Low Interest Rates and Investor Behavior: A Behavioral Perspective

Chen Lian Yueran Ma

MIT Chicago Booth

Boston Fed Economic Conference

How do low interest rates affect investor behavior?

- Low interest rates $\Rightarrow$ higher appetite for risk taking?
  - **"Reaching for yield"**; "risk-taking channel" of monetary policy
- Why might investors reach for yield?

Why Reach for Yield? Institutional Frictions

- Agency problems; funding conditions of intermediaries; etc
  - Theories: Diamond-Rajan 12; Morris-Shin 14; Acharya-Naqvi 15; Drechsler-Savov-Schnabl 17
  - Empirics: Maddaloni-Peydro 11; Jimenez et al 14; Chodorow-Reich 14; Hanson-Stein 15

Why Reach for Yield? Behavioral Perspective

- Intrinsic individual-level tendencies; preferences & psychology
  - How investors perceive and evaluate return and risk trade-offs
  - **Savers** & the "risk-taking channel" of monetary policy

A Simple Experiment

Fix principal. Randomly assign to:

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- Case 1:
  - Safe asset: **5%** interest rate.
  - Risky asset: **10%** average returns; approx. normal 18% vol.

A Simple Experiment

Fix principal. Randomly assign to:

- Case 2:
  - Safe asset: **1%** interest rate.
  - Risky asset: **6%** average returns; approx. normal 18% vol.

A Simple Experiment

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Fix Sharpe ratio of risky asset, lower the interest rate.

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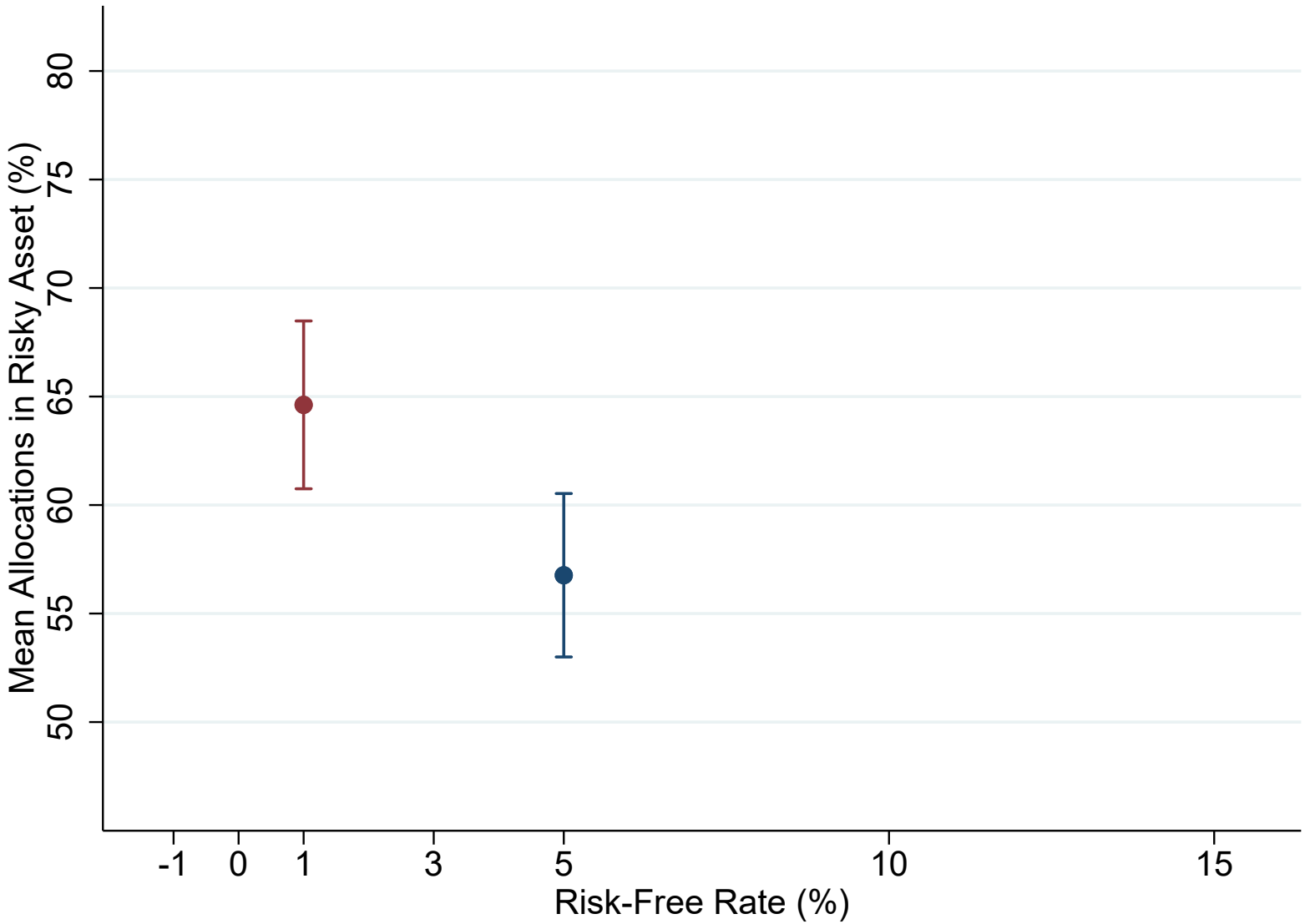
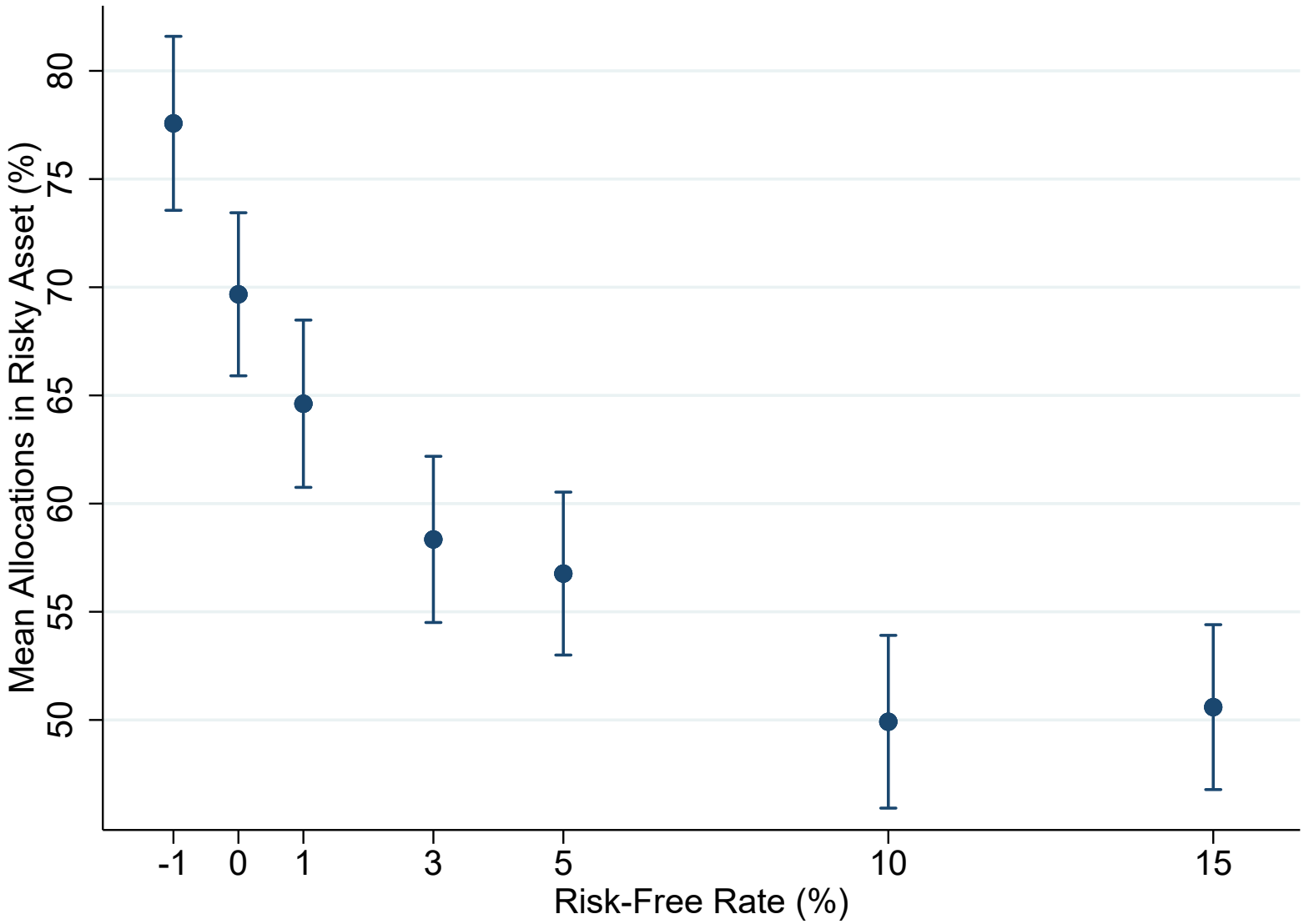
Allocations to the risky asset significantly higher in Case 2.

Preview


Mean Allocations in Risky Asset (%)
50
55
60
65
70
75
80
-1
0
1
3
5
10
15
Risk-Free Rate (%)

Preview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Outline

1. Reaching for Yield in Individual Investment Decisions
   - Randomized experiments (US households, HBS MBAs, Netherlands)
   - Observational data on household investment allocations
2. Mechanisms
   - #1: Reference dependence
   - #2: Salience and proportional thinking
   - Nominal vs. real interest rates
3. Implications
   - Savers in a low interest rate world
   - Financial institutions
   - Asset prices & capital markets

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Benchmark Experiment

- Two conditions with 200 people in each condition.
  - High interest rate condition: 5%—10%.
  - Low interest rate condition: 1%—6%.

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  - High interest rate condition: 5%—10%.
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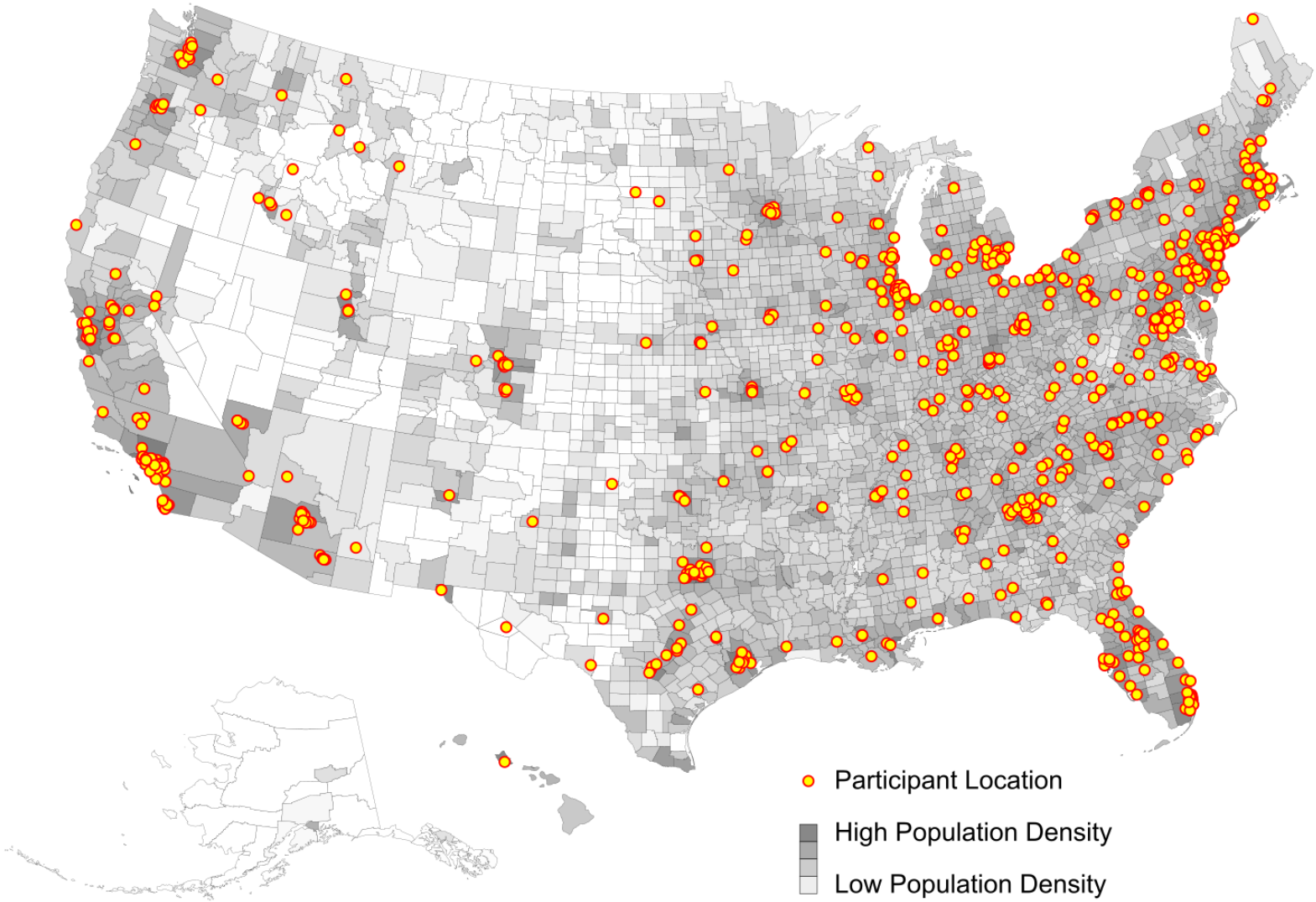
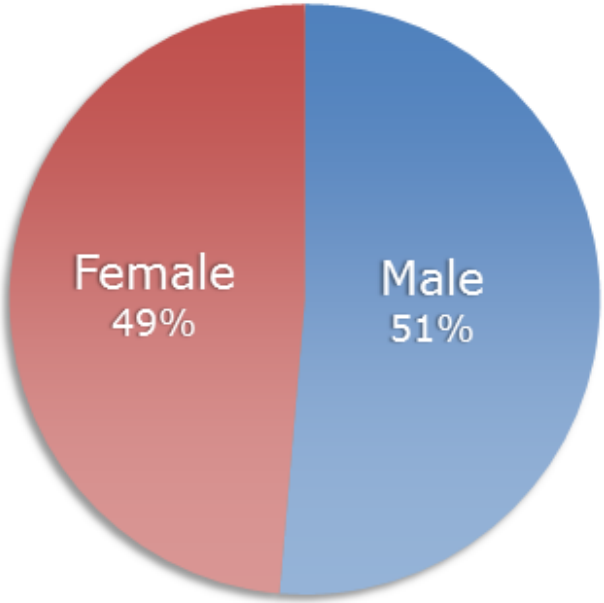
1. **MTurk, Hypothetical**
   - Consider allocating total savings of $100,000
2. **MTurk, Incentivized**
   - Invest experimental endowment of 100,000 Francs
   - Receive bonus payment in dollars, proportional to investment payoff
   - On the scale of $12, paid to 10% randomly selected participants
3. **HBS MBA, Incentivized**
   - Invest experimental endowment of 1,000,000 Francs
   - Receive bonus payment in dollars, proportional to investment payoff
   - On the scale of $200, paid to 10% randomly selected participants

