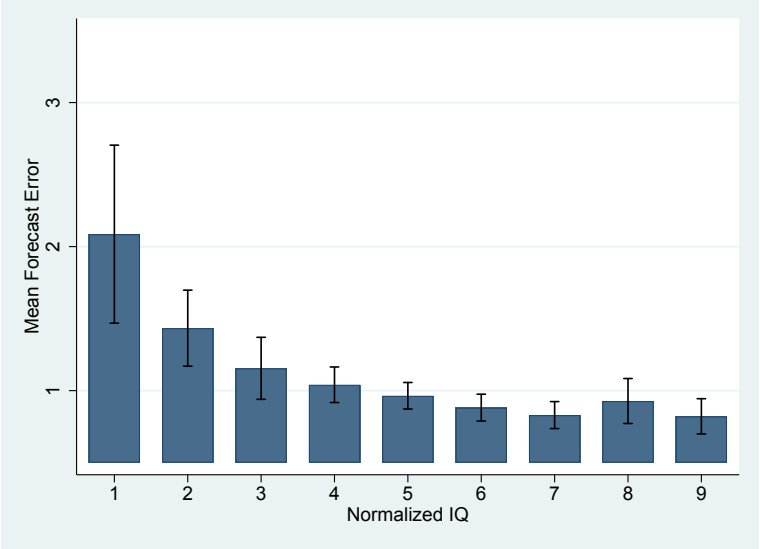
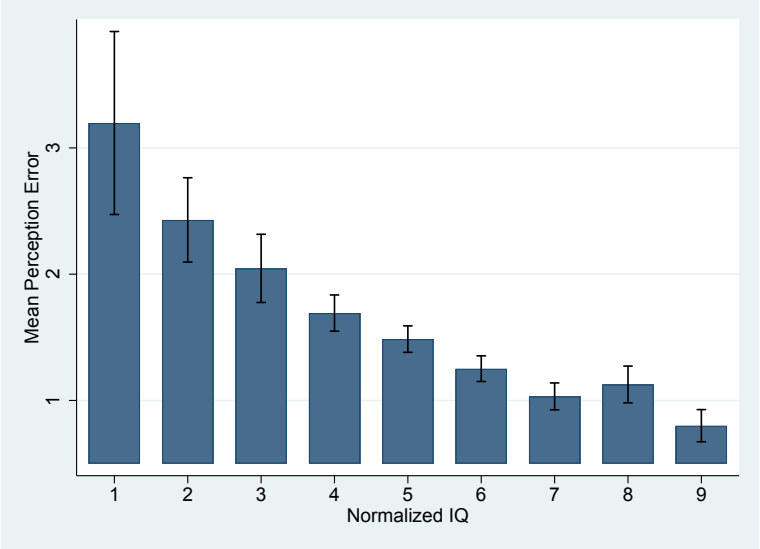
Figure 3: **Average Forecast and Perception Error by IQ**

Panel A. Average Forecast Error by IQ



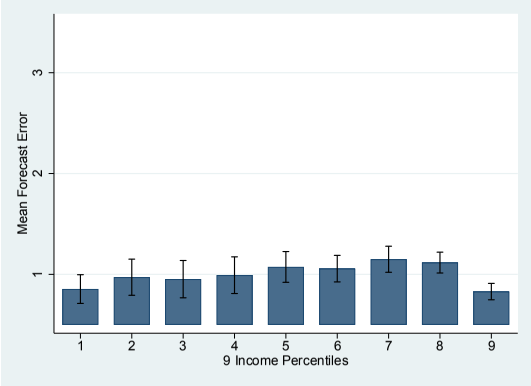
Panel B. Average Perception Error by IQ



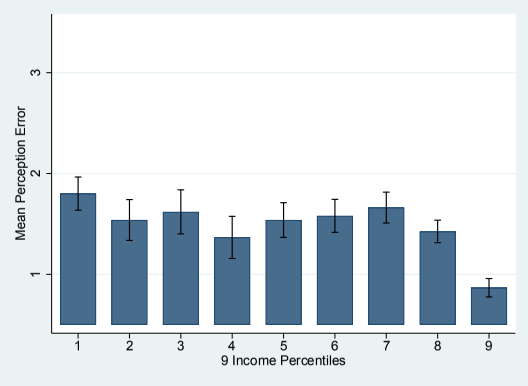
This figure plots the average forecast error (Panel A) and the average perception error (Panel B) for inflation as a function of normalized IQ in Finland. Forecast errors as differences between inflation expectations and ex-post realized inflation. Perception error is the difference between perceived 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 twelve months. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is January 2001 to March 2015 for a total.

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

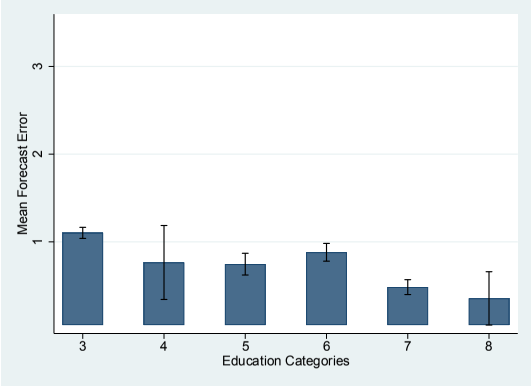
Panel A. Average Forecast Error by Income



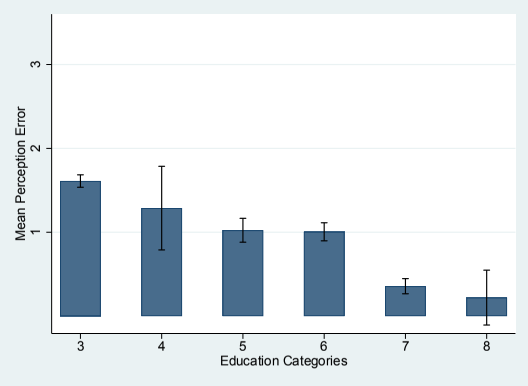
Panel B. Average Perception Error by Income



Panel C. Average Forecast Error by Education



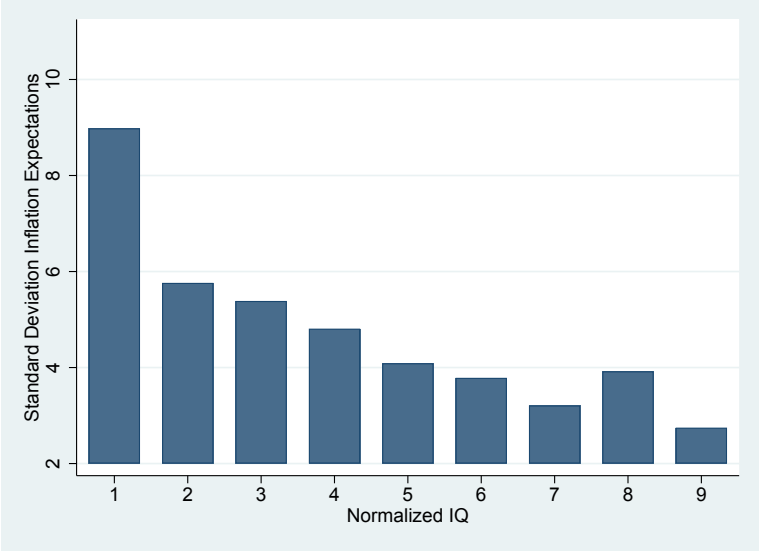
Panel D. Average Perception Error by Education



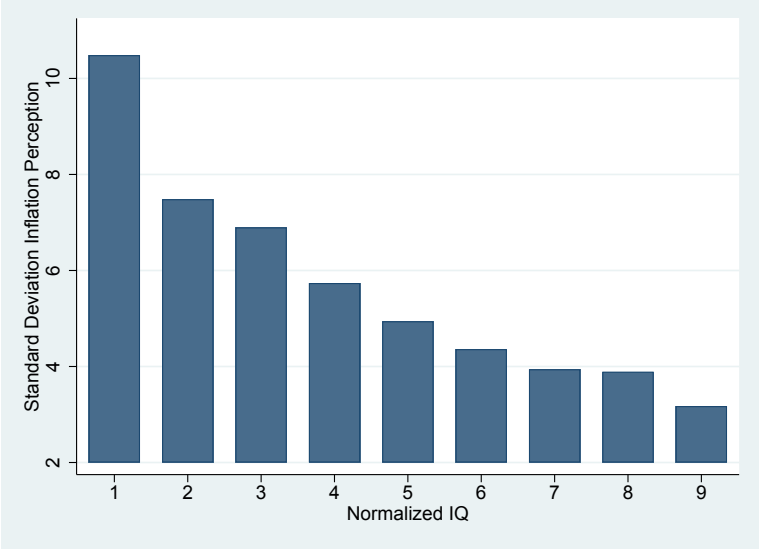
Panel A and Panel B of this figure plot the average inflation forecast error and average inflation perception error as a function of 9 income percentiles in Finland. Panel C and Panel D of this figure plots the average inflation forecast error and average inflation perception error across 6 education 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 twelve months. The sample period is January 2001 to March 2015.

