Social status, war, medical knowledge, and the timing of life expectancy improvements among Germanic scholars over the fifteenth to nineteenth centuries.[*]

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Abstract

When did mortality start to decline, and among whom? We build a large new data set covering over five centuries to analyze the timing of mortality decline and the heterogeneity in the pace of progress among scholars in the Holy Roman Empire. After having recovered from a strong seventeenth century mortality crisis, life expectancy started to increase already early in the eighteenth century, well before the Industrial Revolution. This fluctuation in mortality directly influenced life expectancy and the number of scholars and thus had important implications for the capacity for knowledge accumulation and diffusion. Members of scientific academies – an elite among the scholars – were among the first to benefit from the gains in life expectancy, suggesting that already 300 years ago higher social status conferred advantages that lower mortality. At the same time, the onset of mortality improvements among scholars in the medical profession was delayed. Both, the advance and the lag in mortality, vanished during the nineteenth century.

Keywords: Mortality dynamics, differential mortality, Holy Roman Empire, Knowledge accumulation

JEL Classification numbers: J11, I12, N30, I20, J24

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1 Introduction

The timing of the first mortality improvements and who benefited first from these gains are among the key questions on the first demographic transition. On the basis of local evidence, and for specific social groups, historians and demographers have already shown improvements in seventeenth and eighteenth centuries' mortality.[1] Two recent studies contribute to a more general picture. Cummins (2017) proposes an analysis of the longevity of European nobility over a long period of time, encompassing several critical events such as the Black Death and the Industrial Revolution. It therefore extends the existing demographic studies of Europe's aristocracy considerably. The rise in longevity started as early as 1400, with improvements over the fifteenth century. This phase of improvements was followed by a second one after 1650. The first phase is only observed in Ireland and the UK and is probably subject to a broad confidence region because of the low number of observations. The second tipping point, in the middle of the seventeenth century, is hardly disputable. The second paper from de la Croix and Licandro (2015) focuses on the same aim but builds a different database from the *Index Bio-bibliographicus Notorum Hominum* (IBN), which contains entries on famous people from about 3,000 dictionaries and encyclopedias. They document that there was no trend in adult longevity until the second half of the seventeenth century. Longevity of famous people remained around 60 years during this period. A finding that provides a reliable confirmation to conjectures that life expectancy was rather stable for most of human history and establishes the existence of a Malthusian epoch. They also show that permanent improvements in longevity preceded the Industrial Revolution by at least one century. The longevity of famous people started to steadily increase for generations born during the 1640–1649 decade, reaching a total gain of around nine years in the following two centuries.

In this project, we first gathered data on the population of scholars to overcome a joint weaknesses in the previous studies of de la Croix and Licandro (2015) and Cummins (2017). In their populations, it is not clearly defined who belongs to the sample or when people enter the population at risk. Some people, like famous martyrs, might have entered at

[1] For example, Hollingsworth (1977) builds mortality tables for British peers sampled from genealogical data. Vandenbroucke (1985) provides vital statistics for the Knights of the Golden Fleece, an order starting in 1430 with the Dukes of Burgundy and continued with the Habsburg rulers, the kings of Spain and the Austrian emperors. Carrieri and Serraino (2005) and Hanley, Carrieri, and Serraino (2006) compare the life expectancy of popes and artists, while van Poppel, van de Kaa, and Bijwaard (2013) focus on longevity of artists from the RKDartists database. Comparing the life expectancy of members in the British and the Russian academies of science, Andreev et al. (2011) relies on a population of scholars. Winkler-Dworak (2008) and van de Kaa and de Roo (2007) also study members of academies of sciences, but with a more recent focus and much smaller sample sizes.

death, others like some painters even post mortem, and still others like princes already at birth. In our sample of scholars it is clearly defined who belongs to the population and when they enter. First, we include people born before 1900 who were involved in transmission of knowledge through formal institutions. And secondly, people enter our population at risk, as soon as they are nominated for the first time to one of these scientific institutions. These institutions include all universities and technical universities established before 1800 as well as scientific academies located in the Netherlands and the Holy Roman Empire in their 1648 territories. Restricting the sample on this area has the advantage to rely our study on a relatively continuous institutional set up. Although borders changed over time, the Holy Roman Empire located in Central Europe existed from the Middle Ages until 1806. Furthermore, for most institutions in this universe valuable data sources exit that provide information on scholars' date of nomination, exit, birth and death. Overall, we collected the vital information from more than 31,000 scholars. A sample that combines several advantages: a clearly defined population, the opportunity to take into account left truncation and right censoring and a sufficiently large sample size for a well defined population. Hence, we overcome the dilemma of most of the existing literature: either to calculate the mean age at death for large samples, or to apply more advanced methods on rather small populations.

Relying on the new data we collected, we aim at contributing threefold to the literature: First, scholars' life expectancy adds another missing piece to the jigsaw on the general understanding of mortality dynamics before and during the Industrial Revolution. Our new estimations confirm the improvements in life expectancy starting around 1700 and, hence, well before the Industrialization. Most of the deviations to existing estimates on mortality dynamics are either explained by different methods or the role of social status. However, one conspicuity occurs: a notable mortality crisis around 1620–1650. Coinciding with the Thirty Years' War, the drop in scholar's life expectancy reflects a conservative estimation of the mortality increase at that time.

Secondly, we shed light on differential mortality by comparing members and non-members of scientific academies as well as scholars in the medical profession with all other professions. Members of scientific academies define an elite within the elite. Their higher social status might have translated into mortality advantages, albeit the evidence on the impact of social status on mortality is mixed. Hollingsworth (1977) and Vandenbroucke (1985) document that mortality reductions for the nobility took place as early as in the seventeenth century, showing that improvements in the longevity of the upper social class anticipated the overall rise in life expectancy by at least one century. By contrast, de la Croix and Licandro (2015) find that the mortality reductions did not only occur in the leading countries of the seventeenth and eighteenth century, but almost everywhere in Europe. In addition, the mortality improvements were not dominated by any particular occupation.[2] Bengtsson and van Poppel (2011) conclude that the mortality advantage of elites might have increased, decreased or is only a recent phenomenon without any causal link. We find an advance in mortality gains among members in academies of science around the time when life expectancy started to increase sustainably. The higher social status pays off in terms of lifetime. After one century, this advantage has disappeared. The additional social status at the hands of a membership was probably not enough to translate in mortality gains compared to "ordinary professors at universities" anymore.

The role of the medical profession is less clear. The lag in medical knowledge going along with higher infection risks suggests a mortality disadvantage in early times. Just take the example of the beak-like mask used to protect against the bubonic plague. They were probably useful against the disgusting stench also seen as the main path of infection – a superstition. The interplay of sick people and missing medical insights was life-threatening. Still, we do not find any systematic disadvantage until the beginning of the sustain improvements in longevity. The role of formal medicine for healing appears as a possible explanation. While an academic career certainly was useful for official positions, like court or personal physician, and, hence, linked to social status, it was not necessarily an advantage in competing e.g. with surgeons, midwives, barbers, apothecaries and even numerous folk healers and illegal practitioners on the medical marketplace (Broman 1995). But, when general mortality improvements started and the role of formal medicine increased, gains for the medical profession were delayed. In line with van Poppel et al. (2016), we find some evidence for a mortality disadvantage for half a century. As early as in the nineteenth century the excess mortality vanished. Rapidly increasing medical knowledge might have compensated for the higher infection risks.[3]

Thirdly, our estimation of scholars' longevity fosters insights on the capacity of knowledge accumulation and diffusion. The rise in longevity among the educated segment of society preceded the industrialization, lending credence to the hypothesis that human capital may have played a significant role in the process of industrialization and the take-off to modern growth. In a world where face-to-face communication was essential for both knowledge transmission and enhancement, the length of the productive life of the elite was important

[2]Furthermore, Bengtsson and Dribe (2011) find evidence of a late emergence of a mortality advantage in Sweden. Schumacher and Oris (2011) use data from Geneva to document an advantage of higher classes but also find a convergence in the seventeenth and eighteenth century. Relying on Finnish data in the twentieth century, Elo, Martikainen, and Myrskylä (2014) show that the link between socio-economic status and mortality is still robust if they control for observed and unobserved characteristics in childhood.

[3]An extensive literature on the role of medicine in history exists, see for instance Johansson (1999) or de la Croix and Sommacal (2009).

to determine the extent of their impact on their cultural and economic environments. People picked up ideas from other people they met. The more people they met, the better and more influential they became. Relying on Lucas (2009)' model on the exchange of ideas, de la Croix (2017) shows that, if they lived long, they had many more chances to become excellent at what they did and they also gave many more opportunities to other people to learn from them. Hence, longer lives increased economic growth.[4] Then, estimating the size and the mortality dynamics of scholars and, hence, a population closely related to upper-tail human capital, suggests the following conclusion: Before, the onset of the gains in mortality at the beginning of the eighteenth century, the growing number of scholars increased the capacity of knowledge accumulation and diffusion. Afterwards, both the increasing life expectancy and population of scholars facilitated the Industrial Revolution. Furthermore, a mortality crisis like the Thirty Years' War hit knowledge accumulation twofold via a shrinking population of scholars and a shorter lifetime.

Aiming at studying scholars' mortality dynamics and differential, we organize our investigations in three steps. First, we describe our data set and the population of scholars in Section 2. Then, we study and discuss their mortality dynamics in Section 3. Section 4 uses the heterogeneity in our sample to investigate if medical knowledge or social status might have altered mortality of scholars. Finally, section 5 concludes.

2 A Scholar Catalog for the Holy Roman Empire

2.1 Universities and Scientific Academies in the Holy Roman Empire

Our data set collects information on scholars in the Holy Roman Empire. The Empire was founded in the Middle Ages to continue with the idea of the *Roman Empire*[5] and, hence, well before the first universities in this area. It was seen as God's grace and God's will as pointed out by the auxiliary *Holy*. Its elective monarchy unified the Germanic population

[4]The outstanding role of upper-tail human capital for Europe's historical developments, more precisely, its knowledge accumulation, economic growth and the Industrial Revolution has been emphasized in the recent research literature. The number of people who subscribed to the Diderot's and d'Alembert's Grande Encyclopédie in eighteenth century France for instance predicts economic development later on, both at the city and the county level (Squicciarini and Voigtländer 2015). German cities, who adopted better institutions following the Reformation, displayed more people recorded as famous in the German biography database and grew faster at the same time (Dittmar and Meisenzahl 2016).

[5]Otto I (912–973) is often considered as the first ruler of the Holy Roman Empire, though that term was not used until the twelfth century (Arbage 2004).

and other peoples in a relatively unique cultural area of that time; albeit its borders changed over its almost 850 years of existence. Afterwards, in the nineteenth and twentieth century, substantial losses in the German territory and population movements occurred. To take advantage of the relatively stable institutional set up provided by the Holy Roman Empire, we fix our territory to its 1648 borders, supplemented by the encased Netherlands. Nowadays, this area corresponds to the territories of Austria, Belgium, Germany, Luxembourg, Slovenia, Czech republic as well as parts from Poland and France as pictured in gray in Fig. 1. The surrounded Netherlands are depicted in light gray. In this territory, scholars might have been active in universities, academies of sciences or courts. Since the first two are quantitatively the most important, we define scholars as individuals who were active at one of these two types of scientific institutions and limit their population to persons born before 1900.

