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Cliometrics and the Evolution of Human Capital

Claude Diebolt¹, Roger Fouquet² and Ralph Hippe³

Abstract

Human capital has been seen to be a key factor for current and future economic growth. In a broader sense, it appears that we are moving towards a knowledge economy driven by human capital, technological progress and digitalization. However, although this evolution may be a new trend, similar developments have occurred in history before. In line with this reasoning, the scholarly field of cliometrics has received ever more attention during the last years. In consequence, this paper presents the foundations of cliometrics, and provides insights into the basic conceptual framework and evolution of human capital during the last centuries.

Keywords: Human Capital, Cliometrics, ICT, Economic Development.

JEL codes: I21, N90, O18.

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1. Introduction

Human capital has been seen to be a key factor for current and future economic growth. In a broader sense, it appears that we are moving from a fuel-based economy to a knowledge economy driven by human capital, technological progress and digitalization. This evolution has major repercussions for the structure of the economy, but also for employment and the way we work and learn. Indeed, future education will not stop at school or university, but the future belongs to lifelong learning, i.e. education has to be an important part throughout the entire life cycle.

However, although this move towards the knowledge economy is a new trend, similar developments have occurred before in history. Therefore, economists should pay attention to the past in dealing with current and future economic issues. In line with this reasoning, cliometrics (which was originally known as “new economic history”) has received ever more attention in the last few years.

Therefore, the aim of this paper is to present briefly the scholarly field of cliometrics and the theoretical concept and empirics of human capital. Based on these insights, we point out several key historical features that enabled reaching current human capital levels: training systems (in the form of apprenticeships), new information and communication technologies (in particular, the printing press) and the creation of mass education systems since the 19th century. We base ourselves on a range of recently created historical datasets, which may also offer further opportunities for cliometric research in the future.

In consequence, this paper first presents the foundations of cliometrics, before moving on to the basic conceptual framework of human capital. Then, the historical evolution of human capital is discussed in more detail. Finally, the conclusion sums up the results of the paper and provides an outlook to some future potential developments related to human capital.

2. Cliometrics

Cliometrics can be defined “as the quantitative projection of social sciences in the past” (Diebolt 2016, p. 1). More specifically, cliometrics is “the combination of causal explanations embedded in (economic) models, with or without counterfactual speculation, in order to screen the relative importance of various factors, i.e., of forces (in natural sciences) believed to have been operative in a given historical situation” (Diebolt 2016, p. 1). It has generated a lot of debate in the field of economic history about the appropriate balance between economics and history. The specific emphasis on the use of theory and formal modeling is how it distinguishes itself from the previous “old” economic history. In consequence, the distinction between economic theory and economic history has increasingly become blurred (Diebolt and Hauptert 2016).

The term “cliometrics” has been coined by S. Reiter in 1960 (Goldin 1995, Diebolt 2012). Its two parts “clio” and “metrics” mean together the measurement of history. It is a rather new concept, which traces its origins to the 1950s. It got more attention with Fogel’s work in the 1960s, which can be considered a revolution in the area of economic history, as it radically broke with the previous traditional thinking and practice (Diebolt and Hauptert 2016). Indeed, it allowed the reintegration of history into the realm of economics, as it uses the same terminology and methods.

These characteristics have allowed cliometric research to flourish during the last years. The area has been expanding and has enabled to introduce econometric methods and the use of theoretical models in history. At the same time, economists have become increasingly aware of the usefulness and richness of looking at history or at longer time frames to better understand current economic developments. To truly explain the economic world of today, it is necessary to include how we have come to this development to make better guesses also about the future.

The impact of high-profile historical or long-run publications à la Acemoglu, Galor or Piketty (e.g., Acemoglu et al 2001, Galor et al 2009, Galor 2011, Acemoglu and Robinson 2013, Ashraf and Galor 2013, Piketty 2014) show that it is worth digging into historical data, apply state-of-the-

art econometric methods and economic theoretical models and create new insights and potentially also new models. The construction of new historical databases can often be an exhausting and labour-intensive task, and the effort which it may take to construct the database may not always be appropriately compensated by the rewards one may wish to attain. Similarly, it is clear that historical data are not showing the exact ‘truth’. Like all data, historical data are only an approximation of reality, and can have even more flaws and biases given the less scientific ways of collecting them in the past. This is particularly the case in the area of human capital. Transforming the theoretical concept of human capital – which we will specify in more detail later on – into data is already difficult enough today. There is no way that human capital can be measured in all its aspects, in all its volume that the term might engender. Therefore, a range of proxies are used, all imperfect in their scope and availability across space and time. In history, accomplishing this task is even more complicated, and the precision of measurement less clear. For this reason, the importance of appropriate checks cannot be underestimated. This example shows that using the newest econometric methods is of key relevance, as it may allow to some part to counterbalance the deficiencies and errors inherent in the historical data (Diebolt 2016).

