Culture and the Great Escape*

Hans-Joachim Voth
University of Zurich

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Abstract

This chapter asks what the tools of cultural economics have actually established about the cultural origins of the Industrial Revolution and the escape from Malthusian stagnation. Two grand narratives compete. The first, an *Enlightenment view*, credits the rise of useful knowledge, the collaboration of savants and skilled artisans, and the bourgeois virtues that made commerce and improvement respectable. The second—*Leviathan's shadow*—stresses coercion: factory discipline, clock-time, mass schooling, religious "mind-control," and growing state capacity, which together drilled a reluctant population into the punctual, obedient, and industrious workforce that the factory system demanded. I argue that the two are complements rather than rivals, but that they are not equally easy to test. Grand claims about "high culture" tend to rest on introspection and anecdote; a "culture from below"—individualism, the European Marriage Pattern, a work ethic rooted in soil and climate—is more measurable, more plausibly exogenous, and more directly tied to the loosening of Malthusian constraints. New sources—text and image analysis, large language models, and ancient DNA—promise to extend the credibility revolution to these questions. The cultural roots of the Great Escape, I suggest, may hold more darkness than light.

Keywords: Culture and economic growth; Industrial Revolution; Malthusian stagnation; Cultural economics; Industrial Enlightenment; Bourgeois virtues; Factory discipline; Work ethic; State capacity; European Marriage Pattern.

JEL classification: N13; N33; O33; O43; Z10; J11.

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If we learn anything from the history of economic development, it is that culture makes all the difference.

—David Landes

1 Introduction

According to German folklore, a mythical, beautiful maiden named Lorelei turned the heads of sailors on the Rhine: spellbindingly attractive, tempting them with a siren song, she led people of great experience and judgment to throw caution to the wind, causing shipwreck. Theories about the cultural origins of growth can be similarly seductive – and dangerous. As Landes suggests, cultural interpretations have great intuitive appeal. But do we really know that culture "makes all the difference" in understanding the transition to self-sustaining growth?

Ever since Weber wrote his essay on the Protestant Ethic and the origins of growth, economic developments created dangerous shoals and ragged cliffs for theories of culture-driven growth. No sooner had Weber put pen to paper than development took off in Catholic Europe; when people had convinced themselves that Europeans were uniquely positioned to benefit from modern technology, growth in East Asia surged, demonstrating that whatever the importance of culture, there was no single, secret sauce of attitudes, beliefs, and everyday practices required. These successive empirical challenges to cultural theories have led some scholars to abandon cultural explanations entirely. Comin et al. (2006) argue that Europe's fortunes already began to diverge from the rest of the world millennia ago, driven by early technological dominance. As early as the Neolithic period, the continent was favored by better grain and animal "packages", and all subsequent developments follow, in this perspective, from these superior, accidental starting conditions (Diamond, 1997).

In this essay, I examine what has been learned from applying the toolkit of cultural economics to the question of the Industrial Revolution's origins. Before we begin, it might be helpful to clarify a few things – what are we trying to explain? And what can we hope for analytically, when trying to pin down the cultural origins of the Industrial Revolution, broadly defined?

To understand the role of cultural factors, we need to appreciate the revolutionary nature of the discontinuity in growth. Prior to the Industrial Revolution, stagnation of per capita incomes was the norm (e.g., Ashraf and Galor, 2011). In Malthusian economies, land-labor ratios determined living standards. Stagnation emerges not because of a lack of technological progress, but because any increase in productivity leads to larger populations, reducing death rates and increasing birth rates. As H.G. Wells (1904) put it: Mankind "spent the great gifts of science as rapidly as it got them in a mere insensate multiplication of the common life." To escape the trap, population growth must decouple from economic conditions, or the importance of land in production must diminish: Only when adding more people no longer depletes effective resources can long-term growth occur.

The question of "what led to faster innovation" in the past therefore only indirectly related to what caused the Industrial Revolution. For growth to accelerate on a sustained basis, societies had to shift production away from agriculture and curb fertility growth. Population growth had to remain low even when wages rose. Fertility limitation can deliver

such a disconnect of economic prosperity and demographic growth. There is no doubt that first England, then other parts of (North-Western) Europe witnessed the first sustained escape from Malthusian constraints – not just a few good decades ("efflorescences"), but a permanent uncoupling of living standards from population growth rates (Wrigley and Schofield, 1989; Crafts and Mills, 2022). These countries were also the first where socio-economic factors, and not biology, governed the age of female marriage.

Research on the origins of the Great Escape focuses on why England, Western Europe, and its offshoots more generally were the first to cast off Malthusian shackles. In general, interpretations of economic "leadership" are replete with bold claims and indifferent empirics. This is no accident. Explaining "who goes first" is empirically challenging – going first only happens once, limiting the extent to which statistics can adjudicate between competing hypotheses (Crafts, 1977). Its importance can also be questioned. If we "zoom out" and view the economic development of mankind over the very long term, the question of who went first pales into insignificance (Jones, 2000): Relative to the time when humans as a species separated from other primates, approximately 1 million years ago, England's Industrial Revolution occurred only 0.02% earlier than China's transition to self-sustaining growth.

Culture is also a demanding explanatory framework. Solow (1970) famously dismissed non-economic factors driving growth as "a blaze of amateur sociology." Yet despite such skepticism, it has increasingly become "kosher" to talk about culture in economic analysis (Temin, 1997). Four key challenges make cultural explanations difficult to establish rigorously. First, culture comes in packages – many cultural features are correlated with each other, giving rise to a cultural "curse of dimensionality." Telling apart the effects of individualism from nuclear families, for example, could be regarded as an exercise in futility, as there are basically no historic cultures with a strong nuclear family structure that are not at the same time individualistic. Second, effects of culture on economic performance are, by their nature, often indirect. While the prices of coal and of labor directly affect the profitability of a particular piece of equipment or firm, with immediate effects, this cannot be said of enlightenment ideas, say, or pro-social norms like trustworthiness. Third, culture tends to be slow-moving. While some cultural changes are relatively rapid, many cultural features remain stable over long periods of time; indeed, some define culture as most immutable beliefs and attitudes: culture is composed of the "regularities in the behavior, internal and external, of the members of a society, excluding those regularities which are purely hereditary" (Toynbee, 1972, cited by Akerlof, 1976). This means that cultural change is empirically challenging to analyze; high-frequency data are not available for identification. Fourth, culture is also correlated in space – individual European countries, for example, share a great deal of cultural heritage. The effective number of observations in any one cross-section is smaller than first meets the eye.

Given these methodological challenges, what can be rigorously said about culture's role in the Industrial Revolution – and of European economic exceptionalism more generally? There are two main analytical approaches, as well as two overarching narratives (Table 1). The Cambridge Dictionary defines culture as both "the attitudes, behavior, opinions, etc. of a particular group of people within society" and "the way of life, especially the general customs and beliefs, of a particular group of people at a particular time." This definition juxtaposes "high" and "low" culture – the patterns of everyday life as well as the grand ideas and broad intellectual trends that shape the intellectual outlook of an age.

The first approach, "Culture from Above," focuses on grand narratives centered on a

Table 1: Approaches to cultural origins of the industrial revolution.

	Narrative focus	
Level of culture	**"Enlightenment"**	**"Leviathan"**
High	Science, Bourgeois Virtues (McCloskey/Mokyr)	Nationhood (Colley, Anderson, Alesina)
Low	Civility, Non-Violence (Pinker, Elias)	Discipline, Obedience (Marx, Thompson)

few famous ideas. They can be religious, scientific, or purely cultural, but whether it is through the influence of Luther, Newton, Voltaire, or Bacon, this approach belongs to the "great men make history" tradition. What produces singular talents and breakthroughs is an important, interesting, and almost impossibly difficult question. This literature is on analytically firmer ground when it considers structural factors that facilitated the creation of intellectual breakthroughs or the spread of new ideas, highlighting the early modern network of scholars known as the "Republic of Letters", political fragmentation, or the impact of postal networks on the diffusion of the Reformation (Becker et al., 2020).

The second approach, "Culture from Below," emphasizes everyday culture – not elite intellectual movements but norms and practices shaping daily life. Inspired by anthropology and ethnography, this research has successfully explained many economic and social patterns (Alesina et al., 2013). The key analytical advantage is substantial variation over space. Where such factors are explored as driving forces, identification is also more plausible. There are promising avenues for analysis. Some have been reconnoitered; many more lie unexplored. At the same time, there is a risk that links to economic development become tangential, and that intermediate outcomes absorb much of the variation, making it harder to determine causal relationships. When applied to the case of the Industrial Revolution, the "Culture from Below" view focuses on cultural peculiarities and idiosyncrasies that may have favored Europe's rise to riches. While some factors are slow-moving and occur during the poorly documented Middle Ages – like the decline in cousin marriage in Europe – others are associated with more rapid changes, such as the schism in Western Christianity after 1517, or changes in marriage patterns in North-Western Europe after 1350 – making centuries, but not millennia, the relevant time-frame.

In addition to the methodological perspectives, two broad narratives exist. One set of stories features new ideas, scientific advances, and collaboration across class divides, with unfettered bourgeois virtues laying the foundation for the "Great Escape." Technological breakthroughs emerge from better cooperation, from more talented scholars competing for reputation and infusing practical men with the spirit of science. As proud burghers chase profits and freedom, they enrich not only themselves but others also, accelerating the shift to new technologies. All this leads mankind to the broad, sunlit uplands of sustained growth.

This "Enlightenment View" sees the emergence of science-led invention as the key driver of the Industrial Revolution. It credits the spread of rationality, egalitarianism, and intellectual exchange with fostering innovation. Collaboration between artisans and scientists transforms production, reducing land's importance in the economy. Bourgeois values encourage market-compatible behaviors. The most prominent contributors to this agenda, Joel Mokyr and Deirdre McCloskey, conclude that cultural shifts toward science, scholarly collaboration and 'outreach', curiosity, trustworthiness, and individualism not

only preceded economic takeoff, but directly led to it.

The second narrative casts a darker shadow. It stresses the near-totalitarian mind-control of church and state in many early modern European states. It emphasizes the brutal breaking of old rules and mores that defined the Ancien Régime and the imposition of clock time and military discipline on large parts of the population. This transformation was facilitated by increasing indoctrination in schools, as well as the threat of physical violence. Traditional family structures were destroyed through bans on cousin marriage. Many of these trends were accelerated with the arrival of conscription, universal schooling, and the move to cities.

