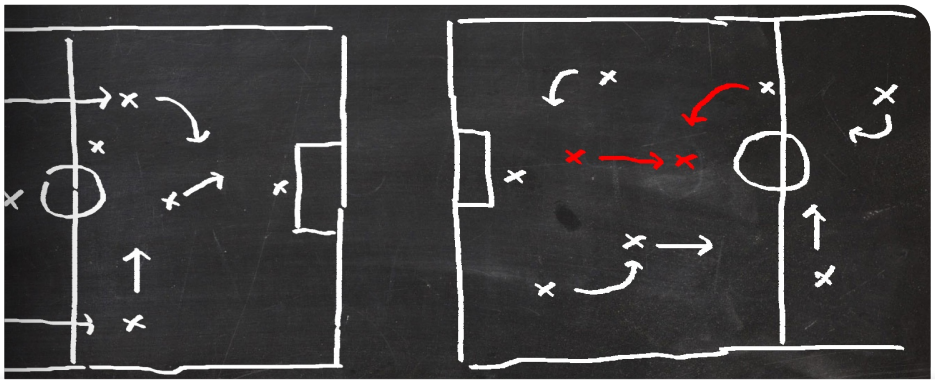
UNIL | Université de Lausanne
HEC Lausanne



Soins de longue durée et tables de dépendance : nouvelles données empiriques pour la Suisse

Long-Term Care Prevalence and Actuarial Tables: New Empirical Evidence from Switzerland

Professor Joël Wagner
Department of Actuarial Science
and Swiss Finance Institute

| le savoir vivant |

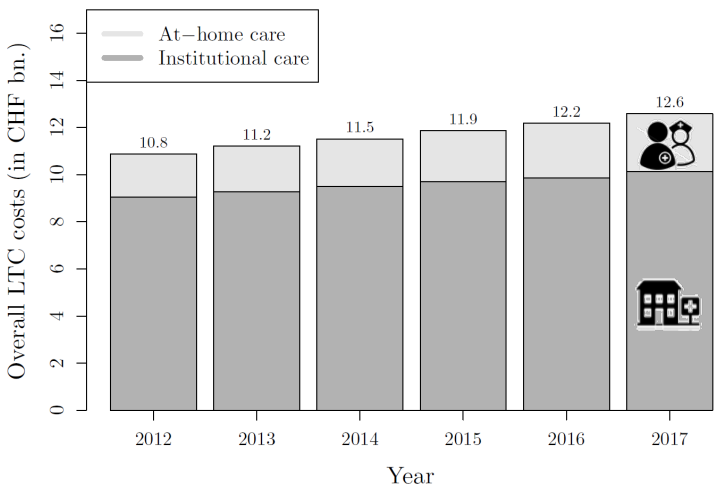
Conférence de l'Institut des Actuaires
Paris, 27 May 2019

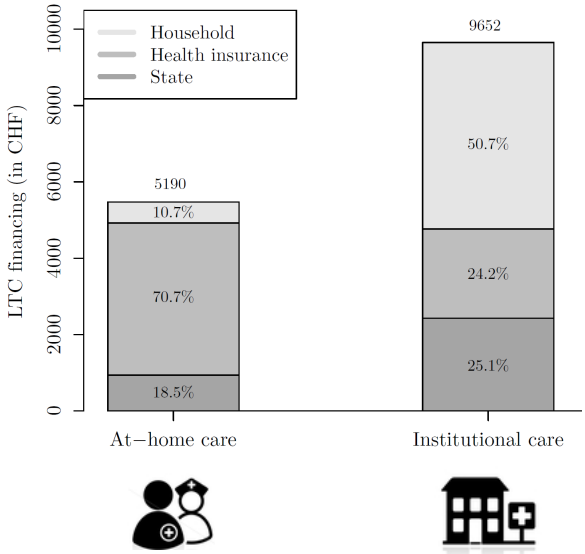
Long-term care

Care provided to elderly with limitations in activities of daily living

- Longevity
- Mostly concerns population 80+
- Gender differences
- Pathologies as drivers
- Limited care infrastructure
- Need for qualified care givers
- Large part financed by households
- Little private insurance
- Lack of data for pricing
- Challenge for social insurance systems
- Systemic risk

LTC costs and financing in Switzerland





Long-term care research questions
(selection for this talk)

What are the drivers of long-term care development in Switzerland? How many dependent elderly need to be cared for by 2045?

→ Old-Age Care Prevalence in Switzerland: Drivers and Future Development 1

What are the probabilities for transiting through different acuity states after a given time spent in one of the states?

→ Long-Term Care Models and Dependence Probability Tables by Acuity Level: New Empirical Evidence from Switzerland 2

What socioeconomic factors determine the duration of long-term care? Is there any substitution effect between at home and institutional care?

→ An Econometric Study on the Duration of Long-Term Care: Main Drivers and Substitution Effect 3

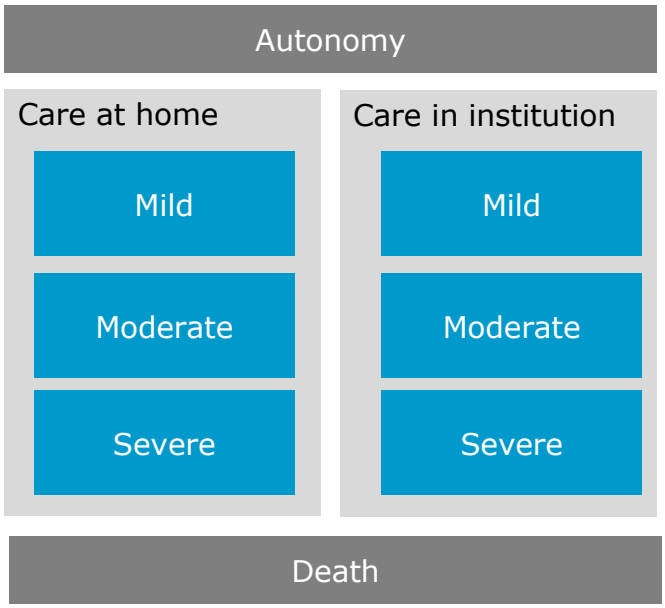
Frailty levels and types of care in Swiss LTC

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

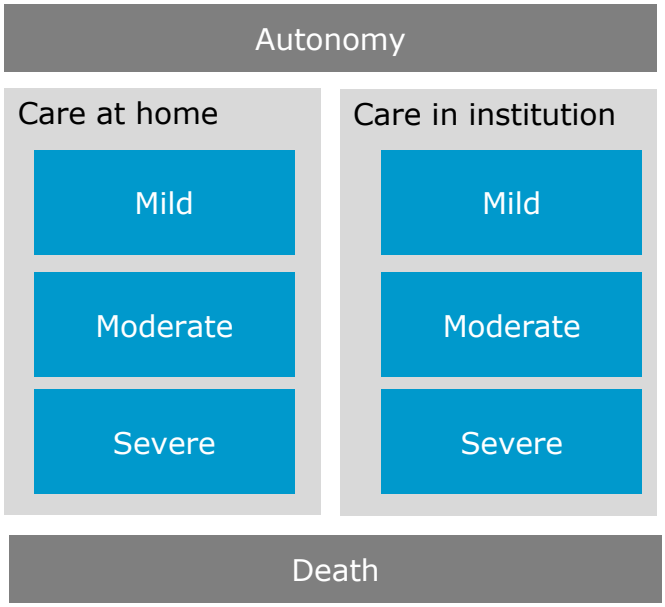


Comprehensive longitudinal dataset

Longitudinal data records individual paths

- **284'482 individuals** followed
- **342'000 transitions** between the dependency states with **269'082 uncensored** observations
- **212'500 complete paths**
- Period **1995 to 2015** covering the **whole Switzerland**
- Information : Gender, Age, Household, Canton, Salary, Nationality

Cross-sectional data built by aggregation



What are the drivers of long-term care development in Switzerland and how many dependent elderly need to be cared for by 2045?

1. Old-Age Care Prevalence in Switzerland: Drivers and Future Development
2. Long-Term Care Models and Dependence Probability Tables by Acuity Level: New Empirical Evidence from Switzerland
3. An Econometric Study on the Duration of Long-Term Care: Main Drivers and Substitution Effect

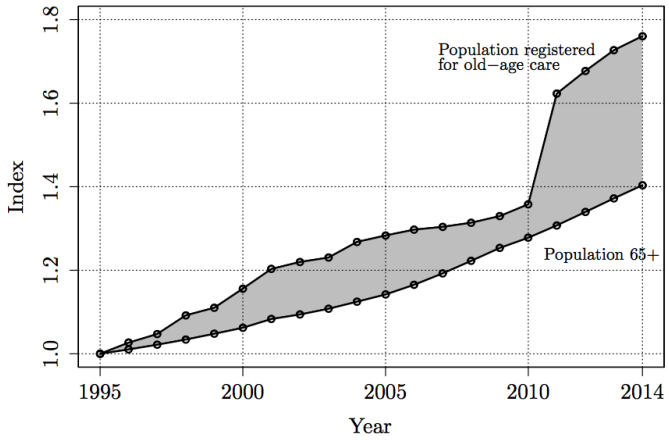
Motivation

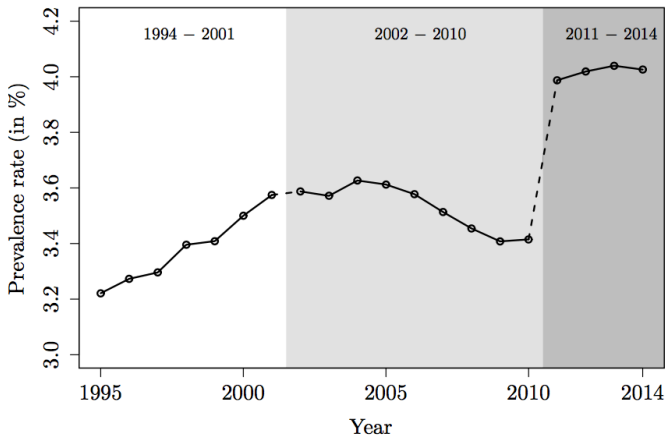
- Population aging in high-income countries is one of the most dramatic challenges
  - → long-term care (LTC) is predicted to increase in the foreseeable future
- Proper financing and pricing of LTC is relevant
  - → state social systems with comprehensive universal or means-tested schemes
  - → health or other private insurance plans
  - → households cover a large part of the formal LTC costs
- Growing demand for LTC creates a systemic threat for the society
  - → financing: sustainable schemes to alleviate the burden of households
  - → infrastructure: limited availability of LTC institutions
  - → skilled workforce: future needs likely entail a lack of qualified staff

Research

- Research objectives
  - → understand the drivers of LTC development in Switzerland
  - → differentiate between frailty levels and types of care
  - → forecast the prevalence rates for the next 30 years on a cantonal level
- Available data and techniques
  - → comprehensive longitudinal dataset covering the total dependent population in Switzerland over a 20-year period (1995–2014)
  - → log-linear regression for the prevalence rates

Strong development of the absolute number of dependent elderly in the last 20 years …



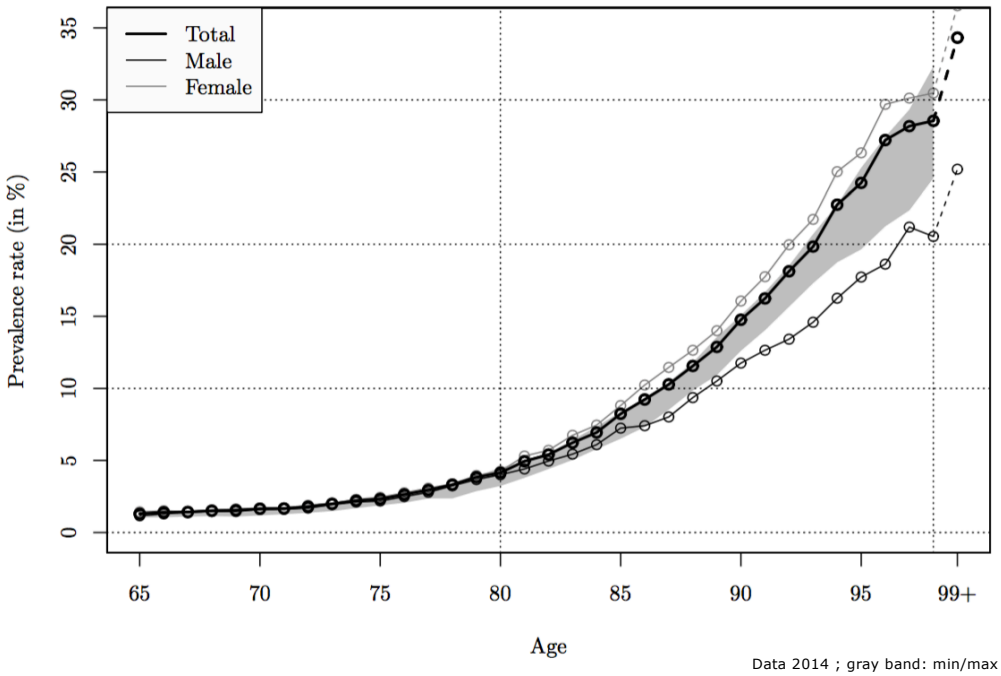


2002: Recognition of dependency at home

2011: Recognition of mild dependency at home

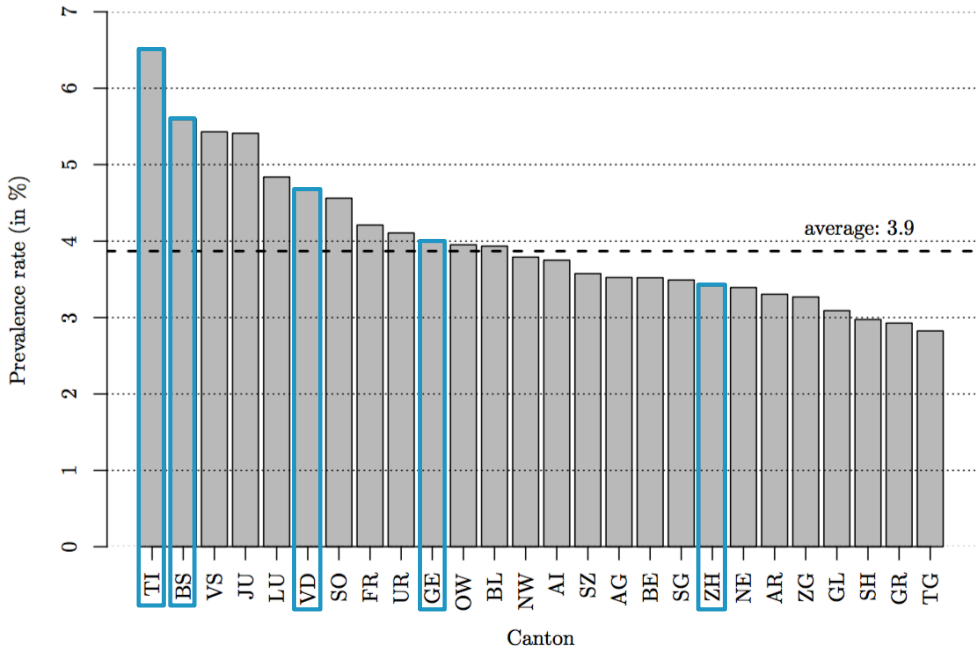
… with constant prevalence rates since 2011

