The Institutional Origins of the Industrial Revolution

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Introduction. The new institutional economics has, so far, had little to say about the Industrial Revolution. In their survey of Institutions and Modern Growth, Acemoglu, Johnson, and Robinson (2005) acknowledge eighteenth century Britain as a successful economy and much like North and Weingast (1989) before them search for the institutional causes in seventeenth-century political developments and in the constraints placed on the British executive (the monarchy and the royal bureaucracy) by Parliament before and after the Glorious Revolution. In this framework a grand coalition of merchants and landowners emerged, keen on protecting commerce and property. For the first time in British history, the commitment problem, in which property rights were enforced by a suitably constrained entity, approached solution.

While neither Acemoglu et al. nor North and Weingast actually say so explicitly, they imply that these reforms paved the road to the British Industrial Revolution.[1] Others are not so prudent. Mancur Olson (1982, pp. 78-83, 128) had no doubt that "a few decades after stable and nationwide government had been established in Britain, the Industrial Revolution was on its way." In his recent survey, Kenneth Dam (2005, p. 84) makes the statement that "the Glorious Revolution provided a strong base for later enjoyment of the fruits of the Industrial Revolution ... that made England arguably the wealthiest country in the world." The accounts pointing to the formal political institutions established in late Stuart and Williamite Britain rely on the notion of credible commitment: the crown deliberately relinquished many of its prerogatives to Parliament, and thus committed itself to pay its debts and to respect the property of its citizens. At the same time, Parliament made its own commitment to sound public finance credible by not removing all of the Crown's power. One way or another, if institutions were the key to economic growth and "rule" in the formulation of Rodrik et al. (2005), they should have played a major role in the central event that triggered modern economic growth: the British Industrial Revolution.

Yet, surprisingly, there has been little effort to apply the new insights of institutional analysis to the central event of modern economic history to date, and the institutional origins of the Industrial Revolution remain poorly understood. The reason for this gap in the literature relates to two sources of confusion. One

[1]North (1981, p. 166) comes close to linking the institutional changes of the late eighteenth century with the Industrial Revolution when he maintains that it was explained by "a combination of better-specified and enforced property rights and increasingly efficient and expanding markets." North and Weingast (1989, p. 831) are more prudent and wonder if arguing that without the Glorious Revolution the British economy would have followed a very different path and would not have experienced an Industrial Revolution would be "claiming too much."

is the distinction between the events in *Britain,* which made it the leading economy in the Industrial Revolution, and developments in the larger North Atlantic economy, which refer to the Industrial Revolution in a wider area and the origins of modern growth in the West. This confusion mars much of the debate. Thus the stress on the Glorious Revolution by the institutionalists cited above, or the heavy emphasis on the fortuitous presence of useful minerals (Pomeranz, 2000; Wrigley, 1987, 1988) can explain the Industrial Revolution in Britain or in the Walloon areas of Belgium, but not in Switzerland or Saxony. On the other hand, emphases on modern science (Bekar, Carlow and Lipsey, 2005; Jacob and Stewart, 2005) or the Enlightenment (Mokyr, 2005; 2006a) stress the pan-european aspects of eighteenth-century developments that created the background for a *European* Industrial Revolution. The latter approach implies that national politics or geographical conditions may well explain British lead, but not the more general economic development that led to the emergence of a multinational convergence club by 1914, in which Britain was at best a primus inter pares.[2] Institutional analysis falls somewhere in between those two approaches. Each country had its own national and local institutions, but certain institutional elements were shared, imitated, and spilled over so that a "European mode" may be discerned in the continent-wide pressures toward reform after 1750. Institutional changes were inspired by Enlightenment thought that affected much of the Western World (Mokyr, 2006c). The analysis in this paper will be concerned with the "smaller" question of Britain's leadership and will thus focus primarily on the institutional environment in Great Britain. In other Western societies, however, institutional changes before 1850 helped create the convergence club as it existed in 1914.

The second source of confusion is that the new Northian literature focuses on formal institutional transformations, in which the Crown committed to respect the property rights of the landowning and mercantile classes, made contracts more enforceable, and reduced transactions costs and uncertainty. Such an account explains growth in an economy in which institutions lubricated the wheels of commerce, finance,

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[2]Arguably, it could be maintained that the Industrial Revolution followed a contagion model, in which Britain was indispensable as a model to be emulated and followed, and that without its leadership, the Continent would not have been able to develop. That the British example was widely followed and imitated in various forms on the Continent cannot be denied. Britain's example shaped some of the forms of the Industrial Revolution on the Continent. But the consensus today is thatFrance, Prussia, Belgium, Switzerland, and Northern Italy followed quite different but equally successful technological and institutional trajectories. Given that much of the nineteenth century technology was actually invented on the Continent, it seems implausible that British leadership was a necessary condition for the Industrial Revolution in the West as a whole.

agriculture, and premodern artisanal manufacturing and cottage industries. It led to an improvement in the allocation of resources and the accumulation of more capital. In this fashion such changes provide an explanation of Smithian Growth, in an economy with a static technology. The Industrial Revolution, however, was far more than that. Had it not been, the process of economic growth would have eventually asymptoted off into a new stationary state. In the final analysis the Industrial Revolution rested on key technological breakthroughs and their application to production by a class of successful industrial entrepreneurs. These successes did not, moreover, lead to a new technological equilibrium but made room for the far more astonishing phenomenon of the non-convergence of technology to a new set of dominant designs. Instead, continued improvement in technology after 1800 became the rule. How are we then to link the essence of the British Industrial Revolution to the events of 1688, and beyond and how did institutional factors, broadly defined, help elevate Britain to the leading position it took in the Industrial Revolution?

Below I argue that the traditional emphasis on *formal* institutions has been over-emphasized, and that the enforcement of property rights by the state was less crucial than the Northian interpretation has suggested. The importance of institutions extended beyond politics and formal institutions. We need to take account "cultural beliefs" as defined by Greif (2005), which created an environment in which inventors and entrepreneurs could operate and cooperate freely. Equally important, we need to pay attention to those institutions that stimulated and encouraged technological progress and not just the growth that depends on well-functioning markets. Formal institutions such as state-enforced patent rights may have been overestimated at the expense of informal private order institutions

II - IPR's and technological progress in the Industrial Revolution

Any institutional analysis that purports to deal with *modern* economic growth needs to recognize that what the Industrial Revolution meant was that technology increasingly became the engine of economic growth and that without it the process would inevitably have fizzled out. Which institutional structure was really conducive to technical innovation? We need to face the possibility that institutions that enhanced efficiency in a static commercial-agrarian economy were not identical to those that transformed production through rapid technological change. Secure property rights in land may have been important in a techno-

logically static commercial economy, whereas a more dynamic economy required the flexibility provided by eminent domain and even the option to extinguish some traditional property rights if need be, such as happened through enclosure and railway acts. Credit markets like Britain's were adapted to short-term merchant credit and bills of exchange, but not necessarily for the fixed capital goods needed to set up a factory. In other words, a technologically dynamic society needs institutions that encourage creative destruction à la Schumpeter rather than those that support static efficiency. To be sure, some of those institutions may have overlapped (e.g. those that provided access to capital under high degrees of uncertainty), but on the whole "good institutions" are historically contingent.