On the other hand, cliometrics is not only about the use of historical data and statistical methods applied to history. It is also about theory, the incorporation of theoretical models into historical research – and – the possibility to generate new theories and abstract theoretical models out of the results of this cliometric research. As is the case for any study using data, also the use and development of theoretical models are imperfect. The advantage of theoretical models is that they are not limited by the availability of actually existing resources in the ‘real world’ (e.g., that historical records exists for a specific topic), but only by the constraints of human imagination (and mathematics). Still, the complexity of reality does not allow to conceive models that incorporate all potential factors into the same model. In other words, abstractions from the real world have to be made, generalizations and assumptions to be introduced, so that it is possible to create a simplified version of it. Of course, these abstractions are imperfections which are then open to criticism and

discussion. One particular aspect in this area is also related to the question: what causes what? Is it truly the factor that the literature has outlined, and that the data suggests, or is it some other factor so far not explicitly considered? Counterfactual methods may help in this debate and have also been increasingly used in cliometric research (Diebolt and Hauptert 2016, Diebolt 2016).

By combining economics with history, cliometrics may allow to overcome the ‘departmental’ thinking of the disciplines, and enrich the debates both in economics by providing new insights from history, and offer to the history discipline novel information and theoretical ideas how to consider and interpret history. This fruitful exchange allows the creation of new ways of exploring data, new ways of constructing theoretical models and thus new innovative ways of understanding and explaining economic developments.

3. Human capital

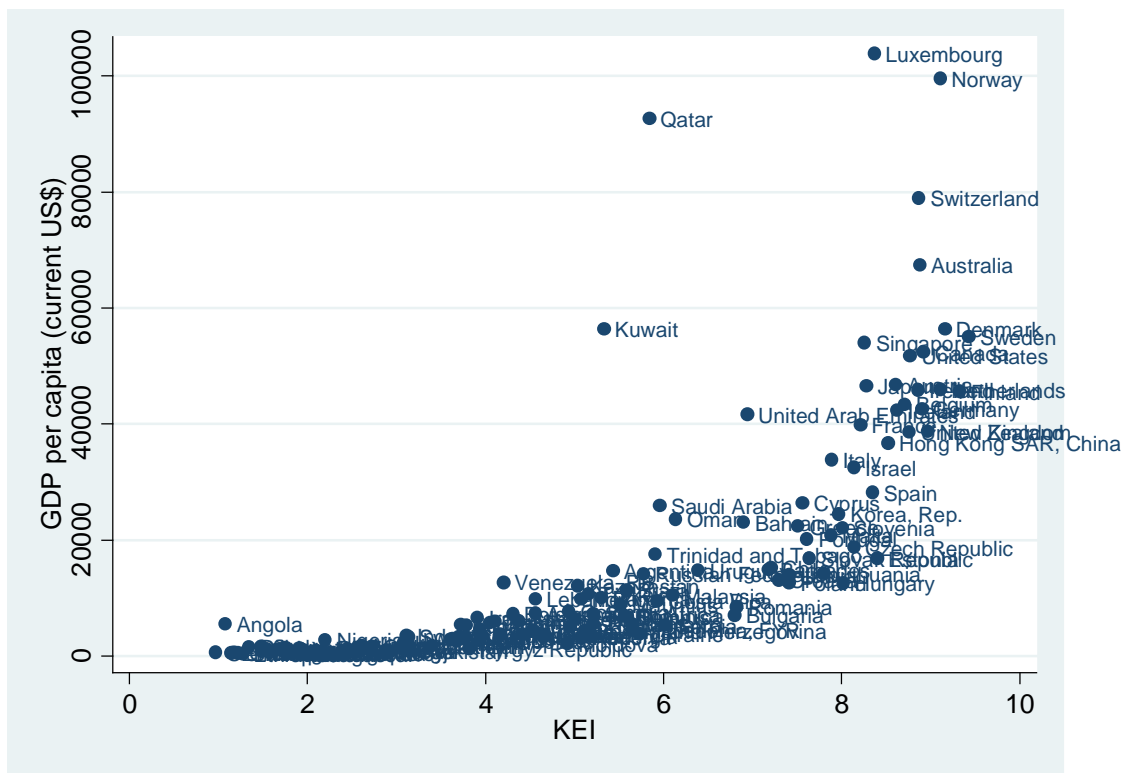
Human capital is a theoretical concept which has been defined in various ways. Becker defined human capital as “the knowledge, information, ideas, skills, and health of individuals” (Becker 2002, p. 3), while the OECD prefers a more economic connotation, emphasising that human capital is “the knowledge, skills, competencies and other attributes embodied in individuals that are relevant to economic activity” (OECD 1998, p. 25). Indeed, in many cases human capital is equated with education or skills, given the practical difficulty to incorporate all its aspects.

Human capital is not a new concept but has been around for many decades and even centuries (see Diebolt 2004, Hippe 2013, Diebolt and Hippe 2018). In fact, its beginnings can already be traced back to Adam Smith in the 18th century. However, it did not have a prominent role in economic thinking for most of its existence. This has only changed during the second part of the 20th century. The most important initial contributor was Becker, who later also received the Nobel Prize for his work on the theory of human capital, alongside Schultz, Arrow and others. Later on, the development of the endogenous growth models in the 1990s has given an important impetus to the awareness that human capital is important for the economy in general and economic growth in

particular. Although a look at the development of the theoretical and empirical literature since the 1950s reveals various waves of optimism and critique towards the importance of human capital for economic development (Demeulemeester and Diebolt 2011), there is little doubt that nowadays researchers and policymakers alike attribute to human capital a pivotal role for current and future economic and social development. As the Council of the European Union indicates, not only “[a]ll individuals need a core package of knowledge, skills and attitudes for employment, inclusion, subsequent learning as well as personal fulfilment and development” (Council of the European Union 2003, C 134/4), but also “[e]ducation and training have made a substantial contribution towards achieving the long-term goals of the Lisbon strategy for growth and jobs” (Council of the European Union 2009, C 119/2).

