Joint Retirement in Europe

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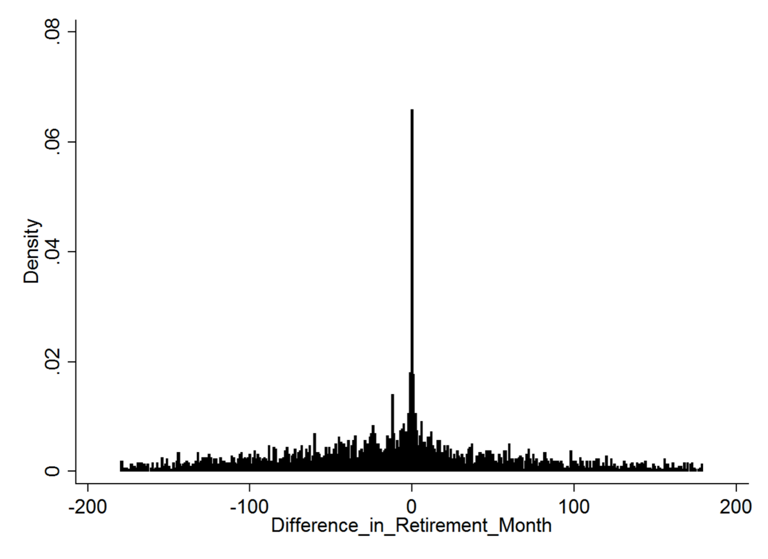
Motivation



Density
0
.02
.04
.06
.08
-200
-100
0
100
200
Difference_in_Retirement_Month

Our goal

- We examine this phenomenon in Europe using data from two different sources.
  - SHARE (4 waves: 2004, 2006/7, 2008/9, 2011/2);
  - ELSA (6 waves: 2002/3, 2004/5, 2006/7, 2008/9, 2010/11, 2012/13).

- Retirement date: self-reported date (in SHARE) or date since last job for those claiming to be retired or self-reported retirement date when not available (ELSA). (Alternative measures give similar results.)
- We focus on age difference in the couple and self-reported health to keep sample size.
- ELSA: Reform increasing female State Pension Age: 60 (2010) $\rightarrow$ 65 (2020).

- Lit on joint retirement: Hurd (1989, 1990), Coile (1999, 2004a, b), Gustman and Steinmeier (2000, 2004, 2009), Blau (1997, 1998), Maestas (2001), Michaud (2003), Michaud and Vermeulen (2004), An, Jesper Christensen and Gupta (2004), Banks, Blundell and Casanova (2007), Casanova (2009), . . .

In Continental Europe . . .

Conditional Retirement Year Frequency (in %) (SHARE)

	Wife							
Husb.	2005	2006	2007	2008	2009	2010	2011	Total
2005	**42.86**	14.29	0.00	7.14	21.43	7.14	7.14	100.00
2006	13.33	**36.67**	6.67	10.00	16.67	13.33	3.33	100.00
2007	8.33	0.00	**41.67**	8.33	20.83	20.83	0.00	100.00
2008	2.86	5.71	17.14	**22.86**	20.00	22.86	8.57	100.00
2009	0.00	11.76	8.82	17.65	**26.47**	32.35	2.94	100.00
2010	3.12	3.12	6.25	31.25	21.88	**21.88**	12.50	100.00
2011	6.06	12.12	18.18	6.06	15.15	24.24	**18.18**	100.00

Source: SHARE. The total number of couples with uncensored retirement years for both spouses is 202. There are many more observations where either husband or wife retire before 2005, but only 2 of those are uncensored for both spouses.

In Continental Europe . . .

Probability of Retirement at Different Ages (SHARE)

