



Career Arduousness and [Healthy] Life Expectancy in Europe

An assessment based on SHARE and O*NET data

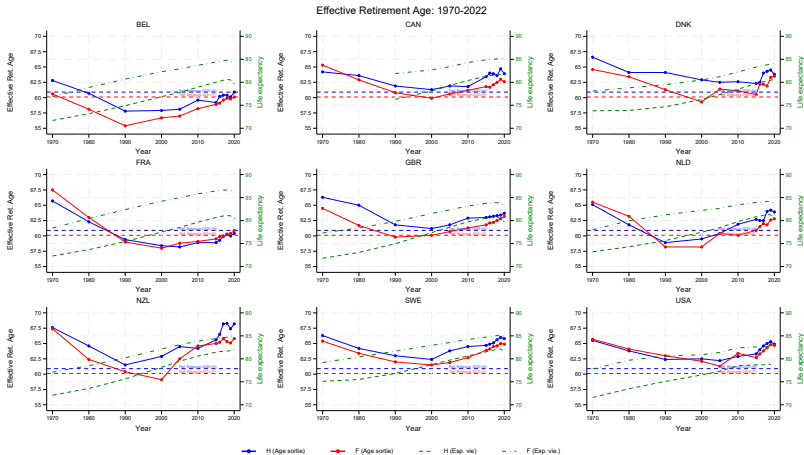
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Belgian Labour Day, Sept. 2026

Introduction

- ▶ The typical policy response to population ageing $\Rightarrow$ raise/index the retirement age ▶ Effective ret.age
- ▶ This has reignited calls for **differentiated retirement ages** compensating **work arduousness** (Bismarck)
- ▶ This paper explores the relevance and feasibility of this idea in Europe
 1. It first quantifies career arduousness using **SHARE wave 7** retrospective ISCO4-digit data on careers + **US O*NET working conditions data**.
 2. Then, using SHARE follow-up data that collect information on ill-health and death among wave 7 respondents, it estimates **(healthy) life expectancy** by career arduousness decile, combining **econometrics** and **life table** methods.
 3. Finally, it discusses retirement policy implications



Source: OECD 2023. Life Expectancy at 40

Figure 1: Effective retirement age in the OECD

Key findings

- ▶ Life expectancy gap between the least (1st dec.) and most arduous careers (10th dec.): 3.2 (M) to 4.2 (F) years.
- ▶ Healthy life expectancy gap. . . : 5.3 (M) to 9 (F) years.
- ▶ Overall, compensatory retirement policies matter more in lower GDP countries ==> higher prevalence of arduous careers
- ▶ Some limitations to Retirement Age Differentiation

Contribution to work arduousness/retirement literature

Ayuso et al. (2016); Leroux et al. (2015) ; Vermeer et al. (2016);
Vandenberghe (2021); Baurin (2021)

- ▶ **The long-term view:** unlike job demands/quality literature (Bakker and Demerouti, 2007; Chen et al., 2017) we prioritize long-term effects: late-life health+ longevity
- ▶ Not just the consequences of the current job, but the succession of jobs forming a **complete career**.
- ▶ The retirement **policy debate** link

Data

SHARE job history: 7th wave, job history (ISCO4) ▶ job history

O*NET occupation arduousness: A direct quantification of work arduousness by ISCO 4 occupation ▶ arduousness

SHARE health beyond 50: many items to quantify (ill)-health

Other SHARE modules used:

- waves 8, 9, 10 and End-of-Life Interviews → likelihood of death
- Pre-labour market determinants: educational attainment and health endowment (parents' death status, pre-15 health status)

Outline of the rest of the analysis

3 steps

- ▶ Quantification of the career arduousness of SHARE wave 7 respondents using Principal Component Analysis (PCA) of O*NET occupational data
- ▶ Estimating econometrically the risk of death/ill health by decile of career arduousness using SHARE follow-up/health data
- ▶ Computing a life table/(healthy) life expectancies for each career arduousness decile

STEP 1 - Quantifying career arduousness

Share job history [▶ Data](#)

