Life Cycle Responses to Health Insurance Status

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Outline

Exogenous changes in health insurance status:

- Termination of employer-provided plans at retirement.
- Medicare (prior to PPACA) provides guaranteed access to subsidized health insurance for 65+.
- Patient Protection and Affordable Care Act (PPACA, a.k.a. Obamacare).

Question asked

What are life cycle effects of exogenous changes in insurance status at given point in life:

- on allocations (consumption, leisure, health expenditures)?
- on status (wealth, health)?
- on welfare?

Health insurance over the life cycle

Should affect decisions at other periods of life:

- Health is durable good. Decisions when young have long lasting effects on future exposition to morbidity, mortality risks [Smith, 1999, *Long Reach of Childhood*].
- Backward induction: Status and consequences of insurance when old need to be internalized when young.

Timing of coverage important

- Employer-provided insurance ending at retirement:
  - Accelerate current expenses before termination.
  - Alters health levels $\rightarrow$ longevity, sickness risks.
- Post-retirement coverage (e.g. Medicare):
  - Postpone health care until coverage begins (Stockpiling).
  - Alters health levels $\rightarrow$ longevity, sickness risks.

Implications:

1. Timing of coverage affects allocations, health and wealth statuses throughout life cycle.
2. Decomposition of effects not trivial.
3. Important to understand life cycle effects of health insurance as Medicare costly, PPACA becomes operational.

Notation

Timing

- Calendar year: $y \in \mathbb{N}$, with $y = 0$, base year,
- Cohort: $\kappa \in \mathbb{N}_-$,
- Age: $t = y - \kappa \in \{0, 1, \dots, T\}$, bounded horizon.

Mortality ($k = m$) and morbidity ($k = s$) shocks generalized Bernoulli:

$$\epsilon_{t+1}^k = \begin{cases} 0 & \text{with prob. } \exp[-\lambda^k(H_t)] \\ 1 & \text{with prob. } 1 - \exp[-\lambda^k(H_t)] \end{cases} \tag{Shocks}$$

$$T^m \in [0, T] = \min\{t : \epsilon_t^m = 1\} \tag{Death}$$

- $\lambda^k(\cdot) > 0$, falling, convex in H: Endo. mortality/morbidity risks.
- Diminishing returns to health-related risks control.

Health dynamics

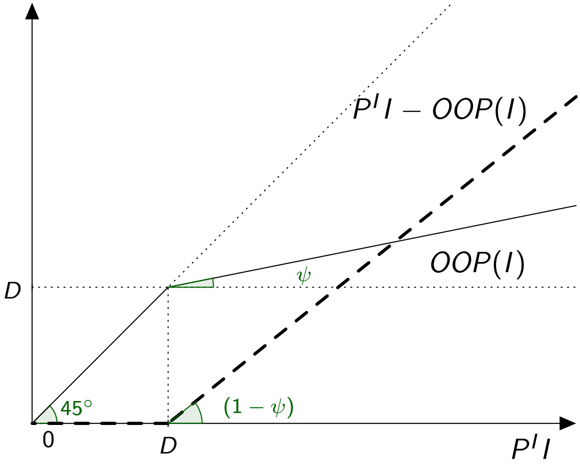
$$H_{t+1} = \left(1 - \delta_t - \phi_t \epsilon^s_{t+1}\right) H_t + A_t I^g(H_t, I_t, \ell_t) \quad \text{(Health)}$$

$$d_t = d_0 \exp[g^d t], \quad d \in \{\delta, \phi\} \quad \text{(Depreciation)}$$

$$A_t = A_0 \exp[g^A (t + \kappa)]. \quad \text{(TFP health)}$$

- $I^g(\cdot)$ increasing, concave, health-dependent.
- Account for healthy leisure (moral hazard) Leibowitz [2004], Sickles and Yazbeck [1998], Ehrlich and Becker [1972].
- Sickness $\epsilon^s_{t+1} = 1 \iff$ additional depreciation.
- Age-increasing deterministic and stochastic depreciation.
- Exogenous technological progress in A_t [e.g. Hall and Jones, 2007].

