Health Heterogeneity, Portfolio Choice and Wealth Inequality

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Introduction

- Question: To what extent health shocks affect inequality?

- Macro-health literature
  - Capatina and Keane (2025); Hosseini, Kopecky and Zhao (2025); DeNardi, Pashchenko and Porapakkarm (2025); Mahler and Yum (2024*a*); Jung and Tran (2023)
  - Structural life-cycle models with a single risk-free asset and incomplete markets

- Main transmission channels
  1. **Preferences**
     Health ⇒ survival probabilities and life expectancy ⇒ savings and wealth accumulation (*health-longevity channel*)
  2. **Budget constraint**
     Health ⇒ labor earnings and medical expenditures ⇒ consumption and savings (*health-expenditure/income channel*)

- Missing channel (*health-wealth portfolio channel*)
  - Health ⇒ portfolio choice and access to risky assets ⇒ investment returns ⇒ wealth accumulation and inequality

This paper

- Add health channel to address **how** **(where)** households save
  - Household finance: wealth/investment portfolio choice
  - Lit. Surveys: Gomes (2020) and Gomes, Haliassos and Ramadorai (2021)

- **Health-wealth portfolio channel**
  - If portfolio **composition** (ratio of risky assets) differs by health $\Rightarrow$ **returns** to investment differ by health
  - If health effect is persistent $\Rightarrow$ compounding of investment returns $\uparrow$ wealth gap over lifecycle (between health types)
  - Health heterogeneity $\Rightarrow$ dynamics of **how** (and how much) households save
  - Health-wealth channel $\Rightarrow$ important implications for wealth inequality
  - Introduces new wealth redistribution role for **health insurance**

This paper

Quantifying the health–wealth portfolio channel

1. **Empirical investigation:** PSID (1984–2019) and HRS (1992–2018)
   - Document the lifecycle pattern of asset holdings and stock market participation by health status

2. **Structural analysis:** a lifecycle model with portfolio choice + counterfactual experiments
   - Quantify the contribution of health and portfolio choice to wealth inequality

Main findings

1. Empirical investigation
   - Individuals with poor health are 27–48 percentage points less likely to hold stocks
     - Gap persists within education groups and widens over the lifecycle

2. Structural analysis:
   - Health-wealth portfolio channel is quantitatively important
     - Removing portfolio choice: P90/P50$\downarrow$ **55%**
   - Health insurance expansion reduces wealth inequality through the portfolio channel
     - P90/P50$\downarrow$**18–25%**
   - Mechanisms
     - Health shocks $\Rightarrow$ background risks and precautionary saving $\Rightarrow$ stock market participation:
       Kimball (1993), Viceira (2001), Cocco et al. (2005), Heaton and Lucas (2000) and Yogo (2016)
     - Compounding turns modest early differences in portfolio composition into large wealth gaps at retirement

Related literature

- Macro-health economics
  - Hosseini, Kopecky and Zhao (2025); Capatina and Keane (2025); DeNardi, Pashchenko and Porapakkarm (2025); Mahler and Yum (2024*a*);
  - Chen, Feng and Gu (2025); Jung and Tran (2023); Jung and Tran (2016); Capatina (2015); De Nardi, French and Jones (2010); Jeske and Kitao (2009)
- Household finance ⇒ lifecycle portfolio choice models
  - Seminal works: Samuelson (1969); Merton (1971)
  - Surveys: Gomes (2020) and Gomes, Haliassos and Ramadorai (2021)
  - Recent related: Campanale, Fugazza and Gomes (2015); Fagereng, Gottlieb and Guiso (2017); Gomes and Smirnova (2021); Tischbirek (2019)
- Health+investment portfolio
  - Yogo (2016) focus on retirees and housing, model starts at 65
  - Lusardi, Michaud and Mitchell (2017) knowledge accum. for "sophisticated" assets, health only affects old
  - Hugonnier and Pelgrin (2013) endog. health, closed form but no lifecycle consideration
- Wealth inequality/dynamics driven by heterogeneity in rates of return:Benhabib, Bisin and Zhu (2015); Gabaix et al. (2016); Benhabib, Bisin and Luo (2019)
  This paper: health at "45–55" ⇒ generating wealth gap via two assets at 65 &

Health-wealth portfolio channel: Empirical evidence

Data

- Data sources: **PSID** 1984–2019 and **HRS** 1992–2018
- Financial wealth
  - Focus on **financial wealth** (no housing, cars, real estate)
  - Collapse 20 asset categories into 2
    1. **safe assets:** checking/savings accts, money market funds, CDs, bonds (government savings bonds, T-bills, corporate, municipal and foreign bonds, bond funds)
    2. **risky assets:** stocks and mutual funds
    - IRAs & 401(k) limited info $\Rightarrow$ assign 45.8% & 41% of holdings to risky assets (Tischbirek, 2019; Agnew, Balduzzi and Sundén, 2003)
    - PSID does not have info about 401(k)
- Health status
  - Five states: 1 excellent, 2 very good, 3 good, 4 fair, 5 poor
  - Two groups by health status at **age 45–55:**
    - **Sick:** 4-fair and 5-poor
    - **Healthy:** 1-excellent, 2-very good, 3-good health

More details

Econometric model

- Reduced form: Poor health (Sick 45–55) $\Rightarrow$ risky asset share

$$y_{it} = \beta + \gamma \times 1_{\{\text{Sick } 45-55,\, i\}} + \delta \times Z_{it} + \varepsilon_{it}$$

- y_{it} risky asset share (in financial portfolio) at 60–70
- $1_{\{\text{Sick } 45-55,\, i\}}$ indicator "bad health in at least one survey wave between 45–55"
- Z_{it} controls
- ε_{it} error term

PSID: Stock share at 60–70

	(1)	(2)	(3)	(4)	(5)
Sick at 45_55	-0.028***	-0.040***	-0.035***	0.008	0.004
	(0.008)	(0.010)	(0.010)	(0.017)	(0.015)
Unemployed at 45_55	-0.004	0.005	-0.004	0.035**	0.035***
	(0.007)	(0.009)	(0.010)	(0.015)	(0.013)
Uninsured at 45_55	-0.030***	-0.047***	-0.031***	-0.018	0.000
	(0.009)	(0.010)	(0.009)	(0.028)	(0.026)
Observations	5625	5625	5625	2335	2335
R^2	0.323	0.302			0.107
Conditional P(Y>0)	No	No	No	Yes	Yes
Random Effects	No	No	Yes	Yes	No
Weighted	No	Yes	No	No	Yes

Selection model: PSID

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.003	-0.271***	0.036***	-0.198***
	(0.015)	(0.051)	(0.009)	(0.058)
Unemployed at 45_55	0.034***	-0.175***	0.003	-0.232***
	(0.012)	(0.047)	(0.008)	(0.053)
Uninsured at 45_55	-0.027	-0.382***	0.044***	-0.170***
	(0.026)	(0.076)	(0.012)	(0.064)
Observations	5625		5625	

HRS regression results

Stochastic lifecycle model

Lifecycle model: portfolio choice, health & HI

- A stochastic lifecycle model of portfolio choice
  - Lifespan: Age 40–94
  - Three skill levels: No high school, high school and college
  - Two assets: Risky (stock) and safe (bond) assets
- Idiosyncratic shocks
  1. Health
     - Longevity
     - Health expenditure
     - Labor productivity
  2. Health insurance/employer type
  3. Labor
- Health insurance (HI)
  - Public HI: Medicaid & Medicare (w/ eligibility criteria)
  - Private HI: Employer sponsored HI (w/ community rating and tax deduct. premium)
- Government
  - Progressive inc. tax, payroll taxes, capital taxes (dividend, cap. gains & interest)
  - Soc. Security, Medicaid, Medicare, min. consumption program

Model details

Worker problem

- State vec: $x_j = \left\{\vartheta, a_j, \epsilon_j^{incP}, \epsilon_j^{h}, \epsilon_j^{\text{ehi}}\right\} \in \{1,2,3\} \times R \times \{1,2,3,4\} \times \{1,2,3,4,5\} \times \{0,1\}$
- Expectation $\Rightarrow \mathbb{E}_{\epsilon_{j+1}^{incP}, \epsilon_{j+1}^{h}, \epsilon_{j+1}^{\text{ehi}}, \epsilon_{j+1}^{s} | \epsilon_j^{incP}, \epsilon_j^{h}, \epsilon_j^{\text{ehi}}}$

$$V(x_j) = \max_{\{c_j, \ell_j, \alpha_j\}} \left\{ u(c_j, \ell_j) + \beta \mathbb{E} \left[\overbrace{\pi_j\left(h\left(\epsilon_j^h\right)\right)}^{\text{Health-longevity channel}} V(x_{j+1}) + \overbrace{\left(1 - \pi_j\left(h\left(\epsilon_j^h\right)\right)\right)}^{\text{Health-longevity channel}} u^{\text{beq}}(a_{j+1}) \right] \right\}$$

s.t.

$$a_{j+1} = \tilde{R}_{j+1} \begin{pmatrix} a_j + \overbrace{y_j\left(\ell_j, \vartheta, \epsilon_j^{incP}, \epsilon_j^h\right)}^{\text{Health-inc. channel}} + \text{tr}_j^{\text{si}} - \overbrace{o_j\left(m_j, \epsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j\right)}^{\text{Health-exp. channel}} \\ \underbrace{-1_{\left[\epsilon_j^{\text{ehi}} = 1\right]} \text{prem}_j^{\text{ehi}}}_{\text{Health-exp. channel}} \quad \underbrace{-\text{tax}_j}_{\text{Health-exp. channel}} \quad - (1 + \tau^c) c_j - 1_{[\alpha_j > 0]} q \end{pmatrix}$$

$$\tilde{R}_{j+1} = \overbrace{\alpha_j\left(1 + \tilde{r}_{net,j+1}^{s}\left(\epsilon_{j+1}^{s}\right)\right) + (1 - \alpha_j)\left(1 + \bar{r}_{net}^{b}\right)}^{\text{Health-wealth porfolio channel}}$$

$$\text{tax}_j = \text{tax}^y\left(y_j^{\text{tax}}\right) + \text{tax}^{\text{ss}}\left(y_j^{\text{ss}}; \bar{y}^{\text{ss}}\right) + \text{tax}^{\text{mcare}}\left(y_j^{\text{ss}}\right)$$

More Details

Retiree problem

- State vector: $x_j = \left\{\vartheta, a_j, \epsilon_j^h\right\} \in \{1,2,3\} \times R \times \{1,2,3,4,5\}$
- Expectation $\Rightarrow \mathbb{E}_{\epsilon_{j+1}^h, \epsilon_{j+1}^s | \epsilon_j^h}$

$$V(x_j) = \max_{\{c_j, \alpha_j\}} \left\{ u(c_j) + \beta \mathbb{E} \left[\overbrace{\pi_j \left(h\left(\epsilon_j^h\right)\right)}^{\text{Health-longevity channel}} V(x_{j+1}) + \overbrace{\left(1 - \pi_j\left(h\left(\epsilon_j^h\right)\right)\right)}^{\text{Health-longevity channel}} u^{\text{beq}}(a_{j+1}) \right] \right\}$$

s.t.

$$a_{j+1} = \tilde{R}_{j+1} \begin{pmatrix} a_j + \text{tr}_j^{\text{ss}}\left(\bar{y}^{\vartheta}\right) + \text{tr}_j^{\text{si}} - \overbrace{o_j\left(m_j, \epsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j\right)}^{\text{Health-exp. channel}} \\ -\text{prem}^{\text{mcare}} \underbrace{-\text{tax}^y\left(y_j^{\text{tax}}\right)}_{\text{Health-exp. channel}} - (1+\tau^c)\, c_j - 1_{[\alpha_j > 0]}\, q \end{pmatrix}$$

$$\tilde{R}_{j+1} = \overbrace{\alpha_j\left(1 + \tilde{r}_{net,j+1}^s\left(\epsilon_{j+1}^s\right)\right) + (1-\alpha_j)\left(1 + \bar{r}_{net}^b\right)}^{\text{Health-wealth porfolio channel}}$$

More Details

Mapping the model to data

Parametrization, calibration and estimation

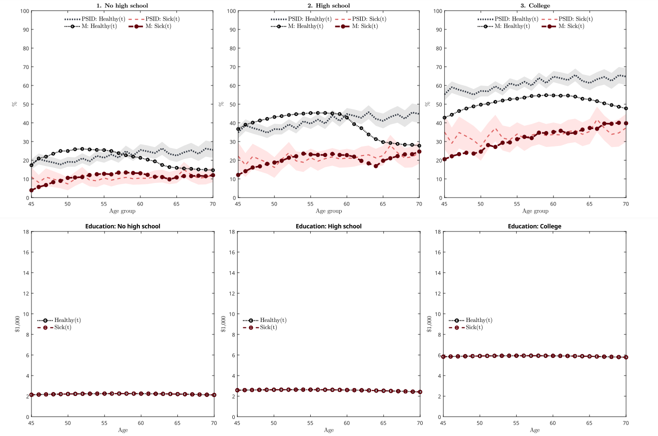
- External parameters and internally calibrated parameters from the following sources:
  - PSID for asset profiles, initial asset distribution
  - MEPS: labor supply, health shocks, health expenditures, coinsurance rates
  - Previous studies: labor productivity process, risk aversion parameter σ, the bequest parameter θ_2
- Estimation of the remaining internal parameters using the MSM:
  - Paras: time discount factor β, weight on consumption η, strength of bequest θ_1, the fixed costs of work $\bar{n}_j$ and stock market participation costs

$$\Theta = \left\{ \beta\left(\vartheta, \epsilon^h\right), \eta, \theta_1\left(\vartheta\right), \bar{n}_j\left(\vartheta, \epsilon^h\right), q(j,\vartheta) \right\}$$