Geographic Distribution: MTurk

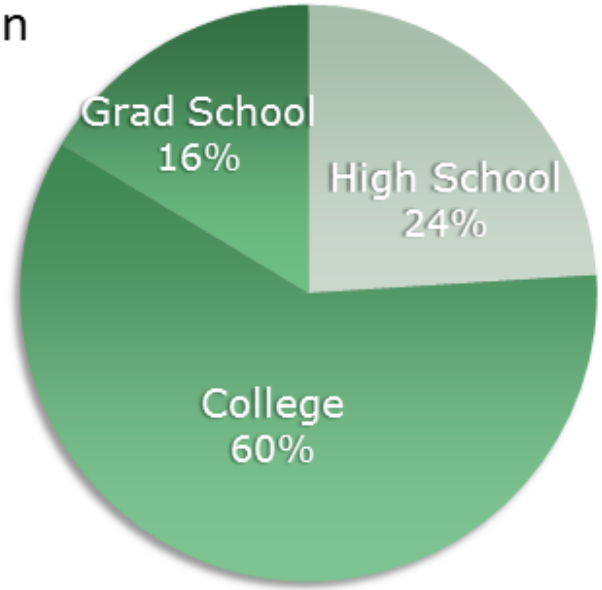


Demographics: MTurk

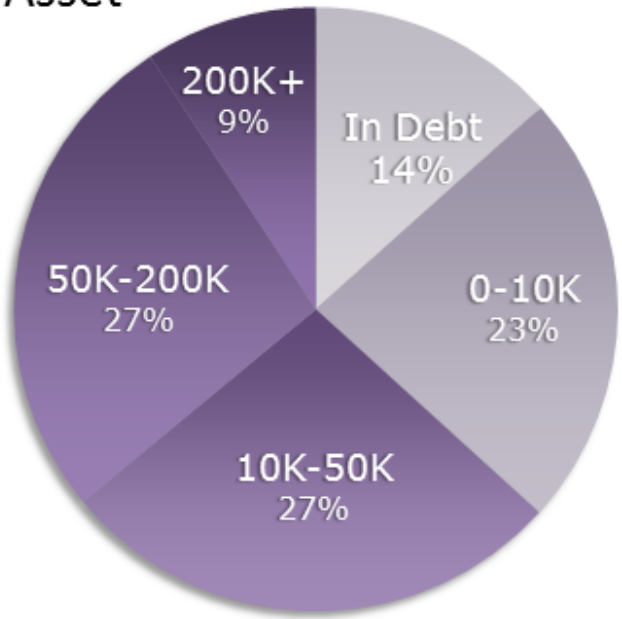
Gender



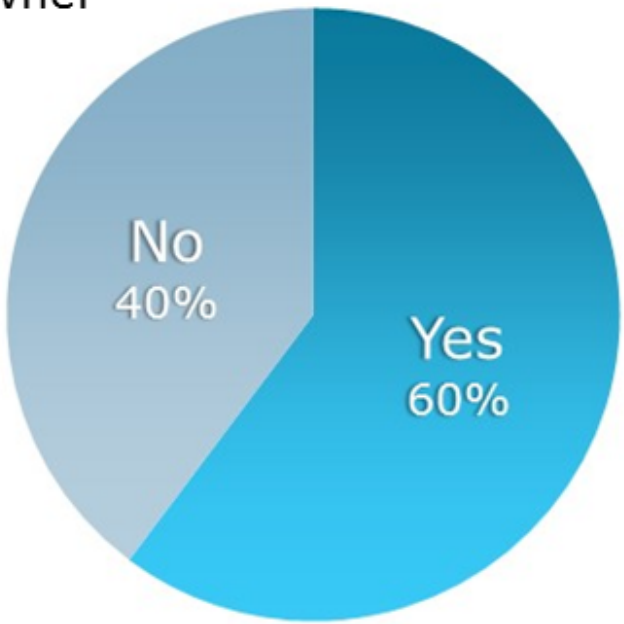
Education



Financial Asset



Stock Owner



Demographics: HBS MBAs

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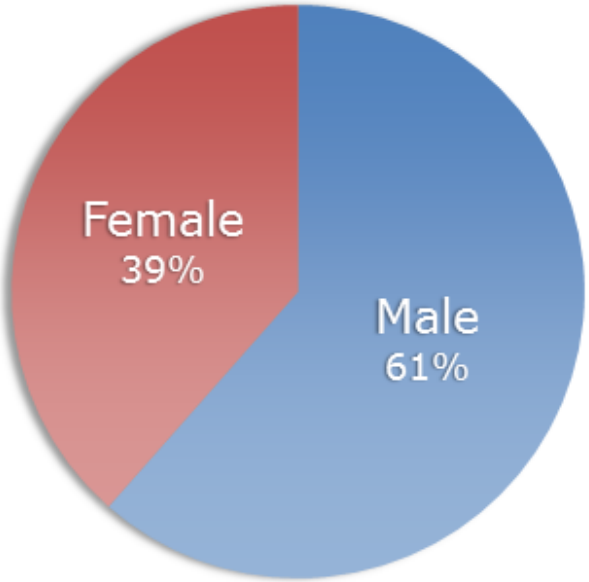
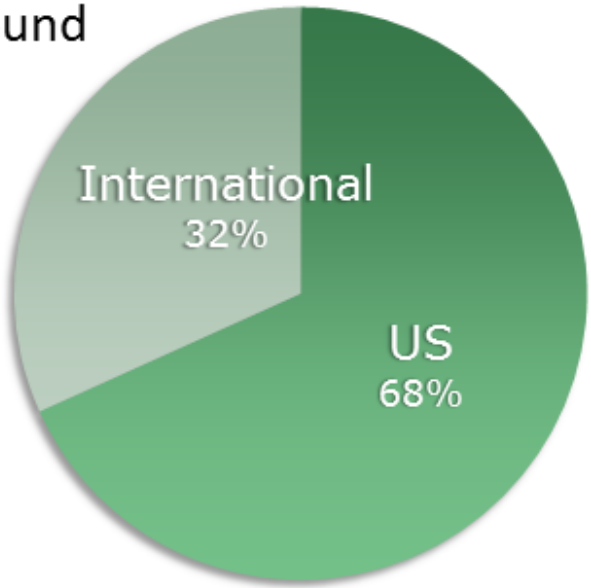
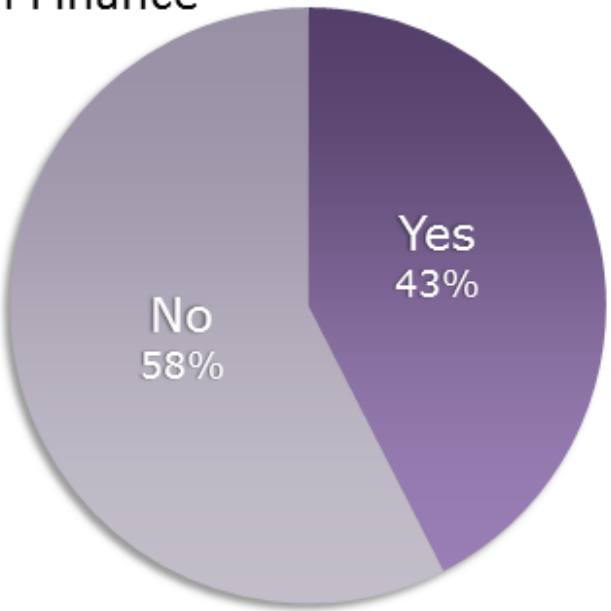
Gender



Background



Worked in Finance



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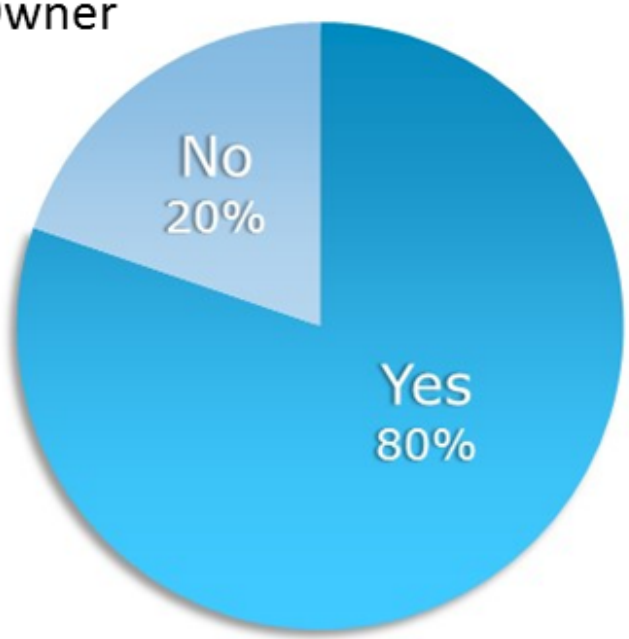


Benchmark Experiment

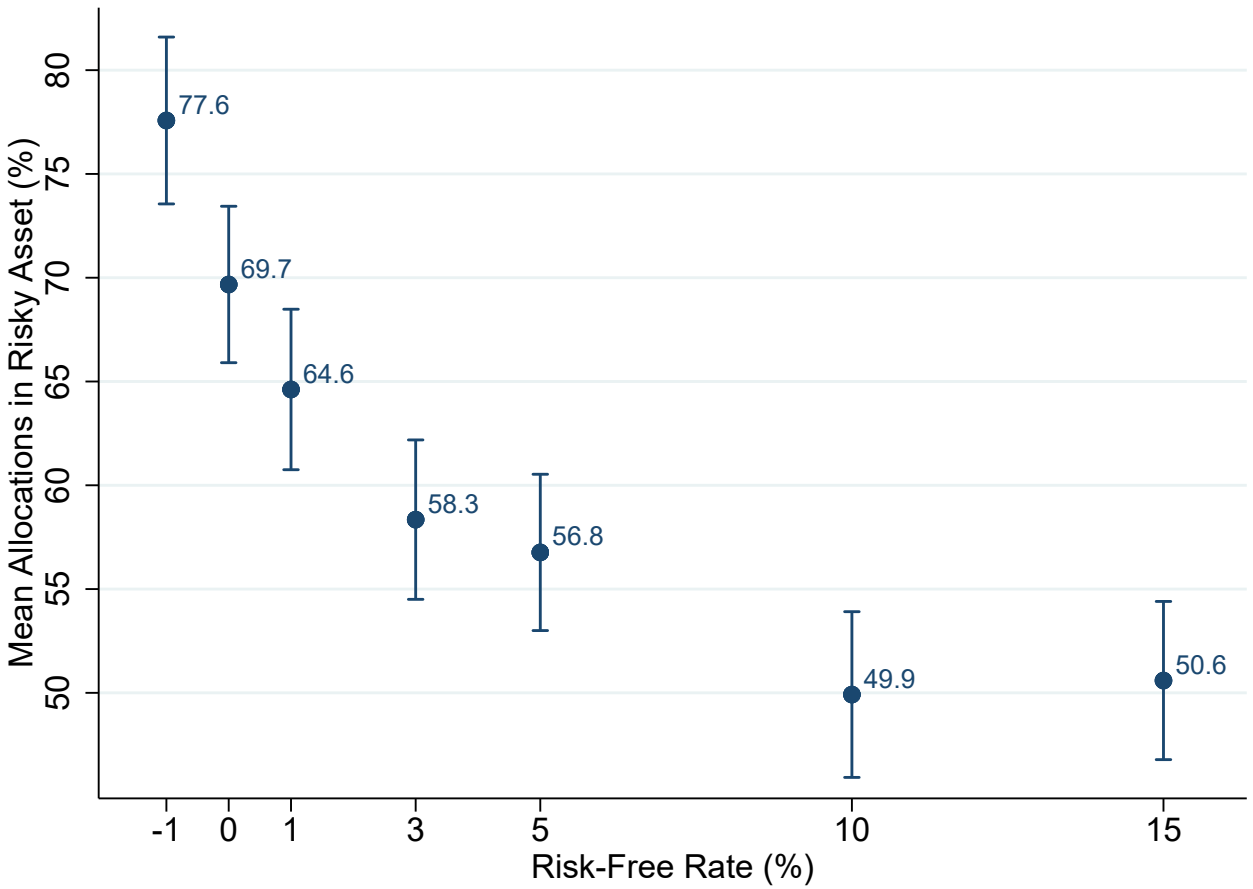
Mean Allocations to Risky Asset (%)

	High: 5—10	Low: 1—6	Dif	[t]
MTurk, Hypo.	48.15	55.32	**7.17**	[2.52]
MTurk, Incen.	58.58	66.64	**8.06**	[3.06]
HBS MBA, Incen.	66.79	75.61	**8.83**	[3.13]

- Similar results across different settings and populations
  - Do not diminish with education, wealth, investment experience

More Interest Rate Conditions

- Fix excess returns (mean 5%), change r_f. 200 people per condition.