At first glance it would seem that the British patent system, in force since 1624, was a classic example of successful protection of intellectual property rights, and that the incentives to innovate it created were central to its economic success (North, 1981).[3] The idea that technological progress depended on inventors' incentives through a patent system has become increasingly dubious on both historical and theoretical grounds (MacLeod, 1988; Boldrin and Levine, 2006; MacLeod and Nuvolari, 2007). Our concept of intellectual property rights has been too limited and too conditioned on modern circumstances. In the centuries before the Industrial Revolution, useful knowledge, both "natural philosophy" or science (broadly defined) and "the useful arts" or technology, developed much more along a system of open science, akin to modern open-source technology (Mokyr, 2006, 2007). While we should not altogether dismiss the role for the British patent system as an institutional factor in the Industrial Revolution, the new research casts some doubt on its strategic importance and at the same time shows the extent to which Britain's advantage on its European neighbors was limited. After all, many European nations adopted a patent law similar to Britain's after the French Revolution, and the patent system of the United States was far more user friendly (for inventors) than Britain's (Khan and Sokoloff, 1998), but none of this reduced British technological lead before 1850. Moreover, Moser (2007) has shown that only a small proportion of the significant inventions

[3]Goethe may have been somewhat naive when he wrote that the British patent system's great merit was that it turned invention into a "real possession, and thereby avoids all annoying disputes concerning the honor due" (cited in Klemm, 1964, p. 173). Note, however, his emphasis on "honor" as opposed to profit. Not so the Scottish Enlightenment writers. In his *Lectures on Jurisprudence* (1762-66 [1978), pp. 83, 472], Adam Smith admitted that the patent system was the one monopoly (or "priviledge" as he called it) he could live with, because it left the decision on the merit of an invention to the market rather than to officials. Smith thought, somewhat unrealistically, that if an "invention was good and such as is profitable to mankind, [the inventor] will probably make a fortune by it."

made in Britain by the middle of the nineteenth century were ever patented.

Eighteenth century writers were torn between the Baconian concept of knowledge-generation as an open, cooperative activity, and the belief in the sanctity of property and individual rights. Contemporary opponents of the patent system identified it as a rent-seeking device, often used to block new entry, conveniently ignoring the fact that those who resisted patents, such as guilds, were sometimes motivated by protecting their own incumbency from unwelcome entrants (MacLeod, 1988, pp. 83, 113). It was also noted in the late seventeenth century that patentees often were not the best qualified persons to exploit the inventions.[4] A different critique, but equally telling, was made by J.T. Desaguliers, who pointed out (1763, Vol. 2, p. viii) that (much like modern venture capitalists), a patent was often interpreted by investors as an official imprimatur of the quality of an invention and that "several persons who have money, ready to supply boasting Engineers with it in the hope of great Returns, and especially if the project has the Sanction of an Act of Parliament to support it, and then the Bubble becomes compleat and ends in Ruin." The problem how society should reward those who gave their time and money to develop knowledge that was of great benefit to the rest of society remained. Such rewards, it was understood, needed to be established if society was to enjoy the fruits of sustained technological progress, but how this was to be achieved remained in dispute.

Moreover, not all inventors sought the rewards of a successful patent, and certainly not many actually attained it. In Britain, the state only recognized and enforced the inventor's right (Hilaire-Perez, 2000). It did not normally evaluate the invention's contribution to society. Britain's patent system, however, was not exactly inviting: it charged a patentee around £ 300 for the right to patent in the entire Kingdom, not counting the costs of traveling to and staying in London (Khan and Sokoloff, 1998).[5] Many patents were infringed upon, and judges were often hostile to patentees, considering them monopolists (Robinson, 1972, p. 137). A considerable number of the inventors in the Industrial Revolution placed their inventions at the public's disposal, and others for one reason or another failed to secure a patent or subsequently lost it. Politicians rea-

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[4]Andrew Yarranton, a seventeenth-century tin-plater and navigation engineer, found his business harmed by a patentee incapable of working it properly (MacLeod, 1988, p. 184).

[5]The bureaucratic procedure to take out a patent was referred to by contemporaries as "cumbrous machinery." It had been little changed since it was established in 1536, and contemporaries delighted in ridiculing it, as in Charles Dickens's short story *A Poor Man's Tale of a Patent.*

lized that rewarding inventors who made significant contributions to the nation's technological capabilities made good public policy, unless it was done excessively and used for patronage. Thus Thomas Lombe, denied a patent extension in 1732, was awarded a substantial cash settlement by Parliament. In the first decade of the nineteenth century, Samuel Crompton, the inventor of the mule, and Edmund Cartwright, the inventor of the power loom, were also voted substantial awards by Parliament in recognition of their unpatented inventions. Such procedures were at times arbitrary (the estate of Henry Cort was denied a similar request), but they reflect a public acknowledgment that invention was costly and risky, and that if society wanted a continuous stream of technical improvements, it had to make the activity that generated innovation financially attractive.[6] It seems that the main effect of the patent system on innovation was to goad potential inventors into believing that they, too, could make as much money as successful patentees such as the Lombe brothers of Derbyshire or James Watt. Although precious few ever did, the expectation may have been enough for many.

Britain was not the only Western nation to cultivate institutions that encouraged technological progress. France and the Netherlands had patent systems in which innovations could yield considerable benefits to their propagators. The type of encouragement given to inventors in Britain differed from the French system, where government agents were put in charge of evaluating the contribution of certain inventions to the realm. The difference between the two systems can be overstated: at times the British authorities recognized the national interest in pursuing a new technology and was willing to take the iniative. An example was the Board of Longitude, established in 1714 by Parliament, which promised a large sum to the person who successful cracked the problem of measuring longitude at sea. Almost a century later, the British Navy under the leadership of Samuel Bentham (Jeremy's brother) established the Portsmouth shipyards where

[6]The pioneers of the paper-making machines, Henry and Sealy Fourdrinier, too, were awarded a grant of £ 20,000 by a Parliamentary committee (after many manufacturers testified selflessly that the continuous paper machines had been of huge benefit to their respective branches), though this amount was later reduced to £ 7,000 and paid as late as in 1840, when Henry was already in his seventies. Edward Jenner was voted a grant of £ 30,000 in 1815. The scientist William Sturgeon, one of the pioneers of electrical technology in the 1830s, fell on hard times toward the end of his life, and was awarded a one -off payment of £200 plus a small pension by Lord John Russell's government. In all these cases, and many others, there was an explicit recognition that these people had added to the well-being of the realm, in other words, they had produced positive externalities. But they also reflect a recognition that invention was costly and risky, and that if society wanted to generate a continuous stream of technical improvements, it had to make the activity that generated innovation financially attractive even to those who had placed their knowledge freely at society's disposal.

the great engineer Marc I. Brunel and the instrument maker Henry Maudslay developed an advanced mass-production interchangeable-parts system in making wooden blocks for the Royal Navy. Military objectives aside, the British government normally left picking technological winners to the free market and the private sector, and the patent system reflected that attitude.

The exact impact of the patent system and other positive incentives on the technological creativity that eventually helped produce a more prosperous nation is hard to establish. Some economists have recently gone so far as to dismiss it altogether. Boldrin and Levine have argued that intellectual property rights were unimportant in bringing about economic growth, and have specifically pointed to the Industrial Revolution as a period that provides "a mine of examples of patents hindering economic progress while seldom enriching their owners and of great riches and economic successes achieved without patents" (Boldrin and Levine, 2005, chapter 4, p. 7). Such an extreme position neglects that the patent system was important ex ante in giving would-be inventors hope for success, in a fashion not dissimilar to why people purchase lottery tickets (Dutton, 1984). If no one ever won the lottery, people would stop buying tickets, but the number of winners need not be very large to keep hope alive.[7] But the continuing debate on the issue exemplifies the complexity of the institution. It also underlines the difficulty in separating exactly those elements we think of as "institutional" and those that belong properly to the category of "technological creativity."