International occupational classification

	cnt3	mergeid	agey	yjobs1	yjobf1	yjobs2	yjobf2	yjobs3	yjobf3	isco1	isco2
1.	AUT	AT-001215-01	78	1956	1957	1958	1958	1958	1984	General office cl	Accounting associ
2.	AUT	AT-001492-01	65	1969	1971					General office cl	
3.	AUT	AT-001492-02	66	1970	1971	1972	1985	1985	2013	Draughtspersons	
4.	AUT	AT-001881-01	87	1944	1987					Agricultural and	
5.	AUT	AT-001881-02	93	1943	1945	1945	1984			Science and engin	Subsistence mixed
6.	AUT	AT-002136-01	66	1978	1980	1980	2012			Dentists	Dentists
7.	AUT	AT-002136-03	64	1970	1980	1980	2012			General office cl	Dental assistants
8.	AUT	AT-002525-01	75	1956	1968	1968	1975	1975	2002	Window cleaners	Textile, fur and
9.	AUT	AT-002525-02	75	1956	1966	1966	2002			Bricklayers and r	Mail carriers and
10.	AUT	AT-002800-01	66	1973	2014					Business services	

Figure 2: SHARE w7: job history

STEP 1 - O*NET arduousness

► Data

Principal component analysis: computing one arduousness score per occupation using O*NET data

1. Occupations × O*NET items

Mean item scores on a 1–5 scale; 3 of 54 items shown

Occupation <i>i</i> / Item <i>j</i>	Public Speaking	Telephone	Whole Body Vibration ¹
Business professionals	$z_{ij}=3.4$	3.1	1.0
Teachers	4.8	2.8	1.0
Drivers / mobile plant	1.5	3.0	4.5
Building trades workers	1.3	2.7	4.0

2. Standardise

Centre and scale each item across occupations

$$z_{ij} = (\text{score}_{ij} - \text{item mean}_j) / SD_j$$

3. PCA

Find the weighted combination with the greatest variance

$$PC1_i = w_1 z_{i1} + \dots + w_3 z_{i3}$$

PC1 item weights (loadings) in this example

Item order above	-0.71	+0.05	+0.71
------------------	-------	-------	-------

4. PC1 arduousness scores

Occupation <i>i</i>	PC1 _{<i>i</i>}
Business professionals	-0.92
Teachers	-1.42
Drivers / mobile plant	+1.18
Building trades workers	+1.19

Illustrative data and PCA results, not O*NET estimates. The sign is chosen so physical exposure scores higher.

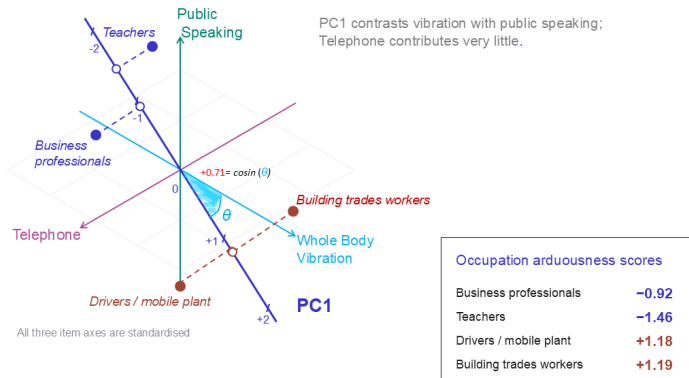
Figure 3: O*NET: arduousness

STEP 1 - O*NET arduousness

► Data

The geometry of the first principal component

Each dot is an occupation. Its projection onto PC1 gives its arduousness score.



$$\text{PC1} = +0.71 \times \text{Whole Body V.} + 0.05 \times \text{Telephone} - 0.71 \times \text{Public Speaking}$$

illustrative data and PCA results, not O*NET estimates.

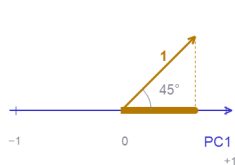
STEP 1 - O*NET arduousness

► Data

PC1 weights/loading factors graphically

The weights/loading factors are $\cos(\theta)$, where θ is the angle between an item axis and positive PC1.