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

Panel A. Dispersion of Inflation Forecasts by IQ

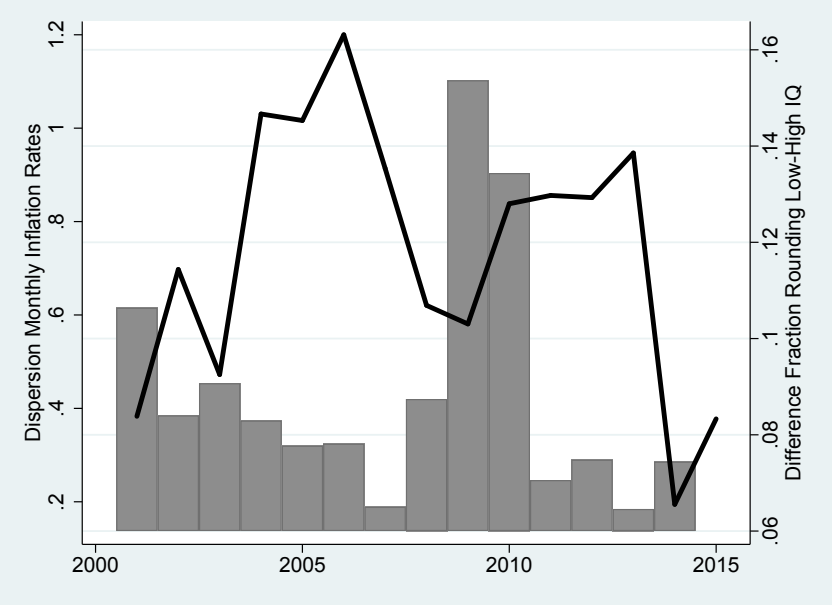


Panel B. Dispersion of Inflation Perception by IQ



This figure plots the standard deviation of inflation forecasts (Panel A) and inflation perception (Panel B) 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 March 1995 to March 2015 for a total of 21 years.

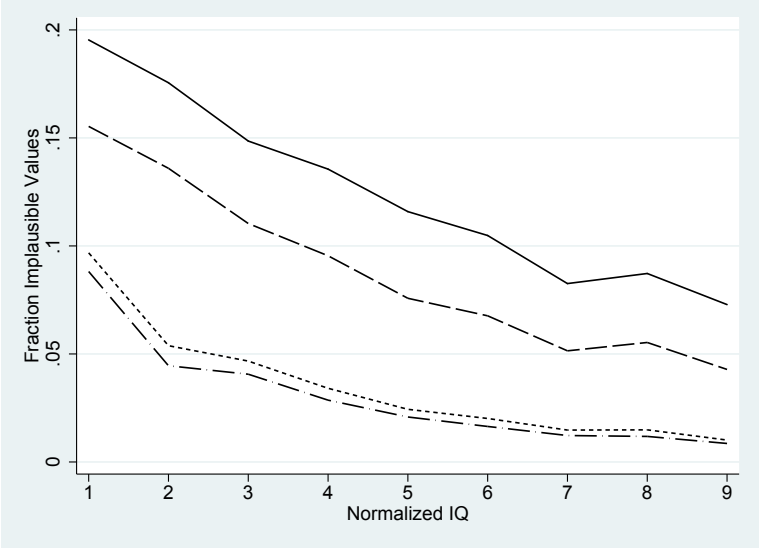
Figure 6: **Yearly Standard Deviation of Monthly Inflation Rates and Fraction of Rounders**



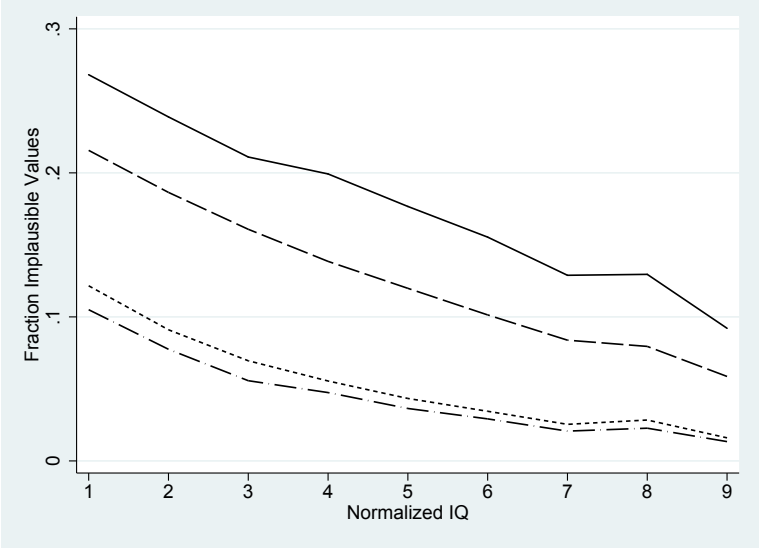
This figure plots the standard deviation of realized inflation within a year on the left y-axxis and the differences in the fraction of rounders between low- and high-IQ men. We define rounders as survey participants that report multiples of 5 for the numeric inflation forecast. We use the confidential 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 variables between 1 and 9. IQ high reflects a normalized IQ larger than 5. The sample period is January 2001 to March 2015.

Figure 7: **Implausible Values for Inflation Expectations and Perception by IQ**

Panel A. Fraction of Respondents Reporting Implausible Values, Expectations

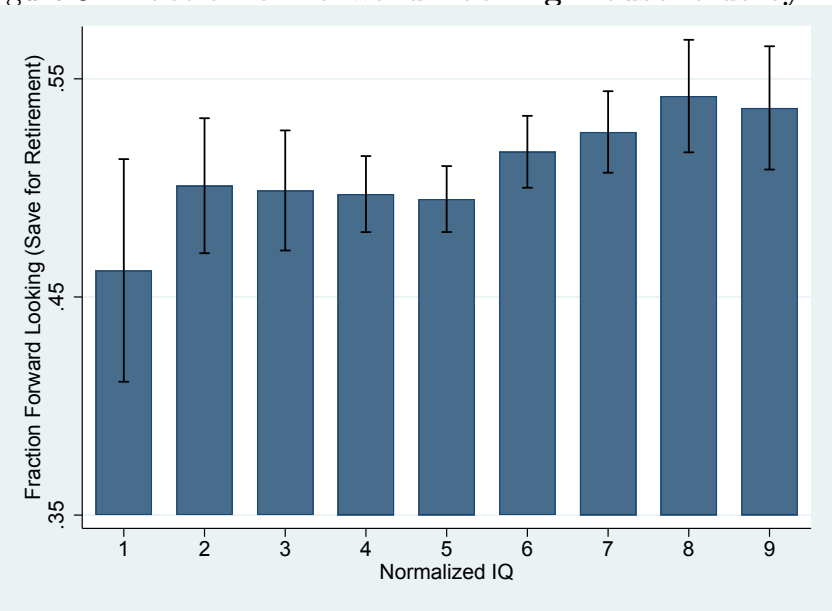


Panel B. Fraction of Respondents Reporting Implausible Values, Perception



This figure plots the share of survey respondends that 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.

