A Supplementary Material

Leaders and Laggards in Life Expectancy Among European Scholars From the Sixteenth to the Early Twentieth Century

Robert Stelter, David de la Croix and Mikko Myrskylä

A.1 Universities and Academies of Sciences

Tab. A1: Sources for Universities and Academies of Sciences

No.	University	Year	QG.	Obs.	Wiki	RAG	Sources
Universities in the Holy Roman Empire 1348–1599							
1.	University of Prague	1348	2	1315	x	x	Čornejová and Fechtnerová (1986); Svatoš (1995)
2.	University of Vienna	1365	2	1508	x	x	Lackner (1976)
3.	University of Heidelberg	1386	1	1995			Drüll (1991; 2002; 2009; 2012)
4.	University of Cologne	1388	2	722	x	x	Bianco (1974)
5.	University of Erfurt	1389	3	309	x	x	
6.	University of Würzburg	1402	2	761			Walter (2010); Reindl (1966)
7.	Leipzig University	1409	1	1184			*Catal. Prof. Lipsiensium*
8.	University of Rostock	1419	1	809			*Catal. Prof. Rostochiensium*
9.	University of Dole	1422	3	63			Fourquet (1929)
10.	University of Louvain	1425	2	680			Brants (1906); Nève (1856); Ram (1861); Lamberts and Roegiers (1990); Tricot-Royer (1927)
11.	University of Greifswald	1456	3	725	x		
12.	University of Freiburg	1457	2	696	x		Bauer (1957); Ruth (2001); Kurrus (1977)
13.	University of Ingolstadt	1472	3	236			
14.	University of Trier	1473	4	69			
15.	University of Tübingen	1477	1	993			Conrad (1960)
16.	University of Mainz	1477	1	974			Benzing (1986)
17.	University of Wittenberg	1502	2	169			Kohnle and Kusche (2016)
18.	Brand. Uni. of Frankfurt	1506	3	135	x		
19.	University of Marburg	1527	1	1634			*Marburger Prof.-katalog* Auerbach and Gundlach (1979); Gundlach and Auerbach (1927)
20.	University of Strasbourg	1538	2	531			Berger-Levrault (1890)
21.	University of Dillingen	1553	3	137	x		
22.	University of Jena	1558	2	625			Günther (1858)
23.	University of Douai	1559	3	63			
24.	University of Eichstätt	1564	4	13			
25.	University of Olomouc	1573	3	303	x		
26.	University of Linz	1574	4	14			
28.	University of Helmstedt	1576	1	294			*Prof.-katalog Helmstedt*
29.	University of Herborn	1584	4	12			
30.	University of Graz	1585	2	531	x		Krones (1886)

Column *QG.* contains the quality group of data sources: 1 (almost) complete data, 2 partially complete data, 3 non-complete data, and 4 scattered data. Column *Obs.* indicates the number of observations, and *Wiki* indicates whether at least some of the observations were found by means of Wikipedia. *RAG* refers to data from the *Repertorium Academicum Germanicum*. Appendix A.5 provides an overview of the links to online professor catalogs that were included.

* Because of a joint source, the University of Strasbourg includes most of the observations.

No.	University	Year	QG.	Obs.	Wiki	RAG	Sources
Universities in the Holy Roman Empire 1600–1799							
32.	University of Gießen	1607	1	1057			Haupt and Lehnert (1907); Rehmann (1957)
33.	University of Stadthagen	1610	1	2**			Hänsel (1971)
35.	University of Paderborn	1614	4	43			
36.	University of Molsheim	1618	2	48*			Berger-Levrault (1890)
37.	University of Rinteln	1621	1	172			Hänsel (1971)
38.	University of Salzburg	1622	4	24			
39.	University of Altdorf	1622	2	98	x		Flessa (1969)
40.	University of Osnabrück	1629	4	29			
42.	University of Kassel	1633	4	4			
44.	University of Bamberg	1647	1	426			*Bamberger Professorinnen- und Professorenkatalog*
47.	University of Duisburg	1655	4	15			
48.	University of Kiel	1665	1	1373			*Kieler Gelehrtenverzeichnis* Volbehr and Weyl (1956)
49.	University of Innsbruck	1669	4	174			
50.	University of Franche-Comté	1691	3	11			Fourquet (1929)
51.	University of Halle	1694	2	1040			*Catal. Prof. Halensis*
52.	University of Breslau	1702	4	177			
53.	University of Göttingen	1734	1	1744			Ebel (1962)
54.	Theol. fac. Fulda	1734	4	58			
55.	University Erlangen-N.	1743	1	733			Wedel-Schaper and Wittern (1993); Ley (1999); Wachter (2009)
56.	TU Braunschweig	1745	1	520			Gundler (1991); Albrecht (1986)
57.	University of Bützow	1760	3	32	x		
58.	TU Freiberg	1765	1	110			Schleiff *et al.* (2015)
59.	TU Berlin	1770	4	7			
60.	University of Münster	1771	4	103			
61.	TU Clausthal	1775	1	147	x		Müller (1999); Valentiner (1925)
62.	University of Bonn	1777	2	607			Wenig (1968)
63.	Karl's High School Stuttgart	1781	3	37	x		
Universities in the Netherlands							
27.	Leiden University	1575	1	682			*Leidse Hoogleraren vanaf 1575*
31.	University of Franeker	1585	2	151	x		Napjus and Lindeboom (1985); Feenstra *et al.* (2003)
34.	University of Groningen	1614	1	443			*C. P. Academiae Groninganae*
41.	University of Amsterdam	1632	1	553			*Album Academicum*
43.	Utrecht University	1636	1	491			*C. P. AcademiæRheno-Traiectinæ*
45.	University of Harderwijk	1648	1	130	x		van Epen (1904)
46.	University of Nijmegen	1655	3	21	x		

Column *QG.* contains the quality group of data sources: 1 (almost) complete data, 2 partially complete data, 3 non-complete data, and 4 scattered data. Column *Obs.* indicates the number of observations, and *Wiki* indicates whether at least some of the observations were found by means of Wikipedia. *RAG* refers to data from the *Repertorium Academicum Germanicum*. Appendix A.5 provides an overview of the links to online professor catalogs that were included.