Similar, the importance of human capital is also taken up by other international organisations in different forms. For example, the World Bank has constructed the ‘Knowledge Economy Index’ (KEI). This index is significantly correlated with GDP per capita (see Figure 1). The KEI comprises various indicators of four pillars that make up the knowledge economy. These pillars are the economic and institutional regime, education and skills, information and communication infrastructure and the innovation system (World Bank Institute 2008).

Figure 1 KEI and GDP per capita, 2012



Source: Own presentation, data by World Bank (2014) and CESifo DICE (2018).

As human capital is a concept which has been developed in economics, human capital theory also includes the use of models which consider the relative role of supply and demand forces that over time lead to an equilibrium with specific observable outcomes. For example, if human capital is equated with education (which we will do for simplification purposes here), we can conceive a market for education with different supply and demand factors. At the same time, it is possible to invest in education and to consume education. Thus, education is seen as a durable good. However, education is different from other durable goods in at least three ways (see Johnes 1993). Firstly, if the private return to education is restricted to an individual's future earnings, it can be measured in a relatively simple manner.⁴ Secondly, education costs cannot be borne in one period but only over a longer time period. For example, one can buy a car instantaneously but not education and skills. Finally, the benefits that education provides are particularly durable. In contrast to other goods, the

⁴ Nonetheless, when further factors are included it becomes increasingly difficult to measure the return.

value of skills and associated knowledge does not tend to depreciate (under the condition that they are exercised in a regular way). These three specific characteristics of education and human capital show its analysis is inherently linked to a time or even long term vision. This is why human capital is particularly appropriate to be considered over longer time horizons, because the expected future returns and the costs that are involved are important factors in the decision to invest in oneself.

To give an example, in its simplest form, a human capital model looks as follows (see Johnes 1993). An individual will take the decision to invest in human if the marginal unit of education is at least

$$\int_0^t C_i e^{-ri} di = \int_t^T R_i e^{-ri} di,$$

with C_i being the marginal unit cost of education (and training) in the period i , R_i being the returns that the individual will obtain in the i^{th} period and r being the interest rate. Educational training lasts t years and an individual will work until T . The first period is $i = 0$.

Several conclusions can be advanced from this simple model. First, the greater the difference between the years of education (t) and the working years (T), the greater the returns for the individual will be (ceteris paribus). Therefore, earlier investments in education bring higher returns. Second, the lower the marginal cost of education (C), the greater the investment will be. In consequence, older individuals generally invest less in education because the gains are smaller than the costs (in particular, due to time and wage sacrifices). Third, the higher the expected return (R), the more an individual will invest (ceteris paribus). Thus, if the skill premium between unskilled and skilled individuals rises, one would expect an increase in the demand for education. More generally, the return to education is a crucial determinant of the demand that can be expected for education. Fourth, the higher the interest rate (r), the lower the demand for education will be. High interest rates will reduce the overall net present value of future earnings, giving fewer incentives to invest. Last, in this model investments will occur up to the moment when the marginal discounted

unit costs of education are higher than the marginal discounted unit benefits. In other words, there has to be a positive private return to education (Johnes 1993).

Clearly, this basic model does not include dynamic features such as the possibility that part of the time of education and part of working time may coincide. Much more elaborate models have been conceived including many additional features. However, for the sake of simplicity, we will not go into further detail here.⁵

4. Evolution of human capital

After this short introduction into the concepts of cliometrics and human capital, let us now consider more in detail the evolution of human capital over time. We will use a range of quantitative data that researchers have uncovered over the last years which provide a rich, and in part, new way of looking at human capital in the long run. These data offer interesting opportunities for further cliometric research in the area (if they have not been used in this way already). We now consider both training and schooling systems to give an impression of the various relevant parts of the education and skills systems that allowed to increase human capital levels over the last centuries. The aim is not to provide an exhaustive overview, but to concentrate on a range of specific factors that are particularly of interest in the present context.