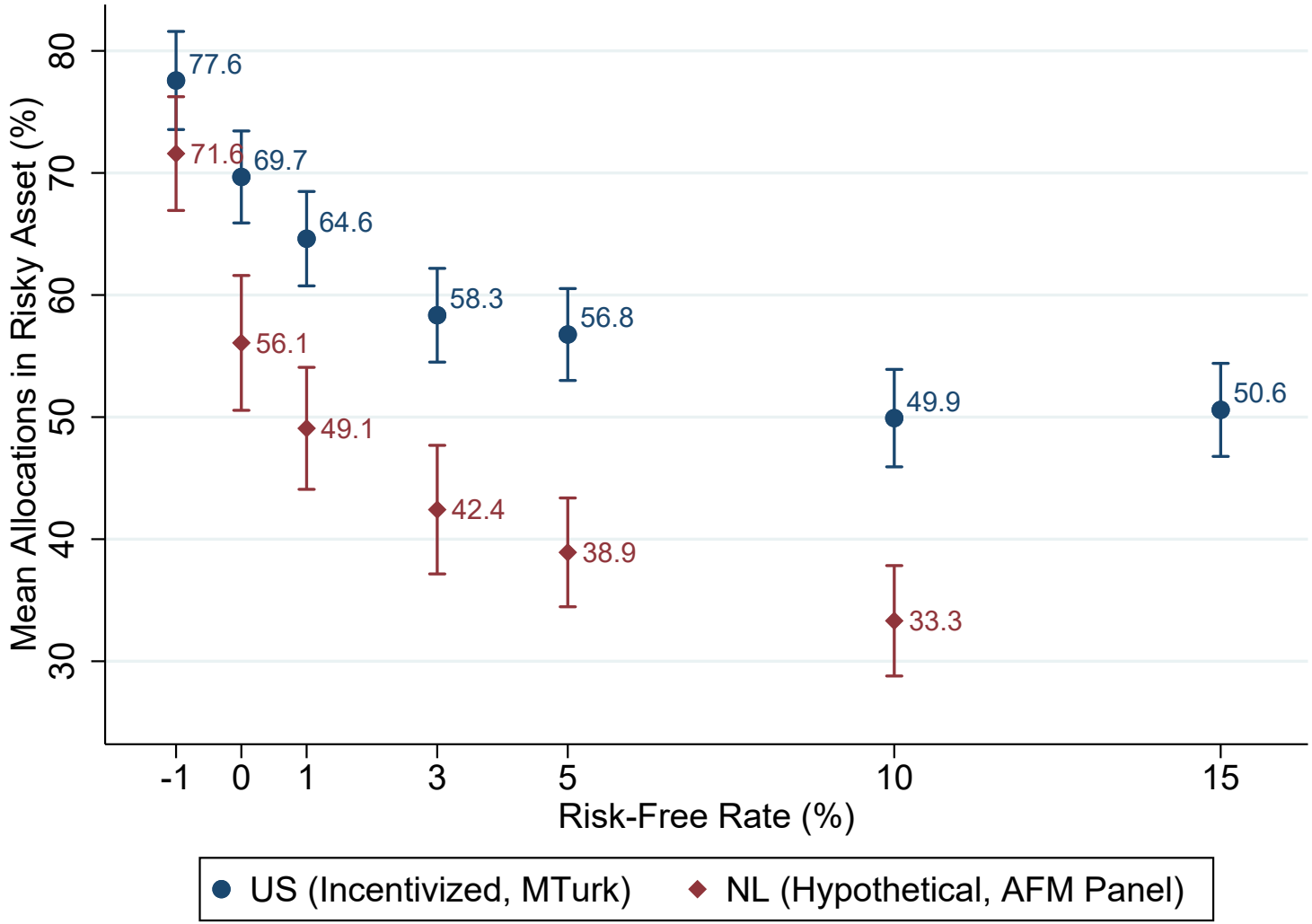


Replication by Dutch Authority for Financial Markets

Om meer inzicht te krijgen in risicobereidheid van Nederlandse consumenten bij een lage of zelfs negatieve spaarrente, repliceerden we in het AFM Consument Panel onderzoek van Chen Lian en Yueran Ma en Carmen Wang "Low Interest Rates and Risk Taking: Evidence from Individual Investment Decisions."

More Interest Rate Conditions

- Fix excess returns (mean 5%), change r_f. US & Dutch.



Observational Data

1. American Association of Individual Investors (AAII)
   - Members report percentage of portfolio allocations to
     - ★ Stocks (directly held & mutual fund)
     - ★ Cash (interest-bearing safe assets)
2. Mutual Fund Flows
   - Flows into equity and high yield corporate bond mutual funds
3. Flow of Funds
   - Household sector flows into stocks and interest-bearing safe assets
4. Structured Financial Products (Celerier-Vallee 17)
   - Low interest rates $\Rightarrow$ attractiveness of structured financial products
   - Europe, Asia

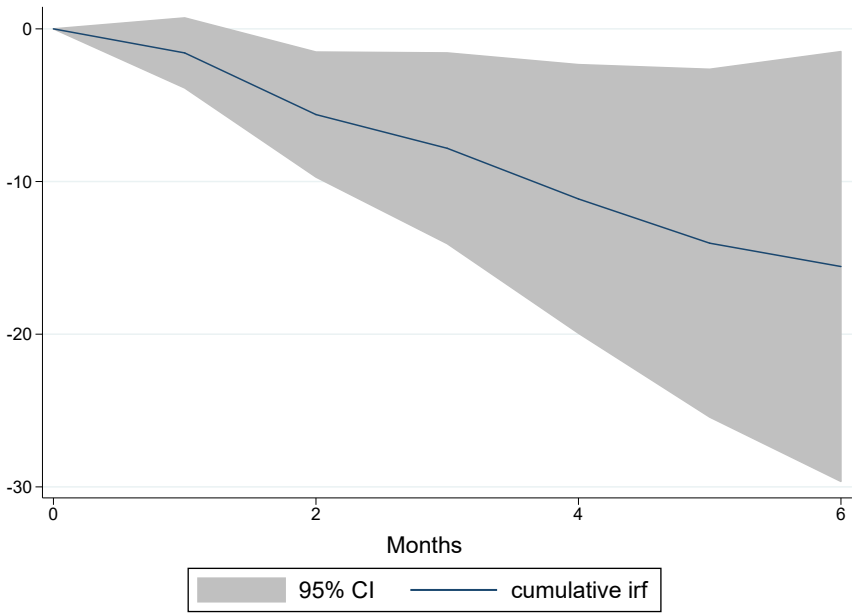
AAII: Allocation to Stock

	Mean Allocations to Stocks			
	(1)	(2)	(3)	(4)
L.r_f	-0.38	**-1.47**	**-1.92**	**-2.00**
	[-0.51]	[-4.49]	[-2.46]	[-2.57]
L.P/E10		0.84		
		[9.16]		
L.*Surp*			6.79	
			[0.40]	
L.$E[rx^{12}_{stk}]$				-0.12
				[-0.60]
L.AAII Sentiment		0.04	0.17	0.16
		[1.66]	[4.01]	[3.67]
L.VIX^2		-6.34	-14.45	-5.73
		[-0.78]	[-0.96]	[-0.27]
L.Past 12M GDP Growth		0.34	2.11	2.17
		[0.85]	[2.61]	[2.77]
L.Credit Spread		-3.87	-2.64	-3.37
		[-4.02]	[-1.34]	[-1.46]
Constant	61.47	52.58	66.01	68.87
	[19.30]	[14.59]	[10.88]	[9.03]
Observations	326	326	326	326

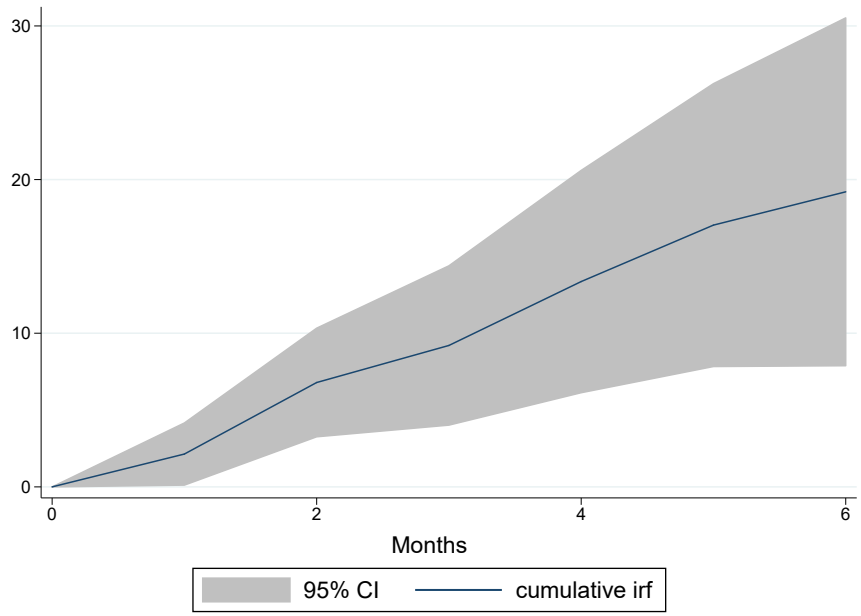
Newey-West t-statistics in brackets

AAII Allocations

Response to Innovations in Short Rate (sVAR)

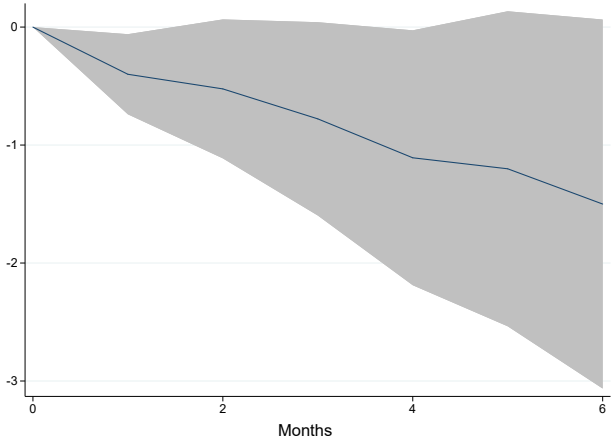


Stocks

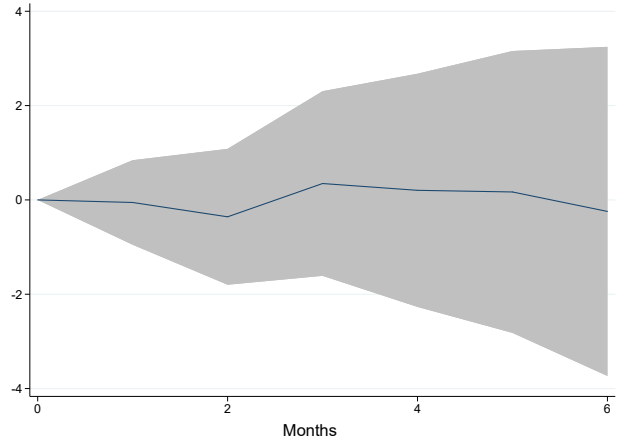


Cash

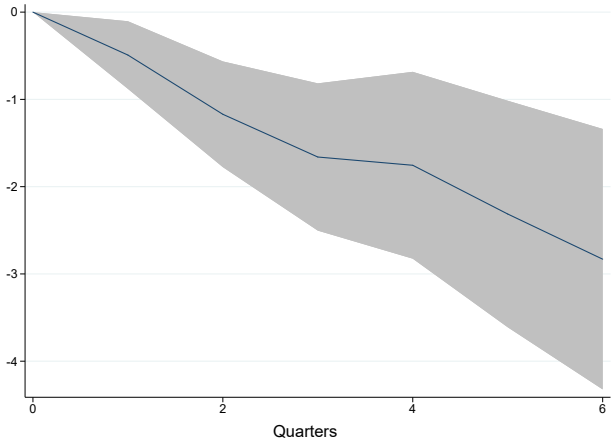
Household Investment Flows



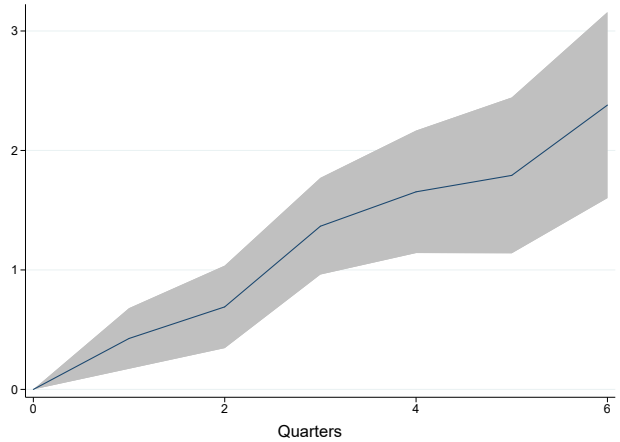
Equity MF (ICI)



