

**ERC Advanced Grant 2019
Research proposal [Part B1]**

Did elite human capital trigger the rise of the West? Insights from a new database of scholars from European universities and academies

UTHC

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Proposal duration in months: 60

My aim is to determine the role of elite knowledge and upper-tail human capital (UTHC) in triggering the rise of the West. I propose to build a database of a large sample of academic scholars in Europe over the period 1000CE-1800CE. Sources will be primary (published cartularia and matricula), secondary (books on the history of universities & academies), and tertiary (biographical dictionaries). To measure the quality of scholars, these data will be matched with the existing catalogues of publications.

Second, we will build a geographical grid of the density, composition, and quality of the UTHC across time, and correlate the UTHC at the cell level with the adoption of new techniques and better institutions, and the development of literacy, numeracy, and urbanization. The individual character of the data will allow basing causal identification on exogenous variations in the European network of both individuals and universities. The migration pattern of scholars will be used to identify sorting and agglomeration forces, witnessing to the functioning of an academic market in the medieval and early modern periods. Families of scholars will be identified to assess the importance of nepotism vs human capital transmission.

Third, we will develop a new theory of the complementarity between sciences and techniques, to determine the incentives under which codified knowledge and practical skills interact, and ideas spread. A second new theoretical model will be devoted to revealing the dynamic interactions between conservative and modern forces within universities and learned societies; the key trade-off here is between vested interests and new paradigms, letting scholarly elites develop a culture of growth. With the data gathered, we will be able to measure the importance of these theoretical mechanisms and how the UTHC and society interact.

Overall, I intend to rethink economic growth by unravelling the rich interactions between scholars & literati and its emergence.

B1.a: Extended Synopsis**Research question: was upper-tail human capital (UTHC) critical to triggering the rise of the West?**

The “Rise of the West” (Mc Neil 1963) described the unleashing of an economic and social transformation which had never been experienced before by any society since the Neolithic Revolution. What happened around 1800 was deeply rooted in history. Many authors have searched for the profound causes of the “Rise of the West”: Landes (1998), Maddison (2001), Galor and Moav (2002), Galor (2011), Mokyr (2009, 2016), and Voigtländer and Voth (2013a, 2013b) among others. For most of them, self-reinforcing dynamics of technological and institutional progress played a key role. The outstanding debate concerns the key forces that made these virtuous circles possible.

The degree to which the long march of history is driven by a “vital few,” such as emperors, religious leaders, and great inventors is disputed. It is particularly controversial as far as their contribution to technological progress is concerned. Were individuals such as Newton, Galileo, Kepler, and Vesalius really needed for the Industrial Revolution to take place? Is it true that, as Mokyr (2016) writes, in a market economy, it is the few who drag along the many? Is it true that, even if the role of overall human capital as an engine of growth (Cervelatti and Sunde (2005), Galor (2011)) remains disputed, it was upper-tail human capital that was key?

The aim of this project is to analyze quantitatively whether elite knowledge and upper-tail human capital (UTHC) were critical to triggering the rise of the West. The current literature, which is mostly based on qualitative approaches, can be grouped into three competing views. The first group claims that the UTHC was essential. This view leans towards considering innovation as driven essentially by the UTHC – those scientists who pushed the envelope of propositional knowledge, which was then applied. For Mokyr (2002), a small group of at most a few thousand people showed the way to the Industrial Revolution. This view is shared by Jacob (2014) and Wootton (2015). In addition to developing technology, the UTHC also contributed to building better institutions as early as the Middle Ages, which would turn out to be complementary to the growth process: theologians promoted nuclear family structures (Mitterauer 2010), lawyers developed Roman and civil law, physicians laid the ground for advances in botany, etc. The opposite view sees innovations as driven by practical knowledge, from craftsmen to barber surgeons, which improves over time through learning-by-doing, and the occurrence of improvements through trial-and-error and serendipity. Formal, codified knowledge plays no role in this approach. For example, pre-modern cathedrals were built with heuristic rules of thumb rather than by using pre-established plans and engineering calculations (Epstein, 2013). This view suggests that the seedbed of revolution rests with craftsmen rather than scholars, in university-less London rather than Oxford, or in Lyons rather than Paris (Porter 1996). A third approach promotes the importance of the indirect effect of elite knowledge. Elites triggered a cultural change in the period 1500-1700, which made part of the population ready for modern technologies and institutions. This thesis is defended by Mokyr (2016): the Enlightenment in the eighteenth century was pivotal in driving economic growth in the nineteenth century (see also Cinnirella, 2018). From a theoretical perspective, this view resembles the threshold externality story of Azariadis and Drazen (1990), in which a take-off occurs once a certain threshold in human capital is reached.

There are currently no global quantitative analyses of the historical effect of the UTHC on the dynamics leading to the Industrial Revolution. Recent country-level studies include Dowey (1916) for England, Squicciarini and Voigtländer (2015) for France, and Dittmar and Meisenzahl (2016) and Cinnirella and Streb (2017) for Germany. Squicciarini and Voigtländer (2015) show that the number of people who subscribed to Diderot and d’Alembert’s *Grande Encyclopédie* in eighteenth-century France predicts economic development later on, both at the city and county levels. Dittmar and Meisenzahl (2016) show that German cities, which adopted better institutions following the Reformation, featured more people recorded as famous in the German biography database, and grew faster at the same time. Although very innovative, these studies are confined to either France or Germany and rely on a limited time frame. Some approaches cover a broader area, but are based either on a selection of people from the elite (often mixing scholars in with a large group of famous or noble people – see below), or on universities, like Cantoni and Yuchtman (2014), or on the production of books, like Bateman and van Zanden (2008), who use data on book production as a proxy for the development of human capital.