** Because of a joint source, the University of Rinteln includes most of the observations.

No.	Academy		Year	QG.	Obs.	Wiki	Reg.	Sources
Academies of sciences								
64.	Leopoldina		1652	1	4886		x	
65.	Berlin-Brandenburg	(BBAW)	1700	1	2449		x	
66.	Göttingen	(AdW)	1751	1	1849			Krahnke (2001)
67.	Erfurt		1752	1	1968			Kiefer (2004)
68.	München	(BADW)	1759	1	2568		x	
69.	Mannheim		1763	3	47	x		Eid (1926)
70.	Brussels		1769	2	56			Hasquin (2009)
71.	Görlitz	(OLGdW)	1779	1	1985			Fröde (2017)
72.	Amsterdam	(KNAW)	1808	1	1602			van de Kaa and Roo (2008)
73.	Leipzig		1846	1	448		x	
74.	Heidelberg		1909	1	310		x	
75.	Mainz		1949	1	175		x	

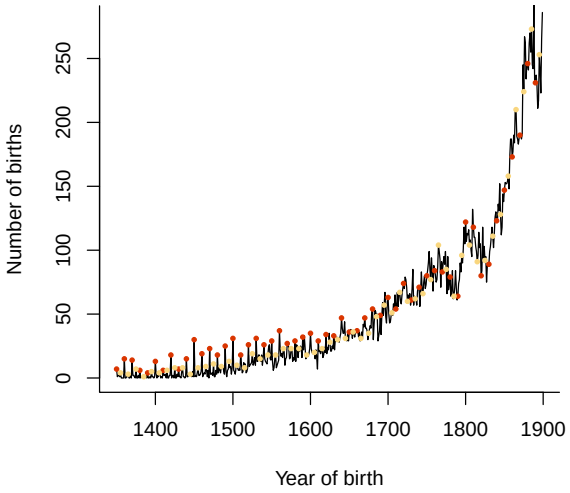
Column *QG.* contains the quality group of data sources: 1 (almost) complete data, 2 partially complete data, 3 non-complete data, and 4 scattered data. Column *Obs.* indicates the number of observations, and *Wiki* indicates whether at least some of the observations were found by means of Wikipedia. *Reg.* refers to sources from official registers provided by the academy.

A.2 Additional Material on the Data Quality

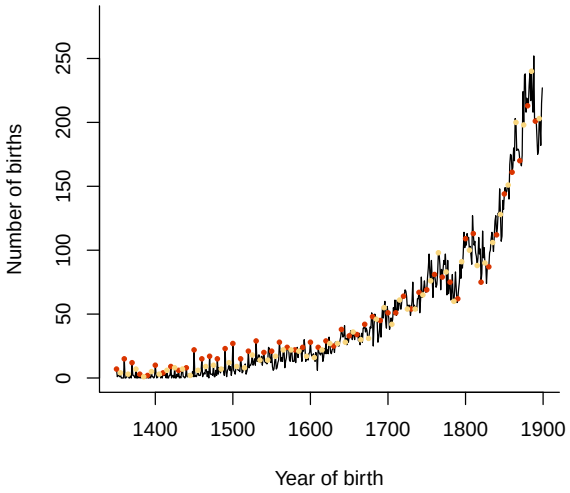
The presentation of histograms (see Fig. A1–A4) and the shares of birth and death years ending with 0 or 5 (see Fig. A5) are only two options for evaluating the quality of the data. The calculation of an adjusted Whipple-Index (Hobbs, 2004) is another option, and it also relates the birth or death years ending with 0 or 5 to the overall number of births or deaths in the period. The index takes values between 0 and 500. The index is 500 if all observations end with 0 or 5, and is 100 if the observations are uniformly distributed. Provided the index is lower than 105, heaping in the year of birth or death is considered low, and the data quality is considered high. Index values of 105–110 indicate that the data are relatively accurate, while index values of 110–125 suggest the data are fairly okay. The data quality can be considered poor at index values of 125–175, and very poor at index values exceeding 175.

Findings in Tab. A2 support the observations from Fig. 2. Already at the beginning of the seventeenth century, the quality of the birth year data is fairly okay. As soon as we only include observations with a year of birth that is not marked as “around”, “approximated” and so on in the sources of our database, the data quality of early observations improves, and is already fairly okay in the second half of the sixteenth century. The adjusted Whipple-Index values on death year heaping show that the data quality is at least fairly okay already

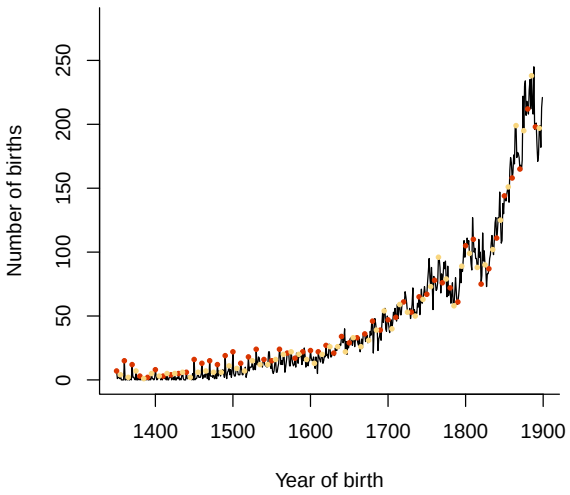
from the beginning of the fourteenth century in the overall sample. However, as soon as we limit the data to the observations from the baseline mortality estimation, the index does not exceed 125 fifty years later.



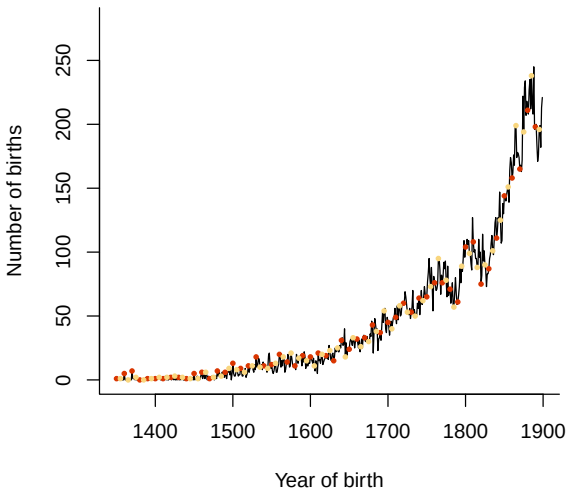
(a) All scholars with birth information



(b) Scholars in the baseline mortality estimation

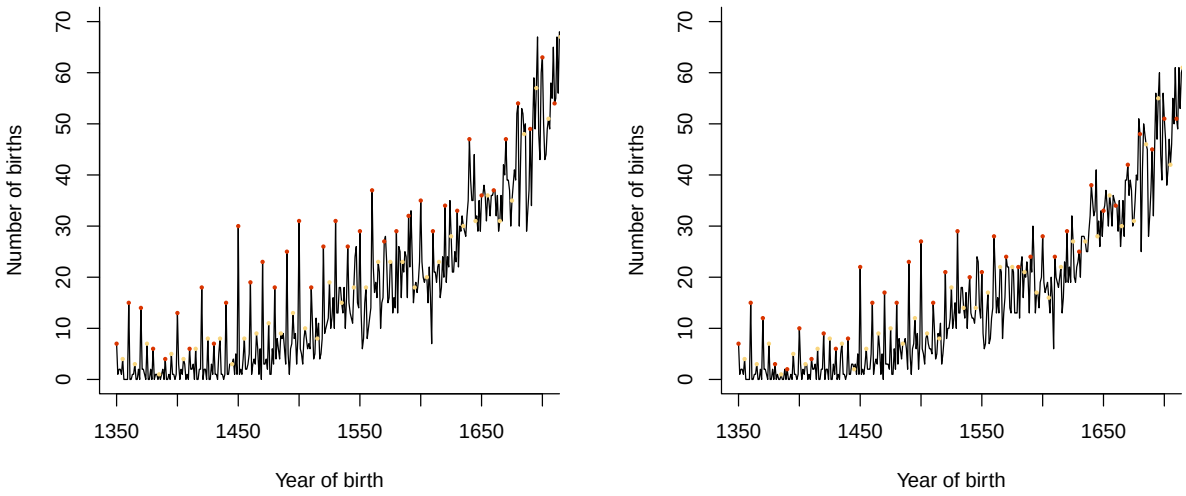


(c) Scholars from almost or partially complete data (quality group 1 or 2)