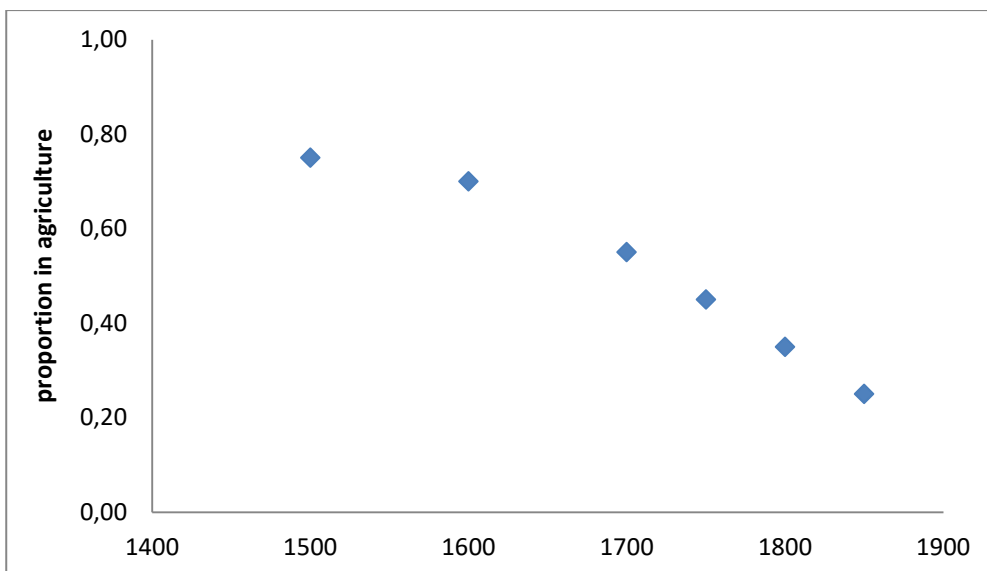
We begin by considering the apprenticeship system, the most important way how young people were trained in the past. Then, we will present first the printing press as the fundamental information and communication technology which led to an explosion of book production and thus, was a significant factor for rising reading (and human capital) levels in Europe since the 15th century. Finally, we show how the rise of mass education since the 19th century has come about and evolved to today's varying degrees of schooling levels in the world.

⁵ A concise overview of the most important human capital theories has recently been published by Diebolt et al (2017).

4.1 Apprenticeships

The apprenticeship system and occupational skills more generally played an important role before and during the Industrial Revolution (e.g., Mokyr 2009, Minns and Wallis 2013). Apprenticeships have been a major type of training for many centuries and the most important for the acquisition of technical knowledge (Epstein 2004). They also made important contributions to the longer-run structural shifts in employment because they lowered the transaction costs of moving from agricultural professions to non-agricultural professions. For example, whereas about 75 % of the English male population worked in agriculture in 1500, this share decreased to less than 25 % by 1850 (see Figure 2). In this way, apprenticeships also supported the growth of trade networks and of commerce more generally. Still, they were not only seen as a means of promoting industry but also of alleviating poverty and maintaining social control in England (Humphries 2006).

Figure 2 Male agricultural employment in England



Source: Shaw-Taylor and Wrigley (2013). Note that data before 1800 are estimates by Wrigley, whereas later data come from censuses.

Regulations of apprenticeships were different in the European countries. Control of apprenticeships by guilds was higher in an important number of German regions than in England, whereas apprenticeships were mostly left to the private decisions of masters and apprentices in some parts of Spain and France (Wallis 2008). An apprenticeship often lasted 7 years in England during the 18th century but the time differed among different crafts (Epstein 1998).⁶ In other European countries, 3 to 5 years were more common (Wallis 2008).

Apprenticeships had the advantage that credit constraints were reduced because young people could (at least partially) finance their training by working for their employer at the same time (Minns and Wallis 2013). In addition, it was obligatory to have done an apprenticeship to be able to work in trade. Apprenticeship contracts were defined between masters and apprentices. They were thus a “private-order, informal mechanism” (Minns and Wallis 2013, p. 349) which complemented the formal rules set out by contemporary institutions. Generally, a master provided the accommodation and board of his apprentices and their training in his shop. Training included vocational and general education (Lauterbach 1994). A major problem for masters was that apprentices could theoretically quit before the end of the contract, even though “the completion of an apprenticeship marked a man out as trustworthy and dutiful” (Humphries 2006, p. 90). Apprentices had a range of profitable alternatives, such as inheritances, learning another trade, marriage, etc. (Wallis 2008). Legal measures to prevent them from quitting were mostly not applied (Minns and Wallis 2013). Moreover, an important share of about 10 % of all apprentices died during an apprenticeship in pre-modern times in England (Wallis 2008).

To avoid losses, masters required apprentices to pay an upfront premium since the 17th century. The payment of a premium could also show the rising value attributed to apprenticeships (Humphries 2006). The premium has traditionally been seen as a barrier to economic mobility because it represented a financial hurdle that not any individual was able (or willing) to overcome.

⁶ In 1562 the legal duration of an apprenticeship was set to 7 years. In addition, apprentices should be at least 24 years old when the contract ended (Wallis 2008).

Thus, the cost of education played an important role for human capital formation in more general terms: “[t]he advance of mass schooling was most rapid in nations where the cost of educating children was lower relative to incomes” (Minns and Wallis 2013, p. 335). Still, according to Minns and Wallis (2013) the importance of premiums in the apprenticeship sector is smaller than previously thought. In their analysis of 18th century England, premiums were typically between 5 pounds and 10 pounds in the trades and about 50 pounds in the professional sector (see Table 1).

