Early Modern Academies, Universities and Growth*

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Abstract

Knowledge production is central to modern economic growth but what role did it play in the past? Despite growing interest in the history of human capital, we still know little about how knowledge shaped long-term development in pre-industrial societies. This paper studies the impact of early modern academies—research-oriented learned societies that spread across Europe between 1650 and 1800—on long-run urban growth and higher education. Drawing on newly assembled data and employing advanced difference-in-differences methods, I show that academies contributed to sustained urban growth. Using individual-level data on scholars, I demonstrate that the results are driven by scientifically oriented academies, while literary academies exhibit weaker and less robust patterns. Complementary analyses suggest that academies also affected nearby cities and improved the quality of existing universities, especially when academies had a scientific orientation. These findings provide the first empirical evidence of the pivotal role scientific academies played in shaping Europe's long-run economic development.

JEL classifications: N13, N23, N33, I23, O31, O47

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1 Introduction

Today, the value of knowledge is widely recognized: human capital and innovation drive economic growth and societal progress (Nelson and Phelps 1966). Skills in science and technology are especially important in modern economies.[1] Yet we still know relatively little about how knowledge and high-level human capital contributed to major technological advances in the past, largely because historical data are scarce.[2] Even when contemporary data allow credible estimation of short-run effects of universities and research institutions (Bianchi and Giorcelli 2020), the long-run consequences of investments in knowledge remain difficult to measure. One way forward is to look backward: historical settings provide horizons in which institutional changes can be observed and their long-run effects assessed.

Early Modern Europe offers such a setting. From the mid-seventeenth century onward, new educational institutions—experimental academies and learned societies—emerged alongside older universities. These institutions gathered skilled individuals with the explicit aim of producing knowledge that could be useful to society. Over the following centuries, Europe became a global scientific leader.

In this paper, I introduce new micro-level data and use recent empirical methods to investigate whether and how academies contributed to Europe's long-run transformation. I revisit the idea that a relatively small group of highly skilled individuals played an important role in European development before the Industrial Revolution (Mokyr 2005b; Mokyr and Voth 2009). Specifically, I study academies—institutions dedicated to experimental research—and their interaction with more traditional universities. I ask two questions. First, did academies contribute to the economic development of European cities? Second, did academies affect universities, for instance by inducing modernization in teaching and organization? To answer these questions, I expand a unique database that tracks scholars active in European educational institutions between 1000 and 1800 (de la Croix, David 2021).

Between the sixteenth and eighteenth centuries, European intellectual life changed substantially. New scientific ideas and methods emerged. Instead of relying on traditional authorities such as Aristotle or Ptolemy, scholars began to base claims on observation, experimentation, and evidence (Mokyr 2016). A new kind of institution developed to support this effort: the academy. These academies—distinct from universities founded from the 12^{th} and 13^{th} centuries—provided a more flexible space for experimentation and problem-solving (McClellan 1985; Applebaum 2000). They prioritized practical knowledge and the improvement of everyday life, often focusing on local needs. This "useful knowledge," as Mokyr describes it, is widely viewed as an important ingredient of Europe's long-run development (Mokyr 2005b, p.287). Because knowledge is non-rival and can diffuse across space (Romer 1990), I also examine whether academy creation generated spillovers to nearby cities. By 1800, nearly every major European urban center either hosted an academy or was influenced by the academy movement (McClellan 1985). I therefore complement the baseline analysis with sensitivity checks designed to assess whether results are disproportionately driven by a

1. C.f. Barro (1991, 2001), Cohen and Soto (2007), and Hanushek and Woessmann (2008)

2. See Cantoni and Yuchtman (2014), Squicciarini and Voigtländer (2015), Dittmar and Meisenzahl (2022), and de la Croix et al. (2023) for recent empirical studies on this topic.

small set of countries that were highly involved in the academy movement.

To study academies across time and space, I assemble a new dataset on scholars affiliated with both academies and universities, building on de la Croix, David (2021). The dataset contains micro-level information on nearly 80,000 individuals from more than 370 institutions across Europe, including institutional affiliations, places of birth and death, and field of study. I also improve the original coverage of experimental academies by incorporating institutions listed in McClellan (1985).[3]

My main outcome is city-level population growth, a standard proxy for historical economic development (Ashraf and Galor 2011; Buringh 2021). Academy creation occurred at different times across cities, and academy presence is non-absorbing because some academies closed during the period of analysis. To estimate dynamic effects in this setting, I use the difference-in-differences estimator proposed by De Chaisemartin and d'Haultfoeuille (2024), which is designed for staggered adoption and accommodates treatments that may switch on and off. Intuitively, the approach compares changes in population growth around the creation of an academy in treated cities to changes in cities that have not yet experienced academy creation with the same period one treatment, while flexibly tracing effects over time (De Chaisemartin and d'Haultfoeuille 2024; Albertus and Gay 2025).

The key identifying assumption is that, in the absence of an academy, treated cities would have followed similar growth trends relative to the appropriate comparison group of cities. The event-study evidence is consistent with this parallel trends assumption in the pre-treatment period, and I further assess anticipation by examining the estimated leads. Nevertheless, concerns about the timing of academy creation remain: unobserved factors might have simultaneously influenced both the decision to create an academy and urban development.

To better understand these concerns, I complement the econometric design with a detailed historical investigation of academy foundations. I collect qualitative evidence on origins, funding, organizational structures, and founder biographies. This historical record consistently shows that most academies were initiated by groups of scholars motivated by the desire to revitalize scientific inquiry, rather than by rulers or economic elites seeking direct development gains. Political authorities—local lords, bishops, or monarchs—often provided support, but typically after the academic community had already laid the groundwork. This pattern reduces, but does not eliminate, the likelihood that academies were strategically founded in response to economic conditions. In the empirical analysis, I include city fixed effects to absorb time-invariant differences across cities and country-by-period fixed effects to account for broader national shocks and trends. Together with the staggered timing and the event-study design, these choices aim to mitigate concerns about omitted variables and reverse causality, while remaining transparent about the limits of causal interpretation.

The results show that the average effects of academy creation on city population growth become positive 150 years after the creation of an academy, treated cities exhibit population growth about 10–16% higher increase relative to the pre-treatment baseline. These patterns are estimated over the period 1500–1900 and are robust across a range of specifications and

3. Access the database at the following link: https://shiny-lidam.sipr.ucl.ac.be/scholars/

sensitivity checks.

The type of academy plays a key role in explaining this effect. Leveraging the scholar-level information in the database, I classify academies based on the fields of study of their members. Scientific academies—those in which more than 50% of members were active in natural sciences, medicine, or related applied disciplines—display the strongest and most persistent associations with higher city growth, with estimated effects around 12–19% at longer horizons. By contrast, literary academies exhibit weaker and more delayed patterns, and their long-run estimates are less stable across sensitivity exercises.

Academies not only contributed to growth—they also appear to have influenced higher-education institutions around them. Historical accounts suggest that academies contributed to the diffusion of empirical methods and helped pressure universities to modernize (Applebaum 2000; McClellan 1985). Using a university quality index from de la Croix et al. (2023), I examine whether university quality changes after academy creation. The evidence indicates that scientific academies are followed by improvements in university quality over time, whereas literary academies are not. This analysis complements the population-growth results by shedding new light on the institutional channel through which academies may have contributed to European development.

This paper contributes to three literatures. First, in economic history, it advances our understanding of the upper tail of the human capital distribution in Europe before the Industrial Revolution (Mokyr 2005a; Mokyr and Voth 2009; Mokyr 2016; Ó Gráda 2016). It provides new micro-level data on scholars and institutions, including detailed biographies and institutional histories. It also complements work on the historical effects of educational institutions (Becker and Woessmann 2009; Cantoni and Yuchtman 2014; Squicciarini and Voigtländer 2015; Cinnirella and Streb 2017; Dittmar and Meisenzahl 2022). Universities have long been the focus of this literature: from Cantoni and Yuchtman (2014) we know that universities played an important role in mediating uncertainty during Middle Ages, educating judges and public administrators, and de la Croix et al. (2023) determine the strength of universities' quality and professors' skills in moving and locating high-level knowledge across Europe during the Middle Ages, until the eve of the Industrial Revolution. This paper highlights the complementary role of academies in producing applied "useful knowledge" (Mokyr 2003; Gage 1938). As far as I am aware, the sole study exploring the newly emerging societies at the end of the 18^{th} century is that of Cinnirella, Hornung, and Koschnick (2024), which centers on German economic societies exclusively. I show that academies more broadly—not just economic ones—played a major role in Europe's intellectual and economic transformation. Additionally, while much of the literature focuses on single-country case studies, my research adopts a pan-European perspective– like Bosker, Buringh, and Van Zanden (2013), de la Croix et al. (2023), and Benos et al. (2024) do– offering a broader view of the economic impact of high-level human capital on the eve of the Industrial Revolution (Serafinelli and Tabellini 2022; de la Croix et al. 2023).

Second, in the economics of innovation, this paper adds to the evidence that scientific knowledge and research-oriented institutions mattered even before 1800 (Mokyr 2003, 2005b; Dittmar 2019; Koschnick 2025b, 2025a), thereby laying the groundwork for later economic growth. For instance, Hanlon (2022) documents how the rise of engineering transformed the process and direction of innovation during the first technological breakthrough, while Dittmar and Meisenzahl (2022) shows that German universities contributed to scientific innovation only after implementing more research activity. Consistent with this view, I find that academies—as research-oriented institutions—are associated with both higher population growth and improvements in university quality when they are scientifically oriented.

Third, this paper contributes to the economics of education by studying interactions between different types of higher education institutions in a historical setting. The evidence suggests that academies and universities were not substitutes: scientific academies are associated with changes in university quality, pointing to potential institutional complementarities.

The rest of this paper is structured as follows. Section 2 provides historical context on academies and their relationship with universities. Section 3 describes the data. Section 4 outlines the empirical methods. Section 5 presents the main findings. Section 6 examines the effects on university quality. Section 7 discusses sensitivity analyses and potential spillover effects. Section 8 concludes.

2 Historical and institutional context

2.1 Universities and academies

Universities were the first wave of higher education institutions in Medieval and Early Modern Europe.[4] A second major institutional development emerged in the mid-seventeenth century with the rise of academies and learned societies. Academies represented a shift in Europe's knowledge system: they bridged the classical university model and a more practice-oriented approach to scientific learning and dissemination that became increasingly prominent in the nineteenth century (McClellan 1985). In this sense, academies are part of what has been described as an *"extraordinary educational breakthrough"* (Schütte 2007, p.545), a transformation that continued to evolve throughout the nineteenth century. Although the academies studied in this paper did not educate students directly, their emphasis on experimental and practical research helped lay foundations for later technical colleges and universities of applied sciences—including German *Fachschulen* (Pahl and Ranke 2019) and Danish *tekniske skolers* (Rasmussen 1969).

The emergence of academies also exposed shortcomings in the institutional structure of universities. Universities were slow to incorporate new ideas—particularly in the natural sciences—and remained anchored to traditional curricula, ancient authorities, and Latin as the primary language of instruction well into the eighteenth century. Universities did teach some scientific subjects, notably within the *Quadrivium*—arithmetic, geometry, astronomy, and music—but often in a qualitative rather than empirical or applied form (Applebaum 2000). These features are often interpreted as signs of cultural conservatism and resistance

4. Universities are among the earliest institutions of higher learning to employ multiple masters. Prior to their emergence, cathedral and monastic schools dominated the landscape. These typically had only one master and focused on a narrow curriculum, often limited to a single subject (Pixton 1998). However, some schools—such as the School of Laon—gained significant popularity and attracted students even from abroad, thanks to the depth and reputation of their teaching (Luscombe 1969).

to innovation. Academies, by contrast, created dedicated spaces for empirical inquiry and experimentation. Their early relationship with universities was frequently tense. For example, the Society of Haarlem, founded in 1752, obtained official recognition only in 1761, after the nearby University of Leiden accepted that the Society would neither deliver lectures nor publish in Latin (Bierens de Haan 1952). Over time, a clearer functional division emerged: universities remained primarily teaching institutions centered on formal instruction and degree granting, whereas academies evolved into research institutions where knowledge was actively produced and exchanged (McClellan 1985; Pepe 2008; Applebaum 2000). The mission of academies centered on the generation and dissemination of "useful knowledge"–knowledge intended to improve living conditions and address practical local challenges (Mokyr 2005b, 2016). Their experimental orientation and engagement with applied problems helped pressure universities to update curricula and organizational structures by the end of the Scientific Revolution (Applebaum 2000).

The case of Turin illustrates these dynamics. Although the University of Turin, founded in 1404 and later supported by Enlightenment-era rulers, underwent several waves of reform, it remained largely oriented toward classical education with limited engagement in the sciences (Vallauri 1875; Zanardello 2022). In 1757, three students of Professor G.B. Beccaria—Lagrange, Cigna, and Saluzzo—founded the Scientific Academy of Turin to provide a platform for empirical research and applied science outside the university's constraints. Formally recognized in 1783 by King Vittorio Amedeo III, the academy adopted the motto *veritas et utilitas* ("truth and usefulness") and organized public competitions to solve concrete, real-world problems. Early topics included employment in the local silk-textile sector, urban lighting, and agricultural modernization (Accademia delle Scienze di Torino; de la Croix and Zanardello (2021)). These activities filled a gap left by the university and exemplify how academies carved out an institutional space for science emphasizing experimentation, application, and local relevance. Figure 8 reflects the longer-run institutional impact of this shift, showing a marked increase in university quality in the late eighteenth century, as measured by scholarly output and the arrival of notable faculty (for details on how scholarly output and institutional quality are measured, see Section 3).

Europe is unusual in the bottom-up development of higher education institutions. These institutions, largely absent elsewhere, were predominantly founded on the European continent. Other regions followed different organizational models. In China, kinship-based institutions such as clans prioritized social stability and security over educational innovation (Chen and Ma 2022). In the Middle East and North Africa, the madrasa was the dominant form of higher education (Bosker, Buringh, and Van Zanden 2013), but it functioned more like a specialized high school than a university in the European sense. At the same time, the scientific method and major innovations were not exclusive to Europe: important discoveries originated in other parts of the world, often earlier than comparable European advances (Needham 1964; Bala 2006). This project nevertheless focuses on Europe as the first region to industrialize and as the earliest setting in which a bottom-up system of higher education institutions became widespread. Figure 1 shows the cumulative number of institutions included in the analysis between 1500 and 1800.

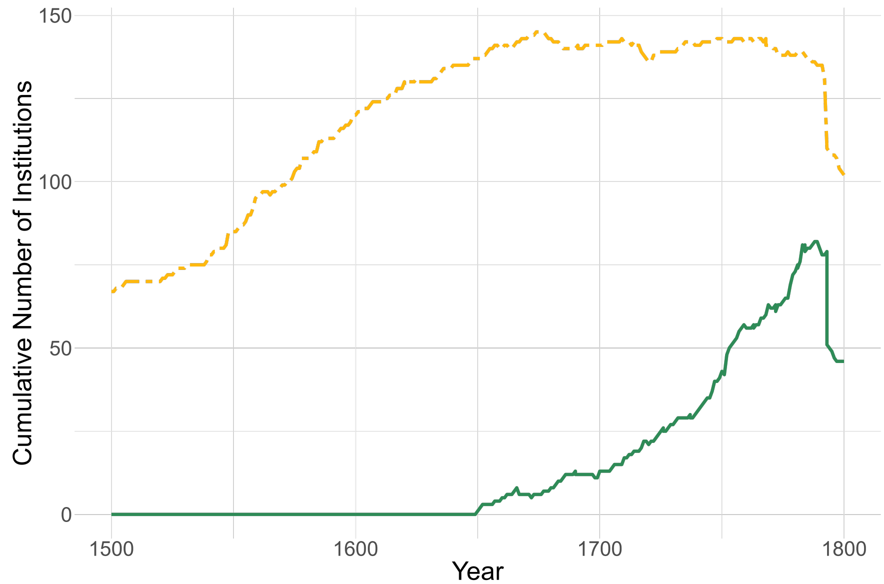


Figure 1: Cumulative number of institutions over time.

This figure shows the number of universities and academies opened (or closed) over time. The dashed yellow line indicates universities; the solid green line indicates academies. Both openings and closures are included.

2.2 Academies' characteristics

Having outlined the institutional distinction between universities and academies, this section describes key features of academies across European countries.

Academies were closely connected to the intellectual currents of the Scientific Revolution and the rise of "New Science," emphasizing experimentation and empirical evidence. A major institutional milestone was the founding of the Accademia del Cimento in Florence in 1657, one of the first academies explicitly dedicated to scientific experimentation (McClellan 1985). Its creation reflected both local demand and strong patronage: Grand Duke Ferdinand II and his brother Leopold, both disciples of Galileo, sought to promote Galileo's methods in an open intellectual environment (Middleton 1971; Maylender 1930). Inspired by this model, many later academies turned toward practical applications of science in agriculture, industry, and commerce, and toward projects framed explicitly around social improvement. Often they began as informal gatherings in private homes. Over time, these circles became more formalized, and official recognition—frequently through royal patronage—was important for institutional consolidation, particularly in France, Italy, Germany, and Sweden.

Academies also formed transnational networks through correspondence and the exchange of publications. Scientific journals played a central role in knowledge diffusion, offering a more accessible and dynamic alternative to books (McClellan 1985). Prominent examples include the *Philosophical Transactions* of the Royal Society in London and the *Journal des Savants*, closely associated with the Académie des Sciences in Paris (henceforth, "Paris Academy"). Other academies produced their own periodicals, such as the *Giornale di Letteratura, scienza ed arti* in Messina (now in Italy), the *Monatliche Auszüge* in Olmouc (now in the Czech Republic), and bulletins from academies in Stockholm, Uppsala, and Verona. These publications likely generated spillover effects beyond academy-hosting cities, a possibility examined in Section 7.3.

Appendix A.1 summarizes institutional characteristics by modern country, including patterns of official recognition, topics of study, membership rules, governance, and funding. France was characterized by a highly centralized system, in which academies often received prompt royal recognition and followed the hierarchical model of the Paris Academy. Italy and Germany displayed greater diversity: Italian academies were often shaped by papal support, while German academies relied more heavily on local patronage. In Great Britain, academies tended to be more informal, focused on experimental science, and received limited government funding.

To complement this institutional overview, I also collected micro-level information on academy founders, defined as individuals involved in an academy's initial establishment. Comparing founders with later affiliates provides additional insight into the origins of these institutions. Founder data were compiled for 90 of the 101 academies in the sample. Four of the eleven excluded cases were created directly by monarchs—such as the Academy of Göttingen (King George II of Great Britain) and the Academy of Naples (King Ferdinand IV of Bourbon)—and therefore have no individual founder recorded in my database of scholars. Excluding these cases and other academies lacking sufficient information, I identify 413 founders across the sample (as academies often had multiple founders).

Table 2 compares founders with non-founder affiliates. Founders display slightly higher individual quality (measured as a composite indicator of citation outputs–see Section 3 for more details), although the difference is not statistically significant once year fixed effects are included. The two groups do not differ significantly in age at appointment or death, but founders tend to remain active in the academy for longer. The most striking differences concern geography: founders are more likely to be local. They were born closer to the academy's location and also died closer to their birthplace, indicating lower geographic mobility. This pattern is consistent with qualitative accounts emphasizing that academies were often founded by local scholars seeking to promote scientific activity in their communities. While this paper does not assume full exogeneity in the spatial distribution of academies, these founder characteristics provide suggestive descriptive evidence.

Appendix A.2 lists each academy with a brief account of its founding.

3 Data

To assess whether academies influenced long-run development in European cities, I combine data on urban population, the presence of academies and universities, university quality, and individual scholars and their fields of study. This section summarizes the main data sources and explains how the key variables are constructed.

Population data. Urban population is a standard proxy for economic development in pre-industrial settings (Bairoch 1988; Bosker, Buringh, and Van Zanden 2013; Squicciarini and Voigtländer 2015; Cantoni and Yuchtman 2014).[5] The primary population source is Buringh (2021), an updated and extended version of Bairoch, Batou, and Pierre (1988). It reports population for 2,262 cities that reached at least 5,000 inhabitants at some point between 700 and 2000. Relative to earlier compilations, Buringh (2021) systematically imputes missing values using city- and period-specific characteristics and corrects earlier miscalculations through new data collection and a refined imputation algorithm. Nonetheless, measurement uncertainty remains, especially in earlier centuries (see Buringh (2021) for details). Because academies emerged primarily after 1650, I restrict the main analysis to the post-1500 period, which helps limit potential measurement error in population data.

The geographical focus is Europe, where higher education institutions followed a distinct historical trajectory. I exclude cities located in territories that were part of the Ottoman Empire, removing 161 cities across 11 countries.[6] To avoid inconsistencies and missing values due to changing administrative boundaries and merged settlements, I aggregate populations for historically distinct places that later formed a single urban unit.[7] The resulting dataset contains population figures for 2,096 cities observed at 19 time points: every century from 700 to 1400 and every 50 years from 1500 to 2000. My main outcome variable is population growth between 1500 and 1900, meaning that each time point corresponds to the growth of urban population in the 50 years before.

Academies and universities. My key explanatory variables capture the presence of higher education institutions—academies and universities—as proxies for advanced knowledge and human capital in cities. I rely on the scholar database described in de la Croix, David (2021), which I extend to improve coverage of experimental and scientific academies. The database includes more than 79,000 scholars active in European universities and academies between 1000 and 1800. For each scholar, it records place and year of birth and death, mobility, institutional affiliations, and a measure of individual quality ("human capital"). Scholars may be affiliated with a university, an academy, or both.

For the main analysis, I aggregate affiliation information into binary city-period indicators. The central variable is a dummy for the presence of an academy, $ACAD$, in city c at time t. It equals 1 starting in the first half-century interval *after* the academy's foundation date and remains 1 until the first recorded end date. For example, the academy in Modena (Italy), founded in 1680 and still active today, takes value 1 from 1700 onward; the academy in Agen (France), founded in 1776 and closed during the French Revolution in 1793, takes value 1 only in 1800. I define an analogous indicator for university presence, UNI. To capture institutional overlap, I also define $ACADxUNI$, which equals 1 when both an academy and a university are active in the same city-period, and 0 otherwise. The version of the

5. This is mostly based on the assumption that such economies operated under a Malthusian regime; meaning that the higher the technological progress, the larger the population (Ashraf and Galor 2011).

6. Excluded countries are listed here: https://en.wikipedia.org/wiki/Outline_of_the_Ottoman_Empire (accessed June 2023). Hungary and Slovakia are retained, as they were only partially under Ottoman rule. These exclusions reflect the argument that Ottoman political and strategic priorities may have shaped educational institutions in ways less influenced by the cultural and intellectual currents driving academy formation in Western Europe.

