o k k p on Ro o umn p

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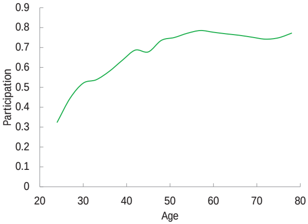
B k o u n

- Large fraction of households do not participate in the stock market, especially when young.



(a) Cohort Effects (b) Time Effects

- Has proved very difficult to explain without imposing nonstandard preferences, stock market participation costs, or imperfect information.

- **Q:** If you get human capital *investment* right (which we do by calibrating to earnings over the life-cycle under observed stock and bond returns), do you get participation right, given observed returns?
- **A:** Yes!

R u

- 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)
- Human capital
  - Ben-Porath (1967), Guvenen (2009), Huggett, Ventura and Yaron (2011)
  - Lindset and Matsen (2011), Roussanov (2010), Kim, Maurer and Mitchell (2013)
- Borrowing Constraints
  - Reduce the demand for equity and raise the equity premium (Constanindes, Donaldson, Mehra, 2002)
  - Make equity demand dependent on liquid wealth (Davis, Kubler and Willen, 2006)

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, $b_t \geq -\underline{b}$

n

xT R.c ..oxTJ R.c .Td Td x R.c ..ExTJ R..Td f.TJ R..c .T...Tf R..Tf Tm .Tm .T

$$\max_{(\{c_t}$$

A

- Interest rates
  - riskfree assets:R_f $(b_t > 0)$
  - risky asset: $R_{s,t+1} = R_f + \mu + \eta_{t+1}$with $\eta_{t+1} \sim N(0, \sigma_\eta^2)$ iid
  - debt: $R_b = R_f + \phi$ $(b_t < 0)$
- Financial wealth $x_{t+1} = R_i b_{t+1} + R_{s,t+1} s_{t+1}$
- Human Capital

$$h_{t+1} = h_t(1 - \delta) + a(l_t h_t)^\alpha$$

n om

- Labor income

$$\log(y_t) = G(w_t, h_t, l_t) + z_t$$

$$\begin{aligned} w_t &= (1+g)^{t-1} \\ z_{it} &= u_{it} + \epsilon_{it} \\ u_{it} &= \rho u_{i,t-1} + \nu_{it} \\ \nu_{it} &\sim N(0, \sigma_\nu^2) \\ \epsilon_{it} &\sim N(0, \sigma_\epsilon^2) \end{aligned}$$

- Means tested transfer income

$$\tau_t(t, y_t, x_t) = \max\{0, \underline{\tau} - (\max(0, x_t) + y_t)\}$$

A n o m

- 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.

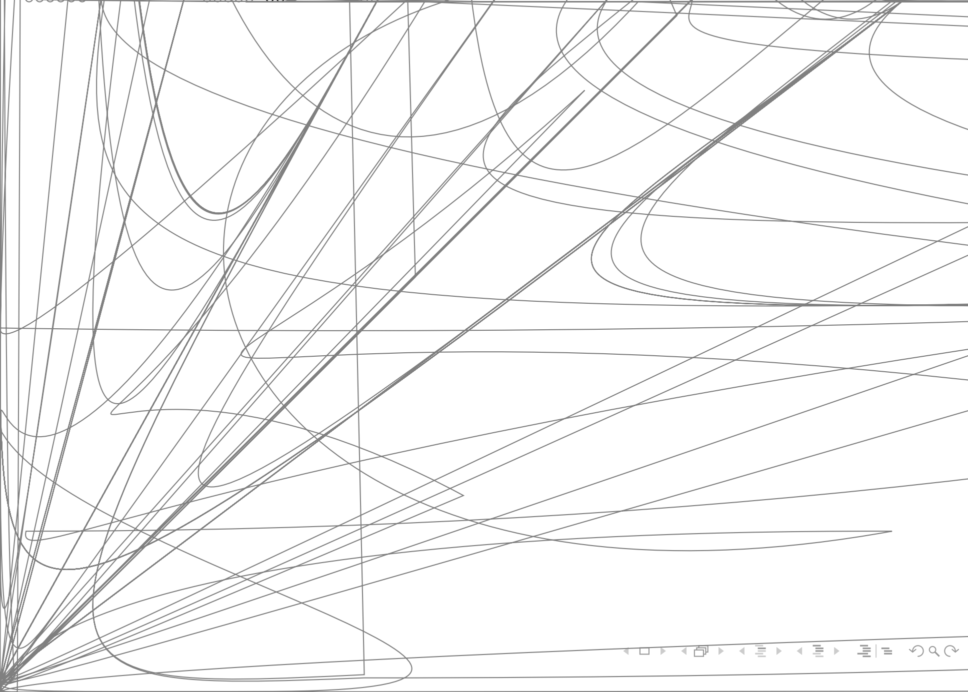
$$c + b^{'} + s^{'} \leq \phi(y_J) + R_i b + R_s s$$

- 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.

