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Research Paper

Academic human capital in European countries and regions, 1200–1793

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ABSTRACT

We present new annual time-series data on academic human capital across Europe from 1200 to 1793, constructed by aggregating individual-level measures at three geographic scales: cities, present-day countries (as of 2025), and historically informed macro-regions. Individual human capital is derived from a composite index of publication outcomes, based on data from the *Repertorium Eruditorum Totius Europae* (RETE) database. The macro-regional classifications are designed to reflect historically coherent entities, offering a more relevant perspective than modern national boundaries. This framework allows us to document key patterns, including the Little Divergence in academic human capital between Northern and Southern Europe, the effect of the Black Death and the Thirty Years' War on academic human capital, the respective contributions of academies and universities, regional inequality across Catholic and Protestant areas of the Holy Roman Empire, and the distinctiveness of the Scottish Enlightenment.

1. Introduction

The systematic collection and analysis of macroeconomic data for Medieval and Early Modern Europe is still in its infancy. A fundamental contribution was made by Maddison (2007), who provided pioneering cross-country estimates of population and GDP per capita over long historical horizons. Building on his work, the inauguration of the Maddison Project aimed to refine these historical national accounts (Bolt and van Zanden, 2025). Similarly, scholars such as Fouquet and Broadberry (2015) have constructed annual GDP per capita series for several European countries, thereby improving the temporal resolution and accuracy of long-run economic comparisons. More recently, the focus has changed to using large-scale data from online libraries, encyclopedias, and catalogs to produce macroeconomic estimates, marking a new phase of cliometric research (Chaney, 2020; Koch et al., 2024; Boerner et al., 2025).

A big part of the debate about preindustrial growth hinges on the possibility to measure the production factors. In preindustrial economic history, human capital has often been overlooked, primarily due to a lack of sufficient data. This paper fills this gap by providing new microdata on upper-tail human capital in the preindustrial period. We introduce a novel data source that can underpin future analyses of the long-run dynamics and the economic role of human capital in preindustrial economies. A key contribution of

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this paper is that data on academic human capital, aggregated by modern-day country (as of 2026), city, and historically relevant macro-region, are made publicly available; the full list of available files is provided in Appendix E.

Theories such as Galor (2011) view long-run development as a discrete sequence of growth regimes, with human capital playing a central role only in the final stage. This stylization is analytically useful as it distills the journey of humanity into a finite number of stages, but it understates the role of human capital before the Industrial Revolution. In fact, human capital accumulation was already underway in the preindustrial era—as documented by a growing cohort of scholars, including Boucekkine et al. (2002), Squicciarini and Voigtländer (2015), and de Pleijt (2018).

Over the past decade, contributors to RETE, the *Repertorium Eruditorum Totius Europae*, have systematically recorded individual-level data on library footprints for the entire population of university professors and members of scientific academies across Medieval and Early Modern Europe. In this paper, we develop an index of academic human capital based on scholars' productivity and other meaningful attributes, exploiting the new elements introduced in the most recent update of the Virtual International Authority File (VIAF). We aggregate these data by city, country, and macro-region. Macro-regions are defined based on different historical academic traditions, ethnolinguistic divisions, religious affiliations, and political boundaries. By using this regional structure we document several salient patterns discussed in the literature: the Little Divergence between Northern and Southern Europe; the impact of two major negative shocks, namely the Black Death and the Thirty Years' War; the respective roles and complementarities of universities and academies; regional disparities within the Holy Roman Empire; and the intellectual distinctiveness of the Scottish Enlightenment. That our data reveals such patterns suggests that academic human capital may have played a meaningful role in shaping these historical outcomes. A more systematic exploration of these relationships is left to future research.

Most existing time series data on human capital rely on macro-level proxies – such as literacy rates (Cressy, 1977; Boucekkine et al., 2007), average years of schooling (de Pleijt, 2018), heaping indexes (A'Hearn et al., 2009), skill premium (Lindert et al., 2002; van Zanden, 2009), and book production (Baten and van Zanden, 2008; Buringh and van Zanden, 2009) – which, although valuable, offer only coarse approximations of the central tendency of an underlying distribution. By contrast, our dataset is constructed from individual-level observations; in fact, universities and academies are among the few educational institutions for which an identifiable set of individuals can be reliably reconstructed over the entire preindustrial period. This granularity increases the framework's versatility and opens up new research questions on the cross-sectional distribution of preindustrial human capital. Therefore, RETE represents the first attempt to provide micro-level data on preindustrial human capital, offering a degree of detail that, to the best of our knowledge, is unprecedented.

We focus on the interval from 1200 to 1793, covering the institutional consolidation of medieval universities up to the outbreak of the French Revolution. However, our original dataset spans the period from 1000, when monastic and cathedral schools dominated the academic landscape, to 1800. In fact, the French Revolution marked a decisive break in the history of higher education: the revolutionary Convention abolished all universities and academies in France, a policy that was subsequently exported to neighboring regions through military conquest. To avoid conflating structural trends with the effects of this exceptional political upheaval, we exclude the period 1793–1800 from our analysis.

Unlike the top-down approach which consists in going from an encyclopedia or database to disaggregated data, our strategy is bottom-up: we begin with specialized secondary sources on universities and academies and aggregate the information from the ground up. This method helps reduce the selection bias inherent in encyclopedic compilations (de la Croix and Licandro, 2015; Laouenan et al., 2022; Serafinelli and Tabellini, 2022; Koch et al., 2024). In contrast to authors who start from library catalogs (Chaney, 2020), our approach offers the additional advantage of clearly defining a universe – academia – from which a large, coherent sample is drawn. We focus primarily on scholars, deliberately excluding lovers, poets and preachers (although occasionally some academy members fall into these categories).

Our dataset captures a substantial share of highly skilled individuals who were involved in producing propositional knowledge, including theologians, lawyers, humanists, physicians, and scientists. Although some doctrines from this period – such as Aristotelian physics – are now regarded as obsolete, these scholars laid the foundations of modern thought. Additionally, they were instrumental in training professionals who were essential to early modern society, such as parish priests, notaries, schoolteachers, doctors, and astronomers. By including members of academies, we also incorporate those who applied new intellectual frameworks from the Scientific Revolution and Enlightenment.

The *Repertorium Eruditorum Totius Europae* relies on a large and diverse set of secondary sources. References are available for each individual observation on the project's website at https://perso.uclouvain.be/david.delacroix/menushiny.html. The dataset is still expanding as new sources are analyzed daily, but version 1.1 – containing 88,000 scholars, 375 institutions, and 684 sources – already provides a sound approximation of academic human capital in Medieval and Early Modern Europe.

In the next section we introduce our measure of human capital, derived from data on university scholars and academicians. In Section 3 we outline our aggregation strategy and the levels of geographical resolution. Next, in Section 4 we present the macro-regional classification that serves as the primary analytical framework. Then, in Section 5 we document the main empirical patterns revealed by the data. Finally, in Section 6 we present our concluding remarks and directions for future research.

2. Measuring individual human capital

Measuring human capital presents inherent challenges due to its intangible nature (Hanushek, 1996; Abraham and Mallatt, 2022). This difficulty is amplified when attempting to quantify the human capital of scholars, particularly in premodern historical contexts. While wages are a standard proxy in labor markets, there are major limitations to this approach in our case. Salary data are often scarce, incomplete, or entirely missing. Compensation varied widely—ranging from student payments and in-kind benefits (e.g., rent,

wine, and grain (Drüll, 1991)) to fixed salaries vulnerable to external shocks. Theology professors, in particular, were often unpaid and instead received prebends (a type of benefice or stipend associated with duties in a cathedral or collegiate church) outside the university (Post, 1932; Paquet, 1958). We elaborate on these challenges and our wage dataset in de la Croix et al. (2024b).

As an alternative, we measure human capital by individual notability as observed today in three contemporary sources, VIAF,[1] Wikipedia, and Wikidata. VIAF contains a broad array of bibliometric indicators of scholarly output and impact, incorporating both authored works and secondary literature about the individual. Wikipedia complements this measure by highlighting forms of "service to society", such as becoming an ambassador, pope, or saint. Initially proposed by de la Croix et al. (2024a) using WorldCat Identities (now defunct) and Wikipedia, this approach was later extended to VIAF by Curtis and de la Croix (2023). In this paper, we further improve the measure by incorporating on new information from the latest update VIAF, in particular that concerning the timing of publications. We also incorporate into the analysis data drawn from Wikidata. Wikidata is a knowledge base run by the Wikimedia Foundation that stores structured data (facts) about people, places, works, and concepts. It acts as a central hub across Wikipedia and other projects. For us, it presents two advantages. It includes some authors present in national biographies (such as Treccani) who are not present in Wikipedia or VIAF. It also lists "occupations", allowing to better account for public services and offices undertaken besides academia.

Among all Wikipedia editions, the English-language version is the oldest, largest, and most widely accessed.[2] Its accuracy compares favorably with more traditional encyclopedias (Giles, 2005). However, Wikipedia is created by volunteer editors, a self-selected population. The existence, length, and content of articles about a historical person will be shaped by which editors are interested in that individual. There are often concerns that coverage may be biased towards English-speaking individuals. One way to address this bias is including other language editions.[3] Including, for example, the French edition increases the coverage of less notable French individuals (Laouenan et al., 2022).[4] Another source of regional bias is historiographic: the quality and accessibility of the source material available to editors may vary by the region and period (De Courson et al., 2023).[5]

To combine the information provided by VIAF, Wikipedia, and Wikidata into one measure, we compute the first principal component of the following indicators:

1. the number of characters of the longest Wikipedia page across all languages (ranging from a minimum of 60 to 261,408); a correction for different languages length was performed, using the length of the Gospel according to Saint Mark in different languages; we have also assumed that having no Wikipedia page is the same as having a very short page of 60 characters, which is a meaningful normalization;
2. the number of languages in which a Wikipedia page exists (ranging from a minimum of 1 to 219);
3. the number of publication countries in VIAF (ranging from 0 to 82);
4. the number of different publishers recorded in VIAF (ranging from 0 to 33);
5. the number of titles in VIAF (ranging from 0 to 788);
6. the number of coauthors in VIAF (ranging from 0 to 43); we do not believe the list of coauthors are all actual coauthors, but rather names appearing on the publication, such as censor, dedicatee etc;
7. the number of publications with ISBN number (ranging from 0 to 2784); this reflects the recent importance of the publications as ISBN numbers (International Standard Book Numbers) were invented in 1966 and formally implemented in 1970;
8. the number of publications before 1900 (ranging from 0 to 10708); this sums the publications by decade indicated in the histogram provided by VIAF; remark publications and titles are two different measures in VIAF;
9. the number of publications after 1900 (ranging from 0 to 7307) from the same histogram;
10. the number of external identities in Wikidata, taking into account references in encyclopedia other than Wikipedia (ranging from 0 to 327);
11. the number of occupations in Wikidata, taking into account public services/offices undertaken besides academia (ranging from 0 to 24).

