IQ, Expectations, and Choice

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Motivation

- **Policy assumes households understand economic incentives fully**
  - Forward guidance
    - Eggertsson & Woodford (2003)
  - Unconventional fiscal policies
    - D’Acunto, Hoang, & Weber (2018)
  - Conventional fiscal policies
    - Farhi & Werning (2017)

- **BUT** policies often less effective: e.g., *forward guidance puzzle*
  - Del Negro, Giannoni, & Patterson (2015)

- Recent theory literature: heterogeneous agents & uninsurable shocks
  - McKay, Nakamura, & Steinsson (2016); Kaplan, Moll, & Violante (2018); Hagedorn et al (2018)
Research Question

“[We assume] Unrealistic cognitive abilities of decision makers”

Woodford (2018)

- Large XS heterogeneity in cognitive abilities + complex policies
- (How much) Does limited cognition matter for policy effectiveness?
- Why might cognitive abilities matter?
  - Cognitive costs of gathering information about current state
  - Cognitive costs of forming expectations
  - Inability to optimize (intertemporally)
- Main empirical hurdles
  - Need to measure cognitive abilities for a representative sample
  - Need to measure impact on policy effectiveness
This Paper

- Measure IQ for all men in Finland from Finnish Military Forces
- Match with unique data on inflation and other expectations
- Link to tax records, observe households’ full balance sheets
- Use matched data to
  - Construct forecast errors for inflation by cognitive abilities
  - Estimate Euler equations
  - Measure $\Delta$ in propensity to take out loan to $\Delta$ interest rates
Men with low IQ: absolute forecast error for inflation of 4.5%

Decreases monotonically with IQ

Effect unrelated to income and education
Other Main Findings

- High IQ men
  - Adjust consumption plans more to inflation expectations
  - Both verbal and quantitative IQ matter
  - Perceptions of current inflation consistent with past expectations
  - Increase propensity to take out loan after cut in rates
  - Decrease propensity to take out loan after increase in rates

- Education, income, and “random” answering do not drive findings

Cognitive abilities important friction to the transmission of policy
Data Sources

- European harmonized survey on consumption climate (EU)
  - 1,500 representative Finnish individuals every month
  - Questions about aggregate and personal economic expectations
  - Sample period: March 1995–March 2015
  - Rich demographics (age, income, marital status, city size, kids, job)

- Military entrance test data (men) from Finnish Armed Forces

- Tax and other administrative data from Statistics Finland
Cognitive Ability Data

- Mandatory military service in Finland: Finnish Armed Forces (FAF)
- Around age 19, 120 questions to measure cognitive abilities
- FAF aggregates scores into a composite: IQ
- FAF standardizes IQ to follow a stanine distribution
  - 9 points to approximate normal
  - Lowest 4% of scores at least 1.75 std from mean: standardized IQ of 1
  - 4% with highest test scores: standardized IQ of 9
EU Survey: Purchasing Plans

Question 8

In view of the general economic situation, do you think that now it is the right moment for people to make major purchases such as furniture, electrical/ electronic devices, etc.?

Answer choices: “it is neither the right moment nor the wrong moment,” “no, it is not the right moment now,” or “yes, it is the right moment now.”
EU Survey: Inflation Expectations

Question 6

*By how many per cent do you expect consumer prices to go up/down in the next 12 months?*

Answer choices: Consumer prices will increase by XXX.X% / decrease by XXX.X%.
EU Survey: Macro Expectations

Question 22

When you think about the general economic situation in Finland, do you think it is ...?

Answer choices: “very bad time to borrow,” “pretty bad time to borrow,” “pretty good time to borrow,” or “very good time to borrow.”
Empirical Results

Inflation Expectations by IQ

<table>
<thead>
<tr>
<th>Low IQ</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>High IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.46</td>
<td>2.80</td>
<td>2.58</td>
<td>2.42</td>
<td>2.40</td>
<td>2.36</td>
<td>2.28</td>
<td>2.30</td>
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<tr>
<td>Std</td>
<td>8.70</td>
<td>5.93</td>
<td>5.52</td>
<td>4.66</td>
<td>4.66</td>
<td>4.16</td>
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<tr>
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<td>2,221</td>
<td>2,860</td>
<td>7,011</td>
<td>9,528</td>
<td>8,099</td>
<td>6,030</td>
<td>3,213</td>
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</table>