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



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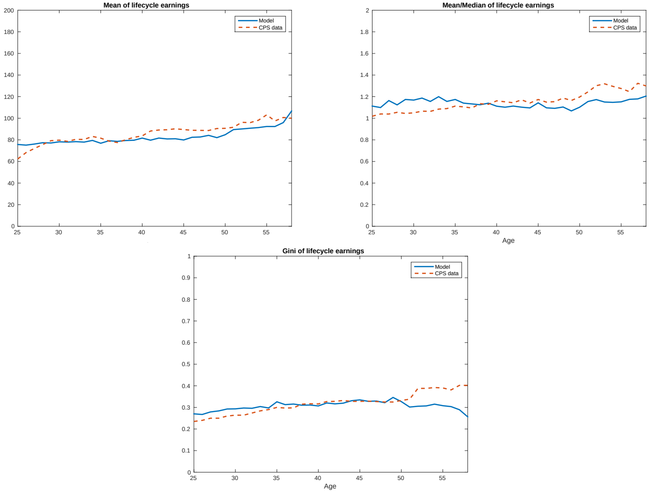
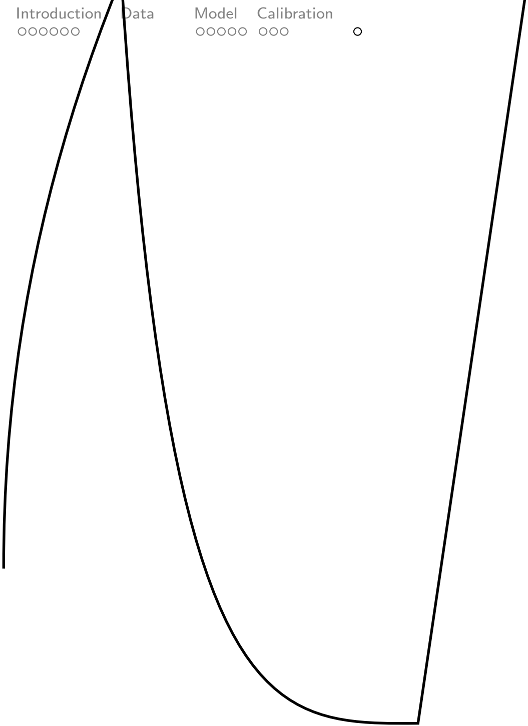

Mean of lifecycle earnings
Model
CPS data
Mean/Median of lifecycle earnings
Model
CPS data
Age
Gini of lifecycle earnings
Model
CPS data
Age

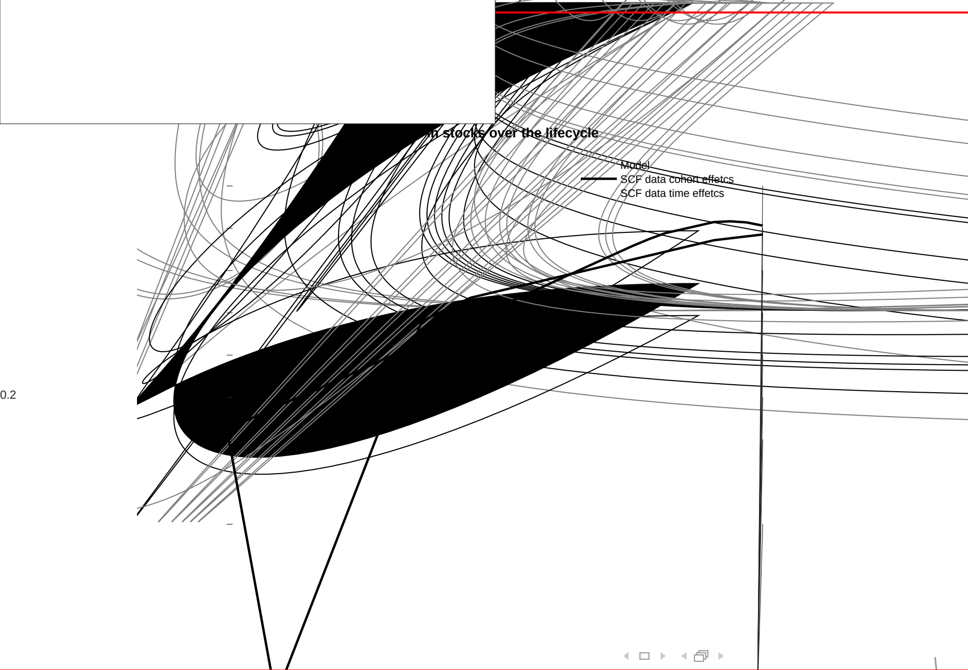
m A o o u m n p ov y n u on

- Agents should want to allocate most time to human capital investment when young
  - Opportunity cost of doing so is low
  - Time horizon to recoup returns is long
  - Marginal returns are high for most given elasticity, initial human capital, and learning ability