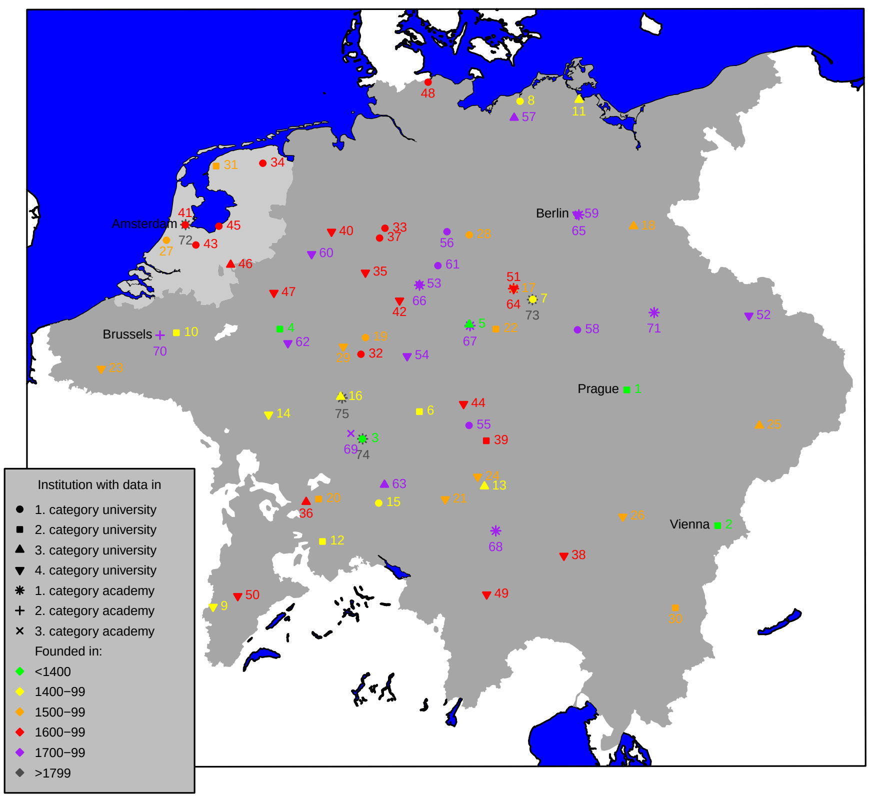


Fig. 1. Universities and academies in the territory of the HRE and the Netherlands

Universities and scientific academies located in the 1648 territories of the Netherlands (light gray) and the Holy Roman Empire (gray) by quality of data sources and century of foundation. Numbers 1–63 mark universities sorted by year of foundation and 64–75 academies of sciences. For an entire list of the corresponding institutions, see Appendix A.1 in Table 2.

Based on Rüegg (1996) and Steiger (1981), we identify 63 universities founded before 1800. A point in time marked by the end of the Holy Roman Empire in 1806 and radical changes in the European university landscape. At the turn of the century, a high number of universities disappeared, in Germany for instance 18 out of 34 universities (Rüegg 2004). More importantly, while universities in our sample still have the character of "*vocational schools for professional training and mere repositories of received knowledge*" (Schimank and Winnes 2000), universities founded in the nineteenth century start to follow the German University Model. These universities are characterized by the Humboldt reform and the idea of "*advancement of knowledge through research*" (Schimank and Winnes 2000).[6]

Focusing on older universities rules out the strong change around 1800. Still, they are rather heterogeneous in several dimensions. Figure 1 illustrates their spatial distribution. While they are generally wide spread, universities are concentrated in the south-western of the HRE. By contrast, only four universities are e.g. located in the north and north-east. Two of them, University of Rostock (8) and University of Greifswald (11), belong to the group of rather old ones and are hosted in Hanseatic Cities. By contrast, University of Bützow (57) is a rather young university which additionally opened for only a very limited time span between 1760 and 1789. The three oldest universities locate in the middle and south of the HRE. Established in 1348, University of Prague (1) is the oldest one in the Holy Roman Empire; followed by the University of Vienna (2) in 1365 and University of Heidelberg (3) in 1386. University of Bonn (62) and Karl's High School (63) are the two youngest universities. However, like the University of Herborn (28), the latter was more a higher elite school than a university in the narrow sense. Finally, we find four more applied universities among the institutions established in the eighteenth century. Braunschweig University of Technology (56) and Freiberg University of Mining and Technology (57) are two examples for these technical universities.

In the Dutch territory, university education started in 1575 with Leiden University (27). Overall, seven universities are identifiable in this territory before 1800, albeit University of Nijmegen (46) educated students only for a very limited number of years and universities in Franeker (31) and Harderwijk (45) closed during or at the end of the Napoleon era. Several universities in the HRE deserved a similar destiny. They were either closed due to the geopolitical movements at that time, like Universities in Cologne (4) and Erfurt (5), or due to the secularization like the University of Bamberg (44) or Dillingen (21).

During history a high number of scientific academies arose and sometimes also disappeared

[6] The first university characterized by the German University Model is the Humboldt University in Berlin established in 1810 (Schimank and Winnes 2000).

again. Because it is even more difficult to come up with an exhaustive overview on scientific academies than for universities, we decided to plot only the twelve academies of sciences we add to the picture.[7] The *Collegium Naturae Curiosorum* established in 1652, better known as *Leopoldina* (64), is probably by far the most important among them. But also the Bavarian Academy of Sciences and Humanities (68) or the Royal Netherlands Academy of Arts and Sciences (72) are well-known academies. The latter illustrates, that we do not introduce a minimum age for academies, as it was founded in 1808. Indeed, with Heidelberg Academy of Sciences and Humanities (74) and the Academy of Sciences and Literature founded 1949 in Mainz (75), we also include rather young institutions.

2.2 Sources of the Data Set

Our sample out of the universe of scholars originates from different kinds of sources. According to the available and consider sources, we classify the institutions into four classes: *(almost) complete data* defines the first class. In this optimal case, we rely on two types of high quality resources, either existing online professor catalogs, such as the catalogus professorum lipsiensium, or books on biographies of professors, like Drüll-Zimmermann (1991, 2002, 2009, 2012) on University of Heidelberg. Overall, 20 universities are ranked to the first class. Ten academies of sciences and hence their majority complete this class. For these academies, we use official lists of members, either directly provided by the academy or their publications.

For other universities, existing catalogs do not capture either the whole time span or all faculties. Since these sources still provide highly reliable sources, they are included in the second class *partially complete data*. Günther (1858) on Jena, for instance, only captures professors until the 300. anniversary of the university. Only professors from the medical faculty in Altdorf are documented in Flessa (1969). University of Vienna is also classified as partially complete as we know all active Jesuits in the faculty of humanities for a certain period from Lackner (1976a, 1976b). In addition to 12 universities that belong to this class the Royal Academy of Sciences, Letters and Fine Arts of Belgium is ranked in this category.

Sources applied in the third category enable to further complete the list of scholars. In this third class *non-complete data*, the degree of the completeness of data further decreases. For nine universities, we reconstructed as many observations as possible from a variety of mainly online sources, including lists on wikipedia. Scholars from University of Erfurt (5)

[7]For an overview on academies see for instance the scholarly societies project (http://www.references.net/societies/).

and Brandenburg University in Frankfurt (18) are two examples. The remaining scientific academy, the Palatinate Academy of Sciences in Mannheim (68) also belongs to this group.

The last class *scattered data* pools the remaining 21 universities. Their members are either captured via other universities from a higher class or come from data collections, like www.koeblergerhard.de. The oldest university in this category is the University of Dole (9). Established in 1422, this university moved as University of Franche-Comté to Besançon in 1691.[8]

2.3 The Population of Scholars

Combining the sources from all four classes and filtering out duplicates, we overall gathered 31,919 scholars. This population forms the sample representing scholars born before 1900 and active in the defined universe of universities and scientific academies. With less than 100 female scholars[9], our population is predominantly male and follows the Law of Motion:

$$S_{t+1} = S_t + N_t - D_t - E_t. \tag{1}$$

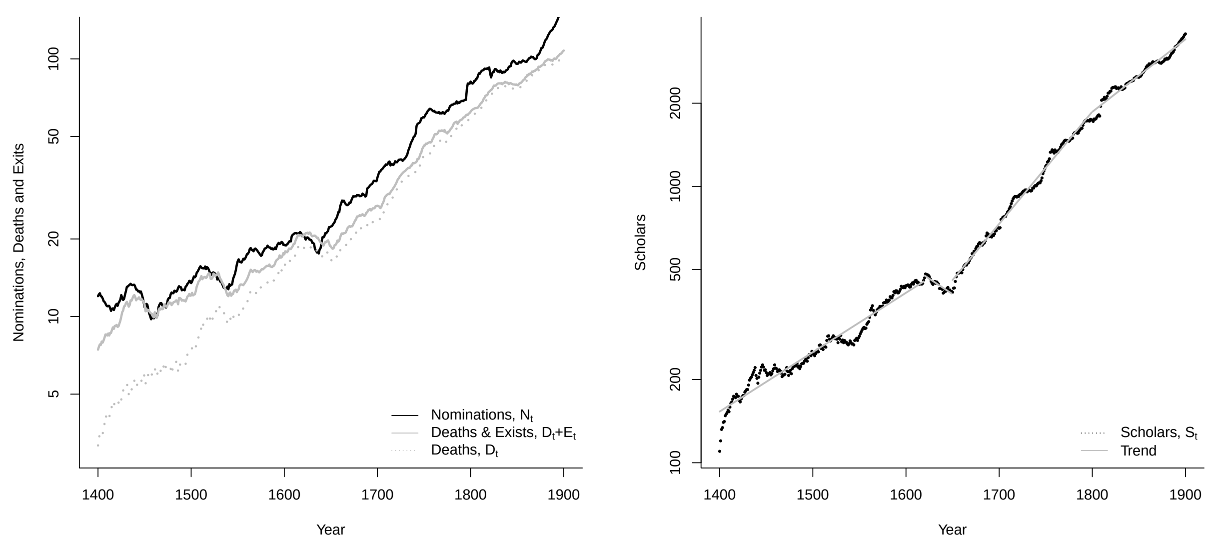
The observed number of scholars S_t at time t increases by first nominated individuals N_t who become scholars. Thus, we have a precise age at first observation of each scholar and tackle the left truncation of our data. Two types of events can drop out scholars of the sample. Ideally, we observe his death D_t which reduces our population. If the information is missing, the observation is right censored, we can still count him in the population at risk until he exits the last time from one of our institutions. Thus, we take into account both left truncation and right censoring.

Figure 2 illustrates the dynamics of the total number of scholars; limited to the sample of 29,738 scholars with known year of nomination and death, or exit if the former is missing (see Column *Nomination* in Tab. 1). Figure 2a plots 25-years moving averages of the first nominations N_t (solid black line) as inflow and outflow (solid gray line). The latter includes both death D_t and last exists E_t for right censored observations. The dotted gray line additionally marks only the number of deaths. Beside the general trend of increasing nominations and exits/deaths, we distinguish four periods, marked by the breaks in the gray trend of Fig. 2b. Before 1620 nominations exceeded the outflow except for two short periods in the middle of the fifteenth and during the first half of the sixteenth century. At these

[8] Table 2 in Appendix A.1 provide complete overviews on the classes and sources of all 75 institutions.

[9] The first women enter our population at risk in the cohorts born in the 1830s. Women never exceed 5% of a birth cohort.

times, we observe periods of stagnation. Overall, on average the number of scholars grew by 0.5% per year and hence at the same pace as the total population.[10] The clear difference between deaths and exits indicates the relatively high number of right censored cases in the fifteenth century. Around 1618, nominations started to decline; terminating this period in the second decade of the seventeenth century, a time, when exits and death reached a local peak clearly above the local minimum of nominations. In the time span 1615–1639, outflows remained above nominations but also declined with some delay. For quarter of a century, the population of scholars decreased by around -0.5% annually. The transition between the second and third period is marked by a strong gain in the inflow of scholars. For the next 250 years, between 1650 and 1900, nominations undoubtedly exceeded exits. Both have an increasing trend over time, albeit we document some periods of stagnation in nominations, for instance around 1760 and 1800. The latter also marks the end of the third period which is characterized by a 0.9% increase in population size each year. Since our universe only considers universities established before 1800, nominations grow less fast in the time after and reduce the average growth rate to 0.6%. Still, at the end of the century, nominations increased again.



(a) 25-years moving averages in in- and outflow (b) The number of scholars

Fig. 2. The dynamics in scholars' population

The trend in nominations and exits/deaths and, hence, also in our total population might be

[10] Pfister and Fertig (2010) document an average growth rate around 0.5% p.a. for the German population size.

driven by different reasons. First, nominations are sensitive to the size of each institution. Secondly, newly established universities and academies as well closed ones, for instance after the Napoleonic Wars, alter the number of nominations and exits. As we do not have exhaustive sources for all institutions in the universe and a certain number of scholars within each institution might be missing, sample selection is a third explanation. Missing information within the sample of scholars on the year of events is a fourth one.