Age and gender strongly influence the prevalence rate



Data 2014 ; gray band: min/max between 1995 and 2014

Regional differences appear to be important



Code	Full name	Linguistic region
AG	Aargau	German
AI	Appenzell Innerrhoden	German
AR	Appenzell Ausserrhoden	German
BE	Bern	German
BL	Basel-Landschaft	German
BS	Basel-Stadt	German
FR	Fribourg	French
GE	Genève	French
GL	Graubünden	German
GR	Grisons	German
JU	Jura	French
LU	Luzern	German
NE	Neuchâtel	French
NW	Nidwalden	German
OW	Obwalden	German
SG	St. Gallen	German
SH	Schaffhausen	German
SO	Solothurn	German
SZ	Schwyz	German
TG	Thurgau	German
TI	Ticino	Italian
UR	Uri	German
VD	Vaud	French
VS	Valais	French
ZG	Zug	German
ZH	Zürich	German

Data 2014

Models

Available variables in the econometric models

Dependent variables

π	Prevalence rates for the total dependent population
Frailty levels	
π^1	Prevalence rates for mildly dependent persons
π^2	Prevalence rates for moderately dependent persons
π^3	Prevalence rates for severely dependent persons
Types of care	
π^a	Prevalence rates for persons being cared for at home
π^b	Prevalence rates for persons being cared for in an institution

Prevalence rates calculated per year (20 years from 1995 to 2014), per age class (7 groups of 5 years), per gender and per canton (26)

Independent variables

AGE	Age class of the observation: 65–69, 70–74, ..., 90–94, 95+
GENDER	Gender of the observation: male, female
YEAR	Calendar year of the observation: 1995, ..., 2014
PERIOD	Time period of the observation: 1995–2001, 2002–2010, 2011–2014
CANTON	Canton in which is located the observation (see Footnote 1)
LING	Linguistic region in which is located the observation: DE, FR, IT

Regression equations

$$\log \pi_i = \beta_0 + \sum_j \beta_1^j AGE_i^j + \beta_2 GENDER_i + \sum_k \beta_4^k PERIOD_i^k + \sum_l \beta_5^l LING_i^l + \epsilon_i. \quad (1)$$

$$\log \pi_i = \beta_0 + \sum_j \beta_1^j AGE_i^j + \beta_2 GENDER_i + \sum_k \beta_4^k PERIOD_i^k + \sum_l \beta_5^l LING_i^l + \sum_n \beta_7^n AGE_i^n \times GENDER_i + \epsilon_i. \quad (2)$$

$$\log \pi_i = \beta_0 + \sum_j \beta_1^j AGE_i^j + \beta_2 GENDER_i + \sum_k \beta_4^k PERIOD_i^k + \sum_m \beta_6^m CANTON_i^m + \epsilon_i. \quad (3)$$

$$\log \pi_i = \beta_0 + \sum_j \beta_1^j AGE_i^j + \beta_2 GENDER_i + \beta_3 YEAR_i + \sum_m \beta_6^m CANTON_i^m + \epsilon_i. \quad (4)$$

$$\log \pi_i = \beta_0 + \sum_j \beta_1^j AGE_i^j + \beta_2 GENDER_i + \sum_m \beta_6^m CANTON_i^m + \epsilon_i. \quad (4')$$

$$\log \pi_i^{(s)} = \beta_0 + \sum_j \beta_1^j AGE_i^j + \beta_2 GENDER_i + \sum_m \beta_6^m CANTON_i^m + \epsilon_i, \quad (5.s)$$

Regression results by periods

Model	(1)	(2)	(3)	(4)	(4)	(4)	(4′)
Period	1995–2014	1995–2014	1995–2014	1995–2001	2002–2010	2011–2014	2011–2014
Intercept	−4.496 *** (.012)	−4.354 *** (.014)	−4.622 *** (.019)	−31.428 *** (5.724)	15.260 *** (3.341)	−8.516 (9.349)	−4.510 *** (.030)
Age (baseline: 65–69)							
70–74	0.265 *** (.012)	0.270 *** (.017)	0.267 *** (.012)	0.303 *** (.021)	0.272 *** (.016)	0.195 *** (.019)	0.195 *** (.019)
75–79	0.763 *** (.013)	0.177 *** (.017)	0.763 *** (.012)	0.819 *** (.021)	0.745 *** (.016)	0.702 *** (.019)	0.702 *** (.019)
80–84	1.374 *** (.013)	1.223 *** (.017)	1.374 *** (.012)	1.423 *** (.021)	1.354 *** (.016)	1.333 *** (.019)	1.333 *** (.019)
85–89	1.967 *** (.013)	1.737 *** (.017)	1.967 *** (.012)	2.012 *** (.021)	1.959 *** (.016)	1.906 *** (.019)	1.906 *** (.019)
90–94	2.503 *** (.013)	2.233 *** (.017)	2.503 *** (.012)	2.559 *** (.021)	2.492 *** (.016)	2.428 *** (.019)	2.428 *** (.019)
95+	2.875 *** (.013)	2.567 *** (.017)	2.874 *** (.012)	2.959 *** (.022)	2.808 *** (.016)	2.869 *** (.020)	2.869 *** (.020)
Gender (baseline: Male)							
Female	0.248 *** (.007)	−0.036 * (.017)	0.248 *** (.006)	0.279 *** (.011)	0.246 *** (.009)	0.200 *** (.010)	0.200 *** (.010)
Period (baseline: 2011–2014)							
1995–2001	−0.151 *** (.009)	−0.152 *** (.009)	−0.152 *** (.009)				
2002–2010	−0.140 *** (.010)	−0.140 *** (.009)	−0.140 *** (.008)				
Year				0.013 *** (.003)	−0.010 *** (.002)	0.002 (.005)	
Linguistic region (baseline: DE)							
FR	0.155 *** (.008)	0.156 *** (.008)					
IT	0.425 *** (.018)	0.427 *** (.017)					
Canton (baseline: ZH)							
AG			0.114 *** (.022)	0.098 * (.041)	0.139 *** (.031)	0.084 * (.037)	0.084 * (.037)
AI			0.165 *** (.022)	0.056 (.042)	0.281 *** (.031)	0.089 * (.038)	0.089 * (.038)
AR			−0.016 (.022)	−0.049 (.041)	0.028 (.031)	−0.060 (.037)	−0.060 (.037)
BE			0.152 *** (.022)	0.270 *** (.041)	0.120 *** (.031)	0.019 (.037)	0.019 (.037)
BL			0.270 *** (.022)	0.346 *** (.041)	0.253 *** (.031)	0.174 *** (.037)	0.174 *** (.037)
BS			0.232 *** (.022)	0.140 *** (.041)	0.262 *** (.031)	0.328 *** (.037)	0.328 *** (.037)
FR			0.476 *** (.022)	0.501 *** (.041)	0.522 *** (.031)	0.327 *** (.037)	0.327 *** (.037)
GE			−0.005 (.022)	−0.041 (.041)	−0.028 (.031)	0.107 ** (.037)	0.107 ** (.037)
GL			0.101 *** (.022)	0.190 *** (.041)	0.123 *** (.031)	−0.106 ** (.038)	−0.106 ** (.038)
GR			0.076 *** (.022)	0.217 *** (.041)	0.056 . (.031)	−0.127 *** (.037)	−0.127 *** (.037)
JU			0.522 *** (.022)	0.658 *** (.041)	0.468 *** (.031)	0.406 *** (.037)	0.406 *** (.037)
LU			0.400 *** (.022)	0.409 *** (.041)	0.409 *** (.031)	0.366 *** (.037)	0.366 *** (.037)
NE			0.053 * (.022)	0.127 ** (.041)	0.014 (.031)	0.010 (.037)	0.010 (.037)
NW			0.023 (.022)	0.091 * (.041)	−0.079 * (.031)	0.133 *** (.037)	0.133 *** (.037)
OW			0.126 *** (.022)	0.080 . (.041)	0.152 *** (.031)	0.148 *** (.037)	0.148 *** (.037)
SG			0.085 *** (.022)	0.118 ** (.041)	0.083 *** (.031)	0.034 (.037)	0.034 (.037)
SH			0.018 (.022)	0.115 ** (.041)	0.011 (.031)	−0.136 *** (.037)	−0.136 *** (.037)
SO			0.233 *** (.022)	0.153 *** (.041)	0.276 *** (.031)	0.275 *** (.037)	0.275 *** (.037)
SZ			0.174 *** (.022)	0.226 *** (.041)	0.157 *** (.031)	0.123 ** (.037)	0.123 ** (.037)
TG			−0.027 (.022)	0.021 (.041)	−0.009 (.031)	−0.152 *** (.037)	−0.152 *** (.037)
TI			0.552 *** (.022)	0.478 *** (.041)	0.605 *** (.031)	0.562 *** (.037)	0.562 *** (.037)
UR			0.311 *** (.022)	0.342 *** (.041)	0.367 *** (.031)	0.127 *** (.037)	0.127 *** (.037)
VD			0.218 *** (.022)	0.345 *** (.041)	0.209 *** (.031)	0.279 *** (.037)	0.279 *** (.037)
VS			0.425 *** (.022)	0.445 *** (.041)	0.386 *** (.031)	0.475 *** (.037)	0.475 *** (.037)
ZG			−0.043 . (.022)	−0.077 . (.041)	−0.050 (.031)	0.030 (.037)	0.030 (.037)
Age–Gender (baseline: 65–69 × Male)							
70–74 × Female		−0.01 (.024)					
75–79 × Female		0.102 *** (.024)					
80–84 × Female		0.300 *** (.024)					
85–89 × Female		0.460 *** (.024)					
90–94 × Female		0.540 *** (.024)					
95+ × Female		0.604 *** (0.24)					
N	7 244	7 244	7 244	2 526	3 266	1 452	1 452
Adj. R^2	0.924	0.936	0.941	0.932	0.947	0.965	0.965

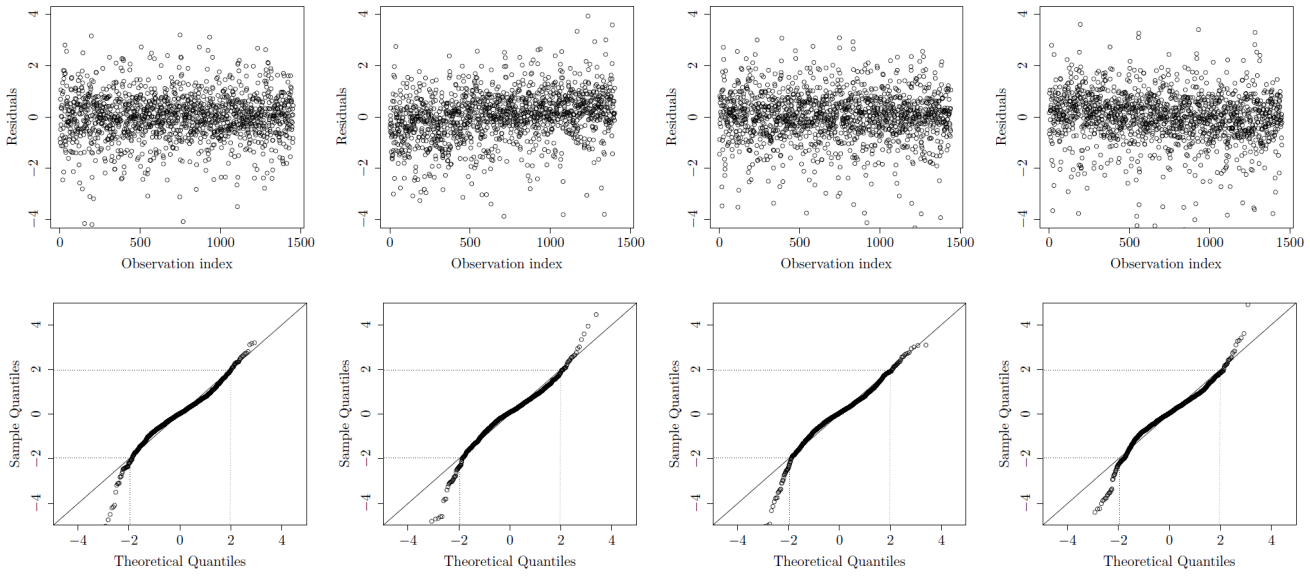
Results by frailty levels and by types of care