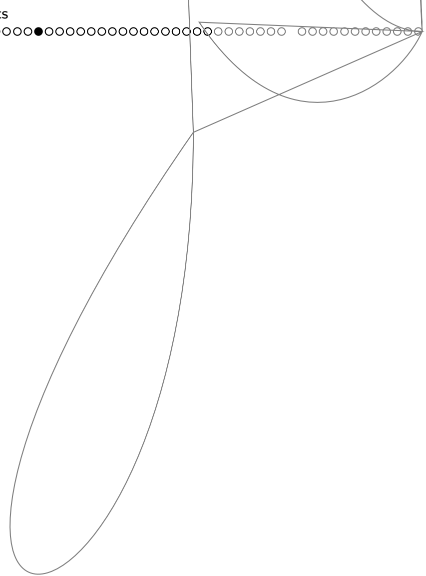
o k k p on ov y n u on

- Most agents allocate time to HC when young.
- As a result, they forgo current earnings.
- They borrow to smooth consumption and do not invest in equities when young.

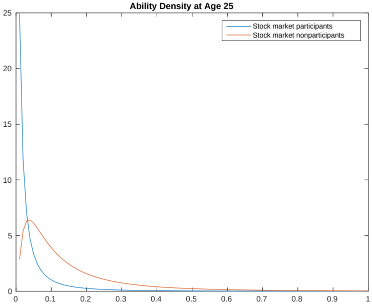

n stocks over the lifecycle
Model
SCF data cohort effetcs
SCF data time effetcs
0.2
0

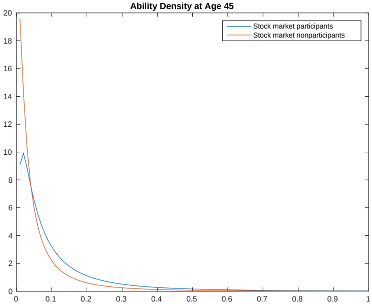
Ro o A b y n n um n p

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

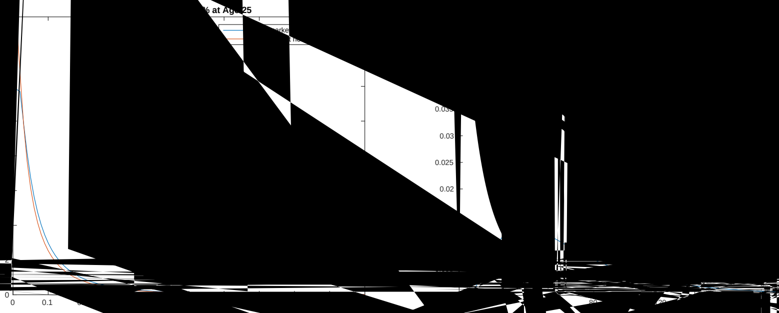


p n v —√on p n

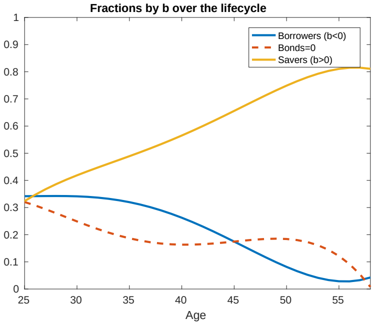

Ability Density at Age 25
Stock market participants
Stock market nonparticipants
25
20
15
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

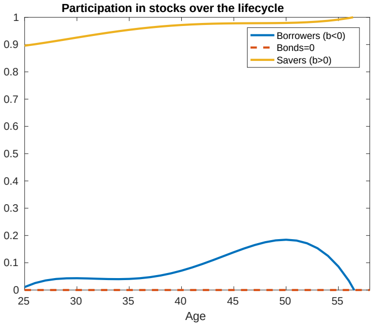

Ability Density at Age 45
Stock market participants
Stock market nonparticipants
20
18
16
14
12
10
8
6
4
2
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

y



Bo o n v o


Fractions by b over the lifecycle
Borrowers (b<0)
Bonds=0
Savers (b>0)
Age
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
25
30
35
40
45
50
55