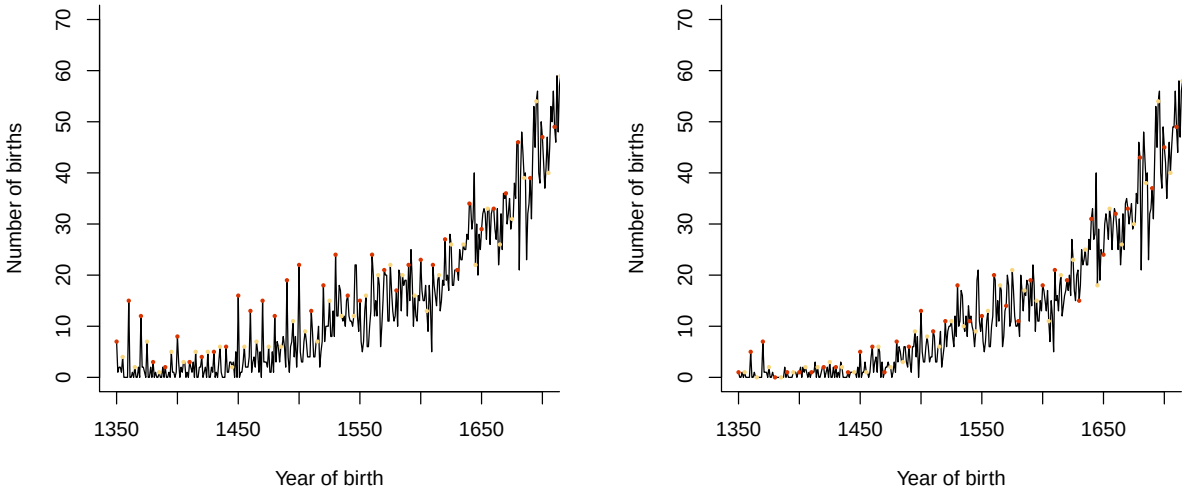
(d) Scholars from almost or partially complete data (quality group 1 or 2) with known year of birth

Fig. A1. Number of observations by birth year



(a) All scholars with birth information

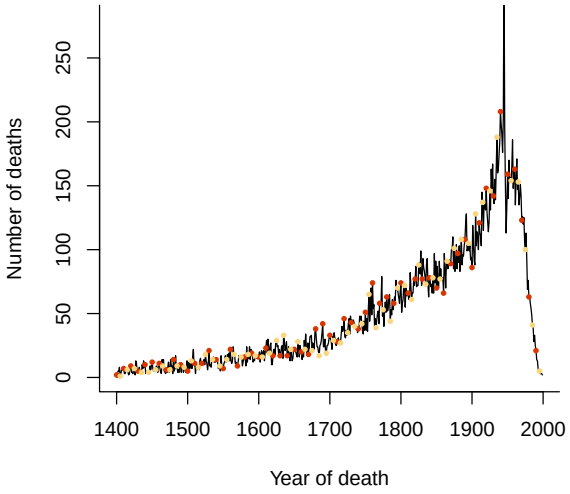
(b) Scholars in the baseline mortality estimation



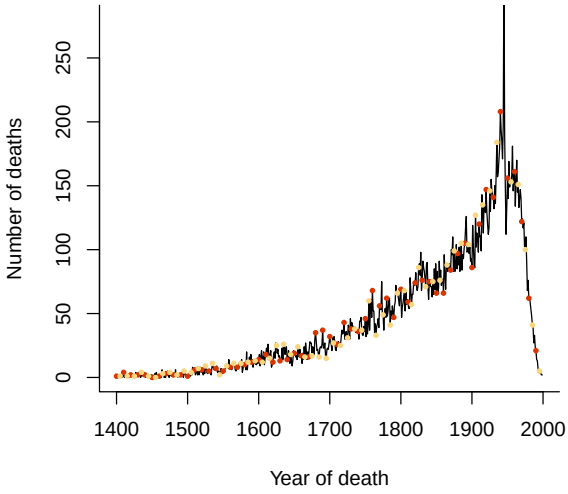
(c) Scholars from almost or partially complete data (quality group 1 or 2)

(d) Scholars from almost or partially complete data (quality group 1 or 2) with known year of birth

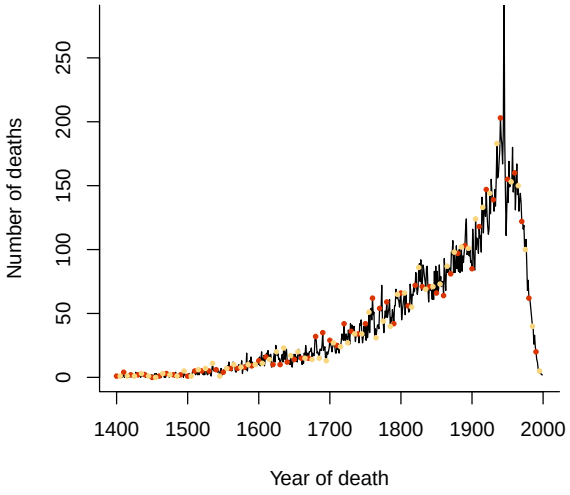
Fig. A2. Number of observations by birth year until 1700



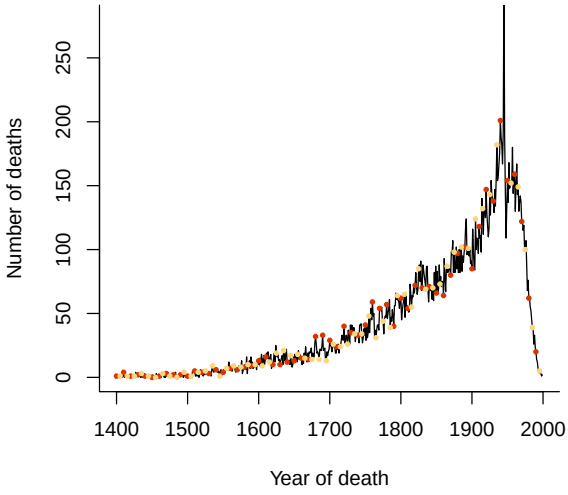
(a) All scholars with death information



(b) Scholars in the baseline mortality estimation

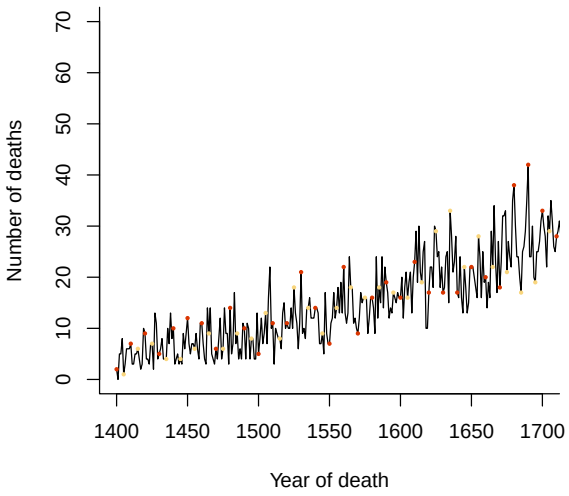


(c) Scholars from almost or partially complete data (quality group 1 or 2)

