DIFFERENTIATING RETIREMENT AGE TO COMPENSATE FOR HEALTH DIFFERENCES

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DISCUSSION PAPER | 2020 / 15

UCLouvain

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April 2020

Abstract

Population ageing in Europe calls for an overall rise of the age of retirement. However, most observers agree that the latter should be differentiated to account for individuals' heterogeneous health when they grow older. This paper explores the relevance of this idea using European SHARE panel data. It first quantifies the health gradient across European countries, and within each of them across sociodemographic groups (i.e. gender$X$education) at typical retirement age. It then estimates the degree of retirement age differentiation that would be needed to equalise expected health at the moment of retirement. Results point at the need of a very high degree of differentiation to equalise expected health, across and within European countries. But the paper also shows that systematic retirement age differentiation would fail to match a significant portion of the full distribution of health status. In a world synonymous with systematic health-based retirement age differentiation, there would still be a lot of what health economists call F-mistakes ([F]ailure of treatment ie. no retirement for people in poor health) and E-mistakes ([E]xcessive treatment ie. people in good health going for retirement).

Keywords: Ageing, Health, Retirement Policy

JEL Codes: J14, I1, J26

1 Introduction

The increase in life expectancy is arguably the most remarkable by-product of economic growth and medical progress. Since the end of the 19$^{\text{th}}$ century, advanced economies have been gaining roughly 2.4 years of longevity every decade (Oeppen and Vaupel, 2002). But this trend — in combination with lower fertility — translates into population ageing. And this has far-reaching economic and socio-political consequences. *Ceteris paribus* population ageing will cause declining labour forces and rising old-age dependency. This may hurt economic growth and the overall quality of life if governments need to divert public spending from, say, education or infrastructure investment to fund elderly-related obligations.

Different things could adjust to combat the contraction of the working age population and the rise of old-age dependency and have been explored theoretically and empirically (Acemoglu and Restrepo, 2018; Acemoglu, 2010). They comprise a higher female participation to the labour force (at least in the countries where it remains very low), slightly longer hours of works, less unemployment or even shorter initial education. But so far, the most common form of adjustment retained by policy markers consists of raising the age of effective retirement. Researchers at the OECD (Martins et al., 2005) have shown numerically that indexing retirement age on (rising) life expectancy could stabilise old-age dependency ratios around their current levels, preventing dramatic tax increases to finance pay-as-you-go pensions, or a general reduction of the level of pensions. And indeed stricter retirement policies implemented since the mid-1990s have proved effective at increasing employment rates (Atalay and Barrett, 2015), although from an historically low level (Costa, 1998).

However, one concern often raised is whether such policies are fair, as elderly workers may differ a lot in terms of their health status[1] and remaining life expectancy.[2] This paper intends to analyse that question by focusing on the health gradient across different countries and, within these countries, across different sociodemographic groups around the age at which retirement typically takes place. It is also to examine the relevance of an automatically differentiated retirement age policy[3] that would aim at equalising expected health at the

[1] A related but quite different question is how many individuals still have the capacity to work beyond a certain age. For a illustration of how SHARE data can be used to quantify that capacity at different ages and in different countries refer to Wise (2017)) .

[2] There is strong evidence that ill health at 50 is correlated with a shorter life span/early death. De Nardi, French, and Jones (2016) show that lifespan is 3.3 years shorter for those with bad health than for those with good health, while Pijoan-Mas and Ríos-Rull (2014) show the equivalent numbers are 5.6 for men and 4.7 for women at age 50.

[3] By "automatically" we mean that the right to retire at a certain age would be granted just on the condition of belonging to a certain category. There would be no need to undergo screening and be subjected

moment of retirement. If ageing is a key determinant of ill health, and if groups' health differ significantly, health-informed retirement age differentiation could represent a relatively straightforward way of making retirement policy more equitable. The question we ask more specifically is this paper is: what would it take in terms of lowering(raising) the retirement age to ensure that all sociodemographic groups retire in similar (ill)-health?

The key result of this paper is that the degree of retirement age differentiation required to equalise health is important, ranging from 50 in Poland (POL) to 76 in Switzerland (CHE). It is also very important across socio-econonomic groups within countries. On average, across the EU, women should be allowed to retire 3 years earlier than men. And very often tertiary-educated individuals should retire more than 10 years latter than those with less than an upper-secondary education attainment.

The rest of this paper is organised as follows. Section 2 reviews the existing literature on retirement age differentiation and exposes our contribution to that literature. In Section 3, we present the SHARE data on (ill-)health used in this empirical paper. Section 4 exposes how we compute the differentiated retirement ages. Section 5 presents the main results of the paper, while Section 6 concludes.

2 Literature

This paper contributes to the literature on ageing and retirement, and more precisely on the importance of health (and indirectly longevity) heterogeneity across countries, across sociodemographic groups within each country, and also between individuals within these groups. It explores empirically whether (and to which extent) policymakers should/can take that heterogeneity into account when designing pension systems; in particular when deciding on legal retirement ages. This paper relates to the literature on health and retirement/labour supply, but with the important nuance that the focus is more on how age of eligibility should vary to account for the existence of a health gradient than on how the latter influences individuals' timing of retirement (for a review of the latter question see French and Jones, 2017). That shift of focus partially reflects the European context underpinning this paper, where retirement is still largely driven by State-edicted rules, and decided paternalistically by the authorities. Along those lines, this paper relates to the literature on demanding occupations and (early)retirement provision (Pestieau and Racionero, 2016; Vermeer, Mastrogiacomo,

to individualised checks, as it is the case to get disability benefits.

and Van Soest, 2016). Also, it presents empirical evidence about the difficulty of properly targeting (or "tagging" using the term coined by Akerlof, 1978) individuals suffering for ill health. The tagging problem was discussed theoretically in the context of pension/disability benefit design (Cremer, Lozachmeur, and Pestieau, 2007) where individuals self-report they health status under imperfect information, creating adverse selection. The problem documented in the final section of this paper is not so much about imperfect information causing adverse selection. It has more to do with the relevance of using group average differences when what truly matters is addressing each individual's specific situation. A focus on group differences, with significant dispersion within each group, leads to what Cornia and Stewart (1993) calls F-mistakes (failure of treatment) and E-mistakes (excessive treatment).

