"Life Cycle Responses to Health Insurance"

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1. Overview
1.1. Key questions

- **Fact**: Health insurance status of individuals can change **exogenously** over life cycle.
  For instance,
  - 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): Extends Medicare provisions for younger agents.

- **Objectives**:
  1. Analyze the impact of exogenous and predictable change in health insurance for life cycle allocations (consumption, leisure, health expenditures), statuses (wealth, health) and welfare and determine the optimal rules.
  2. What are policy implications for public health insurance (Medicare, PPACA)?

1.2. Framework

Theoretical contribution: Augmented Grossman model [Grossman, 1972] with

- Endogenous health expenditures and leisure;
- Endogenous morbidity and mortality risks [Hugonnier, Pelgrin and St-Amour, 2013];
- Uncertain life horizon (with incomplete market);
- Health is a (non transferable) durable good adjusted through leisure and health expenditures;
- Health-dependent decision: health issues cannot be solved completely through health expenditures and leisure.
- Strict preference for life (with bequest motive).

Literature: Health-related risks and Life Cycle allocations

Author(s)	C, W	I	$H'(H, I)$	ℓ	Ret	$H'(H, I, \ell)$	$\lambda^m(H)$	$\lambda^s(H)$
Hubbard et al (1995)	✓							
Rust and Phelan (1997)				✓	✓			
Palumbo (1999)	✓							
French (2005)	✓			✓	✓			
Case and Deaton (2005)	✓	✓	✓					
Scholz et al (2006)	✓							
Hall and Jones (2007)	✓	✓	✓				✓	
Blau and Gilleskie (2008)		✓						
Edwards (2008)	✓							
Fonseca et al (2009)	✓	✓	✓		✓			
DeNardi et al (2009)	✓							
Yogo (2009)	✓	✓	✓					
Khwaja (2010)		✓	✓			✓		
DeNardi et al (2010)	✓	✓						
Ozcan (2011)	✓	✓	✓				✓	✓
French and Jones (2011)	✓			✓	✓			
Scholz and Seshadri (2012)	✓	✓	✓			✓	✓	
Galama et al (2012)	✓	✓	✓		✓			
Hugonnier et al (2013)	✓	✓	✓				✓	✓
Pelgrin and St-Amour (2014)	✓	✓	✓	✓		✓	✓	✓

Three points:

- Two alternative frameworks to study the effects of health-related risks on medical expenses:
    1. Stochastic health expenditures = exogenous and like an undiversifiable income shock [Hubbard et al., 1995; Palumbo, 1999; French, 2005; Scholz and Seshadri, 2013].
    2. Endogenous health expenditures as generating an implicit duration service [Blau and Gilleskie, 2008]:
        1. Health as a durable good providing health utility [Galama et al., 2013; Khwaja, 2010; Hall and Jones, 2007; Case and Deaton, 2005];
        2. Self-insurance services by allowing health to (jointly) reduce mortality and morbidity risks [Hugonnier et al., 2013; Scholz and Seshadri, 2013]
- Abstract from endogenous retirement;
- Abstract from redistribution between rich and poor but provide a separate assessment of the acturial and market completion costs and benefits to young and elders.

Summary:

- Heath dynamics

$$H' = H'(\overset{+}{H}, \overset{+}{I}, \overset{+}{\ell}, \overset{-}{\epsilon'_s}, \overset{-}{t}), \quad \Pr(\epsilon'_k = 1 \mid \overset{-}{H}), k = s, m$$

- Budget constraint:

$$W' = W'[\overset{+}{W}, \overset{-}{C}, \overset{-}{\ell}, \overset{-}{OOP}(\overset{+}{I}, \overset{-}{\mathbb{1}_X}, \overset{+}{t}), \overset{-}{\Pi}(\overset{+}{\mathbb{1}_X}), \overset{+-}{t}]$$

- Life cycle allocations:

$$V(W, H) = \max_{C,I,\ell} U(\overset{+}{C}, \overset{+}{\ell}) + \beta(\overset{+}{H})\mathrm{E}\{V(W', H') \mid \overset{+}{H}\}$$

with exogenous insurance status $(x_y, x_o) \in \{\mathrm{P}, \mathrm{N}, \mathrm{M}\}^2$

- Other ingredients: Health care productivity, prices, deductibles, exogenous, Wages, Social Security.

Key mechanisms: Through (1) The budget constraint and (2) Exposition to morbidity and mortality risks. Notably

- People are exposed to morbidity and mortality shocks: the intensity depends on health status and age. Both reduce health capital.
- Health insurance: Value depends on the variability of health expenditures and the discount rate (which is a function of the stochastic process H);
- Self-insurance: Precautionary savings and health investments:
  - Time endowments (time not working);
  - Health investments (less effective in bad health).
- Ex-ante moral hazard: Health insurance reduces the marginal benefit of leisure;
- Ex-post moral hazard: Health insurance reduces the effective price of health investments (but there is a co-payment and diminishing returns).