Low IQ men have

- Higher average inflation expectations
- Larger forecast dispersion
Forecast Error by IQ

- General upward bias in inflation expectations
- How informed are individuals about aggregate inflation?
- Measure forecast accuracy by forecast error
- Forecast error: predicted inflation minus ex-post realized inflation
- Measure average forecast error for all men by IQ
Empirical Results

Mean Absolute Forecast Error by IQ cont.

- Absolute forecast errors twice as large for low IQ men than for high IQ men
- Monotonic relationship btw absolute forecast error and IQ
Empirical Results

Mean Forecast Error by IQ cont.

- Similar pattern for average forecast error
- Monotonic relationship btw forecast error and IQ
Empirical Results

IQ versus Education

- IQ: innate cognitive abilities or education?
- Difference important for policy
- IQ measured at age of 19 before college
  - Homogeneous society and all education free
- Baseline results control for education
- Compare forecast errors by college and IQ
Empirical Results

Forecast Error by IQ

- Monotonic relationship btw forecast error and IQ
- Average forecast error 4 times larger for low IQ compared to high IQ men
Empirical Results

Forecast Error by Education

- Education dummies: International Standard Classification of Education
- No relationship between average forecast error and education
Empirical Results

Forecast Error by Income

- Taxable income: 9 income percentile dummies
- No relationship between average forecast error and income
Empirical Results

IQ, Rounding & Implausible Values

- Inflation difficult concept
- Individuals uncertain about answers
- Rounding to multiples of 5 as evidence of uncertainty
- Household survey show general upward bias in expectations
- During sample actual inflation hovered around 2%
- Are low IQ men more likely to report “implausible” values?
Empirical Results

IQ and Rounding

- Monotonic relationship btw fraction of rounders and IQ
- Fraction of rounder twice as large for low IQ compared to high IQ men
Empirical Results

IQ and Implausible Values

- Monotonic relationship btw fraction of respondends with large values and IQ
- Fraction almost 3 times larger for low IQ compared to high IQ men
Low Cognitive Abilities and Other Outcomes

- Concern: individuals w/ low cognitive abilities answer randomly
  - e.g., to finish fast

- Limit interpretation of cognitive abilities on effectiveness of policies

- Compare other outcomes for men with low and high cognitive abilities
  - Question on how evaluate current economic condition in Finland by IQ
Empirical Results

Current Situation in Finland by IQ

- Averages for low and high IQ virtually indistinguishable
- Alleviates concerns men with low cognitive abilities answer randomly
Past Expectations and Current Perceptions

- Rational expectations (RE) $\rightarrow$ corr(past expectation, perception) $> 0$

- Rotating panel from 1995 until 1999

- Three times with 6-month lag

- Regress perception of current inflation on past expectations
## Past Expectations and Current Perceptions cont.

<table>
<thead>
<tr>
<th></th>
<th>high IQ</th>
<th>low IQ</th>
<th>high IQ</th>
<th>low IQ</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
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<tr>
<td>Past Inflation expectation</td>
<td>0.23***</td>
<td>0.045</td>
<td>0.23***</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(5.11)</td>
<td>(1.47)</td>
<td>(3.49)</td>
<td>(0.54)</td>
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<tr>
<td>Time fixed effects</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>adj. R²</td>
<td>0.02</td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>Nobs</td>
<td>1,378</td>
<td>1,209</td>
<td>1,083</td>
<td>776</td>
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</tbody>
</table>

Standard errors in parentheses

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

- **Strong association** for men with high IQ
- **No association** for men with low IQ conditional on demographics
Past Expectations and Current Expectations

- Realized inflation highly persistent

- $\text{RE} \rightarrow \text{corr(past expectation, current expectation)} > 0$

- Regress current inflation expectations on past expectations
### Empirical Results