Britain created alternative organizations that encouraged innovation and the dissemination of useful knowledge beyond the Patent system. A notable example is the Society of Arts, founded in 1754, which explicitly aimed at disseminating existing technical knowledge as well as at augmenting it through an active program of awards and prizes, encouraging networking through correspondence, the publication of

[7]Britain's greatest post-1830 inventor, Henry Bessemer, believed that "the security offered by patent law to persons who expend large amounts of money in pursuing novel inventions, results in many new and important improvements in our manufactures" (Bessemer, [1905] 1989, p. 82). Not all inventors concurred with this view, but if enough of them saw it this way, the British patent system deserves some credit. H. I. Dutton (1984, p. 203) has argued that for many inventors patents were the only means by which they could appropriate a sufficient return for their effort and that patents thus provided security in an exceptionally risky activity. The patent law was often poorly defined and the courts unfriendly to inventors, but it remained in most cases the best incentive for inventive activity. Dutton argues that the patent laws were a "slightly imperfect" system that created an ideal system in which there was enough protection for inventors to maintain an incentive for inventions, yet was not so watertight as to make it overly expensive for users. If inventors systematically overestimated the rate of return on inventions by not fully recognizing the weaknesses of the patent system, they would have produced more innovations than in a world of perfect information. Another distinguished engineer, Richard Roberts, stressed that had it not been for the patent system, he would not have invented as much as he did, and the inventions he would have made would have lain on the shelves (Great Britain, 1851, p. 187).

periodicals, and the organization of meetings.[8] Only inventions that had not been patented were eligible for one of the Society's prizes. Although such effects are hard to measure, there can be little doubt that the Society helped to stimulate invention by increasing the social standing of inventors in Britain and improve communication between creative and knowledgeable people. In 1799, two paradigmatic figures of the Industrial Enlightenment, Sir Joseph Banks and Benjamin Thompson (Count Rumford), founded the Royal Institution, devoted to research and charged with providing public lectures of scientific and technological issues. Furthermore, there were the Mechanics Institutes, the first one established by Birkbeck in 1804 in London, and which spread to Scotland and then to the rest of the country. Mechanics Institutes provided technical and scientific instruction to the general public. Private institutions seem to have been quite adequate for most of Britain's needs. All in all, the British patent system was on balance a positive institution, but in no way can we credit it with giving Britain the edge that turned it into the first industrial nation.

In addition to institutions that encourage innovation, a society that hopes to benefit from technological progress needs venture capital. The traditional story is that venture capital in Britain was hard to come by because lenders tended to be conservative. Most fixed capital that embodied the new technology such as machines and engines was scraped together from private sources and from retained earnings. Yet even at the early stages of the Industrial Revolution some of the institutions that emerged in Britain were favorable to venture capital. One such institution was country banks, which experienced a veritable explosion in the second half of the eighteenth century. In 1750 there were no more than a dozen such banks, while in 1800 there were 370. A recent paper (Brunt, 2006) has gone so far as to compare these banks to modern venture capitalists, though the analogy appears stretched. There is some evidence, however, that country bankers believed that they had inside information in high-risk industries and thus invested in them, copper mining in Cornwall being the best-known example . They failed in large numbers during crises, which indeed may be consistent with their participation in vulnerable industries. Yet again, it is important not to see the years of the Industrial Revolution through a twenty-first century perspective. The total amount of fixed capital need

[8]William Shipley, its founder, viewed its purpose as follows "Whereas the Riches, Honour, Strength and Prosperity of a Nation depend in a great Measure on Knowledge and Improvement of useful Arts, Manufactures, Etc... several [persons], being fully sensible that due Encouragements and Rewards are greatly conducive to excite a Spirit of Emulation and Industry have resolved to form [the Society of Arts] for such Productions, Inventions or Improvements as shall tend to the employing of the Poor and the Increase of Trade."

for the Industrial Revolution was not very large in the early stages, and of that, not all was high-risk capital.

III: Law, order, and institutions

Economic growth depends on law and order, but the two are not identical. Legal centralism, as Oliver Williamson has referred to it, places the law, and the state that enforces it, at the center of the stage. The issue then becomes one of credible commitment between a Hobbesian entity with a monopoly of violence, and its subjects. The subjects want the state to enforce the rules of the game but not to accumulate so much power that the state can threaten those very rights it is asked to protect. "Order" in the sense of the protection of property and contract enforcement can be attained through norms reflecting the willingness of individuals to voluntarily overcome their tendency to behave opportunistically. In that fashion they create what can be called an *economic civil society* in which reputational or other mechanisms support a world in which most people believe that it is proper to behave in a cooperative way. The key to successful economic exchanges here is not necessarily an impartial and efficient third-party enforcing agency, but the existence of a level of trust or other self-enforcing institutions within relevant networks of commerce, credit, wage-labor, and other contractual relations that support free market activities. In other words, the state is neither necessary nor sufficient. The simple model in which it is *only* the state and threat of its justice and police systems that makes people behave cooperatively seems a poor description of any known situation.

How much of a "law and order society" was Britain before the Industrial Revolution? Crime was of course a serious problem in this society, though it is not easy to quantify it. The Swiss tourist De Saussure (1902, p. 127) found in 1726 that Britain had a "surprising quantity of robbers" but other foreign travellers also commented widely on the low levels of murder and violent crime in Britain, and one scholar feels that the murder rate in mid eighteenth century London would astonish a modern observer accustomed to modern American or even European cities as "remarkably low" (Langbein, 1983b).[9] Yet the admittedly somewhat

[9]One attempt was made by the famous political economist and magistrate Patrick Colquhoun who tried to count the number of "persons who are supposed themselves by criminal or immoral pursuits." Despite his clear attempt to show the criminality of London's environment, the numbers are actually rather modest. Out of a population of 865,000 he counted 115,000 such persons. This figure seems startlingly high, until we realize that it included 50,000 "unfortunate females who support themselves by prostitution" and 10,000 "servants, male and female out of place principally from ill behaviour and loss of character" not to mention 2,000 "itinerant Jews, wandering from street to street, holding out temptations to pilfer and steal." Cf. Colquhoun, 1797, pp. vii-xi.

tenuous evidence suggests that violent crime was declining over the eighteenth century and that crimes against property moved more or less pari passu with population growth (Beattie, 1974; Beattie, 1986). There was also collective crime. Local rioting, either for economic or political grievances, was common. Machine breaking, bread riots, turnpike riots, or rioting against some unpopular group like Catholics, Irish immigrants, or dissenters were common. Turnpike riots, the Gordon riots of 1780, and the Bristol Bridge riot of 1793 all sowed fear in the hearts of property-owning classes. However, daily crime that seriously endangered the accumulation of capital and the proper conduct of commerce was on the whole rare. To be sure, eighteenth century Britain passed a myriad of draconic laws protecting property by imposing ferocious penalties on those who infringed on it.[10] Food rioters, forgers, thieves, and those who resisted enclosures and new machinery forcibly were all threatened by execution and transport. The harshness of the penalties seems to suggest that violent crime and crimes against property were regarded as serious issues. Yet it also meant that the authorities were reluctant to spend resources on law-enforcement, hoping that the harsh punishments could deter would-be criminals.[11] Hanoverian Britain had no professional police force comparable to the constabulary that emerged after 1830, and the court system was unwieldy, expensive, and uncertain.[12] Britain depended on the deterrent effect of draconian penalties because it had no official mechanism of law-enforcement, prosecution was mostly private, and crime prevention was largely self-enforcing, with more than 80 per cent of all prosecutions carried out by the victims. Few victims were willing to proceed with the costly

[10]By 1760, the great legal scholar Blackstone complained that "Yet, though . . . we may glory in the wisdom of the English law, we shall find it more difficult to justify the frequency of Capital Punishment to be found therein, inflicted ... by a multitude of successive independent statutes upon crimes very different in their natures." He added that the list was so dreadful that crime-victims were reluctant to press charges and juries reluctant to convict (Blackstone, 1765-69, Vol. 4, p. 18).

