

The Human Capital Transition and the Role of Policy

Ralph Hippe
European Commission, Joint Research Centre (JRC)
Directorate for Growth and Innovation, Human Capital and Employment Unit

Roger Fouquet
Grantham Research Institute of Climate Change and the Environment
London School of Economics and Political Science (LSE)

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Abstract

Along with information and communication technology, infrastructure, and the innovation system, human capital is a key pillar of the knowledge economy with its scope for increasing returns. With this in mind, the purpose of this chapter is to investigate how industrialized economies managed to achieve the transition from low to high levels of human capital. The first phase of the human capital transition was the result of the interaction of supply and demand, triggered by technological change and boosted by the demands for (immaterial) services. The second phase of the human capital transition (i.e., mass education) resulted from enforced legislation and major public investment. The state's aim to influence children's beliefs appears to have been a key driver in public investment. Nevertheless, the roles governments played differed according to the developmental status and inherent socioeconomic and political characteristics of their countries. These features of the human capital transition highlight the importance of understanding governments' incentives and roles in transitions.

Keywords: Human Capital, Education, Economic History, Economic Policy.

JEL codes: N33, I25, I28, Q01.

1. Introduction

The transition in human capital is arguably the most important economic and social transformation to have occurred. After all, human capital accounts for two-thirds of overall wealth (i.e., including natural capital) in most industrialized economies (Hamilton and Liu 2014) and, based on rough estimates, has over the last 200 years (McLaughlin et al. 2014). Reflecting its importance, the Council of the European Union states that “[e]ducation and training have a crucial role to play in meeting the many socio-economic, demographic, environmental and technological challenges facing Europe and its citizens today and in the years ahead” (Council of the European Union 2009, p. C 119/2). Given the fundamental role human capital plays in economic growth and development, and especially for the “knowledge economy,” research related to growth needs to include human capital in its analysis (e.g., Hippe and Fouquet 2018).

The particular aim of this chapter is to better understand the following questions: What factors have driven the human capital transition since before the Industrial Revolution? Was there a market failure in the area of human capital such that governments had to step in to foster increased investment? What role did the state play in the provision of mass schooling? What drove the public’s willingness to sacrifice scarce resources for this public good? What role did other stakeholders play?

The human capital transition over the last 500 years, triggered by the development and diffusion of the Gutenberg Press, and, particularly, in the 200 years, with expansion of public schooling, offers numerous lessons for growth. First, it tells us (part of the story of) how we got here – how one of the pillars of the “knowledge economy” developed. Second, it offers an example of a major transition of a key factor of production (hence, crucial for understanding economic development and growth). Third, it provides a lesson about a major transition where market failures were prevalent and government stepped in and provided education. In all cases, understanding past transitions will offer insights into how to promote future transformations.

The history of the human capital transition highlights how the state can have a major role to play in future transitions related to investment in education. Even though demand for a knowledge economy in all its dimensions might be increasing in the most industrialized countries, an effective transition is likely to require further state action. Where demand is especially lacking, such as in less developed countries, the state’s role in achieving a transition to a knowledge economy will be particularly acute. A crucial factor in determining whether the transition moves beyond a first phase may well be the extent to which government directly benefits from the transition.

The chapter is organized as follows: First, we highlight economic development in the long run and the contribution of human capital. Second, we review some of the basic principles of human capital theory. Then, we consider the characteristics and the evolution of the apprenticeship system and the production of books. Subsequently, we emphasize the role of different origins of demand for education. Government policy and its effectiveness are more closely analyzed in the following section. The last section considers different indicators that show the evolution of human capital during the last 200 years and the actions taken by governments in education. Finally, a conclusion sums up the lessons from the human capital transition.

2. Long-Run Economic Development and Human Capital

The idea that human capital may be considered as a determinant of economic development has a long history (Demeulemeester and Diebolt 2011). Smith and Marshall had already incorporated the notion

of something akin to human capital in their thinking. However, the first exogenous growth models developed by Solow and Swan (Solow 1956; Swan 1956) only incorporated capital, labor, and technological progress in the aggregate production function. Subsequently, the importance of human capital was put forward in particular by Becker (1981), an important founder of human capital theory. Furthermore, Nelson and Phelps (1966) emphasized that human capital is important for implementing and adopting new technologies. Schultz (1975) argued that workers are better able to cope with changes in the economic structure and handle new technologies if they have more human capital. An extension of the original Solow-Swan model, the human capital augmented Solow model, was presented by Mankiw et al. (1992). It explicitly included human capital as a factor in the production function.

Nevertheless, the prominence of human capital's role emerged following the development of endogenous growth models. Romer's (1986) work can be seen as the first important contribution in this field. These "new growth models" aim to endogenize the different sources that lead to growth. In this way, the growth rate is not exogenously determined (as in the Solow-Swan models) but is established within the endogenous growth model itself. The overall category of endogenous growth models can be divided into two main approaches (Aghion and Howitt 1998). The first line of thought focuses on human capital accumulation as the main driver of growth (Lucas 1988). The second approach underlines the importance of technological change for the creation of economic growth (Romer 1990). Since the original contributions by Lucas (1988) and Romer (1990), the literature has steadily been advancing (see Ang and Madsen 2011). In fact, these initial models (and models by, e.g., Segerstrom et al. 1990; Grossman and Helpman 1991; Aghion and Howitt 1992) are now considered as the first generation of endogenous growth theory models. A second generation of models takes semi-endogenous (e.g., Jones 2002) or Schumpeterian approaches (e.g., Aghion and Howitt 1998; Peretto 1998; Young 1998). The appropriateness of these new types of models is still being debated and empirically tested (e.g., Madsen 2010; Madsen et al. 2010; Ang and Madsen 2011).

While endogenous growth models have been central to human capital's prominence in economic growth theory, they are limited – in the sense that they are not able to explain the process of economic growth since the beginning of human existence (Galor 2005). A new ambitious theory has been developed aiming at understanding the growth patterns of human kind in the very long run. This unified growth theory (UGT) has particularly been advanced by Galor (e.g., Galor and Weil 2000; Galor and Moav 2002). UGT classifies economic growth in the very long run in the following way. First, a long phase of hunting and gathering was typical for human development between one million BC and 8000 BC. After the Neolithic Revolution, the Malthusian growth regime began. It was characterized by a per capita income which always fluctuated around low levels of subsistence. Accordingly, Fig. 1 shows that GDP per capita in several European countries and China was rather low and fluctuating between 1300 and the takeoff during the Industrial Revolution. Thus, the Industrial Revolution allowed the European countries to escape the Malthusian growth regime. This post-Malthusian growth regime lasted until the demographic transition in Europe around 1870. Economies and populations grew substantively during this epoch.

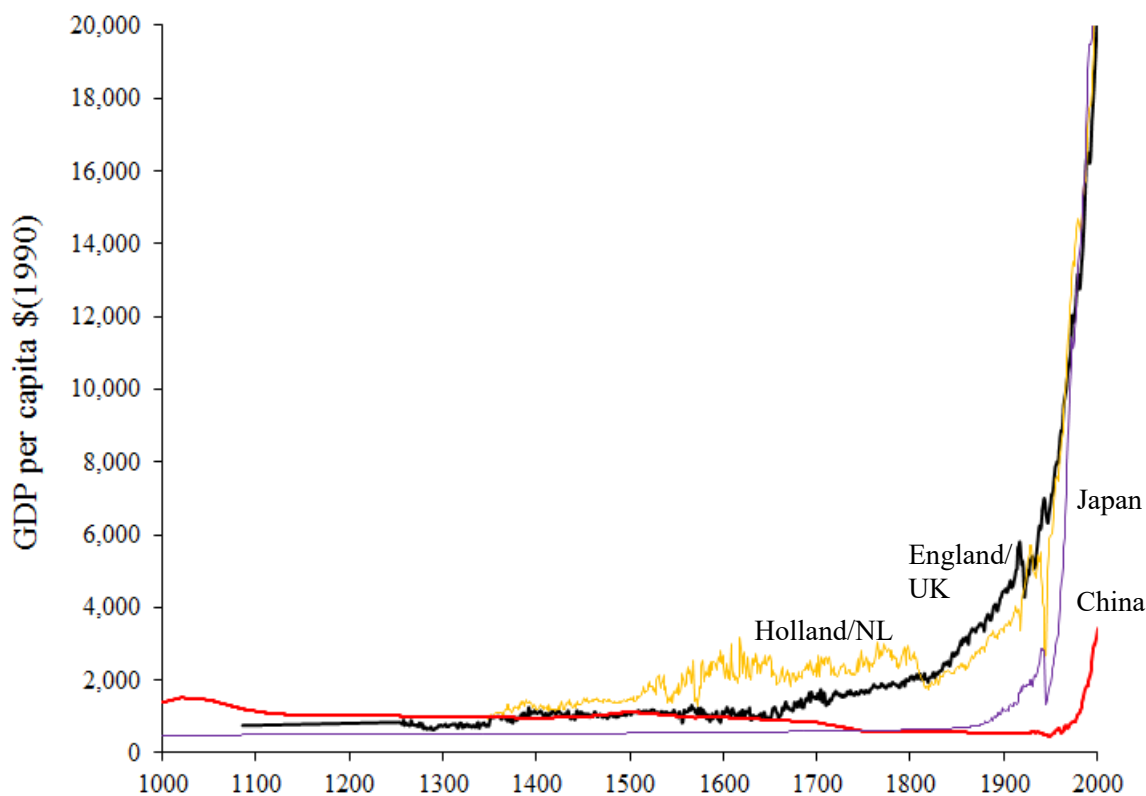


Fig. 1 GDP per capita in selected European and Asian countries, 1000–2000. (Source: Fouquet and Broadberry (2015), Bolt and van Zanden (2014))

The final growth pattern is the modern growth regime, which has characterized the world’s advanced countries from the nineteenth century onward. This regime shows an acceleration of technological progress. Moreover, human capital is increasingly demanded. Thus, UGT postulates that human capital played a crucial role in the transition from the post-Malthusian regime to modern growth. Human capital and technological progress brought about the demographic transition, which has led to lower population growth. The overall result has been high and sustainable growth in per capita output in the most advanced countries. However, not all countries have reached the modern growth regime, and some countries reached it earlier than others. Therefore, a Great Divergence has emerged between the most advanced countries and other countries.

These different theories show that human capital is an important driver for economic growth. Still, there has been some controversy about this issue over the last decades. In fact, Demeulemeester and Diebolt (2011) show that there have been several alternating waves of optimism and skepticism since the Second World War. The early contributions led to the consensus in the 1950s and 1960s that education makes an important contribution to economic growth. In contrast, the 1970s were characterized by skepticism in a time of economic downturn. The new important theoretical contributions of the 1990s once again reinvigorated the case for human capital. These optimistic ideas were supported by different empirical studies (e.g., Barro 1991; Mankiw et al. 1992; Barro and Lee 1993), but also more critical voices appeared, such as Benhabib and Spiegel (1994) and Pritchett (2001). However, measurement errors may account for some of these more pessimistic results (Krueger and Lindahl 2001). Thus, Sianesi and van Reenen conclude in their literature survey in 2003 that “as a whole we feel confident that there are important effects of education on growth” (Sianesi and van Reenen 2003, p. 197). Finally, more recent

studies by, e.g., De La Fuente and Doménech (2006), Cohen and Soto (2007), Hanushek and Woessmann (2008), Ciccone and Papaioannou (2009), and Gennaioli et al. (2013) have further emphasized the crucial impact of human capital on growth and development.

3. Principles of Human Capital Theory

In the economics of education, the acquisition of human capital (through education or training) is assumed to give utility to an individual (see Brewer et al. 2010). It is an investment decision which enables an individual to obtain higher monetary returns in the future. The investment in human capital increases the knowledge and skills of an individual and thus his productivity (e.g., Schultz 1961; Becker 1964; Schultz 1971; Lucas 1988). This investment comes at an expense due to direct costs (e.g., schooling fees), foregone earnings, psychic costs related to the studies, and other related expenses. Still, the private returns of human capital acquisition can be numerous, e.g., higher earnings (Mincer 1958), a better job, and a lower probability of being unemployed. Further positive effects include a higher social status and social prestige, better health, higher social capital, higher cultural capital, and other benefits that are valued by an individual. The combined positive effects of human capital give incentives for individuals to invest in human capital to maximize their well-being during their life. Therefore, human capital theory suggests that a higher level of education is correlated with a higher level of earnings. This positive relationship has been found in many empirical studies, although the return to education can be influenced by many external factors. For example, 1 year of increased schooling gives a global average return of 10% (Psacharopoulos and Patrinos 2004).

Overall, an individual is part of a larger market which is characterized by demand for educational goods and its supply, leading to an equilibrium process whose outcomes can be observed. Thus, the consumption and investment characteristics of education make it similar to other durable goods. Thus, education cannot be described by the use of static models. In consequence, a longer-term view is inherent to the human capital concept. Therefore, the decision to invest in human capital has to be made in accordance with the expected discounted future returns and costs involved.