Model	Frailty level			Type of care	
	Mild (5.1)	Moderate (5.2)	Severe (5.3)	At home (5.a)	In an institution (5.b)
Intercept	−5.486 *** (.056)	−5.415 *** (.051)	−5.992 *** (.050)	−5.136 *** (.057)	−5.324 *** (.036)
Age (baseline: 65–69)					
70–74	−0.084 * (.037)	0.260 *** (.026)	0.431 *** (.033)	−0.413 *** (.037)	0.639 *** (.024)
75–79	0.274 *** (.037)	0.747 *** (.026)	1.075 *** (.033)	−0.440 *** (.037)	1.334 *** (.024)
80–84	0.719 *** (.037)	1.467 *** (.026)	1.725 *** (.033)	0.205 *** (.037)	1.957 *** (.024)
85–89	1.149 *** (.037)	2.082 *** (.026)	2.336 *** (.033)	0.706 *** (.038)	2.552 *** (.024)
90–94	1.463 *** (.037)	2.595 *** (.026)	2.904 *** (.033)	1.053 *** (.037)	3.095 *** (.024)
95+	1.500 *** (.039)	2.962 *** (.026)	3.566 *** (.033)	1.100 *** (.039)	3.600 *** (.024)
Gender (baseline: Male)					
Female	0.150 *** (.020)	0.141 *** (.010)	0.244 *** (.017)	0.124 *** (.020)	0.207 *** (.013)
Canton (baseline: ZH)					
AG	0.138 . (.070)	0.039 (.050)	0.088 (.063)	0.174 * (.072)	0.062 (.045)
AI	0.029 (.077)	0.061 (.052)	0.311 *** (.064)	0.130 . (.077)	0.107 * (.046)
AR	−0.168 * (.072)	−0.063 (.050)	−0.003 (.063)	−0.171 * (.074)	−0.012 (.045)
BE	0.211 ** (.070)	−0.091 . (.050)	0.018 (.063)	0.193 ** (.072)	−0.018 (.045)
BL	0.208 ** (.070)	0.204 *** (.050)	0.105 . (.063)	0.287 *** (.072)	0.132 ** (.045)
BS	0.407 *** (.071)	0.275 *** (.050)	0.344 *** (.063)	0.431 *** (.072)	0.307 *** (.045)
FR	0.026 (.071)	0.348 *** (.050)	0.430 *** (.063)	0.112 (.072)	0.357 *** (.045)
GE	0.390 *** (.070)	−0.115 * (.050)	0.181 ** (.063)	0.472 *** (.072)	0.008 (.045)
GL	−0.048 (.072)	−0.225 *** (.051)	−0.131 * (.063)	−0.163 * (.074)	−0.082 . (.046)
GR	0.155 * (.071)	−0.197 *** (.050)	−0.222 *** (.063)	0.191 ** (.072)	−0.184 *** (.045)
JU	0.661 *** (.071)	0.304 *** (.050)	0.336 *** (.063)	0.691 *** (.072)	0.291 *** (.045)
LU	0.285 *** (.071)	0.364 *** (.050)	0.417 *** (.063)	0.363 *** (.072)	0.355 *** (.045)
NE	0.330 *** (.070)	−0.397 *** (.050)	0.187 ** (.063)	0.459 *** (.072)	−0.131 ** (.045)
NW	0.223 ** (.072)	0.172 *** (.050)	−0.160 * (.063)	0.402 *** (.073)	0.005 (.045)
OW	0.171 * (.071)	0.126 * (.050)	0.046 (.063)	0.309 *** (.074)	0.091 * (.045)
SG	−0.008 (.070)	0.009 (.050)	0.087 (.063)	0.023 (.072)	0.041 (.045)
SH	0.215 ** (.070)	−0.289 *** (.036)	−0.229 *** (.063)	0.274 *** (.072)	−0.266 *** (.045)
SO	0.399 *** (.070)	0.277 *** (.050)	0.159 * (.063)	0.463 *** (.072)	0.215 *** (.045)
SZ	0.059 (.072)	0.018 (.050)	0.244 *** (.063)	0.075 (.073)	0.137 ** (.045)
TG	−0.103 (.070)	−0.159 ** (.050)	−0.207 ** (.063)	−0.028 (.072)	−0.209 *** (.045)
TI	−0.134 . (.070)	0.527 *** (.050)	0.820 *** (.063)	−0.018 (.072)	0.620 *** (.045)
UR	−0.054 (.072)	0.060 (.050)	0.227 *** (.063)	0.058 (.074)	0.131 ** (.045)
VD	0.309 *** (.070)	0.191 *** (.050)	0.365 *** (.063)	0.388 *** (.072)	0.258 *** (.045)
VS	0.530 *** (.070)	0.352 *** (.050)	0.551 *** (.063)	0.566 *** (.072)	0.443 *** (.045)
ZG	−0.324 *** (.071)	0.120 * (.050)	0.002 (.063)	−0.268 *** (.073)	0.081 . (.045)
N	1 401	1 442	1 450	1 402	1 450
Adj. R^2	0.767	0.945	0.933	0.744	0.963

Note: . $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

OLS hypotheses tests

Residuals for the regression models



(4′) (5.1) (5.2) (5.3)

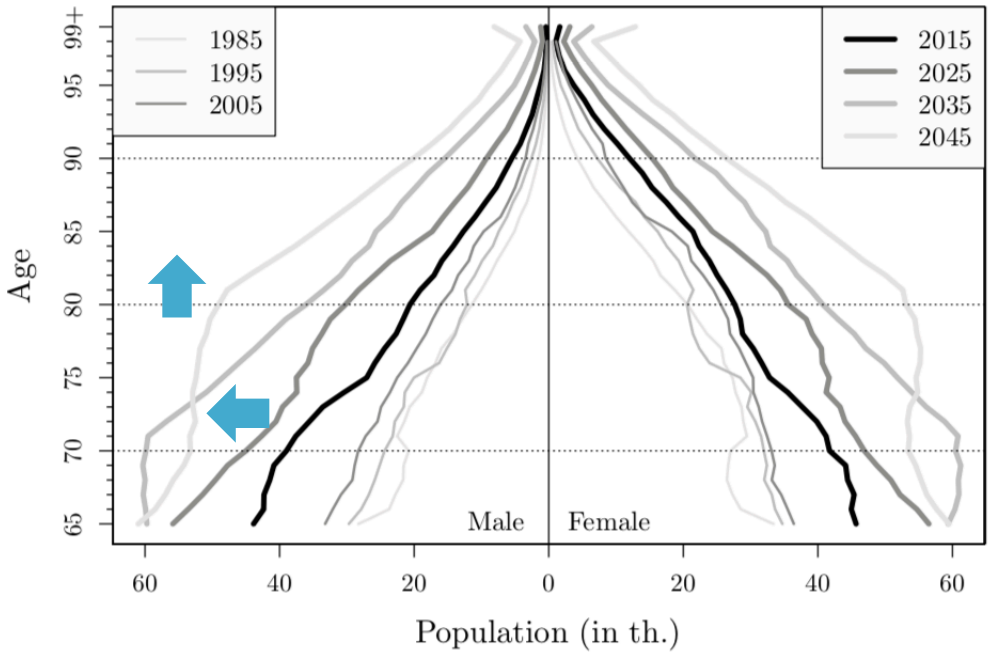
Robustness of results: bootstrap analysis

Model	(4′)		(5.1)		(5.2)		(5.3)	
	$q_{2.5\%}$	$q_{97.5\%}$	$q_{2.5\%}$	$q_{97.5\%}$	$q_{2.5\%}$	$q_{97.5\%}$	$q_{2.5\%}$	$q_{97.5\%}$
Intercept	−4.557	−4.466	−5.564	−5.416	−5.464	−5.366	−6.065	−5.922
Age (baseline: 65–69)								
70–74	0.151	0.238	−0.155	−0.014	0.204	0.315	0.361	0.500
75–79	0.663	0.741	0.213	0.336	0.693	0.801	1.010	1.139
80–84	1.296	1.370	0.659	0.778	1.420	1.515	1.664	1.785
85–89	1.870	1.944	1.085	1.213	2.035	2.128	2.276	2.395
90–94	2.387	2.469	1.395	1.532	2.542	2.648	2.835	2.973
95+	2.821	2.917	1.403	1.597	2.902	3.020	3.488	3.644
Gender (baseline: Male)								
Female	0.179	0.220	0.111	0.188	0.114	0.168	0.210	0.278
Canton (baseline: ZH)								
AG	0.035	0.133	0.038	0.236	−0.018	0.095	0.014	0.165
AI	−0.043	0.220	−0.154	0.212	−0.065	0.183	0.138	0.491
AR	−0.144	0.023	−0.312	−0.022	−0.167	0.038	−0.101	0.099
BE	−0.023	0.061	0.134	0.292	−0.136	−0.045	−0.050	0.086
BL	0.130	0.219	0.117	0.302	0.152	0.253	0.020	0.189
BS	0.268	0.388	0.312	0.503	0.213	0.334	0.258	0.431
FR	0.282	0.375	−0.075	0.128	0.293	0.402	0.354	0.504
GE	0.067	0.149	0.299	0.486	−0.169	−0.060	0.107	0.256
GL	−0.175	−0.039	−0.175	0.085	−0.366	−0.090	−0.271	0.002
GR	−0.183	−0.073	0.058	0.256	−0.270	−0.130	−0.321	−0.122
JU	0.338	0.476	0.541	0.776	0.218	0.382	0.227	0.443
LU	0.321	0.411	0.191	0.381	0.316	0.411	0.345	0.489
NE	−0.043	0.062	0.215	0.449	−0.495	−0.306	0.083	0.287
NW	0.051	0.211	0.064	0.379	0.060	0.278	−0.338	0.009
OW	0.068	0.228	−0.015	0.350	0.013	0.229	−0.102	0.191
SG	−0.012	0.081	−0.087	0.074	−0.036	0.054	0.003	0.169
SH	−0.202	−0.070	0.080	0.352	−0.387	−0.193	−0.332	−0.126
SO	0.236	0.315	0.296	0.508	0.222	0.330	0.081	0.239
SZ	0.075	0.172	−0.055	0.172	−0.050	0.086	0.162	0.325
TG	−0.205	−0.099	−0.202	−0.005	−0.225	−0.093	−0.295	−0.120
TI	0.508	0.614	−0.270	−0.007	0.466	0.583	0.742	0.896
UR	0.063	0.190	−0.195	0.086	−0.036	0.152	0.091	0.353
VD	0.235	0.323	0.227	0.394	0.140	0.241	0.283	0.445
VS	0.419	0.533	0.443	0.620	0.300	0.403	0.453	0.645
ZG	−0.029	0.089	−0.459	−0.186	0.035	0.200	−0.119	0.117
S_B	10 000		10 000		10 000		10 000	
N_B	1 452		1 401		1 442		1 450	

Projections

Development of the population in CH (I)

Federal Statistical Office (FSO) basis scenario A-00-2015



Reference scenario (FSO, A-00-2015)

Development of the population in CH (II)

Federal Statistical Office (FSO) basis scenario A-00-2015

	Census 1985	Projection 2015	Ratio 2015/1985	Projection 2030	Ratio 2030/2015	Projection 2045	Ratio 2045/2015
Population 65+							
Male	367	664	1.81	1 018	1.53	1 283	1.93
Female	552	837	1.52	1 156	1.38	1 407	1.68
Total	919	1 501	1.63	2 174	1.45	2 690	1.79
Population 80+							
Male	67	155	2.32	292	1.88	474	3.06
Female	143	265	1.86	395	1.49	581	2.19
Total	210	420	2.00	687	1.64	1 055	2.51

How does the number of dependent persons develop in the future?

Reference scenario (FSO, A-00-2015)

Projections by cantons

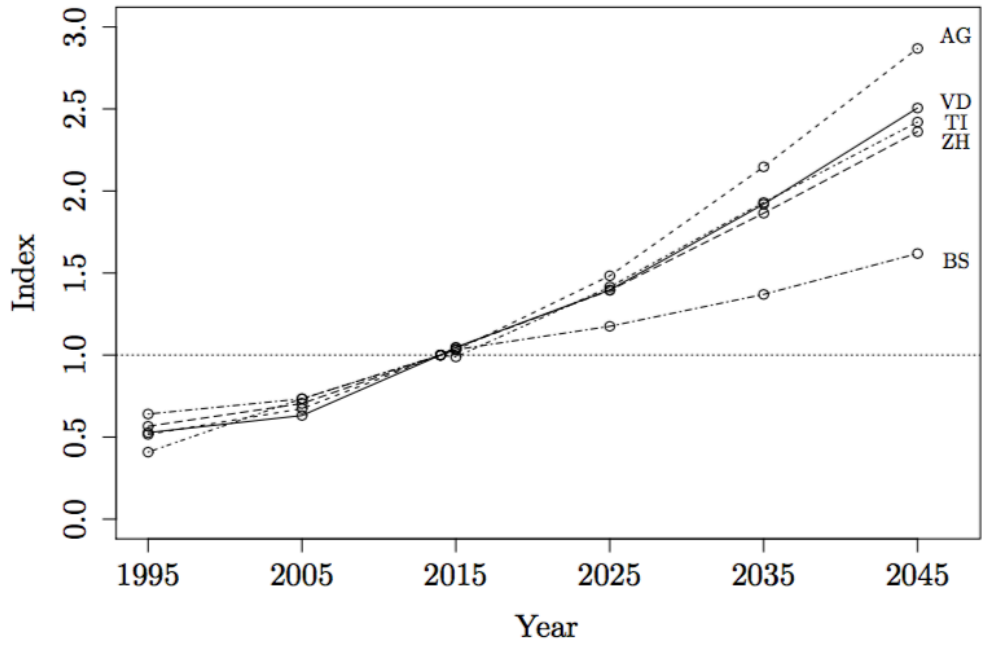
Index 2014, regression 2011-2014, population forecast A-00-2015

