Impact of later retirement on mortality

Evidence from French pension reform

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Motivation

Context

- Demographic ageing
- Financial sustainability of pension systems

Possible channels

- Later retirement increases health
- Later retirement decreases health

Motivation

Two main issues

- Academic issue: link between past career and health
    - Reverse causality issue
- Public policies issues: impact of pension system reforms
    - Acceptability of such reforms
    - Spill effect

Literature

- Large range of health outcomes:
  - **self-reported health** – Shai, 2018; Eibich, 2015; Coe and Zamarro, 2011; Coe and Lindeboom, 2008; Neumann, 2008
  - **mental health** – Mazonna and Peracchi, 2017; Bingley and Martinello, 2013; Bonsang et al., 2012; De Grip et al., 2012; Coe and Zamarro, 2011; Rohwedder and Willis, 2010
  - **physical health** – Neumann, 2008; Dave et al., 2008; Behncke, 2012
  - **health care expenditures** – Shai, 2018; Hagen, 2017; Caroli et al., 2016; Eibich, 2015
  - **health related-behaviors** – Godard, 2016; Eibich, 2015; Insler, 2014
- Choice to focus on mortality
  - Consequences of the whole past health
  - Comparability

Literature

Correlation between early retirement and mortality

- Quaade et al. (2002): positive association
- Kuhn et al. (2010): early retirement increases the chance of premature death

Correlation between later retirement and mortality

- Bamia et al. (2007): an increase in retirement age is associated with a decrease in mortality
- Tsai et al. (2005): no differences between those who retire at 60 and 65

$\Rightarrow$ Selection bias

Literature

- **Causal impact of retirement on mortality**
  - Hernaes et al. (2013): early retirement does not change mortality in Norway
  - Bloemen et al. (2017): early retirement decreases the probability of dying in Netherlands
  - Hagen (2017): later retirement does not change mortality in Sweden
  - Fitzpatrick and Moore (2018): a two percent increase in male mortality after age 62 (RDD on SS threshold) in the US

This paper

Objective

1. Estimate the causal **effect of later retirement on mortality**
   - 1st stage: causal effect of 1993 pension reform on later retirement age
   - 2nd stage: effect of later retirement on mortality

Main results

1. The 1993 pension reform has a strong impact on claiming age and can be used as IV
2. No significant impact of later retirement on mortality

Outline of the presentation

1. French pension system
2. Data
3. Empirical strategy
4. Results

Outline

French pension system

Before the reform, retirement with full replacement rate :

1. Be 60 or older and contribute 150 quarters
2. Be 65 or older

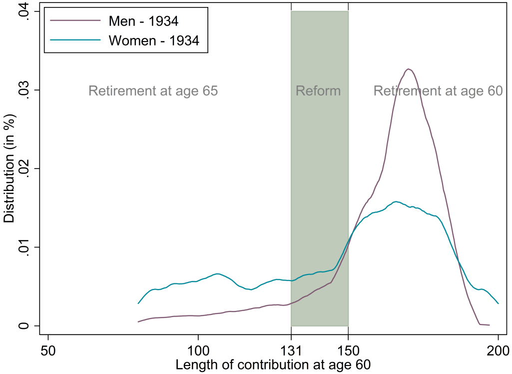
After the 1993 reform, condition 1. change:

Birth year	**Nb of contr. quarters**
1933 and before	150
1934	151
1935	152
1936	153
...	...
1942	159
1943 and after	160

