Human Frictions to the Transmission of Economic Policy*

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Abstract

Men who score high on standardized IQ tests display forecast errors for inflation that are 50% lower than forecast errors for other men in a representative sample of Finnish households. High-IQ men, but not others, have consistent inflation expectations over time and their inflation perceptions align with past expectations. Only high-IQ men increase their consumption propensity when expecting higher inflation in line with the consumption Euler equation. High-IQ men are also twice as sensitive to interest-rate changes when making borrowing decisions. Heterogeneity in education, income, or financial constraints do not explain these results. Limited cognitive abilities are thus *human frictions* to the transmission and effectiveness of economic policy and inform research on heterogeneous agents in macroeconomics and finance.

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

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I Introduction

Conventional monetary policy aims to stabilize the economy by changing interest rates and hence households' consumption expenditure through intertemporal substitution. Intertemporal substitution is also central to the effectiveness of unconventional monetary policy and conventional/unconventional fiscal policies.[1] Policies based on intertemporal substitution assume a deep understanding of economic incentives. For instance, in the case of forward guidance households should understand that keeping interest rates low until after the end of a liquidity trap will generate inflation, which should increase current inflation expectations and hence the propensity to consume. Empirically, intertemporal substitution is not as effective as representative-agent models imply (e.g., see McKay, Nakamura, and Steinsson (2016)).

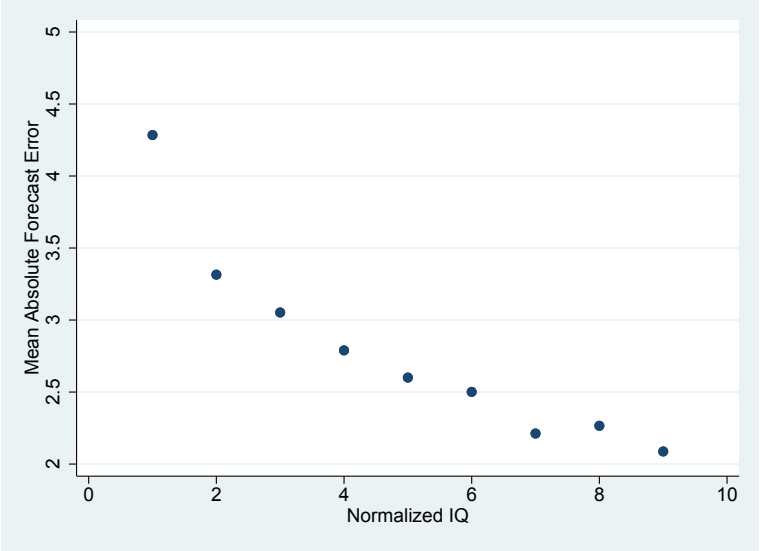
In this paper, we document that households' limited cognitive abilities are *human frictions* to the effectiveness of economic policy. Figure 1 plots the average absolute forecast error for inflation across bins by IQ-test scores for a representative sample of Finnish men. The average absolute forecast 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,

[1] See Eggertsson and Woodford (2003), Farhi and Werning (2016), Correia, Farhi, Nicolini, and Teles (2013), and D'Acunto, Hoang, and Weber (2018).

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. 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 March 1995 to March 2015.

with 9 being the highest). Regressing individual-level absolute forecast errors on a dummy 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 documenting the heterogeneity in the formation of macroeconomic beliefs across IQ levels, we assess the relationship between limited cognitive abilities and households' responsiveness to economic policy. 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 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 that low-IQ men are more likely to be financially constrained than high-IQ men, which might explain our baseline patterns. 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

[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.

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 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.

Our baseline analysis shows that men with low cognitive abilities display higher inflation forecast and perception errors and do not adjust their consumption plans in line with intertemporal substitution. But to what extent do these pattern matter for the transmission and effectiveness of economic policies? To tackle this question, we move on to test whether the relationship between individuals' propensity to borrow and changes in nominal interest rates varies systematically with individuals' cognitive abilities. Central banks commonly lower nominal interest rates to stimulate consumption through a credit channel and increase rates to avoid overheating. Our setting is an ideal laboratory, because the time period our data cover includes several policy interventions on nominal interest rates in opposite directions. The European Central Bank (ECB), which runs monetary policy for Finland since 2000, lowered their policy rate substantially during the stock-market turmoil of 2001 and 2002. They kept rates low until 2005 and started to increase rates subsequently.

The effective transmission of these monetary policy interventions through a household credit channel requires that households increase their demand for loans at times in which nominal rates drop and decrease their demand for loans at times in which nominal rates increase. Consistently, we find high-IQ men increase their propensity to take out loans when rates fall, maintain this propensity constant while interest rates do not move, and lower their propensity to borrow when interest rates rise. To the contrary, low-IQ men

appear to be insensitive to changes in monetary policy when asked about their propensity to borrow, irrespective of the direction of the rate change. These results hold for the full sample as well as if we limit the analysis to households that are unlikely to be financially constrained and if we condition on aggregate and individuals' own income and employment expectations. The fact that men with low cognitive abilities are barely sensitive to monetary policy interventions suggests human frictions might be an important impediment to the transmission of economic policy, because effective transmission requires that households react to changing incentives as predicted by the consumer Euler equation.

Whether low-IQ men represent a fraction of the population large enough to hinder the aggregate effectiveness of policy is an empirical question. In our setting, low-IQ men constitute more than 50% of the sample. More importantly, the share of income that accrues to men with low cognitive abilities is about 50% of the overall Finnish aggregate income. The non-response to policy changes by low-IQ men is thus material to explain the limited effectiveness of policy interventions central banks implement assuming full compliance by households.

Our findings would have relevant policy implications even if the fraction of income accruing to low-IQ men was smaller, because they underline a potential unintended redistributive role of monetary policy. Because low-IQ men do not adjust their plans based on inflation expectations and changes in interest rates, common monetary policy interventions might result in a redistribution of wealth from men with low cognitive abilities to men with high cognitive abilities. To the extent that cognitive abilities are largely innate or determined by environmental factors individuals could barely control in their early life,[3] this redistribution might be interpreted as a form of unintended yet unduly discrimination of economic agents on the part of economic institutions that implement policy interventions.

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

[3]For a review of the scholarly debate on the origins of cognitive abilities see, among others, Mc Gue et al. (1993) and Plomin and Spinath (2004).

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.

A large theoretical literature emphasizes the stabilization role of inflation expectations. On the monetary policy side, Krugman (1998), Eggertsson and Woodford (2003), Eggertsson (2006), and Werning (2012) argue that a central bank can stimulate current spending by committing to higher future inflation rates during periods in which the zero lower bound on nominal interest rates binds. On the fiscal policy side, Eggertsson (2011); Christiano, Eichenbaum, and Rebelo (2011); Woodford (2011); and Farhi and Werning (2015) show that inflation expectations can increase fiscal multipliers in standard New Keynesian models in times of a binding zero lower bound on nominal interest rates. We add to this literature showing that cognitive abilities explain substantial parts of the variation in forecast accuracy of inflation and contribute to determine whether individuals adjust their consumption plans to inflation expectations.

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.

Increasing the transparency of economic policies and facilitating the public's understanding of policy targets are two key aims of the recent monetary policy strategy of the United States. The heterogeneity of our findings across cognitive abilities, as well as the non-response of individuals with low cognitive abilities to policy changes, suggest that some individuals might not fully understand the aims of policy changes and interventions. Cognitive abilities might therefore result in unintended consequences such as the redistribution of resources from individuals with low IQ to individuals with higher

cognitive abilities, which calls for the design of salient policies (see D'Acunto, Malmendier, Ospina, and Weber (2017)).