Year t	1995		2005		2014		2015		2025		2035		2045	
	$I_{t,C}$	$S_{t,C}$	$I_{t,C}$	$S_{t,C}$	$I_{t,C}$	$S_{t,C}$	$I_{t,C}$	$\hat{S}_{t,C}$	$\hat{I}_{t,C}$	$\hat{S}_{t,C}$	$\hat{I}_{t,C}$	$\hat{S}_{t,C}$	$\hat{I}_{t,C}$	$\hat{S}_{t,C}$
Cantons														
AG	0.52	(5.87)	0.67	(5.98)	1.00	(6.43)	1.02	(6.37)	1.47	(6.73)	2.13	(7.13)	2.85	(7.45)
AI	0.77	(0.25)	0.88	(0.22)	1.00	(0.18)	1.04	(0.18)	1.43	(0.19)	1.92	(0.18)	2.44	(0.18)
AR	0.77	(0.77)	0.90	(0.70)	1.00	(0.57)	1.04	(0.57)	1.36	(0.55)	1.81	(0.53)	2.27	(0.52)
BE	0.77	(16.22)	0.86	(14.19)	1.00	(12.04)	1.04	(12.16)	1.38	(11.86)	1.87	(11.75)	2.34	(11.49)
BL	0.51	(3.50)	0.70	(3.77)	1.00	(3.95)	1.04	(3.97)	1.41	(3.97)	1.85	(3.80)	2.24	(3.60)
BS	0.65	(4.15)	0.73	(3.67)	1.00	(3.65)	1.02	(3.66)	1.16	(3.06)	1.35	(2.61)	1.60	(2.40)
FR	0.59	(3.33)	0.88	(3.86)	1.00	(3.21)	1.09	(3.40)	1.53	(3.50)	2.25	(3.76)	3.04	(3.97)
GE	0.50	(4.65)	0.62	(4.58)	1.00	(5.34)	1.03	(5.36)	1.38	(5.27)	1.81	(5.05)	2.23	(4.87)
GL	0.92	(0.64)	1.00	(0.55)	1.00	(0.40)	1.04	(0.39)	1.36	(0.38)	1.84	(0.38)	2.38	(0.38)
GR	0.77	(2.59)	0.92	(2.41)	1.00	(1.91)	1.03	(1.92)	1.42	(1.94)	1.97	(1.96)	2.48	(1.93)
JU	0.74	(1.69)	0.74	(1.32)	1.00	(1.31)	1.01	(1.29)	1.34	(1.25)	1.79	(1.22)	2.26	(1.20)
LU	0.56	(5.40)	0.71	(5.30)	1.00	(5.47)	1.05	(5.55)	1.42	(5.50)	1.93	(5.49)	2.57	(5.70)
NE	0.78	(2.56)	0.85	(2.18)	1.00	(1.88)	1.10	(2.02)	1.36	(1.83)	1.75	(1.71)	2.14	(1.64)
NW	0.38	(0.34)	0.51	(0.35)	1.00	(0.51)	0.98	(0.48)	1.53	(0.55)	2.22	(0.58)	2.73	(0.56)
OW	0.51	(0.37)	0.75	(0.43)	1.00	(0.42)	1.00	(0.41)	1.53	(0.46)	2.29	(0.50)	3.03	(0.52)
SG	0.60	(5.29)	0.78	(5.41)	1.00	(5.06)	1.02	(5.03)	1.41	(5.09)	1.95	(5.14)	2.52	(5.18)
SH	0.83	(1.18)	0.96	(1.06)	1.00	(0.81)	1.07	(0.85)	1.44	(0.83)	1.93	(0.82)	2.44	(0.81)
SO	0.44	(2.94)	0.68	(3.60)	1.00	(3.84)	1.02	(3.81)	1.40	(3.84)	1.90	(3.79)	2.44	(3.81)
SZ	0.56	(1.49)	0.70	(1.48)	1.00	(1.53)	1.04	(1.55)	1.56	(1.69)	2.30	(1.83)	3.14	(1.95)
TG	0.64	(2.34)	0.88	(2.51)	1.00	(2.09)	1.04	(2.10)	1.53	(2.26)	2.25	(2.44)	3.06	(2.59)
TI	0.41	(6.01)	0.74	(8.39)	1.00	(8.30)	0.99	(8.04)	1.41	(8.39)	1.91	(8.32)	2.38	(8.10)
UR	0.69	(0.58)	1.01	(0.67)	1.00	(0.49)	0.99	(0.46)	1.36	(0.47)	1.89	(0.47)	2.41	(0.47)
VD	0.53	(9.08)	0.63	(8.45)	1.00	(9.76)	1.03	(9.82)	1.37	(9.61)	1.89	(9.66)	2.46	(9.85)
VS	0.40	(3.96)	0.58	(4.49)	1.00	(5.64)	0.99	(5.41)	1.43	(5.77)	2.06	(6.07)	2.68	(6.18)
ZG	0.38	(0.73)	0.54	(0.80)	1.00	(1.08)	1.02	(1.07)	1.53	(1.18)	2.19	(1.23)	2.85	(1.25)
ZH	0.57	(14.07)	0.70	(13.63)	1.00	(14.13)	1.03	(14.13)	1.37	(13.84)	1.84	(13.54)	2.33	(13.40)
Linguistic regions														
DE	0.61	(68.71)	0.75	(66.73)	1.00	(64.56)	1.03	(64.67)	1.40	(64.38)	1.91	(64.20)	2.44	(64.20)
FR	0.53	(25.28)	0.67	(24.88)	1.00	(27.14)	1.03	(27.29)	1.40	(27.24)	1.94	(27.48)	2.50	(27.70)
IT	0.41	(6.01)	0.74	(8.39)	1.00	(8.30)	0.99	(8.04)	1.41	(8.39)	1.91	(8.32)	2.38	(8.10)
Whole country														
CH	0.57	(100.00)	0.73	(100.00)	1.00	(100.00)	1.03	(100.00)	1.40	(100.00)	1.92	(100.00)	2.45	(100.00)

Overall CH prevalence to by multiplied by 2.45 in 2045

Important regional differences in future LTC

Index 2014, regression 2011-2014, population forecast A-00-2015



Backtesting of the forecasts (out of sample)

Regression 2011-2013, forecast 2014, compare with 2014 observation

Relative differences in %

Cantons								*Linguistic regions*	
AG	−0.67	GE	−0.68	OW	−4.40	UR	−3.54	DE	+0.22
AI	−0.22	GL	−0.23	SG	−1.28	VD	+0.47	FR	+0.68
AR	+3.02	GR	+3.02	SH	+5.85	VS	−5.10	IT	−4.10
BE	+1.65	JU	−2.90	SO	−1.55	ZG	−2.92	*Whole country*	
BL	+1.00	LU	+1.66	SZ	+0.55	ZH	−0.13	CH	−0.02
BS	+0.04	NE	+11.78	TG	+0.19				
FR	+8.77	NW	−8.62	TI	−4.10				

Evolution of the dependent population in "low" and "high" population scenarios

Year t	2015		2025		2035		2045	
	$\hat{I}^{\text{Low}}_{t,C}$	$\hat{I}^{\text{High}}_{t,C}$	$\hat{I}^{\text{Low}}_{t,C}$	$\hat{I}^{\text{High}}_{t,C}$	$\hat{I}^{\text{Low}}_{t,C}$	$\hat{I}^{\text{High}}_{t,C}$	$\hat{I}^{\text{Low}}_{t,C}$	$\hat{I}^{\text{High}}_{t,C}$
Cantons								
AG	1.02	1.02	1.45	1.49	2.06	2.19	2.68	3.00
AI	1.03	1.04	1.41	1.44	1.87	1.98	2.32	2.56
AR	1.04	1.04	1.34	1.37	1.75	1.87	2.15	2.38
BE	1.04	1.04	1.36	1.40	1.81	1.93	2.21	2.47
BL	1.04	1.04	1.39	1.43	1.79	1.90	2.11	2.36
BS	1.02	1.02	1.14	1.18	1.30	1.40	1.49	1.70
FR	1.09	1.09	1.51	1.55	2.18	2.32	2.87	3.20
GE	1.03	1.03	1.35	1.41	1.72	1.88	2.05	2.40
GL	1.03	1.04	1.33	1.38	1.78	1.90	2.22	2.51
GR	1.03	1.03	1.40	1.44	1.90	2.04	2.32	2.63
JU	1.01	1.02	1.31	1.37	1.72	1.85	2.12	2.39
LU	1.05	1.05	1.40	1.43	1.87	1.99	2.43	2.70
NE	1.10	1.10	1.34	1.38	1.68	1.80	2.00	2.26
NW	0.98	0.98	1.50	1.55	2.13	2.29	2.55	2.89
OW	1.00	1.00	1.51	1.55	2.21	2.36	2.84	3.21
SG	1.02	1.03	1.39	1.43	1.88	2.01	2.37	2.65
SH	1.07	1.07	1.42	1.46	1.86	1.98	2.29	2.57
SO	1.02	1.03	1.39	1.42	1.84	1.95	2.30	2.56
SZ	1.04	1.04	1.53	1.58	2.23	2.37	2.95	3.31
TG	1.04	1.04	1.51	1.55	2.18	2.32	2.88	3.22
TI	0.99	0.99	1.37	1.44	1.81	2.00	2.19	2.55
UR	0.99	0.99	1.34	1.38	1.82	1.95	2.26	2.54
VD	1.03	1.03	1.35	1.40	1.81	1.95	2.29	2.62
VS	0.98	0.99	1.41	1.46	1.98	2.14	2.51	2.85
ZG	1.02	1.02	1.51	1.55	2.11	2.26	2.66	3.02
ZH	1.03	1.03	1.35	1.39	1.77	1.90	2.18	2.46
Linguistic regions								
DE	1.03	1.03	1.38	1.42	1.84	1.97	2.30	2.58
FR	1.03	1.03	1.38	1.43	1.86	2.01	2.33	2.66
IT	0.99	0.99	1.37	1.44	1.81	2.00	2.19	2.55
Whole country								
CH	1.03	1.03	1.38	1.42	1.85	1.98	2.30	2.60

FSO Projections B-00-2015 and C-00-2015

Prevalence in Switzerland: drivers and future development – Key findings

Regression

- Age, gender and canton of residence are significant factors in determining the needs of care: female persons at higher ages present higher prevalence rates.
- The distinction in two series of models shows that the age and the gender distinction have larger influence on the prevalence rates for both the severely dependent persons and the ones being cared for in an institution. Furthermore, we find similarities between mildly dependent persons and persons cared for at home.
- Therefore, the major part of persons in moderate and severe dependency receives care in an institution while mildly dependent persons only receive home-based care.

Forecast

- Our forecasts imply a serious increase of the demand in LTC over the next thirty years (2045).
- By considering the canton of residence, we identify different clusters along the composition of the population. For example, the increase in dependent elderly is higher in rural cantons (x 2.6) than in urban cantons (x 2.4).
- By considering the level of dependency, our model predicts a higher increase in severely dependent than in mildly dependent. We find a similar relation between persons cared for in an institution than persons cared for at home.

Reference European Actuarial Journal, 8(2):321-362, 2018

What are the probabilities for transiting through different acuity states after a given time spent in one of the states?

1. Old-Age Care Prevalence in Switzerland: Drivers and Future Development
2. Long-Term Care Models and Dependence Probability Tables by Acuity Level: New Empirical Evidence from Switzerland
3. An Econometric Study on the Duration of Long-Term Care: Main Drivers and Substitution Effect

Motivation

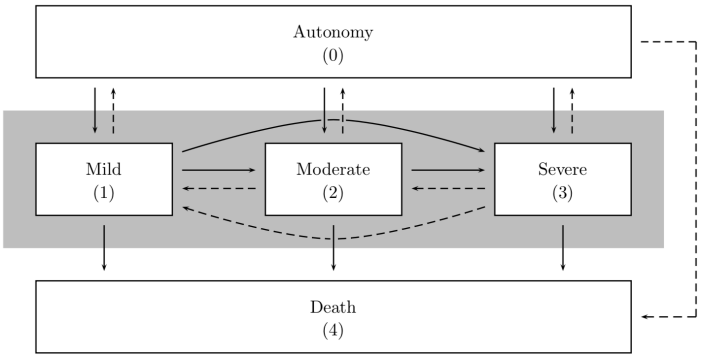
- Availability of insurance is limited even in most developed LTC markets (US, UK, F)
  - → difficulties in determining proper pricing
  - → often entails higher premiums and re-pricing
- Problems in pricing LTC solutions
  - → limited data availability and lack of knowledge
  - → effect of gender, age and sociodemographic factors on individuals' health paths often not well understood
- In Switzerland, no insurance offering exists and out-of-pocket spendings are highest in the world

Research

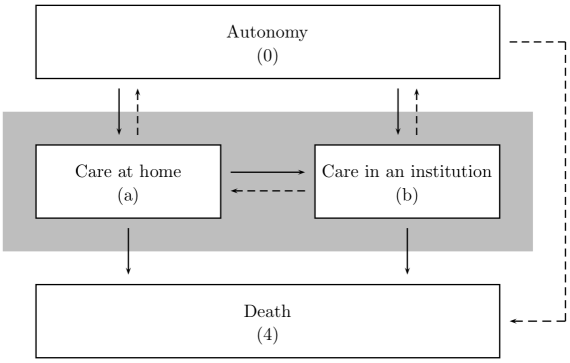
- Research objectives
  - → enhance the understanding of individual transitions through dependence along frailty levels, types of care and the duration
  - → provide dependence tables as basis for the pricing of LTC solutions
  - → detail the transition probabilities by gender and by age
- Available data and techniques
  - → comprehensive longitudinal dataset covering the total dependent population in Switzerland over a 20-year period (1995–2014)
  - → actuarial formulation of transition probabilities in a semi-Markov model

Two dependency models

Frailty level model



Type of care model



Model calibration

Formal development of the semi-Markov model

- $Z = (J_n, T_n)_{n \geq 0}$ defines a semi-Markov process $\quad X_{n+1} = T_{n+1} - T_n > 0$

  semi-markov kernel $Q_{ij}(t) = \Pr(J_{n+1} = j, X_{n+1} \leq t \mid J_n = i)$
- Markov chain disregarding the time $\phi_{ij} = \lim_{t \to +\infty} Q_{ij}(t) = \Pr(J_{n+1} = j \mid J_n = i)$
- duration law $F_{ij}(t) = \Pr(X_{n+1} \leq t \mid J_n = i, J_{n+1} = j)$

  $Q_{ij}(t) = \phi_{ij}\, F_{ij}(t)$
- instantaneous probabilities (Cf. De Dominicis and Janssen, 1984)

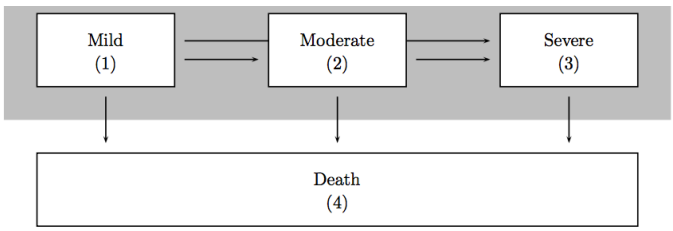
$$\lambda_{ij}(t) = \frac{\phi_{ij}\, f_{ij}(t)}{\sum_{j=1}^{m} \phi_{ij}\, (1 - F_{ij}(t))} \qquad \text{if } \phi_{ij} \neq 0 \text{ and } F_{ij}(t) \neq 1, \quad \text{and } \lambda_{ij}(t) = 0 \text{ otherwise}$$

- transition probabilities solving the semi-Markov model

  backward transitions are not possible

$$p_{ij}(t) = \begin{cases} e^{-\int_0^t \sum_{k>i} \lambda_{ik}(\tau)\, \mathrm{d}\tau} & \text{if } i = j, \\ \int_0^t p_{ii}(\tau) \sum_{k>i} \lambda_{ik}(\tau)\, p_{kj}(t-\tau)\, \mathrm{d}\tau & \text{if } i < j. \end{cases}$$