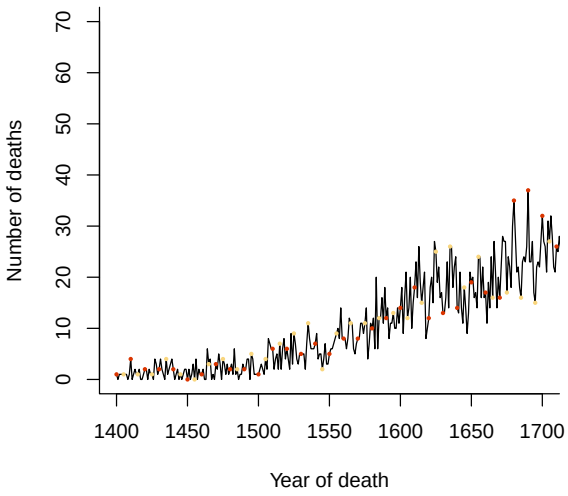


(d) Scholars from almost or partially complete data (quality group 1 or 2) with known year of death

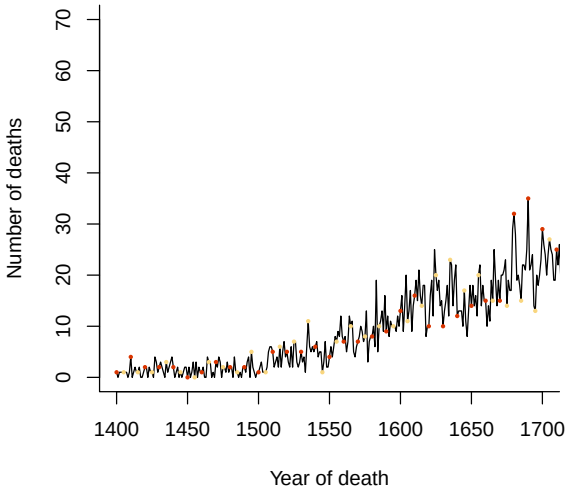
Fig. A3. Number of observations by death year



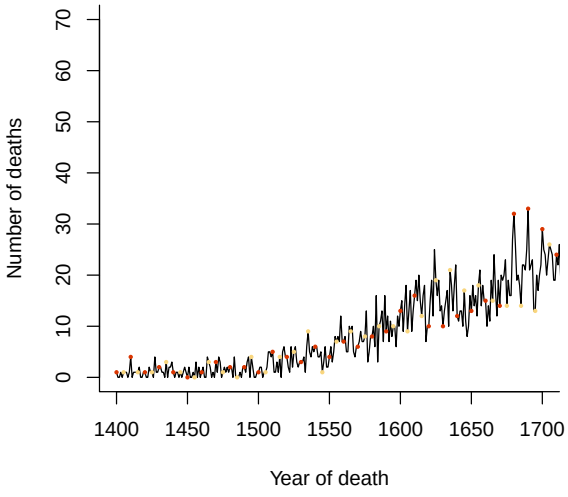
(a) All scholars with death information



(b) Scholars in the baseline mortality estimation

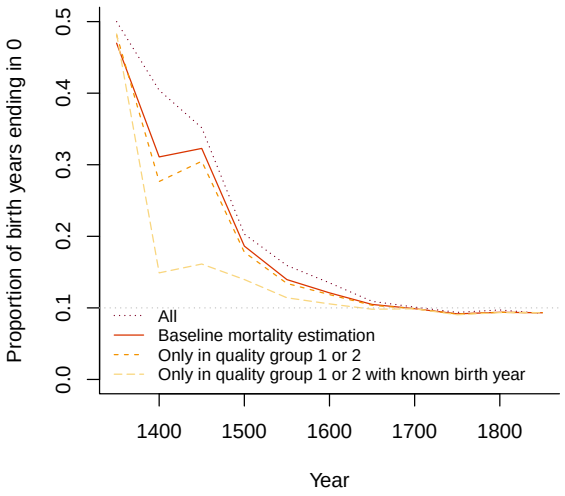


(c) Scholars from almost or partially complete data (quality group 1 or 2)

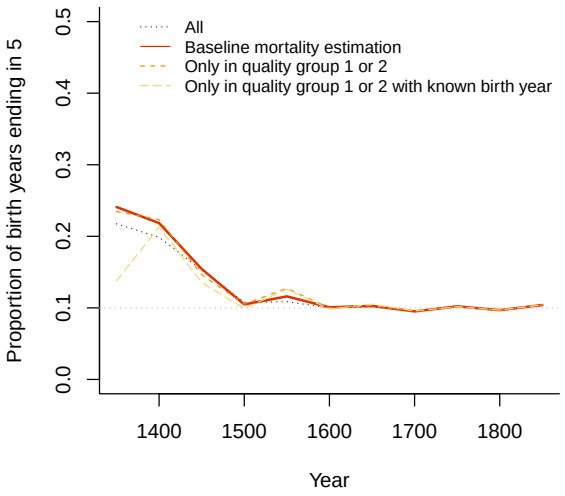


(d) Scholars from almost or partially complete data (quality group 1 or 2) with known year of death

Fig. A4. Number of observations by death year until 1700



(a) Proportion of birth years ending with 0



(b) Proportion of birth years ending with 5

(c) Proportion of death years ending with 0

(d) Proportion of death years ending with 5

Fig. A5. Birth and death years ending with 0 or 5 in the population of scholars

Tab. A2: Adjusted Whipple-Index to measure birth and death year heaping

Period	Birth year heaping						Death year heaping					
	All		With year of birth, app. & death or exit		With certain year of birth		All		With year of birth, app. & death or exit		With certain year of birth	
	Quality groups		Quality groups		Quality groups		Quality groups		Quality groups		Quality groups	
	All	1 or 2	All	1 or 2	All	1 or 2	All	1 or 2	All	1 or 2	All	1 or 2
1348–1397	324.2	325.8	313.3	314.8	293.1	293.1	204.5	204.5	272.7	272.7	250.0	250.0
1398–1447	312.1	295.5	280.2	266.3	196.4	184.8	100.4	95.3	146.2	142.9	170.0	166.7
1448–1497	256.2	235.0	244.6	234.4	157.0	153.3	119.4	122.4	111.1	118.8	107.6	119.4
1498–1547	159.8	150.7	152.7	146.6	127.0	123.8	113.3	109.9	120.3	118.7	115.4	115.4
1548–1597	135.7	139.3	133.8	137.1	117.8	123.3	106.4	103.5	102.6	94.7	107.1	99.5
1598–1647	119.6	116.1	116.0	113.7	105.8	104.4	102.5	102.7	98.5	98.0	95.4	97.3
1648–1697	107.3	106.6	106.1	106.1	102.3	103.6	101.9	102.5	101.3	101.3	100.2	100.6
1698–1747	99.7	99.9	98.8	99.2	97.8	98.7	100.8	102.9	100.2	102.5	100.3	102.0
1748–1797	100.0	99.5	99.5	99.1	98.3	98.1	105.8	104.2	103.8	101.7	103.3	101.3
1798–1847	97.6	97.6	96.8	97.0	96.3	96.5	101.3	100.7	100.5	100.2	99.9	99.5
1848–1897	101.0	101.1	100.4	100.5	100.2	100.4	99.7	99.6	99.4	99.3	99.1	99.2
1898–1947							114.8	115.0	116.2	116.3	116.0	116.1
1948–1997							100.0	100.7	100.5	101.2	100.5	101.2

A Whipple-Index smaller than 105 indicates very high data quality (dark green). The data are relatively accurate in a range of 105–110 (light green); fairly okay in a range of 110–125 (yellow), poor in a range of 125–175 (orange), and very poor if the values exceed 175 (red).