Computation formula of pension benefit

Impact of the 1993 pension reform

Figure 1: Distribution of contribution length at age 60



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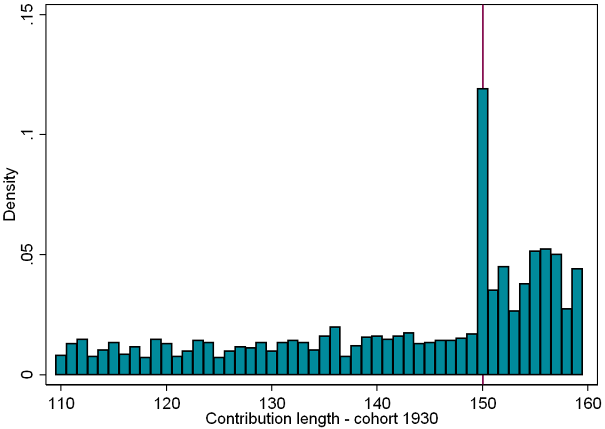
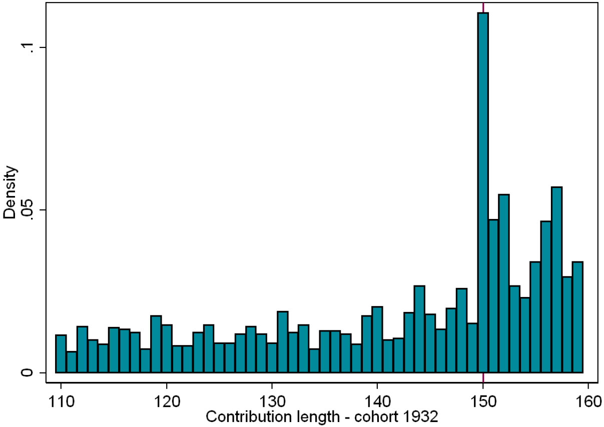
Impact of the 1993 pension reform