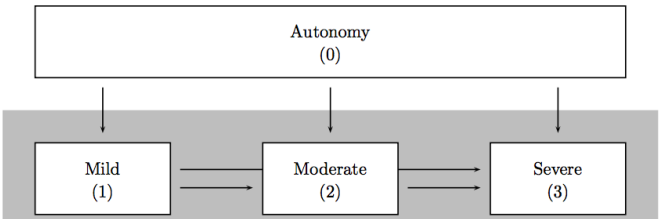
Frailty state model: transition probabilities between frailty states and death



$$p_{11}(t) = e^{-\int_0^t \lambda_{12}(\tau) + \lambda_{13}(\tau) + \lambda_{14}(\tau)\, \mathrm{d}\tau},$$
$$p_{22}(t) = e^{-\int_0^t \lambda_{23}(\tau) + \lambda_{24}(\tau)\, \mathrm{d}\tau},$$
$$p_{33}(t) = e^{-\int_0^t \lambda_{34}(\tau)\, \mathrm{d}\tau},$$
$$p_{44}(t) = 1.$$

$$p_{12}(t) = \int_0^t p_{11}(\tau)\, \lambda_{12}(\tau)\, p_{22}(t-\tau)\, \mathrm{d}\tau,$$
$$p_{13}(t) = \int_0^t p_{11}(\tau)\, [\lambda_{12}(\tau)\, p_{23}(t-\tau) + \lambda_{13}(\tau)\, p_{33}(t-\tau)]\, \mathrm{d}\tau,$$
$$p_{14}(t) = \int_0^t p_{11}(\tau)\, [\lambda_{12}(\tau)\, p_{24}(t-\tau) + \lambda_{13}(\tau)\, p_{34}(t-\tau) + \lambda_{14}(\tau)\, p_{44}(t-\tau)]\, \mathrm{d}\tau,$$
$$p_{23}(t) = \int_0^t p_{22}(\tau)\, \lambda_{23}(\tau)\, p_{33}(t-\tau) \mathrm{d}\tau,$$
$$p_{24}(t) = \int_0^t p_{22}(\tau)\, [\lambda_{23}(\tau)\, p_{34}(t-\tau) + \lambda_{24}(\tau)\, p_{44}(t-\tau)]\, \mathrm{d}\tau,$$
$$p_{34}(t) = \int_0^t p_{33}(\tau)\, \lambda_{34}(\tau)\, p_{44}(t-\tau)\, \mathrm{d}\tau.$$

Frailty state model: estimation of the probability to lose autonomy



prevalence rates $\pi(x)$ for a given age x

Markov probabilities $\phi_{0j}(x)$

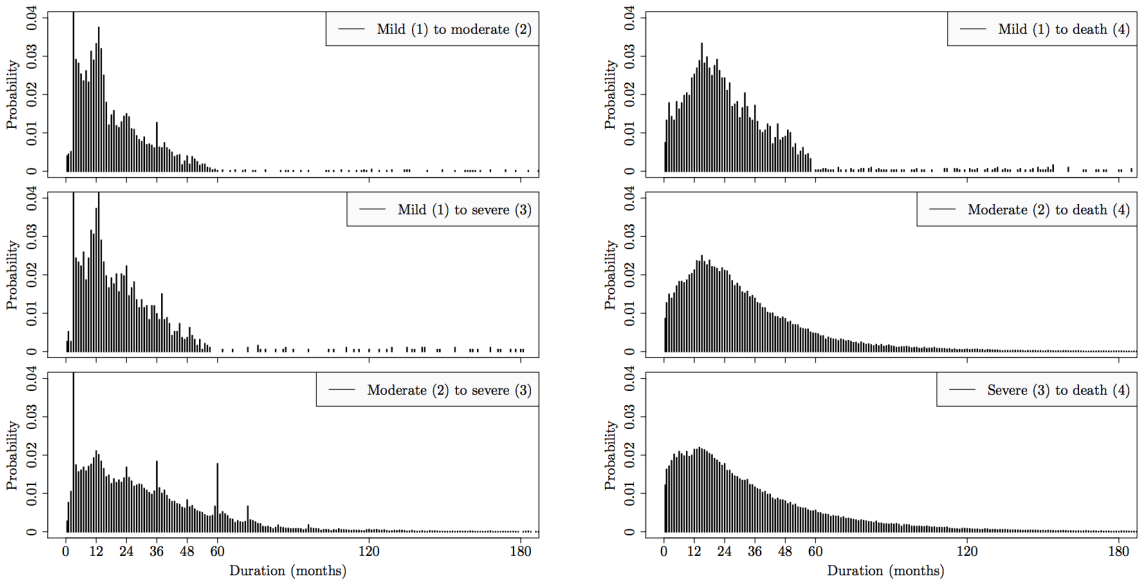
transition probabilities $p_{0j}(x) = \pi(x)\phi_{0j}(x)$

Weibull distribution for duration law

$$F_{ij}(t) = 1 - e^{-(t/\theta_{ij})^{\sigma_{ij}}}$$

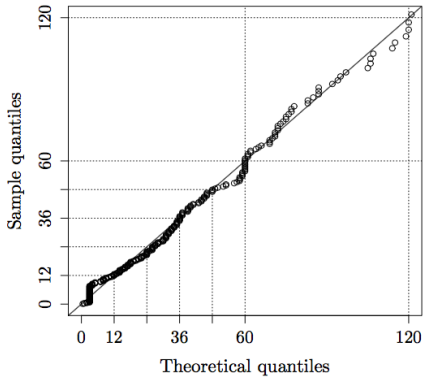
scale

shape parameter

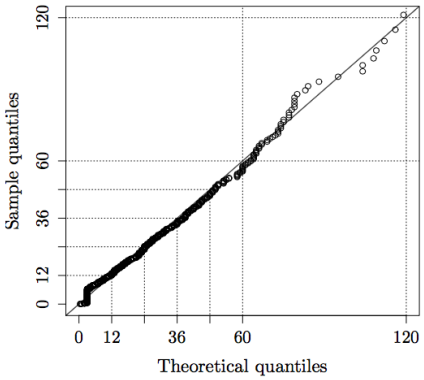


Weibull law goodness-of-fit for durations

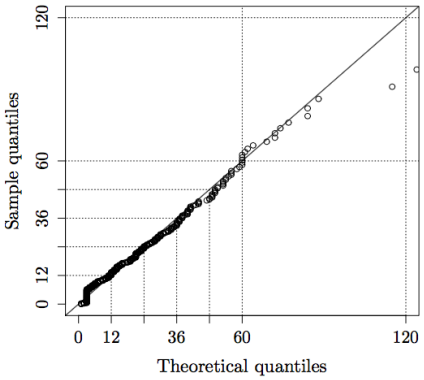
Example: transition moderate (2) → severe (3)



(a) Age 70



(b) Age 80

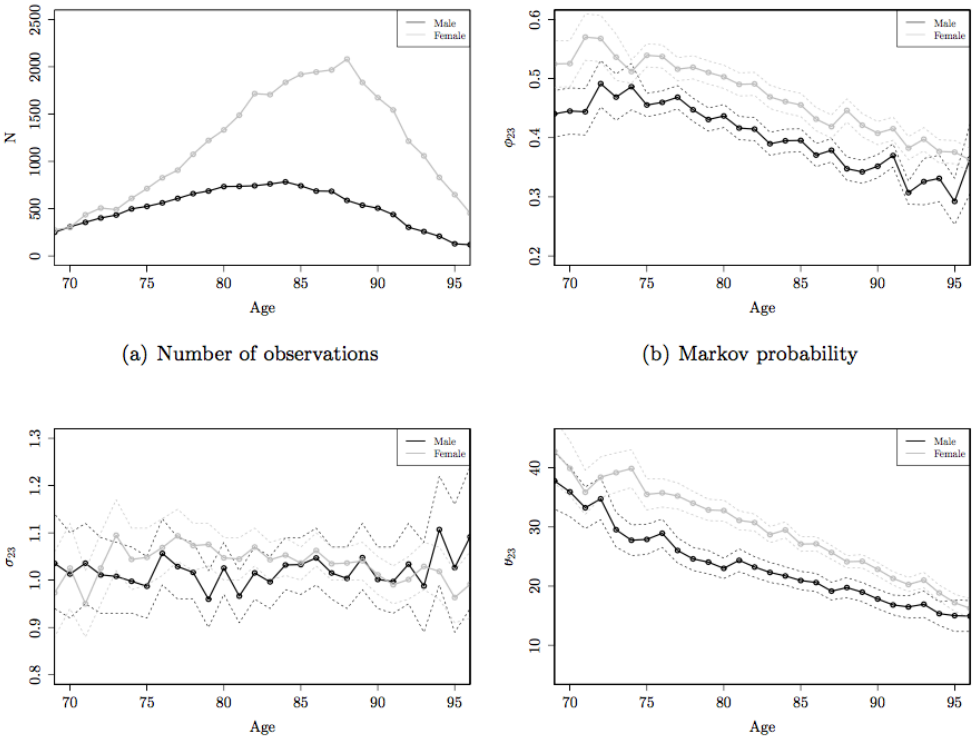


(c) Age 90

Parameter estimates by gender and for ages 70, 80, 90 years in the frailty level model

			Male						Female					
		Age	70		80		90		70		80		90	
Transitions	$1 \to 2$	ϕ_{ij}	0.476	(0.054)	0.564	(0.036)	0.495	(0.035)	0.596	(0.054)	0.619	(0.031)	0.491	(0.026)
		σ_{ij}	0.856	(0.092)	1.051	(0.078)	1.170	(0.089)	0.852	(0.087)	1.143	(0.070)	1.145	(0.065)
		θ_{ij}	14.514	(2.818)	13.209	(1.302)	14.198	(1.286)	19.276	(3.400)	14.312	(1.062)	14.579	(1.012)
		$\mathbb{E}(X)$	15.720		12.952		13.446		20.943		13.644		13.894	
		N	41		105		100		50		156		178	
	$1 \to 3$	ϕ_{ij}	0.198	(0.043)	0.124	(0.024)	0.168	(0.026)	0.190	(0.043)	0.171	(0.024)	0.198	(0.021)
		σ_{ij}	0.922	(0.170)	1.124	(0.180)	1.116	(0.153)	0.771	(0.146)	1.362	(0.170)	1.379	(0.128)
		θ_{ij}	34.098	(9.497)	14.341	(2.820)	15.323	(2.498)	38.564	(13.258)	19.924	(2.338)	18.199	(1.639)
		$\mathbb{E}(X)$	35.410		13.743		14.716		44.907		18.242		16.628	
		N	17		23		34		16		43		72	
	$1 \to 4$	ϕ_{ij}	0.326	(0.051)	0.312	(0.034)	0.337	(0.033)	0.214	(0.045)	0.210	(0.026)	0.311	(0.024)
		σ_{ij}	0.959	(0.138)	1.168	(0.114)	1.718	(0.170)	0.690	(0.128)	1.735	(0.184)	1.677	(0.126)
		θ_{ij}	56.451	(11.757)	24.087	(2.851)	27.383	(2.026)	68.368	(24.658)	29.351	(2.447)	28.364	(1.675)
		$\mathbb{E}(X)$	57.506		22.823		24.415		87.707		26.154		25.332	
		N	28		58		68		18		53		113	
	$2 \to 3$	ϕ_{ij}	0.445	(0.019)	0.437	(0.012)	0.352	(0.013)	0.525	(0.021)	0.503	(0.009)	0.408	(0.008)
		σ_{ij}	1.013	(0.046)	1.026	(0.029)	1.002	(0.034)	1.026	(0.046)	1.047	(0.023)	1.012	(0.019)
		θ_{ij}	35.936	(2.130)	23.002	(0.875)	17.822	(0.839)	39.911	(2.368)	32.777	(0.903)	22.845	(0.583)
		$\mathbb{E}(X)$	35.744		22.764		17.811		39.500		32.180		22.736	
		N	308		734		505		301		1333		1674	
	$2 \to 4$	ϕ_{ij}	0.555	(0.000)	0.563	(0.000)	0.648	(0.000)	0.475	(0.000)	0.497	(0.000)	0.592	(0.000)
		σ_{ij}	1.242	(0.049)	1.284	(0.032)	1.351	(0.034)	1.109	(0.052)	1.364	(0.029)	1.402	(0.022)
		θ_{ij}	47.847	(2.072)	33.680	(0.898)	25.196	(0.644)	52.733	(3.041)	42.754	(0.910)	30.849	(0.470)
		$\mathbb{E}(X)$	44.630		31.187		23.102		50.747		39.137		28.109	
		N	384		947		931		272		1317		2432	
	$3 \to 4$	ϕ_{ij}	1.000	–	1.000	–	1.000	–	1.000	–	1.000	–	1.000	–
		σ_{ij}	1.131	(0.033)	1.176	(0.020)	1.194	(0.023)	1.180	(0.037)	1.244	(0.017)	1.251	(0.013)
		θ_{ij}	51.809	(1.810)	34.019	(0.676)	23.009	(0.495)	69.401	(2.445)	47.718	(0.715)	32.041	(0.353)
		$\mathbb{E}(X)$	49.558		32.174		21.673		65.574		44.490		29.839	
		N	712		2031		1681		638		3192		5844	

Focus on the estimates for the transition moderate (2) → severe (3) for all ages



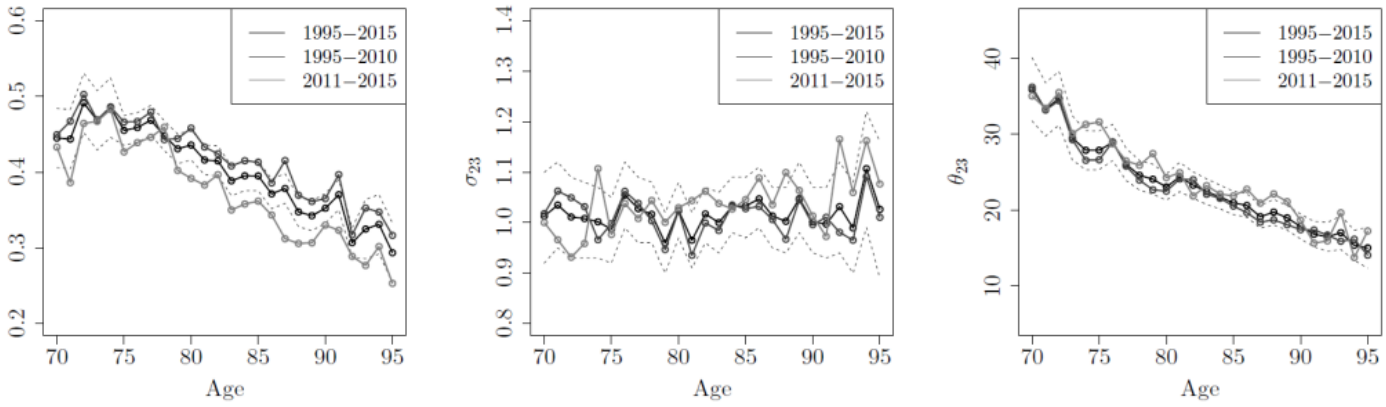
(a) Number of observations (b) Markov probability

(c) Scale parameter of the Weibull law (d) Shape parameter of the Weibull law

Note: Dashed lines indicate the confidence interval at the 95% level.

