The Public Economics of Changing Longevity

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The purpose of this paper is to provide an overview of the effects that changing longevity may have on a number of public policies designed for unchanged longevity.

Outline

- Key stylized facts about longevity increase
- Simple lifecycle model with risky lifetime
- Normative foundations
- Effects of changing longevity on public policy

1. Empirical facts

- Rise in life expectancy at birth
- Convergence across countries
- Increasing differences across individuals: genders, income, education
- Rectangularization first increasing and then stalling

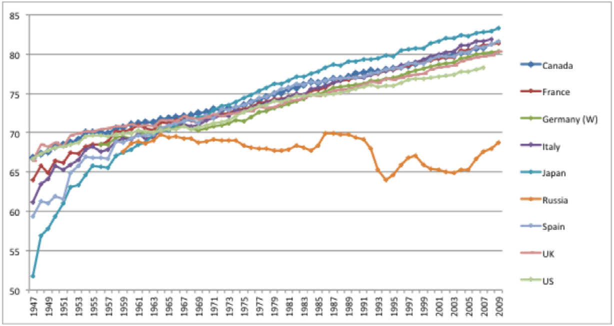

Figure: Period life expectancy at birth (total population) (years (1947-2009)

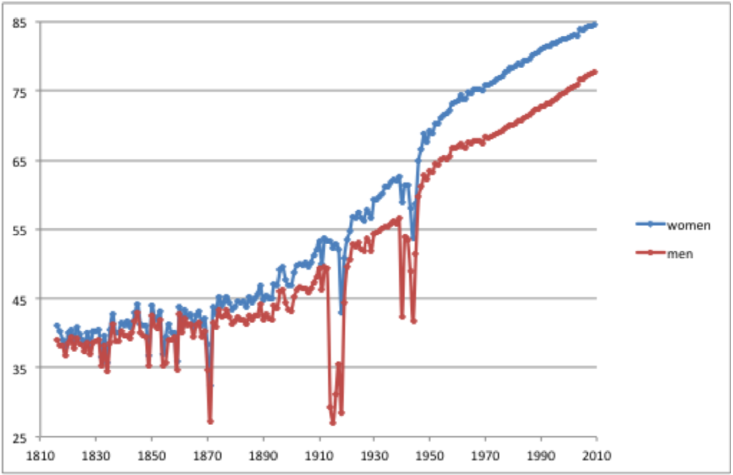

Figure: Period life expectancy at birth, men and women (years), France, 1816-2009

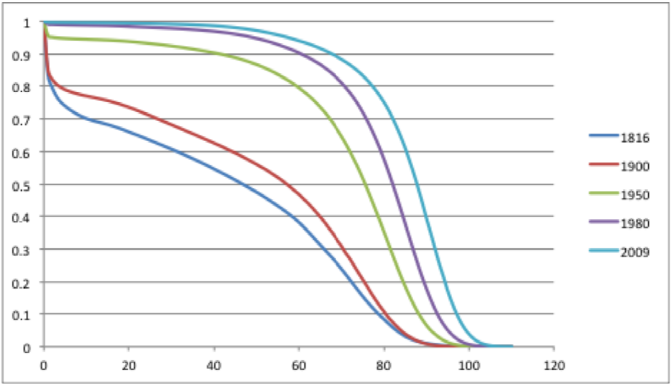

Figure: Period surival curves, women, France, 1816-2009

2. A simple model

2.1. Demography

Life composed of two periods:

- the young age (first period)
- the old age (second period) with survival probability π ($0 < \pi < 1$) and length ℓ ($0 < \ell < 1$)

$$LE = \pi (1 + \ell) + (1 - \pi)1 = 1 + \pi\ell \tag{1}$$

$$\begin{aligned} VAR &= \pi (1 + \ell - (1 + \pi\ell))^2 + (1 - \pi) (1 - (1 + \pi\ell))^2 \\ &= (1 - \pi) \pi\ell^2 \end{aligned} \tag{2}$$

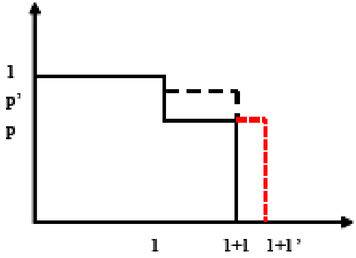

Figure 4: shifts of the survival curve in a two-period model.

