What Drives Investors' Portfolio Choices? Separating Risk Preferences from Frictions

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Motivating example

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    - loss-aversion (Gomes 2005)
    - disappointment-aversion (Ang et al. 2005)
    - ambiguity-aversion (Epstein and Wang 1994)
    - news-utility (Pagel 2018)
    - rank-dependence (Chapman and Polkovnichenko 2009)
    - narrow framing (Barberis et al. 2006)
    - background risk (Benzoni et al. 2007; Catherine 2019)
    - disaster risk (Fagereng et al. 2017)
    - pessimistic beliefs (Briggs et al. 2021)
    - lack of trust (Guiso et al. 2008)

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2. prefers stocks, but faces frictions such as...
   - per-period participation costs (Vissing-Jørgensen 2002; Fagereng et al. 2017; Briggs et al. 2021)
   - one-time adjustment or participation costs (Haliassos and Michaelides 2003; Gomes and Michaelides 2005; Abel et al. 2013)

Preferences or frictions?

- Separating risk preferences from frictions is important
  - positive: distinguishing between theories or calibrating models
  - **normative**: welfare effects of nudging people to hold more stocks (e.g. TDFs)
- Problem: hard to do so because with frictions, observed choices $\neq$ preferences!
- **This paper**: separately identify preferences & frictions as drivers of portfolio choice

Our findings

1. **Cross-sectional**: difficult to separate frictions from risk preferences
   - the life cycle of participation from SCF is consistent with **both**:
     - high risk-aversion + small participation or adjustment costs
     - low risk-aversion + large participation or adjustment costs
2. **Quasi-experiment**: investors' portfolio choices differ from their preferences
   - non-parametric framework + variation in 401(k) default asset allocations give:
     - $\approx$ **94%** of investors prefer stock market participation absent frictions
     - average preferred stock share is $\approx$ **76%** and **declines** over the life cycle
3. **Structural model**: evidence consistent with RRA $\approx$ **2.5** and adjustment cost $\approx$ **$160**

   ✓ quasi-experimental variation useful for identifying structural preference parameters

Outline

Outline

RRA in life cycle portfolio choice

Paper	Friction	Estimate
Fagereng et al. (2017)	per-period cost	14.4
Dahlquist et al. (2018)	one-time cost	14
Fagereng et al. (2017)	per-period cost	11.8
Catherine (2020)	none	11.6
Fagereng et al. (2017)	per-period cost	11
Cocco et al. (2005)	none	10
Reher and Sokolinski (2021)	per-period cost	9.1
Catherine (2020)	per-period cost	8.2
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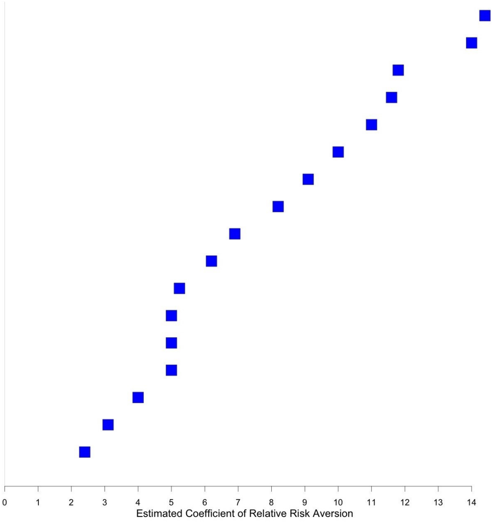
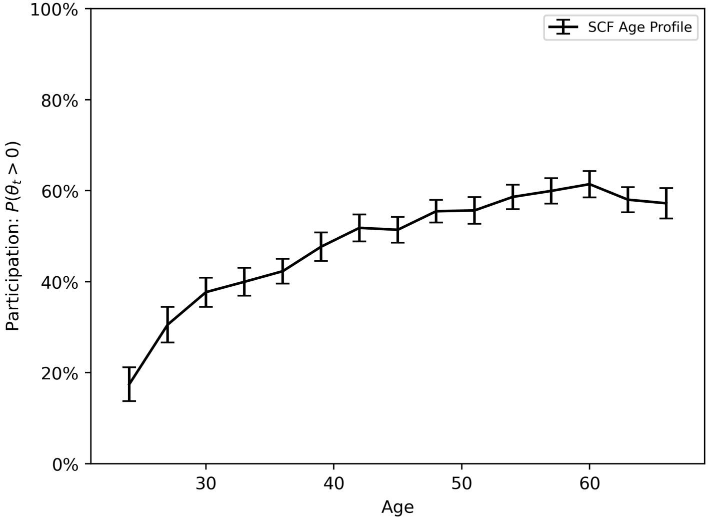
Calvet et al. (2020)	none	5.24
Gomes and Michaelides (2005)	one-time cost	5
Campanale et al. (2015)	one-time cost	5
Benzoni et al. (2007)	none	5
Gomes et al. (2009)	one-time cost	4
Briggs et al. (2021)	one-time cost	3.1
Briggs et al. (2021)	one-time cost	2.4
Average		**7.82**



Risk preferences or frictions?



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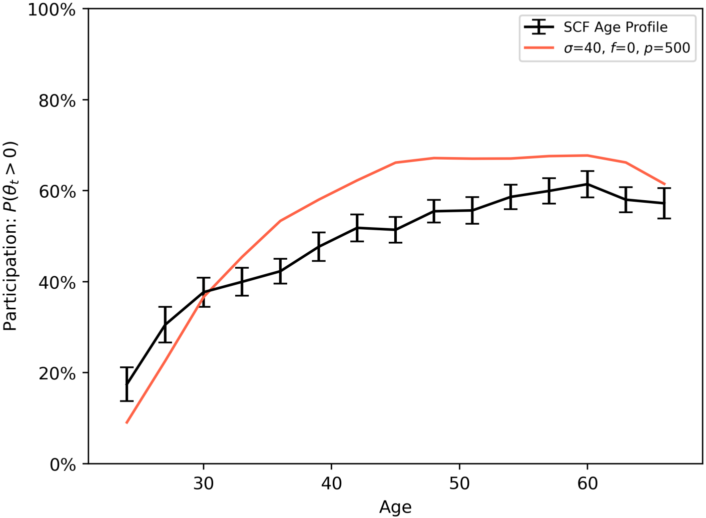

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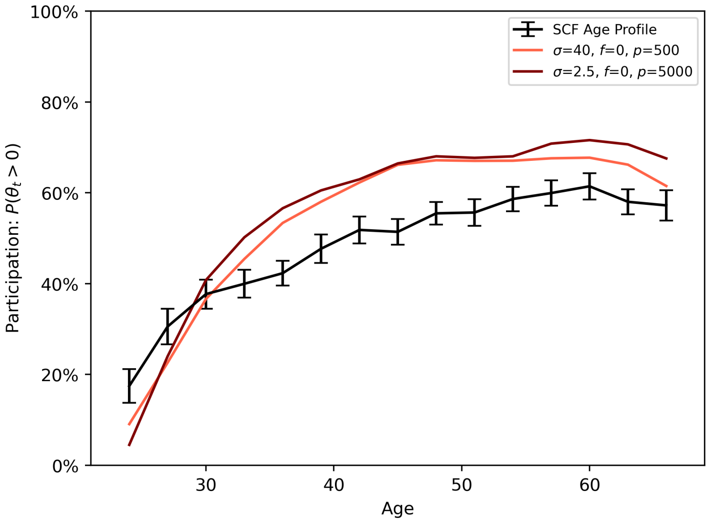

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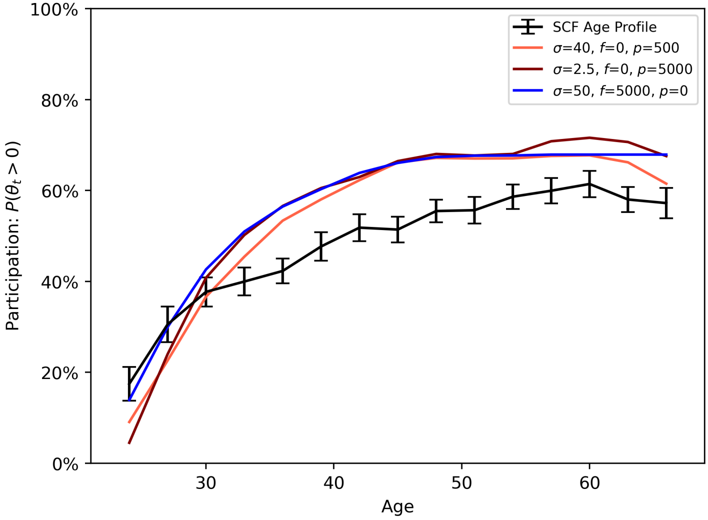

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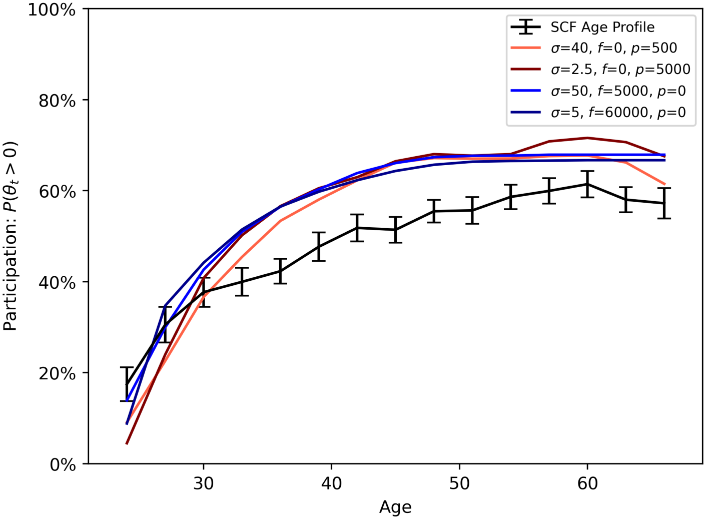

Outline

Data and Identifying Variation

Data description

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  1. need access to employer-sponsored DC plan
     - ✓ $\approx$ 67% of civilian workforce (Myers and Topelski 2020)
  2. must be with our provider
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     - ✓ median age (41), income ($34K), and average balance ($70K) similar to US population
- **Data limitation II**: only observe 401(k) with current employer
  1. individuals may invest outside retirement accounts
     - ✓ 85% of investments held in retirement accounts (SCF 2007-2016)
  2. individuals may invest differently in account with current employer
     - ✓ keep track of current and previous 401(k) and outside savings in model