Figure 2: Distribution of contribution length – cohort 1930



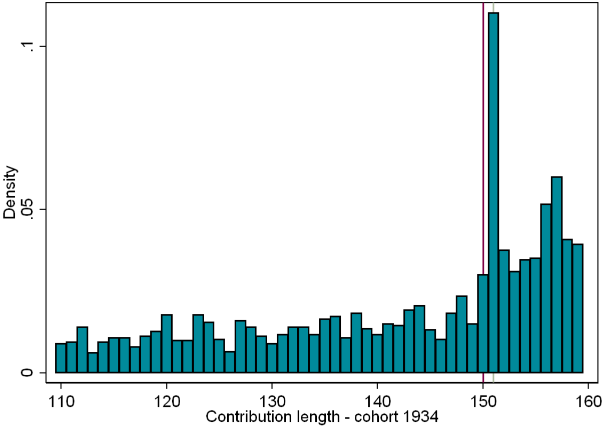
Impact of the 1993 pension reform

Figure 2: Distribution of contribution length – cohort 1932



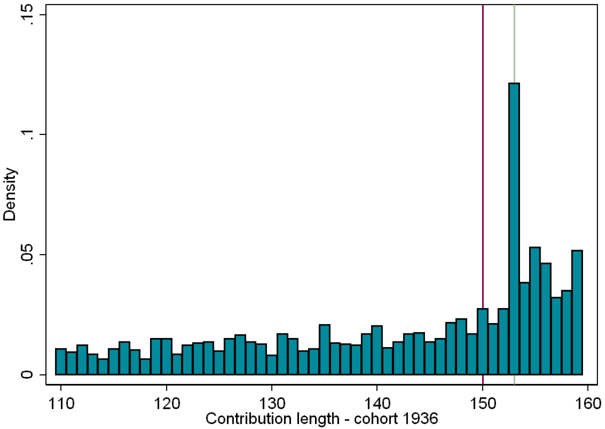
Impact of the 1993 pension reform

Figure 2: Distribution of contribution length – cohort 1934



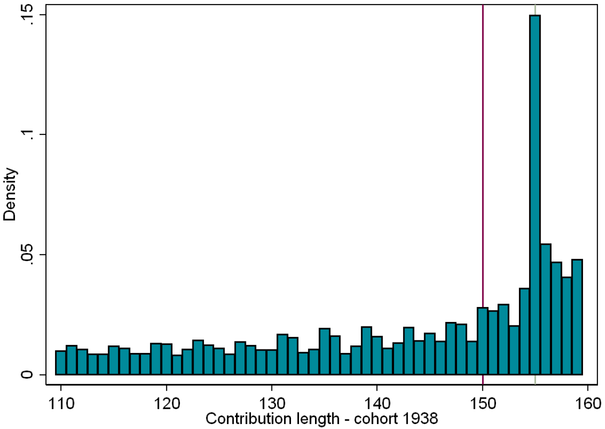
Impact of the 1993 pension reform

Figure 2: Distribution of contribution length – cohort 1936



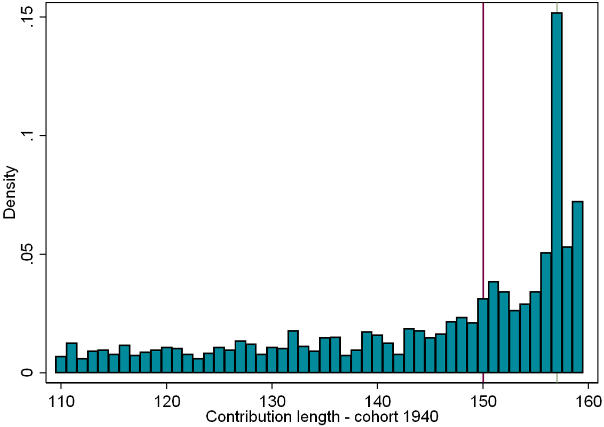
Impact of the 1993 pension reform

Figure 2: Distribution of contribution length – cohort 1938



Impact of the 1993 pension reform

Figure 2: Distribution of contribution length – cohort 1940



Outline

1. French pension system
2. Data
3. Empirical strategy
4. Results

Data

French administrative data on pension benefit

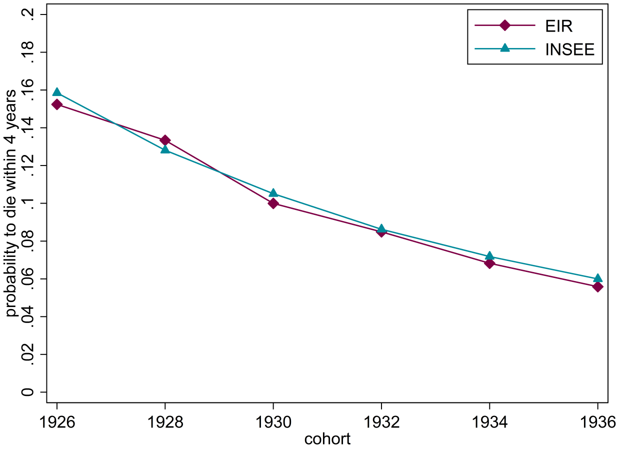
EIR: échantillon interrégime des retraités

- Waves every four years (2004, 2008, 2012)
- Include all retirees born in early october, all even years from 1906 to 1978
- Include information relevant for pension benefit computation (reference wage, contribution length, replacement rate, retirement age, claiming age)
- Information about death (dummy for being death in each wave, month and year of death)
- Characteristics of EIR are similar to the national population. Comparison of death: EIR and INSEE

Data

French administrative data on pension benefit

Figure 3: Death probability within 4 years – EIR and INSEE



Data
Sample

sample by cohort	**sample by age**
Wage earners in the private sector	
Have contributed at age 60 between 80 and 180 quarters	
Benefit from a normal pension (ie. no disability pension)	
born between 1930 and 1938	born in 1934 and 1938
Alive and retired **in 2004**	Alive and retired **at age 70**
Death probability in 2008 and 2012	Death at age 74
$N = 19,962$	$N = 9,588$

Detail on cohort selection

Data

sample

Figure 4: sample by cohort

wave 2004	
1930	74 y.o.
1932	72 y.o.
1934	70 y.o.
1936	68 y.o.
1938	66 y.o.