Period	Nomination	Birth	Medicine	Other Fields	Academy	Uni	Both
<1400	217	96	4.2	95.8	0.0	100.0	0.0
1400–49	606	116	8.6	91.4	0.0	100.0	0.0
1450–99	582	273	6.6	93.4	0.0	100.0	0.0
1500–49	705	578	11.1	88.9	0.0	100.0	0.0
1550–99	905	828	11.4	88.6	0.0	100.0	0.0
1600–49	966	1110	17.5	82.5	10.3	87.0	2.7
1650–99	1435	1767	21.2	78.8	31.4	63.9	4.7
1700–49	2193	2825	19.2	80.8	42.4	48.5	9.1
1750–99	3248	3962	19.3	80.7	56.0	33.1	10.9
1800–49	4473	5269	19.5	80.5	49.5	34.2	16.3
1850–99	5714	9858	23.0	77.0	34.7	48.1	17.3
≥1900	8694	–	–	–	–	–	–
All	29,738	26,682	20.1	79.9	37.9	49.5	12.6

Column *Nomination*: scholars by year of nomination with information on year of death or exit. Column *Birth*: scholars by year of birth with information on nomination and year of death or exit. Columns *Medicine*, *Other Field*, *Academy*, *Uni* and *Both* illustrate the share of scholars from column *Birth* in the field of sciences and kind of institution, respectively.

Table 1: Observations

The population of scholars is heterogeneous in several dimensions. We focus on two of them. Motivated by the potential impact of medical knowledge we first distinguish between scholars with and without a medical background. To identify medics, we check if scholars studied medicine, hold a PhD in medicine, were active at a medical faculty, a chair of medicine, their field of research was linked to medicine or if they were members in a class of medicine in an academy of science.[11] Table 1 documents a slightly increasing share of scholars in medicine from around 4% at the end of the Middle Ages to 23% among the most recent cohorts.

[11]This approach enables to identify the vast majority of scholars correctly into the groups of medics and non-medics. Still, due to missing information, changes in affiliation of medical faculties and so on, we might identify some scholars as *medics* who do not belong to this group in a modern sense and do not cover others.

Secondly, we distinguish scholars by their scientific institution. Members of academies of sciences make up a kind of elite within the knowledge elite. Due to more scientific achievements, better access to networks and so on, they likely enjoyed a better social status. Thus, we use a membership in academies to measure the impact of social status on mortality dynamics. Table 1 shows the number of scholars only active in universities, academies or both kinds of institutions. Once the first academies had established, the first academy among our institutions – the Leopoldina – was established in 1652, the sample quickly balances. Indeed, for cohorts born after the 1700 more than half of the sample were at least active in one academy of science.

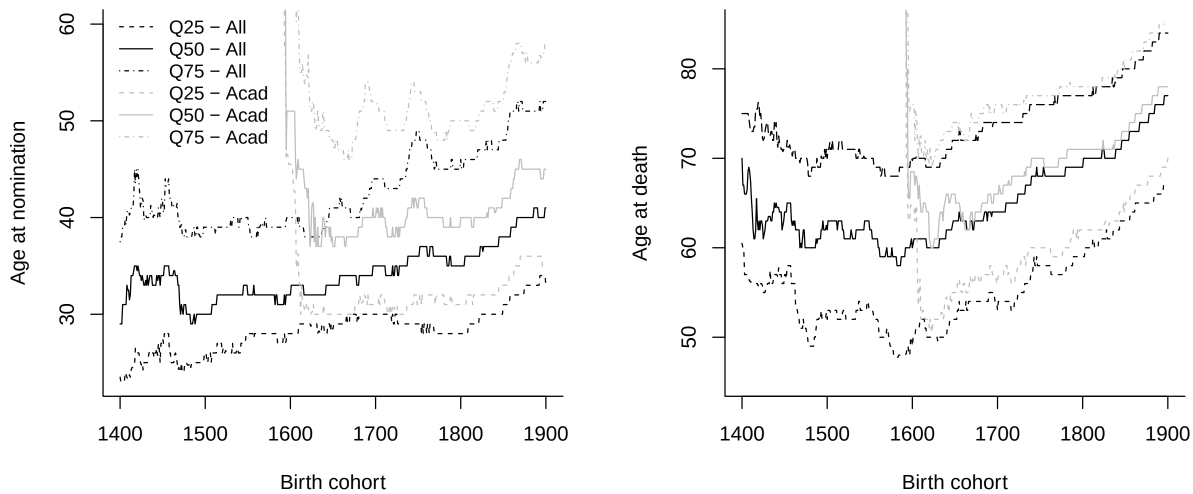
3 Scholars' Dynamics in Life Expectancy

3.1 Small Sample Size and the Age Interval in Life Tables

Scholars enter the population at risk at different ages. Even if we observe first nominations 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. Hence, it is important to define the minimum age of the life table calculation in a first step. Using 25-years rolling intervals[12], Fig. 3a illustrates the increasing first nomination age over time. Indeed, more than 25% of all first nominations were only reached below age 25 in the fifteenth century. Then, the 25%-quantile persisted rather stable between age 28 and 30 for around 300 years and increased at the and of the period under investigation. The increasing trend in the first nomination age is even stronger for the median and the 75%-quantile. From the end of the fifteenth to the end of the nineteenth century, the median increased from age 30 to 41. Compared to similar exercises in the literature, for instance Fornasin, Breschi, and Manfredini (2010) and Andreev et al. (2011), the nomination age of scholars is still rather low and stable, which allows us to conclude already on younger ages. If we limit our sample to first nominations in academies of sciences, like in the paper of Andreev et al. (2011), the median age of nomination is around five years higher on average.[13]

[12]The year always marks the middle of the 25-years rolling interval, e.g. 1450 covers 1438–1462.

[13]Andreev et al. (2011) estimate life expectancy at age 50. Due to data restrictions Fornasin, Breschi, and Manfredini (2010) start even later at age 60.



(a) Age at first nomination

(b) Age at death

Fig. 3. The dynamics of age at nomination and death

Since at least 25% of all first nominations occurred before age thirty – except for the last, rather large cohorts – we fix the initial age for the life table calculations to age 30.[14] Furthermore, adding median, 25%- and 75%-quantile age at death in Figure 3b to the picture illustrates that we observe scholars on average for quite a long age span. Comparing median age at death and nomination, the former is between 26 and 35 years higher. The sub-sample of scholars in scientific academies appreciates an higher median age at death, albeit the difference is low than in age of nomination.

To estimate mortality dynamics we then apply standard demographic tools; conditional life expectancy from life tables for rolling 25-years intervals. Due to the limited sample size in early years, see Column *Birth* in Tab. 1, we smooth death rates in two dimensions – time and age (Camarda et al. 2012). Then, we estimate the conditional life expectancy and apply Monte Carlo simulations to compute the corresponding confidence intervals (Chiang 1984; Andreev and Shkolnikov 2010).[15]

[14]Minimizing the size of the 95% confidence intervals relative to the life expectancy $E_{x,t}$ is an alternative method to determine the optimal conditional age x. We discuss this approach that leads to the same outcome in the online Appendix.

[15]We apply the R-code also provided by C. Camarda that mimics Andreev and Shkolnikov (2010).

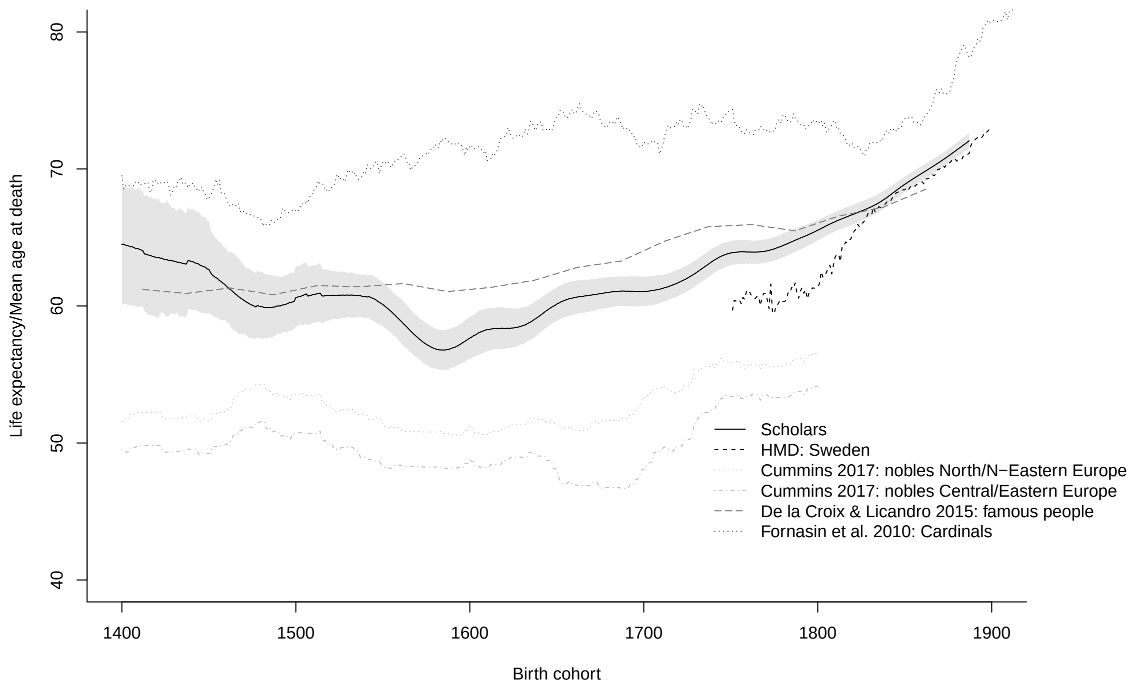
3.2 Cohort and Period Life Expectancy

Three clear patterns characterize scholars' mortality dynamics. First, we do not observe any systematic improvements in life expectancy among scholars before the eighteenth century. Then, secondly, a phase of steady improvements in mortality sets in. Thirdly, we evidence a sharp decline in life expectancy around the first half of the seventeenth century; a rather remarkable mortality crises. A crisis that already affects birth cohorts born in the sixteenth century.

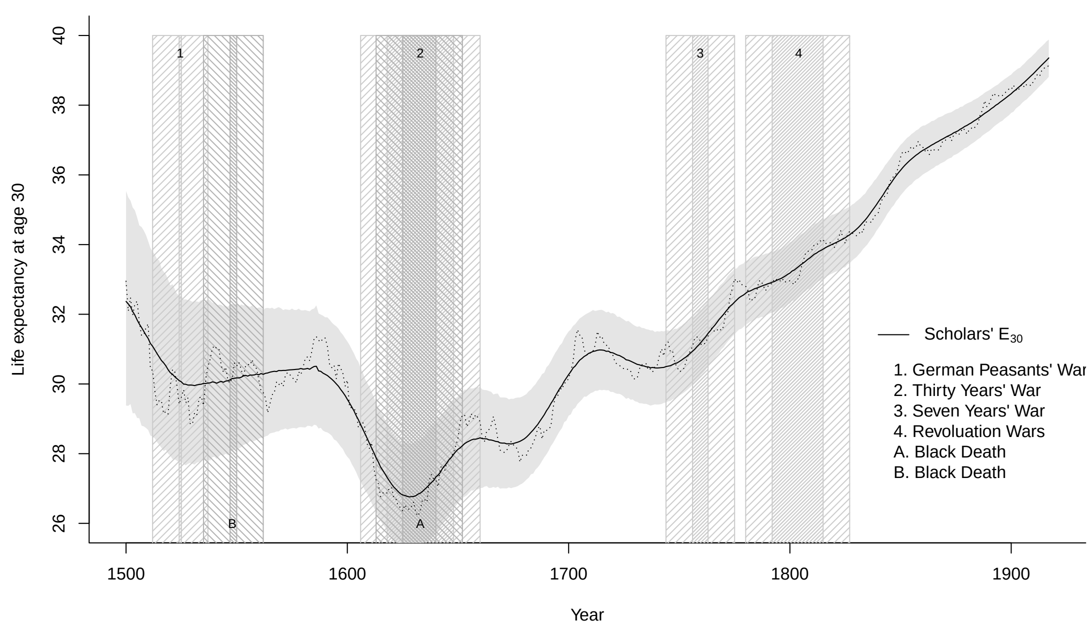
Figure 4a illustrates these three findings. The solid black line in Fig. 4a displays our estimated dynamics of conditional cohort life expectancy from scholars at age 30 in 25-years rolling intervals. The year 1550 for instance covers cohorts born in 1538–1562. The gray area marks the corresponding 95% confidence intervals. In addition to our own estimates, we add five time series to the picture: predicted ages at death from nobles in the phase 1400–1800 in North and North eastern Europe as well as Central and Eastern Europe from Cummins (2017), famous people between 1400–1875 (de la Croix and Licandro 2015), cardinals in 1400–1900 (Fornasin, Breschi, and Manfredini 2010), and, finally, Sweden's official life expectancy between 1751–1899 from the Human Mortality database.