▸ summary stats ▸ SCF

The ideal experiment

Goal: separately identify investors' risk preferences from choice frictions

- **Ideal experiment:** give an investor an account with stocks $\Rightarrow \downarrow$ frictions
- Potential outcomes:
  1. investor sells stocks $\Rightarrow$ prefers non-participation (e.g. loss aversion)
  2. investor keeps stocks $\Rightarrow$ frictions (e.g. adjustment costs) matter

Approximating the ideal experiment

Goal: separately identify investors' risk preferences from choice frictions

- **Ideal experiment:** give an investor an account with stocks $\Rightarrow \downarrow$ frictions
- **Quasi-experiment #1**: 6 firms changing 401(k) default asset allocation
  - control: 1,086 investors auto-enrolled into a money market fund
  - treatment: 1,321 investors auto-enrolled into a target date fund

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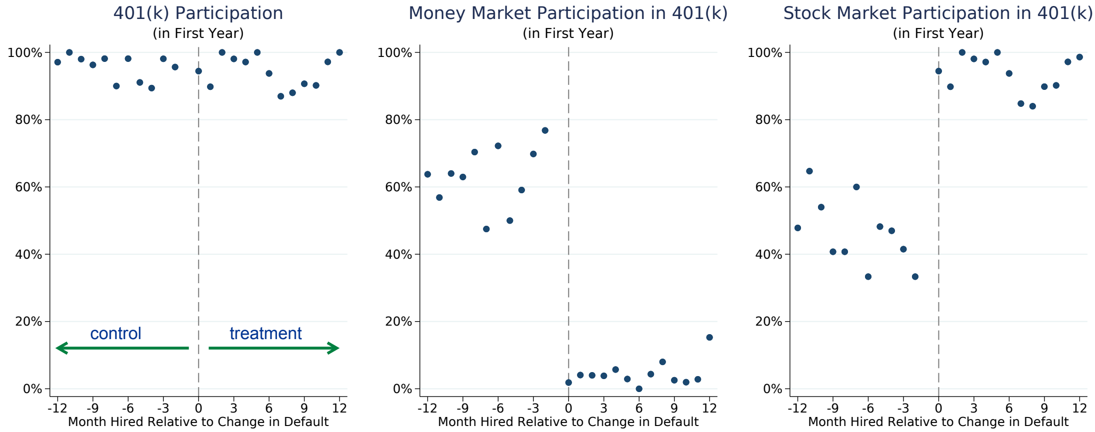
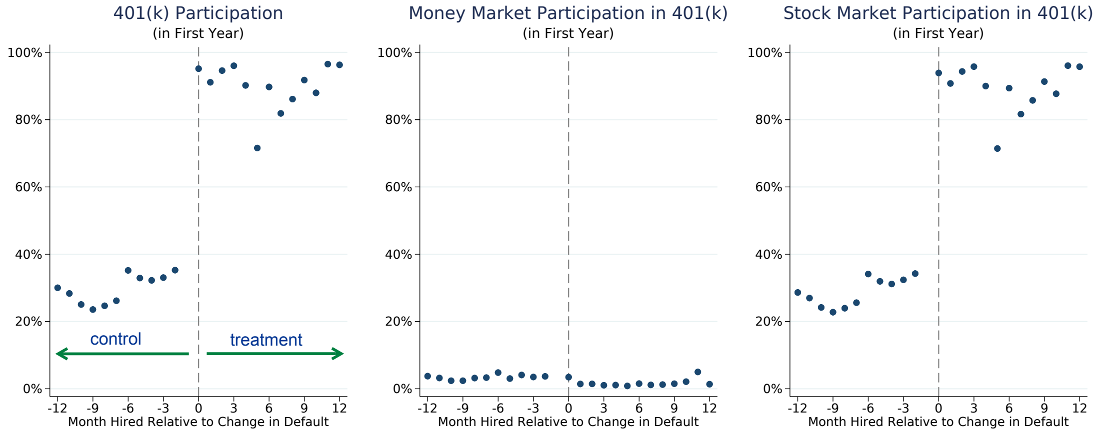
✓ Note: experiments don't remove per-period costs $\Rightarrow$ **lower bound** on impact of frictions

Identifying variation: experiment #1



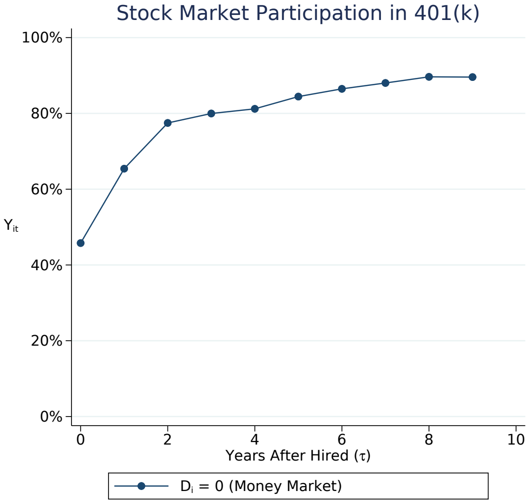
▸ balance checks

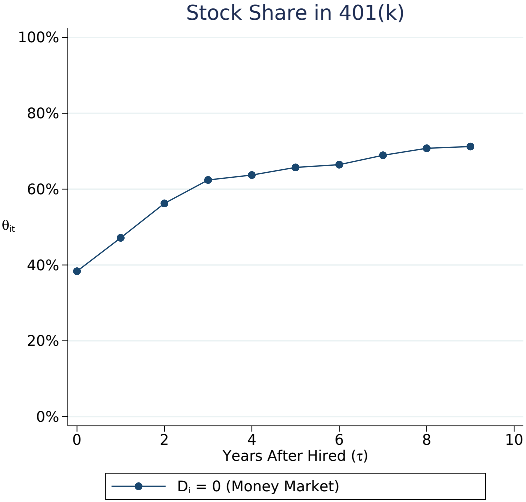
Identifying variation: experiment #2



balance checks timing

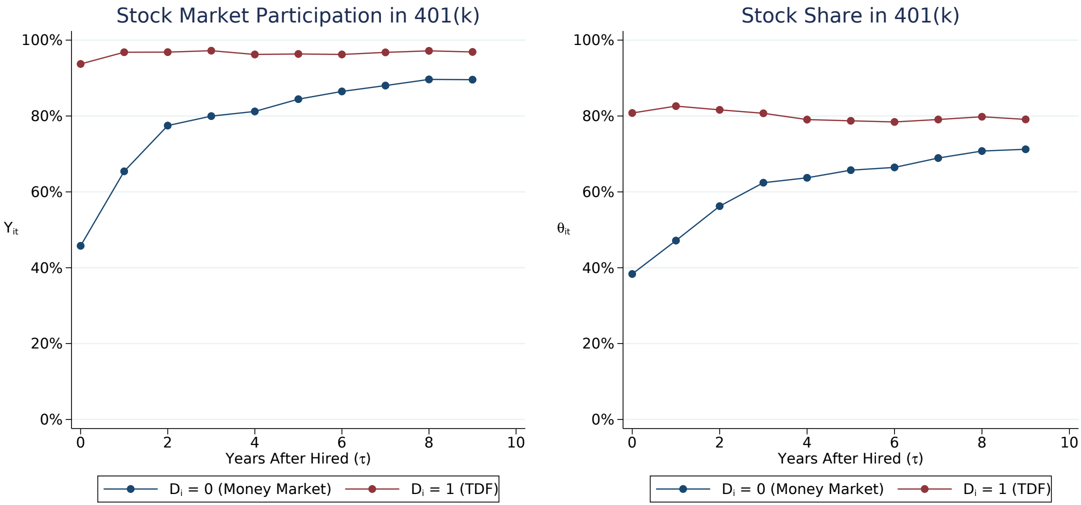
Observed portfolio choice response





opt-in sample
means

Observed portfolio choice response



opt-in sample   means

Observed portfolio choice response: robustness

Portfolio choice response is not driven by

- **peer effects:** similar choices for employees hired multiple years pre-policy
- **survivorship bias:** similar choices for employees across tenures in the job
- **passive rebalancing:** similar asset allocation for new contributions

Estimating Preferences

Identification intuition

- **Goal**: separate risk preferences from frictions

	Investor Types
401(k) Default	
Bonds	
Stocks	
Consistent Prefers Stocks	

Identification intuition

- **Goal**: separate risk preferences from frictions

	Investor Types
401(k) Default	Type 1
Bonds	Bonds
Stocks	Stocks
Consistent	✗
Prefers Stocks	**?**

Identification intuition

- **Goal**: separate risk preferences from frictions

	Investor Types	
401(k) Default	Type 1	Type 2
Bonds	Bonds	Bonds
Stocks	Stocks	Bonds
Consistent	✗	✓
Prefers Stocks	?	✗

Identification intuition

- **Goal**: separate risk preferences from frictions

	Investor Types		
401(k) Default	Type 1	Type 2	Type 3
Bonds	Bonds	Bonds	Stocks
Stocks	Stocks	Bonds	Stocks
Consistent	✗	✓	✓
Prefers Stocks	?	✗	✓

Identification intuition

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	Investor Types		
401(k) Default	Type 1	Type 2	Type 3
Bonds	Bonds	Bonds	Stocks
Stocks	Stocks	Bonds	Stocks
Consistent	✗	✓	✓
Prefers Stocks	?	✗	✓

- Distribution of three types in population reveals:
  - average preference for stocks $\approx$ # Type 2 vs. # Type 3
  - size of frictions $\approx$ # Type 1
- **Key challenge**: inferring preferences of passives $\Rightarrow$ try different identifying assumptions

Formal framework

Goldin and Reck (2020)

- Environment: investor i chooses portfolio at $t \geq 0$ after default set at $t = 0$
- Notation:
  - $D_i \in \{0, 1\}$ = default
  - $Y_{it} \in \{0, 1\}$ = observed participation, $\theta_{it} \in [0, 1]$ = observed stock share
  - $Y^*_{it} \in \{0, 1\}$, $\theta^*_{it} \in [0, 1]$ = **unobserved** preferences
- Two types of people in population:
  - consistent = choices unaffected by frictions (bond-lovers & stock-lovers) $\Rightarrow C_{it} = 1$
  - **in**consistent = choices **affected** by frictions (passives) $\Rightarrow C_{it} = 0$