HY Corp Bond MF (ICI)



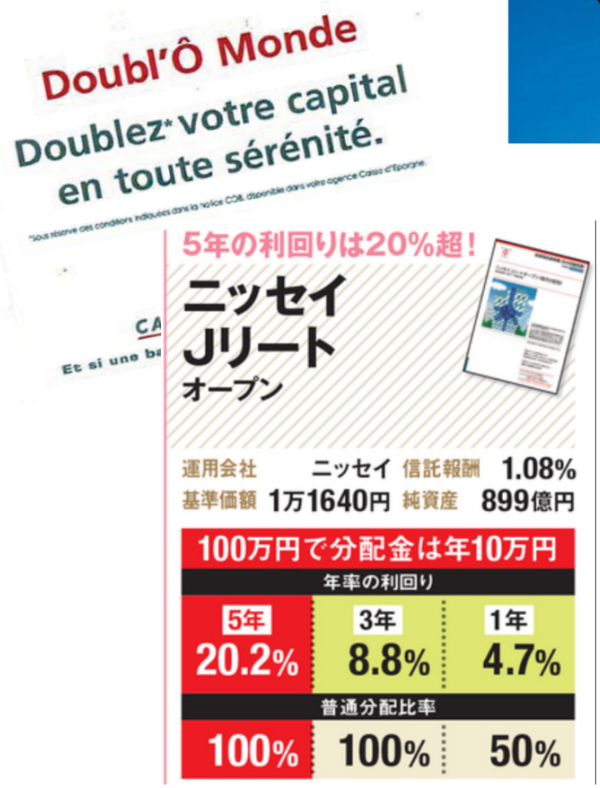
Stocks (FoF)



Deposits (FoF)

- Who is on the other side? Foreign investors. Corporate issuers.

Structured Products and Other Asset Classes



Source: Celerier-Vallee 17

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#1: Reference Dependence

- People form reference points of investment returns
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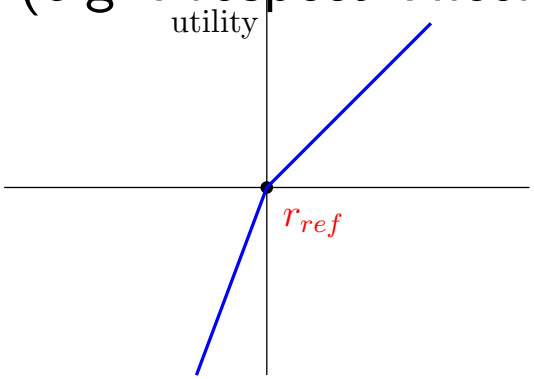
$$u(w(1+r_p)) = \begin{cases} w(r_p - r_{ref}) & r_p \geq r_{ref} \\ -\lambda w(r_p - r_{ref}) & r_p < r_{ref} \end{cases}$$



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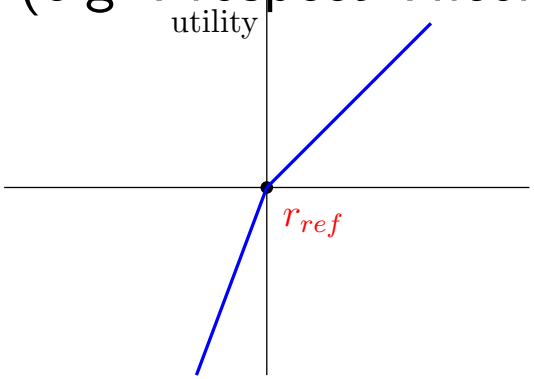

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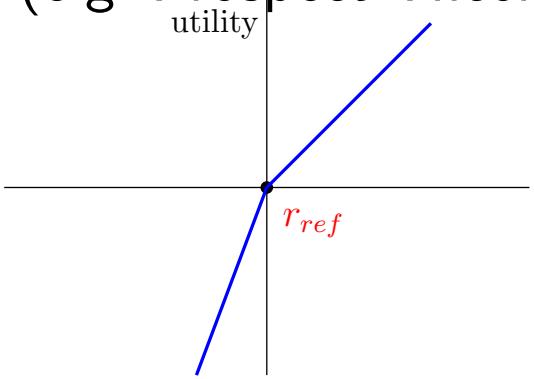

- **Prediction**: when $r_f < r_{ref}$, $r_f \downarrow \Rightarrow$ allocation to risky asset $\uparrow$
  - Corollary: when $r_f < r_{ref}$, $r_{ref} \uparrow \Rightarrow$ allocation to risky asset $\uparrow$

#1: Reference Dependence

Reference Point Formation

- Important source: previous experiences
  - Kahneman-Miller 86; Simonsohn-Loewenstein 06; Malmendier-Nagel 11; Bordalo-Gennaioli-Shleifer 17; DellaVigna et al 17
- Other reference points in literature:
  - Status quo, risk-free rate, forward-looking rational expectations
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- Other reference points in literature:
  - Status quo, risk-free rate, forward-looking rational expectations
  - Hard to explain reaching for yield without experience effect
- Further implication: history dependence
  - Degree of reaching for yield may depend on past economic environment
  - "Low" interest rates are *relative* to investors' experiences

"John Bull can stand many things but he cannot stand 2%."
—Walter Bagehot (1826-1877)

#2: Salience and Proportional Thinking

- Attractiveness of risky asset affected by proportions:
  - 6% looks attractive relative to 1%
  - 10% does not look as attractive relative to 5%
- Formalization: Salience Theory (Bordalo-Gennaioli-Shleifer 13)

$$\max_{\phi \in [0,1]} \delta \mathbb{E} r_p - \frac{\gamma}{2} Var(r_p)$$

where δ is increasing in the ratio of the average returns $(r_f + \mathbb{E}x)/r_f$.

- **Prediction**: Fix excess returns, $r_f \downarrow \Rightarrow \delta \uparrow$
  - Allocation to the risky asset (weakly) increases

Additional Tests

Additional Test: History Dependent Reference Points

- Experiment 1: Mean Allocations to Risky Asset (%)

G1	High: 5—10	Low: 1—6
ϕ (%)	49.23	**66.12**
G2	Low: 1—6	High: 5—10
ϕ (%)	55.64	46.98

Additional Test: History Dependent Reference Points

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G2	Low: 1—6	High: 5—10
ϕ (%)	55.64	46.98

- Experiment 2: Mean Allocations to Risky Asset (%)

G1	Very High: 15—20	High: 13—18	Medium: 3—8
ϕ (%)	37.74	38.43	**60.29**
G2	Very Low: 0—5	Low: 1—6	Medium: 3—8
ϕ (%)	61.57	57.41	**49.80**

*Performed by our discussant Cary Frydman

Additional Test: History Dependent Reference Points

SCF Panel Regressions

Outcome	Risk Tolerance Ordered Probit	Holds Stocks OLS	% in Stocks OLS	% in Deposits OLS
Experienced rates	0.05	0.03	1.58	-1.91
	[3.94]	[6.78]	[6.40]	[-5.81]
Experienced ex stock ret	0.03	0.01	0.36	-0.13
	[3.10]	[4.44]	[2.36]	[-0.74]
High School	0.12	0.02	0.12	-0.56
	[6.47]	[4.15]	[0.34]	[-1.40]
College	0.36	0.13	4.00	-4.52
	[18.13]	[18.90]	[9.72]	[-9.35]
Log financial assets	0.10	0.08	4.68	-6.01
	[28.61]	[53.35]	[28.62]	[-28.80]
Age Dummies	Y	Y	Y	Y
Time Dummies	Y	Y	Y	Y
Other Controls	Y	Y	Y	Y
Obs	41,260	43,947	43,941	43,932
R^2		0.335	0.252	0.286

t-statistics in brackets, corrected for multiple imputation

- 2016 SCF: average equity share of household financial assets
  - age>60 10pp higher than age< 40 (historic high)

Additional Test: Salience and Proportional Thinking

- Benchmark experiments: commonly used net returns
  - Low: 6% vs. 1%; High: 10% vs. 5%.

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- If instead use gross returns
  - Low: 1.06 vs 1.01; High: 1.10 vs 1.05.

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- Benchmark experiments: commonly used net returns
  - Low: 6% vs. 1%; High: 10% vs. 5%.
- If instead use gross returns
  - Low: 1.06 vs 1.01; High: 1.10 vs 1.05.

Mean Allocations to Risky Asset (%)

	High: 5—10	Low: 1—6	**Low - High**	[t]
Baseline	56.77	64.62	**7.85**	[2.85]
Gross	52.70	54.59	**1.89**	[0.69]
Baseline - Gross	**4.06**	**10.03**	5.96	-
[t]	[1.46]	[3.70]	[1.54]	-

- Gross framing: allocation to risky asset ↓, reaching for yield also ↓.

Nominal vs. Real Interest Rates

Nominal or Real Interest Rates?

- Reaching for yield triggered by low nominal or low real interest rates?
  - Reference dependence in nominal or real terms?
  - Salience/proportional thinking in nominal or real terms?

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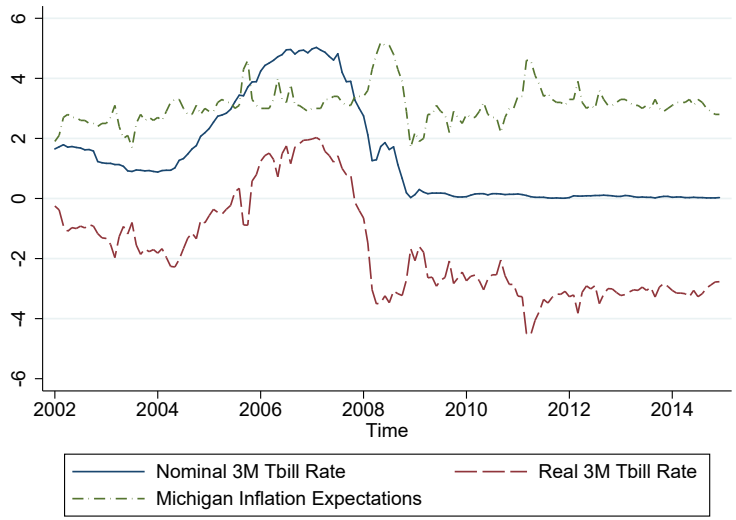
- Last 10 years in US: nominal & real interest rates ↓



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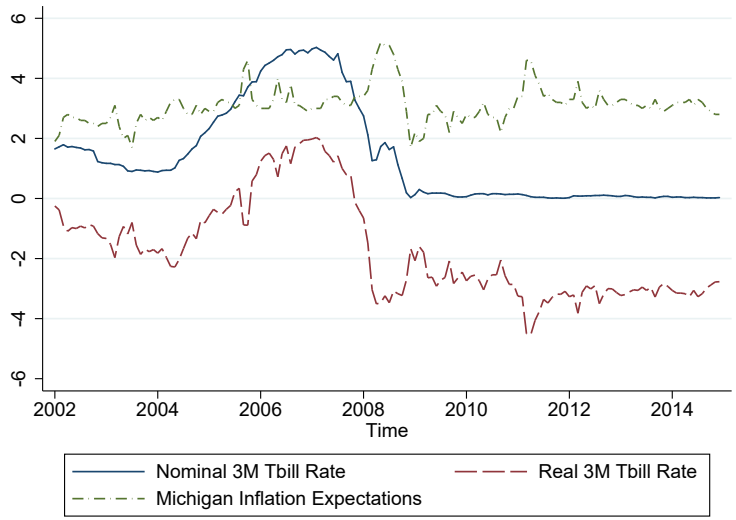

- Nominal vs. real rates: experiments, observational data, anecdotes
  - nominal rates are important; real rates may have additional impact
  - combined impact of low nominal & real rates strongest

Nominal or Real Interest Rates?