- **Endogeneity of the length of life $\ell(\cdot)$ and of the survival function $\pi(\cdot)$:**

$$\pi \equiv \pi(e, \varepsilon, \alpha) \tag{3}$$

  - e : health efforts made by the individual, efforts that can take various forms (food diet, physical exercise, etc.), while
  - ε : genetic background of the individual, and
  - α : degree of knowledge of the individual

2.2. Preferences

$$\begin{aligned} U &= \pi \left[u(c) + \ell u(d) \right] + (1-\pi) \left[u(c) + 0 \right] \\ &= u(c) + \pi \ell u(d) \end{aligned} \tag{4}$$

- **Bommier's critique**

lottery A: $c = d = \bar{c}$, $\pi = 1$ and $\ell = 1/2$.

lottery B: $c = d = \bar{c}$, $\pi = 1/2$ and $\ell = 1$

The expected utility under each lottery is exactly the same, and equal to:

$$u(\bar{c}) + \frac{1}{2}u(\bar{c})$$

Concave transform $V(\cdot)$ of the sum of temporal utility.

$$\pi V[u(c) + \ell u(d)] + (1-\pi)V[u(c)] \tag{5}$$

Expected utility of lotteries A and B

$$V[u(\bar{c})(1.5)] > 0.5V[2u(\bar{c})] + 0.5V[u(\bar{c})]$$

3.1. Inequality aversion

Two types of agents in the population:

- type-1 agents (proportion ϕ) are long-lived, and
- type-2 agents are short-lived

- **LF (same wage)**

$$c_1 = d_1 = \frac{w}{2} < c_2 = w$$
$$U_2 = u(w) < U_1 = 2u\left(\frac{w}{2}\right)$$

- **Utilitarian FB:**

$$\max_{c_1, d_1, c_2} \phi \left[u(c_1) + u(d_1) \right] + (1 - \phi) \left[u(c_2) \right]$$

$$\text{s.t. } \phi c_1 + (1 - \phi) c_2 + \phi d_1 \leq 2w$$
$$c_1 = c_2 = d_2 = \frac{2}{3} w$$

Redistribution from the short-lived towards the long-lived.

- **Concavification of lifetime utilities:**

$$c_1 = d_1 < c_2$$

3.2. Responsibility and luck

Two groups of agents $i = 1, 2$, whose old-age longevity ℓ_i is a function of genes ε_i and health efforts e_i. Type-1 has better longevity genes and lower disutility for effort.

$$\ell_i \equiv \varepsilon_i \ell \left(e_i \right)$$

- **LF problem:**

$$\max_{c_i, d_i, e_i} \; u(c_i) - \delta_i v(e_i) + \varepsilon_i \ell(e_i) \, u(d_i)$$

$$\text{s.t.} \;\; c_i + \varepsilon_i \ell(e_i) \, d_i \leq w$$

where $\delta_1 < \delta_2$ and $\varepsilon_1 > \varepsilon_2$.

$$c_i = d_i$$

$$\delta_i v'(e_i) = \varepsilon_i \ell'(e_i) \left[u(d_i) - u'(d_i) d_i \right]$$

$$e_1 > e_2$$

$$U_1 > U_2$$

- **Optimum**
  - If $\delta_1 = \delta_2 = \bar{\delta}$, $U_1 > U_2$ implies redistribution from type-1 towards type-2.
    Compensation principle ("same responsibility, same welfare") would require equality of utility:

    $$u(c_1^*) - \bar{\delta} v(e_1^*) + \varepsilon_1 \ell(e_1^*) u(d_1^*) = u(c_2^*) - \bar{\delta} v(e_2^*) + \varepsilon_2 \ell(e_2^*) u(d_2^*)$$

  - If $\varepsilon_1 = \varepsilon_2 = \bar{\varepsilon}$, $U_1 > U_2$ does not imply any action
    Responsibility principle ("equal luck, no intervention")

3.3. Ex ante versus ex post equality

All individuals *ex ante* identical with life expectancy $1+\pi$.

- **LF**

$$\max_{c,d} u(c) + \pi u(d)$$
$$\text{s.t. } c + \pi d \leq w$$

$$c = d = \frac{w}{1+\pi}$$

where $\frac{1}{1+\pi}$ is the return of the annuity

- **Ex ante optimum**: maximize the *minimum* expected lifetime welfare.
  Same as LF
- **Ex post optimum**: maximize the *minimum ex post* lifetime welfare:

$$\max_{c,d} \min\{u(c) + u(d), u(c)\}$$
$$\text{s.t. } c + \pi d \leq w$$

Assume that $u(0) = 0$.

$$c > d = \bar{c} = 0$$

4.1. Free-riding on longevity-enhancing effort

Negative effect that longevity enhancing spending can have on the cost of annuities. Private annuity saving and Pay-As-You-Go pension scheme.

$$U = u(w - \theta - s^* - e) + \pi(e)u(s^*(1+r)/\pi(e) + \theta(1+n)/\pi(e)) \quad (6)$$

Optimal saving s^* is given by:

$$u'(c) = u'(d)(1+r) \quad (7)$$

Health expenditure is given by:

$$\pi'(e)u(d) = u'(d)(1+r) + \pi'(e)u'(d)d \tag{8}$$

Ignorance of $\pi'(e)u'(d)d$ calls for a corrective Pigovian tax.

Tragedy of the Commons.

