Why do the Elderly Save? The Role of Medical Expenses

Mariacristina De Nardi
Federal Reserve Bank of Chicago and NBER

Eric French
Federal Reserve Bank of Chicago

John Bailey Jones
University at Albany, SUNY

December 2009

Overview

- **What do we do?** Estimate a structural model of savings after retirement allowing for heterogeneity in:
  - medical expenses
  - life expectancy
- **What are we trying to understand?** The saving of the elderly:
  - Many elderly individuals keep lots of assets.
  - High income individuals deplete their assets more slowly than low income individuals.

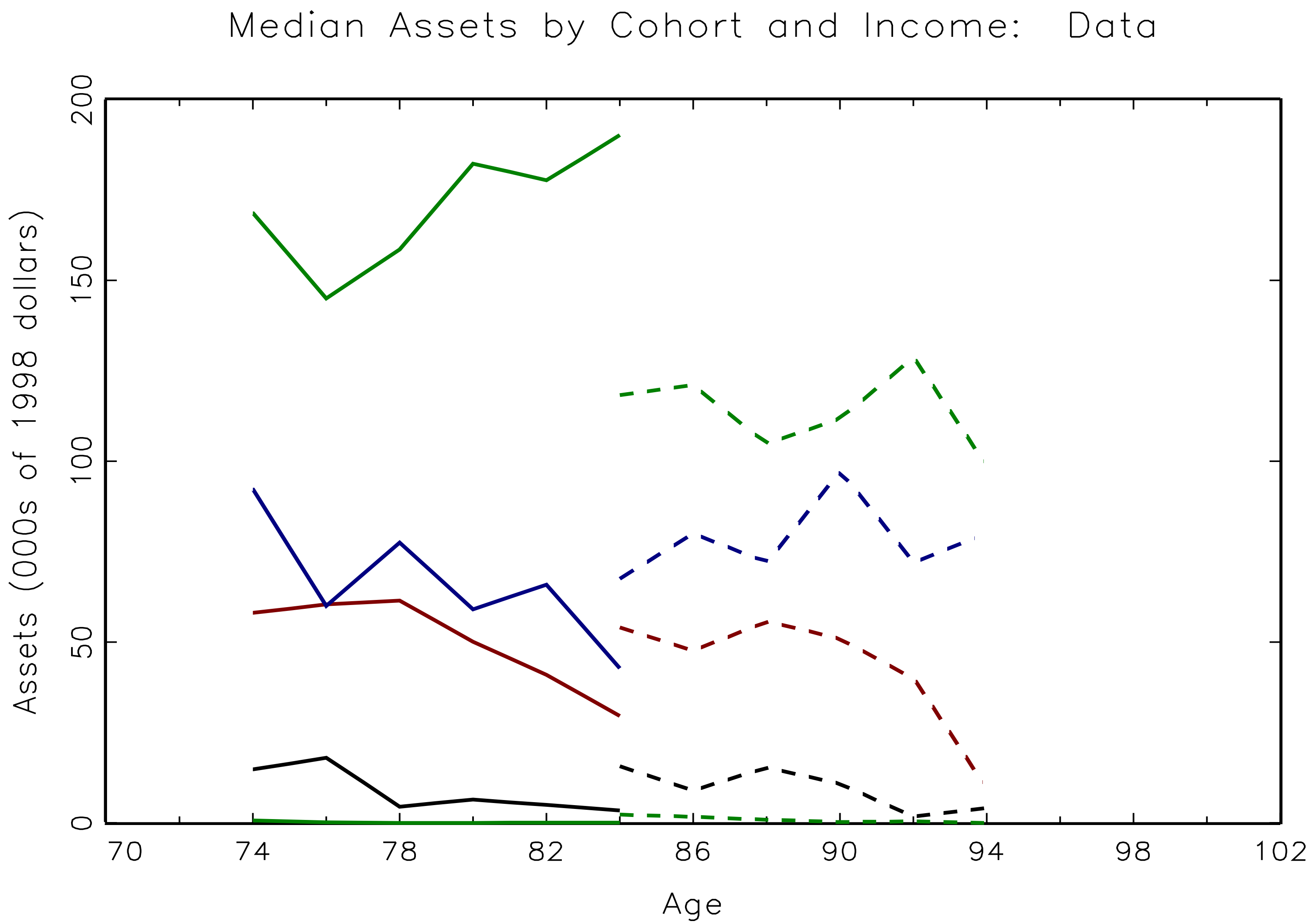


Figure 1: AHEAD data (unbalanced panel)

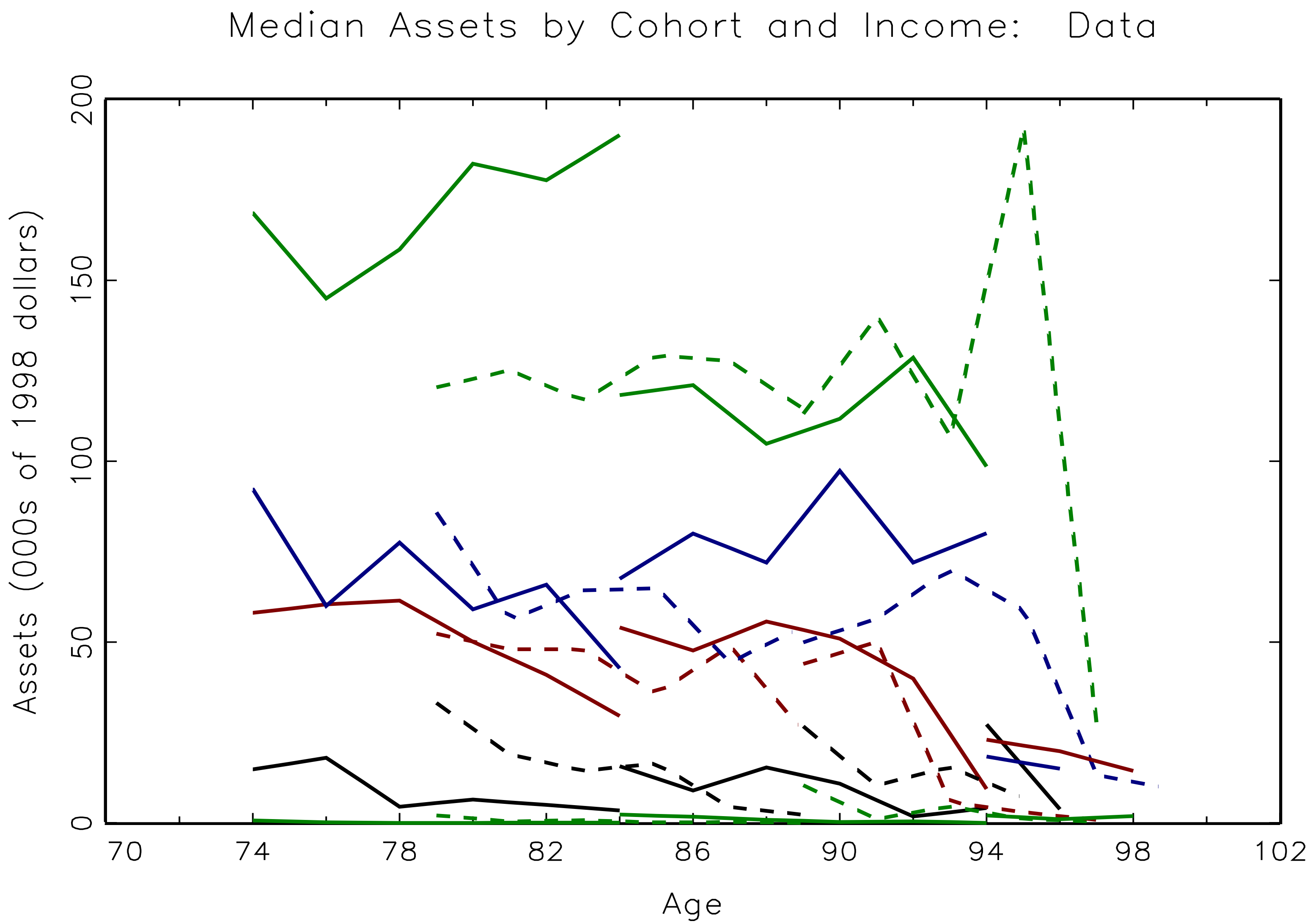


Figure 2: AHEAD data (unbalanced panel)

Why our model?