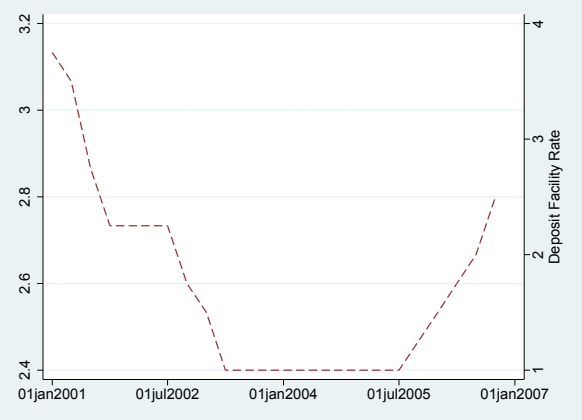
Figure 8: **Fraction of Forward Looking Households by IQ**



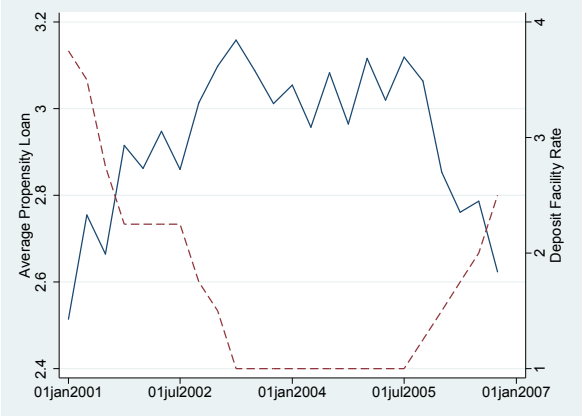
This figure plots the share of households that report they save for retirement (conditional on saving in general) as a function of normalized IQ in Finland. We consider saving for retirement conditional on saving a proxy for whether households are forward looking. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,000 households how consumer prices will evolve in the next twelve months. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is March 1995 to March 2015 for a total of 21 years.

Figure 9: **ECB Deposit Facility Rate and Propensity to Borrow by IQ**

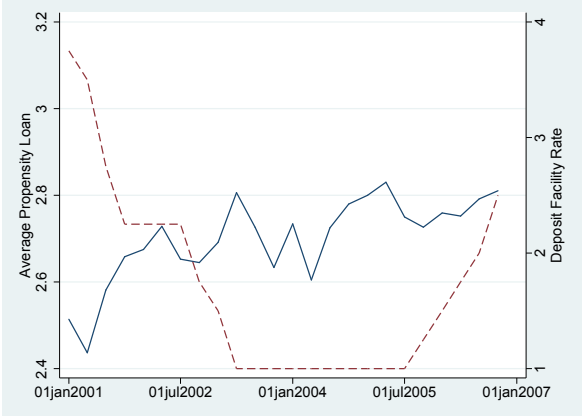
Panel A. ECB deposit facility rate (2001-2007)



Panel B. Borrowing: High-IQ Men



Panel C. Borrowing: Low-IQ Men



Panel A of this figure plots the beginning of quarter European Central Bank Facility Rate from quarter 1 2001 to quarter 4 of 2006. Panel B and Panel C of this figure plot the cross-sectional mean of whether individuals think it's a good time to take out a loan in Finland by IQ levels. High -Q men are all men with the highest 3 scores of the 9-point distribution. Low-IQ men are all men with the lowest 3 scores of the 9-point distribution. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure the propensity to take out a loan. Statistics Finland asks a representative sample of 1,200 households whether they think it's a good time to take out a loan. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is January 2001 to December 2006.

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 March 1995 to March 2015 for a total of 21 years.

Statistics Statistics	Inflation Perception	Inflation Expectation	Forecast Error	Perception Error	Abs Forecast Error	Abs Perception Error	Expectation - Perception	IQ	IQ_{visio}	IQ_{verbal}	IQ_{arith}	Income	Age
Nobs	286,053	287,340	287,340	286,053	287,340	286,053	269,464	47,069	46,606	46,606	46,606	344,210	346,283
Mean	3.09	2.74	1.19	1.55	2.68	2.94	-0.45	5.37	5.41	5.12	5.32	17,454	43.92
Std	5.61	4.85	4.99	5.55	4.38	4.96	4.81	1.89	1.91	1.88	1.96	12,812	16.80
p1	-5.00	-4.00	-5.20	-5.74	0.04	0.04	-15.00	1	1	1	1	0	15
p10	0.00	0.00	-2.41	-2.06	0.32	0.31	-4.00	3	3	3	3	4,000	20
p25	0.00	0.00	-1.10	-1.06	0.79	0.81	-1.00	4	4	4	4	9,500	30
p50	2.00	2.00	0.37	0.50	1.59	1.61	0.00	5	5	5	5	15,500	44
p75	5.00	4.00	2.32	2.64	3.12	3.23	0.00	7	7	6	7	22,800	57
p90	8.00	5.50	5.04	6.09	5.31	6.53	2.00	8	8	8	8	31,300	66
p99	22.00	20.00	18.71	20.69	18.94	21.46	10.00	9	9	9	9	67,000	77
Gender	male	170,256		College		no	112,593						
	female	176,125				yes	89,398						
Single	no	222,687		Urban		no	240,885						
	yes	123,596				yes	105,052						
Unemployed	no	322,043		Helsinki		no	258,538						
	yes	24,240				yes	87,366						
Kids	no	108,658											
	yes	237,723											

Table 2: **Inflation Expectations, Income, and Total Debt 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 for a total of 15 years.

	Low IQ	2	3	4	5	6	7	8	High IQ
Panel A. Distribution of Normalized IQ									
Nobs	1,785	3,921	4,701	10,907	13,797	11,162	7,849	4,043	3,298
Panel B. Inflation Expectations by IQ									
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
Panel C. Taxable Income by IQ									
Mean	15,292	17,577	19,341	20,217	21,355	21,731	26,048	26,836	30,719
Std	14,074	15,238	15,220	16,035	17,765	20,130	22,398	24,893	28,020
Nobs	1,006	2,452	3,138	7,502	10,043	8,478	6,325	3,360	2,775
Panel D. Total Debt by IQ									
Mean	18,558	22,789	25,340	26,950	27,209	27,058	32,019	30,701	33,149
Std	40,825	47,247	46,359	47,035	46,228	47,244	49,231	50,102	55,361
Nobs	1,014	2,459	3,149	7,533	10,074	8,508	6,346	3,374	2,791
Panel E. Total Debt / Taxable Income by IQ									
	0.82	0.77	0.76	0.75	0.78	0.80	0.81	0.87	0.93
Panel F. Income Share by IQ									
	1.86%	4.52%	6.28%	15.38%	21.16%	17.79%	16.11%	8.83%	8.07%

Table 3: **Correlation between IQ and Income**

This table reports the correlation between income and overall IQ and the different subcomponents. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is January 2001 to March 2015.

	IQ	IQ_{logic}	IQ_{verbal}	IQ_{arith}
IQ	1			
IQ_{ogic}	0.83	1		
IQ_{verbal}	0.85	0.56	1	
IQ_{arith}	0.88	0.62	0.66	1
Income	0.15	0.10	0.11	0.15

Table 4: **Absolute Forecast Errors and IQ**

This table reports the coefficient estimates from a linear regression of absolute forecast errors on normalized IQ and household 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 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. IQ dummy equals one 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)
IQ Dummy	−0.54***			
	(−13.33)			
IQ		−0.20***	−0.12***	−0.10***
		(−14.99)	(−7.49)	(−5.74)
Time fixed effects				X
Demographics			X	X
adj. R^2	0.0000	0.0100	0.0100	0.0500
Nobs	44,741	44,741	25,288	25,288

Standard errors in parentheses

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

Table 5: **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 that belong to the category (Panel A) and respondents that 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 variables between 1 and 9. IQ dummy equals one 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 Income	College	Econ degree	White Collar
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A. Repondent in Category							
High IQ	−0.2451***	−0.2728***	−0.1837***	−0.2611***	−0.1243***	−0.1530*	−0.2713***
	(0.0534)	(0.0704)	(0.0597)	(0.0706)	(0.0508)	(0.0884)	(0.0890)
Demographics	X	X	X	X	X	X	X
Pseudo R^2	0.0509	0.0457	0.0467	0.0467	0.0758	0.0093	0.0765
Nobs	16,837	16,256	9,812	10,324	9,463	2,949	4,157
Panel B. Repondent outside Category							
High IQ	−0.2100***	−0.1915***	−0.2745***	−0.1750***	−0.2830***	−0.2563***	−0.3163***
	(0.0618)	(0.0481)	(0.0537)	(0.0494)	(0.0552)	(0.0441)	(0.0575)
Demographics	X	X	X	X	X	X	X
Pseudo R^2	0.0663	0.0682	0.0566	0.0654	0.0447	0.0528	0.0495
Nobs	10,731	16,337	17,756	17,244	18,105	24,619	16,601

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

This table reports the coefficient estimates from a linear regression of inflation expectations on inflation expectations six-months ago for men with high and low IQ. 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. IQ high reflects a normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is March 1995 to December 1999.

