Stock Market Investment: The Role of Human Capital

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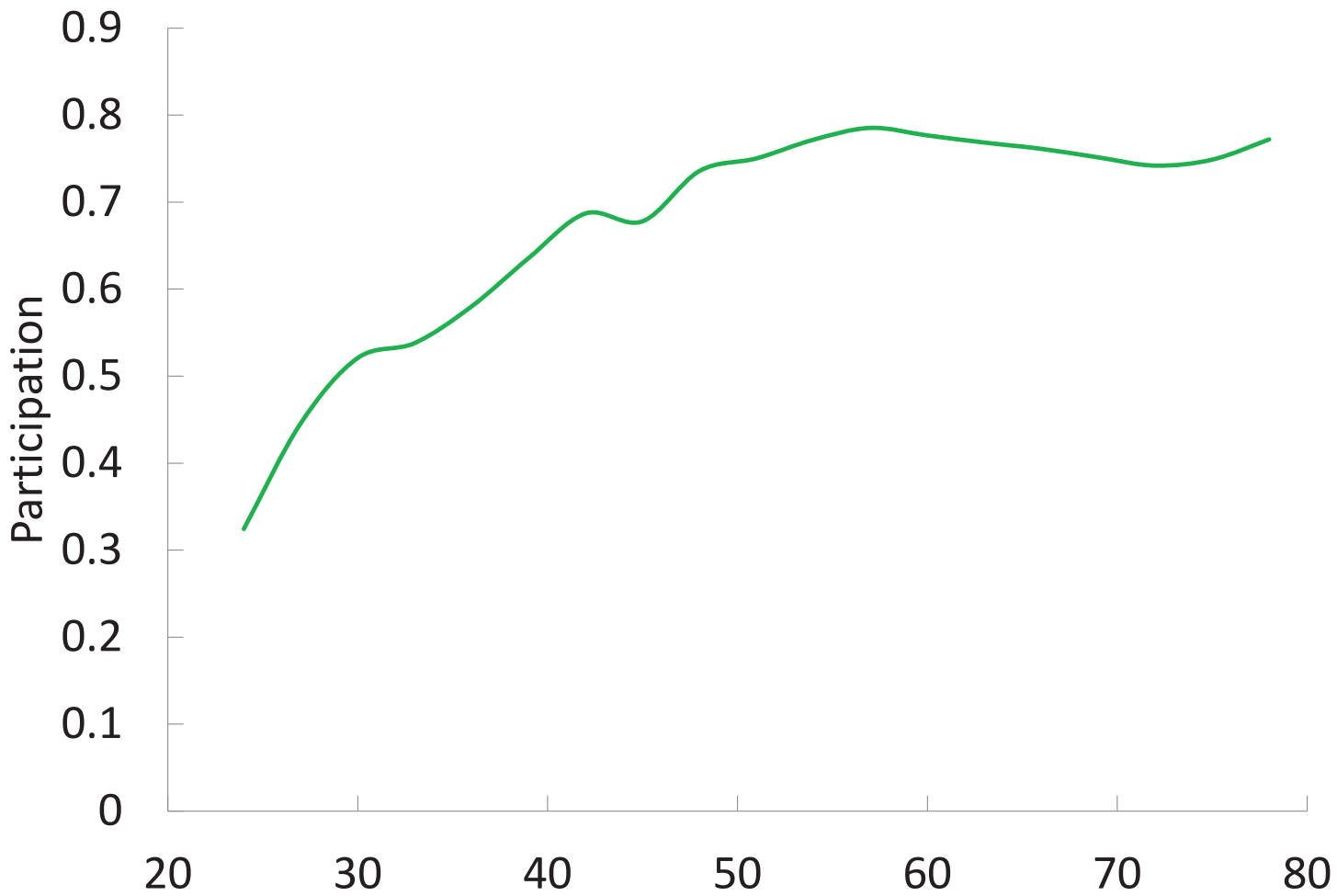
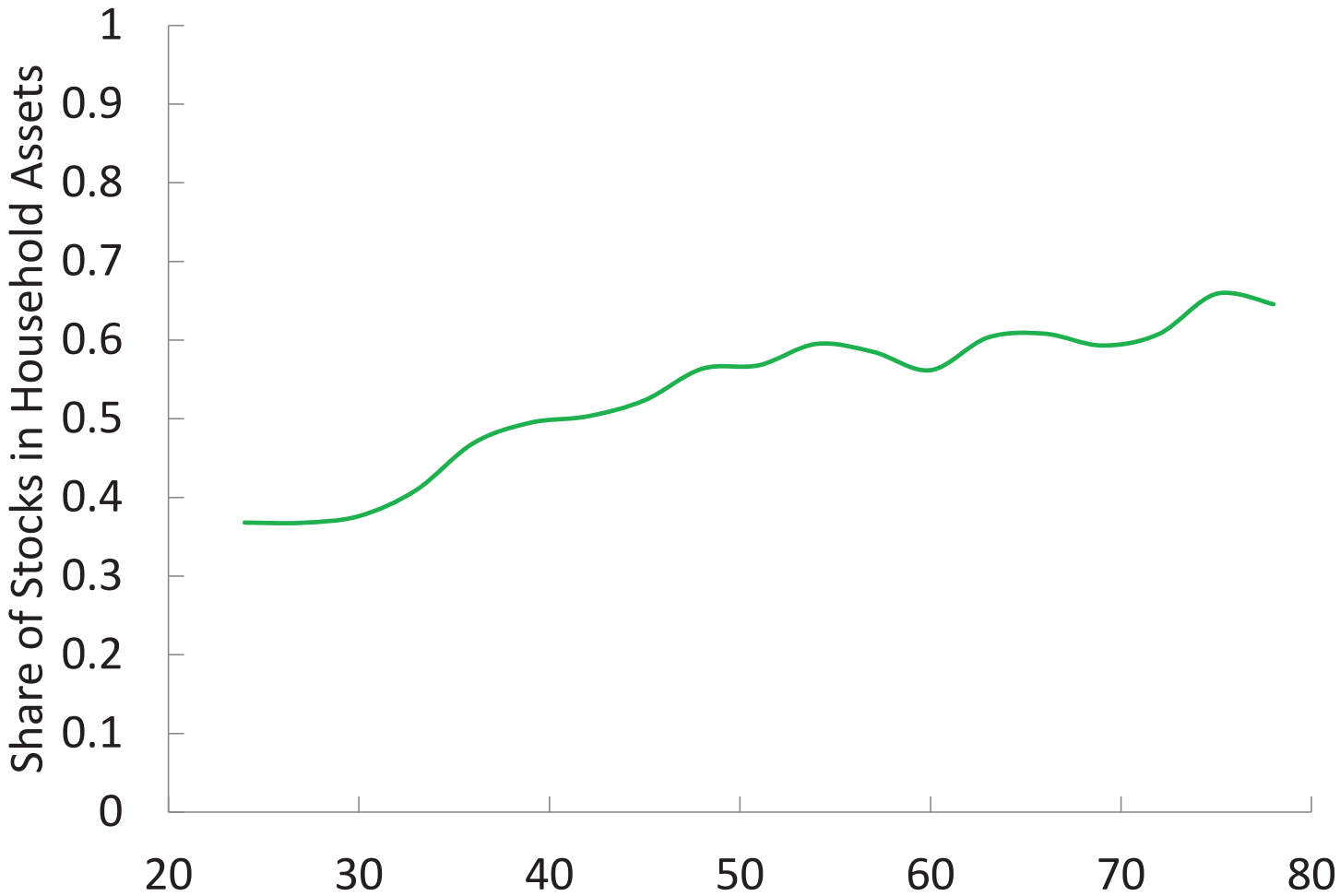
Background

- Stock market investment is generally limited.
  1. Large fraction of households avoid participation altogether.
  2. Even among those who invest, equity holdings as a share of financial wealth are frequently modest.
- These observations have proved extremely challenging to explain in models without imposing nonstandard preferences, stock market participation costs, or imperfect information.

Estimated Participation Rate over the Life Cycle (SCF, 1973-1975 Birth Cohort)



Estimated Average Share of Stocks in Portfolio Conditional on Participation for 1973-1975 Birth Cohort (SCF)



What We Do

- We show that once human capital *investment* is allowed for, stock market investment can be well-understood within an entirely standard setting.
- We embed the classic Ben-Porath (1967) model of time allocation between working ("earning") and human-capital accumulation ("learning") into a life-cycle consumption-savings model with uninsurable idiosyncratic labor income risk and financial portfolio choice.
- To our knowledge, we are the first to study human capital investment and financial investment decisions in such a setting.

What is the basic mechanism?

- Human and financial wealth are competing assets:
  - initial conditions matter for the net returns to investments
  - there is risk and diminishing returns
- Low human capital means high expected marginal returns to learning vs constant expected returns to stocks. For many, human capital wins early in life, stocks later.

Related literature

- Participation
  - **Fixed cost of entry:** Cocco (2005); Campbell, Cocco, Gomes, and Maenhout (2001); Haliassos and Michaelides (2003)
  - **Nonstandard preferences:** Habit formation (Gomes and Michaelides, 2003; Polkovnichenko, 2007) or heterogeneous risk preferences (Gomes and Michaelides, 2005)
  - **Wedge between borrowing and risk-free savings rate:** Davis, Kubler, and Willen (2006)
- Shares
  - **Justifying (100-age) financial planning rule-of-thumb**
    Exogenous labor supply: Cocco, Gomes, and Maenhout (2005)); Viceira (2001)
    Endogenous labor supply: Gomes, Kotlikoff, and Viceira (2008)
    Information frictions: Chang, Hong, and Karabarbounis (2014)
  - **Obtaining empirically-consistent predictions:** Benzoni, Collin-Dufresne, and Goldstein (2007)
- Human capital
  - Ben-Porath (1967), Guvenen (2009), Huggett, Ventura and Yaron (2011)
  - Lindset and Matsen (2011), Roussanov (2010), Kim, Maurer and Mitchell (2013)

Environment

- Life-cycle consumption savings model.
- Agents start life in the model as young adults.
- Endowed with human capital, h_1, immutable learning ability, a, and initial assets, x_1.
  - jointly drawn according to distribution $F(a, h, x)$
- Divide time between work and human capital accumulation (Ben-Porath (1967)).
- Consume and allocate any savings between risky asset s_t and risk-free asset b_t
- Can borrow using non-defaultable debt, $b_t \geq -\underline{b}$

Environment cont.

- Preferences:
  CRRA utility function with common discount factor β
- Financial wealth: $x_{t+1} = R_i b_{t+1} + R_{s,t+1} s_{t+1}$ with
  - $R_{s,t+1} = R_f + \mu + \eta_{t+1}$with $\eta_{t+1} \sim N(0, \sigma_\eta^2)$ iid
  - $R_i = R_f (b_t > 0)$ and $R_i = R_b = R_f + \phi (b_t < 0)$
- Human capital: $h_{t+1} = h_t(1 - \delta) + a(l_t h_t)^\alpha$
- Labor income: $\log(y_t) = G(w_t, h_t, l_t) + z_t$

Agent's Problem I

- Retirement (state t, a, h, b, s)

$$V^R = \sup_{b', s'} \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} + \beta V^{R'} \right\}$$

s.t.

$$c + b^{'} + s^{'} \leq \phi(y_J) + R_i b + R_s s$$

- Working (state t, a, h, b, s, u, ν)

$$V = \sup_{l, h', b', s'} \left\{ \frac{c_t^{1-\sigma}}{1-\sigma} + \beta E_{u'/u} V^{'} \right\}$$

s.t.

