Closing Down the Shop: Optimal Health and Wealth Dynamics near the End of Life

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1- Health falls, 2- death risk exposure increases, esp. poor

Age	40 to 70	70 to 80
Share in poor/ bad health	$\times 2$	$\times 2$
Drop survivors	-19.3%	-29.7%

Notes: Health: [Banks et al., 2015, Smith, 2007, Heiss, 2011, Van Kippersluis et al., 2009], survivors [Arias, 2014].

Income decile	Longevity 1940 cohort
1st	73.3
3rd	77.9
6th	81.8
10th	84.6

Notes: [Bosworth et al., 2016]

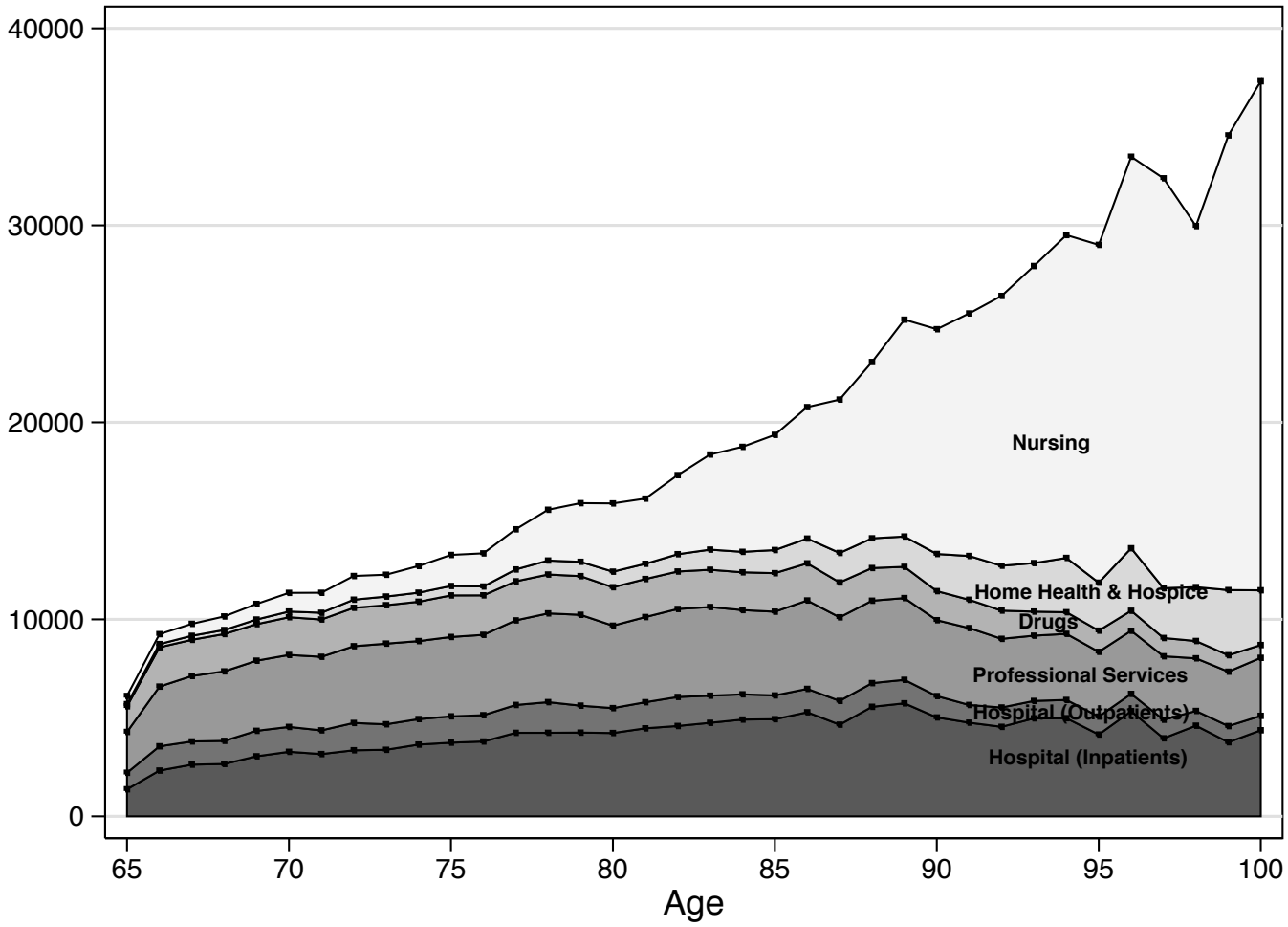
3.a- Health expenses increase

Age	Average total expend.
70–90	\$25'000
last year	\$43'000

Notes: [De Nardi et al., 2015b]

- Concentrated in long-term care (LTC), less curative care.
- LTC very income/wealth elastic $\approx$ normal consumption good.

3.b- Health expenses change in composition



Notes: Source: [De Nardi et al., 2015b, Fig. 3, p. 22].

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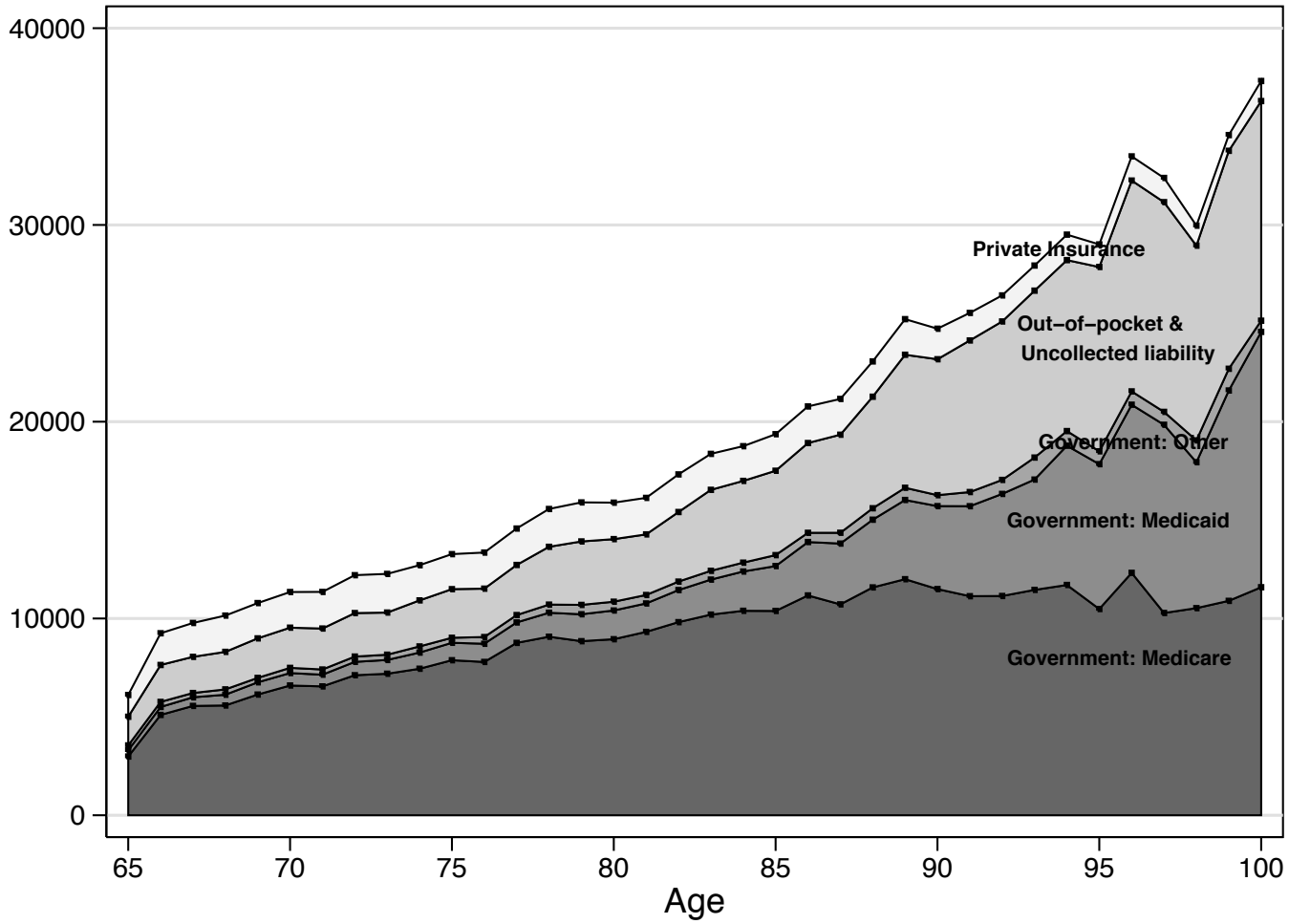