An Experiment

- 3 conditions:
  - C1: High nominal rate (5%—10%) & High real rate (5%—10%)
  - C2: High nominal rate (5%—10%) & Low real rate (1%—6%)
  - C3: Low nominal rate (1%—6%) & Low real rate (1%—6%)
- Results:

Difference in Mean Allocations to Risky Assets

	Dif	$[t]$
C2-C1 (fix nominal, change real)	**3.64**	[1.26]
C3-C2 (change nominal, fix real)	**5.80**	[2.01]
C3-C1 (change nominal & real)	**9.44**	[3.12]

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   - Financial institutions
   - Asset prices & capital markets

Savers in a Low Interest Rate World

- Many studies on expansionary monetary policies & borrowers.
- There is also much to be understood about savers' behavior.
  - Anchors and targets: wealth needs to grow at "decent" rate
  - Salience affects perception
- Consumer protection
- Potential sources of vulnerability in market downturn

Financial Institutions and Capital Markets

Financial Institutions

- Behavioral mechanisms may affect finance professionals
- Institutions can be affected by return and yield chasing flows
  - Institutions' reaching for yield attract inflows (Choi-Kronlund 17)
  - Flows & agency frictions (Feroli-Kashyap-Schoenholtz-Shin 17)
- Promising fixed returns to end investors

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- Promising fixed returns to end investors

Asset prices

- High yield bonds. Stocks. Emerging market assets.
  - Berndt-Helwege 18, Bianchi-Lettau-Ludvigson 18, Miranda Agrippino-Rey 18

Summary

- Individual-level reaching for yield motives
  - Not just institutional frictions
- Mechanisms: reference dependence, salience
  - Nominal rates appear more important
  - Lack of understanding of risk may aggravate the problems
- Savers & "risk-taking channel" of monetary policy

Thank You

Why Experiments

- Cleanly isolate the effect of changes in the risk-free rate
  - hard to find large exogenous variations in interest rates (Ramey 16)
- Perception of returns and risks in capital markets difficult to measure
  - simple and transparent in experiments
- Help to better understand the mechanisms

Despite challenges/caveats, results similar in observational data

External Validity

- Results hold broadly, not limited to particular setting
- Mechanisms seem deeply ingrained in the way people think
  - Apply in many populations
  - Apply across many settings
- Consistent results in observational data
- Help to explain behavior
  - Demand for high yield structured finance product
  - Compressed equity premium (Bianchi-Lettau-Ludvigson 17)

Online vs. Lab

Benefits of online studies:

- Allow large scale
- Diverse populations
- Convenient for participants; low fixed costs

Lab needed when

- Require interactions with researchers or with other participants
- Require in person data collection (e.g. MRI)

Amazon Mechanical MTurk

Properties:

- Large and diverse populations from across the US
- Fast data collection and low cost
- Response quality similar to lab (Casler-Bickel-Hackett 13)

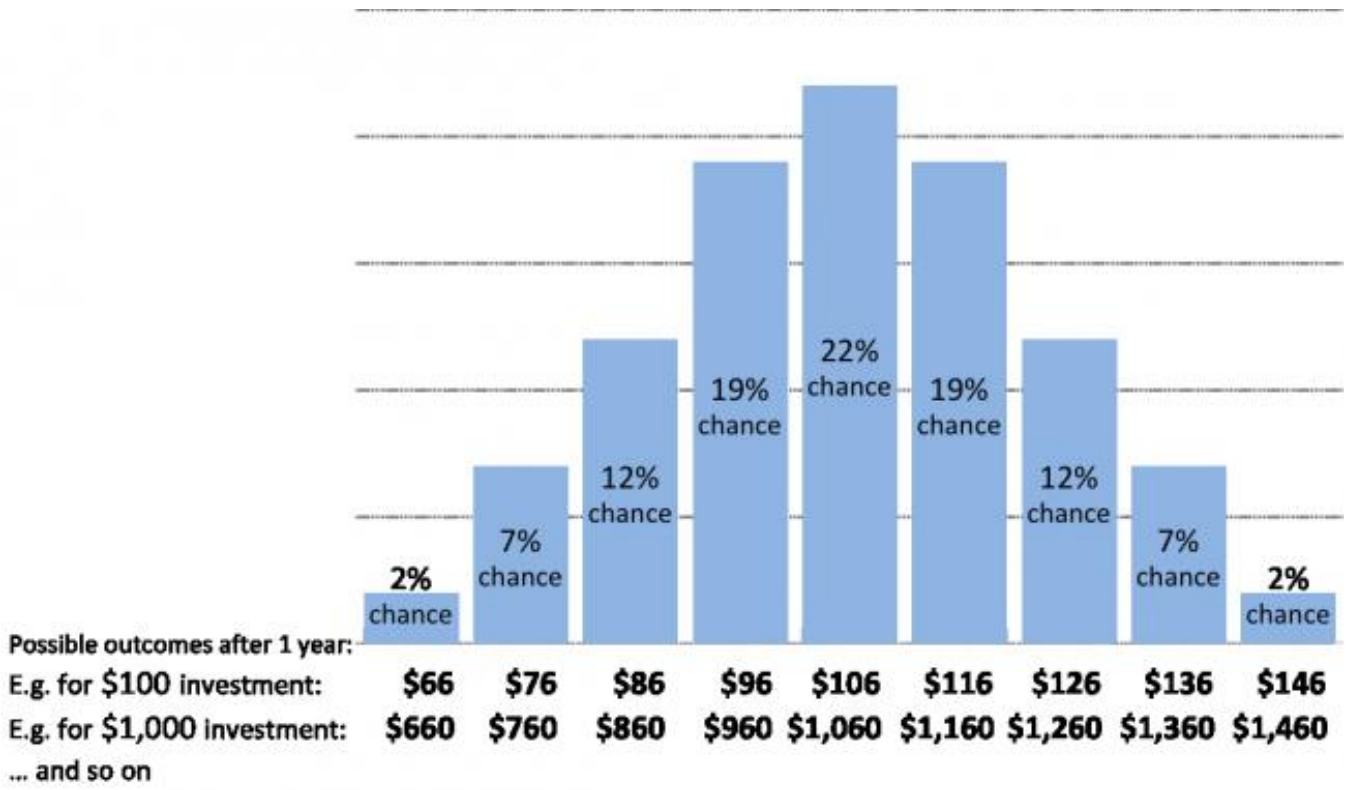
Participants:

- Similar to US general population; fewer elderly people (few above 60)
- Purpose: fruitful way to spend free time and get some cash
  - instead of watching TV

Recent examples: Kuziemko-Norton-Saez-Stantcheva 15; D'Acunto 15; DellaVigna-Pope 17

Investment Decision

- You have $100,000 to invest for one year.
  - Investment A: Annual return is **1%** for sure.
  - Investment B: Average annual return is **6%**. Return volatility is 18%.



forms pay link1 link2 link3

Consent Form (Excerpt)

Purpose of research: The purpose of this research is to study investment decisions in financial assets.

What you will do in this research: You will go through a web-based survey and make hypothetical choices about how you allocate your savings among different investment options.

Time required: We estimate that it will take you about 10 to 15 minutes to complete the survey. You are free to take as much time as you need up to 30 minutes.

Risks: There are no anticipated risks associated with participating in this study.

Questionnaire (Hypothetical)

Please carefully consider the following scenarios, and provide an answer that best describes your preferences.

Suppose you have total savings of $100,000 and you would like to invest them for one year. There are two available investments which are described below. You can choose to allocate your savings between these two investments. You will not be able to change your investments during the year, and your pay-offs will be delivered after one year.

Questionnaire (Hypothetical)

Investment A: Investment A's annual return is 5% for sure.

For example, suppose you put $100 into this investment at the beginning of the year, you will get $105 by the end of the year.

For another example, ...

Investment B: Investment B has nine possible outcomes. Its average annual return is 10%. The volatility of the investment return is 18%. The nine possible outcomes are shown by the chart below, where the number inside each bar indicates the probability of that particular outcome. The outcome of this investment is not correlated with your income or with the overall economic condition.

For example, suppose you put $100 into this investment at the beginning of the year, you will get $110 on average by the end of the year. There is uncertainty about the exact amount of money you will get. The first row of the chart below describes the nine possible outcomes: there is a 19% chance that you will get $120 by the end of the year, there is a 12% chance that you will get $90 dollars by the end of the year, etc. ...

Questionnaire (Incentivized)

In this section, you will make a decision about allocating your money in different investments. At the beginning, you have 100,000 units of currency, called "Francs." There are two available investments, which are described below. You can choose to allocate your money between these two investments. You will receive bonus payments proportional to your investment payoff in Francs, with every 89,500 Francs being converted into one dollar of bonus payment.

Your investment payoff and the amount of bonus will be displayed at the end of this survey....

Small Stakes

1. Well known people not risk neutral when stakes are relatively small
2. Risk neutrality decreases variations in decisions
   - Works against us finding significant differences
3. Experimental decision informative of risk preferences in general
   - Allocations in experiment highly correlated with household portfolios
4. Do not apply to hypothetical experiments
   - We find robust tendencies in different settings

Experimental Decisions and Household Portfolios

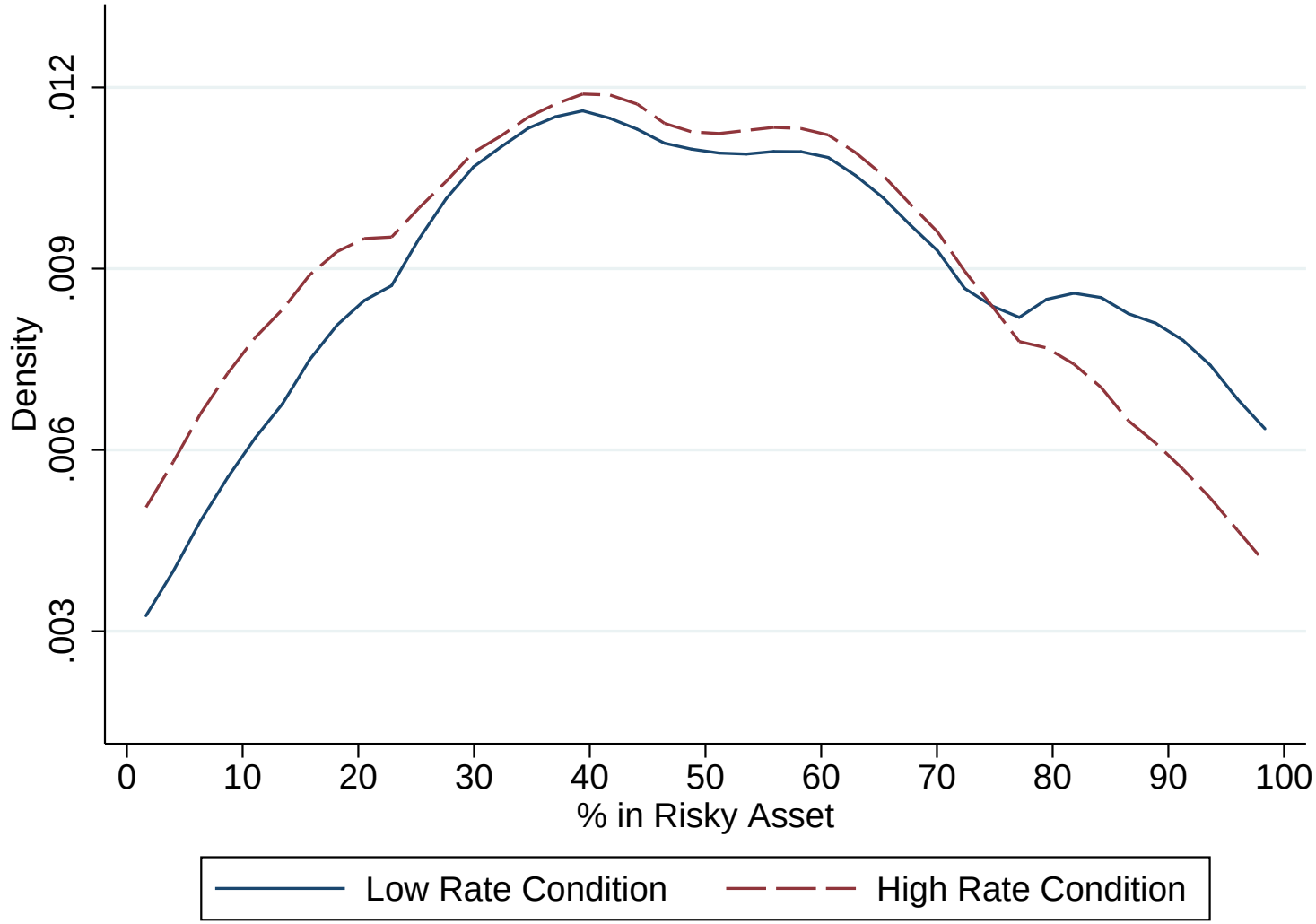
	% in Risky (Experimental Decision)			
	MTurk		MBA	
% Asset in bank deposit	-0.12		-0.13	
	[-3.02]		[-3.29]	
% Asset in stock		0.12		0.10
		[2.69]		[2.52]