	All Periods		Periods of Flat Inflation		Periods of Changing Inflation	
	high IQ	low IQ	high IQ	low IQ	high IQ	low IQ
	(1)	(2)	(3)	(4)	(5)	(6)
Past expectations	0.243***	0.053***	0.300***	0.047*	0.141	0.061**
	(0.047)	(0.021)	(0.054)	(0.028)	(0.090)	(0.024)
Time fixed effects	X	X	X	X	X	X
adj. R^2	0.03	0.02	0.04	0.02	0.03	0.04
Nobs	1,367	1,185	922	782	445	403

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

Table 7: **Current Inflation Perception, Past Inflation Expectations, and IQ**

This table reports the coefficient estimates from a linear regression of inflation perceptions on inflation expectations six-months (6m) and twelve-months (12m) ago for men with high and low IQ. 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. IQ high reflects a normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is March 1995 to December 1999.

	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 Inflation expectation (6m)	0.24***	0.053***			0.28***	0.029		
	(5.16)	(2.63)			(5.33)	(1.00)		
Past Inflation expectation (12m)			0.21***	0.032			0.26**	0.031
			(2.86)	(1.29)			(2.38)	(1.21)
Time fixed effects	X	X	X	X	X	X	X	X
Demographics					X	X	X	X
adj. R^2	0.02	0.01	0.01	0.00	0.02	0.01	0.00	0.00
Nobs	1,368	1,192	563	482	1,065	762	442	310

t-statistics in parentheses

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

Table 8: **Rounding, Implausible Values, and Cognitive Abilities**

This table reports the coefficient estimates from a linear regression of a dummy variable which equals one if the responded reported a multiple of 5 as his inflation forecast in Panel A and if the responded reported a number larger than 5 in absolute value as his inflation forecast for men with high and low IQ. 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. IQ high reflects a normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is January 2001 to December 1999.

Panel A. Rounding

	Inflation Expectations		Inflation Perception	
	(1)	(2)	(3)	(4)
High IQ	−0.1195***	−0.0735***	−0.0870***	−0.0489***
	(0.0051)	(0.0061)	(0.0051)	(0.0062)
Demographics		X		X
Pseudo R^2	0.0142	0.0482	0.0076	0.0447
Nobs	38,289	28,807	38,289	28,807

Panel B. Implausible Values

	Inflation Expectations		Inflation Perception	
	(1)	(2)	(3)	(4)
High IQ	−0.0446***	−0.0194***	−0.0633***	−0.0338***
	(0.0036)	(0.0044)	(0.0042)	(0.0048)
Demographics		X		X
Pseudo R^2	0.0049	0.0417	0.0071	0.0627
Nobs	31,841	24,345	31,251	23,960

Standard errors in parentheses

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

Table 9: **Inflation Expectations and Readiness to Spend: baseline**

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 which equals 1 when a household replies that inflation will increase. Past inflation measures the household perception of the increase in consumer prices during the last twelve months. 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.

				Men with IQ data	Men high IQ	Men low IQ
	(1)	(2)	(3)	(4)	(5)	(6)
Inflation Expectations	0.0136***	0.0214***	0.0174***	0.0147	0.0358***	−0.0096
	(0.0050)	(0.0047)	(0.0056)	(0.0100)	(0.0119)	(0.0138)
Past Inflation		−0.0609***	−0.0680***	−0.0680***	−0.0737***	−0.0629***
		(0.0036)	(0.0039)	(0.0057)	(0.0074)	(0.0058)
Demographics			X	X	X	X
Pseudo R^2	0.0004	0.0067	0.0132	0.0107	0.0108	0.0091
Nobs	312,749	311,164	187,294	32,862	16,606	16,256

Standard errors in parentheses

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

Table 10: **Inflation Expectations and Readiness to Spend: IQ Categories**

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 which equals 1 when a household replies that inflation will increase. Past inflation measures the household perception of the increase in consumer prices during the last twelve months. 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 March 1995 to March 2015 for a total of 21 years.

	high IQ	low IQ	high IQ logical	low IQ logical	high IQ verbal	low IQ verbal	high IQ arithmetic	low IQ arithmetic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Inflation expectation	0.0358***	−0.0096	0.0349***	−0.0078	0.0335**	−0.0078	0.0324**	−0.0058
	(0.0119)	(0.0138)	(0.0120)	(0.0139)	(0.0135)	(0.0139)	(0.0131)	(0.0134)
Past Inflation	−0.0737***	−0.0629***	−0.0725***	−0.0635***	−0.0683***	−0.0635***	−0.0609***	−0.0507***
	(0.0074)	(0.0058)	(0.0074)	(0.0061)	(0.0078)	(0.0061)	(0.0073)	(0.0058)
Demographics	X	X	X	X	X	X	X	X
Pseudo R^2	0.0108	0.0091	0.0115	0.0093	0.0103	0.0093	0.0115	0.0089
Nobs	16,606	16,256	16,911	15,865	15,325	15,865	16,600	16,176

Standard errors in parentheses

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

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

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 which equals 1 when a household replies that inflation will increase. Past inflation measures the household perception of the increase in consumer prices during the last twelve months. 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. Columns (2) and (3) condition on having taxable income above the median income in the cross section and columns (4) and (5) condition on having taxable income above the 25^{th} percentile of income in the cross section. The sample period is March 1995 to March 2015 for a total of 21 years.

		Income $>$ 50th percentile$_t$		**Income $>$ 25th percentile$_t$**	
	Men with IQ data	Men high IQ	Men low IQ	Men high IQ	Men low IQ
	(1)	(2)	(3)	(4)	(5)
Inflation expectation	0.0187	0.0306**	0.0022	0.0343***	−0.011
	(0.0126)	(0.0154)	(0.0195)	(0.0130)	(0.0130)
Past Inflation	−0.0767***	−0.0861***	−0.0676***	−0.0770***	−0.0643***
	(0.0064)	(0.0084)	(0.0070)	(0.0079)	(0.0063)
Demographics	X	X	X	X	X
Pseudo R^2	0.0133	0.0127	0.0121	0.0112	0.0096
Nobs	20,237	10,723	9,514	14,852	14,383

Standard errors in parentheses

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

Table 12: **Inflation Expectations and Readiness to Spend: by Financial Outlook**

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 which equals 1 when a household replies that inflation will increase. Past inflation measures the household perception of the increase in consumer prices during the last twelve months. 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. Columns (1) and (2) condition on having a positive outlook regarding personal income, and columns (4) and (5) condition on having a negative outlook regarding personal income, and columns (5) and (6) use individual expectations regarding personal income and aggregate GDP as controls. The sample period is March 1995 to March 2015 for a total of 21 years.

	High Income Expectations		**Low Income Expectations**		**Expectations as Controls**	
	Men high IQ	Men low IQ	Men high IQ	Men low IQ	Men high IQ	Men low IQ
	(1)	(2)	(3)	(4)	(5)	(6)
Inflation expectation	0.0294*	−0.0166	0.0371**	−0.0046	0.0394***	−0.001
	(0.0165)	(0.0190)	(0.0158)	(0.0176)	(0.0115)	(0.0137)
Past Inflation	−0.0709***	−0.0571***	−0.0750***	−0.0653***	−0.0702***	−0.0565***
	(0.0099)	(0.0090)	(0.0081)	(0.0075)	(0.0072)	(0.0057)
Demographics	X	X	X	X	X	X
Expectations					X	X
Pseudo R^2	0.0115	0.0083	0.0106	0.0104	0.0189	0.0162
Nobs	7,337	6,409	9,269	9,847	16,440	16,026

Standard errors in parentheses

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

Table 13: **Saving and Borrowing Motives and Cognitive Abilities**

This table reports the average marginal effects individuals savings and borrowing motives. Individuals' savings and borrowin motives are the dependent variables which equal dummy variables that equal one if the respond 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
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 14: **Current and Past Inflation Expectations and IQ**

This table reports the coefficient estimates from a linear regression of inflation expectations on inflation expectations six-months ago for men with high and low IQ. 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. IQ high reflects a normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is March 1995 to December 1999.