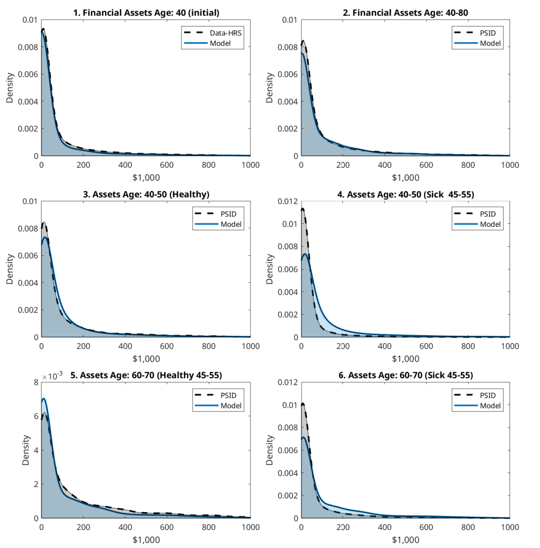
  - Method of simulated moments (MSM)

More calibration/estimation details

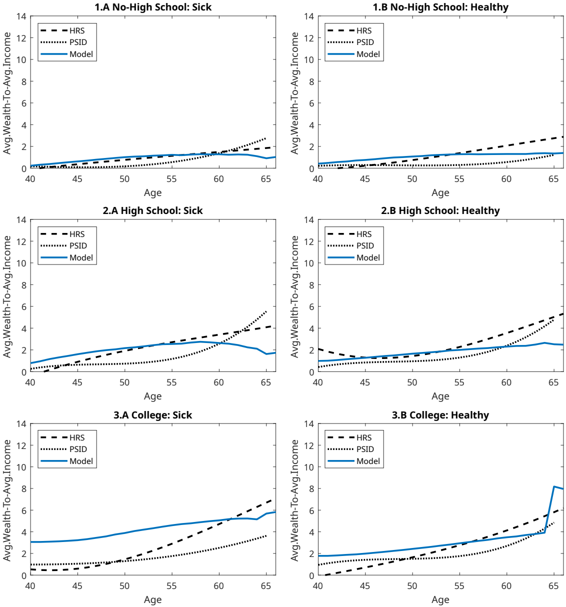
Estimation target: RA participation rate



Performance: Financial asset distribution



Performance: Wealth-to-income ratio



Asset shares regression: model vs data

	Model		PSID	
	Stock Share	P(Stocks)	Stock Share	P(Stocks)
Sick at 45_55	0.006***	-0.246***	0.003	-0.271***
	(0.001)	(0.003)	(0.015)	(0.051)
Unemployed at 45_55	0.017***	-0.480***	0.034***	-0.175***
	(0.002)	(0.003)	(0.012)	(0.047)
Uninsured at 45_55	-0.001	-0.074***	-0.027	-0.382***
	(0.001)	(0.003)	(0.026)	(0.076)
Observations	945861		5625	

- Heckman-selection model
- Left: Regression w/ model generated data
- Right: Regression w/ PSID data

Model performance details

Quantitative Analysis

Experiments/Counterfactuals

Use the model to simulate data for 100,000 individuals from age 40 - 90

1. Experiment 1: The benefit of good health
2. Experiment 2: The contribution of health shocks and portfolio choice
3. Experiment 3: Health insurance expansion

Experiment 1: Benefits of good health

- Counterfactual
  1. Everybody at age 45–55 draws good health (surprise shock)
  2. Everybody at age 40–death draws good health
- Calculate lifetime benefit/cost of good/bad health (annual averages) following DeNardi, Pashchenko and Porapakkarm (2025)

$$\overline{\text{benefit}}_i = \left(\frac{1}{\sum_{j=1}^{J} 1_{\text{alive}_j}}\right) \sum_{j=1}^{J} 1_{\text{alive}_j} \times \left(\overbrace{\left(y_{ij}^{**} - oop_{ij}^{**}\right)}^{\substack{\text{net of med expens.} \\ \text{always healthy}}} - \overbrace{\left(y_{ij}^{*} - oop_{ij}^{*}\right)}^{\substack{\text{net of med expens.} \\ \text{benchmark}}} \right)$$

Experiment 1: Results

	All	By skill level		
		Low	Medium	High
In good health between 40–death				
• % of time in bad health eliminated	16.27%	23.19%	15.17%	10.125%
• Medical cost $\downarrow$ + income $\uparrow$	\$7,913	\$9,256	\$7,534	\$6,971
• Welfare (CEV)	–	+21.45%	+20.01%	+13.68%

Notes: Good health conditions are defined as health states of excellent, very good and good. Skill types include: Low (No high school), Medium (High school) and High (College).

Experiment 2: Health-wealth portfolio channel

- [A] The two asset model

  1. Benchmark $\Rightarrow$ Health shocks + portfolio choice

  2. Remove bad health states (good health surprises)
     $\Rightarrow$ NO health shocks + portfolio choice

- [B] Remove portfolio choice $\Rightarrow$ single asset

  3. Health shocks + NO portfolio choice

  4. NO health shocks + NO portfolio choice
     (Removes **health-wealth-portfolio channel** completely)

Experiment 2: Results

	[A] Two assets economy		[B] Single asset economy	
	Health shocks	No h.s.	Health shocks	No h.s.
Wealth gap				
All age groups				
• P90/P50	13.58	7.14 ($\downarrow$**47.4%**)	6.07 ($\downarrow$55.3%)	4.11 ($\downarrow$69.73%)($\downarrow$**32.29**
Age 65				
• P90/P50	14.02	6.38 ($\downarrow$**54.5%**)	8.13 ($\downarrow$41.5%)	4.78 ($\downarrow$65.90%)($\downarrow$**41.21**
Age 65		**No h.s. (45–55)**		**No h.s. (45–55)**
• P90/P50	15.96	10.23 ($\downarrow$**35.9%**)	9.34 ($\downarrow$41.5%)	6.94 ($\downarrow$56.5%)($\downarrow$**25.7%**)

Decomposition profiles

Experiment 3: Health insurance expansion

- **Benchmark**
  - Employer-sponsored health insurance (EHI) for workers
  - Medicare for retirees
  - Medicaid for the poor

- Option 1**: Medicare for all**
  - expansion of Medicare to all workers and retirees

- Option 2**: EHI for all workers**
  - expansion of EHI to all workers while
  - maintaining Medicare and Medicaid

Experiment 3: Results

	Two assets economy w/ health shocks		
	Benchmark	Exp1: **Medicare for all**	Exp2: **EHI for all workers**
Assets	100	104.3	103.8
Stock participation			
• At 65: sick 45-55	19%	24%	23%
• At 65: healthy 45-55	37%	41%	41%
Wealth gap			
• All age: **P90/P50**	13.58	11.09($\downarrow$ 18.33%)	11.10($\downarrow$ 18.26%)
• At 65: **P90/P50**	14.02	10.44($\downarrow$ 25.5%)	11.20($\downarrow$ 20.11%)
Welfare (CEV)	0	+1.97	+1.93

$\Rightarrow$ **Key:** Insurance reduces inequality partly by enabling sick households to **enter risky asset markets**

HI policy experiment profiles

Conclusion

Conclusion

- Study effects of health shocks on savings, portfolio choice and wealth accumulation over lifecycle

- Approach: Empirical and structural analysis
  - PSID + HRS: descriptive facts and panel regression models
  - Lifecycle model with two assets, health shocks and health insurance

- Main findings
  - **Empirical:** Poor health at ages 45–55 persistently reduces stock market participation — within education groups and across the lifecycle

  - **Structural:** Health–wealth portfolio channel accounts for up to **47%** of the P90/P50 wealth gap — invisible in single-asset models

  - **Policy:** Health insurance expansion reduces P90/P50 by **18–25%** and raises welfare by ~**2% CEV**, partly through increased risky-asset participation

Thank you!

Supplementary material

Related literature I

- Lifecycle portfolio investment literature starting with Samuelson (1969); Merton (1971) and recent surveys in Gomes (2020) and Gomes, Haliassos and Ramadorai (2021)
- Health and wealth inequality
  - Medical expenditures and access to health insurance: De Nardi, French and Jones (2010); Nakajima and Telyukova (2024); Chen, Feng and Gu (2025); De Nardi, Pashchenko and Porapakkarm (2025)
  - Health on labor supply and productivity: Prados (2018); Capatina and Keane (2025); De Nardi, Pashchenko and Porapakkarm (2025);
  - Lifestyle behaviors: Mahler and Yum (2024*b*)
- Wealth on proportion of risky assets has mixed results
  - positive effect: Wachter and Yogo (2010)
  - minor effect: Brunnermeier and Nagel (2008)
  - negative effect: Liu, Liu and Cai (2021)
- Additional channels
  - stock market entry/adjustment costs: Alan (2006); Bonaparte, Cooper and Zhu (2012); Fagereng, Gottlieb and Guiso (2017)
  - education: Cocco, Gomes and Maenhout (2005); Cooper and Zhu (2016)

Related literature II

- unemployment: Bagliano, Fugazza and Nicodano (2014); Bagliano, Fugazza and Nicodano (2019)
- household composition: Inkmann, Michaelides and Zhang (2022)
- demographics and composition of 401k: Egan, MacKay and Yang (2021)
- introduction of Pension Protection Act of 2006: Parker et al. (2022)
- longevity annuities: Zhou, Li and Zhou (2022)
- reverse mortgages: Nakajima and Telyukova (2017); Hambel, Kraft and Meyer-Wehmann (2022)
- cyclicality of skewness of income shocks: Catherine (2022)

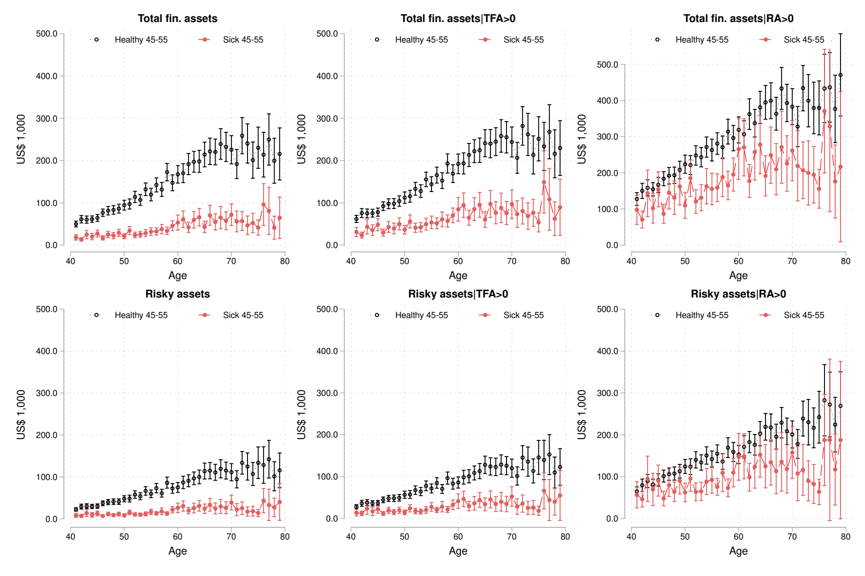
- Estimated structural lifecycle models of portfolio choice and retirement: Yogo (2016); Fagereng, Gottlieb and Guiso (2017); Gomes and Smirnova (2021)
- Calibrated lifecycle models with liquidity costs of stocks and long-term bonds: Campanale, Fugazza and Gomes (2015) and Tischbirek (2019)
- Empirical lit. of **health spending** and **health insurance** on portfolio choice of **elderly:** Goldman and Maestas (2013); Ayyagari and He (2016)
  - Early life health status: Böckerman, Conlin and Svento (2021)
  - Current health status: Rosen and Wu (2004)
  - Subjective health status: Bressan, Pace and Pelizzon (2014)
  - Expected future health shocks: Edwards (2008)

Related literature III

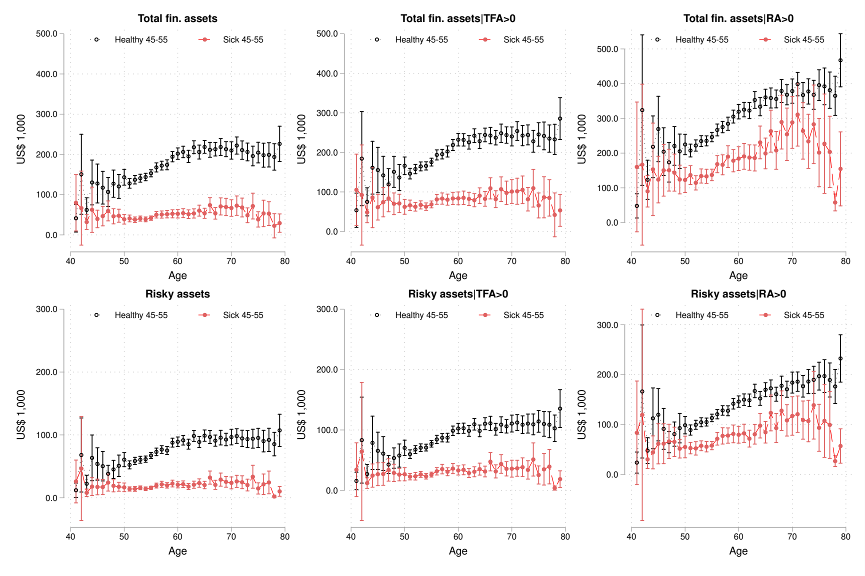
- Empirical **financial literacy**
  - Cognitive abilities and investment decisions: Christelis, Jappelli and Padula (2010); Agarwal and Mazumder (2013); Gamble et al. (2015); Lindeboom and Melnychuk (2015); Mazzonna and Peracchi (2020); Shimizutani and Yamada (2020)
  - Role of financial advising: Rossi and Utkus (2020, 2021)