Our findings also inform the literature on take up of economic programs. In the Great Recession, the U.S. administration initiated programs for underwater homeowners to refinance their mortgages, but the take-up rates were surprisingly low. Agarwal et al. (2017) study the effects and take-up rates of the 2009 Home Affordable Modification Program, which provided intermediaries with sizable financial incentives to renegotiate mortgages. They find a take-up rate of just one third of the overall target population of indebted U.S. households. Our findings suggest low cognitive abilities might help explain the limited effectiveness of these policies.

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. Expectations, Spending, and Borrowing Plans

Our main source of information on individual-level macroeconomic expectations and consumption and borrowing propensities are the confidential micro data underlying the Consumer 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

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

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 2000, the survey employs random samples that change completely from month to month. 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 8 *Given the current economic situation, do you think it's a good time to buy larger items such as furniture, electronic items, etc.?*

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

Question 3 *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 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 survey question 2 in our baseline analysis to disentangle the effects of inflation expectations from inflation perceptions:

Question 2 *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.

B. Cognitive Abilities Data

All Finnish men are required to participate in a mandatory military service. Prior to the induction into 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.

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.

Note that 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.

C. Income and Wealth Data from Tax Returns

We also have access to administrative income and wealth 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.

Figure A.1 of the Online Appendix provides further graphical evidence on the distribution of inflation expectations by IQ levels. Finnish men with low cognitive abilities have substantially more dispersed inflation expectations than men with high cognitive abilities, whereas the median inflation expectations are rather similar.

III Baseline Analysis

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 has real effects through intertemporal substitution. But unconventional monetary policy measures such as forward guidance as well as unconventional fiscal policies also aim to increase households' inflation expectations and stimulate consumption through intertemporal substitution (see Kaplan et al. (2018) and D'Acunto et al. (2018)).

Our baseline analysis focuses on two building blocks instrumental to test whether limited cognitive abilities hinder the transmission of economic policies. First, we aim to test 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. Second, we aim to test whether low-IQ and high-IQ individuals differ in the extent to which they update their consumption plans to changing inflation expectations. 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. Inflation Expectations and Realized Inflation: Forecast and Perception Error

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 forecast 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.

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 (5) display forecast errors that are more than 20% higher than individuals in the top stanine.

We repeat the analysis for an alternative definition of the average 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 2 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 2 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, Panel C of Table 2 suggests a positive association between IQ levels and taxable income, and the relationship appears to be

monotonically increasing in IQ. At the same time, Table 3 also shows that the correlation between IQ and income levels, despite being positive, is quite low (0.15). To address this concern directly, we 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 3, we split our sample in 9 equal-sized bins of taxable income and report the average forecast error 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 stanine, 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 3 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. Even in this case, we fail to detect any substantial negative association between education levels and average forecast error or average perception error, although the association is negative in this case.

To further address the concern that systematic variation in demographics might explain the sensitivity of forecast errors to IQ levels, we 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 stanine 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 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.

B. Inflation Expectations and Consumption Expenditure

Our analysis so far suggests that individuals with low cognitive abilities display larger inflation forecast errors compared to individuals with high cognitive abilities. A crucial question is whether such differences underline any heterogeneity in consumption responses

to changing inflation expectations. This step is necessary for cognitive abilities to have a role in individuals' responsiveness to economic and monetary policy interventions based on intertemporal substitution.

Our univariate analysis used survey-based numerical values of inflation expectations respondents report. A common concern with survey-based numerical values is that households often report implausibly high levels of expected inflation. Moreover, many individuals report expected inflation rates as multiples of 5 or other even values, and a general upward bias exists, which is typically larger for women than for men (e.g., see Binder (2015) and D'Acunto et al. (2017)). Figure 4 shows average inflation expectations across Finnish individuals are highly correlated with ex-post realized inflation, but we detect a general upward bias in inflation expectations even for the case of Finland. The upward bias seems especially high in periods of disinflation.

To avoid all the issues arising when using numerical inflation forecasts (see D'Acunto, Hoang, and Weber (2018) for a detailed discussion), we construct a measure of high inflation expectations based on survey respondents' qualitative expectations. This measure 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 5 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 5, 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 5, 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 consumer 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 5 suggest that men with high cognitive abilities, but not other men, adjust their consumption plans to changes in inflation expectations in line with the consumer Euler equation logic.

C. 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 consumer 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 6 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 6 report the same coefficients we estimate in columns (5) and (6) of Table 5 when using the overall IQ scores. In columns (3), (5), and (7) of Table 6, 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.

D. 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 7 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 wealth shock would 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 wealth effect at the household level.

Table 8 replicates our baseline analysis using individual income expectations. In columns (1)-(2) of Table 8, 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 wealth shocks do not adjust their consumption plans to inflation expectations. In columns (3)-(4) of Table 8, 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 consumer 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 8 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.

E. Consistency of Inflation Expectations and Perceptions

Our results so far exploited cross-sectional variation in cognitive abilities, inflation expectations, and consumption propensities 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. Table 9 investigates the consistency of inflation expectations by cognitive abilities. Columns

(1) and (2) show that past inflation expectations from 6 months before are statistically positively associated with current inflation expectations conditional on time-fixed effects, but the coefficient is substantially larger for high-IQ men. Columns (3) and (4) show the association between past inflation expectations and current expectations vanishes for low-IQ men when we condition on demographics, whereas the association is still large and significant for high-IQ men.

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 10 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.

IV Transmission of Economic Policies

In this section, we test whether the patterns of behavior of low-IQ men we have documented so far might be relevant to the transmission and hence effectiveness of economic policies.

Our data allow us to perform this test. From the survey, we observe respondents' propensity to borrow through bank loans. Moreover, the time period our survey covers includes several instances of large changes in short-term nominal interest rates by the ECB,

which runs the monetary policy of Finland since their entry in the Euro zone in 2000. Central banks often lower nominal interest rates in crisis times in the hope to stimulate consumption through a bank-credit channel. At the same time, central banks might increase nominal interest rates at times of sustained growth and inflationary pressure to avoid overheating, again through lower credit.

As we show in Panel A of Figure 5, our sample period includes variation in ECB policy rates in both directions. On May 31, 2001, the ECB lowered their deposit facility rate from 3.75% to 3.50% (left y-axis) and continued lowering the rate until they reached a bottom threshold of 1.00% on June 30, 2003. The cut was mainly driven by recessionary pressures in France and Germany. In times of low interest rates financing conditions become more favorable and individuals have an incentive to borrow more. In our setting, we can control directly for individual expectations regarding future income and employment status, which absorbs the effects of potentially concurrent recessionary pressures on Finnish households' willingness to borrow. Panel A of Figure 5 further documents that the ECB kept their facility rate stable from June 30, 2003 until June 30, 2005, when they started to tighten monetary policy and increased rates throughout 2006.

Before moving on to the multivariate analysis, we document the average response of the propensity to borrow by high-IQ men and low-IQ men around interest rate changes in the raw data. Individuals can answer now is a "very good time" (4), a "fairly good time" (3), a "fairly bad time" (2), or a "really bad time" (1) to the question "If you think about the general economic situation in Finland, then do you think that at this time:". Comparing Panel B and Panel C of Figure 5, we see that the average propensity to take out loans is about 2.5 for both groups of men at the beginning of the period. During the period 2001-2003, while the ECB decreases the facilty rate substantially, high-IQ men increase their propensity to borrow, with a peak at 3.1 exactly at the time when the facility rate reached its lowest point for the 6-year period we consider. During the same period, low-IQ men's propensity to borrow increases only slightly, peaking at 2.8 in January 2003. Overall, the increase in the propensity to borrow by high-IQ men (0.6) is 100% higher than the increase in the propensity to take out loans by low-IQ men (0.3).