⟹

wave 2008	
1930	78 y.o.
1932	76 y.o.
1934	74 y.o.
1936	72 y.o.
1938	70 y.o.

Data

sample

Figure 5: sample by age

wave 2004	
1934	70 y.o.
wave 2008	
1938	70 y.o.

⟹

wave 2008	
1934	74 y.o.
wave 2012	
1938	74 y.o.

Data

Descriptive statistics

Compare to the national population, our sample is composed by relatively:

- Less women
- More farmers and executives
- Individuals in better health

Table 1: Descriptive statistics

	our sample	**EIR 2004**
Women	40.47%	49.64 %
Farmers	14.21%	10.85 %
Executives	3.47%	2.10%
Death	6.28%	6.57%

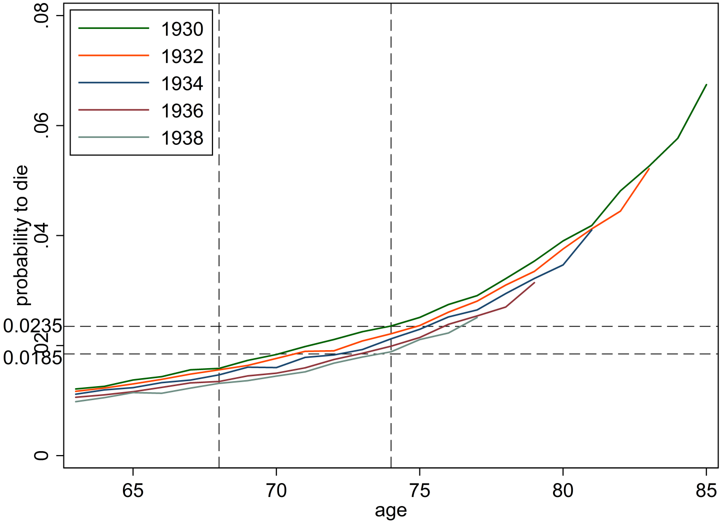
Data

Descriptive statistics

Table 2: Death probability by cohort

Birth year	Total	death proba. between 2004 and 2008		
		Our sample		National statistics
		N	%	% nat.
1930	3851	354	9.19	10.51
1932	3576	308	7.93	8.62
1934	3682	247	6.29	7.18
1936	3839	216	5.33	6.00
1938	6771	307	4.34	5.02
Total	22797	1432	6.28	

Figure 6: Death probability by cohort



Data

Variables of interest

Contribution length at claiming age (Age_{liq}):

- D_{liq}

Contribution length at age 60:

- $D_{60} = D_{liq} - 4(Age_{liq} - 60)$

Variation in contribution length due to the reform:

- $Var_{rcl} = (RCL_{c_i} - D_{60}) - (150 - D_{60})$

Detail

Outline

Empirical strategy

2SLS regression

- Identification strategy: Variation of required contribution length by cohort due to the 1993 reform
- **1st stage of 2SLS**:

$$Ret_i = \alpha_1 + \beta_1 Var_{rcl_i} + \sum_g \gamma_{1,g} \mathbb{1}_{\{yob_i = g\}} + \sum_t \delta_{1,t} \mathbb{1}_{\{D_{60_i} = t\}} + \zeta_1 X_i + \varepsilon_1$$

with:

- Ret_i, claiming age (in quarter) of individual i
- Var_{rcl_i}, quarter of contribution's variation due to the reform
- $\mathbb{1}_{\{yob_i = g\}}$, dummies for cohort
- $\mathbb{1}_{\{D_{60_i} = t\}}$, dummies for the contribution length at age 60
- X_i, control variables (sex, marital status, wage, executive, and farmer)

Empirical strategy
2SLS regression

- **2nd stage of 2SLS**:

$$q4_i = \alpha_2 + \beta_2 \hat{Ret_i} + \zeta_2 Xi + \varepsilon_2$$

with:

  - $q4_i$, Dummy=1 if individual i dies within four years
  - Ret_i, claiming age (in quarter) of individual i
  - X_i, control variables (cohort, sex, D_{60}, marital status, wage, executive and farmer)

- Alternative specification:

$$q8_i = \alpha_3 + \beta_3 \hat{Ret_i} + \zeta_3 Xi + \varepsilon_3$$

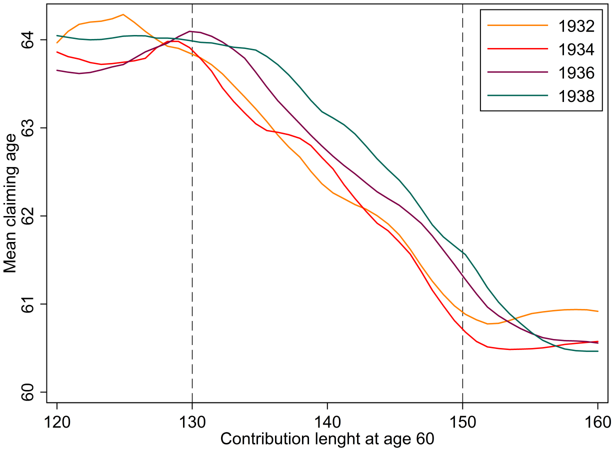
with $q8_i$, Dummy=1 if individual i dies within eight years

Outline

Results

Reform's effect on claiming age

Figure 7: Mean claiming age per contribution length at age 60



Results

Reform's effect on claiming age

Table 3: Effect of the reform on claiming age (first stage)

	All	Men	Women
Sample by cohort			
Reform	0.729***	0.856***	0.516***
	(0.0549)	(0.0637)	(0.0969)
N	19962	11999	7963
Sample by age			
Reform	0.823***	0.973***	0.572***
	(0.0807)	(0.0918)	(0.146)
N	9588	5846	3742

Control for: sex, cohort, executive, farmer, wage, marital status and contribution length at age 60. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Effect of delaying retirement on mortality

Table 4: Effect of later retirement on mortality within 4 years (second stage of the 2SLS) Alternative specification

	Total	Men	Women
Sample by cohort			
Claiming age	0.0070**	0.0056	0.0076
	(0.0031)	(0.0038)	(0.0057)
N	19962	11999	7963
Sample by age			
Claiming age	0.0042	0.0060	0.0005
	(0.0040)	(0.0050)	(0.0074)
N	9588	5846	3742

Control for: sex, cohort, executive, farmer, wage, marital status and contribution length at age 60. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Reduced form

Table 5: Effect of the reform on mortality within 4 years

	Total	Men	Women
Sample by cohort			
Reform	0.0051**	0.0048	0.0039
	(0.0022)	(0.0033)	(0.0028)
N	19962	11999	7963
Sample by age			
Reform	0.0034	0.0059	0.0003
	(0.0032)	(0.0049)	(0.0043)
N	9588	5846	3742

Control for: sex, cohort, executive, farmer, wage, marital status and contribution length at age 60. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Results

Robustness checks

- Non-significant 0.004 effect when controlling for differential mortality effects

Control for sample selection effect Robustness checks

- Results are never significant when cohort 1938 is dropped
- Results are virtually unchanged with contribution length at age 60 between 120 and 160 quarters
- CI=[-0.005;0.02]
- Reduced form See RF

Discussion

- Power analysis

Minimum detectable effect (Duflo, 2006):

$$MDE = (t_{1-k} + t_{\frac{\alpha}{2}}) * \sqrt{\frac{1}{p_T(1-p_T)}} * \sqrt{\frac{\sigma^2}{N}} \qquad (1)$$

Sample size required for a given MDE:

$$N = \frac{1}{p_T(1-p_T)} * \left(\frac{\sigma * (t_{1-k} + t_{\frac{\alpha}{2}})}{MDE}\right)^2 \qquad (2)$$