In addition, human capital may not only have important private returns but also significant social returns (see Lange and Topel 2006). These human capital externalities can be defined as “the sum of the private and external marginal benefits of a unit of human capital” (Lange and Topel 2006, p. 461). Human capital externalities have been analyzed from different perspectives. In particular, growth theorists such as Uzawa (1965) and Lucas (1988) have put forward the positive effects of interactions among individuals, leading to higher social than private returns of human capital. Individuals that have a higher endowment of human capital may increase the productivity of others, so that human capital accumulation leads to an increase in total factor productivity. On the other hand, it is also possible that positive externalities arise, which are not directly associated with productivity, such as lower criminality (Lochner and Moretti 2004), higher political participation (Friedman 1962), externalities connected to consumption, and higher economic growth (Sturm 1993; Hanushek and Kimko 2000; see Brewer et al. 2010).¹

These social returns to human capital have been generally perceived by governments. Therefore, governments have spent an increased amount of public expenditures on education in the long run. One fundamental question that arises in this context is the allocation of these scarce resources to maximize human capital output. The state may not allocate these resources in an efficient manner because, in standard economic theory, markets provide an efficient method for allocating scarce resources. Still, it is possible that markets fail in their attributed task, so that a market failure occurs. Different reasons may lead to such a failure (Brewer et al. 2010). Firstly, it is possible that markets are not perfectly

competitive. Thus, the market may become dominated by one or more agents who are able to set the prices. In the area of education, schooling markets are far from perfect. Secondly, information asymmetries may arise in a market. In particular, the quality of products or services may not always be perceivable by consumers due to a lack of information. In education, parents may not have sufficient information and may not perceive the true value of education. In addition, they may choose schools that may be socially suboptimal (e.g., preference for schools with a certain social or racial profile and not for the quality of a school). Although the market may satisfy the preferences of parents, the obtained solution may not be optimal for society as a whole. Thirdly, the existence of externalities suggests that consumption and production may have effects that are not included in prices. For example, the knowledge and learning of others can have a positive effect on an individual. Furthermore, the individual's decision to invest in education may have positive benefits but also costs for society. However, an individual does not take all of them into account when taking his investment decision. Even if the social benefits are higher than the costs, it is still possible that an individual may choose not to invest and consume a socially optimal amount of education. In this case, governments can intervene by making a certain minimum amount of education obligatory through compulsory schooling. Finally, public goods may not be sufficiently provided by markets because they are nonrival and nonexcludable. To some extent, the notion of public goods applies to education. For example, the consumption of services in the area of education does often not preclude others. A pupil obtains education together with other pupils by a teacher. Libraries give access to books to many individuals. Thus, education may not be sufficiently supplied in a perfectly competitive market, as is the case with other public goods.² For this reason, this has led to the "widespread belief that the market for educational services fails when left to its own devices" (Johnes 1993, p. 14).

Therefore, governments have intervened to avoid the consequences of market failures in this area. They have regulated the education sector, taken an important share of the financial burden, and operated education facilities. This involvement of the state may have led to suboptimal educational outcomes in some areas.³ However, the aim of the state may not always have been to maximize human capital levels. Schooling is never neutral but is a process of socialization that produces beliefs alongside human capital. Therefore, authors of the so-called class-conflict model suggest that there is a struggle between different classes of society in the area of education. The dominating elites of a country are assumed to use formal schooling to impose their social, cultural, and economic values and structures on other parts of society (Bowles and Gintis 1976; Carnoy and Levin 1985; Fuller and Rubinson 1992). Taking a more positive interpretation, one could also argue that "public schooling can promote social cohesion among disparate social groups and alleviate ethnic tensions by providing a core set of common norms that foster trust and promote interaction among individuals" (Gradstein et al. 2005, p. 5).

More generally, governments would not need to produce schooling but could sponsor the private sector to provide schooling. The simple production of skills could be contracted out, and private schools could be subsidized by the use of vouchers or mandates. Yet a government would not be able to control (cultural and ideological) beliefs, and private institutions (e.g., particular religious and social groups) could produce beliefs at school that could challenge the government and the political system.⁴ Furthermore, egalitarian principles have given the state the moral responsibility to provide schooling to ensure that all children obtain a certain minimum level of education so that every child could have equal opportunities in later life. However, the external monitoring of schools is costly and difficult to implement effectively for the state. Therefore, it is argued that given the socializing and equalizing aspects inherent to education, a government needs to produce schooling in a direct way at arm's length (Pritchett 2003; Gradstein et al. 2005).

In addition, it should be mentioned that there are different types of schools and forms of training. More generally, according to Johnes (1993) one can distinguish between general and specific human capital. General human capital can be defined as skills and knowledge that can be used in any work context and increase the productivity of an individual. General human capital can take the form of skills such as numeracy and literacy. On the other hand, specific human capital can only be used in a specific work context to increase an individuals' productivity. For example, some of the specific skills of craftsmen could not be used in other professions. Similarly, if an individual works for a monopsonist, it cannot transfer its skills obtained through training to another employer either.

More generally, investments in human capital can occur (in the terminology of Becker 1993) in the form of on-the-job training in firms (distinguishing general and specific training analogously to the presentation above), schooling, information, and health.⁵ Schools are considered to be specialized institutes that produce training, whereas firms additionally produce goods. Therefore, Becker argues that firms and schools are in many instances “substitute sources of particular skills. This substitution is evidenced by the shift over time, for instance, in law from apprenticeships in law firms to law schools and in engineering from on-the-job experience to engineering schools. [...] [T]here are complementary elements between learning and work and learning and time” (Becker 1993, p. 51). The level of complementarity depends partly on the quantity of formalized knowledge that is available. In some cases, schools can thus be treated as a special form of firms. Therefore, the effects of schooling (as mentioned above) are identical to those of general training.

In addition, there are still other possibilities than on-the-job training and schooling to accumulate human capital and increase one's productivity. These are particularly related to the investment in information. For example, more information about wages and employment possibilities may positively affect the future earnings of an employee. Thus, increased information and knowledge about the economic, social, and political system might increase productivity and incomes.

Finally, investments in health may also lead to improved productivity. Physical and emotional health has significant effects on earnings. While throughout most of history (and still today in some countries) physical strength has been an important factor for expected earnings (at least for an important share of the population), knowledge and skills have replaced physical strength in more developed countries. Similarly, emotional health has important effects on productivity and output (see e.g., Layard 2005).

4. Traditional Education and Skills Transmission

4.1 Apprenticeships

The transmission of technical skills from generation to generation has been central to maintaining productivity levels over centuries, and the transmission of new skills (often in conjunction with new technologies) spatially has been key to raising productivity levels from one decade to the next. Apprenticeships had been the most important source of training and technical knowledge acquisition for many centuries (Epstein 2004). In England, for instance, “domestic, agricultural or industrial apprentices and live-in servants made up 15–20% of the adult male population in early modern England” (Humphries 2006, p. 79, referring to Stone 1966). “In the late sixteenth and seventeenth centuries roughly two-thirds of the English male labor force had at one time or another been apprenticed in one of the greater cities, primarily London” (Epstein 1998, p. 707; see Rappaport 1989). Even in the eighteenth century, apprentices in the nonagricultural sectors accounted for between 7.5% and 10% of the total labor force (Humphries 2006; Wallis 2008).

The apprenticeship was a contract (of between 3 and 7 years depending on the craft and the country (Epstein 1998; Wallis 2008)) between a master and his “student.” Without a contract guaranteeing some return on the investment, few tradesmen would have been willing to share their skills with young men who were likely to leave once the training was complete and work for higher pay.

In addition, from the seventeenth century, masters required apprentices to pay an upfront premium. In eighteenth-century England, premiums were typically between 5 and 10 pounds (roughly £(2000)500 and £(2000)1,000) in the trades and about 50 pounds (£(2000)5,000) in the professional sector (Minns and Wallis 2013). In addition to the nature of the craft and prestige of the guild, premiums also varied according to family connections, experience, expected future income, and other factors that gave signals about the probability of attrition and the level of productivity of the apprentice.

The premium amounted to close to 1 year of a craftsman’s salary, and the apprentice generally depended on financial help from parents and the wider family. For instance, it would take a youth 2 years of work in the agricultural sector to earn 5 pounds. Although a premium had to be paid in many instances, the apprentice received accommodation, boarding and subsistence wages (around 5 pounds per year in the eighteenth century), and a training. This training also offered important informal connections to colleagues and potential clients who might help recover the very expensive setup costs of one’s own shop, which was often 10–20 times the initial cost of a premium (Campbell 1747, in Minns and Wallis 2013).

4.2 The Role of Guilds

Apprenticeships had their roots in the craft guilds, which began to exist from the eleventh century (Lauterbach 1994; Epstein 2004) – although the degree of control over apprenticeships by guilds varied and was greater in many German regions than in England. Apprenticeships were mostly left to the private decisions of masters and apprentices in some parts of Spain and France (Wallis 2008). The guilds were associations of craftsmen with tight regulations, creating conditions similar to cartels. They had many functions; in particular, they “supervised job performance, work conditions, and quality of instruction; enforced contracts through compulsory membership, statutory penalties, and blackballing; and protected apprentices against poor training in craft-specific skills within oligopsonistic labor markets” (Epstein 2004, p. 382). Most guilds sought to limit the poaching of trained apprentices among workshops, protect the apprentices from excessive abuse, and, therefore, promote proper training (Epstein 1998, pp. 691–692). By the sixteenth century, a national system of technical training was being introduced in England (Humphries 2006, p. 75). Thus, along with their other roles, guilds were influential in the production of knowledge in the form of human capital.

Guilds provided an information pool and network for a particular supply of skills across regions. Although these networks were limited and far from efficient, the distribution of information helped signal changes in the demand for the skills and, therefore, provide a supply, if necessary (Epstein 1998, p. 694). Searchers wandered the country assessing practices and demands. Journeymen, either as part of a guild or as independents, travelled the country to provide their skills. In other words, the guilds acted as a means of disseminating knowledge (in the form of human capital) throughout the economy.

In fact, many of the European rulers tried to attract these skilled workers to their cities since the Middle Ages, and particularly during the times of the Renaissance and following the Reformation, especially if they were coming from the enemy. This development found a peak when mercantilist states and guilds tried to inhibit the emigration of skilled workers from the 1650s onward. However, these attempts were mostly unsuccessful due to the lack of administrative capacities and the incentives provided by other

states (Harris 1998). Thus, Epstein believes that “technological leadership moved over time from southern to northwestern Europe [...] largely thanks to skilled migrants” (Epstein 2004, p. 385).

Apart from the opposition of governments and guilds, other factors contributed to the limitations of technical knowledge transfer: trade secrecy, information costs, transport costs, and the nonexistence of a sufficiently high skills base, which made it difficult to locally integrate the knowledge and inventions of migrants. However, where this knowledge base was sufficiently high, the accumulated knowledge of a country transferred by skilled migrants could be combined with the local knowledge, often giving a technological lead to this country. Information costs and transport costs were lowered due to urbanization and state competition over time, making it easier for technologies to diffuse (Epstein 2004).

Guilds have frequently been associated with stifling innovation. At times, they were probably a powerful force in encouraging knowledge to be embodied in human rather than physical capital. Yet, they were also responsible for the invention and diffusion of others. Evidence suggests that, in the face of growing competition and expanding markets, the guilds’ barrier to technological innovation declined after the later Middle Ages (Epstein 1998, p. 694). Furthermore, craft guilds did “increase the supply of technology in three ways: by establishing a favourable environment for technical change; by promoting technical specialization through training and technical recombination through artisan mobility; and by providing inventors with monopoly rents” (Epstein 1998, p. 701).⁶ Thus, Epstein (1998, p. 704) concludes, somewhat controversially (as more evidence is probably needed to conclude fully), the two opposing forces of a monopolistic support system for invention and of the demand for ever-wider competitive markets in skilled labor provided a healthy source of technological innovation and diffusion.

Yet the government increasingly saw the need to intervene in the transmission of these skills. A new structure was set up that defined the legal framework and regulated the apprenticeship training system. For instance, the guilds were formally abolished by decree in Prussia in 1869 – more generally, the state saw the guilds as a competing institution for power (Smits and Stromback 2001; Epstein 2004). Although the guilds may have formally been abolished, Smits and Stromback (2001) argue that they were only “transformed into the Chambers of Crafts and retained substantial control over the apprenticeship system” in Germany (Smits and Stromback 2001, p. 17). Therefore, the organization and ways of training were not determined by the state but were left to the self-administering chambers. In Germany, it may have been a “managed transformation of the highly restrictive guild system to a regulatory regime that allowed industrialisation to proceed” (Smits and Stromback 2001, p. 17).

4.3 The Decline of Apprenticeships

While the apprenticeship system and occupational skills played an important role before and during the Industrial Revolution (Mokyr 2009; Minns and Wallis 2013), the social changes it caused brought about a crisis in apprenticeship training during the late 18th and nineteenth century (Lauterbach 1994), arguing that, at least in Germany, the quality of apprenticeship training was being neglected. Meanwhile, the duration of apprenticeships in England fell to 4 years in the late eighteenth century (Wallis 2008).⁷

Structural shifts altered the demand for human capital during the Industrial Revolution (Weedon 2003, p. 62). Zeira (2009, p.63) argues that “industrialization changed the type of human capital required for production. While prior to the industrial revolution human capital was mainly specific to the profession, the industrial revolution created demand for more general human capital, which included the ability to read, to write, and to perform calculations. Hence, while the apprenticeship system could provide most of the required human capital prior to the industrial revolution, following it there was increasing demand for people who have a much broader and flexible human capital, which can be acquired only at schools.”

Similarly, Collins and Halverson (2010, p. 23) add that “[a]fter the Industrial Revolution, schools stressed the learning of basic skills that children would need to function as intelligent citizens and workers and on the knowledge in the different disciplines.” Thus, the apprenticeship partly lost its role because there was a changing demand for human capital.

Its decline was also partly due to changes in the supply of other forms of education. In principle, dissemination of this specialized technical knowledge could take different forms: through printed media, patents, or migrants. Epstein (2004) argues that, especially early on, texts were not a very successful method for the dissemination of specialized technical knowledge because the manuals were often incomplete and did not include some of the essential information to actually put a new technique into practice. Yet the costs of written education changed over time. In comparison with schooling, an apprenticeship was a much more expensive alternative. Minns and Wallis (2013) estimate that schooling costs were about 1 pound per year in the eighteenth century.⁸ Eventually, in the eighteenth century, books on craft skills became the third most important category of books (the first being religion and the second being law), highlighting the increased importance of reading skills for tradesmen and craftsmen (Cook 2006).

5. Catalyzing the Human Capital Transition

5.1 The Gutenberg Revolution

Critical to the transformation of education in Europe was its ability to reduce the price of books and the written word. Before the invention of the printing press, book production involved the production of handwritten manuscripts. In addition to other costs, this was a very time-consuming exercise, as Clark (2007) illustrates (see also Clark and Levin 2001): Copyists were able to copy 3,000 words (of plaintext) per day, implying that one copy of the Bible took 126 man-days (Clark 2007). Because the copying of a text by hand needed more space than printing it, the area needed per word was also two times greater, further increasing the costs of the employed materials (Clark 2007). For this reason, books cost more than 1 year’s salary for an average man and were, therefore, luxury goods (van Zanden 2009a).