3 Data

This paper uses waves 1-2 and 4-7 (2004-2017) of the SHARE survey; a total of 220,233 individuals$X$waves (Table 1). All individuals in SHARE are 50 or older when interviewed for the first time. Data limitations of different sorts (missing values or variables, absence of repeated observations as the country participated only in one wave) explain that we retain in the analysis only 17 out of the 29 participating countries (AUT, BEL, CHE, CZE, DEU, DNK, ESP, EST, FRA, GRC, ITA, LUX, NLS, POL, SVN, SWE).

SHARE contains a rich set of items describing people's physical health status that we use extensively here. SHARE also contains information about people's mental and cognitive health, but we do not utilise it in this paper. Most health items are self-reported, and many are subjective in the sense that they correspond to how people perceive and self-assess their overall health status (Table 2). But SHARE questionnaires also explicitly refer to many specific health conditions — diagnosed by health professionals (heart attack, hypertension, cholesterol, stroke, diabetes, lung disease, cancer, ... (Table 3). SHARE interviewers also realise measurements like the maximum grip strength of respondents (last column of Table 3).

In what follows, we will make extensive use of physical ill-health indices. These are computed as the first principal component[4] of items listed in Table 2 and Table 3. The relationship of these health indices with age, in each of the 18 countries, is on display on Figure 1. Quite logically we see that the incidence of ill health goes up with age. However,

[4]The values reported later have been standardised internationally. This means that a one-unit change of the index corresponds to one standard deviation of the international distribution of the health index

there are important differences across countries. For instance at the age of 67, the ill-health index in Switzerland (CHE) at -.482 is much lower than in Estonia (EST) where is reaches .36 (Figure 1 long dash lines). There are also differences as to the intensity of the ill health/age gradient. In other words, both the level and the slope of the solid curve vary internationally.

Table 1: Number of respondents by wave

	AUT	BEL	CHE	CZE	DEU	DNK	ESP	EST	FRA	GRC	ITA	LUX	NLS	POL	SVN	SWE	Total
1	607	1,653	409	0	1,239	704	946	0	1,179	1,097	1,055	0	1,261	0	0	1,266	11,416
2	916	2,647	1,243	2,303	2,173	2,189	1,794	0	2,215	2,650	2,331	0	2,285	2,046	0	2,268	27,060
4	4,006	4,304	3,172	4,491	1,318	1,906	2,792	5,357	4,390	0	2,754	0	2,342	1,410	2,178	1,574	41,994
5	3,315	4,528	2,518	4,536	4,825	3,520	4,792	4,206	3,526	0	3,583	1,330	3,499	0	2,339	3,786	50,303
6	2,523	4,639	2,292	3,914	3,704	3,177	3,864	4,098	3,043	3,824	4,072	1,296	0	1,457	3,348	3,078	48,329
7	2,338	3,759	1,835	3,163	2,996	2,711	3,134	3,350	2,482	2,259	3,238	924	0	3,808	2,731	2,403	41,131
Total	13,705	21,530	11,469	18,407	16,255	14,207	17,322	17,011	16,835	9,830	17,033	3,550	9,387	8,721	10,596	14,375	220,233
N	220,233																

Source: SHARE 2004-2017

Table 2: Subjective health evaluation. Respondents aged 50-79

	Poor health[a]	Self-perc. bad health[b]	Long-term illness[c]	Limits[d]	Limits[e]	Limits[f]
AUT	2.90	2.90	0.46	2.44	0.11	0.22
BEL	2.92	2.92	0.45	2.44	0.17	0.25
CHE	2.62	2.62	0.34	2.64	0.06	0.10
CZE	3.26	3.26	0.52	2.35	0.14	0.24
DEU	3.17	3.17	0.59	2.37	0.13	0.18
DNK	2.47	2.47	0.49	2.58	0.10	0.17
ESP	3.18	3.18	0.45	2.66	0.12	0.23
EST	3.75	3.75	0.70	2.23	0.22	0.33
FRA	3.08	3.08	0.43	2.51	0.12	0.17
GRC	2.83	2.83	0.31	2.75	0.06	0.18
ITA	3.11	3.11	0.36	2.58	0.10	0.17
LUX	2.97	2.97	0.46	2.45	0.11	0.18
NLS	2.85	2.85	0.46	2.35	0.07	0.16
POL	3.59	3.59	0.64	2.28	0.23	0.31
SVN	3.22	3.22	0.47	2.42	0.15	0.21
SWE	2.65	2.65	0.52	2.50	0.10	0.15

Source: SHARE 2004-2017
[a]:1-5 European scale
[b]:1-5 US scale
[c]:Yes (1) No (0).
[d]:Limited in activities because of health (3-1 scale).
[e]:Number of limitations with activities of daily living.
[f]:Limitations with instrumental activities of daily living.

Table 3: Health items: incidence of objective conditions (+ grip strength). Respondents aged 50-79

	Hart attack	Hypertension	Cholesterol	Stroke	Diabete	Lung disease	Cancer	Ulcer	Parkinson	Cataract	Hip fracture	Mobility[a]	Grip [b]
AUT	0.10	0.39	0.22	0.04	0.12	0.06	0.04	0.04	0.01	0.07	0.01	1.24	35.15
BEL	0.09	0.33	0.31	0.03	0.10	0.06	0.05	0.06	0.01	0.05	0.02	1.28	35.88
CHE	0.06	0.28	0.15	0.02	0.07	0.04	0.04	0.02	0.00	0.06	0.01	0.64	35.72
CZE	0.12	0.49	0.25	0.04	0.17	0.07	0.05	0.05	0.01	0.08	0.02	1.38	34.91
DEU	0.10	0.41	0.19	0.03	0.13	0.07	0.07	0.03	0.01	0.07	0.01	1.19	36.78
DNK	0.08	0.32	0.23	0.03	0.07	0.07	0.05	0.03	0.01	0.06	0.01	0.82	37.78
ESP	0.08	0.36	0.28	0.02	0.15	0.05	0.04	0.03	0.01	0.07	0.01	1.30	30.51
EST	0.16	0.47	0.20	0.04	0.12	0.06	0.05	0.08	0.01	0.08	0.01	1.73	34.42
FRA	0.10	0.31	0.24	0.02	0.11	0.05	0.05	0.03	0.01	0.05	0.01	1.15	34.24
GRC	0.09	0.38	0.28	0.02	0.11	0.04	0.02	0.07	0.00	0.05	0.02	1.38	33.32
ITA	0.08	0.39	0.23	0.02	0.11	0.05	0.03	0.03	0.00	0.05	0.01	1.22	33.11
LUX	0.09	0.33	0.33	0.02	0.11	0.07	0.07	0.06	0.01	0.07	0.02	1.21	35.26
NLS	0.09	0.27	0.18	0.03	0.09	0.07	0.05	0.02	0.00	0.05	0.01	0.89	36.68
POL	0.16	0.44	0.23	0.04	0.14	0.05	0.04	0.06	0.01	0.06	0.01	1.90	34.24
SVN	0.10	0.44	0.26	0.03	0.13	0.05	0.05	0.06	0.00	0.06	0.02	1.53	35.36
SWE	0.10	0.36	0.17	0.03	0.10	0.04	0.06	0.02	0.01	0.08	0.02	0.88	36.25

