Health Heterogeneity, Portfolio Choice and Wealth Inequality

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Introduction

- Health $\Longleftrightarrow$ earnings/income/wealth inequality
  - Hosseini, Kopecky and Zhao (2021); Capatina and Keane (2023); De Nardi, Pashchenko and Porapakkarm (2024); Mahler and Yum (2024);

- Two health channels affecting **how much** households (HHs) save

  1. **Health-longevity channel**: survival rates $\Rightarrow$ household choices $\Rightarrow$savings/wealth accumulation

  2. **Health-income/expenditure channel**: labor productivity, labor supply, health expenditure $\Rightarrow$ savings/wealth accumulation

This paper

- Add health channel affecting **how/where** households save
  - Household finance: wealth/investment portfolio choice
  - Lit. Surveys: Gomes (2020) and Gomes, Haliassos and Ramadorai (2021)
- Health affects type of investment ⇒ large effects on wealth distribution possible
  - If portfolio **composition** (ratio of risky assets) differs by health ⇒ **returns** to investment differ by health
  - Compounding of investment returns ⇒ larger wealth gap over the lifecycle
  - Connection to inequality dynamics literature: Benhabib, Bisin and Zhu (2015); Gabaix et al. (2016); Benhabib, Bisin and Luo (2019)
- New **health-wealth portfolio channel**
  - Health heterogeneity ⇒ dynamics of how much & **how** households save
  - Implications for wealth inequality

This paper

- Highlight/quantify importance of **health-wealth portfolio** channel
- **Empirical analysis:** reduced form regression
  - Document lasting effect of **poor health at 45–55** on **risky asset**-share at 60–70
  - Evidence from panel regression models using PSID and HRS data
- **Structural analysis:** model + counterfactual experiments
  - Stochastic lifecycle model: portfolio choice, health, and health insurance
  - Decompose effects of **health** and **portfolio choice** on **wealth gap**
  - Examine role of **health+HI** on wealth and wealth inequality

Findings

Empirical: **PSID+HRS data**

- Statistically significant differences of lifecycle patterns of **RA** share by **"health at age 45–55"**
- RA participation of 60–70 olds is negatively correlated with **sick-at-45–55**
- Health effect primarily via extensive (participation) margin in **RA** investments

Structural: **Lifecycle model**

- Average annual lifetime cost of **sick-at-45–55**: \$3,278
- Health-wealth portfolio channel is large
  - counterfactuals: P90/P50 $\downarrow$ between 44–53%
- Expansion of either public or private health insurance
  - stock market participation: $\uparrow$ 4–5%
  - wealth gap: $\downarrow$ 14–24%

Mechanism

- **Health-wealth portfolio** channel is quantitatively important
- Mechanism at work
  1. Bad health
     $\Rightarrow$ lower surv. prob.+income losses+high medical expenditure
     $\Rightarrow$ higher expected future risk (as health shocks are persistent)
     $\downarrow$ stock market participation
  2. Health heterogeneity $\Rightarrow$ Heterogeneity in wealth portfolio $\Rightarrow$ heterogeneous investment returns
  3. Compounding of investment returns $\Rightarrow$ larger wealth gap over time
  4. Expansion of health insurance
     $\Rightarrow \uparrow$ stock market participation $\Rightarrow \downarrow$ wealth gap

Related literature

- Macro-health economics
  - Hosseini, Kopecky and Zhao (2021); Capatina and Keane (2023); Mahler and Yum (2024); Chen, Feng and Gu (2024)
  - Jeske and Kitao (2009); De Nardi, French and Jones (2010); Capatina (2015); Jung and Tran (2016); Jung and Tran (2023) etc.

- 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

This paper: health at "45–55" ⇒ generating wealth gap via two assets at 65 & role of health insurance

Detailed references

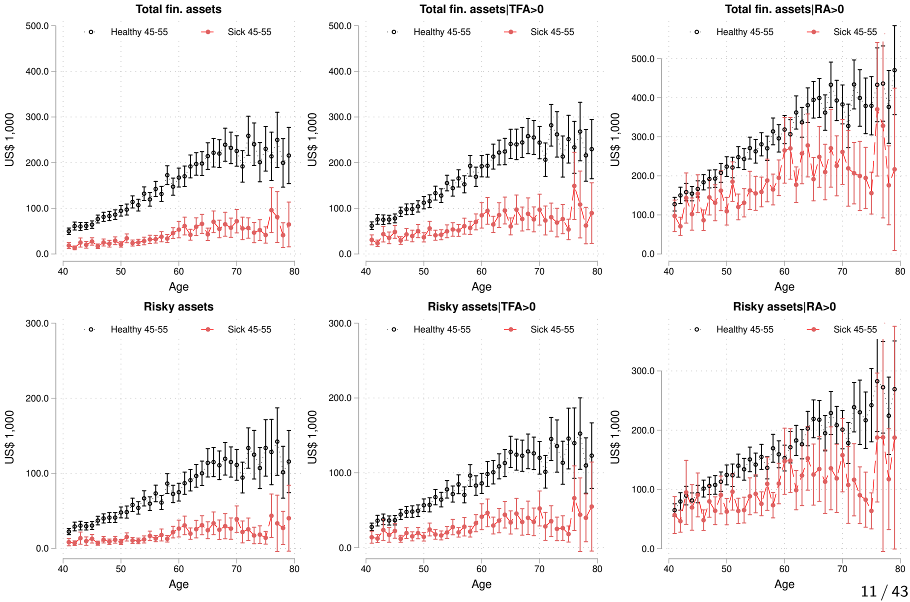
Health-wealth portfolio channel: Empirical evidence

Data

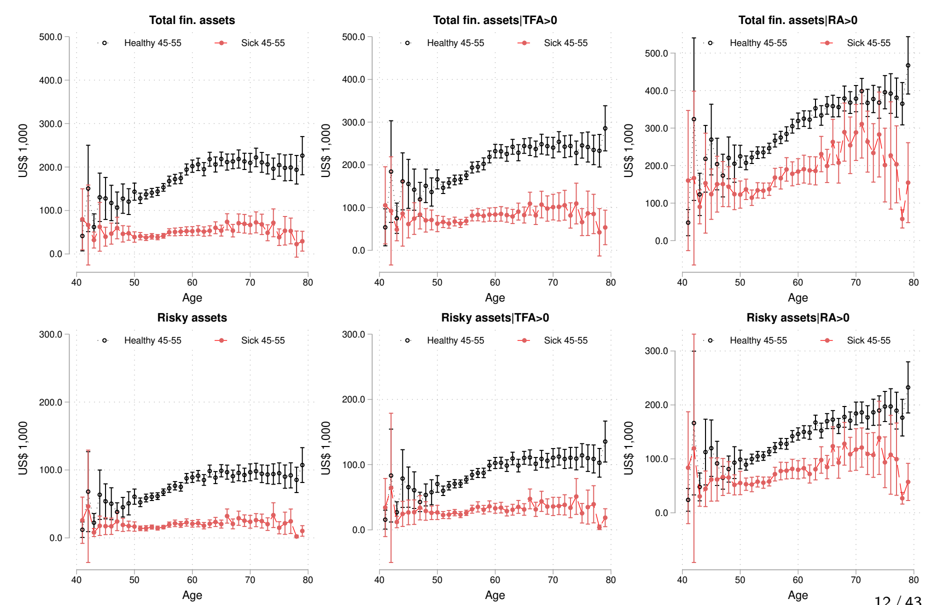
- Data sources: **PSID** 1984–2019 and **HRS** 1992–2018
- Financial wealth
  - Focus on **financial wealth** (no housing, cars, real estate)
  - HRS: Collapse 20 asset categories into 2
    1. **safe assets:** checking/savings accts, money market funds, CDs, bonds (government savings bonds, T-bills, 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