Our estimation methodology: Proceed with simulated method of moments...

- Optimal solution by backward iteration.
- Simulate life cycle trajectories over optimal path.
- Contrast observed, theoretical moments to construct Simulated Moments Estimator of structural parameters.

...with the exceptions that

- Endogenous stochastic processes (mortality and morbidity).
- No ad-hoc stochastic/forcing processes (only a conditional generalized Bernoulli distribution): *Full structural*.

1.3. Output

Key output/ contributions

- Marginal effects on allocations (consumption, leisure, health investment) and statuses (health, wealth, survival) of being insured when young, conditional upon elders' insurance status.
- Marginal effects on allocations and statuses of being insured when old, conditional upon young agents' insurance status.
- Study the impacts of Medicare and (to some extent) Obamacare.

2. Utility specification

Several justifications for our specification :

1. The model specification is isomorphic to a H-based utility function (Hugonnier, Pelgrin, St-Amour, 2013);

2. The within-period utility function, $\mathcal{U}$, does depend positively on H;

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

where U_m bequest u.f., U instantaneous u.f., and $\beta^m(H_t) \equiv \beta \exp[-\lambda^m(H_t)] < \beta$ endogenous discount factor.

$\Rightarrow$ Provide an explicit alternative to implicit models of health valuation $\mathcal{U} = U(C, \ell, H)$.

3. Adding H to the utility function provides an additional intrinsic value for health, which is quite difficult to match empirically:

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

where $\mathrm{E}_{H,t}(\cdot) \equiv \partial \mathrm{E}(\cdot \mid H_t) / \partial H_t$.

4. From an axiomatic point of view, not so clear how to introduce health into the utility function (see Hugonnier et al., 2013).

5. At the end...H enters through (1) the mortality and morbidity functions (λ_m and λ_s) and thus the endogenous discount factor and (2) the budget constraint.

6. From an econometric point of view, since we are estimating the optimal rules, we end up with H.

   Note that our specification is not related to a two-step estimation procedure in which we first estimate the mortality and mortality functions and then the other structural parameters (joint estimation).

3. Couch potatoes

- This is true that all of the leisure time is not necessarily health-improving!
- However, we can replace ℓ by ℓ_H (i.e., only a fraction of the leisure time is healthy-improving). In this case, it will affect the constant term A (productivity parameter) and this is a matter of calibration.
- Finally, we partially control for such an effect through the η_ℓ parameter in the health investment function:

$$I^g(H, I, \ell) = I^{\eta_I} \ell^{\eta_\ell} H^{1-\eta_I-\eta_\ell}, \quad \eta_I, \eta_\ell \in (0, 1). \tag{1}$$

Robustness checks provide support that it does not alter our results.

4. Health investment specification

- Health investment function:

$$I^g(H, I, \ell) = I^{\eta_I} \ell^{\eta_\ell} H^{1-\eta_I-\eta_\ell}, \quad \eta_I, \eta_\ell \in (0,1) \tag{2}$$

  - $I^g(\cdot) \geq 0$ prevents agents from selling their own health in markets;
  - $I^g(\cdot)$ increasing, concave, health-dependent;
  - $\ell =$ non-market inputs in health maintenance (e.g., prevention through physical activities);
  - Account for healthy leisure (moral hazard)[Leibowitz, 2004; Sickles and Yasbeck, 1998; Ehrlich and Becker, 1972].
- By introducing moral hazard, this specification is different from what has been done in the literature.

5. Estimation

5.1. Challenges

Several challenges...

- No analytical solutions!
- Kinks in OOP function.
- Time-varying wages, productivity, prices deductibles, deterministic and stochastic depreciation
- Endogenous discounting
- Data!

Simulated method of moments: Conditional upon some initial calibration, Θ^c and $\Theta^{e,(0)}$, $\Theta^{e,(k)}$ is computed using three steps:

1. Iteration: Solve by backward induction on value function.
2. Simulation: Life cycle trajectories along optimal path.
3. Compute the simulated moments and optimize on parameter set Θ^e.

Then repeat until convergence...

5.2. Data

- Use different sources (and so different statistical units)...and possibly some measurement errors...
- It would be nice to have panel data and more information regarding changes of health insurance over the life-cycle...
- Use 2010 and 2011 data to set both initial conditions and to match life-cycle profiles: Ignore some health trends? Do control for such effects through cohort analysis.
- Need to proceed with counterfactual analysis for non "PM" individuals (PP, PN, NM, and NN "individuals"): best-case scenario?

