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# Early Modern Academies, Universities, and Growth

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This paper explores the historical role of Early Modern educational institutions—academies and universities—in fostering economic growth of European cities before 1800. While the value of human capital for societal progress is well-documented today, the specific contributions of these institutions before the Industrial Revolution remain uncertain. Academies, with their experimental, Baconian approach, were a stark departure from the traditional, Aristotelian perspective dominant in universities. By examining the distinctions and interactions between academies and universities, this study provides new lights for understanding their impact on long-term economic development. The central research question investigates how academies allocated their high-level human capital: were these talents wasted, or did they contribute to higher urban growth?

In the first part of the paper, I study both the local effects and the possible spatial spillover effects on nearby cities, given that knowledge is non-rival (Romer, 1990). I investigate the mechanism through which academies producing more “useful knowledge” (Mokyr, 2005a) fostered local innovations (e.g., more efficient agricultural machines, public lighting, etc.), increased agricultural surplus, and, in turn, led to a faster rate of urban growth. In the second part, I also examine how the presence of academies influenced universities, potentially fostering curricular modernization and structural reforms (Applebaum, 2000; McClellan, 1985). By studying the interactions between these two types of higher educational institutions, this paper sheds new light on their complementary roles in shaping European intellectual landscapes.

**Data & Sources.** I proceed by extending a unique database of academicians and university professors active in Europe between 1000 and 1800 (de la Croix, 2021). This novel database includes micro-level biographical information, enabling precise tracking of scholars’ movements, fields of study, and institutional affiliations. I manually compiled the list of members affiliated to the academies mentioned in McClellan, 1985, from both primary and secondary sources. For academies still active today, websites provided structured data, while historical sources helped completing the information. These sources, often listed in McClellan, 1985, were supplemented by correspondence with historians and experts when necessary. Figure 1 shows the geographical distribution of the institutions entering

my analyses. Full details about the sources are provided in the appendix of the paper.<sup>1</sup>

