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Duration of Long-Term Care: Socio-Economic Factors, Type of Care Interactions and Evolution

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About the speaker



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Structure

1. Introduction

2. Descriptive statistics

3. Model framework

4. Application of the model and results

5. Conclusion

Motivation

- **Major cost determinants of LTC**

- time spent in dependence

- type of care received: at home and in an institution

- **Medical improvements and increased life expectancy over the years**

- direct impact on LTC demand through an increasing number of elderly

- potentially indirect impact on the length of the stay in dependence

- differences between male and female

- **Management of long-term care**

- are care at home and in an institution complements or substitutes (increasing usage of one type of care reduces demand for the other)?

Our research

- **Research objectives**

- estimate care durations as a function of the age at entry and path in dependence, the gender and further socioeconomic covariates
- evolution of the time spent in dependence
- substitution effect between care received at home and in an institution

- **Available data and techniques**

- comprehensive longitudinal dataset covering the total dependent population in Switzerland over a 20-year period (1995–2015)
- generalized linear regression modeling and bootstrapping

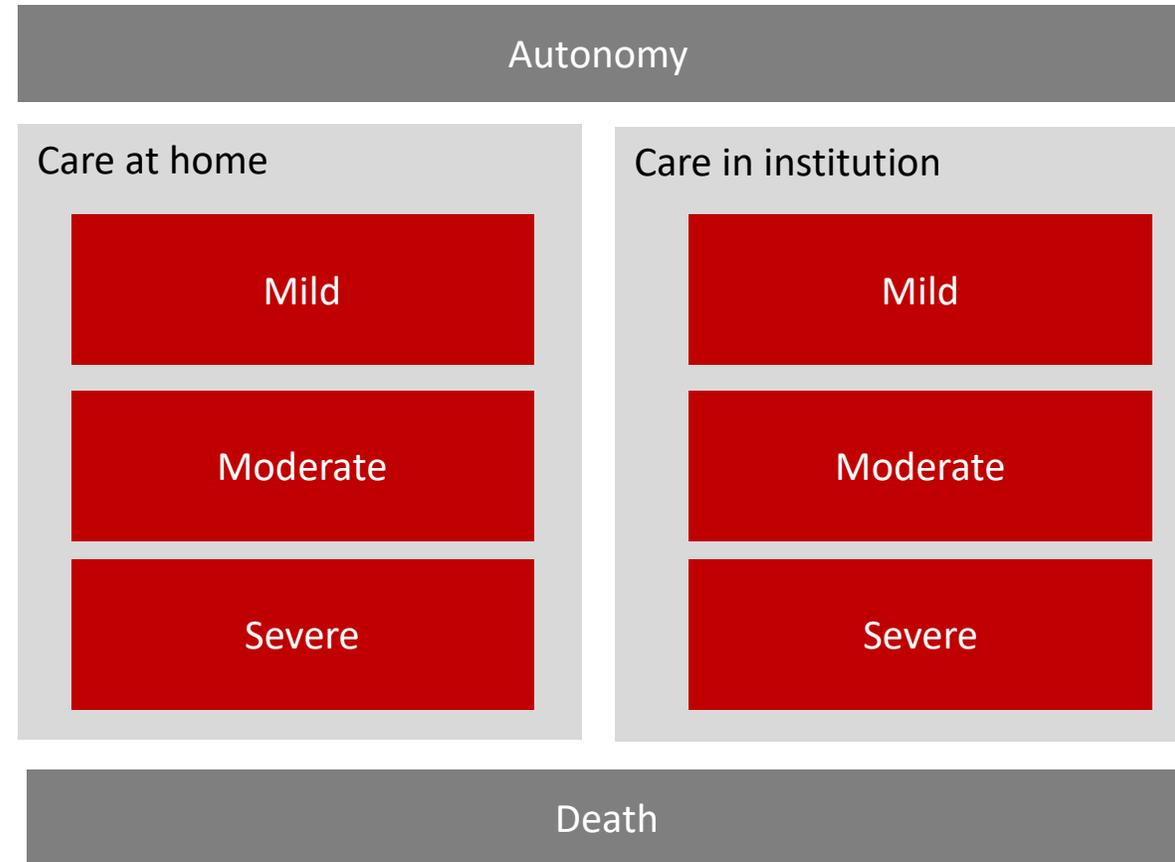
Frailty levels and types of care

Three frailty levels

- **Mild dependence**
need of regular assistance with at least *two* activities of daily living or permanent personal supervision
- **Moderate dependence**
need of regular assistance with at least two activities of daily living and, in addition, *permanent personal supervision*
- **Severe dependence**
need of *regular assistance with all the activities of daily living* and, in addition, *permanent care* or personal supervision

Two types of care

- **Care at home (ambulatory)**
nursing and infrastructure
- **Care in an institution (stationary)**
nursing, assistance, meals, living space



Research questions

- **Research question 1:** How does the time spent in LTC along types of care relate to socio-economic factors?
- **Research question 2:** How does the interaction of at-home and institutional care influence the duration of LTC?
- **Research question 3:** How have the age at entry and the duration of old-age dependence developed over the past years?