The sudden increase in the ECB facility rate starting on June 30, 2005 allows us to assess whether the different sensitivity of high-IQ men and low-IQ men is also true when rates change in the opposite direction. Figure 5 reports this result. High-IQ men reduce their propensity to borrow from 3.1 at the end of June 2005 to 2.6 in the third quarter

of 2006. To the contrary, low-IQ men do not change their propensity to borrow over the same period, despite the substantially higher nominal interest rates. These results point to a difference in the sensitivity of the propensity to borrow to changes in nominal interest rates across men with different levels of cognitive abilities, with high-IQ men reacting more than low-IQ men.

To control for systematic heterogeneity across low-IQ men and high-IQ men not driven by cognitive abilities, as well as to assess the statistical significance of the differences in reaction to changing nominal interest rates, we perform the analysis in a multivariate setting. We estimate the marginal effects for estimating specifications of the following type:

$$Loan_{i,t} = \alpha + \beta IQ_{i,t} \times Post_t + \gamma Post_t + \zeta IQ_{i,t} + X'_{i.t}\delta + \eta_t + \epsilon_{i,t}, \tag{2}$$

where $Loan_{i,t}$ is a dummy variable that equals 1 if respondent i in month t thought it was a good time to take out a loan, and zero otherwise; $IQ_{i,t}$ is a dummy variable that equals 1 when the standardized IQ score of individual i was 6 or above; 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.

Panel A of Table 11 reports the results for estimating equation (2) for the period 2001-2003, during which the ECB cut their facility rate. Whether we absorb demographic characteristics or not and across all estimation methods, we find that (i) on average, all respondents are more likely to think it is a good time to borrow after the cut in interest rates, but (ii) the propensity to borrow increases substantially more for high-IQ men than for low-IQ men. High-IQ men increase their propensity to take out loans by more than 100% and up to 150% more than low-IQ men, as can be seen by comparing the estimated coefficients $\hat{\beta}$ to the estimated coefficients $\hat{\gamma}$ across all specifications.

Panel B of Table 11 reports the results for estimating equation (2) for the period 2003-2006, at the end of which the ECB increased the facility rate. Consistent with the conjecture that high-IQ men react more to changes in incentives from policy interventions, the estimated coefficients $\hat{\beta}$ are negative and statistically different from zero, that is, high-IQ men are substantially less likely than low-IQ men to claim it is a good time to take out a loan once nominal interest rates increase. Once we control for demographic

heterogeneity, high-IQ men are about 3 times less likely to claim it is a good time to take out a loan compared to low-IQ men and compared to the period before the interest-rate increase.

The differential sensitivity in the propensity to take out loan to nominal interest rate for men with high and low cognitive abilities both when interest rates decrease but also when interest rates increase makes it unlikely that financial constraints drive these results. Panel E of Table 2 shows that total debt to taxable income is almost constant across the IQ distribution. Note also the survey question asks respondents whether it is a good time to take out a loan in general, and not for their own households. Nevertheless, in the online appendix we address these concerns directly by estimating equation (2) separately for men in the top fraction of the distribution by income, which includes households that are less likely to face financial constraints. We also control directly for individual income expectations in the regressions. The results of these robustness tests, which we report in Table A.1 and Table A.2 of the Online Appendix, corroborate the view that differences in the reaction to policy changes across levels of cognitive abilities might be driven by a different ability to understand economic incentives and intertemporal substitution between high-IQ men and low-IQ men.

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 are 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 2 shows that low-IQ men have higher perception errors about contemporaneous inflation than high-IQ men. Panel B and Panel D of Table 3 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 12 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 5. 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 12, 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 13 we split our sample in two groups based on the size of the forecast error for future inflation. Columns (1)-(2) of Table 13 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 13), 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

We document a *human friction* to the transmission of economic policies – households' limited cognitive abilities. In a representative sample of Finnish men, we find that high-IQ men display: i) low forecast errors for inflation; ii) changes in consumption plans in line with the consumption Euler equation; iii) consistency between past inflation forecasts and current inflation expectations and perceptions and iv) strong sensitivity of the propensity to borrow to positive and negative interest-rate changes.

High-IQ men are twice as responsive in their propensity to borrow to interest rate changes compared to low-IQ men. Short-term interest rates are the conventional monetary policy tool of central banks and consumer credit a central propagation mechanism of interest rates to the real economy. Our findings suggest that cognitive abilities are indeed a *human friction* that can limit central banks' ability to stabilize demand both in recessions and expansions. This human friction might inform future theoretical and empirical advances in the recent literature on heterogeneous agents in economics and finance.

Macroeconomists often discard data on household inflation expectations because such data are noisy and sometimes extreme observations occur, which economists take as a sign the data are unreliable. To the contrart, the very fact that many policies rely on households reacting to higher inflation expectations makes understanding which households have plausible inflation expectations and which households understand the theoretical link between inflation expectations and consumption propensities crucial for policy effectiveness.

The results in this paper show that many households might ignore these fundamental assumptions of macroeconomic models and policy-making altogether. Thus, policy makers should design policies in a way that is salient and easy to understand for the whole population. Moreover, only by designing salient policies that guarantee widespread reaction policy makers can avoid unintended consequences of policies, such as a redistribution of financial resources from low-IQ men to high-IQ. An example of such

a salient type of policy is unconventional fiscal policy, such as the pre-announcement of future value-added tax increases (e.g., see D'Acunto, Hoang, and Weber (2018)).

More broadly, combining economic policies with limited cognitive abilities is likely to result in large redistributive effects from low-IQ individuals to high-IQ individuals, because only high-IQ individuals enjoy the benefits of changes in economic incentives set by policy interventions. This redistribution could be interpreted as a form of unduly discrimination of low-IQ individuals on the part of policy makers to the extent that cognitive abilities are an innate individual characteristic or are largely determined by early-life environmental factors individuals can barely control. Future empirical and theoretical research should delve into the unintended redistributive effects of economic policies based on individuals' cognitive abilities.

References

Agarwal, S., G. Amromin, I. Ben-David, S. Chomsisengphet, T. Piskorski, and A. Seru (2017). Policy intervention in debt renegotiation: Evidence from the home affordable modification program. *Journal of Political Economy 125*(3), 654–712.

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

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

Arioli, R., C. Bates, H. Dieden, I. Duca, R. Friz, C. Gayer, G. Kenny, A. Meyler, and I. Pavlova (2017). Eu consumers' quantitative inflation perceptions and expectations: An evaluation. Technical report, ECB Working Paper.

Attanasio, O. P. and G. Weber (1993). Consumption growth, the interest rate and aggregation. *The Review of Economic Studies 60*(3), 631–649.

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

Binder, C. (2015). Consumer inflation uncertainty and the macroeconomy: Evidence from a new micro-level measure. *Unpublished Manuscript, UC Berkeley*.

Burke, M. A. and A. Ozdagli (2014). Household inflation expectations and consumer spending: evidence from panel data. *Unpublished Manuscript, Federal Reserve Bank of Boston 13*(25), 1–43.