Variable	Husbands Coef. (Std. Err.)	$< t$ (in %)	$= t$ (in %)	$> t$ (in %)	Wives Coef. (Std. Err.)	$< t$ (in %)	$= t$ (in %)	$> t$ (in %)
Spouse Retires at t	-0.09 (0.27)				0.57 † (0.30)			
Spouse Retired $<$ t	1.75 ** (0.16)				1.19 ** (0.21)			
Age 54	0.25 (0.80)	0.06	0.05	0.32	2.03 ** (0.59)	0.27	0.48	0.89
Age 55	2.44 ** (0.45)	0.50	0.46	2.79	3.15 ** (0.51)	0.83	1.46	2.68
Age 56	2.50 ** (0.46)	0.53	0.49	2.98	3.08 ** (0.52)	0.77	1.36	2.49
Age 57	3.19 ** (0.43)	1.05	0.96	5.74	3.74 ** (0.50)	1.49	2.60	4.73
Age 58	3.18 ** (0.44)	1.04	0.96	5.70	3.98 ** (0.50)	1.88	3.28	5.92
Age 59	3.87 ** (0.42)	2.05	1.88	10.72	4.62 ** (0.49)	3.52	6.05	10.68
Age 60	5.43 ** (0.40)	9.12	8.42	36.49	5.87 ** (0.47)	11.28	18.34	29.42
Age 61	4.69 ** (0.42)	4.57	4.20	21.50	4.99 ** (0.52)	5.01	8.53	14.75
Age 62	4.95 ** (0.43)	5.83	5.37	26.17	5.59 ** (0.52)	8.78	14.54	24.00
Age 63	4.75 ** (0.48)	4.81	4.42	22.44	5.08 ** (0.63)	5.47	9.28	15.96
Age 64	4.62 ** (0.54)	4.28	3.94	20.38	3.88 ** (1.12)	1.71	2.98	5.39
Age $\geq$ 65	6.65 ** (0.48)	25.37	23.75	66.07	6.59 ** (0.71)	20.72	31.58	46.14
N of Individuals	4083				4083			

...and in England.

Probability of Retirement at Different Ages (ELSA)

Variable	Husbands Coef. (Std. Err.)	Husbands $< t$ (in %)	Husbands $= t$ (in %)	Husbands $> t$ (in %)	Wives Coef. (Std. Err.)	Wives $< t$ (in %)	Wives $= t$ (in %)	Wives $> t$ (in %)
Spouse Retires at t	1.19 ** (0.21)				1.47 ** (0.22)			
Spouse Retired < t	1.01 ** (0.16)				0.74 ** (0.17)			
Age 54	0.29 (1.16)	0.07	0.23	0.20	-0.75 (1.06)	0.08	0.34	0.16
Age 55	2.25 ** (0.69)	0.51	1.65	1.39	1.57 ** (0.46)	0.78	3.29	1.60
Age 56	2.15 ** (0.71)	0.46	1.49	1.25	1.89 ** (0.44)	1.06	4.47	2.19
Age 57	2.88 ** (0.65)	0.95	3.06	2.57	1.66 ** (0.47)	0.85	3.61	1.76
Age 58	3.70 ** (0.61)	2.13	6.69	5.66	2.43 ** (0.42)	1.82	7.47	3.73
Age 59	3.01 ** (0.65)	1.08	3.46	2.91	2.67 ** (0.41)	2.29	9.27	4.67
Age 60	4.00 ** (0.61)	2.85	8.82	7.48	4.56 ** (0.36)	13.42	40.32	24.45
Age 61	3.62 ** (0.63)	1.97	6.21	5.25	3.50 ** (0.39)	5.12	19.05	10.13
Age 62	3.67 ** (0.63)	2.05	6.46	5.46	3.63 ** (0.39)	5.76	21.05	11.32
Age 63	4.34 ** (0.61)	3.96	11.95	10.20	3.75 ** (0.40)	6.45	23.11	12.59
Age 64	4.50 ** (0.61)	4.58	13.66	11.69	3.31 ** (0.45)	4.29	16.33	8.55
Age $\geq$ 65	5.34 ** (0.59)	10.07	26.95	23.59	3.49 ** (0.37)	5.06	18.86	10.02
N of Individuals	1391				1391			

Traditional duration models ...

Mixed Proportional Hazard Model

$$\ln\left(Z\left(T\right)\right) = -\ln\left(\varphi(x)\right) - \ln\left(\nu\right) + \eta \tag{MPH}$$

where $\eta \sim \ln\left(-\ln\left(U\left(0,1\right)\right)\right)$.

Accelerated Failure Time Model

$$\log T = x\beta + \log T^{*} \tag{AFT}$$

where the distribution of $\log T^{*}$ is unspecified.

$MPH \cup AFT = GAFT$

$$\ln\left(Z\left(T\right)\right) = -\ln\left(\varphi(x)\right) + \varepsilon \tag{GAFT}$$

where the distribution of ε is unspecified.