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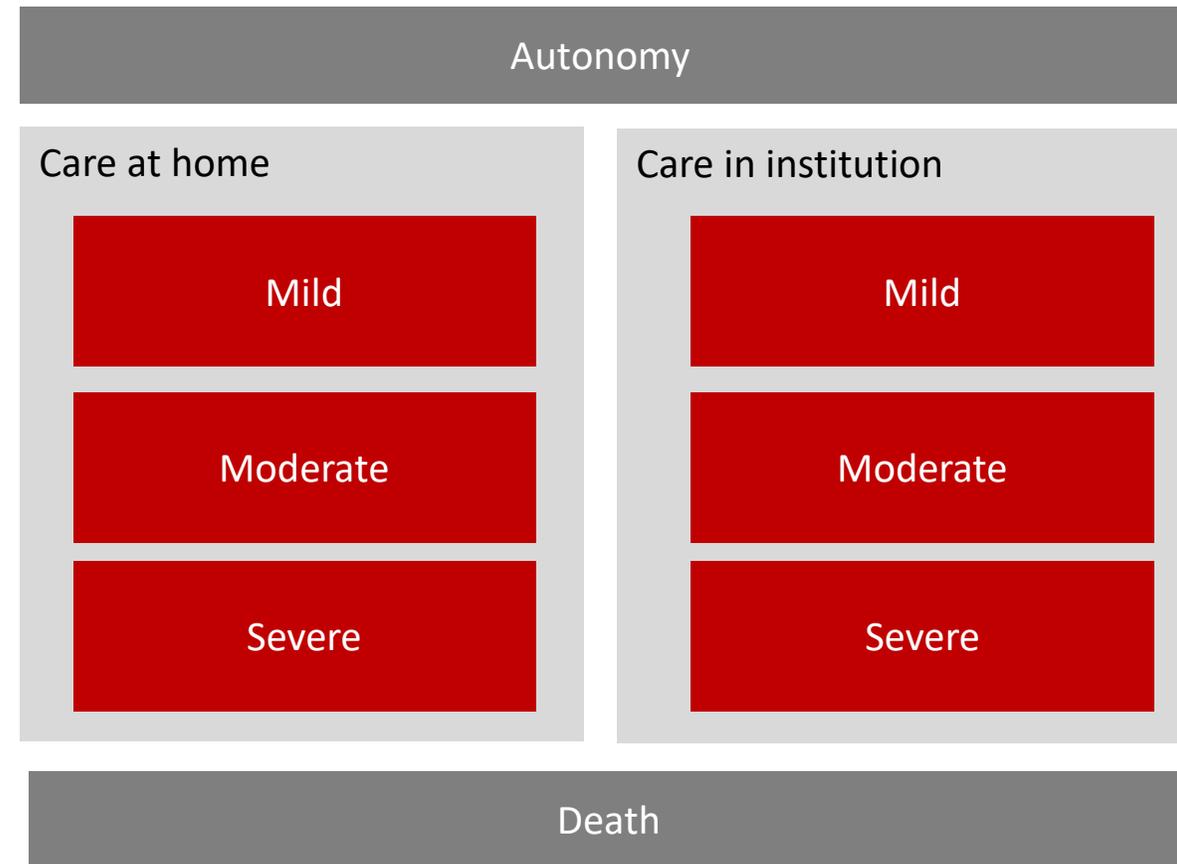
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Comprehensive longitudinal dataset

Longitudinal data records individual paths

- **Over 229'000 individuals** followed
- Period **1995 to 2015** covering the **whole Switzerland**
- Information : Gender, Age, Household, Canton, Salary, Nationality



Variables

Variable	Description	\mathcal{D}_1	\mathcal{D}_2
D	Overall duration in dependence (in months)	✓	✓
D^{HC}	Duration of care at home (in months)	✓	✓
D^{IC}	Duration of care in an institution (in months)	✓	✓
AG	Age at entry in dependence: from 66 to 108 (integer values)	✓	✓
AG^{HC}	Age where care at home is received for the first time	✓	✓
AG^{IC}	Age where care in an institution is received for the first time	✓	✓
GE	Gender: male, female	✓	✓
LR	Linguistic region: German, French, Italian	✓	✓
HH	Household composition: single person, two persons	✓	✓
AL	Acuity level at entry: mild, moderate, severe	✓	✓
TC	Types of care received: HC only, IC only, combination of HC and IC	✓	✓
SA	Pre-retirement income (in CHF)		✓
NA	Nationality: Swiss, Austrian, French, German, Italian and Other		✓

Note: “HC” stands for at-home care, “IC” stands for institutional care.