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4- Wealth falls

- Fall by 50% last 3 years, 30% last year alone, vs 2% for survivors [De Nardi et al., 2015a, French et al., 2006].
- LTC not covered by Medicare, means-testing for Medicaid.
- Correlated with changes in health, family composition [Poterba et al., 2015, Lee and Kim, 2008].

Standard explanation

Ineluctable aging process:

- Biological decline in health status.

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- Medicaid once depleted wealth.

Main research question

Joint decline in (H_t, W_t) $\Longleftarrow$ **optimal decisions**, rather than inevitable?

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  2. Threshold after which health depletion *accelerated*.
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  4. Convergence towards state where *indifferent* between life and death.

Model [Hugonnier et al., 2013, *RESTUD*]

- Health dynamics [Grossman, 1972, augmented]:

$$\mathrm{d}H_t = \left((I_t/H_t)^{\alpha} - \delta\right) H_t \mathrm{d}t - \phi H_t \mathrm{d}Q_{st}, \quad H_0 > 0,$$

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- Wealth dynamics:

$$\mathrm{d}W_t = (rW_{t-} + Y_t - C_t - I_t)\,\mathrm{d}t + \Pi_t \sigma_S \left(\mathrm{d}Z_t + \theta \mathrm{d}t\right) + X_{t-}\mathrm{d}M_{st}.$$

Model [Hugonnier et al., 2013, *RESTUD*]

- Objectives: $V(W_t, H_t) = \sup_{(C,\Pi,X,I)} U_t(C)$, where

$$U_t(C) = 1_{\{T_m > t\}} E_t \int_t^{T_m} \left(f(C_\tau, U_{\tau-}) - \frac{\gamma \sigma_\tau^2}{2U_\tau} - \sum_{k=m}^{s} F_k(U_{\tau-}, H_{\tau-}, \Delta_k U_\tau) \right) \mathrm{d}\tau,$$

where,

$$f(C, U) = \frac{\rho U}{1 - 1/\varepsilon} \left(((C - a)/U)^{1-\frac{1}{\varepsilon}} - 1 \right)$$

$$F_k(U, H, \Delta_k U) = U \lambda_k(H) \left[\frac{\Delta_k U}{U} + u(1; \gamma_k) - u\left(1 + \frac{\Delta_k U}{U}; \gamma_k\right) \right],$$

$$u(c; \gamma_k) = \frac{c^{1-\gamma_k}}{1 - \gamma_k}, \quad k = m, s.$$

subject to health, wealth dynamics.

Health investment: Two components

$$I^*(W,H) = \underbrace{KBH}_{\text{Order-0 demand}} + \underbrace{\mathcal{I}_1 H^{-\xi_m} N_0(W,H)}_{\text{Death risk hedging demand}}$$

where $N_0(W,H)$ is net total wealth. Other solutions for X^*, Π^*.

- If death risk can be hedged $\Longrightarrow$ larger demand for health.

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- If death risk can be hedged $\implies$ larger demand for health.
- Monotone increasing in W.
- Non-monotone in H.

Admissibility and preference for life

- Consumption:

$$C^*(W,H) = a + \left[A + \mathcal{C}_1 H^{-\xi_m}\right] N_0(W,H)$$
$$N_0(W,H) = W + BH + (y_0 - a)/r$$

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  - As approach non-admissible region, become indifferent between life and death.

Expected local dynamics and depletion: Health

1. Local expected changes:

$$\mathrm{E}_{t-}[\mathrm{d}H] = [\underbrace{I^{*h}(W,H)^{\alpha}}_{I^*/H} - \underbrace{\tilde{\delta}}_{\delta+\lambda_{s0}\phi}]H\mathrm{d}t,$$

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2. Health depletion/accelerating regions:

$$\mathcal{D}_H = \{(W,H) \in \mathcal{A} : \mathrm{E}_{t-}[\mathrm{d}H] < 0\},$$
$$\mathcal{AC} = \left\{(W,H) \in \mathcal{D}_H : I_H^h(W,H) > 0\right\}.$$

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Sufficient conditions for Closing down: Realistic for EOL