Robustness test on the estimates for three periods

Example: transition moderate (2) → severe (3)

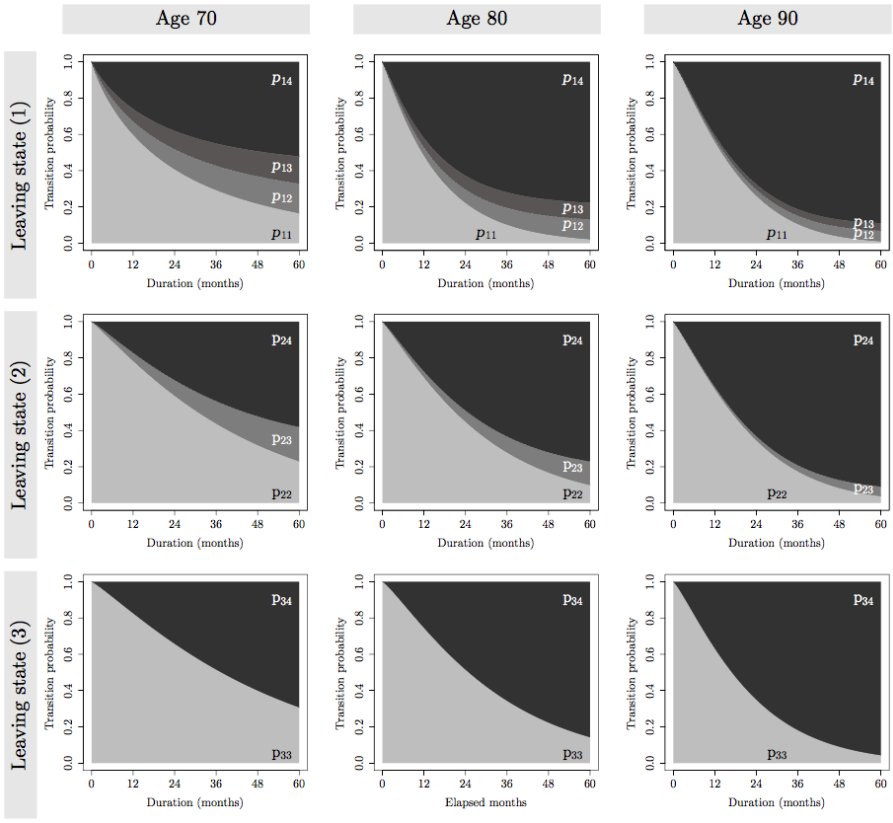


(a) Markov probability (b) Weibull shape parameter (c) Weibull scale parameter

Dashed lines indicate the confidence interval at the 95% level.

Dependence tables

Transition probabilities for male at ages 70, 80, 90 years in the frailty level model



"Dependence tables" by gender and for ages 70, 80, 90 years in the frailty level model

	Male								Female							
	3	6	12	18	24	36	48	60	3	6	12	18	24	36	48	60
Age 70																
p_{11}	0.8522	0.7496	0.5984	0.4899	0.4079	0.2932	0.2180	0.1658	0.8415	0.7391	0.5907	0.4849	0.4054	0.2950	0.2238	0.1755
p_{12}	0.0260	0.0442	0.0719	0.0927	0.1093	0.1336	0.1502	0.1617	0.0301	0.0518	0.0862	0.1137	0.1366	0.1730	0.2009	0.2227
p_{13}	0.0265	0.0443	0.0699	0.0881	0.1020	0.1227	0.1383	0.1509	0.0391	0.0645	0.1006	0.1257	0.1441	0.1693	0.1858	0.1976
p_{14}	0.0953	0.1620	0.2598	0.3293	0.3808	0.4505	0.4936	0.5216	0.0893	0.1446	0.2225	0.2757	0.3139	0.3626	0.3895	0.4042
p_{22}	0.9479	0.8925	0.7840	0.6833	0.5920	0.4384	0.3198	0.2304	0.9450	0.8892	0.7836	0.6881	0.6028	0.4603	0.3497	0.2647
p_{23}	0.0110	0.0220	0.0436	0.0646	0.0849	0.1229	0.1575	0.1880	0.0158	0.0317	0.0630	0.0931	0.1217	0.1742	0.2204	0.2598
p_{24}	0.0411	0.0856	0.1724	0.2521	0.3231	0.4387	0.5227	0.5815	0.0393	0.0791	0.1534	0.2189	0.2756	0.3655	0.4299	0.4755
p_{33}	0.9609	0.9163	0.8259	0.7389	0.6577	0.5155	0.3996	0.3071	0.9757	0.9459	0.8815	0.8159	0.7515	0.6307	0.5235	0.4308
p_{34}	0.0391	0.0837	0.1741	0.2611	0.3423	0.4845	0.6004	0.6929	0.0243	0.0541	0.1185	0.1841	0.2485	0.3693	0.4765	0.5692
Age 80																
p_{11}	0.8470	0.7058	0.4833	0.3285	0.2227	0.1025	0.0475	0.0221	0.8880	0.7653	0.5468	0.3773	0.2527	0.1038	0.0378	0.0121
p_{12}	0.0114	0.0226	0.0426	0.0592	0.0726	0.0914	0.1026	0.1087	0.0180	0.0379	0.0751	0.1057	0.1295	0.1601	0.1753	0.1821
p_{13}	0.0166	0.0312	0.0531	0.0673	0.0765	0.0862	0.0901	0.0917	0.0231	0.0475	0.0887	0.1188	0.1399	0.1640	0.1744	0.1785
p_{14}	0.1250	0.2404	0.4210	0.5450	0.6282	0.7198	0.7598	0.7775	0.0709	0.1493	0.2894	0.3982	0.4779	0.5721	0.6125	0.6272
p_{22}	0.9245	0.8445	0.6932	0.5608	0.4485	0.2792	0.1686	0.0992	0.9474	0.8888	0.7712	0.6604	0.5598	0.3922	0.2674	0.1781
p_{23}	0.0077	0.0155	0.0311	0.0462	0.0606	0.0873	0.1105	0.1294	0.0109	0.0225	0.0461	0.0697	0.0928	0.1368	0.1764	0.2102
p_{24}	0.0679	0.1400	0.2757	0.3931	0.4908	0.6335	0.7210	0.7714	0.0417	0.0887	0.1827	0.2699	0.3474	0.4710	0.5563	0.6117
p_{33}	0.9441	0.8781	0.7455	0.6230	0.5150	0.3434	0.2234	0.1425	0.9685	0.9270	0.8357	0.7428	0.6536	0.4945	0.3652	0.2645
p_{34}	0.0559	0.1219	0.2545	0.3770	0.4850	0.6566	0.7766	0.8575	0.0315	0.0730	0.1643	0.2572	0.3464	0.5055	0.6348	0.7355
Age 90																
p_{11}	0.8933	0.7749	0.5606	0.3901	0.2620	0.1059	0.0369	0.0111	0.9030	0.7903	0.5790	0.4066	0.2757	0.1148	0.0420	0.0135
p_{12}	0.0031	0.0071	0.0156	0.0242	0.0320	0.0445	0.0525	0.0568	0.0061	0.0132	0.0278	0.0414	0.0531	0.0707	0.0812	0.0867
p_{13}	0.0050	0.0103	0.0190	0.0255	0.0303	0.0366	0.0405	0.0429	0.0099	0.0208	0.0404	0.0561	0.0681	0.0832	0.0905	0.0933
p_{14}	0.0986	0.2078	0.4048	0.5602	0.6757	0.8129	0.8701	0.8892	0.0810	0.1757	0.3527	0.4959	0.6031	0.7313	0.7863	0.8064
p_{22}	0.9101	0.8127	0.6286	0.4717	0.3456	0.1749	0.0832	0.0377	0.9288	0.8504	0.6960	0.5561	0.4357	0.2547	0.1413	0.0753
p_{23}	0.0026	0.0052	0.0106	0.0161	0.0217	0.0328	0.0434	0.0527	0.0059	0.0119	0.0240	0.0361	0.0482	0.0713	0.0923	0.1100
p_{24}	0.0873	0.1821	0.3608	0.5122	0.6327	0.7922	0.8734	0.9096	0.0653	0.1378	0.2800	0.4078	0.5162	0.6740	0.7664	0.8147
p_{33}	0.9159	0.8179	0.6314	0.4743	0.3494	0.1815	0.0902	0.0433	0.9496	0.8842	0.7462	0.6150	0.4982	0.3145	0.1905	0.1117
p_{34}	0.0841	0.1821	0.3686	0.5257	0.6506	0.8185	0.9098	0.9567	0.0504	0.1158	0.2538	0.3850	0.5018	0.6855	0.8095	0.8883

Focus on males at age 70

	Male							
	3	6	12	18	24	36	48	60
Age 70								
p_{11}	0.8522	0.7496	0.5984	0.4899	0.4079	0.2932	0.2180	0.1658
p_{12}	0.0260	0.0442	0.0719	0.0927	0.1093	0.1336	0.1502	0.1617
p_{13}	0.0265	0.0443	0.0699	0.0881	0.1020	0.1227	0.1383	0.1509
p_{14}	0.0953	0.1620	0.2598	0.3293	0.3808	0.4505	0.4936	0.5216
p_{22}	0.9479	0.8925	0.7840	0.6833	0.5920	0.4384	0.3198	0.2304
p_{23}	0.0110	0.0220	0.0436	0.0646	0.0849	0.1229	0.1575	0.1880
p_{24}	0.0411	0.0856	0.1724	0.2521	0.3231	0.4387	0.5227	0.5815
p_{33}	0.9609	0.9163	0.8259	0.7389	0.6577	0.5155	0.3996	0.3071
p_{34}	0.0391	0.0837	0.1741	0.2611	0.3423	0.4845	0.6004	0.6929

First actuarial dependence tables for Switzerland – Key findings

Significant factors: the gender, the (entrance) age and the duration

- Staying probabilities decrease with age and duration.
- Leaving probabilities and mortality increase with the duration.
- **For small durations, mildly dependent individuals have a higher mortality when compared to the moderately and severely dependent persons**
  → this may appear counterintuitive since limitations in ADL are typically linked to poorer health
  → two hidden effects
  - **mildly** dependents are **more often cared at home** with no permanent assistance and with no professional care infrastructure.
  - **pathologies** like cancer, may come with a very high mortality but express only few limitations in ADL, while other pathologies including cognitive diseases come along with important ADL limitations without specific impact on the mortality
- Total time in dependence about 3 years; women, compared to men, stay longer in the dependency states given their lower mortality (**women live more years in dependence**)
- An important share of **elderly cared at home enter an institution after one year**

Reference Insurance: Mathematics and Economics, 81:51-70, 2018

What socioeconomic factors determine the duration of long-term care? Is there any substitution effect between at home and institutional care?

1. Old-Age Care Prevalence in Switzerland: Drivers and Future Development
2. Long-Term Care Models and Dependence Probability Tables by Acuity Level: New Empirical Evidence from Switzerland
3. An Econometric Study on the Duration of Long-Term Care: Main Drivers and Substitution Effect

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 trough 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)?

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 (1995–2014)
  → generalized linear regression modeling and bootstrapping

Research questions

- **Research question 1**
  What are the socio-demographic covariates that affect the time spent in LTC along types of care?
- **Research question 2**
  Given the significant factors driving the duration of LTC, what is the predicted mean time an elderly spends in dependence?
- **Research question 3**
  How does the interaction of at-home and institutional care affect the duration of LTC?
- **Research question 4**
  What is the effect of longevity gains on the age at entry in old-age dependence?
- **Research question 5**
  How has the duration of LTC developed over the past years?

Descriptive statistics

Description of 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 in the data D_1 and D_2

	D				D^{HC}				D^{IC}			
	$\mathcal{D}_1$		$\mathcal{D}_2$		$\mathcal{D}_1$		$\mathcal{D}_2$		$\mathcal{D}_1$		$\mathcal{D}_2$	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	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)

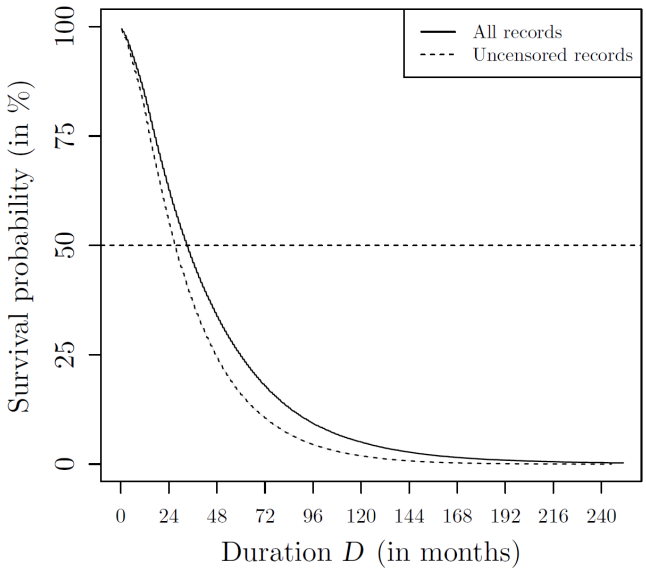
Censoring by calendar year in the data D_1

	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 the survival curve

Illustration for select ages

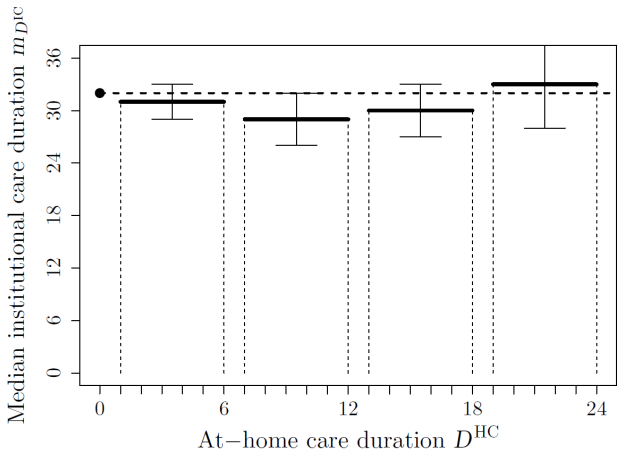


Descriptive statistics (median duration)