Nevertheless, the supply and the demand of manuscripts were promoted by the growth of monastic institutions from the sixth century (see Fig. 2). Additional demand came from the growth of cities throughout Europe between the 12th and 15th centuries. Cities were characterized by an ever more elaborate division of labor, and they generated economic and military demands for individuals who were able to keep records, were trained in administration, and were able to communicate properly. Bureaucracy expanded continuously, and the oral tradition was slowly replaced by the written word. For this reason more young people began to learn to read. In addition, universities were established for the purpose of advanced training and in turn created further demand for themselves (Venezky 1996, see also Hippe 2013a). In addition, the price of book materials was also lowered by economies of scale and learning effects associated with the increased use of paper (van Zanden 2009a). As a result of rising demand and declining costs, manuscript production increased until the eve of the invention of the printing press (see Fig. 2). It is estimated that more than 10,000 copyists worked in manuscript production in Paris and Orléans alone shortly before Gutenberg’s printing press (Chassant 1846).

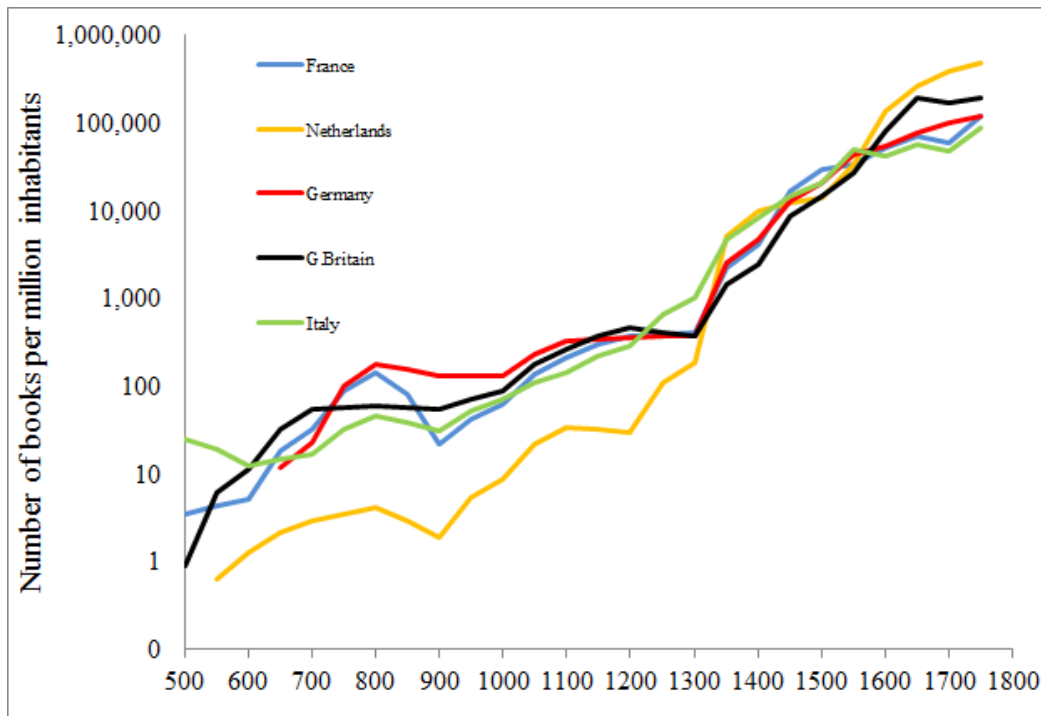


Fig. 2 Book production in Western Europe (per million inhabitants), 500–1750. (Source: Derived from Buringh and van Zanden (2009))

The invention of the printing press by Johannes Gutenberg in Mainz between 1446 and 1450 was, then, partly stimulated by this ongoing and increasing demand for written documents. In fact, Gutenberg was not the only one who tried to improve the existing manuscript production system. Different methods had been explored, including xylography and tabular printing. However, Gutenberg’s printing press proved to be superior in quality and lower in cost for the production of books (Guellec 2004). Therefore, the printing press was not invented by accident but after many years of diligent pursuit carried out by Gutenberg.⁹

The fact that the printing press was invented in Mainz is itself not so much accidental, as the city was part of the Rhine valley, which was quite industrialized for its time and specialized particularly in metallurgy. In consequence, the broad timing of the printing press was the outcome of the several mentioned demand factors. These factors were again conditioned by the availability of paper in Europe in general, and in Germany in particular. Furthermore, the growing market made the development of the printing press increasingly competitive relative to manuscript production (Guellec 2004).

The printing press fundamentally changed the world of book production and knowledge diffusion. It enabled a much faster and less costly production of books. Cuijpers (1998) indicates that printed books were about 50–80% cheaper than their handwritten homologues in the 1460s. Furthermore, the printing press was a technology which was skill and capital intensive. Therefore, this high-tech innovation corresponded perfectly to the needs of the European economy, which was characterized by high labor costs (in contrast, e.g., to the Chinese economy) (van Zanden 2009a). Thus, the new technology spread quickly throughout Europe.

The spread of the printing press allowed a spectacular increase of book production, knowledge diffusion, and human capital accumulation. In the earliest centuries presented here (500–700), overall book production in Europe was restricted to only 12,000 manuscripts written every century, whereas in the eighteenth century, the number increased to more than 1,000,000,000 books (Buringh and van

Zanden 2009). The decisive massive increase in book production clearly occurred during the period after the printing press was invented. The data show that more books (and manuscripts) were produced in Europe in the second half of the fifteenth century than in the entire 1000 years before the invention of the printing press. This radical change in the production of knowledge is also highlighted by the fundamental decrease in the price of books. The fall in book prices had the effect that a literate person was able to consume more books, which in turn increased the incentive (and reduced the cost) to learn to read. Furthermore, the increased output of books itself created economies of scale, lowering book production costs even further and leading to higher price reductions. Van Zanden (2009a) estimates the real price of books (i.e., deflating the book price by a cost of living index) for the Netherlands between 1460 and 1800 (see Fig. 3).

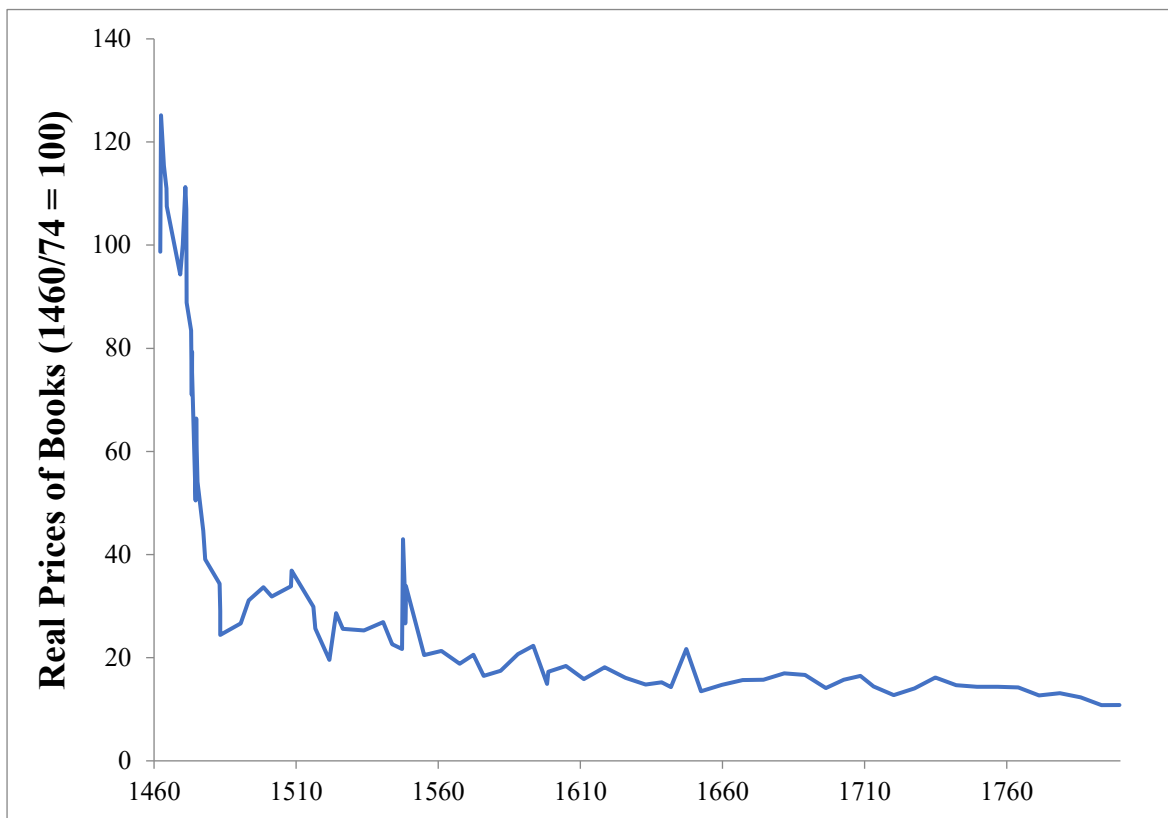


Fig. 3 Estimates of real prices of books in the Netherlands (1460/74 = 100), 1460–1800. (Source: Van Zanden (2009a))

The dramatic fall in the real price of books is more than evident. Van Zanden (2009a, referring to Cuijpers 1998) illustrates this change by using the Gutenberg Bible as a point of reference. An original copy of the Gutenberg Bible was sold at a rate of about an annual wage gained by a laborer. A Bible of comparable quality could be obtained for a price of less than 12 days of a carpenter’s wage before the end of the eighteenth century (and lower quality bibles were also available at prices equivalent to a daily wage).¹⁰ Thus, van Zanden concludes that “within the span of one generation – from 1455 to 1485 – book prices may have declined (in real terms) by 85–90%, a revolution in the price of communication comparable to current developments in ICT [Information and Communication Technology]” (van Zanden 2009a, p. 182).¹¹

5.2 Early Private Demand for Books and Literacy

Clearly, the dramatic decline in book prices following the diffusion of the Gutenberg Press was crucial to increasing the spread of the written word. At the beginning of the sixteenth century, literacy rates in most European countries were below 10%, possibly below 1% in German states (Engelsing 1973; Becker and Woessmann 2008). Then, over the next three centuries, particularly in North-Western Europe, such as the German states, Holland, Sweden, and England, greater access to books enabled literacy rates to increase (see Fig. 4 for England). However, literacy rates would not have reached 50% in the second half of the eighteenth century without a strong demand to read (Mitch 1992b).

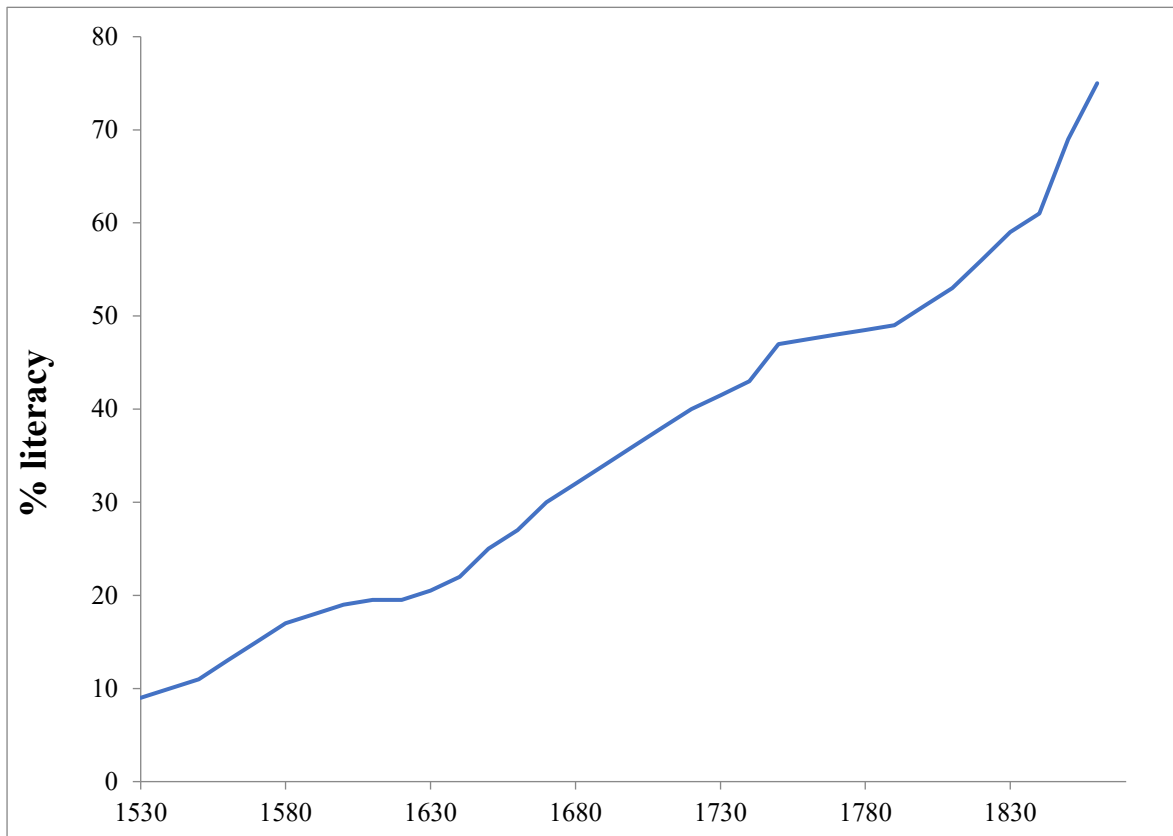


Fig. 4 Literacy in England, 1530–1870. (Source: Cressy (1980))

In fact, demand for literacy, numeracy, and a general education stemmed from many different private and social or public sources (e.g., Cipolla 1969; Fuller and Rubinson 1992; Mitch 1992a; Galor 2011). Commercial demand (i.e., coming from the trade sector), spiritual demand (from the Churches), military demand (to create a more efficient army), industrial demand (e.g., to increase labor productivity), parental demand (e.g., to improve the prospects of the future career of their children), status demand (to distinguish oneself as part of an elite), and “belief-formation” demand (to increase social control and advance nation building) were all private or social drivers to invest in education.

Mitch (1992b) has emphasized that early advances in literacy levels were brought about by private demand, rather than any direct actions by the state. “[T]he success of printing should probably be connected with more general changes in society. The end of the Middle Ages was marked by the rise of the bourgeoisie. Now that it controlled new economic and commercial sectors, the middle class intended to participate in political decisions that concerned them as well, and it signalled its social success by paying more attention to culture, which it adapted to its own interests” (Gilmont 1999, p.