Industrialization, in this perspective, was not just about technological progress, but about coercion and suppression. Culture matters for the "Leviathan View" because a pliant proletariat spells higher profits and facilitates technology adoption. Factory rules, wage suppression, and coercive institutions were necessary to create a disciplined labor force, bending to the rhythm of the machine age. Schools forced an alien ethos of obedience and long, repetitive exercises on children long before they educated them. Military drill in the growing mass armies of early modern Europe exposed more and more young men to a brutalizing regime requiring complete subordination. The profits that ultimately financed the transition to self-sustaining growth were earned in factories staffed by obedient men, women, and children who had become accustomed to and internalized the virtues of automata, working long hours for low pay, enduring great dangers of physical harm, while performing repetitive tasks. Notions of national superiority, first emerging in the eighteenth century, underpinned the growth of state capacity and cultural cohesion of the population. Industrialization did eventually benefit the poor. However, during the transition from stagnation to growth, many of the working poor experienced at best stagnant wages and brutalizing, exploitative conditions for long periods before substantial gains finally materialized.

2 THE ENLIGHTENMENT VIEW

2.1 Science and the culture of innovation

The idea that high culture – and in particular, the intellectual advances of the Enlightenment – might have played a role in the Industrial Revolution is inherently attractive to economists. Ideas are "non-rivalrous," meaning that their use by one does not preclude the use by another – better techniques and technology can raise output for everybody. To explain the transition to self-sustaining growth with a fuel that never runs out has intuitive appeal (Romer, 1990; Aghion and Howitt, 1992; Kremer, 1993).

However, the notion that the Enlightenment mattered because of a boost to invention and innovation was long considered controversial, even unlikely. Paul Montoux, looking at the inventions that drove the transformation of production after 1750, concluded that every technical problem "is first and foremost a practical question. Before ever it becomes a problem to be solved by men with theoretical knowledge, it forces itself upon the men in the trade as a difficulty to be overcome, or a material advantage to be gained. . . [breakthroughs in production] represent economic necessity, silently and powerfully molding men to its will" (Mantoux, 1961, p. 206). Even the chemical inventions of the 19th century that drove the second industrial revolution were preceded by practical progress, not theoretical understanding (Taylor, 1957, p. 167).

The prevailing wisdom was that the Industrial Revolution was primarily driven by practical tinkerers and engineers with little connection to formal scientific knowledge (Mokyr, 1992). For the longest time, the Industrial Revolution's new technologies were considered almost entirely divorced from the progress of science. They were viewed as even further removed from the powerful currents of high culture sweeping the European continent, such as Humanism and the Enlightenment.

One of the earliest examples arguing against this view was Robert K. Merton (1938). In his *Science, Technology and Society in Seventeenth Century England*, he explores the connections between Puritanism, science, and technological progress in England. Merton argues that Puritan values, such as the emphasis on empirical observation and practical utility, contributed to the development of modern science. His thesis, similar to Max Weber's ideas about Protestantism and capitalism, posits a positive association between the rise of Protestant pietism, Puritanism, and early experimental science. Along the same lines, but in a broader perspective, John Nef (1958) believes that the roots of industrialization could be traced back to cultural and intellectual developments in Europe long before the Industrial Revolution. Nef largely abstracts from the religious origins highlighted by Merton. Instead, he focuses on the period between 1540 and 1640, which he sees as crucial for laying the groundwork for later industrial growth. Nef (1958) also saw a new emphasis on precision and measurement, as reflected in the Gregorian calendar, and argued that it created the foundations for experimentation and the systematic progress of practical knowledge.

At the same time, a growing body of research sought new ways to connect the culture of knowledge with industrial and technological advances in England during the 18th century. It broadened the period under consideration and the nature of links between technical progress on the one hand, and intellectual advances on the other. Robert Schofield, in his work on the Lunar Society of Birmingham, claimed it was "an advance guard of the Industrial Revolution" (Schofield, 1963, p. 439). Similarly, Jonathan Chambers (1968) believes that the revolution in textile manufacturing was built directly on scientists' inputs, and T.S. Ashton (1964, p. 13) emphasized growing connections between laboratories and workshops during the 18th century.

A.E. Musson and Eric Robinson (1960) systematize these arguments. They demonstrate how broad the interest in scientific methods and discoveries was in late 18th century England. Lectures, societies, clubs, and popularizing publications stoked the public's imagination and created a growing consensus that scientific advances and industrial development complemented each other. The scale of interaction between practical men and those of science that they document was impressive.

However, whether it had any effect on industrial development is less clear. The evidence collected by Schofield, Chambers, Ashton, Musson, and Robinson documents popular entertainment in the form of lectures, often on subjects of limited practical use like electricity. It also reveals the high social status of popular science, as seen in their description of the Royal Institute, where men of science entertained the capital's elite but there were few interactions with businessmen or inventors. The list of practical advances that preceded theoretical understanding is long. Broadening the definition of "science" to include all practical schemes for technological improvement risks creating tautologies and offers little or no proof of significant association. By the late 1960s, a generation of intellectual effort trying to associate the Industrial Revolution with the Scientific Revolution appeared to have come to naught, or nearly so.

Two ideas make the science-industrialization nexus easier to defend. David Landes

(1969) adds one important element – the importance of scientific *method*, not science itself. Institutionalizing skepticism about novel claims, having high standards of proof, measuring things precisely and repeatedly, and discarding unproven alternatives to a dominant, well-supported paradigm are all cornerstones of the scientific method – but its application to practical problems can solve key challenges even if no scientific advances are necessary. Chemical firms did not make scientific breakthroughs; they identified useful compounds by the proven methods of experimentation. Second, as Schofield, Musson, and Robinson successfully established, science and scientific discourse became part of England's cultural fabric from the 1750s onwards. Previously considered an elite pursuit, it became "woven into the fabric of the nation's life" (Plumb, 1950). This facilitated take-up of new manufacturing techniques.

Margaret Jacob's *Scientific Culture and the Making of the Industrial West* (1997) builds on these ideas. She concludes that a democratization of knowledge and learning, following the English Revolution of the 17th century, married the scientific method with broad applications in society. Relatedly, Jack Goldstone argued that in England from the 18th century onwards, "traditional barriers between upper-class philosophers, market-driven entrepreneurs, large-scale industrialists, and skilled craftspeople and technicians dissolved, so that all these groups came together to initiate a culture of innovation" (Goldstone, 2009, p. 134). Jacob takes up the challenge of explaining why Newtonian physics did not have the same impact on the continent, where it was well-known and widely admired. She weaves an involved story about bureaucratic constraints and educational cultures, arguing that the Netherlands, Prussia, and France were all hamstrung for different reasons, but Britain was not.

Building on these earlier strands, Joel Mokyr's *The Enlightened Economy* (2009) and *A Culture of Growth* (2016) offer what is perhaps the most influential synthesis. Mokyr's work emphasizes the role of cultural beliefs in driving economic and technological progress, with particular focus on how Britain's cultural environment proved uniquely conducive to innovation.

In *The Enlightened Economy*, Mokyr highlights cultural attitudes in Britain during the Enlightenment that facilitated technological progress and economic growth. While the Enlightenment was a European phenomenon, he emphasizes that "British soil proved to be the most fertile" for its seeds (Mokyr, 2009, p. 32). He stresses the importance of the Baconian program of science, the willingness to manipulate nature to benefit man, and the reconciliation of religion with scientific advancement. Protestantism in England was more compatible with scientific progress than religious beliefs elsewhere. The Church of England had largely abandoned concerns about disturbing nature, viewing scientific progress as a reflection of divine wisdom. This belief went hand-in-hand with a cultural openness to borrowing ideas from other societies and challenging established wisdom. In combination, these factors became crucial to fostering innovation and economic success (Mokyr, 2009, pp. 402–403).

'Savants' play a central role in Mokyr's interpretation of the Industrial Enlightenment. He argues that these intellectuals were instrumental in fostering a cultural shift that valued the practical application of knowledge to real-world problems. Along the lines of Landes, Mokyr considers the contributions of savants and scientists as working through spillovers from the scientific endeavor. These include the adoption of scientific methods, such as accurate measurement, controlled experiments, and reproducibility. These methods fostered a rational, evidence-based approach to understanding the natural world, which

in turn influenced technological advancements (Mokyr, 1998, pp. 89–90). The scientific mentality, rooted in the Baconian belief that "Nature is not ruled unless she is obeyed" (Bacon, 1994 [1620], p. 131) emphasized the importance of understanding natural laws to harness them for human benefit.

Mokyr (2016, p. 273) highlights the complementary relationship between "useful knowledge and artisanal dexterity," where intellectuals provided the theoretical insights that artisans and engineers could apply to practical problems. This synergy was essential for economic development, as it allowed for the continuous improvement of technology through both incremental and radical innovations (Spolaore, 2020, pp. 3–4; Mokyr, 2016, p. 288). While skilled artisans were crucial for implementing and refining technologies, Mokyr contends that their efforts alone would not have led to the Industrial Revolution. The infusion of new ideas from natural philosophy, chemistry, and mathematics was essential (Mokyr, 2016, pp. 288–289).

Mokyr also emphasizes the importance of "hybrid" individuals who bridged the gap between science and technology. Figures like Claude Berthollet and Humphry Davy had dual careers in both scientific research and technological innovation. They were able to translate scientific insights into practical applications, such as through Berthollet's chlorine bleaching process or Davy's mining safety lamp (Mokyr, 2002, p. 53). Similarly, applied mathematics greatly helped in the nascent machine tool industry to raise precision, with instrument makers being a driving force (Kelly and Ó Gráda, 2022). This interaction between propositional knowledge (theoretical understanding) and prescriptive knowledge (practical techniques) was a key driver of technological advancements during the Industrial Revolution (Varian, 2004, pp. 2–3). It eventually evolved into a new type of inventor, the professional engineer, who contributed to the rapid advance of technology from the late 18th century onwards (Hanlon, 2025).

In addition, the scientific clubs, associations, journals, and public lectures, as noted by Nef, Musson, and Robinson and tested empirically by Dowey (2017), helped to diffuse scientific methods to a much wider public. This helped to foster a scientific mentality guiding practical experimentation. In this perspective, a confluence of intellectual and artisanal efforts was essential for the sustained economic growth that characterized the Industrial Revolution (Mokyr, 2016, p. 288).

This raises a fundamental question: where did such a culture of practical innovation and improvement come from? In *A Culture of Growth*, Mokyr broadens the focus of his analysis to all of Western Europe. He argues that such a culture's emergence was not an inevitable outcome of Western history but rather the result of accidental, unplanned cultural changes that happened to foster technological progress. Mokyr distinguishes between cultural beliefs that directly influenced attitudes toward nature and technological progress, and broader institutional factors. He argues that while institutions related to human interactions were important – as noted by Musson, Robinson, Jacob, and Goldstone – it was ultimately the cultural shift toward valuing "useful knowledge" that played a decisive role in driving industrial development (Mokyr, 2016, pp. 21–22). He also notes that cultural changes were the result of intellectual innovation and persuasion. This allowed for the defeat of intellectual conservatism, facilitating the transition to modern economic growth.