[11]This argument has been made with great emphasis by Hay (1975), who stressed the strong class-bias in eighteenth-century British criminal law. For a critique, see Langbein (1983a), who has argued effectively that the bark of these draconian criminal codes was worse than their bite.

[12]Eighteenth century law enforcement was in the hands of local magistrates and a part-time local parish constables. For the rest, justice had to rely on volunteers, local informers, vigilante groups, and private associations specializing in prosecutions of felons. Some 450 such organizations were established in England between 1744 and 1856. London developed its first constables after Henry Fielding was appointed magistrate at Bow Street in 1748, and his professional assistants or thieftakers became known as "Bow Street Runners." Yet it was not until after 1830 that anything remotely resembling a professional police force began to emerge in the rest of Britain and as late as 1853, half the counties in Britain were still without police. In fact, the eighteenth century idea of "police" was quite different from ours: the word meant something like a series of regulations and regulatory agencies for the supervision of the manners, morals, and health of society rather than a body of officers (Paley, 2004).

and burdensome tasks of prosecuting a crime (Emsley, 2005, pp. 183-186). Patrick Colquhoun noted in 1797 that "not one in one hundred offences that is discovered or prosecuted" (1797, p. vii). The growing volume of both domestic and international commerce and credit was supported less by formal law and order and third-party arbitration than by private-order institutions.

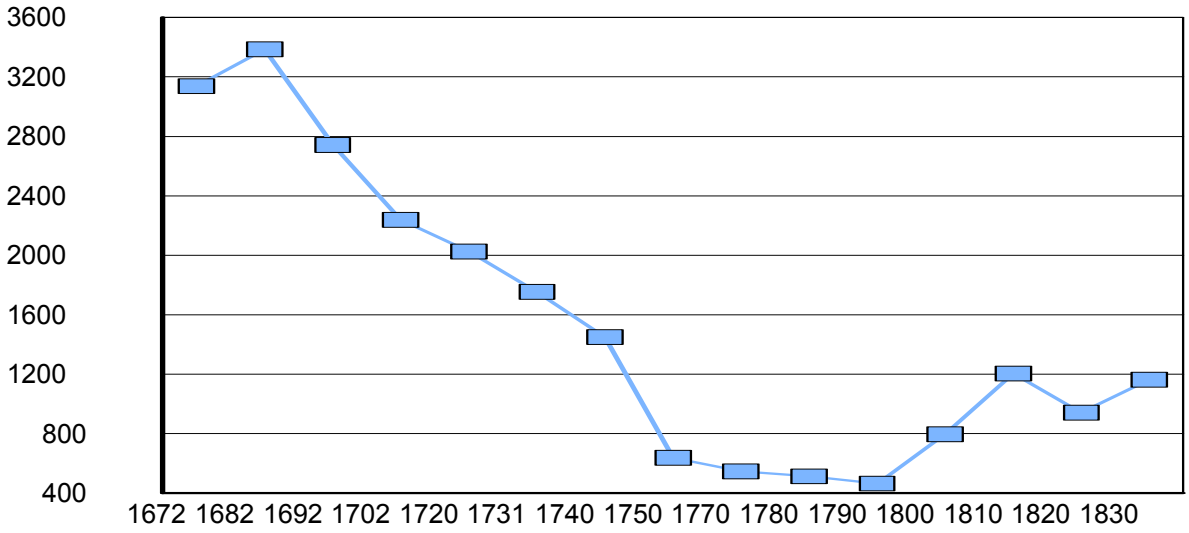
If formal law enforcement was a last resort in the enforcement of contracts and the protection of property rights, how did markets function? What kept transactions costs and opportunistic behavior to mushroom to the point where they jeopardized the levels of exchange and division of labor required for a sophisticated economy? A different way of posing the same question was expressed by the young French economist Adolphe Blanqui (1824, p. 326) visiting London who wondered how a town twice the size of Paris (nearly a million people) could maintain order with only a handful of watchmen and constables. He seemed less than satisfied by the answer that the English go to bed and lock up their shops early, and was more inclined to believe that they were harder-working and more enlightened.

At closer examination, day-to-day security depended more on social conventions and self-enforcing modes of behavior than on the administration of justice by an impartial judiciary. Commercial disputes rarely came to court and were often settled through arbitration.[13] Even patent litigation was rare: out of almost 12,000 patents issued between 1770 and 1850, only 257 ever came before the courts (Dutton, 1984, p. 71). Indeed, the number of civil cases that came to court in the eighteenth century declined precipitously relatively to their mid seventeenth century levels: the number of cases heard at the King's Bench and Common Pleas in 1750 was only a sixth of what it was in 1670 (Brooks, 1989, p. 364). As figs. 1-3 demonstrate, there can be little doubt that the British as a whole were becoming less litigious in the eighteenth century before things

[13]Small debts could be settled through courts of voluntary arbitration known as Courts of Conscience (also known as Courts of Requests), which became increasingly popular after 1750 for settling debts without the burden of expensive court cases. These courts, significantly, were unpopular among working people who objected to the way they dealt with tallies run up in ale houses — a tell-tale sign that they were effective.

Fig. 1: Number of Cases sent to Trial

Common Pleas



picked up again in the nineteenth century. Interpreting this fact seems less than straightforward. Does it support the view that legal institutions were becoming less important as a contract enforcement mechanism? One could argue that if courts were extremely efficient, they might be used less.[14] Or was there a deeper social transformation? Historians such as Lawrence Stone (1985) have indeed argued that the social tensions and violence of the English world before 1650 gradually transformed it into a kinder and gentler environment in which contentiousness declined. Some contemporary commentators felt that in the late eighteenth century, behavior was slowly changing.[15]

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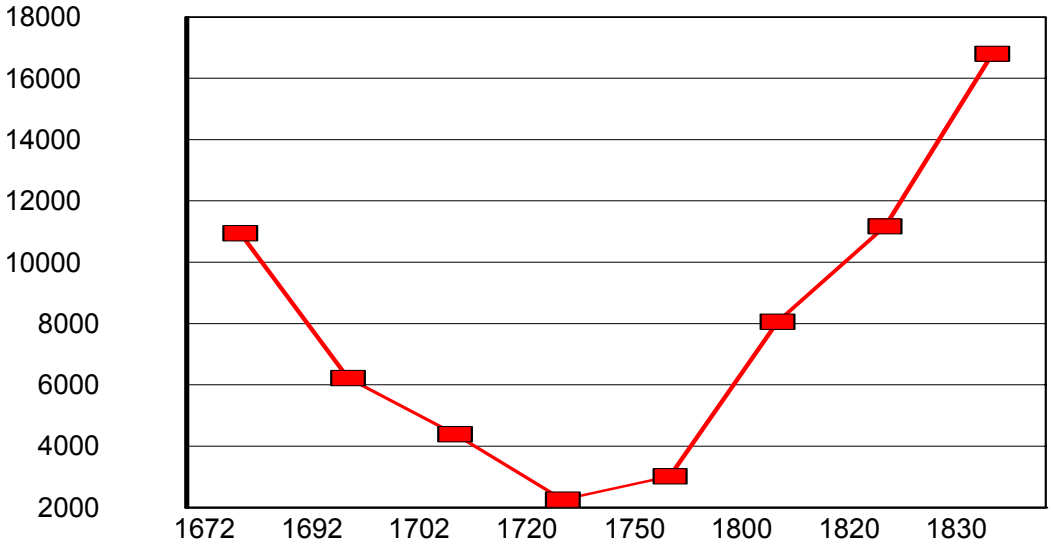
[14]The most likely alternative to a decline in litigiousness is that courts became less accessible and more costly. On the other hand, courts enforced contracts (both written and verbal) increasingly through procedures called "actions on the case" (such as *assumpsit* for debt) in which courts enforced contracts without a formal trial (though such trials could sometimes still result). Brooks (1998, p. 91) adds that it is even possible that the high volume of trials in the seventeenth century may have exerted a "pedagogic effect" on debtor-creditor relationships.