Health expenditures insurance



Health expenditures insurance

Notation:

- $\mathbb{1}_X = \mathbb{1}_{x=P,M}$ (Insured), $\mathbb{1}_M = \mathbb{1}_{x=M}$ (Medicare),
- $\mathbb{1}_D = \mathbb{1}_{P_t^I I_t \geq D_t}$ (Deductible reached),
- $\mathbb{1}_R = \mathbb{1}_{t \geq 65}$ (Retired).

$$OOP_t^x(I_t) = P_t^I I_t - \mathbb{1}_X \mathbb{1}_D (1-\psi)(P_t^I I_t - D_t) \qquad \text{(OOP)}$$

$$\Pi_t^x = \mathbb{1}_X \Pi \left[1 - \mathbb{1}_M \mathbb{1}_R (1-\pi)\right] \qquad \text{(Premia)}$$

$$P_t^I = P_0^I \exp[g^P (t+\kappa)], \qquad \text{(Prices)}$$

$$D_t = D_0 \exp[g^D (t+\kappa)] \qquad \text{(Deduct.)}$$

Cohort effects:

- TFP Health production A_t,
- Health care prices P_t^I
- Deductible D_t

Budget constraint

$$Y_t^x(\ell_t) = \mathbb{1}_R Y^R + (1 - \mathbb{1}_M \tau) w_t (1 - \ell_t) \qquad \text{(Income)}$$

$$W_{t+1} = \left[W_t + Y_t^x(\ell_t) - C_t - OOP_t^x(I_t) - \Pi_t^x\right] R^f \qquad \text{(Wealth)}$$

- Conditionally deterministic.
- Pension income Y^R (Social Security).
- Medicare tax τ, when applicable.
- Post-retirement labour income.
- Single risk-free asset.
- Age-dependent wages w_t.

Preferences

Within-period utility with bequest motive:

$$\begin{aligned}\mathcal{U}_t &\equiv U(C_t,\ell_t) + \beta\left(1-\exp[-\lambda^m(H_t)]\right) U^m(W_{t+1}) \\ &= U(C_t,\ell_t) + [\beta-\beta^m(H_t)]\, U^m(W_{t+1}) \qquad \text{(Preferences)} \\ &= \mathcal{U}_t(C_t, I_t, \ell_t, W_t, H_t) \geq 0\end{aligned}$$

where $\beta^m(H_t) \equiv \beta \exp[-\lambda^m(H_t)] < \beta$.
Properties:

- $\mathcal{U}_t > 0$ (strict preference for life),
- $U^m(W_{t+1}) < 0$ (cost of dying),
- $U^m_W \geq 0$ (joy of giving),
- $\mathcal{U}_H > 0$,
- $\mathcal{U}_{CH} > 0$ [Finkelstein et al., 2013].

Preferences

Value function $V_t = V^x(W_t, H_t, t)$:

$$\begin{aligned} V_t &= \max_{\{C_t, I_t, \ell_t\}_t^{T^m}} \mathcal{U}_t + \mathrm{E}_t \left\{ \sum_{s=t+1}^{T^m} \beta^{s-t} \, \mathcal{U}_s \mid H_t \right\}, \\ &= \max_{\{C_t, I_t, \ell_t\}_t^{T}} \mathcal{U}_t + \mathrm{E}_t \left\{ \sum_{s=t+1}^{T} \prod_{j=t}^{s-1} \beta^m(H_j) \, \mathcal{U}_s \mid H_t \right\}, \\ &= \max_{C_t, I_t, \ell_t} \mathcal{U}_t + \beta^m(H_t) \mathrm{E}_t \left\{ V_{t+1} \mid H_t \right\}, \end{aligned} \tag{Bellman}$$