Christelis, D., D. Georgarakos, T. Jappelli, and M. van Rooij (2016). Trust in the central bank and inflation expectations. *Unpublished manuscript, ECB*.

Christiano, L., M. Eichenbaum, and S. Rebelo (2011). When is the government spending multiplier large? *Journal of Political Economy 119*(1), 78–121.

Coibion, O., Y. Gorodnichenko, and S. Kumar (2015). How do firms form their expectations? New survey evidence. Technical report, National Bureau of Economic Research.

Correia, I., E. Farhi, J. P. Nicolini, and P. Teles (2013). Unconventional fiscal policy at the zero bound. *American Economic Review 103*(4), 1172–1211.

D'Acunto, F., D. Hoang, and M. Weber (2018). The effect of unconventional fiscal policy on consumption expenditure.

D'Acunto, F., U. Malmendier, J. Ospina, and M. Weber (2017). Salient price changes, ination expectations, and household behavior. *Unpublished manuscript, University of Chicago Booth School of Business*.

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

Del Negro, M., M. P. Giannoni, and C. Patterson (2015). The forward guidance puzzle. *FRB of New York Staff Report* (574).

Dräger, L. and M. J. Lamla (2013). Anchoring of consumersï¿½ inflation expectations: Evidence from microdata. *Unpublished Manuscript, University of Hamburg*.

Eggertsson, G. B. (2006). The deflation bias and committing to being irresponsible. *Journal of Money, Credit and Banking 38*(2), 283–321.

Eggertsson, G. B. (2011). What fiscal policy is effective at zero interest rates? In *NBER Macroeconomics Annual 2010*, Volume 25, pp. 59–112. University of Chicago Press.

Eggertsson, G. B. and M. Woodford (2003). The zero bound on interest rates and optimal monetary policy. *Brookings Papers on Economic Activity 2003*(1), 139–211.

Farhi, E. and I. Werning (2015). Fiscal multipliers: Liquidity traps and currency unions. *Unpublished Manuscript, MIT*.

Farhi, E. and I. Werning (2016). Fiscal multipliers: Liquidity traps and currency unions. In *Handbook of Macroeconomics*, Volume 2, pp. 2417–2492. Elsevier.

Gabaix, X. (2018). A behavioral new keynesian model. *Unpublished Manuscript, Harvard University*.

Grinblatt, M., S. Ikäheimo, M. Keloharju, and S. Knüpfer (2015). Iq and mutual fund choice. *Management Science 62*(4), 924–944.

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

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

Ichiue, H. and S. Nishiguchi (2015). Inflation expectations and consumer spending at the zero bound: Micro evidence. *Economic Inquiry 53*(2), 1086–1107.

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

Kaplan, G., B. Moll, and G. L. Violante (2018). Monetary policy according to hank. *American Economic Review 108*(3), 697–743.

Kaplan, G., J. Weidner, and G. L. Violante (2014). The wealthy hand-to-mouth. *Brookings Papers on Economic Activity*.

Krugman, P. R. (1998). It's baaack: Japan's slump and the return of the liquidity trap. *Brookings Papers on Economic Activity 1998*(2), 137–205.

Malmendier, U. and S. Nagel (2009). Learning from inflation experiences. *Unpublished manuscript, UC Berkeley*.

Mc Gue, M., T. Bouchard, W. Iacono, and D. Lykken (1993). Behavioral genetics of cognitive ability: A life-span persepctive. *Unpublished manuscript*.

McKay, A., E. Nakamura, and J. Steinsson (2016). The power of forward guidance revisited. *American Economic Review 106*(10), 3133–58.

Plomin, R. and F. Spinath (2004). Intelligence: Genetics, Genes, and Genomics. *Journal of Personality and Social Pshychology 86*(1), 112.

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

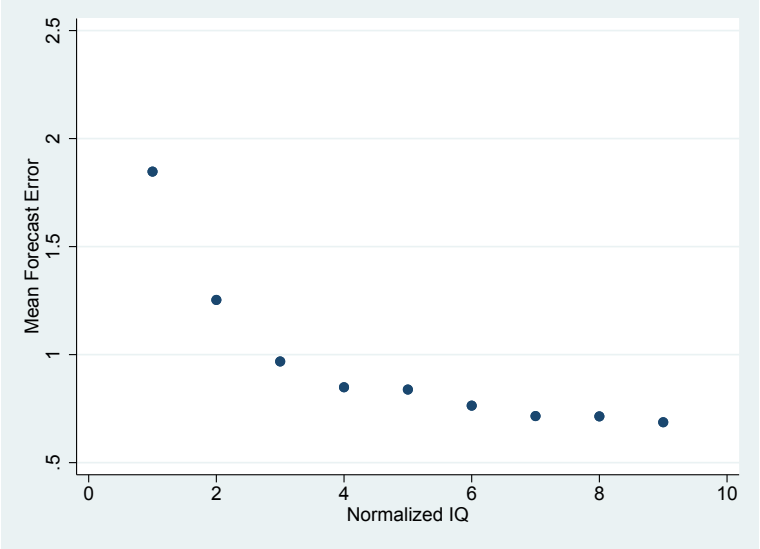
Werning, I. (2012). Managing a liquidity trap: Monetary and fiscal policy. *Unpublished Manuscript, MIT*.

Woodford, M. (2011). Simple analytics of the government expenditure multiplier. *American Economic Journal: Macroeconomics 3*(1), 1–35.

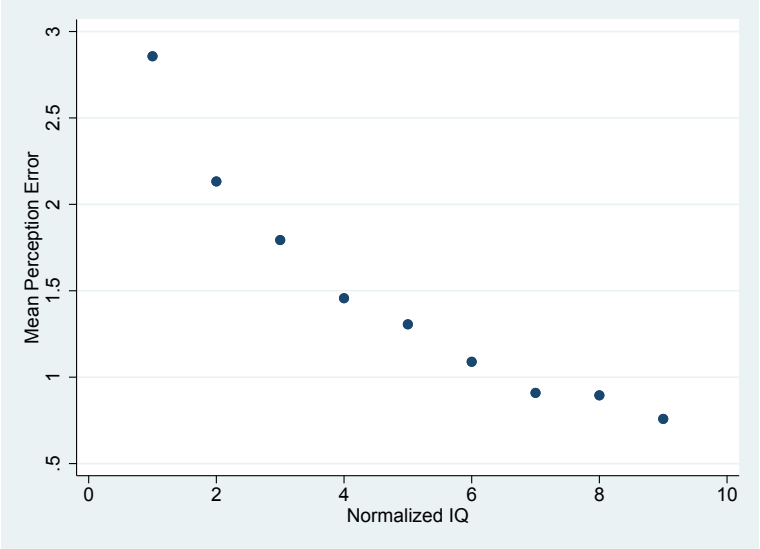
Woodford, M. (2018). Monetary policy analysis when planning horizons are finite. *NBER Macro Annual (forthcoming)*.