Back to literature

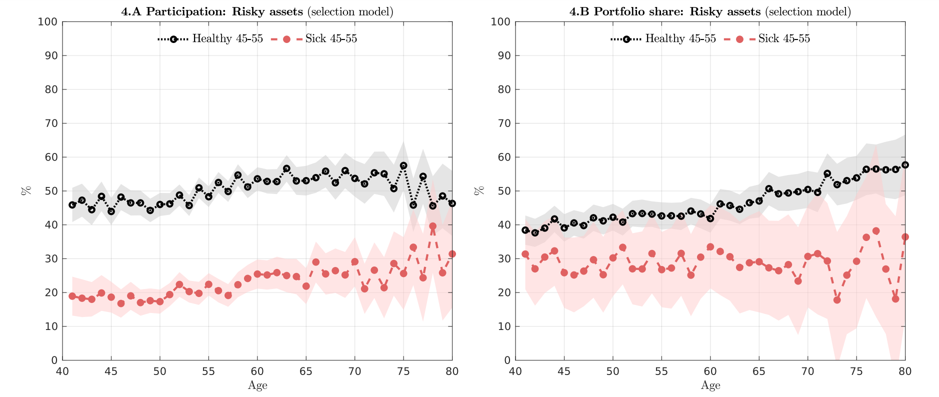
Financial assets over lifecycle: PSID



Financial assets over lifecycle: HRS

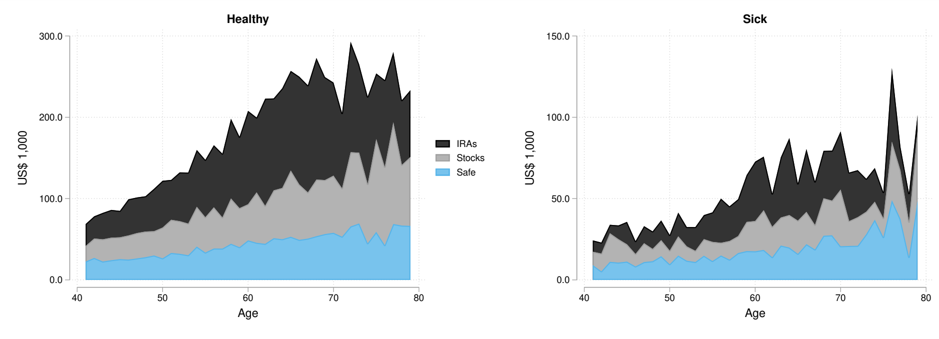


Stock market activities over lifecycle

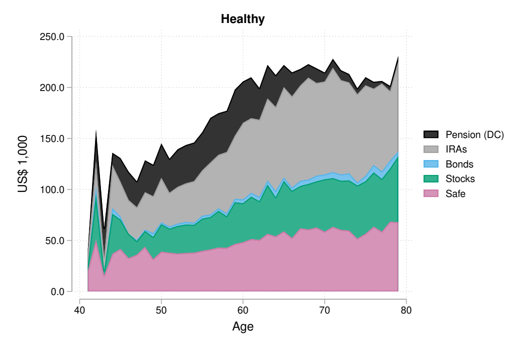


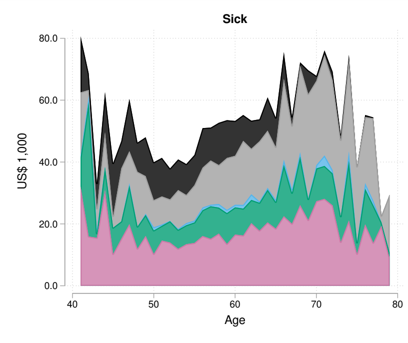
Back to HRS variable definitions

PSID - Asset share by health status 45–55



HRS - Asset share by health status 45–55

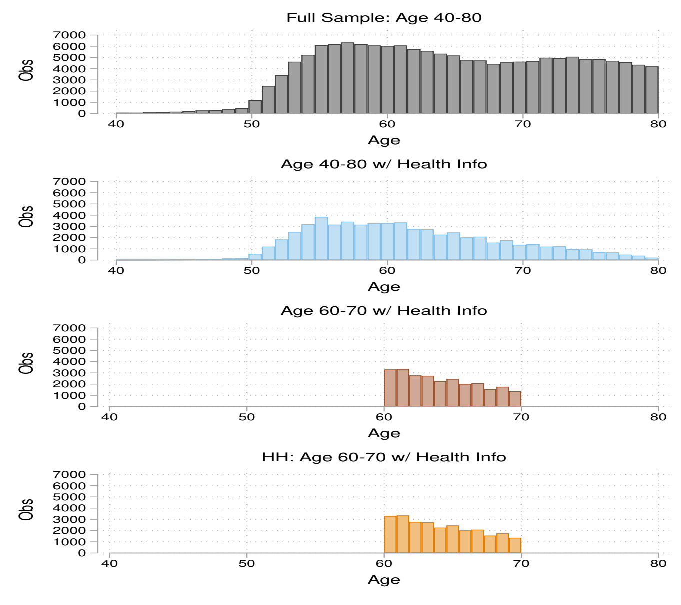




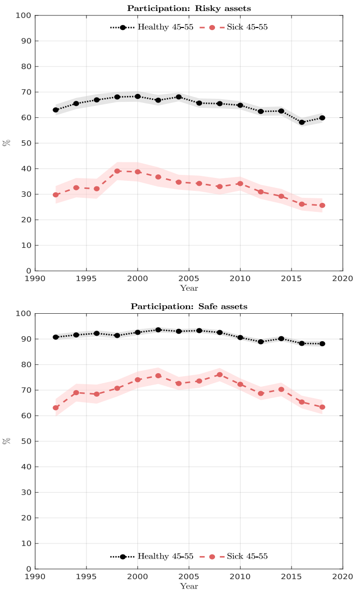
Health & Retirement Study (RAND-HRS) 1992–2018

- Health and Retirement Study (RAND-HRS) - panel data survey
- The majority of them are between 51–61 years
- Limit sample to heads of households and age group of 40–80 with wealth info
- In regressions we use reduced sample of 60–70 year olds
- Variables: labor market behavior, educational attainment, family background, government program participation, family life, health issues, assets, and income

HRS: Full and restricted sample



Asset holdings over time



HRS summary statistics I

	(1) w/H.Info Age:40-80	(2) Sick 45-55 A:40-80	(3) Alive60-70 A:40-80	(4) All A:60-70	(5) w/H.Info A:60-70	(6) Sick 45-55 A:60-70
Sick at 45_55	0.30	1.00	0.28	0.27	0.27	1.00
Health Lim.Wrk at 45_55	0.27	0.62	0.26	0.25	0.25	0.60
Health Limits Work	0.30	0.58	0.31	0.34	0.34	0.63
Spouse: Health Limits Work	0.24	0.32	0.25	0.27	0.27	0.36
Unemployed at 45_55	0.30	0.57	0.28	0.27	0.27	0.53
Uninsured at 45_55	0.29	0.35	0.28	0.27	0.27	0.34
P(Stocks incl. 401k)	0.48	0.26	0.50	0.47	0.49	0.25
P(Safe Assets incl.401k)	0.80	0.63	0.81	0.81	0.82	0.65
Risky Assets incl. 401k ($1,000)	61.38	19.31	67.08	66.92	73.60	22.46
Risky Assets excl. 410k ($1,000)	51.35	15.43	57.21	60.65	64.55	19.21
Safe Assets incl. 401k ($1,000)	79.55	30.16	85.19	86.04	94.45	35.42
Safe Assets excl.401k ($1,000)	65.13	24.58	70.99	77.01	81.44	30.75
Risky Asset Share	0.20	0.10	0.21	0.20	0.20	0.10
Safe Asset Share	0.60	0.52	0.61	0.62	0.62	0.55
Safe Assets incl. Bonds ($1,000)	38.30	16.26	41.26	45.96	45.46	19.62
Stocks and mutual funds ($1,000)	28.69	8.39	32.08	34.41	34.15	9.81
Bonds ($1,000)	2.76	0.81	3.14	3.70	3.45	1.02
IRA/Keogh net value ($1,000)	49.50	15.36	54.85	57.29	66.37	20.53
DC pension wealth ($1,000)	24.44	9.46	24.08	15.30	22.06	7.92
Debt ($1,000)	6.81	6.97	6.40	5.12	5.75	5.23
Net value of primary residence ($1,000)	115.08	63.48	121.96	124.29	134.84	74.12
Mortgage ($1,000)	46.91	27.83	45.72	34.24	43.52	25.76
Other home loans ($1,000)	3.99	1.89	4.27	3.40	4.31	2.04
Income Risk Aversion	3.20	3.26	3.20	3.29	3.25	3.33
Financial planning horizon	3.11	2.86	3.11	3.03	3.07	2.79
Prob. live to 75	61.35	48.72	62.07	62.78	61.98	49.32

HRS summary statistics II

Prob. live to 85	41.30	30.98	41.48	42.84	42.67	30.56
Age	59.85	58.62	61.42	64.63	64.15	63.92
Female	0.31	0.39	0.29	0.34	0.29	0.39
Married/Partnered	0.58	0.47	0.58	0.56	0.58	0.45
Nr. Children Alive	2.91	3.15	2.97	3.19	3.00	3.27
Black	0.22	0.30	0.21	0.21	0.20	0.28
Hispanic	0.13	0.21	0.12	0.11	0.12	0.20
No high school degree	0.25	0.43	0.25	0.30	0.25	0.45
High school degree	0.52	0.48	0.52	0.50	0.51	0.46
College or higher	0.23	0.10	0.23	0.20	0.23	0.09
Labor income ($1,000)	32.20	16.12	30.46	19.98	23.39	9.80
Pre-govt HH income ($1,000)	76.37	43.80	76.45	66.74	73.35	40.59
Employed	0.52	0.35	0.48	0.32	0.36	0.21
Receives Social Security	0.72	0.76	0.84	0.90	0.88	0.91
Health Excellent	0.12	0.02	0.12	0.11	0.09	0.02
Health Very Good	0.28	0.07	0.29	0.27	0.28	0.08
Health Good	0.32	0.23	0.32	0.32	0.33	0.27
Health Fair	0.20	0.46	0.20	0.21	0.21	0.41
Health Poor	0.08	0.22	0.08	0.09	0.08	0.22
First rep. health Excellent	0.20	0.02	0.22	0.20	0.22	0.02
First rep. health Very Good	0.28	0.06	0.28	0.27	0.28	0.06
First rep. health Good	0.29	0.16	0.28	0.29	0.29	0.15
First rep. health Fair	0.16	0.52	0.14	0.16	0.14	0.52
First rep. health Poor	0.07	0.24	0.07	0.08	0.07	0.25
Healthy	0.72	0.32	0.72	0.70	0.71	0.37
Body Mass Index	28.95	30.44	28.81	28.50	29.01	30.48
Smoker	0.23	0.31	0.21	0.19	0.19	0.25
OOP health exp. ($1,000)	3.02	3.70	3.12	3.30	3.34	3.69
Total OOP exp. HH ($1,000)	4.90	5.30	5.12	5.26	5.54	5.49
Insured	0.83	0.81	0.85	0.88	0.88	0.87
Uninsured	0.17	0.19	0.15	0.12	0.12	0.13

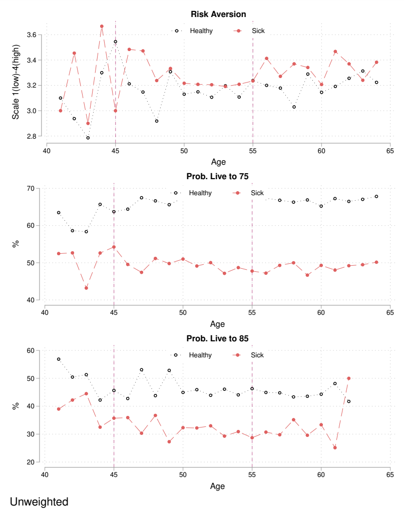
HRS summary statistics III

Public health insurance	0.32	0.47	0.34	0.42	0.41	0.59
Private health insurance	0.52	0.34	0.51	0.46	0.47	0.28
Observations	73465	22243	59262	54707	24773	6755

HRS summary statistics IV

Back to HRS variable definitions

Preference/belief differences by type



Back to HRS variable definitions

HRS: Stock share at 60–70

	(1)	(2)	(3)	(4)	(5)
Sick at 45_55	-0.025***	-0.030***	-0.038***	0.003	-0.002
	(0.007)	(0.009)	(0.010)	(0.015)	(0.012)
Unemployed at 45_55	-0.026***	-0.027***	-0.029***	0.005	-0.003
	(0.007)	(0.009)	(0.010)	(0.014)	(0.012)
Uninsured at 45_55	-0.024***	-0.013	-0.029***	0.006	0.020*
	(0.007)	(0.009)	(0.009)	(0.014)	(0.012)
Observations	6144	6111	6144	3072	3065
R^2	0.290	0.284			0.080
Conditional P(Y>0)	No	No	No	Yes	Yes
Random Effects	No	No	Yes	Yes	No
Weighted	No	Yes	No	No	Yes