[15]Francis Place, (1771-1854), the radical politician and reformer, for instance, noted that "the progress made in refinement of manners and morals seems to have gone on simultaneously with the improvement in arts, manufactures and commerce... we are a much better people than we were [half a century ago], better instructed, more sincere and kind-hearted, less gross and brutal" (cited by George, 1966, p. 18). Beattie (1986, p. 138-9) concurs with this view, and concludes that in 1800 British cities, and especially London, were less violent and dangerous places than in 1660.

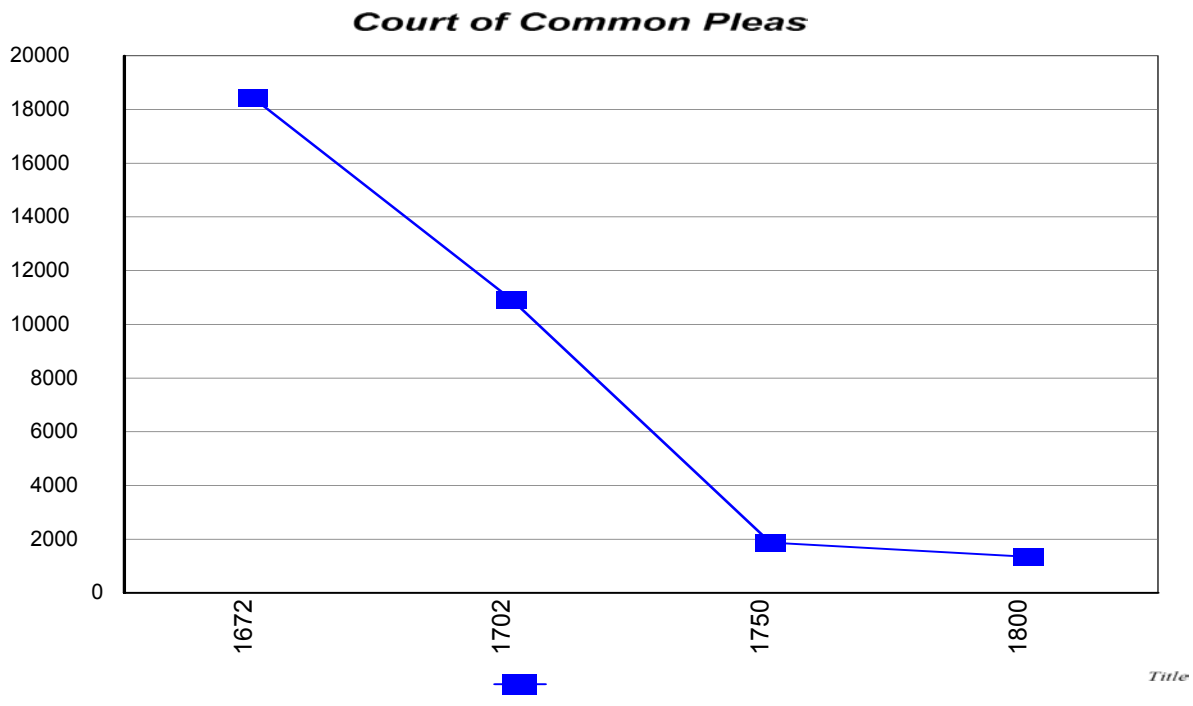
Fig. 2: Cases in advance stages

King's Bench



Whether eighteenth century Britain was really becoming a kinder and gentler place is a difficult issue, but at least within the circles of commerce, finance and manufacturing, trust relations and private settlement of disputes seem to have prevailed over third party enforcement. Most business was conducted through informal codes of conduct and relied on local reputation and religious moralizing to imbue honesty and responsibility. Voluntary compliance and respect for property and rank as social norms (private-order institutions, in Greif's terminology) may have been as important as formal property rights in turning the wheels of the British economy. These norms involved a variety of signalling devices associated with "gentlemanly" codes and were commented on by contemporaries as "politeness" in a variety of contexts (Langrod, 2000). Economics suggests that such behavior is often associated with attempts to signal one's trustworthiness to potential partners in the market. These norms applied only to the middling classes. The laboring classes and

Fig. 3: Cases in Advances Stages



the unwashed poor remained outside this society, so the norms did not apply to them. Hence, these classes

had to be controlled by force, and the draconian laws protecting property from them reflected this need.

Observant contemporaries noted that informal institutions, that is, customs, traditions, and conventions delineating acceptable behavior were at least as important as a formal rule of law. Charles Davenant (1699, p. 55) put it well: "Nowadays Laws are not much observed, which do not in a manner execute themselves" and felt that because the magistrates did not have a strong motive to perform his duty, private persons might be relied upon "to put the laws in execution." Defoe (1701, p. 87) added caustically that "the English must be unaccountably blameable, whose Laws are the people's own Act and Deed, made at their Request ... yet no Nation in the World makes such a jest of their Laws as the English." What Davenant and Defoe were observing that an increasing number of people were bargaining "in the shadow of the law," that is, the parties in disputes knew what the stakes were and the (substantial) loss they would incur in case they went to trial. Yet the law itself set a guideline to dividing up the resources in dispute, and thus made the bargaining process more likely to result in cooperation, since knowledge of the law, as well as the costs of going to trial, were common to both sides, and the legal process may have become more conducive to private ordering by discouraging people to go to trial and compromise.[16] The Hobbesian view, that insists that order can only achieved through firm third-party enforcement, may well be true for many societies (depending on many parameters, delineated by Cooter, Marks, and Mnookin, 1982), but it appears that for Britain in the century following Hobbes's death (1679) it was becoming an increasingly less apt description of social reality in Britain. What this means is that we cannot really place the efficiency of the State at the center of the stage of institutional explanations of the British economic miracle.

Indeed, the argument that Britain's advantage in leading the Industrial Revolution was due to its efficient enforcement of property rights after 1688 needs to be revisited. What mattered was that within the merchant and artisan classes there existed a level of trust that made it possible to transact with non-kin, and increasingly with people who were, if not strangers, certainly not close acquaintances. In an age when the costs of legal action went up, its availability and efficiency declined, fewer and fewer people took a recourse

[16]The term "bargaining in the shadow of the law" originates with Mnookin and Kornhauser, 1979.

to the law and replaced by common behavioral codes among people belonging to the same class.[17] . We might have expected the reverse: the growing integration of goods and factor markets and the widening of the domestic market, and especially the increase in transactions at arm's length throughout the period of the Industrial Revolution eventually necessitated a formal system of law enforcement. But in the eighteenth century this was far from clear.