Robust t-statistics in brackets

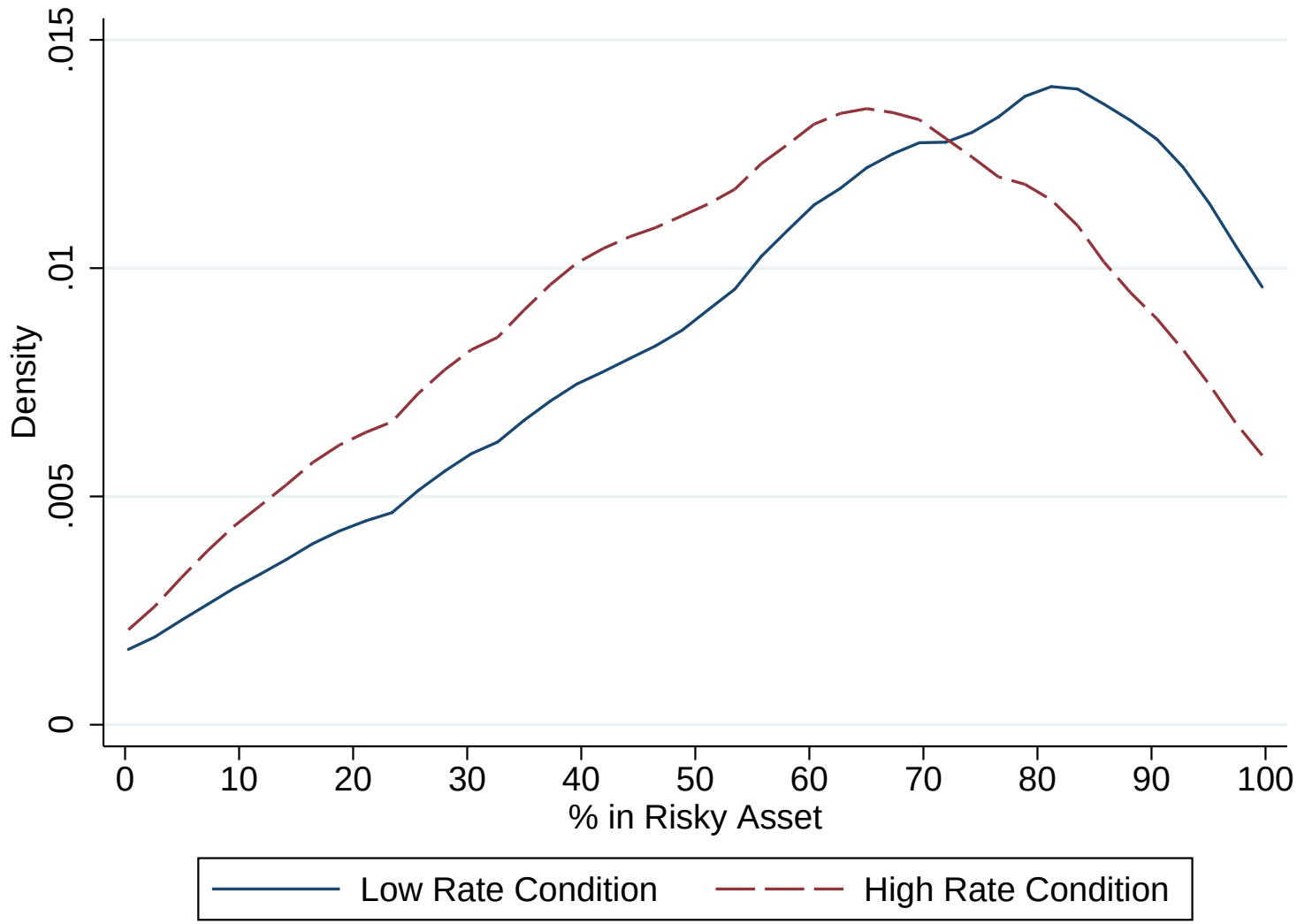
Demand for Dividend/Income

- People treat dividends and capital gains separately
  - Hartzmark-Solomon 17
  - Demand for dividend may be intensified by low rates
- Our focus: low rates and risk taking *in general*
- There may be additional wrinkles
  - In progress: study interaction of biases with payoff design

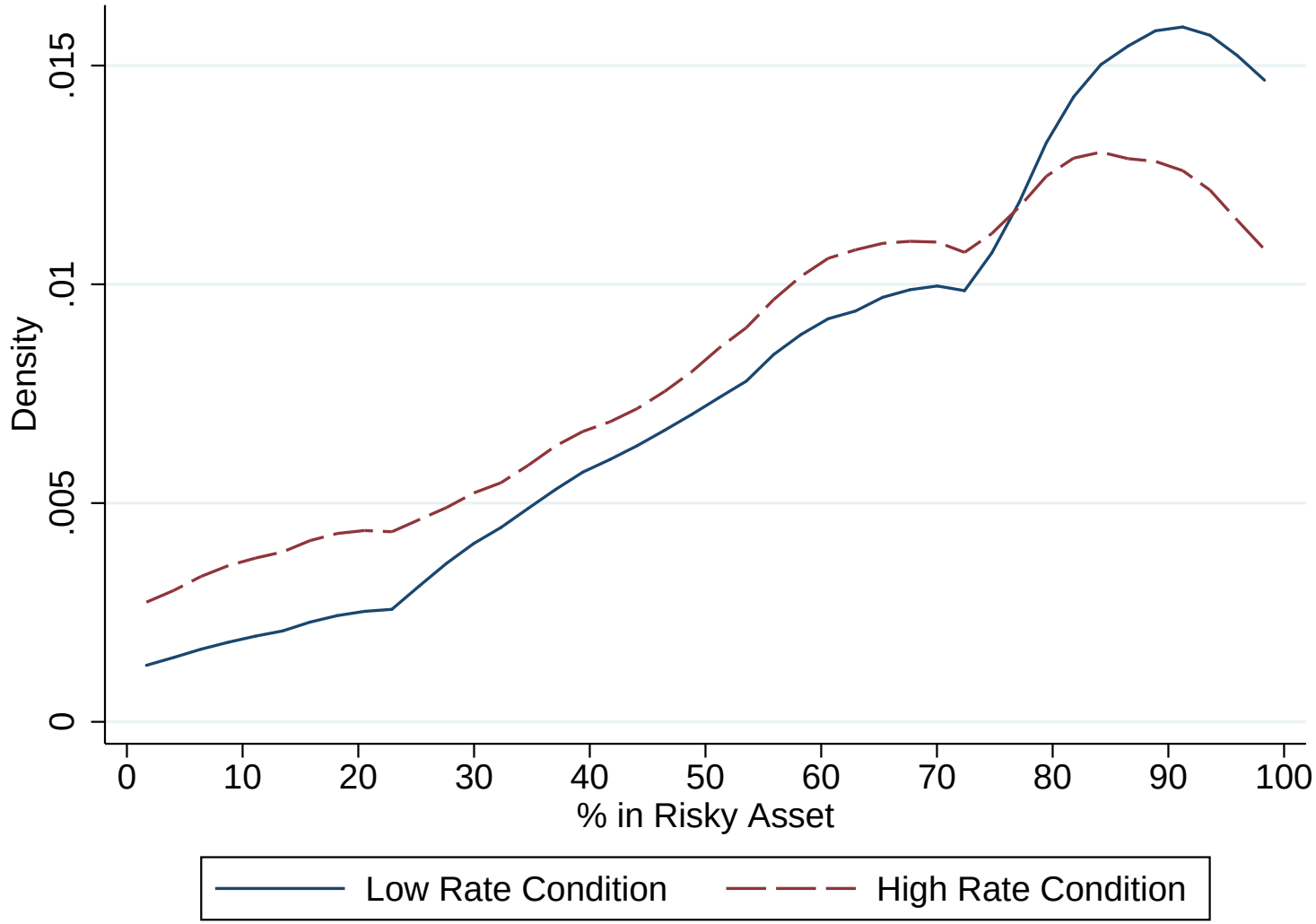
Distribution of Allocations: MTurk, Hypothetical



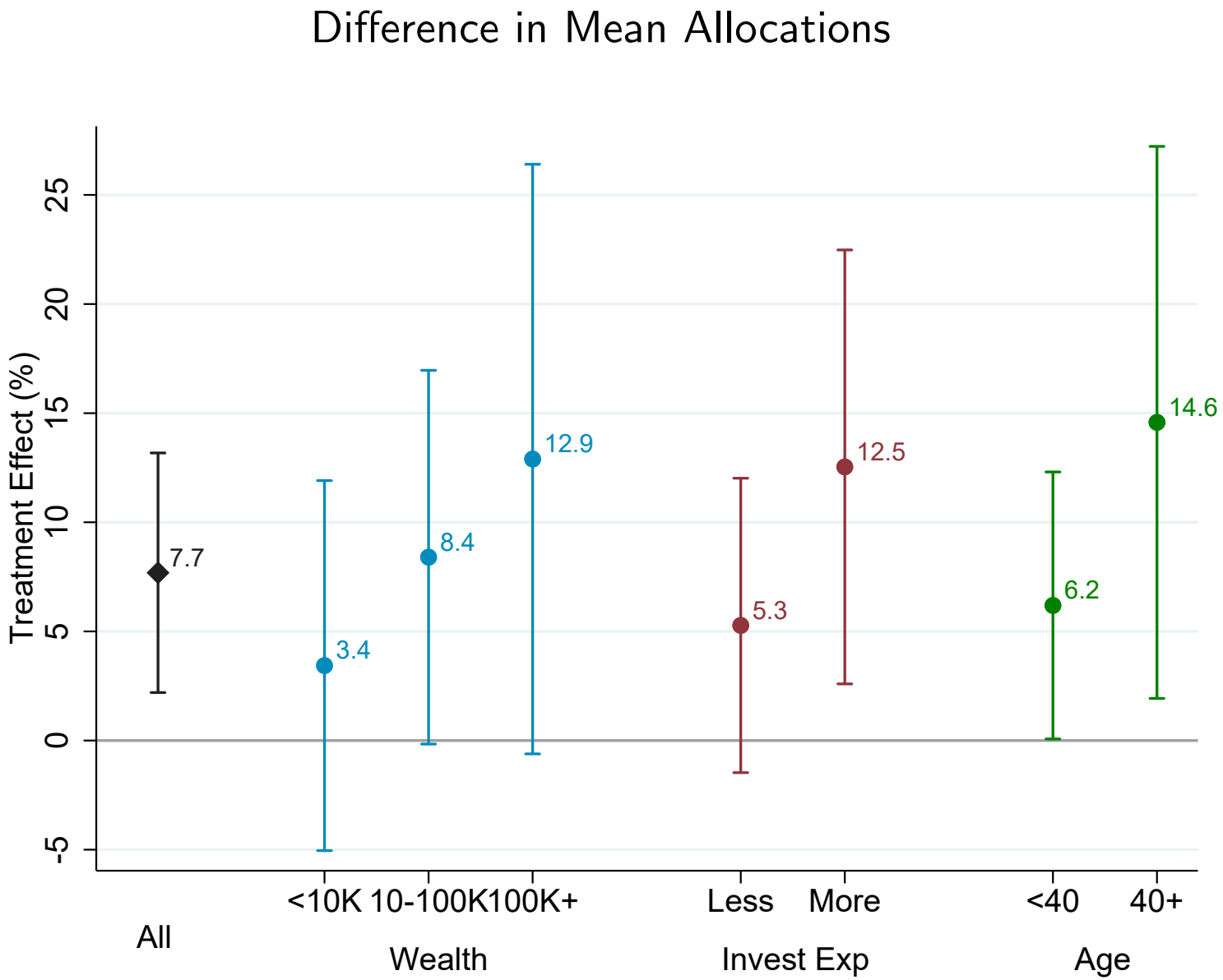
Distribution of Allocations: MTurk, Incentivized



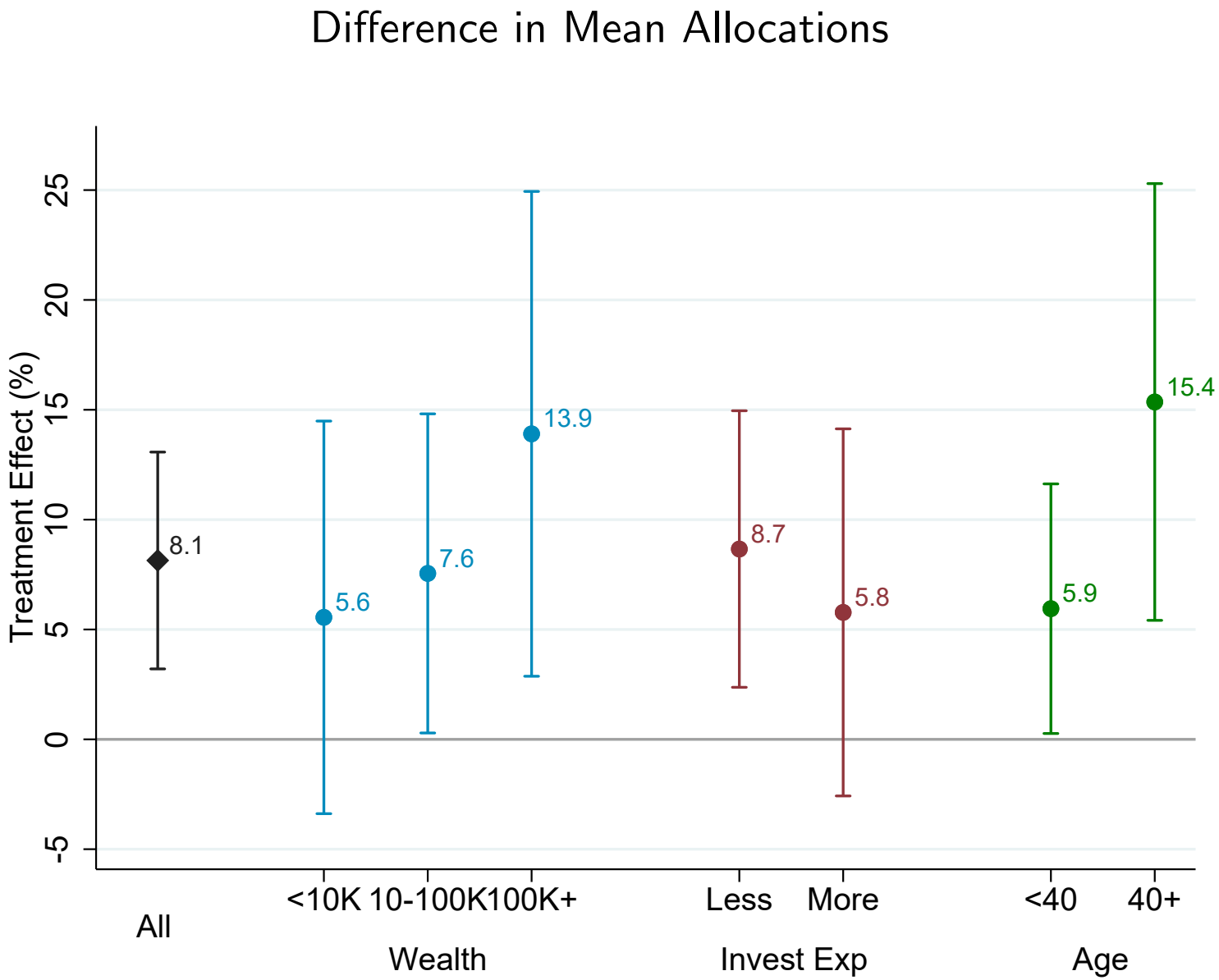
Distribution of Allocations: HBS MBA, Incentivized