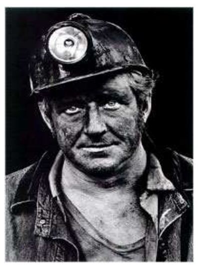
- Data show considerable heterogeneity in
  - life expectancy
  - medical expenses
- By:
  - age
  - gender
  - permanent income
  - health

Heterogeneity implications

- For saving behavior
  - Differential mortality $\Rightarrow$ heterogenous saving rates, with high PI people and women saving more.
  - Medical expenses rise quickly with age $\Rightarrow$ keep assets for old age.
  - Medical expenses rising with PI $\Rightarrow$ high PI people save at higher rate.

Heterogeneity implications: continued

- For observed sample: **mortality bias**
  - Sample composition changes: High PI people and women live longer

 $+$  $\longrightarrow$ 

  - In an unbalanced panel, this causes observed assets to **increase** with age

How we do it

- First step: estimate mortality and medical expenses as a function of age, gender, health and permanent income.
- Second step: use first step results to estimate our model with method of simulated moments.

Contributions

- Estimate medical expenses using better data and more flexible functional forms.
  - Medical expenses rise quickly with age and PI.
- Estimate mortality probabilities by age, gender, permanent income, and health.
  - Variation is large.
- Find that medical expenses and social insurance are important in understanding the elderly's savings.
- Results are robust to:
  - including a bequest motive
  - making medical expenditures endogenous

Related literature (subset)

- Hubbard et al. (1994, 1995), Palumbo (1999)
- Scholz et al. (2006)
- Hurd (1989); De Nardi (2004); Kopczuc and Lupton (2007); Dynan et al. (2002); Ameriks et al. (2009).

Model

- **Singles only,** abstract from spousal survival.
- **Households** maximize total expected lifetime utility.
- **Flow utility** from consumption (CRRA). Utility can vary with health.
- **Rational expectations.** Beliefs about mortality rates, health cost distribution, etc., are estimated from the data.
- **Bequest motive.** Functional form follows De Nardi (2004): bequests are a luxury good.

Income

$$
\begin{aligned}
y_t &= y(g, h, I, t), \\
g &= \text{gender}, \\
h &= \text{health}, \\
I &= \text{permanent income}.
\end{aligned}
$$

Uncertainty

- **Health status:** age-, gender- and permanent-income-specific Markov chain.
- **Survival:** function of gender, age, health status, and permanent income.
- **Medical expenses:**

$$
\begin{aligned}
\ln(m_t) &= m(g, h_t, I, t) + \sigma(g, h_t, I, t)\psi_t, \\
\psi_t &= \zeta_t + \xi_t, \\
\zeta_t &= \text{AR(1) shock}, \\
\xi_t &= \text{white noise shock}.
\end{aligned}
$$

Constraints

- Budget constraint:

$$a_{t+1} = a_t + y_n(ra_t + y_t, \tau) + b_t - m_t - c_t.$$

$y_n(.)$ = post-tax income; y_t = “non-interest” income;
τ = tax parameters; b_t = government transfers;
m_t = medical expenses.

- Transfers support a consumption floor:

$$b_t = \max\{0, c_{min} + m_t - [a_t + y_n(ra_t + y_t), \tau)]\}.$$

- Borrowing constraint:

$$a_{t+1} \geq 0.$$

Constraints in terms of cash-on-hand

- Budget constraint:

$$\begin{aligned} a_{t+1} &= a_t + y_n(ra_t + y_t, \tau) + b_t - m_t - c_t \\ &= x_t - c_t. \end{aligned}$$

- Transfers support a consumption floor:

$$x_t \geq c_{min}.$$

- Borrowing constraint:

$$c_t \leq x_t.$$

Recursive formulation

$$V_t(x_t, g, I, h_t, \zeta_t) = \max_{c_t, x_{t+1}} \Bigg\{ [1 + \delta h_t] \frac{c_t^{1-\nu}}{1-\nu} \\ + \ \beta s_{g,h,I,t} E_t \Big(V_{t+1}(x_{t+1}, g, I, h_{t+1}, \zeta_{t+1}) \Big) \\ + \ \beta (1 - s_{g,h,I,t}) \theta \frac{(x_t - c_t + k)^{(1-\nu)}}{1-\nu} \Bigg\}$$

$x_t =$ cash-on-hand

$g =$ gender; $\quad I =$ permanent income

$h_t =$ health status ($0 \Rightarrow$ bad, $1 \Rightarrow$ good)

$\zeta_t =$ persistent health cost shock

Constraints in Detail

$$x_{t+1} = \max\{x_t - c_t + y\big(r(x_t - c_t) + y_{t+1}, \tau\big) - m_{t+1}, c_{\min}\},$$

$$y_{t+1} = y(g, h, I, t+1),$$

$$x_t \geq c_{min},$$

$$c_t \leq x_t,$$

$$\ln(m_{t+1}) = hc(g, h_{t+1}, t+1, I) + \sigma(g, h_{t+1}, I, t+1)\psi_{t+1},$$

$$\psi_{t+1} = \zeta_{t+1} + \xi_{t+1}.$$

Method of simulated moments

- Match median assets by permanent income quintile, cohort and age.
- 101 moment conditions.
- Correct for cohort effects by using cohort-specific moments and initial conditions.
- Correct for mortality bias (rich people live longer) by allowing mortality rates to depend on permanent income and gender.

AHEAD data

- Household heads aged 70 or older in 1993/4
- Consider only the retired singles
- Follow-up interviews in 1995/6, 1998, 2000, 2002, 2004, 2006
- Asset data begins in 1996 (1994 asset data faulty), uses 2,688 individuals
- Use full, unbalanced panel