Source: SHARE 2004-2017

[a]:Arm function and fine motor limitations.

[b]:Max. of grip strength measure.

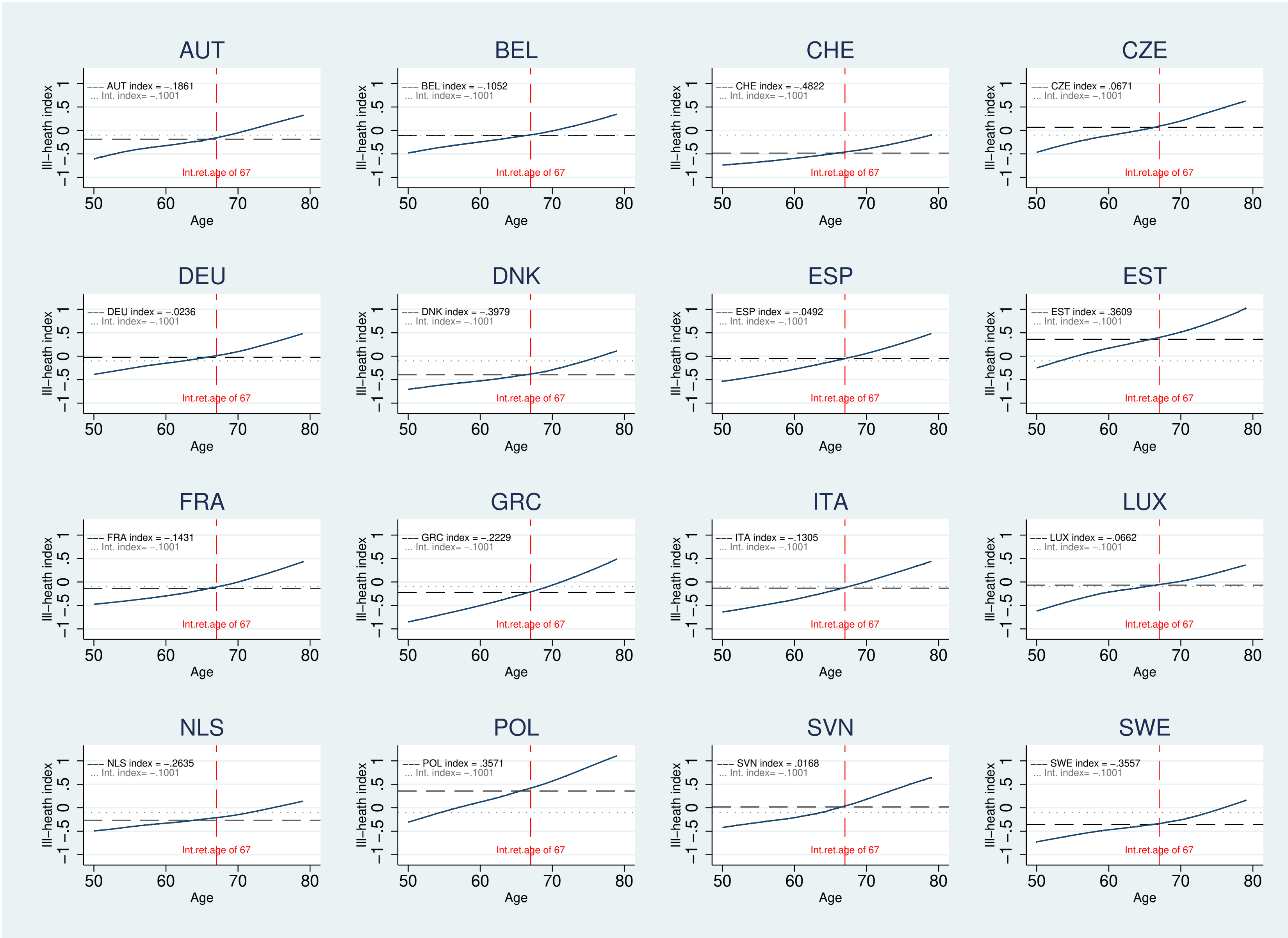

Figure 1: Ill-health index systematically rises with age, but intercept and slope vary across country

4 Analytical Framework

We deploy a two-stage estimation using the SHARE data. Stage one aims at identifying, for each country j, the degree of retirement age differentiation around the age of 67[5] that would ensure its people retire with a level of (expected) ill health equal to the international average. Formally, if Y_j^{67} represents the average ill-health index of respondents aged 67 in country j and Y^{67} the international average, there is potentially an ill-health index gap in that country equal to the difference between these two terms. If β_j^{67} represents the marginal effect of a year of age on the ill-health index[6], then one can estimate the age of retirement ensuring equalisation of expected ill health as

$$
\begin{aligned}
a_j &= 67 - \frac{|Y_j^{67} - Y^{67}|}{\beta_j^{67}} \text{ if } Y_j^{67} > Y^{67} \\
a_j &= 67 + \frac{|Y_j^{67} - Y^{67}|}{\beta_j^{67}} \text{ if } Y_j^{67} < Y^{67}
\end{aligned}
\tag{1}
$$