Counterfactual analysis $\simeq$ "Use" Diffs-in-diffs approach to identify marginal effects insurance status:

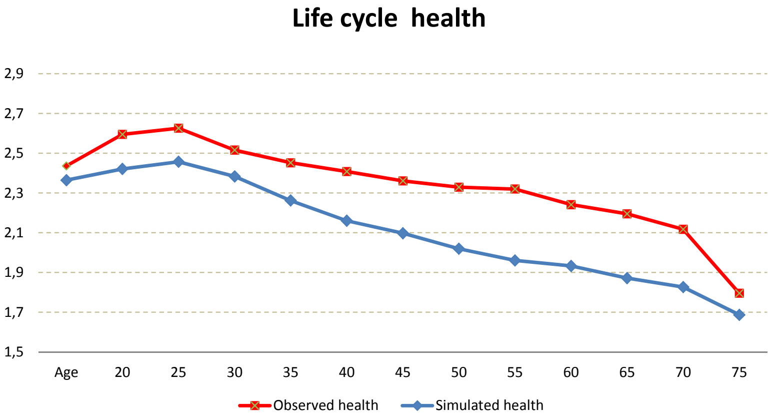
Table : Insurance plans, net effects and restrictions

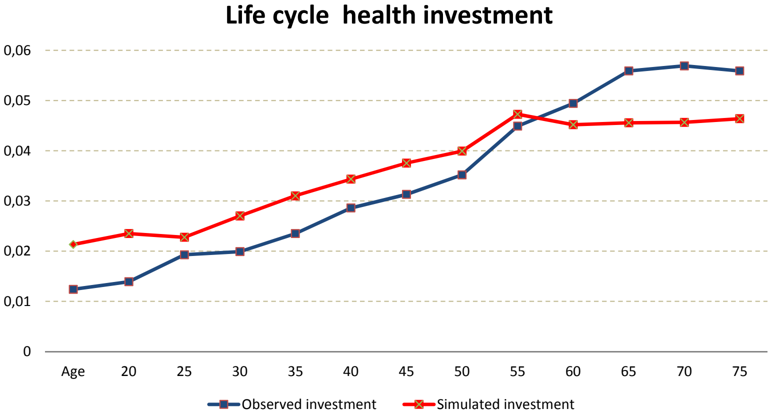
	Status: old			
Status: young	Insured		Uninsured	Net effects
	Medicare	Private		
Insured	**PM**	PP	PN	Insured old
Uninsured	NM		NN	Insured old
Net effects	Insured young		Insured young	

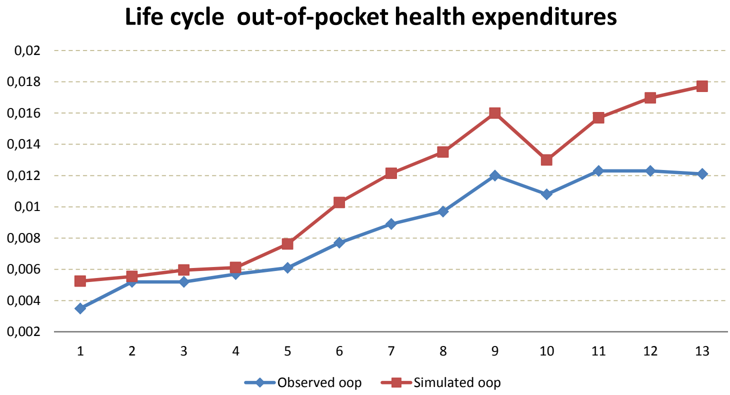
Exogenous insurance plans $x = (x_y, x_o) \in \mathbb{X} = \{\text{PM, PP, PN, NM, NN}\}$

5.3. New results

- Account for survival probabilities
- Allow a better match of λ_m and thus the dynamics of H, OOP and I.
- Results of counterfactual results remain robust.


Life cycle health
2,9
2,7
2,5
2,3
2,1
1,9
1,7
1,5
Age
20
25
30
35
40
45
50
55
60
65
70
75
Observed health
Simulated health


Life cycle health investment
0,06
0,05
0,04
0,03
0,02
0,01
0
Age
20
25
30
35
40
45
50
55
60
65
70
75
Observed investment
Simulated investment


Life cycle out-of-pocket health expenditures
0,02
0,018
0,016
0,014
0,012
0,01
0,008
0,006
0,004
0,002
1
2
3
4
5
6
7
8
9
10
11
12
13
Observed oop
Simulated oop

Can send email for questions: florian.pelgrin@edhec.edu

Thank you!