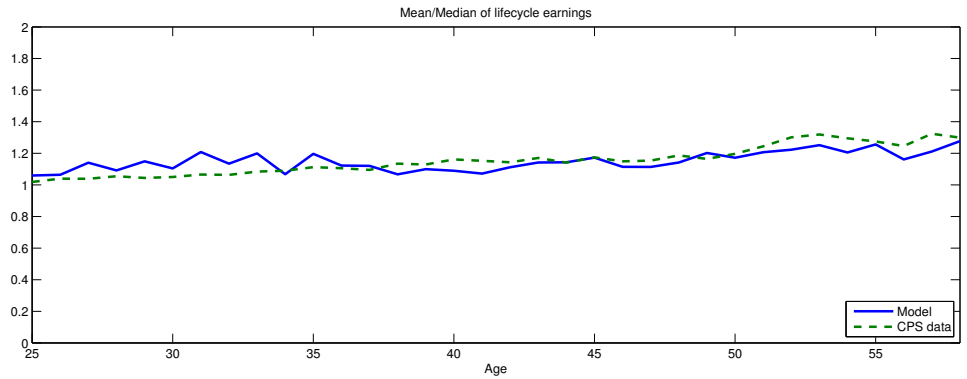
$$\begin{aligned} c + b^{'} + s^{'} &\leq w(1-l)hz + R_i b + R_s s + \tau(t, y, x) && (1) \\ l &\in [0, 1] && (2) \\ h^{'} &= h(1-\delta) + a(hl)^{\alpha} && (3) \end{aligned}$$

Calibration

- Standard parameters
  $\beta = 0.96$, $\sigma = 5$
- Wage and human capital accumulation parameters
  $g = 0.0014$, $\delta = 0.0114$, $\alpha = 0.7$
- Asset markets parameters
  $\mu = 0.06$, $R_f = 1.02$, $R_b = 1.11$, $\sigma_\eta = 0.157$
- Earnings process
  $\rho = 0.955$, $\sigma^2_\omega = 0.055$, $\sigma^2_\nu = 0.017$
- Distribution of initial unobservable characteristics
  Assumed log-normal and estimated to match 102 statistics of the life-cycle earnings distribution in the CPS data
  - The model produces $\rho_{ah} = 0.65$.