**Past Expectations and Current Expectations cont.**

<table>
<thead>
<tr>
<th></th>
<th>high IQ</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Past Inflation expectation (6m)</td>
<td>0.28***</td>
<td>0.03</td>
<td>0.28***</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(5.33)</td>
<td>(1.00)</td>
<td>(2.38)</td>
<td>(1.21)</td>
</tr>
<tr>
<td>Past Inflation expectation (12m)</td>
<td>0.26***</td>
<td>0.03</td>
<td>0.26***</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(2.38)</td>
<td>(1.21)</td>
<td>(2.38)</td>
<td>(1.21)</td>
</tr>
<tr>
<td>Time fixed effects</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>0.00</td>
</tr>
<tr>
<td>Nobs</td>
<td>1,368</td>
<td>1,192</td>
<td>563</td>
<td>482</td>
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</table>

Standard errors in parentheses

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

- **Strong association** for men with high IQ both for 6 and 12 months ago expectations
- **Weak association** for men with low IQ
- Results only true during periods of persistent inflation
Inflation Expectations and Purchasing Propensities

- Men with low cognitive abilities have larger forecast errors
- But do they still substitute intertemporally (Euler equation)?
- i.e., do consumption plans respond to changing inflation expectations?
- Relate inflation expectations to propensity to buy durables by IQ
Baseline Specification: Multinomial Logit

- Assume survey answer is random variable $y$

- Define the response probabilities as $P(y = t|X)$

- Assume the distribution of the response probabilities is

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

- Estimate $\beta_t$ via maximum likelihood

- Marginal effect: derivative of $P(y = t|x)$ with respect to $x$

- Empirically: define “it’s neither good nor bad time” as baseline
## Euler Equations

Marginal Effects:

\[
\frac{\partial P(y = t|x)}{\partial x} = P(y = t|x) \left[ \beta_{tx} - \sum_{z=0,1,2} P(y = z|x) \beta_{zx} \right]
\]

<table>
<thead>
<tr>
<th></th>
<th>Men with IQ data</th>
<th>Men high IQ</th>
<th>Men low IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(1)</strong></td>
<td></td>
<td></td>
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<td><strong>(2)</strong></td>
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<td><strong>(4)</strong></td>
<td></td>
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Inflation expectation

Demographics

Pseudo $R^2$

Nobs

Standard errors in parentheses

$^* p < 0.10, ^{**} p < 0.05, ^{***} p < 0.01$

- LHS: Answer for good time to buy
- RHS: Dummy for inflation increase
- Demo: age, age2, male, single, log income, unemployed, kids, urban, helsinki, college
Euler Equations cont.

Marginal Effects:

$$\frac{\partial P(y = t|x)}{\partial x} = P(y = t|x) \left[ \beta_{tx} - \sum_{z=0,1,2} P(y = z|x)\beta_{zx} \right]$$

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<tr>
<td>Inflation expectation</td>
<td>0.0214***</td>
<td>0.0147</td>
<td>0.0358***</td>
</tr>
<tr>
<td></td>
<td>(0.0047)</td>
<td>(0.0100)</td>
<td>(0.0119)</td>
</tr>
<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.0067</td>
<td>0.0107</td>
<td>0.0108</td>
</tr>
<tr>
<td>Nobs</td>
<td>311,164</td>
<td>32,862</td>
<td>16,606</td>
</tr>
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</table>

Standard errors in parentheses

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

All Finns: Higher inflation → 2% more likely to answer “good time to purchase durables”
Euler Equations cont.

Marginal Effects: \[
\frac{\partial P(y = t|x)}{\partial x} = P(y = t|x) \left[ \beta_{tx} - \sum_{z=0,1,2} P(y = z|x) \beta_{zx} \right]
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Standard errors in parentheses
*p < 0.10, ** p < 0.05, ***p < 0.01

Finnish men with IQ data: **no association** btw inflation expectations and purchasing propensities
Euler Equations cont.