Results from first step estimation

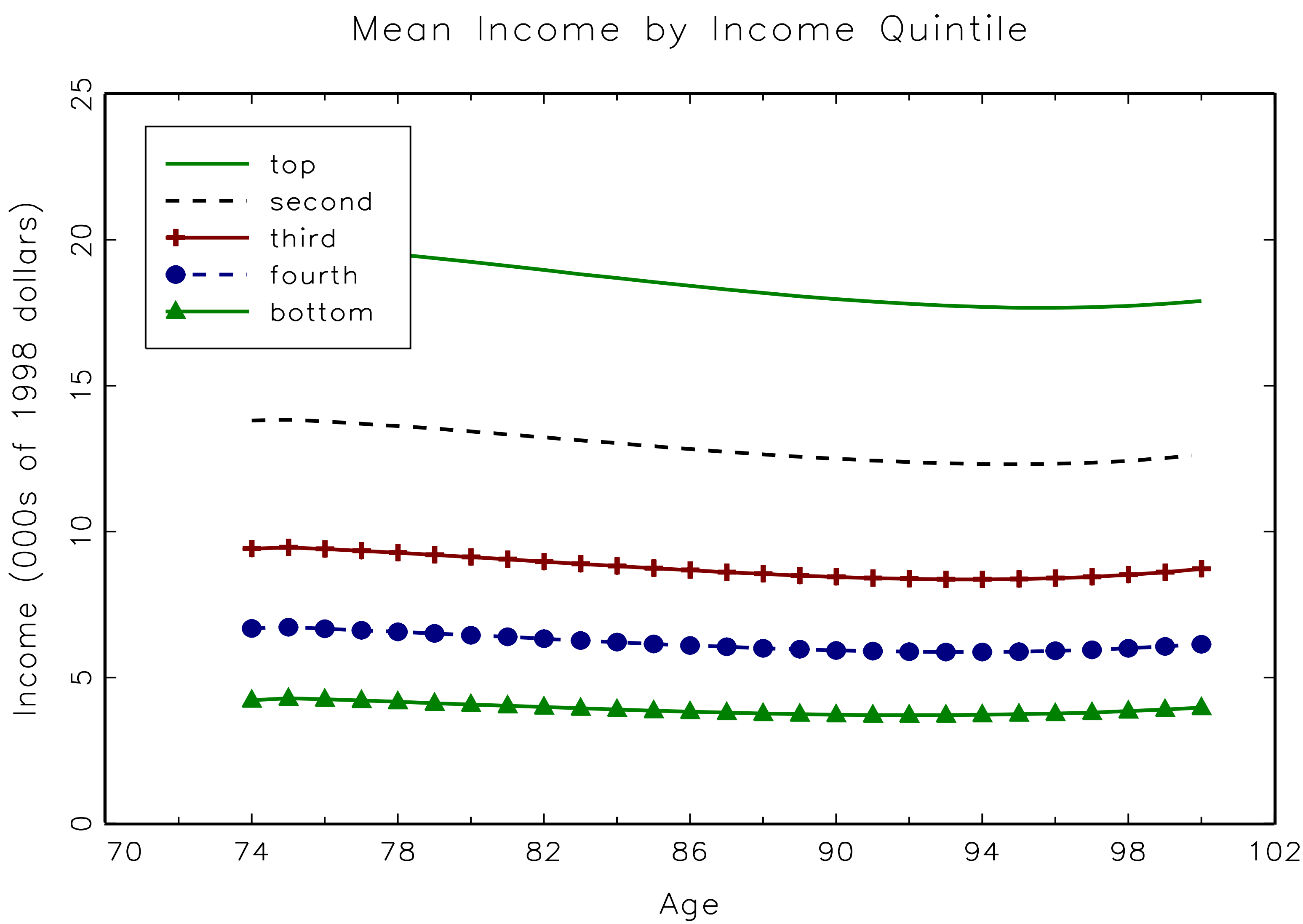


Figure 3: Average income, AHEAD data

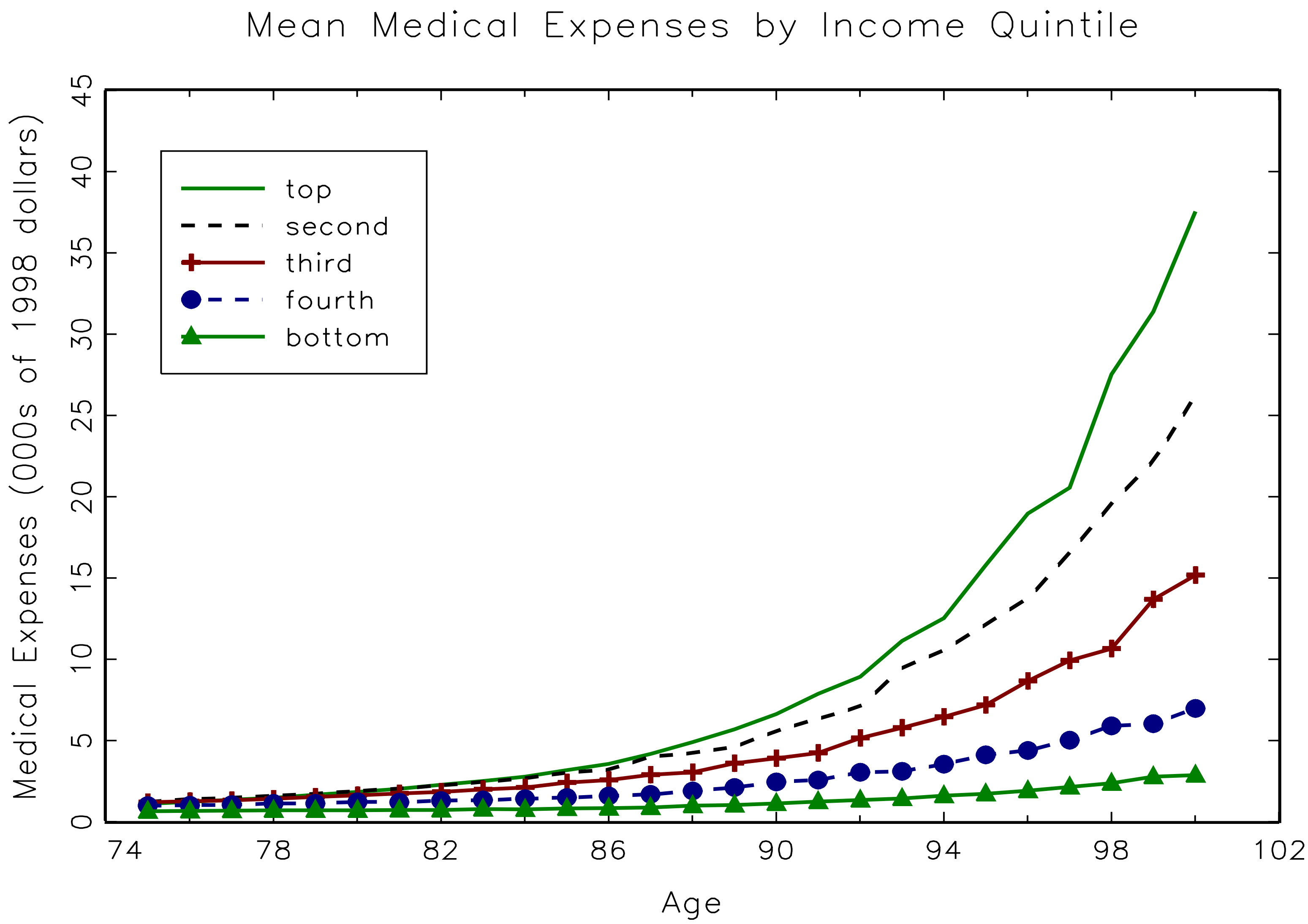


Figure 4: Average medical expenses, AHEAD data

Income Quintile	Healthy Male	Unhealthy Male	Healthy Female	Unhealthy Female	All
bottom	7.6	5.9	12.8	10.9	11.1
second	8.4	6.6	13.8	12.0	12.4
third	9.3	7.4	14.7	13.2	13.1
fourth	10.5	8.4	15.7	14.2	14.4
top	11.3	9.3	16.7	15.1	14.7
Men					9.7
Women					14.3
Healthy					14.4
Unhealthy					11.6

Table 1: Life expectancy at age 70

Results from second step estimation

Parameter	Benchmark (1)	Health (2)	Bequests (3)	All (4)
ν: coeff. relative risk aversion	3.81 (0.50)	3.75 (0.47)	3.84 (0.55)	3.66 (0.55)
β: discount factor	0.97 (0.04)	0.97 (0.05)	0.97 (0.05)	0.97 (0.04)
δ: pref. shifter, good health	0.0 NA	-0.21 (0.18)	0.0 NA	-0.36 (0.14)
c_{min}: consumption floor	2,663 (346)	2,653 (337)	2,665 (353)	2,653 (337)
θ: bequest intensity	0.0 NA	0.0 NA	2,360 (8,122)	2,419 (1,886)
k: bequest curvature (in 000s)	NA NA	NA NA	273 (446)	215 (150)
Overidentification statistic P-value	82.3 87.4%	80.6 88.5%	81.5 85.4%	77.5 90.5%