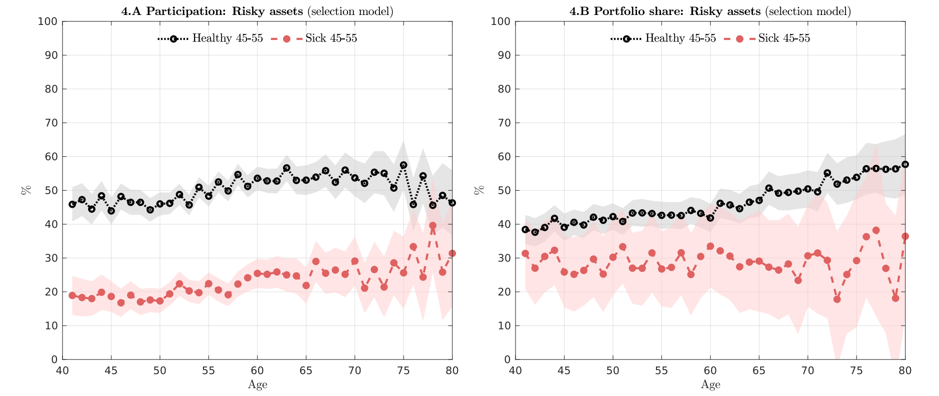
Fin. Assets over lifecycle: PSID



Fin. Asset holdings over life cycle: HRS



Stock market activities over the life cycle



Reduced form: Poor health $\Rightarrow$ risky asset share

Econometric model

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

- 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

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

	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	

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.

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

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

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

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.

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

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

More Details

Mapping the model to data

Parametrization, calibration and estimation

- Data 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:
  - Paras: time discount factor β, weight on consumption η, strength of bequest θ_1 and stock market participation costs

$$\Theta = \left\{\beta,\ \eta,\ \theta_1,\ q\big(\text{age-group},\ \vartheta, \epsilon^h\big)\right\}$$

  - Method of simulated moments

More calibration/estimation details

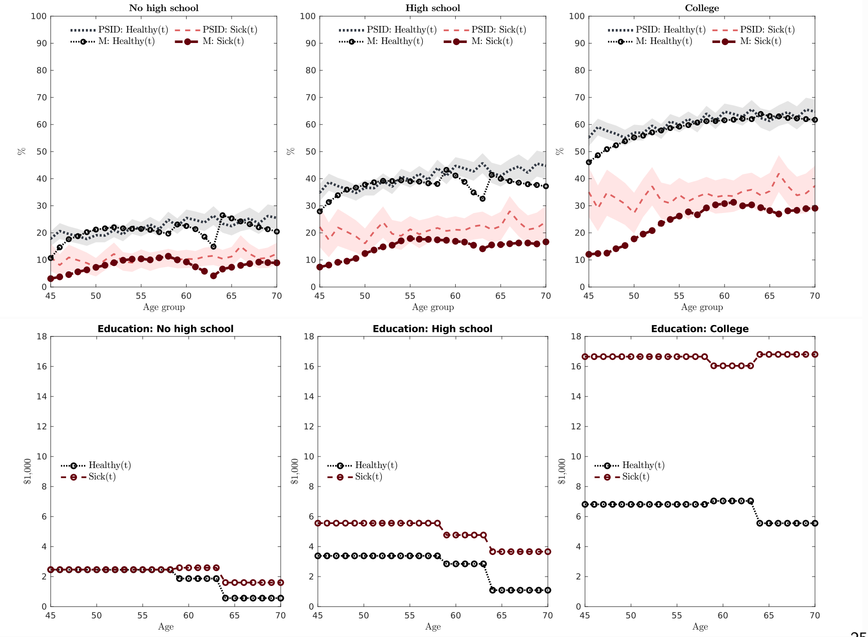
Estimated parameters

Parameters	**Value**	**Std. error**	**P-value**
Time discount factor: β	0.9848	0.0006	0.000
Consumption weight: η	0.2753	0.004	0.009
Strength of bequest motive: θ_1	108.59	24.97	0.025
Stock market participation cost: $q(\text{age-group}, \vartheta, \epsilon^h)$			
Age 40–59	Fig. above		
Age 60–64	Fig. above		
Age 65–80	Fig. above		

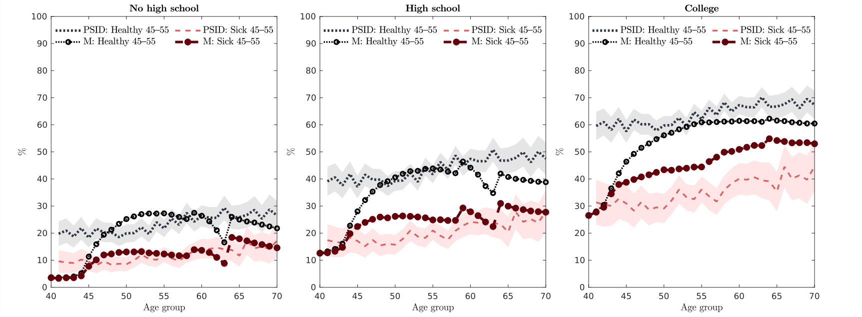
Estimation targets:

- 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
  - three education levels (low, medium and high), two health status (sick and healthy), and three age groups (40-59, 60-64, 65-80)

Estimation target: RA participation rate

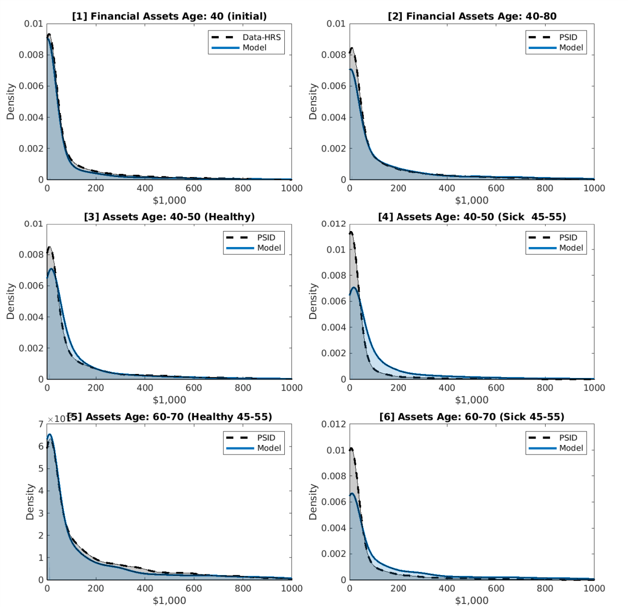


Performance: RA participation by health-at-45-55

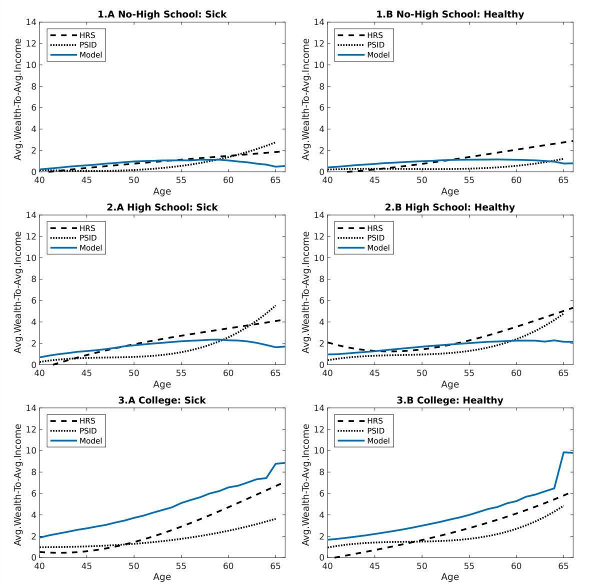


- Model replicates RA participation pattern by health-at-45–55 ⇒ this was not a target