Marginal Effects:

\[
\frac{\partial P(y = t|x)}{\partial x} = P(y = t|x) \left[ \beta_{tx} - \sum_{z=0,1,2} P(y = z|x) \beta_{zx} \right]
\]

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<th>Men low IQ</th>
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</thead>
<tbody>
<tr>
<td>(1)</td>
<td>0.0214***</td>
<td>0.0147</td>
<td>0.0358***</td>
</tr>
<tr>
<td>(0.0047)</td>
<td>(0.0100)</td>
<td>(0.0119)</td>
<td>(0.0138)</td>
</tr>
</tbody>
</table>

Demographics

|                | X                | X            | X           | X           |
|----------------|------------------|--------------|-------------|
| Pseudo R²      | 0.0067           | 0.0107       | 0.0108      | 0.0091      |
| Nobs           | 311,164          | 32,862       | 16,606      | 16,256      |

Standard errors in parentheses

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

- **Strong association** for men with high IQ
- **No association** for men with low IQ
Empirical Results

Euler Equations: Financial Constraints

- Low IQ men do not adjust consumption plans to inflation expectations
- Maybe low IQ men hand to mouth, constrained?
- Limit sample to individuals unlikely to be constrained
- Focus on men with income above threshold: 25th or 50th percentile
Euler Equations: Financial Constraints cont.

\[ \frac{\partial P(y = t|x)}{\partial x} = P(y = t|x) \left[ \beta_{tx} - \sum_{z=0,1,2} P(y = z|x) \beta_{zx} \right] \]

<table>
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<tr>
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<th>Income $&gt; 50^{th}$ percentile(_t)</th>
<th>Income $&gt; 25^{th}$ percentile(_t)</th>
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<tr>
<td></td>
<td>Men high IQ</td>
<td>Men low IQ</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Inflation expectation</td>
<td>0.0306**</td>
<td>0.0022</td>
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<tr>
<td></td>
<td>(0.0154)</td>
<td>(0.0195)</td>
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<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pseudo R(^2)</td>
<td>0.0127</td>
<td>0.0121</td>
</tr>
<tr>
<td>Nobs</td>
<td>10,723</td>
<td>9,514</td>
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Standard errors in parentheses

\*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01

- **Strong association** for men with high IQ
- **No association** for men with low IQ
Empirical Results

Euler Equations vs Income Expectations

- Inflation expectations possibly correlated with income expectations
  - Phillips curve
  - Indirect effects of monetary policy (Kaplan, Moll, & Violante (2018))

- Split sample by personal economic outlook
  - Answer to “Do you think your household’s income will increase?”
Euler Equations vs Income Expectations cont.

Marginal Effects: \[
\frac{\partial P(y = t|x)}{\partial x} = P(y = t|x) \left[ \beta_{tx} - \sum_{z=0,1,2} P(y = z|x)\beta_{zx} \right]
\]

<table>
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<tr>
<th></th>
<th>High Income Expectations</th>
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<th>Low Income Expectations</th>
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<tr>
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<td>Men low IQ</td>
<td>Men high IQ</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Inflation expectation</td>
<td>0.0294∗</td>
<td>−0.0166</td>
<td>0.0371∗∗</td>
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<tr>
<td></td>
<td>(0.0165)</td>
<td>(0.0190)</td>
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<td>X</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>0.0115</td>
<td>0.0083</td>
<td>0.0106</td>
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<tr>
<td>Nobs</td>
<td>7,337</td>
<td>6,409</td>
<td>9,269</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

∗p < 0.10, ∗∗p < 0.05, ∗∗∗p < 0.01

- **Strong association** for men with high IQ
- **No association** for men with low IQ
Subcategories of Cognitive Abilities

- FAF test: 120 questions in 3 categories: logic, reading, & arithmetic
- Correlations between subcategories: 56% to 66%
- Estimate Euler equations by subcategory of cognitive abilities
- Results almost identical to ones for overall IQ
Transmission of Policy

- Low cognitive abilities
  - Larger forecast errors for inflation
  - Don’t adjust consumption to inflation expectations
- Do patterns matter for the effectiveness of economic policy?
Transmission of Policy cont.

- Study propensity to take out a loan to changing interest rates
- May 2001: ECB lowers policy rate from 3.75% to 3.50%
- Trough of 1.00% in June 30, 2003
- Recessions in large countries such as France and Germany drive cuts
- Independent of the origin, low rates $\rightarrow$ more favorable financing
Transmission of Policy cont.