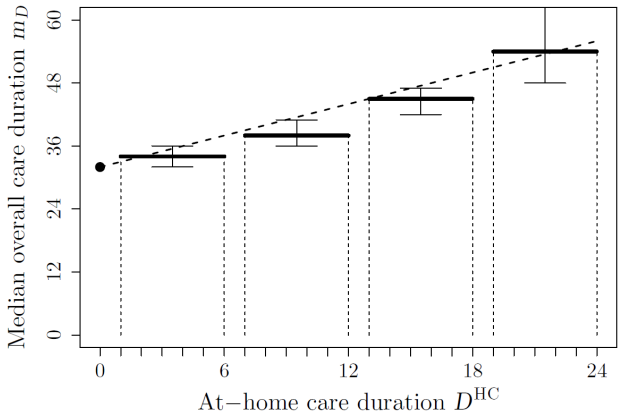
	D				D^{HC}				D^{IC}			
	$\mathcal{D}_1$		$\mathcal{D}_2$		$\mathcal{D}_1$		$\mathcal{D}_2$		$\mathcal{D}_1$		$\mathcal{D}_2$	
	m_D	(%)	m_D	(%)	$m_{D^{\text{HC}}}$	(%)	$m_{D^{\text{HC}}}$	(%)	$m_{D^{\text{IC}}}$	(%)	$m_{D^{\text{IC}}}$	(%)
Age at entry												
66 – 69	66	(3.7)	63	(8.0)	78	(6.8)	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

Interaction between types of care



(a)



(b)

Mean age at entry by calendar year

Calendar year	Male				Female			
	$\varnothing AG$	$q_{5\%}$	$q_{95\%}$	(N)	$\varnothing AG$	$q_{5\%}$	$q_{95\%}$	(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)

Answer RQ4: 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			*								*				

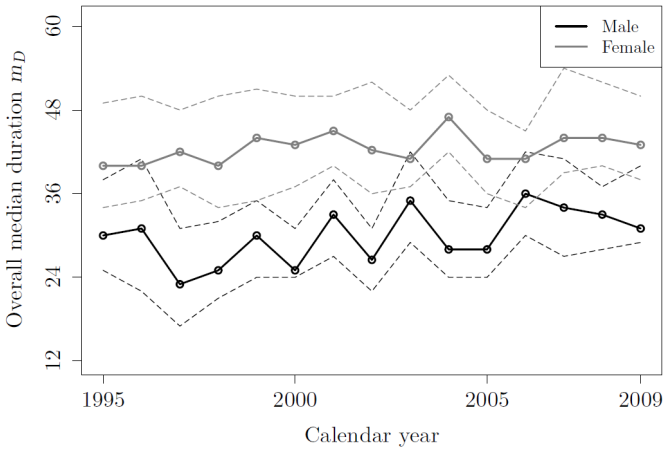
X_2-result: **significant among genders for most calendar years**

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**

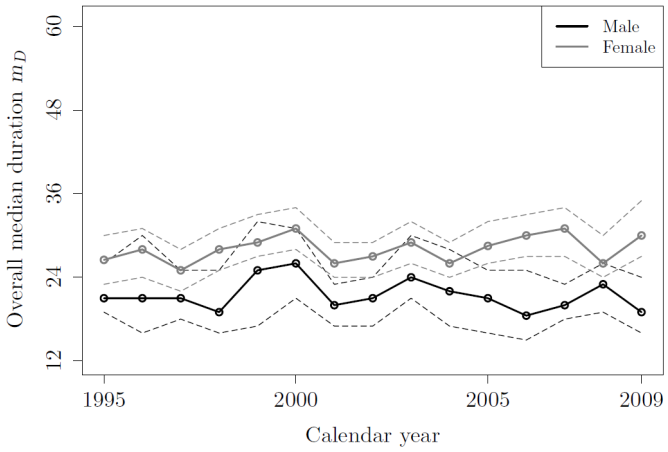
Answer RQ5: Longevity gains have not significantly affected the duration of LTC

Median overall care duration over time

Illustration for select ages



(a) Age 80



(b) Age 90

Econometric models

Accelerated Failure Time (AFT) models:
Gamma distribution with log-link specification

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

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

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

Variables included in the econometric models

		$\mathcal{D}_1$ and $\mathcal{D}_2$							$\mathcal{D}_2$ only	
Model		AG_i	GE_i	LR_i	HH_i	AL_i	TC_i	DH_i	SA_i	NA_i
(30)	D_i	✓	✓	✓		✓	✓		✓	
(31)	D_i^{HC}	✓	✓	✓	✓				✓	
(32)	D_i^{IC}	✓	✓	✓		✓		✓	✓	

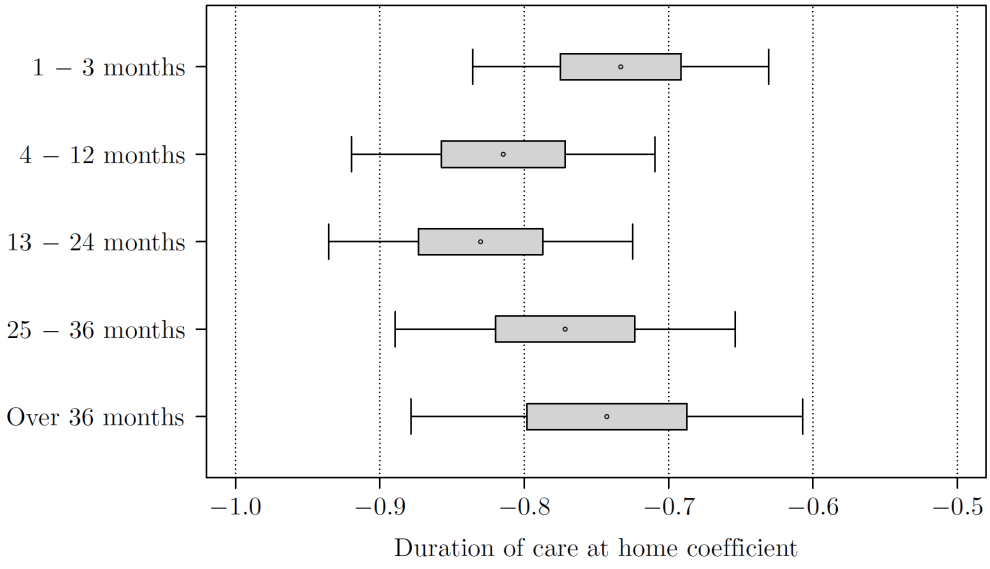
Answer RQ1: Socio-demographic covariates that affect the time spent in LTC along types of care

Results for regression models applied to D_1

Model	(30)	(31)	(32)
	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

Note: Significance levels are reported as follows: p-value < 0.1 . , < 0.05 *, < 0.01 **, < 0.001 ***.

Results for regression models applied to D_1:
Focus on the substitution effect



Answer RQ3: 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)

Results for econometric models applied to D_2

Models	(30)	(31)	(32)
	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
N total	92 898	13 871	84 011

Note: Significance levels are reported as follows: p-value < 0.1 . , < 0.05 *, < 0.01 **, < 0.001 ***.

Predictions

Prediction for selected profiles: 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

Answer RQ2 (males): Predicted mean time an elderly spends in dependence

Prediction for selected profiles: Females

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	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

Answer RQ2 (females): Predicted mean time an elderly spends in dependence

Econometric duration models and substitution effect – Key findings

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

Reference Working Paper (under review in Journal of Risk and Insurance)

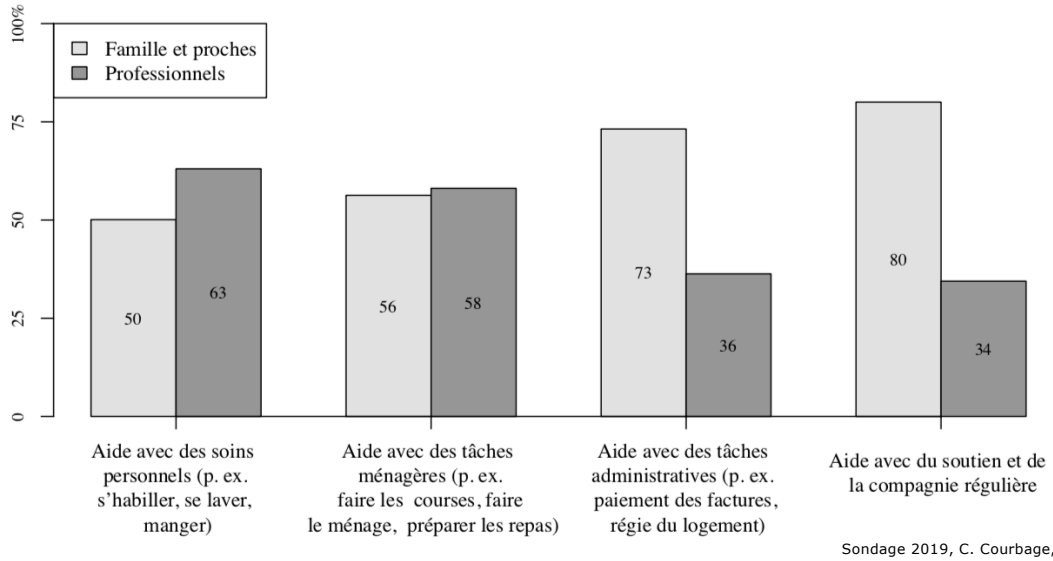
admin.ch

Challenges for insurers in Switzerland

- Create public awareness about the **future challenges in long-term care**
- Foster the development of social and private **insurance products**
- Ongoing **research**:
  - include more information on **pathologies** (first results + work in progress)
  - include specific characteristics of **care at home** and in an **institution** (microdata received, work in progress)
  - ideas for **social insurance** and **private insurance products** (survey, analysis in progress)
  - development of proper **pricing and reserving** for the insurance sector
  - **finally : … what do "customers" want?**

Quelle aide voudriez-vous recevoir et de qui ?

E4. Si vous perdiez votre indépendance pour réaliser certaines activités de la vie courante tout en pouvant rester à la maison, quelle aide voudriez-vous recevoir et de qui ? Plusieurs réponses sont possibles.

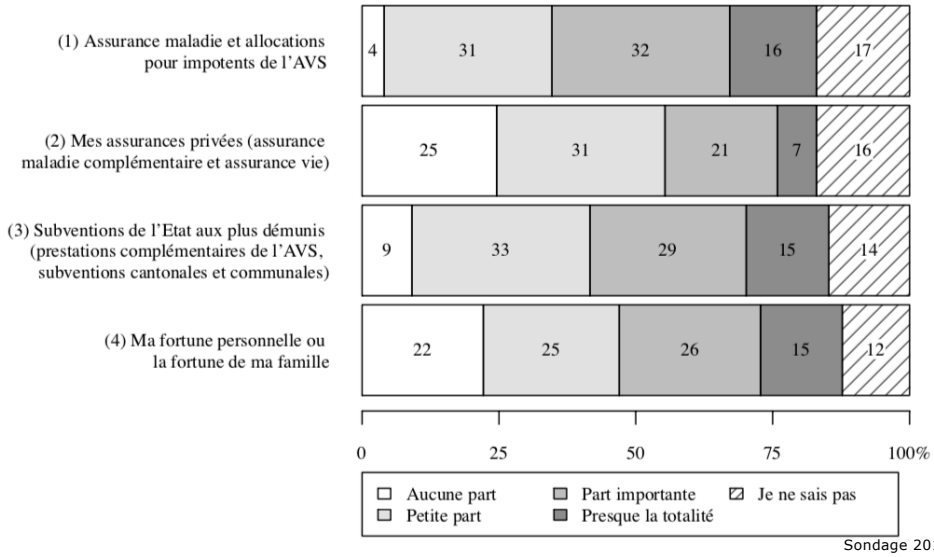


- Pour les soins personnels et l'aide ménagère: préférence pour des aidants professionnels
- Pour l'aide administrative et la compagnie, forte préférence pour la famille et les proches

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Qui prendrait en charge les coûts ?

E6. Imaginez que vous perdiez votre indépendance et que vous ayez recours à une aide professionnelle à domicile ou à un séjour en établissement médico-social. Selon vous, qui prendrait en charge les coûts et à quelle hauteur ?

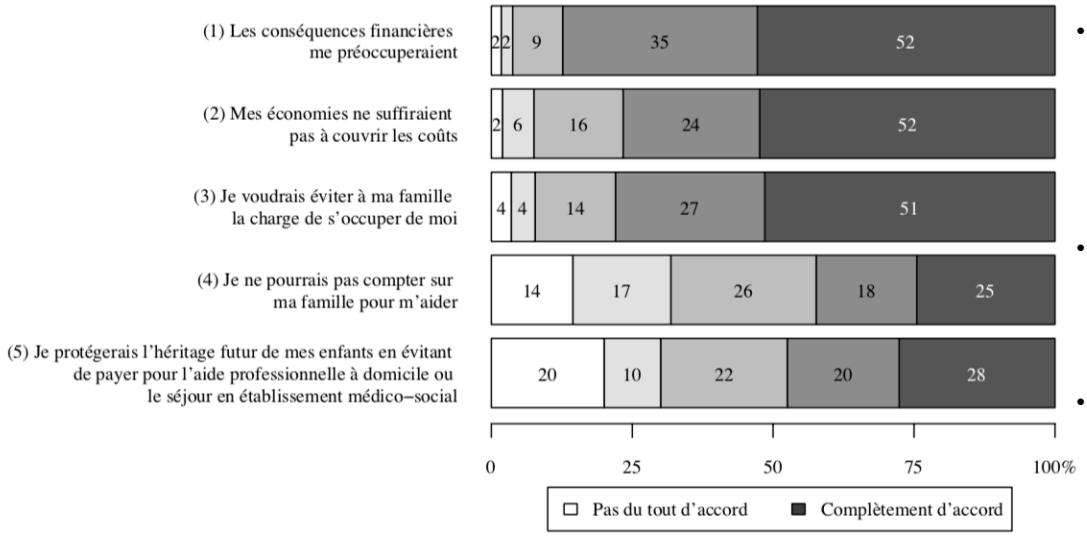


- Perception que les coûts sont pris en charge par l'assurance maladie (48% part importante/ totalité), les subventions cantonales et communales et la fortune personnelle.
- Les assurances privées jouent un rôle secondaire.
- Pour 47% des répondants la fortune personnelle paraît ne pas être en jeu.

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Quelles sont les motivations d'acheter une « assurance dépendance » ?

F4. Vous avez indiqué que vous auriez plutôt de l'intérêt à souscrire une « assurance dépendance ». Quelles en sont les motivations ? Pour chacune des affirmations suivantes, indiquez votre degré d'accord.