7. I combine Barmen and Elberfeld into Wuppertal (Germany); Rheydt into Mönchengladbach; Depford into London (Buringh 2021); and Pest with Buda, which became Budapest in 1873.

database used in this paper contains 79,554 scholars and 375 institutions.[8]

University coverage follows *A History of the University in Europe* (Frijhoff 1996). I include only institutions classified as "typical" universities, excluding convent-universities, seminaries, collegia, and institutions that were never operational.This yields 171 universities. Locations and operating dates come primarily from Frijhoff (1996), supplemented with more precise sources when needed.[9]

Because the original database already provides strong coverage of university professors, my additions focus on academies. I consult mainly secondary sources, together with few primary materials, like the handwritten registers from the Academy of Nîmes. I identify academies using McClellan (1985), restricting attention to institutions characterized by an experimental approach. Renaissance academies are excluded because they followed traditional intellectual models and are not suitable for comparison.[10] I include both official and private academies from McClellan's list and exclude entries without corroborating sources.[11] Dates of creation and closure are taken from McClellan (1985) unless more accurate sources indicate otherwise. For official academies, I use the date of formal recognition; when reliable evidence indicates substantive activity before recognition, I use the foundation year of the society, even if it initially operated privately.

When a city hosted more than one university or academy, I generally retain the oldest institution. This applies to universities in four cities—Aberdeen, Aix-en-Provence, Nîmes, and Rome. For academies, multiple institutions are common (e.g., Bologna, Naples, Florence, and London had three or more academies). In these cases, I select the oldest academy unless a later one lasted substantially longer and can reasonably be considered the most important, as in Bologna, Caen, and Florence.

Figure 2 maps the geographic distribution of higher education institutions between 1000 and 1800. Yellow circles represent universities (from Frijhoff (1996)), and green triangles represent academies (from McClellan (1985)). Cities with overlapping markers indicate potential institutional overlap (captured by $ACADxUNI$). By 1800, most major European cities either hosted an academy or were influenced by the academy movement and its experimental approach (McClellan 1985). Spain has only one academy, in Barcelona; I investigate this further in Section 7.1. The figure reports founding locations only; it does not indicate

8. The version used in this paper is dated January 31, 2025. Institutions with over 100 scholars are documented in the Repertorium Eruditorum Totius Europae: https://ojs.uclouvain.be/index.php/RETE/index.

9. For the University of Modena, for instance, I use information from its official website: https://www.unimore.it/ateneo/cennistorici.html.

10. We track only 57 Renaissance academies: 40 in Italy, 12 in France, and one each in Germany, Croatia, the UK, Spain, and Poland. Most (42) were founded before 1650 and few lasted more than a decade—only 25 survived 50 years—making them unsuitable for comparison.

11. This is the case only in the list of private academies of McClellan (McClellan (1985, p. 281)). I do not consider the Academy *Fisico-matematica* and *dell'Arcidiacono* in Bologna (Italy), the Society in Breman (Germany), the Society in Cuneo (Italy), the Society in Mainz (Germany), the Academy *Clelia de' Vigilanti* in Milan (Italy), the Society in Newcastle-Upon-Tyne (UK), and the *Temple Coffee House Botany Club* of London (UK). I also merged the two academies in Mannheim (Germany): the *Societas Meteorologicae Palatinae* created in 1780 with the *Academia Electoralis Scientiarum et Elegantiorum Literarum Theodoro-Palatina* created in 1763 (Cassidy 1985).

whether institutions remained active until 1800. Figure 9 and Figure 10 document the distribution of founding and closure dates, respectively, and highlight temporal heterogeneity between universities and academies, a key feature for identification. Finally, some measurement error is unavoidable: the dataset necessarily emphasizes institutions with sufficient historical visibility due to survival or record-keeping.

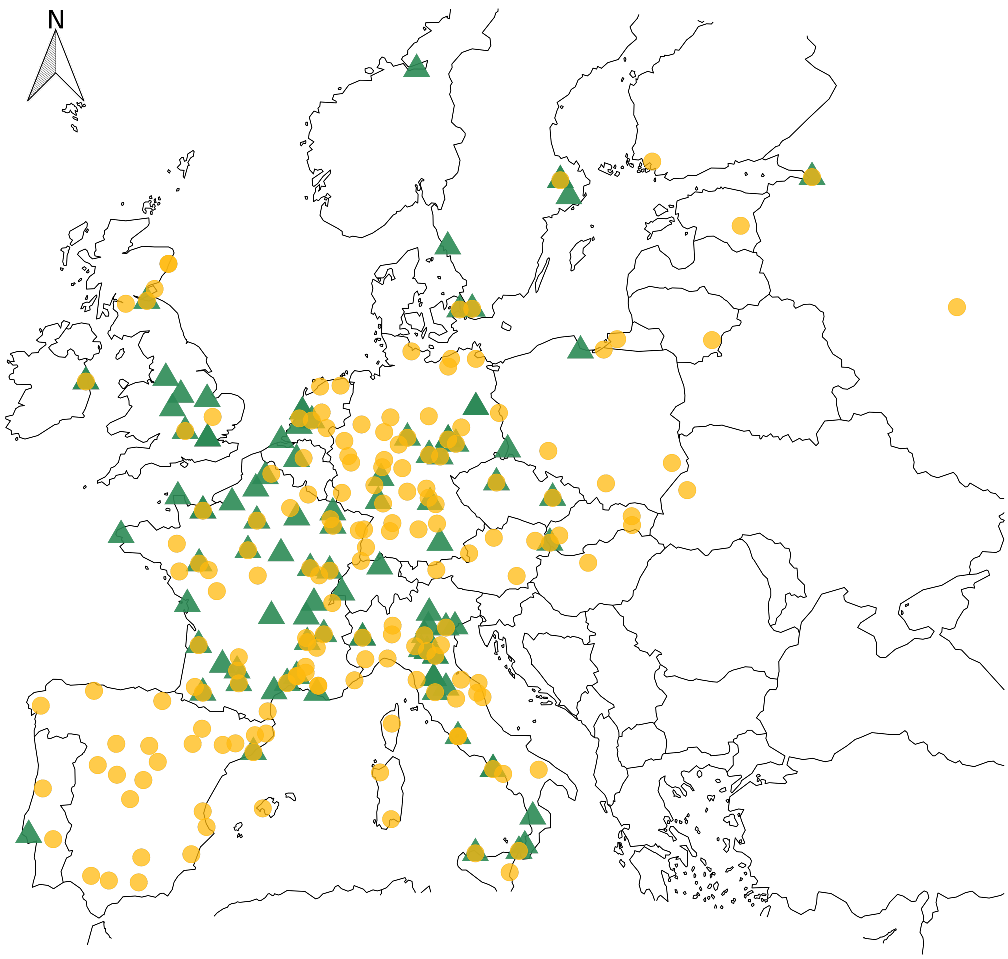


Figure 2: Locations of higher educational institutions (1000 - 1800 CE).

Yellow circles represent universities, and green triangles represent academies. When both institutions are present in the same city, the overlap of the two shapes indicates the possibility of an interaction. Country borders reflect those in the year 2000. Only locations of creation are shown; the figure does not reflect whether institutions were still active in 1800.

Scholars. The database also contains detailed individual-level information. For each scholar it records a VIAF (Virtual International Authority File) identifier—an online authority catalogue that tracks name variants and links to publishers and published works—and metadata drawn from Wikipedia, including entry length (proxied by the number of characters) and the number of languages in which an entry is available.

These sources are used by de la Croix et al. (2023) to construct a composite measure of scholar quality ("human capital"). The index is obtained via principal component analysis, combining the underlying indicators into a single metric (see Curtis and Croix (2023a) for details on the weighting scheme). A limitation is presentist bias: VIAF and Wikipedia reflect current visibility rather than contemporary influence. The measure therefore captures the prominence of scholars whose work and reputation have survived, not necessarily those most influential in their own time.

Language and national biases are also a concern, particularly when using only English-language Wikipedia, which under-represents non-Anglophone scholars (Laouenan et al. 2022). To mitigate this, I use Wikipedia information in all available languages, which substantially reduces this source of bias.

The database further reports scholars' age at death, age at appointment, years of activity, and geographic mobility, measured by the distance between birthplace, institutions of activity, and place of death. Table 1 provides descriptive statistics. Column 1 reports scholars affiliated with academies and Column 2 university professors. To ensure comparability, I restrict the university sample to professors active from 1600 onward, excluding earlier medieval scholars. The two groups differ significantly across all characteristics, with p-values < 0.001. Hence, I do not report standard errors or coefficients, as all differences are strongly significant and recognizable. Consistent with Stelter, Croix, and Myrskylä (2021), academicians appear to live longer than university professors. Stelter, Croix, and Myrskylä (2021) document that academy members were among the first to experience sustained improvements in longevity from the 1750s to the 1850s, which they attribute to social status and access to international networks. This pattern is also visible in Table 1, where academicians display higher individual quality and longer travel distances. Column 3 reports statistics for individuals affiliated with both an academy and a university at some point in their careers (the "interaction" group). Columns 4 and 5 report differences between this group and scholars affiliated exclusively with academies or universities, respectively. The interaction group is distinct from both, but it resembles university professors in two dimensions: the average distance from institution to place of death and from birthplace to place of death. All comparisons include year fixed effects to account for time trends. When scholars are simultaneously active in multiple institutions, I compute the mean of their individual-level statistics and count them only once.

University quality. Using the individual-level quality data, we compute an aggregate measure of university quality. Following de la Croix et al. (2023), I adopt their index, which is based on the top five professors active at each institution during the 25 years preceding the year for which the quality index is calculated (see de la Croix et al. (2023) for further details). In Section 6, I use the 50-year average of this index as the dependent variable.

Fields of study. Universities and academies differed substantially in disciplinary focus, as classified in the database (de la Croix and Zanardello 2022). Figure 11 shows the distribution of institutions by main field of study, defined as the discipline with the highest number

12. Eight years being the median of the affiliation years in the sample of university professors for whom we know the precise beginning and end affiliation dates. This data is consistent with the literature: Koschnick (2025b) finds that the median length of academic careers at Oxford and Cambridge is 9 years.

Table 1: Summary statistics at individual level.

	(1) ACAD	(2) UNI	(3) ACADxUNI	(4) ACADxUNI vs ACAD	(5) ACADxUNI vs UNI
Number of scholars	16002	32112°	1166		
	μ	μ	μ	p-value	
Quality	2.31	1.01	3.34	0.000	0.000
Age at Death	67	63	68	0.007	0.000
Age at Appointment	38	31	30	0.000	0.000
Activity Years$^\diamond$	15	10	30	0.000	0.000
Distance Birthplace-Institution	338	186	257	0.000	0.000
Distance Institution-Death place	428	188	196	0.000	0.504
Distance Birthplace-Death place	380	269	247	0.000	0.770
Year FE*				✓	✓

Note: Summary statistics are reported for scholars affiliated only with Academies (1), only with Universities (2), and with both Academies and Universities simultaneously at least once in their lifetime (3). Columns (4) and (5) report the statistical significance of the differences between group (3) and groups (1) and (2), respectively. All comparisons control for year fixed effects.

°) University professors are included only if active after 1600.

$^\diamond$) For activity year statistics, note that when no precise time frame is available in the database: academicians are assumed to be active for their entire lifetime, while university professors are assumed to be active for 8 years (or until death, if earlier).[12]

*) Year fixed effects are based on the scholar's initial year of activity.

of affiliated members. Universities concentrated primarily on the humanities (e.g., history, literature, philosophy, ethics, rhetoric, Greek, poetry, theology, and law). Many academies, by contrast, were oriented toward science and medicine, although some also had substantial representation in humanities and law. Figure 12 reports the distribution of fields by country, separately for academies and universities.

4 Empirical strategy

This paper estimates the effect of early modern academy creation on urban population growth. The treatment of interest—the founding of an academy—occurred at different dates across cities between 1500 and 1800. I exploit this staggered timing in a panel dataset observed at 50-year intervals. For each treated city, I focus on nine half-century periods, covering approximately four pre-treatment intervals and five post-treatment intervals. Including post-1800 periods is important to capture long-run effects that may materialize well after an academy is established. A practical issue is that the nineteenth century contains a small number of extreme growth observations—cities with population growth rates above 200% or below −100%. To avoid estimates being driven by these tails and to obtain more conservative results, I exclude these outliers from the main analysis.[13] After this exclusion,

13. The thresholds +200%-100% are obtained from an outlier analysis. Out of 62 outliers, only a few occurred before 1800. Examples include: Békéscsaba (HUN), Cacares (ESP), Kronslot (RUS), Orel (RUS),

the main sample includes 2,034 cities, covering 84 academies and 150 universities.

Because academies were founded at different times, the staggered treatment setting naturally allows for treatment effect heterogeneity: for example, the effect of founding an academy in Oxford in 1651 may differ from founding one in Turin in 1757. In such settings, standard TWFE event-study estimators (Clarke and Tapia-Schythe 2021; Jacobson, LaLonde, and Sullivan 1993) can be biased due to inappropriate weighting and implicit homogeneity restrictions (Goodman-Bacon 2021; Roth et al. 2023). To address these concerns, mitigate endogeneity risks, and recover dynamic effects, I rely on the recent DID estimator developed by De Chaisemartin and d'Haultfoeuille (2024).

For this approach to be valid, three classic assumptions are central. First, the *parallel trends assumption* requires that, absent treatment, treated and untreated cities would have followed similar population growth trajectories. Second, the *no anticipation assumption* requires that cities do not adjust growth patterns in advance of an academy's official establishment. Third, the *Stable Unit Treatment Value Assumption* (SUTVA) requires that the treatment effect in one city is not affected by the treatment status of other cities. I assess the plausibility of these assumptions throughout the analysis: the main results support the first two, and the third is further examined in robustness checks using spatial methods and sensitivity exercises (Butts 2021; Berkes and Nencka 2021).

A key reason to use De Chaisemartin and d'Haultfoeuille (2024) in this context is that it accommodates *non-absorbing* treatments: treatment status may switch on and off over time without mechanically biasing estimates. This matters because academy presence is not always permanent: some cities experience both the creation *and* the closure of an academy between 1500 and 1900. Ignoring closures would incorrectly treat these cities as continuously treated, mechanically inflating post-treatment exposure. In my sample, 95.9% of cities are never treated, and 4.1% experience academy creation at least once (84 cities). Among treated cities, 59.5% lose the academy before 1900 (50 cities). None of the treated cities has an academy already in 1500. To rationalize all these aspects, I follow a similar specification to Albertus and Gay (2025), which is:

$$\Delta \ln \mathrm{POP}_{chs} = \sum_{\substack{\ell=-t \\ \ell \neq 0}}^{+T} \beta_\ell \, \mathbb{1}\{\mathrm{EVENT}_{ch} = 1\} \, \mathbb{1}\{h = \ell\} + \mu_c + \psi_{sh} + \varepsilon_{chs}. \tag{1}$$

where the outcome is the 50-year growth rate of log population, $\Delta \ln \mathrm{POP}_{chs}$. Here c indexes cities, h indexes 50-year periods between 1500 and 1900, and s indexes countries defined by borders as in 2000. City fixed effects μ_c absorb time-invariant city characteristics, and ψ_{sh} denotes country-by-period fixed effects capturing national shocks and common trends.[14] Standard errors are clustered at the city level. An implementation detail concerns the number of leads and lags. While De Chaisemartin and d'Haultfoeuille (2024) allows

Rochefort (FRA), Saint Petersburg (RUS), Valletta (MLT), and Versailles (FRA) which grew by more than 200%; and Alcala de Henares (ESP), Bolgary (RUS), Bonifacio (FRA), Burgos (ESP), Hückeswagen (DEU), Lucera (ITA), Worms (DEU) and others, which experienced population declines exceeding 100%.

14. Three countries–Andorra, Luxemburg, and Iceland–only have one reported city in Buringh (2021),

for up to four leads and five lags, I follow their rule-of-thumb (pp. 39–40) and interpret only coefficients estimated with at least half of the total number of switchers (denoted by the dashed line at the bottom of each event-study graph). All considered, the estimated β_ℓ represents the average treatment effect specific to each period of time h computed taking into account the ℓ periods a city had been treated, with respect to cities that had not been treated yet–the not-yet switchers–and with the same period-one treatment (Albertus and Gay 2025; De Chaisemartin and d'Haultfoeuille 2024).

In a separate analysis, I examine whether academy creation affects university quality, motivated by historical claims that academies contributed to raising standards in higher education. Section 6 treats university quality as a distinct outcome to shed light on potential complementarities between institutions and broader educational dynamics.

Finally, Section 7 presents additional analyses, including explicit tests of SUTVA using spatially defined neighborhood treatment variables, sensitivity checks that exclude sample units, and an examination of spillover effects to assess whether impacts extend beyond treated cities.

Taken together, this empirical strategy is designed to provide credible evidence on the relationship between academy creation and long-run urban development.

5 Results

Figure 3 reports event-study estimates of the effect of academy creation (between 1500 and 1800) on urban population growth using the estimator proposed by De Chaisemartin and d'Haultfoeuille (2024). The pre-treatment coefficients are jointly indistinguishable from zero, supporting the parallel trends assumption. Post-treatment estimates indicate that effects become positive and statistically distinguishable from zero only gradually: 150 years after an academy is founded, treated cities exhibit population growth about 10–16% higher relative to the pre-treatment baseline (set to zero in the figure, $sd = 0.308$). As discussed in Section 4, the coefficients associated with the fourth lead and the fifth lag (lighter coloured) are imprecisely estimated because they rely on fewer than half of the total number of switchers, and I therefore cannot consistently interpret them.

To examine whether academies matter differently in cities with established higher education institutions, I restrict the sample to cities that hosted a university at least once and re-estimate the same event-study design. This restriction reduces the sample to 143 cities. Figure 4 shows no evidence that creating an academy in a university city produces additional population growth. The point estimates are initially slightly negative and close to zero, consistent with a null (or possibly negative) marginal effect of adding an academy to a city that already had a traditional university. Although some coefficients turn mildly positive after 150 years, none are statistically different from zero. As in the baseline specification, the fourth lead and fifth lag are excluded from interpretation because they are estimated with too few switchers.

implying that they will be automatically excluded from the estimations with country-by-period FE as they do not have enough variation.

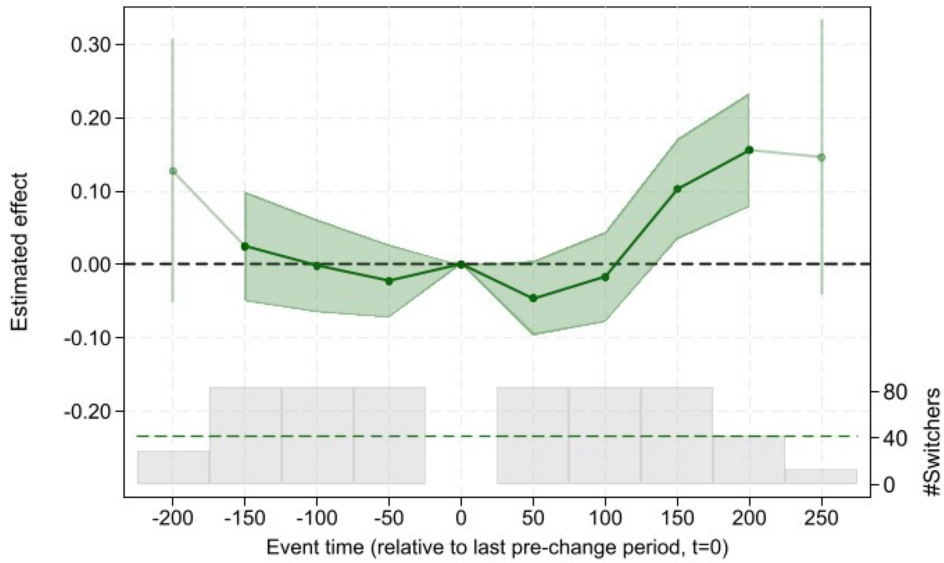


Figure 3: Academy event.

The figure reports dynamic treatment effects of academy establishment on city population growth, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a window restricted to three leads and four lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Data and specification: Outcome is the log city population growth rate. The estimation sample contains 2,031 city clusters. Adjusted $R^2 = 0.299$.

I then explore heterogeneity by disaggregating the $ACADEMY$ event along three dimensions: field of study, longevity, and size. Figure 5 presents results for scientific academies, literary academies, long-lasting academies (that operated for more than 30 years), and large academies 9with more than 30 members). Long-lasting and large academies largely replicate the baseline pattern, whereas field of study yields sharper differences.

Figure 5b focuses on literary academies. While the pre-treatment coefficients display a slight downward pattern, they are not statistically different from zero. The first post-treatment estimate is negative and then becomes slightly positive—though statistically insignificant—up to about 150 years after academy creation. At longer horizons, the estimates suggest a positive association: after 200 years, literary academies are associated with an 11.9% higher increase in population growth relative to the baseline ($sd = 0.308$). However, this finding is not consistently reproduced by the sensitivity analyses reported in Section 7.1, and should therefore be interpreted cautiously.

In contrast, scientific academies display stronger and more robust effects. Figure 5a shows that cities in which more than 50% of academy members were active in science, applied science, or medicine experienced substantially higher population growth rates after academy creation. The estimated effect reaches 12.5% after 150 years (p-value: 0.066, $sd = 0.312$) and increases further at longer horizons, although the 200-year estimate falls just below the

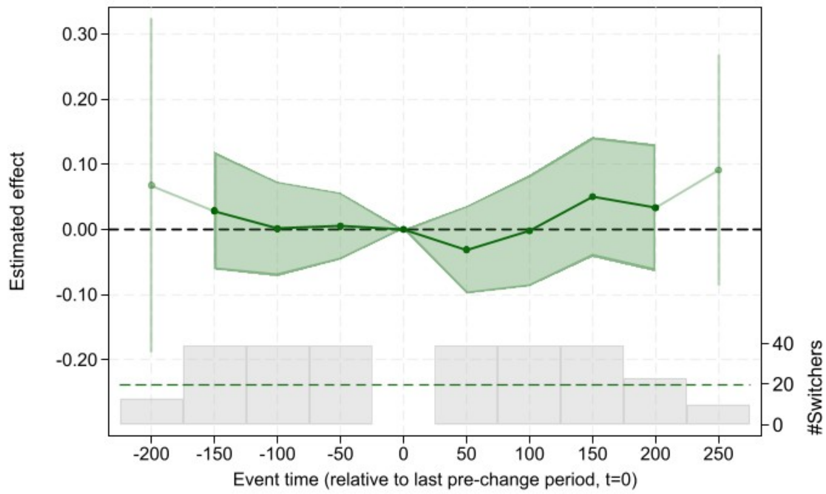


Figure 4: Academy event in university cities.

The figure reports dynamic treatment effects of academy establishment on population growth in cities that hosted a university at least once, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a window restricted to three leads and four lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed line marks one-half of the number of first-period switchers.
Data and specification: Outcome is the log city population growth rate. The estimation sample contains 143 city clusters. Adjusted $R^2 = 0.414$.

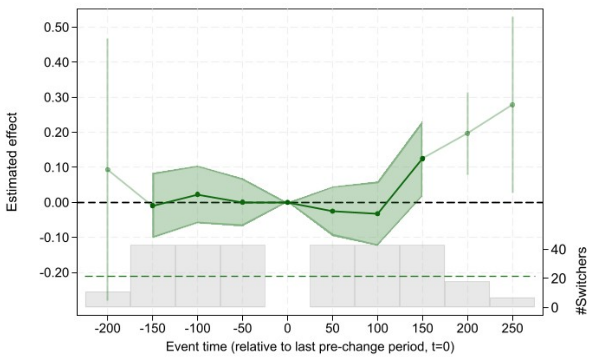
switcher threshold and is therefore not highlighted. Pre-treatment estimates for scientific academies also display tighter parallel trends, increasing confidence in the interpretation of this subsample.