The proposed database: content, purpose, and feasibility

To take the debate to a new level, I propose, in a first step, to build a database of a large sample of university professors and members of scientific academies in Europe from the creation of the first universities (c. 1000) through to the Industrial Revolution (c. 1800). This database will provide the platform for developing new theo-

ry and new empirical studies that will be used in combination with each other. This database will be unique, as it will link scholars to the places where they actually worked and interacted (universities and academies). By aiming at a European view over an 800-year period, this project answers the call to arms of the History Manifesto (Guldi and Armitage 2014), by arguing in favor of the revival of a more global and *longue durée* analysis after a period of comparative retreat among professional historians (a retreat which is found in economics too).

Creating such a database will make it possible to exploit the variation in the composition, density, and quality of the UTHC across time, space, and key fields, and to establish the nature and extent of the correlation between the UTHC and the adoption of new techniques and better institutions, the development of cities, and the rise in literacy and numeracy (see Baten and Hippe, 2018) at the regional level. It will also make it possible to perform causal identification by exploiting exogenous variations in the network of scholars and universities. Another strong point of gathering this data together in this way will be to reveal the location pattern of scholars and to measure positive selection (better people are less sensitive to distance) and sorting (better people concentrate in the region where returns are higher) in the medieval and early modern academic market. Yet, before going into how the database will be exploited, let me discuss the feasibility of the project.

Over the period 1000-1800, the number of universities in Europe rose to nearly two hundred (Frijhoff 1996), while about 100 scientific academies were of some importance. Based on the very complete coverage of the professors at Heidelberg by Drüll-Zimmermann (1991, 2002) and the members of the Leopoldina, the total population of scholars and literati should amount to less than 170k. This stresses the relative risk of the project, as the obstacles we will need to overcome to gather a significant amount of data cannot be fully predicted. I have therefore launched **two pilot studies to determine the upper and lower bounds of the required work**. A first pilot was designed to determine how far one can go with the “low-hanging fruit:” with Stelter and Myrskylä, we collected vital dates and activity periods for 10k scholars using the information offered by Dutch and German universities (for some universities, such as Groningen, Leiden, Leipzig, Rostock, and Utrecht, the list of professors has recently been established and made available on the web. This shows the interest of these universities themselves in such a historical view. For other universities, we use the published books of lists of professors). Pushing beyond this requires resources but is feasible: some universities have not yet established an authoritative list of their professors, but some authors, sometimes a century ago, independently published a biography of these professors. This is true for Cambridge, Padova, Oxford, and Bologna, for example. The worst case is when a university has neither a ready-to-use website nor published biographies of their professors. Here, we will need to combine knowledge from books written on their history, published *matricula* (individuals registered at a given university), and *cartularia* (containing transcriptions of original documents related to the historical events at a university) with local biographical dictionaries. The second pilot study tested this methodology on the University of Aix in Provence (de la Croix and Fabre, 2018). Starting from none, we identified 476 scholars at this university, attesting to the feasibility of the data collection effort.

Once the intermediary goal of reaching 30k scholars is achieved, we will then proceed in two directions: (1) by expanding the database further by increasing the number of scholars, and (2) by enriching the database by incorporating data on books published. Reaching this intermediate stage may require adjustments in the range of universities covered. Priority will be given to expanding the coverage of the hexagon bounded by Glasgow, Copenhagen, Krakow, Naples, Marseilles, and Plymouth (suggested in Ferguson (2011) to cover the key figures of the Scientific Revolution). **A strength of this approach is the scalability of the project and the progressive ongoing expansion of its coverage**. On the whole, I aim at establishing data for at least 60k professors by integrating and combining sources within a new structure that will make new lines of analysis possible.

Over the course of eight centuries, medieval universities preserved a recognizable identity, including their independence from Church and State (Ashby 1963). Each went through phases of glory and decadence. They were sometimes accused of being an obstacle to modernity or of being completely irrelevant for the Scientific Revolution, as exemplified by Manuel’s (1968) comment about Cambridge and Newton: “*an intellectual desert, in which a solitary man constructed a system of the world.*” Examining the evidence for England more closely, Porter (1996) still finds that a high proportion of the great names of early modern science made their careers as professors in university employment. However, an exodus of scientists from the universities is well documented (Pedersen 1996). Hopefully, we will find many significant scholars in the list of members of the Scientific Academies. Taking into account the members of the learned societies will moreover enable us to better capture the shifts in focus that took place following the humanistic revolution. Initiated in Italy, the rise of Academies gained momentum in Northern Europe with the creation of the Académie des Sciences (1666), the Royal Society

of London (1662), and the Academia Leopoldina (1677). In a way, these academies formalized the Republic of Letters, which linked together small bands of intellectuals through a very effective network of publications. This transnational organization is viewed by Mokyr (2016) as a key engine of cultural change. Gathering information on all the members of these academies since their inception is a feasible task as the information is often readily available from the academies themselves. Considered at the European level, it is as yet an untapped resource.

An important aspect of the core database will be the systematic and progressive inclusion of **an army of less known scholars**, who are typically not recorded in encyclopedias, but can still provide information on the features and impact of the UTHC population. Another key aspect lies in gathering data on fields of study. When universities emerged, there were four faculties (arts, law, medicine, and theology), each serving a particular sector of society. Later on, as society's needs increased, some universities expanded the realm of their expertise, while others did not, thus becoming increasingly obsolete. Humanism, directly followed by Protestantism, induced an expansion of the faculty of arts. Encoding properly the field(s) of scholars (many were acting in more than one, typically the polymaths) will make it possible to quantify and map these changes in a precise way, and also to identify the ability of various universities to adjust to and influence the changing world.

To enhance the power of the core database, we will enrich it by integrating a measure of the quantity and quality of the output of scholars from their book production and their impact (as demonstrated, for example, by the number of their works in library holdings in world libraries). Data on books have been collected and harmonized by Buringh and van Zanden (2009) and by Chaney (2017) from various sources. I also propose to measure the quality and influence of institutions (universities and academies) in different complementary ways, namely: [1] the book production and the consequential influence of their members, [2] the diversity of their members in terms of their geographic origin using the index of birthplace diversity as suggested by Alesina, Harnoss, and Rapoport (2016), and [3] the mean distance with respect to the birth place of their members.