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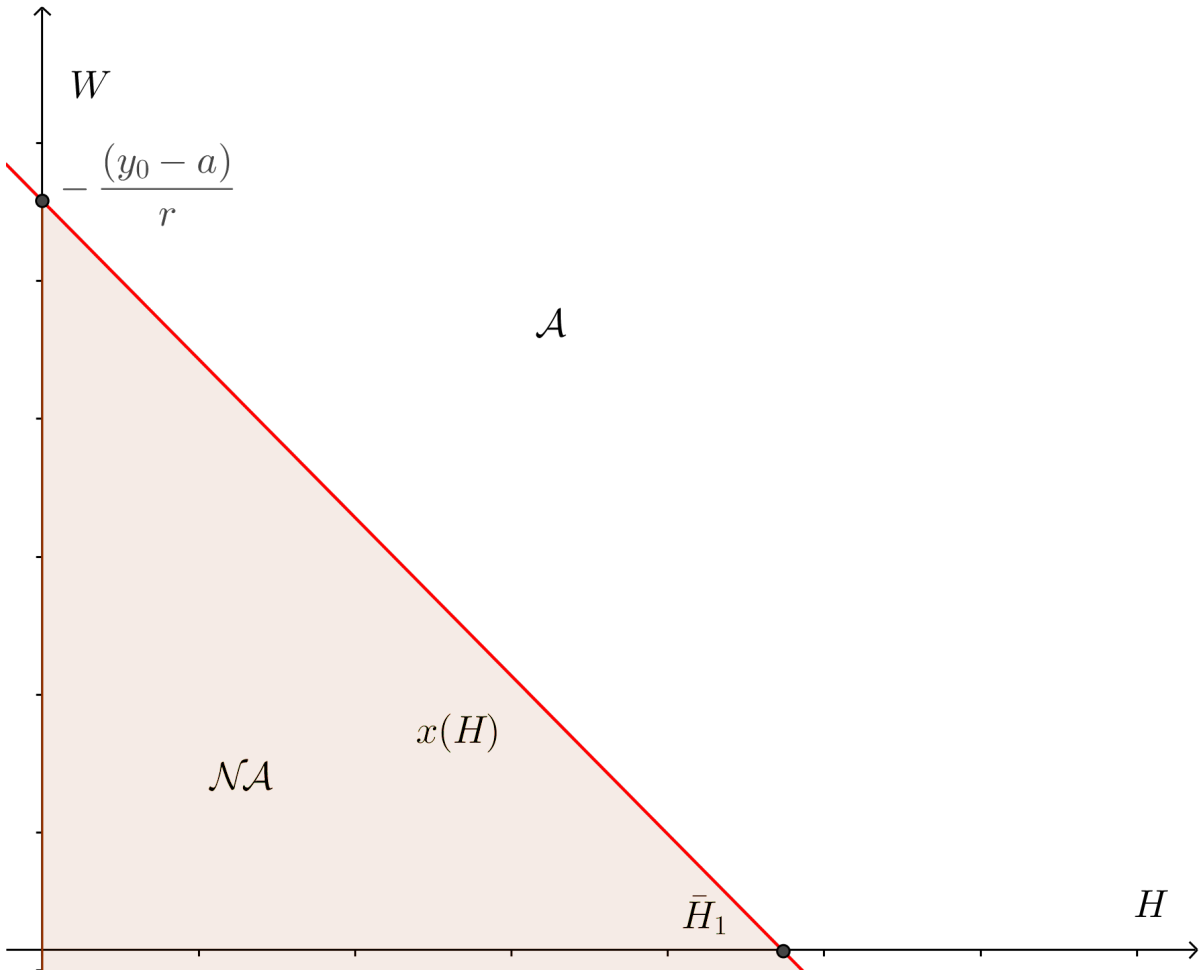
- High consumption $\Longleftarrow$ $(\gamma, \rho, \lambda_{m0}, \gamma_m)$ high

$$(1+\varepsilon)\frac{\theta^2}{2\gamma} < \varepsilon(\rho - r) + (\varepsilon - 1)\frac{\lambda_{m0}}{1-\gamma_m}.$$

Phase diagram



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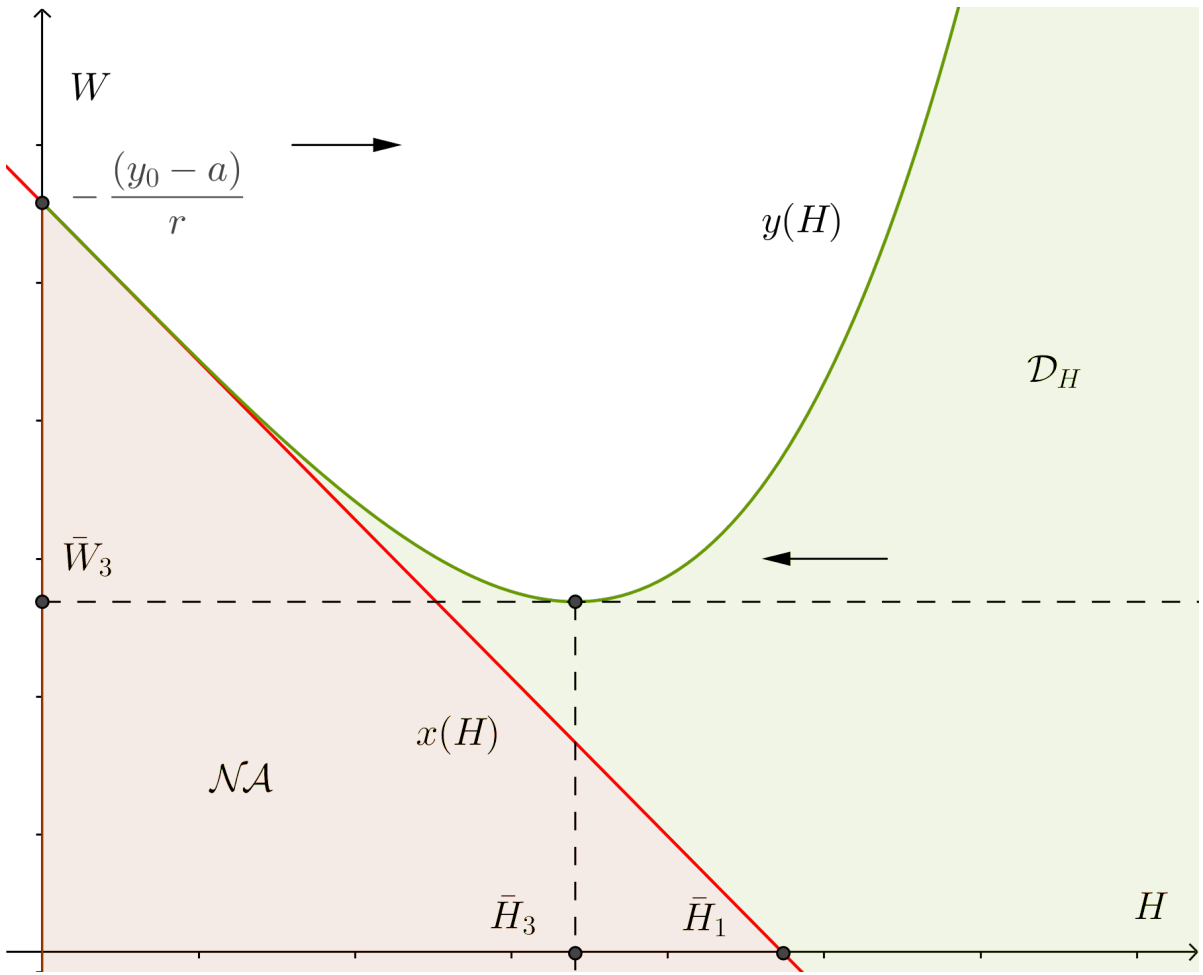