. . . applied to retirement timing in Continental Europe . . .

Weibull Duration Model (SHARE)

	HUSBANDS			WIVES		
Variable	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)
θ_1	5.57 (0.19)	5.75 (0.21)	5.46 (0.22)	5.87 (0.24)	6.38 (0.27)	6.55 (0.29)
Age Dif./10	0.34 $**$ (0.13)	0.44 $**$ (0.13)	0.48 $**$ (0.14)	-1.35 $**$ (0.12)	-1.44 $**$ (0.12)	-1.45 $**$ (0.12)
Exc. or VG Health			-0.37 $**$ (0.13)			-0.10 (0.16)
Fair or Poor Health			-0.39 $*$ (0.19)			0.18 (0.19)
Country Controls	NO	YES	YES	NO	YES	YES
Number of Obs.	4803	4083	3737	4803	4803	3737

Significance levels : † : 10% $*$: 5% $**$: 1%. θ_1 is the Weibull parameter.
Significance levels are not displayed for θ_1. Ommitted category is `Good Health`.

. . . and to retirement timing in England.

Weibull Duration Model (ELSA)

	HUSBANDS		WIVES	
Variable	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)	**Coef.** (Std. Err.)
θ_1	3.24 (0.10)	3.30 (0.11)	3.07 (0.11)	3.14 (0.11)
Age Dif.	-0.05 (0.08)	-0.07 (0.08)	-0.50 $**$ (0.07)	-0.50 $**$ (0.08)
Excellent or Very Good Health		0.03 (0.11)		0.07 (0.12)
Fair or Poor Health		-0.06 (0.16)		0.01 (0.18)
Number of Obs.	1389	1166	1389	1215

Significance levels : † : 10% $*$: 5% $**$: 1%. θ_1 is the Weibull parameter.
Significance levels are not displayed for θ_1. Ommitted category is `Good Health`.

We want to think about simultaneous durations.

- We want to introduce dependence of durations in a “structural” way and not only through unobservables.
- First review what we do in linear regressions

Seemingly unrelated regression

$$\begin{aligned} y_1 &= x_1'\beta_1 + \varepsilon_1 \\ y_2 &= x_2'\beta_2 + \varepsilon_2 \end{aligned}$$

(not what we want to generalize)

Triangular systems

$$
\begin{aligned}
y_1 &= x_1'\alpha_1 + \varepsilon_1 \\
y_2 &= y_1\gamma_2 + x_2'\alpha_2 + \varepsilon_2
\end{aligned}
$$

(also not quite what we want to generalize)

Simultaneous equations

$$
\begin{aligned}
y_1 &= y_2\gamma_1 + x_1'\alpha_1 + \varepsilon_1 \\
y_2 &= y_1\gamma_2 + x_2'\alpha_2 + \varepsilon_2
\end{aligned}
$$

(what we want to generalize!)

Our approach

We will think of T_1 and T_2 as chosen by individuals.

We will allow for models where T_1 and T_2 are each continuous, but $P(T_1 = T_2) > 0$.

We want the effect to not only be through the hazard (although that is often the most reasonable).

Our approach

- Honoré and de Paula [2010]: durations are Nash Equilibria of a game theoretic model.
- Game theoretic model clearly not suitable when agents can coordinate but some of the features seem right.
- So we replace Nash Equilibrium with Nash Bargaining.

Basic setup

Husband and wife ($i = 1, 2$) choose retirement dates $T_i, i = 1, 2$.

Work (non-retirement) provides utility flow: $K_i \sim G(\cdot)$

Retirement provides utility flow: $U(t, x_i) \equiv Z(t)\varphi(x_i)$ where

- $Z : \mathbb{R}_+ \to \mathbb{R}_+, Z'(t) > 0, Z(0) = 0$
- x_i: (observed) individual specific covariates

Simultaneity

$\delta > 1$: incremental utility to outside activity if other has switched.

Figure : Extra Utility from Joint Retirement

In sum:

- The payoff is given by

$$\int_0^{t_i} K_i e^{-\rho s} ds + \int_{t_i}^{\infty} Z(s)\varphi(x_i) D(s, t_j) e^{-\rho s} ds$$

for partner i, where ρ is the discount rate and

$$D(s, t_j) \equiv (\delta - 1)\mathbf{1}(s \geq t_j) + 1, j \neq i.$$

- Information is complete (for the agents), but the econometrician observes only x_i and $T_i, i = 1, 2$.