A.3 Life Expectancy

A.3.1 Life Expectancy and the Conditional Age

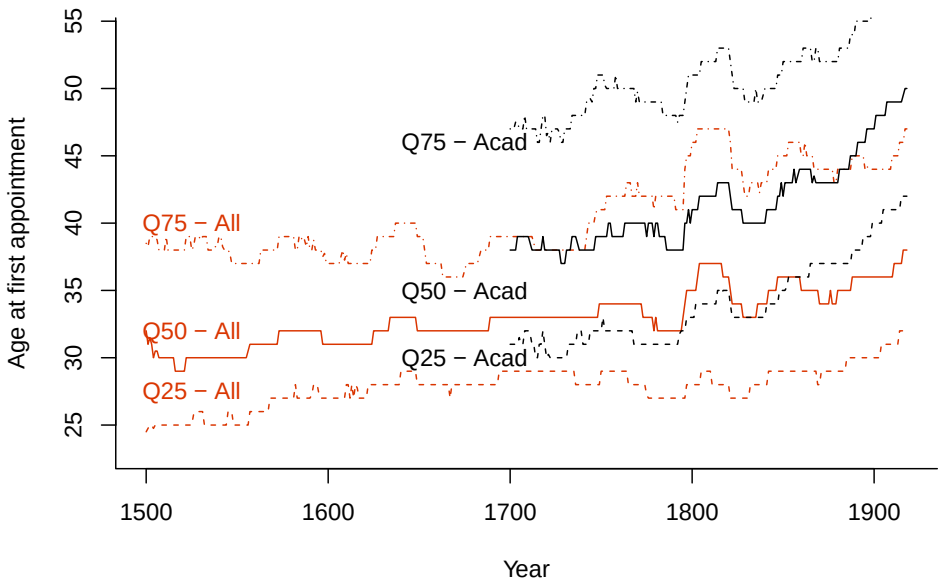
Even if we observe first appointments below age 20, a sufficiently large population at risk is required to obtain convincing estimations of life expectancy $E_{x,t}$ conditional to the corresponding ages x at time t. Using 25-year rolling intervals, Fig. A6a illustrates the increasing first appointment age over time. The year always marks the middle of the 25-year rolling interval; e.g. 1550 covers 1538–1562. Indeed, in the early sixteenth century, more than 25% of all first appointments were made below age 25. For around 350 years thereafter, the 25%-quantile remained rather stable, at between ages 27 and 30; and then increased at the end of the period under investigation. The increasing trend in the first appointment age is more evident when we look at the median and the 75%-quantile. Between 1500 and 1900, the median age increased from 30 to 36. Compared to similar exercises in the literature – for instance, Fornasin *et al.* (2010) and Andreev *et al.* (2011) – we find that the average appointment age of scholars was rather low and stable, which allows us to end our analysis at younger ages.

As in all periods except the early twentieth century at least 25% of all first appointments occurred before age 30, we have decided to fix the initial age for life table calculations at age 30. Furthermore, adding the median, the 25%-quantile, and the 75%-quantile age at death in Fig. A6b illustrates that, on average, we are able to observe scholars for rather long age spans. The gap between the median age at death and the median age at appointment is between 24 and 35 years. In the subsample of scholars in scientific academies, the median ages at death and at first appointment are even higher, although the difference is greater for the age of appointment.

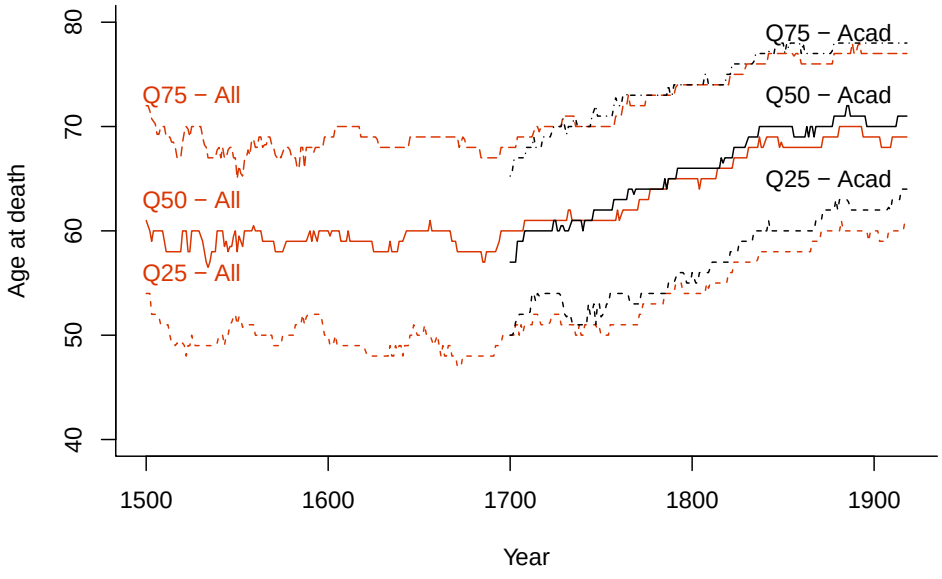
An alternative approach for determining the optimal x relates the difference between upper and lower 95% confidence intervals, $CI^{\text{low}}_{x,t}$ and $CI^{\text{high}}_{x,t}$, to the corresponding life expectancy $E_{x,t}$ and, then computes the age that minimizes this value:

$$argmin_x\{\frac{1}{T}\sum_{t}^{T}\frac{CI^{\text{high}}_{x,t}-CI^{\text{low}}_{x,t}}{E_{x,t}}\}, \tag{1}$$

with T as the number of 25-year rolling time intervals. The initial period of 1400 covers all cohorts born in 1388–1412, and the last period covers all cohorts born in 1875–1899. The rare and scattered observations for the period before 1388 are not included. Hence, we have chosen the age x that minimizes the relative average 95% confidence interval. Proceeding in five-year age steps, this procedure leads to age 30.