Overall, the positive relationship between academies and long-run urban growth appears to be driven primarily by scientific institutions, whereas literary academies do not yield robust effects. These results underscore the importance of micro-level institutional heterogeneity—especially in the fields emphasized—for understanding human capital formation prior to the Industrial Revolution. This interpretation is consistent with the evidence in Section 6, which examines whether academy creation is associated with changes in university quality.

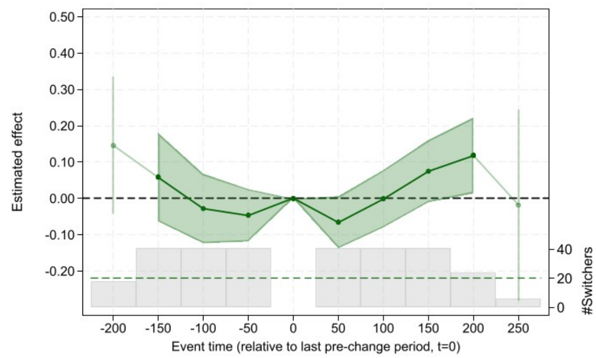
6 Quality of Universities

This section examines whether academy creation influenced university quality over time. I apply the same DID identification strategy as in the main analysis to estimate the effect of academies founded between 1500 and 1800 on this alternative outcome.

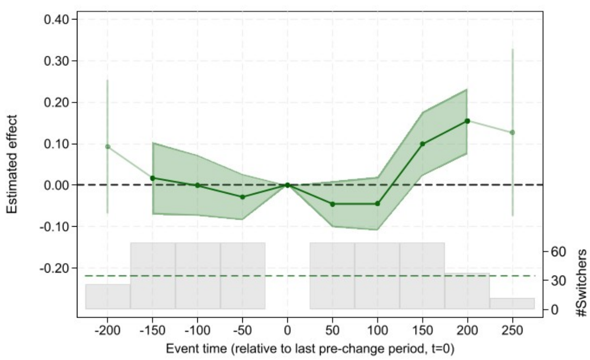
While this exercise cannot fully rule out endogeneity, it offers important insights into the potential mechanism between the rise of academies and the modernization of universities. In particular, it speaks to the hypothesis that academies contributed to the emergence of more



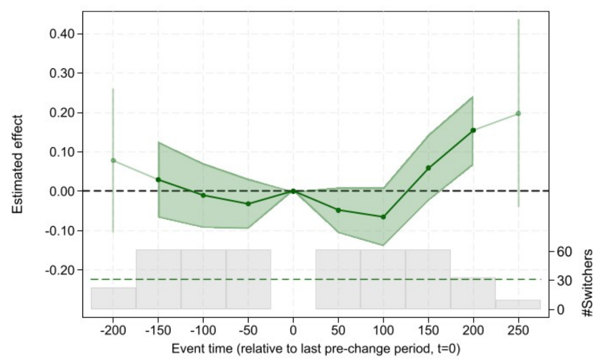
(a) Scientific Academies



(b) Literary Academies



(c) Long-lasting Academies



(d) Big Academies

Figure 5: Academy event by field, size, length.

The figure reports dynamic treatment effects on population growth of establishing (a) a scientific academy, (b) a literary academy, (c) a long-lasting academy (with more than 30 years of activity), and (d) a big academy (with more than 30 members) between 1500 and 1900, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers. *Data and specification:* Outcome is the log city population growth rate. The estimation sample contains 2,031 city clusters. Adjusted R^2 is 0.299 across all four events.

professionally oriented and innovation-driven universities by the nineteenth century.

University quality is measured following de la Croix et al. (2023), using the aggregated quality of the top five professors who taught at a university during the preceding 25 years. I construct average university quality at the 50-year level up to 1800, which allows me to replicate the event-study DID design using the estimator proposed by De Chaisemartin and d'Haultfoeuille (2024). Given the smaller sample (143 cities), the number of switchers falls substantially, so I interpret only two leads and two lags for each event study. This restriction is also motivated by data availability: quality information is not observed after 1800, and longer lags would therefore introduce estimation noise.

Figure 6 presents the baseline results. Pre-treatment coefficients are flat, consistent with

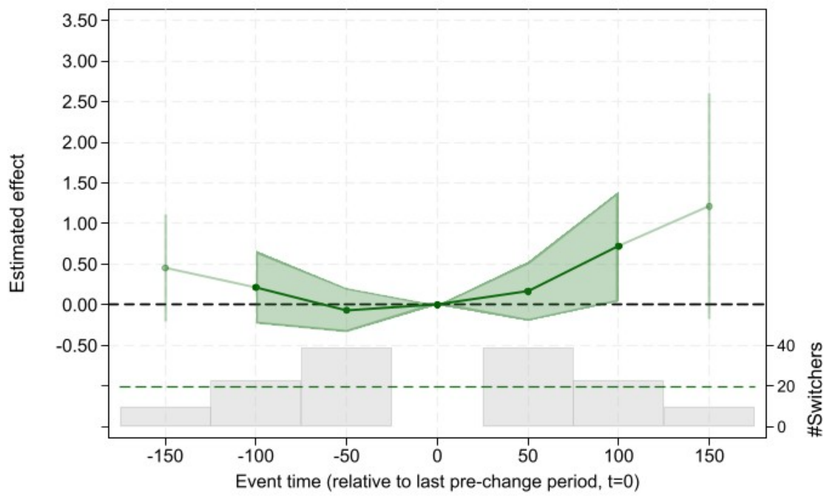


Figure 6: Academy event on university quality.

The figure reports dynamic treatment effects of academy establishment on university quality, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a window restricted to two leads and two lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Data and specification: Outcome is the 50-year average of university quality. The estimation sample contains 143 city clusters. Adjusted $R^2 = 0.746$.

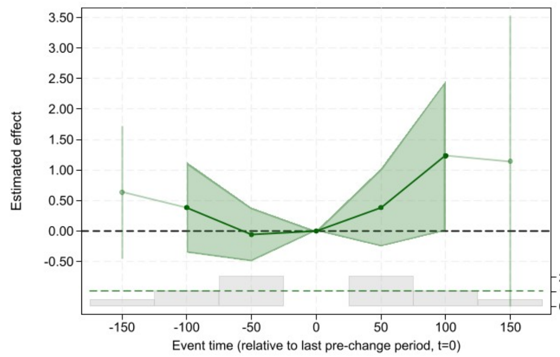
parallel trends and with no anticipation effects. I find a statistically significant increase in university quality following academy creation of about 28% on average with respect to the baseline ($\beta = 0.72$, $\mu = 2.57$, $sd = 2.35$). In other words, establishing an academy in a city with an existing university is followed by substantial improvements in university quality relative to the last pre-change period.

Focusing on science, Figure 7a shows that the creation of a scientific academy improves university quality after 100 years. The estimated coefficient is 1.23, corresponding to an average increase of more than 37% relative to pre-treatment levels ($\mu = 3.27$, $sd = 2.35$). This pattern suggests that scientifically oriented academies played a meaningful role in fostering higher academic standards within universities.

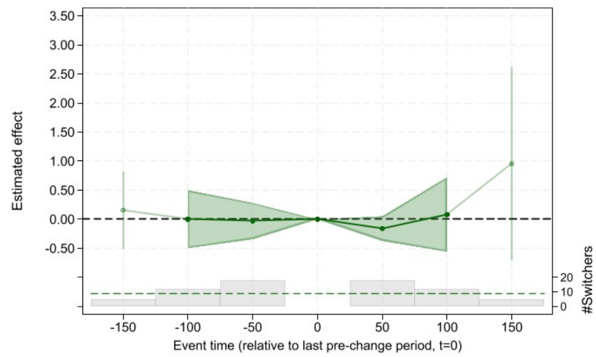
By contrast, literary academies do not exhibit comparable effects. Figure 7b shows stable pre-trends, while post-treatment coefficients are statistically insignificant. This aligns with the main results: literary academies do not appear to robustly enhance either urban growth or university quality.

Finally, I examine heterogeneity by academy size and longevity. Figures 7c and 7d indicate that neither long-lasting nor large academies generate measurable improvements in university quality. These characteristics, while potentially reflective of institutional strength, do not translate into measurable improvements in academic standards.

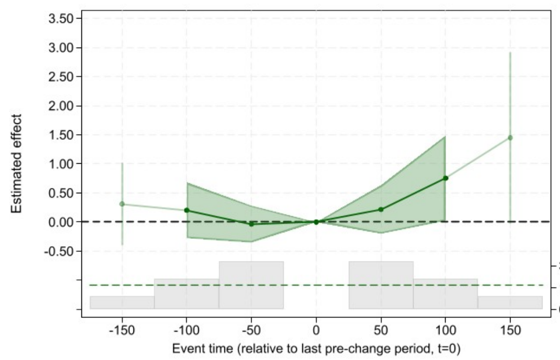
Taken together, these results suggest that scientific orientation, rather than institutional scale or survival, is the key channel through which academies influenced universities. The presence of a scientific academy appears to contribute directly to the development of higher-quality institutions of learning, highlighting the importance of intellectual specialization and research orientation in the evolution of European universities.



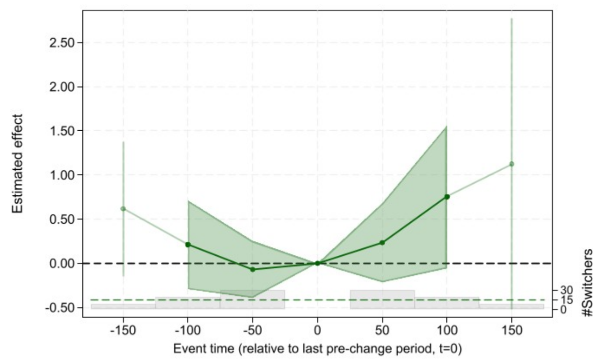
(a) Scientific Academies



(b) Literary Academies



(c) Long-lasting Academies



(d) Big Academies

Figure 7: Academy event by field, size, and length on university quality.

The figure reports dynamic treatment effects on university quality of establishing (a) a scientific academy, (b) a literary academy, (c) a long-lasting academy (with more than 30 years of activity), and (d) a big academy (with more than 30 members) between 1500 and 1800, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers. *Data and specification:* Outcome is the 50-year average of university quality. The estimation sample contains 143 city clusters. Adjusted R^2 is (a) 0.746 across all four events.

7 Additional analyses

This section presents additional analyses to assess the robustness and specificity of the main findings. Section 7.1 reports leave-one-out tests that exclude major countries hosting many academies, such as France, Italy, Germany, and Great Britain. I also test the effect of excluding Spain, a country with only one academy, to address concerns that its limited variation may disproportionately affect the construction of counterfactuals.

Section 7.2 examines the potential for "inbound" spillover effects from nearby cities. The creation of an academy in one city could be influenced not only by the characteristics of that specific urban area but also by those of nearby cities, which could bias the DID estimator. I show that excluding neighboring cities around academies does not materially alter the main patterns, which supports an interpretation in terms of unbiased local effects.

Finally, Section 7.3 presents "outbound" spatial spillovers using "donut" regressions to test whether academy creation affects population growth in surrounding cities.

7.1 Sensitivity analyses: leave-one-out

A European-wide perspective provides a broad and generalizable framework but it raises the possibility that a small number of countries disproportionately drive the results. To address this concern, I conduct leave-one-out sensitivity tests excluding countries with a high concentration of academies: France, Italy, Germany, and Great Britain. I also exclude Spain, which contributes only one academy but many untreated observations.

France. I begin with France, which hosts the largest share of academies (30 of 84) and universities (33 of 150). Excluding France modifies some short-run dynamics. Relative to the benchmark, parallel trends appear stronger but the immediate post-treatment effect becomes small, negative, and statistically significant. This effect is offset within the following century: at 150 years, treated cities grow about 11% faster than the pre-change period. The long-run effect at 150 years is larger than in the baseline (10%) but does not persist (Figure 13). This pattern may reflect France's unique revolutionary history. In 1793, the National Convention abolished all academies linked to the *Ancien Régime*, confiscating their assets and disbanding their networks (Taillefer 1984, p.241).[15] Removing France therefore attenuates these late-period shocks, but it also reduces the number of possible switchers used for identification and, in turn, the number of precisely estimated post-treatment coefficients.

For university quality, excluding France slightly reduces statistical significance (Figure 13b). For the analysis restricted to cities that ever hosted a university, results remain consistent with the benchmark (Figure 13c).

Results by academy type are more sensitive. Excluding France increases the estimated long-run effect of scientific academies on population growth (about 15% after 150 years) but the effect appears to fade over time. However, there are not enough switchers to emphasize horizons beyond the third lag. University quality estimates remain similar in sign but decrease in magnitude and significance, consistent with a loss of statistical power, as France includes 11 out of 43 scientific academies. See Figures 14a and 14b.

For literary academies, excluding France weakens the pre-trends and reveals a temporary negative effect immediately after academy creation, followed by coefficients close to zero. While these results are not significant, they are consistent with theories of rent-seeking

15. The second article of the Decree on August 8, 1793 mandated the closure of academies and the confiscation of all their materials, including "books, manuscripts, medals, machines, tables, and other objects," which were placed in storage. The buildings were also seized and sold as national property in the subsequent years (Taillefer 1984, p.241).

(Murphy, Shleifer, and Vishny 1991) and with recent work linking slower growth to religious-legal scholarship and traditional education systems (Squicciarini 2020; Curtis and Croix 2023b). See Figures 14c and 14d.

Excluding France leaves the estimates for long-lasting academies similar to the general case, whereas results for large academies lose significance (Figures 14e to 14h).

Italy. Excluding Italy does not alter the baseline event study for population growth and slightly weakens the estimated effects on university quality. For scientific academies, significance weakens at 150 years but becomes stronger at 200 years, although there are not enough switchers to confidently interpret coefficients beyond the third lag. Literary academies continue to exhibit insignificant post-treatment effects. See Figures 15a to 16c.

Germany. Removing Germany delays the estimated positive impact of academies by one period (50 years), likely because German academies were, on average, founded later: around 1755 versus 1741 in the full sample–although the difference is only 15 years, it aligns with the cut-off point for sample periods, shifting the results by 50 years. The most notable change concerns scientific academies. In the population growth event study, the third lag loses significance relative to the benchmark; the fourth lag remains positive and significant but falls just below the switcher threshold. In the university quality event study, post-treatment effects become insignificant, suggesting that the six scientific academies in Germany play an outsized role. See Figures 18a and 18b.

Great Britain. Excluding Great Britain does not materially affect the main results. Subgroup analyses by field, size, and longevity remain consistent. However, scientific academies fall outside conventional significance thresholds in the university quality regressions, again consistent with reduced statistical power (Figure 20b).

Spain. Spain hosts only one academy (Barcelona, 1764) and 20 universities. While the treated group is largely unchanged by Spain's exclusion, the donor pool of untreated cities changes more substantially. Despite this, the main results remain robust. Literary academies show slightly improved pre-trends and continue to exhibit a long-run positive effect. See Figures 22a and 22c. Estimates on university quality are also unchanged. This suggests that even in the absence of Spain, the analysis retains sufficient variation and the core findings remain valid.

7.2 Local effects

The event studies above have assumed that the effects of academy creation are purely local. However, hosting cities may themselves be influenced by nearby cities through various channels—such as shared labor markets, intellectual exchange, or regional development patterns. In such cases, the Stable Unit Treatment Value Assumption (SUTVA) may be violated. SUTVA requires that treatment effects depend only on whether a city is treated, not on the treatment status of its neighbors. To address this, a common strategy is to exclude nearby cities to account for potential "inbound" spatial spillovers—i.e., cases where neighboring cities affect the treated unit itself (Butts 2021). This exclusion refines the construction of the counterfactual, ensuring that nearby cities which could bias the estimate of the treated city's outcome are removed. If all such potentially influential cities are excluded, the resulting estimates can be interpreted as unbiased local effects of academy creation.

Following the methodology of Johnson, Thomas, and Taylor (2023), who explore spatial spillovers in a historical context similar to this study, I exclude cities located within 50, 100, and 150 km of an academy, while keeping the hosting city in the sample–I do not extend the exclusion radius beyond 150 km to preserve statistical power. If the results remain robust under these exclusions, the estimated effects can be interpreted as unbiased local impacts of academy creation.

Excluding cities within 50 km leaves the main population-growth pattern largely intact. As expected, statistical significance declines because the sample shrinks (1,617 cities, down from 2,034). Excluding cities within 100 km modestly reduces the magnitude of the positive effects observed after 150 years. When excluding cities within 150 km, estimates lose additional precision, consistent with a further reduction in statistical power. University-quality results display similar dynamics. See Figure 23.

I repeat this exercise by academy type. For scientific academies, results remain robust across radii, although magnitude and significance decline gradually as the sample shrinks (Figure 24). For literary academies, trends remain similar when excluding cities within 50 km, but the long-run positive effect disappears at larger radii and a mildly significant short-run negative effect appears when excluding cities within 150 km, reinforcing the need for caution in interpreting the literary-academy results (Figure 25). For long-lasting and large academies, the spillover adjustments do not change the qualitative pattern: estimates remain positive in the long run but become less precise as the exclusion radius increases. A short-run negative effect becomes somewhat more significant at larger radii, but it is offset by longer-run positive coefficients (Figures 26 and 27).

7.3 Spillover effects

This section investigates "outbound" spillover effects, complementing the previous analysis of unbiased local effects. Rather than asking whether nearby cities bias the treated city's counterfactual, I examine whether academy creation affects population growth in neighboring cities. I implement "donut" regressions commonly used in spatial settings (Butts 2021; Keller and Shiue 2021). Specifically, I construct concentric distance bands around academy-hosting cities and define as treated the cities located in each band, excluding the hosting city itself. Due to statistical power constraints, I focus on cities within 75 km using three rings: 0–25 km, 25–50 km, and 50–75 km. I also explore spillovers up to 150 km, but results beyond 100 km are not statistically significant due to sample limitations.

The results indicate a short-run positive spillover within the 0–25 km band: nearby cities experience a temporary increase in population growth for about 100 years after academy creation, after which the effect fades. In contrast, hosting cities retain long-run benefits. One interpretation is that neighboring cities capture initial knowledge diffusion or reputational spillovers without bearing the institutional costs, whereas persistent gains accrue to the hosting city. For the larger rings, post-treatment coefficients are close to zero.

Disaggregating by academy type, scientific academies generate a positive and statistically significant short-run spillover in the 0–25 km ring, but this effect does not extend beyond that band, mirroring the general case. Literary, long-lasting, and large academies do not exhibit measurable outbound spillovers at any distance, with coefficients close to zero throughout. For large academies, there are no switchers for the 50–75 km ring, so post-treatment effects cannot be estimated. Appendix C.3 reports the full set of results.

8 Conclusions

This paper studies the long-run role of Early Modern academies in the development of European cities. It combines a unique dataset on scholars affiliated with academies and universities between 1500 and 1800 with a DID design that exploits the staggered timing of academy creation across cities. Using city population growth as a proxy for economic development, I find that academy creation is followed by higher long-run urban growth. This pattern is concentrated among science-oriented academies, which display stronger and more persistent effects than literary academies.

I also examine whether academies are associated with changes in local university quality. Using a university quality index based on the top scholars active in each institution (de la Croix et al. 2023), I find evidence of improvements following the creation of scientific academies, while literary academies do not exhibit comparable patterns. This analysis of historical interactions between academies and universities opens the door to further research on the origins of the modern, professionally oriented educational system.

Furthermore, the spatial analyses suggest that positive spillovers, when present, are short-run and are again concentrated around scientifically oriented academies. Taken together, these results are consistent with the view that academies mattered primarily through their scientific orientation and their emphasis on experimentation and practical research.

These findings contribute to our understanding of the relationship between human capital, science, and economic dynamics in historical contexts. They highlight the potential importance of experimental approaches and the production of "useful knowledge" for development even in pre-industrial settings (Mokyr 2005a). At the same time, this paper's focus is necessarily Eurocentric: it centers on European scientific institutions, methods, and scholars, partly because Europe was the first region to experience the Industrial Revolution. Future research could extend this framework to include contributions from other civilizations—particularly Arabic and Chinese traditions—and their connections to the development of the modern scientific method (Bala 2006; Needham 1964; Cohen 1994).

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A Additional details on historical context

A.1 Academies' characteristics by country

In this section, I list the main characteristics of the official recognition, topics of study, memberships and meetings, general governance, and financing of academies by modern country:

- France

Official Recognition. Generally, French academies received official recognition from the King relatively quickly, often within 10 years of their informal foundation. For example, the *Académie des Sciences, belles lettres et arts in Besançon* received official recognition in 1752, just a few years after it was formed in 1748 (Defrasne et al. 2002). The first meeting of the academy of Nancy was held on December 28, 1750, and the patent letters arrived exactly one year later, on December 27, 1751 (Stanislas 2024). Most academies received these patent letters, signifying both royal approval and often some form of financial support either from the Royal Court or from local authorities (e.g., lords and bishops).

Topics of Study. French academies covered a wide range of subjects, including natural sciences, humanities, arts, and practical issues related to local regions. The emphasis on applied science and knowledge for the betterment of society was particularly evident in academies like those in Châlons-sur-Marne and Cherbourg. In Châlons-sur-Marne, the academy's motto was *"L'Utilité"* (literally "The Utility", (Roche 1964)), signalling a focus on improving the living standards of the local community. The *Société Académique* in Cherbourg organized local competitions to incentivize young researchers in hydrography (Académie De Cherbourg 2024). The experimental approach and the influence of the "New Science" were significant factors, as is clear from the creation of the *Académie Royale des Sciences* in Paris. The latter was officially founded by the minister Colbert "to advance scientific knowledge and promote the practical application of scientific research" (de la Croix and Zanardello 2022, p.1).

Memberships and Meetings. French academies typically had three membership categories: ordinary members, who usually resided in the city of the academy; honorary members, who were influential personalities who brought fame and reputation to the institutions without advancing knowledge themselves, and correspondents, often foreign, who did not reside permanently in the city but sent letters with their thoughts and findings to be read by the ordinary members during meetings. There was often an upper limit on the number of ordinary members, explicitly written in the *Statutes* and varying according to the academy, but there was no limit on correspondents and honorary members. Sometimes honorary members were also limited to a specific number, but for this category, exceptions were applied more regularly than the rule itself.

Meetings were generally regular, often weekly or bi-weekly, with meeting days written into the *Statutes* of the academies.

Governance. Most French provincial academies had a hierarchical structure very similar to the Paris Academy, with directors, secretaries, treasurers, librarians, and often a protector (usually a high-ranking figure like the King, or a local noble or bishop).[16] The directors or presidents of the academy were elected members and held office for a certain number of months. Secretaries and librarians were also elected members but usually stayed in their roles permanently. Treasurers were often also the vice-directors, but for this role, there was more variability among the provincial academies.

Finances. Finances often came from a combination of royal support, member fees, private donations, and sometimes bequests. Some academies received annual subsidies from the King (e.g. the Paris Academy, Boissier (1907)), others only at the beginning of their activities, while others relied on private contributions to achieve some independence from the central power.