Selection model: PSID (top) and HRS (bottom)

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.003	-0.271***	0.036***	-0.198***
	(0.015)	(0.051)	(0.009)	(0.058)
Unemployed at 45_55	0.034***	-0.175***	0.003	-0.232***
	(0.012)	(0.047)	(0.008)	(0.053)
Uninsured at 45_55	-0.027	-0.382***	0.044***	-0.170***
	(0.026)	(0.076)	(0.012)	(0.064)
Observations	5625		5625	

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	-0.008	-0.289***	0.040***	-0.200***
	(0.007)	(0.026)	(0.005)	(0.027)
Unemployed at 45_55	0.006	-0.248***	0.023***	-0.179***
	(0.006)	(0.023)	(0.004)	(0.026)
Uninsured at 45_55	-0.011*	-0.317***	0.043***	-0.272***
	(0.006)	(0.023)	(0.005)	(0.025)
Observations	24007		24007	

Back to PSID regression results

PSID - Two Part Model

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	0.000	-0.095***	0.040***	-0.039***
	(0.015)	(0.018)	(0.011)	(0.013)
Unemployed at 45_55	0.035***	-0.035**	-0.006	-0.039***
	(0.013)	(0.016)	(0.010)	(0.011)
Uninsured at 45_55	-0.003	-0.122***	0.052***	-0.097***
	(0.027)	(0.019)	(0.012)	(0.021)
Observations	2335	5625	4746	5625

HRS - Two Part Model

	Stock Share	P(Stocks)	Safe A. Share	P(Safe A.)
Sick at 45_55	-0.003	-0.077***	0.031***	-0.055***
	(0.012)	(0.018)	(0.010)	(0.014)
Health Lim.Wrk at 45_55				
Unemployed at 45_55	-0.003	-0.070***	0.036***	-0.011
	(0.012)	(0.016)	(0.010)	(0.012)
Uninsured at 45_55	0.018	-0.061***	0.010	-0.046***
	(0.012)	(0.015)	(0.010)	(0.012)
Observations	3065	6111	5111	6111

Back to PSID regression results

Preferences

- Preferences

$$u\left(c_j, \ell_j; \bar{n}_j\right) = \frac{\left(\left(\frac{c_j}{\omega_{j,\vartheta}}\right)^{\eta} \times \left[\ell_j - 1_{[0<n_j]} \times \bar{n}_j\right]^{1-\eta}\right)^{1-\sigma}}{1-\sigma} + \bar{u}$$

- Warm-glow bequest

$$u^{\text{beq}}\left(a_j\right) = \theta_1 \frac{\left(a_j + \theta_2\right)^{(1-\sigma)\eta}}{1-\sigma}$$

Health

- Health:
  - 5 idiosyncratic (exogenous) health groups $\epsilon^h \in \{1,2,3,4,5\}$
  - Age dependent health expenditure $m\left(j,\vartheta,\epsilon^h\right)$
  - Health state:

$$h\left(\epsilon^h\right)=\begin{cases}\text{healthy} & \text{if } \epsilon^h\in\{\text{excellent, very good, good}\},\\ \text{sick} & \text{if } \epsilon^h\in\{\text{fair, poor}\}.\end{cases}$$

- Survival probability: $\pi\left(h\left(\epsilon^h\right)\right)$

- Health and labor income shocks:

$$\Pr\left(\epsilon^h_{j+1}|\epsilon^h_j\right)\in\Pi^h\left(j,\vartheta\right)\ ,\ \Pr\left(\epsilon^{incP}_{j+1}|\epsilon^{incP}_j\right)\in\Pi^{incP}_j$$

Health insurance

- **Workers:** exogenous employer HI

$$\epsilon^{\text{ehi}}_{j,\vartheta} = \begin{cases} 0 & \text{not privately insured,} \\ 1 & \text{privately health insurance,} \end{cases} \quad \text{for } j \leq J_w$$

- $\epsilon^{\text{ehi}}_{j,\vartheta}$ follows Markov process with $P\left(\epsilon^{\text{ehi}}_{j+1,\vartheta} | \epsilon^{\text{ehi}}_{j,\vartheta}\right) \in \Pi^{\text{ehi}}_{j,\vartheta}$
- Coinsurance: γ^{ehi}
- Premium: $\text{prem}^{\text{Ins}}_{j}$

- **Poor:** qualify for Medicaid w/ coinsurance γ^{maid} if $y^{\text{agi}}_{j} < y^{\text{maid}}$ and $a_j < a^{\text{maid}}$

- **Retired** $j > J_1$ have Medicare w/ coinsurance γ^{mcare} and premium $\text{prem}^{\text{mcare}}$

Out-of-pocket health spending

$$o_j\left(m_j, \epsilon^{\text{ehi}}_{j,\vartheta}, y^{\text{agi}}_j, a_j\right) =$$

$$= \begin{cases} \overbrace{1_{[\text{maid-yes}]}\gamma^{\text{maid}}}^{\text{primary HI}} \times m\left(j, \vartheta, \epsilon^h_j\right) & \text{if } \overbrace{\epsilon^{\text{ehi}}_{j,\vartheta} = 0 \wedge j \leq J_w}^{\text{working, no private HI}} \\ \overbrace{1_{[\text{maid-yes}]}\gamma^{\text{maid}}}^{\text{Medicaid is secondary HI}} \times \left(\overbrace{\gamma^{\text{ehi}}}^{\text{primary}} \times m\left(j, \vartheta, \epsilon^h_j\right)\right) & \text{if } \overbrace{\epsilon^{\text{ehi}}_{j,\vartheta} = 1 \wedge j \leq J_w}^{\text{working, with private HI}} \\ \overbrace{1_{[\text{maid-yes}]}\gamma^{\text{maid}}}^{\text{Medicaid is secondary HI}} \times \left(\overbrace{\gamma^{\text{mcare}}}^{\text{primary}} \times m\left(j, \vartheta, \epsilon^h_j\right)\right) & \text{if } \overbrace{j > J_w}^{\text{retired, with Medicare}} \end{cases}$$

Labor income

- Profile by health type: $\bar{e}_j = \bar{e}\left(j, \vartheta, h\left(\epsilon^h\right)\right)$
- Exogenous income shock: $e_j\left(\vartheta, \epsilon^h, \epsilon^{incP}\right) = \bar{e}_j\left(\vartheta,\ h\left(\epsilon^h\right)\right) \times \epsilon^{incP}$
- Labor income: $y_j\left(\ell_j, \vartheta, \epsilon_j^{incP}, \epsilon_j^h\right) = \widehat{w} \overbrace{\times e_j\left(\vartheta, \epsilon_j^{incP}, \epsilon^h\right) \times}^{\text{Health-dependent income}} (1 - \ell_j)$

Savings/Assets

- Two types of assets
  - risk-free bond b w/ real return r^b
  - risky stock s w/ return $\tilde{r}^s = r^b + \mu^s + \epsilon^s$
    and risk premium $\mu_s > 0$, stoch. return $\epsilon^s \sim N\left(0, \sigma^2_{\epsilon^s}\right)$
  - assume: $\tilde{r}^s = \frac{1+\tilde{g}+d}{1+\pi} - 1$
- Net returns (see Gomes, Michaelides and Polkovnichenko, 2009)

$$\bar{r}^b_{net} = \frac{1 + \left[\left(r^b + 1\right)(1+\pi) - 1\right]\left(1 - \tau^d\right)}{1+\pi} - 1$$

$$\tilde{r}^s_{\text{net}} = \frac{1 + \tilde{g}\left(\epsilon^s\right)\left(1 - \tau^g\right) + d\left(1 - \tau^d\right)}{1+\pi} - 1$$

- W/ exogenous parameters
  - d, $\tilde{g}$: dividend vs. capital gains
  - τ^d, τ^g: dividend vs. capital gains tax
  - π inflation
- Borrowing limit $b_{j+1} \geq \underline{b}$, stock holdings $s_{j+1} \geq 0$
- Transaction cost q_ϑ when investing in risky asset

Taxes and transfers

- Taxes
  - Labor income (Benabou 2002; Heathcote, Storesletten and Violante 2017)
$$\text{tax}^y\left(y_j^{\text{tax}}\right) = \max\left[0,\, y_j^{\text{tax}} - \lambda \times \left(y_j^{\text{tax}}\right)^{(1-\tau)}\right]$$
    - $0 < \tau < 1$ progressivity
    - λ scaling
  - Payroll: $\text{tax}^{\text{ss}}\left(y_j^{\text{ss}};\, \bar{y}^{\text{ss}}\right)$ and $\text{tax}^{\text{mcare}}\left(y_j^{\text{ss}}\right)$
  - Consumption: τ^c
  - Capital: τ^d on dividends and τ^g on capital gains

- Transfers
  - Social Security: tr^{ss}
  - Medicare, Medicaid
  - Lump-sum transfers tr^{si} to guarantee $c_{\min}$

Back to model overview

Worker Problem I

- State vec: $x_j = \left\{\vartheta, a_{j,}, \epsilon_j^{incP}, \epsilon_j^{h}, \epsilon_j^{\mathrm{ehi}}\right\} \in \{1,2,3\} \times R \times \{1,2,3,4\} \times \{1,2,3,4,5\} \times \{0,1\}$

Worker Problem II

- Expectation $\Rightarrow \mathbb{E}_{\epsilon^{incP}_{j+1},\epsilon^{h}_{j+1},\epsilon^{\text{ehi}}_{j+1},\epsilon^{s}_{j+1}|\epsilon^{incP}_{j},\epsilon^{h}_{j},\epsilon^{\text{ehi}}_{j}}$

$$V(x_j) = \max_{\{c_j,\ell_j,\alpha_j\}} \left\{ u(c_j,\ell_j) + \beta\mathbb{E}\left[\overbrace{\pi_j\left(h\left(\epsilon^h_j\right)\right)}^{\text{Hlth-long channel}} V(x_{j+1}) + \overbrace{\left(1-\pi_j\left(h\left(\epsilon^h_j\right)\right)\right)}^{\text{Health-longevity channel}} u^{\text{beq}}(a_{j+1}) \right] \right\}$$

s.t.

$$a_{j+1} = \tilde{R}_{j+1} \left(\begin{array}{c} a_j + \overbrace{y_j\left(\ell_j,\vartheta,\epsilon^{incP}_j,\epsilon^h_j\right)}^{\text{Health income channel}} + \text{tr}^{\text{si}}_j - \overbrace{o_j\left(m_j,\epsilon^{\text{ehi}}_{j,\vartheta},y^{\text{agi}}_j,a_j\right)}^{\text{Health-expenditure channel}} \\ \underbrace{-1_{\left[\epsilon^{\text{ehi}}_j=1\right]}\text{prem}^{\text{ehi}}_j}_{\text{Health-exp. channel}} \underbrace{-\text{tax}_j}_{\text{Health-exp. channel}} - (1+\tau^c)\,c_j - 1_{[\alpha_j>0]}q \end{array} \right)$$

$$\tilde{R}_{j+1} = \overbrace{\alpha_j\left(1+\tilde{r}^s_{net,j+1}\right) + (1-\alpha_j)\left(1+\bar{r}^b\right)}^{\text{Health-wealth portfolio channel}}$$

$$\text{tax}_j = \text{tax}^y\left(y^{\text{tax}}_j\right) + \text{tax}^{\text{ss}}\left(y^{\text{ss}}_j;\ \bar{y}^{\text{ss}}\right) + \text{tax}^{\text{mcare}}\left(y^{\text{ss}}_j\right)$$

$$\underline{b} \le b_{j+1},\ 0 \le s_{j+1}$$

Worker Problem III

- Total taxable income y_j^{tax} and payroll tax eligible income y_j^{ss}

$$
\begin{aligned}
y_j^{\text{tax}} = y_j - 1_{[\text{in}_{j+1}=2]}\text{prem}_j^{\text{ehi}} \\
- \max\left[0,\ o_j\left(m_j, \epsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j\right) - 0.075 \times (y_j + r_b b_j + r_s s_j)\right]
\end{aligned}
$$

$$
y_j^{\text{ss}} = y_j - 1_{[\text{in}_{j+1}=2]}\text{prem}_j^{\text{ehi}}
$$

- Taxes

$$
\begin{aligned}
\text{tax}_j &= \text{tax}^y\left(y_j^{\text{tax}}\right) + \text{tax}^{\text{ss}}\left(y_j^{\text{ss}};\ \bar{y}^{\text{ss}}\right) + \text{tax}^{\text{mcare}}\left(y_j^{\text{ss}}\right) \\
\text{tax}^{ss}\left(y_j^{\text{ss}};\ \bar{y}^{\text{ss}}\right) &= \tau^{ss} \times \min\left[y_j^{\text{ss}};\ \bar{y}^{\text{ss}}\right] \\
\text{tax}^{\text{mcare}}\left(y_j^{\text{ss}}\right) &= \tau^{\text{mcare}} \times y_j^{ss}
\end{aligned}
$$

Worker Problem IV

- Transfers

$$\mathrm{tr}_j^{\mathrm{si}} = \max\left[0,\ c_{\min} + o\left(m_j\right) - y_j^{\mathrm{at}} - a_j\right]$$
$$y_j^{\mathrm{at}} = y_j - \mathrm{tax}_j$$

- Average past labor earnings:

$$\bar{y}^{\vartheta} = \int_{j \leq J_r} w \times e\left(x\right) \times n\left(x\right) d\Lambda\left(x_j\left(\vartheta\right)\right)$$