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

Panel A. Average Forecast Error by IQ



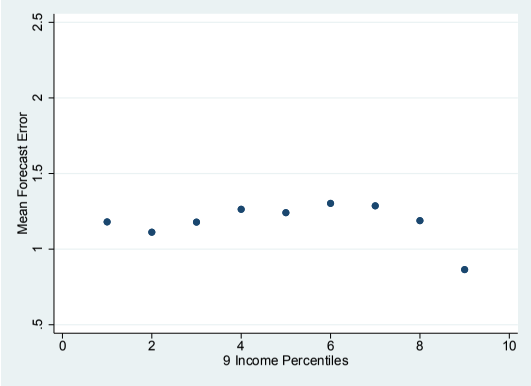
Panel B. Average Perception Error by IQ



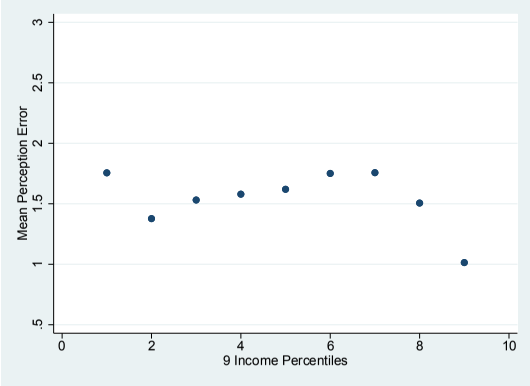
This figure plots the average forecast error (Panel A) and the average perception error (Panel B) for inflation as a function of normalized IQ in Finland. Forecast errors as differences between inflation expectations and ex-post realized inflation. Perception error is the difference between perceived 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 1,00 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 3: **Average Forecast and Perception Error by Income and Education Levels**

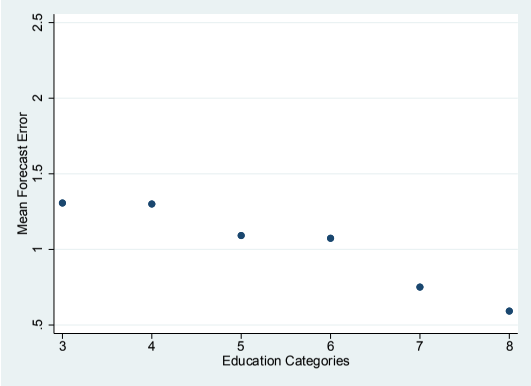
Panel A. Average Forecast Error by Income



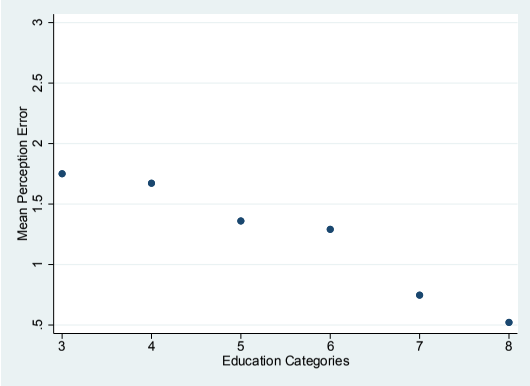
Panel B. Average Perception Error by Income



Panel C. Average Forecast Error by Education

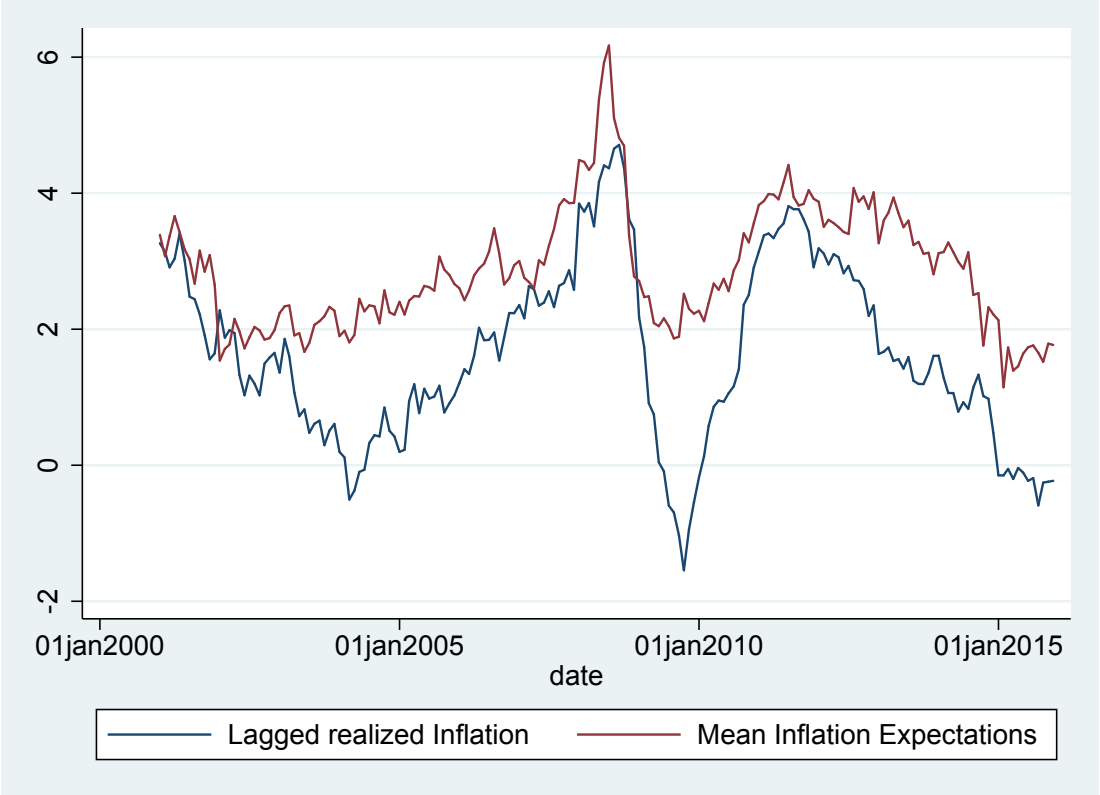


Panel D. Average Perception Error by Education



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

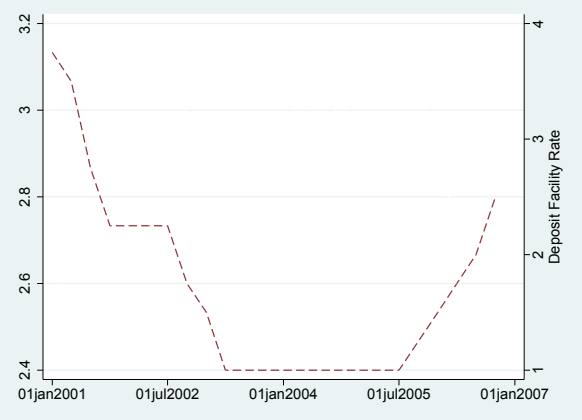
Figure 4: **Inflation Expectations and Ex-post realized Inflation**



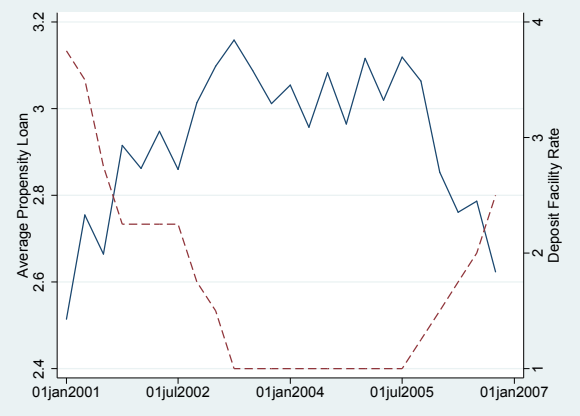
This figure plots average monthly inflation expectation (red line) and the ex-post realized inflation (blue line) in Finland. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,000 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 5: **ECB Deposit Facility Rate and Propensity to Borrow by IQ**

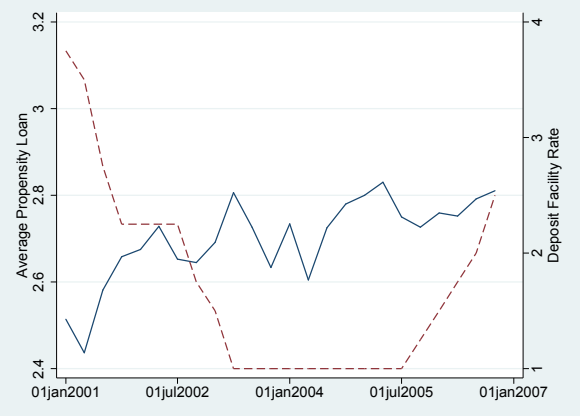
Panel A. ECB deposit facility rate (2001-2007)



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 for a total of 15 years.