- Italy

Official Recognition. Italian academies were often established informally before receiving official recognition from local rulers or the Pope. Official recognition was sometimes delayed, with some academies operating for several decades before receiving official status. For instance, it took 26 years before the King of Savoy recognized the Academy of Sciences in Turin. While many Italian academies were recognized by local rulers, the Pope's authority was significant, particularly for institutions like the *Istituto delle Scienze* in Bologna, which relied heavily on Pope Benedict XIV's donations.

Topics of Study. Italian academies were inspired by the "New Science" and its experimental approach, particularly in the early period, thanks to the influence of scholars like Galileo Galilei and his followers. Academies such as the *Accademia del Cimento* in Florence (founded by two students of Galileo) (Middleton 1971; Maylender 1930) and the *Accademia degli Investiganti* in Naples (Maylender 1930) are examples of early Italian institutions focused on experimental research. Italian academies frequently focused on natural philosophy, physics, mathematics, and astronomy, but also explored literature, history of the homeland, and practical issues like agriculture. In Florence, the Georgofili Academy worked closely with local authorities to reduce the impact of famines in 1791/1792, giving advice which proved to be beneficial and thus gaining credibility (Tabarrini 1856).

Memberships and Meetings. Italian academies had various membership categories, including ordinary members, honorary members, and foreign correspondents, but in a much less centralized manner than their French provincial counterparts. The *Statutes* of Italian academies rarely contain rules about the maximum number of members. Meeting frequency varied significantly depending on the academy, with some meeting only once a month.

Governance. Governance structures were diverse, ranging from the more to less democratic. Some academies were overseen by a patron, while others had elected leaders and committees. The *Accademia ducale dei Dissonanti* of Modena had in its name the word "ducale" (i.e., literally "of the Duke"), explicitly indicating the Ducal patronage and his high level of influence over academic matters (Accademia Nazionale di Scienze, Lettere e Arti di Modena 2023).

16. From here on, when I use the term 'hierarchical' structure, I am referring to the French-like organization, where specific figures are either elected or appointed for life or for a set term.

Finances. Italian academies had various sources of funding, mainly from patronage and member fees, but also from private donations and sometimes subsidies from the local or provincial church. Royal patronage was particularly important for some institutions, as mentioned above, but its generosity varied significantly.

- Germany

Official Recognition. For German academies, official recognition did not follow any specific pattern. It could come from local rulers or patrons, with variations in the timing and type of recognition. For example, the academy of Göttingen was directly established as a "Royal Society" by King George II of Great Britain and Ireland, and Elector of Hanover (Niedersächsische Akademie der Wissenschaften zu Göttingen 2024). The city of Mannheim hosted two academies,[17] thanks to the Elector Palatine of Bavaria, Karl Theodor (Cassidy 1985). Not obtaining recognition often meant more independence, as in the case of the academy of Görlitz, which did not obtain any official recognition, and remained a private society from its foundation in 1779 (Oberlausitzische Gesellschaft der Wissenschaften 2024).

Topics of Study. German academies covered a wide range of subjects, including natural sciences, humanities, and applied sciences. There was a strong emphasis on experimental research and the use of empirical data, as seen in academies like the *Gesellschaft Naturforschender Freunde* in Berlin and the *Naturforschende Gesellschaft* in Jena. The former focused on producing original research on natural history thanks to their own data collections (Böhme-Kaßler 2005). The latter aimed to supplement university lessons with more empirical applications through their collection of instruments and their own laboratory (Böhme-Kaßler 2005).

Memberships and Meetings. German academies had a mix of ordinary members, honorary members, and sometimes foreign correspondents. Meetings were generally regular, with weekly or bi-weekly gatherings being common.

Governance. Unlike France, governance structures in Germany were diverse, ranging from more informal and democratic to more hierarchical and patron-driven.

Finances. Finances were typically derived from a combination of member fees and donations, with patron support and government subsidies both being important sources. Patronage was particularly important in Germany, and the stability of the academy was highly dependent on it.

- Great Britain

Official Recognition. British academies were mostly informal, with only the Royal Society of London and the academy of Edinburgh obtaining official recognition. The timing

17. The *Academia Electoralis Scientiarum et Elegantiorum Literarum Theodoro-Palatina* created in 1763 and the *Societas Meteorologicae Palatinae* founded in 1780.

differed significantly between the two: the Royal Society was recognized in 1662, about two years after its creation, while Edinburgh waited 52 years to obtain its royal charter in 1783.[18]

Topics of Study. British academies were primarily devoted to natural philosophy and scientific experimentation, taking the *Royal Society* as a model. Its motto *"nullius in verba"* (which translates "into take nobody's word for it") is a clear statement of the will to use the experimental perspective to test and verify every fact and conclusion (The Royal Society 2024). The experimental approach was central to their work, as demonstrated by institutions like the *Lunar Society* of Birmingham, which focused on applied science and its relevance to industry, with members like James Watt (a mechanical engineer who worked on steam engines), Erasmus Darwin (natural philosopher, poet, and grandfather of Charles), and Richard Lovell Edgeworth (grandfather of Francis Ysidro)[19] (Schofield 1963).

Memberships and Meetings. British academies typically had various membership categories, including ordinary fellows, honorary members, and foreign correspondents. However, for many British academies, including the Royal Society, it is impossible to distinguish between ordinary and correspondent members, as all members are called "fellows" in their records. In our database, the category is identified only for specific years for which we know the list of foreign members as detailed in De Candolle (1885).

Meetings were generally regular, often weekly, with specific days designated for gatherings.

Governance. Most academies had a hierarchical structure, with presidents, secretaries, treasurers, and sometimes other elected officials.

Finances. British academies had very similar finances to those in other countries, with a combination of member fees and donations. Patron support and subsidies were rarer in Great Britain.

- Rest of Europe
  - **Russia.** The only Russian academy in my analysis is the one in Saint Petersburg. It was created under the direct patronage of Tsar Peter the Great, who fully financed and controlled it by retaining the right to approve new memberships. This academy was devoted to advancing Russia through the study of sciences and mathematics, along with history and humanities. The educational aspect was much more significant for this academy than for those in the rest of Europe.
  - **North Europe.** In the Netherlands, Sweden, Ireland, Belgium, Denmark, and Norway, official recognition was much more widespread than in the rest of Europe, with only a few informal or private academies. Nevertheless, the timing of granting

18. Edinburgh presents a complex case: the 52 years are calculated from the founding of its predecessor, the *"Philosophical Society of Edinburgh"*. Although it was inactive for a period, it later resumed with only minor changes in its membership, which is why we regard both societies as a single academy, established in 1731.

19. Francis Ysidro is considered the pioneer of utility theory with his development of indifference curves and the Edgeworth box.

recognition could vary from almost no wait to 19 years. This was the case for the Royal Dublin Society, which originated from a previous society in 1731 and obtained its royal charter only on April 2, 1750 (Berry 1915). The topics of research were very similar to the rest of Europe, ranging from natural science to practical applications to improve local society.

  - **East Europe.** In the Czech Republic both of the academies, in Prague and Olomouc, received official recognition, while in Switzerland the academies were mostly private societies (Zacek 1968; Kostlán 1996). Olomouc stood out for its open-minded atmosphere, where Catholics and Protestants collaborated and helped each other (Kostlán 1996). The topics of study focused on natural history and improving the efficiency of agriculture, which was especially important for Switzerland (Rübel 1947).[20]
  - **South Europe.** Both Spain and Portugal had one scientific academy each,[21] and both were officially recognized a year after their creation. Patronage was an important source of finance for these societies as well (Teixeira Rebelo da Silva 2015). The topics were similar, focusing on the advancement of the local region.

A.2 Academies' establishments

- **Acad Agen.** The *"Société des Sciences, arts et belles lettres"* was created in Agen (FRA) on January 1, 1776 and officially recogniez in 1788. The main goal was to provide a forum for intellectual discussion. It was focused on advancing knowledge in various fields, including arts, sciences, and belles-lettres (Lauzun 1900).

- **Acad Amiens.** The *"Académie des Sciences, belles lettres et arts"* was founded in Amiens (FRA) in February 1746 and officially recognized in 1750. It was initiated by Chauvelin German Louis (lawyer), Gresset Jean-Baptiste (poet), and d'Albert d'Ailly Michel Ferdinand (governor and scientist). It aimed to cultivate the spirit and shape taste through perfecting language, art, and knowledge. It had a structured governance with a hierarchy and specific tasks for its members (Académie des sciences, des lettres et des arts d'Amiens 1901).

- **Acad Angers.** The *"Académie des sciences, belles lettres et arts d'Angers"* was founded in Angers (FRA) on March 31, 1684, and received official recognition through

20. McClellan (1985) does not include any academy in Poland; however, the "Warsaw Society of Friends of Science" (*Towarzystwo Przyjaciół Nauk*) was established in 1800 and remained active until 1832. It is the earliest scientific academy recorded in Poland. Nevertheless, it is not included in current version of the database.

21. I refer to the list in McClellan (1985), which includes only one Spanish and one Portuguese academy. However, we recently found two other scientific academies in Madrid. The oldest is *Real Academia de Matemáticas de Madrid* created in 1582 and hence out of the academy movement I study in this paper. However, it may be argued that it contributed to its origins. The other is the Royal Spanish Academy, founded in Madrid in 1713 and dedicated to the study of all sciences (Real Academia de Ciencias Exactas, Físicas y Naturales de España 2024). Despite this, it is not included in the version of the database I use in this paper.

patent letters from Luis XIV in June 1685. It was established under the proposition of the mayor of Angers, Jacques Charlot (Bois 2021).

- **Acad Arras.** The *"Académie Royale de belles lettres"* was founded in Arras (FRA) on May 22, 1737, but received official recognition with patent letters in 1773. It was founded by the writer Pierre Antoine de La Place, the military engineer Victor-Hyacinthe d'Artus, and the counsellor Galhaut de Lassus. The academy sought to advance knowledge in literature and the arts. It had a structured governance with different categories of members and a protector. Maximilien de Robespierre joined the Academy of Arras in 1783, highly increasing the academy reputation (Académie des Sciences, Lettres et Arts d'Arras 2024).

- **Acad Arrezo.** The *"Accademia Aretina"* was established in Arezzo (ITA) in 1787. It was founded by a group of 22 scholars to revitalize the intellectual atmosphere that was lacking scientific and literary discussions following the closure of two previous academies (Maylender 1930, Vol 1). It is still active today.

- **Acad Auxerre.** The *"Académie des Sciences, arts et belles lettres"* was founded in Auxerre (FRA) in April 1749 with the permission of the King and support from M. de Caylus, the bishop of Auxerre. The academy aimed to advance knowledge in various fields, including ecclesiastical, civil, and natural history, physics, and agriculture. Arts and literature were also included in their pursuits. It had a director and a perpetual secretary, similar to the Paris Academy (Barres 1851).

- **Acad Barcelona.** The *"Reial Acadèmia de Ciències i Arts de Barcelona"* was founded in Barcelona (ESP) on January 18, 1764, and officially recognized on December 17, 1765. It was established by 15 founders, led by Francesc Subiràs i Barra, the first director. The academy sought to spread scientific and technical knowledge to the city. It is still active today (Reial Acadèmia de Ciències i Arts de Barcelona 2024).

- **Acad Berlin.** The *"Gesellschaft Naturforschender Freunde zu Berlin (GNF)"* was founded in Berlin (DEU) on July 9, 1773. It was established by the doctor and natural scientist Friedrich Heinrich Wilhelm Martini. The academy aimed to recruit and train young scientists, popularize science, and enhance the experimental study of natural history. It has a structured governance, including ordinary, honorary, and extraordinary members, and is still active today. The Prussian State was financing its activities (Böhme-Kaßler 2005).

- **Acad Besançon.** The *"Académie des Sciences, belles lettres et arts"* was founded in Besancon (FRA) in 1748, and in 1752 officially recognized with patent letters from Luis XV. It was established by Pourroy de Quinsonas (president of the Franche-Comte Parliament), the duc de Tallard (governor of Comte du Bourgogne), and Moreau de Beaumont (intendant of Franche-Comte). The academy sought to create a lasting and organized forum for advancing knowledge in the sciences and arts. It had a structured governance with a protector and 40 titular members (Defrasne et al. 2002).

- **Acad Beziers.** The *"Académie des Sciences et belles lettres"* was founded in Beziers (FRA) on August 19, 1723, and became a Royal Academy in 1766 with the receipt of patent letters. It was established by the lawyer Antoine Portalon, the physicist Dortous de Mairan, and the doctor Jean Bouillet (Académie de Béziers 2024).

- **Acad Birmingham.** The *"Lunar Society of Birmingham"* was founded in Birmingham (GBR) in 1766, following the "Lunar Circle" that formed in 1765. It primarily focused on science, both pure and applied, particularly as it related to industrial problems. Its members were mainly "provincial manufacturers and professional men."(Schofield 1963, p.3) The academy did not have a structured governance. It was known for its monthly meetings held near the full moon (Schofield 1963).

- **Acad Bologna.** The *"Istituto delle Scienze di Bologna"* was founded in Bologna (ITA) in 1714, although it had informal roots dating back to 1711 and a predecessor, the Inqueti Academy, established in 1690. The academy was founded by Count Luigi Ferdinando Marsili and Eustachio Manfredi, with papal patronage. It was established to foster reforms within the University. The academy's focus was on experimental sciences, medicine, physics, chemistry, and mathematics. It was the first Italian academy to have academicians employed and paid by public funds (Ercolani 1881).

- **Acad Traccia.** The *"Accademia della Traccia"* was founded in Bologna (ITA) in 1666. It was established by Abate Carlo Sampieri, following the influence of Geminiano Montanari, a professor at the University of Bologna and a corresponding member of the Cimento Academy. The academy was created as an imitation of the Cimento Academy and focused on experimental physics (Maylender 1930, Vol 5).

- **Acad Bordeaux.** The *"Académie royale des sciences, belles-lettres et arts"* was founded in Bordeaux (FRA) in 1712, through letters patent issued on September 5th. The academy's aim was to advance knowledge across a spectrum of disciplines, including belles-lettres, sciences, and arts. Natural history gained prominence with the establishment of the Société d'Histoire Naturelle in 1796. It had a structured governance with ordinary members, associate members, directors, secretaries, and a treasurer (Courteault 1912).

- **Acad Bourg-en-Bresse.** The *"Académie des Sciences, belles lettres et arts"* in Bourg-en-Bresse (FRA) was initially established in 1755 and then reconstructed in 1783. It was founded by a group of notables to foster intellectual pursuits and the exchange of knowledge. The society focused on science, agriculture, letters, and social issues. It had a structured governance, with a Director, Vice-Director, and a perpetual Secretary (Allombert 1899).

- **Acad Bratislava.** The *"Pressburgischen Gesellschaft der Freunde der Wissenschaften"* was the first Hungarian society. It was created in 1752 by a group of protestant scholars, guided by Karl Gottlieb Windisch, and it was active only until 1763 (Réka and Tüskés 2017).

- **Acad Brest.** The *"Académie Royale de Marine"* was founded in Brest (FRA) in 1750 and officially recognized on July 30, 1752. It received royal status in 1769. It was founded by Sébastien Bigot de Morogues, a naval officer and scholar. The academy sought to study everything related to the navy, including naval officer training, shipbuilding techniques, research in mathematics, physics, arts, and natural history, and the compilation of a "Dictionary of Marine." It had a structured governance with honorary academicians, free/associate academicians, correspondents, ordinary academicians, and adjunct academicians (Académie Royale de Marine 2024).

- **Acad Bruxelles.** The *"Académie Royale et Imperiale des Sciences et belles lettres"* was founded in Bruxelles (BEL) in 1769 as an informal society and officially recognized as a society with patent letters from Maria Theresa in 1772. It was founded by Count Cobenzl, who was inspired by the advice of Professor Schoëfflin. The academy aimed to revive interest in literature in the Austrian Netherlands, which was seen as declining. It had a structured governance with honorary members and ordinary academicians (Hasquin 2009).

- **Acad Caen 1.** The *"Académie de physique de Caen"* was founded in Caen (FRA) in 1652, but received patent letters in 1705. It was established by Moisant de Brieux, de Grentemesnil, de Prémont, Halley, Vicquemand, and Bochart. The academy's initial focus was on literature and philosophy, but shifted to scientific matters after the creation of the Royal Society and the Academy of Sciences. It had a structured governance, with a director, a secretary, and a permanent reader (Pontville 1997).

- **Acad Caen 2.** The *"Académie des arts et belles lettres"* was founded in Caen (FRA) in 1662. It was never officially recognized by the King but the ministry Colbert expressed the royal approval. It was established by Pierre-Daniel Huet, who was inspired by the mostly literary works of other academies. The academy focused on physical and mathematical sciences. It had a structured governance and a clear set of objectives for its research (Pontville 1997).

- **Acad Châlons-en-Champagne.** The *"Académie des Sciences, arts et belles lettres"* was founded in Châlons-en-Champagne (FRA) in 1750, officially recognized in 1753, and received patent letters in 1775. Its motto was "L'Utilité," emphasizing practical applications of knowledge. It sought to cultivate belle-lettres, arts, sciences, and research in natural history. It had a structured governance with honorary academicians, titular academicians, "Agrégés pour les Arts," and associate free members (Menu 1869).

- **Acad Cherbourg.** The *"Société Académique"* was founded in Cherbourg (FRA) on January 14, 1755, and officially recognized in 1775. It was established by Jean-François Delaville and other 5 scholars to share knowledge and improve the reputation of the city. It was focused on the history of the local region and archeology, and naval matters also entered into its discussions. It had a structured governance similar to the Paris Academy(Académie De Cherbourg 2024).

- **Acad Cimento.** The *"Accademia del Cimento"* was founded in Firenze (ITA) in 1651 as an informal society and officially established in 1657. It was founded by Grand Duke Ferdinando II and his brother Leopoldo, who advocated for the free application of the "New Science." The academy focused on experimental physics, meteorology, and astronomy. It was considered innovative in its methodology (Middleton 1971).

- **Acad Florence 2.** The *"Accademia Botanica"* was founded in Firenze (ITA) in 1733 and officially recognized in 1739. It was established by Vincenzo Capponi as secretary of the earlier Botanic Society. It focused on scientific research and studies, with a particular interest in botany and the management of the botanic gardens in Florence (Maylender 1930, Vol 1).

- **Acad Florence 3.** The *"Reale accademia dei Georgofili"* was founded in Firenze (ITA) in 1753. The creation of the academy was prompted by an essay by Abbot Ubaldo Montelatici, who also incorporated the previous Botanic Academy of Florence in 1783. It was established to promote research in agronomy, especially to address issues with famine and food shortages in Italy. It had a structured governance (Tabarrini 1856).

- **Acad Clermont Ferrand.** The *"Académie des Sciences, arts et belles lettres"* was founded in Clermont-Ferrand (FRA) in 1747, officially recognized in 1750, and granted patent letters in 1780. The academy was established by Rossignol, Dufraisse de Vernines, and Queriau, with the aim of promoting science and society through research in natural history and literature. The academy had a structured governance (Mège 1884).

- **Acad Copenhagen.** Founded in Copenhagen (DNK) on November 13, 1742, and granted royal status in 1743, the *"Det Konelige Danske Vidensakkernes Selskab"* was established by Johan Ludvig Holstein, Hans Gram, Erik Pontoppidan, and Henrik Henrichsen. The academy aimed to strengthen the position of science in Denmark and promote interdisciplinary understanding. It had a structured governance with a president and a secretary (Lomholt 1950).

- **Acad Cosenza.** The *"Accademia dei Pescatori Cratilidi"* was founded in Cosenza (ITA) in 1753, inaugurated in 1756, and officially approved in 1758. It was established by Gaetano Greco, who wanted to create a new academy following the decline of the previous "Cosentina" academy. The academy's name derived from the Crati river and its motto was "Grandia ab exiguo" (i.e., "from small to large") (Maylender 1930, Vol 4).

- **Acad Dantzig.** The *"Danziger Naturforschenden Gesellschaft"* was founded in Danzig (POL) on January 2, 1743. It was established during an informal gathering, with Daniel Gralath proposing the idea. The academy aimed to advance the understanding of natural phenomena through empirical investigation. It had a structured governance with different types of members and a permanent location (Schumann 1893).

- **Acad Derby.** The *"Derby Philosophical Society"* was founded in Derby (GBR) in February 1783. It's heavily implied that Erasmus Darwin was a driving force behind the society, he was also member of the Lunar Society of Birmingham. The academy aimed to promote knowledge and discussion of natural philosophy and provide access to scientific literature through its library (Sturges 1978).

- **Acad Dijon.** The *"Académie des Sciences, Arts et Belles-Lettres de Dijon"* was founded in Dijon (FRA) in 1725, established through the will of Hector-Bernard Pouffier (dean of the Parliament of Burgundy) and officially recognized by the King in 1740. It primarily focused on scientific subjects like medicine, natural sciences, and applied sciences, but also included a quarter of its members working in the humanities. It had a structured governance and was supported by the regional State of Burgundy (Milsand 1871).

- **Acad Dublin.** The *"Philosophical Society and Medica-Philosophical Society"* in Dublin (IRL) evolved from a previous academy founded in 1683, which is from when I consider it active. However, it became the RDS (Royal Dublin Society) on June 25, 1731. It received royal recognition on April 2, 1750. The Dublin Society focused on improving the economy and the lives of the Irish people by promoting husbandry, manufactures, and useful arts. It had a structured governance with ordinary, honorary, and life members, and received funding through member subscriptions and parliamentary grants (Berry 1915).

- **Acad Irish.** The *"Royal Irish Academy"* was founded in Dublin (IRL) in 1785 and granted a royal charter in 1786. This academy, the first in Ireland to balance research in both sciences and humanities, aimed to promote and investigate the sciences, polite literature, and antiquities. It had a structured governance with scientific and literary members, plus a rotating president (Royal Irish Academy 2024).

- **Acad Edinburgh.** The *"Royal Society of Edinburgh"* was officially founded in Edinburgh (GBR) in 1783, with its first meeting on June 23, 1783. It received a Royal Charter on March 29. Many members of the earlier Philosophical Society became members of the RSE. This earlier society was founded in 1731, which will be the date from when I consider the academy active. It aimed to advance learning and useful knowledge, focusing on natural philosophy and literature. It had a structured governance (Emerson 1981).

- **Acad Erfurt.** The *"Academia electoralis moguntina scientiarum utilium"* was founded in Erfurt (DEU) on July 19, 1754. Its creation was supported by its patron, the Elector of Mainz, Johann Friedrich Carl. The Academy aimed to promote useful sciences, like including natural sciences, mathematics, law, history, and the arts (Kiefer 2004).

- **Acad Gorlitz.** The *"Oberlausitzischen Gesellschaft der Wissenschaften"* was founded in Gorlitz (DEU) on April 21, 1779. It was established by Karl Gottlob Anton, who proposed the idea to Adolf Traugott von Gersdorf. The academy aimed to promote the study of natural science and history in Upper Lusatia and foster scientific research and scholarship (Oberlausitzische Gesellschaft der Wissenschaften 2024).

- **Acad Goteborg.** The *"Kungl. Vetenskaps-och Vitterbets Samhallet"* was founded in Goteborg (SWE) in the 1770s and obtained the royal title from King Gustav III in 1778. It was established by Johan Rosen, a schoolmaster, and later by Martin Georg Wallenstrale and Carl Fredrik Scheffer. The society aimed to promote scientific exchange among different disciplines and to foster the study of sciences for the benefit of the local community.