Model 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	

Model performance details

RA shares: model w/ init. health cond. controls

- Sample of individuals who are healthy at age 40

	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	

Quantitative Analysis

Counter factual: Benefits of good health

- Counterfactual
  1. Everybody at age 45–55 draws good health (surprise shock)
     $\Rightarrow$ Simulates control group to individuals who were sick at 45–55
  2. Everybody at age 40–death draws good health
- Keep policy functions unchanged
- Calculate lifetime benefit/cost of good/bad health (annual averages) following De Nardi, Pashchenko and Porapakkarm (2024)

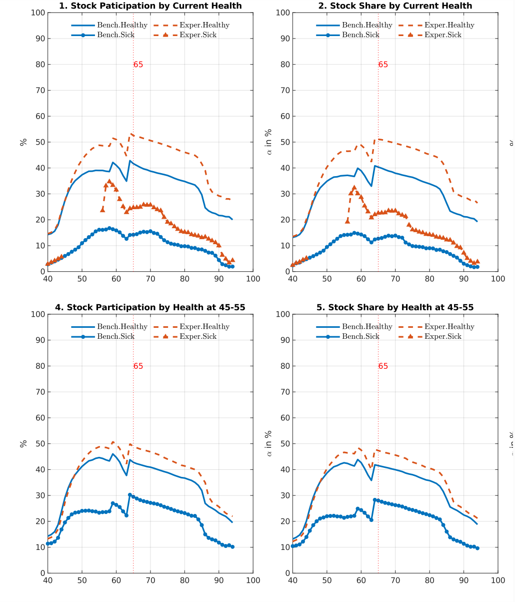
$$\overline{\text{benefit}}_i = \left(\frac{1}{\sum_{j=1}^{J} 1_{\text{alive}_j}}\right) \sum_{j=1}^{J} 1_{\text{alive}_j} \times \left(\overbrace{\left(y_{ij}^{**} - oop_{ij}^{**}\right)}^{\substack{\text{net of med expens.} \\ \text{always healthy}}} - \overbrace{\left(y_{ij}^{*} - oop_{ij}^{*}\right)}^{\substack{\text{net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

Counter factual: Benefits of good health

	All	By skill level Low	 Medium	 High
In good health between 45–55				
• % of time in bad health eliminated	8.89%	12.56%	8.10%	5.64%
• Medical cost ↓ + income ↑	\$3,278	\$3,815	\$3,070	\$3,032
• Welfare (CEV)	–	+9.72%	+8.11%	+5.55%
In good health between 40–death				
• % of time in bad health eliminated	16.49%	23.26%	15.24%	10.15%
• Medical cost ↓ + income ↑	\$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).

Good health at age 45–55



Decomposition: 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)

Decomposition: Results

	[A] Two assets economy		[B] Single asset economy	
	Health shocks	No h.s.	Health shocks	No h.s.
Stock participation				
• **Age 65:** sick 45–55	**34%**	n/a	n/a	n/a
• **Age 65:** healthy 45–55	**47%**	**55%**	n/a	n/a
Assets	100	122.2	62.5	71.6
Labor participation	51.40%	68.80%	51.89%	68.42%
Hours (workers)	100	101.98	98.02	102.12
Consumption	100	104.70	98.62	102.15
Wealth-to-income (W/I)				
• W/I at **65**: all	4.41	5.42	2.79	3.19
• W/I at **65**: sick 45–55	**3.12**	n/a	2.06	n/a
• W/I at **65**: healthy 45–55	**5.29**	**5.42**	3.29	3.19

Decomposition: Wealth gaps

	[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	14.47	8.12 (↓**43.9%**)	8.92 (↓38.4%)	6.37 (↓56.0%)(↓**28.6%**)
• P50/P25	6.58	5.35 (↓**18.7%**)	6.08 (↓7.6%)	3.44 (↓47.7%)(↓**43.4%**)
Age 65				
• P90/P50	15.96	7.72 (↓**51.6%**)	9.34 (↓41.5%)	5.98 (↓62.5%)(↓**36.0%**)
• P50/P25	7.08	6.62 (↓**6.5%**)	7.59 (↑7.2%)	3.73 (↓47.3%)(↓**50.9%**)
Age 65		**No h.s. (45–55)**		**No h.s. (45–55)**
• P90/P50	15.96	10.23 (↓**35.9%**)	9.34 (↓41.5%)	6.94 (↓56.5%)(↓**25.7%**)
• P50/P25	7.08	8.82 (↑**24.6%**)	7.59 (↑7.2%)	6.02 (↓15.0%)(↓**20.7%**)

Decomposition profiles

Health insurance expansion

- **Benchmark**
  - Employer-sponsored health insurance (EHI) for workers
  - Medicare fo retirees
  - Medicaid for the poor
- Exp 1**: Medicare for all**
  - expansion of Medicare to all workers and retirees
- Exp2**: EHI for all workers**
  - expansion of EHI to all workers while
  - maintaining Medicare and Medicaid

Health insurance expansion

	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	34%	39%	38%
• At 65: healthy 45-55	47%	51%	51%
Wealth gap			
• All age: **P90/P50**	14.47	10.53 ($\downarrow$ 27.2%)	11.23 ($\downarrow$ 22.4%)
• All age: P50/P25	6.58	7.94 ($\uparrow$ 20.7%)	7.47 ($\uparrow$ 13.52%)
• At 65: **P90/P50**	15.96	11.43 ($\downarrow$ 28.4%)	12.18 ($\downarrow$ 23.68%)
• At 65: P50/P25	7.08	5.66 ($\downarrow$ 20.1%)	6.91 ($\downarrow$ 2.4%)
Welfare (CEV)	0	+1.97	+1.93

Note: Partial equilibrium results. Reforms are not financed!