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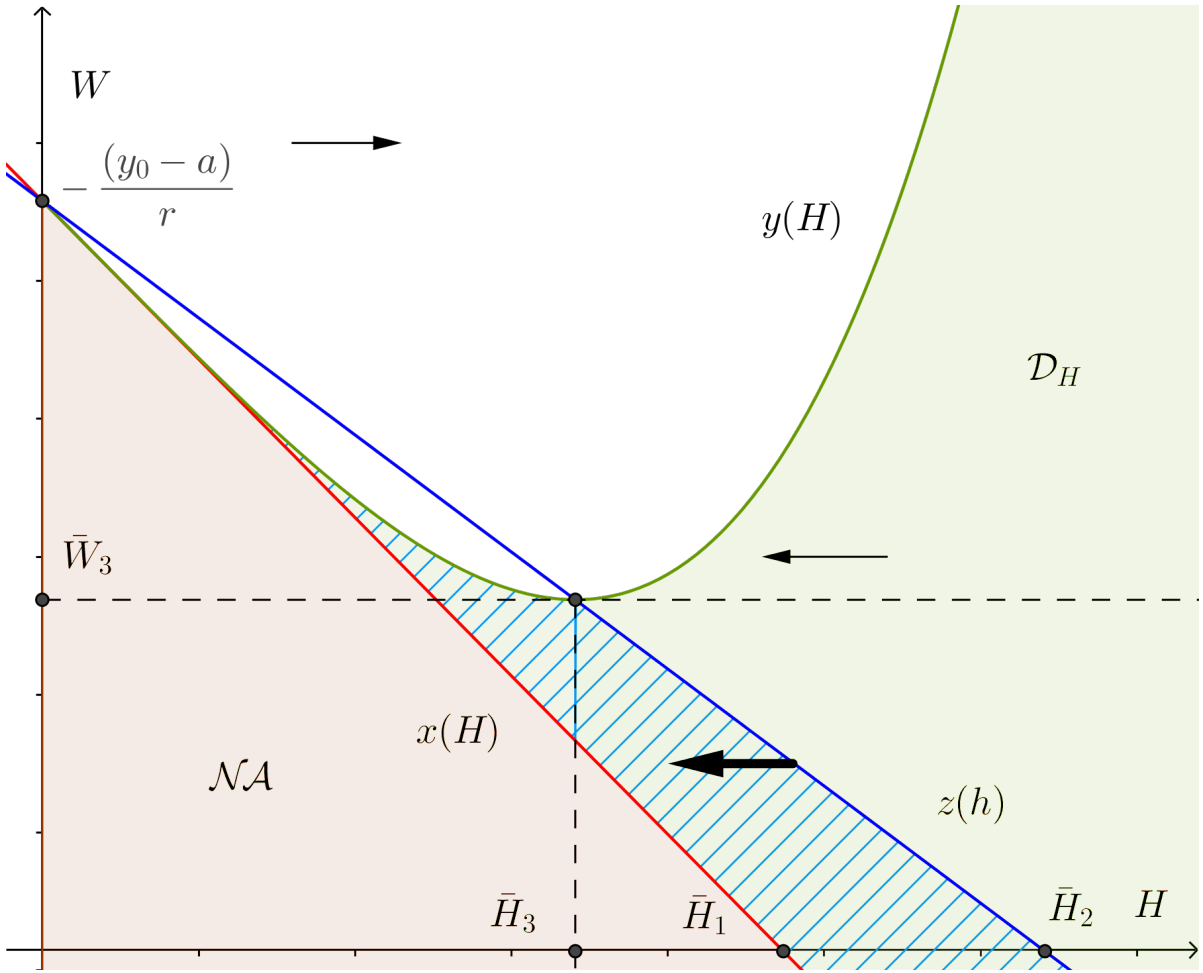

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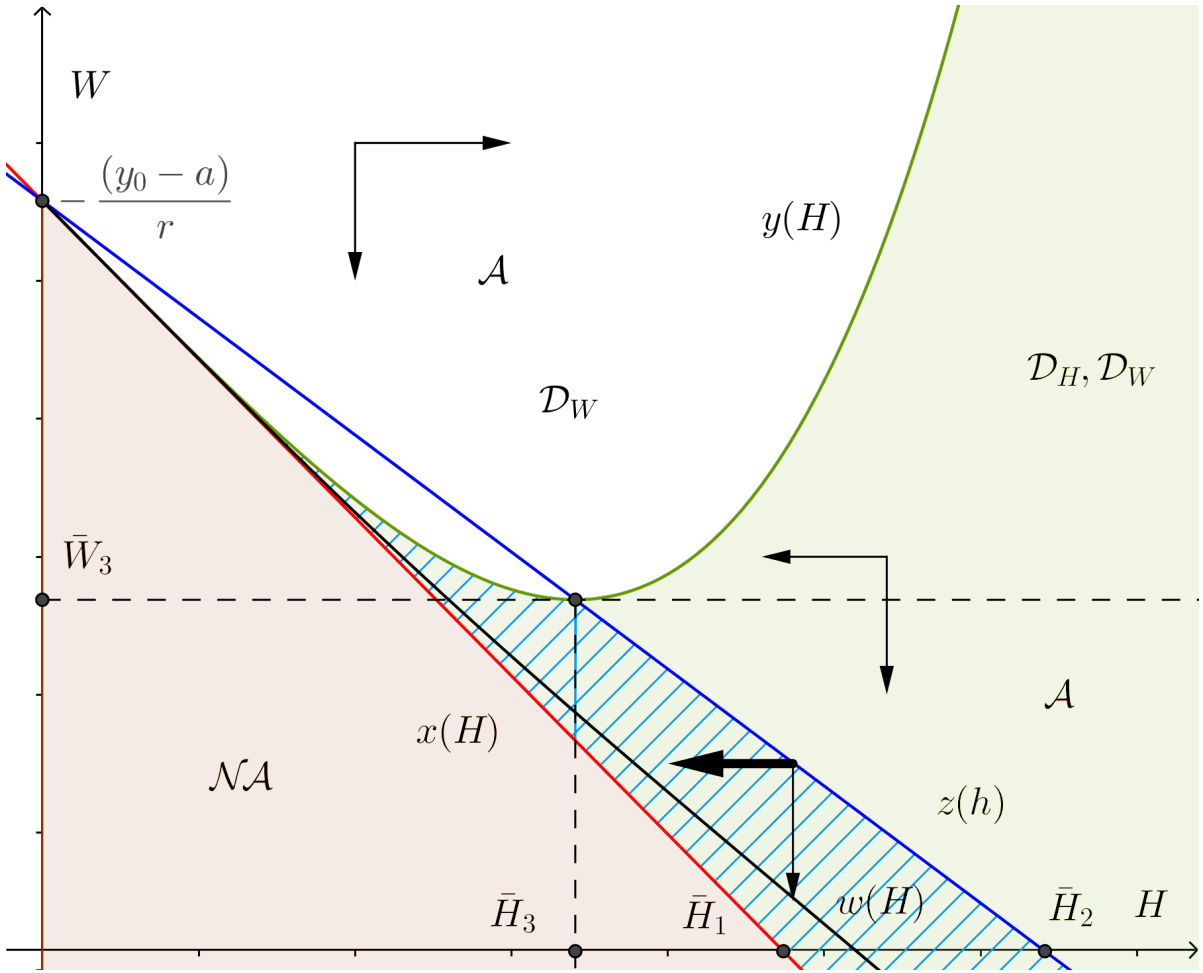