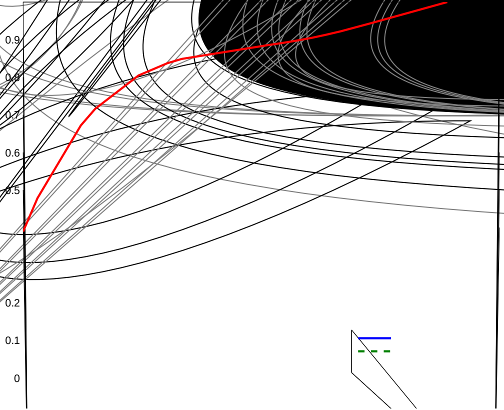

Participation in stocks over the lifecycle
Borrowers (b<0)
Bonds=0
Savers (b>0)
Age
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
25
30
35
40
45
50
55

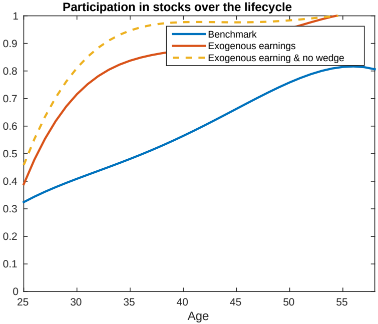
y um n p *investment* mpo n

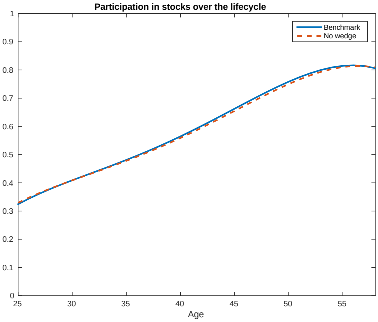
- We've shown that the tilt in earnings and its dispersion matter for participation.
- Endowments determine dispersion in the value of human capital.
- People's choices in response determine their earnings path.
- This opens the door for an additional role for borrowing: financing consumption, not stocks.
- How important is this?

y o k k

n n

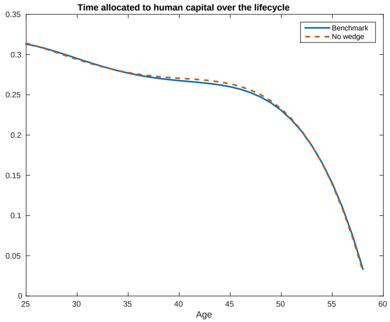


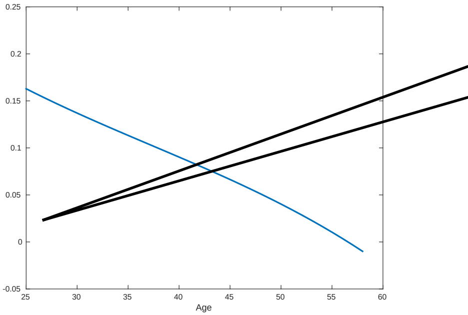




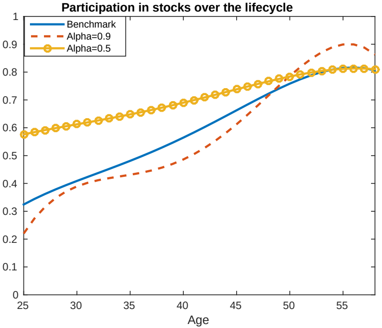
- Exog earnings: Borrow to finance stocks
- Endog earnings: Borrow to finance consumption

umn p n Bo o n o


Time allocated to human capital over the lifecycle
Benchmark
No wedge
Age


Age

Ro o y o um n p


Participation in stocks over the lifecycle
Benchmark
Alpha=0.9
Alpha=0.5
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
25
30
35
40
45
50
55
Age

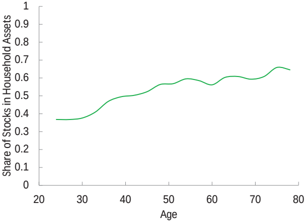
Ro o y o um n p u on

- $\alpha = 0.5$ makes human capital technology less productive
- Makes earnings path flatter, all else equal.
- Decreases agents incentive to invest in human capital
- Results in a lower and flatter path for earnings, higher and flatter path for participation

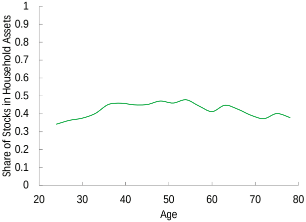
o mp on o

- What you're using borrowing to fund is participation story
- But the model also has predictions for the share of risky assets in the household's portfolio