HI policy experiment profiles

Conclusion

Conclusion

- Study dynamic effects of health shocks on savings, portfolio choice and wealth accumulation over lifecycle
- Empirical analysis using PSID + HRS and panel regression models
- A structural lifecycle model w/ savings (portfolio) decisions, health shocks and health insurance
  - Long-lasting effects of bad health on stock market participation, portfolio choice and wealth gaps
  - Health-wealth portfolio channel is quantitatively important for wealth disparity
- Important role of health insurance in reducing wealth gap over the lifecycle

Future work

- A full dynamic general equilibrium macro-health model
- Liquidity costs
- Housing assets
- Household structure and family insurance
- Transition dynamics (long term goal)
- Endogenous health and medical spending (very long term goal)

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 (2022); De Nardi, Pashchenko and Porapakkarm (2024)
  - Health on labor supply and productivity: Prados (2018); Capatina and Keane (2023); Hosseini, Kopecky and Zhao (2021)
  - Lifestyle behaviors: Mahler and Yum (2022)
- 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

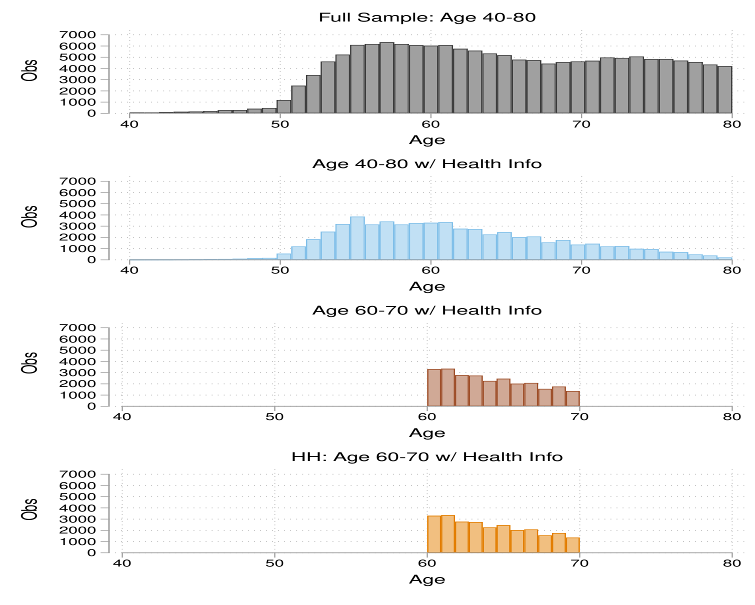
- Empirical **financial literacy**
  - Cognitive abilities and investment decisions: Christelis, Jappelli and Padula (2010); Agarwal and Mazumder (2013); Gamble et al. (2015); Lindeboom and Melnychuk (2015); Mazzonna and Peracchi (2020); Shimizutani and Yamada (2020)
  - Role of financial advising: Rossi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

Back to literature

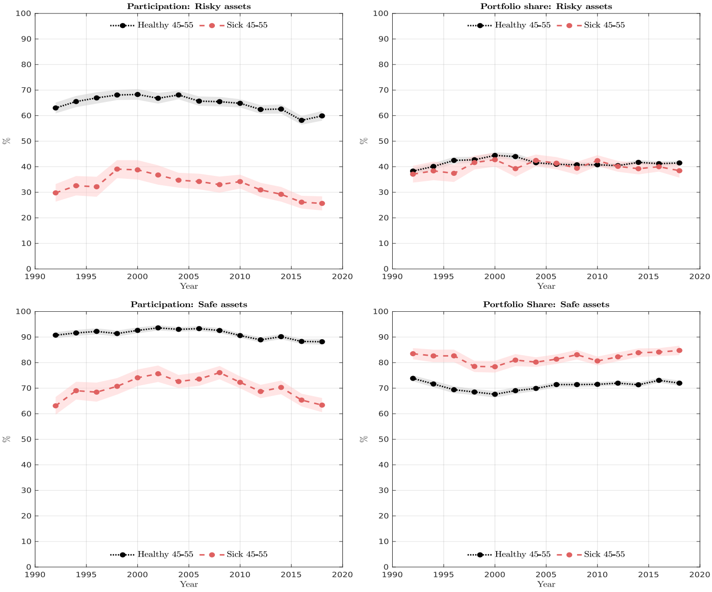
Health & Retirement Study (RAND-HRS) 1992–2018

- 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

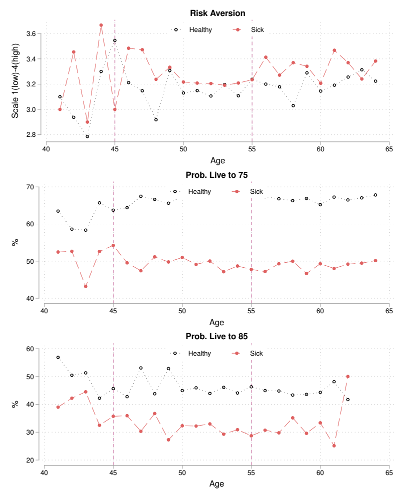
HRS summary statistics III

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



Unweighted

Back to HRS variable definitions

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 risky asset share regression

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

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

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

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

Worker Problem II

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

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

s.t.

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

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

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

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

Worker Problem III

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

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

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

- Taxes

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

Worker Problem IV

- Transfers

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

- Average past labor earnings:

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

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

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

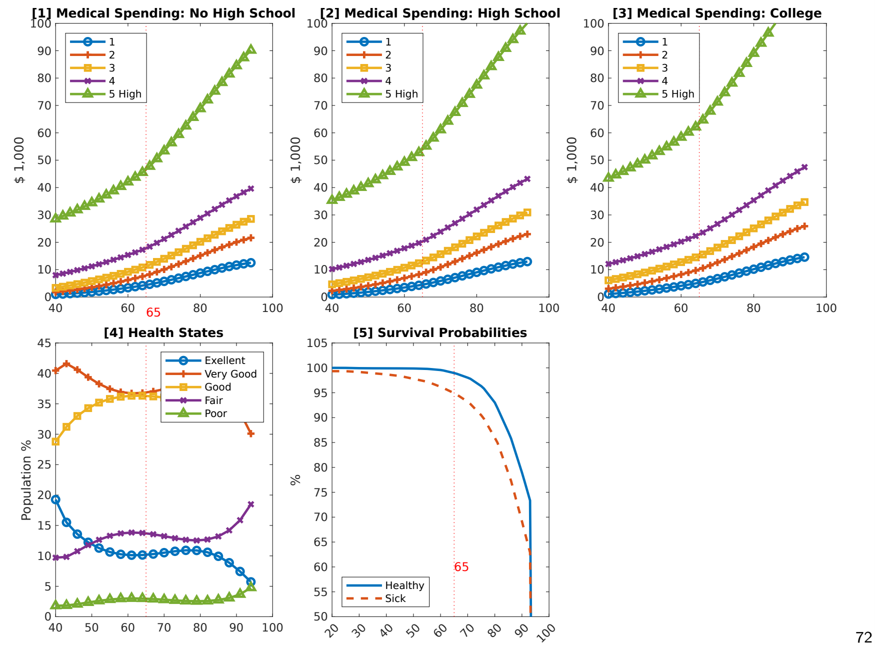
$$\text{tr}_j^{\text{si}} = \max\left[0,\ c_{\min} + o_j\left(m_j\right) + \text{prem}^{\text{mcare}} + \text{tax}^y\left(y_j^{\text{tax}}\right) - a_j - \text{tr}_j^{\text{ss}}\right]$$

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	$\sigma^2_{\epsilon^{\mathrm{incP}}} = 0.0141$	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	$\gamma^{\mathrm{ehi}} = 0.31$	MEPS 1996–2018
Medicaid coinsurance	$\gamma^{\mathrm{maid}} = 0.11$	MEPS 1996–2018
Medicare coinsurance	$\gamma^{\mathrm{mcare}} = 0.30$	MEPS 1996–2018
Consumption tax	$\tau^c = 5\%$	IRS
Bequest parameter	$\theta_2 = \$500,000$	De Nardi (2004); French (2005)
Payroll tax Social Security	$\tau^{\mathrm{ss}} = 10.6\%$	IRS
Payroll tax Medicare	$\tau^{\mathrm{mcare}} = 2.9\%$	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)