Table 1 Apprenticeship premiums in England in selected occupations, 1710-1773

Mean	Mean	Median	Standard deviation	N
Food industries	10	9	13.5	21627
Clothing	11.5	7	18.1	32560
Footwear	6.5	5	8.4	27436
Textiles	15.7	5	35.7	19863
Wood industries	15.6	10.5	17.5	13504
Iron and steel manufacture	9.4	5	19.4	11649
Building and construction	10.9	10	12.5	34684
Other services	16.1	10	33	8655
Professions	73.6	52.5	60.6	16767

Source: Minns and Wallis (2013).

Premiums also varied according to family connections, experience, expected future income and other factors that gave signals on the probability of attrition and the level of productivity of the apprentice. However, not all apprentices had to pay a premium. Guilds with low prestige did typically not charge a premium.⁷ Still, when a premium had to be paid it was often not a trivial sum. Given the fact that unskilled workers in the construction sector typically earned about 12 pounds per year, the premium represented a sum equal to the income of several months. Without the financial help of parents and the wider family, it was quite difficult to pay such a fee. For example, a youth could only gain about 5 pounds during two years of work in the agricultural sector.

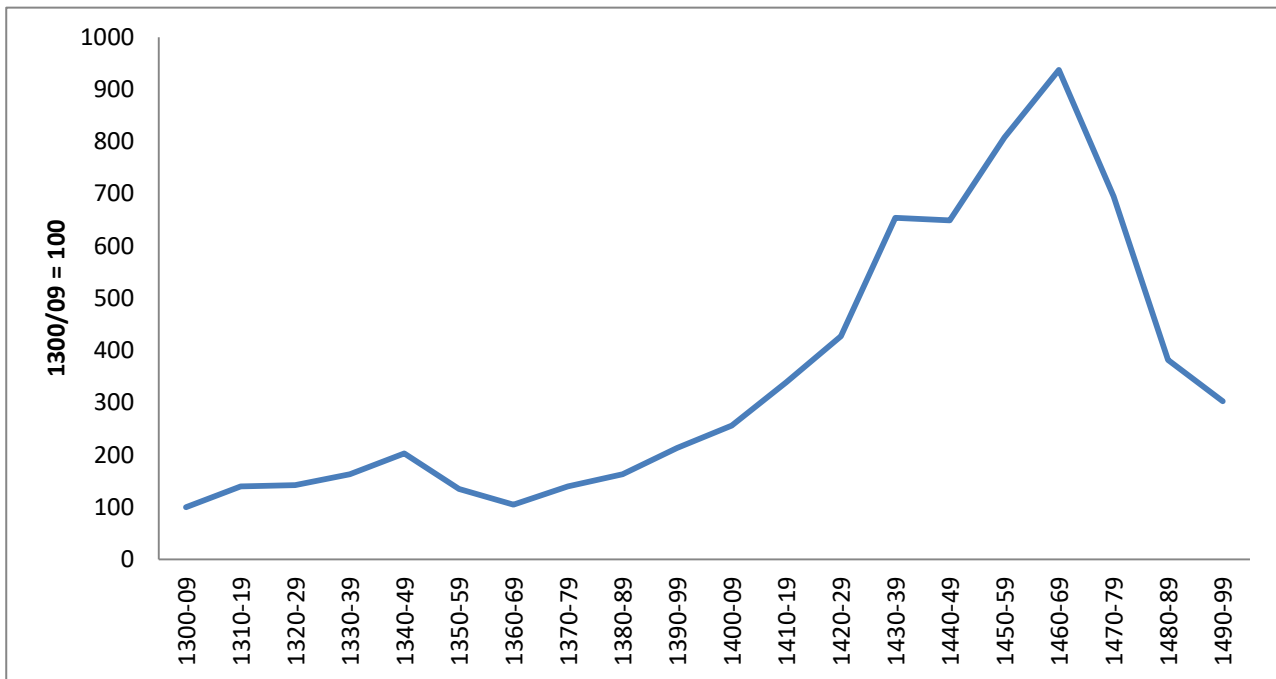
⁷ It was also possible to pay premiums in instalments (Humphries 2006).

In comparison with schooling, it was clearly the much more expensive alternative. Minns and Wallis (2013) estimate that schooling costs were about 1 pound per year in the 18th century. However, the guilds which ran the apprenticeship system vanished with the Industrial Revolution. While the reasons for their disappearance are still an issue of open debate, one reason is certainly that the new economic structure needed different skills. These skills were often more general, such as basic literacy skills.

4.2 The printing press

A prerequisite for mass literacy is the possibility to have a sufficient quantity of books in schools for teaching children. For this reason, the printing press was a fundamental factor which allowed the subsequent organisation of schools for large parts of children. Indeed, it is well known that this new information and communication technology (ICT) had important consequences not only in terms of education, but also in the social, political and economic realms. However, what is less known is that Gutenberg's invention was not due to the ingenuity of a single person, but followed a long-run trend. More specifically, the production of manuscripts had been increasing for centuries previous to his invention in the middle of the 15th century (see Figure 3). Increasing numbers of monasteries and a move towards urbanisation led to a higher demand in the production of manuscripts for almost one hundred years up to Gutenberg's time. Gutenberg was aware of the economic potential of providing a new technology that would allow to decrease dramatically the cost and speed up the process of manuscript production – and he was not the only one. Indeed, a range of alternatives to the traditional labour-intensive process of manually copying manuscripts was proposed by numerous other inventors during his time, but Gutenberg's invention proved superior to those of his competitors (Hippe 2015).