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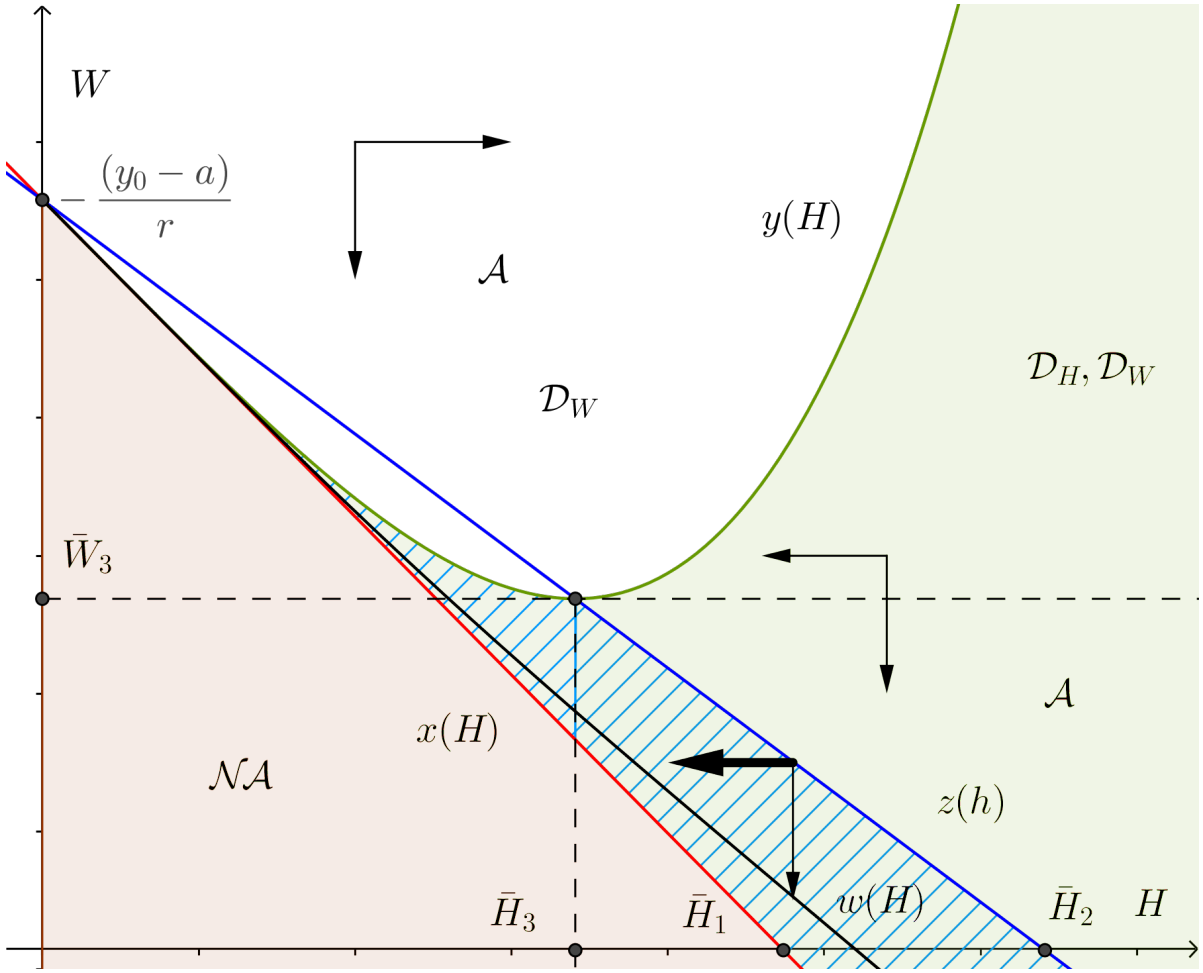
Terminal illness: $\lambda_m(H) = \lambda_{m0}, \forall H$, and $\lambda_{m0}, \tilde{\delta} \uparrow$

Main result: $\mathcal{D}_H = \mathcal{A}; \mathcal{AC} = \emptyset$



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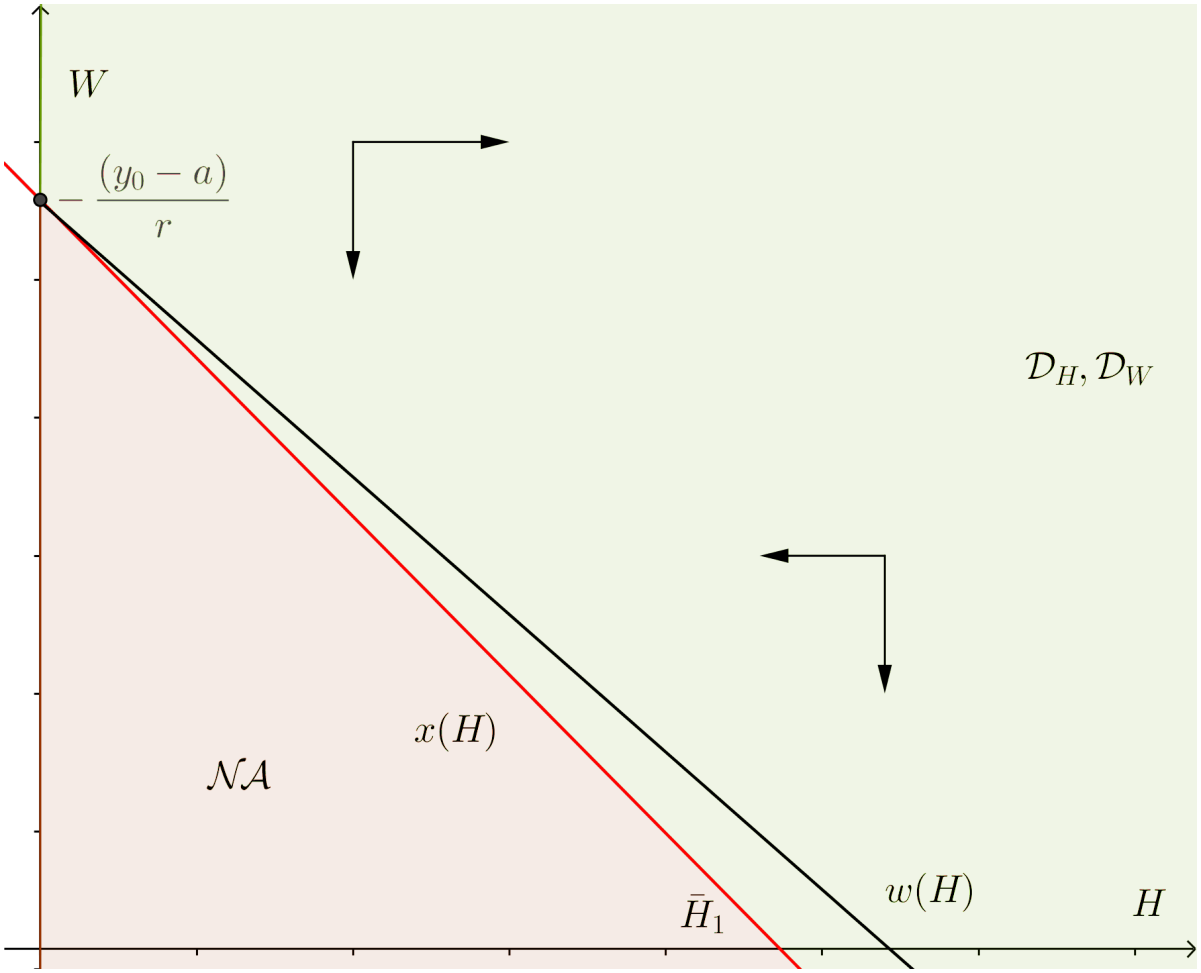