While other parts of Europe did not quite progress at the British pace, Mokyr in *A Culture of Growth* does not consider the differences to be particularly important – had Britain not "gone first", other European countries may well have found ways to prosper,

creating a class of entrepreneurs using the scientific method to invent and improve new technologies (Crafts, 1977; Voigtländer and Voth, 2006). Mokyr places significant weight on the "market for ideas" in Europe, which allowed for the diffusion of new knowledge and open questioning of doubtful hypotheses. He contrasts this with China, where such a mechanism was absent. This intellectual openness, supported by a transnational scholarly community known as the "Republic of Letters", enabled figures like Newton and Darwin to thrive and contributed to Europe's unique intellectual path. The market for ideas and for 'philosophes' allowed aspiring scholars to stake their careers on their reputations. Low as the probability of success may have been ex ante, the expectation of future rewards, employment, and recognition encouraged entry.[1] Building on these themes, he draws on Jacob's idea that radical egalitarianism during the English Revolution was key for transmitting science to society at large. This democratic approach to knowledge, Mokyr suggests, helped create the broader cultural foundation necessary for sustained innovation.

Underlying the role of the Republic of Letters is the importance of political fragmentation – where no centralized political authority could impose cultural uniformity, or ban books for everyone, scholars, intellectuals, writers became free agents, moving to wherever they found a sympathetic ear and a position. Nietzsche (1874) already argued that the extraordinary contributions of early modern German literature and music owed much to political and religious fragmentation. Along the same lines, Europe was favored because it was composed of hundreds of states and statelets. Significant religious cleavages allowed the 'heretics' in one state to flee to another: "The failure of radically heterodox views to catch on in China underlines the fundamental difference between China and Europe: there were repressive and reactionary regimes galore in Europe, but the interstate competitiveness constrained their ability to enforce a specific orthodoxy..." (Mokyr, 2016, p. 317).

Importantly, the cultural shift towards open science was an unintended consequence of scholars seeking reputations and financial security through patronage (David, 1998). It may well have played a significant role in fostering technological progress. Cultural similarity between European countries had a complementary effect. Most educated Europeans were raised intellectually on a similar diet of classic writers, learned Latin and Greek, and shared a Christian faith (for the most part) as well as broad cultural trends. Moving to another principality or country to work and live was never easy, but feasible. Of course, political fragmentation was not unique to Europe; the Middle East and India were similarly fragmented for extended periods. What mattered in Mokyr's view was the combination of fragmentation with underlying cultural unity.

Theories in the style of Mokyr, Jacob, Musson, and Robinson are inherently hard to test. They have plausibility on their side, and they fill an unambiguous gap in the literature – where did the "wave of gadgets" (Ashton, 1955, p. 42) that eventually became the Industrial Revolution come from? But can we confidently state that Britain had a closer connection between tinkerers and savants than other places? Is the national unit of analysis meaningful? Do we want to examine the validity of a theory based on ill-measured differences in timing of hard-to-classify trends and tendencies, like intellectual fashion? Close analysis of the industrial enlightenment in the Midlands and the role of the Lunar Society, for example, does not appear to bear out all of Mokyr's arguments; even outside the capital, most of the interest of local elites and businessmen in science was as a form of

[1] In a classic paper, Lazear and Rosen (1981) show that tournament-style payoffs can be highly effective in aligning incentives.

entertainment. The closer one examines the archival records, the more the case of Watt and Boulton emerges as highly unusual (Jones, 2008).

Arguably even more important for the diffusion of practical knowledge were economic societies. These were founded with the express purpose of furthering economic development through technology adoption. Economic societies at first focused on agriculture, and then extended their scope. The earliest ones originated in Edinburgh, Dublin, and London. As Clark (2000) observed: "By 1800 clubs and societies had penetrated almost every sphere of British social life, frequently annexing much of the territory of established public sociability." They also spread to the rest of Europe, reaching a total of 250–500, depending on definitions. Outside the UK, governments often supported these institutions, hoping to accelerate economic development. Detailed analysis of the diffusion of these economic societies in Germany suggests a marked effect on the presence of skilled mechanics, the diffusion of textile manufacturing, the adoption of vocational training schools, and the creation of useful patents during the Second Industrial Revolution (Cinnirella et al., 2024).

Kelly et al. (2023) quantitatively examine the role of skill supply during the British Industrial Revolution. Their analysis suggests that alternative factors often linked to industrial growth – such as literacy, access to capital, and proximity to coal – were not significant predictors of industrialization, as measured by textile employment, the leading sector of Britain's Industrial Revolution. Instead, using migration and occupation data from the 1851 census, they demonstrate that the presence of artisanal skills strongly correlated with technological progress. Additionally, they find that counties with low wages in 1760 tended to have higher textile employment later on.

Ó Gráda et al.'s finding challenges Allen's thesis that Britain's Industrial Revolution emerged from a unique economic environment where high wages and low energy costs made new technologies profitable. However, the county-level variation in England, as analyzed by Ó Gráda et al., is relatively broad and lacks finer granularity. Moreover, their measure of mechanical skills – derived from the 1851 census by tracing the birthplaces of individuals listed with advanced mechanical abilities – is clever but indirect. Allen's argument is inherently about country-level explanations, and is hard to "test" with cross-sectional data within one country. Finally, while the study pioneers the use of cross-sectional data to test competing theories from Mokyr and Allen about the role of skills in industrialization, its connection to the broader notion of an Industrial Enlightenment is indirect.

Recent work by Voth et al. (forthcoming) examines the diffusion of labor-saving machines in England. They analyze the effects of labor shortages induced by military recruitment during the Napoleonic Wars. While more than one out ten working-age Englishmen was away fighting in the Royal Navy or the British army, threshing machines in particular spread quickly. Using the geography of naval recruitment to pin down causality, they show that, in line with Allen's hypothesis, technology *adoption* was more rapid in areas with greater sex imbalances and labor shortages. At the same time, adoption accelerated where there were more apprentices in mechanical trades, and more patents for agricultural technology and metal goods. This suggests that the Mokyr and Allen interpretations are not mutually exclusive, and may well both have been drivers of technology adoption during the British Industrial Revolution.

Novel evidence on the power of ideas and the growing connections between science and industry comes from recent work by Almelhem et al. (2023). They analyze beliefs in progress using 173,000 works printed between 1500 and 1900. Words used in religious and

scientific texts increasingly diverged as the latter became more progress-oriented during the Enlightenment. Importantly, the biggest changes in using progress-related, techno-optimistic language occurred in practical books and pamphlets, dedicated to scientific and political questions. Progress as a topic in English published works peaked in the 1840/50s.

Another bold attempt to quantify the effects of upper-end human capital and novel ideas on economic development examines the case of France. Squicciarini and Voigtländer (2015) analyze the diffusion of the *Encyclopédie*, one of the canonical Enlightenment projects. Using the location of subscribers in 18th century France, they show that in places where people bought the Encylopédie, and consequently were exposed to Enlightenment thought, experienced faster technology adoption by the 1840s. Their study is important because it offers a path to use cross-sectional data to trace the impact of a Europe-wide movement, the Enlightenment, by using novel data on the local diffusion of ideas.

Broad philosophical movements like the Enlightenment are not the only drivers of scientific advances and technological progress. Inspired by Adam Smith's remark that "[w]onder [...] is the first principle which prompts mankind to the study of Philosophy [science] [...]" (Smith, 1795, p. 26, with modifications), Litina and Roca Fernández (2024) propose that solar eclipses played a significant role in sparking curiosity. They demonstrate that economic development today is greater in regions with higher exposure to solar eclipses. There, writing is more prevalent among ethnic groups, and folklore contains stronger themes of timekeeping and more abstract thought. Technological development, as measured by various indices, is consistently higher in these eclipse-exposed areas. Historically, individuals in such regions were also more likely to pursue scientific careers, suggesting a pathway from natural phenomena to technological innovation through heightened curiosity.

While the Litinia and Roca-Fernandez paper points to a link between curiosity and technology adoption, it only sheds limited light on the drivers of the First Industrial Revolution. Britain, a cradle of early industrialization, experienced few eclipses, while regions with frequent eclipses – such as the Amazon or trans-Ural Russia – did not become hubs of early technological breakthroughs.

Religion is a core element of culture. Its relationship with development is considered in depth in recent work by Becker et al. (2024).[2] Here, I restrict myself to interactions between religiosity and scientific advances. A recent theoretical paper examines the two-way interaction between science and religion (Bénabou et al., 2022). Religion can either block or accept scientific insights, while scientific knowledge potentially undermines religiosity, boosting productivity. This can lead to high religion/low growth and low religiosity/high productivity outcomes; Benabou et al. derive the conditions under which either theocracy (and scientific stagnation) or secularization (and rapid increases in scientific knowledge and output) occur – with a potential for a mixed, high religion, high science equilibrium due to doctrinal adaptation. Such an equilibrium is possible but rare.

Using 19th century data on France, Squicciarini (2020) shows that more Catholic areas developed later. The main mechanism she finds is lower education in the more religious areas. This argument echoes the findings by Becker and Woessmann (2009), who concluded that Protestant areas in Prussia were more economically developed because they had higher literacy rates. Note that the effect of religion differs in the two areas – it increased growth in Prussia, because it boosted literacy, but reduced it in France, by lowering educational attainment. Religious pluralism more generally appears to have had ambiguous effects.

[2]Most of the literature on the "Weber hypothesis" fails to find any direct effect (Cantoni, 2015).

On the one hand, it made it easier for free spirits to escape the tyranny of religious doctrine in any one place; at the same time, persecution and religious dogma arguably increased in scope and intensity after the Reformation, as the Catholic Counter-Reformation sought to "roll back" the schism. Greater religious tolerance is generally associated with higher rates of technological advance (Cinnirella and Streb, 2018).

2.2 Social progress and bourgeois values

Having examined the philosophical and scientific underpinnings of the Enlightenment view of economic development, we now turn to its second variant: the social progress perspective. This approach focuses on how cultural norms, values, and behaviors changed and influenced development, rather than grand ideas and scientific advances. Behavioral economists have long shown that humans cooperate much more than can be explained by immediate payoffs in the lab, showing a regard for moral concepts like fairness and reciprocity (Fehr and Schmidt, 2006). While such prosocial behaviors may be second nature to people in today's rich countries, none of them are innate (Pinker, 2002). Instead, they reflect social evolution and behavioral adaptations over long periods of time (Henrich, 2020). Several deep-rooted cultural features unique to Europe facilitated such exchange. Among the more important are, arguably, the rise of individualism, a decline in cousin marriages and the associated reduction in effective family size, neolocality – with new couples moving out of the parental household, as well as a materialist culture focused on consumption, imbuing hard work with positive connotations.