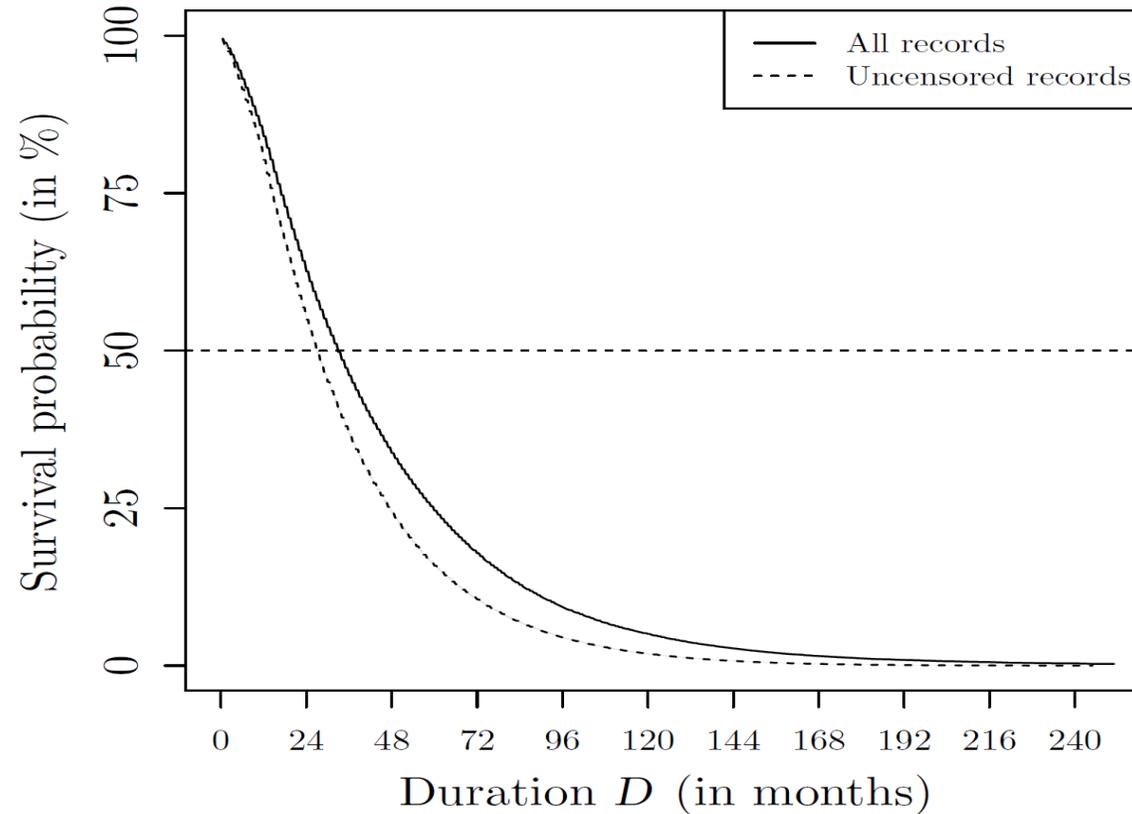
Censoring

	D				D^{HC}				D^{IC}			
	\mathcal{D}_1		\mathcal{D}_2		\mathcal{D}_1		\mathcal{D}_2		\mathcal{D}_1		\mathcal{D}_2	
	N	(%)										
Uncensored	183 752	(80.2)	62 840	(67.6)	10 401	(51.8)	6 923	(49.9)	180 820	(83.5)	60 900	(72.5)
Censored	45 365	(19.8)	30 058	(32.4)	9 668	(48.2)	6 948	(50.1)	35 700	(16.5)	23 111	(27.5)
Total	229 117	(100)	92 898	(100)	20 069	(100)	13 871	(100)	216 520	(100)	84 011	(100)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Uncensored (%)	99.7	99.7	99.6	99.5	99.2	99.0	98.8	98.5	97.9	96.9	96.4
Censored (%)	0.3	0.3	0.4	0.5	0.8	1.0	1.2	1.5	2.1	3.1	3.6
N	8 288	8 521	9 197	9 313	9 523	10 364	10 711	10 506	10 809	11 074	11 008
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Uncensored (%)	95.1	92.9	89.6	85.5	80.0	60.9	53.1	38.6	21.3	9.8	80.2
Censored (%)	4.9	7.1	10.4	14.5	20.0	39.1	46.9	61.4	78.7	90.2	19.8
N	10 719	10 494	10 574	11 148	11 719	19 631	13 467	13 759	12 955	5 337	229 117

Kaplan-Meier estimate of survival curve

Illustration for select ages



Descriptive statistics (median duration)