Figure 3 Estimates of manuscript production in Central Europe



Source: Neddermeyer (1996).

Within the first ten years, the printing press spread to other German cities, Paris and several Northern Italian cities. In the following ten years, it got established in cities still farther away, i.e. in the Netherlands, the South of France, Spain and Central and Southern Italy. The following decades depict an intensification of the use of the printing press in an increasing number of cities. Therefore, as Dittmar (2011) shows, distance to Mainz (where Gutenberg invented the press) was an important factor in its geographical diffusion as the adoption of the printing press was less likely in cities at a higher distance to Mainz. In this sense, Italy and particularly Northern Italy was relatively close to Mainz. Venice quickly became the European capital of printing (Guellec 2004). As shown in Table 2, the adoption rate was highest in Switzerland (21 %), followed by Denmark (20 %), the Netherlands (18 %), Germany (16 %), Czechoslovakia (14 %) and Italy (14 %).⁸

⁸ Note that these shares refer to the 20th century polities and not those in existence at the time.

Table 2 The diffusion of the printing press, 1450-1500

20 th -Century polity	Cities adopting printing press	Total number of historic cities	Share adopting (%)
Austria	1	17	6
Belgium	9	72	13
Czechoslovakia	5	36	14
Denmark	2	10	20
England	3	165	2
France	39	341	11
Germany	40	245	16
Hungary	1	47	2
Italy	56	406	14
Netherlands	11	60	18
Poland	3	55	5
Portugal	6	53	11
Spain	24	265	9
Sweden	1	20	5
Switzerland	4	19	21
Total	205	1,811	11

Source: Dittmar (2011).

It is evident that Italy was not far behind Germany. (Central and Northern) Italy was to that time a relatively prosperous region, with higher GDP per capita values than England, Holland and Spain (see Fouquet and Broadberry 2015). Therefore, commercial demand for printed books, which offered good prospects of profits, was relatively high here. Furthermore, it was not the nobility that was the most important market (as was the case for manuscripts beforehand). Instead, it was the rising middle class which was now able to buy books at affordable rates and had sufficient time to learn reading (Logan 1986). Buringh and van Zanden (2009)'s data further highlight the demand for books, stating that the per capita book consumption of printed books in Italy was the third highest in Europe between 1450 and 1500 (7 per 1000 inhabitants), only excelled by the (much smaller) Switzerland (9) and Netherlands (7.9). Germany had only 4 per 1000 inhabitants, France had 3, Great Britain had 2 and Spain had 1. The case of Great Britain and Spain appears to show that a high number of adopting cities is not equivalent to an actual high production of books per capita:

Spain had 24 adopting cities while England had only 3 but the per capita output was two times higher in Great Britain than in Spain.⁹

The most important factors leading to the success of the printing press can be summarised as follows (van Zanden 2009): first, the technology of type printing was quickly diffused because German printers were mobile and brought the technology to many places in Europe. Given the rapidly advancing competition among publishers and urban centres, their wages stayed relatively low, which decreased the cost of the new technology. Second, moveable type printing was characterised by economies of scale and important learning effects. The costs of production could be significantly reduced by using more characters on each page and by more print runs. Third, books were highly demanded. The rapid spread of book printing across European cities shows that the potential market for books was immense. Fourth, economies of scale existed also in the production of the materials needed to print a book, in particular paper. Paper prices decreased significantly. Given the fact that up to 50 % of book production costs were made up of paper, this fall allowed an important reduction in the cost of producing books. In total, book production costs decreased by 85 to 90 % within only a few decades after Gutenberg's invention – an ICT revolution only comparable to current developments in similar technologies (van Zanden 2009). At the same time, the number of books virtually exploded within a few decades.

A higher number of books and a lower book price also meant that scientific work became more profitable and easier to access. In this way, the printing press could serve as a foundation of the later occurring Scientific Revolution (Eisenstein 1979) and the 'Industrial Enlightenment' leading to the Industrial Revolution (Mokyr 2002; Baten and van Zanden 2008). Accordingly, the number of scientific books exploded over time (see Table 3).

⁹ Note that Dittmar (2011) refers to England, while Buringh and van Zanden (2009) refer to Great Britain. However, all adopting cities were located in England.

Table 3 Scientific books produced in Europe

Period	Number
Ca. 560 – c. 1400	254
Ca. 1450 – 1700	1546
Ca. 1640 – 1859	12889

Source: Xu (2013), citing Gascoigne (1984).

4.3 Mass schooling

Thus, the number of books increased substantially after the printing press, while the prices declined in the same way. Only during the Industrial Revolution, similar decreases in the cost of written documents were achieved thanks to mechanisation (Hippe and Fouquet 2018). Given the lower cost of books, it was also easier to teach students and it facilitated the development of written education. In this way, traditional work skills as taught in apprenticeships could be complemented by a basic education in reading, writing and calculating. As a consequence in the long run, schools were created in more and more areas in Europe, and broader parts of the child population had access to education.