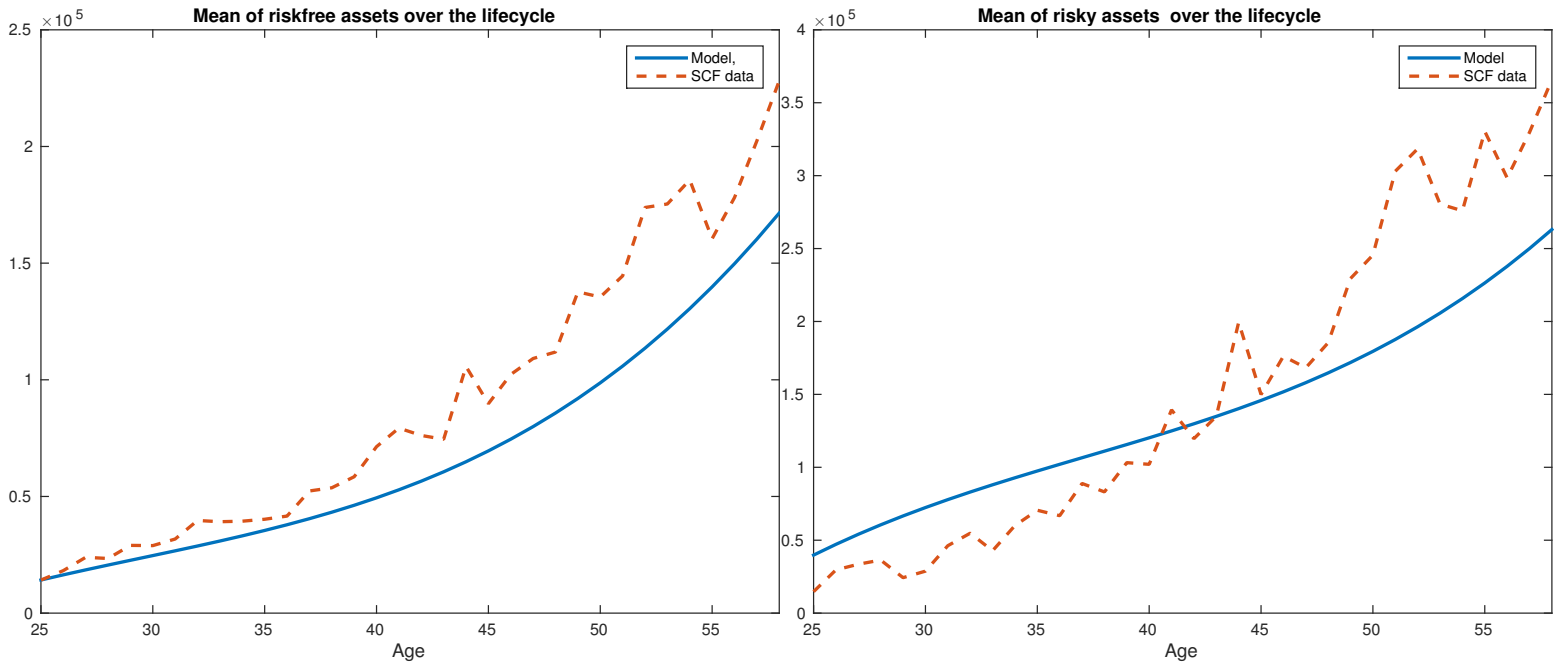
Model Fit


Mean of lifecycle earnings
Model
CPS data
Age

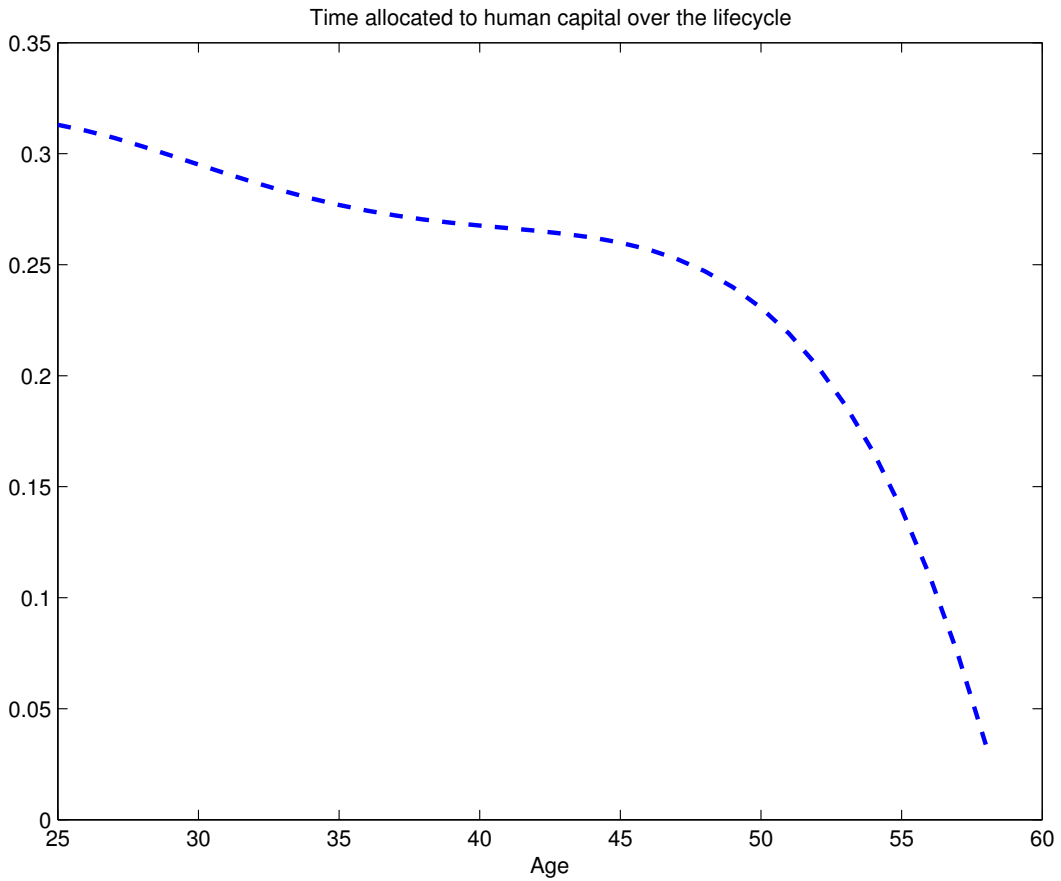

Mean/Median of lifecycle earnings
Model
CPS data
Age


Gini of lifecycle earnings
Model
CPS data
Age

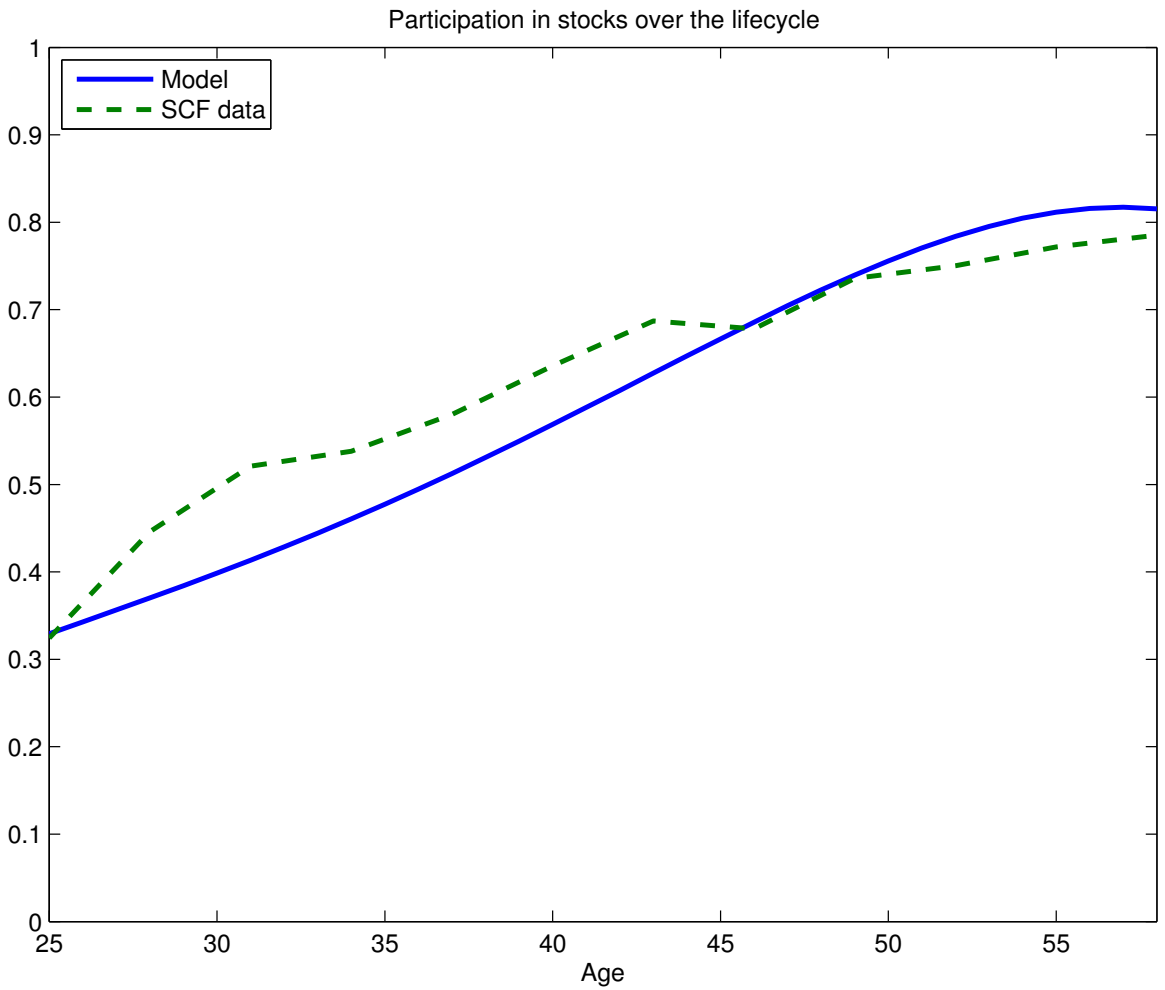
Non-targeted wealth over the life-cycle



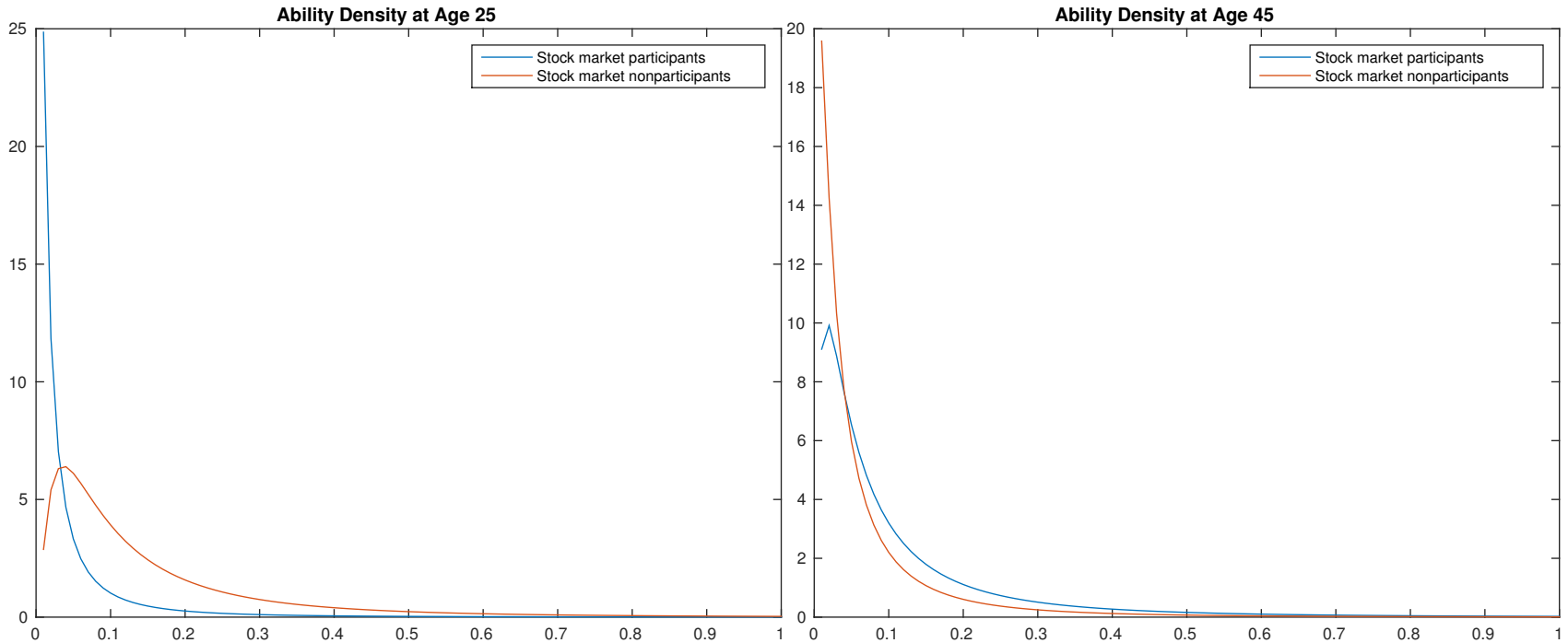
Time Allocated to Human Capital over the Life Cycle



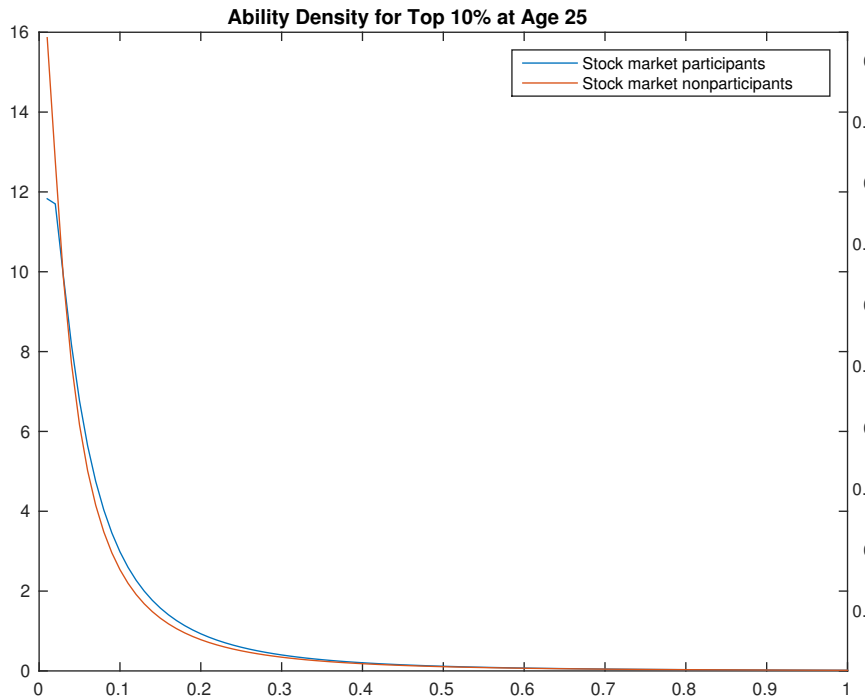
Stock-Market Participation over the Life Cycle