Compared to the existing literature on famous people using big data, the proposed database will have unique advantages. Unlike most historical demography (see Cummins 2017 for the *apogée* of this discipline), it will not focus on noble families, which might not be the prime depositors of upper-tail human capital. Compared to generalist studies of famous people (see de la Croix and Licandro 2015) or of authors (Chaney 2017), I propose to target one precisely defined group, the members of scientific academies and universities, for whose the nomination date and the migration patterns can be known in most cases. Finally, compared to studies based on electronic resources (two fascinating new studies are by Gergaud, Laouenan, and Wasmer 2016 and Tabellini and Serafinelli 2017), we will focus on this specific group, using much more thorough and university-specific sources.

Empirical step: establishing to what extent the UTHC is related to growth and modernization

I will now detail the way in which the new database will be used to address the core research question. The aspects of the UTHC that we will focus on are: composition (by field and place of birth), density, quality and quantity of output, mobility, birthplace diversity, and longevity. An additional strength of this methodology will be the ability to observe where the scholars actually worked, which is not the case when only the place of birth and the place of death are known. The units of analysis will be geographic cells, which can be aggregated to the desired level depending on the outcome variable. To measure outcomes, we will rely on existing sources, for example: Bairoch, Batou, and Chèvre (1988) built a database of city population for almost all cities in Europe that reached 5k inhabitants before 1850. City growth is often used as an indicator of economic vitality. DeLong and Shleifer (1993) built an indicator of whether cities were free or subject to the will of a prince. Beyond cities, Dittmar (2011) compiles information from three different sources on the adoption of the printing press during its infancy period (1450-1500). To measure regional development in terms of broad human capital, we can rely on numeracy indexes based on age-heaping measures, as suggested by A'Hearn, Baten, and Crayen (2009), and on anthropometric measures (Cinnirella and Komlos 2007, Baten et al. 2010). Literacy in the pre-industrial period can be measured by signatures on marriage registers.

On the **demographic side**, we will use nonconventional methods (in economics) to identify characteristic statistical patterns in the location of scholars. Drawing inspiration from Schich et al. (2014), we will (1) provide a macroscopic view of the history of scholars and universities in all parts of Europe, which were, or not, the crucibles of the Scientific and Industrial Revolutions, and (2) document the historical trends in the primacy of knowledge centers beyond the scope of the specific events or narrow time intervals that historians usually restrict themselves to. Moreover, the large number of observations, as well as the knowledge of the age at nomination for scholars will allow us to properly estimate their life expectancy. Life expectancy can be computed for different regions and time periods, and also correlated to outcome variables.

When exploiting the database empirically, we will have to address the issue of the endogeneity of the localization of human capital which many other researchers have already faced (see historical examples in Becker and Woessmann 2009, and Becker et al. 2010). For this, we will **design an identification strategy which is catered to our particular problem and exploit the individual nature of the data**. We will build networks of individuals and of universities, and use exogenous changes in their position in the network to instrument our measures of the UTHC. The network of scholars will represent individuals as nodes. Edges (links between individuals) will be assumed when two scholars share the same institution during the same period. Alternatively, the network of universities will represent universities as nodes, and a link between two universities will be assumed when the same scholar held positions in both universities during his/her life. In these two networks, individuals and universities will be characterized by their centrality. After having designed the networks, we will look for sources of random variations, which modified the allocation of the UTHC without altering other unobserved variables. Such variations will affect the centrality of every node in both networks, providing instruments for the UTHC.

The creation of universities itself can be seen in some cases as a natural experiment. Why universities were sometimes founded late in important cities are questions which remain a mystery for historians (Rüegg 1992). Persecution by the authorities is a surprising ingredient in the foundation of new universities. This is what happened in Cambridge, with masters and students fleeing Oxford following the execution of a few students at the behest of the mayor (Verger 1992). The same pattern was repeated in Paris in 1229-31, leading to the creation of universities in Orléans and Angers. The Great Schism between the Pope and the Emperor played a major role in the creation of German universities, and is treated as a natural experiment by Cantoni and Yuchtman (2014). Later, **the religious conflicts between Catholics and Protestants** led to major changes in the university landscape (Becker et al. 2016), including the shutdown of certain schools (e.g. Sedan) and the creation of new ones (e.g. Marburg). The Huguenot diaspora to Prussia was part of this movement (Scoville 1953, Hornung 2014).

Another channel linking elites to outcomes is the contact time effect. In a world where face-to-face communication was essential for knowledge transmission and enhancement, the productive life of the elite had to be long enough to significantly affect their environment. A formal link between productivity growth and longevity is provided by Lucas (2009). In his model, people learn ideas from the people they meet. The more people they meet, the more creative and productive they become. If they live long, they provide more opportunities for other people to learn from them. This effect of longevity on growth might be sizeable, which justifies why several authors have tried to assess changes in the longevity of the elite before the Industrial Revolution (Cummins 2017, de la Croix and Licandro 2015). We will, however, be able to go well beyond these studies, as we will know precisely where the scholars interacted and for how long.