Reducing incidence of Closing Down strategies

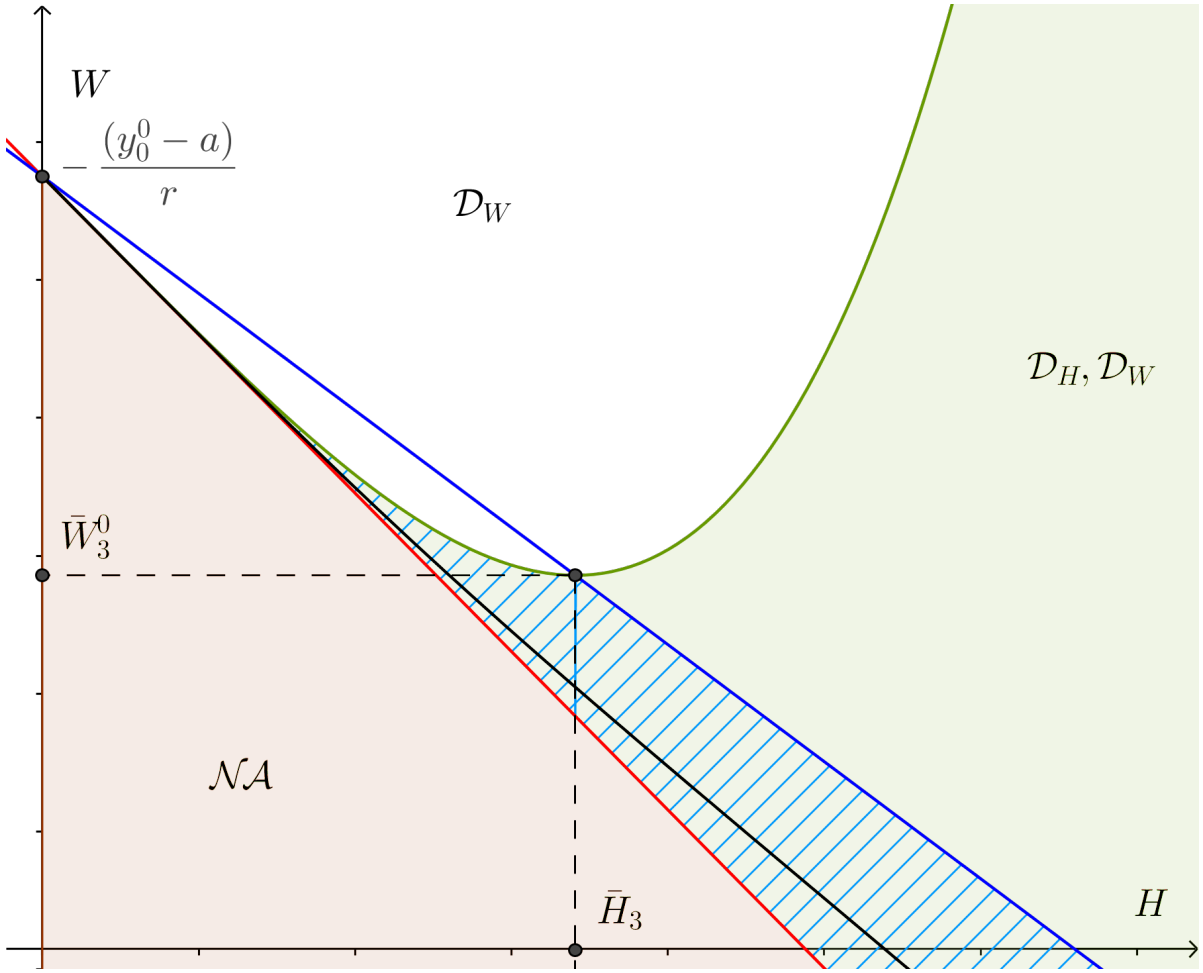

Figure: Increase in y_0 (e.g. Social Security)

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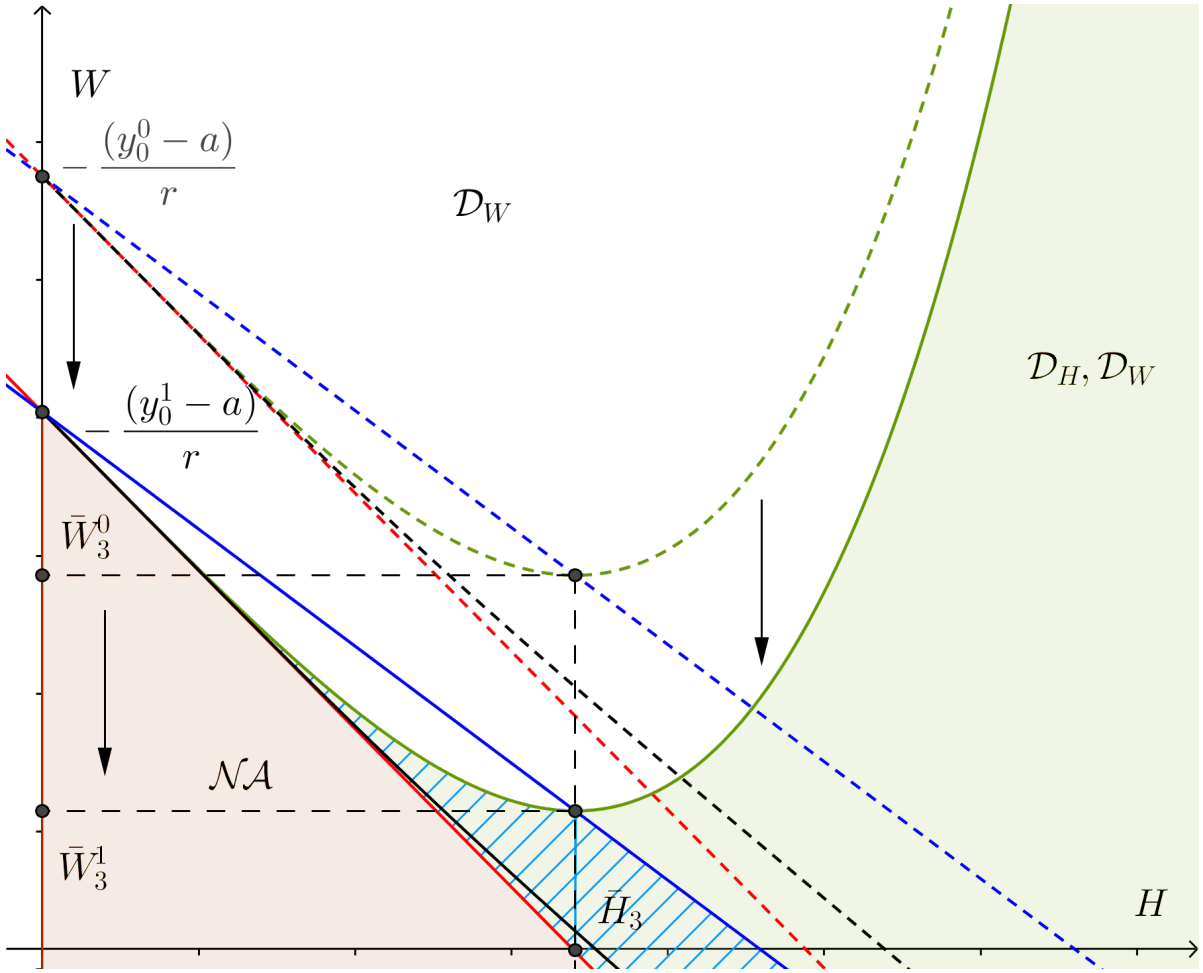