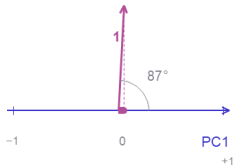
Whole Body Vibration



$$\cos(45^\circ) \approx +0.71$$

Aligned with positive PC1

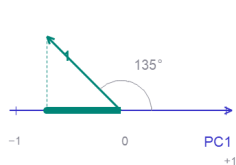
Telephone



$$\cos(87^\circ) \approx +0.05$$

Almost perpendicular to PC1

Public Speaking



$$\cos(135^\circ) \approx -0.71$$

Points against positive PC1

Illustrative data and PCA results, not O*NET estimates. The sign is chosen so physical exposure scores higher.

STEP 1 - SHARE & O*NET combined

► Data

mergeid	agey	gender	iscd_r	pen_1	pen_2	pen_3	njobs	ngaps	everpa~w	phealth	bmi	chron~7c
AT-001215-01	78	2	5	-0.98	-1.02	-0.20	3	0	1. Yes	1	30.06	5
AT-001492-01	65	2	3	-0.98	.	.	1	0	1. Yes	0	21.05	3
AT-001492-02	66	1	4	-0.75	.	.	1	1	1. Yes	0	23.89	2
AT-001881-01	87	2	1	0.90	.	.	1	0	1. Yes	0	26.40	2
AT-001881-02	93	1	1	0.58	0.91	.	2	0	1. Yes	0	34.66	4
AT-002136-01	66	1	6	-0.18	-0.18	.	2	0	1. Yes	1	27.13	4
AT-002136-03	64	2	3	-0.98	0.26	.	2	0	1. Yes	0	23.74	0
AT-002525-01	75	2	1	0.57	.	0.36	3	0	1. Yes	1	21.51	3
AT-002525-02	75	1	3	2.43	0.22	.	2	0	1. Yes	1	26.00	1
AT-002800-01	66	2	5	-0.78	.	.	1	0	1. Yes	1	22.84	3

Age, gender, educ

O*Net PC1

III health beyond 5

Figure 4: SHARE & O*NET combined (career arduousness) & SHARE health

STEP 1 - Arduousness, gender and GDP

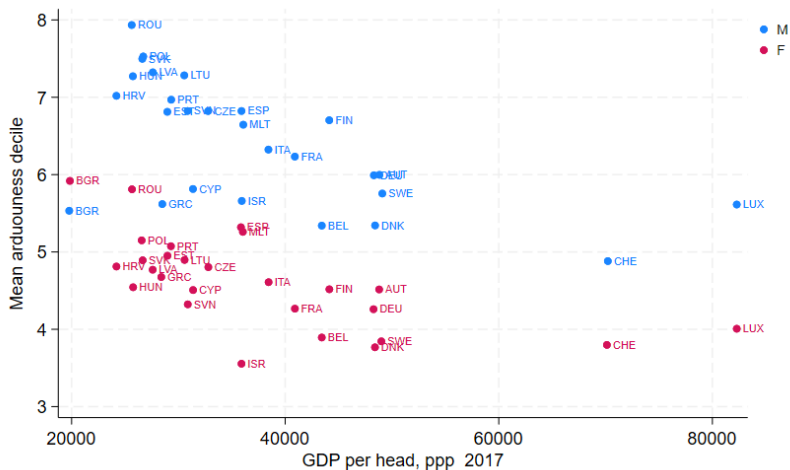


Figure 5: Country and Gender heterogeneity in terms of arduousness decile

STEP 1 -arduousness, gender and GDP (variant)