Other MDE formula | Graph of statistical power

Discussion

Table 6: MDE considering the sample size

	Sample size	Share of treated	Death proba.	$\hat{\beta}$	MDE
Us	9,588	16.88%	6.09%	0.004	0.02
Bloemen	133,379	82.48%	0.8832%	-0.026	0.001887
Hernaes	148,037	80.00%	5.90%	0.002	0.0043
Hagen	133,026	29.05%	4.30%	0.000283	0.0034

Discussion

Table 7: Required sample size considering an expected MDE

	MDE	N
Our main sample	0.004	200,000
Bloemen et al. (2017)	-0.026	703
Hernaes et al. (2013)	0.002	680,108
Hagen et al. (2017)	0.000283	16,435,400

Discussion

Conclusion

- Large impact of the 1993 reform on claiming age
- No significant impact on mortality when controlling for differential mortality effects

Limits: selection effects

- Selection of individuals alive at age 70
- Selection of individuals who benefit from a normal pension
- Disentangle income effect and later retirement effect
- The reform does not affect individuals with very long or short career Detail

Futher work

- Use exhaustive data to improve the power of our results

Appendix

Table A1: Detail of EIR cohort by cohort

	october		EIR				
Cohort	**from**	**to**	**1997**	**2001**	**2004**	**2008**	**2012**
1930	1	6	Yes	Yes	Yes	Yes	Yes
1932	1	6	Yes	Yes	Yes	Yes	Yes
1934	1	6	Yes	Yes	Yes	Yes	Yes
	7	10	No	Yes	No	Yes	Yes
	11	12	No	Yes	No	No	No
1936	1	6	Yes	Yes	Yes	Yes	Yes
	7	10	No	No	No	Yes	Yes
1938	1	6	Yes	Yes	Yes	Yes	Yes
	7	10	No	No	Yes	Yes	Yes
	11	24	No	No	Yes	No	Yes

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pension formula:

$$P = \tau \times PC \times W_{ref}$$

with τ the replacement rate, PC, the proratisation coefficient, and W_{ref} the reference wage

Replacement rate formula (pre-reform):

$$\tau = 0.5 - \delta \times max[0; min(4 \times (65 - a); 150 - d)]$$

with a is the claiming age; d the number of quarters contributed; and δ is the minimization coefficient, equal to 1.25 % per missing quarter. Back to presentation

Table A2: Reform impact

Var_{rcl}	Cohort	D_{60}
0	1930-32	All
	1934	$\in [0; 130] \cup [151; +\infty[$
	1936	$\in [0; 130] \cup [153; +\infty[$
	1938	$\in [0; 130] \cup [155; +\infty[$
1	1934	$\in [131; 151[$
	1936	$\in (\{131\}; \{152\})$
	1938	$\in (\{131\}; \{153\})$
2	1936	$\in (\{132\}; \{151\})$
	1938	$\in (\{132\}; \{153\})$
3	1936	$\in [133; 151[$
	1938	$\in (\{133\}; \{152\})$
4	1938	$\in (\{134\}; \{151\})$
5	1938	$\in [135; 151[$

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Table A3: Effect of later retirement on mortality within 4 years (IV – binary model with endogenous explanatory variable)

	Total	Men	Women
Sample by cohort			
Claiming age	0.0070**	0.0056	0.0076
	(0.0031)	(0.0038)	(0.0057)
N	19962	11999	7963
Sample by age			
Claiming age	0.0040	0.0068	0.0004
	(0.0040)	(0.0050)	(0.0090)
N	9588	5846	3742

Control for: sex, cohort, executive, farmer, wage, marital status and contribution length at age 60. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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Table A4: 2SLS

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Dep. variable: death from 2004 to 2008