4.2. Optimal policy and heterogeneity

Individuals with 3 characteristics: $w_i, \alpha_i, \varepsilon_i$

$$U_i = u(h_i \mathbf{W}_i - s_i^* - e_i) - v(h_i) + \pi(e_i, \boldsymbol{\varepsilon}_i, \boldsymbol{\alpha}_i) u(s_i^* / \pi(e_i))$$

- **Utilitarian Paternalist FB**

$$\sum n_i \left[u(c_i) - v\left(\frac{y_i}{w_i}\right) + \pi(e_i, \varepsilon_i, 1) u(d_i) \right]$$

subject to

$$\sum n_i (c_i + e_i + \pi(e_i, \varepsilon_i, 1) d_i - y_i) = 0$$

  - $w_2 > w_1$ implies $h_2 > h_1$
  - $c_i = d_i = \bar{c} \; \forall i$.
  - $\varepsilon_i > \varepsilon_j$ implies $e_i > e_j$ if $\pi_{\varepsilon e} > 0$, that is if both arguments are complements.

- **SB optimum**

  Asymmetric information on ε and w.

  Two types

  - $\alpha < 1$
  - Type 2 mimicking type 1

$$\begin{aligned} & u(c_2) + \alpha_2 \pi(\varepsilon_2, e_2) u(c_2) - v(h_2) \\ \geqslant \; & u(c_1) + \alpha_2 \pi(\varepsilon_2, e_1) u(c_1) - v\left(\frac{y_1}{w_2}\right) \end{aligned}$$

  Outcome depends on the relative values of both w_i and ε_i and of the substituability of e and ε in the longevity function.

  Tax on labor, τ, saving, σ, health, θ.

Table : Signs of taxes in the second-best

Second Best		BP	IC	MO	Total effect
$\pi_{\varepsilon e} > 0$	σ_1	0	$+$	-	?
$w_2 \geqslant w_1$	σ_2	0	0	-	-
and $\varepsilon_1 < \varepsilon_2$	θ_1	$+$	$+$	-	?
	θ_2	$+$	0	-	?
	τ_1	0	$+$	0	$+$
	τ_2	0	0	0	0

4.3. Retirement and social security

Individuals:

- 4 types denoted by kj with $k = L, S$ and $j = 1, 2$
- same productivity w
- 2 levels of longevity: $\ell_S < \ell_L$
- 2 occupations with probability of long life: $\pi_2 > \pi_1$

The individual utility is given by:

$$U = u(c) + \ell u(d) - v(z; \ell) \tag{9}$$

with a budget constraint equal to

$$c + \ell d = w(1 + z) \tag{10}$$

Choice of z

$$u'(d)w = v'(z; \ell) \tag{11}$$

with $dz/d\ell > 0$ if $dv'/d\ell < 0$.

Assume $\pi_1 = 0$ and $\pi_2 = 1$, then c=d for all types and $z_1 > z_2$.

Assume now $\pi_1 > 0$ and $\pi_2 = 1$. Then $U_{L1} > U_{L2}$.

Ex ante optimum: age of retirement will be lower than in the *ex post* one.

4.4. Long term care social insurance

Case for LTC social insurance. Risk of dependence correlated with income through longevity.

- General problem:

$$\begin{aligned} & \max_{s,\theta} \; u\left((1-\tau)hw - v(h) - s - \theta + a\right) + \pi(1-\varphi)u\left(\tfrac{s}{\pi}\right) \\ + \; & \varphi\pi H\left(\tfrac{s}{\pi} + g + \tfrac{\theta\gamma_p}{\varphi\pi}\right), \end{aligned}$$

where θ is insurance premium, γ_p, loading factor, φ, probabilty of dependence, a, demogrant, g, social LTC benefit and τ, the payroll tax rate.

No tax distortion, no loading factor, $g = 0$ and $\tau = 1$.

Tax distortion, a=0, and loading factor: no subsidy on θ and $g > 0$.

Identical results with non linear schemes.

4.5. Preventive and curative health care with endogenous longevity

Longevity function : $\ell(\alpha x, e)$, where α equals 1 for a rational individual, and 0 for a myopic one. $\ell_x < 0, \ell_e > 0$.

The social planner - or a rational individual - maximizes:

$$U = u(c) + u(x) + \ell(x, e)u(d)$$

subject to the resource constraint:

$$c + x + e + \ell(x, e)d = w$$

A myopic individual maximizes in the first period:

$$U = u(w - s - x) + u(x) + \ell(0, e)u\left[(s - e)/\ell(0, e)\right]$$

In the second period, given x, he allocates his saving between d and e so as to maximize:

$$\ell(x, e)u((s - e)/\ell(x, e))$$

Need to subsidize (or tax) saving and tax the sin good.

5. Conclusion

- Other topics:
  - Poverty alleviation
  - Public education and PAYG in a growth model with increasing (endogenous or not) longevity
- Extension:

  Most of the surveyed results rest on the utilitarian approach. Need to extend them to deal with the normative problems mentioned above.