	All Periods		Periods of Flat Inflation		Periods of Changing Inflation	
	high IQ	low IQ	high IQ	low IQ	high IQ	low IQ
	(1)	(2)	(3)	(4)	(5)	(6)
Past expectations	0.243***	0.053***	0.300***	0.047*	0.141	0.061**
	(0.047)	(0.021)	(0.054)	(0.028)	(0.090)	(0.024)
Time fixed effects	X	X	X	X	X	X
adj. R^2	0.03	0.02	0.04	0.02	0.03	0.04
Nobs	1,367	1,185	922	782	445	403

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

Table 15: **Current Inflation Perception, Past Inflation Expectations, and IQ**

This table reports the coefficient estimates from a linear regression of inflation perceptions on inflation expectations six-months (6m) and twelve-months (12m) ago for men with high and low IQ. 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. IQ high reflects a normalized IQ larger than 5. Standard errors are clustered at the quarter level. The sample period is March 1995 to December 1999 for a total of 5 years.

	low IQ (1)	high IQ (2)	low IQ (3)	high IQ (4)	low IQ (5)	high IQ (6)	low IQ (7)	high IQ (8)
Past Inflation expectation (6m)	0.053***	0.24***			0.029	0.28***		
	(2.63)	(5.16)			(1.00)	(5.33)		
Past Inflation expectation (12m)			0.032	0.21***			0.031	0.26**
			(1.29)	(2.86)			(1.21)	(2.38)
Time fixed effects	X	X	X	X	X	X	X	X
Demographics					X	X	X	X
adj. R^2	0.01	0.02	0.00	0.01	0.01	0.02	0.00	0.00
Nobs	1,192	1,368	482	563	762	1,065	310	442

t-statistics in parentheses

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

Table 16: **Change in the Propensity to Borrow around Interest Rate Changes**

This table reports the coefficient estimates from the following specification:

$$Loan_{i,t} = \alpha + \beta IQ_{i,t} \times Post_t + \gamma Post_t + \zeta IQ + X'_{i.t}\delta + \eta_t + \epsilon_{i,t},$$

where $Loan_{i,t}$ is a dummy variable that equals 1 if the respond answers it is a good time to take out a loan, and zero otherwise; and $Post_t$ is a dummy variable that equals 1 in the months in which the ECB changes the facility rate, and zero in the months before the change. We estimate this specification with a linear probability model (OLS) as well as using non-linear estimators. 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. IQ dummy equals one if normalized IQ is larger than 5. The sample period is January 2001 to December 2002 for a total of 2 years.

	OLS	Probit	Logit	OLS	Probit	Logit
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Rate Cut: Jan 2001 – June 2003					
IQ Dummy	−0.0278	−0.0241	−0.0248	−0.0482	−0.0445	−0.0448
	(0.0293)	(0.0274)	(0.0282)	(0.0325)	(0.0295)	(0.0308)
Post	0.0618***	0.0590***	0.0597***	0.0648***	0.0597**	0.0619**
	(0.0218)	(0.0222)	(0.0225)	(0.0251)	(0.0258)	(0.0263)
Post × IQ Dummy	0.0945***	0.0913***	0.0919***	0.0884**	0.0875***	0.0883***
	(0.0319)	(0.0287)	(0.0297)	(0.0352)	(0.0313)	(0.0326)
Demographics				X	X	X
R^2	0.0121	0.0101	0.0101	0.0509	0.0463	0.0464
Nobs	5,850	5,850	5,850	4,070	4,070	4,070
	Panel B. Rate Increase: July 2003 – December 2006					
IQ Dummy	0.0789***	0.0811***	0.0806***	0.0358***	0.0411***	0.0407***
	(0.0108)	(0.0109)	(0.0108)	(0.0124)	(0.0127)	(0.0128)
Post	0.005	0.00464	0.00471	−0.0328**	−0.0308**	−0.0337**
	(0.0136)	(0.0130)	(0.0132)	(0.0155)	(0.0154)	(0.0157)
Post × IQ Dummy	−0.0753***	−0.0855***	−0.0833***	−0.0823***	−0.0939***	−0.0948***
	(0.0202)	(0.0233)	(0.0226)	(0.0218)	(0.0262)	(0.0256)
Demographics				X	X	X
R^2	0.007	0.0067	0.0067	0.0442	0.0465	0.0475
Nobs	8,601	8,601	8,601	5,937	5,937	5,937

Statistics in parentheses

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

Table 17: **Inflation Expectations and Readiness to Spend: by Perception error**

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 which equals 1 when a household replies that inflation will increase. Past inflation measures the household perception of the increase in consumer prices during the last twelve months. 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. Columns (1) and (2) condition on having an absolute perception error of current inflation below the median perception error, and columns (4) and (5) condition on having an absolute perception error of current inflation above the median perception error. The sample period is March 1995 to March 2015 for a total of 21 years.

	Abs Perception Error <= Median$_t$		**Abs Perception Error > Median$_t$**	
	Men high IQ	Men low IQ	Men high IQ	Men low IQ
	(1)	(2)	(3)	(4)
Inflation expectation	0.0472***	0.0209	0.0170	−0.0491**
	(0.0153)	(0.0165)	(0.0256)	(0.0216)
Past Inflation	−0.0830***	−0.0581***	−0.0651***	−0.0662***
	(0.0118)	(0.0097)	(0.0078)	(0.0078)
Demographics	X	X	X	X
Pseudo R^2	0.0104	0.0061	0.0118	0.0126
Nobs	10,115	8,984	6,491	7,272

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

Table 18: **Inflation Expectations and Readiness to Spend: by Forecast error**

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 which equals 1 when a household replies that inflation will increase. Past inflation measures the household perception of the increase in consumer prices during the last twelve months. 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. Columns (1) and (2) condition on having an absolute forecast error of current inflation below the median perception error, and columns (4) and (5) condition on having an absolute forecast error of current inflation above the median perception error. The sample period is March 1995 to March 2015 for a total of 21 years.

	Abs Forecast Error <= Median$_t$		**Abs Forecast Error > Median$_t$**	
	Men high IQ	Men low IQ	Men high IQ	Men low IQ
	(1)	(2)	(3)	(4)
Inflation expectation	0.0401**	0.0069	0.0326*	−0.0196
	(0.0184)	(0.0243)	(0.0174)	(0.0180)
Past Inflation	−0.0836***	−0.0636***	−0.0627***	−0.0610***
	(0.0102)	(0.0090)	(0.0086)	(0.0070)
Demographics	X	X	X	X
Pseudo R^2	0.0101	0.0083	0.0126	0.0111
Nobs	9,699	8,694	6,907	7,562

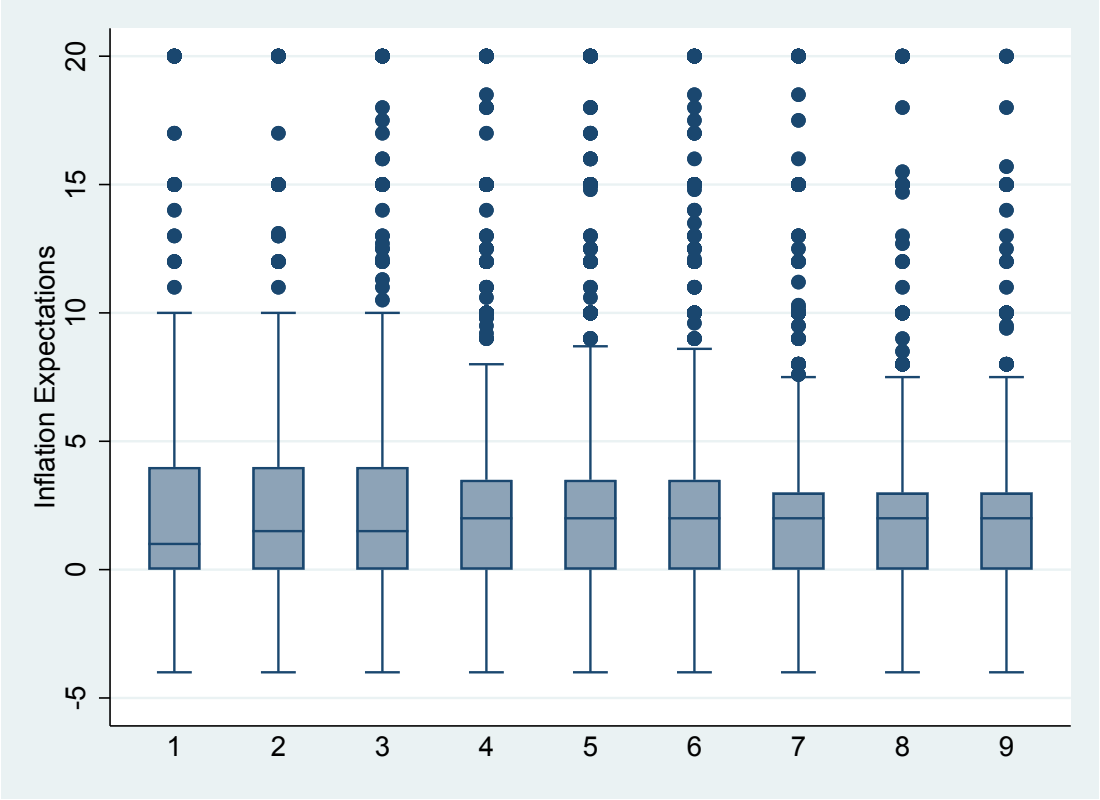
Standard errors in parentheses
$*p < 0.10, **p < 0.05, ***p < 0.01$