	D		D^{HC}		D^{IC}	
	\mathcal{D}_1	\mathcal{D}_2	\mathcal{D}_1	\mathcal{D}_2	\mathcal{D}_1	\mathcal{D}_2
	m_D (%)	m_D (%)	$m_{D^{HC}}$ (%)	$m_{D^{HC}}$ (%)	$m_{D^{IC}}$ (%)	$m_{D^{IC}}$ (%)
Age at entry						
66 – 69	66 (3.7)	63 (8.0)	78 (6.8)	74 (9.3)	61 (3.4)	58 (7.5)
70 – 79	46 (21.4)	44 (38.5)	44 (26.8)	44 (33.6)	44 (21.0)	41 (38.7)
80 – 89	33 (49.6)	33 (47.3)	33 (49.6)	32 (48.4)	32 (49.6)	30 (47.4)
90 – 99	25 (24.6)	26 (6.2)	23 (16.5)	20 (8.7)	24 (25.3)	23 (6.4)
100+	20 (0.7)	–	16 (0.3)	–	20 (0.7)	–
Gender						
Male	29 (32.5)	33 (57.7)	27 (35.6)	27 (49.8)	28 (32.4)	31 (58.9)
Female	35 (67.5)	47 (42.3)	38 (64.4)	47 (50.2)	34 (67.6)	42 (41.1)
Linguistic region						
German	32 (66.8)	36 (68.3)	30 (68.9)	31 (70.2)	30 (66.8)	34 (68.5)
French	35 (25.9)	40 (25.1)	45 (26.7)	49 (25.6)	33 (25.7)	37 (24.7)
Italian	44 (7.3)	49 (6.6)	38 (4.4)	39 (4.2)	42 (7.5)	47 (6.8)
Type of household						
Single person	33 (68.0)	39 (50.3)	37 (55.7)	42 (49.1)	31 (68.6)	36 (50.0)
Two persons	35 (32.0)	37 (49.7)	30 (44.3)	29 (50.9)	33 (31.4)	34 (50.0)
Acuity level at entry						
Mild	77 (8.8)	86 (14.9)	34 (99.1)	34 (98.9)	32 (3.5)	33 (6.1)
Moderate	36 (50.3)	39 (51.7)	85 (0.6)	85 (0.7)	36 (53.2)	39 (57.0)
Severe	28 (40.9)	31 (33.4)	64 (0.3)	64 (0.4)	28 (43.3)	31 (36.9)
Received at-home care						
No	32 (91.2)	35 (85.1)	–	–	32 (96.5)	35 (94.1)
Yes	74 (8.8)	83 (14.9)	36 (100)	36 (100)	31 (3.5)	31 (5.9)
Received institutional care						
No	n.a. (5.5)	n.a. (9.6)	n.a. (62.8)	n.a. (64.1)	–	–
Yes	32 (94.5)	36 (90.4)	11 (37.2)	10 (35.9)	32 (100)	35 (100)
Pre-retirement income						
Below 22 308		34 (25.0)		28 (25.2)		31 (25.2)
22 308 – 49 538		45 (25.0)		42 (26.1)		41 (24.8)
49 539 – 77 134		40 (25.0)		41 (25.2)		37 (24.9)
Over 77 134		35 (25.0)		34 (23.5)		32 (25.1)
Nationality						
Swiss		37 (86.7)		34 (84.6)		34 (87.0)
Italian		48 (6.2)		41 (6.9)		44 (6.1)
German		41 (2.2)		36 (2.5)		38 (2.2)
Austrian		45 (0.9)		28 (1.1)		40 (0.9)
French		43 (0.8)		89 (1.0)		37 (0.8)
Other		47 (3.2)		50 (3.9)		43 (3.1)
Overall	33 (100)	38 (100)	34 (100)	36 (100)	32 (100)	35 (100)
N	229 117	92 898	20 069	13 871	216 520	84 011

Kaplan-Meier estimates of median duration

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Selection of the distribution

Distribution	\mathcal{D}_1			\mathcal{D}_2		
	D	D^{HC}	D^{IC}	D	D^{HC}	D^{IC}
Log-normal	1 774 241	68 111	1 733 824	658 264	46 118	631 497
Exponential	1 772 430	68 847	1 732 090	657 465	46 504	630 833
Weibull	1 759 287	68 025	1 719 865	653 841	46 070	627 683
Gamma	1 757 512	67 966	1 717 948	653 249	46 035	627 028

Regression equations

$$\log(D_i) = \alpha + \beta_{AG}AG_i + \beta_{GE}GE_i + \beta_{LR}LR_i + \beta_{AL}AL_i + \beta_{TC}TC_i + \gamma + \epsilon_i \\ (+ \beta_{SA}SA_i).$$

$$\log(D_i^{HC}) = \alpha + \beta_{AG^{HC}}AG_i^{HC} + \beta_{GE}GE_i + \beta_{LR}LR_i + \beta_{HH}HH_i + \gamma + \epsilon_i \\ (+ \beta_{SA}SA_i),$$

$$\log(D_i^{IC}) = \alpha + \beta_{AG^{IC}}AG_i^{IC} + \beta_{GE}GE_i + \beta_{LR}LR_i + \beta_{AL}AL_i + \beta_{DH}DH_i + \gamma + \epsilon_i \\ (+ \beta_{SA}SA_i).$$

Overview variables included in models

Model	\mathcal{D}_1 and \mathcal{D}_2						\mathcal{D}_2 only		
	AG_i	GE_i	LR_i	HH_i	AL_i	TC_i	DH_i	SA_i	NA_i
(2) D	✓	✓	✓		✓	✓		✓	
(3) D^{HC}	✓	✓	✓	✓				✓	
(4) D^{IC}	✓	✓	✓		✓		✓	✓	