m Av o o k n o o o on on on p on

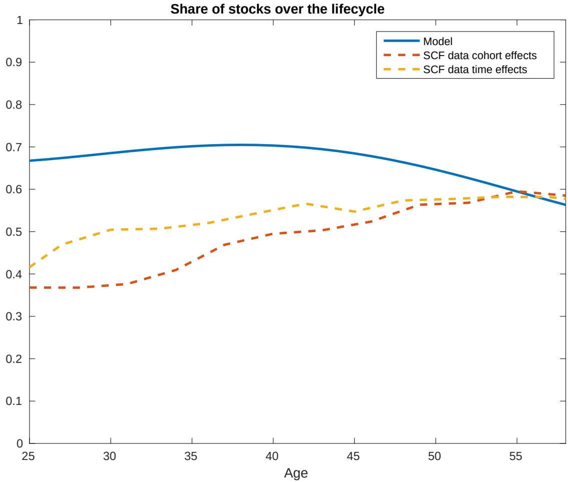


(a) Cohort Effects

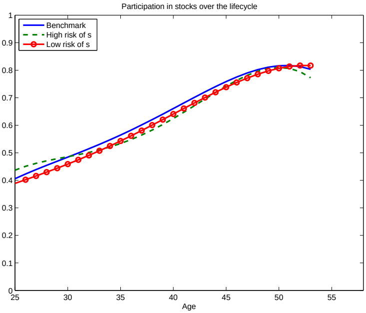


(b) Time Effects

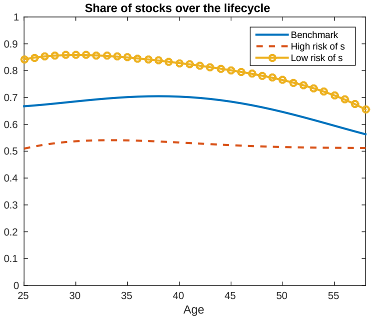
o k k nv m n


Share of stocks over the lifecycle
Model
SCF data cohort effects
SCF data time effects
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
25
30
35
40
45
50
55
Age