Optimality

$$U_{C,t} = \overbrace{[\beta - \beta^m(H_t)]\, R^f\, U^m_{W,t+1}}^{\text{Value bequeathed wealth}} + \beta^m(H_t) \mathrm{E}_t \left\{ U_{C,t+1} \mid H_t \right\} R^f, \tag{Consumption}$$

$$U_{C,t} OOP^x_{I,t} = \beta^m(H_t) \mathrm{E}_t \left\{ V_{H,t+1} \mid H_t \right\} A_t I^g_{I,t}, \tag{Investment}$$

$$(1 - \mathbb{1}^M \tau) w_t = \frac{U_{\ell,t}}{U_{C,t}} + \underbrace{\frac{I^g_{\ell,t}}{I^g_{I,t}} OOP^x_{I,t}}_{\text{Value OOP reduction}}, \tag{Leisure}$$

Marginal value health

Solves recursion:

$$
\begin{aligned}
V_{H,t} = & \overbrace{\beta^m_{H,t}\mathrm{E}_t\left\{V_{t+1} - U^m_{t+1} \mid H_t\right\}}^{\text{Mortality control value}} + \overbrace{\beta^m(H_t)\mathrm{E}_{H,t}\left\{V_{t+1} \mid H_t\right\}}^{\text{Morbidity control value}} \\
& + \underbrace{\beta^m(H_t)\mathrm{E}_t\left\{V_{H,t+1}\left[1-\delta_t-\phi_t\epsilon^s_{t+1}+A_t I^g_{H,t}\right] \mid H_t\right\}}_{\text{Durability and productive capacity value}},
\end{aligned}
\qquad \text{(Value health)}
$$

where

$$
\begin{aligned}
\mathrm{E}_{H,t}\left\{V_{t+1} \mid H_t\right\} &= -\lambda^s_{H,t}\exp[-\lambda^s(H_t)]\mathrm{E}_t\left\{V(W_{t+1},H^+_{t+1}) - V(W_{t+1},H^-_{t+1})\right\} \\
H^+_{t+1} &\equiv (1-\delta_t)\,H_t + A_t I^g(H_t, I_t, \ell_t) \\
H^-_{t+1} &\equiv H^+_{t+1} - \phi_t H_t
\end{aligned}
\qquad (1)
$$

Functional forms

Parametrizing the model:

$$\lambda^m(H) = \lambda_0^m + \lambda_1^m H^{-\xi^m}, \qquad \text{(Death intensity)}$$

$$\lambda^s(H) = \lambda_2^s - \frac{\lambda_2^s - \lambda_0^s}{1 + \lambda_1^s H^{-\xi^s}}, \qquad \text{(Sickness intensity)}$$

$$I^g(H, I, \ell) = I^{\eta_I} \ell^{\eta_\ell} H^{1-\eta_I-\eta_\ell}, \quad \eta_I, \eta_\ell \in (0,1), \qquad \text{(Gross investment)}$$

$$U(C, \ell) = \left[\mu_C C^{1-\gamma} + \mu_\ell \ell^{1-\gamma}\right]^{\frac{1}{1-\gamma}}, \quad \mu_C, \mu_\ell \in (0,1), \qquad \text{(Utility)}$$

$$U^m(W) = \mu_m \left(\frac{W^{1-\gamma}}{1-\gamma}\right). \qquad \text{(Bequest function)}$$

Insurance plans

Exogenous insurance plans $x = (x_y, x_o) \in \mathbb{X} = \{\text{PM, PN, NM, NN}\}$.
Diffs-in-diffs approach to identify marginal effects insurance status:

Table: Insurance plans, net effects and restrictions

	Status: old		
Status: young	Insured	Uninsured	Net effects
Insured	**PM**	PN	Insured old
Uninsured	NM	NN	
Net effects	Insured young		

Empirical strategy

No analytical solutions

- Kinks in OOP function.
- Time-varying wages, productivity, prices deductibles, deterministic and stochastic depreciaiton
- **Endogenous discounting**