Identifying assumptions

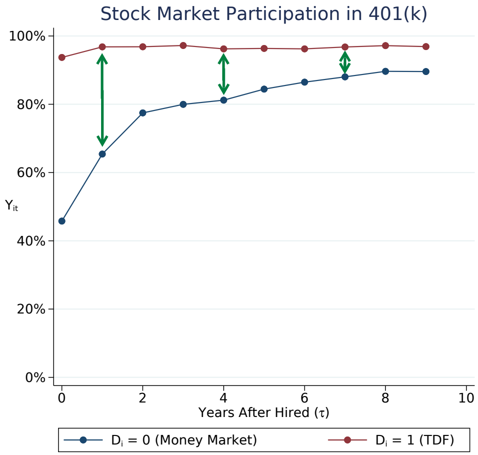
A1 **Frame separability**: investors' preferences unaffected by default

A2 **Frame exogeneity**: default chosen by firm is independent of investors' preferences

A3 **Consistency principle**: participate under both defaults $\Rightarrow$ prefer to participate

A4 **No defiers**: there are no types that always choose opposite of default

Bounding population preferences



A1-A4 $\Rightarrow$ at $\tau = 2$, $E\left(Y_{it}^{*}\right) \in [78\%, 95\%]$

▸ opt-in sample

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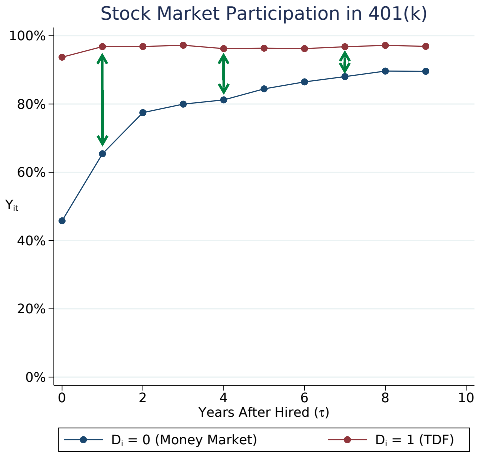

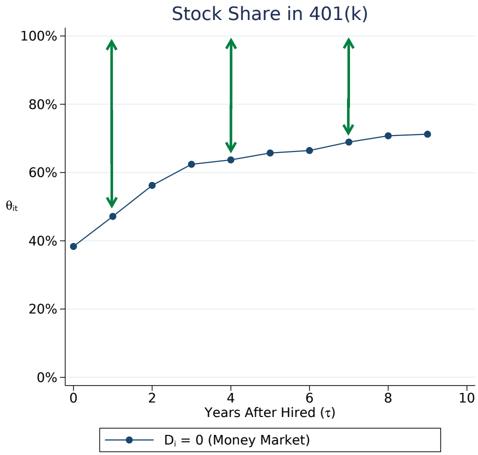

A1-A4 $\Rightarrow$ at $\tau = 2$, $E\left(Y^*_{it}\right) \in [78\%, 95\%]$

A1-A4 $\Rightarrow$ at $\tau = 2$, $E\left(\theta^*_{it}\right) \geq 58\%$

▸ opt-in sample

Identifying assumptions

A1 Frame separability: investors' preferences unaffected by default

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$$\underbrace{E_\tau\left(\theta_{it}^*\right)}_{\text{population preferences}} = \underbrace{E_\tau\left(\theta_{it}^* \mid C_{it} = 1\right)}_{\text{consistent preferences}} - \text{constant} * \underbrace{cov_\tau\left(\theta_{it}^*, C_{it}\right)}_{\text{selection}}$$

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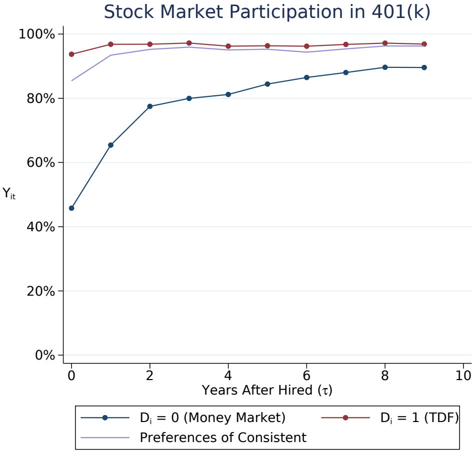
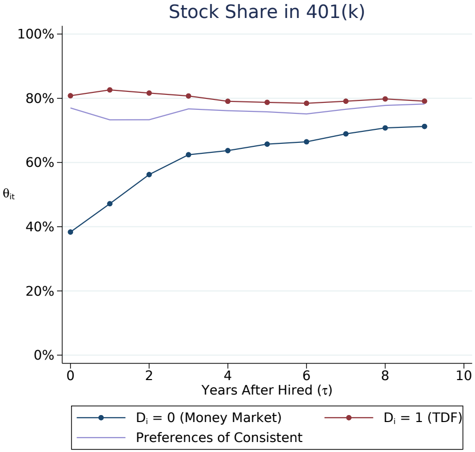
A5 **Consistency independence**: preferences consistent = inconsistent (with same tenure)

Average preferences





$E_\tau\left(Y_{it}^*\right) \approx 94\%$

$E_\tau\left(\theta_{it}^*\right) \approx 76\%$

▸ test of A5 ▸ by default ▸ opt-in sample ▸ # consistent

Preferences over the Life Cycle

Relaxing consistency independence

$$E_\tau\left(\theta^*_{it}\right) = \underbrace{E_\tau\left(\theta^*_{it} \mid C_{it} = 1\right)}_{\text{prior slide}} - \text{constant} * \underbrace{cov_\tau\left(\theta^*_{it}, C_{it}\right)}_{\text{selection}}$$

- Consistency independence (A5) might be violated due to age effects

  A6 **Conditional consistency independence**: consistent & inconsistent have same preferences

  1. *conditional* on tenure at firm
  2. *conditional* on age when hired

- Replacing A5 with A6, can identify:

  1. average population preferences by conditioning on age + tenure
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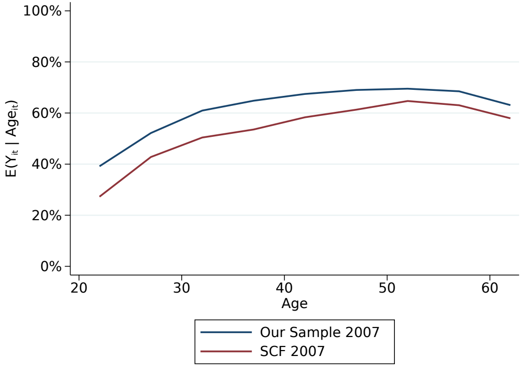
✓ Results robust to conditioning on income as well

Participation: choices vs. preferences



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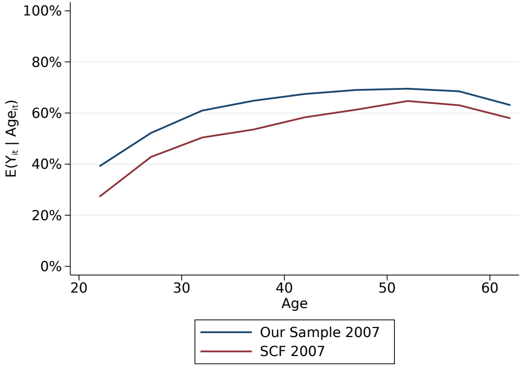
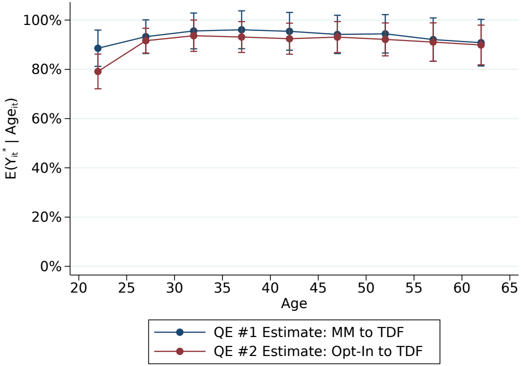
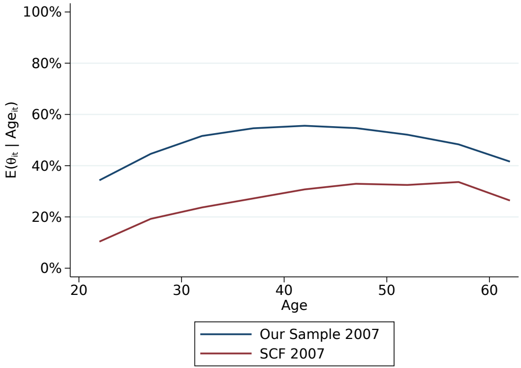




Stock share: choices vs. preferences



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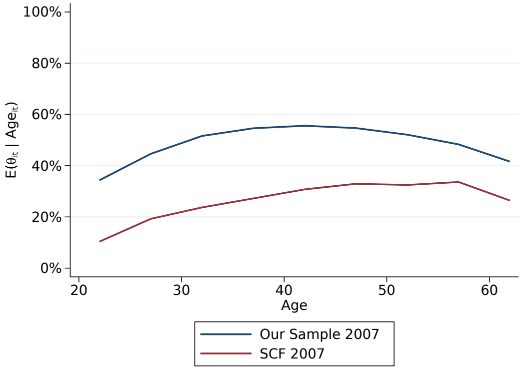

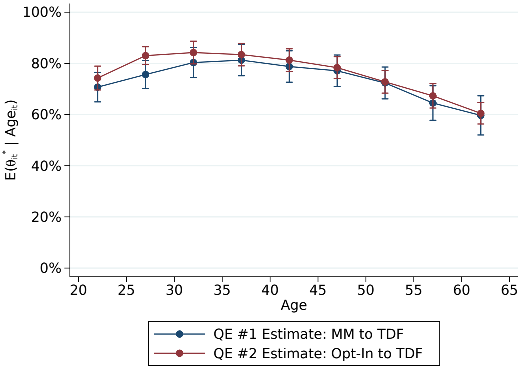

- Absent frictions, preferences look more consistent with textbook life cycle theory Merton (1971)