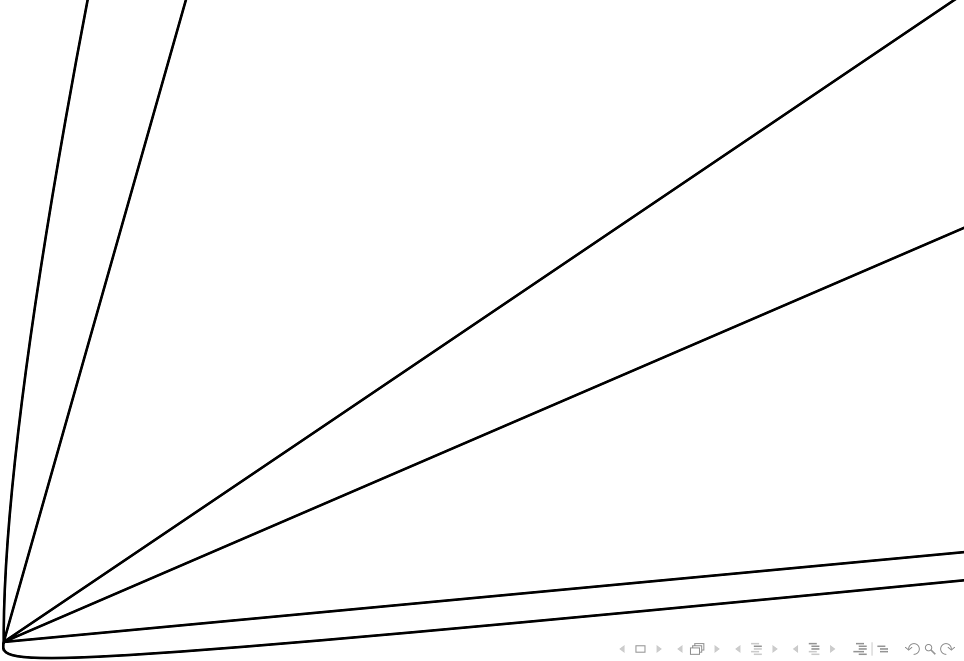
o k k nv m n o n o k k R k



(a) Participation



(b) Shares



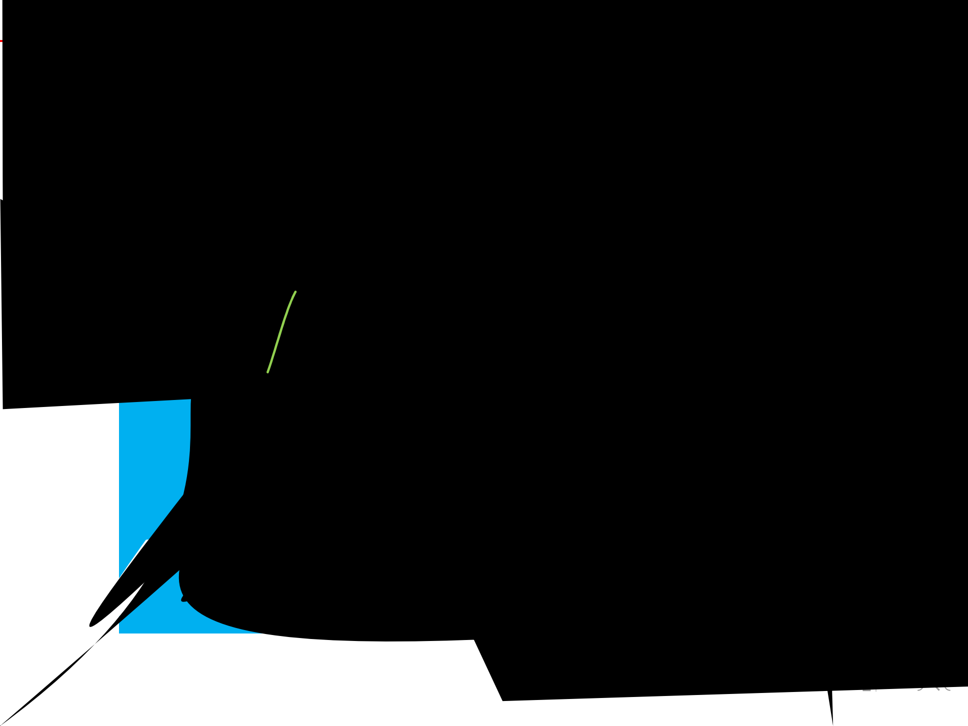
umm y o n n

- Unlike participation, shares not sensitive to time invested in human capital
- Shares sensitive to riskiness of stocks and risk aversion
- **Forces driving shares differ from forces driving participation**.

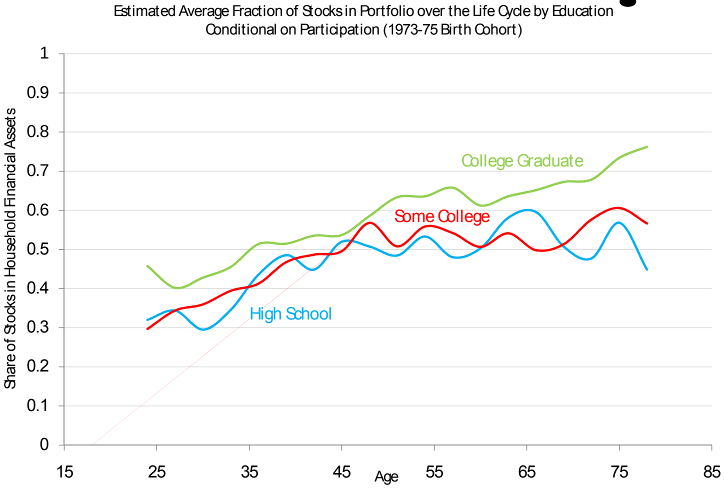
v o R o k

o o o n v nv m n op on

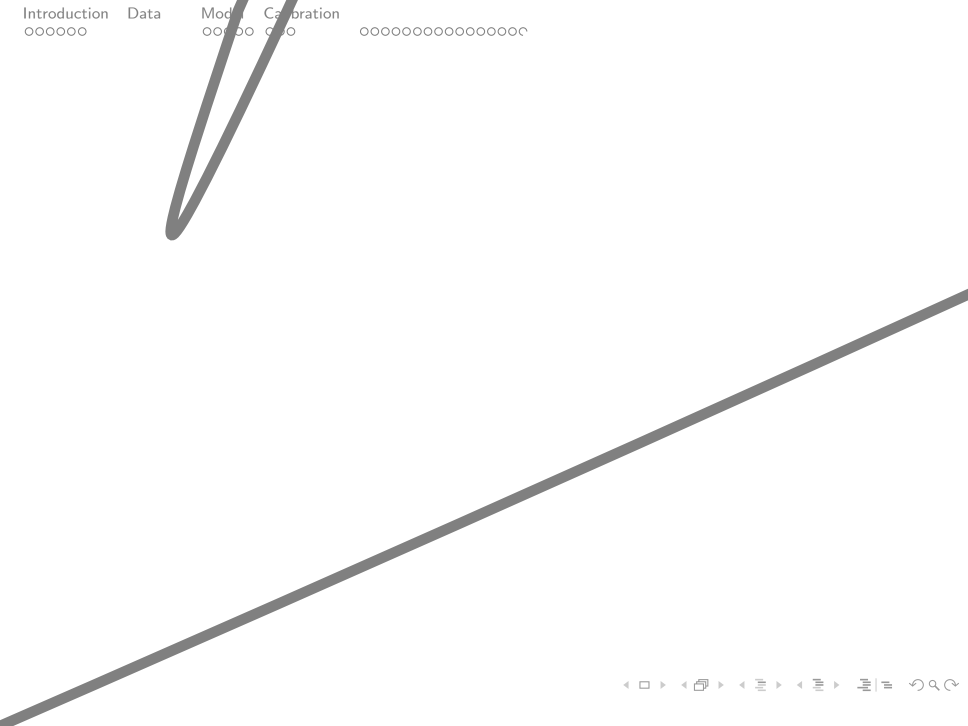
ou o b n b ov y



on o o k n po o o v o xp n



- College experience separates people early, and permanently (in earnings and financial assets)
- College is risky: risks vary across individuals
- College is costly: costs vary across individuals
- Observed relationship between education and financial investment hinges on risks and net-returns, and their dispersion across households