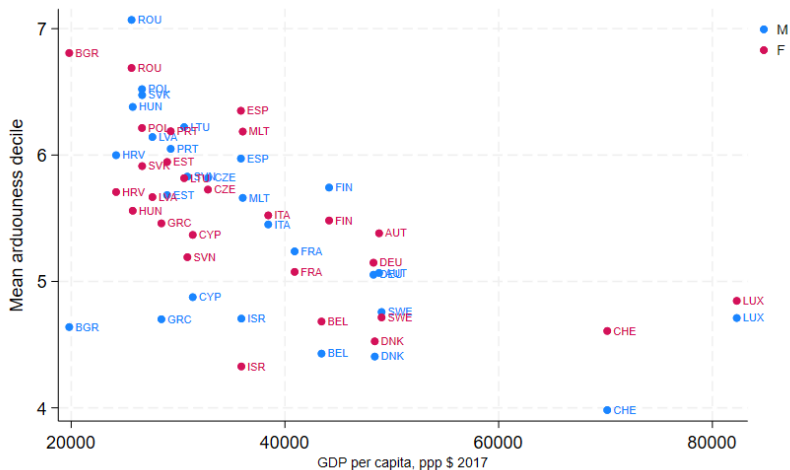


Figure 6: Country and Gender heterogeneity in terms of arduousness decile

STEP 1 - Career arduousness/ill-health beyond 50

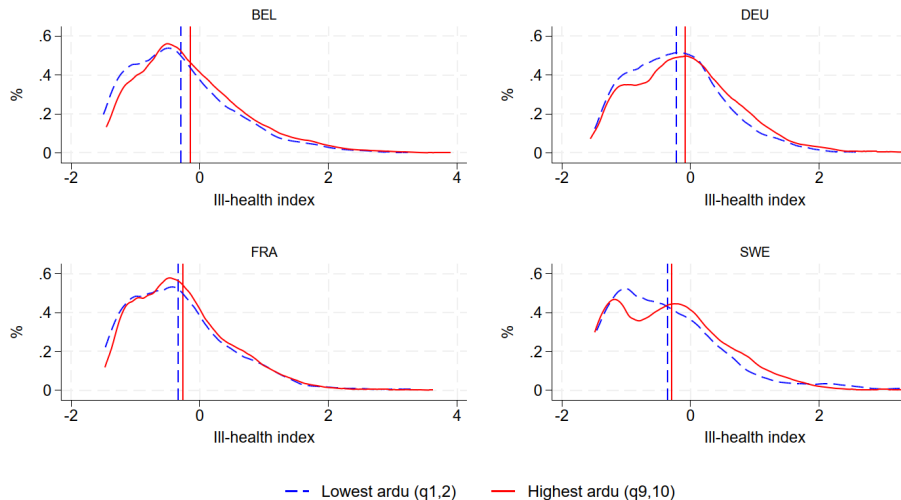


Figure 7: Results - illustration: Belgium, Germany, France, Sweden (55-64)

STEP 2 - from arduousness to death/ill health using econometrics

For each gender separately . . .

- ▶ We use follow-up data on death to compute death dummies
- ▶ Using health data by age, we compute ill-health dummies: “Good, Fair and Poor=1” v.s “Excellent and Very good=0”
- ▶ We then estimate a LOGIT model regressing death/bad health on AGE , AGE^2 , $ARDUdec$ and $ARDUdec \times AGE$.
- ▶ Controls:
 - duration of the career and COVID dummy (all models).
 - pre-labour endowment variables (parental death status and childhood health, plus educational attainment (variant))

▶ econometric results

STEP 3 - Estimating life tables by arduousness decile

Madans and Molla (2008)

- ▶ One life table for each career **arduousness decile** $k = 1, \dots, 10$
- ▶ Using death $\times$ age $\times$ ard. dec. pred. prob. $\hat{q}_{x,k}$, we compute the **survivorship** by age $\times$ arduousness dec. :

$$l_{x,k} = l_{x-1,k} \times (1 - \hat{q}_{x,k})$$

- ▶ NB: we impose survivorship for **ardu. dec. 4,5** equal EU ref. $l_{x,EU}$. For other deciles, we add to EU reference the **deviation** from our survivorship estimates and the average of our estimates for ardu. dec. 4,5:

$$\tilde{l}_{x,k} = l_{x,EU} + [l_{x,k} - \bar{l}_x]; k \neq 4, 5$$

STEP 3 - Estimating life tables by arduousness decile

- ▶ Using ill-health $\times$ age $\times$ ard. dec. pred. prob. $\widehat{bh}_{x,k}$, the healthy survivorship by age becomes:

$$\tilde{hl}_{x,k} = (1 - \widehat{bh}_{x,k}) \times \tilde{l}_{x,k}$$

- ▶ Finally, (healthy) life expectancies $e_{x,k}$; $he_{x,k}$ are computed as integrals (age 50-102) of (EU-normalized) survivorship functions $\tilde{l}_{x,k}$; $\tilde{hl}_{x,k}$.