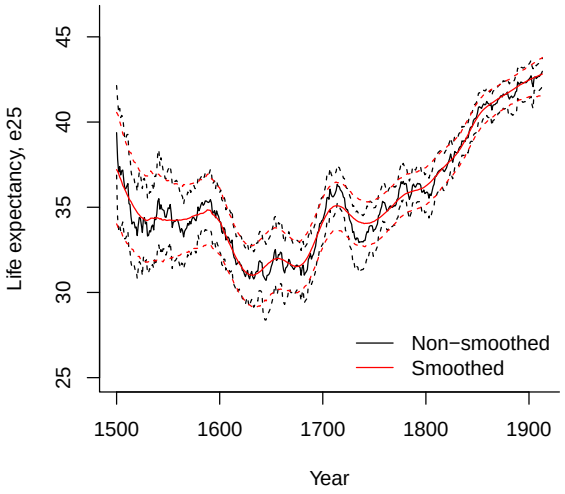


(a) Age at first appointment

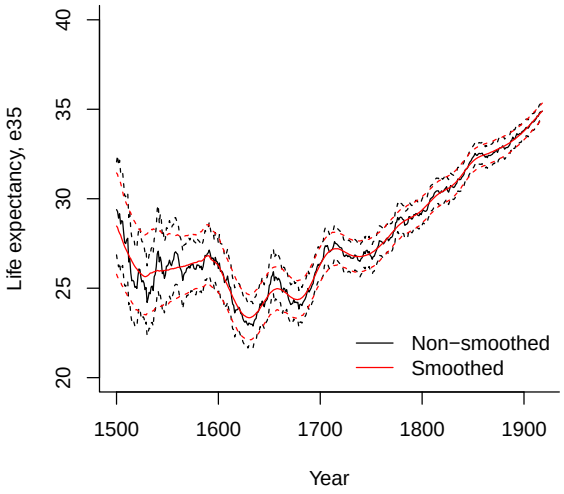


(b) Age at death

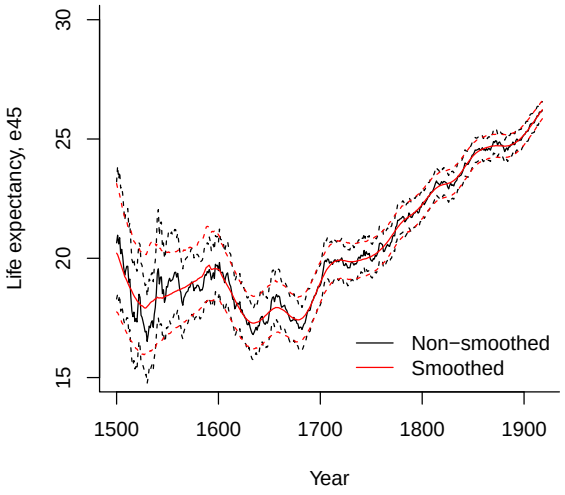
Fig. A6. The dynamics of age at appointment and age at death in 25-year rolling intervals



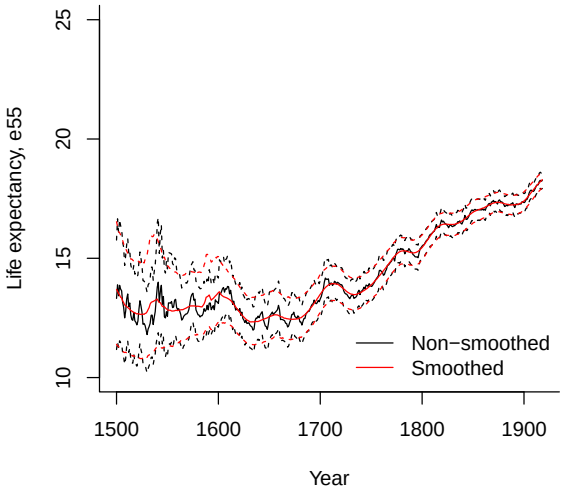
(a) Life expectancy at age 25



(b) Life expectancy at age 35



(c) Life expectancy at age 45



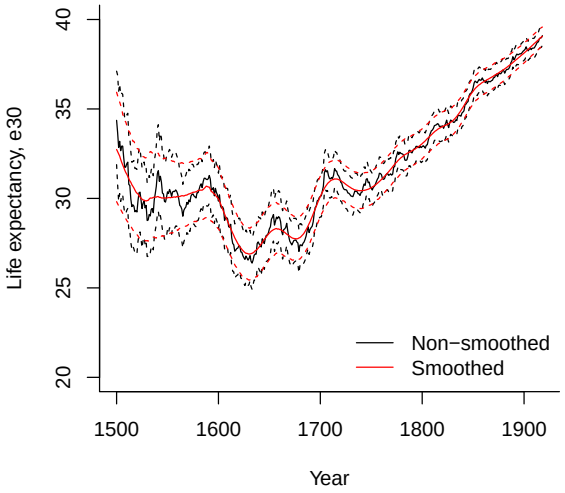
(d) Life expectancy at age 55

Fig. A7. Dynamics of life expectancy at various ages

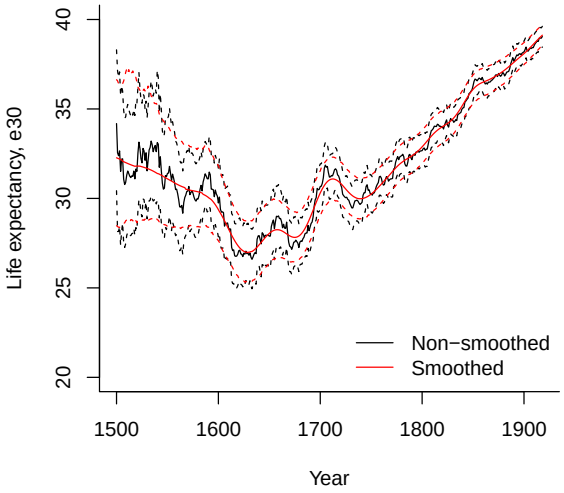
Figure A7 applies 25-year rolling intervals and two-dimensional smoothed data. Dashed lines mark 95% confidence intervals.

In addition to the baseline age 30, which is presented from the period perspective in Section *Life Expectancy* and from the cohort perspective in Section *Comparison With Other Studies*, Fig. A7 illustrates the mortality dynamics for life expectancy conditional to ages 25, 35, 45, and 55.

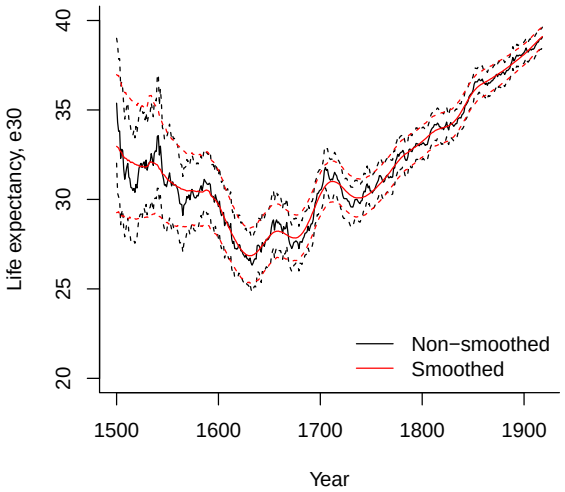
A.3.2 Additional Figures on the Robustness of Life Expectancy Dynamics