Table 2: Estimated Structural Parameters

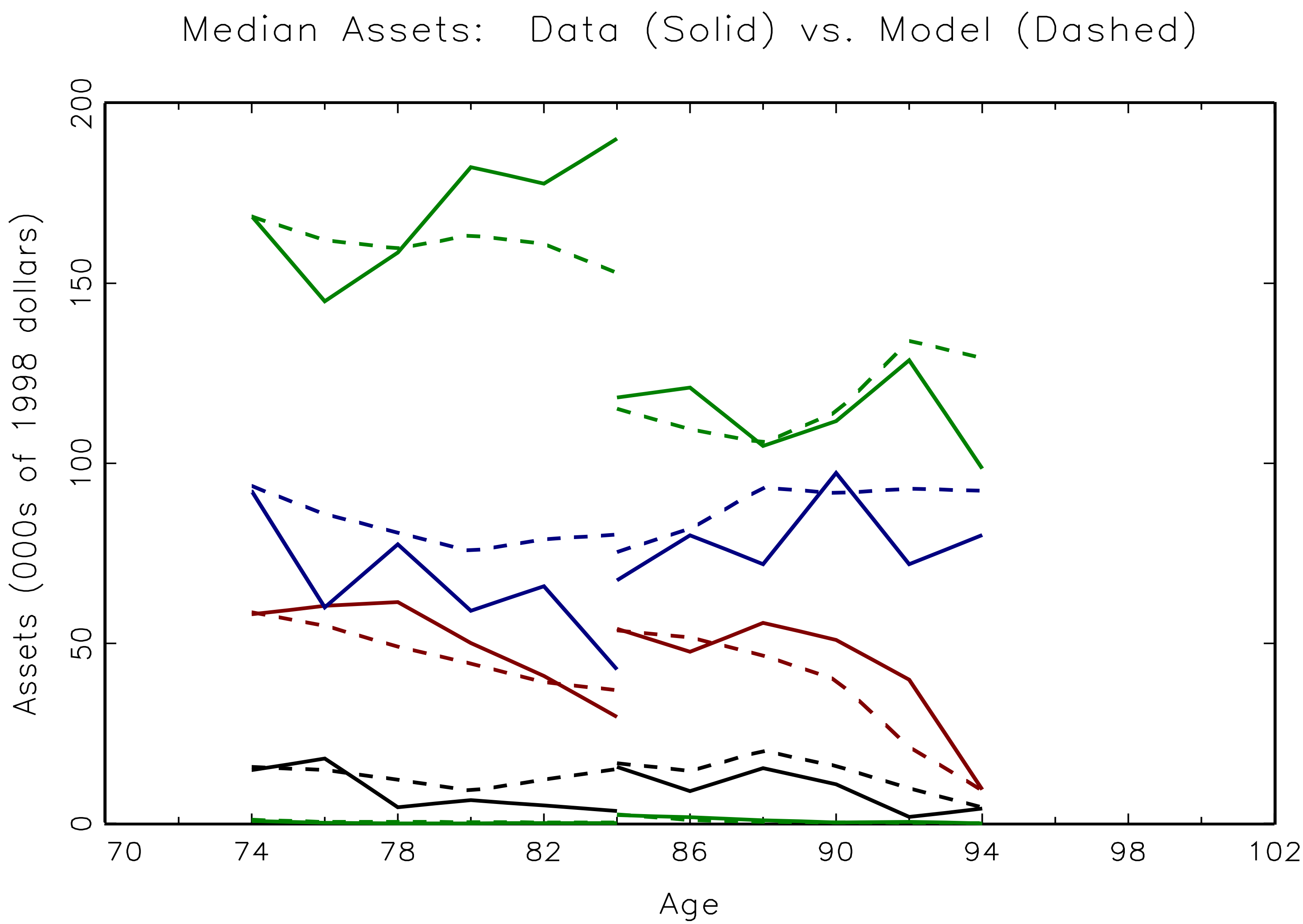


Figure 5: Median assets by cohort and PI quintile: data and benchmark model

Mortality bias

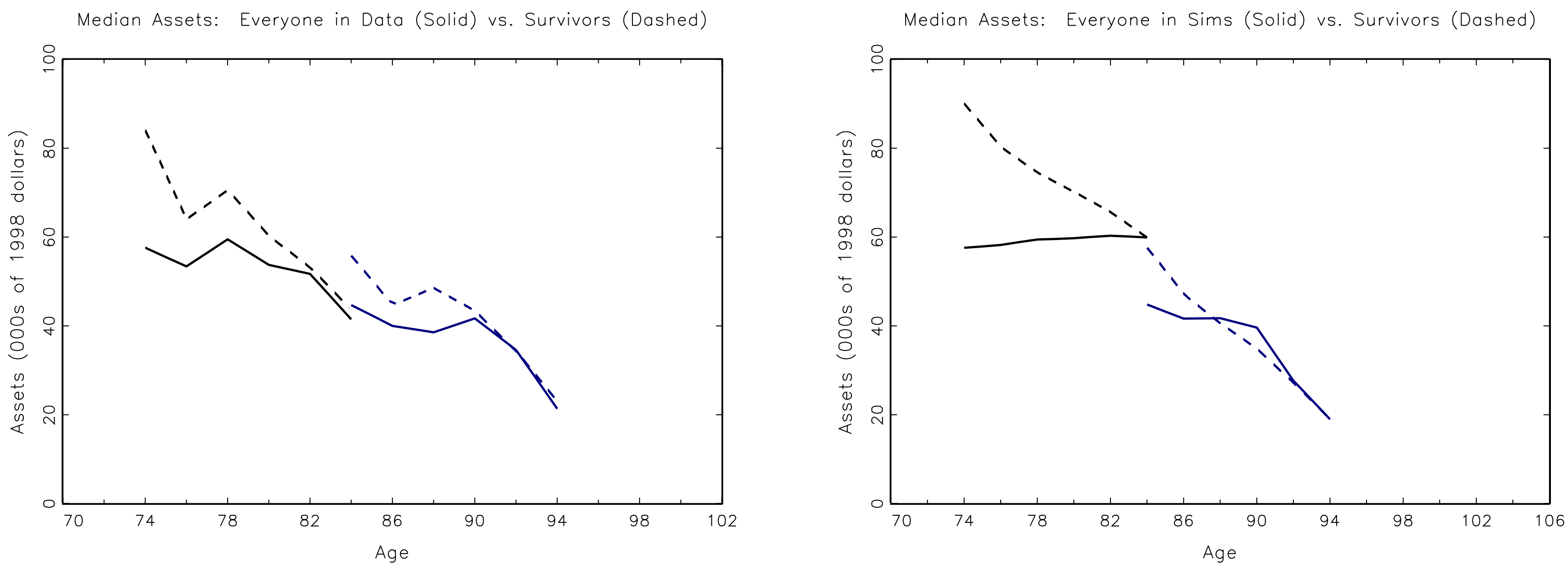


Figure 6: Left panel → AHEAD data; right panel → benchmark model

Bequests

- Bequest motives are large for the richest people, but very imprecisely estimated.
  - They do not improve the model's fit.
  - They do not not change other parameters.
- This does **not** mean bequests are unimportant:
  - The estimated bequest motive implies that the rich bequeath 88 cents of every dollar.
  - Our data set does not contain many rich people.

Distribution of bequests: data and model

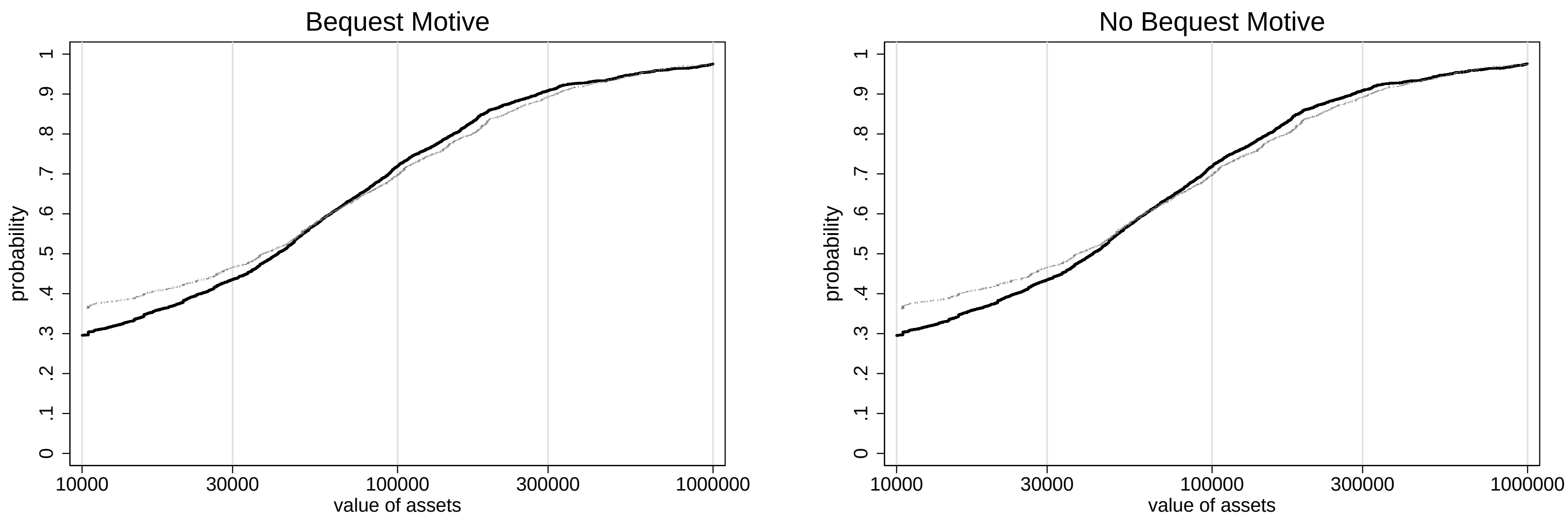


Figure 7: Cumulative distribution function of assets held 1 period before death. Left, model with bequest motives. Right: model without. Solid line: model, lighter line: data.