Key results: Age 50 (healthy) life exp. (M)

Ard. dec.	Without controls					With controls			
	Levels		Gaps ^a			Levels		Gaps ^a	
	L. exp. ^b	H.l. exp. ^c	L. exp. ^d	H.l. exp. ^e	B.h.l.exp. ^f	L. exp. ^b	H.l. exp. ^c	L. exp. ^d	H.l. exp. ^e
1	31.91	23.24	0.00	0.00	0.00	31.58	22.39	0.00	0.00
2	31.68	22.76	-0.23	-0.48	0.25	31.40	22.01	-0.18	-0.38
3	31.45	22.27	-0.46	-0.97	0.51	31.19	21.62	-0.38	-0.77
4	31.07	21.52	-0.84	-1.72	0.89	30.90	21.09	-0.68	-1.29
5	30.44	20.71	-1.47	-2.54	1.06	30.44	20.50	-1.14	-1.88
6	30.44	20.11	-1.47	-3.13	1.66	30.44	20.06	-1.14	-2.33
7	29.73	19.17	-2.18	-4.07	1.89	29.93	19.39	-1.64	-2.99
8	29.03	18.10	-2.88	-5.14	2.26	29.41	18.56	-2.17	-3.83
9	28.57	17.39	-3.34	-5.85	2.51	29.07	18.06	-2.51	-4.32
10	27.61	16.09	-4.30	-7.16	2.85	28.38	17.08	-3.20	-5.30

Figure 8: (Healthy) life expectancy by ardu. dec. (M) at the age of 50

Key results: Age 50 (healthy) life exp. (F)

Ard. dec.	Without controls					With controls			
	Levels		Gaps ^a			Levels		Gaps ^a	
	L. exp.	H.l. exp.	L. exp.	H.l. expx	B.h.l.exp	L. exp.	H.l. exp.	L. exp.	H.l. expx
1	39.15	24.85	0.00	0.00	0.00	38.91	24.53	0.00	0.00
2	38.86	23.79	-0.29	-1.07	0.78	38.66	23.64	-0.25	-0.89
3	38.53	22.64	-0.63	-2.21	1.59	38.38	22.69	-0.53	-1.84
4	38.17	21.47	-0.99	-3.38	2.39	38.06	21.70	-0.85	-2.83
5	37.45	20.18	-1.70	-4.68	2.98	37.45	20.63	-1.45	-3.90
6	37.45	19.18	-1.70	-5.68	3.98	37.45	19.83	-1.45	-4.70
7	36.65	17.83	-2.51	-7.03	4.52	36.76	18.65	-2.14	-5.88
8	35.93	16.58	-3.22	-8.27	5.05	36.16	17.61	-2.75	-6.92
9	35.15	15.32	-4.00	-9.53	5.53	35.49	16.56	-3.41	-7.97
10	34.23	14.10	-4.92	-10.75	5.83	34.71	15.45	-4.20	-9.08

Figure 9: (Healthy) life expectancy by arduousness decile (F) at the age of 50

Implications for Retirement Policy

- ▶ Arduousness matters for [healthy]longevity
- ▶ There is a case for arduousness differentiated ret. ages
 - ▶ Compensating wage
- ▶ But
 - Implementation is complicated: econometrically (selection bias, expansion bias ▶ exp.b), and logistically
 - Legal challenges - Risk of moral hazard - Health and early death remain a lottery: ▶ lottery
 - Alternative policies exist: Health and disability (or life) **insurance**; Deannuitization/front-loaded retirement payments (Vandenberghe, 2024)
 - Implicit diff. ret exists ▶ Alternatives
 - ▶ Alternatives Gap M

-  Ayuso, Mercedes, Jorge Bravo, and Robert Holzmann (2016). *Addressing Longevity Heterogeneity in Pension Scheme Design and Reform*. IZA Discussion Papers 10378. Institute of Labor Economics (IZA).
-  Bakker, Arnold B and Evangelia Demerouti (2007). “The job demands-resources model: State of the art”. *Journal of managerial psychology* 22.3, pp. 309–328.
-  Baurin, Arno (2021). “The limited power of socioeconomic status to predict lifespan: Implications for pension policy”. *The Journal of the Economics of Ageing* 20, pp. 1–13.
-  Chen, Yang et al. (2017). “The Relationship between Job Demands and Employees’ Counterproductive Work Behaviors: The Mediating Effect of Psychological Detachment and Job Anxiety”. *Frontiers in Psychology* 8, pp. 1–15.
-  Leroux, Marie-Louise, Pierre Pestieau, and Grégory Ponthière (2015). “Longévité différentielle et redistribution: enjeux théoriques et empiriques”. *L’Actualité économique* 91.4. Publisher: HEC Montréal, pp. 465–497.