215). Indeed, the percentage of households owning books increases from one in ten in 1560, one in four in 1580, and one in three in 1590 to nearly one in two by 1620 (Morgan 1997, p. 14). Similarly, the average size of personal libraries grew (Gilmont 1999). Increases in book collections offer an insight into the different income elasticities among different professions and social status. “Between 1500 and 1525 the average physician’s collection increased from 26 to 62 books; the average jurist’s from 25 to 55; the average merchant’s from four to ten and the average artisan’s from one to four” (Morgan 1997, pp. 13–14).

Basic education in the form of literacy or numeracy had become increasingly important in economic affairs throughout history. Cook (2006, p. 71) suggests that “one of the earliest exceptions to the exclusion of literacy to all but social elites was its appearance among the trades,” in particular due to the need of record keeping. For example, reading and writing ability became a prerequisite to obtaining an apprenticeship with English goldsmiths in 1478 (Anderson 1965; Venezky 1996). Increasing urbanization led to an economic environment that demanded more bookkeepers, administrators, and clerks, and more sophisticated forms of bureaucracy. More generally, “[l]iteracy continued [...] to be driven by practical utility, appearing first and to the highest degree in those trades most closely associated with the market economy (Thomas 1986), and in areas where new technologies were forcing change, such as navigation and warfare” (Venezky 1996, p. 59).

Meanwhile, demand for spiritual guidance, and the associated religious competition, was crucial ingredient for the explosion of printed works, particularly from the early sixteenth century. As already mentioned, the increasing number of monasteries throughout Europe during the Middle Ages reflected the growth in the supply of and demand for spiritual guidance.

With the cheaper costs of printing, Luther could dare to propose that everybody should be able to read the bible. Given that fewer than one German in one hundred was able to read at that time, his ambition must have seemed just a utopian vision (Engelsing 1973, Becker and Woessmann 2008). However, it is important to remember that for the first 70 years after the invention of the printing press, around 1450, the Bible had been printed in Latin. Most people did not read, but it made it harder to learn to read when the Bible was in Latin. Although translations had existed before (into Old French, Spanish, Catalan, and German in the thirteenth century and the Wycliffe Bible into English in 1383), these were usually banned and as a result were very hard to access and extremely expensive (Biller and Hudson 1996). The first printed non-Latin Bible was into Greek by Erasmus in 1516. However, it was Luther’s translation into German of Erasmus’ Greek Bible in 1521 that made the Bible accessible and at a low cost, electrifying the book market (see Fig. 5). In 1526, a Dutch Bible was printed; another German Bible was out of Zurich in 1530, in Italian in 1532, and in French in 1535 (Gilmont 1999). As a consequence, one of the most powerful drivers of European demand for books from the 1520s onward was the translation of the Bible into European languages.

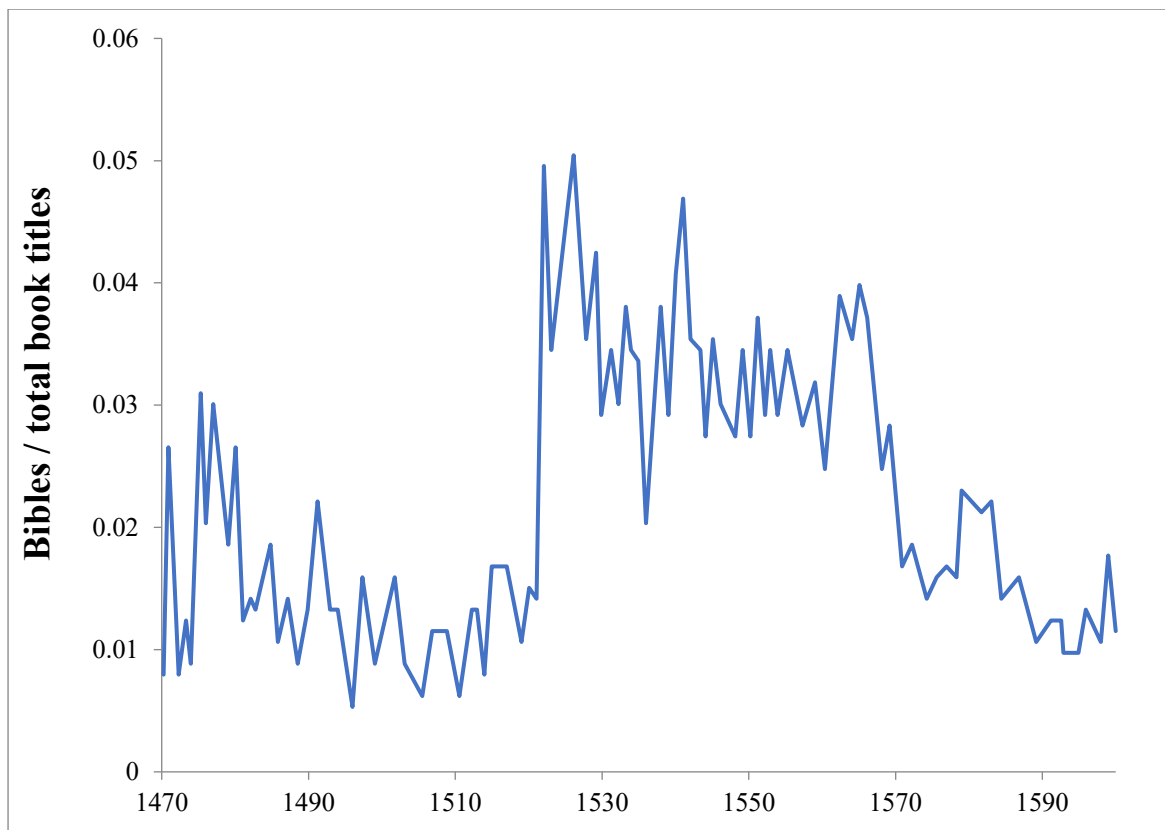


Fig. 5 Share of bibles in total book output in Europe, 1470–1600. (Source: Dittmar (2013))

5.3 Early Spiritual Demands for Mass Education

With the aim of ensuring that all should read the Bible, Luther argued for the establishment of compulsory schools and claimed that local rulers were responsible for their establishment. This would have effectively implied a shift of instruction from religious to secular authorities. In consequence, a range of ordinances that promoted schooling were passed in Protestant territories and their implementation was controlled (Becker and Woessmann 2009). For example, a first landmark church order was passed in Braunschweig in 1528, supporting the creation of new schools and defining the school curricula. It was soon followed by others (e.g., Saxony in 1557, Württemberg in 1559, Lüneburg 1564) (Green 1979). Yet Luther’s preaching did not lead to universal mass schooling (Stone 1969; Ramirez and Ventraensca 1992).

Luther also urged parents to value the education of their children and send them to school. For example, he writes that “I see that the common people are dismissive to maintaining the schools and that they withdraw their children from instruction altogether and turn solely to the care for food and bellies, and besides they either will not or cannot consider what a horrible and un-Christian thing they are doing and what great and murderous harm they are doing everywhere in so serving the devil” (Luther 1909, p. 526, as cited in Becker and Woessmann 2009, p. 541). Thus, Luther’s insistence over moral obligations might have altered the beliefs of parents and rulers about the benefits of educating children (Becker and Woessmann 2009).

At first, the Catholic Church attempted to ban Bible translations. Similarly, the state sought to censor publications. Henry VIII’s experience highlights the difficulties of introducing policies to control information production and dissemination. In the early sixteenth century most publications read in England were printed on the continent. Following Henry VIII’s break with the Catholic Church,

Luther's sympathizers were frustrated by Henry's lack of theological reforms and "bombarded England with highly aggressive pamphlets printed in Antwerp" (Gilmont 1999, p. 216). Unable to censor these publications, Henry VIII encouraged printers to be set up in England, which they did over the next two decades, and thus, he was better able to police their activities (Gilmont 1999).

Although the Catholic Church's Counter-Reformation¹² tried to undo many of Luther's teachings, it eventually embraced the ideal of improving literacy levels and the concept of schooling (Ramirez and Ventraensca 1992). Religious competition,¹³ and the threat of losing an even greater share of the "market for spiritual and moral guidance," may have been an important factor. "In the face of Protestant competition, religious and secular authorities in Catholic areas also increased their efforts to provide popular schooling; it is notable that the parts of Europe where schooling lagged most seriously were those, like Spain and Italy, where the Counter-Reformation triumphed completely and eliminated religious competition" (Glenn 2012, p. 140).

Overall, the churches played a major role in the supply of schooling for the next 300 years. Their importance only declined with the rise of the national state. In the nineteenth century, religious authorities feared that state-provided education would be secular and educational content not in line with their own views (Boli 1992). This was the case of the Catholic Church in France. In France enrollment was relatively widespread before the central state developed a modern organized entity (Archer 1979) because the Catholic Church was interested in controlling the socialization of children. Later competition with the state further increased French schooling (Fuller and Rubinson 1992). Thus, enrollment rates of children were about one-third in the 1830s and reached 80% by the 1880s (see Galor 2011).

In other locations, particularly in Protestant regions, the state worked together with the Church. In particular, the early worldwide leader in reading, Sweden, passed a Church law in the seventeenth century with the intention of spreading literacy due to religious motivations. Thus, Venezky argues that "reading ability was pressed on the population by church and state [...] through regular parish examinations, fines for parents who failed to teach their children and denial of Communion and marriage rights to those adults who could not read and recite the catechism" leading to almost universal reading ability in the population until 1750 (Venezky 1996, p. 48). Similarly, the state cooperated with the Lutheran Church in Prussia (Soysal and Strang 1989).¹⁴

In general, where the state was weak, it had to rely more on the infrastructure of the Church, giving the Church more power and influence (Vincent 2000). The USA is another example where enrollment rates were high in the presence of a relatively weak central state. Meyer (1989) proposes that this fact can be explained by a particular faith in schooling and literacy (due to Protestantism) and its positive effects on nation building. These ideas originated in Britain and were spread to America. Once again, spiritual demand had been an important driver of education.

6. Demand for Education

6.1 The Pros and Cons of Mass Education

Although some early reformers had promoted mass education, formal schooling was not widespread before 1800. Instead, most education was provided in more informal settings. The diversity of opportunities to become literate is highlighted by Cipolla (1969), making reference to Rashin's (1958) study. Still, in 1883–1884, the study shows that in a province of Moscow, Russian Empire, the distribution of 7,123 factory workers with the capacity of reading according to the source of their

education is that 38% became literate in their village, town, or district schools, 36% outside school, 10% in factory schools, 9% with clergy, and 7% during military service (Rashin 1958).

Mitch (1992b, referring to Briggs 1978; Mitch 1982) claims that fees for private schools at the elementary level were at levels that working-class families could afford in many European countries between the 16th and nineteenth century. He further argues that private instruction could then have achieved universal literacy without the state.

Yet different classes tended to have different demands for education. Whereas the middle class sought secondary or tertiary education for their children to move up the social ladder, workers might not seek education beyond the primary level because they failed to see the benefits of education. In this way educational differences among the classes, and perhaps also regions of countries, were exacerbated, and access to higher status jobs was often limited to particular groups of society, hindering mobility between social classes.

This point illustrates that the ruling elites in many countries were wary of the threat that more education posed to their political, economic, and social position. These elites feared that education would make the workers despise their lot in life, a life that had been assigned to them “by nature.” Therefore, education was perceived by some to lead them to seek more rights and make them more prone to resist domination (Graff 1991; Lindert 2004).

Despite these upper-class fears, there had been a growing demand for mass education for military and industrial reasons. Indeed, supporters of military conscription had particular interest in mass schooling. In fact, there had been an important demand for gunners in the sixteenth century (Cipolla 1969). Because gunners had to be literate to perform their profession, a number of European governments created specialized schools for their education. There they learned to read, write, and calculate, as well as some basics in ballistics. Sweden had promoted mass schooling for instilling national loyalty, teaching discipline, and lessening social tensions among the population, and their leaders found that literate soldiers were also considered much more effective in warfare (Malmström 1813). Similarly, Napoleon was aware of this fact and promoted the education of his recruits. Later on, his enemies used this insight to create an educated army (Vincent 2000). For instance, defeated Prussia successfully reformed its education system. This may have been one of the reasons Prussia (and the other German states) won the Franco-German War in 1870. “[I]n 1870 there were more than 20 per cent illiterates among the recruits of the French army while there were only about 3 per cent among those of the Prussian army [...]. As the French remarked at the time: *Sedan est la victoire du maître d’école allemande*” (Cipolla 1969, pp. 23–24, see also Fourrier 1965). Cipolla states that “[s]ocieties which produced an increasing number of literate soldiers had a decisive advantage over those that failed to do so” (Cipolla 1969, p. 23). Accordingly, Vincent notes that “[a]s Europe prepared for war, most of the potential combatants had ensured that their recruits would be able to read the instructions on their weapons and write back to their families” (Vincent 2000, p. 10). In other words, military objectives played a role in the provision of education by the state in the nineteenth century.

6.2 Books in the Industrial Revolution

The basic technology did not significantly change after Gutenberg until the nineteenth century (Chappell 1970). Afterward, the Industrial Revolution had a dramatic impact on the supply of printed materials. Steam power began to be used in the pressing process as early as 1810. At the same time, the first successful attempts were made with machine-produced (pulp fiber) paper, and machines for mass production entered the market in the 1840s. Further advances in paper production and in printing

machines (in particular the linotype) immensely cut time and capital costs in printing in the second part of the century (Cook 2006). These changes had their effects on the number of published titles.

Weedon analyzes England over the period 1836–1916 in more detail. He concludes that the time between 1846 and 1916 “saw a fourfold increase in production and a halving of book prices” (Weedon 2003, p. 57, see also Fig. 4).

What were the determinants of these important changes in book and print production in the nineteenth century? Weedon suggests that technological transformations were essential in the process. She emphasizes that paper, an essential part of the production costs of a book, could now be produced by the use of machines. The cost of paper fell by about two-thirds between 1866 and 1896, making book production much cheaper.

Even more spectacular increases were recorded for the newspaper industry. Cipolla (1969) highlights that “in the United Kingdom in 1831, the average monthly issue of the newspaper press amounted to about 3,240,000 copies (equivalent to about 137 copies per 1,000 inhabitants). By 1882 it had gone up to 135 million (about 3,700 copies per 1,000 inhabitants) (Cipolla 1969, p. 107).”¹⁵ To put UK newspaper circulation in perspective, Murch (1870) states that about 38,648,000 copies were in circulation in 1831, which increased to 546,059,000 copies in 1864 (i.e., an increase of 1,313%). Not only were more newspapers printed, but the cost of newspaper production decreased. For example, the price of newsprint fell by a factor of ten between the 1860s and 1890s (Cook 2006). In other words, steam power was revolutionizing all forms of print media.