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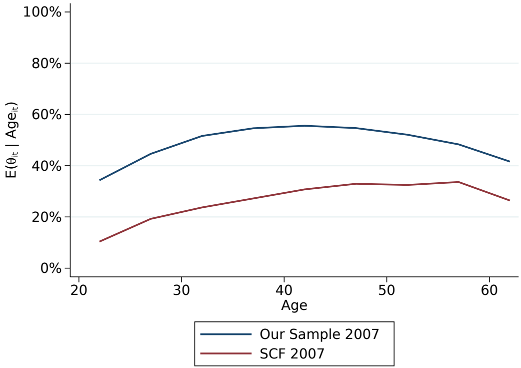

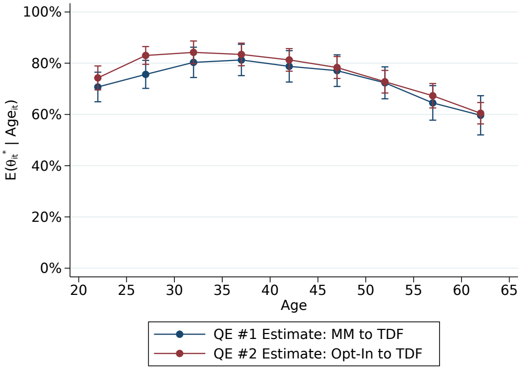

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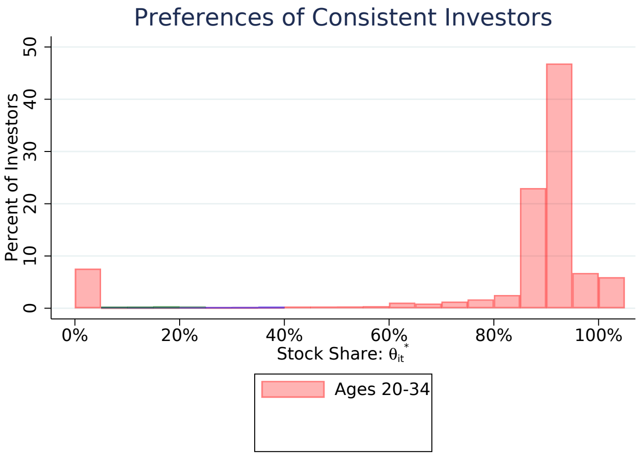
▸ sold TDF

Preference heterogeneity increases with age



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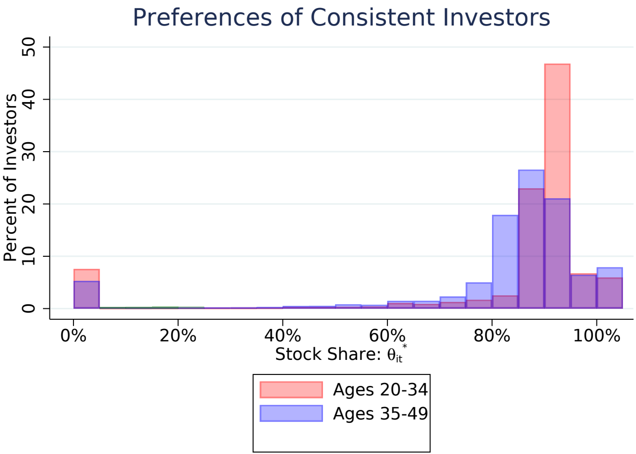

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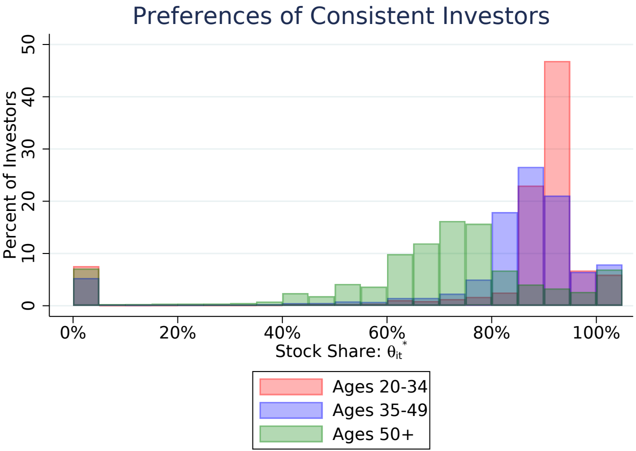
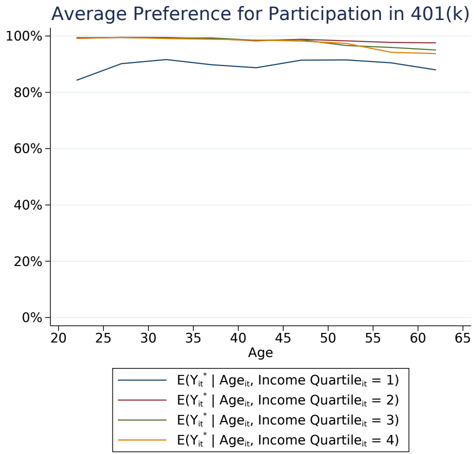
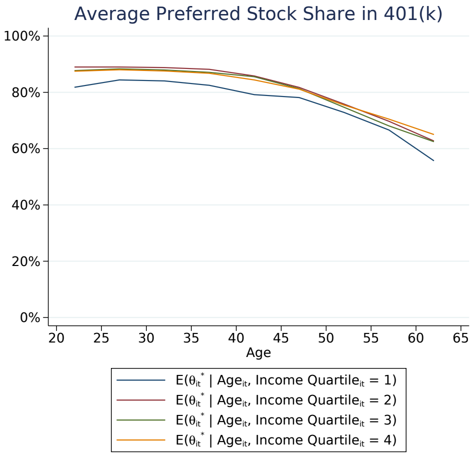
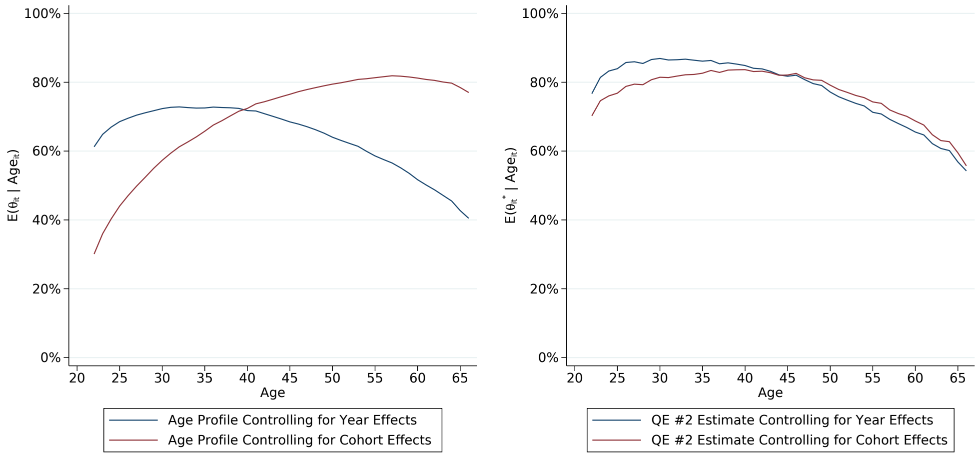


Minimal preference heterogeneity by income





No cohort or year effects in preferences



⇒ Year/cohort effects in choices might be driven by frictions changing!

Outline

Model Description

Model summary

We build a rich life cycle portfolio choice model with default effects

1. **Three savings accounts**: liquid savings and illiquid tax-exempt DC retirement account
   - liquid savings goes into liquid asset
   - retirement savings with current employer allocated between stocks and bonds
   - accumulated retirement savings with past employers

2. **Adjustment costs**: changing portfolio or contribution rate requires incurring utility cost

3. **Asset allocation:** can choose different portfolios for existing and new DC contributions

4. **Uncertainty:** about earnings and employment ⇒ value of delaying adjustments

▸ SMM

Model: adjustment costs

- Class of models can be represented via cost of adjusting from default (Masatlioglu and Ok 2005)

- Two adjustment costs:
  - k_θ = portfolio adjustment cost
  - k_s = retirement account contribution adjustment cost

$$\text{flow utility} = u\left(c - k_\theta * 1_{\{\theta \neq \theta_d, \Theta \neq \Theta_d\}} - k_s * 1_{\{s^{dc} \neq s_d\}}\right)$$

- Adjustment costs could capture
  - **real costs** = filling out form, transaction costs, paying for professional advice
  - **attention costs** = cost of considering full menu of choices (Masatlioglu et al. 2012)
  - **optimization costs** = hassle cost of comparing different scenarios (Ortoleva 2013)

- Parismonious: same cost for all investors and periods

Model: environment

- **Preferences**: recursive Epstein-Zin-Weil to separate EIS and RRA
  - consumption adjusted for equivalence scale

- **Employment states** (emp_t):
  1. employed for employer: $\text{income}_t = f(age_t) * \text{AR1 productivity shock}_t^E$
  2. job-transition between employers: $\text{income}_t = f(age_t) * \text{AR1 productivity shock}_t^{JJ}$
  3. unemployment: UI benefits = 40% replacement of last wage
  4. retirement at age 65: SS benefits = 40% of average wage

- **Financial assets**:
  1. Liquid asset: $1 + r(1 - \tau_c)$
  2. Risk-free bond: $R_f = 1 + r$
  3. Risky stock: $\ln R_t = \ln R_f + \mu + \varepsilon_t$, $\varepsilon_t \sim N(0, \sigma^2)$

Model: savings accounts

- **Liquid savings account**:

$$L_{t+1} = \left(L_t + s_t^l\right)\left[1 + r\left(1 - \tau_c\right)\right], \quad L_t \geq 0$$

- **DC retirement account**:
  - new contributions subject to employer match up to cap with vesting risk
  - θ_t^j = share of new contributions in asset $j \in \{B, S\}$
  - Θ_t^j = share of existing savings in asset $j \in \{B, S\}$

$$A_{t+1} = A_t * \text{return}(\Theta_t^j) + \text{new contributions} * \text{return}(\theta_t^j)$$

  - need to separate portfolio choices because of adjustment costs!