Online Appendix: Human Frictions to the Transmission of Economic Policy

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

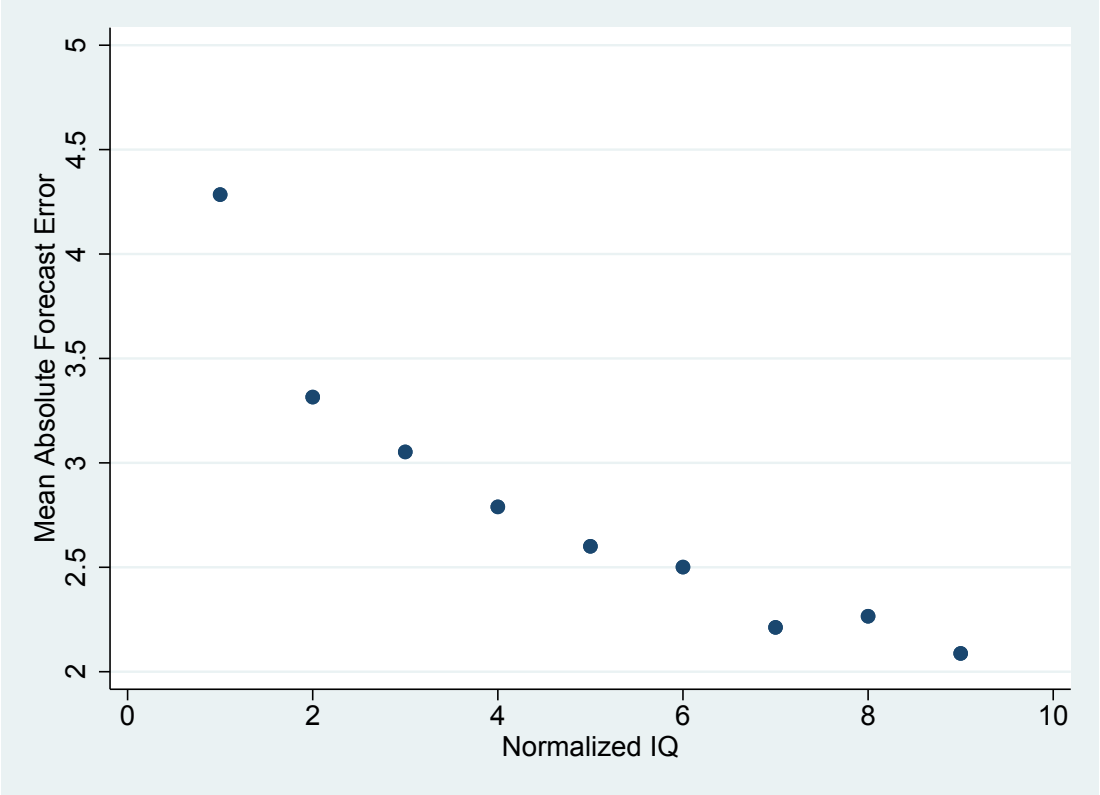
Not for Publication

Figure A.1: **Box Plot of Inflation Expectations by IQ**



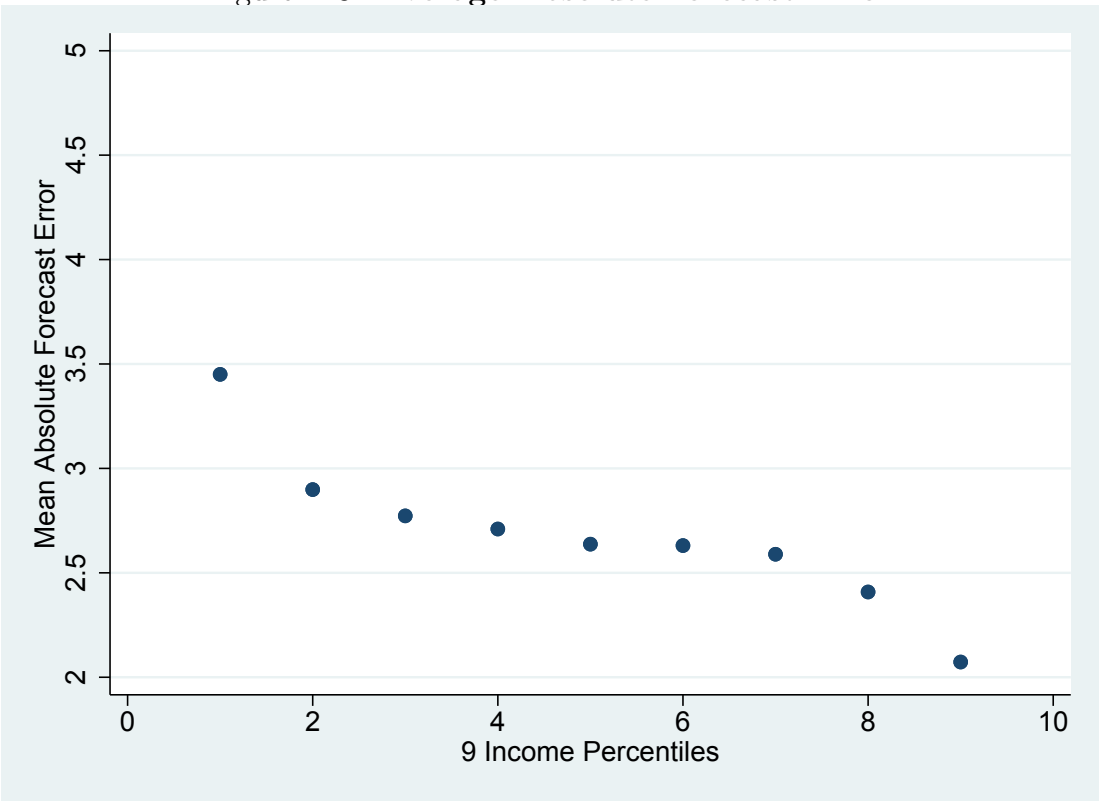
This figure plots box plot of inflation expectation by IQ for all men in Finland. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,200 households how consumer prices will evolve in the next twelve months. The sample period is January 2001 to March 2015 for a total of 15 years.