2.2.1 Individualism

Gorodnichenko and Roland (2017) show that, around the globe today, more individualistic cultures are richer and more innovative. In particular, countries with lower genetic distances to the US are more individualistic, and have higher total factor productivity, higher per capita incomes, register more patents, and score higher on indicators of innovation. This pattern holds even within each continent, when we instrument individualism with genetic variables, and it survives inclusion of key control variables. They also document important synergies with institutions, especially property rights protection. Whether we should consider individualism as a genetic trait, or genetic and ethnic distance to the Anglo-Saxon world that pioneered such attitudes as a 'resistance factor' that slows the uptake of a purely cultural phenomenon, is an open question. Given how strong the documented correlations are, it is interesting to ask whether individualism can be plausibly connected with the arrival of industrialization.

Alan Macfarlane (1979) famously argues that the roots of Western individualism can be traced back to medieval England. He finds that English society, unlike many contemporaneous European societies, possessed a legal system and used inheritance rules that allowed individuals to act independently of family and communal obligations. This is in contrast with systems based on extended kinship ties. England's legal frameworks promoted nuclear family structures and individual ownership rights, encouraging people to make decisions based on personal interest rather than collective duty. Macfarlane sees this as crucial for a distinctive English ethos that prized autonomy and self-determination, setting England apart from the more communal structures of Continental Europe and, especially, the rest of the world.

This individualism, according to Macfarlane, celebrated personal achievement and laid the groundwork for a culture in sync with capitalist development. By allowing for greater social and economic mobility, the English system fostered a climate in which innovation and entrepreneurial endeavors came to flourish. In such an environment, personal success and wealth accumulation are readily viewed as legitimate and morally acceptable, fueling the aspirations central to England's economic expansion. Macfarlane's hypothesis thus places cultural individualism at the heart of England's economic evolution, suggesting that these values enabled a society where people saw themselves not merely as members of a community but as autonomous agents pursuing personal goals – a perspective that may well have proven crucial in the transition to modernity.

David C. McClelland's *The Achieving Society* (1961) explores related themes, but generalizes the aspects highlighted by Macfarlane. He argues that the need for achievement (n-Ach), a psychological trait characterized by a desire for accomplishment and excellence, plays a crucial role in fostering innovation and productivity. Drawing on empirical data and cross-cultural comparisons, he links high levels of n-Ach in a population to entrepreneurial activity and economic success. McClelland identifies cultural practices, such as child-rearing methods that emphasize independence and achievement, as key to fostering this trait in individuals. The book also discusses how societies with high n-Ach tend to experience dynamic economic progress, whereas those with low n-Ach often stagnate. McClelland proposes that fostering achievement-oriented values through education, leadership, and policy can stimulate economic growth.

2.2.2 Demographic influences

Two medieval developments, instigated by the Catholic church, contributed to these changes. The medieval church increasingly banned cousin marriages; while relatively distant unions were initially accepted by the early church, by the 11th century, even marriages to sixth cousins were banned (Schulz et al., 2019). By banning cousin marriage, the church began to destroy tribal structures and sources of allegiance. It sought to increase its influence; once extended families were no longer the primary focus of economic, social, and cultural life, the Catholic church became a focal point for everyday life. Instead of towns and villages being composed of only a handful of large, extended families, they consisted of numerous smaller units. Conflicts could be mediated by churchmen, instead of family elders. Marriages outside the extended family created ties across previously unrelated groups, and reduced the importance of extended families while simultaneously increasing the cohesion among co-residents in villages and cities. Family feuds, often carried out over generations, became harder to sustain once the offspring of each warring group considered each other as possible romantic partners instead of looking only at cousins on the marriage market – a triumph of Romeo and Juliet over endless cycles of revenge (Moscona et al., 2017).

Eroding extended family structures can also improve the allocation of talent. While discrimination leading to talent misallocation in modern societies has attracted substantial attention (Hsieh et al., 2019), the same cannot be said for historical settings. As the strength of family ties declined, young men increasingly had to seek out masters from outside their immediate social group. The set of potential professions they could pursue went up; and master craftsmen could choose from a wider set of potential hires, improving the quality of such matches. Recent work by de la Croix et al. (2018) compares Chinese and

European arrangements for apprenticeships. They argue that Chinese clans, by restricting the pool of potential hires, reduced the quality of craftsmanship training and the benefits of masters from becoming known for their skill. In contrast, in Europe, vigorous competition from both sides – masters and potential apprentices – kept incentives sharp and allowed a flourishing of skill and craftsmanship. This argument can be generalized – cities composed of nuclear families in Europe favored and conditioned people for anonymous exchange between unrelated individuals, creating institutions that enabled long-term growth. In contrast, clans such as in China did the opposite (Greif and Tabellini, 2010, 2017; Greif et al., forthcoming).

Second, the role of women in Christian religious thought changed markedly during the Middle Ages. For St Augustine, women still had little religious standing on their own; their status derived exclusively from their family, and marriage was a union between two families – not a match between two individuals. Consequently, fathers could marry off their daughters without their consent. By the time of Pope Nikolas (800–867), however, Catholic church doctrine had undergone a decisive shift. Women, it was now acknowledged, have a soul of their own; marriage requires an active, voluntary act of the will by the future bride. While the actual practice of such potential defiance of the fatherly will may have been fraught with difficulty, it laid the foundations for an extraordinary institution, with important social, cultural, and economic consequences – the European Marriage Pattern (EMP) (cf. Biller, 2003; De Moor and Van Zanden, 2010; Hajnal, 1965; Sheehan, 1996).

Hajnal (1965) located the EMP West of an imaginary line from St. Petersburg to Trieste. Where it reigned, women married relatively late – often as late as 28 by the 16th century. In sharp contrast, almost everywhere else in the world, biological fertility determined the age of marriage; the age of first menarche was the age of marriage. In addition, a significant part of each cohort never married, and consequently never reproduced. There were almost no out-of-wedlock births. Finally, age at first marriage responded to economic conditions, with couples postponing marriage until they had saved up enough to set up on their own. Underlying this European marriage pattern was a strong pattern of what anthropologists call "neo-locality" – the tendency of young couples to form a new household, living with neither the family of the groom nor the bride. The extent to which new household formation occurred upon marriage varied even within Western Europe – and the pattern was particularly pronounced in England, along the northern Atlantic seaboard, and in Scandinavia.

Marriage patterns and the ban on cousin marriages are likely to have fueled the rise of a different set of attitudes and beliefs. Where young couples moved out of the parental household, parental authority was weakened. Buoyant labor demand, especially for female servants, after the Black Death will have reinforced this effect (De Moor and Van Zanden, 2010). Later marriage – and the formation of new families upon marriage, moving out of the parental household – enhanced women's bargaining position. Many women who had worked as servants for up to a decade prior to marriage brought sizable savings and important skills with them. Along the north-western seaboard of Europe, dowries were rare; men and women had more equal access to property rights. Protestantism, by furthering female literacy, provided an extra impetus to greater equality between the sexes (Becker and Woessmann, 2008). All of this spelled an unusually high level of "girl power" (De Moor and Van Zanden, 2010; Voigtländer and Voth, 2013a).

2.2.3 *Work and consumer culture*

Jan De Vries (1994, 2008) popularized the concept of the "Industrious Revolution." It refers to a change in household behavior in early modern northwestern Europe, particularly between the 17th and 18th centuries. This period saw families reallocating their time and labor towards market-oriented production and consumption. Households reduced leisure and non-market activities, increasingly engaging in wage labor and producing goods for sale. Arguably, a desire to purchase new consumer goods was an important motivator. Newly imported goods like coffee, tea, chocolate, tobacco, and sugar came to account for a substantial and rising share of total consumer expenditure (Hersh and Voth, 2022; Horrell, 1996). There is some empirical evidence that high labor input preceded the transition to self-sustaining growth, and that countries that led the way in the First Industrial Revolution (Clark and Werf, 1998; Henrich, 2020; Humphries and Weisdorf, 2019; Voth, 1998) had long working hours before. In addition, hours went up as industrialization spread. Few people before the Industrial Revolution worked more than 200 to 220 days in paid employment, at least in England; by the 1830s, up to 320 days was closer to the norm.

Cross-sectional differences in labor-leisure trade offs are arguably easier to conceptualize as causal than time-series evidence. Galor and Özak (2016) argue that agricultural conditions powerfully shaped time preferences. Where agricultural investment yielded greater returns, people are more patient today. In a related spirit, Fouka and Schläpfer (2020) investigate the historical roots of work ethic and the latter's persistence in contemporary societies. They hypothesize that societies cultivating crops requiring high labor inputs, such as rice or potatoes, developed a stronger preference for hard work over time. Pre-industrial hours arguably reflect soil and climatic conditions. Using a theoretical model of cultural transmission and empirical evidence from European and U.S. data, they construct a labor intensity index based on agricultural suitability. They find a positive relationship between historically labor-intensive agriculture and actual working hours in 1870. Present-day work patterns, desired working hours, and attitudes towards work still vary with a region's labor input requirements in prehistoric times. This strongly suggests that historical labor returns influenced cultural norms and preferences for work, and that such preferences were transmitted intergenerationally. While they do not examine the effect of this pre-industrial work ethic on industrialization outcomes, such a link is plausible – and the regions with low and very low labor input requirements in agriculture around the globe appear to have developed later than the rest.

Some of these changes may have had deeper historical roots. The Cistercian order, in particular, emphasized hard work and thrift. Andersen et al. (2017) show that areas of England where the Cistercian order founded monasteries in the Middle Ages experienced faster population growth thereafter; and across Europe, areas with more Cistercian monasteries value work more in recent waves of the European Value Survey; they also have higher employment and greater output. Along similar lines, the 'Brethren of the Common Life', a religious community founded in the 14th century emphasizing the religious importance of bible study, may have contributed to the early spread of literacy in the Netherlands (Akçomak et al., 2016).

Synergistic with the emergence of an "Industrious Society" was the rise of consumer culture in early modern Europe. While Europeans' health in all pre-industrial cities was poor, by many accounts, wages were relatively high (e.g., Allen, 2001; 2009; Broadberry and Gupta, 2006; Broadberry, 2021). De Vries (2008) and Van Zanden (1999) argued for greater

labor input as an explanation why wages seemingly stagnated in so many early modern European countries, while probate inventories show rapid accumulation of consumer goods. McKendrick et al. (1982), Shammas (1990), and others go as far as to argue that 18th century England witnessed the birth of a consumer society. Competing for standing through conspicuous consumption, through extravagant dress, large carriages, grand estates and opulent food is a great constant of human societies, with ample examples from antiquity. Many societies limited such displays of status through sumptuary laws, residential restrictions, etc. By the early modern period, such restrictions increasingly disappeared in early modern Europe; and while miserable wages for the many limited the scope for conspicuous consumption, the middling sort could buy big-ticket consumer items on an increasing scale – helped by manufacturing progress and the associated decline in prices.