- **Taxation**:
  - taxes on wages and DC withdrawals, DC contributions tax-exempt
  - capital gains tax on liquid wealth returns, DC capital gains tax-free

Model: defaults

- **Default portfolio shares**:

$$\text{new contributions}: \quad \theta^j_{d,t} = \begin{cases} \text{default asset allocation}_e & \text{if } emp_t = JJ, \\ \theta^j_{t-1} & \text{else.} \end{cases}$$

$$\text{existing assets}: \quad \Theta^j_{d,t} = \Theta^j_{t-1} * \text{adjustment for realized returns}_t$$

- **Default DC contribution rate**:

$$s_{d,t} = \begin{cases} \text{default savings rate}_e & \text{if } emp_t = JJ, \\ s^{dc}_{t-1} & \text{else.} \end{cases}$$

Model: investors' problem

$$V(\boldsymbol{X_t}) = \max_{\boldsymbol{Y_t}} \left\{ (1-\beta) n_t \left[\frac{c_t - k_\theta * 1_{\left\{\theta_t^j \neq \theta_{d,t}, \Theta_t^j \neq \Theta_{d,t}\right\}} - k_s * 1_{\left\{s_t^{dc} \neq s_{d,t}\right\}}}{n_t} \right]^{1-\sigma} + \beta \left[m_t E_t V(\boldsymbol{X_{t+1}})^{1-\gamma} \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

Model: investors' problem

$$V(\boldsymbol{X_t}) = \max_{\boldsymbol{Y_t}} \left\{ (1-\beta) n_t \left[\frac{c_t - k_\theta * 1_{\{\theta_t^j \neq \theta_{d,t}, \Theta_t^j \neq \Theta_{d,t}\}} - k_s * 1_{\{s_t^{dc} \neq s_{d,t}\}}}{n_t} \right]^{1-\sigma} + \beta \left[m_t E_t V(\boldsymbol{X_{t+1}})^{1-\gamma} \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

10 state variables $\boldsymbol{X_t} = \{\mathbf{age_t}, \boldsymbol{emp_t}, \boldsymbol{L_t}, \boldsymbol{A_t}, \boldsymbol{\eta_t}, \boldsymbol{ten_t}, \boldsymbol{ae_t}, \boldsymbol{s_{d,t}}, \boldsymbol{\theta_{d,t}}, \boldsymbol{\Theta_{d,t}}\}$:

- $\mathbf{age_t}$: age in years
- $\boldsymbol{emp_t}$: employment status
- $\boldsymbol{L_t}$: liquid wealth
- $\boldsymbol{A_t}$: DC retirement wealth
- $\boldsymbol{\eta_t}$: labor productivity
- $\boldsymbol{ten_t}$: tenure in current job
- $\boldsymbol{ae_t}$: average lifetime income
- $\boldsymbol{s_{d,t}}$: default contribution rate
- $\boldsymbol{\Theta_{d,t}}$: default risky share of existing balance
- $\boldsymbol{\theta_{d,t}}$: default risky share for new contributions

Model: investors' problem

$$V(\boldsymbol{X_t}) = \max_{\boldsymbol{Y_t}} \left\{ (1-\beta) n_t \left[\frac{c_t - k_\theta * 1_{\left\{\theta_t^j \neq \theta_{d,t}, \Theta_t^j \neq \Theta_{d,t}\right\}} - k_s * 1_{\left\{s_t^{dc} \neq s_{d,t}\right\}}}{n_t} \right]^{1-\sigma} + \beta \left[m_t E_t V(\boldsymbol{X_{t+1}})^{1-\gamma} \right]^{\frac{1-\sigma}{1-\gamma}} \right\}^{\frac{1}{1-\sigma}}$$

4 choice variables $\boldsymbol{Y_t} = \left\{ \boldsymbol{s_t^l}, \boldsymbol{s_t^{dc}}, \boldsymbol{\theta_t}, \boldsymbol{\Theta_t} \right\}$:

- $\boldsymbol{s_t^l}$: liquid savings next period
- $\boldsymbol{s_t^{dc}}$: DC contribution rate
  - $s_t^{dc} \geq 0$ when employed
  - $s_t^{dc} \leq 0$ when unemployed/retired
- $\boldsymbol{\theta_t}$: risky share for new contributions
- $\boldsymbol{\Theta_t}$: risky share of existing balance

Estimation and Model Fit

Estimation strategy

- **Estimation**: SMM with optimal weighting matrix

- **Moments (38)**:
  - response of stock market participation to default change = QE #1 (14)
  - stock share by age in first year under MM and TDF default = QE #1 (16)
  - contribution rates in first-year under opt-in and AE (8)

- **Identification of preference parameters (5)**:
  - γ = stock shares of consistent investors
  - k_θ = bunching at default 401(k) asset allocation
  - k_s = bunching at default 401(k) contribution rate
  - β = average level of 401(k) contributions
  - σ = bunching in contribution rates at match cap (Best et al. 2017)

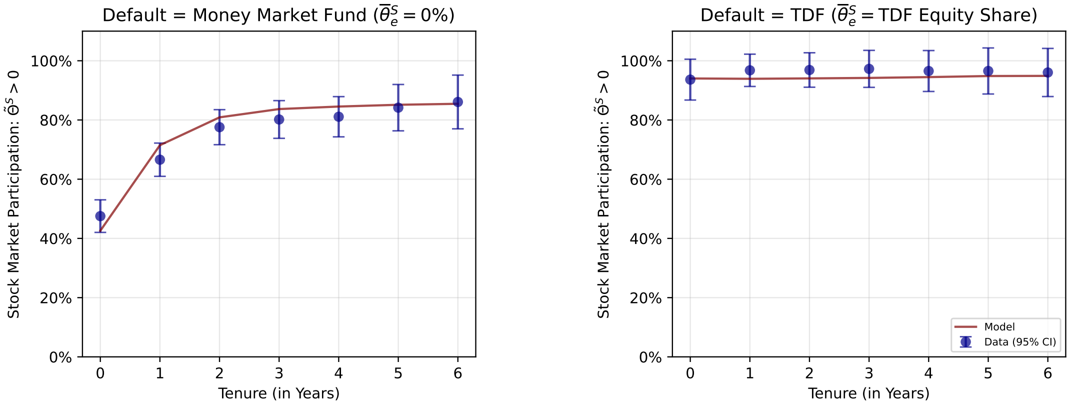
first stage

Estimation results

Preference Parameter		Estimation (1)	(2)	(3)	(4)
Discount Factor	β	0.940			
		(0.001)			
Relative Risk Aversion	γ	2.54			
		(0.09)			
Elasticity of Intertemporal Substitution	σ^{-1}	0.253			
		(0.018)			
Portfolio Adjustment Cost	k_θ	\$156			
		(\$6.01)			
Contribution Adjustment Cost	k_s	\$488			
		(\$16.60)			
Model Specification					
Preference Specification		EZW			
No Adjustment Costs					
Moments Targeted					
Participation (MM Default)		✓			
Participation (TDF Default)		✓			
Equity Share by Age (MM Default)		✓			
Equity Share by Age (TDF Default)		✓			
Contribution Rates (Opt-In)		✓			
Contribution Rates (AE at 3%)		✓			
Total Number of Moments		38			

Model fit I/III

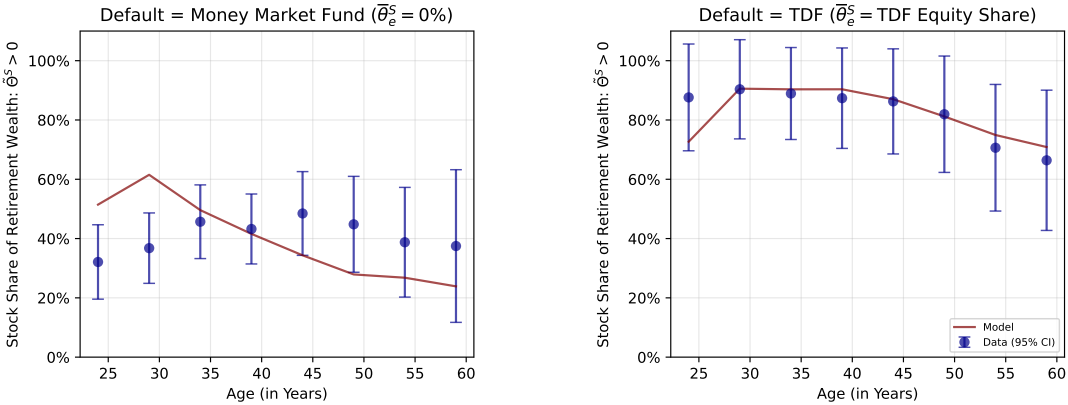
Quasi-experiment #1



Sample: employees hired within 12 months of MM to TDF change at 6 firms in QE #1

Model fit II/III

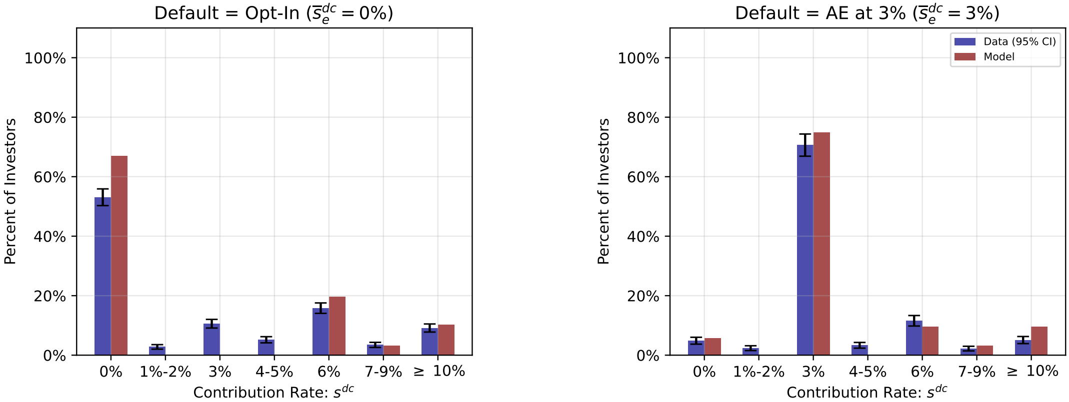
Stock share age profile by default



Sample: employees hired within 12 months of MM to TDF change at 6 firms in QE #1

Model fit III/III

Contribution rates in first year of tenure



Sample: employees hired within 12 months of 3% AE adoption at 34 firms with 50% match up to 6%