Figure A.2: **Average Absolute Forecast Error**



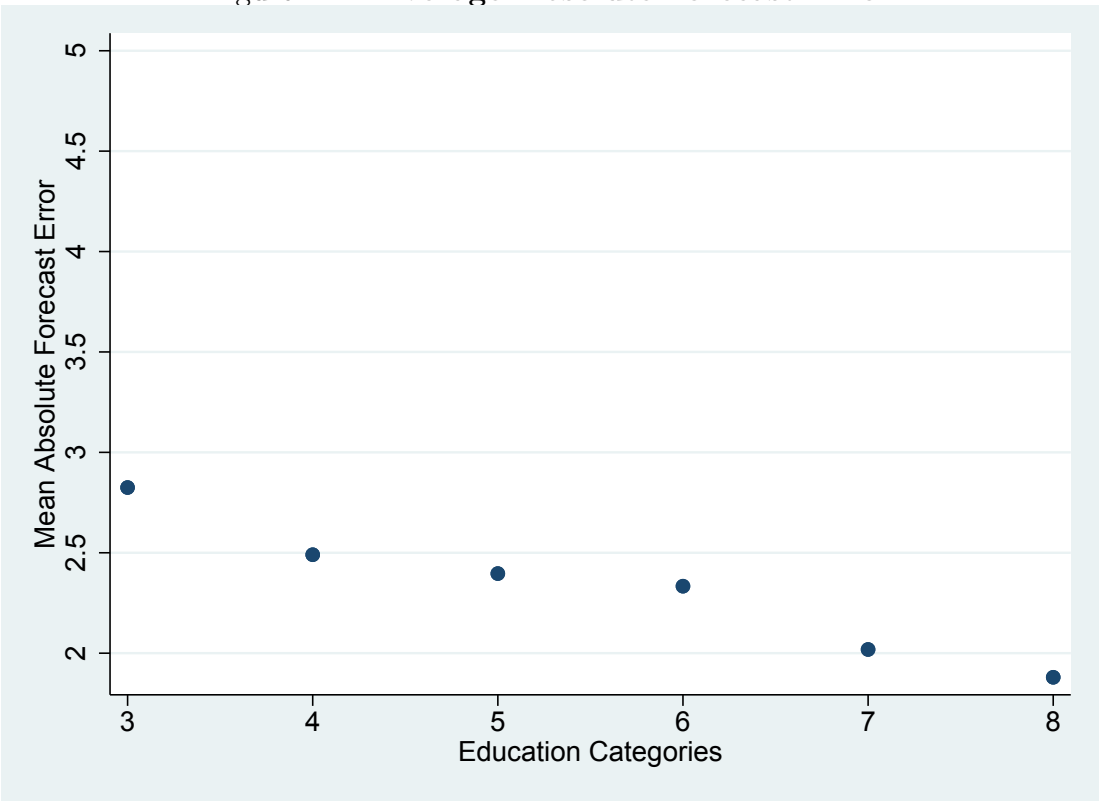
This figure plots the average absolute forecast error for inflation as a function of normalized IQ in Finland. We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,000 households how consumer prices will evolve in the next twelve months. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is March 1995 to March 2015 for a total of 21 years.

Figure A.3: **Average Absolute Forecast Error**



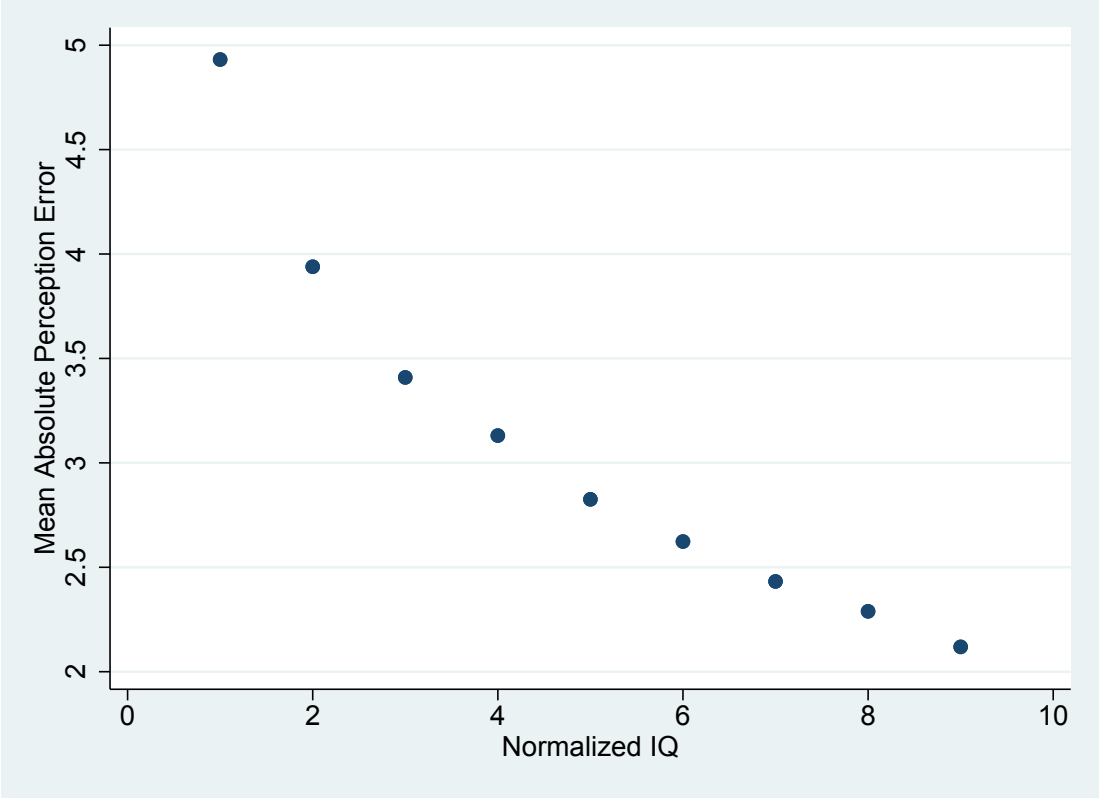
This figure plots the average absolute forecast error for inflation as a function of 9 income percentiles in Finland. We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,00 households how consumer prices will evolve in the next twelve months. The sample period is March 1995 to March 2015 for a total of 21 years.

Figure A.4: **Average Absolute Forecast Error**



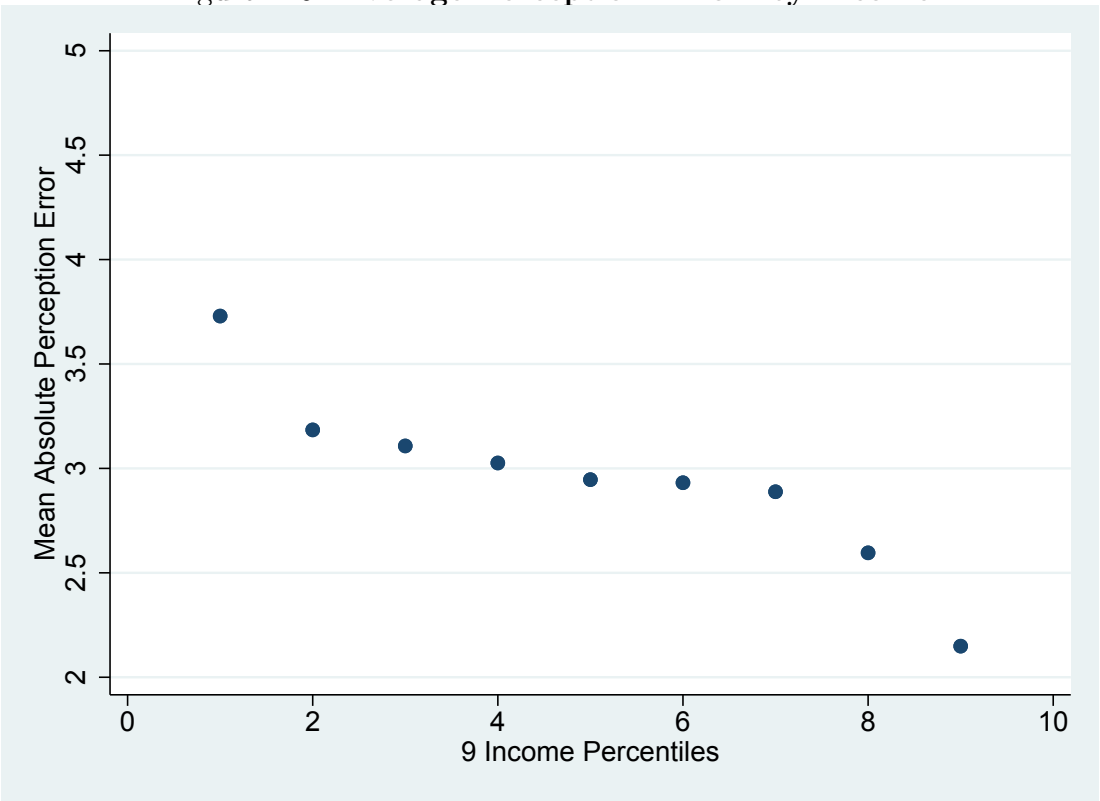
This figure plots the average absolute forecast error for inflation as a function of normalized IQ in Finland. We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,00 households how consumer prices will evolve in the next twelve months. Education dummies follow the International Standard Classification of Education. The sample period is March 1995 to March 2015 for a total of 21 years.