Imagine a horizontal line around age 61. It directly clarifies that no improvements in cohort life expectancy occurred between 1450 and 1700 and, thus, over 250 years. Afterwards, we observe improvements in longevity. Within the cohorts born in the eighteenth century, conditional life expectancy increased by 4.5 years from 31 years in 1700 to 35.5 in 1800. Taking into account the specific characteristics of each time series, this estimation fits quite well in the existing literature. Cummins (2017) predicts the age at death at birth and, hence, also includes infant and child mortality. By contrast, we assume a certain survival up to age 30, which obviously results in higher estimations. The same argument applies vice versa for the cardinals in gray. Following Fornasin, Breschi, and Manfredini (2010), we estimate life expectancy of cardinals with a certain survival up to age 60. The reason for the discrepancy in levels. Nevertheless, cardinals underwent the same systematic improvements in mortality in the nineteenth century as we find in our estimation and in Sweden's time series. Furthermore, we observe the decreasing life expectancy in the fifteenth century. Hence, it is not clear at all, if this initial drop is driven by observed mortality dynamics, a potential selection bias or the right censoring, as mentioned in Section 2.3. But, opposed to scholars, no improvements are observable in the eighteenth century.

The closest estimation comes from de la Croix and Licandro (2015) and almost perfectly coincidences with our estimation in the time span 1450–1550 and at the end of the period



(a) Cohort life expectancy



(b) Period life expectancy and historical events

Fig. 4. The dynamics of scholars' life expectancy

Scholars' life expectancy in black with 95% confidence intervals (gray area) supplemented by estimations from the literature and human mortality database in Figure 4a. and with important wars (hatched in falling order) and epidemics (hatched in ascending order) in Figure 4b.

under investigation. Opposed to Fornasin, Breschi, and Manfredini (2010), they also find the mortality improvements starting in the eighteenth century which we, as well as Cummins (2017), document in our time series. The main difference to de la Croix and Licandro (2015) arises for cohorts born after 1550. In line with findings on the mean age at death, see Fig. 3b, scholars underwent a period of poor life expectancy in the pre-eighteenth century phase of stagnation. Mortality rapidly increased for cohorts born in the second half of the sixteenth century. Scholars' conditional life expectancy at age 30 declined from above 30 to less than 27 years at the end of the century. We do not find a similar sharp decline in life expectancy in any of the other time series from the literature in Figure 4a.

To shed light on potential historical events that might have caused the mortality crises, Figure 4b presents dynamics of period life expectancy. Years now indicate the middle of the 25-years rolling intervals. First of all, we observe the same stagnation in mortality in period life expectancy we already observed in cohort life expectancy. However, the stagnation lasts a little longer until the middle of the eighteenth century. In the 1750s life expectancy at age 30 was still around 31 years, when the period of clear gains entered. Until 1800, an increase of more than two years was already achieved. As first potential events, we add some important wars. The most important is probably the Thirty Years' War from 1618–1648, marked by the area No. 2 hatched in falling order. In addition to the 30 years of war densely hatched, the thinly surrounding years indicate estimated life expectancies that include years altered by the war due to the rolling intervals. The sharp decline in life expectancy perfectly coincidences with the Thirty Years' War. Period life expectancy reduced from around 30.5 years before the crises below 27 years at the beginning of the war. We identify three additional military conflicts that might have been important for the mortality dynamics albeit a clear impact is not documentable. The German Peasants' War 1524–1525 (no. 1) coincidences with the reduced life expectancy at the very beginning.[16] The role of the Seven Years' War 1756–1763 (no. 3) is less clear. The non-smoothed data shows some decline at the beginning of the war that might be related to this military conflict. Finally, the Revolutionary and Napoleonic Wars 1803–1815 (no. 4) did not go along with an increase in mortality, moreover, the period of permanent growth in life expectancy was initially interrupted.

Wars probably had primarily a mediate effect. Not the military conflicts themselves likely killed scholars, but their indirect effects. Passing soldiers spread infectious diseases and

[16]We would not like to overvalue the sharp decline in cohort life expectancy before 1450 and period life expectancy before 1550. A limited number of observation goes hand in hand with rather large confidence intervals. Furthermore, missings on the year of birth and/or death among less known scholars who might have died young might upwards bias life expectancy. The share of right censoring is also relatively high at that time. We show in Figure 7d that the high initial values disappear if we apply a discrete time survival model.

deteriorate hygienic situations. The endless number of Black Death waves in the years 1625–1640 during the Thirty Years' War, marked by the area B hatched in ascending order in Figure 4b, are a suitable example and perfectly fit to the highest death rates. Beside the plague, famine during the war is another potential explanation. Hence, the interplay of the three famous Malthusian mechanisms – famine, epidemics and war – were likely operating (Flinn 1981). The Great Black Death in 1547–1550 (the area A hatched in ascending order) is an example, where a pandemic probably reduced the life expectancy – non-related to war.

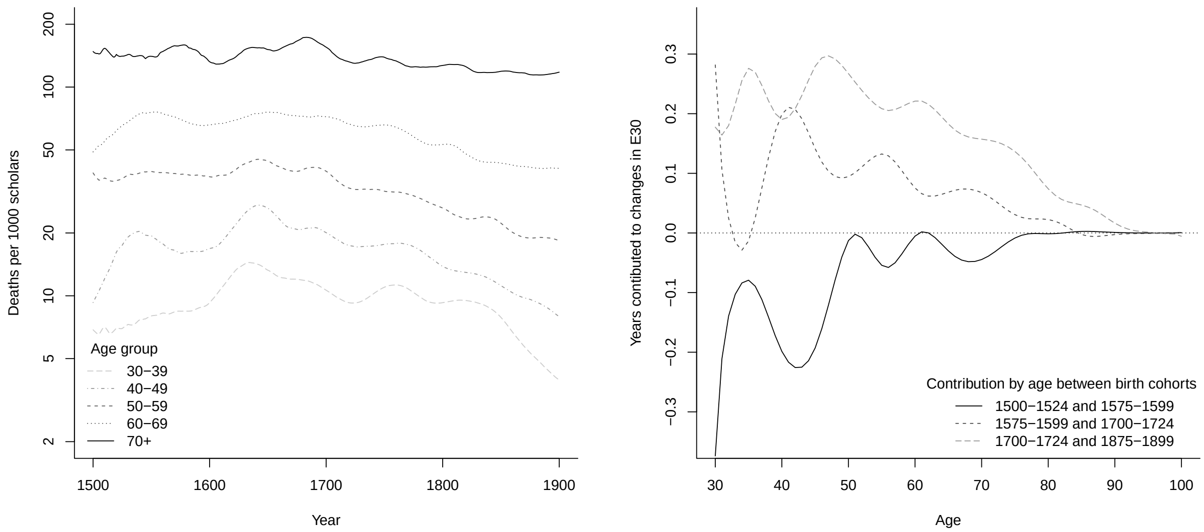
The three patterns we find in the dynamics of scholars life expectancy are rather robust. Neither using non-smoothed data nor Poisson estimations, see Fig. 7a–c in Appendix A.2, instead of Monte Carlo simulations alters the dynamics of life expectancy noteworthy. The same applies if we estimate life expectancy conditional to surrounding ages.[17] Finally, life table calculations presented so far have in common that they do not control for institutional characteristics. But, we have different types of institutions. Scholars from scientific academies, for instance, define a successful sub-population of all scholars. A kind of elite in our knowledge elite. Furthermore, the different kinds of sources and categories of scholars covered by our institutions might bias our outcomes. To take into account these issues, we estimate a discrete time survival model with time and institutional dummies presented in more detail in 4. Applying 1700–1709 as reference period, see Fig. 7d in Appendix A.3, illustrates the mortality dynamics of our estimated model with institutional fixed effects. It almost perfectly traces the three patterns plotted in Figure 4a: the absence of significant mortality improvements before the eighteenth century, the clear improvements afterwards and the strong mortality crises between 1560–1569 and 1620–1629. Thus, the findings also hold if we take into account the specific characteristics related to the institutions and alternative estimation methods.

3.3 Dynamics of Age Specific Mortality Rates

The mortality dynamics described in Fig. 4 do not necessarily affect all ages the same way. Therefore, we turn our attention to age specific mortality patterns in Fig. 5. The strong mortality crisis during the first half of the seventeenth century in particular hit scholars below age 50. At the beginning of the crisis we observe a yearly increase in mortality up to 2% in death rates for the age 30–39. After the crisis, death rates started to decrease, accompanied by some fluctuations, for instance in the first part of the eighteenth century. While mortality started to reduce above age 40, no noteworthy improvements occurred in the age group 30–

[17]Findings are documented in the online material.

39. Instead, this age benefited most from gains in mortality in the nineteenth century. Death rates shrunk with up to 1.5% annually. A finding that is confirmed by decomposing gains in life expectancy by the contribution of each age. Therefor, we apply the stepwise replacement algorithm from Andreev and Shkolnikov (2012) described in Andreev, Shkolnikov, and Begun (2002).



(a) Age specific death rates (b) Years contributed to changes in life expectancy

Fig. 5. Decomposition of gains in life expectancy.

Fig. 5 applies 25-years rolling intervals and two-dimensional smoothed data.

As illustrated in Fig. 5b ages below age 50 mainly contributed to the decreasing life expectancy for cohorts born at the end of the sixteenth century. The curve is mirrored if we compare the crisis with the cohorts born between 1700–1724. While no gains are attained in the mid-thirties, the following ages up to age 80 clearly added to the higher life expectancy. During the eighteenth and nineteenth century all ages contribute to the overall gain of almost 11 years. Up to age 60 each age adds more than 0.2 years. Afterwards, the positive contribution shrinks linearly and becomes negligible around age 90.

4 Social Status or Medical Knowledge – What Mattered for Mortality Improvements?

4.1 Estimation Strategy

We now turn our attention from the general mortality dynamics to the heterogeneity among scholars: the field of medicine and social status. To consider the different nomination ages between universities and academies of sciences shown in Fig. 3a, we estimate discrete time survival models. To do so, we first reorganize our data set to record one row per person-year.[18] Overall, the observations from Tab. 1 translate into 769,360 person-years and 25,794 deaths. 155,380 person-years and 5143 deaths are linked to medicine, remaining observations and events belong to all other fields of sciences. Regarding social status, the data set includes 435,131 person-years and 12,408 deaths exclusively linked to universities. 250,373 person-years and 10,086 deaths belong to scholars only active in academies. Finally, we observe 83,822 person-years and 3300 deaths from scholars found in universities and academies.

We apply logit-specification to estimate the predicted probability of dying $\hat{\pi}_i$:

$$\hat{\pi}_i = \frac{\exp(\eta_i)}{1 + \exp(\eta_i)} \tag{2}$$

in two kinds of discrete time survival models. First, we use interacted decade-institution $Dec_{in} \times Inst_i$ and decade-medicine dummies $Dec_{in} \times Medi_i$. Like in Fig. 4, we focus on the period 1500 to 1930. Since we include all years before 1500 in the dummy *<1500* and everything after 1929 in the dummy *≥1930*, we have $N = 45$ decade dummies. Additionally, our model includes the decade dummies Dec_{in} with $n \in [1, N-1]$ and age Age_i to capture the general mortality trends over time and age:

$$\begin{aligned} \eta_i = \beta^{const} + \beta^{Age} Age_i + \sum_{n=1}^{N-1} \beta_n^{Dec} Dec_{in} + \sum_{n=17}^{N} \beta_n^{Dec \times Inst} Dec_{in} \times Inst_i \\ + \sum_{n=1}^{N} \beta_n^{Dec \times Medi} Dec_{in} \times Medi_i \end{aligned} \tag{3}$$

Since the *Leopoldina*, our first academy, was established in 1652, the first decade for an academy is 1650–1659 ($n = 17$).

Secondly, we estimate the model with cubic splines (polynomial splines of degree 3) with knots every 50 years between 1600 and 1900. Instead of the interacted decade-institutions

[18] Details are documented in the online material.

and decade-medicine dummies the logit-estimation includes the B-spline matrix representing the family of piecewise polynomials for the period 1500–1930.[19] Finally, to check for the impact of institutions, estimations are done with and without institutional dummies.