- Dec 2005: rates start increasing again
- Dec 2006: deposit facility rate at 2.50%
- Study propensity to take out loan by IQ
- Both for increase and decrease in rates
- Allows to differentiate from borrowing contraits
- Also: in general good time to take out loan
Deposit Facility Rate: Beginning of Quarter

- Till end 2001: rate falls from 3.75% to 2.25%
- Trough of 1% in June 2003
- December 2005 rates start increasing; 2.5% end of 2006
Empirical Results

Propensity to take out Loan: High IQ

- Early 2001: average propensity to take out loans of around 2.5
- Next 2.5 years: rates fall and propensities increase to more than 3
- Till mid 2005: rates and propensities flat
- Afterwards: rates increase, propensities fall
Early 2001: average propensity to take out loans of around 2.6

Next 6 years: propensities hover around 2.8
Transmission of Policy cont.

- $\Delta$ propensity taking out loan by IQ for decreasing & increasing rates
- Population w low cognitive abilities doesn’t react to incentives
- Policies less effective than representative agent models predict?
- But: other differences across high and low IQ men might drive effect
- Estimate regressions controlling for characteristics
Decreasing Rates

- Focus on sample Jan 2001 to June 2003

\[ \text{Loan}_{i,t} = \text{cons} + \beta_1 \text{High IQ}_i + \beta_2 \text{Post}_t + \beta_3 \text{High IQ}_i \times \text{Post}_t \]

- Loan: dummy 1 if says good time to take out loan
- High IQ: dummy 1 if normalized IQ is larger than 5
- Post: dummy 1 if after May 2001
### Decreasing Rates cont.

<table>
<thead>
<tr>
<th></th>
<th>OLS (1)</th>
<th>Logit (2)</th>
<th>Probit (3)</th>
<th>OLS (4)</th>
<th>Logit (5)</th>
<th>Probit (6)</th>
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<tbody>
<tr>
<td>High IQ</td>
<td>-0.028</td>
<td>-0.0241</td>
<td>-0.0248</td>
<td>-0.048</td>
<td>-0.0445</td>
<td>-0.0448</td>
</tr>
<tr>
<td></td>
<td>(-0.95)</td>
<td>(-0.88)</td>
<td>(-0.88)</td>
<td>(-1.48)</td>
<td>(-1.51)</td>
<td>(-1.45)</td>
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<tr>
<td>Post</td>
<td>0.062***</td>
<td>0.059***</td>
<td>0.060***</td>
<td>0.065***</td>
<td>0.060**</td>
<td>0.062**</td>
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<td>(2.84)</td>
<td>(2.66)</td>
<td>(2.65)</td>
<td>(2.58)</td>
<td>(2.31)</td>
<td>(2.35)</td>
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<tr>
<td>Post × High IQ</td>
<td>0.095***</td>
<td>0.091***</td>
<td>0.092***</td>
<td>0.088***</td>
<td>0.088***</td>
<td>0.088***</td>
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<tr>
<td></td>
<td>(2.96)</td>
<td>(3.18)</td>
<td>(3.09)</td>
<td>(2.51)</td>
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<td>(2.71)</td>
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<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.0116</td>
<td>0.0101</td>
<td>0.0101</td>
<td>0.0479</td>
<td>0.0463</td>
<td>0.0464</td>
</tr>
<tr>
<td>Nobs</td>
<td>5,850</td>
<td>5,850</td>
<td>5,850</td>
<td>4,070</td>
<td>4,070</td>
<td>4,070</td>
</tr>
</tbody>
</table>

*Note: t-stats in parentheses*

- Unconditional higher likelihood (6%) to say good time to take out loan
- Effect twice as large for men with high IQ
Increasing Rates

- Focus on sample July 2003 to Dec 2006

\[ \text{Loan}_{i,t} = \text{cons} + \beta_1 \text{High IQ}_i + \beta_2 \text{Post}_t + \beta_3 \text{High IQ}_i \times \text{Post}_t \]

- Loan: dummy 1 if says good time to take out loan
- High IQ: dummy 1 if normalized IQ is larger than 5
- Post: dummy 1 if after Dec 2005
## Empirical Results