Directions of causality are difficult to establish here. Most enlightenment thinkers believed that the correlation between people cooperating and behaving honestly was caused by a mechanism running from prior commercialization to behavior. It was thought that commerce led to more trustworthy behavior, much like Montesquieu's influential notion of *doux commerce* which established an association between the "gentle ways of man" and the establishment of trade (Hirschman, 1977, p. 60).[18] But it seems more plausible that the causal arrow went primarily in the other direction, that is, certain forms of behavior led to cooperative behavior that made market transactions possible, even at arm's length, and thus encouraged economic development.

By 1700, "gentleman" had come to mean quite different things, one an socio-economic status, the other a code of behavior.[19] A gentleman, Asa Briggs (1959, p. 411) notes, was someone who accepted the

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[17]As Brewer, 1982, p. 214, who was one of the first to point to the importance of this phenomenon, noted, "reliability, fairness and generosity were the qualities most highly valued... these attitudes oiled the wheels of commerce and enabled men to make greater profits."

[18]Adam Smith, in his *Lectures of Jurisprudence,* thought he had the answer: "Whenever commerce is introduced into any country, probity and punctuality always accompany it. These virtues in a rude and barbarous country are almost unknown. Of all the nations in Europe, the Dutch, the most commercial, are the most faithfull to their word...There is no natural reason why an Englishman or a Scotchman should not be as punctual in performing agreements as a Dutchman. It is far more reduceable to self interest, that general principle which regulates the actions of every man, and which leads men to act in a certain manner from views of advantage, and is as deeply implanted in an Englishman as a Dutchman. A dealer is afraid of losing his character, and is scrupulous in observing every engagement... Where people seldom deal with one another, we find that they are somewhat disposed to cheat, because they can gain more by a smart trick than they can lose by the injury which it does their character" (1762, p. 327).

[19]Defoe (1703, p. 19) famously wrote that "Wealth, however got, in England makes lords of mechanics, gentlemen of rakes; Antiquity and birth are needless here; 'Tis impudence and money makes a peer." Dr. Johnson, in the same spirit, noted that "An English tradesman is a new species of gentleman" if he prospered sufficiently (Porter, 1990, p. 50). McCloskey (2006, pp. 294-96) traces the transformation of the word "honor" in English and French from its aristocratic sense ("reputation") to its more capitalist sense of "honesty" (reliability, truth-telling) and "politeness" ("doing the right thing") when the importance of these concepts began to increase in the eighteenth century, and discovers that the same change occurred in the Dutch language.

notion of progress but was always suspicious of the religion of gold. An individual signalled that he was trustworthy and would not behave opportunistically because, like a true gentleman, he was not primarily motivated by greed. Gentlemanly capitalism was a way in which opportunistic behavior was made sufficiently taboo that only in a few cases was it necessary to use the formal institutions to punish deviants, since the behavior is to a large extent internalized.[20] The notion that eighteenth century landowners were scrupulously honest or indifferent to money is a myth, but the pretension was a good signal for behavior that was less than maximally opportunistic and could thus sustain more readily cooperative trust-equilibria. The idea of a gentlemanly culture is traditionally associated with an aristocratic aversion to business and is thus often held to be antithetical to economic development.[21] But in a different sense, being a gentleman meant that one could be trusted and Gentlemanly Capitalism provided a shared code, based on honor and obligation, which acted as a blueprint to prevent opportunistic behavior (Cain and Hopkins, 1993). The behavior of actual country gentlemen and the moral codes believed to be associated with them and emulated if one was to be regarded as such should not be confused. Landowning parasitic drones were no more "gentlemen" than sword-wielding medieval thugs were "chivalrous." By adopting these codes, an individual signalled that he was trustworthy and would not behave opportunistically. In eighteenth-century Britain, a businessman's most important asset was perhaps his reputation as a "gentleman" even if he was not a gentleman by birth or occupation.

Economists and other social scientists have come to the conclusion that social norms of cooperation and decency can prevail even in societies with ineffective formal law enforcement (Ellickson, 1991). This happens in tightly knit groups in which reputational mechanisms work effectively and social remedial norms can be applied. One such model (e.g., Spagnolo, 1999) is supported by the linkage of two types of games,

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[20]By the mid-Victorian times, this was expressed almost as a caricature by Samuel Smiles describing what really mattered for the gentleman: "The true gentleman has a keen sense of honour, - scrupulously avoiding mean actions. His standard of probity in word and action is high. He does not shuffle or prevaricate, dodge or skulk; but is honest, upright, and straightforward. His law is rectitude - action in right lines. When he says YES, it is a law... Above all, the gentleman is truthful. He feels that truth is the 'summit of being,' and the soul of rectitude in human affairs" (Smiles, 1859).

[21]As Daunton (1989, p. 125) summarizes the traditional argument, "the more an occupation or a source of income allowed for a life style which was similar to that of the landed classes, the higher the prestige it carried and the greater the power it conferred. The gentleman-capitalist did not despise the market economy but he did hold production in low regard and avoided full-time work."

one a social game that lasts for a very long time and the other a one-shot economic game. If two agents face one another in both spheres, the punishment in one game may be used to induce cooperation in the other.[22] This is in some sense a formalization of the importance of trustworthiness through social networking and its effect on market efficiency. These models point to the likelihood that trust can be transferred from a social relationship into an economic relation and thus sustain cooperative outcomes in which exchange can take place and disputes are resolved even without the strict enforcement of contracts by a powerful system of impartial courts or arbiters. It is this kind of environment, whether or not one wants to refer to it as "social capital", that created the possibility of cooperation even when standard behavior in finite games would suggest that defection and dishonest behavior might have been a dominant strategy. In Britain during the Industrial Revolution, the social norms of what was perceived to be a gentlemanly culture with an emphasis on honesty and meeting one's obligations, supported cooperative equilibria that allowed commercial and credit transactions to be consummated and partnerships to survive without overly concern about possible defections and other forms of opportunistic behavior. Gentlemen (or those who aspired to become gentlemen) moved in similar circles and faced one another in a variety of linked contexts.

The prevalence of a social convention that defined "gentlemanly" or "polite" behavior and penalized serious deviations from it through irreparable damage to one's reputation, supplemented formal (legal) relations with a moral code that enabled an effective mode of transacting without relying on the State except in extremis. Blackstone referred to Britain as a "Polite and Commercial People." Politeness was widely equated with law-abiding behavior, and it was intuitively sensed that commercial success depended a great deal on politeness. A market economy depended on people constraining their inclination to behave opportunistically. In other words, economic agents did not play necessarily "defect" (even if that might have been in their immediate interest) and expected others to do the same. Modern economics teaches that if this is to be effective, agents need to send out costly signals that indicate to others that they are reliable and trustworthy because they belong to a class of reliable and trustworthy agents (see e.g., Posner, 2000). Such

[22]An example of this kind of arrangement existed in Manchester in the 1820s, where the Manchester Fire and Life Assurance Company's boardroom provided "interconnected circuits of political, business, and social activities" to generate not only information underlying collective action but also regarding the reputations of the major players. Similar conditions were noted among Bristol sugar refiners in 1769 (Pearson, 1991, p. 388).

signals were what "politeness" were all about: gentlemanly customs in dress, manners, housing, transportation, and speech observed by the British upper classes, and their gradual adoption by the commercial and skilled artisanal classes in the eighteenth century marks the change in British society. They helped created a gentlemanly capitalism and thus an environment in which businessmen and entrepreneurs could deal with one another and with their subordinates in a cooperative fashion that made commerce work even without the heavy hand of third-party law enforcement. In other words, what made commerce and credit possible was that middle class people increasingly absorbed and imitated a set of behavioral norms that made them eschew opportunistic behavior that might have been personally advantageous in the very short run but socially destructive.