Beyond the effect of UTHC density, quality, and longevity on outcomes, we will also gain new insights from modelling **the location behavior of individuals**. The spread of knowledge through the mobility of students and professors has been a key aspect of European universities since their inception. Until the seventeenth century, all universities taught in Latin, which facilitated *peregrinatio academica*, or academic pilgrimage (Rydder-Symoens 1992). As the proposed database will integrate records from universities and academies, it will enable us to identify the patterns of migration for scholars in a systematic way, thus going beyond what is presently known for only the most outstanding individuals (for example, Vesalius tutored briefly in Louvain, then moved to Padova). In particular, we will be able to identify and explain the selection and sorting patterns underlying the location decisions of university professors. In general, positive selection refers to the force that drives the increase in the prevalence of advantageous traits. In the context of migration, positive selection refers to the fact that high-skilled workers are more likely to migrate (Abramitzky, Boustan, Eriksson 2012 & 2014, McKenzie and Rapoport 2007). In the context of our university professors, this would imply that the best people are less sensitive to distance when choosing where to settle. Sorting therefore appears when individuals with better attributes are concentrated in the region where the returns are higher. In the context of this study, there will be sorting if better people are more likely to settle in more prestigious universities. Finding both positive selection and sorting would back the claim that medieval universities were one of the most original creations of Western Civilization, where students were educated by a plurality of masters coming from all parts of Europe (Rashdall 1895). The database will also be rich enough to see how this pattern changed over time, and across regions and fields.

New theories of the complementarity between (A) elite knowledge and practical techniques, and between (B) elites and the adoption of enlightened institutions.

The possible link between the UTHC and modernization arises through the adoption of new techniques and the establishment of new institutions. To further understand such mechanisms, we will develop a new theory of the

complementarity between (A) elite knowledge and applied techniques, and between (B) elites and the adoption of enlightened institutions. We cannot rely on existing explicit models of endogenous technological progress built on R&D efforts by firms to model productivity growth, following the seminal papers of Romer (1990) and Aghion and Howitt (1992). While such models are useful to analyze innovation in modern times, their applicability to long-run historical change is doubtful since legal protections for intellectual property only became widespread later. Instead, we will need to build a new model on the assumption that productivity growth is based on the exchange of ideas from person to person, and that new ideas cannot be protected for long.

Concerning the first complementarity (A), the existing literature (see de la Croix, Doepke, and Mokyr 2018), assumes that apprentices acquired ideas from master craftsmen, but also got new ideas exogenously (maybe from contacts with the elite), and that they implemented the best of the two. The literature on the history of science (Valleriani 2017), however, shows that the interface between the UTHC and practical knowledge is more complex than just adopting a new idea for free, and that more elaborate modelling is required to understand the incentives underlying fast adoption and diffusion. We will model this interface by considering three layers. The first layer is theoretical knowledge, *scientia*, mostly developed by intellectuals and generally codified in books. The second layer is codified practical knowledge, often in collections of recipes or in almanacs. The third layer is *ars*, the knowledge of master craftsmen, which is mostly uncoded, acquired through experience during apprenticeships. Such a theoretical framework allows the three layers of knowledge to interact by explicitly modelling the process of publishing recipe collections which is at the core of the second layer. One key question the model will address is determining the conditions under which an economy will either come to rely on applied codified knowledge in addition to tacit knowledge, speeding up the diffusion of ideas, or stick to the traditional way of learning through interpersonal contacts. Incentives depend on the printing technology, the density of the population, the literacy of the population, and the effective protection of intellectual property. As patents and copyright did not apply during the period considered so that intellectual property was not formally protected, I plan to consider mechanisms of innovation without monopoly rents inspired from Boldrin and Levine (2008). To bring the theory to data, I intend to use existing data on innovations at the dawn of the Industrial Revolution (patents and individual data from exhibits and world fairs) and correlate them with our measures of the UTHC using the same instrumentation strategies based on exogenous changes in scholarly networks.

With regard to the complementarity between elites and the adoption of enlightened culture and institutions, I start from the idea that the presence of learned institutions is a double-edged sword. There are cases in history when universities fought against novelty. This might have arisen because universities had a vested interest in the status quo, for example when the Scientific Revolution involved the repudiation of key Aristotelian dogmas (Porter 1996), which had been taught for centuries. A theoretical way to model this insight can be based on Acemoglu (2008). As many new universities emerged in Europe as corporations of masters and students (see Greif and Tabellini 2012 on why the adoption of corporations in Europe was much more attractive), they fit Acemoglu's oligarchic institutions well. Along this line, a university may initially enjoy a high rate of growth, but also tends to extract rents and to establish barriers to entry. Over time, innovation inevitably moves from one location to the next, so that members of a sitting oligarchy do not remain at the frontier. However, there are many cases in which universities and academies favored modernity. To model this race within universities between conservative and modern forces, universities will be considered as firms offering several products (fields). Investing in the development of a new product line puts universities closer to the frontier, but conflicts with the vested interests of the scholars working in the existing fields. The analysis of the dynamic interactions between conservative and modern forces within universities and learned societies will enable us to derive the conditions under which modernity prevailed, and to use the richness of the database to examine where and when it did so.

Conclusion

To conclude, constituting the proposed database and developing empirical and theoretical research which relies on its depth and wealth will allow us for the first time to have a view at the European level of the role of the UTHC in the rise of the West, which is rigorously grounded in evidence, and which can be reproduced, falsified, and developed further. For research in growth and development, this proposal intends to change the way we think about macroeconomic outcomes by unravelling the rich interactions between the behavior of and the incentives faced by scholars & literati and development.