While partly a response to changes in relative prices and incomes, consumption patterns also often reflect cultural preferences and changes (Atkin, 2016). Greater utility from consumption, and a reduced leisure preference, could easily have shifted labor supply upwards. This would have, ceteris paribus, reduced wages, raised profits, and increased spending on consumer goods – and all the more so the higher the share of high fixed-cost, low variable cost investments in the economy. In other words, theoretically, it is straightforward to hypothesize how a shift in consumer expenditure could have facilitated economic development – perhaps even leading to the take-off into sustained growth (along the lines of DeVries' argument). Based on rigid theoretical reasoning, an older literature rejected the notion of "demand" playing any role in the transition to Industrial Revolution (e.g., Mokyr, 1977). Since then, the growth literature has examined the preconditions for technology adoption, and for innovation to move the needle of an economy at large. In this perspective, productivity gains from inventions are not enough; the structure of the economy has to be such that adopting innovations pays. Few modern production techniques would have been profitable to adopt if demand had been limited to a handful of princes and rich merchants; productivity gains are markedly more likely in sectors of the economy where mass adoption is possible and economics of scale and scope can be realized (Matsuyama, 2002). An earlier literature in the economics of growth explored the importance of the structure of demand and of non-homothetic preferences (Murphy et al., 1989; Foellmi and Zweimüller, 2006). While difficult to demonstrate empirically, careful calculations from household budget surveys in industrializing England suggest that surplus income – above subsistence, and available for discretionary purchases – increased rapidly after 1800. However, it was not buying by the lower classes that channeled purchasing power into new products, but "middle class" demand (Horrell, 1996).

2.2.4 Bourgeois values

While market exchange is old and common around the globe in some form or other, it is rarely celebrated as virtuous and admirable. In her trilogy on bourgeois virtues, Deirdre McCloskey (2007) points out that the bourgeois values underlying market exchange triumphed after 1500 in several countries along the North-Western seaboard of Europe, before eventually taking the world by storm. In other words, the values of the bourgeoisie like thrift, risk-avoidance, prudence, justice, hope, faith, and hard work became "virtues", imbued with a moral authority and importance that was, according to McCloskey, new in history. The Dutch, having rid themselves of their imperial masters, the Spanish kings, in

the 16th and 17th centuries, as well as the German trading cities and Italian city republics celebrated liberty, equality, thrift, financial probity, caution, patience, hard work, discipline, and attention to detail as virtues, when an earlier, aristocratic age barely countenanced mercantile and money-grubbing attitudes. Egalitarianism is an important part of the mix: Social differences were no longer seen as immutable and conferred by birth; merchants could aspire to higher status. These attitudes then diffused to the commercial elites of many European countries, having first taken root in the Netherlands and England. Part of their success was in "infecting" the outlook of the existing ruling class, which increasingly intermarried and merged with rich burghers (Appleby, 1978).

McCloskey (2007) argues that bourgeois virtues are an analytical necessity for understanding the Industrial Revolution because no other set of variables can explain the enormous leap in output per capita over the last few centuries. Neither education nor capital accumulation are sufficient, she argues, and the black box of total factor productivity must reflect hidden factors like the impact of egalitarian attitudes, freedom of association, exchange, and expression, bourgeois self-reliance, and the economic benefits of celebrating hard work. Because measurable inputs did not increase enough to explain the miracle of per capita output growing more than ten-fold, we should take bourgeois virtues seriously.

In McCloskey's telling, culture spread "laterally", across individuals and families, mostly by imitation and adoption of new ideas, and the growing social standing of the bourgeoisie. Greg Clark (e.g., 2006, 2007) proposes a related explanation, building on work of Galor and Moav (2002) – the idea that the rich (with bourgeois attitudes and values) had more (surviving) children than the poor. In other words, where McCloskey emphasized horizontal cultural diffusion, Clark argues that bourgeois values took over because the "right types" outbreeding the rest. Using detailed data on the number of surviving offspring in England, stratified by socioeconomic status based on probate records, Clark shows that the wealthier had greater reproductive success before the early 19th century. In this regard, Clark's argument is closely related to the broader narrative in Henrich's (2015) *The Secret of our Success*, which emphasizes the co-evolution of culture and genes.

Humans breed slowly compared to most other mammals. Nonetheless, over centuries, differential reproductive success could cause a shift in the cultural outlook of entire populations. The necessary ingredient, vertical cultural transmission (from parents and grandparents to children) is well-documented and a cornerstone of many models in cultural economics. Selection by social status is common in historical societies (e.g., Herlihy, 1973, Bandyopadhyay and Green, 2013; Cummins, 2020; de la Croix et al., 2019; Göttlich and Selgert, 2024; Hu, 2023, Kumon and Saleh, 2023). However, whether the European rich outbred the poor more than the rich in the rest of the world is unclear. Many cultures outside Europe practiced forms of polygamy, either through explicit multiple marriages (as in Islamic countries), or because of widely accepted use of concubines (as in China). In both cases, rich and powerful men were much more likely to have multiple wives/concubines, and their chances of outbreeding the poor were correspondingly higher. In China in particular, highly educated officials had a good chance to outbreed even prosperous merchants, which would have skewed population composition towards higher levels of human capital (Hu, 2023; Voth, 2008). In contrast, the strict monogamy imposed by the European Marriage Pattern acted as an important "speed limit" to differential reproductive success for the elites; it is difficult to see why the "Farewell to Alms" did not become visible in the Middle or Far East first, where long-distance trade has a proud tradition and polygamy was widely practiced, if the Clark argument is key.

Recently, Bergeron et al. (2024) have argued that there is a unifying theme underlying cultural changes preceding the Industrial Revolution – a switch out of "zero-sum" mentality. They point out that in modern surveys, zero-sum thinking correlates with lower income, less education, a reduced belief in hard work as a source of success, and lower life satisfaction. In developing countries, more zero-sum thinking is also associated with demotivating beliefs, including a belief in witchcraft, as well as envy and jealousy. Bergeron et al. argue that correlated changes – from the "Industrious Revolution" to the Enlightenment – worked against demotivating beliefs in Europe from the 1700s onwards. Using word counts in Google Books, they show that mentions of 'progress' increase sharply in frequency during and after the IR, while mentions of envy and jealousy decline. Work by Ash and Xue (2024), using the evolution of English proverbs, points in the same direction. They examine the main theme or point of proverbs, linked to the geographical origin of the author, and find evidence of a shift towards "Bourgeois Virtues", especially in regions that industrialized earlier.

2.2.5 Discussion

A broad set of related cultural factors changed in Europe in the centuries prior to the Industrial Revolution. It is common to divide potential drivers of these changes into broad categories. At the same time, this risks obscuring that there were important synergies between demographic factors, culture, and economic development. An important work of synthesis linking individualism, prosperity, demographic patterns, and related cultural changes is Henrich's (2020) analysis of Western societies as WEIRD (Western, Educated, Individualistic, Rich, and Democratic). He emphasizes the Catholic Church's war on cousin marriage and the effects of the Reformation. Breaking the influence of tribes and clans through the ban on cousin marriages and the matching of apprentices with masters outside the extended family enhanced talent allocation and encouraged the evolution of market-compatible *mores*.

Other demographic factors contributed to the emergence of WEIRDness[3]: The transition to a high consumption, high labor input society with well-functioning labor, credit, and product markets occurred first in unusually individualistic societies, where age of marriage was not determined by biology but socio-economic and cultural choice. In Europe, marriage and childbearing was often postponed, with many women in Northern-Western Europe marrying in the mid-to late 20s. This facilitated some "initial accumulation" of material goods. Extended periods of living outside the parental household, before founding a new family, encouraged and allowed saving up, often while youngsters worked as servants and apprentices. Many of the moving parts of the European Marriage Pattern were set in motion or strengthened by the biggest demographic shock in European history, the Black Death (Voigtländer and Voth, 2013a). At the same time, Higher incomes after the Black Death clearly increased demand for non-subsistence goods, many of which were produced not in-house but commercially, in cities, and sold for money (Voigtländer and Voth, 2013b). This simple, basic change in the structure of demand, driven by the response of a Malthusian economy to a large population decline, increased the importance of exchange between unrelated individuals.

[3]This is in line with the recent trend in economic theory, increasingly breaking down the distinction of culture on the one hand, and institutions on the other (Bisin and Verdier, 2024).

3 Leviathan's shadow: discipline, order, and the rhythm of the factory

The story so far has a distinct "motherhood and apple pie" feel to it – brilliant scientists stimulate cutting-edge manufacturing practices, proud and virtuous bourgeois merchants optimistically embrace new opportunities. In a setting with the right institutions, riches should follow. And yet, for any Martian visiting planet earth in 1800, Europe's relative riches, greater individualism, late marriages, and the free association of savants and skilled craftsmen would have been only one of many factors they would have noticed. A darker force was casting its shadows over everyday life – the disciplining of the workforce, in the immediate form of factory discipline, as well as a broader set of correlated cultural changes that facilitated the transition to self-sustaining growth

3.1 Factory discipline

Industrial work patterns marked a stark departure from traditional labor practices. Working conditions in the "dark Satanic mills" (William Blake) were often hellish. A powerful economic logic underpinned them. As one cotton magnate explained in the 19th century: "When a laborer lays down his spade, he renders useless, for that period, a capital worth eighteen-pence. When one of our people leaves the mill, he renders useless a capital that has cost £100,000" (as cited by Karl Marx (1977, p. 529) in *Das Kapital*). This economic imperative drove the technological organization of early factories. The technology of early factories had a strong "O-ring" element – because different steps in production depended on each other, in part because a central power source (steam engines or water power) was used. This interdependence meant that a single person being absent (or making mistakes) could create major disruptions to the entire factory's output. The need to move at the speed of the machine, and becoming almost like a machine itself, dominated production for over a century, from the earliest days of factory production until the late 20th century. Beautifully lampooned by Charlie Chaplin in "Modern Times", the robot-like behavior of workers needed to run the factory was the final, logical endpoint of the social disciplining that was deeply rooted in broad social and cultural trends during the early modern period.

One powerful insight into the importance of factory discipline is provided by Greg Clark (1987). He begins with the observation that factories the world over adopted British textile machinery during the 19th century. Workers had to perform more or less the same tasks, producing a highly standardized good with a few routine movements. Despite the similarity of tasks and the near-identical equipment, output per capita differed markedly. By 1910, a single worker in England performed as much work as 4–5 Chinese, Indian, Greek, or Japanese workers. Had non-European workers kept pace with their European peers, profit-rates in textile factories would have been sky-high – "convergence" through rapid capital accumulation would have been easy.