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

	(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: **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 March 1995 to March 2015 for a total of 21 years.

				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 6: **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 7: **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 8: **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 9: **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 for a total of 5 years.

	high IQ	low IQ	high IQ	low IQ
	(1)	(2)	(3)	(4)
Past Inflation expectation	0.23***	0.045	0.23***	0.03
	(5.11)	(1.47)	(3.49)	(0.54)
Time fixed effects	X	X	X	X
Demographics			X	X
adj. R^2	0.02	0.00	0.01	0.00
Nobs	1,378	1,209	1,083	776

Standard errors in parentheses

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

Table 10: **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 11: **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 12: **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 13: **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

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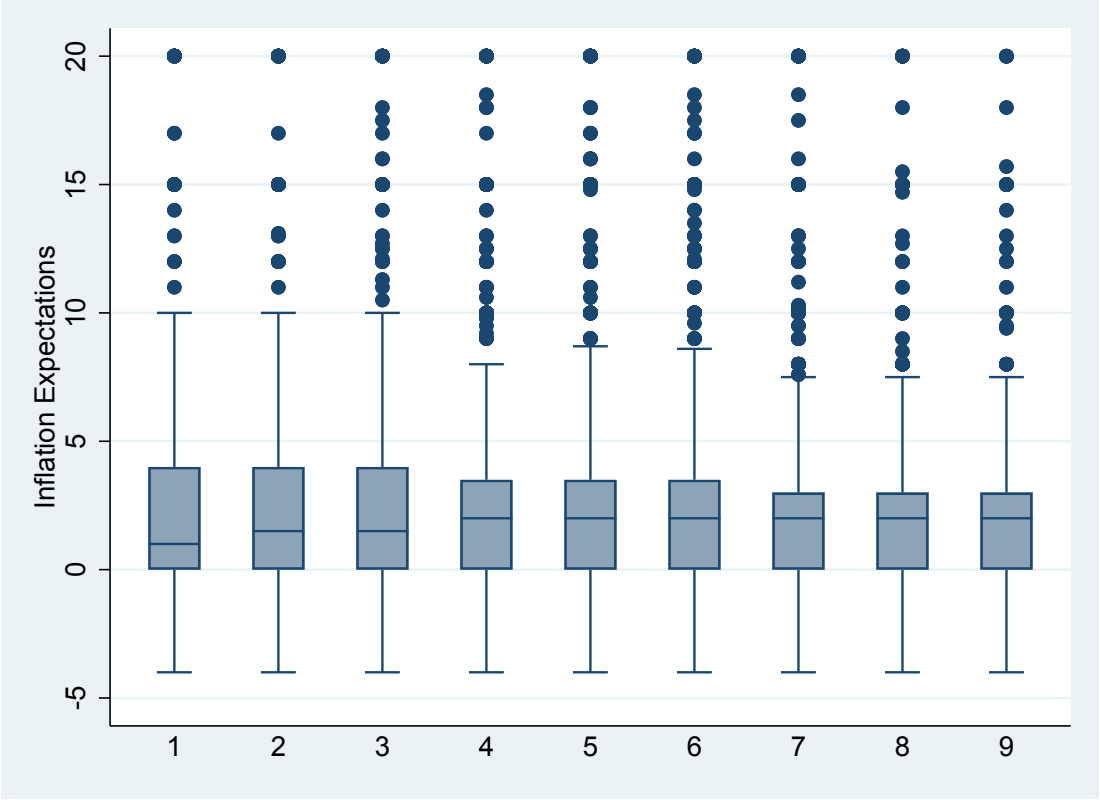
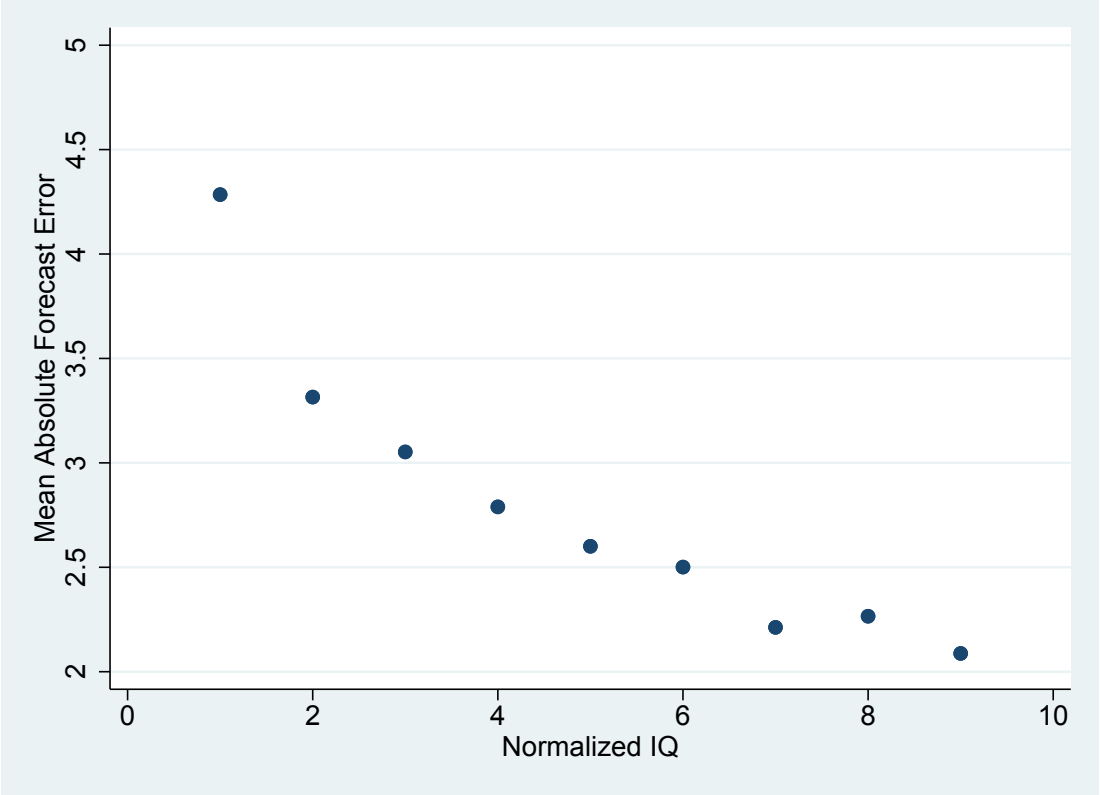
Not for Publication