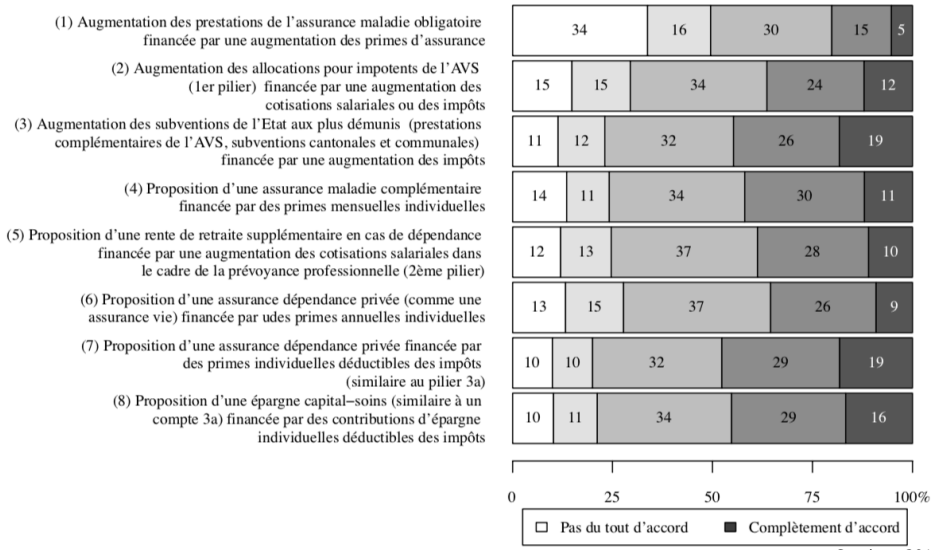


- Conséquences financières et insuffisance de l'épargne sont les facteurs principaux
- 2e motivation: éviter d'être à la charge de la famille.
- Résultats hétérogènes par rapport à l'héritage

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Quelle solution de financement préféreriez-vous ?

F6. Afin de garantir le financement d'une aide professionnelle à domicile ou d'un séjour en établissement médico-social, différentes solutions sont envisageables. Veuillez indiquer votre degré d'accord concernant les propositions suivantes.

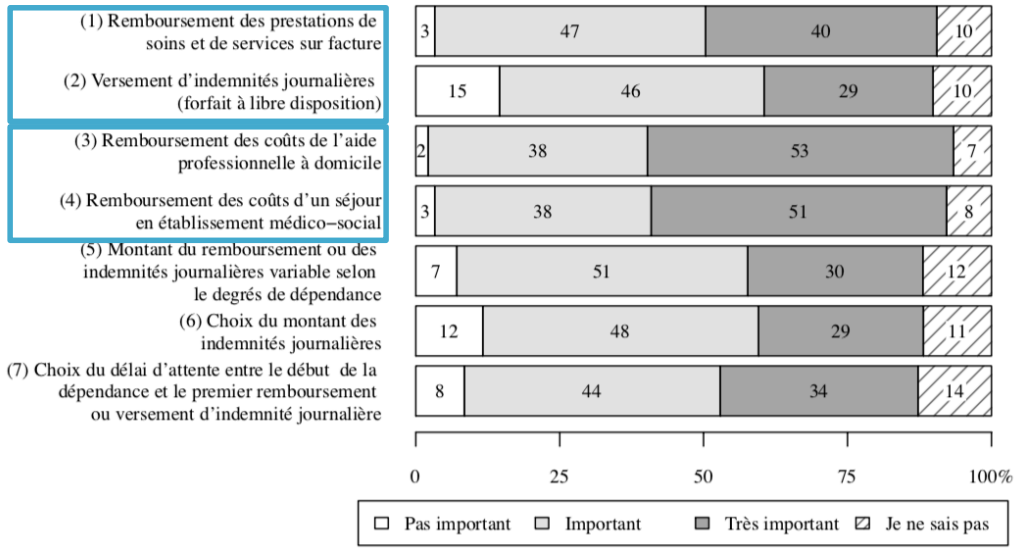


- Peu d'accord pour une inclusion dans l'assurance maladie (augmentation des primes !)
- Solutions étatiques avec financement solidaire (impôts) avec accord plus important.
- Ass. maladie privée, ass.-dépendance privée et épargne capital-soins parmi les options préférées (entre 40% et 50% d'accord)

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Quelles caractéristiques pour une « assurance dépendance » ?

F7. Différents modèles d'assurance, niveaux de couverture et options à choix peuvent être proposés dans une « assurance dépendance ». Veuillez indiquer l'importance que vous donnez aux caractéristiques suivantes.

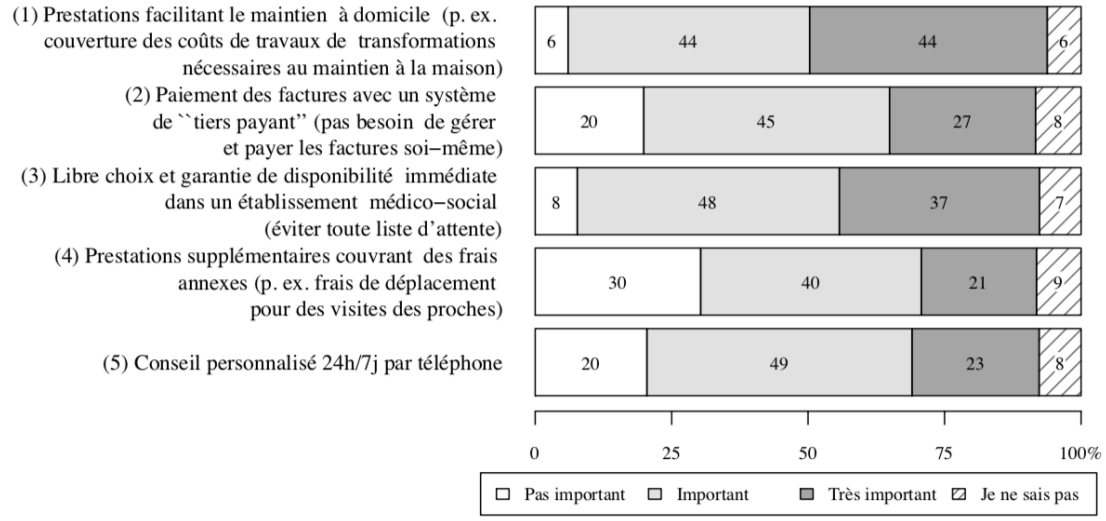


- Remboursement sur facture préféré en comparaison à des forfaits
- Recherche de couverture assurantielle aussi bien pour les soins à domicile qu'en institution (pas de distinction)

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Quels services à valeur ajoutée dans une « assurance dépendance » ?

F8. Différents services à valeur ajoutée peuvent être intégrés dans une « assurance dépendance ». Veuillez indiquer l'importance que vous donnez aux caractéristiques suivantes.



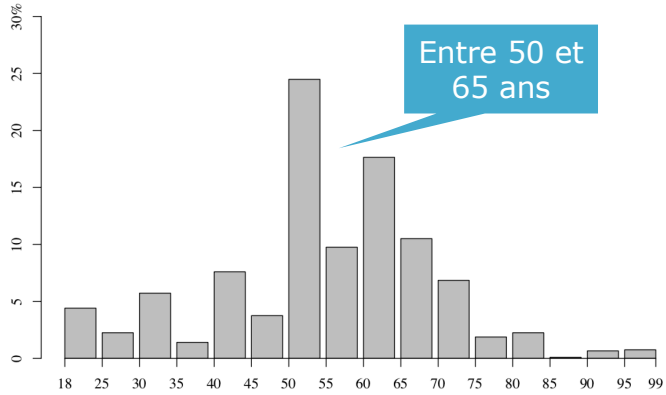
- Prestations facilitant le maintien à domicile et libre choix/ garantie de disponibilité en institution sont des caractéristiques importants

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

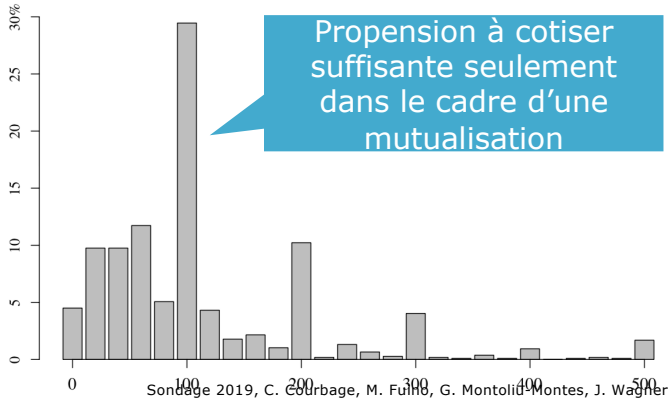
Quel âge de début et quelle hauteur des cotisations d'assurance ?

F9. Imaginez qu'avec une forte probabilité vous ayez besoin d'une aide professionnelle à domicile ou d'un séjour en établissement médico-social dès l'âge de 80 ans.

A partir de quel **âge** seriez-vous disposé à commencer à constituer une épargne ou à souscrire une « assurance dépendance » ?



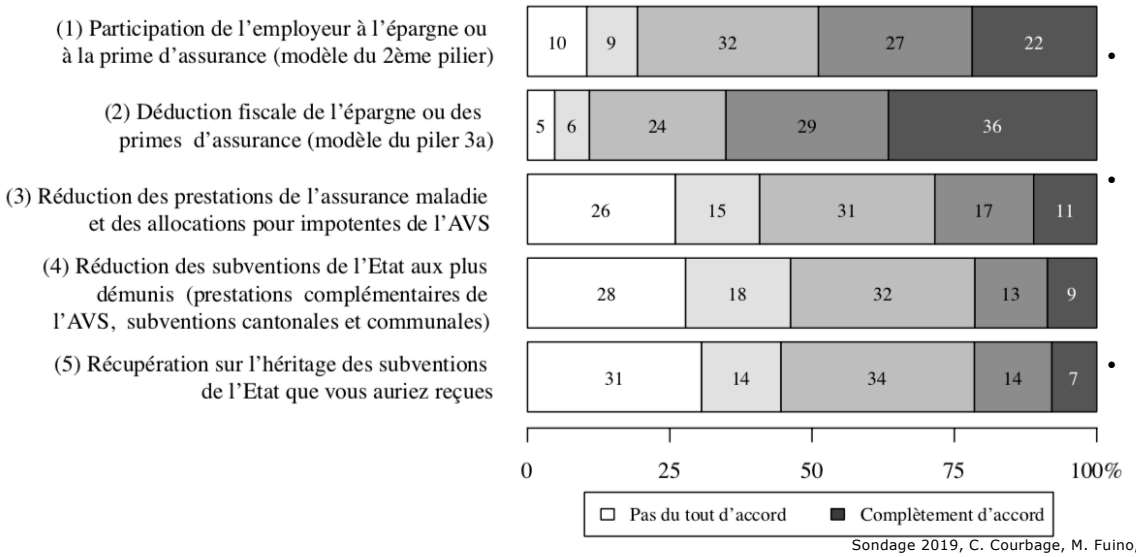
Quel **montant** seriez-vous disposé à mettre de côté chaque mois pour constituer une épargne ou pour payer une prime d'assurance ?



Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Qu'est-ce qui pourrait inciter la constitution d'une épargne ou l'achat d'une assurance ?

F14. Parmi les mesures suivantes, lesquelles pourraient vous inciter à constituer une épargne ou à souscrire une assurance pour vous protéger financièrement en cas de dépendance ? Pour chacune des mesures suivantes, indiquez votre degré d'accord.

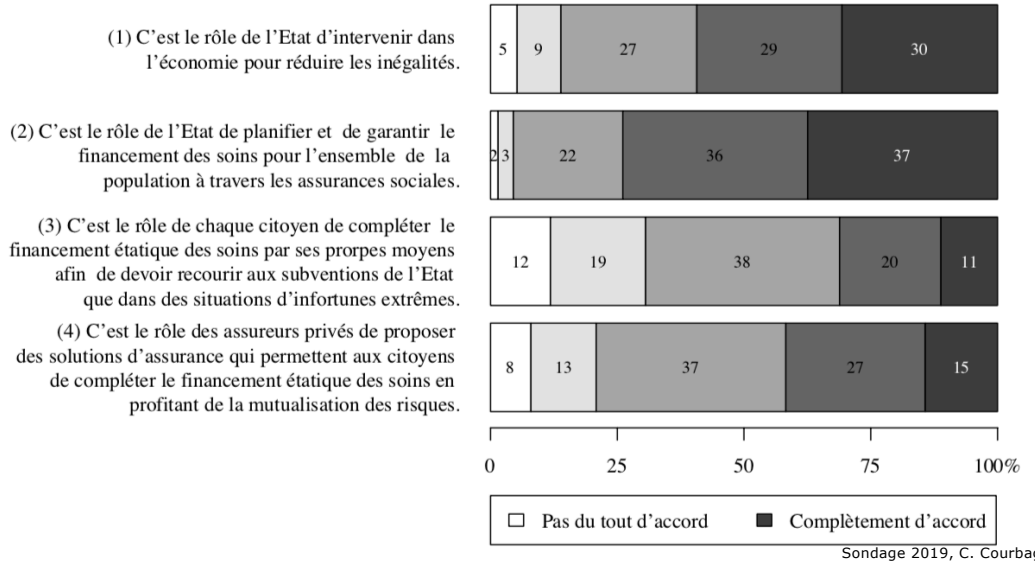


- Défiscalisation des cotisations est l'incitation principale
- En 2e position: participation de l'employeur (cf. système d'ass. sociales, e.g. DE)
- Désaccord à 45% d'une récupération des subsides sur l'héritage

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Quel est le rôle de l'État, du citoyen et des assureurs privés ?

G14. Concernant le rôle de l'État, veuillez indiquer votre degré d'accord pour chacune des affirmations suivantes.



- L'Etat doit jouer un rôle important en intervenant et en garantissant le financement des soins

Sondage 2019, C. Courbage, M. Fuino, G. Montoliu-Montes, J. Wagner

Contact

UNIL | Université de Lausanne
HEC Lausanne

s:fi

GCIE Global Centers of Insurance Excellence

Professor Joël Wagner

E-Mail joel.wagner@unil.ch

Téléphone +41 21 692 33 58

Bureau Extranef, no. 202

Université de Lausanne
Faculté des Hautes Etudes Commerciales
Département de Sciences Actuarielles
UNIL Chamberonne - Extranef
CH-1015 Lausanne