$\rightarrow$ Need numerical methods

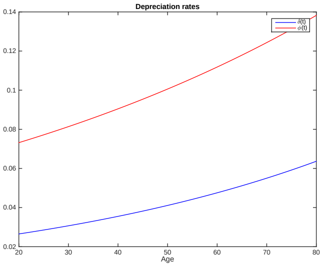
Conditional upon parametrization, parameter $\Theta = (\Theta^c, \Theta^e)$, three phases:

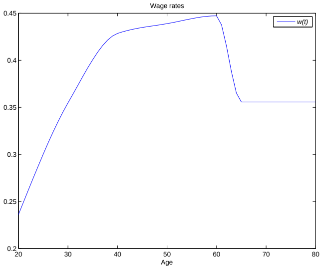
1. Iteration: Solve by backward induction on value function.
2. Simulation: Life cycle trajectories along optimal path.
3. Estimation: Iterate on parameter set $\Theta^e \subseteq \Theta$.

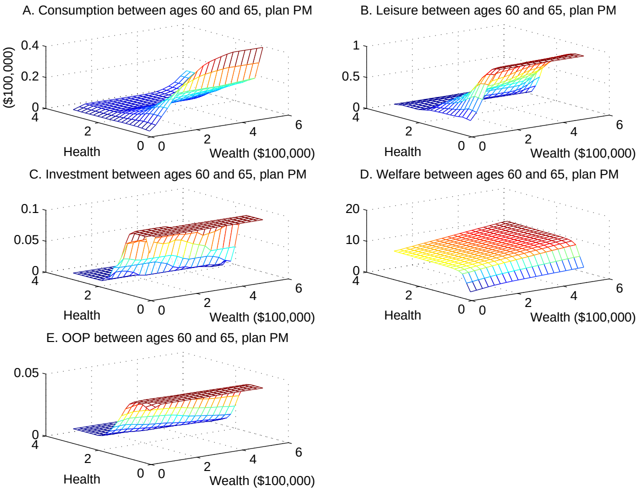
Table: Data sources

Variables	Data (2010, 2011), and explanations
W	Survey of Consumer Finances (SCF), Federal Reserve Bank. Financial assets held.
H	National Health Interview Survey (NHIS), Center for Disease Control. Self-reported health status (phstat) where Poor=0.10, Fair=0.825, Good=1.55, Very good=2.275, Excellent=3.0.
S	National Vital Statistics System (NVSS), Center for Disease Control. Survival rates
I	Medical Expenditures Survey (MEPS), Agency for Health Research and Quality. Total health services mean expenses per person with expense and distribution of expenses by source of payment.
OOP	Medical Expenditures Survey (MEPS), Agency for Health Research and Quality. Out-of-pocket health services mean expenses per person with expense and distribution of expenses by source of payment.
ℓ	American Time Use Survey (ATUS), Bureau of Labor Statistics. Share of usual hours not worked per week, 1-uhrsworkt/40
C	Consumer Expenditures Survey (CEX), Bureau of Labor Statistics. Non-durables consumption, net of health expenditures and vehicle purchases = 4*(totex4pq - healthpq - vehicle)

λ_0^m	λ_1^m		ξ^m
0.0061 (0.0021)	0.0073 (0.0026)		2.5
λ_0^s	λ_1^s	λ_2^s	ξ^s
0.3376 (0.1621)	3.6041 (1.1022)	50.0	4.9
δ_0	g^δ	ϕ_0	g^ϕ
0.0198 (0.0066)	0.0146 (0.0054)	0.0592 (0.0266)	0.0106 (0.0051)
A_0	g^A	η_I	η_ℓ
1.5	0.004	0.20	0.40
μ_C	μ_M	β	γ
0.33	0.02	0.9656	3.8769 (1.8005)