-  Madans, Jennifer H. and Michael T. Molla (2008). “Estimating healthy life expectancies using longitudinal survey data; methods and techniques in population health measures”. *Vital Health and Statistics Series 2* 146, pp. 1–24.
-  Vandenberghe, Vincent (2021). “Differentiating retirement age to compensate for health differences”. *IZA Journal of Labor Policy* 11.2, pp. 1–34.
-  Vandenberghe, Vincent (2024). “Partial de-annuitization of public pensions vs. retirement age differentiation: Which is best to account for longevity differences?” *Journal of Pension Economics and Finance* 23.1, pp. 111–131.
-  Vermeer, Niels, Mauro Mastrogiacomo, and Arthur Van Soest (2016). “Demanding occupations and the retirement age”. *Labour Economics* 43. Publisher: Elsevier, pp. 159–170.

Appendix: Econometrics

	Death				Bad health			
	M		F		M		F	
	M1	M2	M3	M4	M1	M2	M3	M4
Age	1.125*** (0.017)	1.128*** (0.017)	1.123*** (0.017)	1.126*** (0.017)	1.070*** (0.003)	1.067*** (0.003)	1.055*** (0.002)	1.049*** (0.002)
Age ²	1.001 (0.000)	1.000 (0.000)	1.001*** (0.000)	1.001*** (0.000)	1.000*** (0.000)	1.000*** (0.000)	1.000*** (0.000)	1.000*** (0.000)
Ard. dec.	1.150*** (0.027)	1.120*** (0.028)	1.186*** (0.036)	1.172*** (0.038)	1.125*** (0.004)	1.093*** (0.004)	1.132*** (0.004)	1.106*** (0.004)
Age X Ard. dec.	0.995*** (0.002)	0.995*** (0.002)	0.993*** (0.002)	0.992*** (0.002)	0.998*** (0.000)	0.998*** (0.000)	1.000 (0.000)	1.000 (0.000)
Career dur.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Covid	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Educ	No	Yes	No	Yes	No	Yes	No	Yes
Child health	No	Yes	No	Yes	No	Yes	No	Yes
Mother death status	No	Yes	No	Yes	No	Yes	No	Yes
Father death status	No	Yes	No	Yes	No	Yes	No	Yes

Figure 10: Econometrics results

Appendix: Age of death (Male)

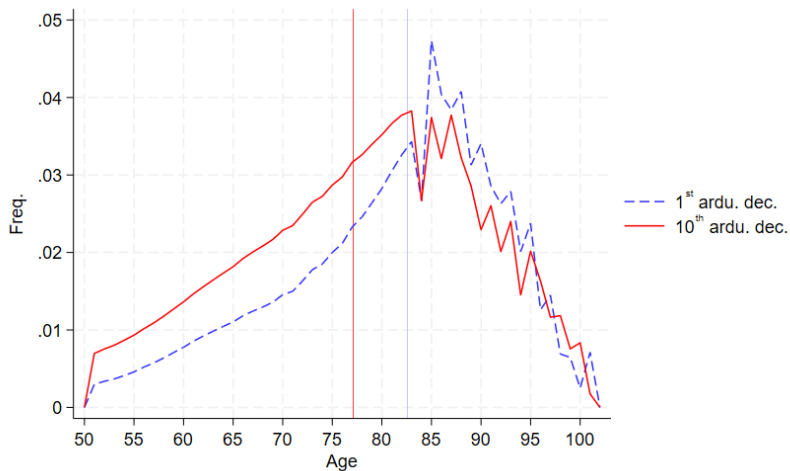


Figure 11: Age of death distribution: 1st vs 10th ardu. dec. (M)

Appendix: Age of death (Female)