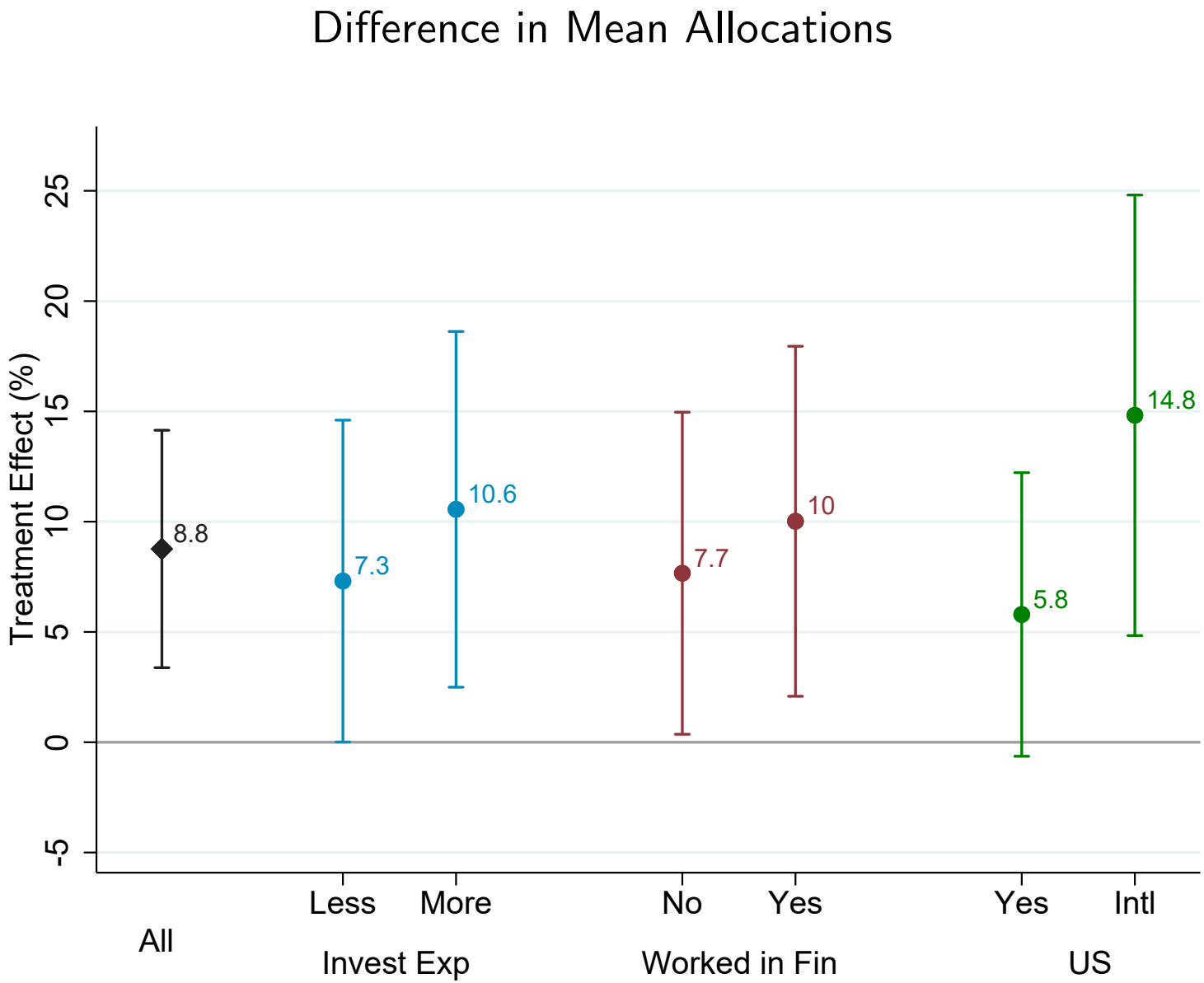
Results by Demographics: MTurk, Hypothetical



Results by Demographics: MTurk, Incentivized



Results by Demographics: HBS MBA, Incentivized



Reaching for Yield in Subsamples

Experiment B1: MTurk, Hypothetical

	Wealth			Investment Experience		Education	
	<10K	[10K, 100K]	>100K	No/Limited	Some/Extensive	HS	College+
β	3.43	8.40	12.90	5.27	12.54	13.48	5.79
[t]	[0.79]	[1.92]	[1.87]	[1.53]	[2.47]	[2.23]	[1.80]
N	161	170	69	266	134	102	298

Experiment B2: MTurk, Incentivized

	Wealth			Investment Experience		Education	
	<10K	[10K, 100K]	>100K	No/Limited	Some/Extensive	HS	College+
β	5.55	7.55	13.90	8.66	5.78	3.66	8.89
[t]	[1.22]	[2.04]	[2.47]	[2.70]	[1.36]	[0.65]	[3.11]
N	133	175	92	254	146	90	310

Experiment B3: HBS MBA, Incentivized

	Investment Experience		Worked in Finance	
	No/Limited	Some/Extensive	No	Yes
β	7.31	10.56	7.66	10.02
	[1.96]	[2.57]	[2.06]	[2.47]
N	222	178	230	170

Benchmark Results: Controls

$$Y_i = \alpha + \beta Low_i + X_i'\gamma + \epsilon_i$$

- Gender: males more risk taking in most cases
- Education, age, wealth: no consistent impact
- Investment/work experience: weak positive impact
- Risk tolerance: significant impact
  - Treatment effect of low rate condition (8 pp) $\sim$ risk tolerance $\uparrow$ by 1/3 of individuals in each sample

Summary Stat: MTurk, Hypothetical

		Low		High	
		N	%	*N*	%
Gender	Male	82	40.0	102	52.3
	Female	123	60.0	93	47.7
Education	Graduate school	38	18.5	30	15.4
	College	112	54.6	118	60.5
	High school	53	25.9	45	23.1
Age	Below 30	103	50.2	98	50.3
	30–40	63	30.7	56	28.7
	40–50	16	7.8	25	12.8
	Above 50	23	11.2	16	8.2
Financial wealth (ex. housing)	200K+	10	4.9	17	8.7
	50K–200K	56	27.3	56	28.7
	10K–50K	57	27.8	43	22.1
	0–10K	59	28.8	51	26.2
	In debt	23	11.2	28	14.4
Investing experience	Extensive	7	3.4	6	3.1
	Some	61	29.8	60	30.8
	Limited	88	42.9	75	38.5
	No	49	23.9	54	27.7
Total		205		195	

Summary Stat: MTurk, Incentivized

		Low		High	
		N	%	*N*	%
Gender	Male	116	56.6	111	56.9
	Female	89	43.4	84	43.1
Education	Graduate school	30	14.6	33	16.9
	College	122	59.5	125	64.1
	High school	52	25.4	35	17.9
Age	Below 30	103	50.2	88	45.1
	30–40	54	26.3	66	33.9
	40–50	30	14.6	23	11.8
	Above 50	18	8.8	18	9.2
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	50K–200K	47	22.9	55	28.2
	10K–50K	60	29.3	58	29.7
	0–10K	42	20.5	35	17.9
	In debt	31	15.1	25	12.8
Investing experience	Extensive	6	2.9	6	3.1
	Some	68	33.2	66	33.8
	Limited	83	40.5	75	38.5
	No	48	23.4	48	24.6
Total		205		195	

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	No	48	23.4	48	24.6
		201		199	

Robustness to Payment Structure

Mean Allocations to Risky Asset

	High: 5—10	Low: 1—6	**Dif**	[t]	U test (p)
Proportional, immediate	59.20	66.68	7.48	[2.64]	(0.00)
Proportional, one year	60.63	67.79	7.16	[2.43]	(0.01)
Randomized, immediate	58.07	66.80	8.73	[3.13]	(0.00)
Randomized, one year	58.58	66.64	8.06	[3.06]	(0.00)

Investment Allocation Benchmark

- Mean-variance analysis:
  - Sharpe ratio matters; r_f per se does not matter.
- General case:
  - Utility function twice differentiable and concave
    Decreasing *absolute* risk aversion $\Rightarrow$ Risky allocation $\uparrow$ when $r_f \uparrow$
  - Intuition: high interest rate condition $\Rightarrow$ slightly wealthier
- Dynamic portfolio choice:
  - Dynamic hedging, life cycle portfolio choice

Additional Discussion

Dynamic hedging

- perceive better hedging property when assigned to low rate condition?
- weight on hedging component increasing in risk aversion
- our findings do not vary with general level of risk aversion

Life cycle

- model mechanisms driven by labor income
- mechanisms generally diminish with age and weak for retirees
- our findings are strong among elderly people

Forms of Reference Points

1. Psychological anchors
2. Savings/consumption targets
3. Performance targets

All tend to be history dependent.

What if world always had 0% interest rates?

Alternative Theories of Reference Points

1. Status quo wealth level: $r_{ref} = 0$
   - Kahneman-Tversky 79
   - $r_{ref} < r_f$
2. Risk-free rate : $r_{ref} = r_f$
   - Barberis-Huang-Santos 01
3. Rational expectations of asset returns in the investment choice set
   - Koszegi-Rabin 06

In the last two cases, when r_f changes while excess returns are held fixed

- Returns on all assets and the reference point move in parallel
- Allocation to the risky asset stays the same

Nominal Illusion

- Investors may confuse real and nominal returns
  - Modigliani-Cohn 79; Campbell-Vuolteenaho 04; Cohen-Polk-Vuolteenaho 05
- Nominal illusion *alone* does not generate reaching for yield
  - Sharpe ratio not affected by whether people think about returns in nominal or real terms
- "Nominal illusion" may interact with reference dependence
  - Reference points could be more about nominal returns

Inflation

- Reference points could be nominal
  - low inflation $\Rightarrow$ low nominal interest rate, vice versa

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  - low inflation $\Rightarrow$ low nominal interest rate, vice versa
- Inflation hedging?
  - Inflation (risks) higher when (nominal) rates high
    - ★ if risky asset hedges inflation (?), could work against us

Inflation

- Reference points could be nominal
  - low inflation $\Rightarrow$ low nominal interest rate, vice versa
- Inflation hedging?
  - Inflation (risks) higher when (nominal) rates high
    - ★ if risky asset hedges inflation (?), could work against us
  - Hedging demand depend on risk aversion
    - ★ our results do not vary much with level of risk aversion

Narrow Framing

- Investors have tendency to consider investment problems in isolation
  - rather than mingling them with other risks
- Important for explaining many things (Barberis-Huang-Thaler 06)
  - e.g. lack of risk neutrality to modest risks
- Plausibly participants frame the investment problem narrowly
- More sources of reference points outside of narrow framing

Diminishing Sensitivity

DS: utility concave above reference point; convex below

- DS above the reference point contributes to reaching for yield
  - if $r_p > r_{ref}$ and $r_f \downarrow$, excess returns $\Rightarrow$ higher marginal utility gain
- DS below the reference point theoretically ambiguous
  - if $r_{ref} > r_p > r_f$ and $r_f \downarrow$, excess returns $\Rightarrow$ lower marginal utility gain
  - if $r_p < r_f$ and $r_f \downarrow$, excess returns $\Rightarrow$ lower marginal utility loss
- Quantitatively: contributes to reaching for yield, but impact small

Reference Dependence Functional Forms

With Kahneman-Tversky specification (state-by-state evaluation):

- When $r_f > r_{ref}$, $r_f \downarrow \Rightarrow$ allocation to risky asset $\phi^* \downarrow$
- Reaching against yield, i.e. $\partial \phi^* / \partial r_f > 0$.
- Intuition: when $r_f > r_{ref}$ but falls,
  - Safe asset does not incur utility loss from loss aversion
  - Risky asset has a higher chance of getting into the loss region

If reference point in average returns, no "reaching against yield" prediction

Alternative Formulation of Reference Dependence

- Reference point about mean returns, instead of state by state.
- Formalize through a variant of mean-variance analysis

$$\max_{\phi \in [0,1]} v\left(\mathbb{E}r_p, r_r\right) - \frac{\gamma}{2} Var\left(r_p\right)$$

- $v\left(\mathbb{E}r_p, r_r\right) = \begin{cases} \mathbb{E}r_p - r_r & \mathbb{E}r_p \geq r_r \\ -\lambda\left(r_r - \mathbb{E}r_p\right) & \mathbb{E}r_p < r_r \end{cases}$,
- Fix excess return x, allocation to risky asset (weakly) decreasing in r_f.

$$\phi^*_{mv,r} = \begin{cases} \frac{\mathbb{E}x}{\gamma Var(x)} & \frac{(\mathbb{E}x)^2}{\gamma Var(x)} + r_f > r_r \\ \frac{r_r - r_f}{\mathbb{E}x} & \frac{\lambda(\mathbb{E}x)^2}{\gamma Var(x)} + r_f \geq r_r \geq \frac{(\mathbb{E}x)^2}{\gamma Var(x)} + r_f \\ \frac{\lambda \mathbb{E}x}{\gamma Var(x)} & \frac{\lambda(\mathbb{E}x)^2}{\gamma Var(x)} + r_f < r_r \end{cases}.$$

History Dependent Reference Point

2 similar households:

- Household A: moves from San Francisco to Chicago
- Household B: moves from Detroit to Chicago

All else equal, A is likely to buy/rent a larger home than B

History Dependent Reference Point

Is 20° F winter day cold?