Experiments

- Fix preference parameters at baseline estimates, vary other parameters.
- Eliminating out-of-pocket medical expenditures has a big effect on savings.
- Eliminating medical expense risk has a small effect.
- Lowering the consumption floor by 20% has a big effect on savings, even for the rich.

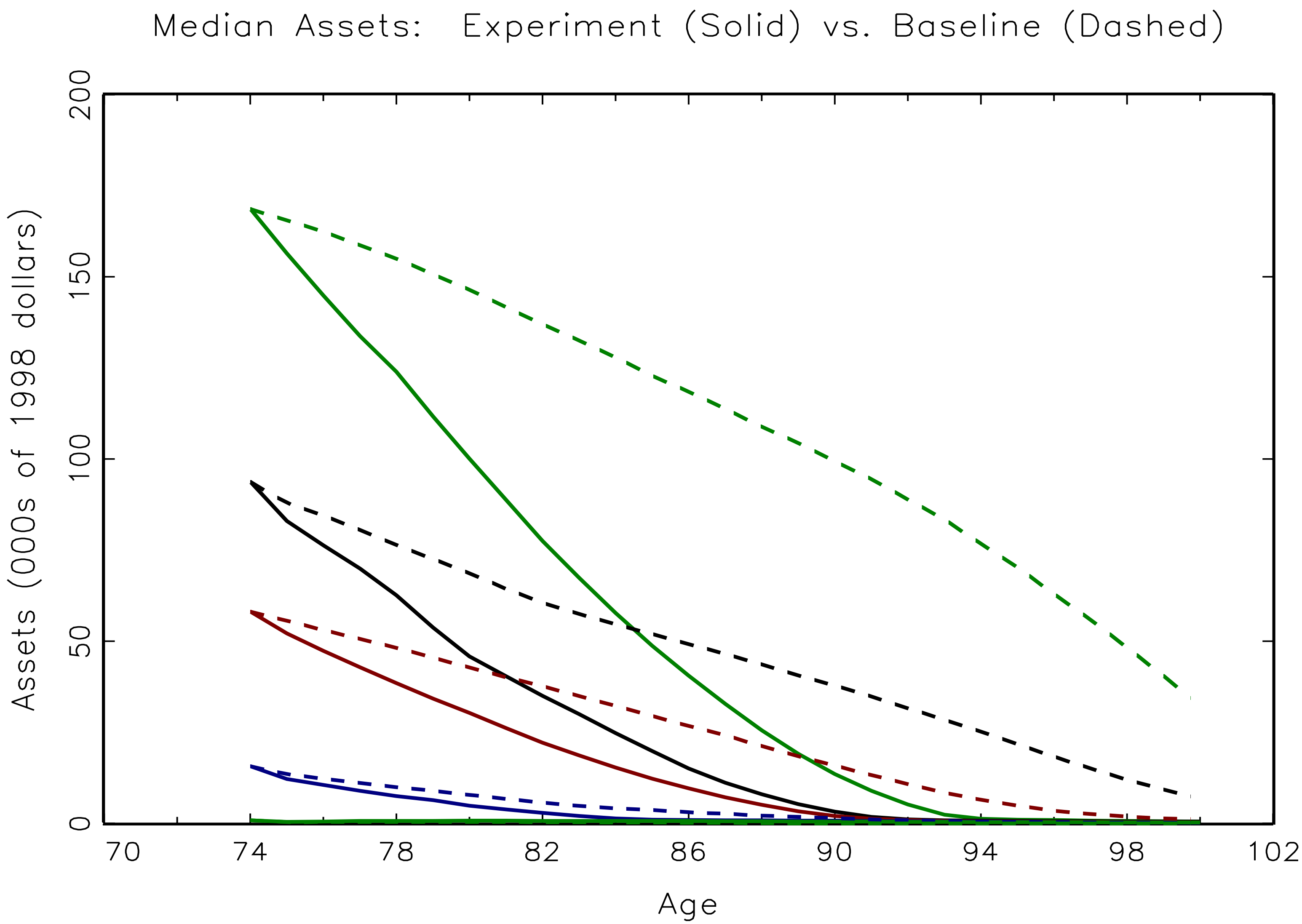


Figure 8: Benchmark and model with no medical expenditures

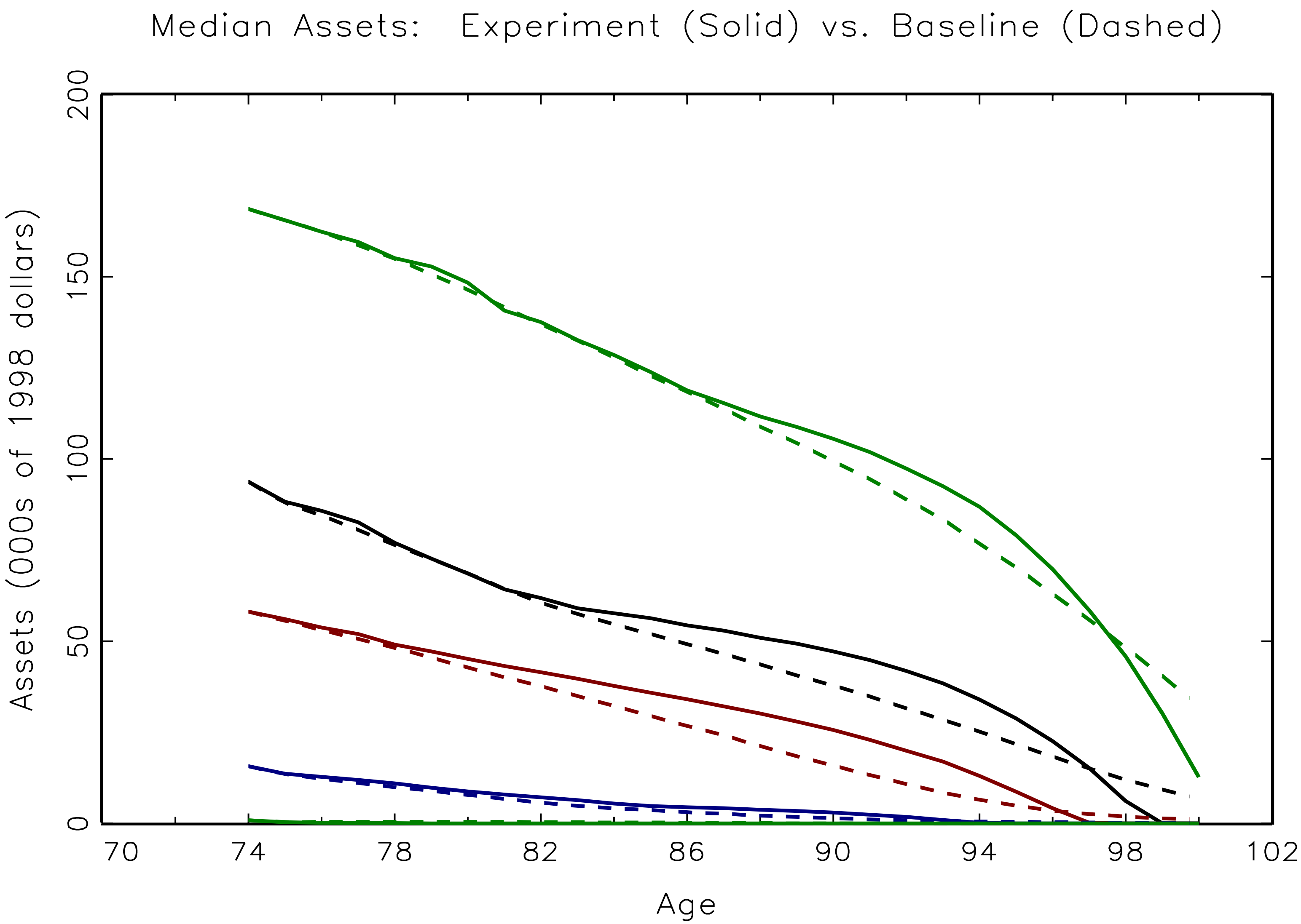


Figure 9: Benchmark and model with no medical expense risk

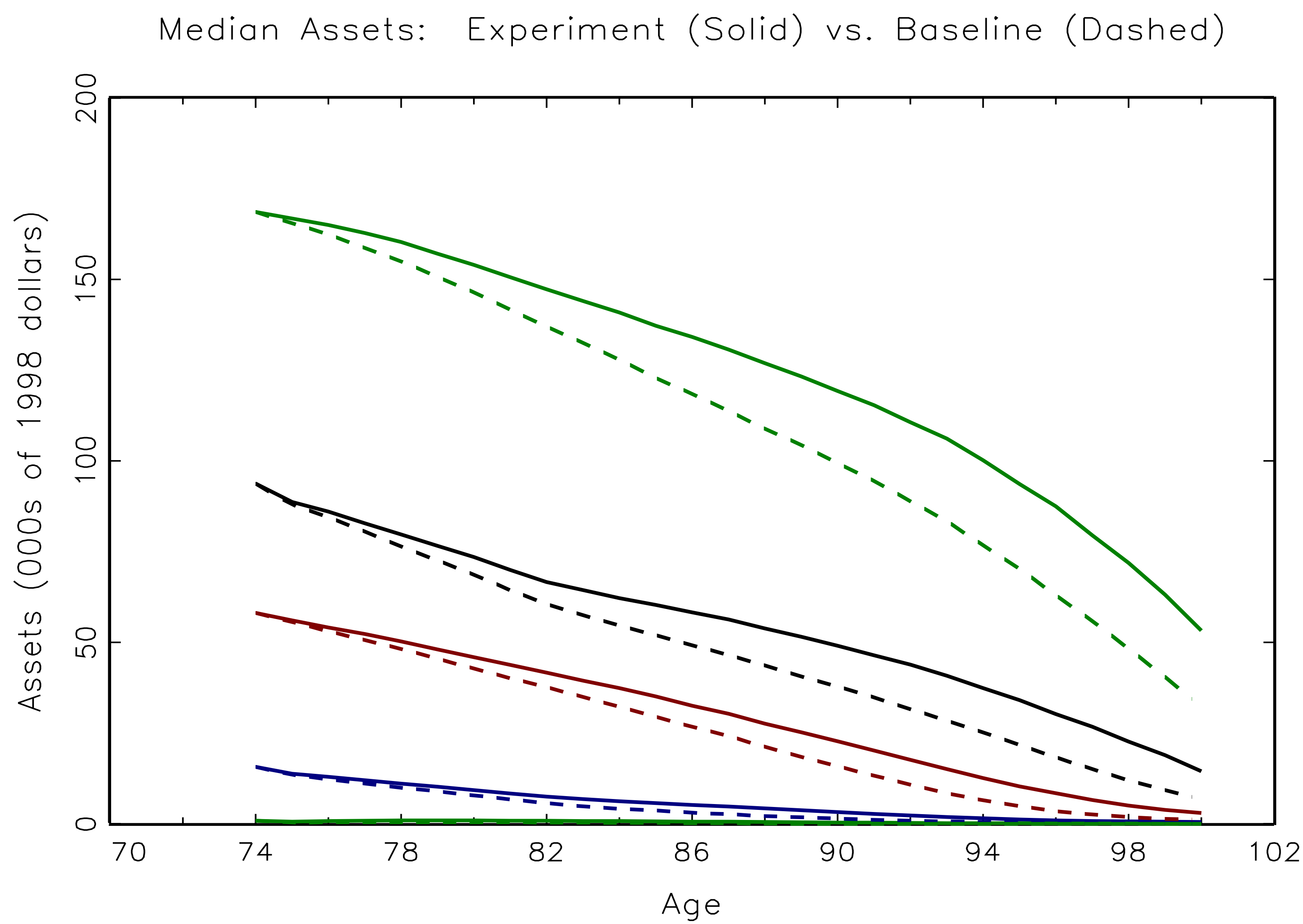


Figure 10: Benchmark and model with the consumption floor reduced by 20%

Making medical expenditures endogenous

- Retirees receive utility from medical goods.
- Medical expenses do not affect health and/or survival: RAND experiment (Brook et al., 1983); Fisher et al. (2003); Finkelstein and McKnight (2005); Khwaja (2009).

Endogenous medical expenditure model

- Flow utility:

$$u(c_t, m_t, h_t, \zeta_t, \xi_t, t) = \frac{1}{1-\nu} c_t^{1-\nu} + \mu(t, h_t, \zeta_t, \xi_t) \frac{1}{1-\omega} m_t^{1-\omega},$$

  $\mu(\cdot)$: medical "preference shifter"
  m_t : **total** medical expenditures
  $q(t, h_t) m_t$: out-of-pocket medical expenditures

- Transfers: set to guarantee a minimum level of utility, and thus depend on $\mu(\cdot)$:

$$b(t, a_t, g, h_t, I, \zeta_t, \xi_t) = \max\{0, b^*(t, a_t, g, h_t, I, \zeta_t, \xi_t)\}.$$

Expanded estimation

- In addition to matching asset profiles, we now match:
  - mean and 90^{th} percentile of medical spending, conditional on age and permanent income
  - 1^{st} and 2^{nd} autocorrelations of logged medical spending

Results for endogenous expenditure model

- Estimated parameters: $\nu = 2.15$; $\omega = 3.19$; $\beta = 0.99$.
- Model does a reasonable job of fitting the asset data.
- Model fits the medical expenditure data better than baseline model.
- **Medical spending is still important:** Eliminating out-of-pocket medical expenditures still has a big effect on savings.
- The effect of reducing the consumption floor is smaller than before, but still important at all income levels.