4.2 Findings

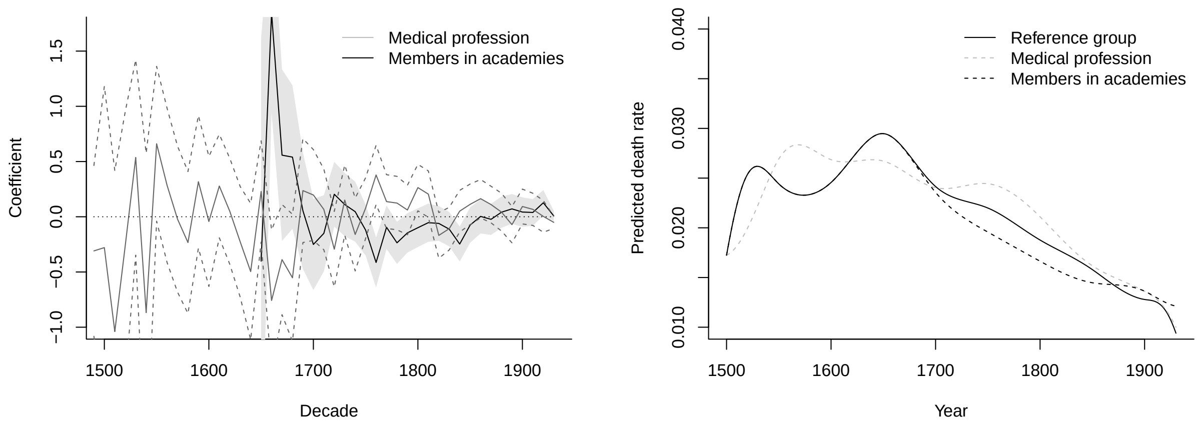
Our findings on the link between mortality and medical discipline and social status, respectively, are summarized in Fig. 6.[20] Figure 6a illustrates the dummy on medicine or a membership in an academy of sciences with moving reference decades. In early times, mortality of scholars in the medical field fluctuates around zero. Taking into account that formal medicine competed with folk practitioners and other groups of healers on the medical marketplace this is not surprising (Broman 1995). The medical profession of scholars played only a limited role in the daily provision of health care. In fact, a medical degree often opened the possibility for official positions. The University of Gießen for instance, offered August Schaarschmidt the position as town physicus in addition to the professorial chair (Broman 1995). In this case, the university degree was more related to social status than higher mortality risks; maybe the reason why we find some decades with a mortality advantage for the medical profession during the early period. The picture changes in the middle of the eighteenth century, due to several institutional changes. The newly established academies of sciences encouraged medical knowledge accumulation. The growing number of clinical hospitals allowed specialized research and enhanced the role of formal medicine (Johansson 1999), but potentially at the price of higher contagious risks in the medical profession. This additional risk might first have annihilated the general gains in mortality caused by income, hygienic and medical improvements. Indeed, the sustained gains in mortality of scholars linked to the medical field were delayed. In line with findings from van Poppel et al. (2016) coefficient on medical mortality from 1760 to 1810 are positive and significant in 1760 and 1800.[21] The delay in mortality improvements is also detectable in Fig. 6b, albeit coefficients are not significant.[22] Over time, the increasing medical knowledge did not translate into a mortality advantage, but it enabled to close the temporary disadvantage. Since the early nineteenth century, mortality of scholars in the field of medicine is close to those in all other fields of sciences.

[19]We neglected the person-years and events before and after this period such that the overall sample shrinks to 596,848 person-years and 17,968 deaths.

[20]Estimations illustrated in the Figure neglect institutional dummies. Taking them into account does not change the Figures at all.

[21]van Poppel et al. (2016) document a slightly shrinking life expectancy among the medical profession in the Netherlands at the beginning of the nineteenth century.

[22]See online material for more details.



(a) Dummies on medical and social status with 95% confidence intervals

(b) Predicted death rate at age 50 from polynomial spline

Fig. 6. The impact of medicine and social status on mortality

The Reference group includes all scholars without a membership in an academy of sciences from other than the medical field.

Our estimations suggest the opposite finding for social status measured by a membership in a scientific academy. From 1750 to 1850 we document a mortality advantage for members, albeit only a limited number of coefficients is significant (1760, 1780 and 1840). The fact that those with a higher social status gained faster from the mortality improvements is supported by the spline estimation in Fig. 6b.[23] In the middle of the nineteenth century, the higher social status of members in scientific academies was not sufficient to translate into an mortality advantage anymore. Groups with lower social status were gradually involved in the mortality gains and professors without a membership already appreciated a very high social status. Furthermore, with the Humboldt reform universities changed from *vocational schools* to *research institutions* (Schimank and Winnes 2000). The advance in social status of being a member in a scientific academy compared to an "ordinary" professor might have declined. An additional explanation for the vanishing mortality advance of members in academies of sciences.

[23]The estimated coefficients are documented in the online Appendix.

5 Conclusion

We gathered data from around 31,900 scholars in the 1648 territory of the Holy Roman Empire and the surrounded Netherlands. Vital information combined with nomination and exit information allow us to compute mortality dynamics taking into account left truncation and right censoring in our sample of scholars. A population that permanently increased over time, except for a period of stagnation in the first half of the seventeenth century. In this phase, a combination of lower nomination and higher death rates reduced the number of scholars.

To investigate whether dynamics in death rates come from selection or composition effects, we first control for the age structure by computing life expectancies with life tables and estimate their confidence intervals via Monte-Carlo simulations. Results show a significant drop of around 3.5 years in period life expectancy in the first part of the seventeenth century. Permanent improvements in cohort life expectancy started around 1700 followed by gains in period life expectancy in the middle of the century. Findings, that persist several robustness checks and perfectly fit into the existing literature on long-run mortality dynamics. Taking into consideration the link between social status and mortality as well as the different measures of mortality, the comparisons with previous results emphasizes the quality of our new estimations. A discussion in the light of historical events also underlines their plausibility and provides some new general insights. The drop in life expectancy during the Thirty Years' War, documented in the elite of scholars, contributes to the understanding of the magnitude of this crisis. While the elite already lost several years of life expectancy, ordinary people were likely hit even more by the bad socio-economic conditions and pandemics. Our outcomes might be interpreted as a very conservative estimation of the remarkable impact of the crisis on mortality. It took almost one century to catch up with the pre-war level in life expectancy.

The heterogeneity in our population of scholars enables us to study differentials in the timing of mortality improvements. Albeit missing knowledge, for instance on contagious risks, suggest a lower life expectancy of scholars in medicine in early times, we do not find such an effect. But we find some evidence, that when mortality started to decline sustainably in the second part of the eighteenth century, the medical profession suffered a delay. At the same time, the higher social status of members in scientific academies accelerated the improvements in life expectancy. The faster mortality gains for the more successful elite within our elite is in line with the literature, see for instance Johansson (1999). Still, the advance of social status and the excess mortality of the medical profession vanished during the nineteenth century.

Finally, our findings allow some conclusions on the capacities of knowledge accumulation and diffusion. Since scholars are the population embodying human capital, their population size is one key element of this capacity. As argued by Lucas (2009) and de la Croix (2017) life expectancy was the other one. A longer life enables to become more excellent and increases the opportunities to transmit the own knowledge.

Up to the beginning of the eighteenth century the increasing number of scholars might have been the driving force for knowledge transmission and diffusion. No systematic improvements in life expectancy are observable. Afterwards, the interplay of an increasing stock of scholars and a longer life might have accelerated knowledge accumulation and, hence, favored the Industrial Revolution. By contrast, the Thirty Years' War as a strong crisis hit knowledge accumulation twofold – via a shrinking population size and a shorter lifetime. To study the interplay between scholars life expectancy, population size and economic growth in a more systematic way is on our future research agenda.

References

Albrecht, Helmut. 1986. *Catalogus professorum der Technischen Universität Carolo-Wilhelmina zu Braunschweig: Teil 1. Lehrkräfte am Collegium Carolinum 1745-1877.* Volume 8 of *Beiträge zur Geschichte der Carolo-Wilhelmina.* Braunschweig: Universitätsbibliothek.

Andreev, Evgueni M, Dmitri Jdanov, Vladimir M Shkolnikov, and David A Leon. 2011. "Long-term trends in the longevity of scientific elites: Evidence from the British and the Russian academies of science." *Population studies* 65 (3): 319–334.

Andreev, Evgueni M, and Vladimir M Shkolnikov. 2010. "Spreadsheet for calculation of confidence limits for any life table or healthy-life table quantity." *Rostock: Max Planck Institute for Demographic Research (MPIDR Technical Report)*, vol. 5.

———. 2012. "An Excel spreadsheet for the decomposition of a difference between two values of an aggregate demographic measure by stepwise replacement running from young to old ages." *Rostock: Max Planck Institute for Demographic Research (MPIDR Technical Report TR–2012–002).*

Andreev, Evgueni M, Vladimir M Shkolnikov, and Alexander Z Begun. 2002. "Algorithm for decomposition of differences between aggregate demographic measures and its application to life expectancies, healthy life expectancies, parity-progression ratios and total fertility rates." *Demographic Research* 7:499–522.

Arbage, Martin. 2004. "Otto I." In *Medieval Italy: An Encyclopedia*, edited by Christopher Kleinhenz, Volume 2, 810. Routledge.

Auerbach, Inge, and Franz Gundlach. 1979. *Catalogus professorum academiae Marburgensis: Die akademischen Lehrer der Philipps-Universität Marburg.* Volume 15 of *Veröffentlichungen der Historischen Kommission für Hessen.* Marburg: Elwert.

Bauer, Johannes Joseph. 1957. *Zur Frühgeschichte der Theologischen Fakultät der Universität Freiburg i. Br.(1460-1620): Universität Freiburg im Breisgau 1457-1957. Gabe d. Theologischen Fakultät.* Albert.

Bengtsson, Tommy, and Martin Dribe. 2011. "The late emergence of socioeconomic mortality differentials: A micro-level study of adult mortality in southern Sweden 1815–1968." *Explorations in Economic History* 48 (3): 389–400.

Bengtsson, Tommy, and Frans van Poppel. 2011. "Socioeconomic inequalities in death from past to present: An introduction." *Explorations in economic History* 48 (3): 343–356.

Benzing, Josef. 1986. *Verzeichnis der Professoren der alten Univerität Mainz.* Mainz.

Berger-Levrault, Oscar. 1890. Catalogus Professorum Academiarum et Universitatum alsaticarum XVI–XVIII seculi (Interfolié de papier blanc).

Bianco, Franz Joseph von. 1974. *Darstellung: Kölner Gelehrte des 14. - 18. Jahrhunderts. Verzeichnisse der Rektoren und bedeutender, an der Universität immatrikulierter Personen.* Volume einzige Abteilung des geplanten Werkes: Die alte Universität Köln und die spätern Gelehrtenschulen dieser Stadt; in 2 Bänden ; Bd. 1 of *Die alte Universität Köln sowie die zu Köln administrierten Studienstiftungen Die alte Universität Köln.* Aalen: Scientia-Verl.

Brants, Victor. 1906. *La faculté de droit de l'Université de Louvain à travers cinq siècles <1426-1906>.* Louvain: Ch. Peeters.

Broman, Thomas. 1995. "Rethinking professionalization: Theory, practice, and professional ideology in eighteenth-century German medicine." *The Journal of Modern History* 67 (4): 835–872.

Brosius, Dieter. 1972. *Das Stift Obernkirchen: 1167 - 1565.* Volume 30 of *Schaumburger Studien.* Bückeburg: Grimme.

Camarda, Carlo G, et al. 2012. "MortalitySmooth: An R package for smoothing Poisson counts with P-splines." *Journal of Statistical Software* 50 (1): 1–24.

Carrieri, Maria Patrizia, and Diego Serraino. 2005. "Longevity of popes and artists between the 13th and the 19th century." *International journal of epidemiology* 34 (6): 1435–1436.

Chiang, Chin Long. 1984. "Life table and its applications." In *Life table and its applications.* Robert E. Krieger Publishing.

Conrad, Ernst. 1960. *Die Lehrstühle der Universität Tübingen und ihre Inhaber (1477-1927): Tübingen, Univ., Zulassungsarb., 1960.* Tübingen.

Čornejová, Ivana, and Anna Fechtnerová. 1986. *Životopisný slovnı.*

Cummins, Neil. 2017. "Lifespans of the European Elite, 800–1800." *The Journal of Economic History* 77 (2): 406–439.

de la Croix, David. 2017. "Did Longer Lives Buy Economic Growth? From Malthus to Lucas and Ben-Porath." In *Demographic Change and Long-Run Development*, edited by Matteo Cervellati and Uwe Sunde, 69–89. MIT Press.

de la Croix, David, and Omar Licandro. 2015. "The Longevity of Famous People from Hammurabi to Einstein." *Journal of Economic Growth* 20:263–303.

de la Croix, David, and Alessandro Sommacal. 2009. "A Theory of Medical Effectiveness, Differential Mortality, Income Inequality and Growth for Pre-Industrial England." *Mathematical Population Studies* 16 (1): 2–35.