References

- Abramitzky, Ran, Leah Platt Boustan, and Katherine Eriksson. 2012. "Europe's Tired, Poor, Huddled Masses: Self-Selection and Economic Outcomes in the Age of Mass Migration." *American Economic Review*, 102 (5): 1832-56.
- Abramitzky, Ran, Leah Platt Boustan, and Katherine Eriksson. 2014. "A nation of immigrants: Assimilation and economic outcomes in the age of mass migration." *Journal of Political Economy* 122 (3): 467–506.
- Acemoglu, Daron. 2008. Oligarchic Versus Democratic Societies. *Journal of the European Economic Association*. **6**, 1-44.
- A'Hearn, Brian, Baten, Jörg, and Dorothee Crayen. 2009. Quantifying Quantitative Literacy: Age Heaping and the History of Human Capital, *The Journal of Economic History*, 69, 783-808.
- Aghion, Philippe and Peter Howitt. 1992. A Model of Growth through Creative Destruction. *Econometrica* **60** (2): 323–351.
- Alesina Alberto, Johann Harnoss and Hillel Rapoport. 2016. Birthplace diversity and economic prosperity. *Journal of Economic Growth*, **21**, 101-138.
- Ashby, Eric. 1963. *Technology and the Academics – an Essay on Universities and the Scientific Revolution*. London: MacMillan.
- Azariadis Costas and Alan Drazen. 1990. Threshold externalities in economic development, *Quarterly Journal of Economics*, 105, 501–526.
- Bairoch, Paul, Jean Batou and Pierre Chèvre. 1988. *La Population Des Villes Européennes*, Geneva: Librairie Droz.
- Baten, Jörg, Debin Ma, Stephen Morgan, and Qing Wang. 2010. Evolution of living standards and human capital in China in the 18-20th centuries: Evidences from real wages, age-heaping, and anthropometrics. *Explorations in Economic History*, **47**, 347-359.
- Baten, Jörg and Jan Luiten van Zanden, 2008. Book production and the onset of modern economic growth, *Journal of Economic Growth*, **13**(3), 217-235.
- Baten, Jörg and Ralph Hippe, 2018. Geography, land inequality and regional numeracy in Europe in historical perspective. *Journal of Economic Growth*, **23**(1), 79-109.
- Becker, Sascha, and Ludger Woessmann. 2009. Was Weber wrong? A human capital theory of Protestant economic history. *Quarterly Journal of Economics* **124**, 531-596.
- Becker, Sascha, Francesco Cinnirella, and Ludger Woessmann. 2010. The trade-off between fertility and education: evidence from before the demographic transition. *Journal of Economic Growth*, **15**(3), 177-204.
- Becker, Sascha, Steven Pfaff and Jared Rubin. 2016. Causes and consequences of the Protestant Reformation. *Explorations in Economic History*, **62**, 1-25.
- Boldrin, Michele, and David K. Levine. 2008. Perfectly competitive innovation. *Journal of Monetary Economics* **55** (3): 435–453 (April).
- Cantoni, Davide and Noam Yuchtman. 2014. Medieval Universities, Legal Institutions, and the Commercial Revolution, *Quarterly Journal of Economics*. **129** (2), 823–887.
- Cervellati Matteo and Uwe Sunde. 2005. Human capital formation, life expectancy and the process of development, *American Economic Review* **95**, 1653–72.
- Chaney, Eric. 2017. *Scientific Revolution: Institutions and the Intellectual Rise of the Western World*. Harvard University, mimeo.
- Cinnirella, Francesco and Ruth Schueler. 2018. Nation Building: The Role of Central Spending in Education. *Explorations in Economic History*. **67**(1): 18-39.
- Cinnirella, Francesco and John Komlos. 2007. European Heights in the Early 18th Century. *Vierteljahrschrift fuer Sozial- und Wirtschaftsgeschichte*, **94**(3), 271-284.
- Cinnirella, Francesco and Jochen Streb . 2017. The Role of Human Capital and Innovation in Economic Development: Evidence from Post-Malthusian Prussia. *Journal of Economic Growth*, **22**(2). 193-227.
- Cummins, Neil. 2017. Lifespans of the European Elite, 800-1800, *Journal of Economic History*, **77**(2): 406-439.

- de la Croix, David, and Omar Licandro. 2015. The Longevity of Famous People from Hammurabi to Einstein. *Journal of Economic Growth*, **20**:263-303.
- de la Croix, David, Matthias Doepke, and Joel Mokyr. 2018. Clans, Guilds, and Markets: Apprenticeship Institutions and Growth in the Pre-Industrial Economy. *Quarterly Journal of Economics*, **133**, 1-70.
- de la Croix David, and Alice Fabre. 2018. A la découverte des professeurs de l'ancienne université d'Aix. Submitted.
- DeLong, Bradford and Andrei Shleifer. 1993. Princes and Merchants: City growth before the Industrial Revolution, *Journal of Law and Economics*, **36**, 671-702.
- Dittmar, Jeremiah. 2011. Information technology and economic change: the impact of the printing press. *Quarterly Journal of Economics*, **126**, 1133-1172.
- Dittmar, Jeremiah and Ralf Meisenzahl (2016), State Capacity and Public Goods: Institutional Change, Human Capital and Growth in Early Modern Germany, CEP Discussion Paper No 1418.
- Dowey, James. 2016. *Mind over Matter. Access to Knowledge and the British Industrial Revolution*. LSE Ph.D thesis.
- Drüll-Zimmermann, Dagmar. 1991. Heidelberg Gelehrtenlexikon: 1652-1802. Berlin, Heidelberg: Springer.
- Drüll-Zimmermann, Dagmar. 2002. Heidelberg Gelehrtenlexikon: 1386-1651. Berlin, Heidelberg: Springer.
- Epstein, Stephan R. 2013. Transferring Technical Knowledge and Innovating in Europe, c. 1200-c. 1800. Chapter 1 of *Technology, Skills and the Pre-Modern Economy in the East and the West*, edited by Jan Luiten van Zanden and Marten Prak. Boston: Brill.
- Galor, Oded and Omer Moav. 2002. Natural Selection and the Origin of Economic Growth. *Quarterly Journal of Economics*, **17**(4), 133-192.
- Galor, Oded. 2011. *Unified Growth Theory*. Princeton, NJ: Princeton University Press.
- Greif, Avner and Guido Tabellini. 2012. The Clan and the City: Sustaining Cooperation in China and Europe. IGIER Working Paper Series, 445.
- Guldi, Jo and David Armitage. 2014. *The History Manifesto*. Cambridge: Cambridge University Press.
- Hornung Erik, 2014. Immigration and the Diffusion of Technology: The Huguenot Diaspora in Prussia, *American Economic Review*, **104**(1), 84-122.
- Jacob, Margaret C. 2014. *The First Knowledge Economy - Human Capital and the European Economy, 1750–1850*, Cambridge: Cambridge University Press.
- Kelly, Morgan, and Cormac Ó Gráda. 2016. “Adam Smith, Watch Prices, and the Industrial Revolution.” Forthcoming, *Quarterly Journal of Economics*.
- Landes, David. 1998. *The Wealth and Poverty of Nations*. New York: W. W. Norton.
- Maddison, Angus. 2001. *The World Economy—A Millennial Perspective*, Development Centre Studies, OECD, Paris.
- Manuel, Frank E. 1968. *A portrait of Isaac Newton*. Cambridge, MA: Belknap Press of Harvard University Press.
- McKenzie, David, and Hillel Rapoport. 2007. “Network effects and the dynamics of migration and inequality: theory and evidence from Mexico.” *Journal of development Economics* 84 (1): 1–24.
- Mc Neil, William. 1963. *The Rise of the West. A History of the Human Community*. Chicago: University of Chicago Press.
- Mitterauer, Michael. 2010. *Why Europe? The Medieval Origins of Its Special Path*. Chicago: University Of Chicago Press.
- Mokyr, Joel. 2002. *The Gifts of Athena. Historical Origins of the Knowledge Economy*, Princeton: Princeton University Press.
- Mokyr, Joel. 2009. *The Enlightened Economy*, New York and London: Yale University Press.
- Mokyr, Joel. 2016. *A Culture of Growth, The origins of the modern economy*, Princeton: Princeton University Press.