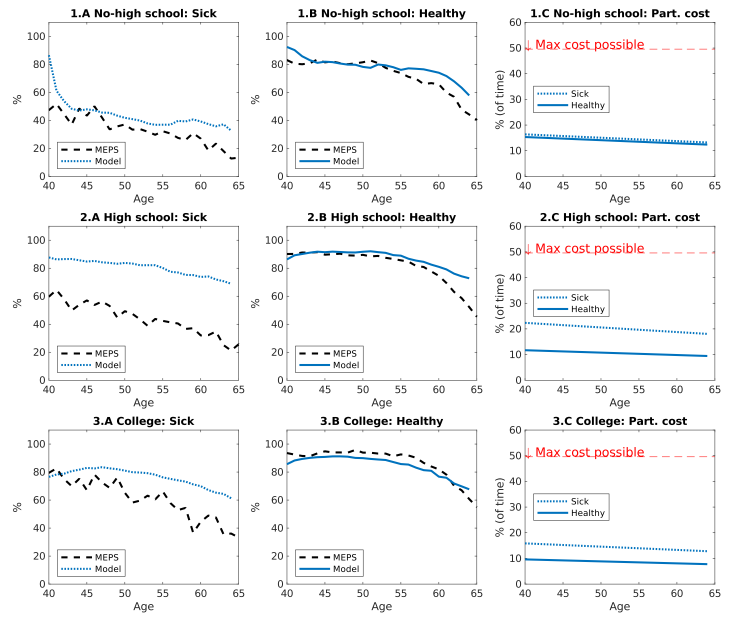
Exogenous health status



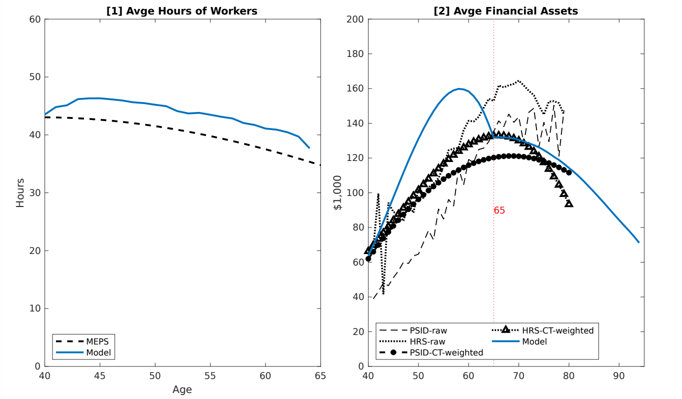
Internal (calibrated) parameters

Parameters	Values	Calibration target	Model	Data	Source
Fixed cost of work	$\bar{n}_{j,\vartheta}$	Avge. work part.	Pan.2,Fig.75	Pan.2,Fig.75	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.76	Pan.2,Fig.76	MEPS 1996–2018
Medicaid income test	$\bar{y}^{\text{maid}} = \$5.5k$	Age 20–39 on Maid	Pan.2,Fig.76	Pan.2,Fig.76	MEPS 1996–2018
Consumption floor	$c_{\text{min}} = \$3.2k$	Frac. net-ass.$<$\$5k	20% (of popul.)	20%	Jeske and Kitao (2009)

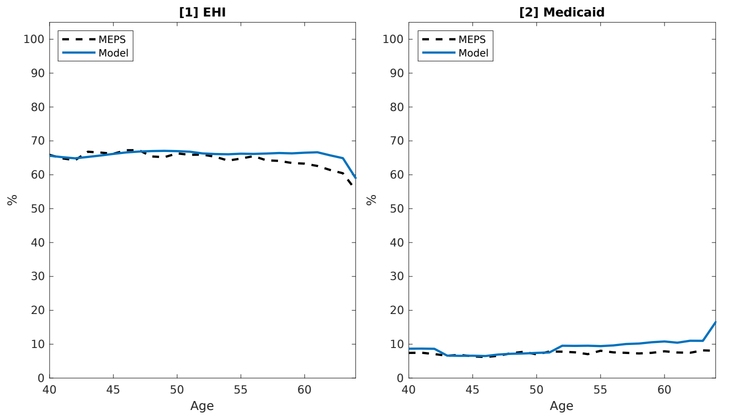
Calibration target: labor force participation



Calibration targets



Calibration targets (only Medicaid is a target)

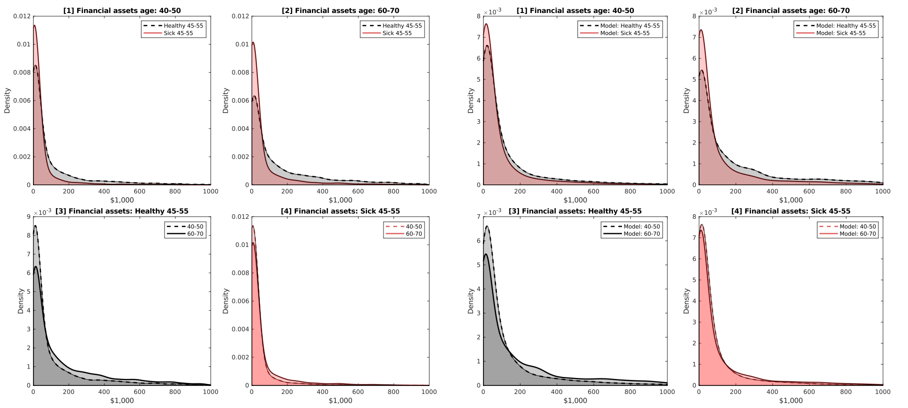


Note: only Medicaid take-up is a target

Back to calibration

Performance (not targets)

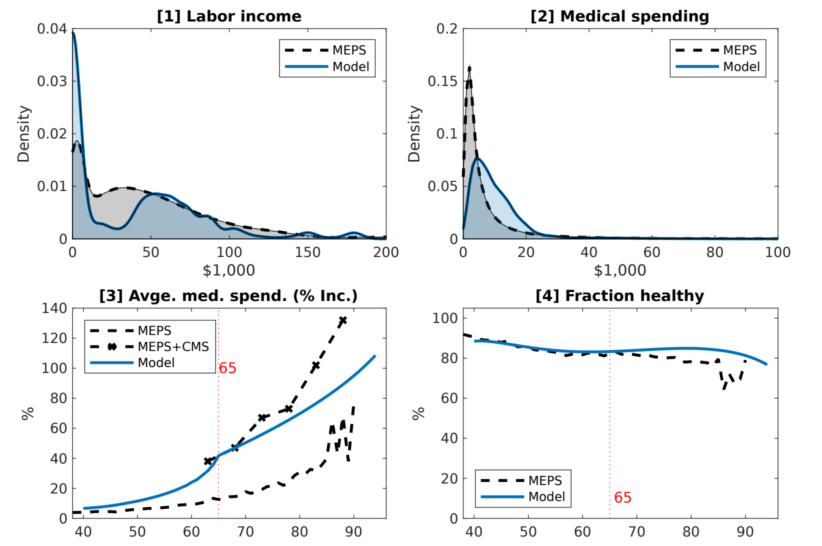
Data | Model



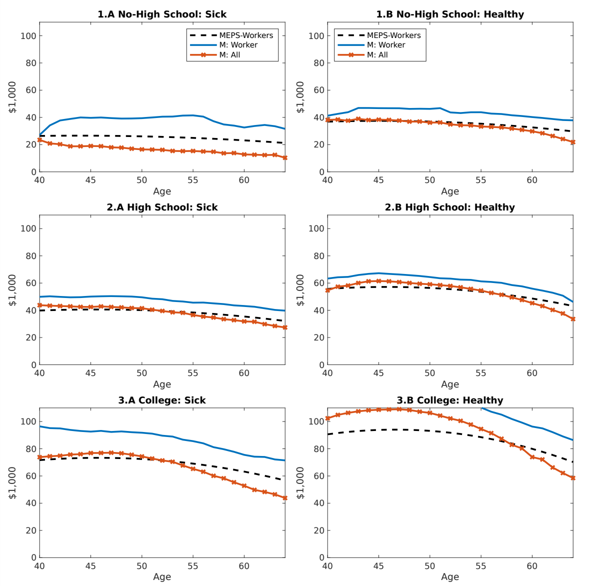
Bench. model: Risky assets by health at age 45–55