Dittmar, Jeremiah, and Ralph R. Meisenzahl. 2016, March. "State Capacity and Public Goods: Institutional change, Human Capital and Growth in Early Modern Germany." Cep discussion papers dp1418, Centre for Economic Performance, LSE.

Drüll, Dagmar. 2009. *Heidelberger Gelehrtenlexikon 1933–1986*. Berlin Heidelberg: Springer Berlin Heidelberg.

———. 2012. *Heidelberger gelehrtenlexikon 1803–1932*. Springer.

Drüll-Zimmermann, Dagmar. 1991. *Heidelberger Gelehrtenlexikon: 1652–1802*. Berlin, Heidelberg: Springer Berlin Heidelberg.

———. 2002. *Heidelberger Gelehrtenlexikon 1386–1651*. Berlin, Heidelberg: Springer Berlin Heidelberg and Imprint and Springer.

Ebel, Wilhelm, ed. 1962. *Catalogus professorum Gottingensium: 1734 - 1962*. Göttingen and Göttingen: Vandenhoeck & Ruprecht and Niedersächsische Staats- und Universitätsbibliothek.

Eid, Ludwig. 1926. *Die gelehrten Gesellschaften der Pfalz*. Speyer, Lehrerbildgsanst.: [Selbstverl.].

Elo, Irma T, Pekka Martikainen, and Mikko Myrskylä. 2014. "Socioeconomic status across the life course and all-cause and cause-specific mortality in Finland." *Social Science & Medicine* 119:198–206.

Feenstra, Robert. 2003. *Bibliografie van hoogleraren in de rechten aan de Franeker Universiteit tot 1811*.

Flessa, Dorothee. 1969. *Die Professoren der Medizin zu Altdorf von 1580 - 1809*. Universität Erlangen-Nürnberg, Dissertation.

Flinn, Michael Walter. 1981. "The European demographic system 1500-1820." *Johns Hopkins Symposia in Comparative History*. Johns Hopkins University Press Baltimore Md. United States 1981.

Fornasin, Alessio, Marco Breschi, and Matteo Manfredini. 2010. "Mortality patterns of cardinals (sixteenth–twentieth centuries)." *Population* 65 (4): 631–652.

Fröde, Tino, ed. 2017. *Biographisches Lexikon der Mitglieder der Oberlausitzischen Gesellschaft der Wissenschaften: 1779-1945*. Volume Band 18 of *Beiheft zum Neuen Lausitzischen Magazin*. Görlitz: Oberlausitzische Gesellschaft der Wissenschaften e. V.

Gundlach, Franz, and Inge Auerbach. 1927. *Catalogus professorum academiae Marburgensis; die akademischen Lehrer der Philipps-Universität in Marburg.* Veröffentlichungen der Historischen Kommission für Hessen und Waldeck, 15. Marburg <Hessen>: N. G. Elwert'sche Verlagsbuchhandlung G. Braun.

Gundler, Bettina. 1991. *Catalogus Professorum der Technischen Universität Carolo- Wilhelmina zu Braunschweig: Teil 2: Lehrkräfte 1877-1945.* Volume 9 of *Beiträge zur Geschichte der Carolo-Wilhelmina.* Braunschweig.

Günther, Johannes. 1858. *Lebensskizzen der Professoren der Universität Jena seit 1558 bis 1858.*

Hanley, James A, Maria Patrizia Carrieri, and Diego Serraino. 2006. "Statistical fallibility and the longevity of popes: William Farr meets Wilhelm Lexis." *International journal of epidemiology* 35 (3): 802–805.

Hasquin, Hervé. 2009. *L'Académie impériale et royale de Bruxelles. Ses académiciens et leurs réseaux intellectuels au XVIIIe siècle.* Bruxelles: Académie Royale de Belgique.

Haupt, Herman, and Georg Lehnert. 2006. *Chronik der Universität Gießen von 1607 - 1907.* Gießen: Universitätsbibliothek.

Hollingsworth, Thomas. 1977. "Mortality in the British peerage families since 1600." *Population* 32:323–352.

Johansson, Sheila Ryan. 1999. *Death and the doctors: medicine and elite mortality in Britain from 1500 to 1800.* Cambridge Group for the History of Population and Social Structure.

Kiefer, Jürgen. 2004. *Bio-bibliographisches Handbuch der Akademie Gemeinnütziger Wissenschaften zu Erfurt: 1754 - 2004 ; aus Anlaß der 250. Jahrfeier ; bio-bibliographisches Handbuch der Protektoren und Spezialprotektoren, der Träger von Ehrentiteln und Inhaber von Ehrenämtern, der Preisträger sowie der Ehren-, Ordentlichen und Auswärtigen Mitglieder, einschließlich einer chronologischen Übersicht aller Aufnahmen, der Mitglieder der Erziehungswissenschaftlichen Gesellschaft an der Akademie (eröffnet 1927) und einer Auswahl von Vortragenden, die nicht Mitglieder der Akademie waren ; [Festgabe im Jubiläumsjahr].* Erfurt: Akad. Gemeinnütziger Wiss. zu Erfurt.

Kohnle, Armin, and Beate Kusche. 2016. *Professorenbuch der theologischen Fakultät der Universität Wittenberg: 1502 bis 1815/17 / herausgegeben von Armin Kohnle und Beate Kusche.* Volume Bd. 27 of *Leucorea-Studien zur Geschichte der Reformation und der Lutherischen Orthodoxie.*

Krahnke, Holger. 2001. *Die Mitglieder der Akademie der Wisenschaften zu Göttingen 1751-2001.* Volume Bd. 246 of *Abhandlungen der Akademie der Wissenschaften zu Göttingen. Philologisch-historische Klasse. Dritte Folge.* Göttingen: Vandenhoeck & Ruprecht.

Krones, Franz Xaver. 1886. *Geschichte der Karl Franzens-Universität in Graz.* Verlag der Karl Franzens-universität.

Kurrus, Theodor. 1977. *Die Jesuiten an der Universität Freiburg im Br. 1620 – 1773.* Volume 2. Alber.

Lackner, Franz. 1976a. *Die Jesuitenprofessoren an der philosophischen Fakultät der Wiener Universität (1712-1773).* Volume 1. VWGÖ, Verb. d. Wissenschaftl. Gesellschaften Österreichs.

———. 1976b. *Die Jesuitenprofessoren an der philosophischen Fakultät der Wiener Universität (1712-1773).* Volume 2. VWGÖ, Verb. d. Wissenschaftl. Gesellschaften Österreichs.

Ley, Astrid, and Renate Wittern-Sterzel. 1999. *Medizinische Fakultät.* Volume 9 of *Erlanger Forschungen Sonderreihe.* Erlangen.

Lucas, Jr., Robert E. 2009. "Ideas and Growth." *Economica* 76 (301): 1–19.

Müller, Goerg. 1999. *Technische Universität Clausthal: Der Lehrkörper 1775 - 1999.* Hannover: Schlütersche GmbH & Co.KG.

Napjus, J. W., and Gerrit Arie Lindeboom. 1985. *De hoogleraren in de geneeskunde aan de Hogeschool en het Athenaeum te Franeker.* Volume 15 of *Nieuwe Nederlandse bijdragen tot de geschiedenis der geneeskunde en der natuurwetenschappen.* Amsterdam: Rodopi.

Pfister, Ulrich, and Georg Fertig. 2010. "The population history of Germany: research strategy and preliminary results." *MPIDR WORKING PAPER WP 2010-035.*

Ram, Pierre François Xavier de. 1861. *Les quatorze livres sur l'histoire de la ville de Louvain du docteur et professeur en théologie Jean Molanus: Historiae lovaniensium.* Collection de chroniques belges inédites. Bruxelles: Hayez.

Rehmann, Wilhelm. 2006. *Chronik der Ludwigs-Universität Gießen 1907-1945 und der Justus Liebig-Hochschule Gießen 1946-1957.* Gießen: Universitätsbibliothek.

Reusens, Edmond Henri Joseph. 1892. *Documents relatifs à l'histoire de l'Université de Louvain (1425-1797).* Volume 5. Se trouve clez l'auteur.

Rüegg, Walter. 1996. *A History of the University in Europe, Volume 2: Universities in the Early Modern Europe (1500-1800).* Volume 2. Cambridge: Cambridge University Press.

———. 2004. *A history of the university in Europe: Volume 3, Universities in the nineteenth and early twentieth centuries (1800–1945).* Volume 3. Cambridge University Press.

Ruth, Horst. 2001. "Das Personen-und Ämtergefüge der Universität Freiburg (1520-1620)." *Bd. I.*

Schimank, Uwe, and Markus Winnes. 2000. "Beyond Humboldt? The relationship between teaching and research in European university systems." *Science and public policy* 27 (6): 397–408.

Schleiff, Hartmut, Roland Volkmer, and Herbert E Kaden. 2015. *Catalogus Professorum Fribergensis: Professoren und Lehrer der TU Bergakademie Freiberg 1765 bis 2015.* Verlag TU Bergakademie.

Schumacher, Reto, and Michel Oris. 2011. "Long-term changes in social mortality differentials, Geneva, 1625–2004." *Explorations in Economic History* 48 (3): 357–365.

Squicciarini, Mara P., and Nico Voigtländer. 2015. "Human Capital and Industrialization: Evidence from the Age of Enlightenment." *The Quarterly Journal of Economics* 130 (4): 1825–1883.

Steiger, Günter. 1981. Magister und Scholaren, Professoren und Studenten: Geschichte deutscher Universitäten und Hochschulen im Überblick.

Svatoš, Michal, Ivana Čornejová, and František Kavka, eds. 1995. *1347/48 - 1622.* Vyd. 1. Volume publikaci vydala Univerzita Karlova k 650. výročí svého založení / red. František Kavka ... ; 1 of *Dějiny Univerzity Karlovy 1348 - 1990.* Praha: Univ. Karlova.

Tricot-Royer, Joseph JG. 1927. *Coup d'oeil sur l'ancienne faculté de médecine de Louvain.* F. Ceuterick.

Valentiner, Siegfried. 1925. *Die Preußische Bergakademie zu Clausthal 1775/1925: Festschrift zur 150-Jahrfeier.* Leipzig: Breitkopf & Härtel.

van de Kaa, D. J., and Y. de Roo. 2008. *De Leden Van De Koninklijke Nederlandse Akademie Van Wetenschappen: Een Demografisch Perspectief: 1808 Tot 2008 (Bijdragen Tot De Geschiedenis Van De Knaw) (Dutch Edition).* Edita KNAW.

van Epen, Didericus Gysbertus. 1904. *Album studiosorum Academiæ gelro-zutphanicae MDCXLVIII-MDCCCXVIII.* Hagae Comitis: apud Jacobum Hoekstra.

van de Kaa, Dirk J, and Yves de Roo. 2007. "The members of the Royal Netherlands Academy of Arts and Sciences: 1808 to 2000. A demographic view." *Netherlands Interdisciplinary Demographic Institute, Working paper*, vol. 2007/2.

Vandenbroucke, Jan. 1985. "Survival and expectation of life from the 1400's to the present - A study of the knighthood order of the Golden Fleece." *American Journal of Epidemiology* 22 (6): 1007–1015.

van Poppel, Frans, Govert Bijwaard, Mart van Lieburg, Fred van Lieburg, Rik Hoekstra, and Frans Verkade. 2016. "The Life Expectancy of Medical Professionals in the Netherlands, Sixteenth to Twentieth Centuries." *Population* 71 (4): 619–640.

van Poppel, Frans, Dirk J. van de Kaa, and Govert E. Bijwaard. 2013. "Life expectancy of artists in the Low Countries from the fifteenth to the twentieth century." *Population Studies* 67 (3): 275–292.

Volbehr, Friedrich, and Richard Weyl. 1956. *Professoren und Dozenten der Christian-Albrechts-Universität zu Kiel: 1665 - 1954. Mit Angaben über d. sonstigen Lehrkräfte u.d. Universitäts-Bibliothekare u.e. Verz. d. Rektoren.* 4. Aufl., bearb. von Rudolf Bülck, abgeschlossen von Hans-Joachim Newiger. Volume N.F., Nr. 7 of *Veröffentlichungen der schleswig-holsteinischen Universitätsgesellschaft.* Kiel: Hirt.