### Increasing Rates cont.

<table>
<thead>
<tr>
<th></th>
<th>OLS (1)</th>
<th>Logit (2)</th>
<th>Probit (3)</th>
<th>OLS (4)</th>
<th>Logit (5)</th>
<th>Probit (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High IQ</strong></td>
<td>0.079***</td>
<td>0.081***</td>
<td>0.081***</td>
<td>0.036***</td>
<td>0.041***</td>
<td>0.041***</td>
</tr>
<tr>
<td></td>
<td>(7.27)</td>
<td>(7.44)</td>
<td>(7.46)</td>
<td>(2.89)</td>
<td>(3.24)</td>
<td>(3.18)</td>
</tr>
<tr>
<td><strong>Post</strong></td>
<td>0.005</td>
<td>0.005</td>
<td>0.005</td>
<td>-0.033**</td>
<td>-0.031**</td>
<td>-0.034**</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(0.36)</td>
<td>(0.36)</td>
<td>(-2.12)</td>
<td>(-2.00)</td>
<td>(-2.15)</td>
</tr>
<tr>
<td><strong>Post × High IQ</strong></td>
<td>-0.075***</td>
<td>-0.086***</td>
<td>-0.083***</td>
<td>-0.082***</td>
<td>-0.094***</td>
<td>-0.095***</td>
</tr>
<tr>
<td></td>
<td>(-3.72)</td>
<td>(-3.67)</td>
<td>(-3.69)</td>
<td>(-3.77)</td>
<td>(-3.58)</td>
<td>(-3.70)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demographics</th>
<th>X</th>
<th>X</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>R²</td>
<td>0.0067</td>
<td>0.0067</td>
<td>0.0067</td>
</tr>
<tr>
<td>Nobs</td>
<td>8,601</td>
<td>8,601</td>
<td>8,601</td>
</tr>
<tr>
<td></td>
<td>5,937</td>
<td>5,937</td>
<td>5,937</td>
</tr>
<tr>
<td>R²</td>
<td>0.0442</td>
<td>0.0465</td>
<td>0.0475</td>
</tr>
<tr>
<td>Nobs</td>
<td>5,937</td>
<td>5,937</td>
<td>5,937</td>
</tr>
<tr>
<td>t-stats in parentheses</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

- Weak decrease to say good time to take out loan to increasing rates
- High IQ large decrease in propensity to take out loan
Empirical Results

Total Debt by IQ

- Do low IQ men react less because cut off financial markets?
- Measure total debt by IQ from Statistics Finland

<table>
<thead>
<tr>
<th>IQ</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Mean</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low IQ</td>
<td>18,558</td>
<td>22,789</td>
<td>25,340</td>
<td>26,950</td>
<td>27,209</td>
<td>27,058</td>
<td>32,019</td>
<td>30,701</td>
<td>33,149</td>
</tr>
<tr>
<td>High IQ</td>
<td>40,825</td>
<td>47,247</td>
<td>46,359</td>
<td>47,035</td>
<td>46,228</td>
<td>47,244</td>
<td>49,231</td>
<td>50,102</td>
<td>55,361</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Debt / Taxable Income by IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.82</td>
</tr>
</tbody>
</table>

- Low IQ men and high IQ substantial amount of debt
- Unlikely restricted access to financial markets drive Δ loan propensity to Δ rate
Empirical Results

Change in Debt and Changes in Interest Rates

- So far: inflation expectations, interest rates, and survey decisions
- Family & friends or financial advisors shape actual decisions?

\[ \Delta debt_{i,t} = \alpha + \beta IQ_{i,t} \times \Delta rates_t + \zeta IQ_{i,t} + X'_{i,t} \delta + \eta_t + \epsilon_{i,t} \]

<table>
<thead>
<tr>
<th></th>
<th>2001-2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>(IQ_{i,t} \times \Delta rates)</td>
<td>-121.73 (* * *)</td>
</tr>
<tr>
<td></td>
<td>(41.58)</td>
</tr>
<tr>
<td>(IQ_{i,t})</td>
<td>45.74</td>
</tr>
<tr>
<td></td>
<td>(33.10)</td>
</tr>
<tr>
<td>Demographics</td>
<td>X</td>
</tr>
<tr>
<td>Year FE</td>
<td>X</td>
</tr>
<tr>
<td>Nobs</td>
<td>154,175</td>
</tr>
</tbody>
</table>