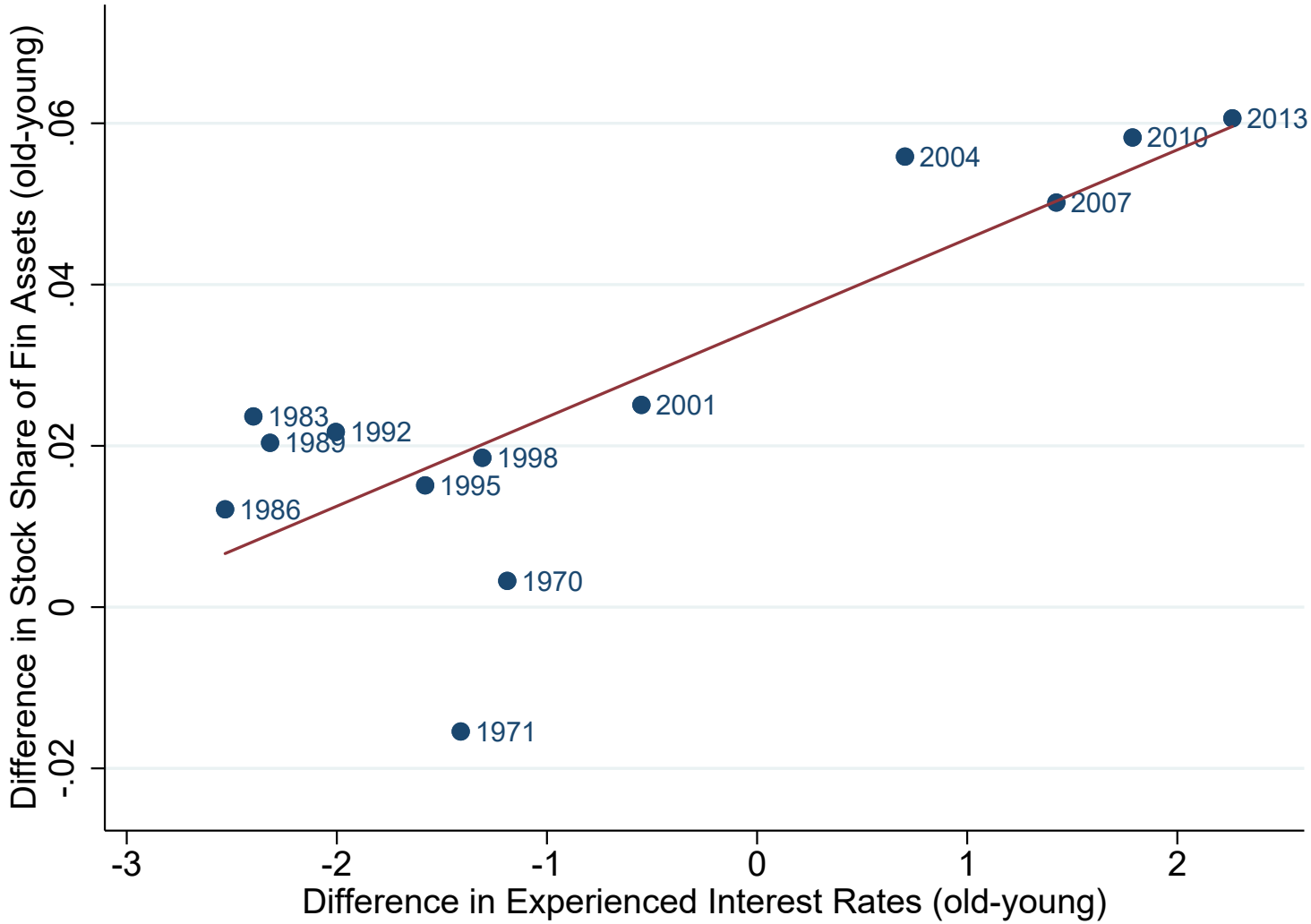
Long-term experiences:

- Floridian vs. Bostonian

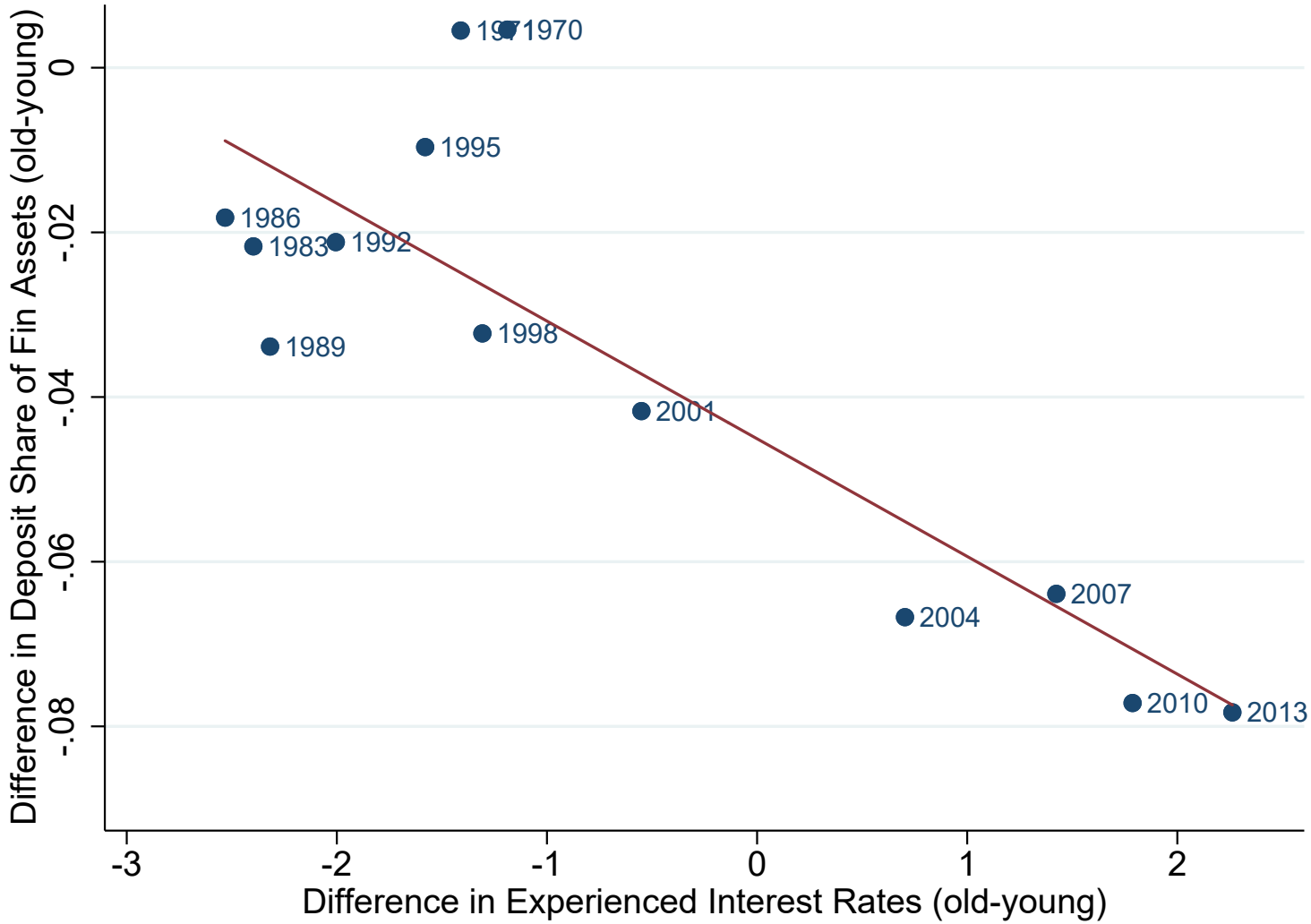
Short-term experiences:

- Bostonian vacationed in Florida vs. Bostonian vacationed in Montreal

SCF: Difference in Stock Shares across Cohorts



SCF: Difference in Deposit Shares across Cohorts



Salience and Proportional Thinking

Example 1

- Drive 5 extra miles to save $200 on $800 furniture
- Drive 5 extra miles to save $200 on $30,000 car

Example 2

- French syrah from Rhone Valley vs. Australian shiraz (same grape)
- Store: $20 vs. $10. Restaurant: $50 vs. $40

Monetary Policy Shocks

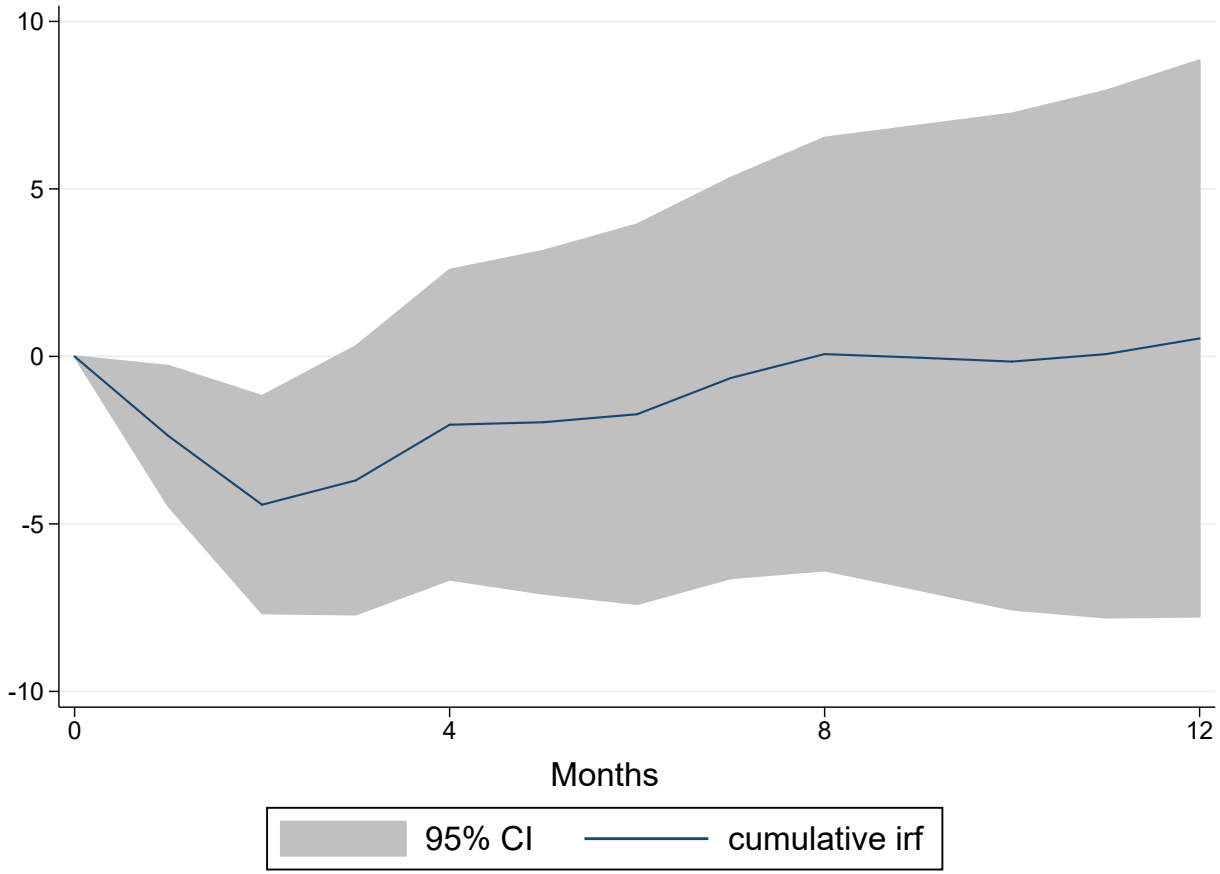
Panel A. Change in Mean Allocations to Stocks (AAII)								
Romer-Romer	-3.89	-4.48	-4.24	-5.05				
	[-2.82]	[-2.89]	[-2.77]	[-3.12]				
Gertler-Karadi					-3.52	-2.73	-2.87	-3.66
					[-1.06]	[-0.80]	[-0.83]	[-1.03]
Panel B. Change in Mean Allocations to "Cash" (AAII)								
Romer-Romer	2.89	3.26	3.11	3.64				
	[2.30]	[2.34]	[2.22]	[2.52]				
Gertler-Karadi					1.40	0.80	0.87	1.35
					[0.45]	[0.25]	[0.27]	[0.40]
Panel C. Equity Mutual Fund Flows (ICI)								
Romer-Romer	-0.05	-0.13	-0.25	-0.56				
	[-0.22]	[-0.56]	[-1.18]	[-1.60]				
Gertler-Karadi					-1.29	-1.30	-1.32	-1.52
					[-2.71]	[-2.80]	[-2.75]	[-2.97]
Panel D. High Yield Corp. Bond Mutual Fund Flows (ICI)								
Romer-Romer	-1.40	-1.22	-1.19	-1.34				
	[-2.25]	[-1.90]	[-1.83]	[-1.44]				
Gertler-Karadi					-2.61	-2.40	-2.58	-2.53
					[-1.51]	[-1.40]	[-1.51]	[-1.52]
Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Newey-West t-statistics in brackets

SVAR Specifications

- Inputs and order (slowest moving first)
  - economic conditions
    - ★ inflation and industrial production
  - portfolio allocations/flows
  - capital market conditions
    - ★ investor sentiment, VIX^2, P/E10
  - 3-month Treasury rate
- Order short rate last to be conservative

Interest Rates and Excess Stock Returns



Sources of Low Interest Rates

1. Monetary policy
2. Shortage of safe assets (e.g. Chinese government demand)
3. Low productivity growth...