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Model and data

- Structural trivariate econometric model:

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\begin{aligned}
I_j &= K_0 B H_j + K_m H_j^{-\xi_m} N_0(W_j, H_j) + u_{Ij}, \\
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  - Closed-form solutions for parameters.
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  - By iterative 2-step ML.
- Data: HRS, 2002
  - Detailed info on total health spending.
  - Focus on elders 65+, with positive wealth (9,817 obs., mean age 75.3).
  - No consumption data.
  - Medicare $\implies$ drop optimal insurance.

Estimated and calibrated parameters

Realistic for relatively old population (75.3 years):

Param.	Value	Param.	Value	Param.	Value
α	0.6940^{*}	δ	0.0723^{*}	ϕ	0.011^{c}
λ_{s0}	0.2876^{*}	λ_{m0}	0.2356^{*}		
λ_{m1}	0.0280^{*}	ξ_m	2.8338^{*}		
y_0	$0.0082^{*\$}$	β	0.0141^{*}		
μ	0.108^{c}	r	0.048^{c}	σ_S	0.20^{c}
a	$0.0127^{*\$}$	ε	1.6738^{*}	γ	2.7832^{*}
ρ	0.025^{c}	γ_m	0.75^{c}	γ_s	N.I.

Notes: *: Estimated structural and induced parameters (standard errors in parentheses), significant at 5% level; c: calibrated parameters; \$: In \$M; N.I.: non-identifiable/irrelevant under the exogenous morbidity restriction.

Conditions for depletion: All verified

Parameter	Value	Parameter	Value
$\beta - \tilde{\delta}^{1/\alpha}$	-0.0086^*	$\theta^2/\gamma + r - A$	-0.5533^*

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Estimated and calibrated parameters

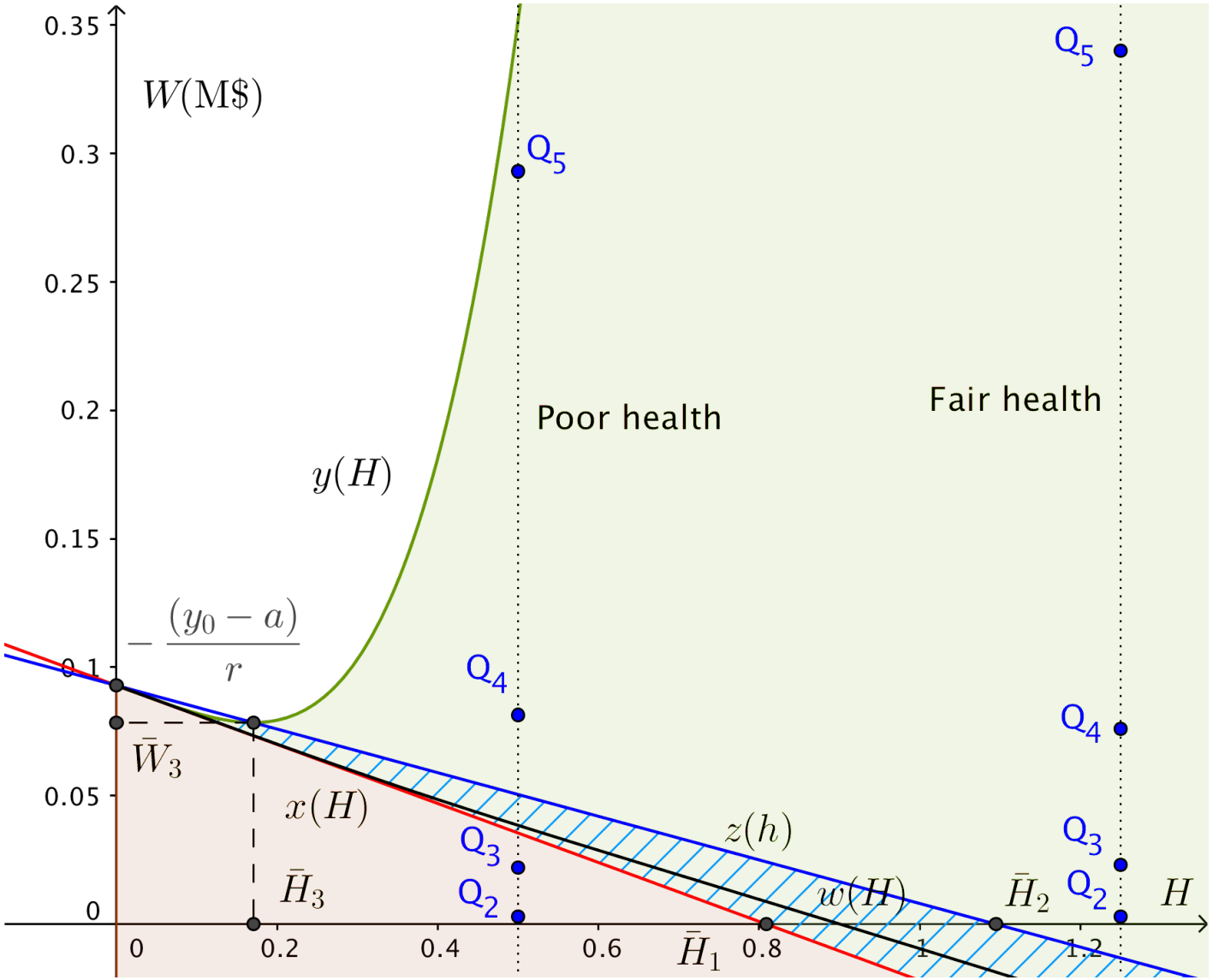
Out-of-sample checks: Expected longevity