	Total			Men			Women		
Panel	m.e.	s.e.	N	m.e.	s.e.	N	m.e.	s.e.	N
A	0.0109	(0.0085)	4996	0.0098	(0.0118)	2677	0.0111	(0.0113)	2319
B	0.0108	(0.0071)	13518	0.0067	(0.0083)	7993	0.0191	(0.0154)	5525
C	0.0072**	(0.0036)	7136	0.0076	(0.0050)	3888	0.0046	(0.0051)	3248
D	0.0070**	(0.0031)	19962	0.0056	(0.0038)	11999	0.0076	(0.0057)	7963

Dep. variable: death from 2004 to 2012

	Total			Men			Women		
Panel	m.e.	s.e.	N	m.e.	s.e.	N	m.e.	s.e.	N
A	0.0118	(0.0123)	4996	0.0105	(0.0170)	2677	0.0136	(0.0174)	2319
B	0.0110	(0.0102)	13518	0.0136	(0.0124)	7993	0.0087	(0.0196)	5525
C	0.0049	(0.0052)	7136	0.0030	(0.0069)	3888	0.0066	(0.0080)	3248
D	0.0035	(0.0043)	19962	0.0026	(0.0053)	11999	0.0028	(0.0081)	7963

Dep. variable: death within four years

	Total			Men			Women		
Panel	m.e.	s.e.	N	m.e.	s.e.	N	m.e.	s.e.	N
E	0.0071	(0.0089)	2450	0.0116	(0.0133)	1322	0.0043	(0.0116)	1128
F	0.0122	(0.0081)	6725	0.0149	(0.0100)	3953	0.0124	(0.0153)	2772
G	0.0055	(0.0054)	3308	0.0110	(0.0076)	1831	-0.0018	(0.0074)	1477
H	0.0042	(0.0040)	9588	0.0060	(0.0050)	5846	0.0005	(0.0074)	3742

Control for: sex, cohort, executive, farmer, wage, marital status and contribution length at age 60. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each line presents the coefficient associated with Var_{rcl} (m.e.) for men and women resp. Panel A (resp. B) includes individuals born in 1930, 32, 34, 36 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters). Panel C (resp. D) includes individuals born in 1930, 32, 34, 36 and 38 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters). Panel E (resp. F) includes individuals born in 1932 and 36 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters). Panel G (resp. H) includes individuals born in 1934 and 38 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters).

Table A5: RF

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	Dep. variable: death from 2004 to 2008								
	Total			Men			Women		
sample	m.e.	s.e.	N	m.e.	s.e.	N	m.e.	s.e.	N
A	0.0076	(0.0057)	4996	0.0074	(0.0089)	2677	0.0069	(0.0065)	2319
B	0.0074	(0.0047)	13518	0.0059	(0.0072)	7993	0.0085	(0.0057)	5525
C	0.0055**	(0.0027)	7136	0.0065	(0.0042)	3888	0.0030	(0.0033)	3248
D	0.0051**	(0.0022)	19962	0.0048	(0.0033)	11999	0.0039	(0.0028)	7963
	Dep. variable: death from 2004 to 2012								
	Total			Men			Women		
sample	m.e.	s.e.	N	m.e.	s.e.	N	m.e.	s.e.	N
A	0.0082	(0.0084)	4996	0.0080	(0.0130)	2677	0.0085	(0.0104)	2319
B	0.0076	(0.0069)	13518	0.0118	(0.0106)	7993	0.0039	(0.0086)	5525
C	0.0038	(0.0040)	7136	0.0025	(0.0059)	3888	0.0043	(0.0051)	3248
D	0.0026	(0.0032)	19962	0.0023	(0.0046)	11999	0.0014	(0.0042)	7963
	Dep. variable: death within four years								
	Total			Men			Women		
sample	m.e.	s.e.	N	m.e.	s.e.	N	m.e.	s.e.	N
E	0.0060	(0.0075)	2450	0.0104	(0.0119)	1322	0.0032	(0.0086)	1128
F	0.0095	(0.0060)	6725	0.0148	(0.0096)	3953	0.0061	(0.0070)	2772
G	0.0044	(0.0043)	3308	0.0098	(0.0067)	1831	-0.0012	(0.0050)	1477
H	0.0034	(0.0032)	9588	0.0059	(0.0049)	5846	0.0003	(0.0043)	3742