Estimation results

		Estimation
Preference Parameter		(1)
Discount Factor	β	0.940
		(0.001)
Relative Risk Aversion	γ	2.54
		(0.09)
Elasticity of Intertemporal Substitution	σ^{-1}	0.253
		(0.018)
Portfolio Adjustment Cost	k_θ	\$156
		(\$6.01)
Contribution Adjustment Cost	k_s	\$488
		(\$16.60)
Model Specification		
Preference Specification		EZW
No Adjustment Costs		
Moments Targeted		
Participation (MM Default)		✓
Participation (TDF Default)		✓
Equity Share by Age (MM Default)		✓
Equity Share by Age (TDF Default)		✓
Contribution Rates (Opt-In)		✓
Contribution Rates (AE at 3%)		✓
Total Number of Moments		38

Estimation results

		Estimation	
Preference Parameter		(1)	(2)
Discount Factor	β	0.940	0.934
		(0.001)	(0.001)
Relative Risk Aversion	γ	2.54	2.81
		(0.09)	(0.017)
Elasticity of Intertemporal Substitution	σ^{-1}	0.253	·
		(0.018)	·
Portfolio Adjustment Cost	k_θ	\$156	\$194
		(\$6.01)	(\$3.90)
Contribution Adjustment Cost	k_s	\$488	\$522
		(\$16.60)	(\$26.00)
Model Specification			
Preference Specification		EZW	CRRA
No Adjustment Costs			
Moments Targeted			
Participation (MM Default)		✓	✓
Participation (TDF Default)		✓	✓
Equity Share by Age (MM Default)		✓	✓
Equity Share by Age (TDF Default)		✓	✓
Contribution Rates (Opt-In)		✓	✓
Contribution Rates (AE at 3%)		✓	✓
Total Number of Moments		38	38

Estimation results

		Estimation		
Preference Parameter		(1)	(2)	(3)
Discount Factor	β	0.940	0.934	0.791
		(0.001)	(0.001)	(0.004)
Relative Risk Aversion	γ	2.54	2.81	18.94
		(0.09)	(0.017)	(0.246)
Elasticity of Intertemporal Substitution	σ^{-1}	0.253	·	0.481
		(0.018)	·	(0.012)
Portfolio Adjustment Cost	k_θ	\$156	\$194	
		(\$6.01)	(\$3.90)	·
Contribution Adjustment Cost	k_s	\$488	\$522	
		(\$16.60)	(\$26.00)	·
Model Specification				
Preference Specification		EZW	CRRA	EZW
No Adjustment Costs				✓
Moments Targeted				
Participation (MM Default)		✓	✓	✓
Participation (TDF Default)		✓	✓	
Equity Share by Age (MM Default)		✓	✓	✓
Equity Share by Age (TDF Default)		✓	✓	
Contribution Rates (Opt-In)		✓	✓	✓
Contribution Rates (AE at 3%)		✓	✓	
Total Number of Moments		38	38	19

Estimation results

Preference Parameter		(1)	(2)	(3)	(4)
		Estimation			
Discount Factor	β	0.940	0.934	0.791	0.960
		(0.001)	(0.001)	(0.004)	(0.001)
Relative Risk Aversion	γ	2.54	2.81	18.94	2.25
		(0.09)	(0.017)	(0.246)	(0.123)
Elasticity of Intertemporal Substitution	σ^{-1}	0.253	·	0.481	0.513
		(0.018)	·	(0.012)	(0.040)
Portfolio Adjustment Cost	k_θ	\$156	\$194		
		(\$6.01)	(\$3.90)	·	·
Contribution Adjustment Cost	k_s	\$488	\$522		
		(\$16.60)	(\$26.00)	·	·
Model Specification					
Preference Specification		EZW	CRRA	EZW	EZW
No Adjustment Costs				✓	✓
Moments Targeted					
Participation (MM Default)		✓	✓	✓	
Participation (TDF Default)		✓	✓		✓
Equity Share by Age (MM Default)		✓	✓	✓	
Equity Share by Age (TDF Default)		✓	✓		✓
Contribution Rates (Opt-In)		✓	✓	✓	
Contribution Rates (AE at 3%)		✓	✓		✓
Total Number of Moments		38	38	19	19

Outline

Summary

- Risk preferences central in economics + finance, but lack of consensus on specification
  - stock market non-participation often presented as evidence of first-order risk-aversion
- Our results: non-participation primarily driven by frictions not preferences
  - limited support for explanations of low participation based on first-order risk-aversion
- Frictions break mapping from observed choices $\longrightarrow$ underlying preferences
  - caution against estimating behavioral models using cross-sectional moments
- Consistent with behavioral "biases" being optimal given cognitive constraints
  - see e.g. Woodford 2020, Puri 2022, Enke-Graeber 2024, Oprea 2024

Implications for default design

1. Retirement investors are less risk-averse than previously thought
   - aggressive allocations are preferred by most workers, **including** low-income
2. On **average**, TDFs close to preferences of older workers, but are slightly high for young
3. One-size-fits-all defaults work better for young, but less well for older workers
   - preference heterogeneity increases substantially with age
4. Models to derive an optimal glide path should incorporate adjustment frictions
   - otherwise, risk aversion will be overestimated

Implications for default design

1. Retirement investors are less risk-averse than previously thought
   - aggressive allocations are preferred by most workers, **including** low-income
2. On **average**, TDFs close to preferences of older workers, but are slightly high for young
3. One-size-fits-all defaults work better for young, but less well for older workers
   - preference heterogeneity increases substantially with age
4. Models to derive an optimal glide path should incorporate adjustment frictions
   - otherwise, risk aversion will be overestimated

- **Work-in-progress**: whose preferences should optimal defaults target?
  - e.g., should it target passive (younger/low-income) rather than average worker?

Thank You!

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APPENDIX

Simple model

$$V(X_t) = \max_{c_t, \theta_t \in [0,1]} \left\{ \frac{n_t \left(c_t / n_t - \overbrace{k * 1\{\theta_t \neq \theta_{d,t}\} - p * 1\{\theta_t > 0\}}^{\text{frictions}} \right)^{1-\sigma}}{1-\sigma} + \beta \Big[(1 - m_{t+1}) E_t V(X_{t+1}) \Big] \right\}$$

$$\text{state variables:} \quad X_t = (age_t, w_t, A_t, \theta_{t-1})$$

$$\text{default portfolio share:} \quad \theta_{d,t} = \begin{cases} 0 & \text{if } age_t = 21 \\ \theta_{t-1} * \frac{R_t}{(1-\theta_{t-1})R_f + \theta_{t-1} R_t} & \text{else} \end{cases}$$

$$\text{budget constraint:} \quad A_t = A_{t-1} \left[(1 - \theta_{t-1}) R_f + \theta_{t-1} R_t \right] + w_t - c_t$$

$$\text{borrowing constraint:} \quad A_t \geq 0$$

$$\text{income process:} \quad \ln w_t = f(age_t) + \eta_t, \quad \eta_t = \rho \eta_{t-1} + \nu_t, \quad \nu_t \sim F(\cdot)$$

$$\text{return process:} \quad \ln R_t = \ln R_f + \mu + \varepsilon_t, \quad \varepsilon_t \sim \mathcal{N}(0, \sigma_r^2)$$

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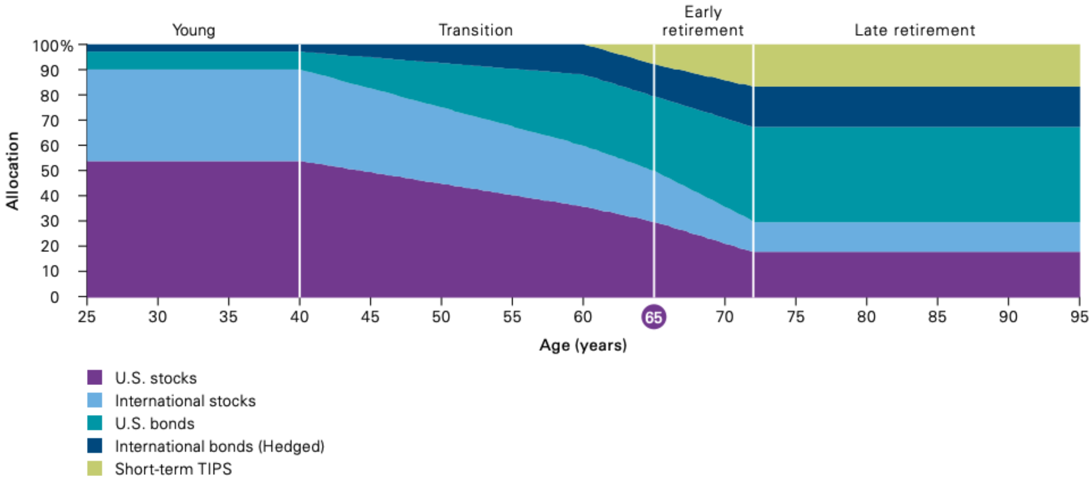
Vanguard TDF glide path



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Summary statistics

	Our Sample 2006-2017	
	$N = 18,398,750$	
	Mean	Median
Age	41.59	41.00
Wage Income		33,854.40
401(k) Balance	69,658.18	19,758.30
Stock Market Participation in 401(k)	0.68	1.00
Stock Share in 401(k)	0.53	0.73

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SCF summary statistics

	All Households		Retirement Account Eligible	
	Mean	Median	Mean	Median
Age	44.45	45.00	44.09	45.00
Wage Income	47,235.74	34,006.39	59,546.96	43,722.50
Retirement Wealth	53,206.22	1,814.59	76,688.93	16,512.71
Investable Wealth	106,347.92	3,877.58	132,161.00	20,105.97
Ratio of Retirement to Investable Wealth	0.80	1.00	0.85	1.00
Stock Share of Retirement Wealth	0.29	0.00	0.42	0.40
Ratio of Equity Holdings in Retirement to Total	0.42	0.00	0.63	0.97
Stock Market Participation in Retirement Wealth	0.49	0.00	0.73	1.00
Stock Market Participation Outside Retirement	0.13	0.00	0.15	0.00
Stock Market Participation Only Outside Retirement	0.04	0.00	0.02	0.00