- Pedersen, Olaf. 1996. Tradition and Innovation, in: Ridder-Symoens, Hilde de (ed.): *A History of the University in Europe. Vol. II: Universities in Early Modern Europe (1500–1800)*, Cambridge: Cambridge University Press, pp. 451–487.
- Porter, Roy. 1996. The scientific revolution and universities, in: Ridder-Symoens, Hilde de (ed.): *A History of the University in Europe. Vol. II: Universities in Early Modern Europe (1500–1800)*, Cambridge: Cambridge University Press, pp. 531–562.
- Rashdall, Hastings. 1895. *The universities of Europe in the Middle Ages*. Oxford: The Clarendon Press.
- Romer, Paul. 1990. Endogenous Technological Change. *Journal of Political Economy* **98** (5): S71–S102.
- Rüegg, Walter, 1992. Themes. In Rüegg, Waster (ed.): *A History of the University in Europe. Vol. I: Universities in the Middle Ages*, Cambridge: Cambridge University Press, 3–34.
- Schich, Maximilian, Chaoming Song, Yong-Yeol Ahn, Alexander Mirsky, Mauro Martino, Albert-László Barabási, and Dirk Helbing. 2014. A network framework of cultural history, *Science*, **345** (6196), 558–562.
- Scoville, W. C. 1953. Minority migrations and the diffusion of technology. *Journal of Economic History* **11** (3), 347–360.
- Squicciarini, Mara and Nico Voigtländer. 2015. Human Capital and Industrialization: Evidence from the Age of Enlightenment, *The Quarterly Journal of Economics* **130** (4): 1825–1883.
- Stelter, Robert, David de la Croix and Mikko Myrskylä. 2019. Social status, war, medical knowledge, and the timing of life expectancy improvements among Germanic scholars over the fifteenth to nineteenth centuries, mimeo.
- Tabellini, Guido and Michel Serafinelli 2017, Creativity over Time and Space, mimeo.
- Valleriani Matteo 2017, *The Structures of Practical Knowledge*, Springer.
- Vergèr Jacques. 1988. Peut-on faire une prosopographie des professeurs des universités françaises à la fin du Moyen Âge?, *Mélanges de l'Ecole française de Rome. Moyen-Age, Temps modernes* **100**, 55–62.
- Voigtländer, Nico, and Joachim Voth. 2013a. How the West 'Invented' Fertility Restriction. *American Economic Review*, **103**(6), 2227–64.
- Voigtländer, Nico, and Joachim Voth. 2013b. The Three Horsemen of Riches: Plague, War and Urbanization in Early Modern Europe. *Review of Economic Studies*, **80**(2), 774–811.
- Wootton, David. 2015. *The Invention of Science: A New History of the Scientific Revolution*, London: Allen Lane.

Section b: Curriculum vitae**PERSONAL INFORMATION**

David de la Croix

Belgian nationality. Born April 22, 1964.

website: <http://www.de-la-croix.be>

orcid.org/0000-0002-7589-8535

EDUCATION

1992: Ph.D. in Economics (Université catholique de Louvain) on “Union-Firm Bargaining and Equilibrium Unemployment in Quantity Rationing Models.” Director: H. Sneessens.

CURRENT POSITION(S)

2005- : Full professor at Université catholique de Louvain

PREVIOUS POSITIONS

Invited professor at the University of California, Los Angeles (2000-2001), University of Copenhagen (2008), National Taiwan University (2009), University of Cape Town (2012), University of Poznan (2015), NYU Abu Dhabi (2018).

1995-2005: Research Associate at the National Fund for Scientific Research (Belgium).

1992-1993: Research Fellow at the Rijksuniversiteit Limburg (Maastricht).

1989-1993: Research assistant (1989-1993) and Post-doctoral Researcher (1993-1995) at the National Fund for Scientific Research.

FELLOWSHIPS AND AWARDS

2017-2018: Fellow at Iméra, Center for Advanced Studies, Marseille

2015-2017: International Panel on Social Progress

2014-2017: Francqui Research Professorship

2010-2013: United Nations: Panel on New Challenges in Population and Development (IUSSP)

2003-2004: Francqui Chair, Ghent University.

2000-2001: Fulbright research grant.

2000-2001: NATO research grant.

SUPERVISION OF GRADUATE STUDENTS

I firmly believe that Ph.D. students are the blood and flesh of any good department. Among the twenty Ph.D. students who completed their dissertation under my supervision, fifteen are working in research and teaching positions (among whom nine already hold permanent positions at universities or in Central Bank research centers), five are in executive positions in major institutions (EU and World Bank). I am currently supervising four Ph.D. students (1 almost ready to complete).