Such rhythms did not arise naturally or voluntarily. The enforcement of this new industrial discipline was often severe. Workers faced harsh penalties for even minor infractions: arriving a few minutes late could cost an hour's wages, while at Cheshire's Quarry Bank Mill, being 15 minutes late resulted in losing half a day's pay. Children faced physical punishment for small violations, and workers could be heavily fined for basic activities like washing themselves during work hours (Pollard, 1963). Clark later argued (1994) that workers actually desired external enforcement of demanding schedules, as they struggled to maintain such discipline of their own volition. In this perspective, factories

succeeded partly because they helped workers overcome their own tendency to work less than they really wanted to, effectively serving as commitment devices for maintaining productive routines.

Clark attributes international differences in work intensity to workers outside England (and especially, outside Europe and European offshoots) having a "mental life different from our own" – meaning a preference among workers to share employment between many individuals, even at the cost of each person earning little. The fundamental insight into the powerful effect that factory discipline has on firm productivity does not depend on this interpretation, however. Clark shows no evidence that non-European workers (at that point in time) had internalized the requirements of factory work sufficiently so that they could have rivaled the pace of English and American workers. Of course, to perform work at the pace of English and New England workers required manual dexterity, concentration, and physical stamina that may have been beyond what was attainable in poorly nourished environments such as 19th century India or China. There is ample evidence that malnutrition and general scarcity can interfere with task performance (Mullainathan and Shafir, 2013), and that nutritional shocks in particular might have adverse effects on cognitive development (Baten et al., 2014).

The rhythm of the factory was unnatural, brutal, and often highly detrimental to the health of workers. Factory life in the pre-1850 era was characterized by grueling schedules. Workers typically spent 72–84 hours per week at their machines – 12–14 hours daily, for six days straight (Matthews et al., 1982). While the UK's Factory Act of 1833 eventually limited children's weekly hours to 48, this came after decades of exploitation and long hours.

3.2 Clock time

The rise of industrial factory discipline was preceded by broader cultural shifts. Factory discipline was only the end-point of these changes in Europe since the Middle Ages, particularly the widespread adoption of "clock time" and the growing emphasis on teaching children discipline, precision, and obedience. E.P. Thompson (1967) famously argued that industrialization changed how people used time and their notion of time – from time "passed" to time "spent". Though pre-industrial work could be intense, especially during harvest seasons, such periods of high exertion were typically intermittent rather than constant. The Industrial Revolution fundamentally transformed European society by relocating populations from rural to urban areas. It also replaced traditional work rhythms, governed by weather, seasons, irregularity, and personal choice, with rigid schedules dictated by machinery and factory owners' profit motives.

Central to this temporal transformation was the spread of mechanical timekeeping. A seemingly innocent symbol of cultural change was the spread of clocks and watches. The first public clocks were built in the 13th century. These phenomenally expensive machines diffused slowly, with early examples of adoption in England and Italy. By the 17th century, most major European cities boasted one or several clock towers striking the hour. Personal clocks and watches became common later, with cities like Geneva and Augsburg playing pivotal roles in their technical refinement and manufacturing (Cipolla, 1993). By the late 18th century, these timepieces had become attainable luxury items even for craftsmen and farmers.[4] The diffusion of clocks and watches in early modern Europe marked a profound

[4] Kelly and Ó Gráda (2016) recently showed how greater productivity in manufacturing lowered the price of watches.

shift in the perception and organization of time, reshaping daily life and economic practices. By standardizing timekeeping, clocks transformed European life, making schedules more precise and enabling the coordinated rhythm of urban markets, public events, and later, industrial production. Clocks in church towers, town halls, and public squares helped to coordinate citizens' activities; they also symbolized civic order and progress, reflecting both technological prowess and a new collective experience of time. Boerner et al. (2021) find a large impact on city growth from adopting public clocks, of 30–50%, over the period 1300–1700, which possibly has a causal interpretation.

David Landes (1969) emphasized how timepieces became integral to the emerging capitalist mindset, encouraging punctuality, discipline, and efficiency. Portable watches, increasingly affordable by the 17th century, made personal time management accessible, reinforcing ideals of individual responsibility and productivity. Along the lines of Thompson, Landes argued that this gradual internalization of time discipline aided the shift from agrarian rhythms to structured work schedules, essential for modern economic growth. Thus, clocks and watches did more than tell time; they embodied the values of precision and productivity that became one important element of Europe's transformation towards a regimented, disciplined society in which industrial capitalism could thrive.

3.3 State capacity

No government or church deliberately planned to supply pliant workers. Yet the peculiar early modern European combination of state capacity and church control produced pliable, punctual, obedient, resilient workers in abundance. A multitude of religious, military, and social motivations encouraged the power of churches and governments to be extended into every village and town, down to the smallest hut, and into the minds of people.

European states were undoubtedly more "capable" than those in the rest of the world. By 1500, Europeans were already conquering vast parts of the globe, in India and the Americas; by 1800, their armies regularly triumphed over all others. Higher taxation, more skilled bureaucrats, and elaborate organizational structures contributed to Europe's quantum leap in state capacity after the Middle Ages. While "better" (i.e. more deadly) germs played a role (Diamond, 1997), Europe's rise to world domination was also driven by a powerful combination of professional bureaucracies, effective taxation, military might, and growing nationalism in leading European countries.

This rise in state capacity found its complement in a gradual "domestication" of citizens. After the Middle Ages, violence began to decline; ideals of peacefulness and reasonable behavior became sources of social status where lawless, violent behavior had once been admired. The changes were profound, ranging from the choice of clothes to how sexuality was treated and discussed, as well as behavior at the dining table. As eating with fork and knife became indicators of being a member of the civilized strata of society, so open discussions of lust and greed became morally questionable; self-control, from checking one's temper to controlling one's appetite, envy, and sexual desires gradually became established as ideals of behavior. This is what Norbert Elias (1939) called the "civilizing process"; what Gerhard Oestreich (1969) refers to as "social disciplining"; and Stephen Pinker (2012) recently popularized the notion in *The Better Angels of our Nature*.

On one end of the spectrum, these cultural changes involved asserting the government's monopoly on violence and taking personal vendettas and feuds out of the hands of ordinary men and women; it also required establishing norms and ideals of civility based

on docility and cooperation. Oesterreich emphasized that, after the High Middle Ages, urban authorities, and from the beginning of the 16th century also princely administrations, literally showered the general public throughout Europe with thousands of mandates, commands and prohibitions, decrees, regulations, rules, and edicts that regulated all areas of society and the life of each individual from birth to death in the smallest detail: baptism, marriage, burial, dress codes, eating, drinking, waste disposal, coinage, measures, weights, trade, crafts, mining, manufactures, working and wage conditions, borrowing, maintenance of highways and bridges, product quality, luxury bans, illegal workers, usury, pre-emption, and much more. For example, the Max Planck Institute for European Legal History's research project "Repertorium of Police Ordinances" has so far recorded over 200,000 regulatory laws in its database for this period. For Oesterreich, what mattered was the change in "habitus" – what people did and how they presented themselves in public; whether their attitudes changed was immaterial. In Elias' perspective, instead, people's beliefs and values changed gradually, in line with the precepts of governments and the demands of social desirability.

Being subject to a central state appears to create, in the long run, a mental "software" that is oddly congenital to economic growth. Within Africa, Gennaioli and Rainer (2007) show that regions with a greater number of historical hierarchy levels are richer today. Putterman and Weil (2010) note that state antiquity is a strong predictor of per capita incomes today – places where the state is "old" are much richer than where it is recent. Importantly, it is not the local infrastructure, legal framework etc. that is responsible for this connection – when they adjust state antiquity in any one country, taking into account the major migrations since 1500, the predictive power of state antiquity improves. In this way, they consider that few of the people living in Australia or the US today are descendants of indigenous populations there in 1500. The increase in predictive power suggests that it is the exposure of populations to a strong, centralized state that engenders growth-compatible attitudes. Along the same lines, in a detailed study of the effects of prolonged exposure to the centralized Dai Viet monarchy, Dell et al. (2018) show that areas with greater experience of a strong state are more prosocial, trusting, and productive.[5] Submission to a central state does not always leave behind cooperative norms (Lowes et al., 2017); areas subjected by neighboring territories, and without an extended experience of self-governance in Switzerland show markedly fewer pro-social behaviors today (Rustagi, 2024).

Many of these cultural changes did not fall from the sky. All over Europe, military-fiscal states competed with each other to turn soldiers into automata; in battle they were expected to march towards each other in perfect lines, drilled to such an extent that the best infantry could load and fire front-loading muskets up to six times a minute (Delbrück, 2000).[6] Ships of the line with more than 1000 men each, with towering masts and rigging, could traverse the globe. In naval engagements, they would bombard each other at point-blank range, synchronizing the firing of 100 or more guns.[7] Armies and navies had to overcome vast

[5]Contrary to the patterns identified by Putterman and Weil (2010) and hypothesized by Elias and Pinker, Lowes et al. (2017) find that in modern-day Africa, descendants of the subjects of one of the most centralized African states, the Kuba Kingdom, are not more prosocial.

[6]Few armies came close to fulfilling the ideal of military theorists of the age, closely modeled on Prussian practice (Burns, 2025).

[7]Royal Navy ships generally managed to fire 2–3 broadsides every 5 minutes, requiring coordination of up to 100 gun teams (Rodger, 2006), each composed of 6–14 men, and involving seven distinct tasks to be performed in precise order (load cartridge, wadding, ball, prime, running out, aim and fire, spunge).

logistical problems, feeding and equipping increasingly large bodies of troops in far-flung locations (Van Creveld, 1977). To mobilize the resources to do so, European countries taxed more and spent more, relative to national income, than most countries in recorded history before them. As they did so, they also created new habits. To "render unto Caesar" instead of trying to avoid taxes as much as possible became ingrained as a habit, grumble though the people might. Taking the King's shilling and enlisting subjected men to brutal discipline. While the image of battleships as floating concentration camps is somewhat exaggerated (Rodger, 2006), there are good reasons why that notion first took hold; captains had power over life and death; many would routinely have their men flogged even for minor infractions. Similar or harsher discipline was a staple of military life in European armies.

3.4 Schooling and the invention of nationalism

Where armies led, schools soon followed. They were introduced to habituate children to a harsh regime of obedience and discipline, with often brutal beatings to punish even the smallest transgressions (Paglayan, 2024). The military aim of such schooling was all too obvious – retired army sergeants often served as elementary school teachers in Prussia, for example. Prussia introduced tax-funded universal education for all boys from age 5 to 13 in 1763. The General Guide to Schooling (*Generallandschulreglement*) exhorted teachers to punish pupils using reeds or sticks, but to avoid inflicting irreversible bodily harm on their pupils while doing so. It also exhorted pupils to accept the punishments willingly and with pleasure ("gern"). But schooling was not introduced only to provide more obedient soldiers. Governments across Europe seized on the opportunity to indoctrinate the children of the lower classes, to turn them into compliant subjects that would serve the state, pay their taxes, and submit to the labor demands of the elite.