Nash Bargaining (Zeuthen)

$$\max_{t_1, t_2} \left(u_1\left(t_1; t_2\right) - a_1 \right) \left(u_2\left(t_2; t_1\right) - a_2 \right)$$

where (for $i \neq j \in \{1, 2\}$)

$$u_i(t_i; t_j) \equiv \int_0^{t_i} K_i e^{-\rho s} ds + \int_{t_i}^{\infty} Z(s)\varphi(x_i)\delta(s \geq t_j)e^{-\rho s} ds$$

Can be motivated aximatically

- Pareto Optimality.
- Independence of Irrelevant Alternatives.
- A Certain Symmetry.

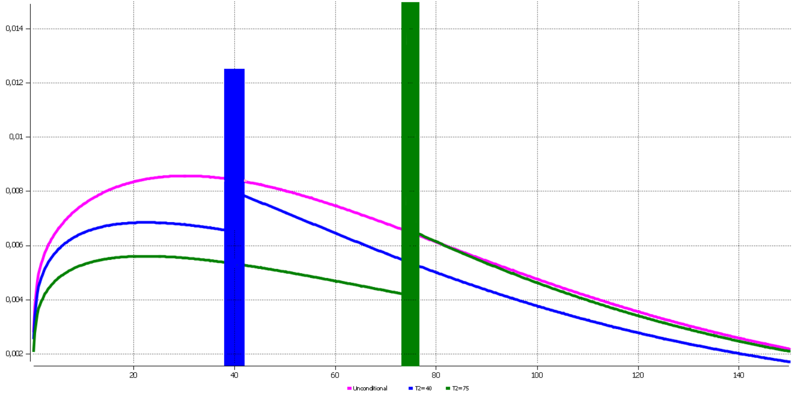


Figure : Marginal and Conditional distribution of T_1

Simultaneous equations GAFT

As in Honoré and de Paula [2010], this will lead to durations of the form

$$\ln\left(Z\left(T_i\right)\right) = -\ln\left(\varphi(x_i)\right) + \ln\left(K_i\right)$$

or the form

$$\ln\left(Z\left(T_i\right)\right) = -\ln\left(\varphi(x_i)\right) - \delta + \ln\left(K_i\right)$$

for some draws of (K_1, K_2).

So this is a generalization of the GAFT.

Implementation: Indirect Inference

Suppose that rather than doing MLE in the true model with parameter θ, you do it in some approximate (*auxiliary*) model with parameter β, then

$$\widehat{\beta} = \arg\max_b \sum_{i=1}^{n} \log \mathcal{L}_a(b; z_i) \xrightarrow{p} \arg\max_b E_{\theta_0}\left[\log \mathcal{L}_a(b; z_i)\right] \equiv \beta_0(\theta_0)$$

If we knew the right-hand-side as a function of θ_0, then we could use this to solve the equation

$$\widehat{\beta} = \beta_0\left(\widehat{\theta}\right).$$

We don't know $\beta_0(\theta)$, but we can simulate it!!!!

Model

- $Z(t) = t^{\alpha}$ ($\Rightarrow$ Weibull hazard)
- $\varphi_i(\mathbf{x}_i) = \exp(\mathbf{x}_i^\top \beta_i), i = H, W$
- $K_i \sim \exp(1)$
- $\rho = 5\%$ per year
- Threat points: fraction of utility level obtained if his or her partner never retired.

Correlated unobservables

Copula

- Keep marginals.
- Allow dependence in the underlying uniforms.