Control for: sex, cohort, executive, farmer, wage, marital status and contribution length at age 60. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each line presents the coefficient associated with Var_{rcl} (m.e.) for men and women resp (linear probability model). Panel A (resp. B) includes individuals born in 1930, 32, 34, 36 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters). Panel C (resp. D) includes individuals born in 1930, 32, 34, 36 and 38 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters). Panel E (resp. F) includes individuals born in 1932 and 36 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters). Panel G (resp. H) includes individuals born in 1934 and 38 who have contributed between 120 and 160 quarters (resp. 80 to 180 quarters).

Table A6: Formules MDE et Taille d'échantillon optimale

	Bloom (1995)	Duflo(2006)	McConnell et al. (2015)
MDE	$\sqrt{\frac{p_0(1-p_0)(1-R^2)A^2}{T(1-T)N}}$	$\sqrt{\frac{A^2 p(1-p)}{T(1-T)N}}$	$\sqrt{\left(\frac{p_0(1-p_0)}{1-T}+\frac{p_1(1-p_1)}{T}\right)\frac{A^2}{N}}$
N^*	$\frac{p_0(1-p_0)(1-R^2)A^2}{T(1-T)\delta^2}$	$\frac{A^2 p(1-p)}{T(1-T)\delta^2}$	$\frac{A^2}{\delta^2}\times\left(\frac{p_0(1-p_0)}{1-T}+\frac{p_1(1-p_1)}{T}\right)$

avec N la taille d'échantillon;
N^* la taille d'échantillon requise pour un coefficient δ;
δ le MDE;
T la proportion de traités;
p La probabilité que l'outcome binaire soit égal à 1 $(p = p(Y = 1)$;
$p_0 = p(Y = 1|T = 0)$ et $p_1 = p(Y = 1|T = 1)$;
$(1 - R^2)$ obtenu en régressant T sur les covariables.
$A = t_{1-k} + t_{\alpha/2}$.

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Figure A1: Représentation graphique de la puissance statistique

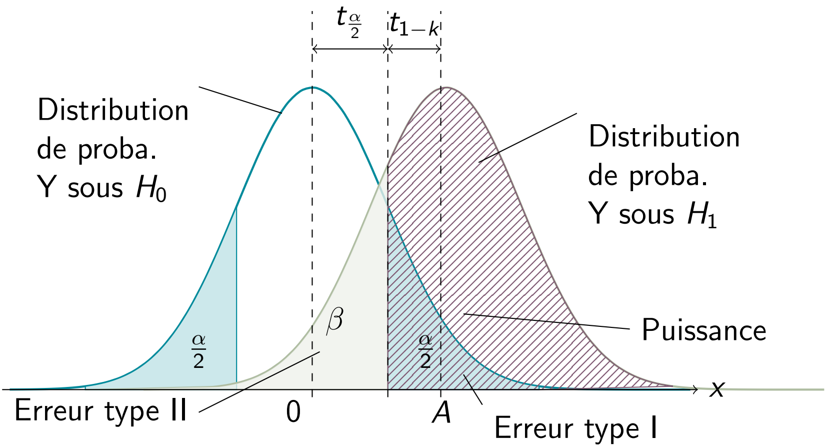

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Table A7: Définition des deux types d'erreur

		Vraie valeur	
		$\beta = 0 \Leftrightarrow H_0 vraie$	$\beta \neq 0 \Leftrightarrow H_0 fausse$
Valeur estimée	$\beta = 0 \Leftrightarrow H_0$ acceptée	OK	Erreur type II
	$\beta \neq 0 \Leftrightarrow H_0$ rejetée	Erreur type I	OK

◂ Retour à la présentation