- **Acad Göttingen.** The *"Akademie der Wissenschaften zu Göttingen"* was established in Göttingen (DEU) in 1752 as the *"Königliche Societät der Wissenschaften"* (Royal Society of Sciences). It was founded under the patronage of King George II of Great Britain and Elector of Hanover. The academy aimed to advance learning and knowledge (Krahnke 2001).

- **Acad Grenoble.** The *"Académie Delphinale"* was founded in Grenoble (FRA) in 1772, received patent letters in 1780, and formally adopted its name in March 1789. It was established by a group of enlightened and noble men who purchased books following the death of the bishop of Grenoble. The academy focused on enhancing humanities like history, letters, and arts, but also included sciences and technical matters (*Lettres Patentes* 1790).

- **Acad Haarlem.** The *"Hollandsche Maatschappij der Wetenschappen"* was founded in Haarlem (NLD) in 1752. It was established by seven leading citizens of Haarlem with the aim of promoting science. The academy has a twofold structure, with social members (representing society's interest in science) and scientific members (a group of scientists). It is still active today (Hollandsche Maatschappij der Wetenschappen 2024).

- **Acad Tweede.** The *"Teylers Tweede Genootschap"* was founded in Haarlem (NLD) in 1756 and officially opened in 1778. It was established based on the will of Pieter Teyler van der Hulst. The academy aimed to promote science and the arts through discussion and prize competitions.

- **Acad Bad-Homburg.** The *"Société patriotique de Hesse-Hamburg pour l'encouragement des connaissances et des moeurs"* was founded in Bad-Homburg (DEU) in 1775, with statutes adopted in 1777. The academy aimed to promote "knowledge and morals" (from the name of the academy) and therefore focused on intellectual and ethical development (Société Patriotique de Hesse-Hombourg 1777).

- **Acad Investiganti.** The *"Accademia degli Investiganti"* was founded in Napoli (ITA) in 1650 by Cornelio Tommaso and di Capua Leonardo. It was inspired by the Lincei academy in Rome, and sought to study and investigate "things of nature." It primarily focused on natural philosophy before 1735 and on literary matters after that (Maylender 1930, p.369, Vol3).

- **Acad Naples.** The *"Reale Accademia della Scienze e Belle-Lettere"* was founded in Napoli (ITA) in 1778 and officially established in 1780. It was established by King Ferdinando IV of Borbon to advance public education, progress, and human conviction.

It had a structured governance with a president, vice-president, treasurer, fiscal lawyer, and secretary, and received financial support from a royal annuity (Maylender 1930, Vol 5).

- **Acad Jena.** The *"Naturforschende Gesellschaft zu Jena"* was founded in Jena (DEU) in 1793 by August Johann Georg Karl Batsch. The academy aimed to support members in choosing a career through natural-historical studies and to contribute to their moral advancement (Böhme-Kaßler 2005).

- **Acad La Rochelle.** The *"Académie Royale des Belles lettres"* was founded in La-Rochelle (FRA) in 1730 and officially recognized in 1744. It was founded by Jean-Jacques Franc de Pompignan, who was considered the soul of the academy. The academy focused on the study of literature and eloquence, specifically poetry. It had a structured governance with a director and a permanent secretary (Flouret 2009).

- **Acad Lausanne.** The *"Société des sciences physiques"* was founded in Lausanne (CHE) on March 10, 1783. It aimed to cultivate interest in natural history and to study all that concerns the sciences, arts, agriculture, industry, commerce, and the local patrimony (Société des sciences physiques de Lausanne 1789).

- **Acad Leipzig.** The *"Fürstlich Jablonowskische Gesellschaft"* was founded in Leipzig (DEU) in 1768. Further sources have been asked to the current academy.

- **Acad Leopoldina.** The *"Deutsche Akademie der Naturforscher Leopoldina"* was founded in Halle (DEU) on January 1, 1652, and officially recognized by the Emperor Leopold I in August 1677. It was established by four physicians: Bausch, Fehr, Metzger, and Wohlfahrth. The academy aimed to explore nature for the glory of God and the good of mankind. It had a structured governance and received special privileges from the Emperor Leopold I (Deutsche Akademie der Naturforscher Leopoldina 2024).

- **Acad Halle.** The *"Gesellschaft der Naturforschenden Freunde"* was founded in Halle (DEU) in 1779 by some theology students with the support of Friedrich-Wilhelm von Leysser, who became the first president. The academy aimed to increase acceptance and interest in natural history among students (Böhme-Kaßler 2005).

- **Acad Lisbon.** The *"Academia real das ciencias de Lisboa"* was founded in Lisboa (PRT) in 1779 and officially recognized by the King in 1780. It was established by the Duke of Lafões, who provided significant financial support. The academy aimed to promote scientific knowledge and cultural development within Portugal. It had a structured governance and was primarily funded through royal patronage and private donations (Teixeira Rebelo da Silva 2015).

- **Acad Lund.** The *"Kungl Fysiografiska Sallskapet"* was founded in Lund (SWE) in 1772, and officially recognized by King Gustav III in 1788. It was established by Theologian Hesselen, doctor in Medicine Barfort, and Magistrat Retzius. The academy aimed to encourage a passion for science in youth and to associate those who shared this passion to produce useful findings for the general public. It was devoted to natural history and economics (Gertz 1940).

- **Acad Lyon.** The *"Académie Royale des Sciences, belles-lettres et arts de Lyon"* was founded in Lyon (FRA) in 1700, and officially recognized with patent letters in 1724. It was established by Claude Brossette and other notable citizens, aiming to promote the advancement of science, art, and literature in Lyon and the region. It had a structured governance with a director and a vice-director (Académie Royale des Sciences, belles-lettres et arts de Lyon 2024).

- **Acad Manchester.** The *"Literary and philosophical society"* was founded in Manchester (GBR) in 1781. The academy was established by Thomas Percival and a group of men who sought to improve the living standards of the city, especially for the working class. It aimed to improve the local society and bring it towards more unity and progress (Manchester Literary and Philosophical Society 1896).

- **Acad Mannheim 1.** The *"Academia Electoralis Scientiarum et Elegantiorum Literarum Theodoro-Palatina"* was founded in Mannheim (DEU) between October 15–20, 1763. The academy was established by Karl Theodor, the Elector Palatine of Bavaria, and effectively organized by the French historiographer Johann Daniel Schöpflin and Leopold Maximilian, Baron of Hohenhausen, the Prince's chamberlain. The academy aimed to promote both science and the humanities. It had a structured governance system with a president and a secretary appointed for life (Cassidy 1985; Academiae Electoralis Scientiarum et Elegantiorum Literarum Theodoro-Palatina 1766). Another relevant institution, the *"Societas Meteorologica Palatina"*, was also founded in Mannheim (DEU), on September 5, 1780. It was likewise initiated and supported by Elector Palatine Karl Theodor and strongly advocated by scholars Father Hemmer and Stefan von Stengel. This academy focused on meteorology, aiming to connect international meteorological stations equipped with similar instruments to allow for comparative measurements. It, too, had a structured governance system and received financial support from Karl Theodor (Cassidy 1985). I consider these two academies as a unique one, especially given the presence of intermediary societies and institutions that bridged the two, paving the way for the latter meteorological society.

- **Acad Mantua.** The *"Accademia Virgiliana"* was founded in Mantova (ITA) in 1686. It took the name *"Royal Academy of Sciences, Lettres, and Arts"* in 1768. It was established by the co-regnant Maria Teresa and Giuseppe II, with the aim of continuing intellectual development in the Austrian Lombardy. It initially focused on theology and letters, but later expanded to include sciences useful to society. It had a structured governance with members and a patron (Maylender 1930, Vol 5).

- **Acad Marseille.** The *"Académie des belles-lettres, sciences et arts"* was founded in Marseille (FRA) in August 1726 and officially recognized by King Luis XV with patent letters in 1766. The academy's primary goal was to promote French language and literature in the region. It had a structured governance (Académie des Sciences Lettres et Arts de Marseille 2024).

- **Acad Messina.** The *"Accademia Peloritana dei Pericolanti"* was founded in Messina (ITA) in 1728. It was established by Paolo Aglioti and others, following the death of

Pietro Guerriera who had initially pushed for a similar academy. The academy focused on Letters, Moral and Natural Philosophy but also on Mathematics, Geography,and Duel and Knights subjects. After 10 years of activity, it focused primarily on scientific matters. It had a structured governance (Accademia Peloritana dei Pericolanti 2024).

- **Acad Metz.** The *"Société Royale des Sciences et Arts"* was founded in Metz (FRA) in April 1757 and received patent letters in July 1760. The Marshal-Duke Charles Louis Auguste Fouquet de Belle-Isle was its founder and protector. The academy aimed to advance sciences, letters, and arts to make them useful to the local society of Metz.

- **Acad Middelburg.** The *"Zeeuwsch Genootschap der Wetenschappen"* was founded in Vlissingen (NLD) in 1765 and officially founded in 1769. It was established to provide a local organization for scientific practice and to promote the ideas of the Enlightenment (Zeeuwsch Genootschap der Wetenschappen 2024).

- **Acad Modena.** The *"Accademia ducale dei Dissonanti di Modena"* was founded in Modena (ITA) in 1680 and formally active in 1684. It was established by the citizens of Modena to ask for the reopening of the University and the creation of the Academy. The academy was initially active only in humanities and letters, but added a scientific section in 1790 (Accademia Nazionale di Scienze, Lettere e Arti di Modena 2023).

- **Acad Rangoniana.** The *"Accademia Rangoniana"* was founded in Modena (ITA) in 1783. It was established by Gherardo Aldobrandino Rangone, who was already financing and hosting scientific experiments of Michele Rosa, who worked on blood transfusions among animals. The academy focused on scientific experiments, mechanics, and physics (Maylender 1930, Vol 4).

- **Acad Montauban** The *"Académie des belles lettres"* was founded in Montauban (FRA) in 1730 and officially recognized in 1744. The soul of the academy was Jean-Jacques Franc de Pompignan. The academy focused on literary subjects, particularly poetry and letters (Forestié 1888).

- **Acad Montpellier** The *"Société Royale des Sciences"* was founded in Montpellier (FRA) in 1706. The King wanted to reassure his domain into the Mediterranean coast during the Spanish Succession. It was initially focused on mathematics, anatomy, chemistry, botany, and physics. It played a role in compiling the Encyclopédie of Diderot and d'Alembert (Société Royale des Sciences 2024; Dulieu 1975).

- **Acad Munich** The *"Bayerische Akademie der Wissenschaften"* was founded in Munchen (DEU) on October 12, 1758 and officially recognized on June 25, 1759. It was established by Johann Georg von Lori and aimed to advance all useful sciences in Bavaria (Bayerische Akademie der Wissenschaften 2024).

- **Acad Nancy** The *"Société des Sciences et belles lettres - Académie Stanislas"* was founded in Nancy (FRA) on December 28, 1750, and received patent letters on December 27, 1751. It was founded by Stanislas Leszczynski, the king of Poland and duke of Lorraine and Bar. It aimed to enhance the study of sciences and literature and culture. It created a public library too (Stanislas 2024).

- **Acad Nimes** The *"Academie Royale de Nimes"* was founded in Nimes (FRA) on March 28, 1682, and received patent letters in August 1682 from Luis XIV. It was established by Jules de Fayn, and aimed to enhance the local patrimony by studying antiquities and the local language (Nicolas 1854).

- **Acad Nuremberg** The *"Cosmographical Society"* was founded in Nurnberg (DEU) in 1747.

- **Acad Olmouc.** The *"Societas Eruditorum Incognitorum"* was founded in Olomouc (CZE) in 1747 by Josef Petrash, who had traveled the world as a soldier and poet. The academy aimed to free higher education from the influence of Jesuits. It sought to cultivate the fine sciences and liberal arts (Kostlán 1996).

- **Acad Orleans.** The *"Académie Royale des Sciences, arts et belles lettres"* was founded in Orleans (FRA) on April 23, 1781, and received patent letters on March 20, 1784. The academy was established by a group of 10 scholars. It aimed to promote physics and natural sciences (Nicolas 1908).

- **Acad Oxford.** The *"Oxford Philosophical Society"* was founded in Oxford (GBR) in 1645 as an informal society and formally established in 1651 by John Wilkins and other natural philosophers. It was inspired by the London group of natural philosophers, and the remnants of William Harvey's circle at Oxford. The academy focused on magnetic experiments, dissections, antiquities, astronomy, and geometry (Gunther 1925; Applebaum 2000).

- **Acad Padua.** The *"Accademia dei Ricovrati/Accademia di Scienze, lettere ed Arti"* was founded in Padova (ITA) in 1599, which is still considered a Reinassance Academy (McClellan 1985). It became the "Accademia di Scienze, lettere ed Arti" in 1779, when the Venetian Senate ordered its fusion with the *Accademia di Arte Agraria*. It was founded by Federico Cornaro, and Galileo was a founding member of the earlier Ricovrati Academy. The academy aimed to promote the study of humanities and science via the experimental approach (Maggiolo 1983). The academy enter into my analysis only from 1779.

- **Acad Palermo.** The *"Accademia Palermitana"* was founded in Palermo (ITA) in 1718, though it only received recognition in 1752. It was established by Pietro Filangieri and other enlightened men. The academy aimed to tell Sicily's story and advance letters and sciences (Maylender 1930, Vol 1).

- **Acad Palma.** The *"Accademia Boreliana"* was founded in Palmi (ITA) in 1673 by Gio. Alfonso Borelli. It focused on physics and natural history, especially on the respiration moto Maylender (1930, Vol 1).

- **Acad Pau.** The *"Académie Royale des Sciences et beaux arts"* was founded in Pau (FRA) in 1718.

- **Acad Prussia.** The *"Königlich-Preußische Akademie der Wissenschaften"* was founded in Berlin (DEU) on July 11, 1700, and immediately officially recognized. It was established by Gottfried Wilhelm von Leibniz, with sponsorship from the noble Hohenzollern family. The academy aimed to advance both humanities and natural sciences (Königlich-Preußische Akademie der Wissenschaften 2024; de la Croix, Eisfeld, and Ganterer 2021).

- **Acad Prague.** The *"Regia Societas Scientiarum Bohemica"* was founded in Praha (CZE) in 1769 and officially recognized in 1790. The academy was established by count Frantisek Josef Kinsky and Ignac Born. It aimed to diffuse the experimental approach and critical thinking but also Bohemian History (Zacek 1968).

- **Acad Reggio d'Emilia.** The *"Accademia degli Ipocandriaci"* was founded in Reggio-Emilia (ITA) in 1746. It was established by Achille Crispi, the captain of the Duke Francesco III. The academy had a structured governance (Maylender 1930, Vol 3).

- **Acad Roma.** The *"Accademia di Fisico-Mathematica*" was founded in Roma (ITA) on July 6, 1677. It was established by Giovanni Giustino Ciampini, who provided the academy with tools and machines for scientific experiments. The academy focused on natural sciences and experiments, including anatomy, physics, mathematics, and mechanics (Maylender 1930, Vol 3).

- **Acad Rotterdam.** The *"Battafsch Genootschap der Proefonderwindelijke Wijsbegeerte"* was founded in RotterdamNLD on May 14, 1769 (Lieburg 1985).

- **Acad Rouen.** The *"Académie Royale des Sciences, belles lettres et arts"* started informally in Rouen (FRA) in 1736 and formally with patent letters from Luis XV on June 17, 1744. It was established by Fontanelle and Le Cornier de Cideville, and focused on botany (Gosseaume 1985).

- **Acad Rovereto.** The *"Imperiale Regia Accademia degli Agiati"* was founded in Rovereto (ITA) in 1750, officially recognized in 1753. It was established by Giuseppe Valeriano Vannetti and other four important local scholars. The academy was initially focused on letters, history, and science, but later expanded to include agricultural research (Accademia Roveretana degli Agiati di Scienze, Lettere ed Arti 2024).

- **Acad Paris.** The *"Académie Royale des Sciences"* was founded in Paris (FRA) in the spring of 1666. The academy was established by Minister Colbert under Luis XIV, who fully funded its creation and operations. The academy was a symbol of royal patronage. Its focus was on natural philosophy, mathematics, and the application of the laws of nature to practical reforms (Académie Royale des sciences 2024).

- **Acad Siena.** The *"Reale Accademia della scienze di Siena"* was founded in Siena (ITA) in 1690. It was established by Pirro Maria Garieli, a professor at the University of Siena. The academy focused on natural science, philosophy, medicine, and poetry Maylender (1930, Vol 3).

- **Acad Spalding.** The *"Philosophical Society"* was founded informally by Maurice Johnson in 1710 to foster the study of archaeology and antiquarianism. Two years later the organization of the society became more formal with structured meetings and transcription of the minutes (Spalding Gentlemen's Society 2025).

- **Acad Stockholm.** The *"Kungliga Vetenskapsakademien"* was founded in Stockholm (SWE) on June 2, 1739. It was modelled after the Royal Society of London and the Académie Royale des Sciences in Paris. The academy was created as an independent, non-governmental scientific society. It was primarily focused on natural sciences and mathematics (Kungliga Vetenskapsakademien 2024).

- **Acad St Petersburg.** The *"Academia Scientiarum Imperialis Petropolitanae"* was founded in Saint-Petersburg (RUS) in 1724. It was established by Peter the Great, who was inspired by academies in Europe. The academy aimed to bring the Russian Empire into the modern era. It was initially focused on mathematics, physical sciences, and humanities, and included training in scientific subjects (de la Croix and Doraghi 2021; Gordin 2000).

- **Acad Toulouse.** The *"Académie Royale des Sciences, inscriptions et belles lettres"* was founded in Toulouse (FRA) in 1640-1645/1665-1685 as an academic conference and officially recognized in 1746. It was established by Sage Antoine, Carrière, and Gouazé Pierre. The academy aimed to advance sciences, inscriptions, and belles-lettres. It had a structured governance (Taillefer 1984).

- **Acad Trondheim.** The *"Det Kongelige Norske Vienskabers Selskab"* was founded in Trondheim (NOR) in 1760 and received royal recognition in 1767. It was established by Bishop Johan Ernst Gunnerus, rector Gerhard Schoning, and councilor Peter Friderich Suhm to create an institutional space for enhancing and spreading the New Science (Schmidt 1960).

- **Acad Turin.** The *"Accademia delle scienze di Torino"* was founded in Torino (ITA) in 1757 and officially recognized in 1783. It was founded by Joseph-Louis Lagrange, Giuseppe Francesco Cigna, and Giuseppe Angelo Saluzzo. The academy aimed to advance scientific research that could not find enough space within the university of the city (Accademia delle Scienze di Torino 2023).

- **Acad Filopatria.** The *"Accademia Filopatria"* was founded in Torino (ITA) on July 2, 1782. It was established by a group of enlightened men in the city of Turin. The academy focused on antiquities and the history of the homeland, including letters, poetry, and moral values but also on public economics, and sciences (Campori 1887).

- **Acad Uppsala.** The *"Societatis Regiae Scientiarum Upsaliensis"* was founded in Uppsala (SWE) in 1710. It was reorganized in 1719, and received royal recognition on November 11, 1728. It was founded by the librarian Eric Benzelius. The academy initially focused on scientific discussions and later established a scientific journal (Karlberg 1977).

- **Acad Uppsala.** The *"Cosmographiska sällskapet"* was founded in Uppsala (SWE) in 1758 by Anders Akerman and other enlightened men. The academy focused on cosmography, constructing globes for the earth and the sky.

- **Acad Utrecht.** The *"Provinciaal Utrechtsh genootschap van Kunsten en Wetenschappen"* was founded in Utrecht (NLD) in 1773 and officially founded in 1778. It was established by Mr. J. van Haeften and L. Praalder. The academy aimed to preserve local heritage, modern art, and publications, as well as to develop and improve science (Singels 1923).

- **Acad Valence.** The *"Société Académique et Patriotique"* was founded in Valence (FRA) in 1784, receiving King's Letters Patent in December 1786. The academy aimed to advance sciences, arts, and belles-lettres. It had a structured governance and it organized 3 prizes every year (Colonjon 1866).

- **Acad Venice.** The *"Accademia dei Planomaci"* was founded in Venezia (ITA) circa 1740. It was established by the abate D. Meodoro Rossi. The academy published the *"Novelle Letterarie,"* a journal of reviews and critiques of new works. It had a structured governance with a protector (Maylender 1930, Vol 4).

- **Acad Verona.** The *"Societa Italiana delle Scienze"* was founded in Verona (ITA) in 1766 and officially established in 1782. It was founded by Antonio Mario Lorgna. The academy focused on scientific matters and published the periodical *"Memorie accademiche"* (Maylender 1930, Vol 1).

- **Acad Zurich.** The *"Naturforschende Gesellschaft"* was founded in Zurich (CHE) in 1745 and formally established in 1746. It was established by Johanes Gessner. The academy aimed to provide a space for students and personalities who studied abroad to return home and share their knowledge. It had a structured governance and relied heavily on member contributions (Rübel 1947).

- **Royal Society.** The *"Royal Society of London"* was founded in London (GBR) in 1660 and officially established in 1662. It was established by John Wilkins and other polymaths. The academy focused on natural philosophy and experiments, including trade, manufacture, and crafts, as well as scientific experiments. It had a structured governance with a president, a treasurer, and two secretaries (The Royal Society 2024).

- **Acad Botanical.** The *"Botanical Society"* was founded in London (GBR) in 1721. It was established by Johann Jakob Dillen and John Martyn to increase knowledge of and spread interest in minerals, plants, and animals.

- **Acad Linnaus.** The *"Linnean Society of London"* was founded in London (GBR) in 1788 by James Edward Smith, Samuel Goodenough, and Thomas Marsham. The academy was named after Carl Linnaeus, who is considered the father of taxonomy. The academy was devoted to natural history, focusing on the evolution theory and biological taxonomy.

B Descriptive Statistics

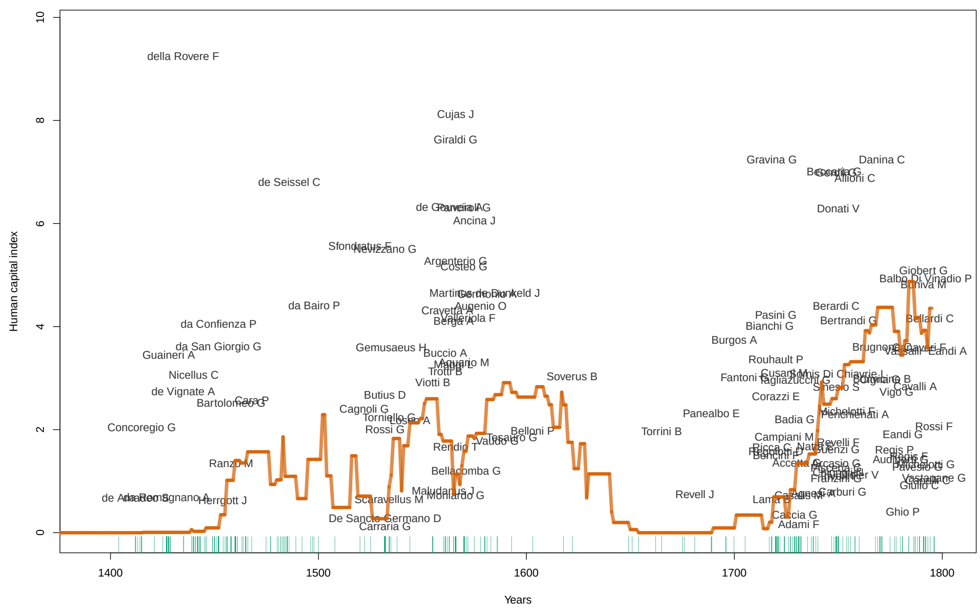


Figure 8: Notable scholars at the University of Turin.