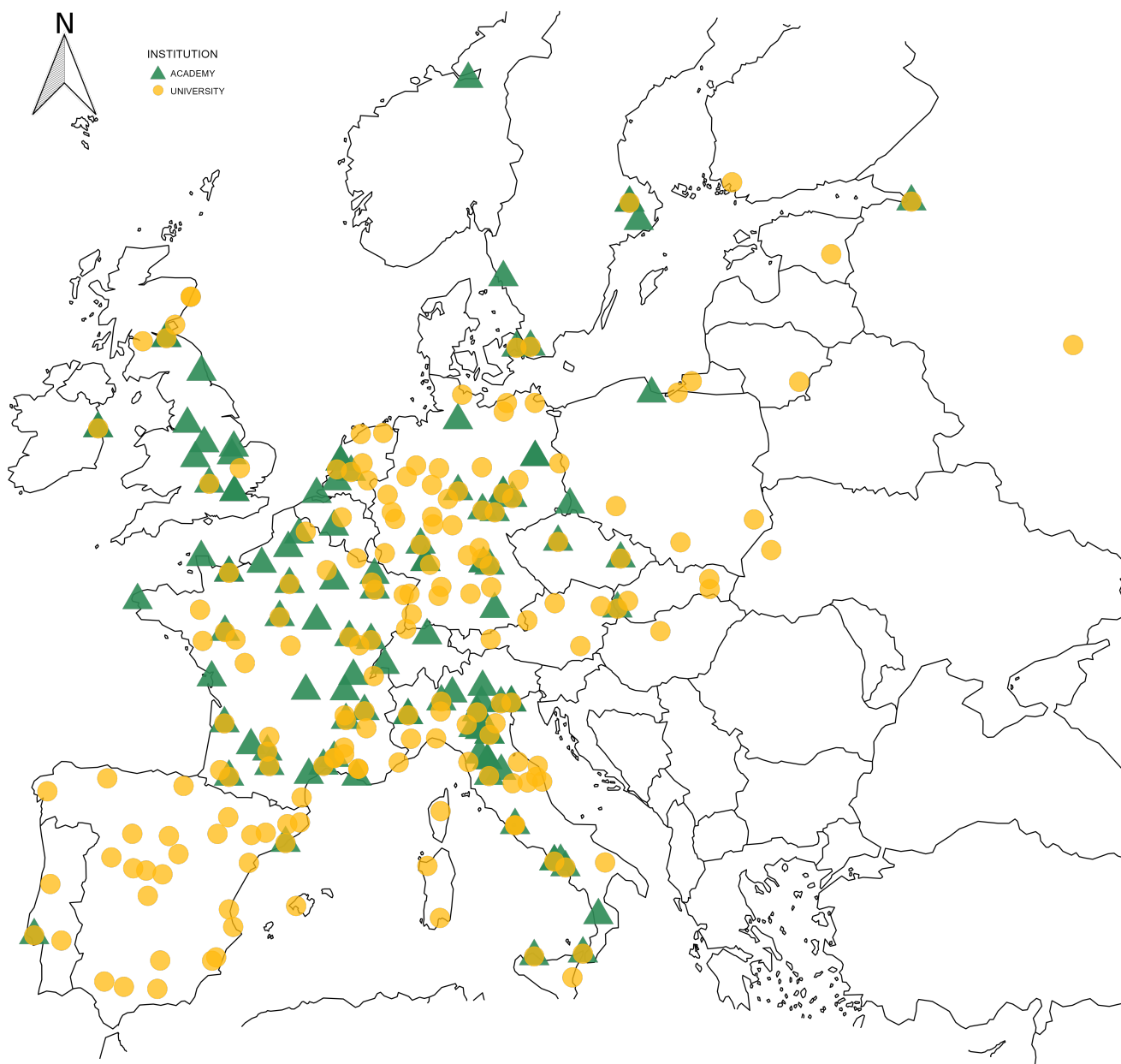


Figure 1: Locations of higher educational institutions (1000 - 1800 CE): universities in yellow, academies in green. The overlapping of the two means that there is an interaction (e.g. the two institutions are created in the same city). Countries borders are those in the year 2000 for visualization purposes only.

**Methodology.** In my analysis, I focus on academies that adopted an experimental approach between 1650 and 1800. Using population growth rates at the city level as a proxy for technological progress (Ashraf & Galor, 2011), I first employ OLS regressions with city and time fixed effects, revealing a significant positive relationship between academies and urban development. However, OLS estimates suffer from reverse causality issues, so I construct a difference-in-differences (DID) framework to fully exploit the temporal dimension of my data. Traditional dynamic Two-Way Fixed Effects estimators are also biased when events are stag-

<sup>1</sup>You can find the most recent version of the paper [HERE](#).

gered (Roth et al., 2023), and the event I analyze is the creation of academies, which may occur at different times. To account for heterogeneity across time and space, I apply advanced DID estimators based on Sun and Abraham, 2021. I also present results using estimators developed by Callaway and Sant’Anna, 2021 and De Chaisemartin and d’Haultfoeuille, 2024.

First, the parallel trends assumption always holds, which already reduces reverse causality concerns. However, questions remain about the exogeneity of the events’ timing. Indeed, there could be factors influencing both the creation of academies and urban growth at the same time. Hence, I gathered extensive information on the history of these innovative institutions, including their organizational and financial structures, along with the biographies of their founders. The history of the origins of these academies support the notion that the great majority were established by eminent scholars who mainly aimed to revitalize scientific studies, which were seen as crucial for societal advancement. Only later local lords, bishops, and some kings also recognized the importance of these institutions and advocated for their creation. In this paper, I do not claim that these institutions, both universities and academies, are entirely exogenous. Instead, I use this step-by-step empirical strategy to progressively reduce concerns about endogeneity, such as reverse causality. Additional concerns may arise from unobserved variables that affect both city growth and the creation of these institutions. However, I include city and time fixed effects to — at least partially — mitigate concerns related to omitted variables.

I also define buffer zones around each city with an academy to test for spatial spillovers. Excluding cities within each buffer zone does not change the main results. Therefore, the effect I find is an unbiased local effect: the main results show the effect of innovative institutions only on the local area (Butts, 2021), possibly underestimating the overall effect. This does not preclude the institutions’ impact from reaching locations outside the urban area, consistent with models of technology being a non-rival good (Romer, 1990). Using “donut” regressions, I observe that cities in the first donut of 25km experience an early positive effect compared to cities hosting an academy, which sees a positive impact only later, although it persists for the remainder of the sample period. This may be because the hosting cities bear the initial costs of establishing the academy and only later yield the long term benefits.

**Main results.** I find that cities with academies initially experience a slower population growth rate with respect to cities without academies, followed by an increase in the urban growth rate in the subsequent century that more than compen-

sates for the initial relative downturn. Leveraging the individual-level information in the database, I show that the scholars' field of study is crucial for understanding where this pattern originates from: cities that establish scientific academies (e.g., with more than 50% of members specializing in scientific subjects) exhibit around a 15% higher growth rate after 100 years, compared to cities without scientific academies (Pre-treatment statistics:  $\mu = 0.182$ ,  $sd = 0.245$ ).

By contrast, cities creating literary academies, with over half of their members focusing on humanities, experience relative negative effects for the initial 50 years, with a population growth rate that is 10-13% slower compared to cities without literary academies (Pre-treatment statistics:  $\mu = 0.217$ ,  $sd = 0.302$ ). While this effect appears to diminish over the following 50 years, its impact is still noteworthy. Murphy et al., 1991 already demonstrates the critical role that talent allocation plays in economic growth. My findings suggest that scientific academies direct resources towards economically beneficial activities, whereas literary academies divert human capital into low-return projects. This interpretation aligns with recent literature exploring the inhibitory effects of religion and law on economic progress (Curtis & de la Croix, 2023; Squicciarini, 2020).