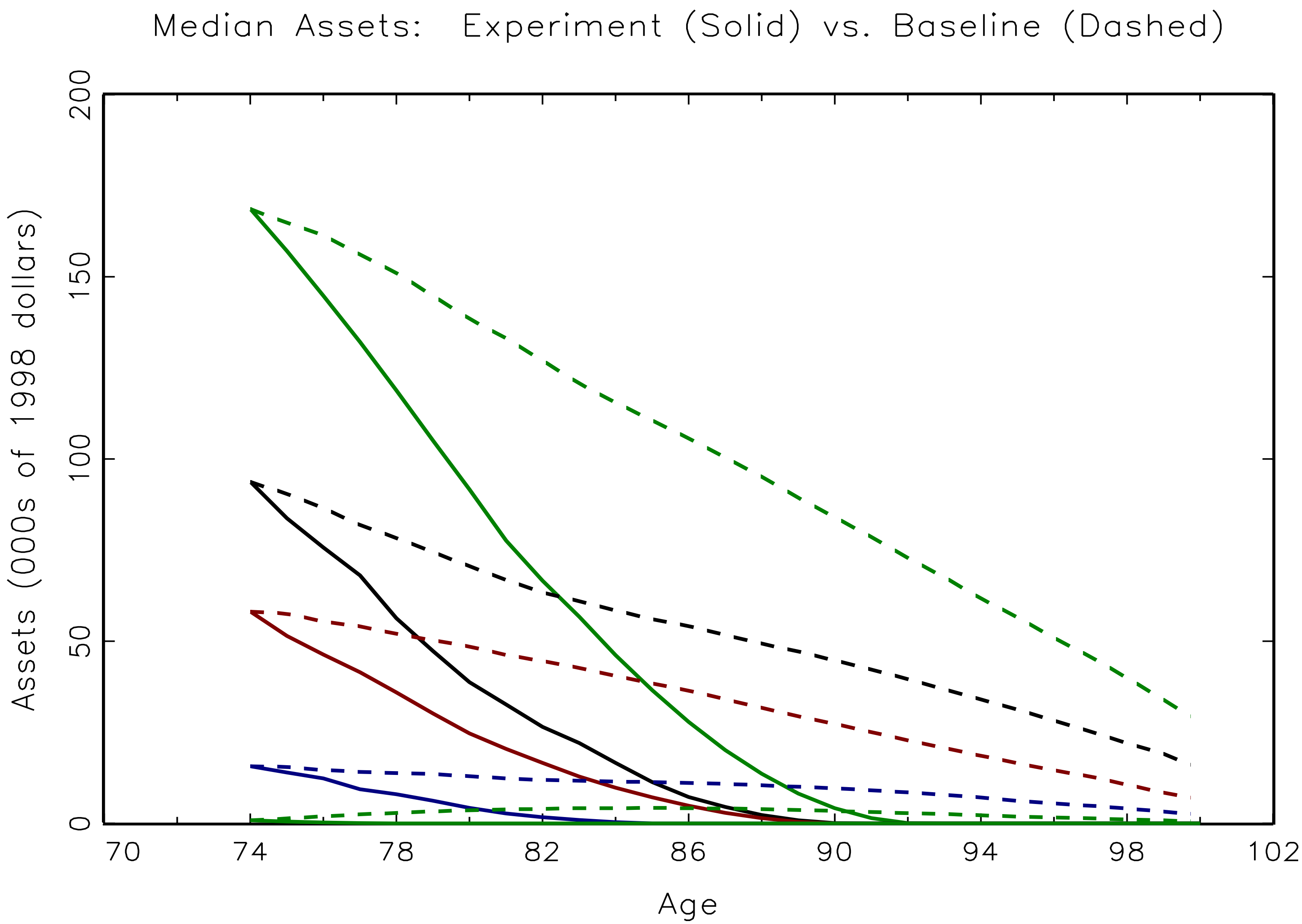


Figure 11: Benchmark and model with no medical expenditures

Effects of reducing the consumption floor

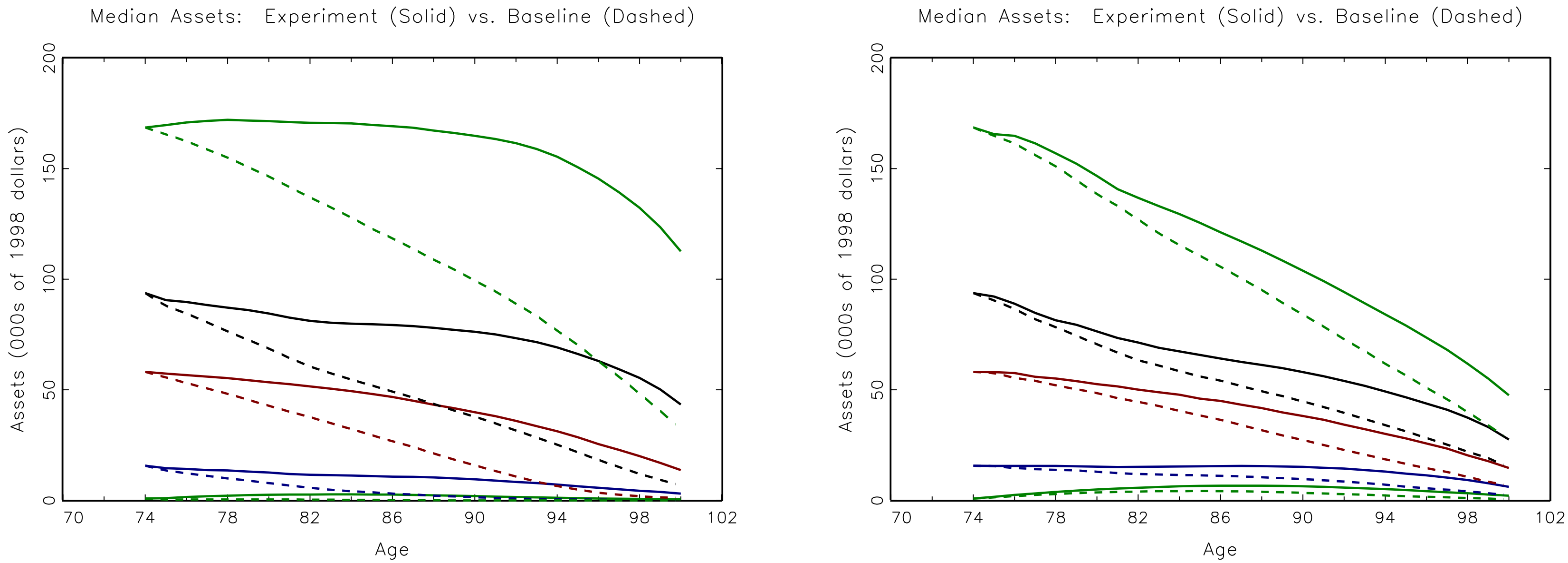


Figure 12: Median assets: baseline and model with 50% of the consumption floor for the exogenous (left panel) and endogenous (right panel) medical expense models.

Conclusions

- Model fits data well with reasonable preference parameter values.
- Key elements include:
  - heterogeneous lifespans
  - medical expenses that rise with age and PI
  - consumption floor
- Results are robust to:
  - including a bequest motive
  - making medical expenditures endogenous

Income Quintile	Healthy Male	Unhealthy Male	Healthy Female	Unhealthy Female	All
			Percentage living to age 85		
bottom	10.1	6.9	35.7	28.6	28.8
second	13.7	9.3	41.1	34.1	35.3
third	17.8	12.3	46.4	40.2	38.9
fourth	23.3	16.6	51.7	45.5	45.2
top	27.8	21.2	57.1	49.9	46.5
			Percentage living to age 95		
bottom	0.6	0.4	6.3	5.1	5.0
second	0.9	0.6	7.9	6.7	6.7
third	1.3	0.9	9.6	8.4	7.8
fourth	2.0	1.4	11.6	10.2	9.5
top	2.6	2.0	13.8	11.8	10.0

Method of simulated moments: details

- Consider household i of birth cohort c in calendar year t, belonging to the qth permanent income quintile.
- Let a_{qct} denote the model-predicted median asset level.
- Moment condition for GMM criterion function:

$$E\Big(I\{a_{it} \leq a_{qct}\} - 1/2 \mid q, c, t, \text{hh } i \text{ alive at } t\Big) = 0.$$

- Convert into an unconditional moment:

$$E\Big(\big[I\{a_{it} \leq a_{qct}\} - 1/2\big] \times I\{q_i = q\} \times I\{c_i = c\} \times I\{\text{hh } i \text{ alive at } t\} \,\Big|\, t\Big) = 0.$$