One advantage of combining multiple variables to construct the Human Capital Index, q_i, is that it helps to mitigate distortions inherent in any single source. For instance, including Wikipedia data can offset the bias whereby affiliation with a prestigious institution increases the likelihood of titles appearing in VIAF regardless of individual merit.

[1] "The VIAF (Virtual International Authority File) combines multiple name authority files into a single OCLC-hosted name authority service. The goal of the service is to lower the cost and increase the utility of library authority files by matching and linking widely-used authority files and making that information available on the Web". From https://viaf.org/.

[2] https://en.wikipedia.org/wiki/List_of_Wikipedias.

[3] This also leads to a male bias, a Western bias, and an interest in technical and academic subjects (Yu et al., 2016). While an important limitation of Wikipedia data, these biases are less relevant here as we are explictly interested in European academics, who in this period are overwhelmingly male (de la Croix and Vitale, 2023).

[4] However, depending on the application, this does not always appear to be necessary Koch et al. (2024).

[5] Depending on the application, inclusion of time and location fixed effects may help improve analyses based on wikipedia data (Serafinelli and Tabellini, 2022).

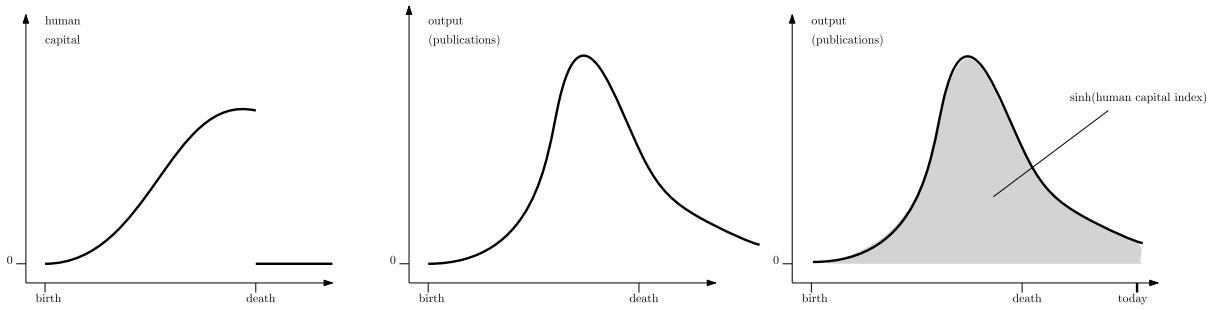


Fig. 1. From human capital to publications, and to the human capital index.

A conceptual issue in measuring human capital is the highly skewed distribution of the indicators discussed above. These measures have fat tails due to the presence of "superstars"—scholars with far more publications and much longer Wikipedia pages than their peers. Consider François Arouet de Voltaire (1694–1778), a towering Enlightenment figure, elected to the Académie française in 1746 and a lifelong advocate of reason, civil liberties, and free speech. Voltaire has 396 recorded titles, and his longest Wikipedia page contains 120,896 normalized characters. Compare this with Charles Batteux (1713–1780), a respected but less famous Enlightenment thinker. A member of the Académie française (elected 1754) and professor at the Royal College (now Collège de France), Batteux also advanced Enlightenment ideals through his commentaries on classical philosophy, especially Aristotle. Yet he has only 54 recorded titles, and his longest Wikipedia page contains 5645 normalized characters. Is it plausible that Voltaire's human capital was over ten times greater than Batteux's?

This is related to the economic theory of superstars (Rosen, 1981), where rewards are modeled as a convex production function of talent, disproportionately favoring top performers. If we treat publications or Wikipedia length as rewards and talent as human capital, this implies that human capital should be a concave function of these metrics: small differences in human capital may yield large disparities in observable output, particularly at the top. Conversely, modest increases in skill at lower levels may not translate into proportionate gains in visibility or productivity.

We thus interpret the variables from Wikipedia, VIAF, and Wikidata as reward-based measures that are heavily skewed towards the upper tail of the distribution. We apply a concave transformation to all variables, namely the inverse hyperbolic sine (asinh), before conducting the principal component analysis. We interpret such transformation as the inverse of a production function spanning from a space of cognitive and behavioral skills to a space of outputs; where by "outputs" we mean the dimensions of the PCA. Such a transformation enables to easily deal with scholars without any bibliographic information, unlike e.g. the logarithmic operator.

A second conceptual issue is the following. We measure human capital as a life-cycle invariant variable: an index built from scholarly output summed over an entire lifetime. This is shown in Fig. 1. The left panel represents the standard notion of human capital, as defined by Becker (1964). When the scholar dies, their human capital is lost and goes to zero. The middle panel represents the number of surviving publications (net of the depreciation due to poor archival work or natural disasters), some of which are published when the scholar is still alive, while others are postmortem publications. They are produced by human capital but with a delay, and some publications are printed only after death. The area under the curve in the right panel shows our empirical object: the cumulative stock of surviving publications. For illustrative purposes, we assume that q_i is built using only one dimension, i.e. surviving publications, so that the area under the curve equals $\sinh(q_i)$.

Hence, in technical terms, what we label human capital index is a transformation of the cumulative outputs produced during lifetime and beyond. In a historical setting like ours, allowing for age variation creates severe measurement challenges. Constructing an age-varying measure would require reliable information on the timing of first editions, which in turn would require a much richer integration of library records than VIAF currently provides. The problem is even more acute for medieval scholars, for whom dating individual manuscripts is often difficult or impossible. Moreover, a time-varying index would force us to allocate posthumous visibility to particular career stages and to impose largely untestable assumptions about the depreciation of scholarly skills. Dropping the posthumous component would discard a substantial share of the available information, especially for earlier scholars.

Going back to the PCA analysis, Table 1 presents the loadings of the first two principal components derived from the transformed variables. Following the common eigenvalue-greater-than-one heuristic, only the first component qualifies as statistically relevant: it has an eigenvalue of 8.49 and explains 77% of the total variance. In this component, all the measures drawn from Wikipedia and VIAF enter positively with relatively similar loadings of around 0.3. We interpret this component as a summary index of a scholar's human capital and use it throughout the analysis. Despite its lower eigenvalue (0.91) and modest explanatory power (8%), the second component reveals an interesting pattern. It loads negatively on indicators related to recent international reach and digital visibility, such as the number of Wikipedia language editions and ISBN counts. We return to this component later.

On the basis of the first principal component, we can compute our Human Capital Index q_i, as:

$$q_i = -1.38 + 0.31\ LengthWikiN + 0.29\ NWikiLanguage + 0.36\ countries + 0.36\ publishers + 0.36\ titles + 0.35\ coauthors$$

Table 1
First two principal components of the indicators.

Variable (in asinh)	PC1 (q_i)	PC2 (p_i)
Wikipedia: No. characters of longest page (*LengthWikiN*)	0.29	−0.02
Wikipedia: No. pages in different languages (*NWikiLanguage*)	0.26	−0.46
VIAF: No. publication countries (*countries*)	0.32	0.04
VIAF: No. different publishers (*publishers*)	0.32	0.24
VIAF: No. titles (*titles*)	0.33	0.20
VIAF: No. coauthors (*coauthors*)	0.32	0.27
VIAF: No. isbn (*isbn*)	0.23	−0.66
VIAF: No. publications before 1900 (*pubbef1900*)	0.32	0.18
VIAF: No. publications after 1900 (*pubaft1900*)	0.29	−0.34
Wikidata: No. of identities/external ids (*nidentities*)	0.32	0.17
Wikidata: No. of occupations (*noccupations*)	0.30	0.10
Eigenvalue	8.49	0.91
Proportion of Variance explained	0.77	0.08

Note: all variables transformed with inverse hyperbolic sine.

$$+0.27\ isbn + 0.36\ pubbef1900 + 0.33\ pubaft1900$$
$$+0.3\ (nidentities) + 0.3\ noccupations \quad (1)$$

In this equation, the constant term was chosen to give $q_i = 0$ for someone with neither a Wikipedia page, nor a VIAF page, nor a Wikidata page.

To discuss further the merits and drawbacks of using q_i, let us consider the scholars at the top of the distribution. Table 2 provides the list. All periods and many regions of Europe are represented. Different types of institutions are also present (Universities, Renaissance academies, Scientific academies). The scholar with the all-time highest human capital is Martin Luther, professor at the university of Wittenberg. He was not a scientist like Galileo Galilei, Isaac Newton, or Carl Linnaeus, but it is fair to recognize that he profoundly influenced institutional changes in Europe (Becker et al., 2020). Next comes François Arouet de Voltaire, the prolific French philosopher, member of many academies in the 18th century. At the third place, we find Thomas Aquinas, the medieval theologian, professor at the Universities of Paris and Naples. The first scientist is René Descartes, who was a member of the informal Mersenne academy in Paris.

In the list of Table 2, there are some scholars who only have a weak link to our selected institutions. Jean-Jacques Rousseau is only weakly attached to the Academy of Sciences and Arts of Dijon. Jeremy Bentham is weakly attached to the university of Oxford (student, but teacher?). Further below, the famous French poet François Villon, ranked 76th, received a master from the University of Paris, so he could have taught in principle, but probably never did. There are also some who were actual teachers but are better known, at least nowadays, for non-scholarly reasons: François Rabelais, known for his novels, was also a physician who taught at Montpellier; Friedrich von Schiller, a German poet and professor at the University of Jena, also falls into this category.

Our ranking of human capital is very much in line with other rankings in the recently published databases of Schich et al. (2014) and Yu et al. (2016) which use recent data on the scientific impact and the influence of scholars. All three are built from a contemporary point of view. Some scholars gained recognition through postmortem publications, while others may have been highly esteemed in life, yet their work did not survive and they are now entirely forgotten.

A related question concerns the relation between longevity and our q_i. Regressing q_i against longevity in logs with decade fixed effect, we find a positive and statistically significant correlation (2.18694 (SE: 0.07679)). This may reflect both a mechanical effect (longer life implies more time to write and publish) and an incentive effect à la Ben-Porath (1967) (longer life implies higher return to investment in human capital). The non-stationary nature of longevity over the long run certainly increases our estimates of q_i for the most recent scholars.

One final remark before moving to the second principal component. The human capital index we built is based on digitally-native sources, Wikipedia and VIAF, which are regularly updated. Wikipedia pages can change every day based on the work of those who collaborate to the project. VIAF is periodically altered as well, for example whenever a new library joins the system.

As reported above, the second principal component loads negatively on indicators related to recent digital visibility (Wikipedia, ISBN, and publications after 1900) relative to the other measures which enter positively. With this component we can build a Faded Fame Index p_i. Scholars with a high p_i are those with a large number of titles and many publishers and publications before 1900, but no Wikipedia page, no publications after 1900, and no ISBN. They did a lot but were forgotten. We further explore this index in Appendix B.