6.3 Industrial Demands for Education

The industrial demand for literacy was slower to develop. In the first phase of the Industrial Revolution, industrial demand for skilled labor was rather limited (Galor 2011). Some factory workers needed to be literate and numerate, but most processes were still handled by illiterate workers (Landes 1969, in Galor 2011). Furthermore, the developing factory system increased the opportunity costs of education for young children because they could be employed in factories (Cipolla 1980; Venezky 1996), leading to stagnating educational levels. The evidence to date finds little importance for the role of formal education in the Industrial Revolution in Britain (Mitch 1999).

However, Becker et al. (2011) identify an important role for education in Prussia’s industrialization catch-up during the second half of the twentieth century. Furthermore, industrial modernization led to the need for skilled labor and created demand in the second phase of the Industrial Revolution (Galor and Weil 2000; Galor 2011). Certainly by the second half of the nineteenth century, industrialists identified a growing need for workers to be educated in order to effectively use the machines.

Human capital became more important in the process of production because it was complementary to (physical) capital and technological progress. Labor productivity was also higher for skilled individuals (Galor et al. 2009; Galor 2011). In addition, educated individuals were considered to be more easily adaptable to technological change and open to new arriving ideas (Cipolla 1969). Technological progress was advancing quickly during this period, and thus the corresponding demand for human capital took off. Therefore, Zeira argues that “[b]oth the mechanization of production and the increase in the scale of production changed dramatically the whole character of producing and marketing. It now required new skills, of reading, writing, and arithmetic. The need to handle and operate machines and to take care of them required some knowledge in science and engineering and at least some literacy skills, to read manuals, to correspond with producers on problems in machines, etc.” (Zeira 2009, p. 602).

Mitch (1992a) estimates that a literate worker gained about 13% more than an illiterate one around 1870. The increasing opportunities for members of the lower classes to enter into competition for higher-ranked jobs and more frequent opportunities to use literacy skills in everyday life no doubt stimulated private efforts to become educated. More generally, the structural changes in the sectors of the working population had its own repercussions on the requirement of literacy with a long-run move out of agriculture, where literacy was less needed (Table 1). Finally, the demographic transition further increased the need to invest in each child due to the lower number of children.

Table 1 Usefulness of literacy in English male population, 1841-1891

Category of occupational usefulness of literacy	1841	1851	1871	1891
Literacy required	4.9	5.6	7.9	11.1
Literacy likely to be useful	22.5	22.8	25.3	26.1
Literacy possibly useful	25.7	24.2	24.5	25.9
Literacy unlikely to be useful	46.9	47.0	42.3	37.0

Source: Mitch (1992a)

Note: “Usefulness” refers to the degree that literacy was useful in a work context

According to Galor et al. (2009), capitalists had an interest in promoting public education because they needed skilled workers in their factories during the second part of the Industrial Revolution. In contrast, large landowners preferred to block educational expansion because industrialization threatened their social status. In addition, workers would be more prone to migrate to better-paying urban centers and would be less willing to accept existing working conditions in the fields. Finally, landowners were often those who had to pay the taxes for improving the educational system, and they did not want to take this financial burden (see also Baten and Hippe 2017).

Thus, against the interests of landowners, capitalists were active in lobbying for public education and tried to influence government actions toward intervention in the education field. In particular, technical education was seen to be an important way of providing skilled workers. The example of England may illustrate this. It was the industrial leader, but late in the provision of public education. According to Galor (2011), the government changed its prior laissez-faire politics when it became clear that other countries (such as Germany or France) were becoming more inventive and innovative in industry. According to a jury member of the Paris exhibition of 1867, the exhibition showed that there was insufficient progress in the English industrial sector. The reason for this “upon which there was most unanimity conviction is that France, Prussia, Austria, Belgium and Switzerland possess good systems of industrial education and that England possesses none” (Green 1990, p. 296, in Galor 2011, p. 476). Later on, the vice president of the committee of the Council of Education believed that “[u]pon the speedy provision of elementary education depends our industrial prosperity ... if we leave our work-folk any longer unskilled ... they will become overmatched in the competition of the world” (Hurt 1971, pp. 223–224, in Galor 2011, p. 477). Thus, Galor (2011) argues that the English government finally gave in to the demand of capitalists and expanded public education.

Together with the process of industrialization, the public became increasingly aware that more modern skills and knowledge related to modern production processes had to be acquired. Therefore, in their analysis of the USA between 1890 and 1970, Rubinson and Ralph (1984) find a significant impact of technological change on the expansion of schooling (i.e., enrollment rates). However, they acknowledge

the fact that schooling and literacy were already important in the USA before the Industrial Revolution. They were part of a process of status competition among different parts of the population (according to ethnic origins, occupational status, religious affiliation, etc.). Moreover, the importance of technological change weakened over time because the schooling system was expanded more by political considerations.

6.4 The Incentives for the Nation-State to Provide Mass Schooling

Alongside military and industrial reasons, illiteracy also started to be seen as a disgrace for a nation (Cipolla 1969), putting pressure on governments that did not want to fall behind the “civilized” leaders. Therefore, international reputation and competition can be seen as factors that influenced government policy in this context. In addition, there was a growing belief in the role of mass education in forming the beliefs of the population and in directing and possibly controlling their behavior.

Ramirez and Ventraensca (1992, p. 49) consider the later phases of the construction of mass schooling to be a project of the nation-state, emphasizing its overall transnational character. They argue that mass schooling evolved and standardized around similar ideological and organizational forms. It allowed the nation-state to connect with individuals. The rise of the nation-state was, therefore, intrinsically related to mass schooling. Public life became increasingly reordered around the nation-state, and former transnational populations were transformed into citizens of nation-states. Education as such became its own institution, with its own goals, interests, and stakeholders. “Almost all European governments took steps which homogenized their populations: the adoption of a state religion, expulsion of minorities, institution of a national language, eventually the organization of mass public instruction” (Tilly and Tilly 1973, p. 44, cited in Alesina and Spolaore 2005, p. 184). Later on, former colonies proceeded in a similar fashion to achieve the goal of nation building in the second part of the twentieth century.

In line with this idea, Alesina and Reich (2013) argue that the magnitude of homogenization aimed at by a government depended on its particular regime. In particular, they distinguish between democratic regimes, “safe” nondemocratic regimes, and “unsafe” nondemocratic regimes. For example, in France the Ancien Régime was powerful but not interested in pursuing homogenization. The French Revolution toppled the regime, but other elites soon came to power. Still, the threat of more democracy necessitated increased efforts of nation building and homogenization. One important way to homogenize the population was linguistic homogenization by enforcing French as the only language used at school. The cases of Italy and England similarly illustrate that mass schooling was perceived to be a requirement for nation building. Similarly, in many African states after decolonization, an important share of enrollments was only realized after the (re)organization of a more or less effective national state. Increasing enrollments had different advantages. It had a signaling effect, emphasizing that the nation-building process was underway. Moreover, it was aimed at showing that the ideals of progress were embraced by the elites, giving further legitimacy and credibility to their ruling. Thus, the erection of schools also had an important symbolic effect in several dimensions (Ramirez and Ventraensca 1992).

7. Government Intervention in Education

How can the European countries be classified according to the importance of government involvement in education? Mitch (1992b) distinguishes between two categories of European countries. First, the countries that were the leaders in industrialization (e.g., England, France, Germany) showed a gradual increase of literacy over several centuries prior to the eve of mass schooling (see Fig. 4 for England).¹⁶ This gradual process may have involved local demand, which was met by local supply. Second, the late-industrializing nations (such as Russia, Italy, Spain) had much lower literacy levels, but then these countries increased them much more rapidly. In fact, the governments were aiming at closing the gap

with the leading European countries. Thus, the role of the central state was much more important in these countries, and local elites had a less decisive influence in advancing educational levels.

Using a different approach, Soysal and Strang (1989) divide the European countries into three groups according to the conflict and competition within societies on the subject of education. The first category, the “statist construction of education,” includes Prussia and Scandinavian countries (Denmark, Norway, Sweden). In these cases, the state was able to build upon the know-how and physical infrastructure of the national churches. In fact, instruction was mostly provided by churches before the nineteenth century (Vincent 2000). Thus, the alliance between the state and the church was crucial.

Second, the “societal construction of education” took place in countries such as France, the Netherlands, Switzerland, Great Britain, and the USA. In these countries there were many conflicting interests articulated by important stakeholder groups. These were of a religious order (e.g., Great Britain and the Netherlands) or of local character (e.g., the USA). Therefore, a centralized, nationwide educational system was only constructed relatively late, although schooling had already been expanding quite significantly before the involvement of the state.

Finally, the “rhetorical construction of education” in countries such as Portugal, Italy, Greece, and Spain meant that compulsory education laws were passed relatively early, but actual action did not take place for many decades. The dates of the introduction of compulsory education and enrollment ratios in 1870 illustrate this discrepancy (Table 2). For example, although Greece introduced compulsory schooling quite early in 1834, its insufficient implementation led to primary enrollment ratios of only 20% in 1870. In this and the other countries that had a “rhetorical construction of education,” there was no competition over education, and enrolment rates were also relatively low. In addition, the state was too weak and had too little power to enforce its own legislation in its territory.

Table 2 Introduction of compulsory education and primary enrollment ratios in 1870

Country	Introduction of compulsory education	Primary enrollment ratios in 1870
Prussia	1763	67
Denmark	1814	58
Greece	1834	20
Spain	1838	42
Sweden	1842	71
Portugal	1844	13
Norway	1848	61
Austria	1864	40
Switzerland	1874	74
Italy	1877	29
United Kingdom	1880	49
France	1882	75
Ireland	1892	38
Netherlands	1900	59
Luxembourg	1912	-
Belgium	1914	62
United States	-	72

Source: Soysal and Strang (1989)

Another question concerns the effectiveness of state policy in education. When was state action effective? Mitch (1992b) points out that a state’s education policy might not have been very effective

if demand was low. Even if a sufficient supply of education was guaranteed by the state, lacking interest or even resistance from parents meant that classrooms stayed half empty. Furthermore, state policy was rather ineffective when there had already been a high level of literacy and a large supply of private schools. In this case, Mitch (1992b) argues that public policy initiatives were redundant, and in many cases already existing private schools were only turned into public ones. In contrast, a state's policy may have been quite effective when a clear shortage of supply did not meet popular demand. In addition, state policy could overcome local resistance where local elites blocked the provision of educational facilities against the will of the local population. Moreover, public policy could be effective when an initial level of instruction was present, but this level had to be advanced still further. Here, the state's policy (in particular in England, France, and Germany) was directed toward the construction of new schools, the standardization and improvement of teaching, the reduction or elimination of schooling fees, and the establishment of compulsory schooling laws. National literacy campaigns (e.g., in Scandinavia in the seventeenth century) may have also been an important tool to increase the effectiveness of education policy.

In consequence, Mitch emphasizes that an effective educational policy needed the concordance between the demand for instruction and the influence of policy measures. Both are dependent on the popular attitude toward literacy and the power relations within society.¹⁷ Thus, education policy needed to count on popular and local elite support to be effective. Where one or both of those factors were lacking, national public policy was often without great effect. Therefore, local institutions and local elites played an important role. Accordingly, Lindert (2004) notes that many of the early high performers in mass education had decentralized education systems. For example, he argues that the Prussian education system was essentially based on bottom-up structures.¹⁸ Other examples for decentralized education systems include the USA and Canada. In all of these countries, local governments were able to levy their own local taxes that financed the school system. Thus, local actors were able to choose whether they wanted to be committed to schooling or not and were freed of interests that may have been existing at the national level. Local leaders were thus influenced by local debates and local demand. Thus, local funding also meant that regional differences in education could become even more striking. In consequence, whereas in the first phase decentralization enabled educational levels to increase in the most favorable regions, in the second phase, it tended to fail to increase educational standards in the laggard regions. In the latter phase, the government was needed to avoid such a market failure¹⁹ and to centrally enforce higher educational spending.²⁰

In what specific ways can the state act in order to avoid market failures in the education sector? First, the state can provide sufficient supply. In theory, the private sector could also be fully responsible for the supply side: according to Lindert (2014), investments in primary education have brought high private and social returns for at least the last 600 years. However, he points out that the private sector has never solved the "capital constraint" problem, i.e., that universal education investments are to be paid back by the increased future earnings of children. For this reason, the state has to step in to avoid underinvestment in education. Yet this supply of schools, teachers, and materials generates important costs for the government. This is one reason why the state was not able to finance public education throughout most of history. In fact, it did not have the necessary fiscal capacity due to inefficient state bureaucracies, etc. On the other hand, the willingness to invest in education, and thus to increase taxes, was dependent on the interests of the ruling classes. As long as these ruling classes, in particular landowners, were opposed to educational reforms, progress was limited or inexistent in this area (see also Baten and Hippe 2017). Therefore, Lindert (2014) argues that the provision of voting rights to larger segments of the population made a crucial change to the composition and attitude of governments toward educational investment. Thus, government spending on education has risen dramatically during

the last two centuries. Higher spending does not necessarily translate into higher enrollments but is often well correlated (see Fuller 1983; Walters and O'Connell 1988).

Second, the state can create demand for education. Thus, investing in the quality and credibility of schools may have an important impact on demand and enrollment. The quality of schools depends on several factors, among other things on the quality of teachers. The supply of those teachers depends on their salaries and the social status of the teaching profession (Cipolla 1969).²¹ Assuring the quality of teachers can thus be an important policy objective. In addition, the state can politically construct the organization of work. For example, it has the power to create minimum educational standards for the entry into jobs in the public and private sectors. If parents or their children want to enter this well-paid job market, they have to invest in education. In consequence, the state can create a public demand in a politically directed way. Likewise, the state can decrease the opportunity costs for sending children to school (e.g., by limiting child labor and giving schools a normative legitimization).

Finally, the ideological and symbolic compound associated with education (e.g., economic and social opportunity, but also Western ideals such as nation building, individual development, and progress) can be used by the state to advance mass schooling through corresponding signaling activities (such as literacy campaigns) (Fuller and Rubinson 1992).