This kind of behavior was observed and blessed by Enlightenment thinkers.[23] The Enlightenment view associated with Montesquieu cited above that commerce made people more virtuous and honest must be seen to operate in reverse: it is a sense of honesty and the importance of maintaining a gentlemanly reputation that allowed a market economy to function effectively. To be sure, the ideal of "gentleman" was not static and changed over the course of the eighteenth century, and the relation between ideal and norm on the one hand and reality on the other is always problematic. The question is not whether the preponderance of British middle- class economic agents invariably behaved like this, as much as whether it affected their behavior (and the way other expected them to behave) enough to make a growing market economy feasible without the need for incessant litigation.[24]

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[23] John Locke, for instance, wrote in 1693 that a gentleman's upbringing should endow him with a love of virtue and reputation make him from within "a good, a vertuous, and able man" and with "Habits woven into the very Principles of his Nature," not because he feared retribution but because this defined his very character (Locke, [1733, pp. 46-47). Many decades later, the French historian Hippolyte Taine, who stayed in London in 1858, summarized the concept of a gentleman as "the three syllables that summarize the history of English society" (Taine [1872], 1958, p. 144). The essence of the gentleman as Locke and his successors saw him "was to be his integrity" (Carter 2002, p. 335). Paul Langford (2000, p. 126) observes that one of the British aristocracy's prime characteristics was the belief in fair play and that a cheating lord was a traitor to his class.

[24]The French traveler Pierre Jean Grosley noted the "politeness, civility and officiousness" of citizens and shopkeepers "whether great or little" (Grosley, 1772, Vol. 1, pp. 89, 92). The eighteenth century Italian writer and philosopher Alessandro Verri felt that London merchants were far more trustworthy than their Paris counterparts (cited by Langford, 2000, p. 124). One French visitor to early nineteenth century London noted that British shopkeepers were fundamentally honest, and that a child could shop as confidently as the most street-wise market shopper (Nougaret, 1816, *Londres* vol. ii p. 12, cited in Langford, 2000, p. 125). Charles Dupin (1825, pp. xi-xii) went as far as to attribute Britain's economic successes to the "wisdom, the economy and above all the probity" of its citizens. Reputation was

One issue is whether the cooperative norms of behavior were the result of the fear of social sanctions and loss of reputation, or whether they had been "internalized" into a belief in virtue and good behavior (McCloskey, 2006, *passim)*. Intellectual Historians seem to favor the internalization hypothesis. Pocock (1985, p. 49) feels that "manners" (that is, cooperative codes of behavior) combined ethical behavior with legal concepts, "with the former predominating." Yet the importance of a good reputation in the business world of eighteenth century Britain was clearly paramount, and Daniel Defoe was only one of many to realize this when he compared the reputation of a tradesman to that of a maiden, easily damaged by evil tongues and almost impossible to repair and describes how such reputations were made and lost around the coffee house through slander (Defoe, 1738, Vol. I, p. 197). Elsewhere he notes (ibid., p. 361) that a shopkeeper may borrow at better terms than a prince "if he has the reputation of an honest man." An illustration is the career of William Stout (1665-1752), whose autobiography appeared in 1851, and whose economic success was largely fueled by his meticulous reputation for honesty and generosity.[25] He covered the debts incurred by a dissolute apprentice as well as a nephew. As a Quaker, Stout may have been an unusual case, but his success in business was clearly consistent with the notion that cooperation was a remunerative strategy.

In order to function, a reputation-based system needed good information and communications, and these were provided through the many networks of friendly societies and masonic lodges that emerged all over Britain in the eighteenth century (Jacob, 1997, pp. 92-94). Such networks exist in every society, but the ones established in the eighteenth century were open and accessible to middle class men and thus were an ideal vehicle for the transmission of the information that supports reputational mechanisms. Many of these clubs were purely social, eating and drinking clubs, or devoted to common interests and hobbies, but they

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critical. Prosper Mérimée, commenting on the open access policies in the British Museum Library in 1857, observed that "The English have the habit of showing the greatest confidence in everyone possessing character, that is, recommended by a gentleman ... whoever obtains one is careful not to lose it, for he cannot regain it once lost" (1930, pp. 153-54).

[25] "At my begining I was too credulos and too slow in caling, and seldom made use of atturney, except to write letters to urge payments, being always tender of oppressing poor people with law charges, but rather to loose all or get what I could quietly, than give it to atturnies. And I never sued any to execution for debt, nor spend 20s in prosecuting any debter, and to loose all was more satisfaction to me than getting all to the great cost of my debtor, and to the preservation of my reputation." Stout (1967), pp. 120-21.

clearly functioned as clearing houses for information as well.[26] From the point of view of commercial and financial development, what mattered was the emergence of networks of merchants, industrialists, engineers, inventors, and financiers whose interactions and information exchanges (much of it in the form of gossip and rumor-mongering) were critical to the emergence of these social norms.[27] The unskilled workers and paupers were not part of these circles and thus not expected to behave the same way, but harsh as this may sound, they did not matter in this context.

Cooperation and the Industrial Revolution

As noted, institutions that foster cooperative behavior are conducive to efficiency and well-functioning markets, which are clearly growth-enhancing. However, it is not clear how they would be instrumental in bringing about an Industrial Revolution, which was driven by innovation. One way to connect social norms and technological progress is to realize that social norms determined the way entrepreneurs interacted with their economic environment, with customers, suppliers, workers, and competitors, and to stress that within a competitive economy, many of the most successful actors were actually more cooperative than we would like to expect. These were norms that were increasingly important in determining the behavior of the inventors, skilled craftsmen, financiers, merchants, and the owners of the new mills and mines that defined the Industrial Revolution.

An emphasis on middle class social norms provides us with answers to some long-debated issues regarding entrepreneurship in the British Industrial Revolution (Mokyr, 2007). The typical successful British entrepreneur in the Industrial Revolution was not so much a self-absorbed obsessive monomaniac as much as a networked and connected member of a community, his behavior constrained by its moral codes. A tell-tale sign of that is the diversified projects in which many of them engaged, investing in local improvements

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[26]The extent of the spreading of these clubs is reflected by the founding of the Sublime Club of Beefsteaks" devoted to carnivory in 1735. The total number of friendly societies membership in 1800 is estimated at 600,000 (Porter, 1990, pp. 156-57).