3. Aggregation

Aggregating human capital involves grouping universities and academies into defined sets for which we compute totals. We propose three main approaches to aggregating our individual-level data. First, by city of activity, allowing users to further aggregate data as needed. Second, by grouping institutions according to present-day national borders. Third, we offer alternative aggregations, called macro-regions, based on qualitative historical information about former states and their associated systems of higher education (see Section 4). For each of these aggregation levels, we provide four types of data.

Table 2
Top 64 academic scholars with their human capital index q_i.

#	name	institution	q_i	#	name	institution	q_i
1	Luther	U. Wittenberg	19.64	35	Jefferson	A. Edinburgh	16.85
2	Voltaire	15 academies	19.21	36	Swedenborg	A. Stockholm	16.81
3	Rousseau	A. Dijon	19.01	37	Llull	U. Paris	16.67
4	Aquinas	U. Paris	18.83	38	Schelling	U. Jena	16.65
5	von Schiller	U. Jena	18.81	39	Fichte	U. Jena	16.60
6	Kant	U. Königsberg	18.67	40	de Groot	A. Mersenne	16.59
7	Swift	A. Dublin	18.61	41	Rameau	A. Dijon	16.55
8	Diderot	A. Prussia	18.42	42	Kepler	A. Lincei	16.53
9	Erasmus	U. Louvain	18.39	43	Melanchthon	U. Wittenberg	16.50
10	Machiavelli	A. Plato	18.32	44	da Fidanza	U. Paris	16.47
11	Descartes	A. Mersenne	18.27	45	Rabelais	U. Montpellier	16.45
12	von Leibniz	4 academies	18.22	46	Hohenheim	U. Basel	16.45
13	La Fontaine	A. Française	17.85	47	Euler	8 academies	16.39
14	Lessing	A. Prussia	17.79	48	Wieland	A. Prussia	16.39
15	Calvin	U. Genève	17.78	49	Copernicus	U. Sapienza	16.37
16	Boccaccio	U. Florence	17.76	50	Wesley	U. Oxford	16.31
17	Petrarca	U. Florence	17.76	51	de Quevedo	A. Oziosi	16.29
18	Perrault	A. Française	17.71	52	Bentham	U. Oxford	16.28
19	Franklin	12 academies	17.70	53	de Cusa	U. Cologne	16.26
20	Linnaeus	U. Uppsana	17.68	54	Bruno	7 universities	16.26
21	Montesquieu	6 academies	17.50	55	Berkeley	U. Dublin	16.24
22	A. Humboldt	3 academies	17.44	56	Holberg	U. Copenhagen	16.24
23	Goldoni	A. Rovereto	17.40	57	Abélard	U. Paris	16.23
24	Hume	U. Edinburgh	17.38	58	Tasso	U. Ferrara	16.23
25	Locke	U. Oxford	17.36	59	Pope	A. Spalding	16.20
26	Newton	U. Cambridge	17.34	60	Burke	A. Edinburgh	16.20
27	Racine	A. Française	17.33	61	F. Humboldt	A. Erfurt	16.17
28	Pascal	A. Mersenne	17.30	62	Alberti	A. Plato	16.16
29	Galilei	U. Padua	17.30	63	d'Alembert	12 academies	16.15
30	Bacon	U. Cambridge	17.21	64	Cook	Royal Society	16.12
31	Corneille	A. Française	17.06	⋮	⋮	⋮	⋮
32	Hobbes	A. Mersenne	16.98				
33	Smith	U. Glasgow	16.96	27 645	Roero Di Piea	A. Turin	0.17
34	von Herder	A. Prussia	16.90	27 646	Ortiz	U. Vilnius	0.17

Note: q_i computed from Eq. (1). Only main institution is reported.

- Total human capital in universities. We sum individual human capital based on individuals' affiliations. In cases with missing end dates for affiliations, human capital is conservatively attributed only to the starting year to avoid over-counting. In each year, multiple affiliations across different universities are accounted for by attributing an equal share of the individual human capital to each institution. Individuals affiliated with both a university and an academy in the same year have their human capital attributed solely to the university. As a result, the human capital associated with academies is drawn from scholars exclusively affiliated with them.
- Number of universities. The list of universities, along with their respective years of establishment and closure, is based on Frijhoff (1996), with the addition of some other higher education institutions. See Appendix D for details.
- Additional human capital in academies. We sum the human capital of the scholars who only belong to academies. In the case of multiple affiliations to multiple academies, we allocate individual human capital across institutions with equal shares.
- Number of academies. The list of academies is based on The British Library (2021) for Renaissance universities and McClellan (1985) for the scientific academies of the 17th and 18th centuries. See Appendix D for details.

Our measure of human capital captures, by design, the upper-tail of the distribution. This should be seen as a complement to methods of measuring human capital at other parts of the distribution. For example, signature-based measures of literacy and age-heaping based measures of numeracy estimate basic levels of education (A'Hearn et al., 2009; Baten and Hippe, 2018), per-capita book consumption estimates advanced literacy skills (Baten and van Zanden, 2008; Buringh and van Zanden, 2009; de Pleijt and van Zanden, 2016), and historical occupational wages estimate skill premia (Williamson and Lindert, 1980; Goldin and Katz, 1999; Baten and Blum, 2011). For a detailed time-series comparison between q_i and several other measures of human capital, see Appendix A.

4. Definition of the macro-regions

To facilitate historical analysis, we complement modern country-based aggregation with an alternative classification into 18 macro-regions, shown in Fig. 2. These are defined to reflect long-term institutional, linguistic, religious, and political commonalities, offering a more coherent framework for studying the development of academic human capital between 1200 and 1793. To ensure

meaningful cross-regional comparisons, the boundaries of each macro-region are held constant over time. This approach facilitates the tracing of long-run patterns of continuity and divergence and avoids the complications arising from time-varying borders.

This macro-regional approach enables more meaningful comparisons of academic human capital across time and space, accounting for historically embedded patterns of governance, religion, and institutional development. It also avoids the pitfalls of imposing present-day national categories on premodern dynamics. We briefly describe them here, while more details are given in Appendix C

The delineation begins with the geopolitical situation in the aftermath of the Peace of Westphalia (1648), which ushered in a relatively stable territorial order in Europe. We define macro-regions by grouping modern administrative units (primarily NUTS-2 and NUTS-3 regions in their 2016 edition) into larger, historically coherent territories. For areas like Ukraine and Belarus, where the NUTS system does not apply, we rely on equivalent oblast-level units taken from Natural Earth (2023). We also used academic traditions, institutional typologies, linguistic boundaries, and religious affiliations to guide the grouping.

Several contrasting cases illustrate the relevance of this approach. In the British Isles, we distinguish Scotland from the "English Realms" (England, Wales, and Ireland). This reflects not only political autonomy but also clear institutional and religious differences. Scottish universities were Presbyterian after the Reformation. They were early adopters of Enlightenment ideals, offering broad curricula in science and philosophy (Mokyr, 2005, p. 311; Wood, 2006, pp. 191–194). By contrast, English and Irish universities were Anglican, and have traditionally been portrayed as more conservative institutions,[6] retaining a strong emphasis on the liberal arts and theology well into the eighteenth century (Schmitt, 1983, p. 40). The development of external academies, such as the Royal Society in London, partly compensated for this delay in university reform (Hunter, 1989).

In the Iberian Peninsula, we distinguish between Levante and Castilla, which align roughly with the historic territories of the Crowns of Castile and Aragon, respectively. This division reflects differences in language, academic institutions, and patterns of state centralization. While Spain had many universities, it had relatively few scientific academies, in contrast to Northern Europe. Though small in institutional numbers, Portugal maintained a distinct political and linguistic identity and is treated as a separate region (Disney, 2009).

France is divided into Francia and Occitania, following the historic langue d'oïl/langue d'òc boundary. This line reflects deep cultural differences, which were reinforced during the Reformation. Francia, in the North, was more integrated into centralized Catholic structures, while Occitania had more Protestant sympathies and a more fragmented institutional landscape (de Félice, 1853). This divide also mirrors Grendler (2004)'s typology of southern versus northern European universities: Occitania resembled the Italian and Spanish model with a focus on law and medicine, whereas Francia leaned towards theology and the arts.

Italy is split into Northern, Central, and Southern regions. Southern Italy largely corresponds to the territories of the Spanish-controlled Kingdoms of Naples, Sicily, and Sardinia. Central Italy aligns with the Papal States, where universities like Bologna and Rome were under strong ecclesiastical influence. Northern Italy was more politically fragmented and culturally diverse, with institutions like the University of Padua operating under relatively autonomous republics. The North played a leading role in fostering scientific academies and Renaissance scholarship (Maylender, 1930), while the South remained more centralized and doctrinal.

The Holy Roman Empire is divided into Evangelical Germania (the Protestant north) and Tridentine Germania (the Catholic south and center). This split captures the long-term impact of the Reformation and Counter-Reformation on academic structures. Protestant territories founded numerous new institutions, often closely tied to local rulers and reform movements (Hammerstein, 1996). Catholic regions, by contrast, relied heavily on the Jesuits and emphasized doctrinal control. This division is critical for understanding the confessional foundations of early modern knowledge regimes.

Other important macro-regions include the Netherlands, which emerged as a major intellectual and commercial hub in the seventeenth century, with Calvinist-leaning universities and a strong academic network; the Lotharingian corridor, a transitional region between France and Germany with dense academic activity and historical ties to the house of Burgundy and, later, the Spanish Habsburgs; and the Austrian Habsburg Lands, where university development followed a more centralized Catholic pattern, with strong Jesuit involvement (Grendler, 2019) and a late shift towards Enlightenment reforms under Maria Theresa.

We also identify Poland–Lithuania as a macro-region, encompassing a wide range of universities and academies in a decentralized but academically dynamic context, and with a strong Jesuit presence. Switzerland is treated as a distinct unit, with its patchwork of Protestant and Catholic cantons, each supporting their own academic institutions or relying on foreign universities (Zurbuchen, 2011; Neumann, 2014). Finally, we group the Kingdoms of Denmark–Norway and Sweden under Scandinavia, reflecting their shared Lutheran orientation and monarchical structures, which shaped a relatively homogeneous academic environment.

The presence on Wikipedia, VIAF, and Wikidata of our regions varies. Table 3 gives the percentage of scholars by region having a Wikipedia page and a VIAF page. The highest percentages are obtained in Protestant regions such as in Scotland, the Netherlands, Scandinavia, and Evangelical Germania. English Realmsis an exception, but the universities in this region include a very large number of short-term fellows whose footprints in libraries are small.

When we observe that fewer academic scholars have a Wikipedia page or a VIAF record, such as for example in Levante, Southern Italy, or Portugal, at least four explanations are possible.

First, scholars in that region may in fact be less productive, having written fewer works and attracted less attention.