Wachter, Clemens. 2009. *Philosophische Fakultät, Naturwissenschaftliche Fakultät.* Volume 13 of *Erlanger Forschungen Sonderreihe.* Erlangen.

Walter, Ludwig K. 2010. *Dozenten und Graduierte der Theologischen Fakultät Würzburg 1402 bis 2002.* Volume 63 of *Quellen und Forschungen zur Geschichte des Bistums und Hochstifts Würzburg.* Würzburg: Schöningh.

Wedel-Schaper, Eva, and Renate Wittern. 1993. *Theologische Fakultät, Juristische Fakultät.* Volume 5 of *Erlanger Forschungen Sonderreihe.* Erlangen: Univ.-Bund Erlangen-Nürnberg e.V.

Winkler-Dworak, Maria. 2008. "The low mortality of a learned society." *European Journal of Population/Revue européenne de Démographie* 24 (4): 405–424.

A Appendix

A.1 Universities and Academies of Sciences

No.	University	Year	Cat.	Obs.	Wiki	RAG	*Catalogs* & Books
Universities in the Holy Roman Empire 1348–1599							
1.	University of Prague	1348	2	1310	x	x	Čornejová and Fechtnerová 1986; Svatoš, Čornejová, and Kavka 1995
2.	University of Vienna	1365	2	1487	x	x	Lackner 1976a, 1976b
3.	University of Heidelberg	1386	1	1980			Drüll 1991, 2002, 2009, 2012
4.	University of Cologne	1388	2	688	x	x	Bianco 1974
5.	University of Erfurt	1389	3	295	x	x	
6.	University of Würzburg	1402	2	527			Walter 2010
7.	Leipzig University	1409	1	1159			*Catal. Prof. Lipsiensium*
8.	University of Rostock	1419	1	808			*Catal. Prof. Rostochiensium*
9.	University of Dole	1422	4	38			
10.	University of Louvain	1425	2	578			Ram 1861; Reusens 1892; Tricot-Royer 1927; Brants 1906
11.	University of Greifswald	1456	3	704	x		
12.	University of Freiburg	1457	2	657	x		Bauer 1957; Ruth 2001; Kurrus 1977
13.	University of Ingolstadt	1472	3	221			
14.	University of Trier	1473	4	45			
15.	University of Tübingen	1477	1	974			Conrad 1960
16.	University of Mainz	1477	3	194			Benzing 1986
17.	University of Wittenberg	1502	2	165			Kohnle and Kusche 2016
18.	Brand. Uni. of Frankfurt	1506	3	134	x		
19.	University of Marburg	1527	1	1636			*Marburger Prof.-katalog* Auerbach and Gundlach 1979; Gundlach and Auerbach 1927
20.	University of Strasbourg	1538	2	493			Berger-Levrault 1890
21.	University of Dillingen	1553	3	119	x		
22.	University of Jena	1558	2	579			Günther 1858
23.	University of Douai	1559	4	33			
24.	University of Eichstätt	1564	4	9			
25.	University of Olomouc	1573	3	286	x		
26.	University of Linz	1574	4	16			
28.	University of Helmstedt	1576	1	294			*Prof.-katalog Helmstedt*
29.	University of Herborn	1584	4	12			
30.	University of Graz	1585	2	507	x		Krones 1886

* Observations are also included in the University of Strasbourg, because of a joint source.

Table 2: Sources of Universities and Academies of Sciences

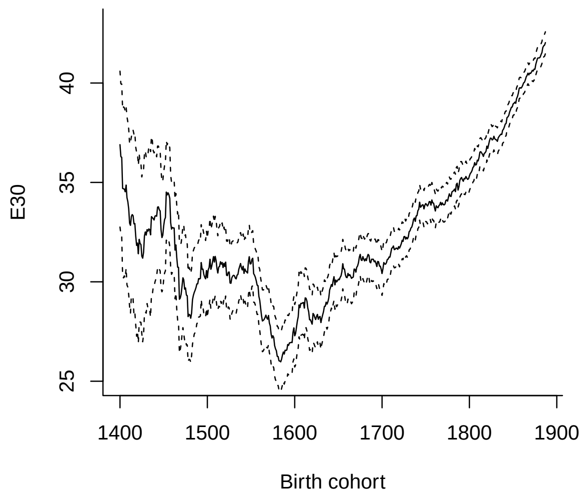
No.	University	Year	Cat.	Obs.	Wiki	RAG	*Catalogs* & Books
Universities in the Holy Roman Empire 1600–1799							
32.	University of Gießen	1607	1	1055			Rehmann 2006; Haupt and Lehnert 2006
33.	University of Stadthagen	1610	1	2**			Brosius 1972
35.	University of Paderborn	1614	4	31			
36.	University of Molsheim	1618	2	23*			Berger-Levrault 1890
37.	University of Rinteln	1621	1	172			Brosius 1972
38.	University of Salzburg	1622	4	23			
39.	University of Altdorf	1622	2	98	x		Flessa 1969
40.	University of Osnabrück	1629	4	11			
42.	University of Kassel	1633	4	3			
44.	University of Bamberg	1647	4	77			
47.	University of Duisburg	1655	4	14			
48.	University of Kiel	1665	1	1376			*Kieler Gelehrtenverzeichnis* Volbehr and Weyl 1956
49.	University of Innsbruck	1669	4	154			
49.	University of Franche-Comté	1691	4	0			
51.	University of Halle	1694	4	141			
52.	University of Breslau	1702	4	72			
53.	University of Göttingen	1734	1	1740			Ebel 1962
54.	Theol. fac. Fulda	1734	4	17			
55.	University Erlangen-N.	1743	1	733			Wedel-Schaper and Wittern 1993; Wachter 2009; Ley and Wittern-Sterzel 1999
56.	TU Braunschweig	1745	1	520			Gundler 1991; Albrecht 1986
57.	University of Bützow	1760	3	31	x		
58.	TU Freiberg	1765	1	110			Schleiff, Volkmer, and Kaden 2015
59.	TU Berlin	1770	4	3			
60.	University of Münster	1771	4	53			
61.	TU Clausthal	1775	1	146	x		Müller 1999; Valentiner 1925
62.	University of Bonn	1777	4	99			
63.	Karl's High School Stuttgart	1781	3	37	x		
Universities in the Netherlands							
27.	Leiden University	1575	1	681			*Leidse Hoogleraren vanaf 1575*
31.	University of Franeker	1585	2	151	x		Napjus and Lindeboom 1985; Feenstra 2003
34.	University of Groningen	1614	1	443			*C. P. Academiae Groninganae*
41.	University of Amsterdam	1632	1	551			*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	19	x		

** Most observations are included in University of Rinteln, because of a joint source.

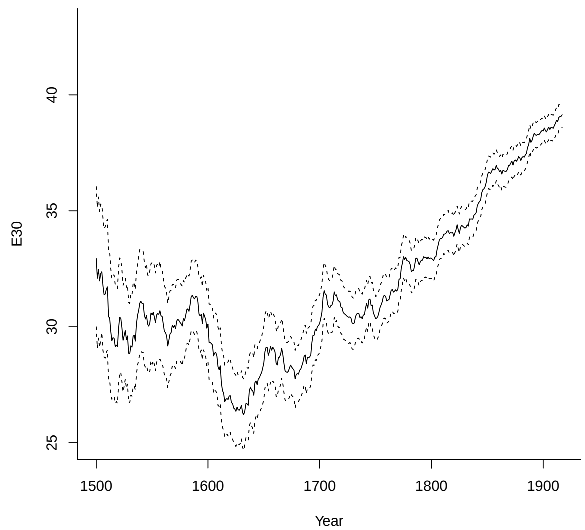
No.	Academy		Year	Cat.	Obs.	Wiki	Reg.	Books
Academies of sciences								
64.	Leopoldina		1652	1	4886		x	
65.	Berlin-Brandenburg	(BBAW)	1700	1	2481		x	
66.	Göttingen	(AdW)	1751	1	1849			Krahnke 2001
67.	Erfurt		1752	1	1968			Kiefer 2004
68.	München	(BADW)	1759	1	2568		x	
69.	Mannheim		1763	3	47	x		Eid 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 *Wiki* indicates if at least some observations are found by means of Wikipedia. *Reg* characterizes sources from official registers provided by the academy. Appendix A.6 provides an overview on links to included online professor catalogs.

A.2 Sensitivity checks

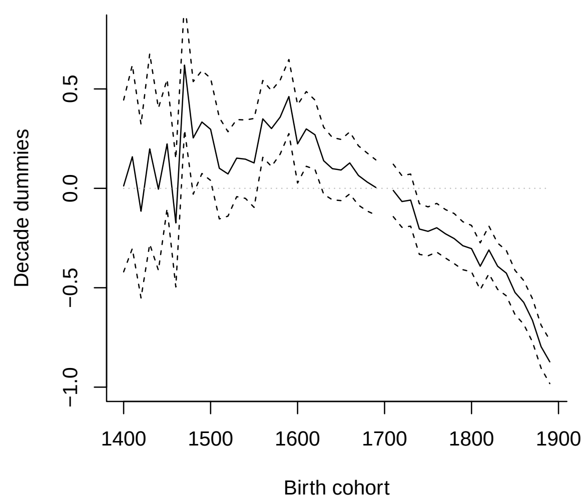


(a) Non-smoothed cohort life expectancy



(b) Non-smoothed period life expectancy

(c) Poisson estimations of life expectancy



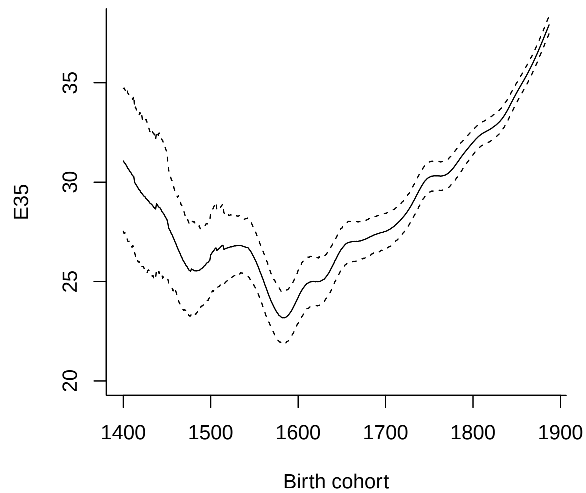
(d) Discrete time Survival model

Fig. 7. Sensitivty checks on dynamics of life expectancy at age 30.

Fig. 7a and b apply non-smoothed 25-years rolling intervals for birth cohorts and periods, respectively. Fig. 7c applies Poisson estimations of life expectancy in 25-years rolling intervals for birth cohorts. Fig. 7d plots decade dummies from our discrete time survival model with institutional dummies and 1700-1709 as reference decade. Dashed lines in Fig. mark 95% confidence intervals.

A.3 Life expectancy the conditional age

(a) Cohort life expectancy at age 25



(b) Cohort life expectancy at age 35

(c) Cohort life expectancy at age 45

(d) Cohort life expectancy at age 55

Fig. 8. Dynamics of life expectancy at various ages

Fig. 8 applies two-dimensional smoothed 25-years rolling intervals for birth cohorts. Dashed lines mark 95% confidence intervals.

A sufficiently large population at risk is required to obtain convincing estimations of life expectancy $E_{x,t}$. A potential approach to determine 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:

$$argmin_x\{\frac{1}{T}\sum_t^T \frac{CI^{\text{high}}_{x,t} - CI^{\text{low}}_{x,t}}{E_{x,t}}\}, \tag{4}$$

with T as the number of 25-years rolling time intervals. The initial period 1400 covers all cohorts born in 1388–1412 and the last one 1875–99. The rare and scattered observations before 1388 are neglected. Hence, we choose the age x that minimizes the relative average 95% confidence interval. Proceeding in five year age steps, this procedure leads to age 30. In addition to the baseline age 30, presented in Section 3, Fig. 8 illustrates mortality dynamics for life expectancy conditional to age 25, 35, 45 and 55.