However, it appears that the state's involvement to improve educational quality and quantity might have been too late in some countries. For example, Mitch (1986) indicates that this may have been the case in nineteenth-century England. In consequence, was the UK spending too little on education (and too late)? To have a better grasp of the amount of public spending in comparison with economic output, public investment in education can be directly measured as a share of GDP. Carpentier (2007) shows the relative position of the UK with other countries that were catching up. In particular, he considers the differences between the UK, France, and the USA (Fig. 6). The very low values of the UK until the end of the nineteenth century also appear to be quite low in comparison to these other industrializing countries. This illustrates the claim that the major deficiency of the UK in the second part of the Industrial Revolution was its lack of skilled workers due to a lack of education. The USA was by far the leading country among these three nations in 1870, spending almost 1% of its GDP on education. France follows with a large gap at about 0.5%, while the UK lags far behind. The UK became aware of this later on and the government increased its expenditures much more pronouncedly. France also increased its relative expenditure on education, for a decade becoming the leader of these three countries. Subsequently, the UK had the highest shares until First World War. However, the real takeoff in education spending shares occurred only between the 1950s and the 1970s. Since then, education spending has mostly been between 4% and 6% of GDP in all three countries.

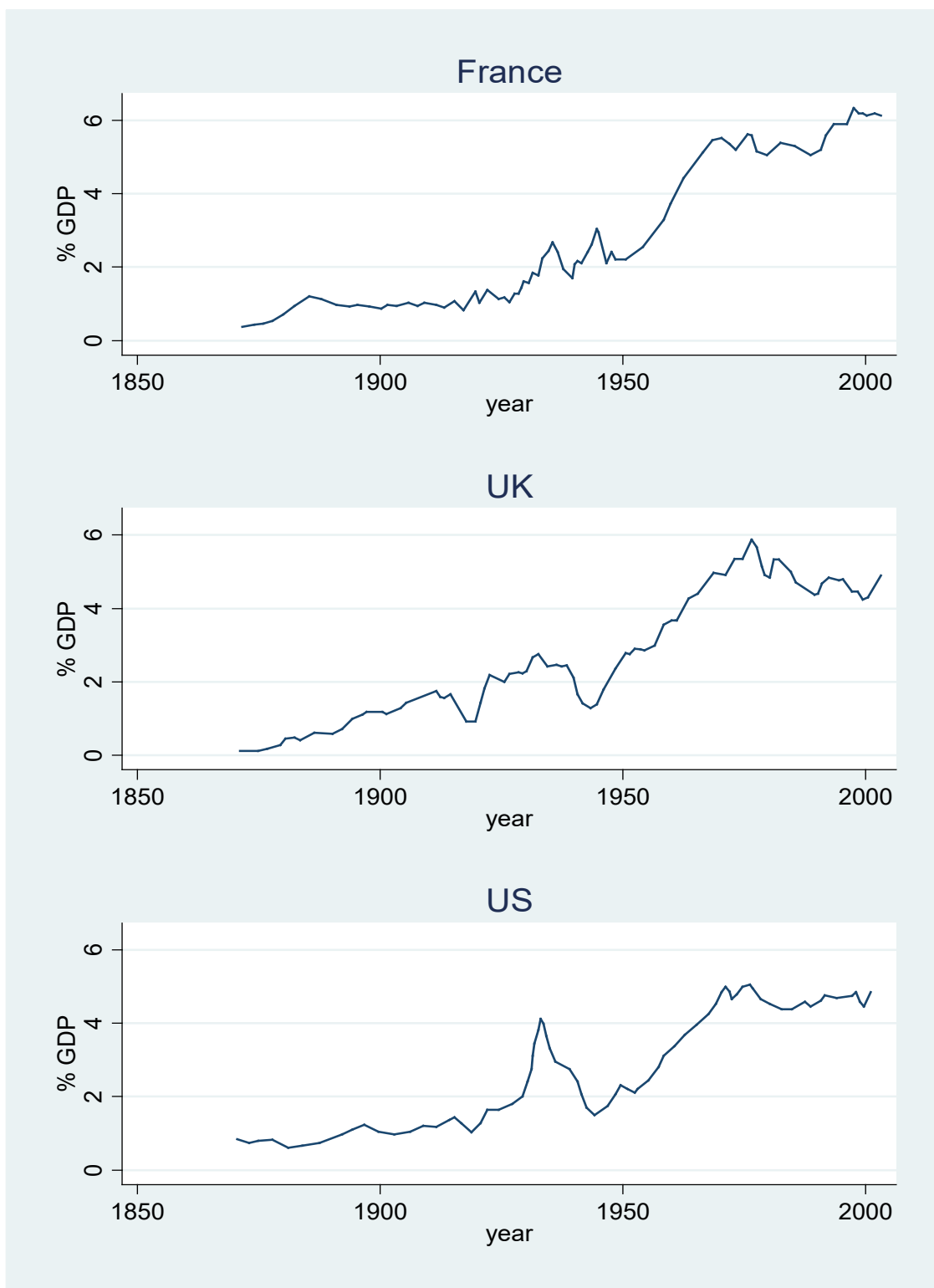


Fig. 6 Public expenditure on education as a share of GDP in the UK, France, and the USA, 1870–2003. (Source: Carpentier (2007); see also Diebolt (2000) and Diebolt and Fontvieille (2001))

These data illustrate the evolution of public expenditure on education. However, they do not include private investment in education. The overall investment in education might have been much higher than the public investment alone. Lindert (2004) provides some estimates on total (i.e., public and private) expenditure on all levels of education in a number of countries between 1850 and 1910 (see Fig. 7).

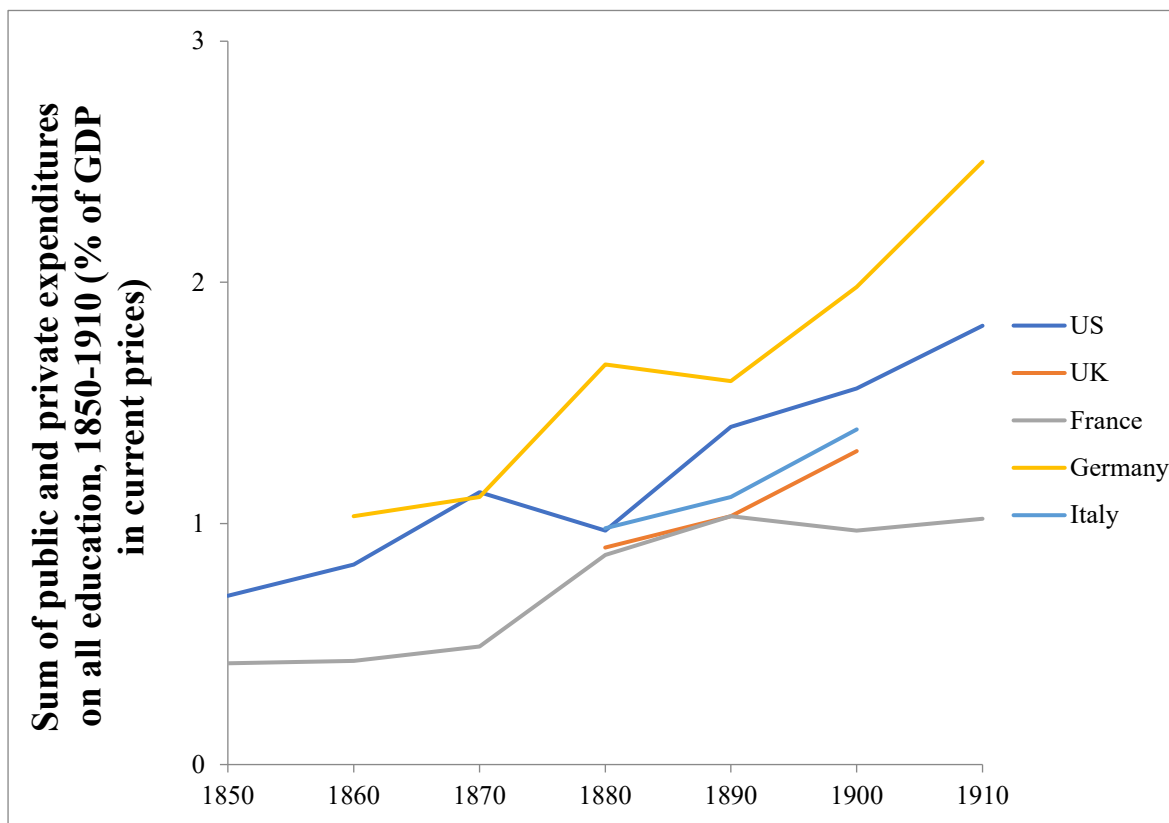


Fig. 7 Total of public and private expenditure as a share of GDP, 1850–1910. (Source: Derived from Lindert (2004))

The data suggest that overall investment in education was highest in Germany throughout the second part of the nineteenth century, followed by the USA. France appears to have had much lower levels, and the gap to the leading countries widened at the end of the 19th and the beginning of the twentieth century. Data on Italy and the UK are even more tentative but could suggest a more intermediary position.

The next logical step is to ask about the composition of this investment. Was private investment in education higher or lower than public expenditure? Thus, did public investment replace private investment over time? The next figure illustrates the relative importance of public and private investment (as a share of GDP) in these countries (see Lindert 2004 for details) (Fig. 8).

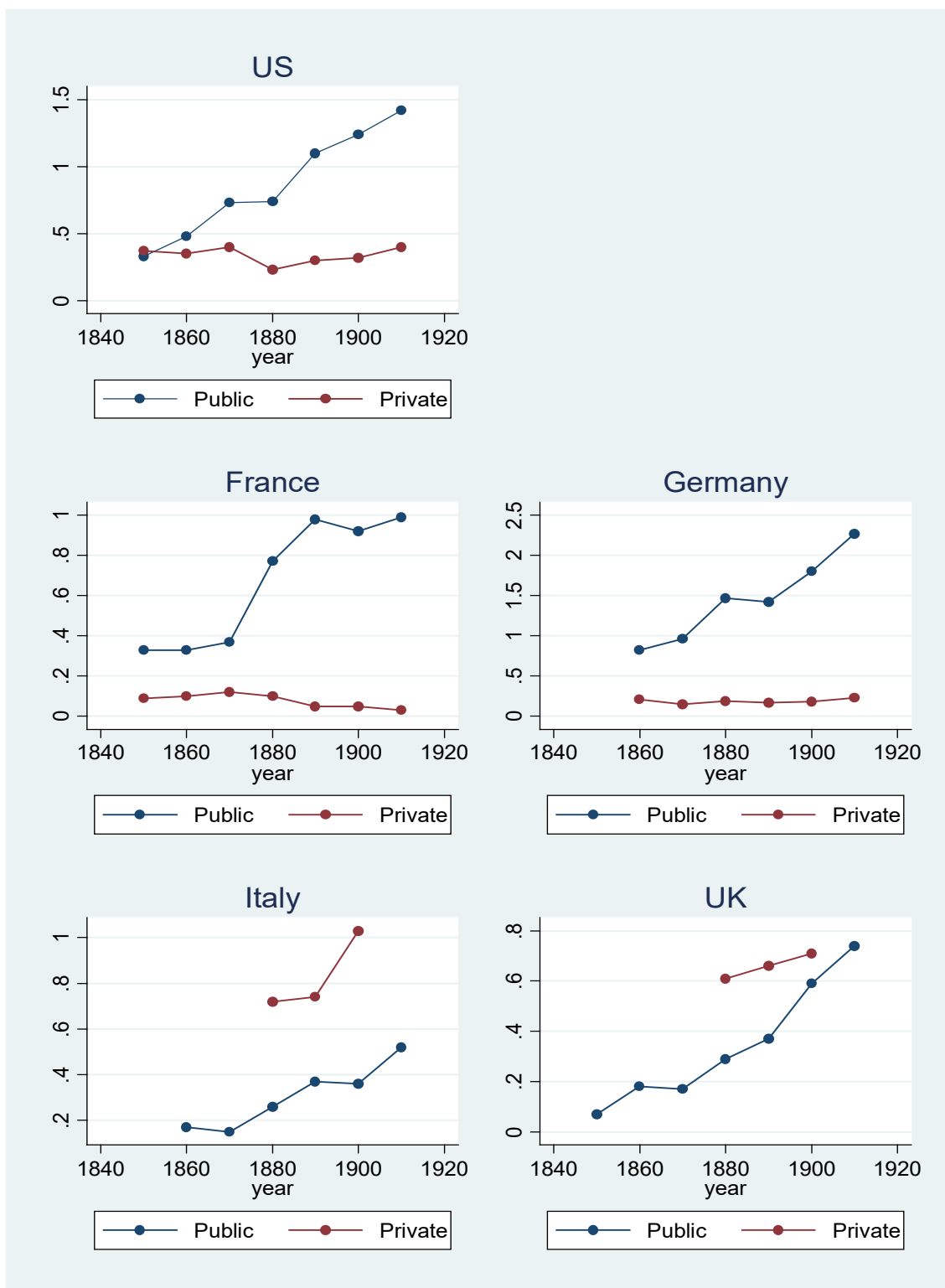


Fig. 8 Public and private expenditure as a share of GDP, 1850–1910. (Source: Derived from Lindert (2004). Note: Vertical axis refers to expenditures on all levels of education as a % share of GDP in current prices. The value for private expenditure for the UK in 1890 has been interpolated)

Three different patterns emerge. First, private and public expenditures were more or less at the same level in the USA in the 1850s. However, public expenditures as a share of GDP rise (almost)

continuously, whereas private expenditures stagnate. The initially slightly higher levels for private expenditures might possibly suggest that public expenditures partly replace private ones. Second, public expenditures are much higher than private ones in both France and Germany throughout the period. The gap also widened, given the increased efforts of the government to provide schooling. Finally, private expenditures appear to have been higher in Italy and the UK at the end of the nineteenth century. Therefore, the tentative evidence would suggest that government spending became the major form of investment in education only in the twentieth century, much later than in other countries.