[6] This view, supported by historians such as Hill (1965), Westfall (1980, 1971), Mokyr (2002, 2010), has been challenged by Feingold (1984) and more recently by Koschnick (2025), who question both the degree of conservatism and universities' role during the Scientific Revolution.

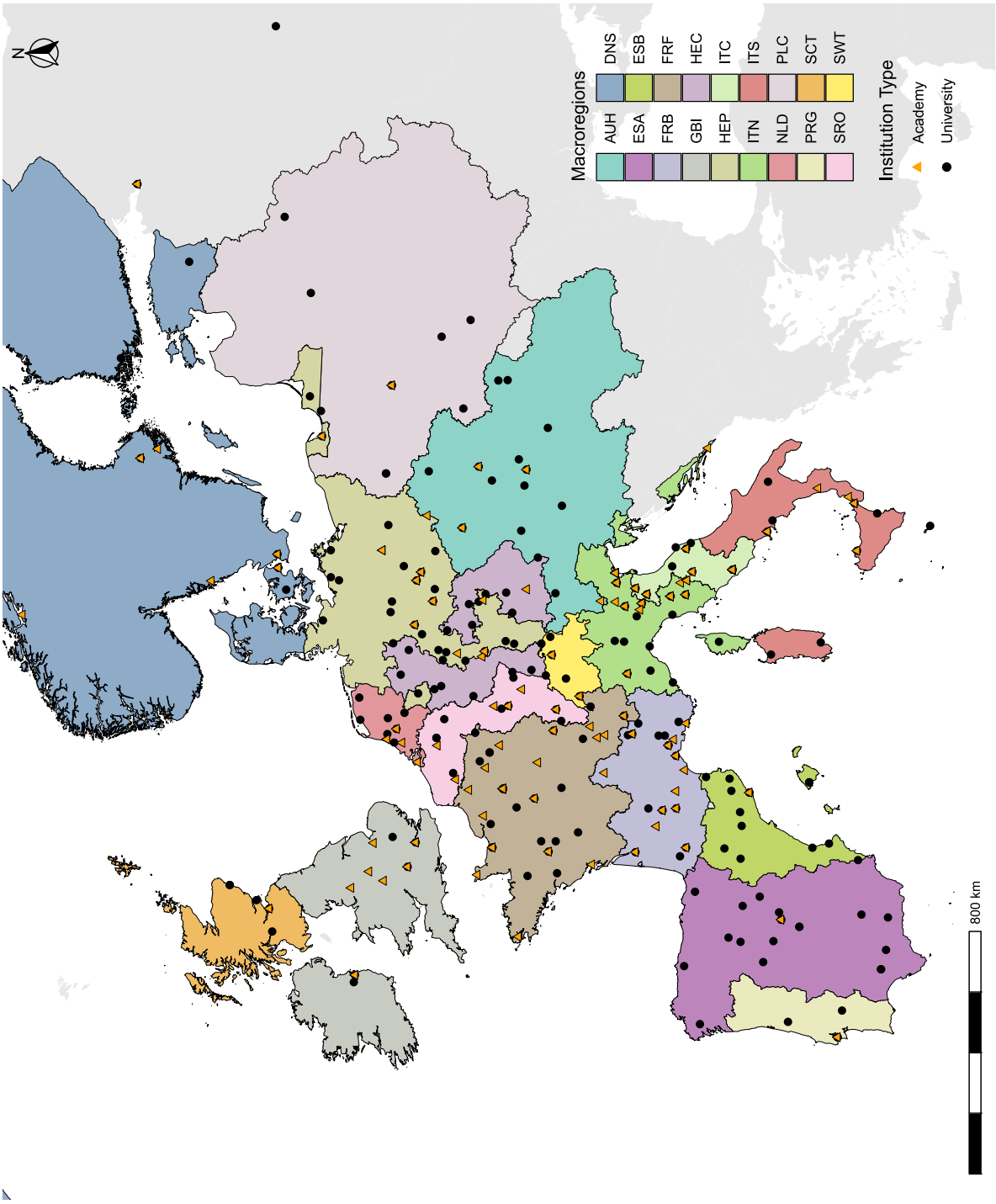


Fig. 2. Macro-regions.

Second, the quality and depth of the secondary sources used to construct our database may be higher for that region, so that we capture more minor scholars who held lower positions or were active only briefly. In that case, the share of scholars with a VIAF link is inversely related to the source quality.

Third, some regions may be simply less inclined to produce Wikipedia entries, or their libraries may maintain only partial catalogs of works. This can misleadingly suggest that scholars from that region were less active. Such biases may also appear from the way data are transmitted from the central bibliographic agencies of each country to VIAF. The quality and completeness of the

Table 3
Percentage of activities by region having a Wikipedia page and a VIAF page.

Region	No. scholars	% with Wikipedia	% with VIAF	% with Wikidata
Scotland	1092	53.57	54.4	56.23
English Realms	16 881	27.84	29.6	30.85
the Netherlands	2139	52.5	81.77	67.88
Scandinavia	2563	72.38	80.34	75.58
Evangelical Germania	8871	65.48	82.01	77.75
Tridentine Germania	7583	22.83	50.36	38.57
Poland–Lithuania	3730	18.28	36.01	26.76
Austrian Habsburg Lands	3865	25.05	39.79	35.99
Lotharingian corridor	3952	19.71	36.61	28.09
Switzerland	918	40.31	72.22	60.02
Francia	12 144	32.35	39.78	35.78
Occitania	5028	21	31.5	25.5
Southern Italy	2272	17.3	25.66	22.23
Central Italy	11 278	16.26	25.74	21.35
Northern Italy	13 851	20.24	31.23	27.39
Castilla	2222	12.11	17.33	14.54
Levante	4129	13.59	18.29	16.64
Portugal	2215	15.17	25.28	18.37
All	104 733	28.44	39.54	35.17

information available in VIAF ultimately depend on the capacity of national libraries to maintain, update, and regularly transmit their authority files. Since VIAF ingests data exclusively through these central institutions – rather than from individual libraries – any gaps, delays, or uneven coverage at the national level are directly propagated into VIAF's clustering process. This results in cross-country discrepancies, particularly for lesser-known individuals or for figures who are only marginally represented in their respective national catalogs. Including Wikidata helps to mitigate this bias, as it relies on a variety of sources independent from VIAF.

Fourth, there may be a compositional effect over time. If a region contributes relatively more authors from before the advent of printing, and if manuscripts are underrepresented in VIAF, then that region will systematically show lower VIAF coverage. Unlike the first three biases, this is a bias that we can measure by computing Table 3 on early modern data only (after 1517 for example) and comparing with the table on the full sample. For example, for Northern Italy, the number of observations drops from 13,874 to 10,343 when we exclude the medieval scholars. This barely increases the Wikipedia coverage (from 20.2% to 22.04%). The VIAF coverage increases a bit more (from 31.15% to 35.06%) but this is far from enough to explain the gap between Northern Italyand the Netherlandsfor example.

5. Reviewing some established facts

In this section, we highlight key patterns previously discussed in the literature that are observable in the human capital data. To facilitate meaningful cross-regional comparisons, we normalize aggregate human capital for each macro-region by the corresponding urban population in the same year. This approach captures the intensity of human capital rather than its absolute scale. Total urban population serves as a proxy for the overall size of the economy, so the index measures the degree to which the productive sector relies on human capital.

$$i_{m,t} = \frac{\sum_{i \in I_{m,t}} q_i}{\sum_{c \in C_m} p_{t,c}} \tag{2}$$

In Eq. (2), the numerator represents total human capital; it is the sum of the human capital of all the scholars, i, who are affiliated to an institution located in the macro-region, m, at time t, belonging to the set $I_{m,t}$. Unless stated otherwise, the human capital used to construct the index is the one related to both universities and academies. The denominator is the total urban population—the sum of the population of every city, c, at time, t, belonging to the same macroregion, contained in the set C_m.

Urban population estimates are drawn from Buringh (2021), which provides one observation per century prior to 1500 and one every fifty years thereafter. Approximation errors in the coordinates may leave some cities unassigned. Before conducting the analysis, we perform a fuzzy matching procedure based on the Jaro–Winkler string distance[7] between the city names in Buringh (2021) and those in our database. For matched cities, we replace Buringh's coordinates with our own. If the geographic distance between Buringh's coordinates and ours exceeds 10 km, the replacement is carried out only when the city names match exactly, that is, when the Jaro–Winkler distance equals zero. To construct a yearly series, these observations are interpolated using a natural cubic spline. Urban population is expressed in thousands, so that an index of 1 corresponds to one scholar with unit human capital

[7] To do so, we use the package by Van der Loo (2014) in R.

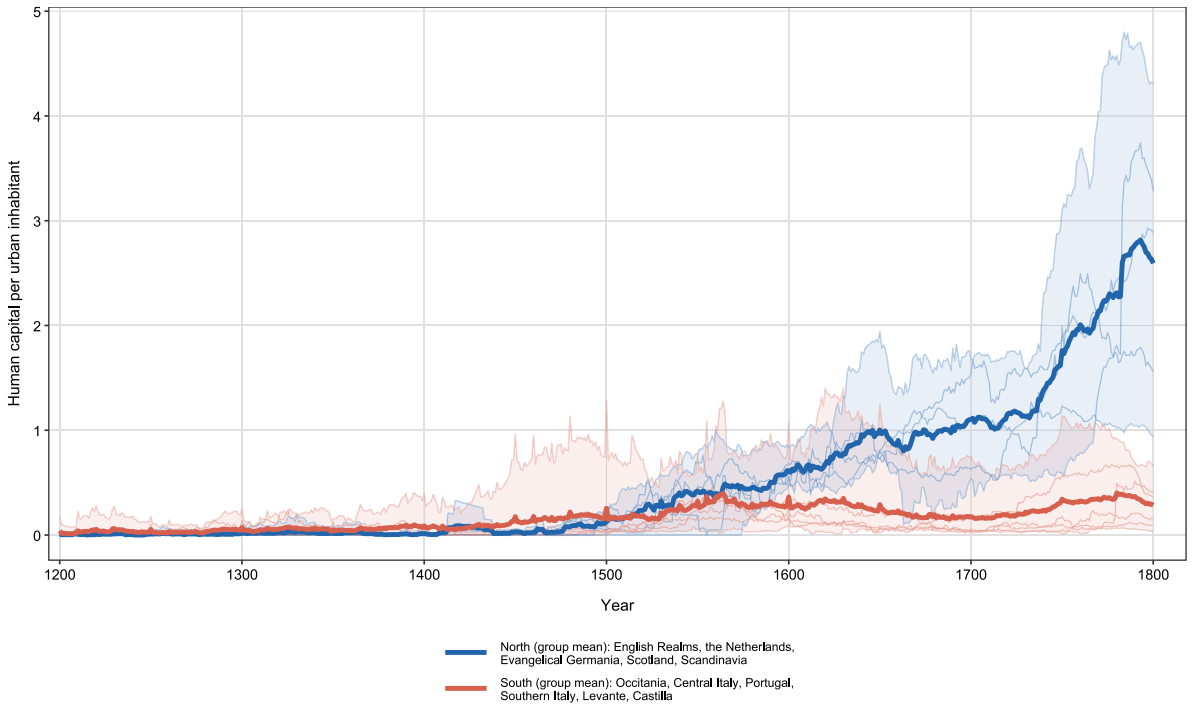


Fig. 3. The Little Divergence in academic human capital, as measured by human capital of academies and universities per urban population. Northern Europe (the English Realms, the Netherlands, Evangelical Germania, Scotland, and Scandinavia). Southern Europe (Occitania, Southern Italy, Portugal, Levante, and Castilla).

per thousand urban inhabitants; equivalently, an urban population of 18,340 inhabitants corresponds to Martin Luther (see Table 2).