As we have already seen, the demand for books, and thus for literacy, played a crucial role in the success of the printing press in many parts of Europe. More specifically, bibles had a relevant share in book production, and Martin Luther and other prominent figures of Protestantism further stimulated this demand. Later on, the interplay of various factors such as military advantages provided by literate recruits, the economic usefulness of education in industry and commerce, parental demands to educate their children, and international reputation, mutually reinforced the attractiveness of investing collectively in education (see Hippe and Fouquet 2018 for more details). In other words, there were a range of demand and supply factors that interacted in this early phase of the expansion of education.

In later phases, that is during the creation of mass education for most parts of the population during the 19th century, the state played a more prominent role, as it was the central actor during this time. Government intervention was triggered by factors such as economic or military shocks

(for example, Prussia's defeat against Napoleon, or Germany's economic rise troubling the British Empire) or the aim of nation building (such as in Italy), leading the respective governments to reform and invest more heavily in the education system. On the one hand, this investment was done to improve human capital levels, to improve the skills of the population for better military or economic competition with other countries. On the other hand, the aim was to influence the values of the population, by e.g. enforcing a unique national language to be used in schools to homogenise the population, and by strengthening the identification of the future generations with the state (Hippe and Fouquet 2018).

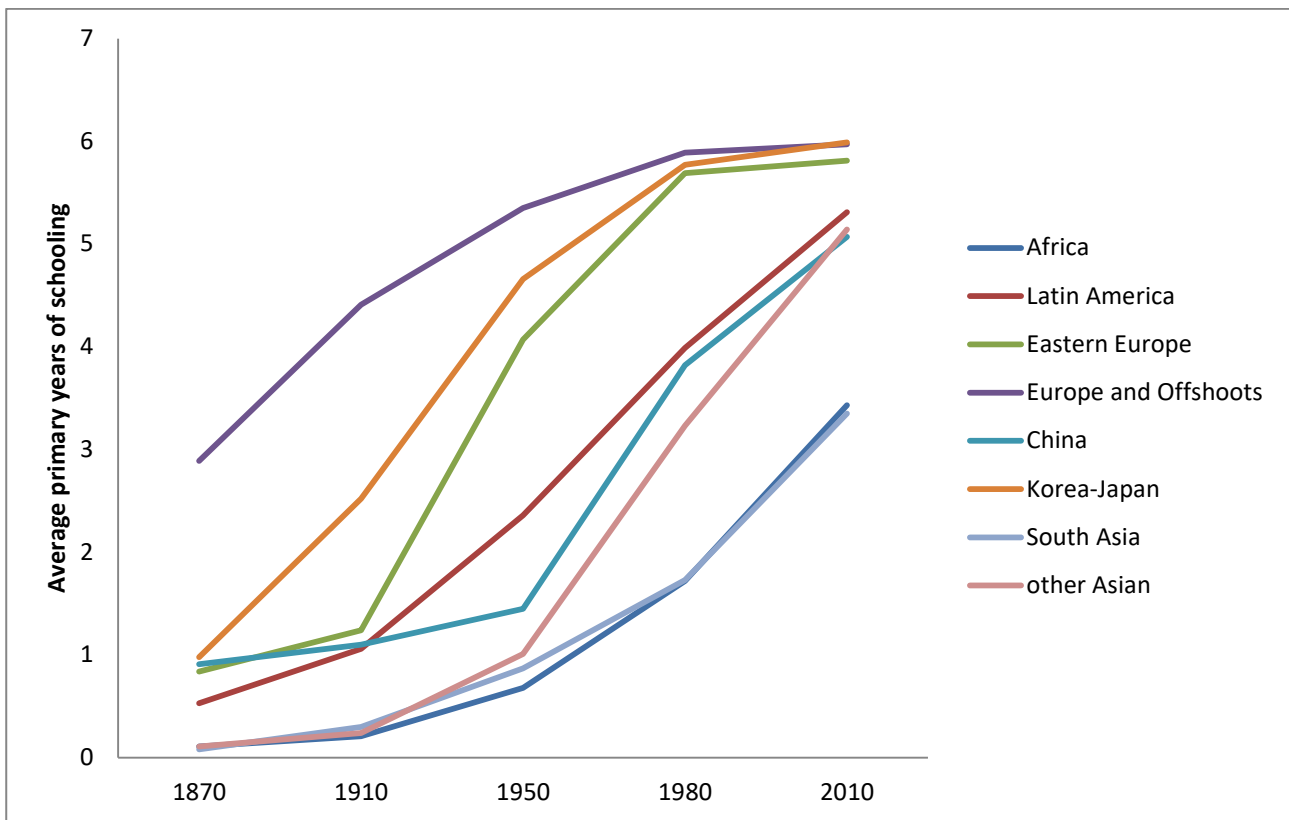
However, the support to mass schooling was not unanimous. Among others, landlords feared to have to pay the required taxes for schooling, and that the labourers in their fields would emigrate to the more urban and industrial centres. As they had an important power in political, economic and educational decision making, they had an interest in blocking or at least slowing down the process towards mass schooling. Still, with the rise of the capitalists, who needed more educated workers in their industries, the relative power balance shifted, and also landlords began to obtain relevant stakes in industry, decreasing their resistance to mass schooling (Baten and Hippe 2017).