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



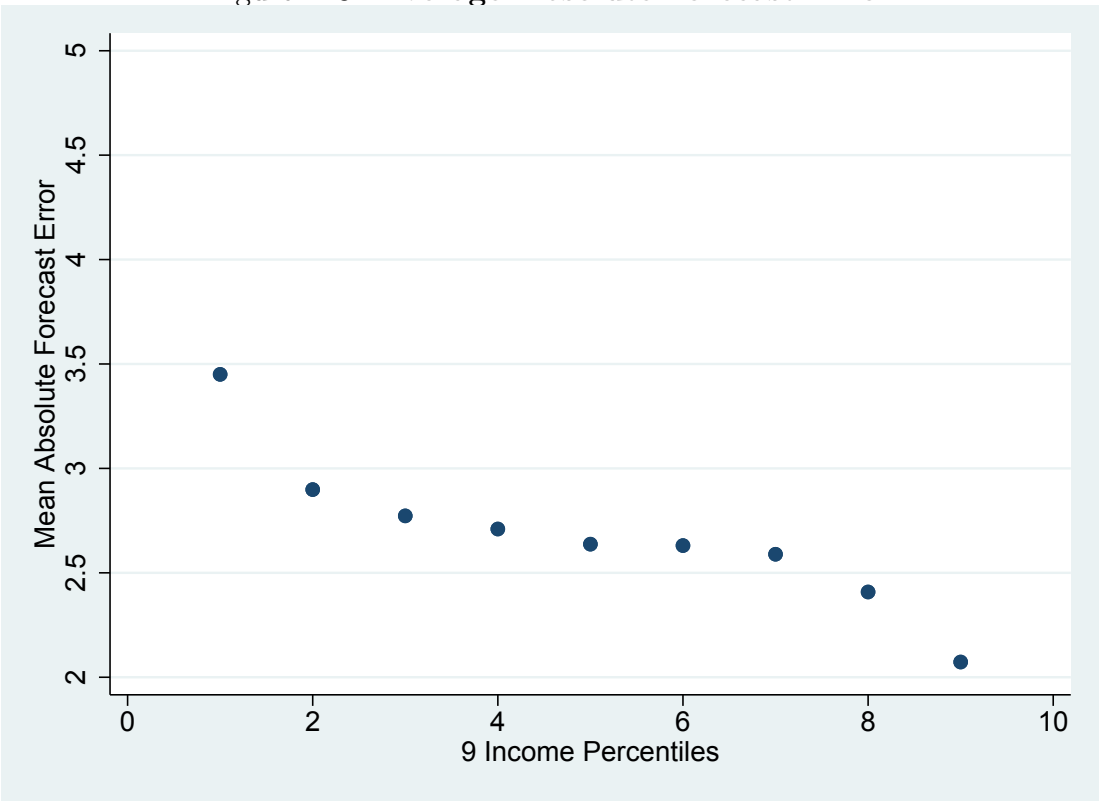
This figure plots box plot of inflation expectation by IQ for all men in Finland. We use the confidential micro data underlying the official European Commission consumer confidence survey to measure inflation expectations. Statistics Finland asks a representative sample of 1,200 households how consumer 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**



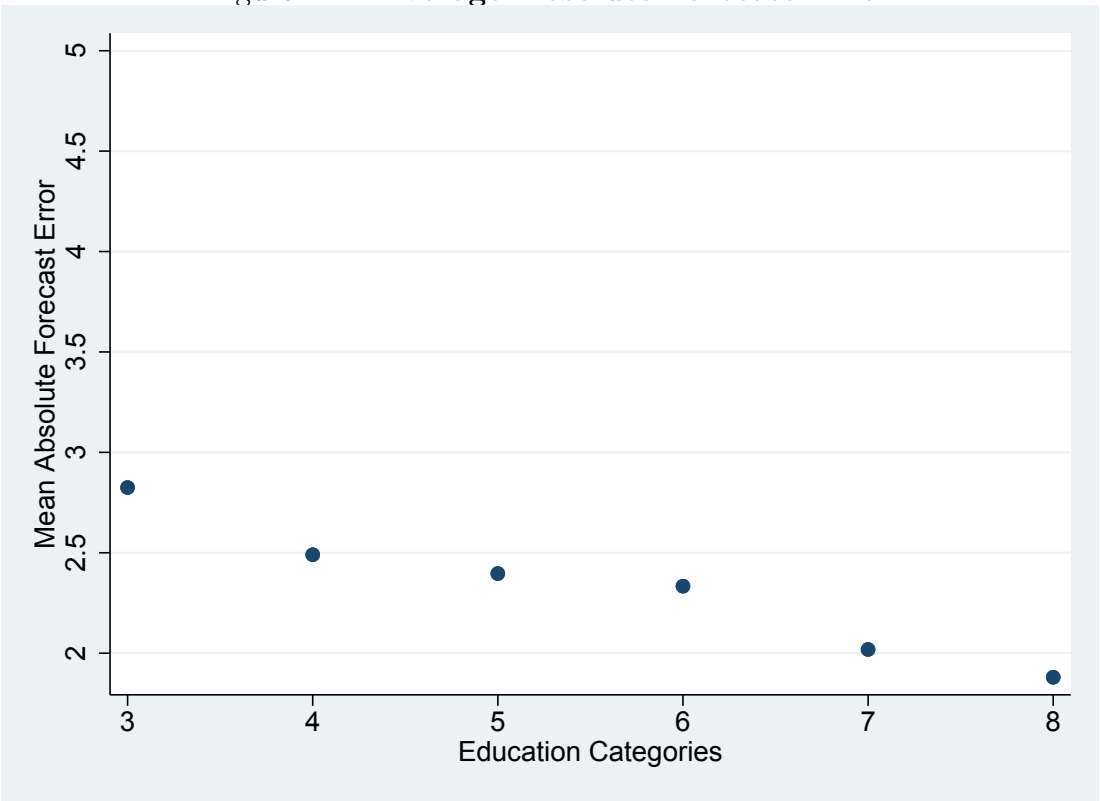
This figure plots the average absolute forecast error for inflation as a function of normalized IQ in Finland. We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission consumer 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**



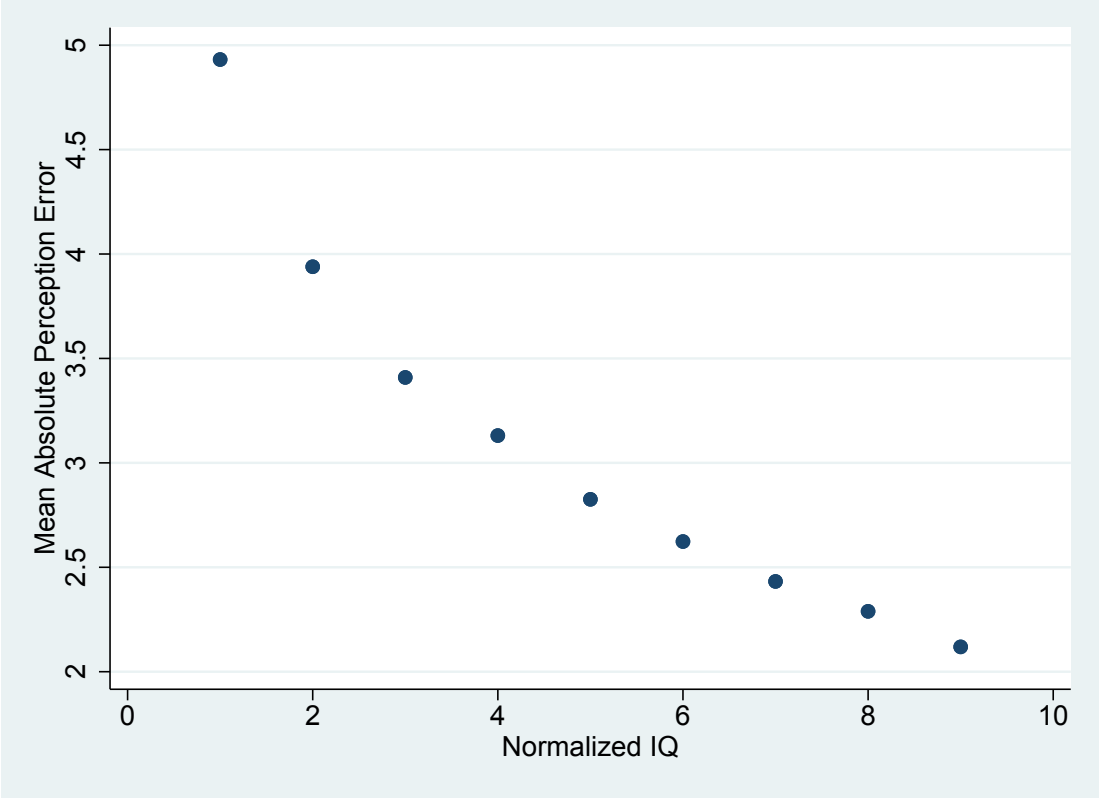
This figure plots the average absolute forecast error for inflation as a function of 9 income percentiles in Finland. We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission 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**