The figure displays ordinary members of the University of Turin with a non-negative individual quality index. Vertical green lines represent the distribution of scholars over time, including those with a quality index of zero. The orange line shows the evolution of the university's aggregate quality. Source: Zanardello (2022).

Table 2: Summary Statistics: Founders vs. Non-Founders of Academies.

	(1) **Founders**	(2) **Not Founders**	(3) **t-test**
Obs.	413	16860	
	μ	μ	p-value
Quality	2.67	2.41	0.426
Age at death	68	67	0.189
Age at Appointment	36.7	37.3	0.611
Years Active	19.5	16	0.338
Distance Birthplace-Academy	220	344	0.003
Distance Academy-Death place	317	421	0.260
Distance Birthplace-Death place	248	368	0.074
Year FE⋆			✓

Note: Column (1) reports summary statistics for scholars who founded an academy; Column (2) shows statistics for those who did not. Column (3) reports p-values from t-tests comparing the means between the two groups, controlling for year fixed effects.

⋆Year fixed effects refer to the scholar's initial year of activity.

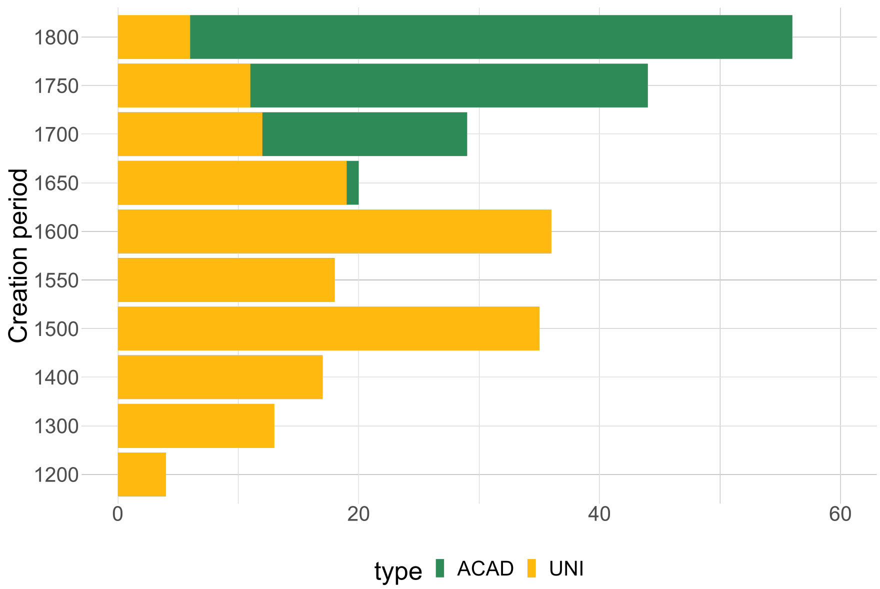


Figure 9: Creation Timeline of Academies and Universities.

Note: The figure shows the cumulative number of institutions established up to the year indicated on the y-axis. Universities (yellow) exhibit a more heterogeneous timeline, with establishments beginning in the 11^{th} century. In contrast, academies (green) began to proliferate in the second half of the 17^{th} century.

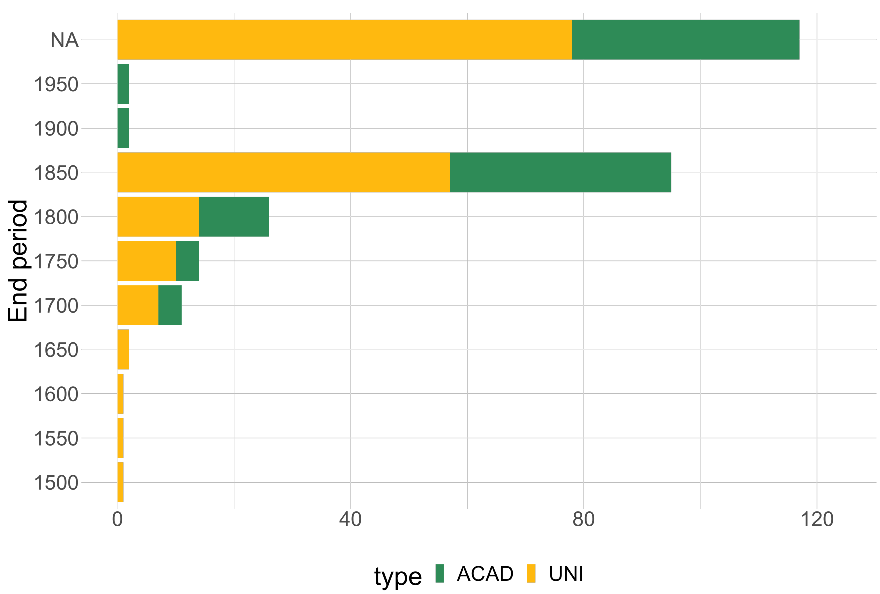
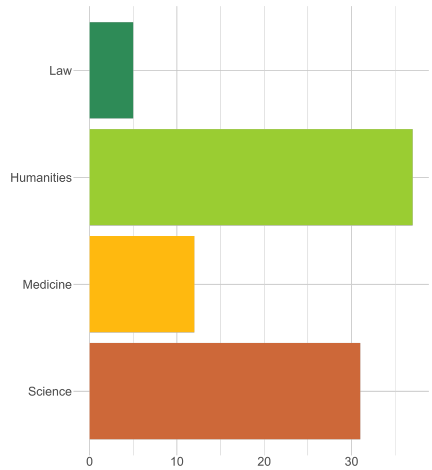
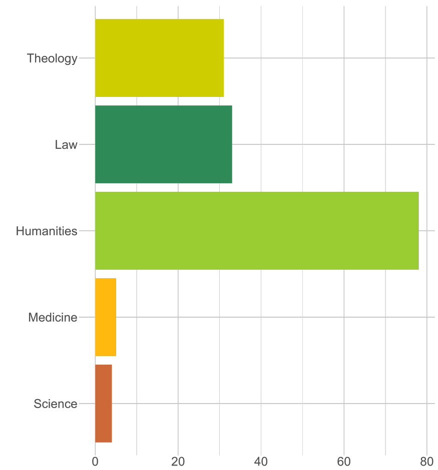


Figure 10: Closure Timeline of Universities and Academies.

Note: The figure shows the number of institutions that closed in the 50 years preceding the year indicated on the y-axis. Universities are shown in yellow; academies in green. *NA* refers to institutions that never closed. Most institutions remained open before 1800; a wave of closures occurred between 1800 and 1850, although the majority are still active today.



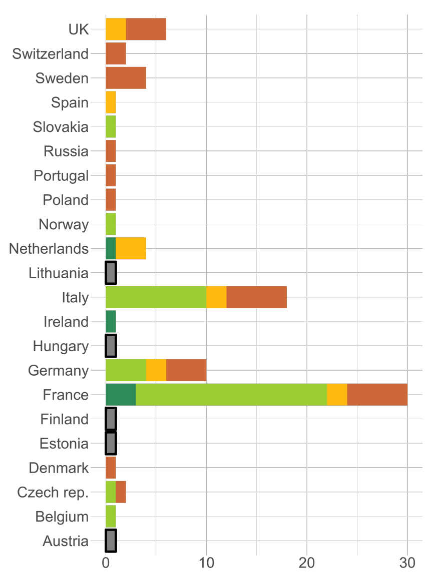
(a) Academies



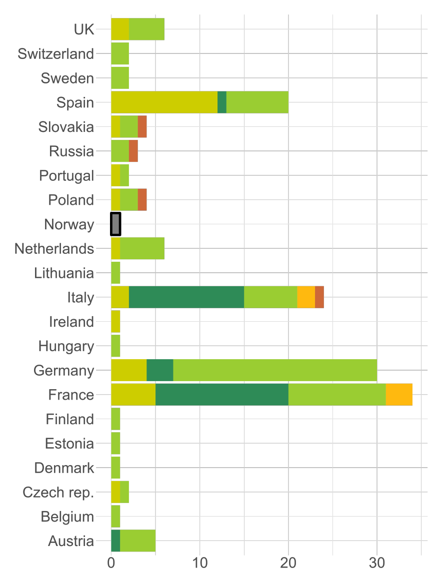
(b) Universities

Figure 11: Institutions by Main Field of Study.

Note: Number of institutions by their main field of study, defined as the field in which the majority of the institution's members were active.



(a) Academies



(b) Universities

Figure 12: Institutions by Major Field of Study per Country.

Note: Number of institutions by major field of study, shown by country. The major field of study refers to the most commonly studied field within each institution, without applying a minimum threshold. Science is shown in red, Medicine in gold, Humanities in light green, Law in dark green, and Theology in lime. Countries without any identified institutions are shown in grey and outlined with a solid black border.

Table 3: Types of Academies by Country.

	(1) **ACAD**	(2) **Scientific ACAD***	(3) **Literary ACAD****	(4) **Long-lasting ACAD**	(5) **Big ACAD**
Europe	84	43	40	68	62
France	30	11	19	24	22
Italy	18	8	9	15	12
Germany	10	6	4	9	7
UK	6	6	0	5	5
Belgium	1	1	0	0	1
Czech Republic	2	1	1	1	1
Denmark	1	0	1	1	1
Ireland	1	0	1	1	1
Netherlands	4	2	2	4	3
Norway	1	0	1	1	1
Poland	1	1	0	1	1
Portugal	1	0	1	1	1
Slovakia	1	0	1	0	0
Spain	1	1	0	1	1
Sweden	4	4	0	4	3
Switzerland	2	2	0	1	2

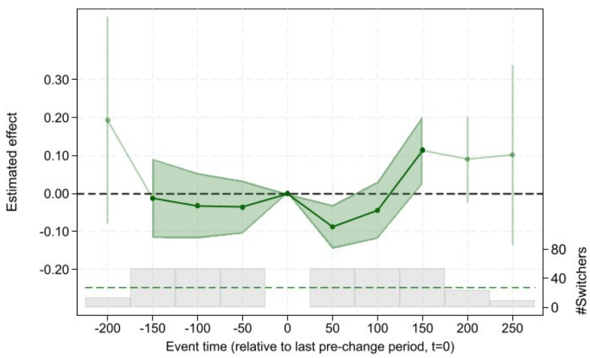
Note: This table shows the number of the academies in my sample by type and by country. Columns (2) and (3) add up to Column (1). Columns (4) and (5) are independent of each other.
* An academy (ACAD) is classified as scientific if at least 50% of its members study science, applied science, or medicine.
** An academy is classified as literary if at least 50% of its members study theology, law, humanities, or social sciences.

Table 4: Pre-treatment Summary Statistics.

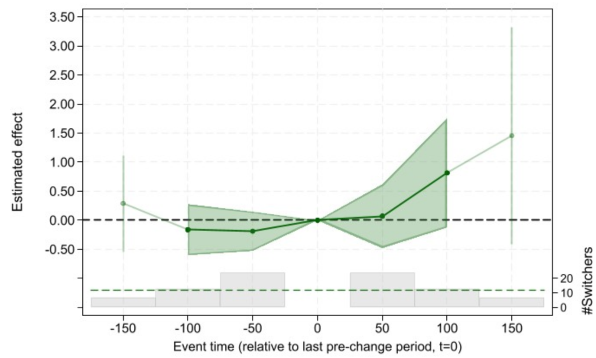
EVENT	Observations	Mean	Standard Deviation	Minimum	Maximum
Outcome variable: $\Delta lnpop$ 1500-1900, 50-years interval					
Academy	84	0.200	0.308	−0.318	1.139
Scientific Academy	43	0.205	0.312	−0.318	1.139
Literary Academy	41	0.196	0.308	−0.236	1.099
Long-lasting Academy	69	0.206	0.296	−0.318	1.099
Big Academy	62	0.221	0.320	−0.318	1.139
Outcome variable: $AvgQ$ 1500-1900, 50 years interval					
Academy	41	2.566	2.355	0	7.060
Scientific Academy	21	3.270	2.345	0	7.060
Literary Academy	20	1.828	2.182	0	6.768
Long-lasting Academy	35	2.782	2.301	0	7.060
Big Academy	32	2.555	2.266	0	7.060

C Robustness checks

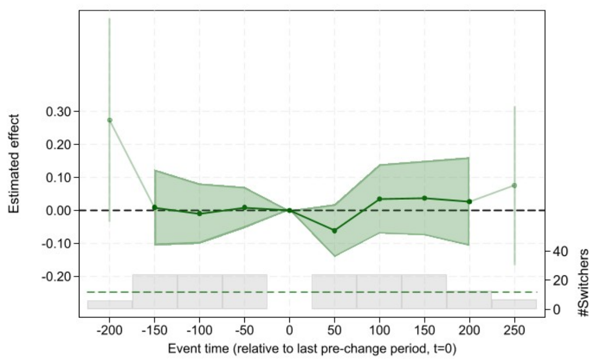
C.1 Sensitivity analyses: leave-one-out



(a) Academy on population growth



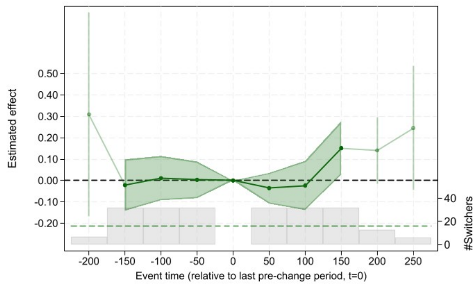
(b) Academy on university quality



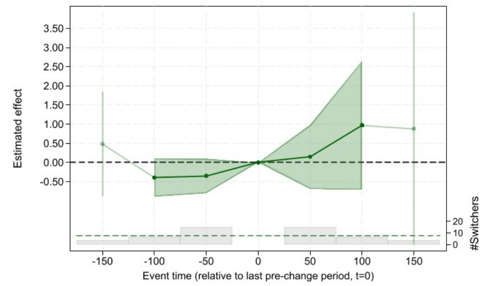
(c) Academy in UNI cities on population growth

Figure 13: Academy events leaving France out.

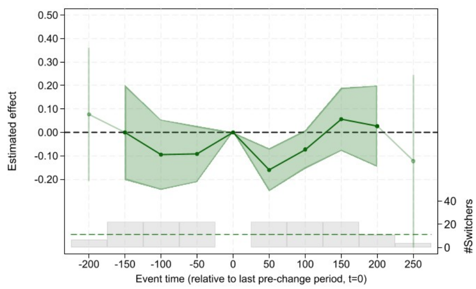
The figure reports dynamic treatment effects of creating (a) an academy on log city population growth rate, (b) an academy on university quality, and (c) an academy in cities that hosted a university at least once on log city population growth rate, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: France is excluded from the sample.



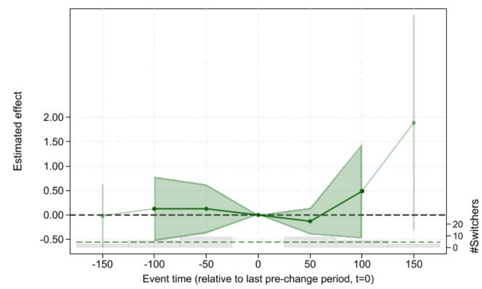
(a) Scientific Academy on population growth



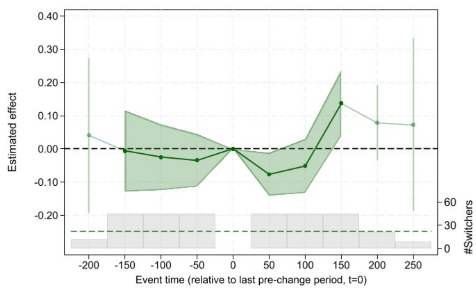
(b) Scientific Academy on university quality



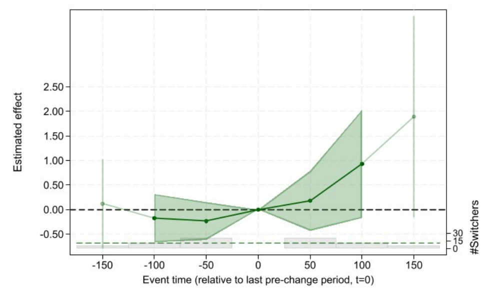
(c) Literary Academy on population growth



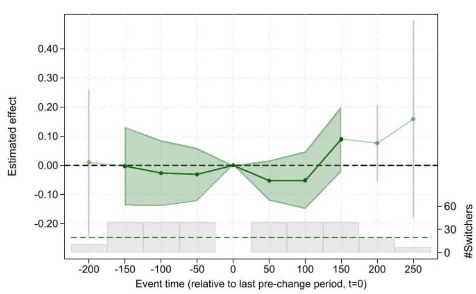
(d) Literary Academy on university quality



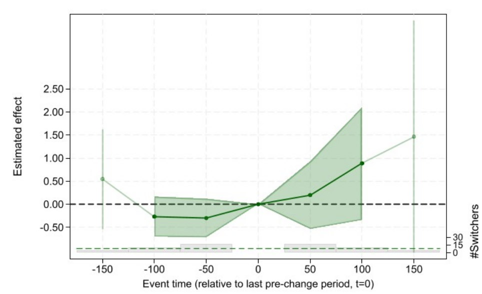
(e) Long-lasting Academy on population growth



(f) Long-lasting Academy on university quality



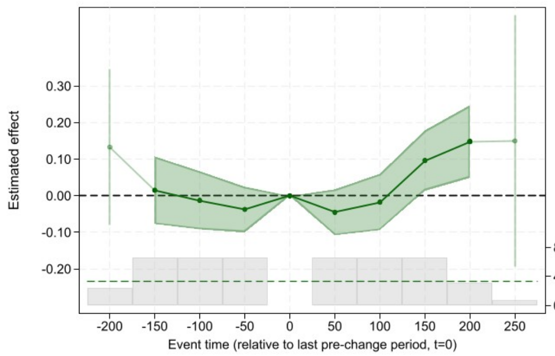
(g) Big Academy on population growth



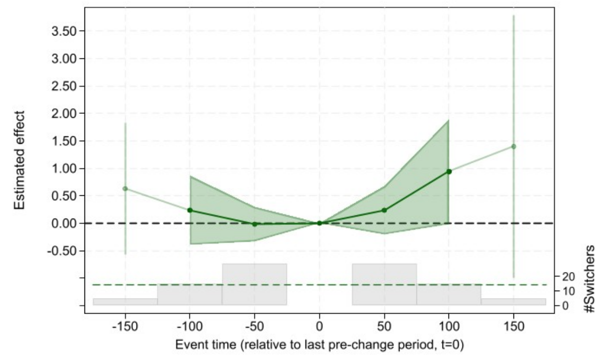
(h) Big Academy on university quality

Figure 14: Academy events by field, size, length leaving France out.

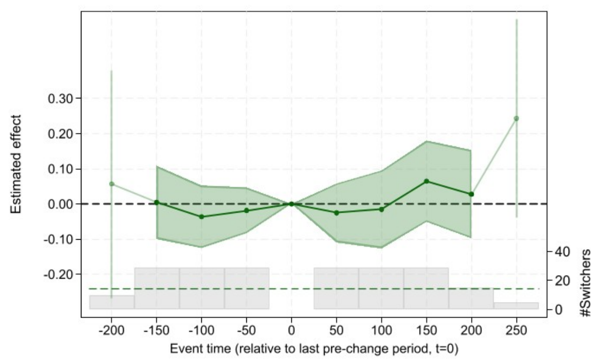
The figure reports dynamic treatment effects of creating (a - b) a scientific academy, (c - d) a literary academy, (e - f) a long-lasting academy, and (g - h) a big academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column. France is excluded from the sample.



(a) Academy on population growth



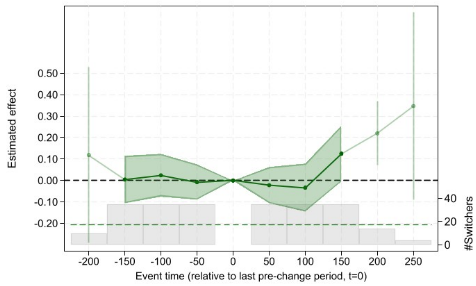
(b) Academy on university quality



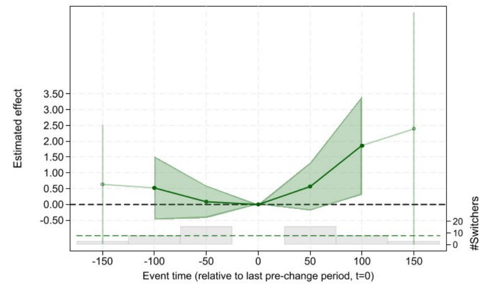
(c) Academy in UNI cities on population growth

Figure 15: Academy events leaving Italy out.

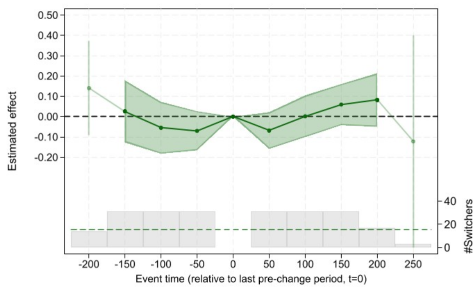
The figure reports dynamic treatment effects of creating (a) an academy on log city population growth rate, (b) an academy on university quality, and (c) an academy in cities that hosted a university at least once on log city population growth rate, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: Italy is excluded from the sample.