8. The Worldwide Human Capital Transition and the State

8.1 Trends in Worldwide Human Capital Levels During the Last Two Centuries

It appears important at this stage to provide a general overview of the long-run human capital transition in the world before moving on to the role of the state. We may begin with numeracy levels (Crayen and Baten 2010). Numeracy is measured here by the age heaping method, which measures the share of people who are able to count.²² The industrial countries have the highest numeracy levels of all countries at the beginning of the nineteenth century. These countries are relatively closely followed by East Asia, which has similarly high numeracy levels as the industrial countries in the 1880s. Not far behind East Asia are the Eastern European/Central Asian countries, which achieve the maximum numeracy values by the 1900s. Thus, these three regions reach the upper limit of numeracy levels at the end of the nineteenth century. No other world regions were able to achieve such a level until the middle of the twentieth century. The most advanced area of these follower regions is Latin America/Caribbean, which has been inspired by the educational policies of the industrialized countries. The lagging world regions are Southeast Asia, Sub-Saharan Africa, and the Middle East/North Africa. South Asian countries had the lowest level of numeracy throughout the period.

Numeracy is just one indicator of human capital levels. Literacy is surely the most common variable for long-run education (see also Diebolt and Hippe 2017, 2018a, b; Hippe and Perrin 2017; Diebolt et al. 2018). The overall trends since 1870 (Fig. 9) are quite similar in many respects to the ones identified in numeracy. In particular, literacy levels are once again led by the West. The gap between the West and all other countries appears to be much more important than in numeracy. One important reason for this is that literacy levels are much lower than basic numeracy at the beginning of the period. This circumstance is related to the underlying concept of measurement: the numeracy indicator proxies very simple counting skills, which are even more basic than literacy skills. In any case, the West is again followed by East Asian countries (i.e., Korea-Japan and China) and Eastern Europe. Eastern European countries show a particular sharp increase in literacy between 1910 and 1950. In contrast to Korea-Japan, China does not substantially increase its literacy levels until the second half of the twentieth century and thus falls back. Latin America takes an overall similar evolution as China. Although its literacy levels speed up between 1910 and 1950, progress is more slowly achieved afterward. In China, the reverse is the case. Societies characterized by almost complete illiteracy in the 1870s come from South Asia, “other Asian” countries, and Africa. Whereas the “other Asian” countries are able to close the gap with the leading regions by 2010, South Asia and Africa show important, but not sufficient, progress. However, it seems that they may be able to join all other regions in the decades to come.

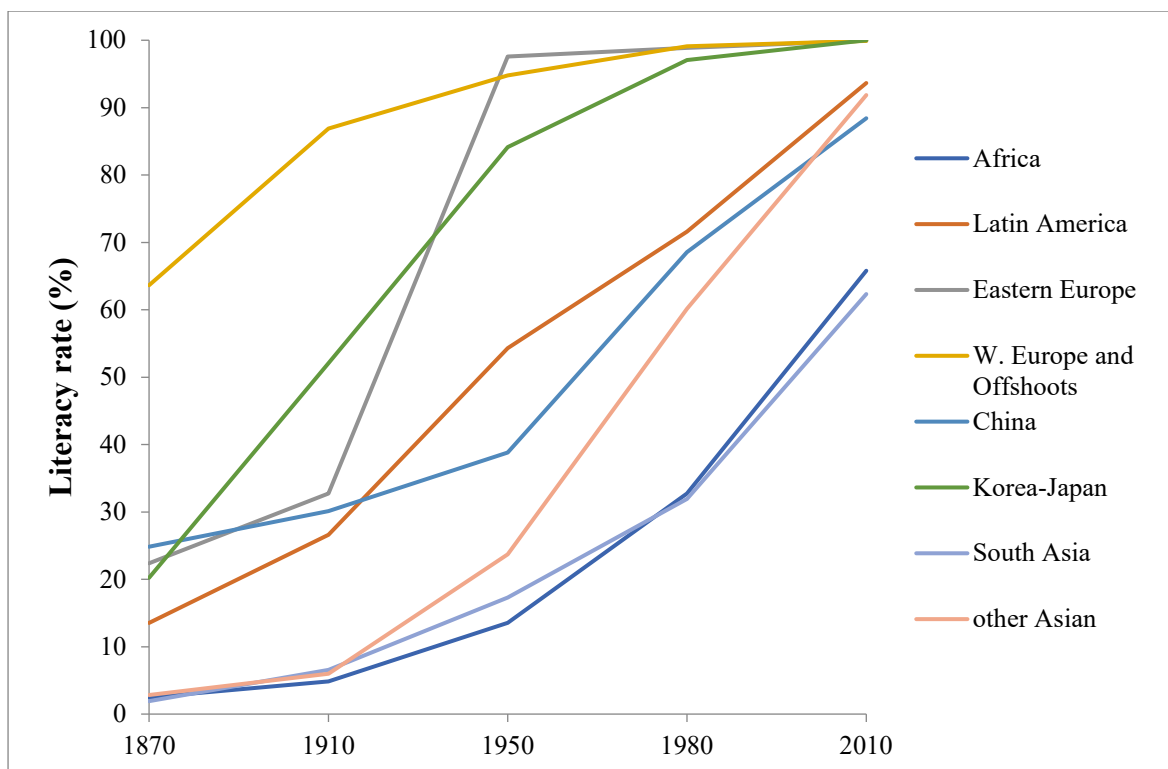


Fig. 9 Evolution of literacy in world regions, 1870–2010. (Source: Morrisson and Murtin (2013))

Taking another standard indicator, the years of primary education, the conclusions are quite similar (see Morrisson and Murtin 2013). Clearly, this variable is even more closely related to the state because most schooling has been provided by the state during the considered time span. The increases are not as impressive as in literacy in many cases, but this is partly due to the nature of the indicator. Still, the trends that were discernible in the literacy data can also be found here. Primary years of schooling amounted to about 3 years in the West in 1870, whereas it ranged from 0 to 1 years in all other regions. In 2010, three different regimes exist: about 6 years of primary education in the West, Korea-Japan, and Eastern Europe; about 5 years in Latin America, China, and other Asian countries; and, finally, about 3.5 years in South Asia and Africa. Except for the leading group, all other regions appear to be converging to the leaders in the longer run.

Primary education is a measure of basic human capital. Thus, it is similar to literacy and numeracy. If we want to enlarge the concept of human capital to include more advanced skills, we should also take into account the role of secondary education. Therefore, the total years of schooling indicator give a fuller comprehension of basic and more advanced human capital levels (Fig. 10). However, it is clear that an important part of this variable is constituted by the levels of primary education, as shown in the previous figure. Most of the trends in the average total years of schooling are, therefore, in line with the results for primary education. The most evident change in the pattern is the evolution of Eastern Europe. In primary education, Eastern Europe was already at similar levels as the West and Korea-Japan by 1980. In primary and secondary education, there still remained an important gap of about 1.5–2 years. In addition, this gap was not closed, but actually widened until 2010. This change was probably motivated by the fall of Communism and the subsequent transition period in these countries.

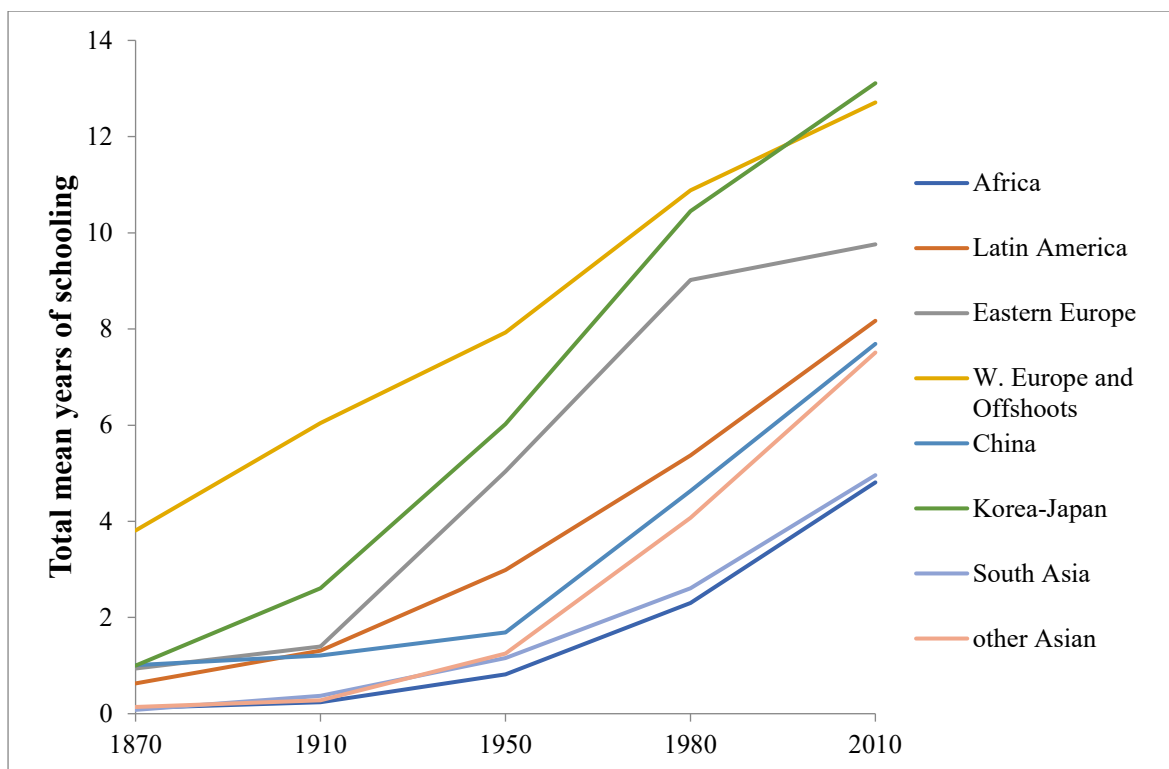


Fig. 10 Evolution of total years of schooling in world regions, 1870–2010. (Source: Morrisson and Murtin (2013))

One can also look at these data in another way. The notion of the technological frontier has been very important in the growth literature (e.g., Vandebussche et al. 2006). The same idea can be applied to human capital. If we consider the leader of human capital (i.e., the West) as marking the frontier of human capital, we can calculate the simple distance of other regions to this frontier (using total years of schooling). Taking this perspective, it becomes clear that the gap between the West and “the rest” remained rather stagnant and very wide between 1870 and 1910. Only Korea and Japan exhibit significant progress. Afterward, all countries exhibit different rates of convergence to the human capital frontier, but (apart from Korea-Japan) all countries are still quite far away.

Thus, all the indicators employed in this analysis illustrate a move from relatively low human capital levels to much higher levels during the last 200 years. In schooling, this transition has taken place in all regions between 1870 and 2010. The West already had relatively high schooling levels in the second part of the nineteenth century (so that one needs to go back to the early nineteenth century to see the entire trend), but these levels are still very low compared to contemporary current levels. The human capital transition is a phenomenon of the last 200 years, and the state has been playing an important role in this transition.

8.2 Human Capital and the State

The involvement of the state in the transition from low mass levels of education to high levels becomes evident when considering different indicators. Passing compulsory schooling rules is one clear sign that a state intends – at least symbolically – to improve its educational levels. Figure 11 shows the evolution of the cumulative share of countries in a world region that have passed compulsory schooling rules. Western Europe appears to be the leader in state laws on education, achieving a rate of around 50% by

1880. It is followed by the Americas and Eastern Europe, both culturally linked to the leaders. Asia and the Pacific were the next to follow slowly. The Middle East began its major involvement in state education even later, from the 1910s onward. Both regions show a parallel spectacular growth between the 1930s and the 1950s, with a lead of one decade for Asia and the Pacific region. Progress was less striking from then onward. In Africa, the turning point came in the 1950s and the period of decolonization. Afterward, similar levels as in the former two regions were almost reached. Accordingly, Ramirez and Boli-Bennett (1982) argue that there is an acceleration phenomenon, i.e., there is a correlation between the date of independence of a country and the time to pass compulsory schooling: the younger a country is, the faster it passes compulsory schooling laws (Adick 2003). Overall, the transition from almost non-existing official legal involvement in compulsory schooling to almost universal compulsory schooling in many parts of the world is very clear.

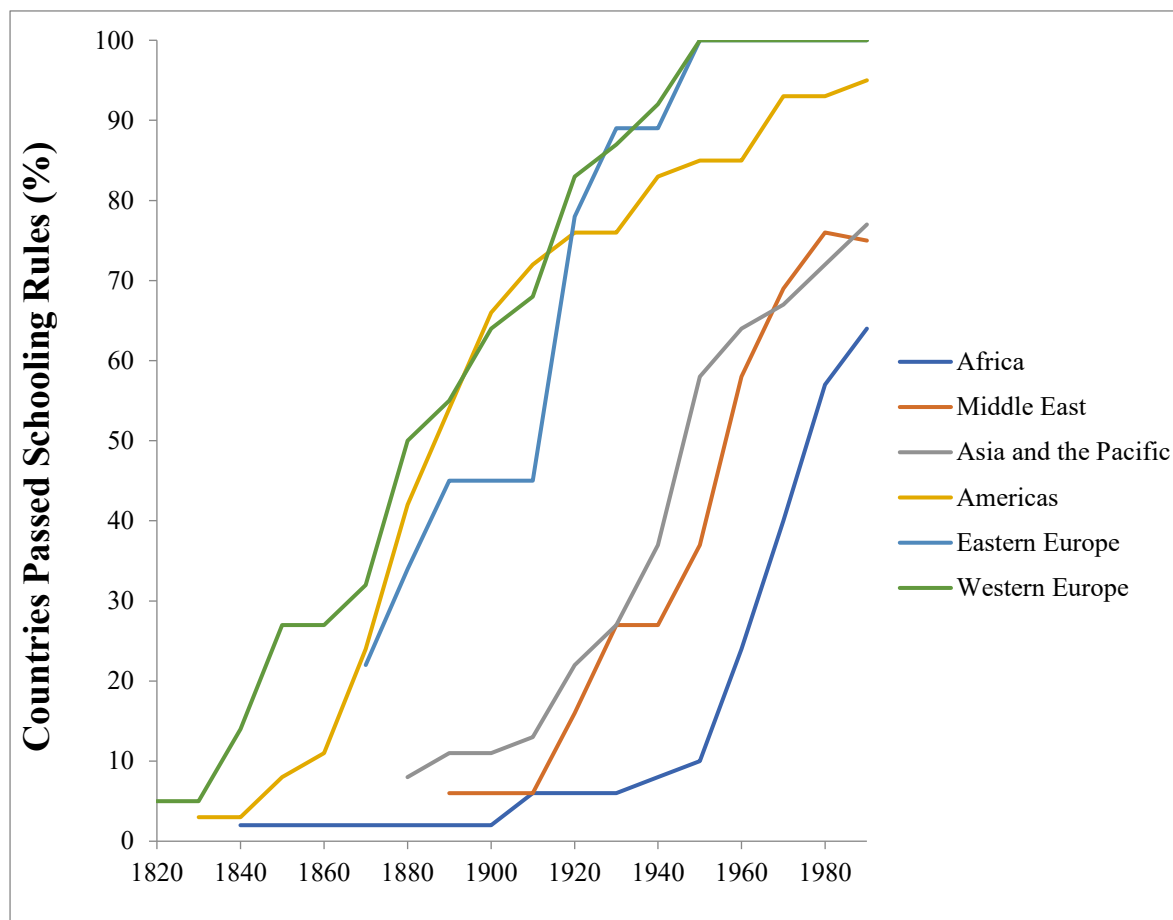


Fig. 11 Proportion of countries having passed a compulsory schooling rule, by region and decade, 1820–1990. (Source: Ramirez and Ventraensca (1992))

We can also consider another indicator related to state involvement. It is the cumulative share of countries within a world region that have created a central education authority (Ramirez and Ventraensca 1992). In some respects this indicator shows similar trends. Western Europe leads in this area until the 1870s. The share of countries with central education authorities then dramatically increases over the next century. Thus, all major world regions had almost universally central education authorities by the 1990s – except for the former leader Western Europe, where compulsory schooling laws and centralized state control have been contested for the last 200 years. For this reason, still in the

1990s, centralized state control was not implemented in a sizable share of Western European countries. In contrast, the idea of a central education authority has been deemed to be necessary in the other world regions that followed Western Europe. Less resistance and more conviction of the necessity of central state policy has characterized experiences in these continents. It highlights once again the connection between the (in part newly created) nation-states and mass schooling in these countries.