Depreciation rates
δ(t)
φ(t)
0.14
0.12
0.1
0.08
0.06
0.04
0.02
20
30
40
50
60
70
80
Age


Wage rates
w(t)
0.45
0.4
0.35
0.3
0.25
0.2
20
30
40
50
60
70
80
Age


A. Consumption between ages 60 and 65, plan PM
($100,000)
0.4
0.2
0
4
2
Health
0
0
2
4
6
Wealth ($100,000)
B. Leisure between ages 60 and 65, plan PM
1
0.5
0
4
2
Health
0
0
2
4
6
Wealth ($100,000)
C. Investment between ages 60 and 65, plan PM
0.1
0.05
0
4
2
Health
0
0
2
4
6
Wealth ($100,000)
D. Welfare between ages 60 and 65, plan PM
20
10
0
4
2
Health
0
0
2
4
6
Wealth ($100,000)
E. OOP between ages 60 and 65, plan PM
0.05
0
4
2
Health
0
0
2
4
6
Wealth ($100,000)

Population statistics

Table: Data and simulated unconditional moments (age 20–80)

Series	Data	Simulated PM	Simulated PN	Simulated NN	Simulated NM
Out-of-pocket, OOP^*	0.0162	0.0138	0.0156	0.0218	0.0199
Leisure, ℓ	0.3774	0.3784	0.3808	0.3877	0.3852
Wealth, W^*	2.2112	2.2933	2.2465	1.9364	1.9754
Health, H	2.0863	2.0184	2.0184	2.0126	2.0142
Survival, $S^\dagger$	77.9	78.17	78.15	77.42	77.76
Welfare, V	NaN	6.5767	6.5267	6.2101	6.3785

Notes: *: in 100,000$, †: in years.