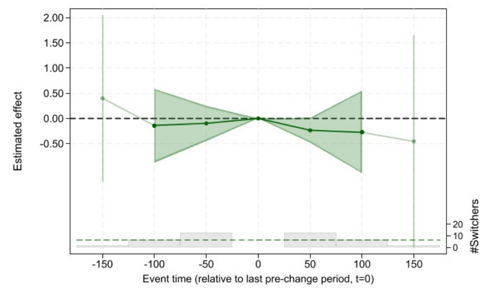
(a) Scientific Academy on population growth



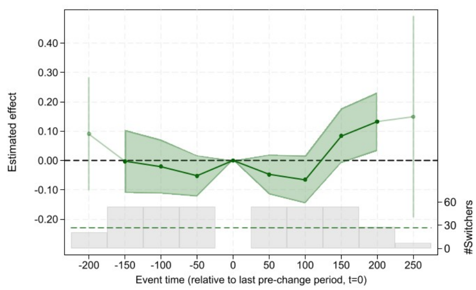
(b) Scientific Academy on university quality



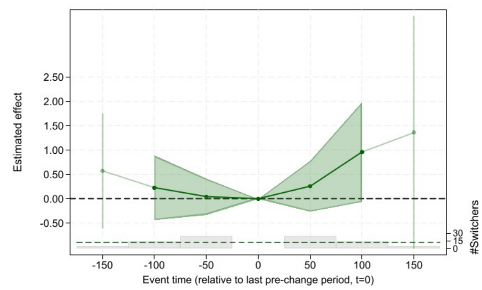
(c) Literary Academy on population growth



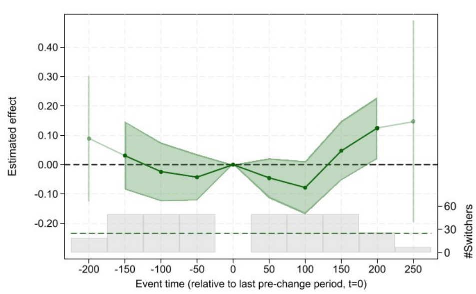
(d) Literary Academy on university quality



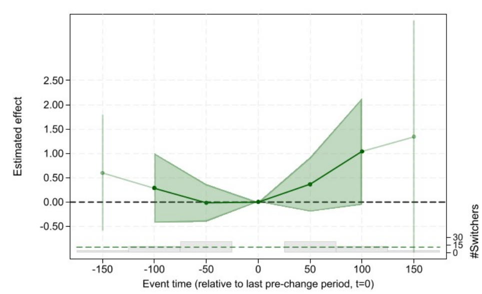
(e) Long-lasting Academy on population growth



(f) Long-lasting Academy on university quality



(g) Big Academy on population growth

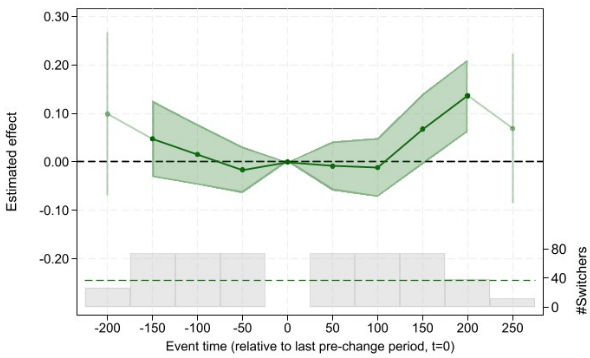


(h) Big Academy on university quality

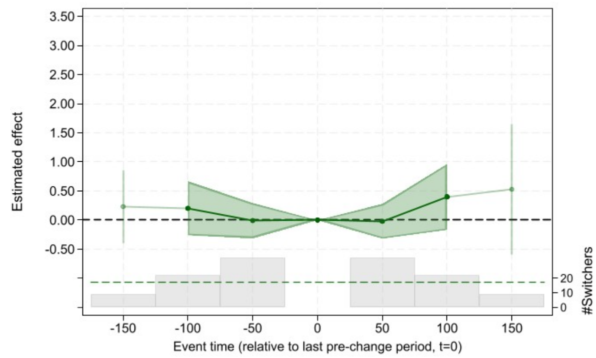
Figure 16: Academy events by field, size, length leaving Italy out.

The figure reports dynamic treatment effects of creating (a - b) a scientific academy, (c - d) a literary academy, (e - f) a long-lasting academy, and (g - h) a big academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

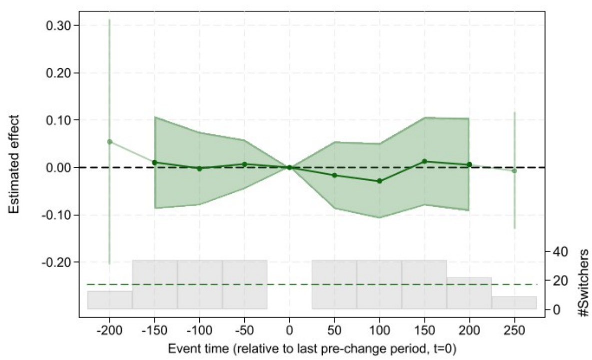
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column. Italy is excluded from the sample.



(a) Academy on population growth



(b) Academy on university quality

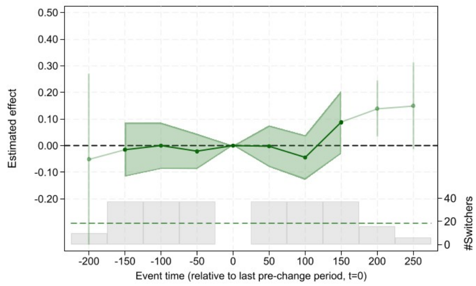


(c) Academy in UNI cities on population growth

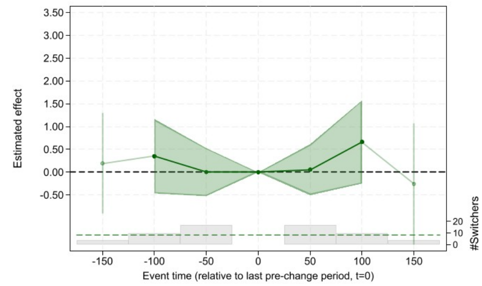
Figure 17: Academy events leaving Germany out.

The figure reports dynamic treatment effects of creating (a) an academy on log city population growth rate, (b) an academy on university quality, and (c) an academy in cities that hosted a university at least once on log city population growth rate, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

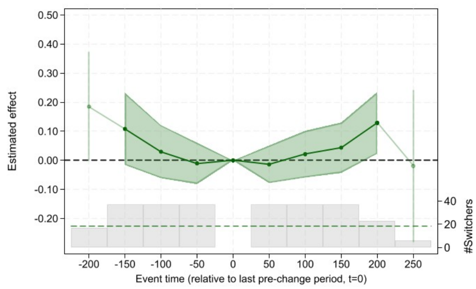
Note: Germany is excluded from the sample.



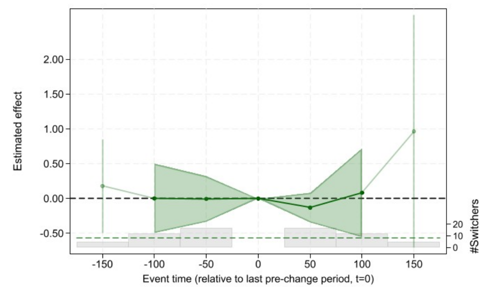
(a) Scientific Academy on population growth



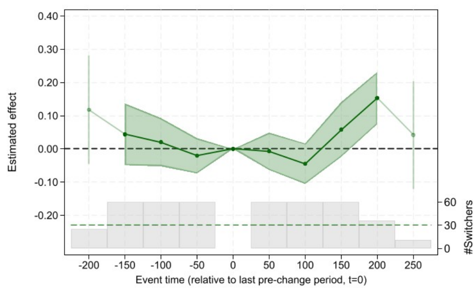
(b) Scientific Academy on university quality



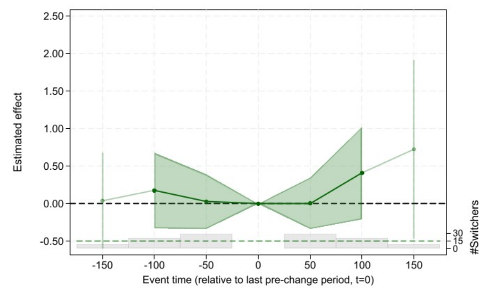
(c) Literary Academy on population growth



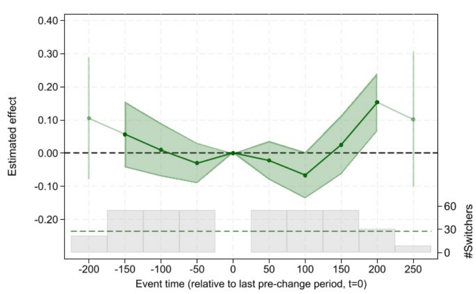
(d) Literary Academy on university quality



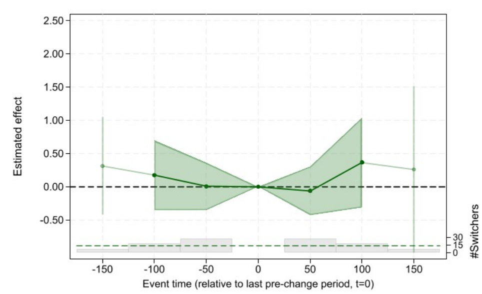
(e) Long-lasting Academy on population growth



(f) Long-lasting Academy on university quality



(g) Big Academy on population growth

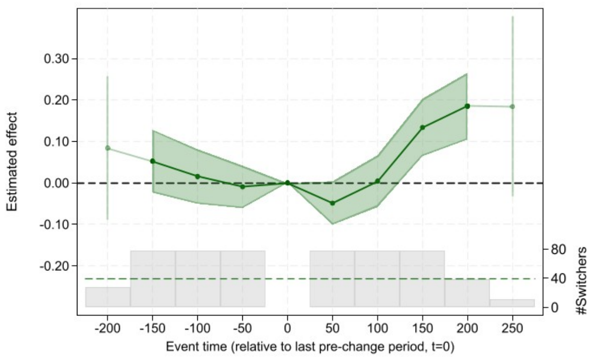


(h) Big Academy on university quality

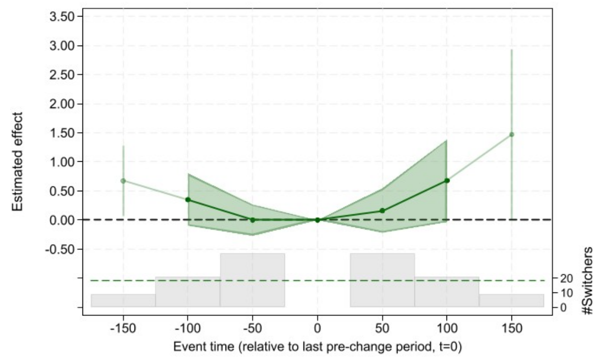
Figure 18: Academy events by field, size, length leaving Germany out.

The figure reports dynamic treatment effects of creating (a - b) a scientific academy, (c - d) a literary academy, (e - f) a long-lasting academy, and (g - h) a big academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

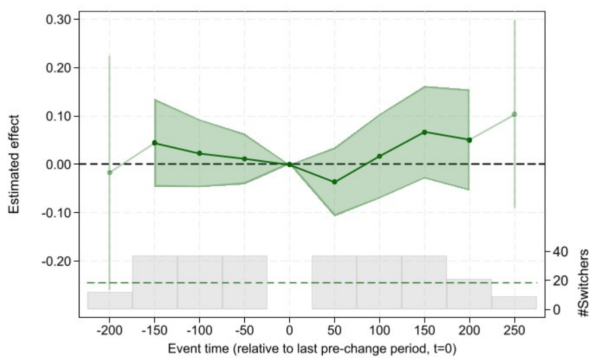
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column. Germany is excluded from the sample.



(a) Academy on population growth



(b) Academy on university quality

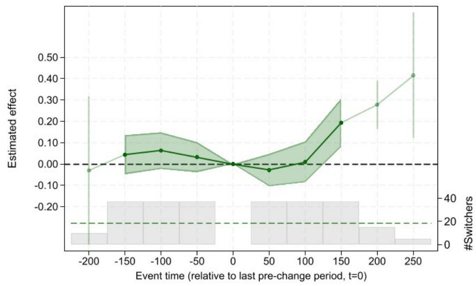


(c) Academy in UNI cities on population growth

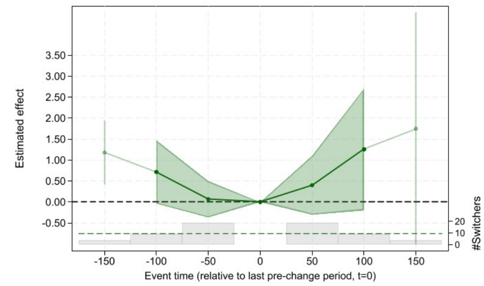
Figure 19: Academy events leaving UK out.

The figure reports dynamic treatment effects of creating (a) an academy on log city population growth rate, (b) an academy on university quality, and (c) an academy in cities that hosted a university at least once on log city population growth rate, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

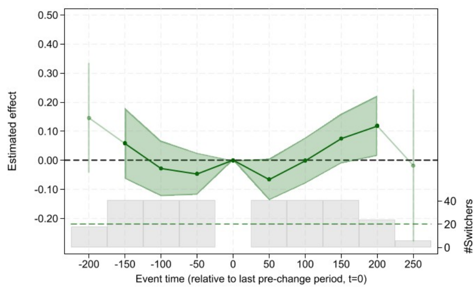
Note: UK is excluded from the sample.



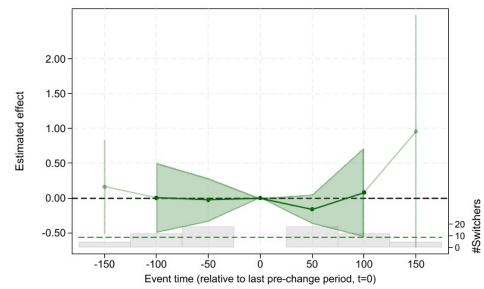
(a) Scientific Academy on population growth



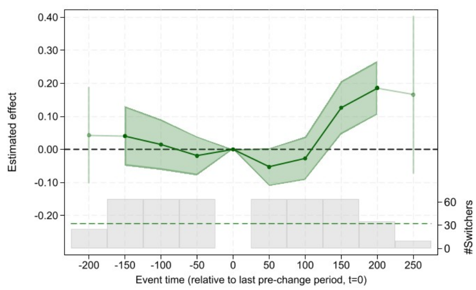
(b) Scientific Academy on university quality



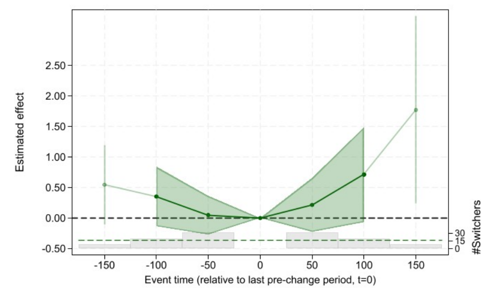
(c) Literary Academy on population growth



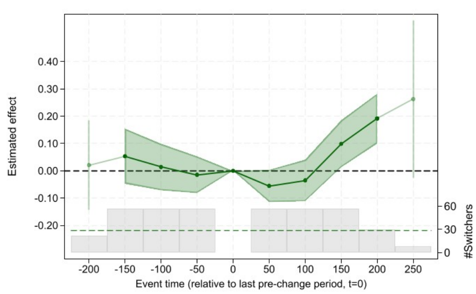
(d) Literary Academy on university quality



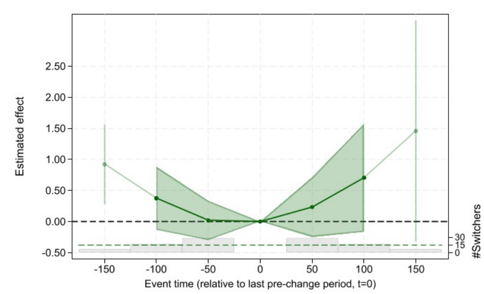
(e) Long-lasting Academy on population growth



(f) Long-lasting Academy on university quality



(g) Big Academy on population growth

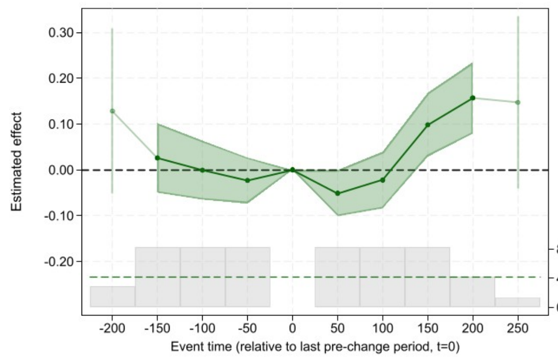


(h) Big Academy on university quality

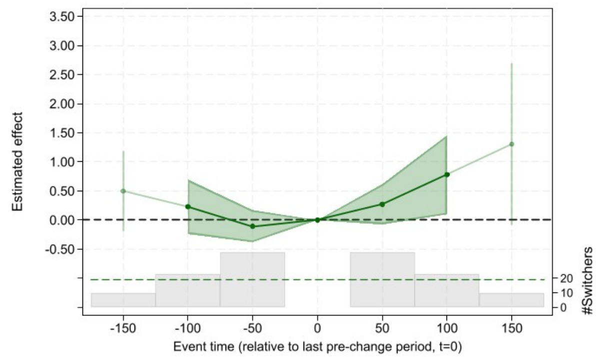
Figure 20: Academy events by field, size, length leaving UK out.

The figure reports dynamic treatment effects of creating (a - b) a scientific academy, (c - d) a literary academy, (e - f) a long-lasting academy, and (g - h) a big academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

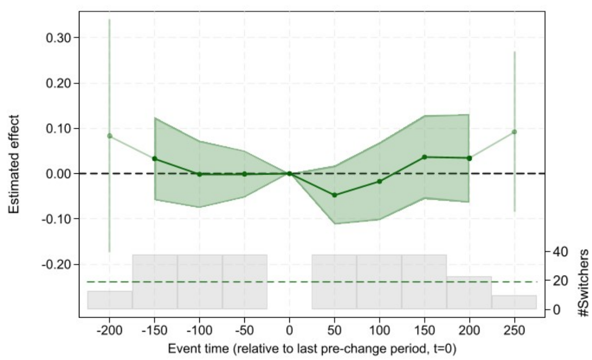
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column. UK is excluded from the sample.



(a) Academy on population growth



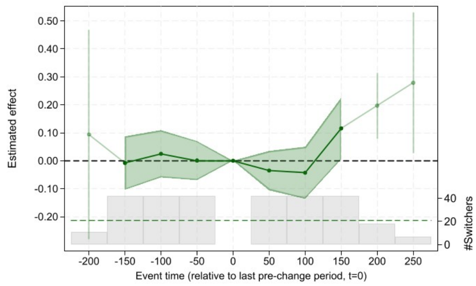
(b) Academy on university quality



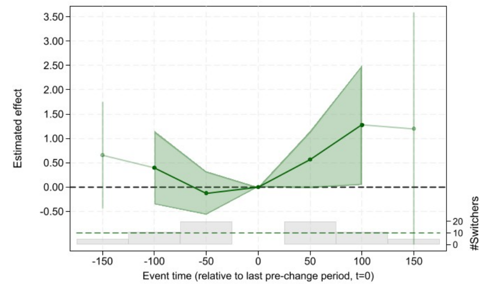
(c) Academy in UNI cities on population growth

Figure 21: Academy events leaving Spain out.

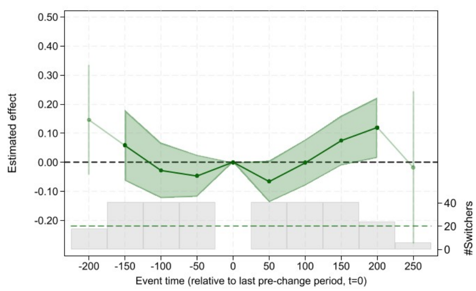
The figure reports dynamic treatment effects of creating (a) an academy on log city population growth rate, (b) an academy on university quality, and (c) an academy in cities that hosted a university at least once on log city population growth rate, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: Spain is excluded from the sample.



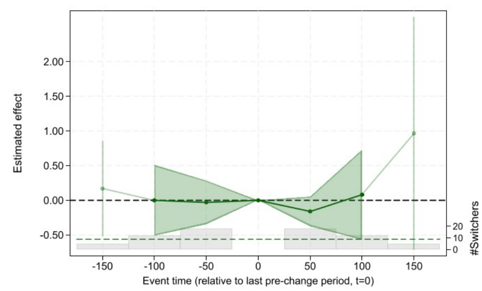
(a) Scientific Academy on population growth



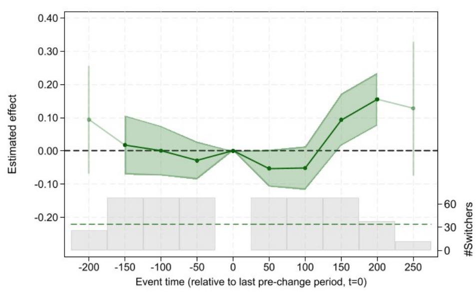
(b) Scientific Academy on university quality



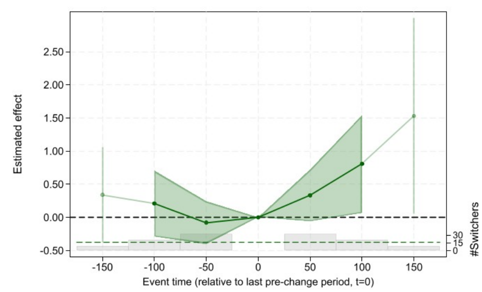
(c) Literary Academy on population growth



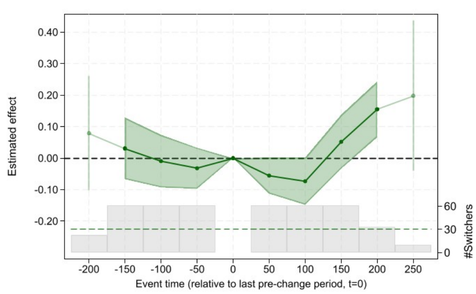
(d) Literary Academy on university quality



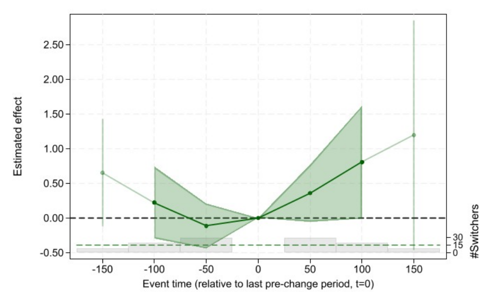
(e) Long-lasting Academy on population growth



(f) Long-lasting Academy on university quality



(g) Big Academy on population growth



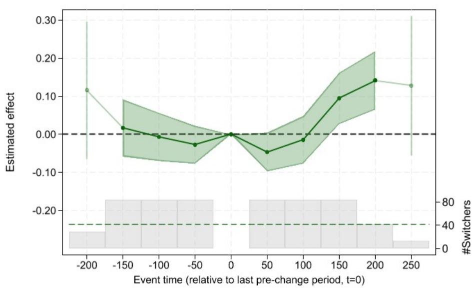
(h) Big Academy on university quality

Figure 22: Academy events by field, size, length leaving Spain out.

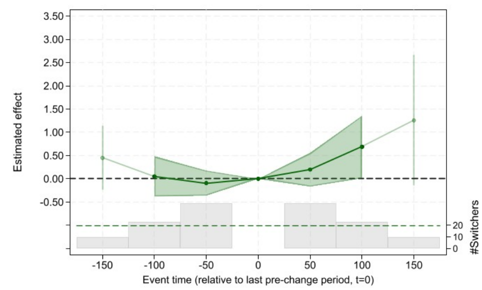
The figure reports dynamic treatment effects of creating (a - b) a scientific academy, (c - d) a literary academy, (e - f) a long-lasting academy, and (g - h) a big academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column. Spain is excluded from the sample.