Variation in total human capital over time can reflect changes either in the average number of affiliated scholars (quantity) or in their average human capital (quality). The concave transformation outlined in Section 2 limits the influence of extreme values in quality, ensuring that changes in total human capital are largely driven by shifts in institutional size rather than by a few exceptionally productive individuals. An individual contributes to the total stock of human capital only during the period in which they hold an institutional affiliation—for example, Luther was affiliated with the University of Wittenberg from 1508 to 1546, so his impact is confined to those 38 years.[8] Consequently, the long-run trends we observe over centuries cannot be attributed to a narrow group of superstars. This approach reinforces the conservativeness of our measure and highlights that the trends reported reflect broad evolutions rather than the outsized influence of a niche of exceptional scholars.

5.1. The little divergence

A notable economic divergence emerged in Europe prior to 1800: the sustained economic ascent of northwestern regions over their southern counterparts. This phenomenon, often termed the "Little Divergence", is empirically observed across various socioeconomic indicators, including real GDP per capita (Maddison, 2007), urbanization rates (De Vries, 1984; Bairoch et al., 1988; Buringh, 2021), book production (Baten and van Zanden, 2008; Buringh and van Zanden, 2009), and quality of institutions (Hough and Grier, 2015; Henriques and Palma, 2023), among others. While the precise causes remain a subject of scholarly debate, de Pleijt and van Zanden (2016) propose that human capital, proxied by book consumption, significantly accounts for a substantial portion of this divergence, a claim that contrasts with findings by Acemoglu et al. (2005).

Fig. 3 exhibits the average human capital per urban inhabitant for some representative macro-regions of the North and South of Europe. Starting in 1500, the English Realms, Scotland, Evangelical Germania, the Netherlands and Scandinavia witnessed a remarkable increase in the human capital per urban inhabitant. Conversely, the southern regions of Occitania, Southern Italy, Portugal stagnated.

From the perspective of human capital, this shift had a twofold manifestation. In Southern Europe – particularly on the Italian Peninsula – it was associated with the cultural and intellectual Renaissance movement. Conversely, in Northern Europe it materialized with the Northern Renaissance, which was concomitant with the Reformation. While different in nature, these

[8] Moreover, Luther accounts for around only 6, 5, and 3% of total human capital in Evangelical Germaniarespectively in 1508, 1517 and 1546.

movements both coincided with a resurgence of human capital, which, in Northern Europe, proved to be quantitatively more substantial and persistent. In fact, the decline of the Renaissance brought Italy back to stagnation. Conversely, the Northern Renaissance marked a period of sustained prosperity for Northwestern Europe, elevating it above the Southern and Central regions in terms of human capital. For example, during the 16th century, Scandinavia – and notably Sweden – began a trajectory that would make it one of the most literate regions in Europe on the eve of industrialization, earning it the epithet of the "impoverished sophisticate" (Sandberg, 1979).

A recently revived strand of the literature has emphasized the importance of the Counter-Reformation in explaining the lag of the South in knowledge production. Becker et al. (2021), Drelichman et al. (2021), Cabello (2022), Dewitte et al. (2022), Blasutto and de la Croix (2023) suggest that the institutional and religious constraints imposed by the Counter-Reformation curtailed intellectual innovation and the accumulation of human capital in Southern Europe and the Spanish Low Countries, reinforcing the divergence in long-term economic and scientific development between the North and the South.

In terms of academic human capital, Portugal had a very different path compared to Spain. The arrival of the Jesuits around 1540, as part of a broader project of evangelization and cultural control over the colonial territories, marked an initial, albeit temporary, phase of growth. A renewed impetus came in the mid-eighteenth century with the reform program of the Marquis of Pombal – which also included the expulsion of the Jesuits – aimed at reorganizing educational institutions along more modern lines and improving their overall quality (Maxwell, 1995; Vitale, 2022; de la Croix et al., 2023).

The 17th century was characterized by numerous conflicts and plague outbreaks. Both the Netherlands and Evangelical Germania suffered a brief decline, most likely due to the Thirty Years' War (1618–1648) and the Dutch War of Independence from the Habsburgs (1568–1648). The English Realms' human capital reached its peak in this period, coinciding with the Educational Revolution (Stone, 1964), before the Stuart Restoration ushered in a long period of stagnation in tertiary education.[9] This trend is particularly notable as it occurs while English GDP per capita was beginning its sustained rise (Broadberry et al., 2015, p. 204). This phenomenon cannot be attributed to a demographic boom in Ireland as urban population evolved at approximately the same pace throughout the period between 1400 and 1800. Some authors linked the subsequent stagnation to a phenomenon of *elite overproduction* (Curtis, 1962; Stone, 1965; Goldstone, 1991), others to the rise of competing institutions. The end of the English Interregnum was marked by legislation restoring Anglican primacy, notably the Act of Uniformity (1662) and the Test Acts (1670s), which restricted university access to members of the Church of England. This exclusion prompted the establishment of Dissenting Academies (Parker, 1914; Queen Mary Centre for Religion and Literature in English, 2025), intellectual centers run by nonconformists who refused to adhere to the Book of Common Prayer. Some scholars have argued that Dissenters, and in particular the Puritans, played a pivotal role in the Scientific Revolution (Merton, 1938), suggesting that their departure and the broader Great Migration that followed Interregnum may have contributed to the decline in human-capital formation in England. Yet, regarding the ability of dissenting academies to divert a substantial portion of students, Shapiro (1971, p. 80) observes that "the thirty or so founded between 1662 and the turn of the century do not seem to have made a substantial contribution". Similarly, Scottish universities did not expand significantly until the early eighteenth century, limiting their competitive effect (Gascoigne, 1990). It remains an open question what justified the drop in human capital, which is also coupled with a decline in the matriculations at Oxford and Cambridge (Koschnick, 2025, Fig. A.8).

Similar trends can be spotted using alternative macro-level measures of human capital. By 1600, Great Britain and the Netherlands were the Western European regions with the highest literacy rates, while Ireland, Poland and Spain had the lowest rates (Buringh and van Zanden, 2009, tab. 9). Moreover, the relatively comparable literacy rates in the Netherlands and English Realms during the 17th century were matched by their academic systems, with human capital per urban inhabitant remaining broadly similar until the 1650s. The Thirty Years' War marked the beginning of English predominance in academic human capital relative to the Netherlands, a position that was reversed in the second half of the 18th century. A slightly different gradient appears in per capita consumption of printed books (Buringh and van Zanden, 2009, tab. 4), where the Netherlands is at a systematically higher level than the English Realms after the 1550s.

5.2. The Black Death and the Thirty Years' War

Two events are particularly relevant for analyzing human capital-intensity: the Black Death and the Thirty Years' War. Both constitute large, well-documented shocks that had lasting negative consequences, including substantial disruptions to universities and the broader academic market. Other events, such as the Italian plague of 1629–1631 (Alfani, 2013, pp. 426–427), were found to have exerted a negative effect on human capital.[10] However, as far as the academic market is concerned, the Black Death and the Thirty Years' War seem to be the two main negative shocks.

Around 1348, Europe was struck by one of the most devastating pandemics in recorded history. The plague is traditionally believed to have arrived via Genoese ships retreating from the Mongol siege of the commercial outpost of Caffa (in present-day Crimea) (Jedwab et al., 2022). The Sicilian port of Messina was the first to be infected and from there the pathogen spread all

[9] The Educational Revolution aligns with data on grammar school foundations (Boucekkine et al., 2007, fig. 1), while the subsequent decline is evident in the average tertiary education (de Pleijt, 2018, fig. 4) and matriculation rates to universities and the Inns of Court (Stone, 1964, p. 69; 1974).

[10] Alfani and Percoco (2019) found that mortality was high also among skilled workers, thus it was thus not anymore a "plague of the poor" (Alfani and Percoco, 2019, p. 1183), hitting only the most disadvantaged social classes. Our series for academic human capital in Northern Italy start declining as early as in 1600—around 30 years before the outbreak of the plague.

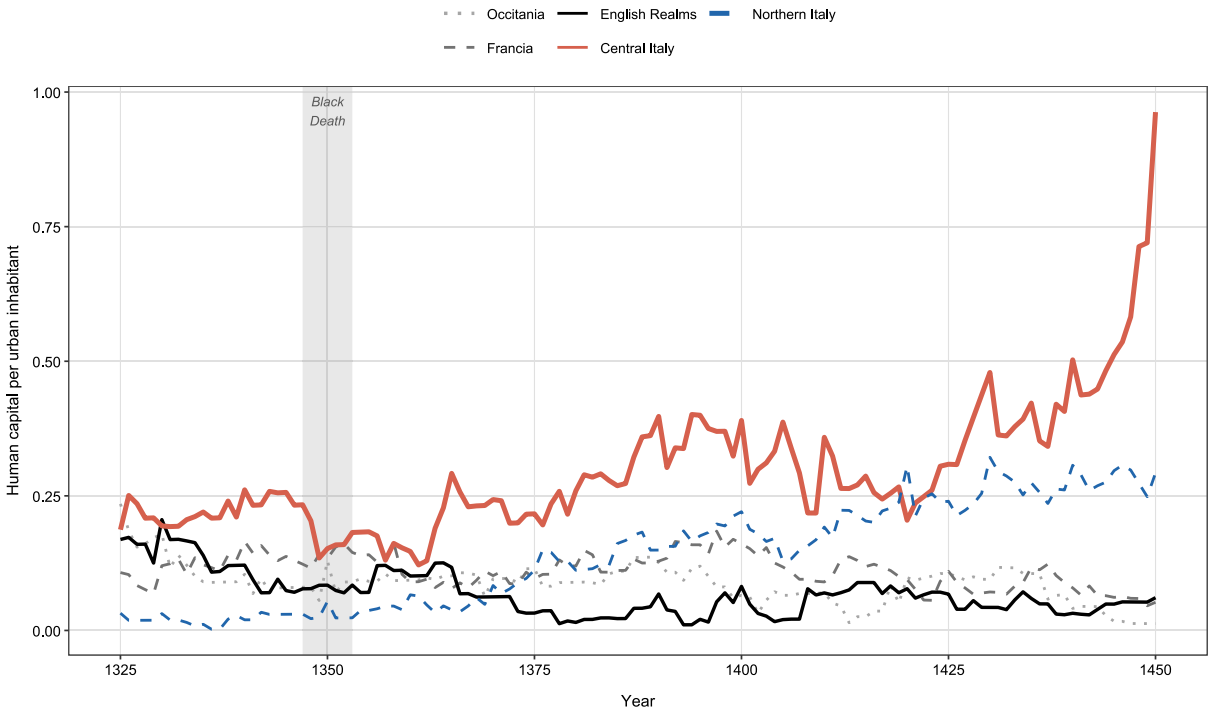


Fig. 4. The effect of the Black Death in the macro-regions following the Parisian model (the English Realms, Francia, and Occitania) and the macro-regions following the Bolognese model (Northern Italy and Central Italy).

over Europe. Jedwab et al. (2024, p. 5) noted that the cities that were hit first were the ones who suffered the highest death tolls. Interestingly, they find that having a university was not associated with a faster demographic recovery.