O

- Working after College (state t, a, h, b, s, u, ν)

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

s.t.

$$\begin{aligned} & & (1)\text{-}(3) \quad & \text{for} \quad t = P+1, .., J-1 \\ c + b' + s' &\leq w(1-l)hz + R_j b + R_s s + \tau(t,y,x) - p(x_1) & & \text{for} \quad t = 5, .., P \end{aligned}$$

- College

$$V^C(5,a,h,b,s,u,\nu) = \pi(h_5)V^{CG}(5,a,h,b,s,u,\nu) + (1-\pi(h_5))V^{SC}(5,a,h,b,s,u,\nu)$$

$$V^C = \max_{l,h',b',s',d} \left[\frac{c^{1-\sigma}}{1-\sigma} + \beta V^{C'} \right]$$

s.t.

$$\begin{aligned} c + b' + s' &= w_{col}(1-l) + t(a) + R_b b + R_s s + \frac{d}{4} - \hat{d} \\ (2)\text{–}(3) & \\ d \in D &= [0, \max(d_{max}, \overline{d} - x)] \text{ for } t = 1 \end{aligned}$$

- Education decision

$$\max[V^C(1,a,h,x), V^{HS}(1,a,h,x)]$$

College Investment

o nv m n

Characteristic	College Enrollment	College Completion
Ability		
Low	29	48
Medium	44	54
High	71	59
Human Capital		
Low	38	42
Medium	47	54
High	59	68

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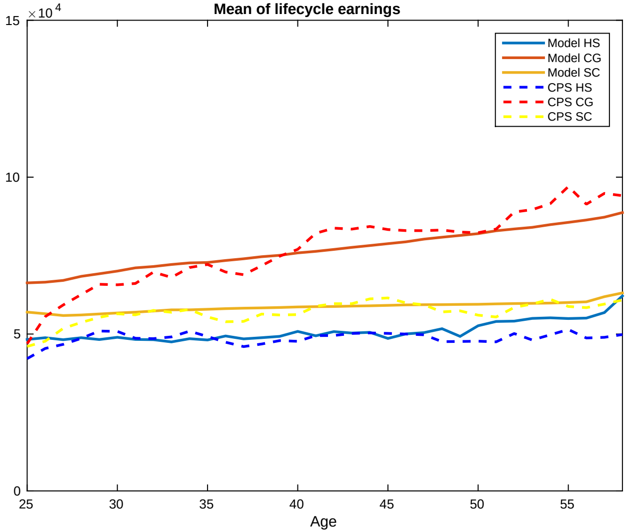
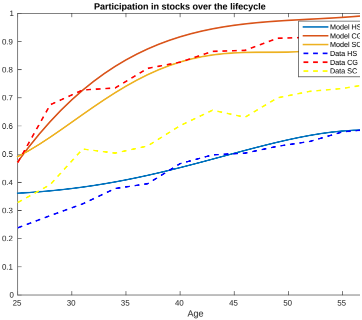
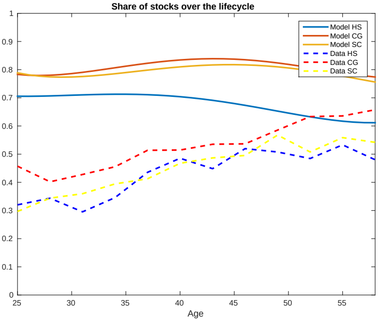
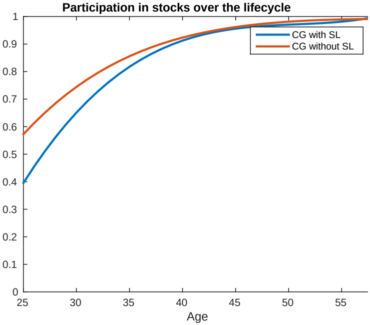

Mean of lifecycle earnings
×10^4
15
10
5
0
25
30
35
40
45
50
55
Age
Model HS
Model CG
Model SC
CPS HS
CPS CG
CPS SC