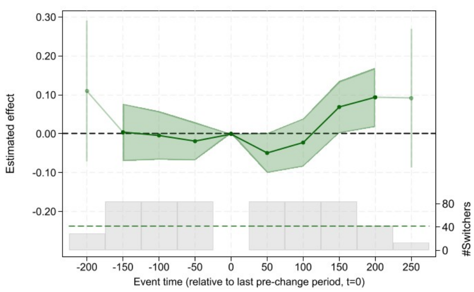
C.2 Local effects



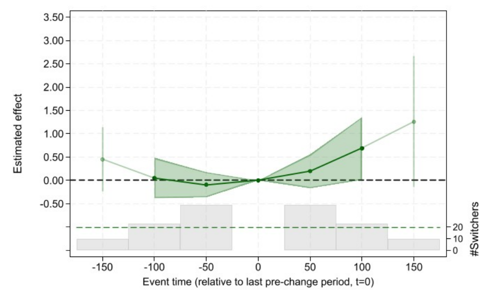
(a)



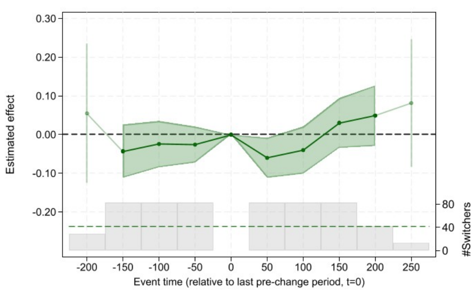
(b)



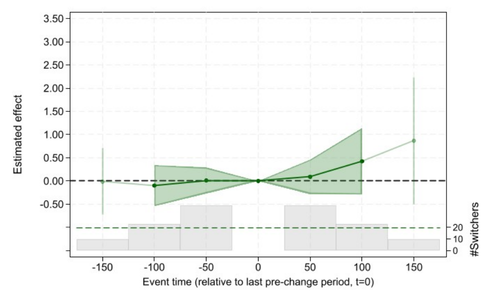
(c)



(d)



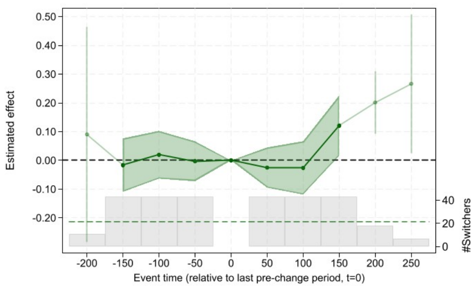
(e)



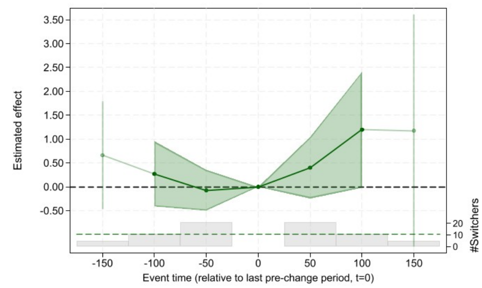
(f)

Figure 23: Test for local effects of academy events.

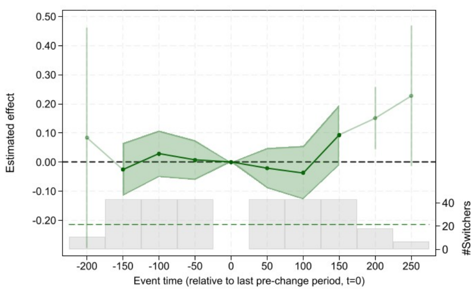
The figure reports dynamic treatment effects of creating an academy excluding cities (a - b) within 50 km, (c - d) within 100 km, and (e - f) within 150 km from the seat of the academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column.



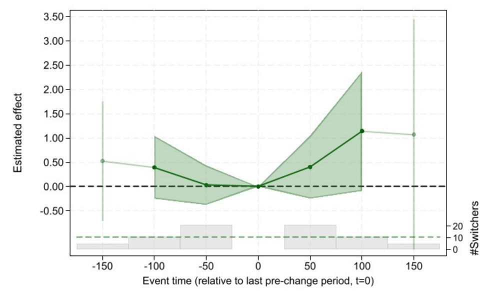
(a)



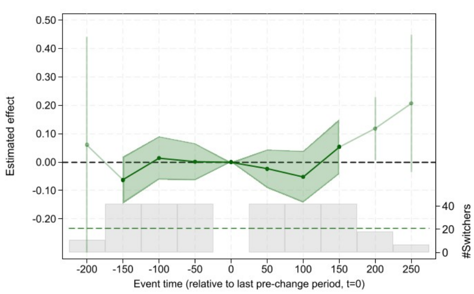
(b)



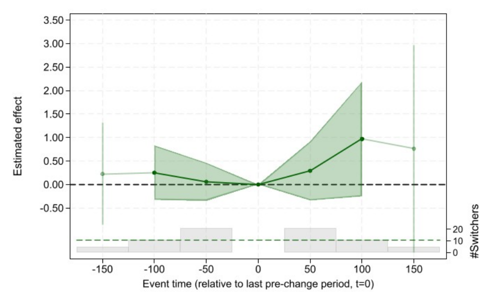
(c)



(d)



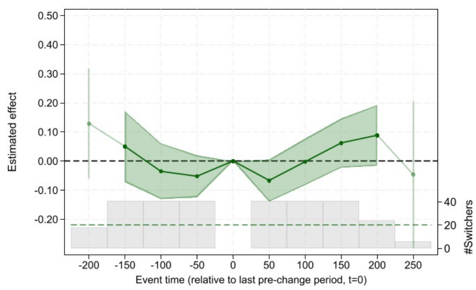
(e)



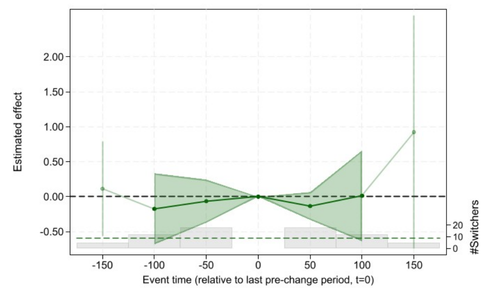
(f)

Figure 24: Test for local effects of scientific academy events.

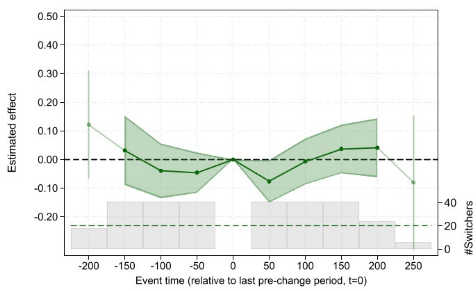
The figure reports dynamic treatment effects of creating a scientific academy excluding cities (a - b) within 50 km, (c - d) within 100 km, and (e - f) within 150 km from the seat of the academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column.



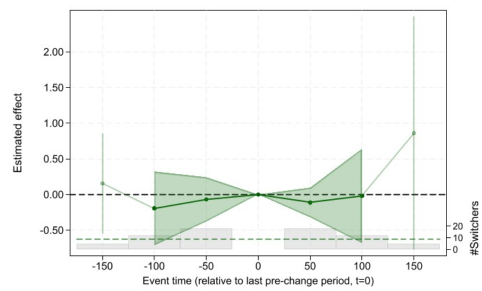
(a)



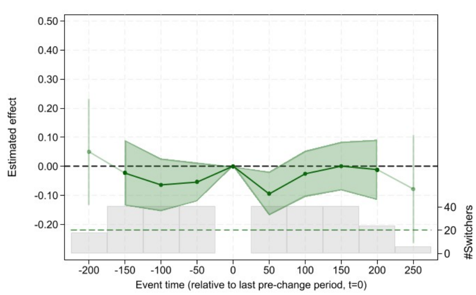
(b)



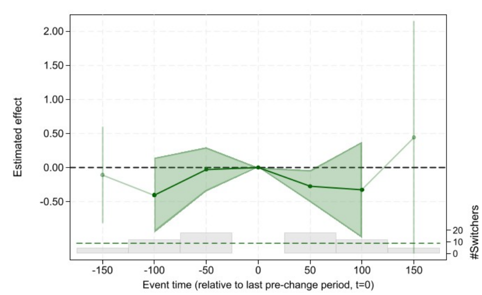
(c)



(d)



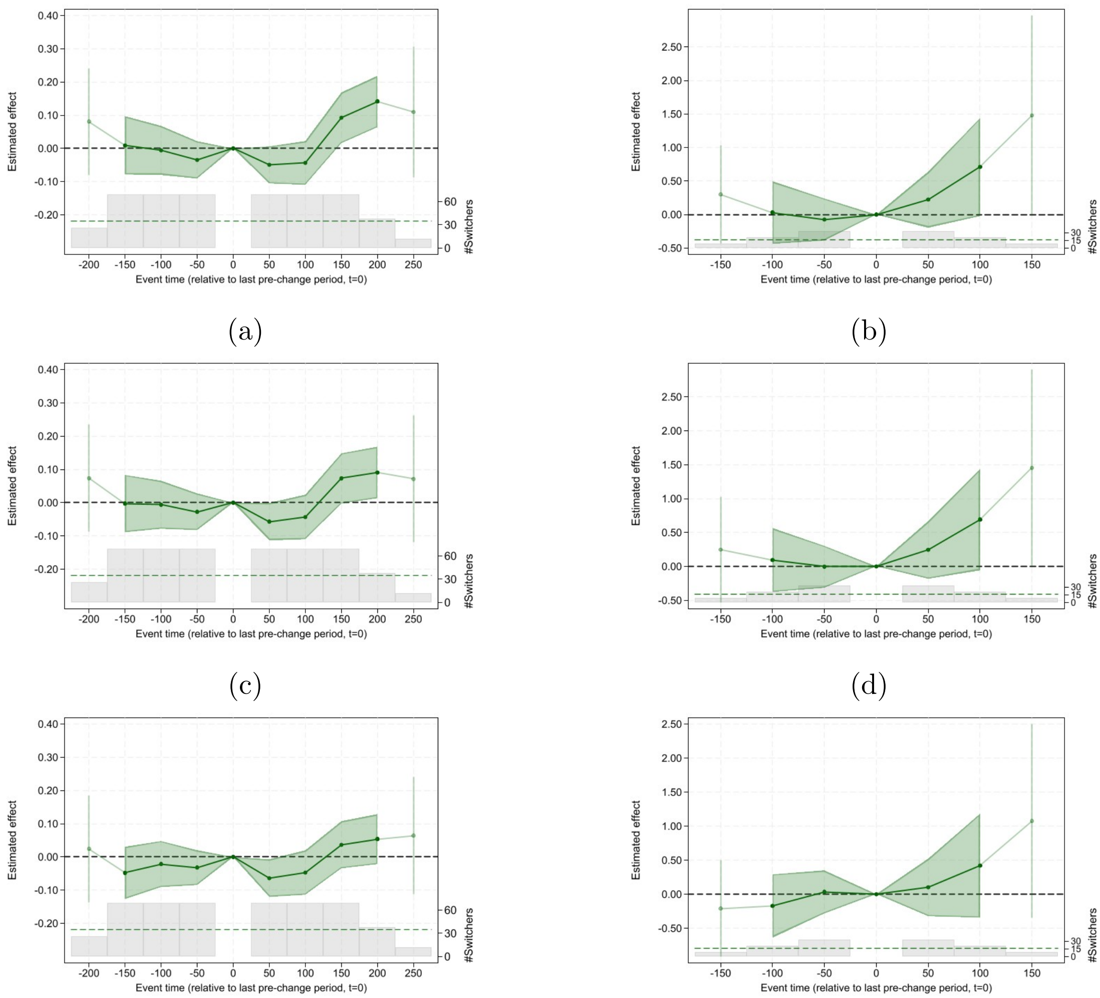
(e)



(f)

Figure 25: Test for local effects of literary academy events.

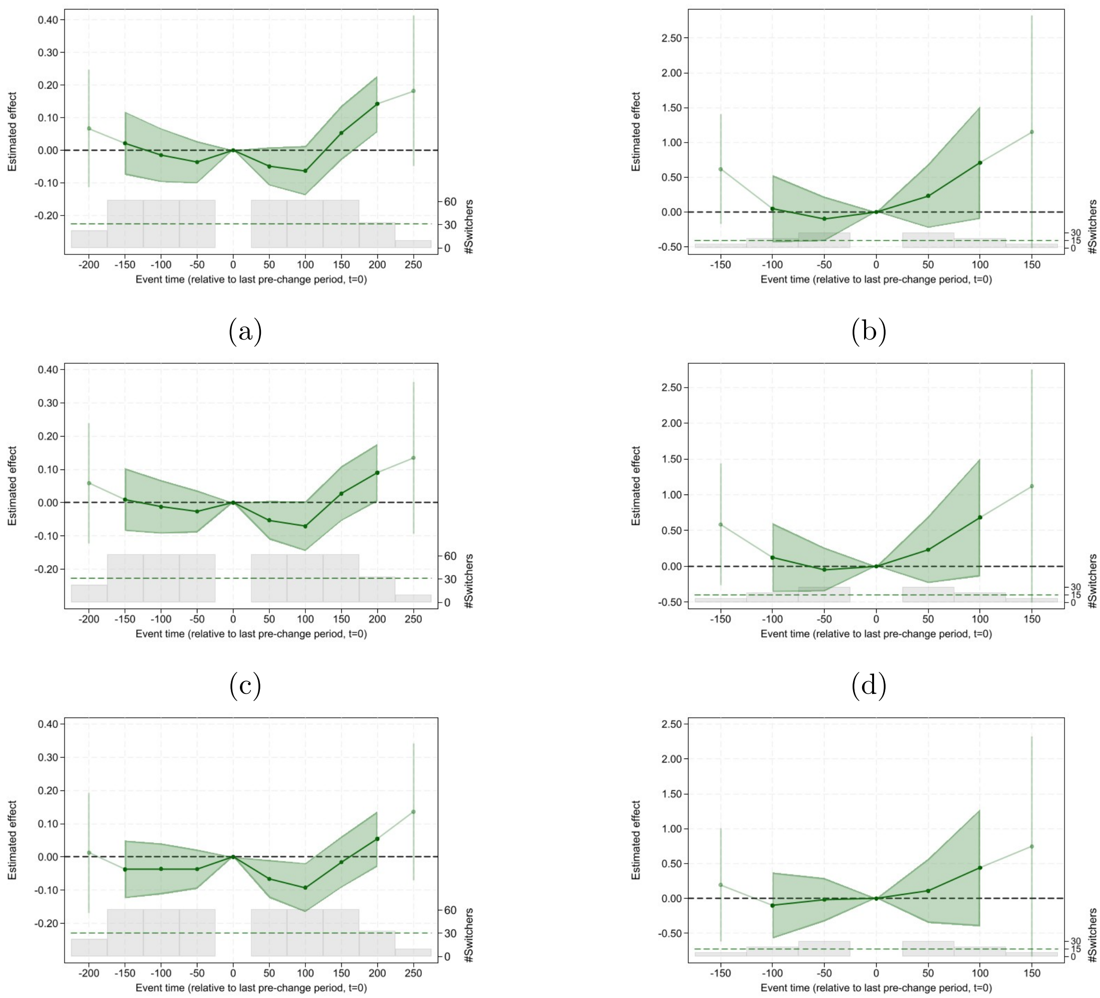
The figure reports dynamic treatment effects of creating a literary academy excluding cities (a - b) within 50 km, (c - d) within 100 km, and (e - f) within 150 km from the seat of the academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column.



(a) (b) (c) (d) (e) (f)

Figure 26: Test for local effect of long-lasting academy events.

The figure reports dynamic treatment effects of creating a long-lasting academy excluding cities (a - b) within 50 km, (c - d) within 100 km, and (e - f) within 150 km from the seat of the academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column.



(a) (b)

(c) (d)

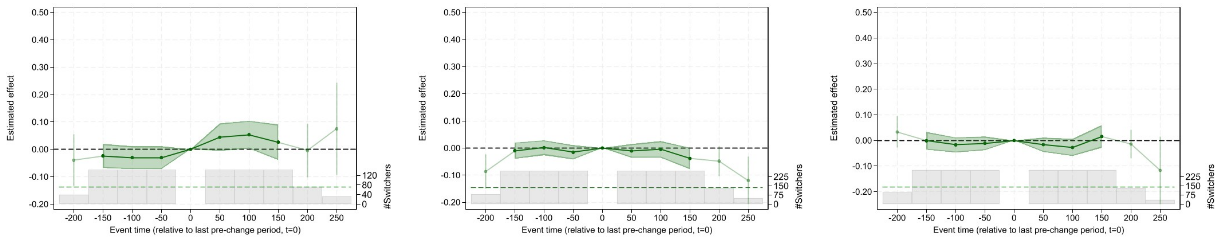
(e) (f)

Figure 27: Test for local effects of big academy events.

The figure reports dynamic treatment effects of creating a big academy excluding cities (a - b) within 50 km, (c - d) within 100 km, and (e - f) within 150 km from the seat of the academy, estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

Note: The dependent variable is log city population growth rate in the left column, and university quality in the right column.

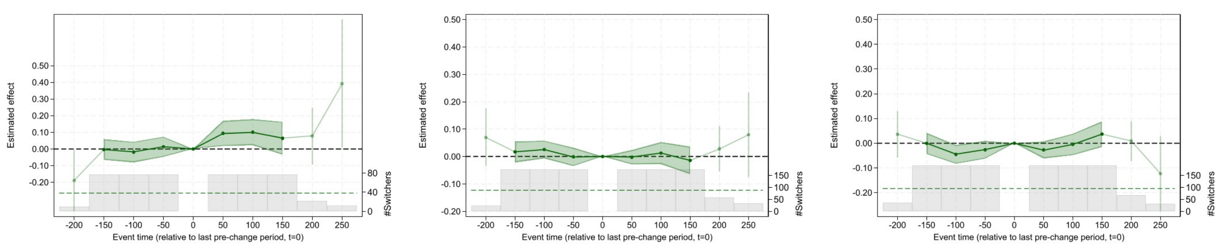
C.3 Spillover effects



(a) (b) (c)

Figure 28: Test for spillover effects of academy events.

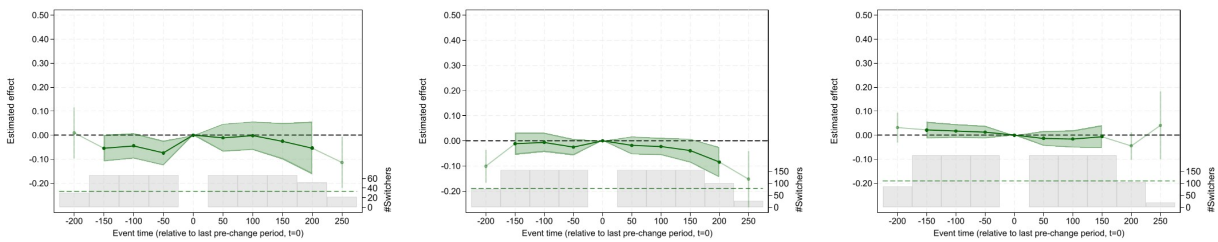
The figure reports dynamic treatment effects of creating an academy in cities (a) within 25 km from the hosting cities, excluding the hosting city, (b) between 25 km and 50 km from the hosting cities, excluding hosting cities and within the 0–25 km “donut,” (c) between 50 km and 75 km from the hosting cities, excluding hosting cities and within the 25–50 km “donut”; estimated with De Chaisemartin and d’Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate.



(a) (b) (c)

Figure 29: Test for spillover effects of scientific academy events.

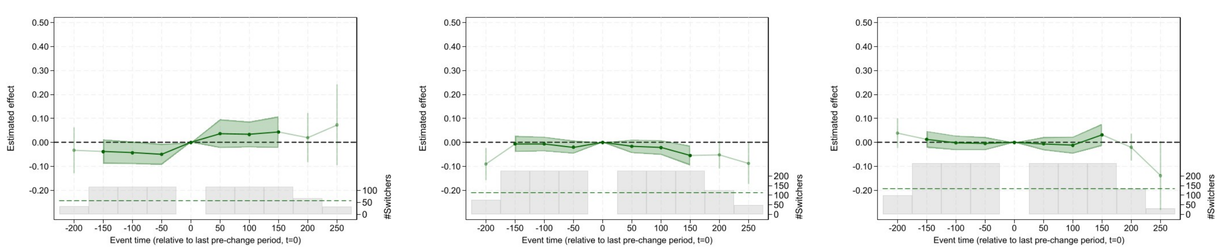
The figure reports dynamic treatment effects of creating a scientific academy in cities (a) within 25 km from the hosting cities, excluding the hosting city, (b) between 25 km and 50 km from the hosting cities, excluding hosting cities and within the 0–25 km “donut,” (c) between 50 km and 75 km from the hosting cities, excluding hosting cities and within the 25–50 km “donut”; estimated with De Chaisemartin and d’Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate.



(a) (b) (c)

Figure 30: Test for spillover effects of literary academy events.

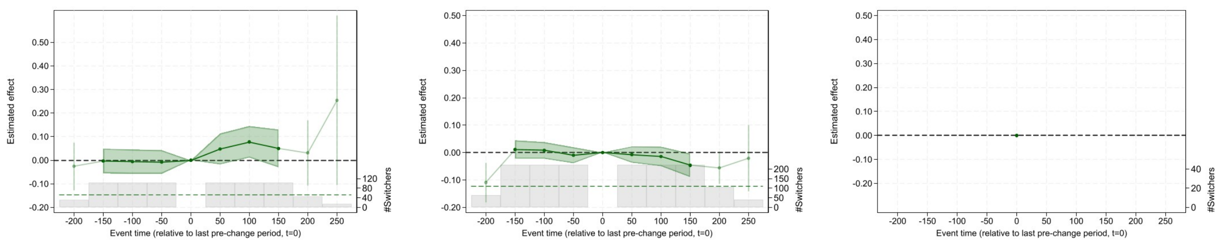
The figure reports dynamic treatment effects of creating a literary academy in cities (a) within 25 km from the hosting cities, excluding the hosting city, (b) between 25 km and 50 km from the hosting cities, excluding hosting cities and within the 0–25 km “donut,” (c) between 50 km and 75 km from the hosting cities, excluding hosting cities and within the 25–50 km “donut”; estimated with De Chaisemartin and d’Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate.



(a) (b) (c)

Figure 31: Test for spillover effects of long-lasting academy events.

The figure reports dynamic treatment effects of creating a long-lasting academy in cities (a) within 25 km from the hosting cities, excluding the hosting city, (b) between 25 km and 50 km from the hosting cities, excluding hosting cities and within the 0–25 km “donut,” (c) between 50 km and 75 km from the hosting cities, excluding hosting cities and within the 25–50 km “donut”; estimated with De Chaisemartin and d’Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.
Note: The dependent variable is log city population growth rate.



(a) (b) (c)

Figure 32: Test for spillover effects of big academy events.

The figure reports dynamic treatment effects of creating a long-lasting academy in cities (a) within 25 km from the hosting cities, excluding the hosting city, (b) between 25 km and 50 km from the hosting cities, excluding hosting cities and within the 0–25 km "donut," (c) between 50 km and 75 km from the hosting cities, excluding hosting cities and within the 25–50 km "donut" for which there are no switchers and no effect can be estimated. All the effects are estimated with De Chaisemartin and d'Haultfoeuille (2024). Estimates are indexed by event time, with $t = 0$ denoting the last period prior to a change in treatment status. The shaded region shows 90% confidence intervals. The darker green series corresponds to a restricted window of leads and lags; the lighter green series uses the full available set of leads and lags. The histogram plots the number of switchers contributing to each event-time estimate; the dashed green line marks one-half of the number of first-period switchers.

Note: The dependent variable is log city population growth rate.