Stage two proceeds along the same lines as stage one, but within each country j and for each sociodemographic group k. The retirement age differentiation is computed around the stage-one-estimated and country-specific retirement age a_j, using the ill-health gap applicable to group k and of the marginal impact of a year of age on the ill-health index $\beta_{j,k}^{a_j}$ of that group around age a_j.

$$
\begin{aligned}
a_{j,k} &= a_j - \frac{|Y_{j,k}^{a_j} - Y^{a_j}|}{\beta_{j,k}^{a_j}} \text{ if } Y_{j,k}^{a_j} > Y^{a_j} \\
a_{j,k} &= a_j + \frac{|Y_j^{a_j} - Y^{a_j}|}{\beta_{j,k}^{a_j}} \text{ if } Y_{j,k}^{a_j} < Y^{a_j}
\end{aligned}
\tag{2}
$$

Key with such a setting are estimates of the ill-health index gaps and of the βs. As to the latter, we resort to fixed-effect estimation (FE) that exploits the panel dimension of SHARE data (remember that SHARE consists of up to 7 waves, measuring individuals' ill health every 2-3 years). In other words, the estimated βs) only reflect the within-respondent deterioration of health over time. This eliminates many of the biases that may contaminate

[5]Internationally, the age of 67 is gradually becoming the new reference (OCDE, 2019). Not so long ago, the statutory retirement age was rather 65, at least for men.

[6]Note the presence of subscript j indicating that the marginal effect can vary from country to country, and the superscript 67 that it is calculated around the age of 67.

estimates based on cross-sectional data.

5 Results

5.1 Health-equalising differentiated retirement ages

Key results appear on Figure 2 and Table 4. They display the rather important degree of retirement age differentiation that would be required to equalise ill-health at the moment of retirement. Focusing on cross-country differences, we see that Poland (POL) is the country where the age of retirement would have to be the lowest at 50.07. By contrast, it would have to be as high a 76.21 in Switzerland (CHE). By construction, these retirement age differences mostly reflect ill-health gaps among elderly people. And it is quite interesting to visualise how much the former — and presumably also the latter — parallel GDP per capita differences (Figure 3).

Also, inside each country, additional differentiation of the age of retirement would be needed to account for the significant variations of health across sociodemographic groups. In Poland (POL) for instance, retirement age should range from 43.08 to 61.17. And in Switzerland our estimates are that it should be comprised between 71.48 and 81.86. The combination of across- and within-country ill-health differences among elderly individuals results in (ill-)health-equalising retirement ages ranging from 41.53 (Estonia, low-educated females) to 81.46 (Switzerland, highly-educated males).

Table 5 reports our estimates of the across-country ill-health gaps (3$^{\text{rd}}$ column), as well as their degree of significance (4$^{\text{th}}$ column). The last two columns report the FE-estimated marginal impact of one extra year of age on the ill-health index (β). The ratio of the ill-health gap by these βs is what drives the results presented in the first two columns of Table 4. The health gaps and βs underpinning the within-country-across-sociodemographic-group retirement age differentiation are reported in (resp.) Table 6 and Table 7.

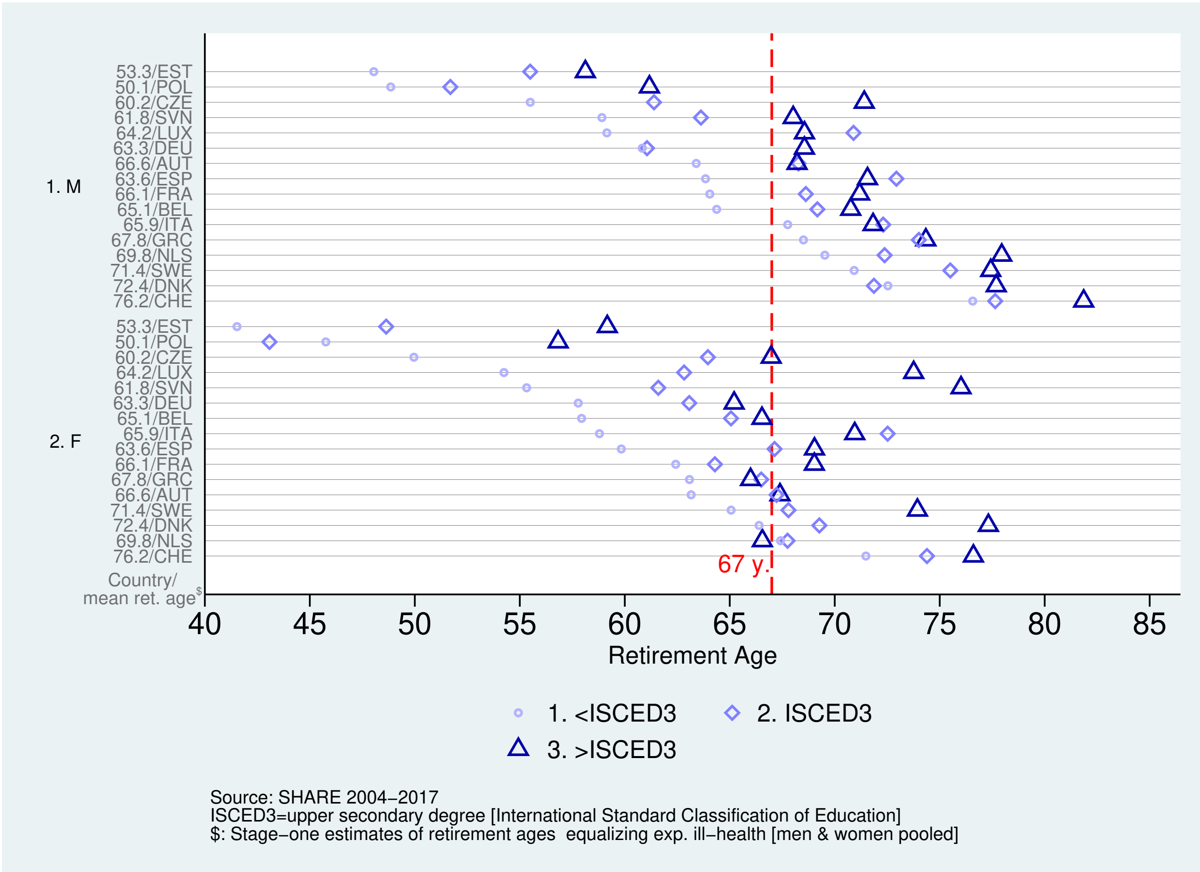

Figure 2: Differentiated retirement ages equalising (expected) ill health, across and within countries