20 completed dissertations as supervisor: Alexandra Rillaers (2000), Rafael Munoz (2000), Géraldine Mahieu (2002), Joao Medeiros (2003), Lionel Artige (2004), Fabio Mariani (2005), Tapas Mishra (2006), Carmen Camacho (2007), Alessandro Sommacal (2008), Davide Dottori (2009), Luca Marchiori (2009), Gül Ertan Özgüler (2010), Paolo Melindi Ghidi (2012), Paula Eugenia Gobbi (2013), Emeline Bezin (2015), Pierre Pecher (2016), Hamzeh Arabzadeh (2016), Robert Stelter (2016), Lucia Granelli (2018), Zainab Iftikhar (2018), Elisa Rizzo (2018).

INSTITUTIONAL RESPONSIBILITIES

2018- : Head of IRES (research center in economics at UCL)

2015-2016: Member of scientific commissions at the National Fund for Scientific Research.

2010-2015: Member of the promotion committee (UCL).

2010-2014: Member of the Research Council of the University (UCL).

2005-2010: Director of the doctoral program in Economics, UCL.

ACADEMIC ENTREPRENEURSHIP

When I started working on long-run growth at IRES in the nineties, I was alone on the subject. Over the years, I participated with other colleagues to the transformation of IRES, a business cycle advising unit founded in 1928, into a modern research center publishing in the best journals. I lead the team on long-run growth and demographic economics, which now includes three other permanent professors, 3 post-docs and 15 Ph.D. students.

Trying to get people of different horizons to work together is one of my aims. In 2008, I obtained a large grant for a joint project on “sustainability” between economists and applied philosophers of the Hoover Chair of economic and social ethics, thereby promoting a new interdisciplinary approach to long-term growth. In 2015, I obtained another large grant on “Family transformations”, involving economists and demographers.

More information: <http://perso.uclouvain.be/david.delacroix/arc-family.html>

Four years ago, I created a new journal. The Journal of Demographic Economics (JODE, published by Cambridge University Press) is intended to be the premier professional outlet for what has become a vibrant and flourishing subfield within economics. The objective is to encourage research in this field, exploiting the complementarities between theory and empirics, and promoting interdisciplinary collaborations between demographers and economists.

More information: <http://perso.uclouvain.be/david.delacroix/jode.html>

OVERVIEW OF PUBLICATION RECORD

54 coauthors, 89 published articles, 2 monographs, 2 encyclopedia entries, 32 popular articles.

Significant publications in top-5 journals:

De la Croix D., M. Doepke, and J. Mokyr, Clans, Guilds, and Markets: Apprenticeship Institutions and Growth in the Pre-Industrial Economy, *Quarterly Journal of Economics*, **133**, 1-70, 2018.

Baudin T., De la Croix D., and P. Gobbi, Fertility and childlessness in the United States, *American Economic Review*, **105**, 1852-1882, 2015.

De la Croix D. and F. Mariani, From Polygyny to Serial Monogamy: a Unified Theory of Marriage Institutions, *Review of Economic Studies*, **82**, 565-607, 2015.

De la Croix D. and M. Doepke, To Segregate or to Integrate: Education Politics and Democracy, *Review of Economic Studies*, **76**, 597-628, 2009.

De la Croix D. and M. Doepke, Inequality and growth: why differential fertility matters, *American Economic Review*, **93**, 1091-1113, 2003.

Most cited publications:

De la Croix D. and M. Doepke, Inequality and growth: why differential fertility matters, *American Economic Review*, **93**, 1091-1113, 2003. GS # citations: 792

De la Croix D. and P. Michel, *A Theory of Economic Growth: Dynamics and Policy in Overlapping Generations*, Cambridge University Press, 2002. ISBN 978-0521001151. GS # citations: 602

Boucekkine R., D. De la Croix and O. Licandro, Vintage human capital, demographic trends and growth, *Journal of Economic Theory*, **104**, 340-375, 2002. GS # citations: 489

Appendix: All ongoing and submitted grants and funding of the PI (Funding ID)
Mandatory information (does not count towards page limits)

On-going Grants

<i>Project Title</i>	<i>Funding source</i>	<i>Amount (Euros)</i>	<i>Period</i>	<i>Role of the PI</i>	<i>Relation to current ERC proposal</i>
ARC project 15/19-063 on "family transformations: incentives and norms"	French-speaking community of Belgium	700,000€ (2 post-docs, 3 docs, research money)	Sep 2015 – Sep 2020	Main Promotor (other promotors: Luca Pensieroso, Ester Rizzi, Fabio Mariani)	unrelated

Applications Pending

<i>Project Title</i>	<i>Funding source</i>	<i>Amount (Euros)</i>	<i>Period</i>	<i>Role of the PI</i>	<i>Relation to current ERC proposal²</i>
none					

Section c: Ten-year track record

BIBLIOMETRY (July 22, 2019)

5,079 citations (G. Scholar), 1,487 citations in Scopus.

h-index: 33 according to G. Scholar, 18 according to Scopus.

In **Repec**, among the top 1% authors at the world level according to 38 criteria, among which: Number of Distinct Works, Number of Citations, h-index, Number of Journal Pages, Strength of students.

TOP 10 SCIENTIFIC PUBLICATIONS in the last 10 years

Baudin T., De la Croix D., and P. Gobbi, Endogenous Childlessness and Stages of Development, **Journal of the European Economic Association**, forthcoming.

Measures the importance of opportunity driven and poverty driven childlessness in 36 developing countries with a structural model of fertility and marriage. Shows that the endogenous response of marriage and childlessness matter for determining the impact of social progress.

De la Croix D., M. Doepke, and J. Mokyr, Clans, Guilds, and Markets: Apprenticeship Institutions and Growth in the Pre-Industrial Economy., **Quarterly Journal of Economics**, **133**, 1-70, 2018.