A.4 Discrete Time Survival Estimations

A.4.1 Academic careers and recoding of the data set

To estimate discrete time survival models, we first need to reorganize our data set to record one row per person-year. Arising data issues, for instance due to gaps or overlaps in observed biographies, we handle by approximating the timing of events according to the strategy illustrated in Figure 9. We plot Karl Christian von Langsdorf as an example. Born in 1757, we observe his first nomination at age 23 from the Academy of Sciences in Erfurt. As memberships in academies generally lasted throughout life, each nomination, marked by a gray solid line, added an additional institution to his activities. At his age of death, he was active in four academies. By contrast, at each point in time scholars were not active in more than one university. At age 24 von Langsdorf was nominated at University of Gießen. For simplicity, we then assume that employments at universities persisted until the next observed nomination. Von Langsdorf, for instance, left Erlangen at age 47 and started two years later in Heidelberg. These two years are still taken into account as years under risk at University of Erlangen (marked by dashed line). This assumption is important when it comes to the end of life. Not everybody, like von Langsdorf, was active at a university until his death. To avoid that a crucial number of deaths are not linked to a university the last one always covers the event. Hence, in each point in time a scholar is related to one (or none) university, but might have in addition several memberships in scientific academies.[24]

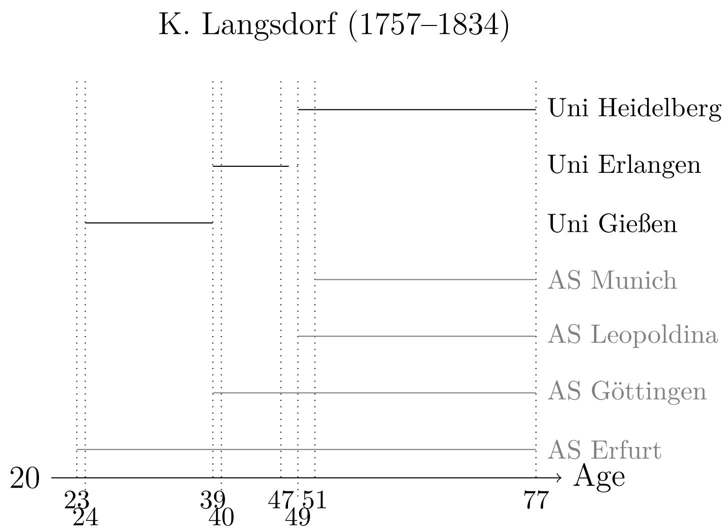
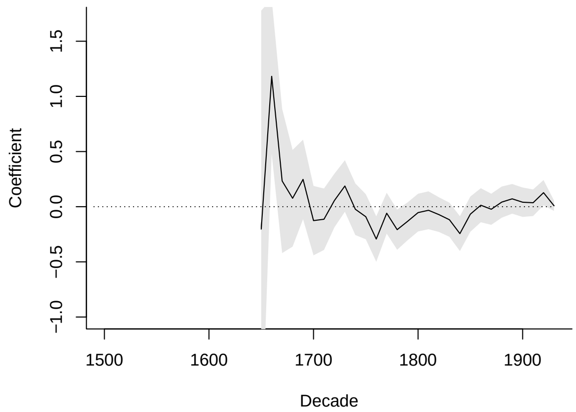


Fig. 9. An example for the timing of events

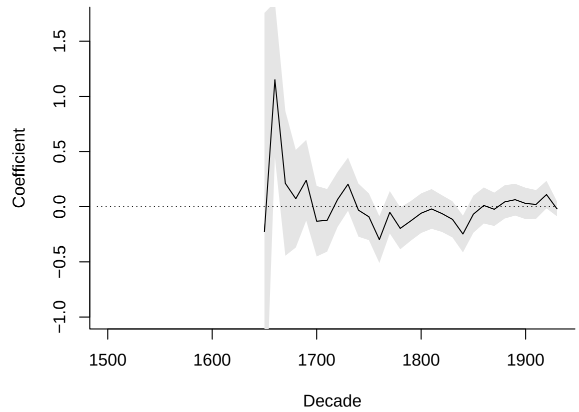
A.4.2 Discrete time survival model with interacted dummies

Fig. 10 displays findings from the discrete time survival models outlined in Section 4 in six different specifications. On the top, we only include memberships in scientific academies in the estimations to identify the differential mortality linked to social status. In the middle, we replace the interacted academy-decade dummies by interacted medicine-decade dummies. As a non-negligible share of scholars in academies belonged to the medical profession, the majority of members in the *Leopoldina* for instance has a background in natural science or medicine, we jointly estimate a model with interacted academy-decade and medicine-decade dummies with scholars without a membership in an academy of sciences from other than the medical field as the reference group. Findings on the social status are rather robust across the alternative models. The coefficients are always negative in the period 1750 to 1850 indicating the mortality advantage. However, the coefficient on the mortality disadvantage of the medical profession is stronger in the joint estimation of social status and medical profession. This might be explained by the fact, that the higher social status of the medical profession with a membership in an academy of sciences partially counterbalances the mortality disadvantage of the medical profession in general.

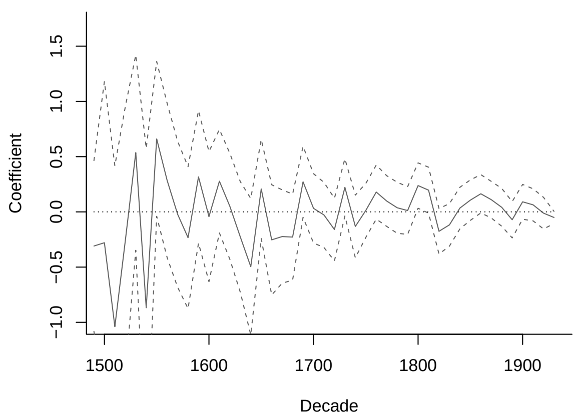
[24] For a very limited number of observations, professors stayed for less than one year at a university. Albert Döderlein e.g. taught since 1888 in Leipzig. In 1897, he moved as ordinary professor to Groningen. However, University Tübingen already nominated him in the same year. In this case, the person-year in 1897 is only considered at University of Tübingen.



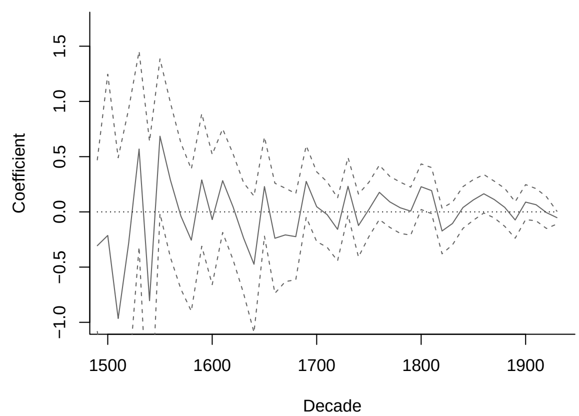
(a) Impact of social status



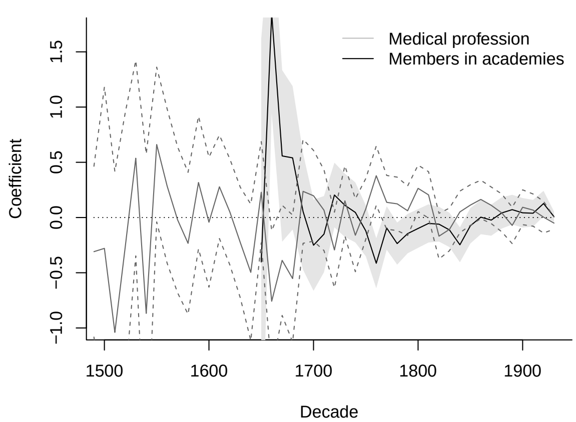
(b) Impact of social status (with institutional dummies)



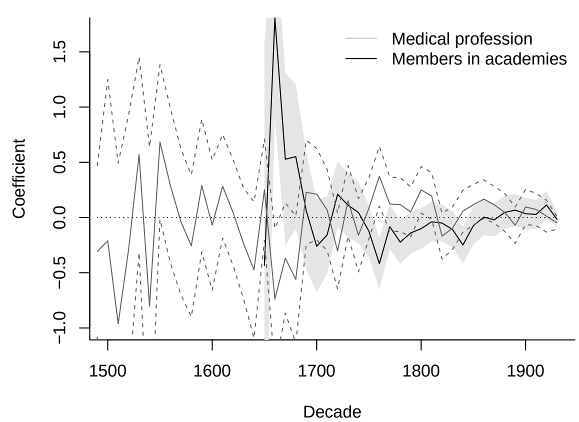
(c) Impact of the medical profession



(d) Impact of the medical profession (with institutional dummies)



(e) Impact of social status and medicine



(f) Impact of social status and medicine (with institutional dummies)

Fig. 10. Findings on the impact of medicine and social status on mortality

A.4.3 Estimation results from discrete time survival models with polynomial splines

Variable	Model 1		Model 1a		Model 2		Model 2a	
Intercept	-7.8964	***	-7.921	***	-7.8954	***	-7.8912	***
Age	0.0771	***	0.0781	***	0.0770	***	0.0779	***
$(1500, 1600)$	0.5293		0.5554		0.5766		0.6011	
$(1500, 1650)$	0.3112		0.3709		0.2752		0.3387	
$(1500, 1700)$	0.3165		0.2363		0.3033		0.2317	
$(1550, 1750)$	0.6540	*	0.6400	*	0.6784	**	0.6654	*
$(1600, 1800)$	0.2778		0.2179		0.2751		0.2221	
$(1650, 1850)$	0.2626		0.2083		0.2855		0.2309	
$(1700, 1900)$	0.0329		0.0137		0.0713		0.0315	
$(1750, 1930)$	-0.1768		-0.2447		-0.0524		-0.1327	
$(1800, 1930)$	-0.1986		-0.2567		-0.3500		-0.4189	
$(1850, 1930)$	-0.3337		-0.3935		-0.2963		-0.3502	
$(1900, 1930)$	-0.4513	.	-0.5141	*	-0.6148	*	-0.6744	*
Acad$(1650, 1850)$					-0.1524		-0.1621	
Acad$(1700, 1900)$					-0.1043		-0.0775	
Acad$(1750, 1930)$					-0.1661	.	-0.1808	.
Acad$(1800, 1930)$					0.1822	.	0.1979	.
Acad$(1850, 1930)$					-0.0434		-0.0654	
Acad$(1900, 1930)$					0.2570	**	-0.2432	*
Med$(1500, 1600)$					-0.5317		-0.4597	
Med$(1500, 1650)$					0.3747		0.3729	
Med$(1500, 1700)$					0.0878		0.0424	
Med$(1550, 1750)$					-0.1755		-0.1375	
Med$(1600, 1800)$					0.0063		-0.0298	
Med$(1650, 1850)$					0.1197		0.1273	
Med$(1700, 1900)$					0.1626		0.1203	
Med$(1750, 1930)$					-0.0515		-0.0266	
Med$(1800, 1930)$					0.1590		0.1320	
Med$(1850, 1930)$					-0.0391		-0.0330	
Med$(1900, 1930)$					0.0628		0.0561	
Institutional dummies			x				x	

$Pr(>|z|)$. < 0.1, * < 0.05, ** < 0.01, *** < 0.001

Table 3: Discrete time survival models with polynomial splines

A.5 Acknowledgements

The data collection greatly benefited from all the universities that were willing to share their professor catalogs with us: University of Amsterdam (album acaemicum), University of Groningen (catalogus professorum academeiae groninganae), Leiden University (leidse hoogleraren vanaf 1575), University of Leipzig (catalogus professorum lipsiensis), University of Marburg (catalogus professorum academiae marburgensis), University of Rostock (catalogus professorum rostochiensium) and University of Utrecht (catalogus professorum academiae rheno-traiectinae). We also deeply acknowledge the data on members provided by the following academies of science: the Academy of Sciences and Literature in Mainz, the Bavarian Academy of Sciences and Humanities, the Berlin-Brandenburg Academy of Sciences and Humanities, the Heidelberg Academy of Sciences and Humanities, the Leopoldina and the Saxon Academy of Sciences. Furthermore, we are thankful to Dagma Drüll and Tino Fröde for sharing with us additional material and their knowledge in supplement to their published works on the University of Heidelberg and the Upper Lusatian Academy of Sciences, respectively, to Tino Steyer for providing the data on the University of Helmstedt, to the members of the working group on the Kiel professors for sharing their work in progress, to the Göttingen Academy of Sciences and Humanities and the Royal Netherlands Academy of Arts and Sciences for sending us books with the available data and to all the others who provided us with valuable information and input in the process of data collection. Finally, we thank Julie Duchêne and Guillaume Catoire for their help in building the database for Louvain and we are deeply grateful for the patient support of Annika Onemichl in the process of gathering and cleaning the data.

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A.6 Online professor catalogs

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	http://www.uni-kiel.de/cpc/
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/

Table 4: Overview on online available Professor catalogs