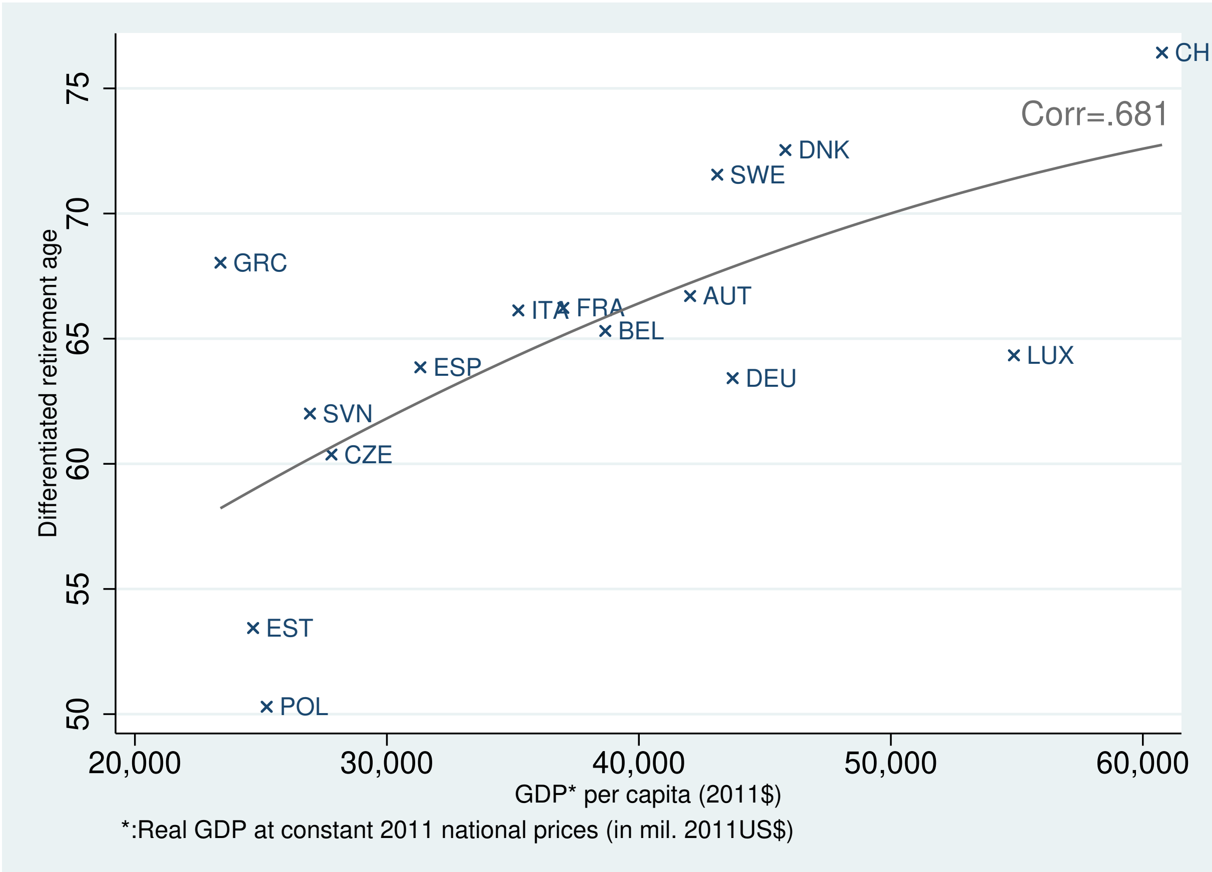

Figure 3: Differentiated retirement ages equalising (expected) ill health across countries. Correlation with GDP per head

Table 4: Differentiated retirement age equalising ill health. Between- and within-country differentiation

	Diff. retirement	Diff. to int. ref.(67)	Male			Female					
			<ISCED3	ISCED3[a]	>ISCED3	<ISCED3	ISCED3	>ISCED3	ret. max	ret. min	max-min
AUT	66.57	-0.43	63.40	68.27	68.21	63.16	67.23	67.39	68.27	63.16	5.11
BEL	65.13	-1.87	64.38	69.17	70.76	57.94	65.06	66.53	70.76	57.94	12.82
CHE	76.21	9.21	76.57	77.64	81.86	71.48	74.39	76.60	81.86	71.48	10.37
CZE	60.16	-6.84	55.50	61.39	71.40	49.96	63.96	66.97	71.40	49.96	21.45
DEU	63.27	-3.73	60.83	61.06	68.56	57.78	63.07	65.21	68.56	57.78	10.77
DNK	72.35	5.35	72.53	71.87	77.69	66.40	69.27	77.32	77.69	66.40	11.29
ESP	63.65	-3.35	63.85	72.94	71.56	59.84	67.13	69.04	72.94	59.84	13.10
EST	53.26	-13.74	48.05	55.50	58.12	41.53	48.64	59.17	59.17	41.53	17.64
FRA	66.05	-0.95	64.05	68.62	71.19	62.43	64.29	69.03	71.19	62.43	8.76
GRC	67.84	0.84	68.51	74.01	74.34	63.08	66.50	65.99	74.34	63.08	11.26
ITA	65.90	-1.10	67.76	72.31	71.83	58.79	72.52	70.95	72.52	58.79	13.72
LUX	64.16	-2.84	59.15	70.89	68.56	54.25	62.83	73.76	73.76	54.25	19.51
NLS	69.76	2.76	69.53	72.38	77.95	67.42	67.75	66.55	77.95	66.55	11.40
POL	50.07	-16.93	48.85	51.69	61.17	45.76	43.08	56.83	61.17	43.08	18.10
SVN	61.80	-5.20	58.91	63.63	68.02	55.33	61.60	76.02	76.02	55.33	20.69
SWE	71.38	4.38	70.93	75.50	77.43	65.06	67.80	73.94	77.43	65.06	12.37
Int. ref.	67										