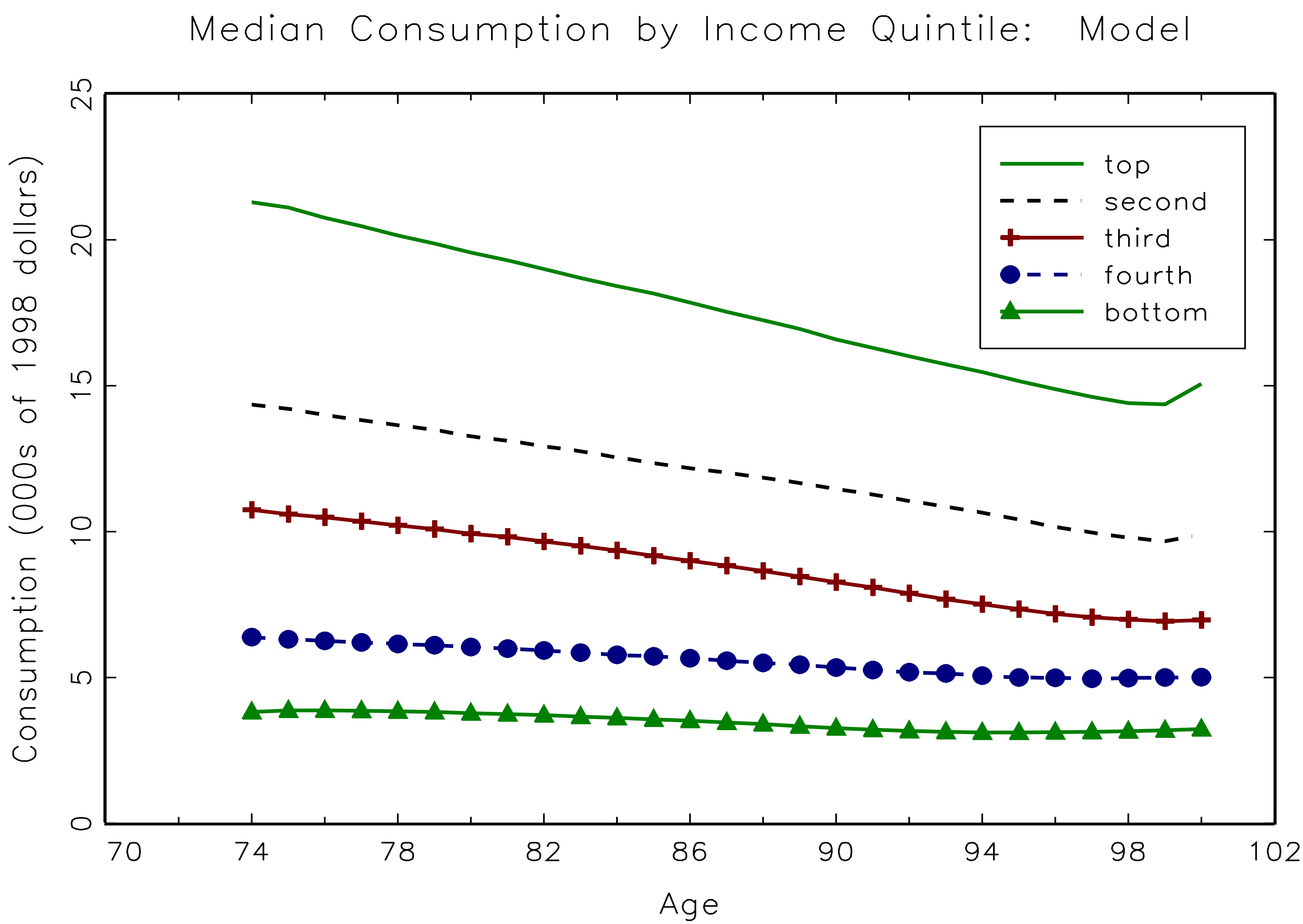


Figure 13: Median consumption by cohort and PI quintile: benchmark model

Endogenous medex: recursive formulation

$$V(t, a_t, g, h_t, I, \zeta_t, \xi_t) = \max_{c_t, m_t, a_{t+1}} \left\{ \frac{c_t^{1-\nu}}{1-\nu} + \mu(t, h_t, \zeta_t, \xi_t) \, \frac{m_t^{1-\omega}}{1-\omega} \right.$$

$$\left. + \;\; \beta s_{g,h,I,t} E_t \Big(V(t+1, a_{t+1}, g, h_{t+1}, I, \zeta_{t+1}, \xi_{t+1}) \Big) \right\},$$

subject to:

$$\begin{aligned} a_{t+1} = a_t + y_n(r a_t + y_t) + b(t, a_t, g, h_t, I, \zeta_t, \xi_t) \\ - c_t - m_t q(t, h_t), \end{aligned}$$

and other constraints.

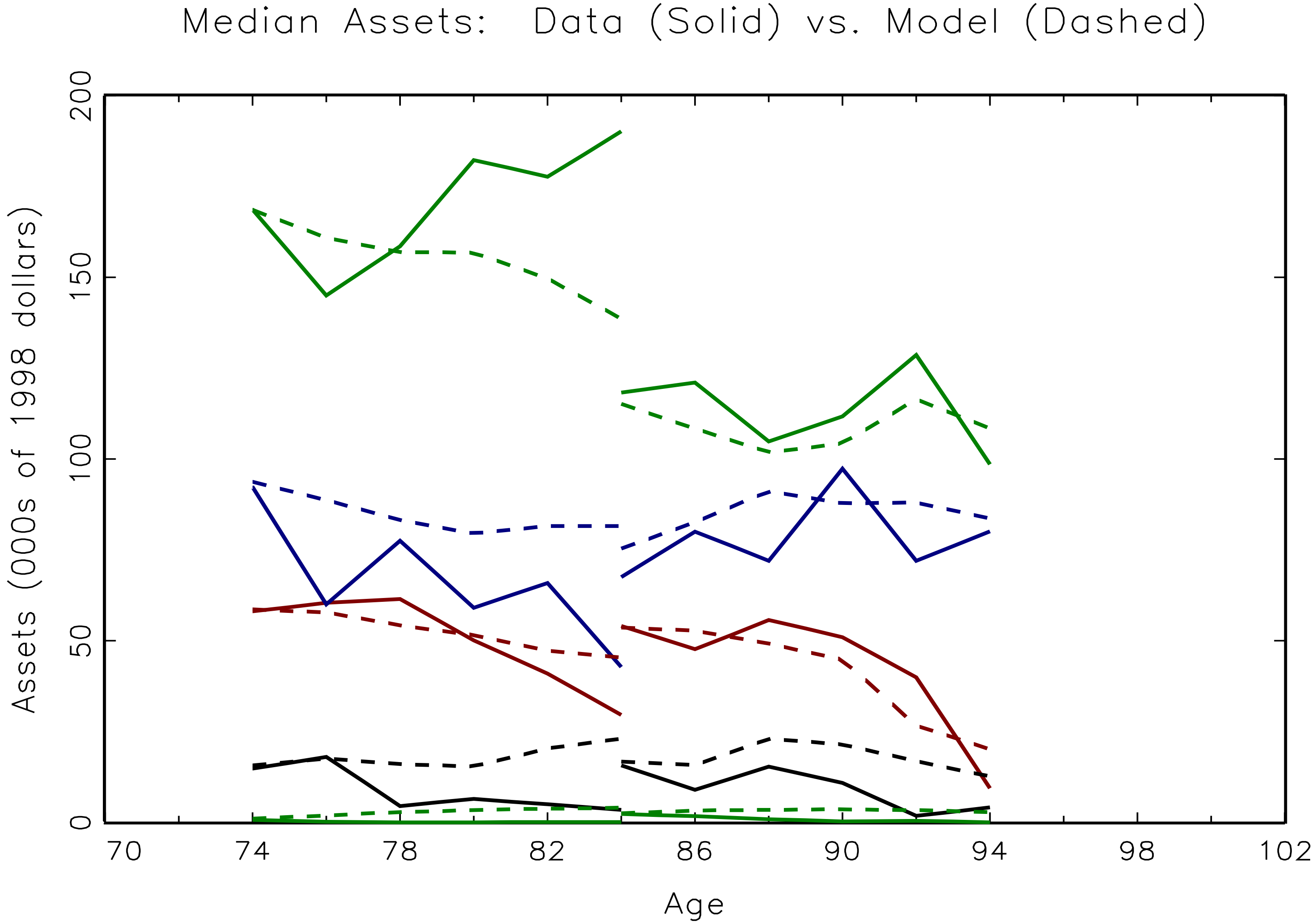


Figure 14: Median assets by cohort and PI quintile: data and model with endogenous medical expenditures