	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

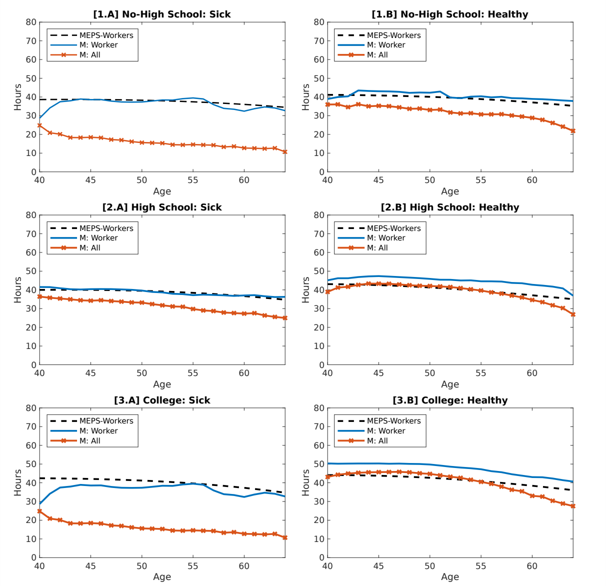
Model performance (not targeted)



Performance: labor income

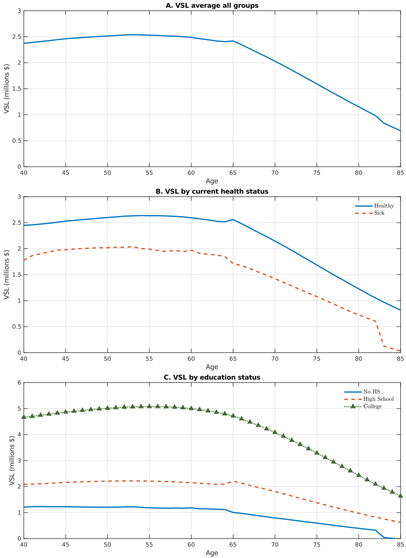


Performance: hours worked



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



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

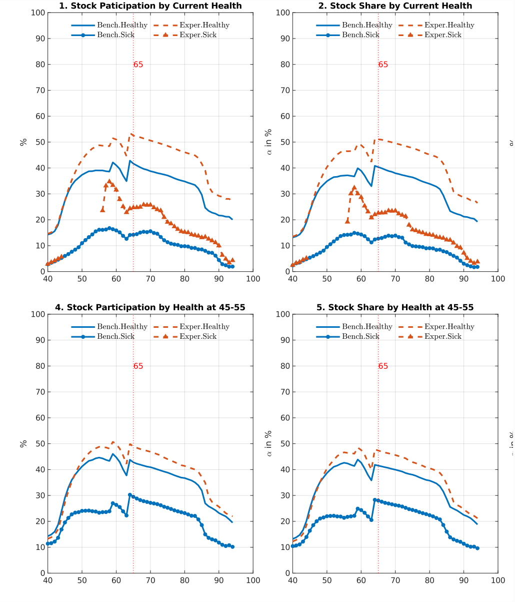
$$\text{VSL}_j\left(\vartheta, a_j, \epsilon_j^{\text{incP}}, \epsilon_j^h, \epsilon_j^{\text{ehi}}\right)=\frac{\Delta a_j}{\Delta\pi_j\left(\varepsilon_j^h\right)}.$$

Value of statistical life II

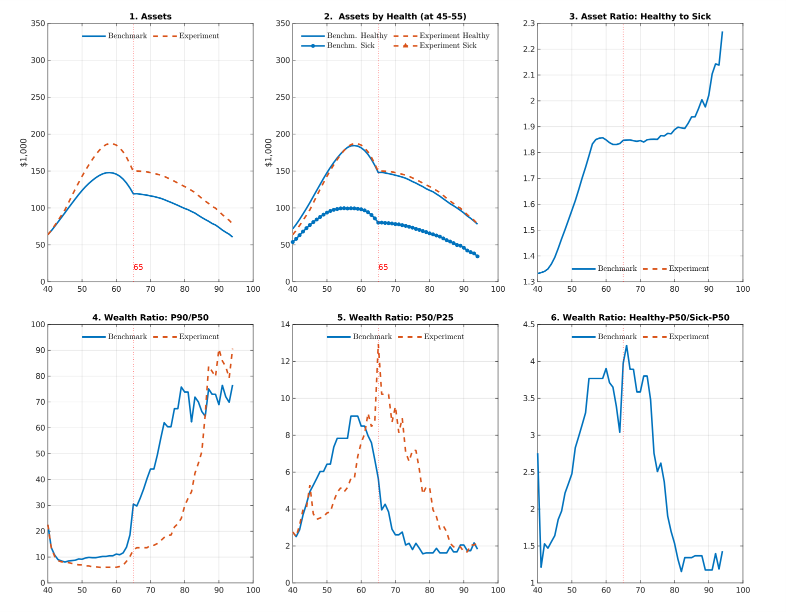
- Intuitively, the VSL is the marginal rate of substitution between wealth and survival probability
- VSL range between 1–16 million USD according to a survey by Viscusi (1993)
- We target 2.5 million USD for the working age population of 40–65 year olds

Back to VSL

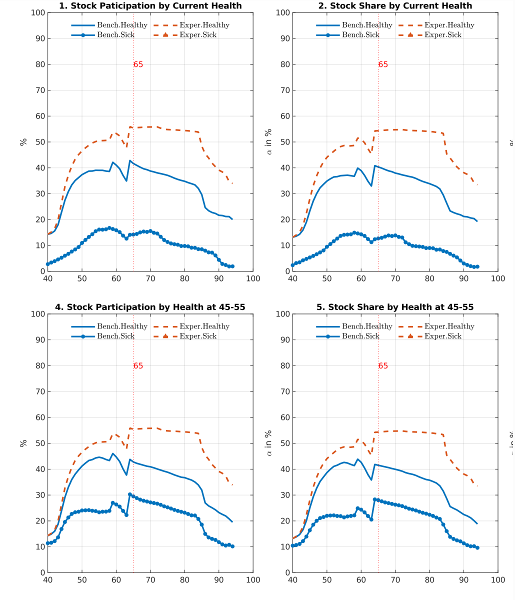
Exp. 8 (no bad health at 45–55): RA participation