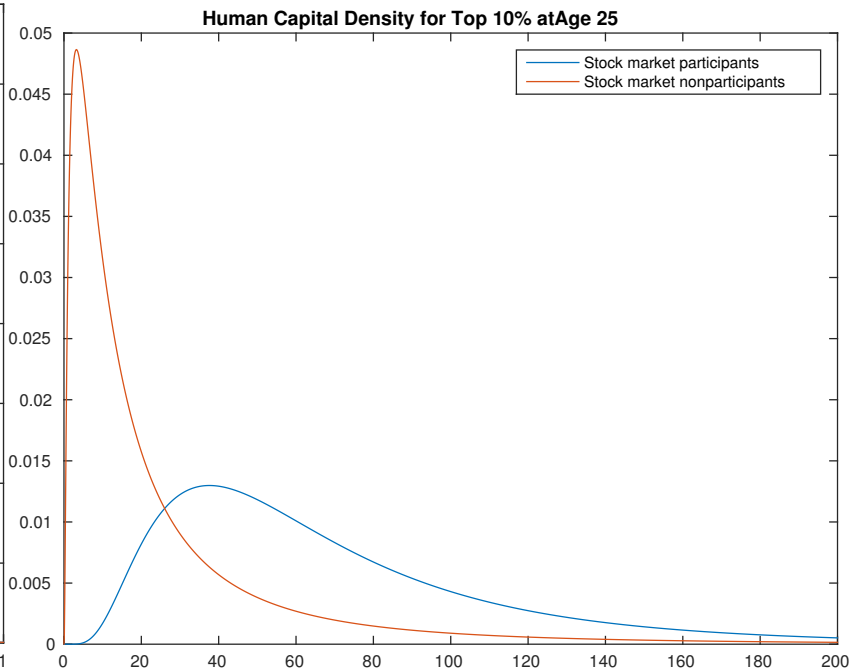


Participants vs. Non-Participants

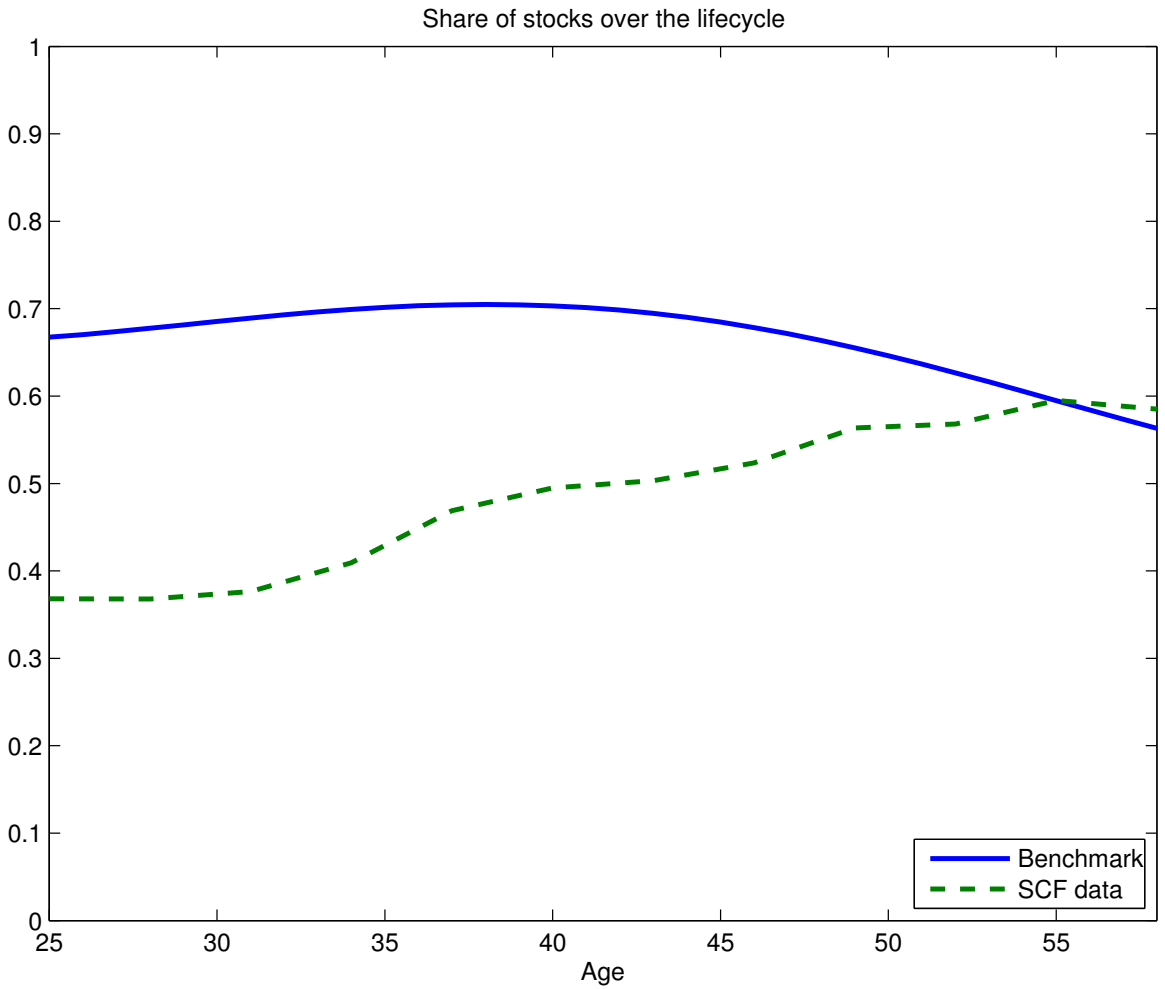


Wealthy Participants vs. Non-Participants





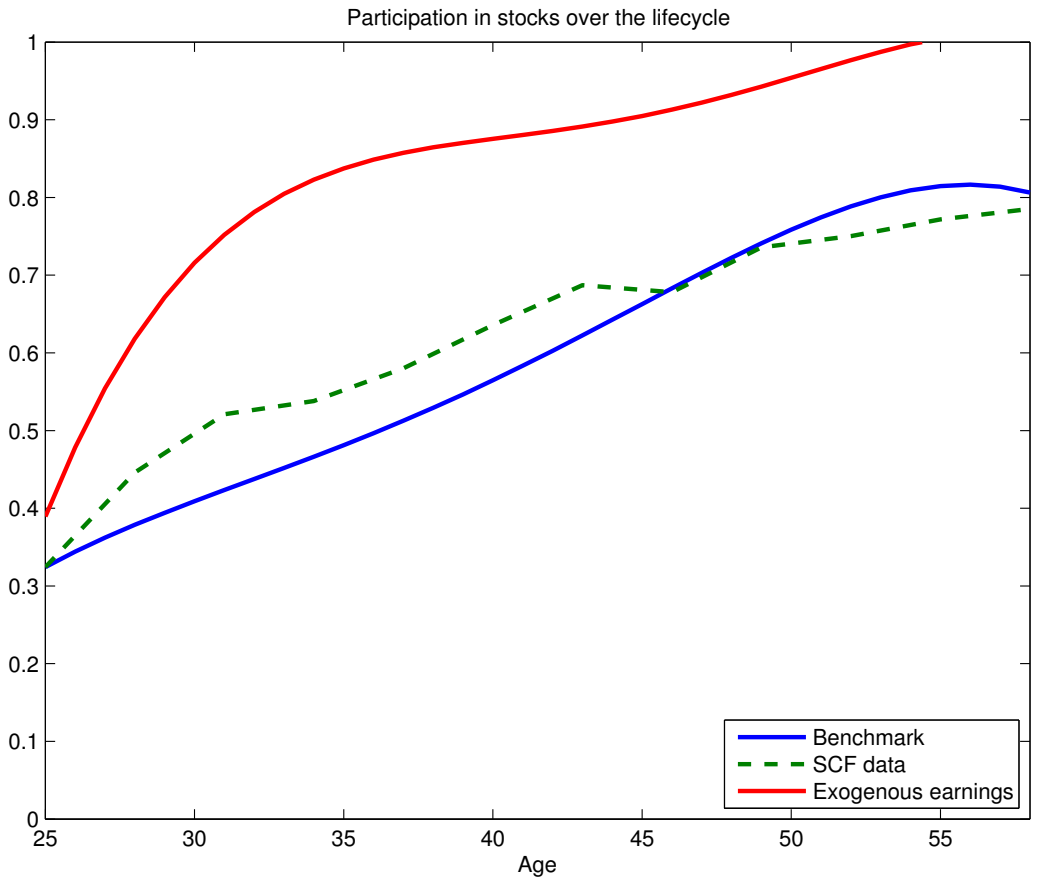
Stock market investment: shares



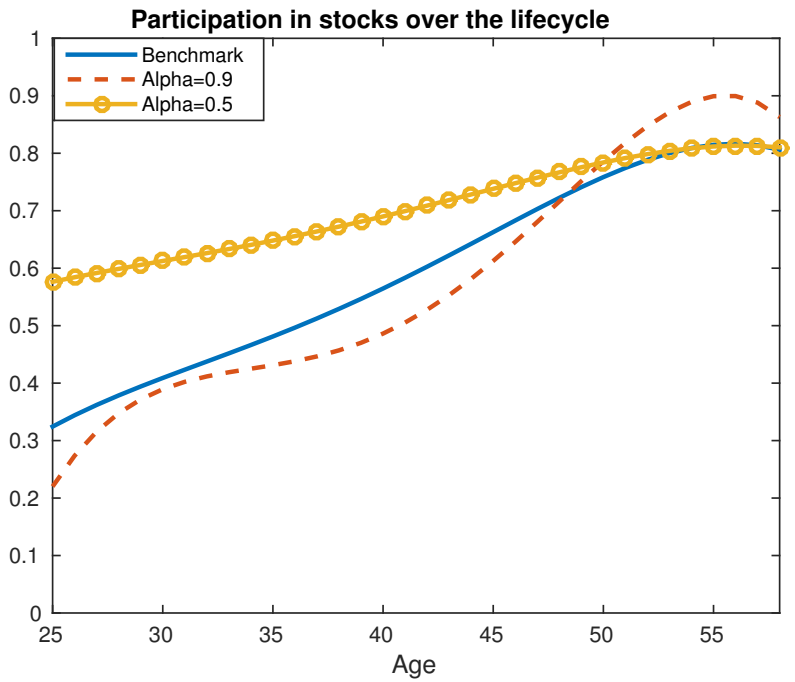
The key mechanism: the role of endogenous human capital

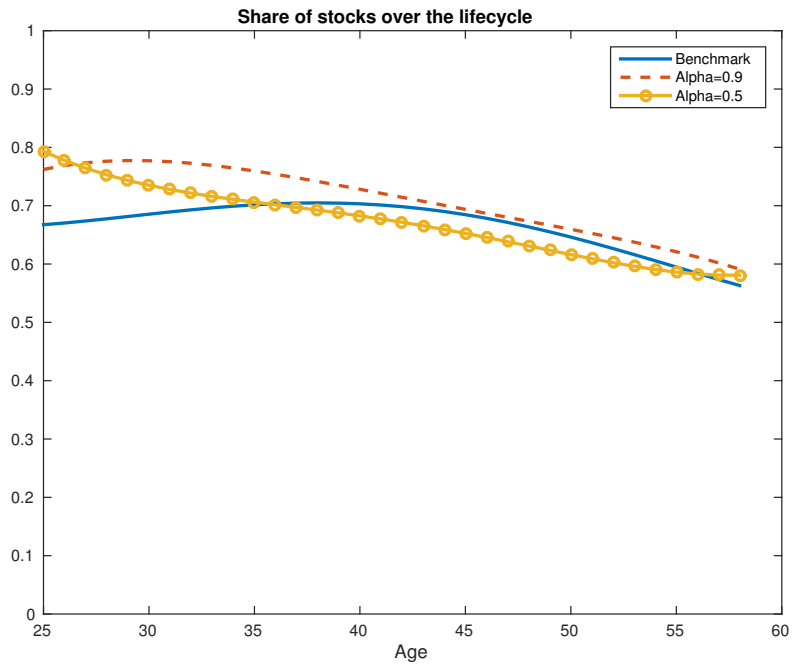
- Shut down endogenous human capital investment.
- Recover participation results in Davis, Kubler, and Willen Under the exogenous earnings assumption our setting is similar to theirs.
- In this setting, it is the wedge between the savings and borrowing rate that is lowering participation.