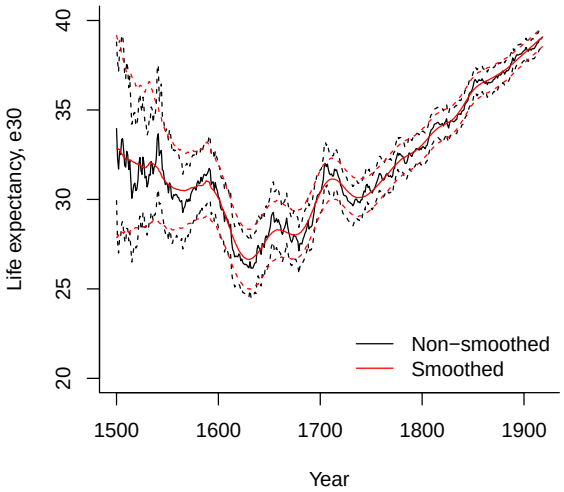
(a) Baseline estimation



(b) Estimation including only observations with known birth year



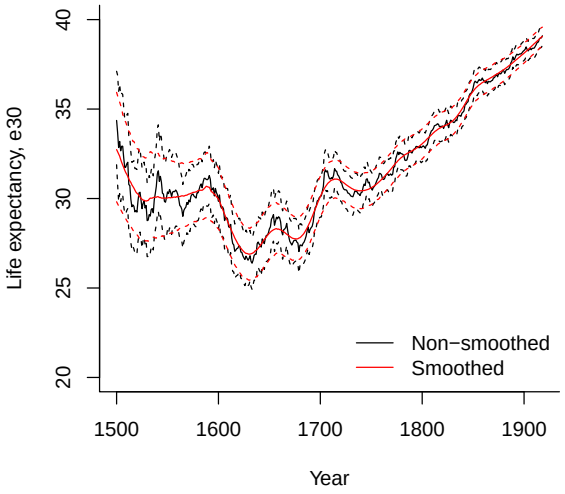
(c) Estimation including only observations from almost or partially complete data (quality group 1 or 2)



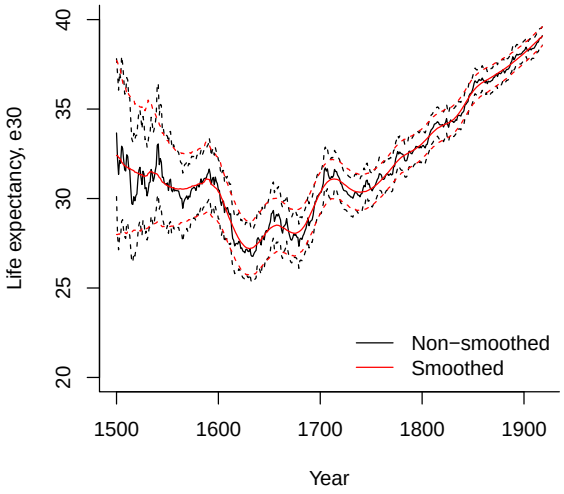
(d) Estimation including only observations from almost or partially complete data (quality group 1 or 2) with known birth year

Fig. A8. Dynamics of life expectancy according to the data quality

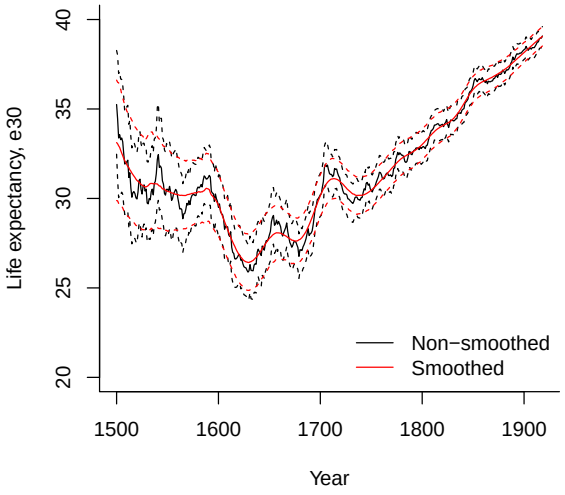
Figure A8 applies 25-year rolling intervals and two-dimensional smoothed data. Dashed lines mark 95% confidence intervals.



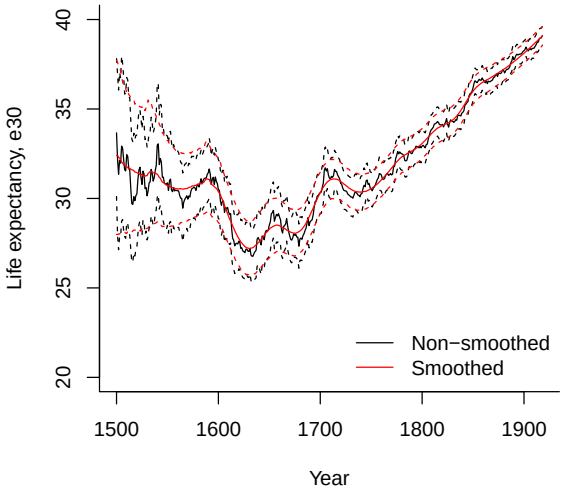
(a) Baseline estimation



(b) Estimation without birth years ending in zero



(c) Estimation without birth years ending in five

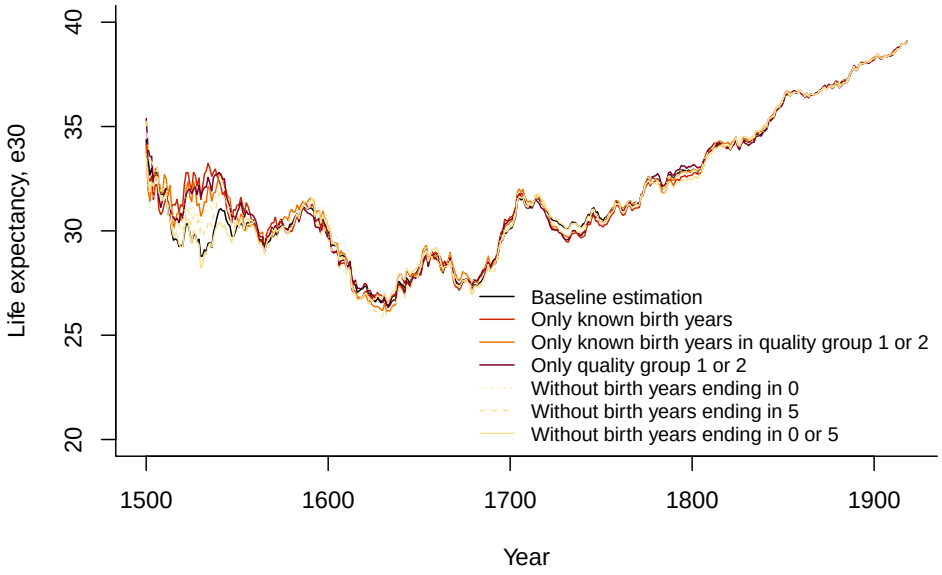


(d) Estimation without birth years ending in zero and five

Fig. A9. Dynamics of life expectancy excluding potential birth year heaping

Figure A9 applies 25-year rolling intervals and two-dimensional smoothed data. Dashed lines mark 95% confidence intervals.