$$\ell(W_t, H_t) = (1/\lambda_{m0})(1 - \lambda_{m1}\kappa_0 H_t^{-\xi_m})$$

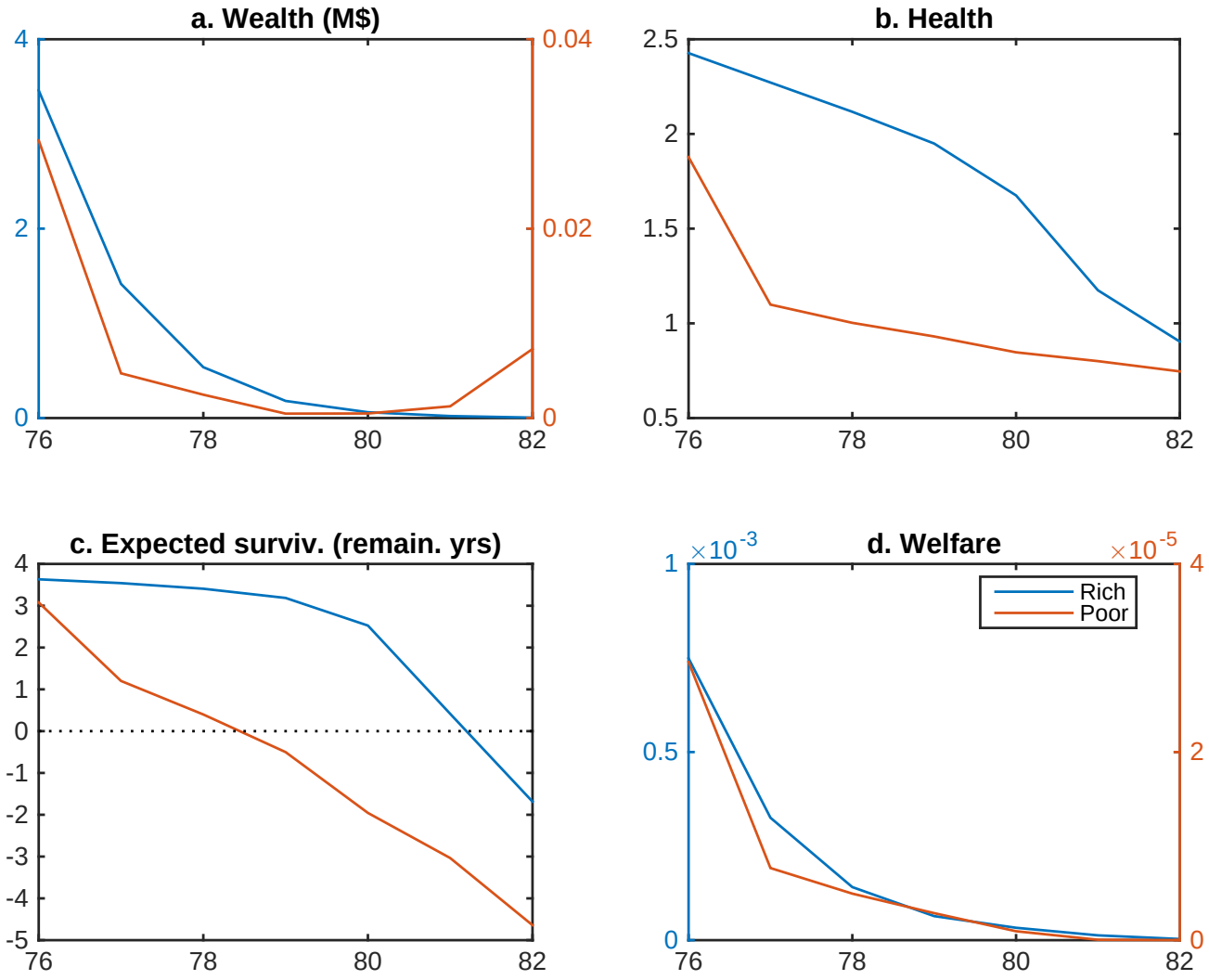
Level	H	% Pop.	Exp. longev.
Poor	0.50	10.7	51.94
Fair	1.25	21.1	77.49
Good	2.00	31.5	79.00
Very good	2.75	26.9	79.32
Excellent	3.50	9.9	79.43

Data (2002): 74.5 (M); 79.9 (F); 77.3 (A)

Estimated partitions: All in $(\mathcal{D}_H, \mathcal{D}_W)$ for $H \geq$ Fair



Simulated life paths: Closing Down the Shop



Concluding remarks

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Concluding remarks

Closing down the shop strategy:

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  3. Change in composition: Less curative care.
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- Applicable to incurable terminal diseases.

Normative issues

Reducing incidence of closing down:

1. Feasible? Yes.
   - Base income $y_0 \uparrow$ (e.g. Soc. Sec., min. revenues, Medicaid).
   - Subsidized medical research $\delta, \lambda_{s0}, \phi \downarrow$.
   - ... but (W, H) distribution will adapt.

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2. Optimal? No clear normative arguments.
   - Myopia? No, fully endogenize effects of choices $\iff$ horizon.
   - Market failure? No, optimal strategy by agents in *complete* markets setting.
   - Redistribution? No, poverty endogenously determined.
   - Against excessive/aggressive EOL therapy.
   - In favor of rights to refuse treatment.

Arias, E. (2014).
United States life tables, 2010.
National Vital Statistics Report, 63(7):1–62.

Banks, J., Blundell, R., Levell, P., and Smith, J. P. (2015).
Life-cycle consumption patterns at older ages in the US and the UK: can medical expenditures explain the difference?
IFS Working Papers W15/12, Institute for Fiscal Studies.

Bosworth, B. P., Burtless, G., and Zhang, K. (2016).
Later retirement, inequality in old age, and the growing gap in longevity between rich and poor.
Economic Studies at Brookings, Brookings Institute.

De Nardi, M., French, E., and Jones, J. B. (2015a).
Savings after retirement: A survey.
Working Paper 21268, National Bureau of Economic Research.

De Nardi, M., French, E., Jones, J. B., and McCauley, J. (2015b).
Medical spending of the U.S. elderly.

Working Paper 21270, National Bureau of Economic Research.

French, E., De Nardi, M., Jones, J. B., Baker, O., and Doctor, P. (2006).
Right before the end: Asset decumulation at the end of life.
Federal Reserve Bank of Chicago Economic Perspectives, 30(3):2 – 13.

Grossman, M. (1972).
On the concept of health capital and the demand for health.
Journal of Political Economy, 80(2):223–255.

Heiss, F. (2011).
Dynamics of self-rated health and selective mortality.
Empirical Economics, 40(1):119 – 140.

Hugonnier, J., Pelgrin, F., and St-Amour, P. (2013).
Health and (other) asset holdings.
The Review of Economic Studies, 80(2):663–710.

Lee, J. and Kim, H. (2008).

A longitudinal analysis of the impact of health shocks on the wealth of elders.
Journal of Population Economics, 21(1):217 – 230.

Poterba, J., Venti, S., and Wise, D. A. (2015).
What determines end-of-life assets? a retrospective view.
Working Paper 21682, National Bureau of Economic Research.

Smith, J. P. (2007).
The impact of socioeconomic status on health over the life-course.
Journal of Human Resources, 42(4):739 – 764.

Van Kippersluis, H., Van Ourti, T., O'Donnell, O., and van Doorslaer, E. (2009).
Health and income across the life cycle and generations in Europe.
Journal of Health Economics, 28:818–830.