Life-Cycle Stock Market Participation Under Exogenous Earnings



Role of Elasticity of Human Capital





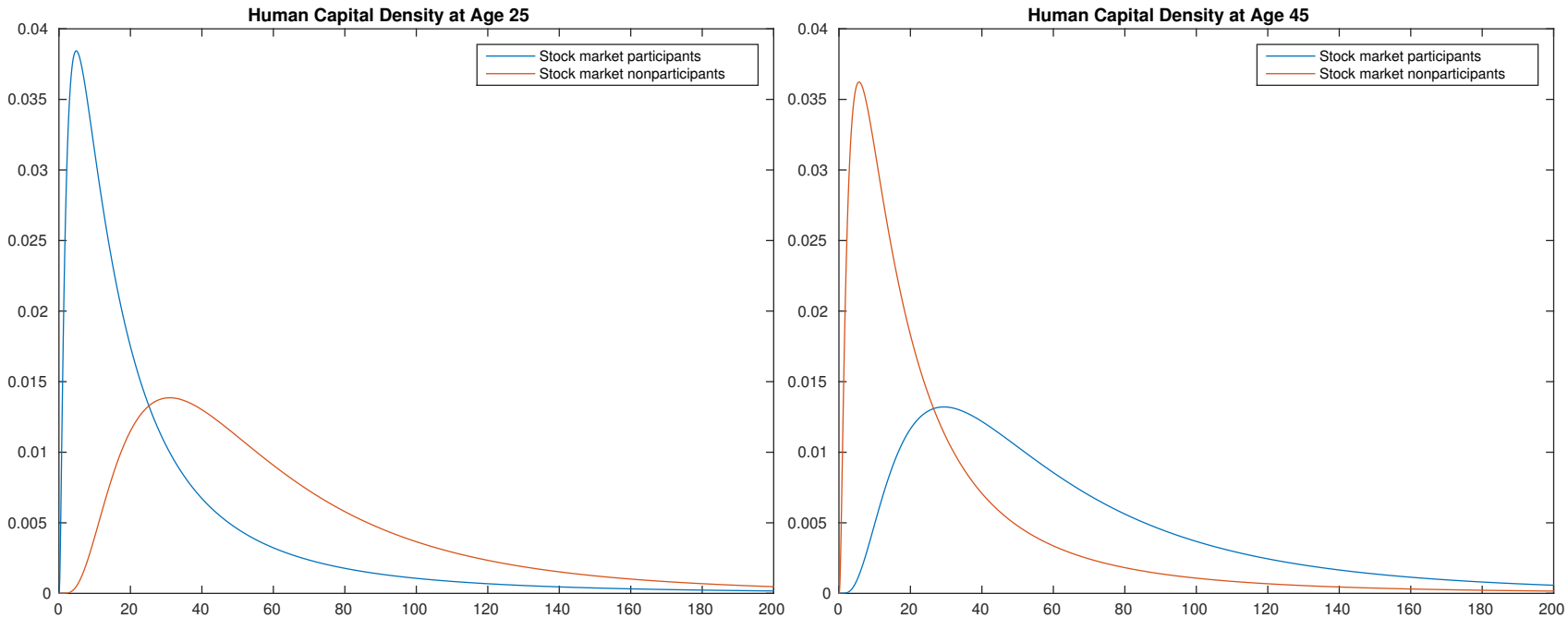
Experiments

1. Borrowing cost
2. Risk of stocks
3. Risk aversion
4. Participation cost

Concluding Remarks

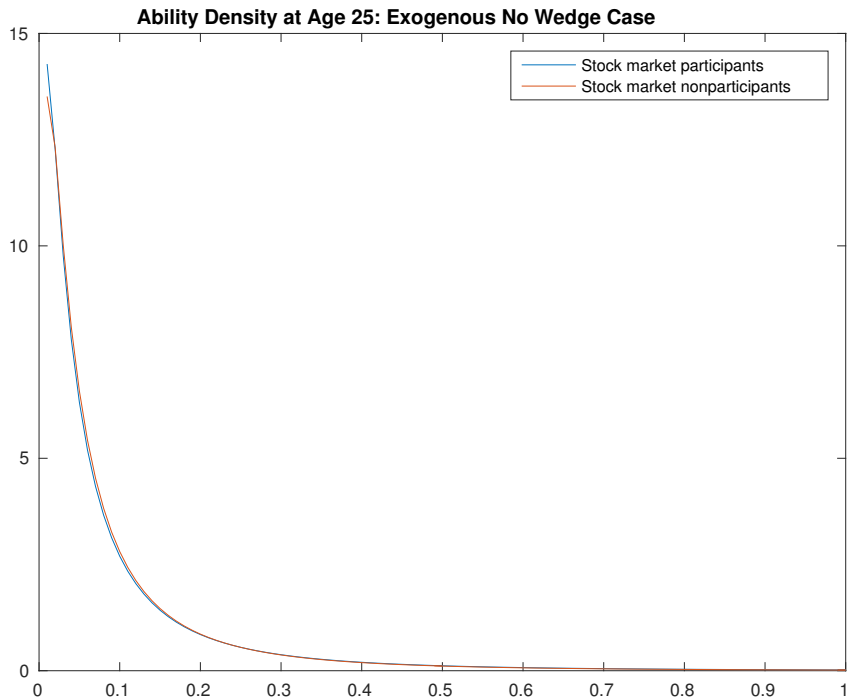
- Stock market investment is generally limited: both participation and equity holdings as a share of financial wealth frequently modest.
- Hard to explain in models without additional frictions.
- Contribute by acknowledging the role of human capital investment.
- Show that we can largely understand data with "standard" human capital theory.
- Current work: consider less abstract investment in human capital (college) and study how its structure matter for path of financial portfolios

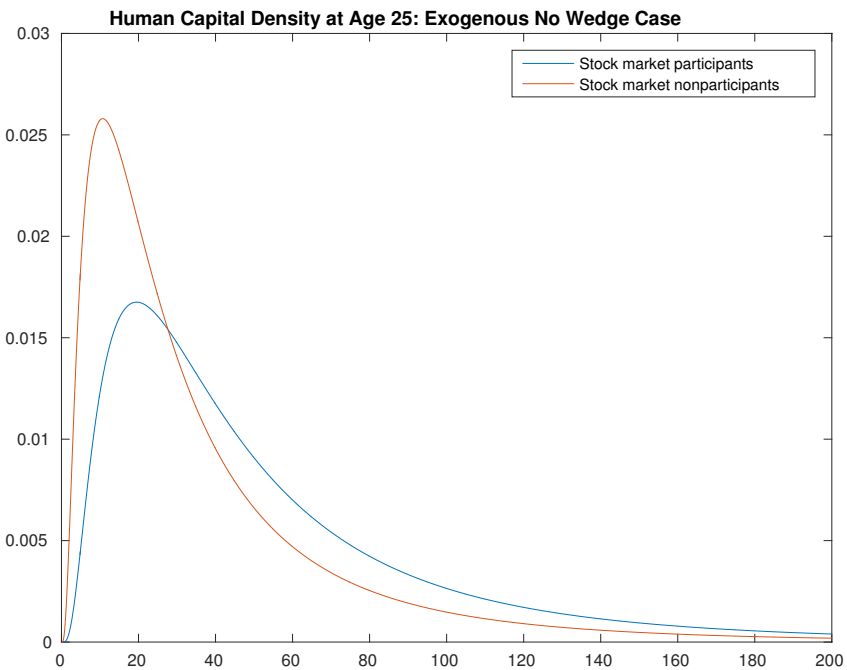
Participants vs. Non-Participants



◂ Participants

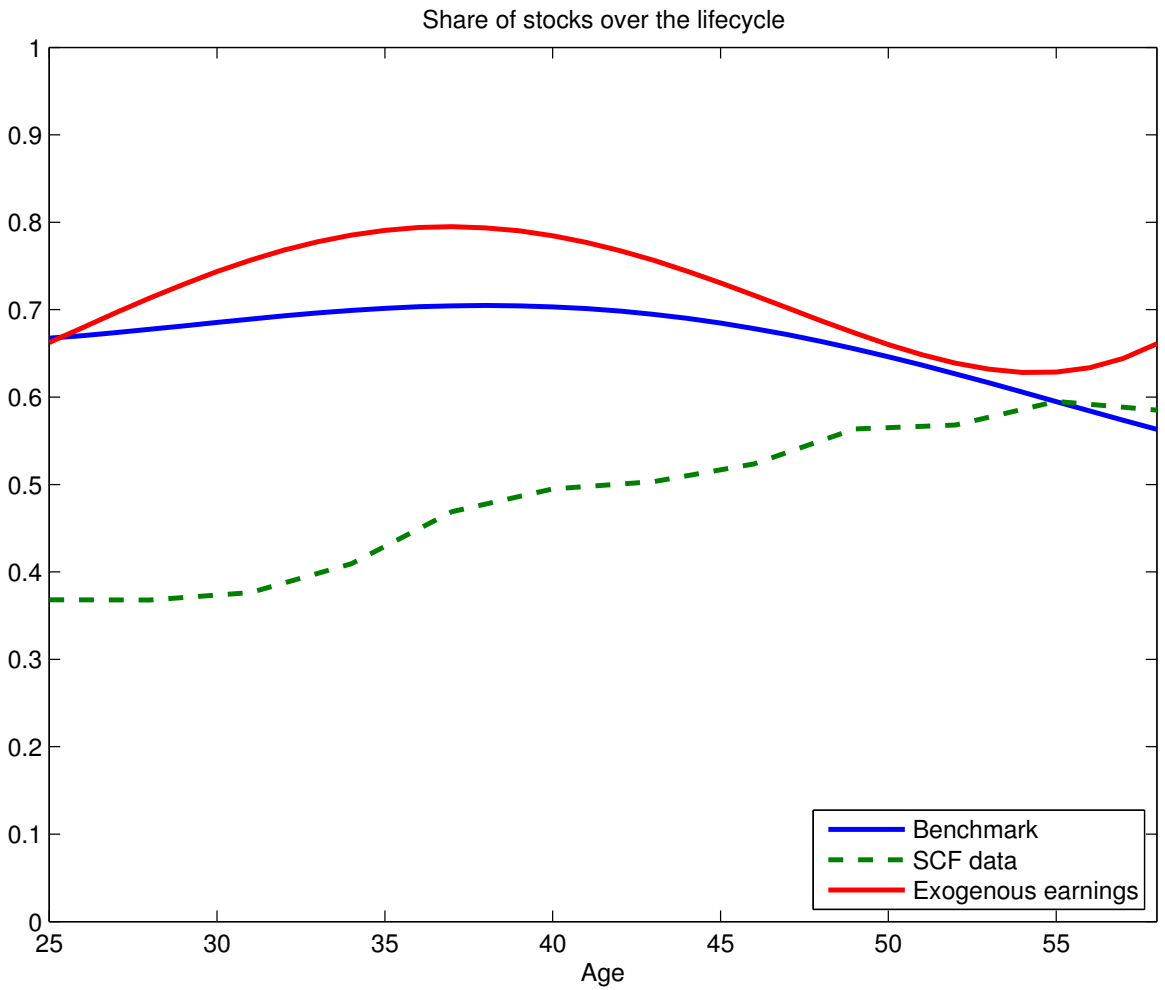
Participants vs. Non-Participants in the Exogenous No Wedge Case