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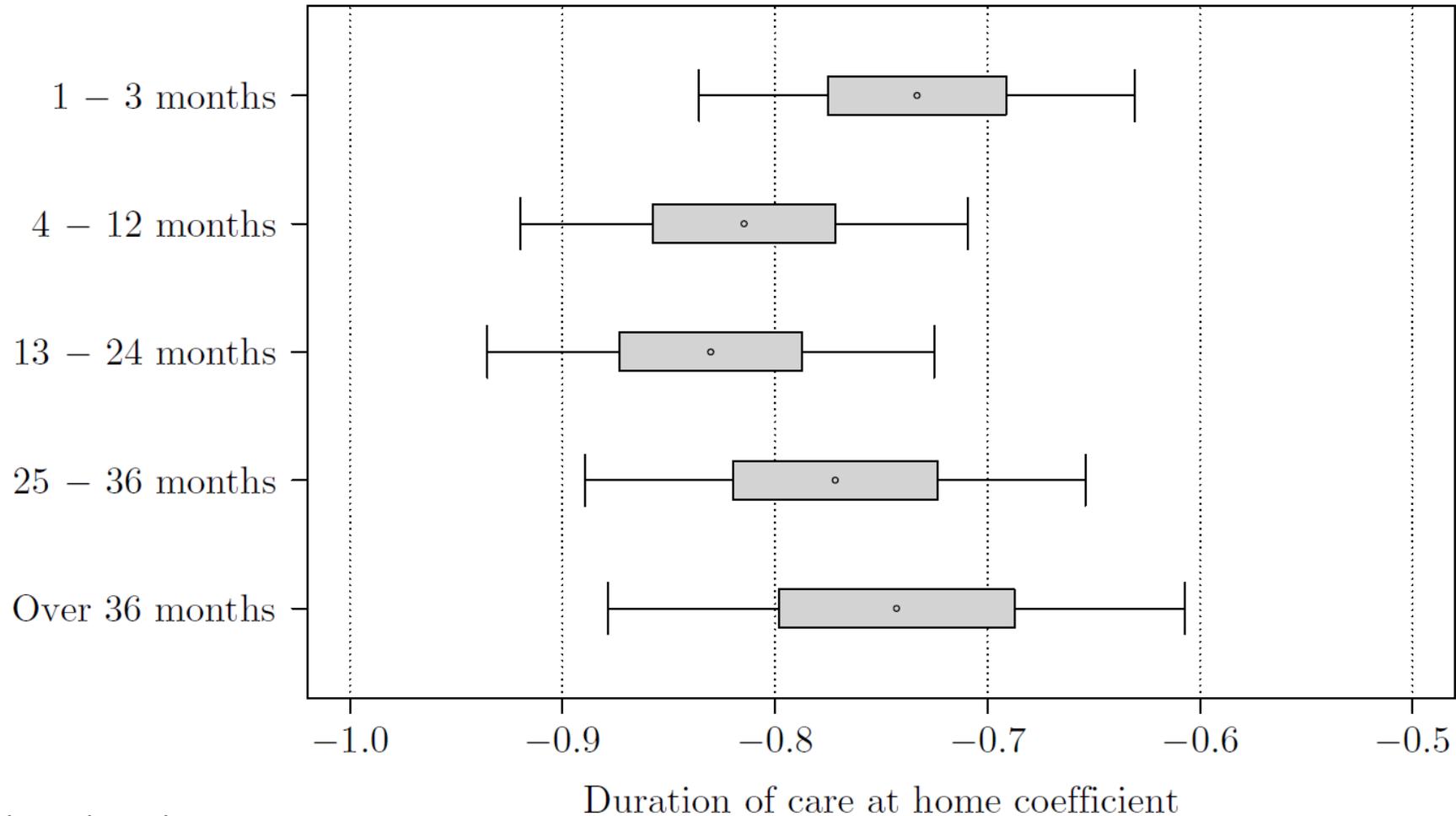
Results for regression models (1)

Model	(2)	(3)	(4)
	D	D^{HC}	D^{IC}
Age at entry	-0.039 (.000) ***	-0.038 (.001) ***	-0.038 (.000) ***
Gender (baseline: Female)			
Male	-0.293 (.004) ***	-0.311 (.021) ***	-0.285 (.004) ***
Linguistic region (baseline: German)			
French	0.085 (.004) ***	0.334 (.023) ***	0.080 (.004) ***
Italian	0.290 (.007) ***	0.088 (.047)	0.279 (.007) ***
Type of household (baseline: Single person)			
Two persons		-0.199 (.021) ***	
Acuity level at entry (baseline: Moderate)			
Mild	0.500 (.048) ***		0.566 (.059) ***
Severe	-0.203 (.004) ***		-0.203 (.004) ***
Type of care (baseline: IC only)			
HC only	0.147 (.048) **		
HC and IC	-0.175 (.049) ***		
Duration of care at home (baseline: 0 months)			
1 – 3 months			-0.733 (.062) ***
4 – 12 months			-0.815 (.064) ***
13 – 24 months			-0.830 (.064) ***
25 – 36 months			-0.772 (.072) ***
Over 36 months			-0.743 (.083) ***
Shape σ	1.580 (.005)	1.057 (.012)	1.580 (.005)
Scale θ	0.001 (.000)	0.001 (.000)	0.001 (.000)
Year fixed effect	Yes	Yes	Yes
N total	229 117	20 069	216 520

Results for regression models (2)