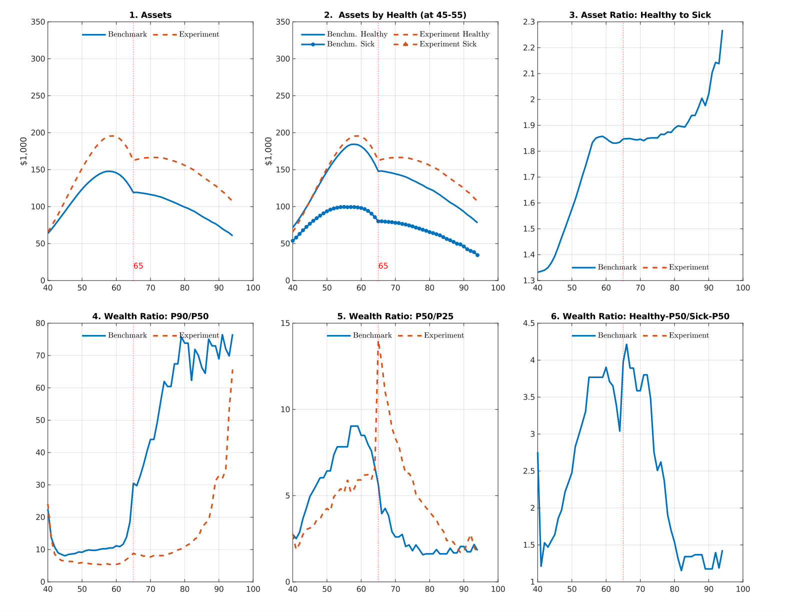
Exp. 8 (no bad health 45–55): Asset profiles



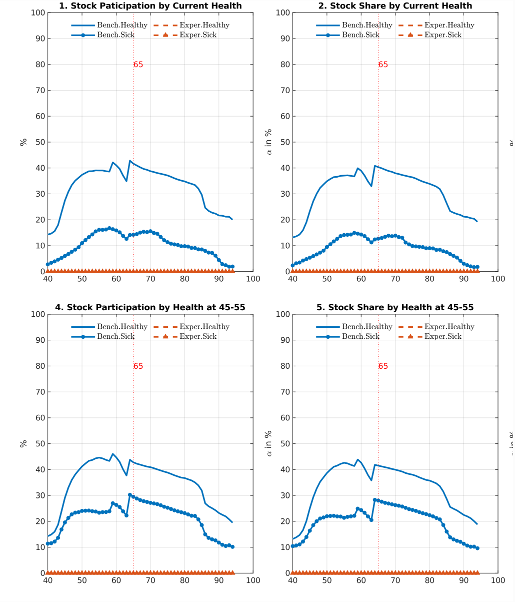
Exp. 7 (no bad health–death): RA participation



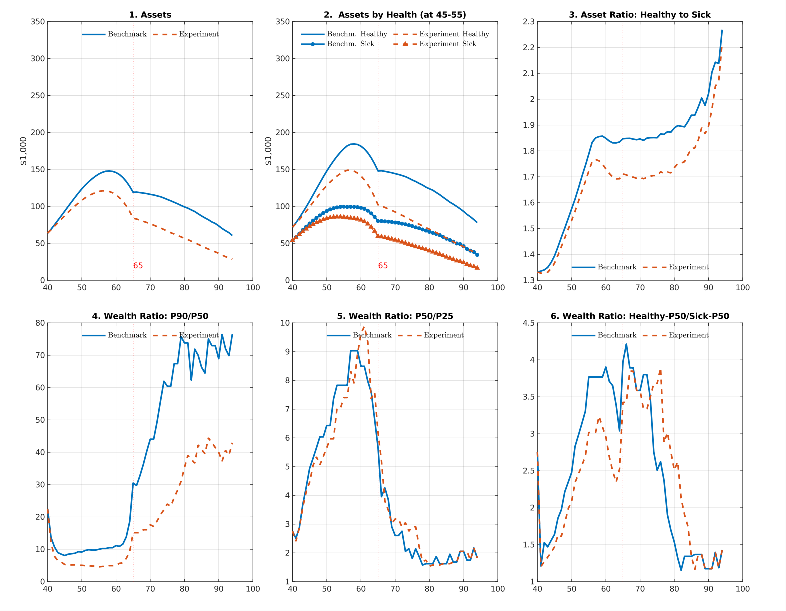
Exp. 7 (no bad health–death): Asset profiles