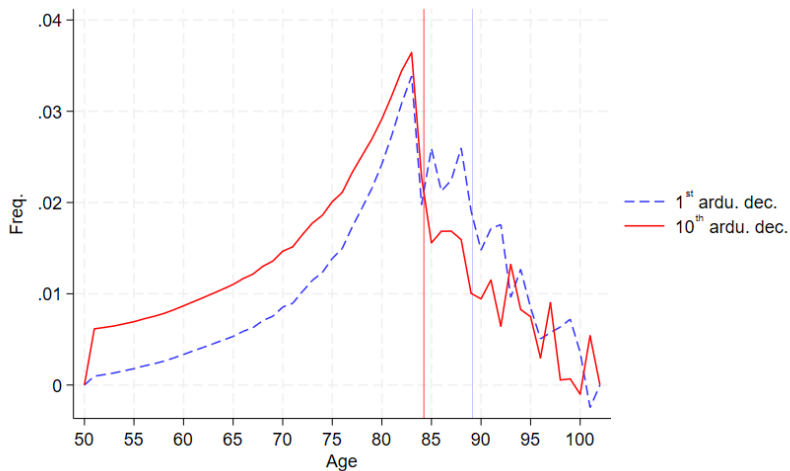


Figure 12: Age of death distribution: 1st vs 10th ardu. dec. (M)

Appendix: Employment (50-70) by arduousness dec.

► Conclusion

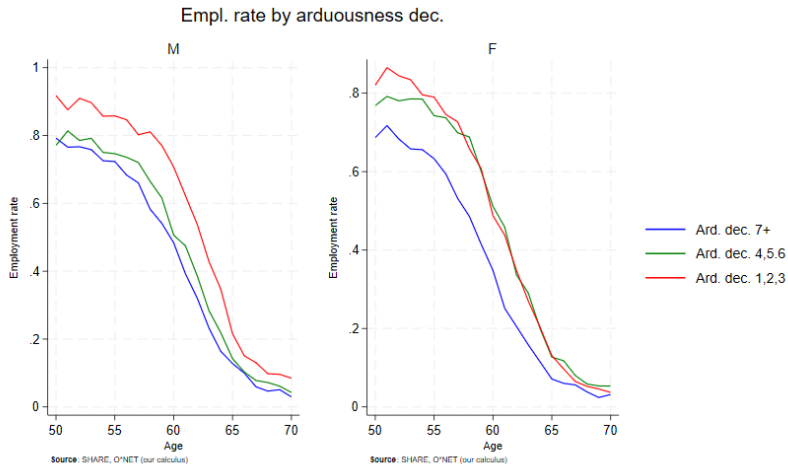


Figure 13: Employment rate by ardu. dec., 50-70

Appendix: Benefit Receipt (50-70) by arduousness dec.

► Conclusion

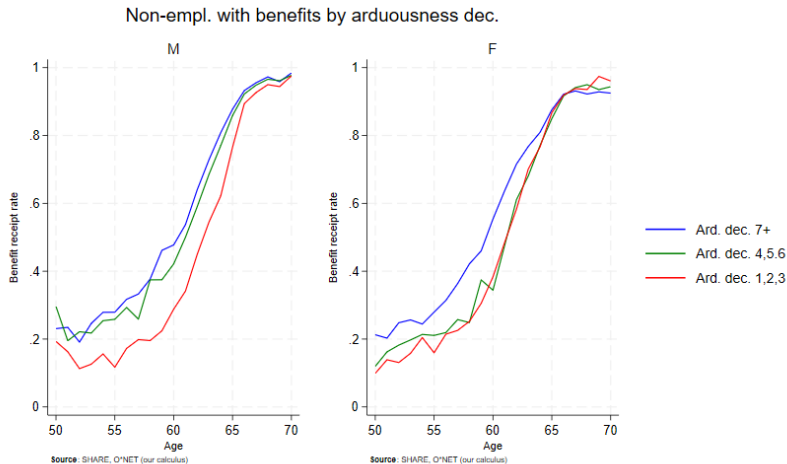


Figure 14: Benefit receipt rate by ardu. dec., 50-70

Appendix: Year Gaps of (non)Employment and/or Benefit Receipt (50-70) M, by arduousness dec.