Models	(2)	(3)	(4)
	D	D^{HC}	D^{IC}
Age at entry	-0.038 (.001) ***	-0.033 (.002) ***	-0.039 (.001) ***
Gender (baseline: Female)			
Male	-0.259 (.008) ***	-0.388 (.033) ***	-0.251 (.008) ***
Linguistic region (baseline: German)			
French	0.094 (.008) ***	0.376 (.029) ***	0.091 (.008) ***
Italian	0.282 (.014) ***	0.074 (.061)	0.284 (.014) ***
Type of household (baseline: Single person)			
Two persons		-0.233 (.027) ***	
Acuity level (baseline: Moderate)			
Mild	0.439 (.054) ***		0.545 (.068) ***
Severe	-0.203 (.007) ***		-0.203 (.068) ***
Type of care (baseline: IC only)			
HC only	0.255 (.007) ***		
HC and IC	-0.134 (.055) ***		
Duration of care at home (baseline: 0 months)			
1 – 3 months			-0.723 (.072) ***
4 – 12 months			-0.840 (.075) ***
13 – 24 months			-0.756 (.076) ***
25 – 36 months			-0.759 (.088) ***
Over 36 months			-0.695 (.102) ***
Pre-retirement income (baseline: 49 539 – 77 134)			
Below 22 308	-0.024 (.010) *	0.026 (0.037)	-0.028 (.010) **
22 308 – 49 538	0.039 (.009) ***	-0.028 (0.035)	0.039 (.010) ***
Over 77 134	-0.034 (.009) ***	0.033 (0.037)	-0.035 (.010) ***
Shape σ	1.490 (.008)	1.013 (.015)	1.460 (.008)
Scale θ	0.001 (.000)	0.002 (.002)	0.001 (.000)
Year fixed effect	Yes	Yes	Yes
<i>N</i> total	92 898	13 871	84 011

Effect of selected at home care durations on institutional care duration



90% and 95% confidence bounds

Evolution of the mean age at entry for male and female between 1995 and 2009

Calendar year	Male				Female			
	\bar{A}_G	$q_{5\%}$	$q_{95\%}$	(N)	\bar{A}_G	$q_{5\%}$	$q_{95\%}$	(N)
1995	81.3	69	93	(2 510)	84.9	72	95	(5 778)
1996	81.4	69	92	(2 514)	85.0	72	95	(6 007)
1997	81.4	68	93	(2 831)	85.2	72	95	(6 366)
1998	81.5	69	93	(2 859)	85.1	73	95	(6 454)
1999	81.3	69	93	(3 016)	85.3	73	95	(6 507)
2000	81.7	68	93	(3 208)	85.2	72	95	(7 156)
2001	81.7	69	93	(3 418)	85.4	73	96	(7 293)
2002	81.7	68	93	(3 270)	85.5	73	96	(7 236)
2003	82.1	69	94	(3 372)	85.5	73	96	(7 437)
2004	82.2	69	94	(3 440)	85.6	73	96	(7 634)
2005	82.4	69	94	(3 439)	85.6	73	96	(7 569)
2006	82.4	69	94	(3 433)	85.6	73	96	(7 286)
2007	82.6	69	94	(3 500)	85.7	73	96	(6 994)
2008	82.2	69	94	(3 460)	85.7	73	96	(7 114)
2009	82.2	68	95	(3 711)	85.7	73	96	(7 437)
'95 vs '09	***				***			

The age at entry in dependence has shifted towards higher ages in line with longevity improvements.