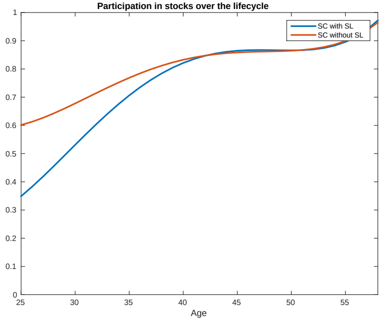
nv mn n ok b y u on ou p



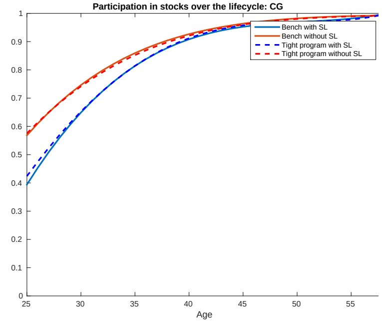


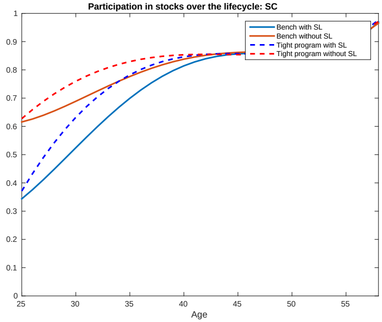
o u n o n


Participation in stocks over the lifecycle
CG with SL
CG without SL
Age
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
25
30
35
40
45
50
55


Participation in stocks over the lifecycle
SC with SL
SC without SL
Age
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
25
30
35
40
45
50
55

o y n y u n o n p o m





E n n

- We compute 102 statistics of age-earnings profiles for each education group from the CPS for 1969-2002 family files for heads of household using a synthetic cohort approach
- We distinguish between the three education groups in our model, namely, those with 12 years of schooling (high-school), those with at least 12 years but less than 16 years of completed schooling (some college) and those with at least 16 years of completed schooling (college graduates)
- We compute mean real earnings, inverse skewness, and Gini of individuals of type (j, k) by averaging over the earnings of household heads between the ages of $j - 2$ and $j + 2$ in education group k for the appropriate year

Data

n n o

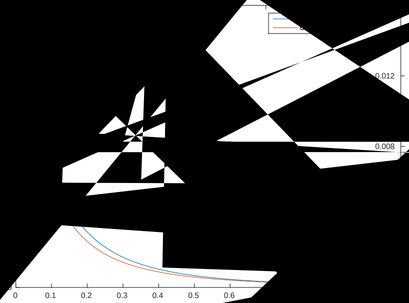
- The stochastic part of the labor income for household i at time j is:

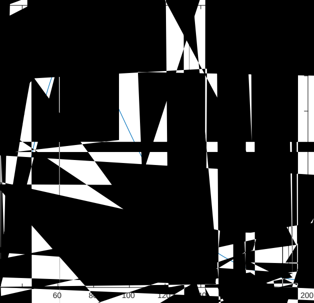
$$
\begin{aligned}
z_{ij} &= u_{ij} + \epsilon_{ij} \\
u_{ij} &= \rho u_{i,j-1} + \nu_{ij}
\end{aligned}
$$

  where $\epsilon_{ij}\ N(0, \sigma_{\epsilon}^2)$ and $\nu_{ij}\ N(0, \sigma_{\nu}^2)$
- 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

[redacted] on [redacted]





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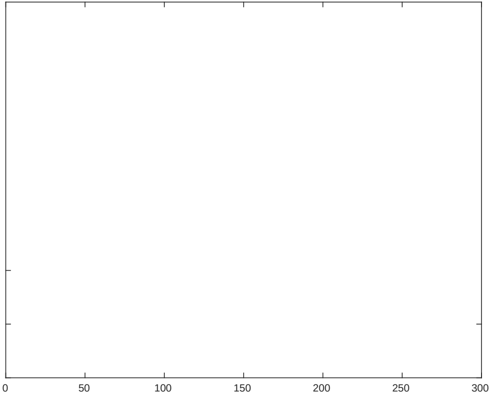
u m n p u p b y A 2



on o n u on

- 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

$$\min_{\gamma} \left(\sum_{j=5}^{J} |log\,(m_j/m_j(\gamma))|^2 + |log\,(g_j/g_j(\gamma))|^2 + |log\,(d_j/d_j(\gamma))|^2 \right)$$

- The model produces $\rho_{ah} = 0.65$ and the fit is 8.5%

Calibration

m on

- Controlling for cohort effects

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

- Controlling for time effects (following Ameriks Zeldes, 2004)

$$Y_i = \delta + \sum_{n=2}^{21} \xi_n age_{i,n} + \sum_{t=2}^{8} \eta_t year_{i,t} + \mu_i$$

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