Back to worker problem

Retiree's Dynamic Optimization Problem I

- State vector: $x_j = \left\{\vartheta, a_j, \epsilon_j^h\right\} \in \{1,2,3\} \times R \times \{1,2,3,4,5\}$
- Expectation $\Rightarrow \mathbb{E}_{\epsilon_{j+1}^h, \epsilon_{j+1}^s | \epsilon_j^h}$

$$V(x_j) = \max_{\{c_j, \alpha_j\}} \left\{ u(c_j) + \beta \mathbb{E} \left[\overbrace{\pi_j \left(h \left(\epsilon_j^h \right) \right)}^{\text{Health-longevity channel}} V(x_{j+1}) + \overbrace{\left(1 - \pi_j \left(h \left(\epsilon_j^h \right) \right) \right)}^{\text{Health-longevity channel}} u^{\text{beq}}(a_{j+1}) \right] \right\}$$

s.t.

$$a_{j+1} = \tilde{R}_{j+1} \left(\begin{array}{c} a_j + \text{tr}_j^{\text{ss}} \left(\bar{y}^{\vartheta} \right) + \text{tr}_j^{\text{si}} - \overbrace{o_j \left(m_j, \epsilon_{j,\vartheta}^{\text{ehi}}, y_j^{\text{agi}}, a_j \right)}^{\text{Health-expenditure channel}} \\ -\text{prem}_j^{\text{mcare}} \underbrace{-\text{tax}^y \left(y_j^{\text{tax}} \right)}_{\text{Health-exp. channel}} - (1 + \tau^c) c_j - 1_{[\alpha_j > 0]} q \end{array} \right)$$

$$\tilde{R}_{j+1} = \overbrace{\left(\alpha_j \left(1 + \tilde{r}_{net,j+1}^s \right) + (1 - \alpha_j) \left(1 + \bar{r}^b \right) \right)}^{\text{Health-wealth portfolio channel}}$$

$$\underline{b} \leq b_{j+1}$$

$$0 \leq s_{j+1}$$

Retiree's Dynamic Optimization Problem II

$$y_j^{\text{tax}} = \text{tr}_j^{\text{ss}} - \max\left[0,\ \left(o_j\left(m_j\right) + \text{prem}^{\text{mcare}}\right) - 0.075 \times \left(r_b \times b_j + r_s \times s_j + \text{tr}_j^{\text{ss}}\right)\right]$$

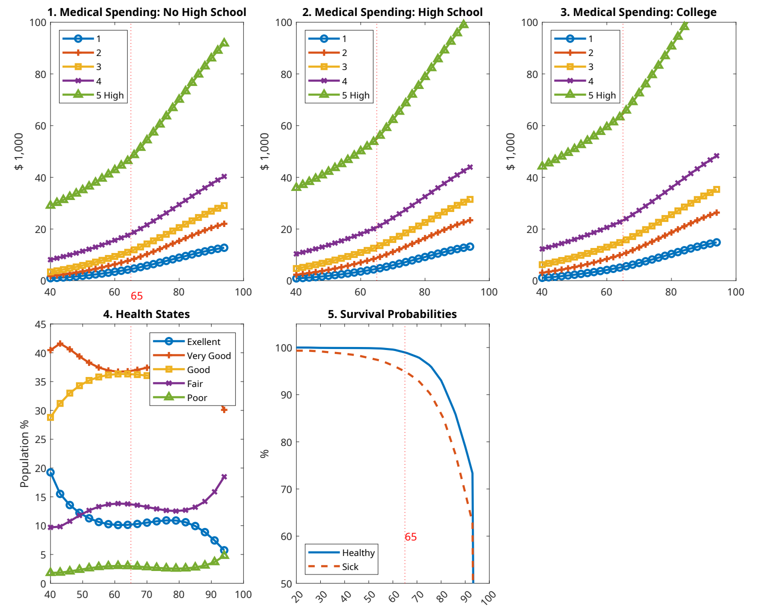
$$\text{tr}_j^{\text{si}} = \max\left[0,\ c_{\min} + o_j\left(m_j\right) + \text{prem}^{\text{mcare}} + \text{tax}^y\left(y_j^{\text{tax}}\right) - a_j - \text{tr}_j^{\text{ss}}\right]$$

Back to retired problem

Exogenous parameters

Parameter description	Parameter values	Source
Periods	$J = 55$	
Work periods	$J_w = 25$	Age 40–64
Years modeled	years $= 55$	Age 40–94
Relative risk aversion	$\sigma = 3$	Standard values between $2.5 - 3.5$
Survival probabilities	$\pi_j\left(h\left(\epsilon^h\right)\right)$ see online appendix	İmrohoroğlu and Kitao (2012)
Health Shocks	ϵ_j^h see online appendix	MEPS 1996–2018
Health transition prob.	Π_j^h see online appendix	MEPS 1996–2018
Persistent labor shock autocor.	$\rho = 0.977$	French (2005)
Risk premium	$\mu = 0.04$	Mehra and Prescott (1985)
Risk free rate	$r^b = 0.02$	McGrattan and Prescott (2000)
RA log return std. dev.	$\sigma_{\epsilon^s} = 0.157$	Mehra and Prescott (1985)
Variance of transitory labor shock	$\sigma^2_{\epsilon^{\text{incP}}} = 0.0141$	French (2005)
Bias adjusted wage profile	$\bar{e}_j\left(\vartheta, h\left(\epsilon^h\right)\right)$ see online appendix	MEPS 1996–2018
Private employer HI	$\gamma^{\text{ehi}} = 0.31$	MEPS 1996–2018
Medicaid coinsurance	$\gamma^{\text{maid}} = 0.11$	MEPS 1996–2018
Medicare coinsurance	$\gamma^{\text{mcare}} = 0.30$	MEPS 1996–2018
Consumption tax	$\tau^c = 5\%$	IRS
Bequest parameter	$\theta_2 = \$500,000$	De Nardi (2004); French (2005)
Payroll tax Social Security	$\tau^{\text{ss}} = 10.6\%$	IRS
Payroll tax Medicare	$\tau^{\text{mcare}} = 2.9\%$	SSA (2007)
Tax progressivity	τ_1^i =0.053	Guner, Lopez-Daneri and Ventura (2016)
Dividend tax	$\tau^d = 25\%$	Gomes, Michaelides and Polkovnichenko (2009)
Capital gains tax	$\tau^g = 20\%$	Gomes, Michaelides and Polkovnichenko (2009)
Dividend yield	$d = 3.2\%$	Gomes, Michaelides and Polkovnichenko (2009)
Inflation	$\pi^i = 2.8\%$	Gomes, Michaelides and Polkovnichenko (2009)

Exogenous health status



Internal (calibrated) parameters

Parameters	Values	Calibration target	Model	Data	Source
Fixed cost of work	$\bar{n}_{j,\vartheta}$	Avge. work part.	Pan.2,Fig.76	Pan.2,Fig.76	MEPS 1996–2018
Utility constant	$\bar{u} = 10$	VSL of workers	2.5 mill.$	1–16 mill.$	Viscusi (1993)
Prog. tax scaling	τ_0^i =1.016				Jung and Tran (2022)
Medicaid asset test	$\bar{a}^{\text{maid}} = \$75k$	Age 40–64 on Maid	Pan.2,Fig.77	Pan.2,Fig.77	MEPS 1996–2018
Medicaid income test	$\bar{y}^{\text{maid}} = \$5.5k$	Age 20–39 on Maid	Pan.2,Fig.77	Pan.2,Fig.77	MEPS 1996–2018
Consumption floor	$c_{\text{min}} = \$3.2k$	Frac. net-ass.<$5k	20% (of popul.)	20%	Jeske and Kitao (2009)

Estimation targets and estimateed parameters

Estimation targets include

- Wealth-to-income ratio at 65
- Avge. work participation 40–64
- Asset holdings of 85 year olds
- Risky asset market participation rates by education, health and age
  - We target 3 education levels (low, medium and high),
  - 2 health status (sick and healthy), and
  - 3 age groups (40-59, 60-64, 65-80)

Estimated structural parameters (I)

Parameters	Value	S.E.
Consumption weight: η	0.2778	0.0016
Time discount factor		
No high school		
$\beta(\vartheta = 1, \text{healthy})$	0.9788	0.0009
$\beta(\vartheta = 1, \text{sick})$	0.9563	0.0072
High school		
$\beta(\vartheta = 2, \text{healthy})$	0.9783	0.0011
$\beta(\vartheta = 2, \text{sick})$	0.8822	0.0061
College		
$\beta(\vartheta = 3, \text{healthy})$	0.9859	0.0014
$\beta(\vartheta = 3, \text{sick})$	0.7541	0.0091
Bequest motive		
$\theta_1(\vartheta = 1)$	334.0142	69.5270
$\theta_1(\vartheta = 2)$	241.8307	0.5716
$\theta_1(\vartheta = 3)$	111.6670	6.1756

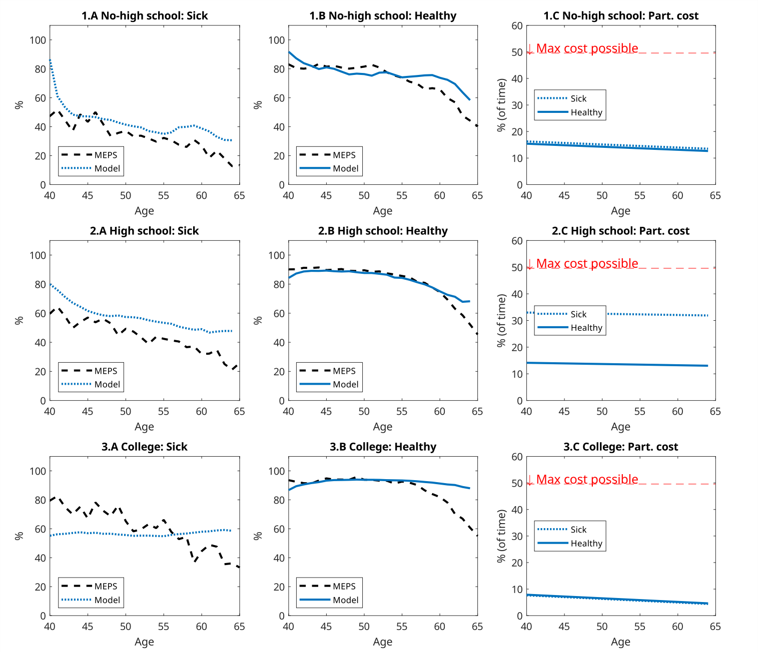
Estimated structural parameters (II)

Parameters	Value	S.E.
Stock market participation cost:		
$q(j, \vartheta) = \delta_{s,\vartheta,1} + \delta_{s,\vartheta,2} j + \delta_{s,\vartheta,3} j^2$		
No high school		
$\delta_{s,\vartheta=1,1}$	0.0076	0.0058
$\delta_{s,\vartheta=1,2}$	0.0001	0.0343
$\delta_{s,\vartheta=1,3}$	-0.0000	0.0344
High school		
$\delta_{s,\vartheta=2,1}$	0.0094	0.0038
$\delta_{s,\vartheta=2,2}$	0.0001	0.0120
$\delta_{s,\vartheta=2,3}$	-0.0000	0.0130
College		
$\delta_{s,\vartheta=3,1}$	0.0216	0.0029
$\delta_{s,\vartheta=3,2}$	0.0001	0.0042
$\delta_{s,\vartheta=3,3}$	-0.0000	0.0041

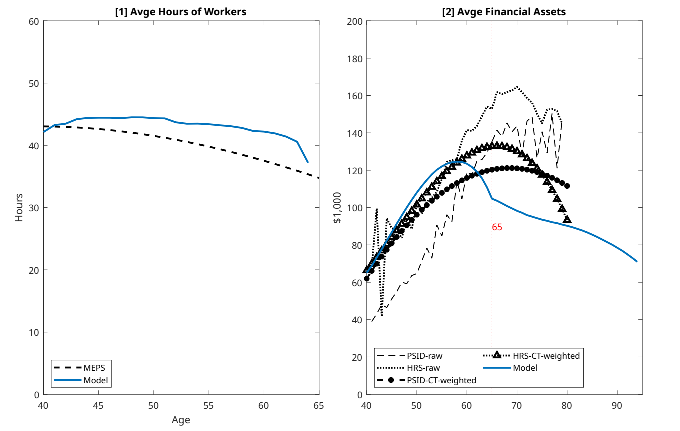
Estimated structural parameters (III)

Parameters	Value	S.E.
Labor force participation cost:		
$\bar{n}_j(\vartheta,\ h(\epsilon^h)) = \delta_{\ell,\vartheta,h,1} + \delta_{\ell,\vartheta,2} j$		
No high school		
$\delta_{\ell,\vartheta=1,\text{healthy},1}$	0.1540	0.0024
$\delta_{\ell,\vartheta=1,\text{sick},1}$	0.1627	0.0000
$\delta_{\ell,\vartheta=1,2}$	-0.0011	0.0001
High school		
$\delta_{\ell,\vartheta=2,\text{healthy},1}$	0.1414	0.0039
$\delta_{\ell,\vartheta=2,\text{sick},1}$	0.3298	0.0000
$\delta_{\ell,\vartheta=2,2}$	-0.0005	0.0003
College		
$\delta_{\ell,\vartheta=3,\text{healthy},1}$	0.0788	0.0046
$\delta_{\ell,\vartheta=3,\text{sick},1}$	0.0764	0.0000
$\delta_{\ell,\vartheta=3,2}$	-0.0014	0.0003