Campbell (1931) remains the first major monograph dedicated to this question, pioneering the study of the Black Death's impact on European higher education. The most immediate and intuitive consequence was the death of scholars and students. Despite the scale of demographic loss, Oxford, for instance, appears not to have contracted significantly in size (Brockliss, 2016, p. 33), perhaps thanks to the students and faculty's young age.[11] In the decades that followed, however, we observe that human capital per urban inhabitant declined considerably in the English Realms, as Fig. 4 shows.

The immediate post-plague labor shortage may have led individuals at the margin to forego higher education, resulting in an immediate decline in university enrollments (a short-run effect) and in a subsequent contraction in the pool of qualified teachers (a long-run effect). Nevertheless, the sharp rise in land-labor ratios and real wages increased the demand for human capital-intensive goods, like books (Baten and van Zanden, 2008; fig. 1; Dittmar, 2011, pp. 1139, 1156), generated growing interest for tertiary education, and contributed to rising urbanization rates (Buringh, 2021). As the supply of qualified instructors failed to keep pace with this rising demand, universities and grammar schools increasingly resorted to hiring underqualified academics, potentially accounting for the widely observed qualitative decline in instruction. Conversely, Courtenay (1980) attributes the decrease to the limited ability to replace grammar school teachers – mostly clergy – who suffered disproportionately high mortality. While both theories offer an account of this persistent deterioration, they lack the support of modern quantitative methods and continue to be debated.

Conversely, Grendler (2002, p. 7–8) reports that, starting with about 17 professors in 1351, the University of Bologna grew steadily through the 1440s, when the faculty stabilized at about 85–110 members. Available evidence on the effect of the plague on the quality of Southern European universities is extremely scattered and scarce. Nonetheless, we note a striking increase in human capital intensity both in Northern Italy and Central Italy. One possible explanation is that teaching at Bologna focused primarily on law and medicine. In the aftermath of the Black Death, demand for both disciplines likely increased: legal studies were vital for regulating urban life and enforcing public health measures, while medicine was central to managing health crises and searching for effective treatments. This made both fields strategically important for the university and for society more broadly. To maintain and strengthen teaching quality, especially after the demographic impact of the Black Death, the university actively sought to attract new professors, likely expanding its international network of scholars. Another possible explanation is that several Italian universities

[11] In European universities, some students were as young as 14 years old (Ridder-Symoens, 1996, pp. 285–286), and to become eligible to teach, they typically needed to graduate—a process that generally required between 8 and 12 years of study (Ridder-Symoens, 1996, pp. 360–361).

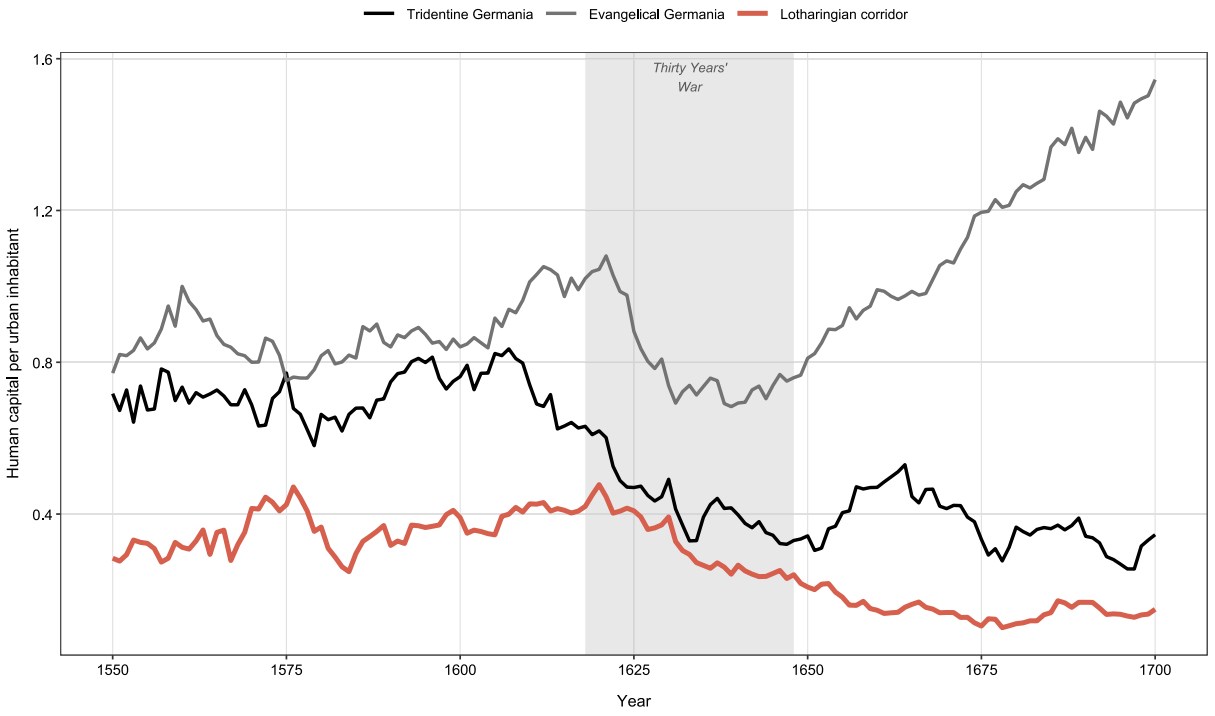


Fig. 5. The Thirty Years' War in Tridentine Germania, Evangelical Germania and the Lotharingian corridor.

– particularly in the North – temporarily relocated to avoid the plague. Such relocations may have contributed to maintaining, or even improving, the quality of human capital at these institutions.

On the whole, universities across Europe responded unevenly to the pandemic. Although the Black Death disrupted academic life in nearly all macro-regions, institutions shaped by the Parisian tradition (centered around theology and philosophy) experienced a sharper decline, whereas those following the "Bologna model" (centered around law and medicine) proved more resilient. The plague impacted almost all the macro-regions and here we assumed that the demography of each of them was affected equally.

The Thirty Years' War (1618–1648) was a protracted and devastating conflict that engulfed much of continental Europe. Like the Black Death, it had profound demographic and institutional consequences. Among its many effects, the war led to the closure or disruption of numerous universities (Stelter et al., 2021). Using matriculation data, Hotson (2018, Fig. 4.5, 4.13) shows that Reformed universities of Calvinist tradition – notably Heidelberg, Duisburg, and Basle – were among the hardest hit. Notwithstanding several aborted attempts to reopen it, the University of Heidelberg remained closed from 1622 to 1652 (Hotson, 2018, pp. 143–144). In contrast, some Catholic and Lutheran institutions also experienced increases in matriculations, likely due to their safer locations or confessional alignments. Overall, the war severely disrupted international academic networks, deepened religious polarization, and led to forced displacement of students and scholars to neighboring macro-regions.

Fig. 5 illustrates the evolution of human capital across the three regions of Evangelical Germania, Tridentine Germania, and the Lotharingian corridor in the period 1550–1700. All regions experienced an initial decline, yet their trajectories diverged notably as the conflict progressed. While both Tridentine Germania and especially the Lotharingian corridor entered a period of prolonged stagnation around the war's midpoint, Evangelical Germania underwent a marked recovery. In the subsequent centuries, both Tridentine Germania and Evangelical Germania reached primacy at the European level.

5.3. Universities vs. academies

From around 1500, the first academies emerged in European cities. The first wave stems from the Humanistic Revolution, mostly in Italy (Maylender, 1930). The second wave, from around 1650, stems from the Scientific Revolution (McClellan, 1985; Applebaum, 2003). In contrast to universities, whose mission was primarily educational, academies were chiefly devoted to research. From a data standpoint, a key distinction between the two concerns the attribution of scholarly affiliation. University professors were typically salaried educators, often subject to requirements such as celibacy and residency on campus. Academicians, by contrast, were not obliged to teach and were generally not subject to such constraints. This institutional divergence had important geographic implications. Universities had a clearly defined local sphere of influence tied to their physical location. Academies, however, operated within more diffuse and networked structures. It was common for them to include "corresponding members"—scholars who contributed to academic discussions via epistolary exchange without residing near or ever visiting the academy's headquarters. These correspondence networks played a central role in shaping the so-called Republic of Letters (Mokyr, 2010, 2016; Zanardello,

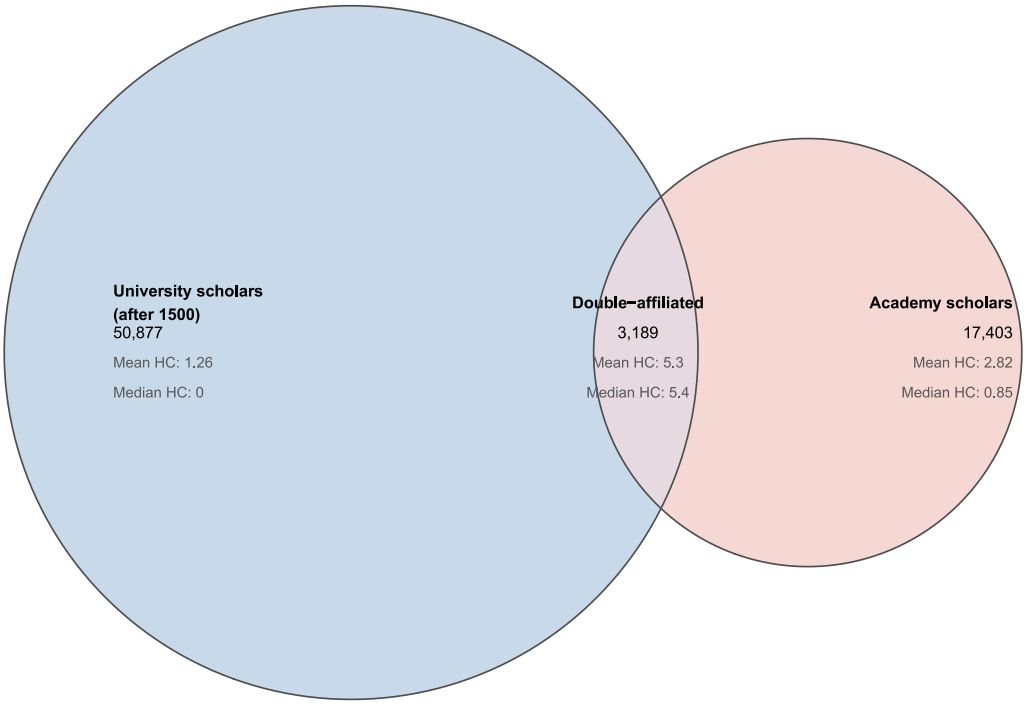


Fig. 6. Venn diagram of scholars by type of affiliation.