Elementary schooling in particular was initially almost never about "human capital"; it was mainly intended as a way to ensure religious conformity and social control. For much of mankind's history, religious leaders had intermediated between rulers and the population. They had often been in charge of indoctrination, inculcating a spirit of obedience and passive acceptance of the existing social, political, and economic system. However, as the Lutherans and Calvinists quickly realized in the early 16th century, the reach of religious authorities was often limited. With the rise of public schooling, teachers' prime role was to indoctrinate children in a new substitute religion – the importance of the "nation" (and prior to the 19th century, the importance of the ruling dynasty).

The 'invention' of nation states was the logical end-point of a process that saw citizens internalize norms conducive to economic development, social stability, and economic progress. Nations and nationalism are relatively recent inventions – 'imagined communities' (Anderson, 1983; Harari, 2014). Loyalty to royal dynasties was a common notion in Europe by the late Middle Ages, but the idea of nationhood, defined by common culture and language, only emerged in the 18th century. England was arguably one of the first countries that deliberately sought to create a shared identity, following the Act of Union (1707) between Scotland and England. Emphasizing Protestantism, the opposition to France's ambitions of European hegemony, imperial ambitions, and the importance of overseas commerce, Britishness was closely associated with domestic virtues (Colley, 1992). While nation-building primarily reflected the needs of 'warfare states' and was part of an attempt to subdue and pacify the lower orders of society (Alesina et al., 2020), the imposition of a

uniform language in linguistically heterogeneous countries like Italy and France may have yielded economic benefits by raising human capital (Weber, 1976). In addition, a sense of shared nationhood likely facilitated anonymous exchange and the provision of public goods.

3.5 Religious mind-control

Religious strife within Europe also fostered increasing social and intellectual control. With the Reformation, both Protestants and Catholics realized that the "commanding heights" of the Church – the leading bishops, the faith of rulers, and official doctrine – were not enough to ensure the survival of their confession. Instead, the beliefs of common people became a key battleground. Reinhard (1983) and Schilling (1992) introduced the concept of 'confessionalization' to describe the process of increasingly close connections between the confessional churches and state administration, while religious institutions implemented new forms of social disciplining. Religious practice and education underwent standardization across territories, fostering the development of distinct confessional identities among subjects. This process served dual religious and political purposes by strengthening territorial rulers' control over their subjects and creating more homogeneous populations. It established clearer boundaries between different confessional groups while contributing to the modernization of state administration and education systems. This emphasis on doctrinal purity had practical consequences. Protestantism in particular emphasized the need for greater literacy (Becker and Woessmann, 2009), building schools and hiring teachers.

Protestant church leaders pioneered an intrusive and often punitive system of visitations (Räisänen-Schröder, 2014). The reformer and humanist Philipp Melanchton wrote one of the first manuals for church visitations. For the first time since the advent of Christianity, specially appointed delegates of the Church came to visit every parish in their area of responsibility, examining the doctrinal purity of ministers as well as parishioners' knowledge of the bible, the catechism, and basic elements of religious doctrine. The Catholic church soon participated in the indoctrination arms race, increasing centralization and discipline. It required bishops to live in their diocese, instead of in Rome or on luxurious estates in the countryside; church visitations by zealous priests, once unheard of, became an ideal to be pursued and implemented. Carlo Borromeo, Archbishop of Milan and a strong advocate of greater social control, for example, visited most of the far-flung parishes under his jurisdiction – and was canonized as a result, highlighting that these new methods were a way to holiness inside the Catholic Church.

Gorski (2003) argues that Calvinism was particularly important in driving a "disciplinary revolution." Through a combination of social control, punishments, and bureaucratic surveillance, Calvinist communities pioneered the disciplinary actions that later came to define almost every European state. More generally, ascetic Protestantism in the Dutch Republic, Scandinavia, and Prussia pioneered the confluence of social control, bureaucracy, and frequent punishments of even small transgressions that came to characterize the package that made European states so powerful by 1800.

Along similar lines, a Catholic institution devoted to social and mind-control actually predated the Reformation – the Inquisition. Inquisitions as a way to combat heresy originated in 12th century France, where they were used against the Waldensians, Cathars, and Beguines (Baigent and Leigh, 2000). Its most famous incarnation came in the form of the Spanish Inquisition created in 1478 and initially tasked with rooting out crypto-Christians

in Spain – Muslims and Jews who had officially converted to Christianity after the Reconquista, but clung to their old faith in a clandestine fashion (Kamen, 2014). It projected its power into the furthest corners of the Spanish Empire, visiting even small villages every few years. Once it arrived, it encouraged people to incriminate each other, hearing evidence of alleged misdeeds and acts of heresy. Without direct funding from the Crown, the Spanish Inquisition had to fund itself from securing convictions, levying fines or seizing property – which ensured a substantial rate of persecution. Talking to one's neighbors, being known as a free spirit, questioning doctrine or the local authorities could quickly result in an invitation to appear before the tribunal. Penalties ranged from fines to a gruesome form of the death penalty, burning at the stake, known as the auto-da-fé. Because the Inquisition was self-financing through fines and property seizures, it had limited incentives to levy fines in an even-handed manner. Even centuries after the abolition of the Inquisition, areas of Spain exposed to it continue to have lower trust, less education, and lower output (Drelichman et al., 2021).

The Inquisition also created and maintained lists of banned books – the *Index Librorum Prohibitorum*. Initiated in 1559, it was maintained and regularly updated until 1966. Both secular and religious texts were regularly banned, including major philosophical and scientific works such as Kepler's book on Astronomy or Kant's Critique of Pure Reason. Mind-control arguably mattered even more once literacy rates were sufficiently high. Maintaining lists of banned books had the intended effect – it reduced innovation and independent thinking, with major declines in the rate of book production and intellectual advance (e.g., Becker et al., 2021; Blasutto and de la Croix, 2023; Cabello, 2023; Dewitte et al., 2024).

The Church's and the secular governments' concerted efforts to turn unruly, uneducated, irreverent, and largely untaxed peasants into obedient, literate, respectful taxpayers and soldiers took centuries to make headway. Arguably, battlefield drill, religious and civic indoctrination, and brutal inculcation of obedience, punctuality, and attention to detail helped to prepare the ground for the Industrial Revolution.

3.6 Slavery

This darker narrative also highlights other forms of exploitation and repression underpinning industrial growth – the exploitation of countless human beings, mainly from Africa, through slavery. The slave trade still casts dark shadows over economic development on the African continent (Nunn, 2008; Nunn and Wantchekon, 2011). Much of its impact is driven by destroying trust among neighbors and relatives, as much of the slave trade involved the catching of Africans by Africans. Whether such exploitation helped Europe to grow has long been debated. Skepticism is wide-spread – the Southern US was somewhat poorer than the North, despite slavery (Bleakley and Rhode, 2024). There is some evidence that the riches created by slavery on Caribbean plantations accelerated British growth (Heblich et al., 2023). In addition, there may be an indirect way in which Marx's famous dictum that "In fact the veiled slavery of the wage-laborers in Europe needed the unqualified slavery of the New World as its pedestal" may ring true for cultural reasons – the brutal disciplining of large workforces, kept in check by a regime of harsh punishments and backed up by armed force, has clear echoes of what the "dark Satanic mills" looked like from the 1770s onwards. In other words, the slave plantations in the Caribbean and the US South preceded large-scale industrial mills by at least a century; the cultural attitudes

Table 2: Coverage of non-European societies, selected works.

Book	Total pages	Pages containing non-European places/concepts	% of all pages
Goody (2004)	160	67	42
Landes (1998)	524	272	52
McCloskey (2007)	508	54	11
Mokyr (2002)	297	14	5
Mokyr (2009)	489	31	6
Mokyr (2016)	341	116	34

that allowed the exploitation of humans by treating them as slave owners' chattel readily prefigured what became the norms of conduct in early factories.

4 Distant mirrors

Much of the theorizing about the origins of growth and the wealth of nations is implicitly or explicitly comparative. Adam Smith already made several observations about China's poverty, and the effect of population pressure. The discussion about the cultural origins of Europe's (or a particular country's) early escape from Malthusian shackles is predicated on assumptions about the rest of the world – to highlight the role of science meeting tinkerers, of bourgeois values, or of social disciplining in one area is to implicitly claim that similar interaction patterns, or values, were not common elsewhere. Interestingly, the amount of attention devoted to non-European places in several famous contributions has been limited, if we accept page counts as a rough but plausible indicator (Table 2). Even comparisons within Europe, based on uneven understanding of the histories of various countries, can overstate differences when they highlight the uniqueness of one location, without a full appreciation of the situation elsewhere.[8]

Several scholars have argued that development across different regions of the world was relatively equal before 1500. J. M. Blaut (1993), for instance, argued that before the European colonial conquests, no inherent superiority existed in Europe compared to other regions such as China, India, or the Islamic world. He emphasized that advancements in commerce, urbanization, and knowledge systems were shared across Eurasia through "criss-cross diffusions" (Goody, 2004, pp. 82–84). Blaut, together with Immanuel Wallerstein and Andre Gunder Frank also critiqued the notion of a "European miracle," attributing Europe's later dominance to the discovery of the Americas and colonial exploitation rather than any pre-existing advantage (Frank, 1978; Wallerstein, 2004). Kenneth Pomeranz (2000) and other proponents of the "California School" have argued for a polycentric development model, suggesting that economic and cultural advancements were comparable across Eurasia before the Industrial Revolution. Pomeranz emphasized that comparisons of Europe's most advanced countries (like the Dutch Republic or England) with China are unfair, and that a like-with-like comparison of the most advanced regions (like the Yangtze region of

[8] Kelly and O'Grada (2022) is a case in point – an article devoted to the idea that instrument makers were essential for the Industrial Revolution and unique to Britain only discusses France by way of comparison. In the comparative section about other countries, even spectacular cases like the young glass maker Joseph Fraunhofer, are entirely ignored. Fraunhofer came from humble origins, trained as an optician, and went on to revolutionize astronomy with his optical instruments.

China) would show much smaller differences. Not all claims of the revisionist California School have held up well in the light of subsequent empirical scholarship – there is strong evidence of a "First Divergence" that preceded the Great Divergence of the 19th century (Broadberry and Gupta, 2006; Allen, 2009). Can this earlier divergence be attributed to similar factors as the later one?