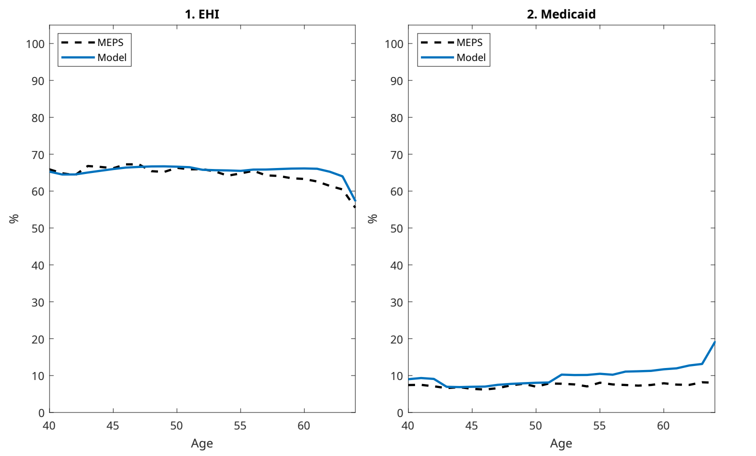
Calibration target: labor force participation



Calibration targets



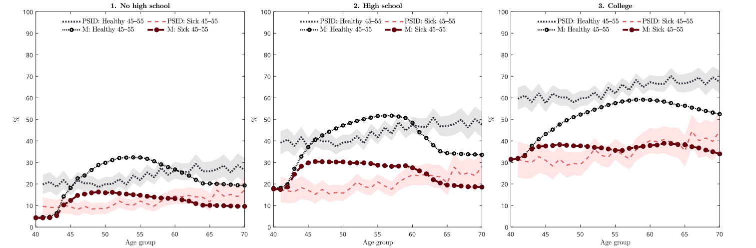
Calibration targets (only Medicaid is a target)



Note: only Medicaid take-up is a target

Back to calibration

Performance (not targets)
Risky assets participation by health-at-45-55

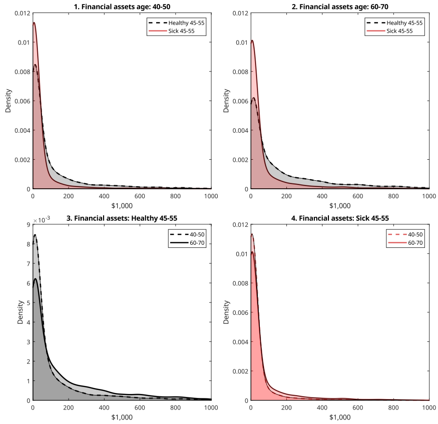


- Model replicates RA participation pattern by health-at-45–55 ⇒ this was not a target

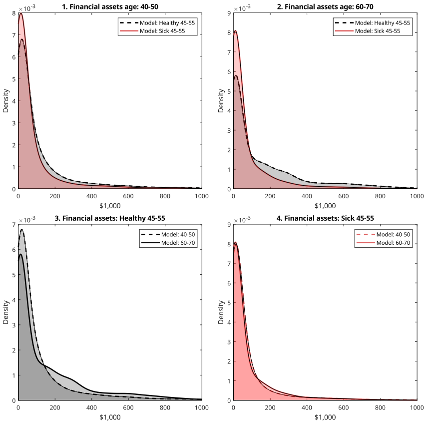
Back to performance

Performance (not targets)

Data



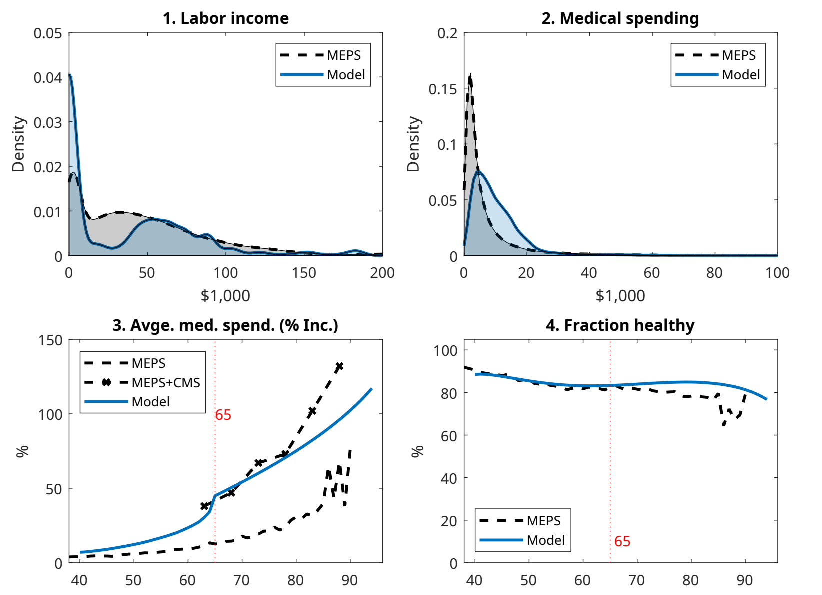
Model



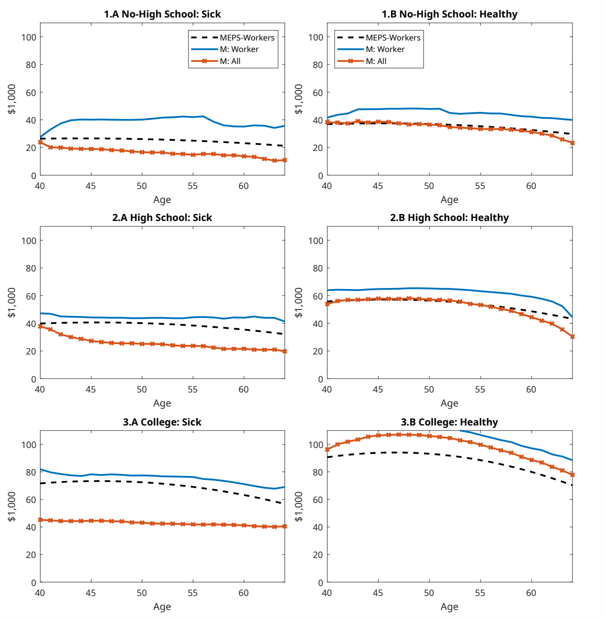
Bench. model: Risky assets by health at age 45–55

	Healthy at 45–55	Sick at 45–55
- Risky asset share α (at 65)	50%	31%
- Stock part. (at 40)	32%	26%
- Stock part. (at 65)	51%	32%
- Wealth-to-inc (at 65)	5.07	3.29

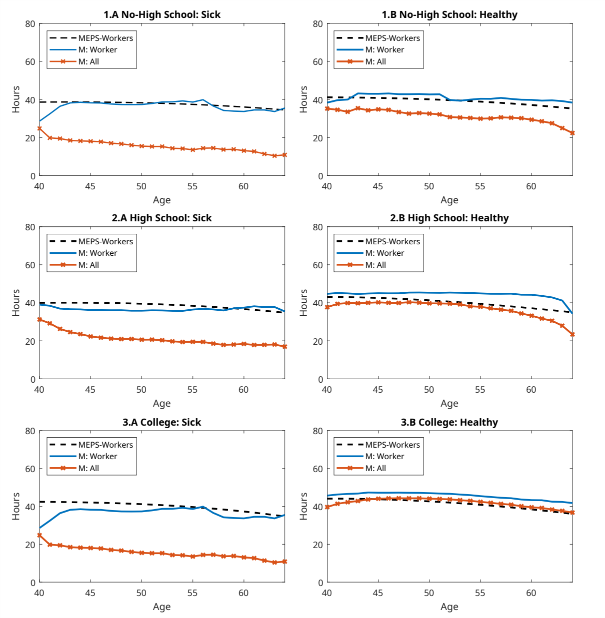
Model performance (not targets)



Model performance: labor income (not targets)



Performance: hours worked



Model performance (not targets)

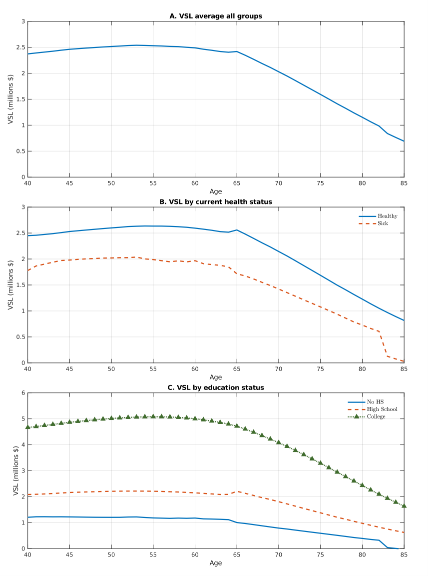
Moments	Model	Data	Sources
Medical exp/income	Figure 11	Figure 11	MEPS 1996–2018
Gini medical spending	0.56	0.60	MEPS 1996–2018
Gini gross income	0.40	0.46	MEPS 1996–2018
Gini labor income	0.55	0.54	MEPS 1996–2018
Gini financial assets	0.73	0.76	PSID 1984–2019
Frisch labor supply elasticities	1.19–1.51	1.1–1.7	Fiorito and Zanella (2012)
Avge. interest rate: r	5.9%	5.2 – 5.9%	Gomme, Ravikumar and Rupert (2011)
Wealth: P90/P50 at 65	14.47	16.84	PSID 1984–2019

Risky asset shares regressions

	No-HS		HS		College	
	Stock Sh.	P(Stocks)	Stock Sh.	P(Stocks)	Stock Sh.	P(Stocks)
Sick at 45_55	-0.023***	-0.143***	-0.011***	-0.263***	-0.001	-0.162***
	(0.004)	(0.007)	(0.002)	(0.004)	(0.001)	(0.006)
Unemployed at 45_55	-0.106***	-0.912***	-0.010***	-0.381***	0.000	-0.346***
	(0.017)	(0.008)	(0.003)	(0.004)	(0.002)	(0.006)
Uninsured at 45_55	-0.017***	-0.078***	-0.001	-0.072***	-0.002***	-0.034***
	(0.003)	(0.008)	(0.001)	(0.004)	(0.001)	(0.007)
Observations	214841		429942		200359	

- Risky asset shares: model w/ initial health condition controls
- Sample of individuals who are healthy at age 40

Back to performance



VSL details

Back to performance

Value of statistical life I

- The VSL is the monetary value corresponding to reduction in mortality risk that prevents **one** statistical death
- Follow Aldy and Smyth (2014)
  - Consider small increase in surv. probability $\Delta\pi_j\left(\varepsilon_j^h\right)$ so that surv. prob. is $\pi_j\left(\varepsilon_j^h\right)+\Delta\pi_j\left(\varepsilon_j^h\right)$
  - Using this new surv. prob. solve HH with otherwise identical paras $\Rightarrow V^*\left(\vartheta, a_{j,}, \epsilon_j^{\text{incP}}, \epsilon_j^h, \epsilon_j^{\text{ehi}}\right)$
  - Search additional wealth Δa_j so that

$$V\left(\vartheta, a_j+\Delta a_j, \epsilon_j^{\text{incP}}, \epsilon_j^h, \epsilon_j^{\text{ehi}}\right)=V^*\left(\vartheta, a_{j,}, \epsilon_j^{\text{incP}}, \epsilon_j^h, \epsilon_j^{\text{ehi}}\right)$$

  - Calculate VSL as

$$\text{VSL}_j\left(\vartheta, a_j, \epsilon_j^{\text{incP}}, \epsilon_j^h, \epsilon_j^{\text{ehi}}\right)=\frac{\Delta a_j}{\Delta\pi_j\left(\varepsilon_j^h\right)}.$$

Value of statistical life II

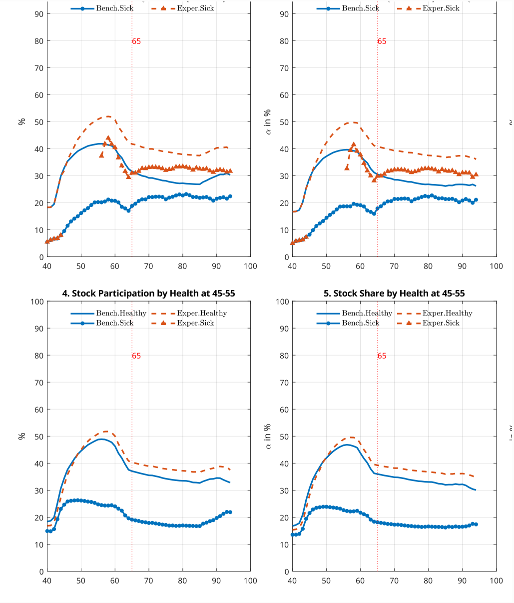
- Intuitively, the VSL is the marginal rate of substitution between wealth and survival probability

- VSL range between 1–16 million USD according to a survey by Viscusi (1993)