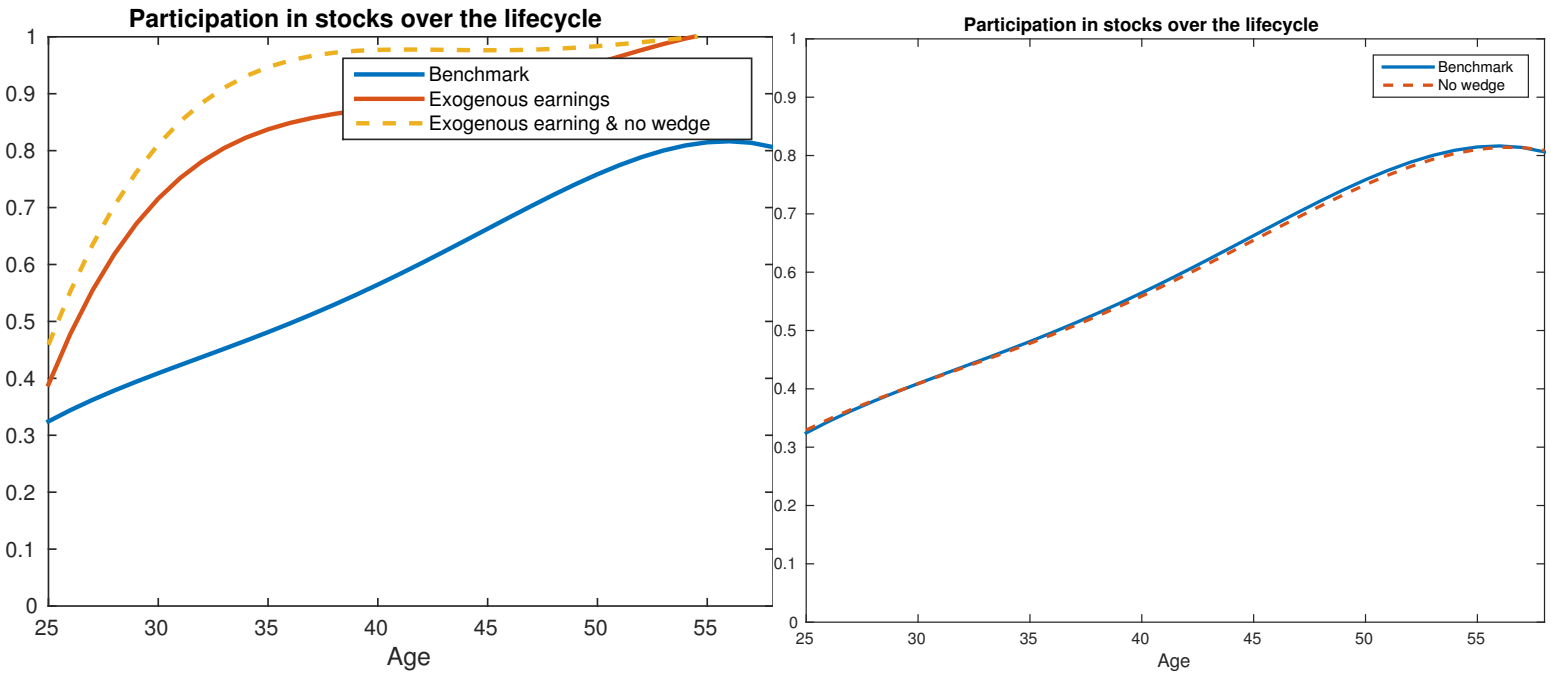


◂ Participants

Life-Cycle Stock Market Shares Under Exogenous Earnings

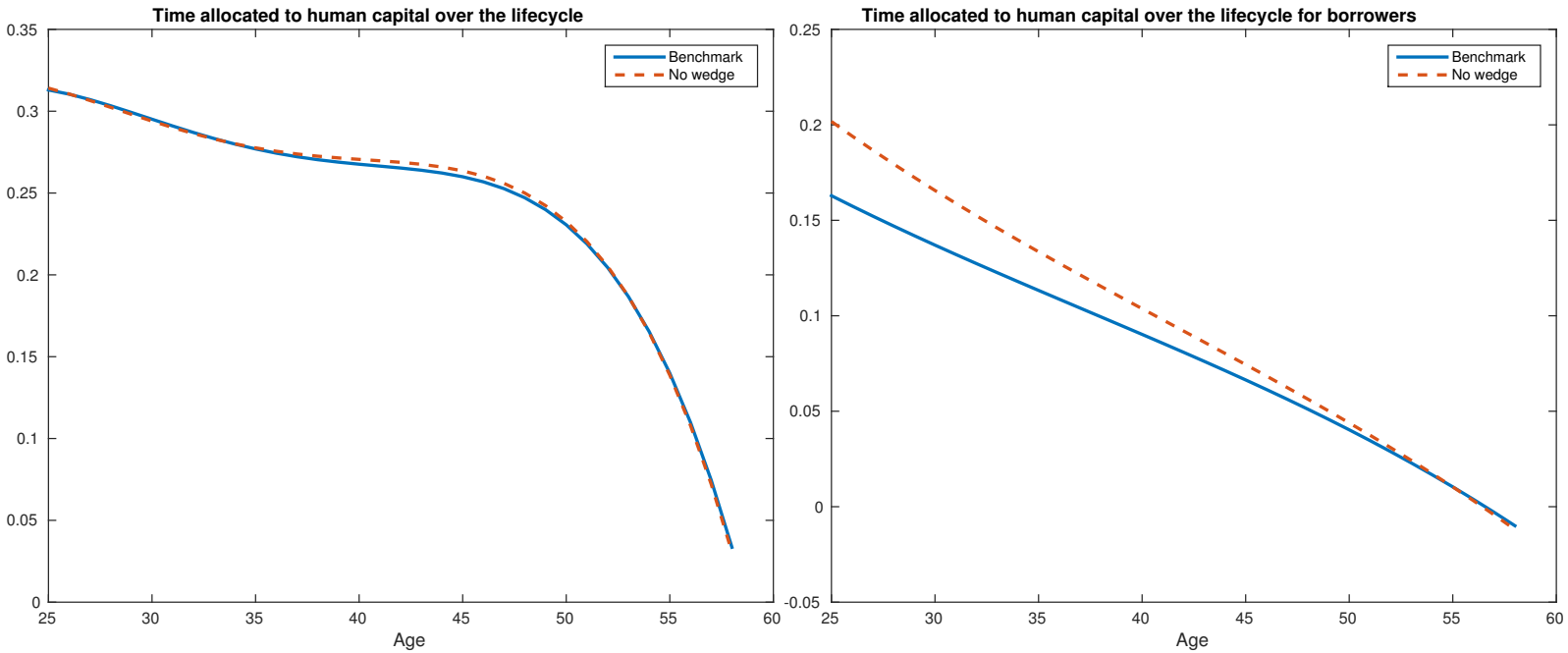


The Relevance of Borrowing Cost



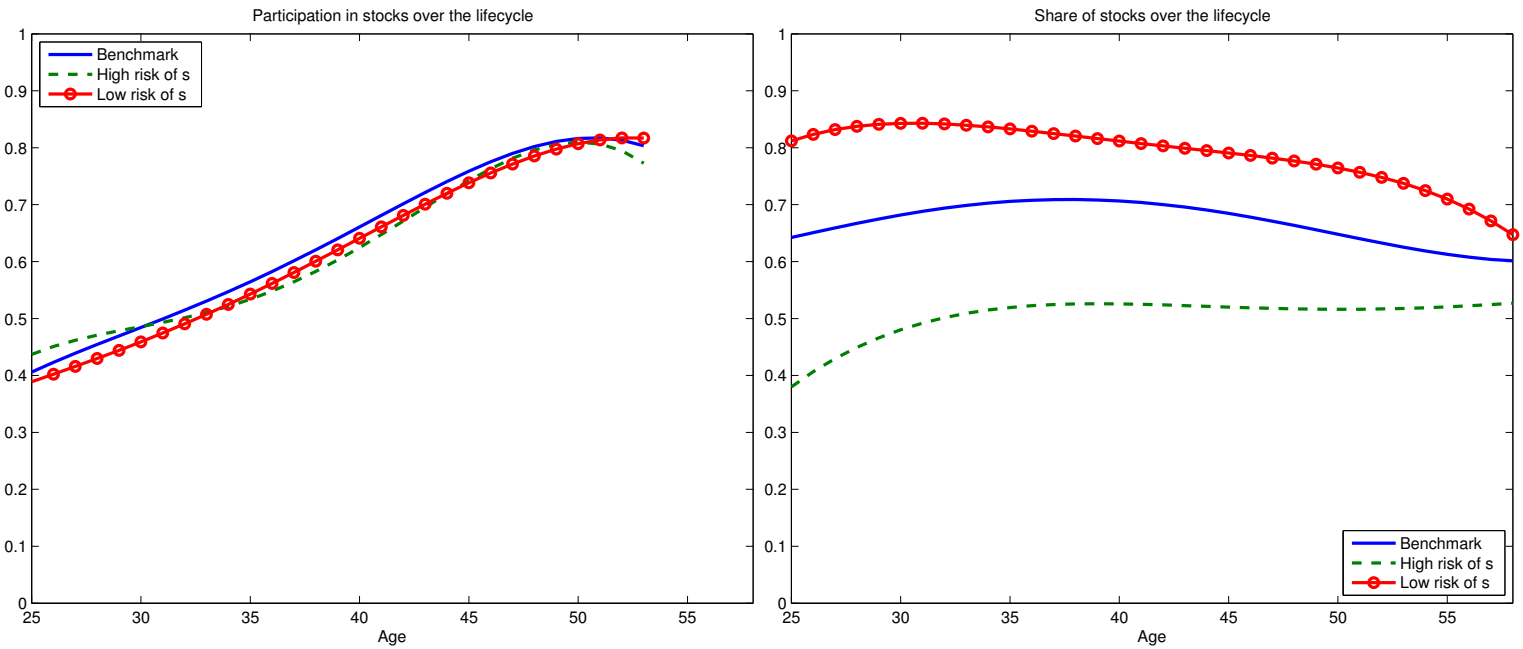
◂ Experiments

The Relevance of Borrowing Cost



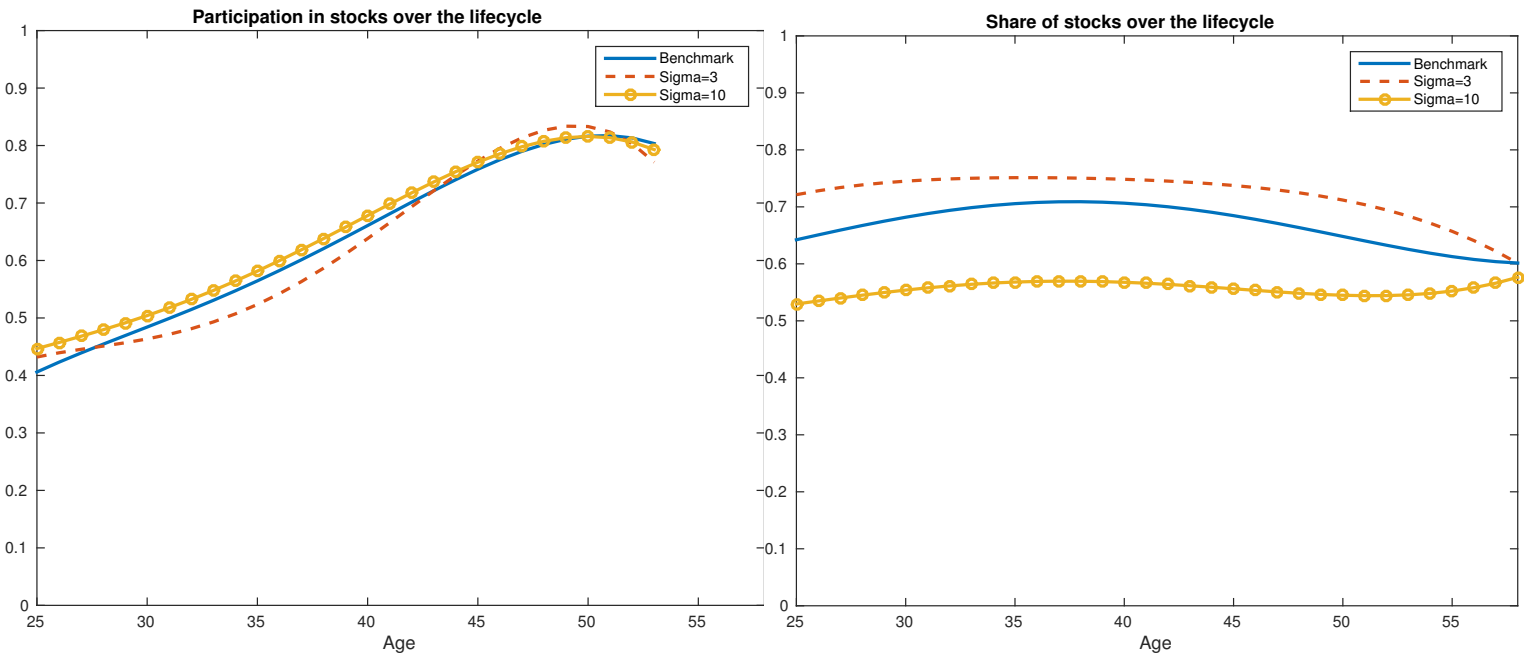
◂ Experiments

Stock Market Investment with Low and High Risk of Stocks



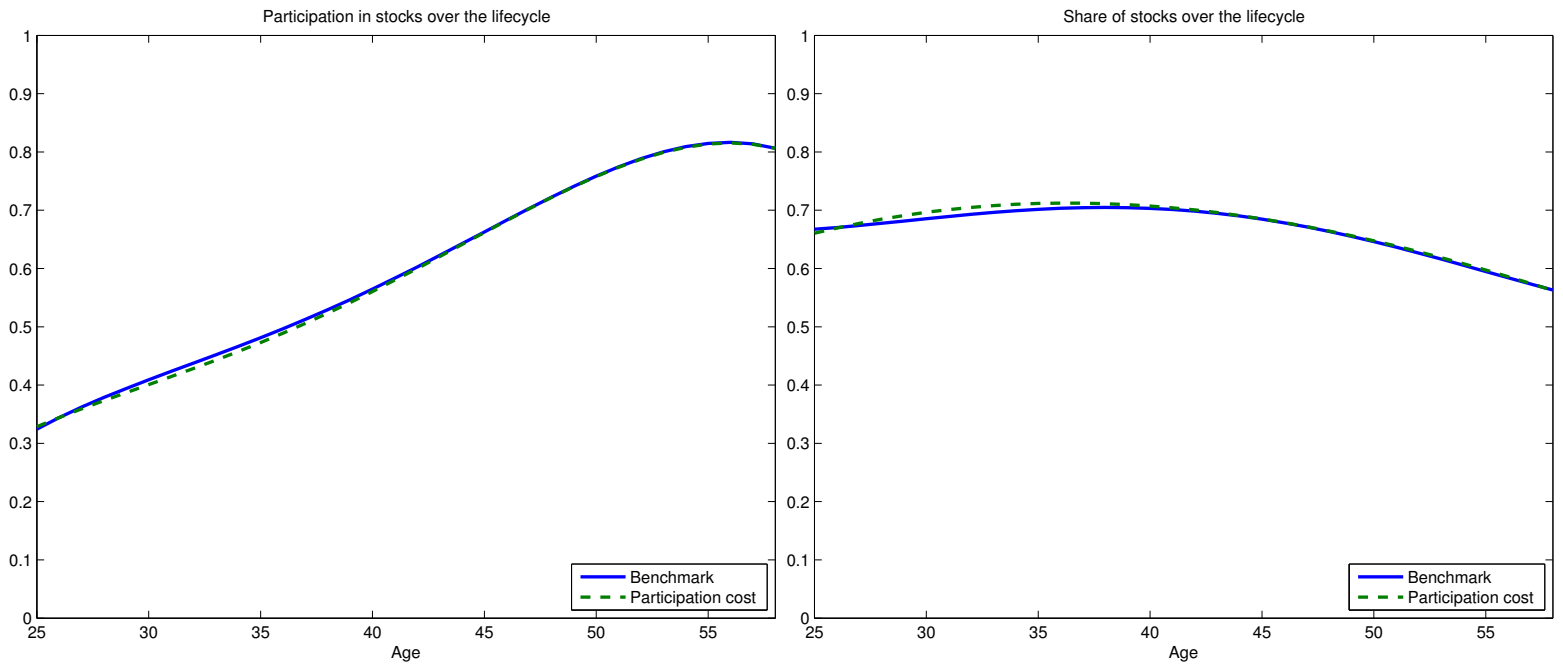
◂ Experiments

Effect of Changing Risk Aversion on Stock Market Investment



Experiments

The Relevance of Participation Cost



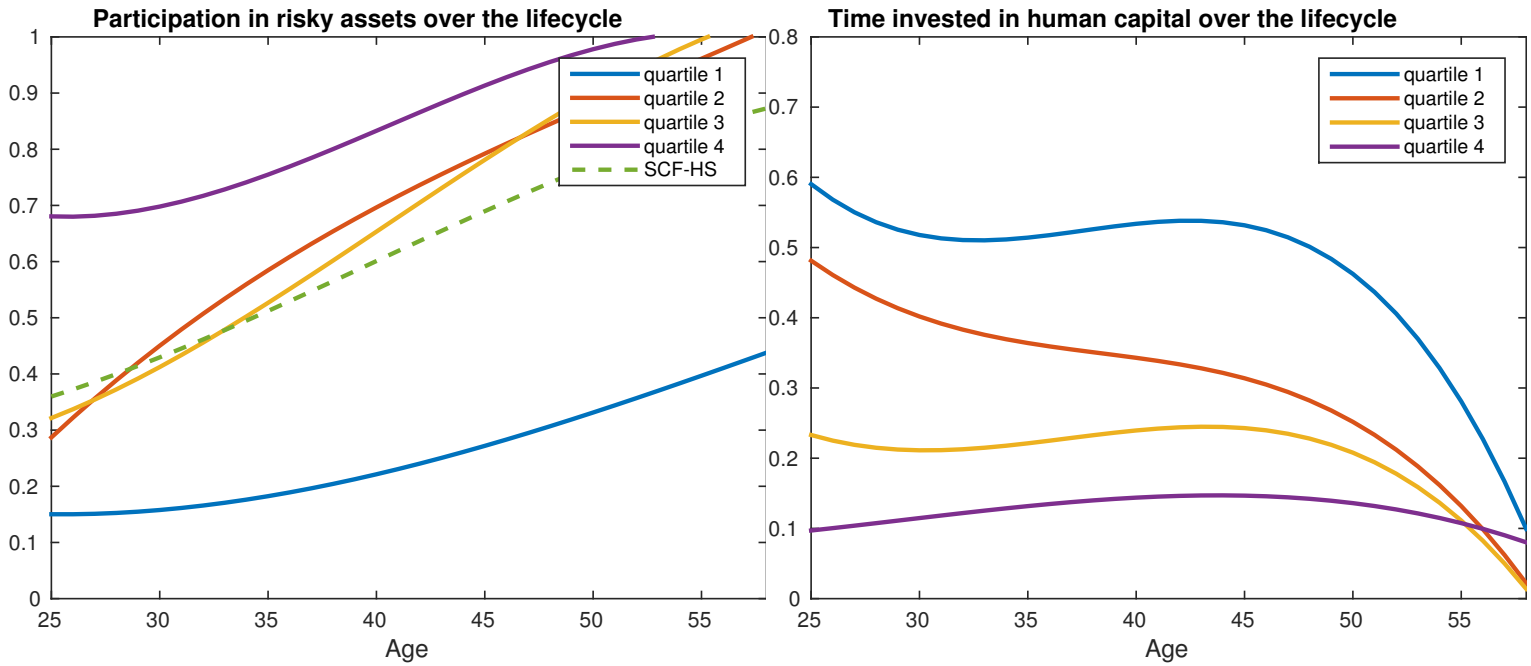
◂ Experiments

Separating the Roles of Ability and Initial Human Capital

- Want to see how each dimension matters separately