2024; Cervellati et al., 2025). While available data do not always allow us to distinguish between resident and corresponding members, anecdotal evidence suggests that several academicians visited their affiliated institutions very rarely.

Fig. 6 is a Venn diagram that shows the extent of joint membership of universities and academies. It also shows that scholars affiliated exclusively with academies had more than twice the level of human capital, on average, than those affiliated exclusively with universities after 1500. Several mechanisms could account for this difference: we focus on two in particular.

Firstly, given their research-oriented mission, academicians primarily engaged in scholarly production rather than teaching. This likely contributed to a greater number of published works (both in terms of titles and editions), which is directly reflected in our human capital index. In contrast, teaching activities do not directly factor into the construction of this index.

Secondly, the practice of appointing corresponding members – often prestigious scholars from outside the local area – allowed academies to extend their intellectual reach and institutional prestige at minimal cost. This contributed to a broader geographic footprint for academies relative to universities. Although inter-institutional affiliations constitute a minority of the overall sample, these scholars exhibit markedly higher human capital. On average, their human capital index is almost twice as big as that of scholars affiliated only with academies, and around four times greater than that of university-only scholars. These disparities are even more pronounced at the median: the median scholar affiliated only with a university has no bibliometric information (no VIAF, Wikipedia, or Wikidata link), and therefore a human capital index of zero.

Fig. 7 displays the relationship between total European human capital produced by universities and by academies after 1600. The outputs of the two types of institution appear to be at least partially complementary. Their aggregate human capital levels tend to move in the same direction over time. Zanardello (2024) provides evidence that the establishment of academies spurred growth in existing universities, suggesting a positive spillover effect.

The role of academies is particularly visible when comparing Francia to Occitania. Figs. 8(a) and 8(b) display the human capital series first for universities and then for the sum of universities and academies. Academies located in Francia, and especially in Paris,[12] played a substantial role in raising the region's human capital-intensity. The post-1500 rise of Northern French institutions in Fig. 8(b) was driven by scholars who never taught at a university. The relatively high levels of human capital experienced by Occitania between the 13th and 14th centuries gradually waned. From 1600 the series starts to diverge. While the northern region of Francia seems to be tied to the trends of the English Realms and the Netherlands, Occitania stagnates, as do most other Southern European regions. When looking at universities alone, this divergence appears modest; the inclusion of academies, however, reveals a much wider gap.

[12] According to our data, until 1750 the academies located in Paris contributed to more than half of the total human capital supplied by academies in Francia.

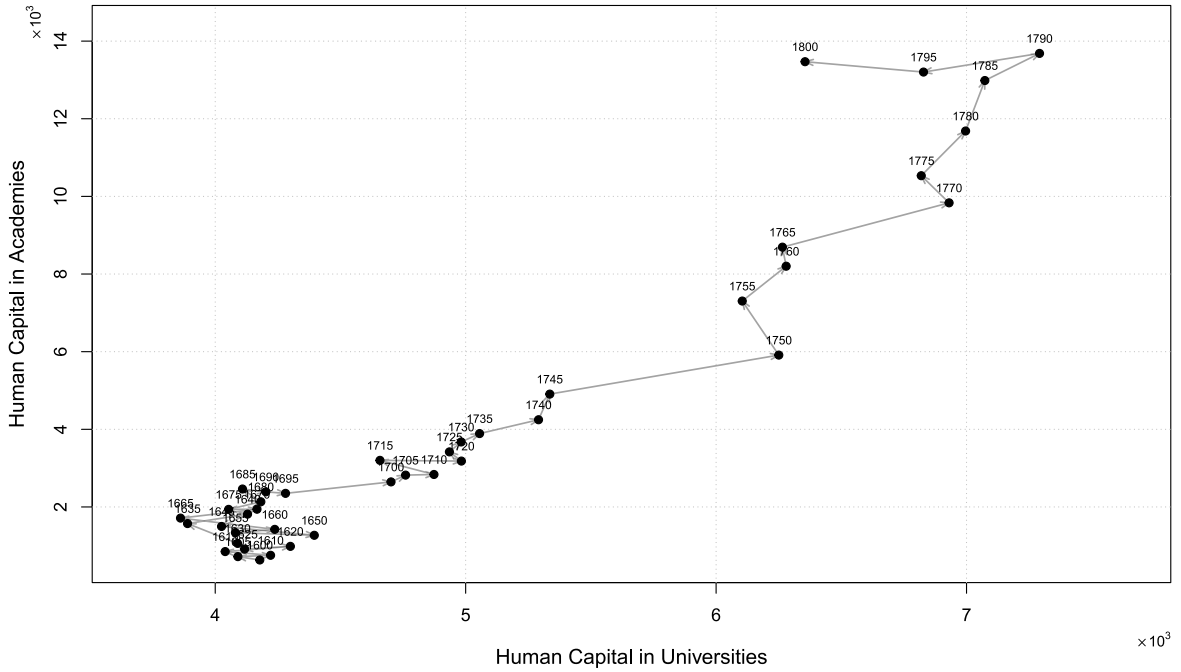


Fig. 7. Scatter plot of the total human capital produced in universities and academies after 1600.

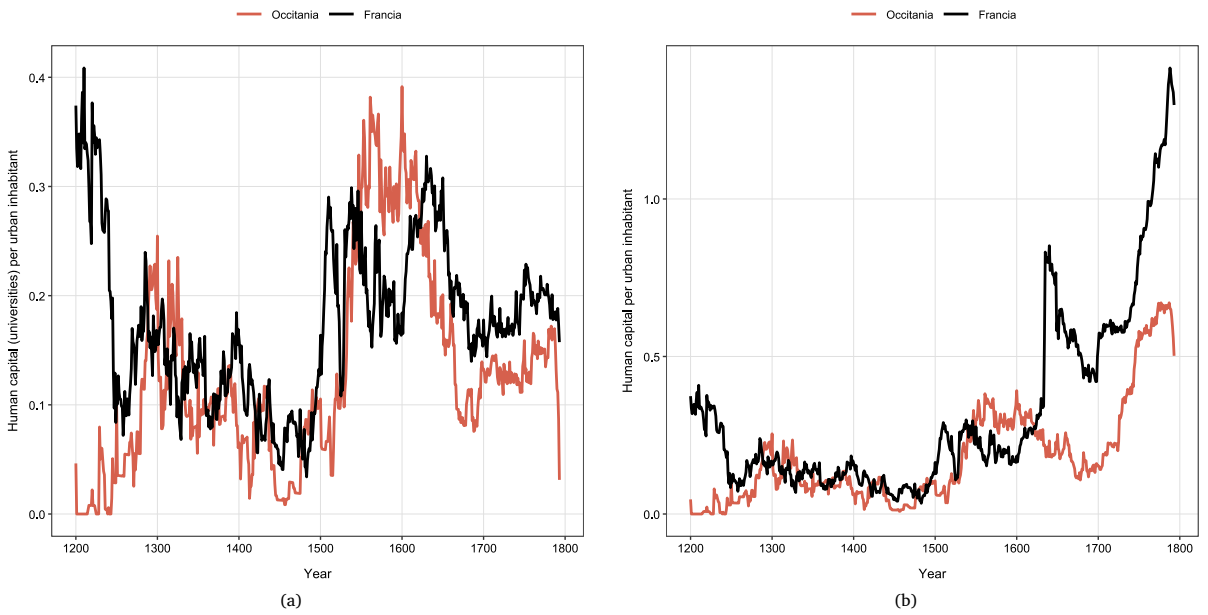
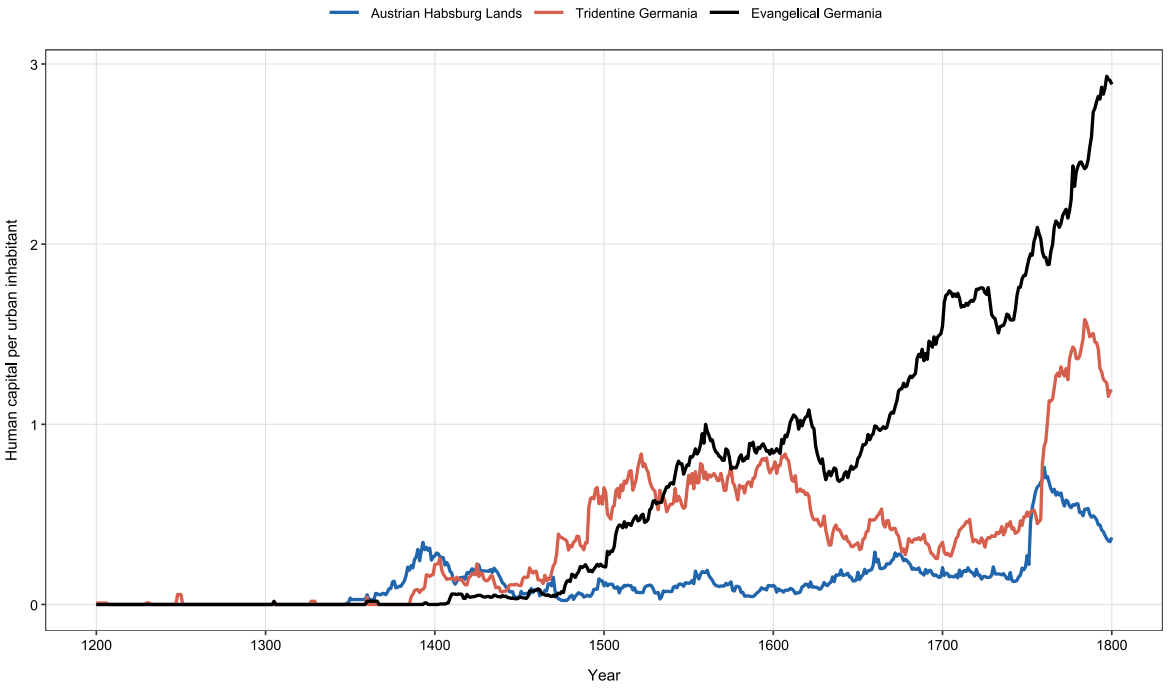


Fig. 8. Human capital in universities per urban population 8(a) and human capital in universities and academies per urban population 8(b) in Occitania and Francia.