Thus, as in the case of the printing press, the uptake of mass schooling and the eradication of literacy took not place at the same speed across all of Europe. Overall, northern and central Europe was most advanced in literacy and numeracy than southern and eastern Europe during the 19th and the beginning of the 20th centuries, leading to a marked geographical pattern (Hippe and Baten 2012, Diebolt and Hippe 2017a,b, Diebolt et al 2018). Nevertheless, the European periphery was able to introduce effectively mass schooling during the course of the 20th century.

Thus, the expansion of education ultimately became a success, as Figure 4 shows. Primary education was the most common form of education in the 19th century, only later secondary and then tertiary education gained track. Western Europe and its offshoots were the clear leaders in primary education at the end of the 19th century. This region had about 3 years of primary years of schooling on average to that time. In comparison, all other world regions had less than 1 year. The

higher level of Western Europe remained until very recently. Eastern Europe was heavily influenced by the debates and policies in the West, so that in particular Communist leaders in the 20th century increased education levels. Similarly, Japan and Korea had a long tradition of education, which only during that century was materialised into increased educational levels for all children. Most other world regions are on their way to reach similar levels than these three groups, only South Asia and Africa are still around levels that Western Europe and its offshoots had around the end of the 19th century. Still, their trend is positive so that it is possible that during the next generation they can come importantly closer to the other world regions.

Figure 4 Evolution of primary education in world regions, 1870-2010



Source: Morisson and Murtin (2013).

5. Conclusions and outlook

This paper has considered cliometrics and human capital, providing insights in the growing field of cliometrics and the development of human capital during the last centuries. Cliometrics combines economics with history à la Ranke, *wie es eigentlich gewesen ist* (how it actually was). Its interdisciplinary and innovative nature is the foundation for a fruitful line of future research. The central role of human capital for economic development, as many authors argue, makes it also a key topic for cliometric research. To this end, we have provided a short introduction to the concept of human capital and a brief outline of some major aspects related to the development of human capital during the last centuries. These data can be the basis for further future cliometric research, which uses more advanced theoretical and econometric techniques to increase our knowledge of the past.

From these insights into history, what can we say about the future of human capital in general, and of education more specifically? For example, we can use Collins and Halverson (2010)'s approach. They provide a long-run conceptualisation with three eras of education, which is one way to connect the past to the future. The authors generalise the evolution of education into the following periods: apprenticeship, universal schooling and life-long learning. Of course, these periods cannot be taken as being completely separate, in fact they do overlap substantially, as also our previous sections indicate.

According to the authors, in the apprenticeship era, the state was weak and did not take a lot of responsibility for providing or regulating education. Thus, the responsibility to educate one's children was the parents'. The skills which were most important were practical, manual skills. Although reading and writing was certainly also important, the low levels of literacy also implied lower importance of this skill in a range of occupations. Learning was taking place at home or in the work place.

In contrast, in the universal schooling era, the state took increased responsibility and offered education to children. Reading and writing became more and more important as a precondition for a range of jobs, and the universal attainment of basic literacy became a major international movement. At the same time, in the early periods, factories needed disciplined workers, so that disciplinary knowledge was also integrated into strict schooling plans. Learning was taking place in these schooling organisations, so that there was a shift away from learning at home (and the work place).

Finally, today and in the future, the responsibility for educating oneself became the individual's and parents', once again. Basic skills will not be sufficient anymore for the job market. With technological progress, more generic skills are needed, and the ability of "learning to learn" comes to the forefront. In other words, what is learnt today is quickly outdated tomorrow, so that it is important to learn and relearn. Thus, the location of learning can be in many places, not only in the school, but at any time, anywhere. Mobile applications and MOOCs allow the learners to continue their learning in any place they are, and also at any age. Learning is more emphasised to be a life-long process.

Therefore, as also Stiglitz and Greenwald (2014) emphasise, the economy needs to be based on learning. This requires an economic transformation, new theoretical models and economic policies. The heart of this learning economy consists of the educational system which has an important influence on learning skills and the change of priorities and mindsets. As change is a major prerequisite for learning, change has to be seen as positive and something that has and should be achieved. The maximum flow of ideas is also crucial for generating a learning economy. For this reason, a democratic and open society is the best system to create a dynamic learning environment. However, this dynamism may generate losers in the short run, necessitating trade-offs. Inevitably, the potential losers will resist change. For example, existing inequities may be questioned, so that there is a strong incentive for the better-off to influence the beliefs on these inequities. Therefore, it

is important to create inclusive economic growth to prevent persisting and growing inequalities because they are detrimental to a dynamic learning economy.

Given the important positive spillover and externality effects of learning, the role of government is even more pronounced in the learning economy (Stiglitz and Greenwald 2014). It has to correct market failures that lead to low-learning and high inequality paths. The government's policies affect the learning environment and should be designed to create an open and learning society. For example, the rather recent success of many East Asian economies can be traced back to the importance they attributed to learning and education. In consequence, existing policies in all countries have to be re-examined and potentially modified to enhance learning.

In this regard, cliometric research may offer valuable insights, so that the current learning systems and policies are seen in a broader context and errors of the past will (hopefully) not be repeated in the future once again.

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