Clayton and Cuzick (1985):

$$K(u, v; \tau) = \begin{cases} \left(u^{-\tau} + v^{-\tau} - 1\right)^{-1/\tau} & \text{for} \quad \tau > 0 \\ uv & \text{for} \quad \tau = 0. \end{cases}$$

Kendall's rank correlation

$$\frac{\tau}{2 + \tau}$$

Auxiliary models

- Weibull Proportional Hazard models for man and woman
  $\Rightarrow \mathcal{L}_{men}, \mathcal{L}_{women}$, timing of retirement
- Ordered Logit Model: $P(t_h > t_w|x), P(t_h = t_w|x), P(t_h < t_w|x)$
  $\Rightarrow \mathcal{Q}$, pervasiveness of joint retirement
- Covariance of (residual) failure times
  $\Rightarrow \mathcal{C}$, correlation of K
- Overall auxiliary model pseudo-loglikelihood:
  $\ln \mathcal{L}_{men} + \ln \mathcal{L}_{women} + \ln \mathcal{Q} + \ln \mathcal{C}$

Simultaneous Duration (SHARE)

Variable	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)
δ	1.08 (0.18)		1.01 (0.29)		1.08 (0.51)		1.00 (0.02)	
θ_1	6.44 (0.45)	5.84 (0.24)	6.53 (2.40)	5.84 (0.32)	6.55 (1.90)	5.95 (0.87)	6.73 (0.36)	5.95 (0.78)
Age Diff.	-1.58 $**$ (0.57)	0.31 (0.14)	-1.50 $**$ (0.80)	0.30 (0.22)	-1.76 $**$ (0.42)	0.34 $\dagger$ (0.19)	-1.52 $**$ (0.36)	0.34 (0.44)
$\geq$ V.G. Health					-0.16 (0.23)	-0.45 $**$ (0.15)	-0.13 (0.22)	-0.45 $*$ (0.18)
$\leq$ Fair Health					0.21 (0.27)	-0.57 $**$ (0.21)	0.06 (0.33)	-0.48 $*$ (0.22)
Country Ctrls.	YES		YES		YES		YES	
τ			0.81 (2.58)				0.77 (1.00)	
N	4083		4083		3715		3715	
Func. Value	6.09		1.68		7.42		2.02	

Significance levels :$\dagger$: 10% $*$: 5% $**$: 1%. Significance levels are not displayed for θ_1 or δ. $\rho = 0.004$ and $R = 10$.

Simultaneous Duration (ELSA)

Variable	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)
δ	1.46 (0.12)		1.03 (0.32)		1.36 (0.18)		1.01 (0.13)	
θ_1	2.82 (0.17)	2.85 (0.11)	2.94 (0.34)	3.18 (1.11)	3.01 (0.36)	3.29 (0.27)	3.11 (0.19)	3.38 (0.18)
Age Diff.	-0.74 ** (0.26)	0.16 (0.16)	-0.56 ** (0.26)	0.01 (0.20)	-0.56 ** (0.42)	0.12 (0.19)	-0.53 (0.38)	-0.08 (0.23)
$\geq$ V.G. Health					0.16 (0.24)	0.05 (0.20)	0.12 (0.21)	0.11 (0.20)
$\leq$ Fair Health					0.29 (0.24)	0.14 (0.34)	0.22 (0.36)	0.17 (0.27)
τ			2.26 (5.13)				2.81 (2.56)	
N	1389		1389		1110		1110	
Func. Value	1.91		0.01		3.72		0.11	

Significance levels : † : 10% $*$: 5% $**$: 1%. Significance levels are not displayed for θ_1 or δ. $\rho = 0.004$ and $R = 10$.

Simultaneous Duration: Reform (ELSA)

Variable	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)	Wife Coef. (Std. Err.)	Husb. Coef. (Std. Err.)
δ	1.33 (0.13)		1.26 (0.22)	
θ_1	2.79 (0.19)	3.06 (0.21)	2.93 (0.27)	3.28 (0.18)
Reform	-0.71 ** (0.26)	0.05 (0.18)	-0.69 ** (0.31)	0.08 (0.22)
Age Diff.	-0.44 ** (0.36)	0.14 (0.19)	-0.31 (0.43)	0.13 (0.23)
$\geq$ V.G. Health			0.15 (0.18)	0.04 (0.19)
$\leq$ Fair Health			0.25 (0.24)	0.12 (0.29)
N	1389		1110	
Function Value	3.50		3.65	

Significance levels :† : 10% $*$: 5% $**$: 1%. Significance levels are not displayed for θ_1 or δ. $\rho = 0.004$ and $R = 10$.

Discussion

- Robustness checks (e.g., aggregation levels, auxiliary models).
- Expectations.
- Joint retirement pre- and post-crisis.

Thank You

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