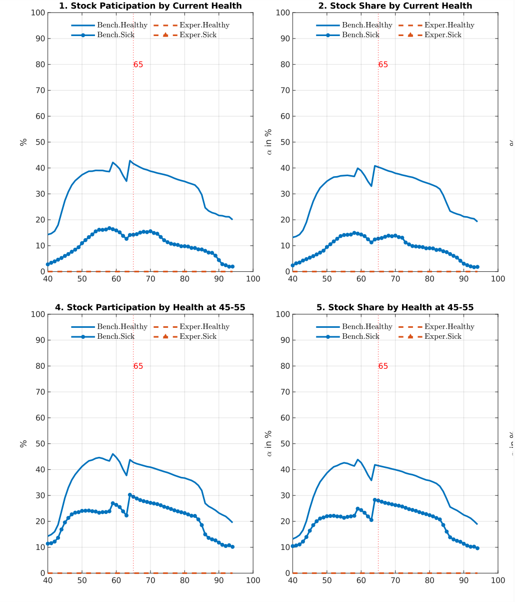
Exp. 1 (No RA): RA participation



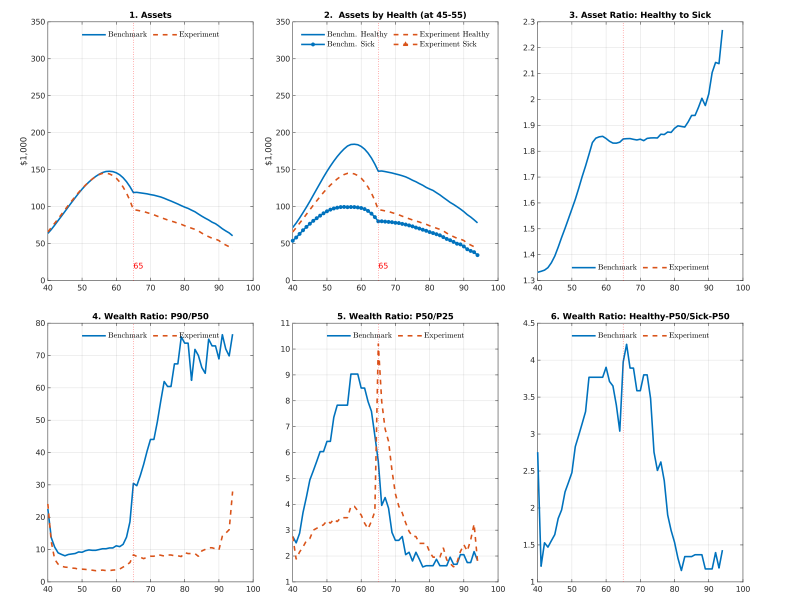
Exp. 1 (No RA): Asset profiles



Exp. 9 (no bad health + no RA): RA participation



Exp. 9 (no bad health + no RA): Asset profiles



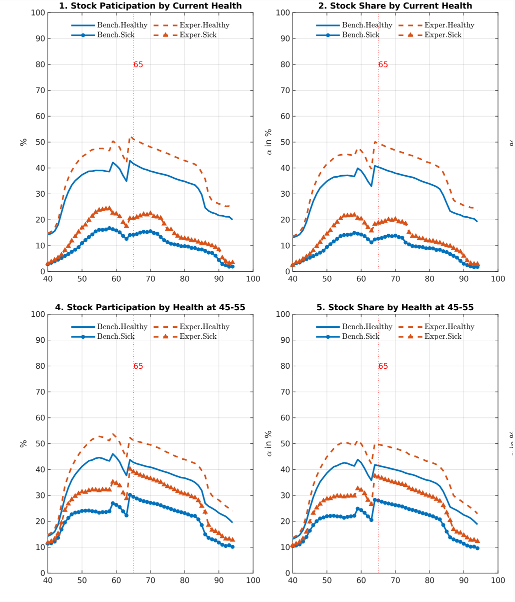
Decomposition experiments done

Back to decomposition experiments table

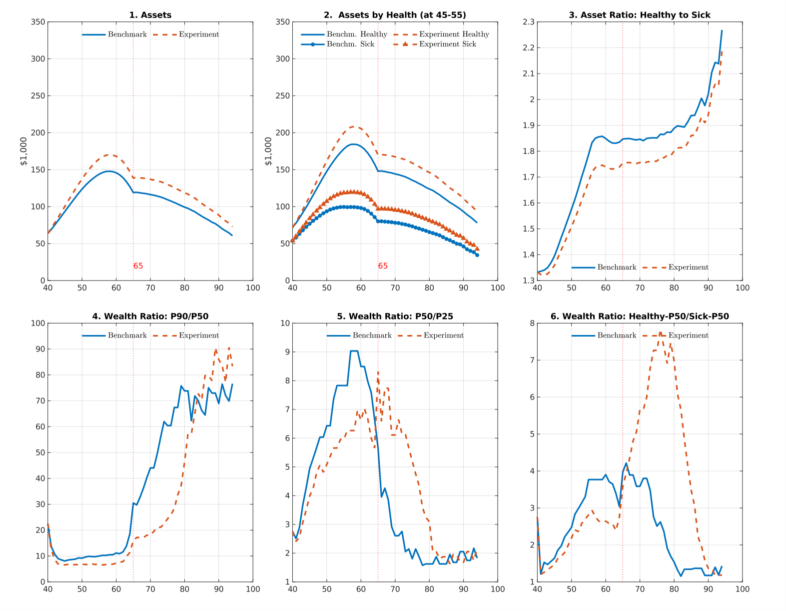
Policy experiments

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

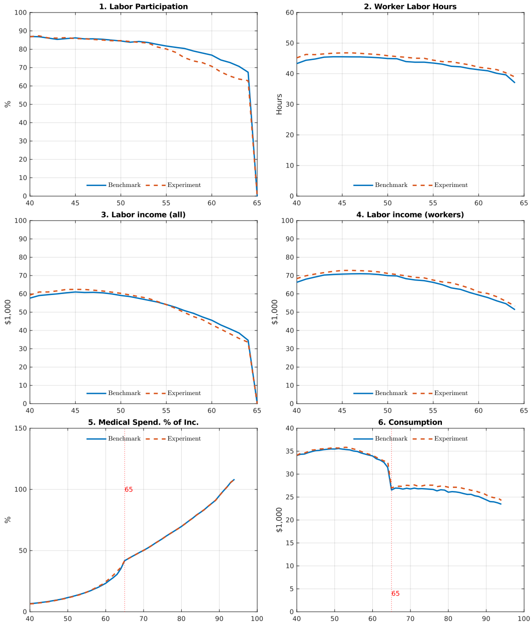
Exp. 1 (Medicare-for-all): RA participation



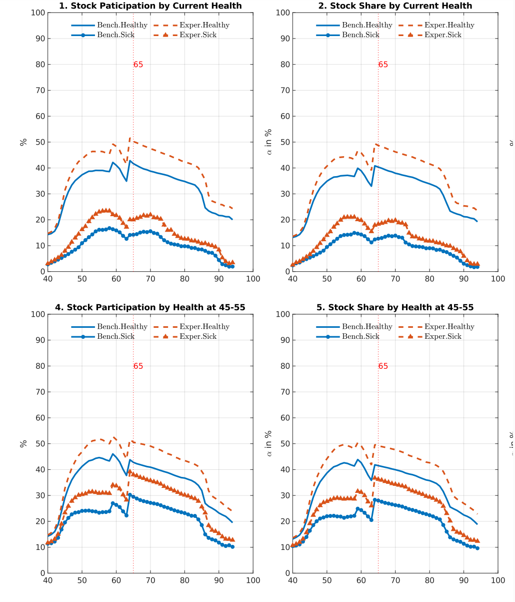
Exp. 1 (Medicare for all): Asset profiles



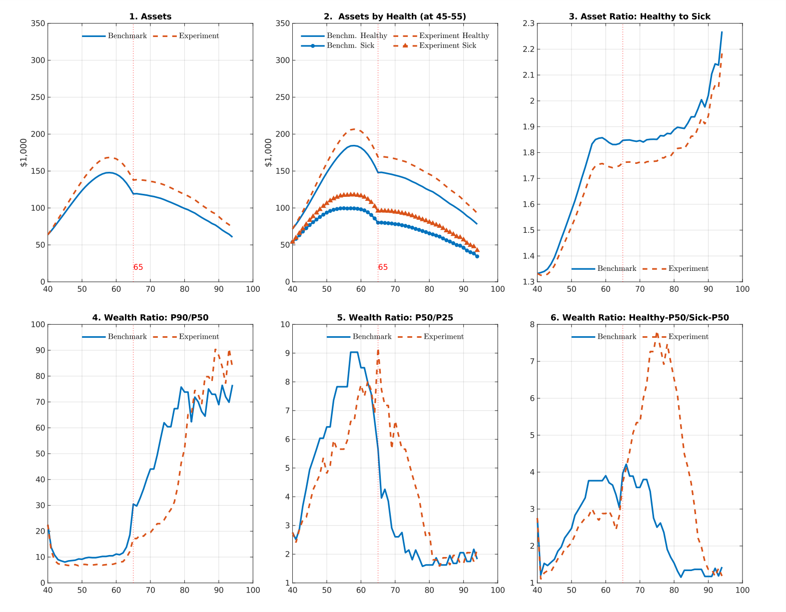
Exp. 1 (Medicare for all): Labor profiles



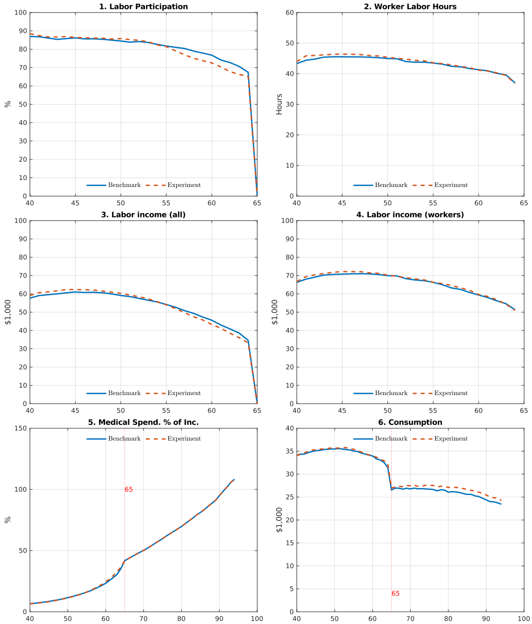
Exp. 2 (EHI all workers): RA participation profiles



Exp. 2 (EHI all workers): Asset profiles



Exp. 2 (EHI all workers): Labor profiles



HI experiments done

Back to HI policy experiments table

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