Source: SHARE 2004-2017

[a]: ISCED3=upper secondary degree [International Standard Classification of Education]”

Table 5: Ill-health cross-country differences around the age of 67

	[a] Ill-health index [int. ref]	[b] Ill-health index[a]	[b]-[a] Ill-health gap (ref. intern.av.)	H0 [b]-[a]=0 (p-value)	β^{b} marginal impact of one year of age	H0 β=0 (p-value)
AUT	-0.100	-0.186	-0.09	0.0000	0.0548	0.0000
BEL	-0.100	-0.105	-0.01	0.7861	0.0400	0.0000
CHE	-0.100	-0.482	-0.38	0.0000	0.0341	0.0000
CZE	-0.100	0.067	0.17	0.0000	0.0346	0.0000
DEU	-0.100	-0.024	0.08	0.0001	0.0442	0.0000
DNK	-0.100	-0.398	-0.30	0.0000	0.0405	0.0000
ESP	-0.100	-0.049	0.05	0.0072	0.0376	0.0000
EST	-0.100	0.361	0.46	0.0000	0.0393	0.0000
FRA	-0.100	-0.143	-0.04	0.0210	0.0409	0.0000
GRC	-0.100	-0.223	-0.12	0.0000	0.0432	0.0000
ITA	-0.100	-0.131	-0.03	0.0952	0.0337	0.0000
LUX	-0.100	-0.066	0.03	0.4537	0.0402	0.0000
NLS	-0.100	-0.263	-0.16	0.0000	0.0344	0.0000
POL	-0.100	0.357	0.46	0.0000	0.0306	0.0000
SVN	-0.100	0.017	0.12	0.0000	0.0366	0.0000
SWE	-0.100	-0.356	-0.26	0.0000	0.0401	0.0000

Source: SHARE 2004-2017

[a]: A higher value indicates a poorer health

[b]: Estimated using "within" respondent variation of ill health across waves (ie. FE estimation).

Table 6: Ill-health within-country differences. Gaps by gender (Male,Female) and educational attainment[ISCED])

	Ill-health	Male index			Female index			Male, H0:gap=0			Female,, H0: gap=0		
	index[a]	<ISCED3	ISCED3[b]	>ISCED3	<iISCED3	ISCED3	>ISCED3	<ISCED3	ISCED3	>ISCED3	<ISCED3	ISCED3	>ISCED3
								[p-value]	[p-value]	[p-value]	[p-value]	[p-value]	[p-value]
AUT	-0.186	0.20	-0.09	-0.08	0.24	-0.03	-0.03	0.0667	0.0502	0.1495	0.0000	0.3809	0.4795
BEL	-0.105	0.03	-0.16	-0.24	0.32	0.00	0.00	0.4341	0.0005	0.0000	0.0000	0.9584	0.2922
CHE	-0.482	-0.01	-0.06	-0.21	0.12	0.05	0.05	0.8802	0.1913	0.0062	0.0340	0.2204	0.9233
CZE	0.067	0.16	-0.06	-0.44	0.26	-0.12	-0.12	0.0006	0.1518	0.0000	0.0000	0.0000	0.0000
DEU	-0.024	0.13	0.11	-0.25	0.31	0.01	0.01	0.3468	0.0042	0.0000	0.0000	0.7984	0.2010
DNK	-0.398	-0.01	0.02	-0.23	0.31	0.11	0.11	0.9203	0.6987	0.0001	0.0000	0.0624	0.0086
ESP	-0.049	-0.01	-0.28	-0.28	0.15	-0.10	-0.10	0.8076	0.0001	0.0000	0.0000	0.1546	0.0093
EST	0.361	0.25	-0.09	-0.28	0.43	0.16	0.16	0.1199	0.0307	0.0000	0.0002	0.0000	0.0000
FRA	-0.143	0.11	-0.10	-0.23	0.16	0.05	0.05	0.0263	0.0096	0.0000	0.0001	0.2273	0.0372
GRC	-0.223	-0.03	-0.27	-0.29	0.20	0.05	0.05	0.5440	0.0000	0.0000	0.0000	0.3991	0.4400
ITA	-0.131	-0.07	-0.24	-0.31	0.23	-0.13	-0.13	0.0245	0.0000	0.0000	0.0000	0.0031	0.0150
LUX	-0.066	0.09	-0.27	-0.25	0.37	0.08	0.08	0.4601	0.0050	0.0069	0.0001	0.4451	0.0103
NLS	-0.263	0.01	-0.09	-0.25	0.08	0.07	0.07	0.8828	0.2231	0.0004	0.1497	0.3531	0.2514
POL	0.357	0.05	-0.07	-0.41	0.13	0.10	0.10	0.7742	0.3557	0.0078	0.1430	0.0556	0.0012
SVN	0.017	0.21	-0.08	-0.26	0.26	0.00	0.00	0.0251	0.0729	0.0003	0.0000	0.9222	0.0000
SWE	-0.356	0.02	-0.18	-0.26	0.25	0.11	0.11	0.6229	0.0004	0.0000	0.0000	0.0210	0.0530

Source: SHARE 2004-2017
[a]: A higher value indicates a poorer health
[b]: ISCED3=upper secondary degree [International Standard Classification of Education]”

Table 7: Marginal impact of one year of age on ill health (β). Breakdown by gender (M,F) and educational attainment[ISCED])