- Break population up into ability quartiles
- Isolate by assuming correlation=0 (contrast with baseline=0.65)

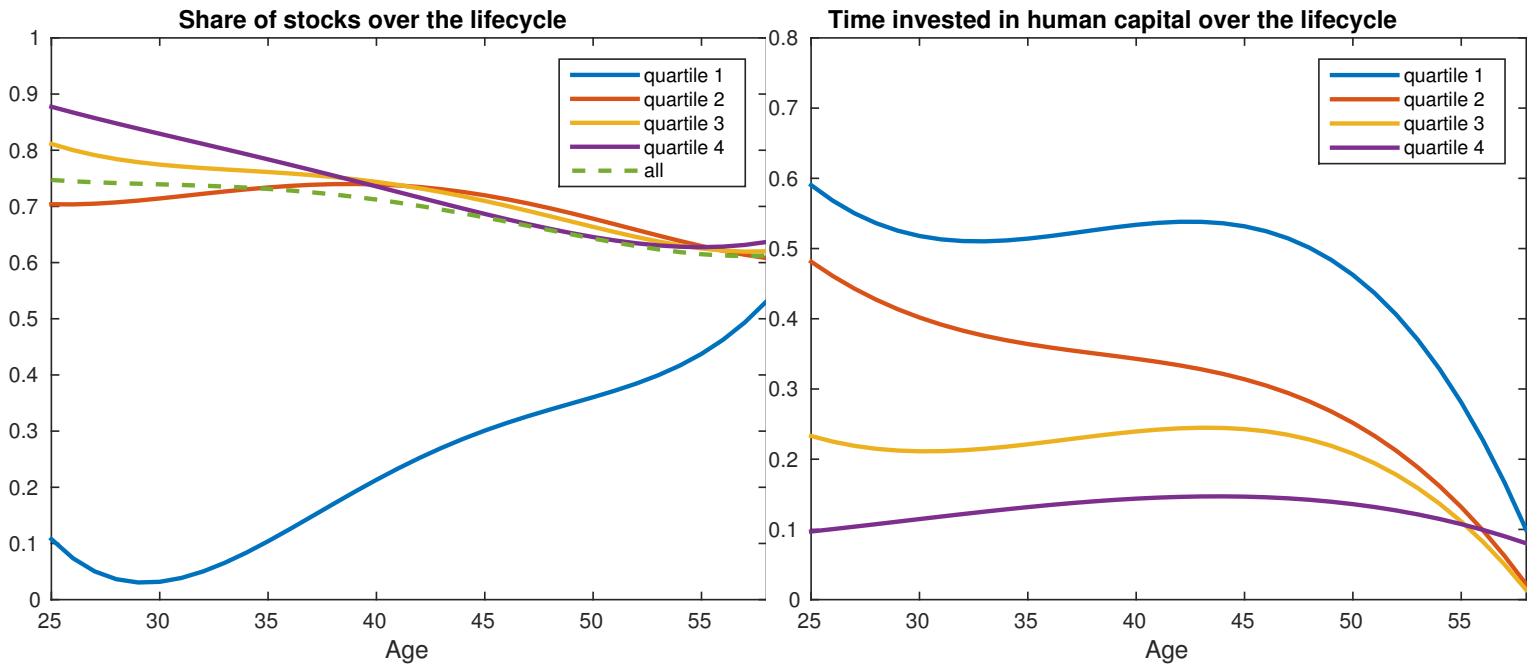
◂ Participants

Role of Initial Human Capital:Participation



Participants

Role of Initial Human Capital: Shares



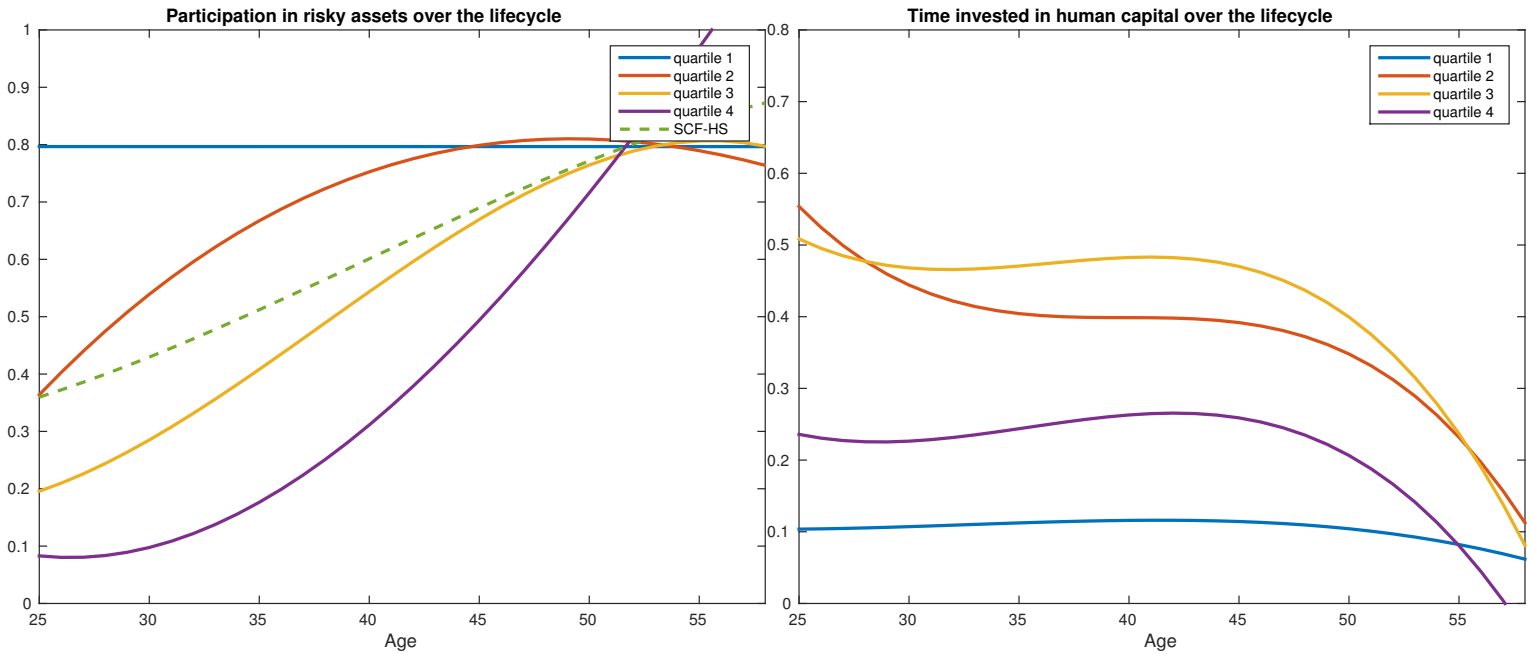
Participants

Role of Initial Human Capital: Discussion

- Higher initial HC agents spend little time on HC accumulation
- Model predicts that all else equal: Lower participation throughout life by less skilled households—horse race with ability!
- Higher initial HC agents: more participation throughout life
- Shares: insensitive again except for bottom initial human capital quartile
- The option to *invest* in human capital investment matters