Median overall care duration

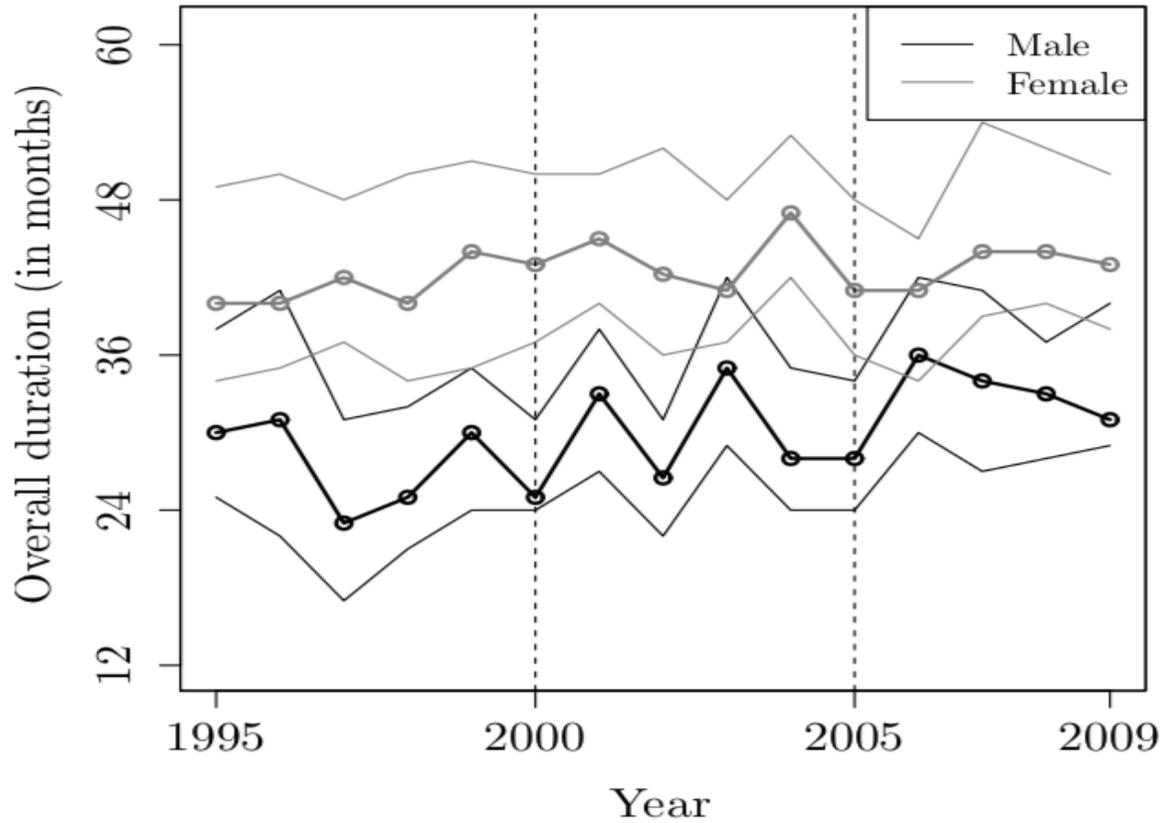
Calendar year	Male						Female						M/F		
	70		80		90		70		80		90		70	80	90
	m_D	(N)	m_D	(N)	m_D	(N)	m_D	(N)	m_D	(N)	m_D	(N)			
1995	61	(49)	30	(113)	21	(89)	67	(38)	40	(214)	27	(320)	***		*
1996	49	(40)	31	(106)	21	(99)	55	(65)	40	(174)	28	(328)	***		**
1997	47	(55)	23	(93)	21	(90)	55	(38)	42	(200)	25	(340)	***		*
1998	50	(61)	25	(135)	19	(83)	59	(41)	40	(199)	28	(381)	***		***
1999	33	(72)	30	(149)	25	(95)	52	(43)	44	(206)	29	(388)	***		**
2000	37	(61)	25	(152)	26	(109)	66	(52)	43	(272)	31	(410)	*	***	*
2001	52	(58)	33	(164)	20	(121)	45	(45)	45	(248)	26	(426)		***	***
2002	52	(69)	27	(156)	21	(127)	52	(39)	42	(240)	27	(447)		***	***
2003	40	(60)	35	(146)	24	(109)	67	(57)	41	(267)	29	(406)	**	*	***
2004	36	(68)	28	(146)	22	(133)	59	(57)	47	(262)	26	(477)	**	***	*
2005	55	(63)	28	(164)	21	(123)	80	(53)	41	(269)	29	(380)	*	***	**
2006	39	(50)	36	(151)	19	(114)	60	(58)	41	(250)	30	(333)	**		***
2007	52	(39)	34	(155)	20	(137)	64	(45)	44	(238)	31	(333)		***	***
2008	42	(56)	33	(164)	23	(128)	83	(44)	44	(239)	26	(368)	**	***	***
2009	31	(71)	31	(173)	19	(119)	50	(44)	43	(168)	30	(413)	*	***	***
'95 – '09			*										*		

X_2 -result: **significant among genders for most calendar years**

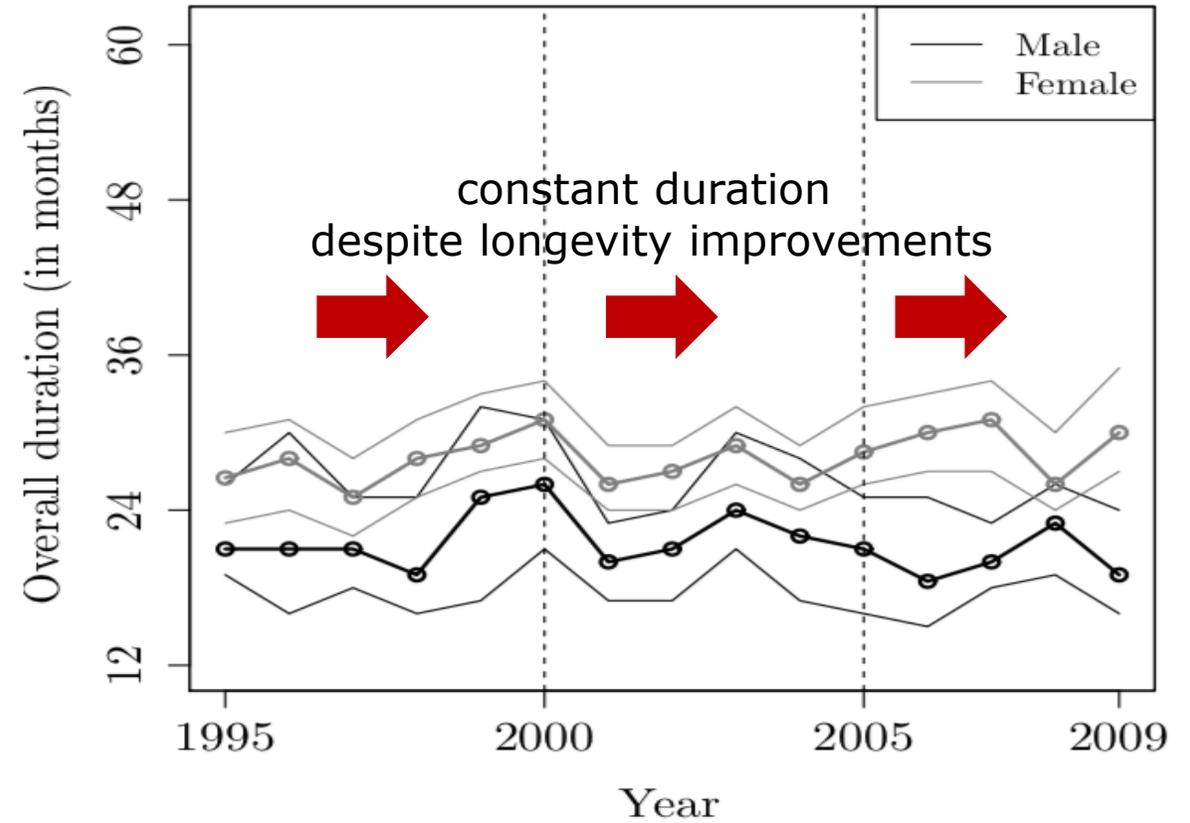
Peto & Peto modification of the Gehan-Wilcoxon test (more weight on short duration): **quite no significant changes for the calendar years from 1995 to 2009**