	β	β's Male[a]			β's Female[a]			Male, H0:β=0			Female, H0:β=0		
	country level[a]	<ISCED3	ISCED3[b]	>ISCED3	<ISCED3	ISCED3	>ISCED3	<ISCED3 [p-value]	ISCED3 [p-value]	>ISCED3 [p-value]	<ISCED3 [p-value]	ISCED3 [p-value]	>ISCED3 [p-value]
AUT	0.05	0.06	0.05	0.05	0.07	0.05	0.05	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
BEL	0.04	0.05	0.04	0.04	0.04	0.03	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CHE	0.03	0.04	0.04	0.04	0.03	0.03	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CZE	0.03	0.03	0.05	0.04	0.03	0.03	0.04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DEU	0.04	0.05	0.05	0.05	0.06	0.04	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DNK	0.04	0.05	0.05	0.04	0.05	0.04	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ESP	0.04	0.04	0.03	0.04	0.04	0.03	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
EST	0.04	0.05	0.04	0.06	0.04	0.04	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FRA	0.04	0.06	0.04	0.04	0.04	0.03	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GRC	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
ITA	0.03	0.04	0.04	0.05	0.03	0.02	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LUX	0.04	0.02	0.04	0.06	0.04	0.06	0.03	0.1980	0.0009	0.0000	0.0011	0.0000	0.0620
NLS	0.03	0.04	0.04	0.03	0.03	0.04	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
POL	0.03	0.04	0.04	0.04	0.03	0.01	0.04	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001
SVN	0.04	0.07	0.04	0.04	0.04	0.02	0.02	0.0000	0.0000	0.0000	0.0000	0.0002	0.0003
SWE	0.04	0.05	0.04	0.04	0.04	0.03	0.03	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: SHARE 2004-2017
[a]:Estimated using "within" respondent variation of ill health across waves (ie. Fixed Effect estimation) around the country-specific retirement age
[b]: ISCED3=upper secondary degree [International Standard Classification of Education]"

5.2 The limit to retirement age differentiation

In this section, we focus on what happens inside each country, and we examine what econometricians call the importance of the variance "within" sociodemographic groups. So far, inside each country, we have essentially been looking at the "between" group variance in an attempt to differentiate retirement age (i.e. introduce a certain dose of tagging Akerlof, 1978). We have shown that (ill-)health varies significantly between groups at any given age beyond 50 (Table 6). And we have used these differences (in combination with group-specific age/ill health gradients) to compute differentiated retirement ages ensuring equalisation of expected ill health across groups (Table 4).

But his amounts to focusing on the average characterising the different sociodemographic groups, ignoring the potentially huge dispersion within each of them. The point is that we are then prone to making what Cornia and Stewart (1993) calls F-mistake and E-mistake errors. The first type of errors, synonymous with "failure of treatment", corresponds to individuals suffering from ill health but who belong to the socioeconomic group that — on average — fairs relatively well and got assigned a high retirement age. The second type of errors — synonymous with "excessive" treatment, is just the symmetric case; i.e. individuals whose health is expected to be relatively bad given the socioeconomic group they belong to, and thus are allowed to retire early, but who *de facto* are in good shape. Note that type-E and type-F errors could easily be related to the concept of statistical discrimination. Arrow (1971) and Phelps (1972) explained in their seminal works that a decision maker could based his decision on average characteristics and, by doing so, some high-performing members belonging to an under-performing group are discriminated against. The same could arise in the context of differentiated retirement. In particular, frail "rich" individuals risk being penalised because the social planner only considers the average health status of the rich as a group.

Figure 4 illustrates, for some of the countries forming our data set, how difficult it is to avoid Type-F and Type-E errors. Both remain very frequent whatever the age band considered. There is no doubt that highly educated females are, on average, in better health than their less-educated peers. The doted line in grey is clearly located to the left of the solid line. But it is also clear that distributions overlap. There are highly-educated females with a high ill-health index (higher than the average for low-educated females). These would be denied early retirement in spite of their ill health. Similarly, there are many low-educated women with a low ill-health index (lower than the average for highly-educated women). This hints at the possibility of many low-educated women in relatively good condition who would (illegitimately) be granted the right to retire early due to inaccurate tagging.

One way to go beyond visual evidence is to resort to variance decomposition techniques commonly used in microeconometrics. Table 8 contains the share of total country-level ill-health variance explained by the sociodemographic categories (Gender$X$Education) used above. As the last column suggests, that share is small, often inferior to 5%, and never larger than 9%.