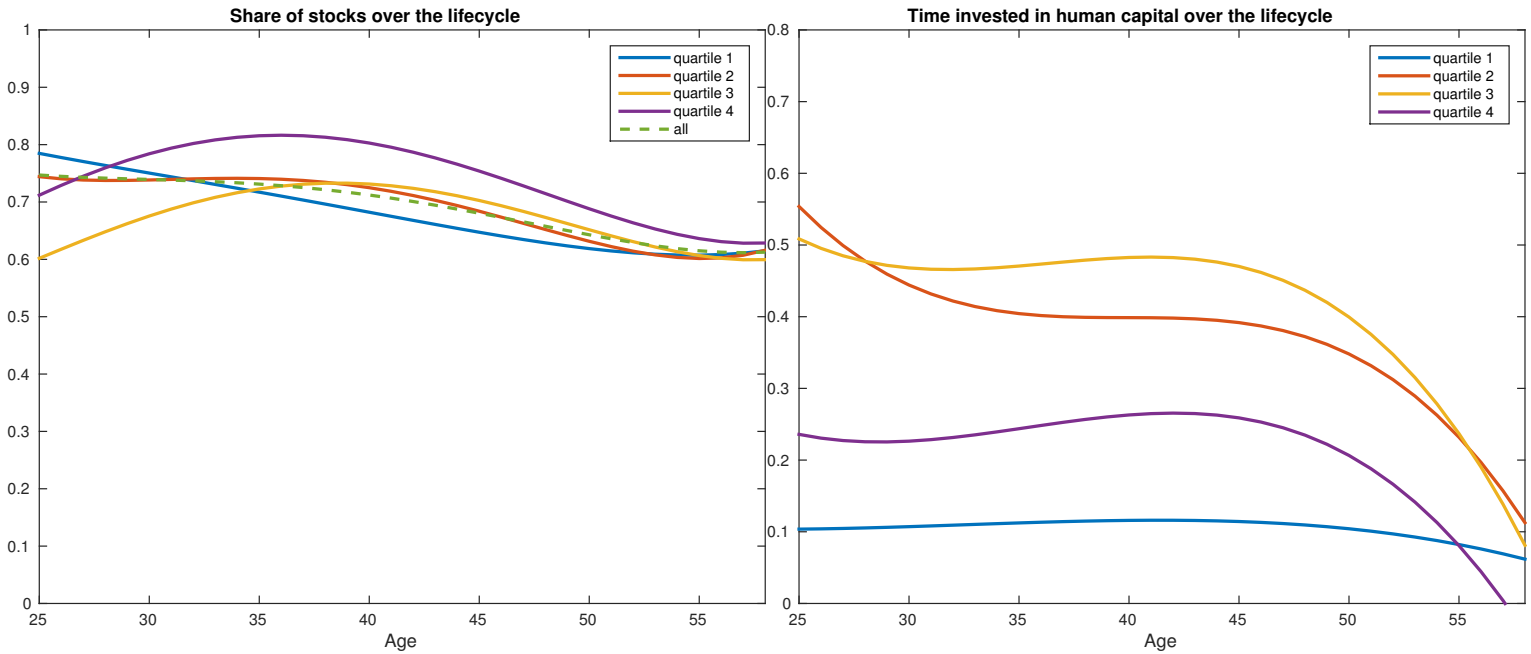
◂ Participants

Role of Ability:Participation



Participants

Role of Ability: Shares



Participants

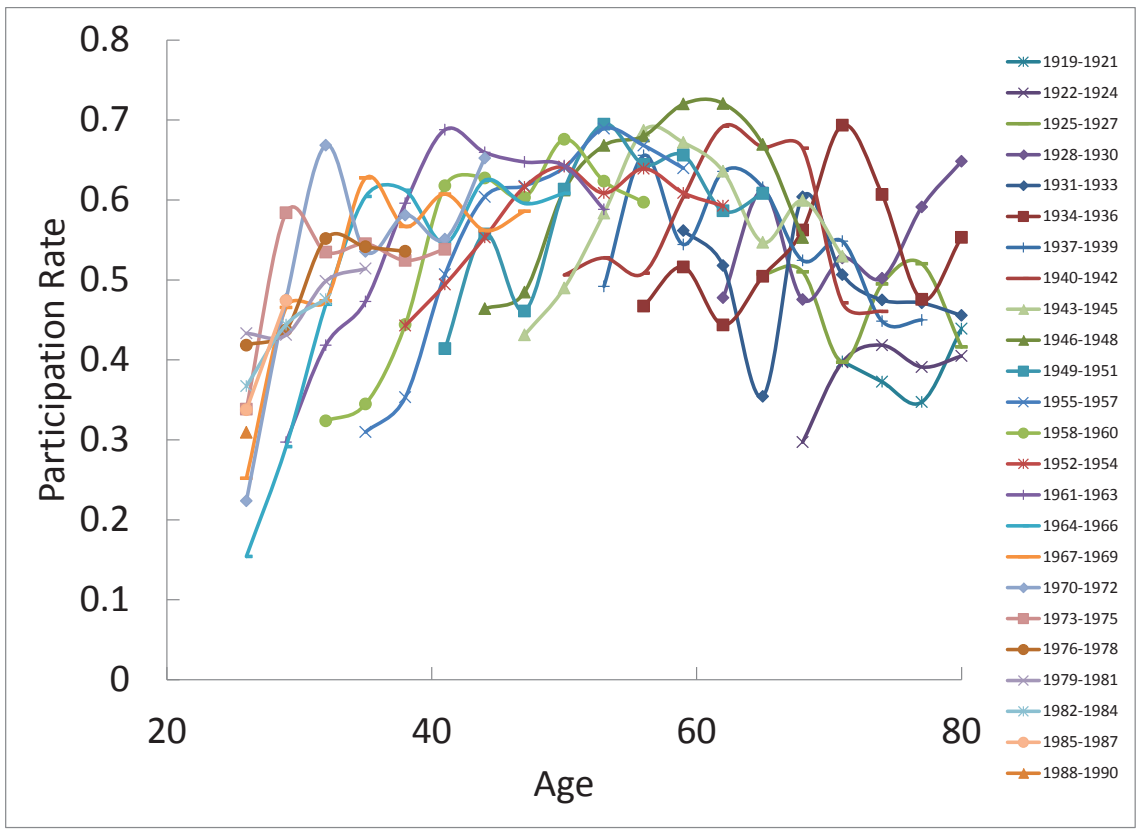
Role of Ability: Discussion

- Higher ability agents accumulate HC more rapidly initially
- Model predicts that all else equal: (much) higher participation early in life by *less* skilled households
- Less participation until very late: rapid catch-up for high ability as HC falls
- Path of Shares: Remarkably insensitive to ability

◂ Participants

Data

- Household-level data from U.S. Survey of Consumer Finances (SCF) – not a panel
- Household Stock Market Participation Rate by Cohort (SCF)



Estimation strategy

- Follows Poterba Samwick (1997)
- Each successive cross-sectional survey will include a random sample of a cohort if the number of observations is sufficiently large.
- Using summary statistics about the cohort from each cross section, a time series that describes behavior as if for a panel can be generated.
- Use standard Probit regression (excluding time effects) to estimate participation rates.
- Use standard OLS to estimate share of stocks conditional on participation.

◂ Introduction

Estimation: Participation

$$S_i^* = \alpha + \sum_{n=2}^{21} \beta_n age_{i,n} + \sum_{m=2}^{24} \gamma_m cohort_{i,m} + \epsilon_i$$

- $S_i = 1$ if $S_i^* > 0$ and 0 otherwise
- $age_{i,n}$: dummy variable indicating whether age of household head lies in one of 19 age categories ranging from 23–25 to 77–79
- $cohort_{i,m}$: dummy variable indicating whether household head belongs to one of 24 cohorts in the range 1919–1921 to 1988–1990.

◂ Introduction

Estimation: Shares

$$Y_i = \alpha + \sum_{n=2}^{21} \beta_n age_{i,n} + \sum_{m=2}^{24} \gamma_m cohort_{i,m} + \epsilon_i$$

- $Y_i = \ln \frac{\frac{s}{s+b}}{1-\frac{s}{s+b}}$
  - s: Risky assets
  - b: Risk-free assets

◂ Introduction

Calibration of the Initial Distribution (a,h)

- We use a parametric approach: joint log-normal distribution characterized by the vector of parameters $\gamma = (\mu_a, \sigma_a, \mu_h, \sigma_h, \rho_{ah})$
  - Find γ that solves

$$\min_{\gamma} \left(\sum_{j=1}^{J} |log(m_j/m_j(\gamma))|^2 + |log(g_j/g_j(\gamma))|^2 + |log(d_j/d_j(\gamma))|^2 \right)$$

- The model produces $\rho_{ah} = 0.65$.

◂ Calibration

Earnings Data

- We compute 102 statistics of age-earnings profiles from the CPS for 1969-2002 family files for heads of household using a synthetic cohort approach
- We obtain mean real earnings, inverse skewness, and Gini of individuals of type (j) by averaging over the earnings of household heads between the ages of $j-2$ and $j+2$ for the appropriate year

◂ Calibration

Earnings Process

- The stochastic part of the labor income for household i at time j is:

$$\begin{aligned} z_{ij} &= u_{ij} + \epsilon_{ij} \\ u_{ij} &= \rho u_{i,j-1} + \nu_{ij} \end{aligned}$$

where ϵ_{ij} $N(0, \sigma_\epsilon^2)$ and ν_{ij} $N(0, \sigma_\nu^2)$

- We set$\rho = 0.955$, $\sigma_\omega^2 = 0.055$, and $\sigma_\nu^2 = 0.017$ for high-school graduates and $\rho = 0.945$, $\sigma_\omega^2 = 0.052$, and $\sigma_\nu^2 = 0.02$ for college graduates

◂ Calibration