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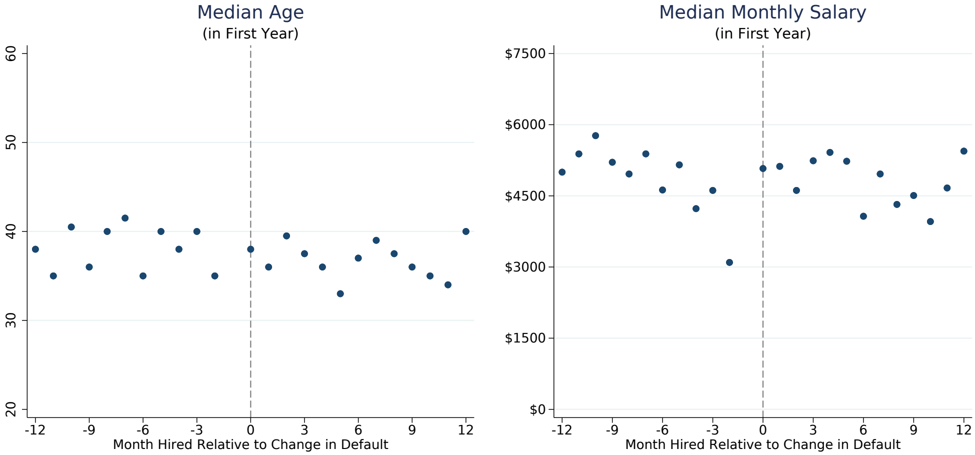
Balance checks

MM to TDF sample



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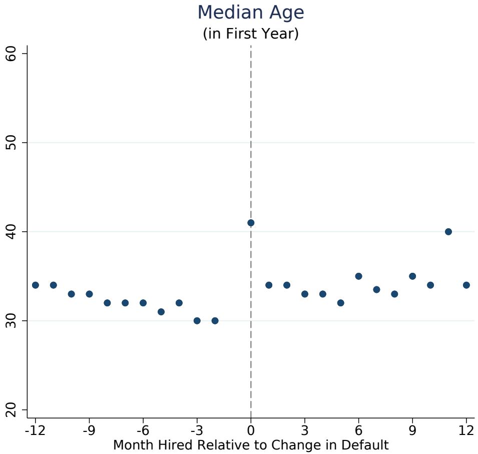
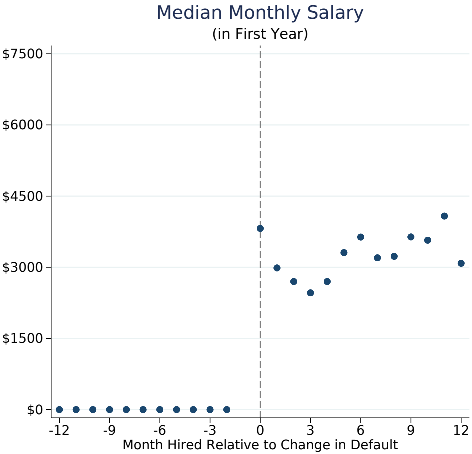
Balance checks

Opt-in to TDF sample





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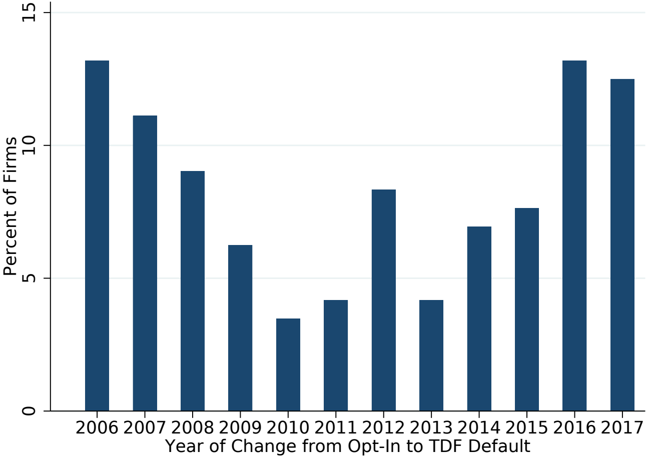
Timing of changes

Opt-in to TDF sample



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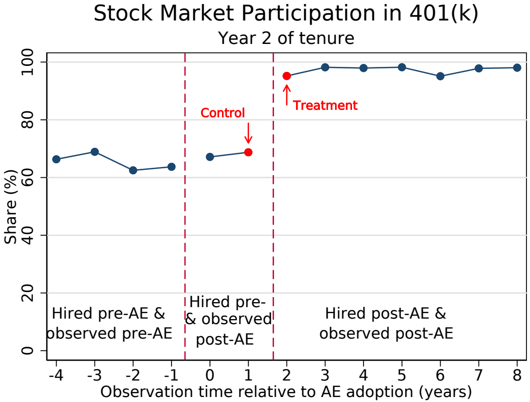
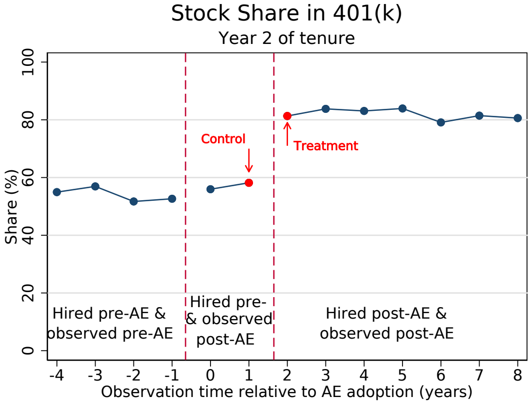
Observed portfolio choice response

Peer effects i/ii





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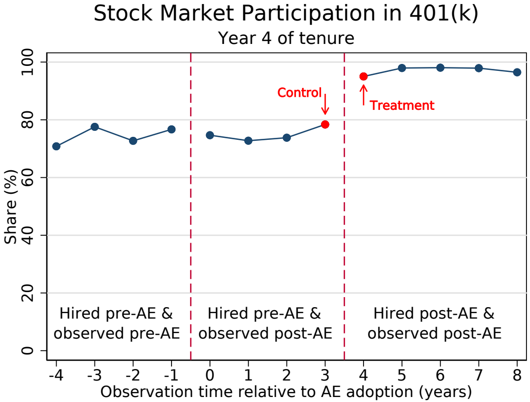
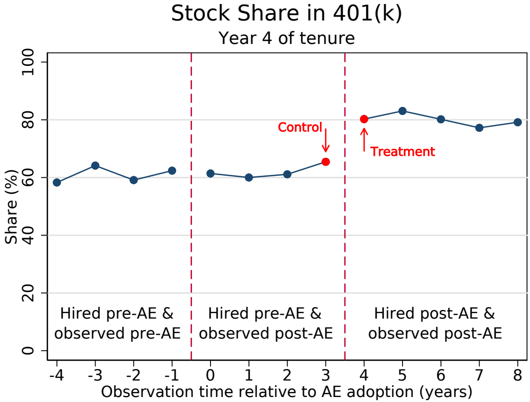
Observed portfolio choice response

Peer effects ii/ii





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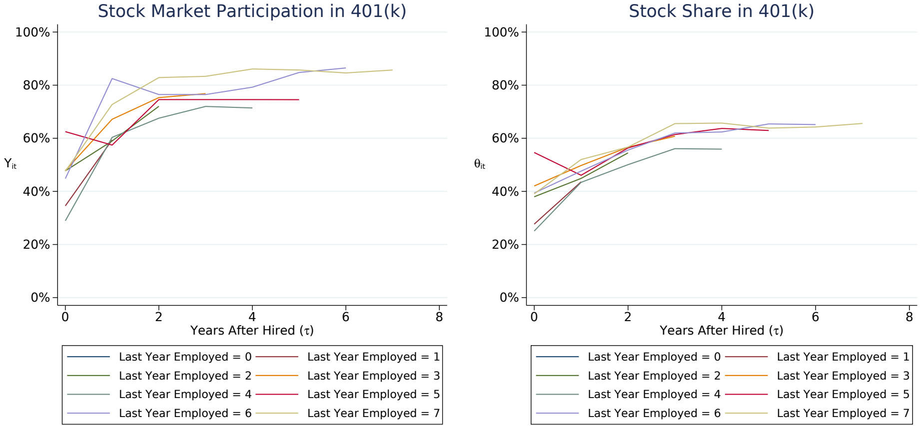
Observed portfolio choice response

Composition change



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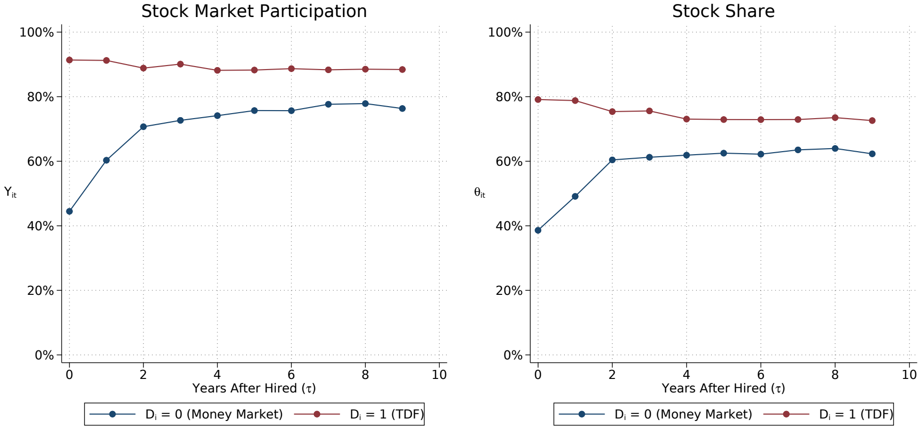
Observed portfolio choice response