Figure A.5: **Average Absolute Perception Error**



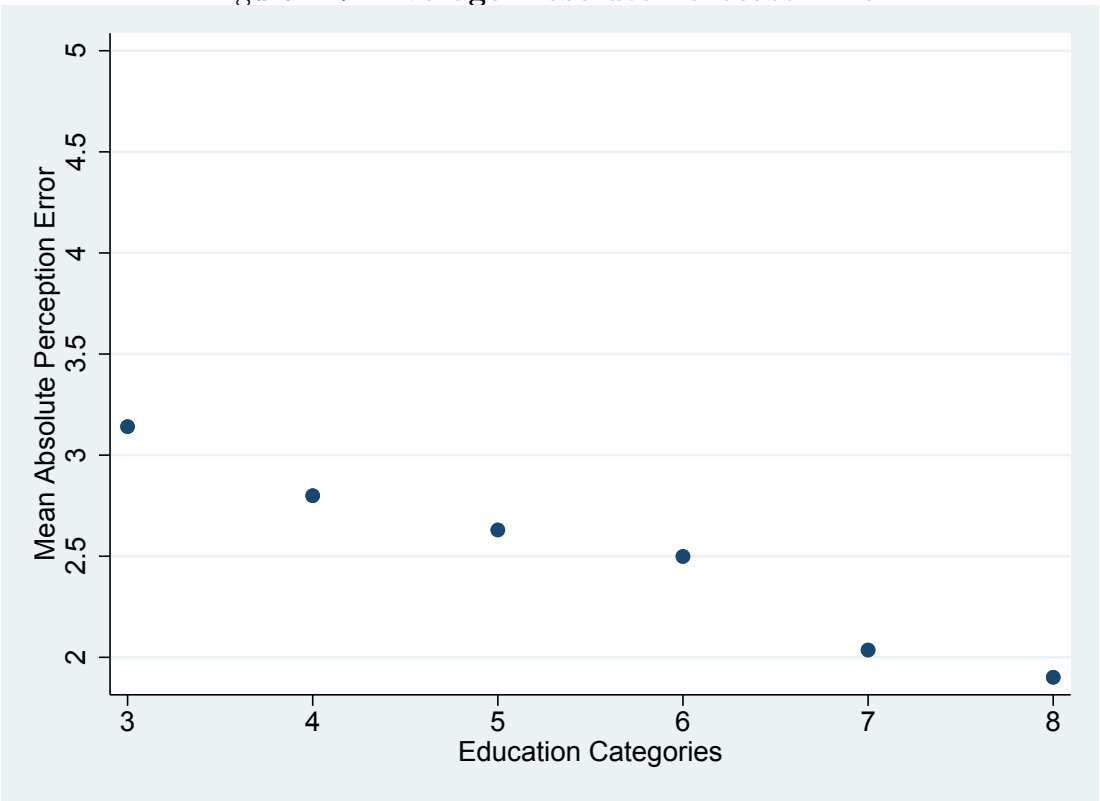
This figure plots the average absolute perception error for inflation as a function of normalized IQ in Finland. We define perception errors as differences between inflation perception and actual realized inflation. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,000 households how consumer prices will evolve in the next twelve months. We measure normalized IQ using data from the official military entrance exam in Finland. The sample period is March 1995 to March 2015 for a total of 21 years.

Figure A.6: **Average Perception Error: by Income**



This figure plots the absolute average perception error for inflation as a function of 9 income percentiles in Finland. We define perception errors as differences between inflation perceptions and current 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 1,00 households how consumer prices will evolve in the next twelve months. The sample period is March 1995 to March 2015 for a total of 21 years.

Figure A.7: **Average Absolute Forecast Error**



This figure plots the average absolute perception error for inflation as a function of normalized IQ in Finland. 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 1,00 households how consumer prices will evolve in the next twelve months. Education dummies follow the International Standard Classification of Education. The sample period is March 1995 to March 2015 for a total of 21 years.

Table A.1: **Change in the Propensity to Take out Loan to Rate changes: unconstrained**

This table reports the coefficient estimates from a difference-in-difference estimation of the propensity to take out a loan on normalized IQ, a dummy which equals 1 after 2001, the interaction term of the two, and household demographics. The propensity to take out a lot is a dummy which equals 1 if the respond answers it is a good time to take out a loan. 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. IQ dummy equals one if normalized IQ is larger than 5. All columns condition on having taxable income above the 25^{th} percentile of income in the cross section. The sample period is January 2001 to December 2002 for a total of 2 years.

	OLS	Probit	Logit	OLS	Probit	Logit
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. Rate Cut: Jan 2001 – June 2003					
IQ Dummy	0.0005	0.0004	0.0004	−0.0361	−0.0339	−0.0342
	(0.0319)	(0.0284)	(0.0299)	(0.0335)	(0.0299)	(0.0315)
Post	0.1002***	0.0936***	0.0951***	0.0753***	0.0685***	0.0708***
	(0.0238)	(0.0250)	(0.0253)	(0.0257)	(0.0265)	(0.0271)
Post × IQ Dummy	0.0663*	0.0693**	0.0688**	0.0789**	0.0805**	0.0808**
	(0.0348)	(0.0305)	(0.0319)	(0.0361)	(0.0317)	(0.0333)
Demographics				X	X	X
R^2	0.0179	0.0158	0.0158	0.0468	0.0439	0.0437
Nobs	4,422	4,422	4,422	3,804	3,804	3,804
	Panel B. Rate Increase: July 2003 – December 2006					
IQ Dummy	0.0676***	0.0731***	0.0720***	0.0363***	0.0427***	0.0415***
	(0.0116)	(0.0119)	(0.0117)	(0.0125)	(0.0129)	(0.0129)
Post	−0.0269*	−0.0247*	−0.0252*	−0.0396**	−0.0369**	−0.0398**
	(0.0147)	(0.0144)	(0.0147)	(0.0157)	(0.0156)	(0.0160)
Post × IQ Dummy	−0.0847***	−0.0997***	−0.0963***	−0.0858***	−0.0987***	−0.0986***
	(0.0216)	(0.0259)	(0.0250)	(0.0221)	(0.0268)	(0.0261)
Demographics				X	X	X
R^2	0.011	0.0115	0.0115	0.0433	0.0451	0.0459
Nobs	6,548	6,548	6,548	5,650	5,650	5,650

Statistics in parentheses

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

Table A.2: **Change in the Propensity to Take out Loan to Rate changes: outlook**

This table reports the coefficient estimates from a difference-in-difference estimation of the propensity to take out a loan on normalized IQ, a dummy which equals 1 after 2001, the interaction term of the two, and household demographics. The propensity to take out a lot is a dummy which equals 1 if the respond answers it is a good time to take out a loan. 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. IQ dummy equals one if normalized IQ is larger than 5. All columns control for individual expectations regarding personal income and aggregate GDP. The sample period is January 2001 to December 2002 for a total of 2 years.

	Rate Cut: 01/01 – 06/03			**Rate Increase: 07/03 – 12/06**		
	OLS	Probit	Logit	OLS	Probit	Logit
	(1)	(2)	(3)	(4)	(5)	(6)
IQ Dummy	−0.0505	−0.0453	−0.0457	0.0301**	0.0350***	0.0346***
	(0.0327)	(0.0296)	(0.0309)	(0.0123)	(0.0126)	(0.0127)
Post	0.0624**	0.0588**	0.0619**	−0.0293*	−0.0274*	−0.0299*
	(0.0254)	(0.0262)	(0.0267)	(0.0154)	(0.0152)	(0.0157)
Post × IQ Dummy	0.0864**	0.0840***	0.0847***	−0.0779***	−0.0886***	−0.0889***
	(0.0353)	(0.0315)	(0.0328)	(0.0217)	(0.0260)	(0.0255)
Demographics	X	X	X	X	X	X
R^2	0.0606	0.0556	0.0559	0.0586	0.0594	0.0601
Nobs	4,007	4,007	4,007	5,878	5,878	5,878

Statistics in parentheses

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