(a) Smoothed life expectancy

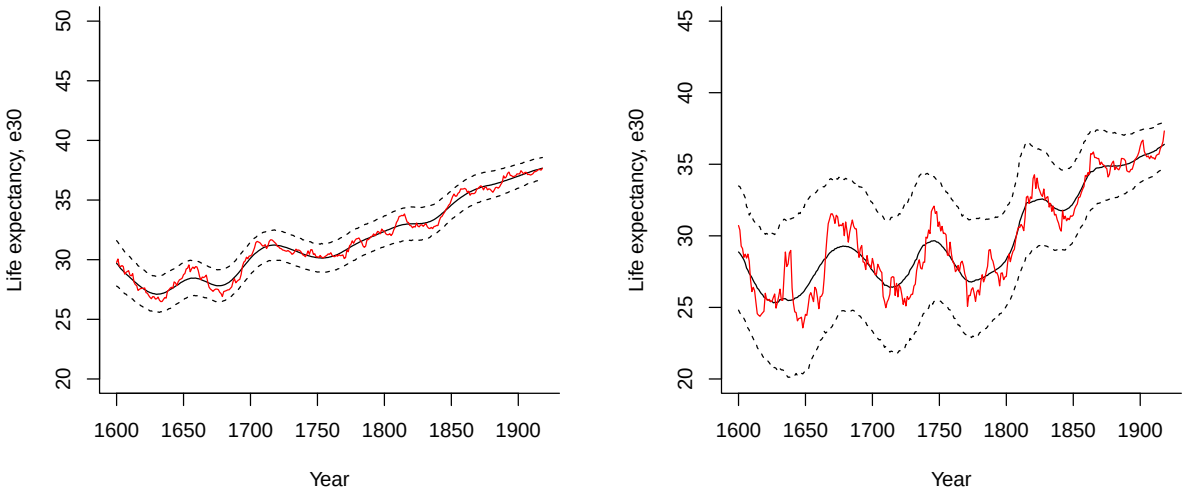


(b) Non-smoothed life expectancy

Fig. A10. Summary of life expectancy at age 30 according to data quality

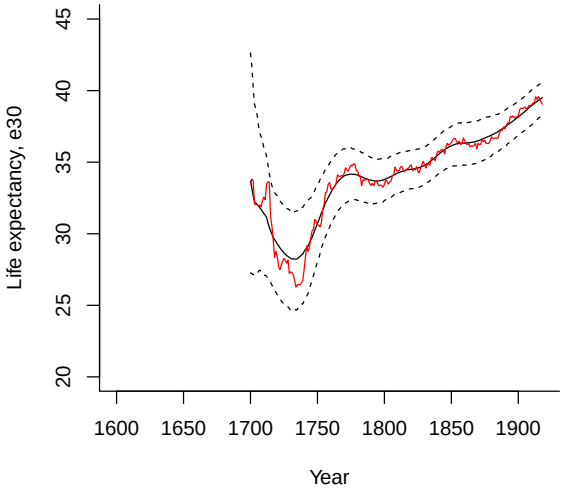
Figure A10 applies 25-year rolling intervals and two-dimensional smoothed data.

A.3.3 Additional Figures on Medicine, Academies, and Life Expectancy

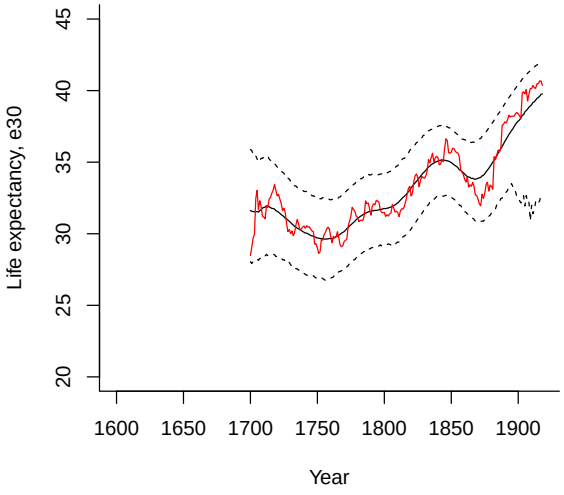


(a) Nonmedicine and university

(b) Medicine and university



(c) Nonmedicine and academy



(d) Medicine and academy

Fig. A11. Dynamics of life expectancy according to social status and field of science

Figure A11 applies 25-year rolling intervals and two-dimensional smoothed data. Dashed lines mark 95% confidence intervals.

A.4 A Brief History of Universities

The characteristics of our institutions and their members evolved over time. At the very beginning of our study period, in the late medieval age, the structure of universities differed considerably from that of modern institutions, which had consequences for the income and social status of scholars. The characteristics of scholars evolved accordingly.

A typical full university had a lower faculty of Arts and three higher faculties: Medicine, Theology, and Law. Scholars in the higher faculties also had higher incomes. While universities were rather independent at that time, it was common for teachers at the theological faculty to belong to a religious order. Academic titles mainly signaled that a person was a master in his field, and was linked to prestige and high social status. However, the incomes of scholars were generally rather low (Verger, 2003).

Until the end of the eighteenth century, a variety of positions, such as ordinary and extraordinary professors, doctors, and lectors, existed. These positions came with different obligations and responsibilities, and with different privileges and salaries. While all scholars enjoyed a variety of privileges – such as a special jurisdiction, tax and dress privileges, or the right to carry weapons – they lost much of their medieval freedom. Salaries remained generally low, and were often not paid regularly. Thus, it was quite common for scholars from higher faculties to work in the profession they taught. Scholars from lower faculties often held positions at schools. Incomes and privileges varied across universities. Moreover, a doctoral degree was not always required for academic positions, and the obligation to publish varied considerably. Appointments driven by kinship were rather common at universities like Gießen or Tübingen (Vandermeersch, 2003).

With the crisis of universities in the second half of the eighteenth century – the population of students declined drastically – and the emergence of the German university model, institutions changed rapidly. In the first half of the nineteenth century, payments in kind ended, salaries increased and were paid regularly. Thus, working at a university became a full-time job. The introduction of scientific standards in the process of appointments gradually reduced the role of kinship. However, kinship was still important at several universities, such as the University of Kiel. Thus, it was a period of social change toward the emergence of an academic elite. Scholars were envisioning themselves as scientists. Privileges and the role of professor dynasties declined, while the social status of tenured professors increased (Klinge, 2004; McClelland, 1988).

A.5 Online Professor Catalogs

Tab. A3: Overview of the professor catalogs available online and used

University	Catalogue	Link
University of Rostock	Catalogus Professorum Rostochiensium	http://cpr.uni-rostock.de/
Leipzig University	Catalogus Professorum Lipsiensium	https://research.uni-leipzig.de/catalogus-professorum-lipsiensium/
University of Marburg	Marburger Professorenkatalog	https://www.uni-marburg.de/uniarchiv/pkat
University of Helmstedt	Professorenkatalog Helmstedt	http://uni-helmstedt.hab.de/
University of Kiel	Kieler Professorenkatalog	https://cau.gelehrtenverzeichnis.de/
Leiden University	Leidse Hoogleraren anaf 1575	https://hoogleraren.leidenuniv.nl/
University of Groningen	Catalogus Prof. Academiae Groninganae	https://hoogleraren.ub.rug.nl/
University of Amsterdam	Album Academicum	http://www.albumacademicum.uva.nl/
Utrecht University	Catalogus Prof. Academiæ Rheno-Traiectinæ	https://profs.library.uu.nl/
University of Mainz	Gutenberg Biographics	http://gutenberg-biographics.ub.uni-mainz.de/home.html/
University of Halle	Catalogus Professorum Halensis	https://www.catalogus-professorum-halensis.de/

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