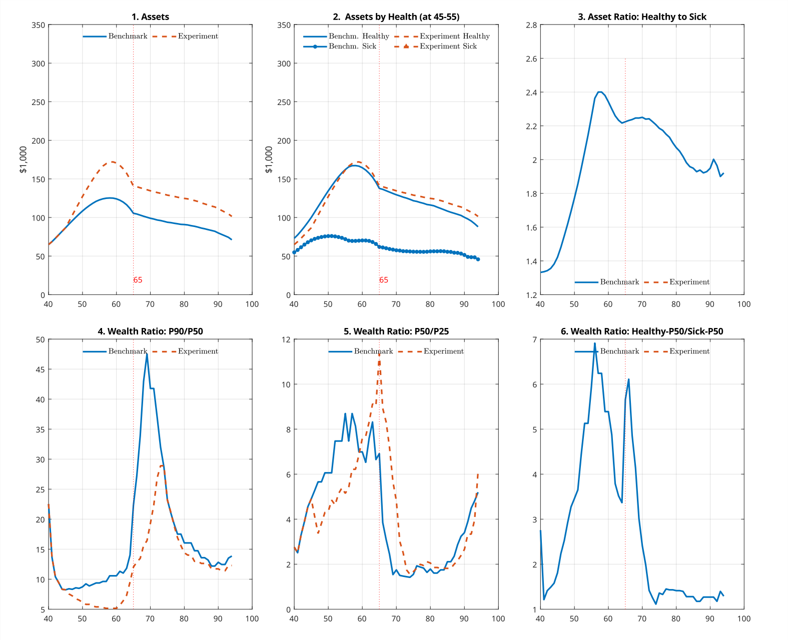
- We target 2.5 million USD for the working age population of 40–65 year olds

Back to VSL

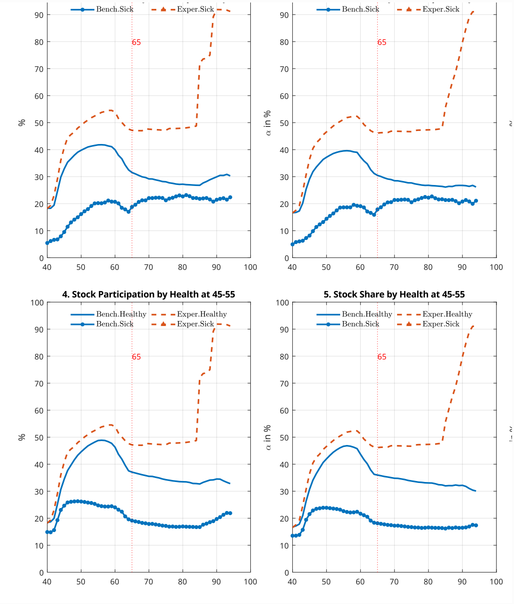
Exp. 8 (no bad health at 45–55): RA participation



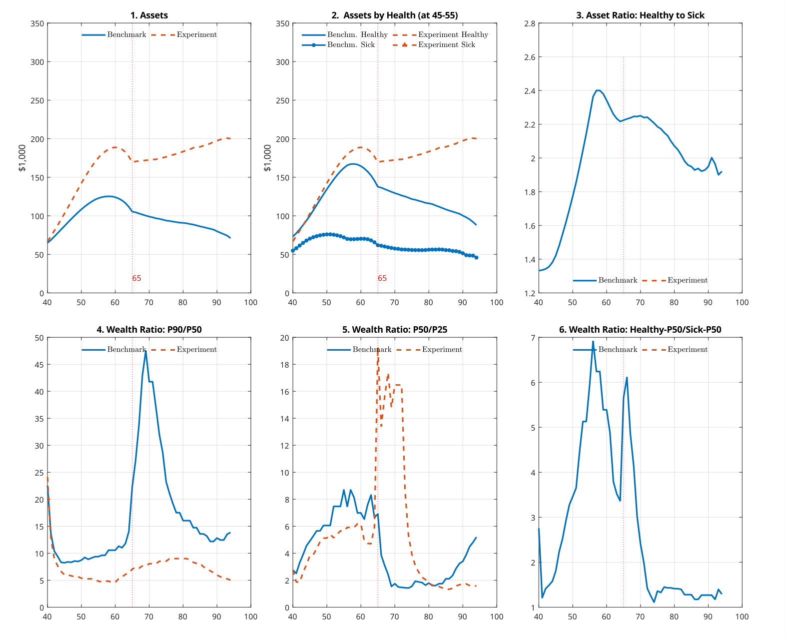
Exp. 8 (no bad health 45–55): Asset profiles



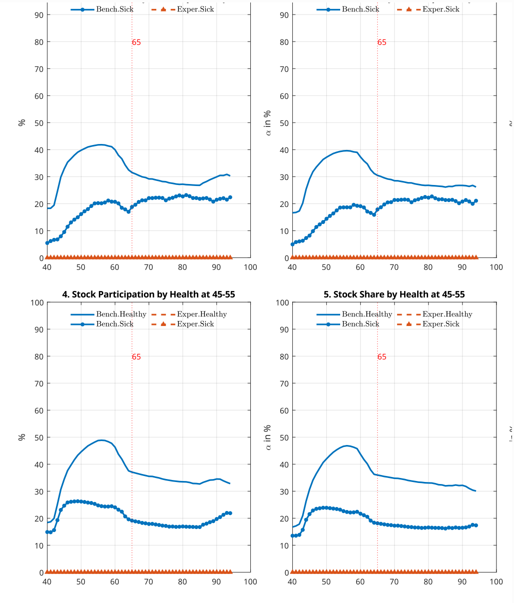
Exp. 7 (no bad health–death): RA participation



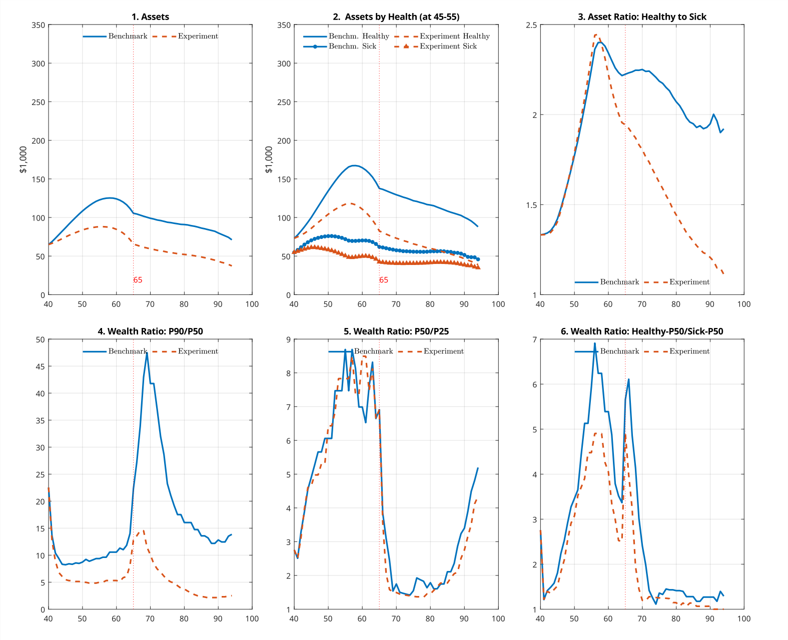
Exp. 7 (no bad health–death): Asset profiles



Exp. 1 (No RA): RA participation



Exp. 1 (No RA): Asset profiles



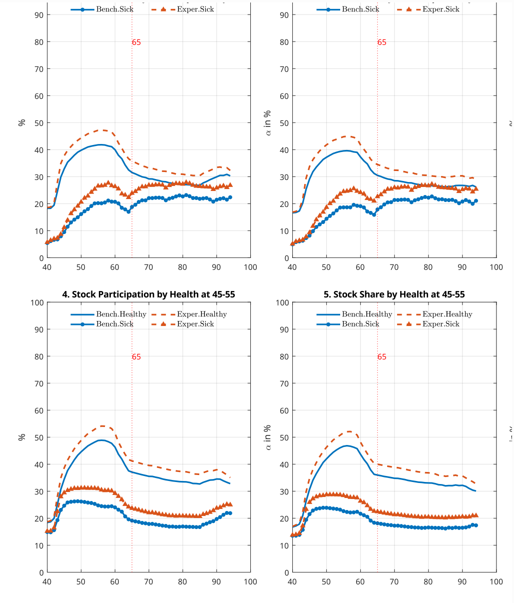
Decomposition experiments done

Back to decomposition experiments table

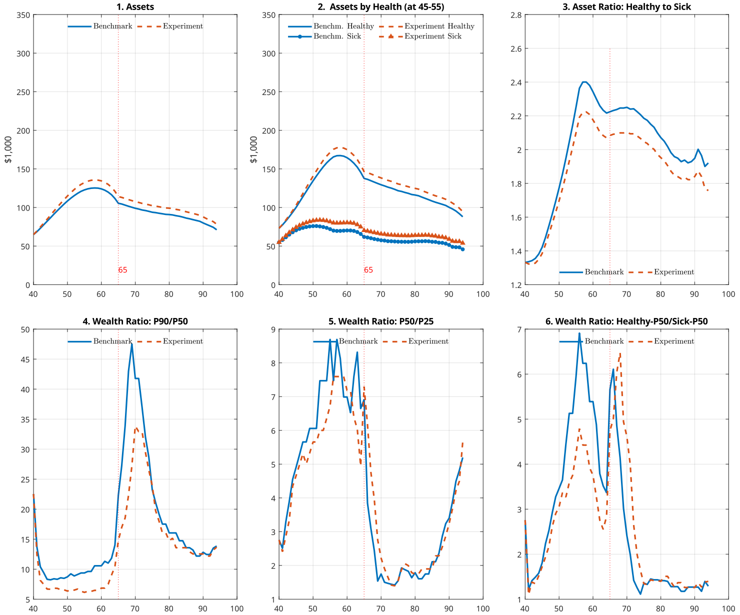
Policy experiments

- Exp 1: Expansion of **Medicare** to 20–64 year olds (UPHI)
- Exp 2: Expansion of **EHI to all workers**

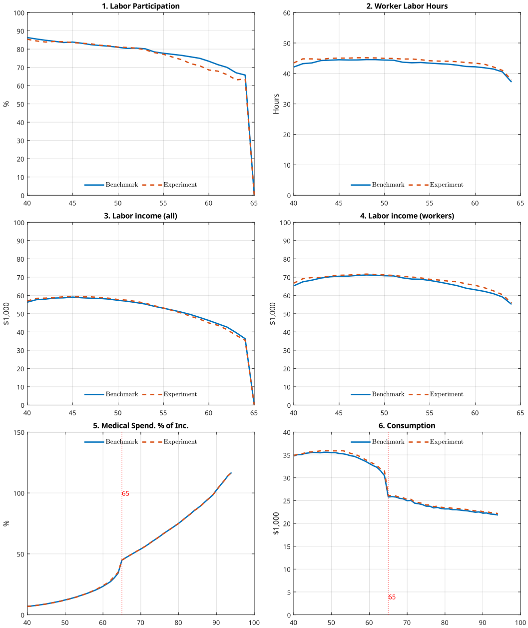
Exp. 1 (Medicare-for-all): RA participation



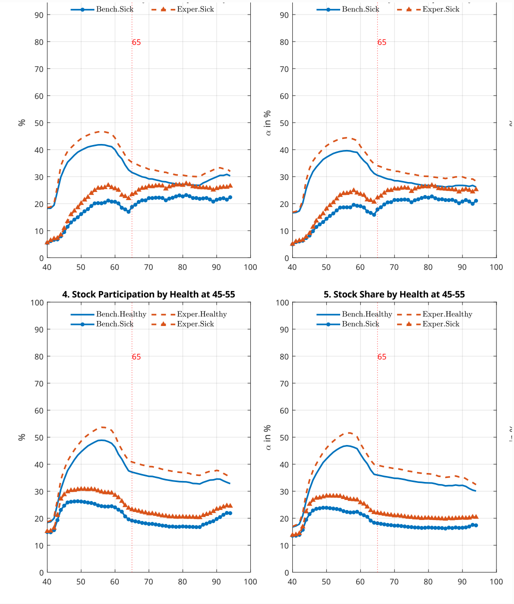
Exp. 1 (Medicare for all): Asset profiles



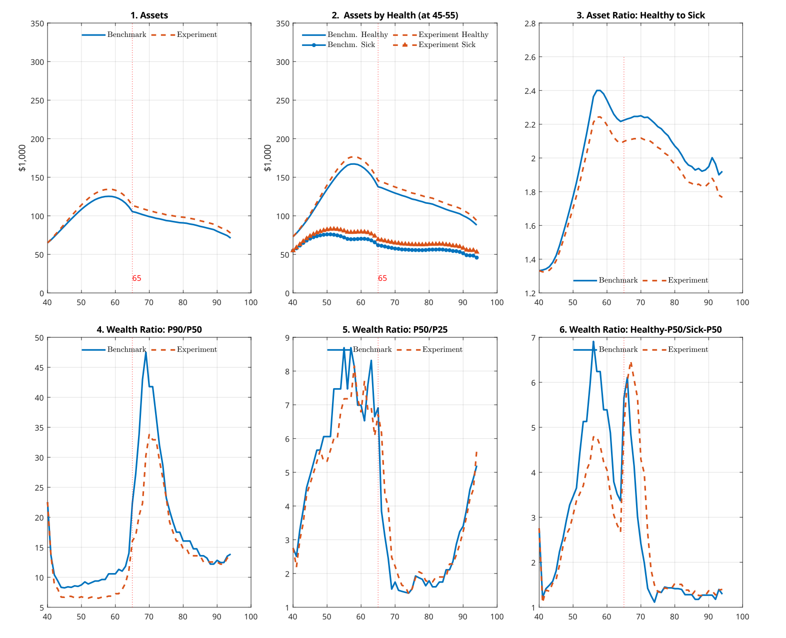
Exp. 1 (Medicare for all): Labor profiles



Exp. 2 (EHI all workers): RA participation profiles



Exp. 2 (EHI all workers): Asset profiles



HI experiments done

Back to HI policy experiments table

References I

Agarwal, Sumit and Bhashkar Mazumder. 2013. "Cognitive Abilities and Household Financial Decision Making." *American Economic Journal: Applied Economics* 5(1):193–207.