Figure: Health and leisure

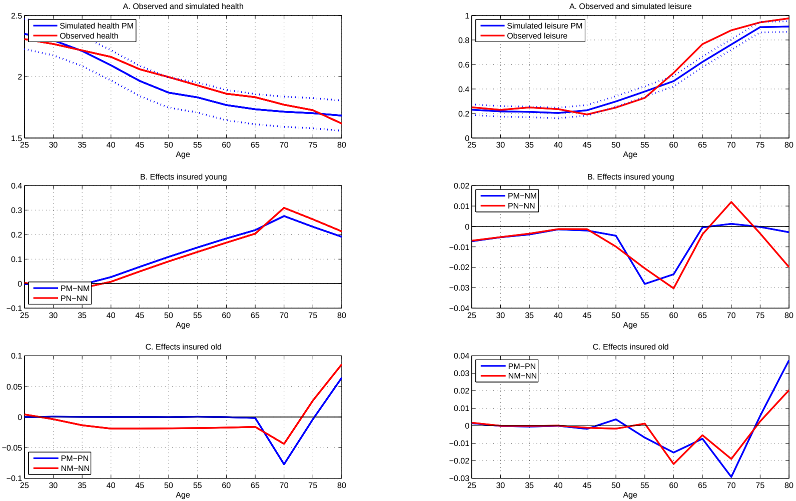


Figure: Investment and OOP's

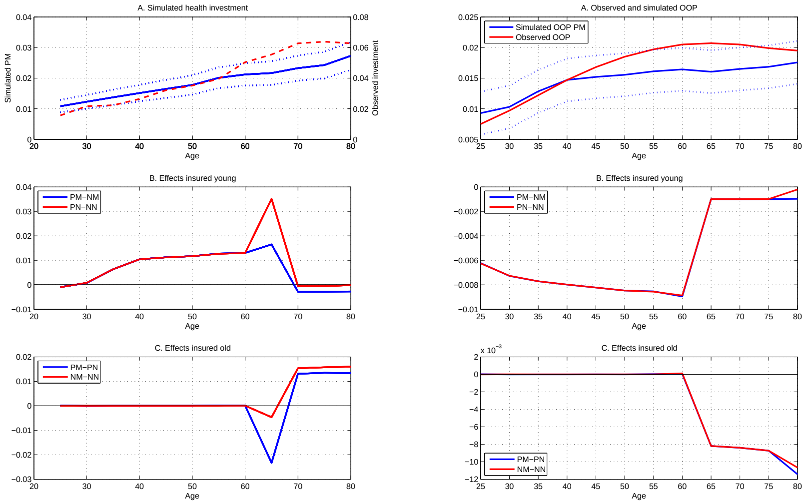


Figure: Wealth and welfare

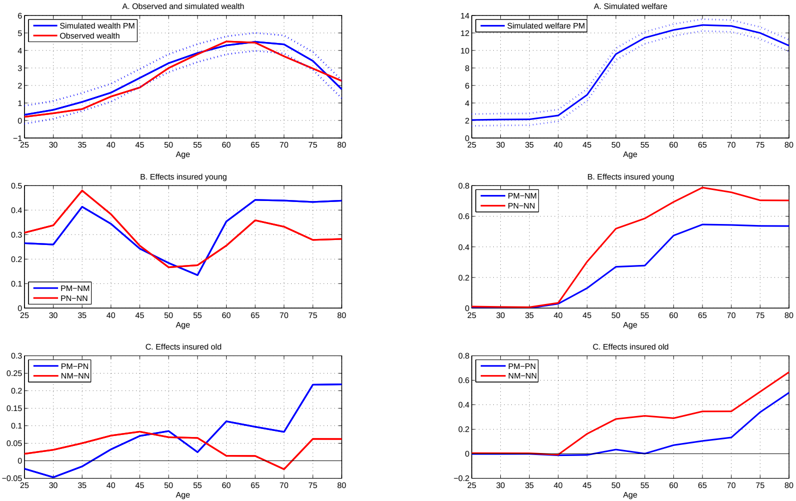
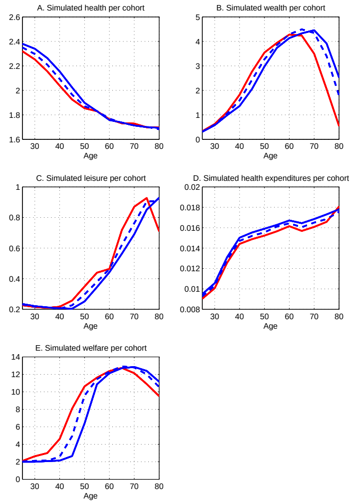
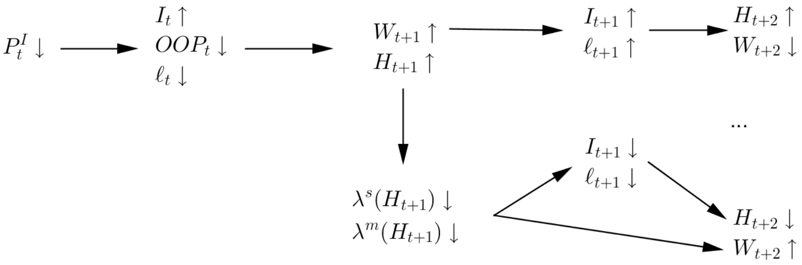


Figure: Cohort effects



Conclusion

Complex dynamic effects of health insurance when morbidity/mortality risks exposition is endogenous:



Conclusion

Can keep track with (relatively) parsimonious framework

- Health as human capital.
- Leisure and investment as inputs.
- Endogenous exposition to mortality/morbidity risks.

Very good empirical properties: Health, wealth, OOP's, leisure, longevity.

- Population statistics.
- Life cycle statistics.

Conclusion

Marginal effect of insurance status:

- When young, conditional upon old status.
- When old, conditional upon young status.

Main findings:

- Substitution:
  - Static (leisure vs investment).
  - Dynamic (stockpiling, leisure over life cycle, . . .)
- Adjustment risk exposition (through precautionary health, wealth balances).