Allocation of new contributions - MM to TDF



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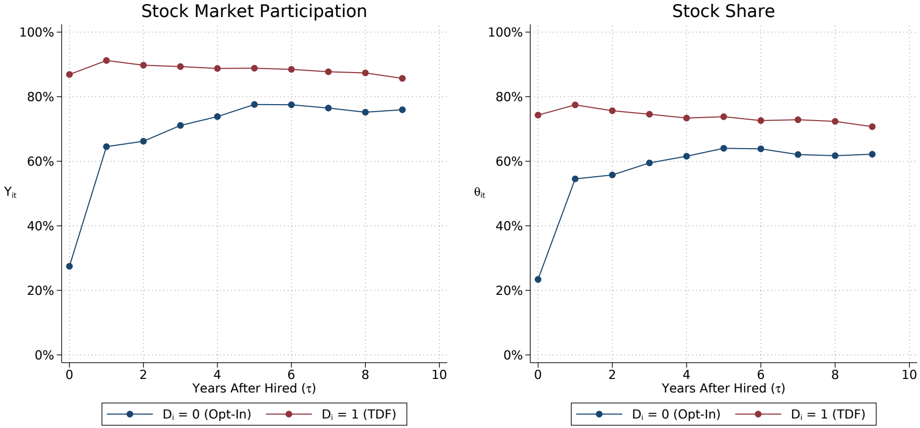
Observed portfolio choice response

Allocation of new contributions - Opt-in to TDF



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Observed portfolio choice response

Opt-in to TDF sample

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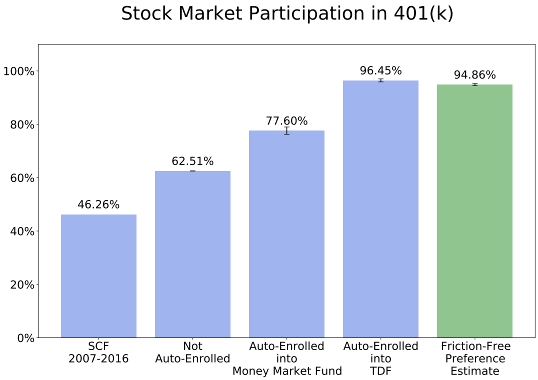
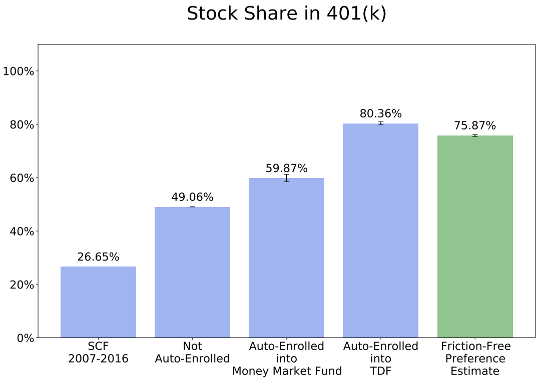
Average preference estimates

Opt-in to TDF sample





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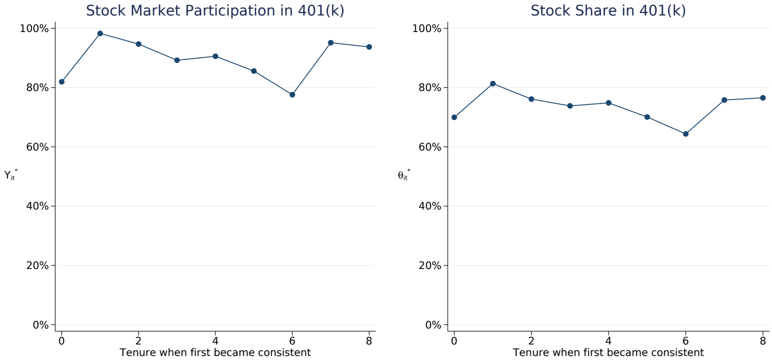
Testing consistency independence

- **Challenge:** can't directly measure $cov_\tau\left(\theta^*_{it}, C_{it}\right)$
- **Informal test:** compare choices of investors based when they become consistent
  - difference between active choices of early vs. late is informative about $cov_\tau\left(\theta^*_{it}, C_{it}\right)$



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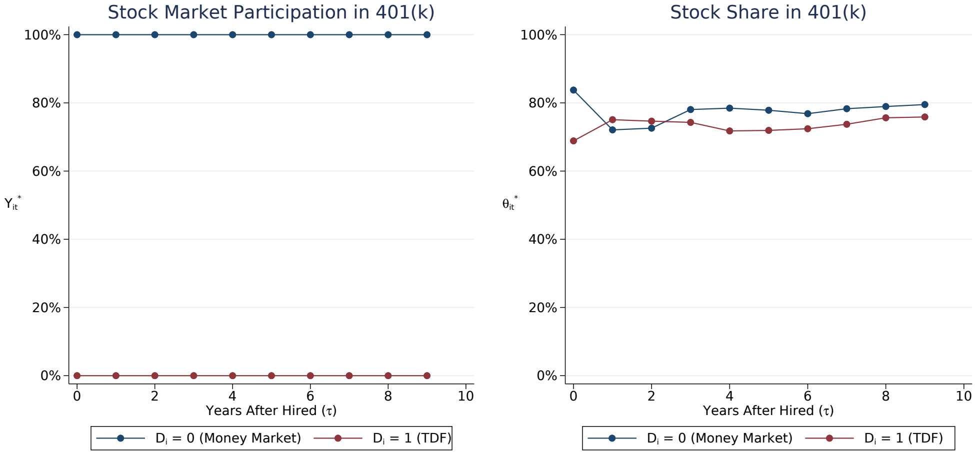
Consistent preferences by default

MM to TDF sample



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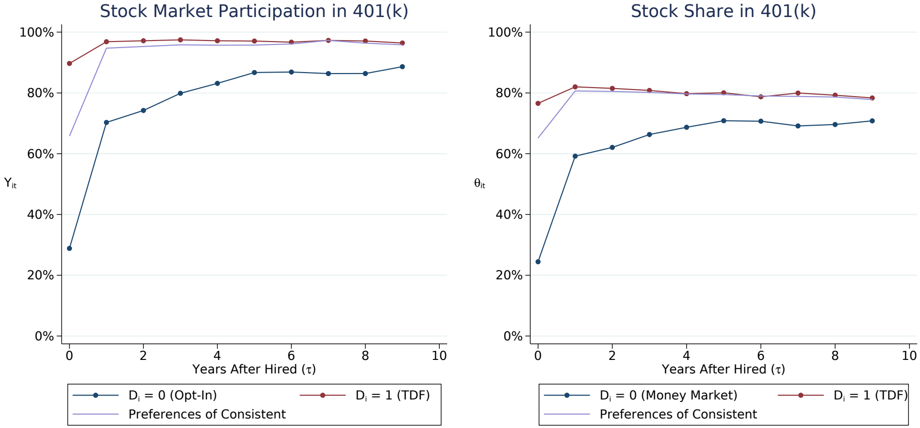
Preferences of consistent

Opt-in to TDF sample



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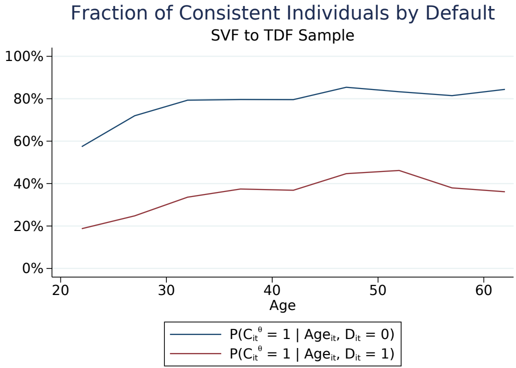
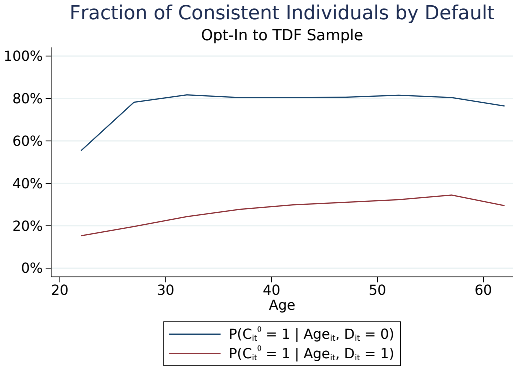
Fraction of consistent people





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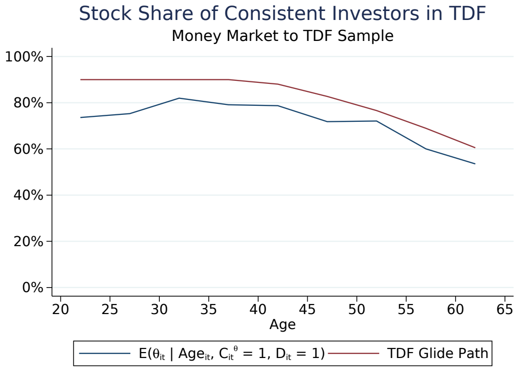
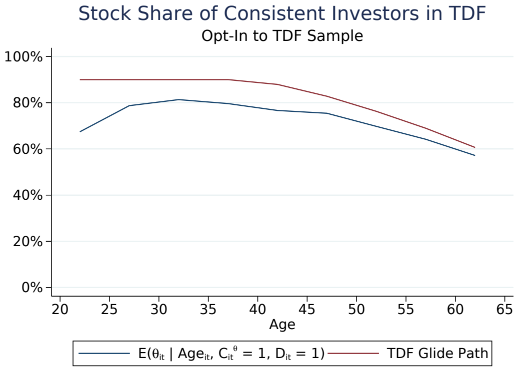
Preferences of investors selling TDF

both samples





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First-stage estimation

- **Labor market parameters**: estimated using SMD with SIPP data
- **Asset returns**:
  - risk-free rate = 2%
  - equity premium (in levels) = 6.4% (CRSP VW)
  - SD of log returns = 19% (CRSP VW)
  - correlation with labor income = 0 (Campbell et al. 2001)
- **Other parameters**:
  - survival probabilities = US life tables
  - equivalence scale = PSID
  - employer match rate = 50%, match cap = 6%, vesting schedule = plan data
  - income taxes = 2006 federal tax schedule, capital tax = 21%
  - Social Security + Medicare = 2006 formulas
  - UI replacement = 40%

◂ back