Agnew, Julie, Pierluigi Balduzzi and Annika Sundén. 2003. "Portfolio Choice and Trading in a Large 401(k) Plan." *American Economic Review* 93(1):193–215.

Alan, Sule. 2006. "Entry costs and stock market participation over the life cycle." *Review of Economic Dynamics* 9(4):588–611.

Aldy, Joseph E. and Seamus J. Smyth. 2014. Heterogeneity in the Value of Life. Nber working Paper no. 20206.

Ayyagari, Padmaja and Daifeng He. 2016. "Medicare Part D and Portfolio Choice." *The American Economic Review* 106(5):339–342.

Bagliano, Fabio C., Carolina Fugazza and Giovanna Nicodano. 2014. "Optimal Life-Cycle Portfolios for Heterogeneous Workers." *Review of Finance* 18(6):2283–2323.

Bagliano, Fabio C., Carolina Fugazza and Giovanna Nicodano. 2019. "Life-Cycle Portfolios, Unemployment and Human Capital Loss." *Journal of Macroeconomics* 60:325–340.

Benabou, Roland. 2002. "Tax and Education Policy in a Heterogeneous Agent Economy: What Levels of Redistribution Maximize Growth and Efficiency?" *Econometrica* 70(2):481–517.

Benhabib, Jess, Alberto Bisin and Mi Luo. 2019. "Wealth Distribution and Social Mobility in the US: A Quantitative Approach." *American Economic Review* 109(5):1623–1647.

Benhabib, Jess, Alberto Bisin and Shenghao Zhu. 2015. "The Wealth Distribution in Bewley Models with Capital Income Risk." *Journal of Economic Theory* 159:459–515.

Böckerman, Petri, Andrew Conlin and Rauli Svento. 2021. "Early Health, Risk Aversion and Stock Market Participation." *Journal of Behavioral and Experimental Finance* 32:100568.

Bonaparte, Yosef, Russell Cooper and Guozhong Zhu. 2012. "Consumption smoothing and portfolio rebalancing: The effects of adjustment costs." *Journal of Monetary Economics* 59(8):751–768.

Bressan, Silvia, Noemi Pace and Loriana Pelizzon. 2014. "Health Status and Portfolio Choice: Is Their Relationship Economically Relevant?" *International Review of Financial Analysis* 32:109–122.

References II

Brunnermeier, Markus K. and Stefan Nagel. 2008. "Do Wealth Fluctuations Generate Time-Varying Risk Aversion? Micro-evidence on Individuals." *American Economic Review* 98(3):713–736.

Campanale, Claudio, Carolina Fugazza and Francisco Gomes. 2015. "Life-Cycle Portfolio Choice with Liquid and Illiquid Financial Assets." *Journal of Monetary Economics* 71:67–83.

Capatina, Elena. 2015. "Life-cycle Effects of Health Risk." *Journal of Monetary Economics* 74:67–88.

Capatina, Elena and Michael Keane. 2025. "Health Shocks, Health Insurance, Human Capital, and the Dynamics of Earnings and Health." *Forthcoming in Journal of Political Economy* .

Catherine, Sylvain. 2022. "Countercyclical Labor Income Risk and Portfolio Choices over the Life Cycle." *The Review of Financial Studies* 35(9):4016–4054.

Chen, Chaoran, Zhigang Feng and Jiaying Gu. 2025. "Health, Health Insurance, and Inequality." *International Economic Review* 66(1):107–141.

Christelis, Dimitris, Tullio Jappelli and Mario Padula. 2010. "Cognitive abilities and portfolio choice." *European Economic Review* 54(1):18–38.

Cocco, João F., Francisco J. Gomes and Pascal J. Maenhout. 2005. "Consumption and Portfolio Choice over the Life Cycle." *The Review of Financial Studies* 18(2):491–533.

Cooper, Russell and Guozhong Zhu. 2016. "Household Finance Over the Life-Cycle: What Does Education Contribute?" *Review of Economic Dynamics* 20:63–89.

De Nardi, Mariacristina. 2004. "Wealth Inequality and Intergenerational Links." *Review of Economic Studies* 71:743–768.

De Nardi, Mariacristina, Eric French and B. John Jones. 2010. "Why Do the Elderly Save? The Role of Medical Expenses." *Journal of Political Economy* 118(1):39–75.

De Nardi, Mariacristina, Svetlana Pashchenko and Ponpoje Porapakkarm. 2025. "The Lifetime Costs of Bad Health." *The Review of Economic Studies* 92(3):1987–2026.

DeNardi, Mariacristina, Svetlana Pashchenko and Ponpoje Porapakkarm. 2025. "The Lifetime Costs of Bad Health." *The Review of Economic Studies, Forthcoming* 92(3):1987ï¿½2026.

References III

Edwards, Ryan D. 2008. “Health Risk and Portfolio Choice.” *Journal of Business & Economic Statistics* 26(4):472–485.

Egan, Mark L., Alexander MacKay and Hanbin Yang. 2021. “What Drives Variation in Investor Portfolios? Evidence from Retirement Plans.” NBER Working Paper No. 29604.

Fagereng, Andreas, Charles Gottlieb and Luigi Guiso. 2017. “Asset Market Participation and Portfolio Choice over the Life-Cycle.” *The Journal of Finance* 72(2):705–750.

Fiorito, Riccardo and Giulio Zanella. 2012. “The Anatomy of the Aggregate Labor Supply Elasticity.” *Review of Economic Dynamics* 15(2):171–187.

French, Eric. 2005. “The Effects of Health, Wealth, and Wages on Labour Supply and Retirement Behaviour.” *The Review of Economic Studies* 72(2):395–427.

Gabaix, Xavier, Jean-Michel Lasry, Pierre-Louis Lions and Benjamin Moll. 2016. “The Dynamics of Inequality.” *Econometrica* 84(6):2071–2111.

Gamble, Keith Jacks, Patricia Boyle, Lei Yu and David Bennett. 2015. “Aging and Financial Decision Making.” *Management Science* 61(11):2603–2610.

Goldman, Dana and Nicole Maestas. 2013. “Medical Expenditure Risk and Household Portfolio Choice.” *Journal of Applied Econometrics* 28(4):527–550.

Gomes, Francisco. 2020. “Portfolio Choice Over the Life Cycle: A Survey.” *Annual Review of Financial Economics* 12(1):277–304.

Gomes, Francisco, Alexander Michaelides and Valery Polkovnichenko. 2009. “Optimal savings with taxable and tax-deferred accounts.” *Review of Economic Dynamics* 12(4):718–735.

Gomes, Francisco, Michael Haliassos and Tarun Ramadorai. 2021. “Household Finance.” *Journal of Economic Literature* 59(3):919–1000.

Gomes, Francisco and Oksana Smirnova. 2021. “Stock Market Participation and Portfolio Shares Over the Life-Cycle.” SSRN Working Paper No. 3808350.

References IV

Gomme, Paul, B. Ravikumar and Peter Rupert. 2011. "The return to capital and the business cycle." *Review of Economic Dynamics* 14(2):262–278.

Guner, Nezih, Martin Lopez-Daneri and Gustavo Ventura. 2016. "Heterogeneity and Government Revenues: Higher Taxes at the Top?" *Journal of Monetary Economics* 80:69–85.

Hambel, Christoph, Holger Kraft and André Meyer-Wehmann. 2022. "When Should Retirees Tap Their Home Equity?" SSRN Working Paper No. 3681834.

Heathcote, Jonathan, Kjetil Storesletten and Giovanni L Violante. 2017. "Optimal Tax Progressivity: An Analytical Framework." *Quarterly Journal of Economics* 132(4):1693–1754.

Hosseini, Roozbeh, Karen Kopecky and Kai Zhao. 2025. "How Important Is Health Inequality for Lifetime Earnings Inequality?" *Forthcoming in Review of Economic Studies* Working Paper.

Hugonnier, J. P. St-Amour and F. Pelgrin. 2013. "Health and (other) Asset Holdings." *Review of Economic Studies* 80(2):663–710.

İmrohoroğlu, Selahattin and Sagiri Kitao. 2012. "Social Security Reforms: Benefit Claiming, Labor Force Participation, and Long-run Sustainability." *American Economic Journal: Macroeconomics* 4(3):96–127.

Inkmann, Joachim, Alexander Michaelides and Yuxin Zhang. 2022. "Family Portfolio Choice over the Life Cycle." SSRN Working Paper No. 3965481.

Jeske, Karsten and Sagiri Kitao. 2009. "U.S. Tax Policy and Health Insurance Demand: Can a Regressive Policy Improve Welfare?" *Journal of Monetary Economics* 56(2):210–221.

Jung, Juergen and Chung Tran. 2016. "Market Inefficiency, Insurance Mandate and Welfare: U.S. Health Care Reform 2010." *Review of Economic Dynamics* 20:132–159.

Jung, Juergen and Chung Tran. 2022. "Social Health Insurance: A Quantitative Exploration." *Journal of Economic Dynamics and Control* 139:104374.

Jung, Juergen and Chung Tran. 2023. "Health Risk, Insurance and Optimal Progressive Income Taxation." *Journal of the European Economic Association* 21(5):2043–2097.

References V

Lindeboom, Maarten and Mariya Melnychuk. 2015. "Mental Health and Asset Choices." *Annals of Economics and Statistics* (119/120):65–94.

Liu, Xuan, Haiyong Liu and Zongwu Cai. 2021. "Time-Varying Relative Risk Aversion: Mechanisms and Evidence." SSRN Electronic Journal.

Lusardi, Annamaria, Pierre-Carl Michaud and Olivia S. Mitchell. 2017. "Optimal Financial Knowledge and Wealth Inequality." *Journal of Political Economy* 125(2):431–477.

Mahler, Lukas and Minchul Yum. 2024*a*. "Lifestyle Behaviors and Wealth-Health Gaps in Germany." *Econometrica* 92(4):1697–1733.

Mahler, Lukas and Minchul Yum. 2024*b*. "Lifestyle Behaviors and Wealth-Health Gaps in Germany." *Econometrica* 92(5):1697–1733.

Mazzonna, Fabrizio and Franco Peracchi. 2020. "Are Older People Aware of Their Cognitive Decline? Misperception and Financial Decision Making." IZA Discussion Paper No. 13725.

McGrattan, Ellen R. and Edward C. Prescott. 2000. "Is the stock market overvalues?" *Quarterly Review, Federal Reserve Bank of Minneapolis* 24:20–40.

Mehra, Rajnish and Edward C. Prescott. 1985. "The equity premium: A puzzle." *Journal of Monetary Economics* 15(2):145–161.

Merton, Robert C. 1971. "Optimum consumption and portfolio rules in a continuous-time model." *Journal of Economic Theory* 3(4):373–413.

Nakajima, Makoto and Irina A. Telyukova. 2017. "Reverse Mortgage Loans: A Quantitative Analysis." *The Journal of Finance* 72(2):911–950.

Nakajima, Makoto and Irina A. Telyukova. 2024. "Medical Expenses and Saving in Retirement: The Case of U.S. and Sweden." *American Economic Journal: Macroeconomics* .

Parker, Jonathan A., Antoinette Schoar, Allison T. Cole and Duncan Simester. 2022. "Household Portfolios and Retirement Saving over the Life Cycle." NBER Working Paper No. 29881.

References VI

Prados, María José. 2018. "Health and Earnings Inequality Over the Life Cycle: The Redistributive Potential of Health Policies." Working Paper, USC - Dornsife (Dissertation Paper, Dept. of Economics, Columbia University).

Rosen, Harvey S and Stephen Wu. 2004. "Portfolio Choice and Health Status." *Journal of Financial Economics* 72(3):457–484.

Rossi, Alberto G. and Stephen P. Utkus. 2021. "Who Benefits from Robo-advising? Evidence from Machine Learning." SSRN 3552671.

Rossi, Alberto G. and Stephen Utkus. 2020. "The Needs and Wants in Financial Advice: Human versus Robo-advising." Working Paper.

Samuelson, Paul A. 1969. "Lifetime Portfolio Selection By Dynamic Stochastic Programming." *The Review of Economics and Statistics* 51(3):239–246.

Shimizutani, Satoshi and Hiroyuki Yamada. 2020. "Financial Literacy of Middle-Aged and Older Individuals: Comparison of Japan and the United States." *The Journal of the Economics of Ageing* 16:100214.

SSA. 2007. "Social Security Update 2007." SSA Publication No. 05-10003.

Tischbirek, Andreas. 2019. "Long-Term Government Debt and Household Portfolio Composition." *Quantitative Economics* 10(3):1109–1151.

Viscusi, Kip W. 1993. "The Value of Risks to Life and Health." *Journal of Economic Literature* 31(4):1912–1946.

Wachter, Jessica A. and Motohiro Yogo. 2010. "Why Do Household Portfolio Shares Rise in Wealth?" *The Review of Financial Studies* 23(11):3929–3965.

Yogo, Motohiro. 2016. "Portfolio Choice in Retirement: Health Risk and the Demand for Annuities, Housing and Risky Assets." *Journal of Monetary Economics* 80:17–34.

Zhou, Rui, Johnny Siu-Hang Li and Kenneth Zhou. 2022. "The Role of Longevity Annuities in Different Socioeconomic Classes: A Canadian Case Study." SSRN 4156290.