Compares growth under alternative institutions to deal with the moral hazard problem in master-apprentice relationship. Guilds and market-based systems allow knowledge to cross the family/clan boundaries. Guild adoption is more likely when initially in a nuclear family system.

De la Croix D. and F. Perrin, French Fertility and Education Transition: Rational Choice vs Cultural Diffusion, **European Economic Review**, **108**, 221-245, 2018.

Studies the French fertility and education transition in nineteenth century. Determines how much a structural rational-choice model can explain and show that additional insights are gained by considering cross county differences in family structure.

Baudin T., De la Croix D., and P. Gobbi, Fertility and childlessness in the United States, **American Economic Review**, **105**, 1852-1882, 2015.

Theory of parenthood decisions to understand and measure the reasons behind childlessness, and analyze its change over time and across education groups in the US.

De la Croix D. and F. Mariani, From Polygyny to Serial Monogamy: a Unified Theory of Marriage Institutions, **Review of Economic Studies**, **82**, 565-607, 2015.

Explains the transition from polygyny to monogamy, and the rise of serial monogamy as following the urban revolution and Industrial Revolution.

De la Croix D. and O. Licandro, The longevity of famous people from Hammurabi to Einstein, **Journal of Economic Growth**, **20**, 263–303, 2015.

Describes a new database built from the Index Biobibliographicus Notorum Hominum (IBN), containing vital dates and characteristics of 300,000 famous people. Identifies the moment when adult longevity started to increase prior to the Industrial Revolution.

De la Croix D. and F. Docquier, An incentive mechanism to break the low-skill immigration deadlock, **Review of Economic Dynamics**, **18**, 593-618, 2015.

Design of a migration policy maximizing global welfare subject to the constraints that rich countries are at least as well off as in the current situation.

De la Croix D. and O. Licandro, The Child is Father of the Man - Implications for the Demographic Transition, **The Economic Journal**, **123**, 236-261, 2013.

Theory of the demographic transition and the Industrial Revolution based on the evidence that physical development during childhood is an important predictor of adult life expectancy.

De la Croix D. and F. Docquier, Do Brain Drain and Poverty Result from Coordination Failures?, *Journal of Economic Growth*, **17**, 1-26, 2012.

Analyzes whether a high brain drain can be the outcome of an expectations-driven poverty trap.

De la Croix D. and M. Doepke, To Segregate or to Integrate: Education Politics and Democracy, *Review of Economic Studies*, **76**, 597-628, 2009.

Studies why societies vary in their choices regarding the mix of private and public schooling, and how education and fertility decisions interact with voting on public schooling expenditures.

RESEARCH MONOGRAPHS & chapters in collective volumes

De la Croix D., *Fertility, Education, Growth and Sustainability*, **Cambridge University Press**, 2012. ISBN 978-1107029590.

De la Croix D., Did Longer Lives Buy Economic Growth? From Malthus to Lucas and Ben-Porath, in *Demographic Change and Long-Run Development*, M. Cervellati and U. Sunde eds, **MIT Press**, 2016.

Summary of the possible impact of increases in adult longevity on economic growth with a focus on two particular channels: the contact time effect and the incentive effect.

Ph.D. STUDENT MENTORING – COMPLETED 2008-2018 with their current employer

Alessandro Sommacal (U. Verona), Davide Dottori (B. of Italy), Luca Marchiori (U. Luxemburg), Gül Ertan Özgüler (U. Izmir), Paolo Melindi Ghidi (U. Paris X), Paula Eugenia Gobbi (U. Brussels), Emeline Bezin (CNRS), Pierre Pecher (U. Aix-Marseille), Hamzeh Arabzadeh (U. Aachen), Robert Stelter (Max Planck Rostock), Lucia Granelli (Eur. Commission), Zainab Ifikhar (Goethe U., Munich).

PARTICIPATION TO INTERNATIONAL CONFERENCES (selected examples)

American Economic Association - ASSA Meeting (San Diego, Jan 2013, Philadelphia, Jan 2014)

Meeting of the Society for Economic Dynamics, Edinburgh June 2017, Toulouse June 2016, Toronto June 2014, Seoul, June 2013, Limassol June 2012, Montreal, July 2010.

Conference on Growth and Development New Delhi, Indian Statistical Institute, (Dec 2015, Dec 2009)

Barcelona GSE Summer forum (June 2016, June 2015, June 2014, June 2013)

INVITATIONS TO WORKSHOPS (selected recent examples)

“Family Macroeconomics” Edesheim, Germany, June, 2015, Mannheim, Germany, October 2018.

“Institutions, Culture, and Long-run Development”, Munich, Germany, November 13-14, 2015

“Deep-rooted Factors in Comparative Development”, Brown RI, USA, May 2016, May 2017

EDITORIAL AND EXPERT ACTIVITIES

Editor in Chief of *Journal of Demographic Economics* (2015-). Member of the **Editorial Board** of *Fiscal Studies* (2006-), *Recherches Economiques de Louvain* (1997-2014), *Cliometrica* (2006-). **Associate Editor** of *Journal of Economic Dynamics and Control* (2004-2013), *Journal of Development Economics* (2011-), *Journal of Public Economic Theory* (2011-2015).

External **Expert** for the FNRS (Belgium), CNRS (France), the FCT (Portugal), the ISF (Israel Science Foundation), the SNF (Switzerland), and the European Commission (Marie-Curie, ERC).

Participation in **Ph.D. committees** as a foreign member: Uppsala University (Sweden), Vienna University (Austria), Ecole Polytechnique (Paris), EHESS (Paris), University of Aix-Marseille II, University of Paris I (France), University of Namur, University of Ghent (Belgium).

Participation to “**habilitation**” **committees** at: Aix-Marseille II, Leipzig, Paris 1, and Toulouse.

AWARDS (See CV)