- High-IQ men decrease debt EUR 90 to 120 more to 1% increase in rate
- Corresponds to 3% to 4% of the average change during sample
Channels

- Why might cognitive abilities matter?
  - Cognitive costs of gathering information about current state
  - Cognitive costs of forming expectations
  - Inability to optimize (intertemporally)
Euler Equations by Perception Errors

- Financial constraints or (income) expectations unlikely drivers
- Low-IQ men less informed about economic fundamentals
- Low-IQ men miscalibrated beliefs about macroeconomic variables?
- Split sample by perception error for inflation at individual level
Euler Equations by Perception Errors cont.

<table>
<thead>
<tr>
<th>Abs Perception Error (_{it} \leq) Median(_t)</th>
<th>Men high IQ</th>
<th>Men low IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Inflation expectation</td>
<td>0.0472***</td>
<td>0.0209</td>
</tr>
<tr>
<td></td>
<td>(0.0153)</td>
<td>(0.0165)</td>
</tr>
<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pseudo R(^2)</td>
<td>0.0104</td>
<td>0.0061</td>
</tr>
<tr>
<td>Nobs</td>
<td>10,115</td>
<td>8,984</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
\(*p < 0.10, \**p < 0.05, \***p < 0.01

- **Strong association** for men with high IQ and accurate inflation perceptions
- **No association** for men with low IQ even if accurate inflation perceptions
Channels cont.

- Why might cognitive abilities matter?
  - Cognitive costs of gathering information about current state
    - Same patterns for low-IQ with accurate inflation perception
  - Cognitive costs of forming expectations
    - Inability to optimize (intertemporally)
Euler Equations by Forecast Errors

- Low-IQ men less informed about current inflation
- Do low-IQ men not react because less informed about future inflation?
- Split sample by forecast error for inflation at individual level
Euler Equations by Forecast Errors cont.

<table>
<thead>
<tr>
<th></th>
<th>Men high IQ</th>
<th>Men low IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abs Forecast Error</strong>&lt;sub&gt;<em>it</em>&lt;/sub&gt; &lt;= Median&lt;sub&gt;<em>t</em>&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation expectation</td>
<td>0.0401**</td>
<td>0.0069</td>
</tr>
<tr>
<td></td>
<td>(0.0184)</td>
<td>(0.0243)</td>
</tr>
<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Pseudo R&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.0101</td>
<td>0.0083</td>
</tr>
<tr>
<td>Nobs</td>
<td>9,699</td>
<td>8,694</td>
</tr>
</tbody>
</table>

Standard errors in parentheses
*<sup>p</sup> < 0.10, **<sup>p</sup> < 0.05, ***<sup>p</sup> < 0.01

- **Strong association** for men with high IQ both for high and low forecast errors
- **No association** for men with low IQ even if accurate inflation expectations
Channels cont.

■ Why might cognitive abilities matter?

■ Cognitive costs of gathering information about current state
  ■ Same patterns for low-IQ with accurate inflation perception

■ Cognitive costs of forming expectations
  ■ Same patterns for low-IQ with accurate inflation expectations

■ Inability to optimize (intertemporally)
  ■ Inability to map objective state into optimal action

Ilut & Valchev (2017)
Conclusion

- Low cognitive abilities:
  - Larger forecast errors
  - Larger forecast dispersion
  - No adjustments in consumption plans
  - Lower response in propensity to take out loan to lower rates

- Cognitive abilities impediment to effectiveness of policy

- Unintended consequences: redistribution from low to high IQ men
Implications for the Conduct of Monetary Policy

- Salience, financial education, & policy communication important

- Households react to salient policy changes
  D’Acunto, Hoang, & Weber (2018)

- Coverage in media not sufficient for communication effectiveness
  Coibion, Gorodnichenko, & Weber (2018)

- Simple, easy-to-understand, & repeated communication required