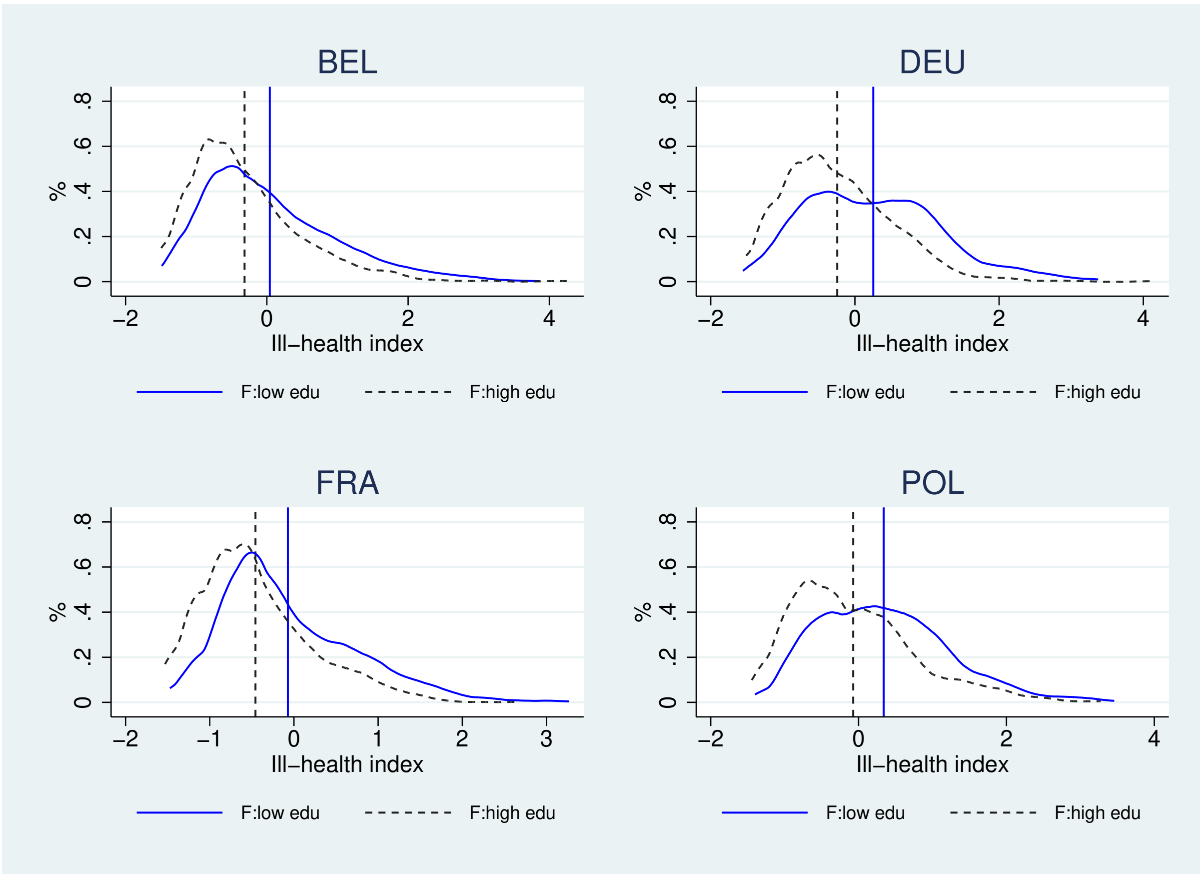

Figure 4: The difficulty to tag (importance of type-E and type-F errors). The case of low- vs. highly-educated females aged 55-65 in Germany (DEU), France (FRA), Belgium (BEL) and Poland (POL)

Table 8: Share of variance of ill health inside countries explained by sociodemographic categories

	Ill-health index	Variance ill-health	Share explained [a]
AUT	-0.24	0.75	0.02
BEL	-0.17	0.76	0.03
CHE	-0.54	0.61	0.02
CZE	0.03	0.76	0.09
DEU	-0.02	0.69	0.06
DNK	-0.47	0.88	0.03
ESP	-0.10	0.69	0.02
EST	0.41	0.69	0.09
FRA	-0.18	0.65	0.02
GRC	-0.37	0.69	0.05
ITA	-0.13	0.69	0.02
LUX	-0.09	0.80	0.08
NLS	-0.24	0.67	0.02
POL	0.33	0.76	0.06
PRT	0.32	0.64	0.05
SVN	-0.04	0.69	0.09
SWE	-0.40	0.78	0.03

Source: SHARE 2004-2017
[a]:Using 6 sociodemographic groups (i.e. gender X education, where education consists of 3 levels [<ISCED3, ISCED3=upper secondary degree, >ISCED3])

6 Concluding Remarks

This paper has explored the idea of a differentiated retirement age policy aimed at accounting for people's health inequality when they grow older. Using European SHARE data on health and how the latter varies across countries, and within countries across sociodemographic groups, we compute the degree of retirement age differentiation that would be required to equalise (ill)-health at the moment of retirement. Such a policy would be a way to systematise earlier suggestions that pensions reforms (in particular those aimed a raising the retirement age) should make an exception for workers with demanding occupations, since health considerations may make it unreasonable to expect them to work longer. They also echo recent work on the fairness of retirement systems under unequal lifetime (Ponthiere, 2020); health and residual life expectancy are indeed highly correlated.

Results of this paper are essentially fourfold.

First, European elderly populations vary significantly in terms of their health around the typical retirement ages. This is true across countries (with evidence that higher GDP per capita translates into better health), but also within countries, between sociodemographic groups, with lower-educated elderly individuals being systematically less health than their more educated peers.

Second. Unsurprisingly, ageing causes a decline of health. This is true in every European country considered here and across every sociodemographic group we examined. But this almost trivial result also means that advancing (or postponing) the age or retirement is a way to equalise (expected) health at the moment of retirement.

Third, that equalisation can be achieved both across countries and inside each country, but requires extensive retirement age differentiation. To equalise expected health for the different sociodemographic groups forming their populations, most European countries would have to admit more than 10 years of difference between those with the worst vs. best health status.

Fourth, there are limitations as to what can be achieved via health-based retirement age differentiation. SHARE data clearly show that such a policy would still be prone to extensive F-mistake errors (failure of treatment i.e. retirement rights not granted to people in poor health) and E-mistake errors (excessive treatment i.e. rights granted to people in good health). And this is essentially due to the importance of what econometricians call "within" socioeconomic group variation of health status; and the fact that retirement age differentiation would, by construction, be based on "between" group statistical (thus average) differences. In Section 5.2, we show that allowing retirement age to differ across 6 groups (3 educational attainment levels X gender) would account for (at most) 9% of country-level health variance. If what matters socially is the equalisation of each individual's health upon retirement (and not just group average equalisation) then the gains that can be achieved by abandoning a uniform retirement age policy are probably limited.

Of course, other policies than differentiated retirement could be adopted. And some of our results are supportive of this option. For instance, the sheer magnitude of health status differences highlighted here legitimises upstream public-health policies, or other social policies aimed at combating health inequality, already at early stages of life. Also, the importance of the unaccounted interindividual health inequalities within our retirement groups probably calls for a more individualised treatment of health differences. But, in principle, this is the role of disability insurance. In many countries, disability benefits are closely linked to old age pension systems. And their role is to provide "retirement" opportunities (i.e. replacement earning) to people who suffer from ill health but aren't yet eligible for proper retirement/pension money.[7] And it is also common that workers who receive disability benefits subsequently shift to the old-age pension system once they reach the official retirement age. This raises the question of which policy is best suited to account for health inequalities. Should policymakers go for *i)* socioeconomic, group-based differentiated retirement ages as we simulate in this paper? Or should they stick to what has been the historical norm; i.e. *ii)* a unique/uniform retirement age, supplemented by disability benefits conditional on individualised — but time-consuming and also error-prone (Cremer, Lozachmeur, and Pestieau, 2007) — assessment of health status?

Acknowledgement

This paper uses data from SHARE Waves 1, 2, 4, 5, 6 and 7. See Börsch-Supan et al. (2013) for methodological details.

The SHARE data collection has been funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N211909, SHARE-LEAP: GA N227822, SHARE M4: GA N261982) and Horizon 2020 (SHARE-DEV3: GA N676536, SERISS: GA N654221) and by DG Employment, Social Affairs Inclusion. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see www.share-project.org)

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