9. Conclusion

The expansion of the “knowledge economy” offers a potential way to place the global economy on a more sustainable trajectory. With this in mind, our aim in this chapter was to better understand the market and institutional forces that led to the human capital transition in present-day industrialized nations – that is, the development of a key pillar of the “knowledge economy.”

To this end, we sought to answer the following questions: What factors have driven the demand for and supply of human capital over the last 1000 years in Europe? Has there been a market failure in the formation of human capital? What role has the state and other institutions played in the provision of schooling? Why were government and the public willing to invest heavily in this public good? To better understand the forces that led to the human capital transition, we brought together a wealth of evidence on the history of education, and broader human capital formation, across Europe.

One of the central features of the history of the European human capital transition has been the decline in the price of written education, in the fifteenth century following the development of the Gutenberg Press and in the nineteenth century with its mechanization. This incentivized the development of written education and implied that traditional work skills were complemented by a broader education in literacy and numeracy and the ensuing improvements.

However, this narrative also seeks to emphasize, as Mitch (1992b) did, *the fundamental role demand played in driving the early human capital transition*. Early demands in transitions are often driven by “luxury” services, where some consumers have a relatively high willingness to pay, creating niche markets (Fouquet 2008). In the case of education, this was associated with the demand for spiritual guidance. The initial demand to read the Bible (either in Latin or, for most Europeans, in their mother tongue) was stimulated by Luther and other champions of the Reformation. In other words, capitalizing on a technological revolution, one persuasive voice (accompanied by a growing number of followers) can initiate a transformation in beliefs that stimulates an initial (immaterial) demand for one of the key sources of modern economic growth.

In time, the demand for written education stemmed from many additional sources, associated with commercial, military, industrial, parental, status, and “belief-formation” factors. So, the first phase of growth in human capital levels (particularly in literacy) in the leading countries can be explained by the interplay of supply and demand. This provided a basic level of education to upper and middle classes. Mirroring this experience, the declining costs of using ICT are enabling developing countries to accelerate investment in human capital and seek to catch up with the industrialized nations. However, if human capital transitions in developing economies unfold in a similar way to the transitions in Europe, then certain segments of the population will be left behind. That is, while probably upper and middle classes in developing economies become highly educated, a poorer segment will struggle to raise their levels of human capital. *Thus, without major efforts from government, educational and ultimately income inequality is likely to increase.*

Indeed, the second phase of the human capital transition (i.e., the spread of mass literacy and the construction of mass schooling beginning in the nineteenth century) was particularly driven by the state.

In certain cases, *shocks* (e.g., wars, the loss of international competitiveness) played a key role in altering beliefs about the value of education and stimulating public investment in human capital. For instance, Prussia's move to embrace education more forcefully was triggered by defeat in the Napoleonic wars. Similarly, industrialists in the UK at the end of the nineteenth century started to realize that their ability to keep up with foreign competitors, particularly Germany and the USA, depended on having a well-educated workforce from which to hire.

However, in general, the role of the state was more important in those countries that had to catch up with the leaders. Particularly in lagging economies in Europe, there was a market failure – in the sense that although the social and economic benefits of higher human capital levels would have been significant, education was not provided by the private sector. The construction of state fiscal capacities (including the building up of efficient bureaucracies) and falling resistance from social elites against public educational investments were often important prerequisites for state intervention. Once the state got involved in the education sector and created a mass public schooling system, this market failure was at least partly resolved over time. Naturally, recognition of the importance of the human capital investment needed to be followed up with effective implementation strategies and public financial support (often around 2–5% of GDP).

One reason the implementation and financial support for mass education often followed swiftly behind recognition was because the state, along with religious institutions and other nongovernmental organizations, placed a value on “belief-formation” and the control of the provision of education. The desire for nation building implied that instilling values and cultural attributes (e.g., language), which would encourage future generations to identify with the state, was an important driver of public investment in education (Pritchett 2003). In other words, this secondary benefit of education (to government) may well have been pivotal to the second phase of the human capital transition.

When considering potential future transitions, it is important to consider the benefits that government may gain from the transition. *Identifying the existence of a principal-agent problem and finding direct benefits for government might be a powerful means to incentivize government officials to develop effective implementation strategies and find public financial support.*

With this objective in mind, it is important to remember that major transitions are typically long-term processes. The human capital transition (here, defined as an increase from 10% to 90% literacy rate) in Europe took roughly 400 years, from Luther's printed translation of the Bible into a European vernacular language until the First World War. In Japan and Korea, it took a little over 100 years (from about 1850 to 1960). In South Asia and Africa, this is likely to take around 100 years. *Thus, even in countries implementing basic education programs today, there is a limit to how fast a transition can be achieved.* This is partly because new generations need to be educated, and this takes decades.

Yet even in the case of education, vested interests may inhibit a successful transition. *Therefore, these vested interests have to be identified and considered in any policy.* Indeed, the central state interacts with a range of stakeholders in educational policy. In particular, there are religious authorities (in Europe the churches), elites (landowners and capitalists), parents, ideological movements (including liberals and conservatives), and the local authorities. Any of these can alter the rate and nature of the transition. On the other hand, if government has direct benefits from a transition, then these vested interests are likely to be more swiftly overcome.

Disclaimer

The views expressed are purely those of the writers and may not in any circumstances be regarded as stating an official position of the European Commission.

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Endnotes

¹ In contrast, another strand of the literature suggests that there might also be negative externalities because human capital would not increase productivities but only waste valuable resources due to signaling effects (e.g. Spence 1973). However, Lange and Topel (2006) do not find important negative impacts; the positive effects largely dominate.

² In addition, the assumption of perfect competitive markets implies that capital markets should be perfectly functioning. In this case, parents should always be able to find a way of financing the education of their children. This, however, is not the case either (Johnes 1993).

³ For example, the existence of public schools may have led to a monopoly of these schools in certain geographical areas. Taking the point of view of the market, schools may thus not have been under market pressure to ensure quality standards and low operating costs. Some recent reforms have been aimed at improving the status quo and in part reorganizing the involvement of the state in this sector (Brewer et al. 2010).

⁴ For example, Milton Friedman also suggests that “a stable and democratic society is impossible without a minimum degree of literacy and knowledge on the part of most citizens and without widespread acceptance of some common set of values. Education can contribute to both” (Friedman 1962, p. 86; in Gradstein et al. 2005, p. 5). He further argues that “the major problem in the United States in the 19th and early twentieth century was not to promote diversity but to create the core of common values essential to a stable society... Immigrants were flooding the United States... speaking different languages and observing diverse customs ... The public school had an important function in this task, not least by imposing English as a common language” (Friedman 1962, p. 96, in Gradstein et al. 2005, p. 9).

⁵ According to Sweetland (1996), the area of education can be further broken down: “[t]here is formalized education at primary, secondary, and higher levels (Cohn and Geske 1990), informal education at home and at work (Schultz 1981), on-the-job training and apprenticeships (Mincer 1974), and specialized vocational education at secondary and higher levels (Corazzini 1967)” (Sweetland 1996, p. 341).

⁶ An interesting question is whether there were also incentives for inventing technologies to sidestep the guilds. Epstein mentions that inventors had an incentive to keep their inventions secret from the guild. Yet, “although technical secrets were often kept within the craftsman’s family, it is unlikely that significant breakthroughs could withstand a guild’s scrutiny for long. On the other hand, an inventor had to weigh the guild’s offer of a temporary quasi-monopoly rent against the possibility of obtaining a one-off royalty (net of migration costs) from a rival craft or government” (1998 p. 704).

⁷ A comment from the early 1960s, after the decline in this form of training, summarizes what happened: “apprenticeship has all but disappeared, partly because it is now inefficient and partly because schools now perform many of its functions. Its disappearance has been hastened no doubt by the difficulty of enforcing apprenticeship agreements. Legally they have come to smack of indentured service” (Schultz 1961, p. 10).

⁸ They estimate this number in the following way: “Assuming that youths would earn a rising fraction of adult income with age (20% at age 14, 40% at age 15, 60% at age 16, 70% at age 17, 80% at age 18, 90% at age 19, and [100]% at age 20 – see Van Zanden (2009b), p. 160), a provincial adult unskilled wage of 1 s per day, that youths work 228 days per year (Voth 2001), and a discount rate of 7.5%, the present value of lost earnings during an apprenticeship, relative to a subsistence income of £5 per annum, was about 26 pounds” (Minns and Wallis 2013, p. 344).

⁹ In fact, the printing press was first invented in Korea. For more details, see Hippe (2015).

¹⁰ This fall in prices also had a major impact on the spread of the ideas of Protestantism. For example, Luther’s translation of the New Testament in 1522 was affordable even to laborers (Stöber 2004).

¹¹ Similarly, Clark (2004, p. 8) calculates that “the estimated price of a standard page of text in the middle ages was 50 times the price in 1700–59.”

¹² See Ekelund et al. (2002) for an economic interpretation of the Protestant reformation and Ekelund et al. (2004) for an exploration of the economics of the Counter-Reformation.

¹³ The question whether religious competition leads to more or less religious participation by individuals is still disputed. On the one hand, it is argued that the existence of various religions leads to a decrease in the plausibility of a given religion and thus less religious participation (Chaves and Gorski 2001). On the other hand, authors such as Adam Smith suggest that a non-state-sponsored religious group has to provide special care for its believers, raising the quality of and participation rate in religious activities (Iannaccone et al. 1997). For more information, see Höhener and Schaltegger (2012).

¹⁴ More generally, the authors see the values in formal education close to those of Protestantism, as highlighted by Weber (1958): “formal education’s emphasis on individual socialization and achievement parallels the Protestant emphasis on the individual’s unmediated relation to God and individual salvation” (Soysal and Strang 1989, p. 279).

¹⁵ Numbers from France emphasize the stark increase in newspaper production: “[i]n 1840 the monthly issue of all the Paris journals totalled less than three million copies. By 1882 it was up to 44 million copies (Cipolla 1969, p. 107).”

¹⁶ The same can be said of the evolution in numeracy (A’Hearn et al. 2009).

¹⁷ He distinguishes three cases: egalitarian, elite, and autocratic forms of power distribution. In the egalitarian case, the preferences of the majority were implemented by the elites. Thus, there was a high risk that policy measures were simply redundant or not meeting private demand. In these societies, the acquisition of education meant the prospect of moving up the social ladder, leading to popular demand. When the powers in society were more concentrated but upward mobility was still possible (e.g., in France and Germany), the effectiveness of public educational policy was probably higher. Finally, in the case of more autocratic forms of government, when power was extremely concentrated (such as in Spain and Portugal) and the masses lived at low standards of living, public action was ineffective. On the one hand, demand was low and actions by the state were perceived as intruding into family life. On the other hand, local elites blocked educational changes that may have been intended at the national level (Mitch 1992b).

¹⁸ Overall, the Prussian kings were not fervent promoters of the spread of mass education. They “did as much, and said as much, to *block* schooling and free thought as to spread it” (Lindert 2004, p. 118).

¹⁹ Here, it is assumed that all regions benefit socially from higher education levels.

²⁰ Some studies have suggested the existence of a human capital Kuznets curve, adapting the idea of Kuznets (1955) to education. In other words, increases in human capital inequality in earlier phases are followed by subsequent reductions in human capital inequality in later phases of economic development. For empirical contributions, see, e.g., De Gregorio and Lee (2002), Castello and Domenech (2002), Lim and Tang (2008), and Morrisson and Murtin (2013); for theoretical models see, e.g., Galor and Tsiddon (1996), Glomm and Ravikumar (1998), and Matsuo and Tomoda (2012).

²¹ The level of salaries was quite diverse across Europe. However, for the most part, they seem to have been low. Thus, Cipolla (1969) suggests that the average salary of a teacher was comparable to that of a craftsman before the nineteenth century. In addition, the social status of teachers still varied importantly from one European country to the other in the nineteenth century. For example, teachers enjoyed high public respect in Germany (and Prussia in particular) (Cipolla 1969). Social prestige and income may thus be causes of high quality. Perhaps a long-standing tradition of the teaching profession was also an important factor. In contrast, schoolmasters and mistresses did not have a good reputation and did not have much prestige in England and southern Italy in the nineteenth century.

²² It uses a particular heaping phenomenon in the age distribution of censuses and other comparable data to calculate numeracy levels. More specifically, individuals over-reported ages ending in 0 and 5 to census takers, leading to significant spikes in the age distribution. The reason for this was that they were not able to count and to know their exact age, so that they rounded it. This is a well-known phenomenon that can be found in historical sources and in a range of developing countries today. For further information, see A’Hearn et al. (2009), Hippe and Baten (2012), Hippe (2012, 2013b, 2014).