► Conclusion

Ard. dec.	Gaps ^a			Levels		
	Empl.	Ben..	Non-empl.& ben.	Empl.	Ben.	Non-empl.& ben.
1	.	.	.	13.96	7.02	4.98
2	-0.20	0.30	0.30	13.75	7.32	5.28
3	-0.41	0.63	0.62	13.55	7.66	5.59
4	-0.61	1.00	0.94	13.34	8.02	5.91
5	-0.82	1.40	1.25	13.13	8.42	6.23
6	-1.03	1.84	1.55	12.92	8.86	6.53
7	-1.24	2.31	1.84	12.71	9.33	6.82
8	-1.46	2.81	2.12	12.50	9.83	7.10
9	-1.67	3.34	2.39	12.28	10.36	7.36
10	-1.89	3.90	2.65	12.07	10.92	7.62

Figure 15: Year gaps and levels by ardu. dec., 50-70

Appendix: Year Gaps of (non)Employment and/or Benefit Receipt (50-70) F, by arduousness dec.

► Conclusion

Ard. dec.	Gaps ^a			Levels		
	Empl.	Ben..	Non-empl.& ben.	Empl.	Ben.	Non-empl.& ben.
1	.	.	.	13.43	8.33	5.84
2	-0.22	0.27	0.27	13.21	8.60	6.11
3	-0.44	0.53	0.54	12.99	8.87	6.37
4	-0.66	0.81	0.81	12.76	9.14	6.64
5	-0.89	1.09	1.08	12.53	9.42	6.91
6	-1.12	1.37	1.35	12.30	9.70	7.18
7	-1.36	1.65	1.62	12.07	9.98	7.45
8	-1.60	1.94	1.89	11.83	10.27	7.73
9	-1.84	2.23	2.16	11.58	10.56	8.00
10	-2.09	2.52	2.44	11.34	10.85	8.27

Figure 16: Year gaps and levels by ardu. dec., 50-70

Expansion bias

► Conclusion

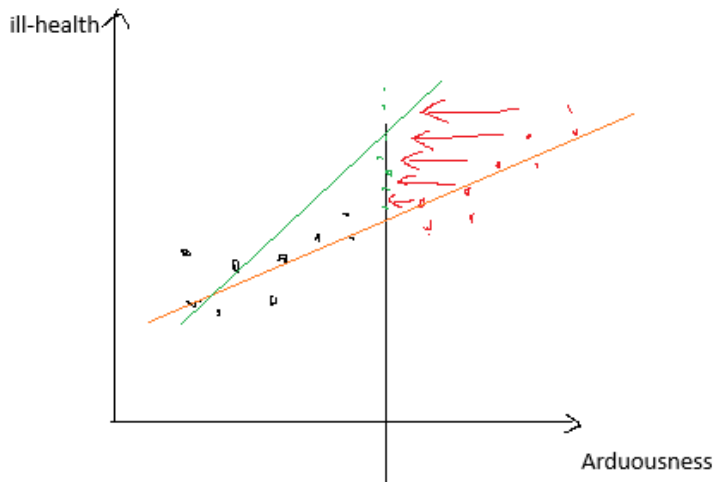


Figure 17: Risk of expansion bias due to right-hand X truncation

Appendix: Evidence of Compensating Wage Differentials?

Country × gender specific wage percentile (50-64): ref. ard. dec.1/age 50/ISCED 3 ► Conclusion

	M	F
Ard. dec.2	-2.830*** (0.970)	-2.033** (0.953)
Ard. dec.3	-4.677*** (0.979)	-3.271*** (0.896)
Ard. dec.4	-6.868*** (1.053)	-6.911*** (0.967)
Ard. dec.5	-10.420*** (1.086)	-7.516*** (0.915)
Ard. dec.6	-9.426*** (1.116)	-10.195*** (1.023)
Ard. dec.7	-13.374*** (1.139)	-11.430*** (1.042)
Ard. dec.8	-10.537*** (1.115)	-12.565*** (1.043)
Ard. dec.9	-10.833*** (1.133)	-16.236*** (1.132)
Ard. dec.10	-10.243*** (1.254)	-12.928*** (1.276)
Constant	52.911*** (2.016)	50.113*** (1.668)
Age	Yes	Yes
Country	Yes	Yes
Educ	Yes	Yes
N	12,395	14,152

Source: SHARE, O*NET, our calculations