Longevity gains have not significantly affected the duration of LTC

Evolution of median time in dependence significantly differs between men and women



(a) Age 80



(b) Age 90

95% confidence bounds

Males

Profile	AG	LR	AL	TC	SA	$\widehat{\varnothing D}$	$\widehat{\varnothing D}_{\text{lower}}$	$\widehat{\varnothing D}_{\text{upper}}$	\widehat{m}_D
Base	80	German	Moderate	IC	cat. 3	44.0	42.8	45.2	34.8
A	70	German	Moderate	IC	cat. 3	62.3	60.7	63.8	51.2
B	90	German	Moderate	IC	cat. 3	30.1	29.3	31.0	23.7
C	80	French	Moderate	IC	cat. 3	48.2	46.9	49.4	38.3
D	80	Italian	Moderate	IC	cat. 3	57.2	55.3	58.9	46.2
E	80	German	Mild	IC	cat. 3	64.7	59.1	70.1	53.7
F	80	German	Severe	IC	cat. 3	36.1	35.2	37.1	28.4
G	80	German	Moderate	HC	cat. 3	56.0	51.1	61.4	45.1
H	80	German	Moderate	HC and IC	cat. 3	38.8	34.2	43.1	30.6
I	80	German	Moderate	IC	cat. 1	43.0	42.0	44.1	34.0
J	80	German	Moderate	IC	cat. 2	45.7	44.4	46.9	36.2
K	80	German	Moderate	IC	cat. 4	42.6	41.5	43.6	33.6

Females

Profile	AG	LR	AL	TC	SA	$\widehat{\varnothing D}$	$\widehat{\varnothing D}_{lower}$	$\widehat{\varnothing D}_{upper}$	$\widehat{m_D}$
Base	80	German	Moderate	IC	cat. 3	56.0	54.8	57.0	45.1
A	70	German	Moderate	IC	cat. 3	74.7	73.4	76.0	66.3
B	90	German	Moderate	IC	cat. 3	39.0	38.0	40.1	30.7
C	80	French	Moderate	IC	cat. 3	60.7	59.3	62.2	49.6
D	80	Italian	Moderate	IC	cat. 3	70.0	68.4	71.8	59.8
E	80	German	Mild	IC	cat. 3	76.8	71.9	80.8	69.6
F	80	German	Severe	IC	cat. 3	46.5	45.3	47.7	36.9
G	80	German	Moderate	HC	cat. 3	68.8	63.7	73.4	58.4
H	80	German	Moderate	HC and IC	cat. 3	49.9	45.1	55.6	39.7
I	80	German	Moderate	IC	cat. 1	54.9	53.6	56.3	44.1
J	80	German	Moderate	IC	cat. 2	58.0	56.7	59.2	46.9
K	80	German	Moderate	IC	cat. 4	54.3	53.0	55.7	43.6

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Conclusion

Significant factors: age at entry, gender, linguistic region of residence, acuity state at entry, type of household, type of care received and pre-retirement income.

- Women stay on average one year longer in dependence than men.
- Living in a two persons household reduces the duration in dependence.
- **An important concern for LTC financing and planning stems from the interaction between at-home and institutional care:**
 - Receiving at-home care prior to institutional care can reduce up to **6 months** the care duration
 - However, after having received at-home care for one year or longer, any further increase will not reduce the institutional care duration (non-reducibility of institutional care at some stage)
- Our study also shows that, over the last 20 years:
 - Age at entry has shifted towards higher ages along with the reported longevity gains
 - Median time spent in dependence has not changed over the years
 - Nonetheless, we remark significant gender differences in the LTC duration

Thank you for your attention



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