In addition, creating an academy in cities with existing universities might trigger complementarities that yield benefits other than direct economic growth. There is some historical evidence documenting how universities reformed and updated their organization and curricula towards the end of the eighteenth century thank to the presence of academies (Applebaum, 2000; McClellan, 1985).

Exploiting the features of our database, I investigate whether and how much universities reformed. I use the university quality index based on de la Croix et al., 2023 as a dependent variable, and I show a significant positive effect of creating a scientific academy on university quality after 50 years. Universities in cities with a science-focused academy improve their quality by 57.86% on average, compared to universities in cities without scientific academies (Pre-treatment statistics:  $\mu = 0.318$ ,  $sd = 2.287$ ). Literary academies do not pushed universities to innovate.

Both the sign and the timing of these findings align with the historical academic context and evidence that scientific academies prompted reforms within universities that persist to the present day (Applebaum, 2000; McClellan, 1985). To the best of my knowledge, my paper is the first to empirically assess this impact.

I also present detailed sensitivity analyses to assess the impact of certain units of analysis that may influence the results, given their large involvement with the academy movement. I find no significant variation when excluding from the sample the two most important cities for innovative academies, London and Paris. Ex-

cluding Italy, Germany, and the British Islands alone do not bring about relevant changes in the results. However, France appears to slightly affect the main results; excluding France (with its 30 academies, and its Revolution) from the analyses mitigates the initial negative impact and increases the positive long-run effect.

**Contributions to the literature.** My paper contributes to three different fields of study. First, I engage with the literature related to economic history. I contribute new data to measure the Upper Tail of the Human Capital distribution. Existing literature has often emphasized the importance of highly skilled and well-educated individuals active in Europe (e.g., UTHC) during the pre-industrial era (Mokyr & Voth, 2009), a time when the foundations of the Scientific Revolution and the Enlightenment were being framed (Mokyr, 2016; Ó Gráda, 2016). However, current digitized databases lack biographical information. Here, I further extend the database of de la Croix, 2021, augmenting it with micro-data on European academicians before 1800. I also systematically collected new information on the origins and historical context in which these academies were created.

With these data, I contribute to demonstrating the importance of higher educational institutions before the Industrial Revolution (Becker & Woessmann, 2009; Cantoni & Yuchtman, 2014; Galor, 2005; Serafinelli & Tabellini, 2022; Squicciarini & Voigtländer, 2015). To date, at the aggregate level, universities have mostly been used to represent high-level human capital in long-run empirical studies (Bosker et al., 2013; Serafinelli & Tabellini, 2022; Squicciarini & Voigtländer, 2015). While universities played a role in mediating uncertainty during the Middle Ages (Cantoni & Yuchtman, 2014), recent research fails to provide clear evidence of significant benefits for urban areas from hosting a university (Bairoch, 1988; Bosker et al., 2013). Nevertheless, a recent study by Dittmar and Meisenzahl, 2022 finds positive and significant effects of German universities on innovation and scientific activity from the early 1800s, but only after research activities and more practical curricula were implemented. My research supports this mechanism. In addition, de la Croix et al., 2023 examine the strength of universities' quality and professors' skills in moving high-level knowledge across Europe during the Middle Ages, up to the eve of the Industrial Revolution. I demonstrate that academies also played a crucial role as the first institutions to institutionalize the use of the experimental approach for the practical improvement of local communities. As far as I am aware, the sole study exploring the newly emerging societies at the end of the 18<sup>th</sup> century is that of Koschnick et al., 2024, which focuses exclusively on German economic societies. I argue that not only economically-oriented academies but also all institutions motivated by the new experimental approach may have influenced

the economic growth of European cities.

Finally, I also extend the current empirical studies, which have primarily focused on specific countries, to analyze high-quality knowledge in pre-industrial times (Cantoni & Yuchtman, 2014; Cinnirella & Streb, 2017; Dittmar & Meisenzahl, 2022; Squicciarini & Voigtländer, 2015). I emphasize the importance of taking a pan-European perspective (Bosker et al., 2013) to better gauge the economic impact of high-level human capital on the eve of the Industrial Revolution (de la Croix et al., 2023; Serafinelli & Tabellini, 2022).

The second field I engage with is the economics of innovation. I contribute to the literature studying the relevance of science before the Industrial Revolution (Abramitzky & Sin, 2014; Curtis & de la Croix, 2023; Dittmar, 2019; Dittmar & Meisenzahl, 2022; Dittmar & Seabold, 2019; Hanlon, 2022; Koschnick et al., 2024; Mokyr, 2005b, 2016; Mokyr & Voth, 2009). I show that the positive impacts on both urban population growth and university quality stem specifically from academies that predominantly focus on scientific subjects, rather than literary ones.

The third field of study I contribute to is the economics of education. I show how the interactions between academies and universities benefit societies through a channel other than urban growth: scientific academies encouraged universities in the same city to innovate and reform, laying the foundations for the modern, professional-oriented universities we know today.

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