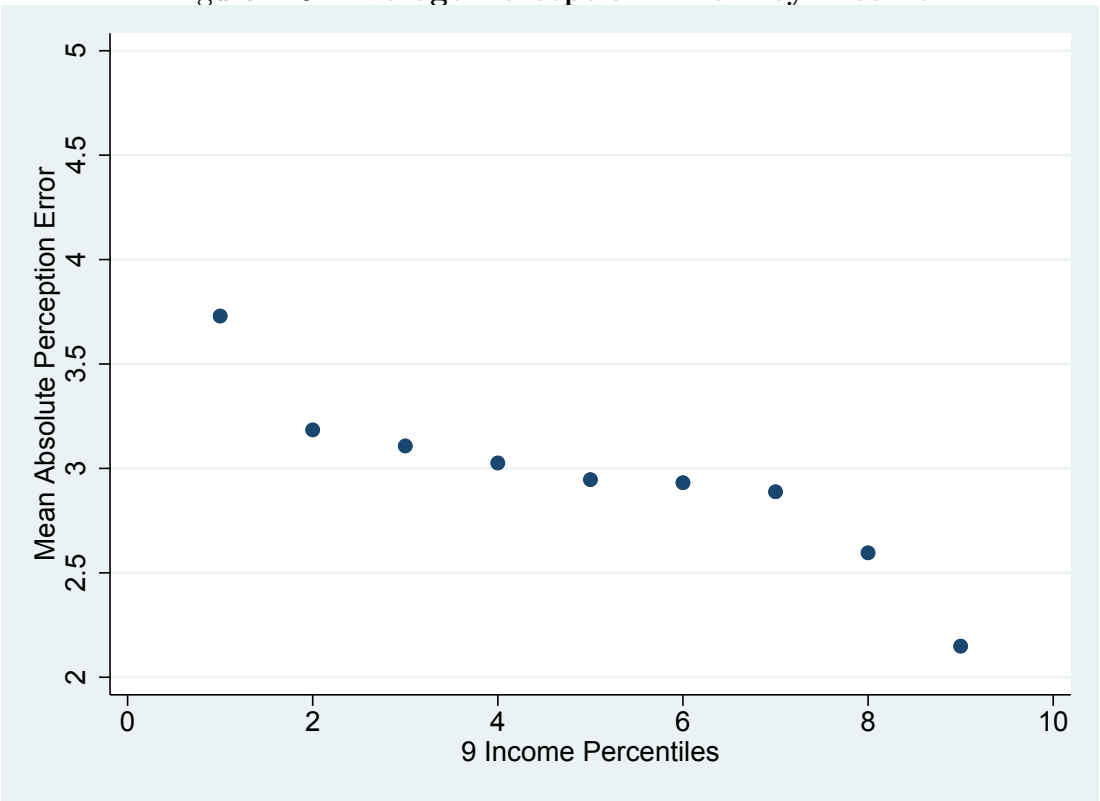
This figure plots the average absolute forecast error for inflation as a function of normalized IQ in Finland. We define forecast errors as differences between inflation expectations and ex-post realized inflation. We use the confidential micro data underlying the official European Commission consumer 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**



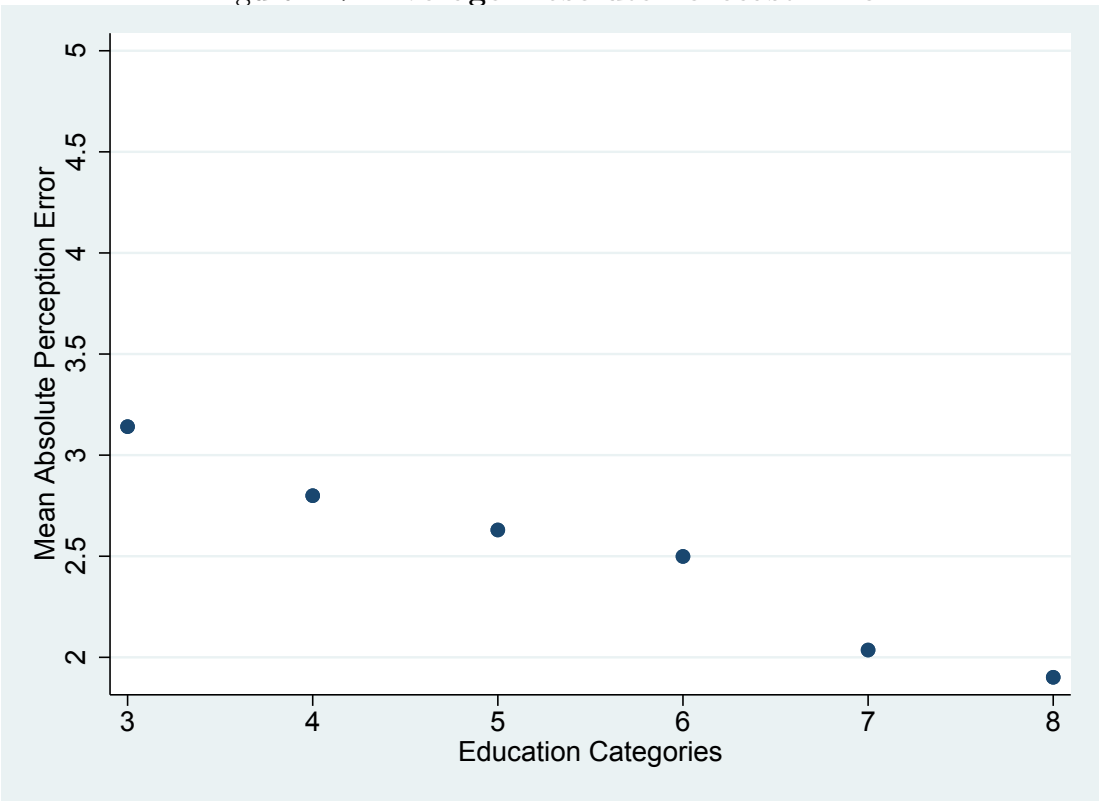
This figure plots the average absolute perception error for inflation as a function of normalized IQ in Finland. We define perception errors as differences between inflation perception and actual realized inflation. We use the confidential micro data underlying the official European Commission consumer 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

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