Family structures diverged early, as discussed above. In a Malthusian world, this limited downward pressure on living standards, changing labor market options for women and the structure of demand. European governance patterns also differed markedly from much of the rest of the world, in part because of the peculiarities of the European family structure. Older narratives suggest a facile dichotomy between a democratic Europe and a despotic Orient (Goody, 2004, pp. 53–54). The distinction between constrained and absolutist rule was not simply a European versus non-European divide. Whether Philip II of Spain was a less constrained ruler than Henry VIII, and whether Suleyman the Magnificent deserves to rank even higher on the list of "absolutist" power, is debatable. From the Middle Ages, the tenure of rulers in Islamic regions began to diverge from the European norm. The main source of military manpower differed between regions – European rulers relied on vassals while Islamic rulers used military slaves. This created a need to accommodate the demands of noblemen, possibly setting in motion a virtuous cycle leading to stability and constrained monarchs (Blaydes and Chaney, 2013). Kuran (2011) argued that the economic and scientific underperformance of Islamic regions was a result of legal constraints and a failure to develop the legal institutions to support large enterprises and long-distance trade. To this, Rubin (2011) adds important reflections on the deep origins of the close alignment of religion, law, and political rule in Islamic regions, where no body of codified law like Roman law previously existed.

Similarly and famously, Joseph Needham highlighted the string of important innovations and inventions originating in China, from gunpowder to printing and the compass – and the failure to capitalize on them. The juxtaposition of success and failure is known as the "Needham Puzzle" (e.g., Needham, 1969). Needham originally argued that without the capitalist structures and impetus of Europe, innovations failed to transform societies and to overcome feudalism in China.

How much of the divergence is strictly cultural in origin is subject to debate. Jack Goody has prominently argued that many of the traits often attributed to Europe, such as capitalism, democracy, and scientific progress, were not exclusive to the West and had parallels in other regions, particularly those that experienced the Bronze Age urban revolution (Goody, 2004, pp. 54–56). At the same time, scholars such as Goody reject the notion that all societies were equally prepared for modernity by 1492. In particular, he points to the absence of a shared Bronze Age, urban, mercantile heritage in many regions, particularly in Africa and the pre-Columbian Americas, as a key factor contributing to differing levels of development. The greater diffusion of social stratification in Eurasia and societal complexity compared to Africa influenced kinship and inheritance practices may have further contributed to uneven development (Goody, 2004, pp. 81–82, Herbst, 2014; Gennaioli and Rainer, 2007).

Arguments advanced by critics of Eurocentric interpretations highlight how little we know in comparative perspective. Can we be sure that scholars and tinkerers in 11th century Cairo or Wangcheng did not engage in detailed and open exchange? What was really missing from Islamic science or Chinese tinkerers that was present in abundance in the West? Were the merchants of Baghdad so much less bourgeois in their values than

those of Amsterdam? Recent work connecting culture and economic development that is explicitly comparative in nature (Greif et al., forthcoming) is beginning to address some of these shortcomings.

A bold new departure connects cultural (and genetic) differences with comparative economic development. Ashraf and Galor (2013) show that migratory distances from mankind's point of origin in the Horn of Africa predict genetic diversity today – in line with the hypothesis that as humans migrated across the earth, the original population in more distant places had fewer members initially. They then show that diversity can be too high (Africa) as well as too low (Americas). While not directly connected to the advent of the Industrial Revolution in Europe, it has rich implications – income levels today are to a large extent explained by the timing of the transition to self-sustaining growth. More generally, the tradeoff between efficiency given current technology (enhancing efficiency, facilitated by cultural uniformity) and technological advance (which may benefit from greater diversity) is a rich analytical paradigm that could arguably be applied to other periods and settings.[9]

5 Light vs dark: the great escape

This essay has contrasted two competing narratives of the cultural changes that underpinned the transition to self-sustaining growth. One emphasizes enlightenment ideas and ideals, technological progress, and bourgeois virtues; the other, the need for a regimented, pliant, disciplined workforce that bent to the demands of the factory system, as well as the (often brutal) enforcement of property rights.

Neither dimension can be said to be purely cultural; the synergy between cultural and institutional factors is a topic of growing importance (Acemoglu and Johnson, 2023; Acemoglu and Robinson, 2019). Nor are the two main stories necessarily mutually exclusive. Both Elias and Pinker weave eloquent stories how the civilizing process fed on economic development and benign cultural change, including enlightenment thought. Development – as elegantly argued by McCloskey – surely benefited from the rise of bourgeois values. As people became less violent, more educated, and more capable of self-restraint, the incentives and possibilities to engage in productive economic activity surely increased. This was undoubtedly complementary to bourgeois values and commercial success, creating a positive feedback loop due to the civilizing effect of commerce (Montesquieu, 2002 [1748]). And the fact that the greatest scientific advances, in order to help the coming of the machine age, needed to be built into reliable, precise, durable apparatuses was surely helped by the increasingly machine-like behaviors forced on a (highly reluctant) populace.

Yet this appealing synthesis may obscure darker realities. The 'civilizing process' itself deserves scrutiny – much as Tacitus questioned Roman claims of bringing peace, observing that they "... create desolation and they call it peace." By the same token, it might be said that the "civilizing process" celebrated by Norbert Elias and Stephen Pinker was more cruel than civilizing, more exploitative than humane, creating the human grist for the dark Satanic mills that created the profits of early and high industrialization. This perspective suggests the Industrial Revolution was not solely a triumph of enlightened ideals, of a new culture of cooperation between scholars and skilled workmen, or the result of the hard-working ideals of the bourgeoisie – it was partly built on the attitudes and behaviors instituted by proto-totalitarian institutions imposing top-down control, pioneered by the

[9] Cf. the recent paper by Posch et al. (2025).

increasingly intrusive religious practices of Reformation and Counter-Reformation Europe. The poor, as Deirdre McCloskey, may have "won" as a result of the Industrial Revolution in the long run, but it was arguably a triumph that was well-disguised for several generations.

The rich, voluminous, eloquent, and highly influential literature on the Industrial Enlightenment has struggled to find a significant number of practical examples where science and collaborations between savants and craftsmen directly led to important breakthroughs. The closest to a plausible and testable – but as yet still largely untested – story is Landes' notion that the use of scientific methods by tinkerers and inventors boosted the rate of useful innovation (Kelly et al., 2023). A broader conceptualization of the range of societies that may contribute to growth, and of the knowledge that made a difference, may well prove useful (Cinnirella et al., 2024; Clark, 2000; Squicciarini and Voigtländer, 2015). The dark side of early modern European culture, on the other hand, maps directly into what drove businessmen into the new sectors of the Industrial Revolution – profits. Robert C. Allen (2009) powerfully argued that the inventions of the First Industrial Revolution at first only paid off in one country – Britain – because of dear labor and cheap energy. In the same spirit, any back-of-an-envelope calculation, as hinted at by Mr. Ashworth, the cotton magnate cited by Karl Marx, eloquently testifies to the power of social conditioning for business enterprise. Given the high interdependence of workers in the new factories, with output crucially determined by simultaneous, highly synchronized effort, the need for a new set of behaviors became an imperative for profits. Without a workforce that had, over centuries, been taught to obey, to be on time, and to internalize norms of precision and attention to detail, no factory in the great industrial cities of 19th century Europe could have operated for a day. In other words, more detailed research on the cultural origins of the Industrial Revolution may find more darkness than light, more Leviathan and Puritanical thought control than Enlightenment.

Research on the cultural origins of the transition to self-sustaining growth is now full of vibrant ideas, original approaches, and bold arguments. Empirical work has barely begun to catch up with the idea frontier. Grand narratives, especially when centered on "high culture", often compete based on introspection and plausibility, with data scarce and the weight on anecdotes high. To extend the "credibility revolution" to the study of the Industrial Revolution's cultural origins is becoming easier. "Culture from below" as an analytical angle has two main advantages, compared with research focused on high culture. First, hypotheses are easier to test empirically; cross-sectional differences can be exploited, within Europe and across continents. Local variation in exposure to Cistercian monasteries, say, to high-labor input agriculture, or to the European Marriage Pattern is in principle measurable. Also, there are good reasons to think that at least some of these differences have their origins in quasi-random factors, such as climatic or soil conditions – plausibly excludable from industrialization, but undoubtedly a major factor for how agriculture was conducted for centuries. Second, links with the loosening of Malthusian shackles and the eventual "Great Escape" are more direct and easier to argue from first principles. While important inventions and proud burghers pursuing profits were undoubtedly part and parcel of the societies that experienced an Industrial Revolution, we do not have a clear, reliable, detailed set of results demonstrating how uncommon they were in places and periods where no escape from Malthus occurred. We do know, however, that what was missing were highly disciplined, pliant citizens, drilled in obedience through a web of military drill and religious thought-control, with a strong work ethic composed of small families where late marriage became the norm and individualistic values were cherished.

Anthropological approaches have been more commonly used in analyzing modern-day underdevelopment (Moscona et al., 2020; Bergeron et al., 2024), or in broad sweeps of history (Bowles and Gintis, 2003); the historical settings to which they have so far been applied are predominantly non-European or global (Alesina et al., 2013). This suggests rich opportunities for intellectual arbitrage in understanding transitions in early modern Europe.

New data sources will also facilitate progress. Climate variation as a plausibly exogenous source of variation driving cultural evolution is only beginning to be explored (Giuliano and Nunn, 2021). Text analysis of either deep-rooted cultural artifacts like folklore, or of historical publications – as in the work by Michalopoulos and Xue (2021), Ash and Xue (2024) and Almelhem et al. (2023) – allows a more detailed and insightful look at attitudes and beliefs. It does so by going beyond "elite" sources of information on culture. Text analysis allows for broad-based quantification of sentiment, going beyond a few elite texts by exploiting such sources as proverbs, the content of thousands of books, or corpora of folk tales. In addition, recently digitized newspapers, combined with the text analysis abilities of transformer architectures – as embodied in large language models (LLMs) – offer the potential to put many theories of culture and technological progress to the test. Also, the use of images as a source (Safra et al., 2020; Gorin et al., 2024; Caprini, 2024; Adukia et al., 2023; Voth and Yanagizawa-Drott, 2024) can shed light on a wider range of cultural practices, from trustworthiness to individualism.

The full promise of whole-genome analysis for shedding light on changes in the composition of populations (Reich, 2018; Ebstein et al., 2010; Akbari et al., 2026) is yet to be realized. Characteristics like neuroticism and susceptibility to oxytocin (associated with greater pro-sociality) appear to be well-identified polygenic traits (Stern et al., 2021; Kosfeld et al., 2005). This in turn suggests that the growing data on the genes of ancient populations will allow detailed testing of important hypotheses, such as ones linking compositional drift, preferences, and economic development (Galor and Moav, 2002; Clark, 2007). Similarly, Atari et al. (2022) show that pathogen prevalence appears to affect moral beliefs over time and in the cross-section. Indeed, Atari et al. (2025) call for psychology to become a geographical and historical science, based on rich new sources in genetics, image analysis, archeology, and text2data methods.

These recent advances in sources and analyses techniques will make it far easier to collect and analyze broad associational patterns and correlations. As a result of the confluence of new computational tools, applied to text and image analysis, with potential insights from human genome mapping, the prospects for shedding more empirical light on the diffusion of cultural characteristics facilitation the "Great Escape" appear bright.

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