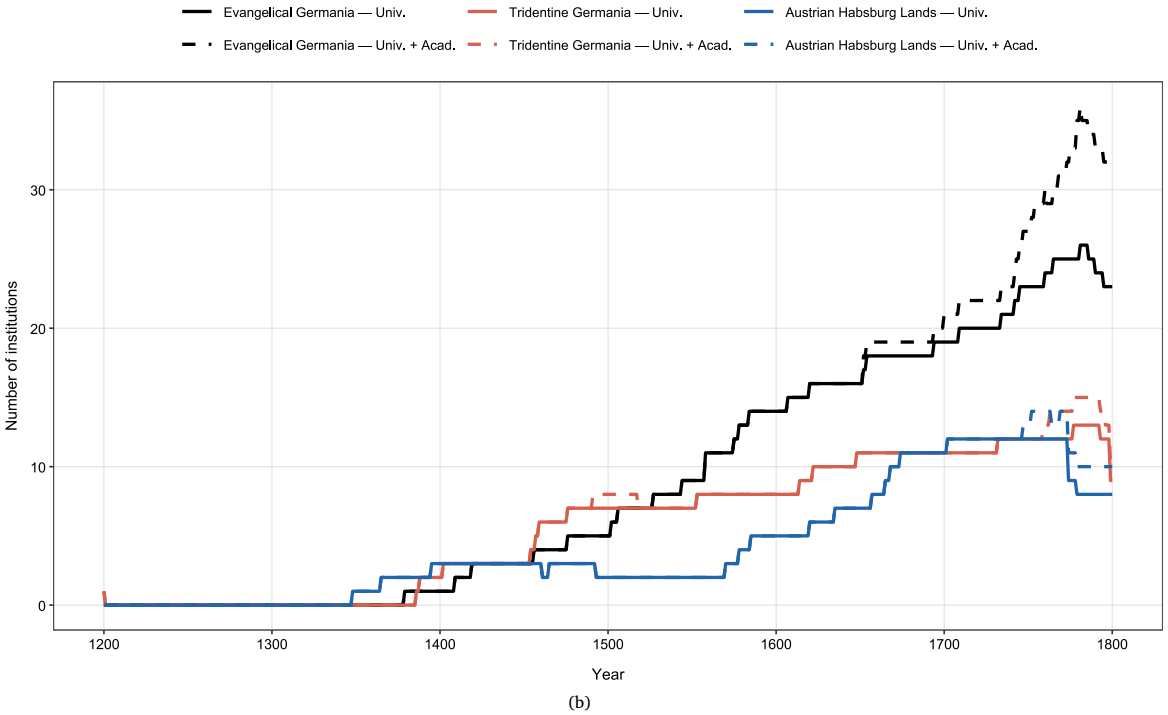
5.4. Heterogeneity in Germania and the Habsburg Lands

The religious separation of the Holy Roman Empire allows us to identify a pattern long debated in economic history: the relative performance of Protestant versus Catholic regions (Weber, 1930; Becker and Woessmann, 2009; Becker et al., 2016; de la Croix and Morault, 2025). Between 1200 and 1793, we find that Tridentine Germania and Evangelical Germania substantially diverged in human capital per urban inhabitant. The series is shown in Fig. 9(a).

The Reformation spurred the creation of new institutions dedicated to training clergy in Lutheran doctrine. For instance, the founding charter of the University of Giessen (1607) explicitly identifies this as its main purpose. Similar aims motivated the



(a)



(b)

Fig. 9. Human capital per urban population for Evangelical Germania, Tridentine Germania and the Austrian Habsburg Lands (Fig. 9(a)) and number of active universities (solid lines) and universities and academies (dashed lines) (Fig. 9(b)).

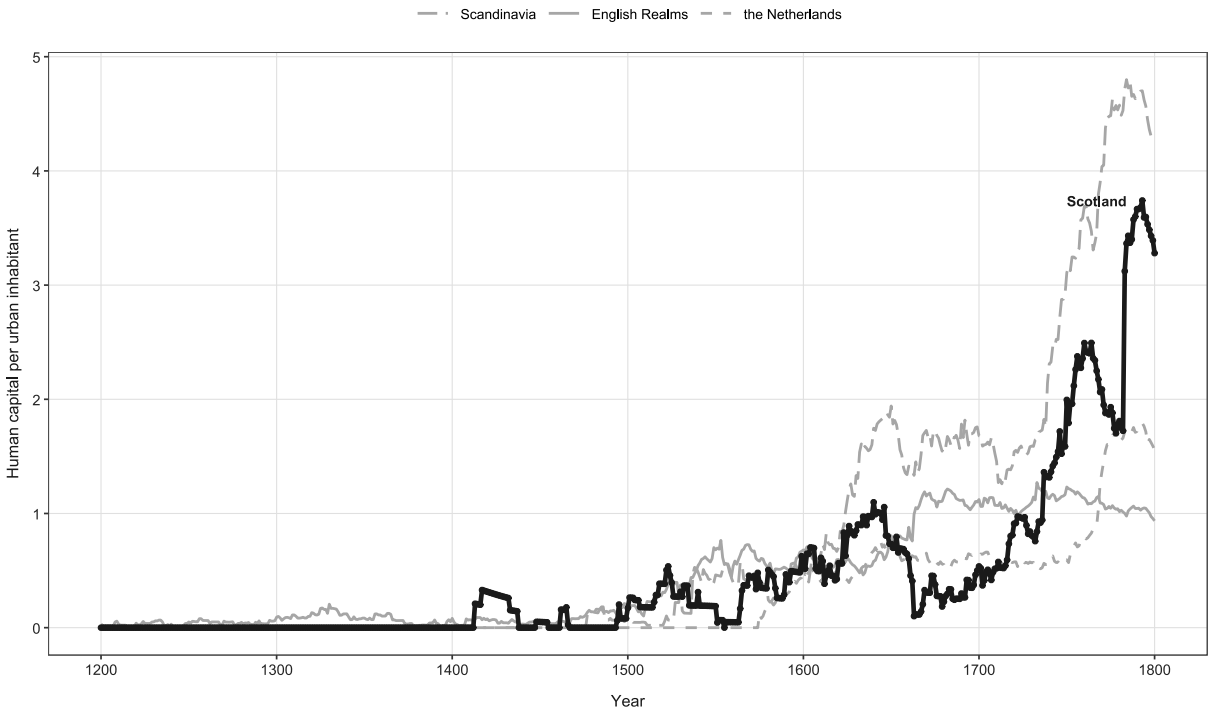


Fig. 10. Human capital in Scotland compared to other Northern European macro-regions (English Realms, the Netherlands, and Scandinavia)

foundation of universities such as Marburg (1527), Königsberg (1544), and Jena (1558), among others. However, Protestant cities were on average more populous than the Catholic ones and the normalization by the size of the urban population allows to account for that. Several big protestant cities had small institutions, e.g. Gdańsk, which deflate our index considerably.

The principle of "cuius regio, eius religio",[13] enshrined in the Peace of Augsburg (1555), inaugurated a wave of foundations of "Regal Universities", established by local rulers to reinforce the prestige and autonomy of their territories (Ridder-Symoens, 1996, pp. 140–141). As shown in Fig. 9(b), the number of universities in Protestant regions more than doubled between the mid-1500s and the mid-1600.

While before 1600 Tridentine Germania was more human capital-intensive than Evangelical Germania, after then the situation reversed. The performance of the Austrian Habsburg Lands was overall stationary until the mid-1700s, when the first academies were founded and caused a rise in the index. Such rise brought the region at a higher level, albeit still remaining peripheral in knowledge production if compared to the Northern part of the Holy Roman Empire. Similarly, the foundation of the Bavarian Academy of Sciences in 1759 inaugurated a period of glory for Tridentine Germania.

Our index unveils a significant divergence in human capital intensity between Catholic and Protestant regions. While Evangelical Germania seems to have been more resilient than Tridentine Germania in the aftermath of the Thirty Years' War, the subsequent glory experienced by the academies in Catholic cities alleviated the divide between the two.

5.5. The Scottish Enlightenment

The Scottish Enlightenment was a period of intense intellectual and cultural development in 18th-century Scotland, spanning approximately 1700 to 1793. It was one of the most influential movements in European history, laying foundations for modern economics, philosophy, sociology, and science. Scottish universities like Edinburgh, Glasgow, and Aberdeen, which had previously been second order, started to focus on critical thinking, empiricism, practical reason, and moral philosophy (Broadie, 2001). Hume, Smith, and Reid were the leading figures. Herman (2007) defends the view that the Scottish Enlightenment transformed Scotland into a cultural powerhouse and changed the trajectory of Western thought.

Fig. 10 shows the evolution of human capital intensity in Scotland, the English Realms, the Netherlands, and Scandinavia. It shows that Scotland was modest until very late in our period, when it overtook the Netherlands and Scandinavia and caught up with the English Realms. The time series include here both universities and academies. Academies were important in all four of the plotted regions during this period; for example, The Royal Society of Edinburgh was the institutional heart of scientific and intellectual exchange in the city during the later stages of the Enlightenment.

[13] Latin for "whose realm, his religion", granting rulers the right to determine the official religion of their territory.

6. Conclusions

We have presented new data on the evolution of academic human capital in preindustrial Europe based on systematic individual-level data and historically-grounded regional classifications. The patterns we have uncovered point to persistent and meaningful differences in the distribution, organization, and development of scholarly activity across space and time. These regularities suggest that academic human capital might have been not merely a byproduct of broader economic or political transformations but an organized and historically contingent phenomenon worthy of independent analysis.

Crucially, the patterns identified here open a wide range of research directions. Future work could investigate the causal role of academic human capital in regional divergence, examine its responsiveness to institutional and demographic shocks, and explore its interactions with confessional polarization and the process of modern European political integration. The distinct trajectories of universities and academies invite further studies on their respective functions in knowledge production and diffusion. Lastly, the granular temporal and spatial resolution of our dataset provides a unique empirical foundation for embedding elite human capital more firmly into macroeconomic models of long-run growth.

By illuminating these pathways, our findings encourage a reappraisal of human capital's historical role, not only as an outcome of development, but as a potential engine of divergence and transformation in its own right.

CRediT authorship contribution statement

Matthew Curtis: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **David de la Croix:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Filippo Manfredini:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Mara Vitale:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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Appendix A. Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.eeh.2026.101756.

Data availability

The data and replication package for this paper are available at https://doi.org/10.3886/E247226V1 (Curtis et al., 2026).

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