[27]Pearson (1991) documents in details the interconnected political, social, and financial networks of Manchester's cotton elite in the post 1815 period. These tight circuit were more effective in provincial towns, where information flowed more easily than in the metropole, and may have been a contributor to the advantage that provincial towns had over the capital.

and subscribing to projects such as roads, bridges, canals, dockworks, and later railroads.[28] They could engage in sectors they knew little about because they felt they could trust their partners (Pearson and Richardson, 2001). It may thus be the case that an entrepreneurial explanation of Britain's early success is not far off the mark, but rather than look only at the incentives and characteristics of individuals, we may be advised to see how they dealt with one another.[29]

Britain was not unique in developing such social norms, but on the eve of the Industrial Revolution it had far more of a middle class than any other nation (excepting the United Provinces), and it was this bourgeoisie that was at the center of affairs. This class consisted of merchants, artisans, farmers, and mechanics, people with a mentality of acquisitiveness, a desire toward social upward mobility, and a willingness to invest in the education and well-being of one's children (Doepke and Zilibotti, 2006). As a result, perhaps, more of the middle class children survived to maturity by the late seventeenth century, and this led to a slow swelling of their ranks (Clark and Hamilton, 2005). These values were also followed and emulated by others, aspiring to join the better life of the better-off bourgeoisie. In Britain, more than on the Continent, the energies of this class were directed toward activities that we would regard as productive and entrepreneurial. I would add here that a middle class adopting the social norms of "gentlemen" created the environment of trust and cooperation that was necessary for the Industrial Revolution to take place. The emergence of a middle class created a demand for non-subsistence goods, especially home furnishings and hardware, which demanded artisans with the kind of skills that were needed if the great inventors were to be able to turn their blueprints into reality.

One interesting possibility for such an effect is through the idea of cooperation in technological progress itself. Economic historians have found some examples of what Allen (1983) has termed collective invention, that is, the main actors in technological innovation freely sharing information and claiming no ownership to it. There are three reasonably well-documented cases of successful collective invention: the case

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[28]The great ironmonger John Wilkinson, who played such a strategic role in helping Watt cast his cylinders, invested widely outside his field of expertise such as banks, agricultural improvements, mines, and the many canals promoted by his friend and fellow ironmaster, Richard Crawshay.

[29]Recent work on the history of entrepreneurs in the United States seems to have come to the same conclusion that networks and trust-through-connections are as important in entrepreneurial success as talent and ambition. See Laird (2006).

documented by Allen (1983) of the Cleveland (UK) iron industry between 1850 and 1875; the case documented by MacLeod (1988, pp. 112-113, 188) of the English clock- and instrument makers, and the case documented by Nuvolari (2004) of the Cornish steam-engine makers after 1800. Examples of such cases are not many, and they required rather special circumstances that were not common, and collective invention in its more extreme form, to judge from its short lifespans, was vulnerable and ephemeral.

On a more general level, however, Gentlemanly Capitalism generated a great deal of cooperation in the generation of technological progress. The main point to keep in mind is that most of the people who generated useful knowledge during the British Industrial Revolution did not do so *primarily* to make money. This does not mean that they were indifferent to money (though a few were independently wealthy) but rather that the game they were in was not a profit-maximizing project but a signalling game in which individuals tried to demonstrate to their peers their intellectual and technical capabilities. Useful knowledge that was not immediately patentable (and some that was) was placed in the public realm. New scientific knowledge, since the great breakthroughs of the seventeenth century, was expected to be published and made available. In earlier centuries many natural philosophers had been keeping knowledge under a cloak of secretiveness, believing that it somehow conveyed power or gave the owner an edge in some deep and mysterious way. Such habits impeded its diffusion and access by others. The culture of secretiveness had begun to abate long before 1700, by which time the notion of "credit by priority" had been well-established, as the famous quarrel between Newton and Leibniz on the origins of calculus attests.[30] Scientific discoveries of any kind were to be published, communicated, and placed in the public realm.[31] When the unusual case occurred that an eccentric scientist (e.g. John Flamsteed, the first astronomer royal, or the pathologically shy Henry Cavendish, a leading chemist of the second half of the eighteenth century) refused to do so, others would take exception.

Open science, much like open source technology, was not practiced primarily by idealistic altruists

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[30]Other early examples of such priority disputes can be cited such as the dispute between Newton and Hooke (about the inverse-square force law) or the battle between two Dutchmen, Jan Swammerdam and Reinier de Graaf. on the discovery of certain aspects of female reproduction.

[31]This process has been documented in great detail by Eamon, 1994, pp. 319-50 who pointed to the influence of Francis Bacon and his followers in establishing this rule, as they realized that any progress was going to be the result of a cooperative effort. More recently Paul David (2004) has argued that open science established the quality of intellectual superstars, much in demand by courts and universities for prestige reasons.

whose objective was the warm glow from seeing humanity enriched by their knowledge (though there were some of those). It was run by ambitious and hard working people who had clear objectives in mind. Yet the standard pecuniary incentive system central to the economic interpretation of technological change must be supplemented by a more complex one that includes peer recognition and the sheer utility of being able to do what one desires. Credit was given in terms of reputation, which correlated with university positions, court-related appointments, public honors, and sometimes a pension from a ruler or a rich citizen. Even those scientists who discovered matters of significant importance to industry, such as Claude Berthollet, Count Rumford, Joseph Priestley, or Humphry Davy, usually wanted credit, not profit.[32] Berthollet willingly shared his knowledge of the bleaching properties of chlorine with some savvy Scots, who soon were able to turn his discovery into a profitable venture."When one loves science," wrote Berthollet to one of those Scots, James Watt, "one had little need for fortune which would only risk one's happiness" (cited by Musson and Robinson, 1969, p. 266). The great engineer John Smeaton took only one patent in his entire illustrious career, his colleague John Rennie none at all. Some entrepreneurs, too, refused to take out patents out of principle. Abraham Darby II declined to take out a patent on his coke-smelting process allegedly saying that "he would not deprive the public from such an acquisition" (cited by McLeod, 1988,p. 185) and Richard Trevithick, a century later, likewise failed to take out a patent on his high pressure engine. William Godwin noted in 1798 that "Knowledge is communicated to too many individuals to afford its adversaries a chance of suppressing it. The monopoly of science is substantially at an end. By the easy multiplication of copies and the cheapness of books, everyone has access to them" (Godwin, 1798, pp. 282-83). In that more general sense, social norms did have an effect on technology, though it is hard to quantify them.

An overlooked but critical consequence of these social norms is in the formation of human capital. As I have argued elsewhere, what set Britain apart from other European countries was not its capacity to accumulate more and better science or even a higher propensity to invent, but the much higher level of *competence* of its skilled workers. Britain could draw on a large cadre of highly skilled craftsmen and technicians. These

[32]A recent survey (Bowler and Morus, 2005, pp. 320-21) refers to the class of "gentlemanly specialists", men who led the development of useful knowledge but did not make their living from it and were suspicious of anyone who did. At the same time, those who were not independently wealthy needed to find patronage either as University Professors or from government, industry, or wealthy individuals.

people might not have been the flashy inventors who came up with the revolutionary insights, but they were those who could read a blueprint, understood practical technicalities such as tolerance, lubrication, tension, and torque, and had experience with the qualities of iron, wood, leather and other materials (Mokyr, 2007b).[33] Harris (1992, p. 33) describes them as "unanalysable pieces of expertise, the 'knacks' of the trade," that is to say, knowledge that is primarily tacit and could not be learned except through experience and imitation. Harris's view may be conditioned by his expertise of the coal and iron industry, but much of the same was true in hardware, textiles, instrument-making, and engineering. He notes that such skills were taken for granted at home and thus were noted mostly by foreign visitors, including industrial spies (*ibid.,* p. 26, see also Harris, 1998). Harris singles out the competence of the British iron puddler, requiring not only skills but experience and "almost artistic judgement," and adds that foreigners would have had a hard time importing this competence, because it was the British skilled worker who was the repository of the knowledge. He absorbed the skills needed to work with coal and iron "with the sooty atmosphere in which he lived" and would find it hard to know even what needed to be explained (Harris, 1992, pp. 28, 30). It was understood that these skills could not be readily transferred from country to country.[34]

The evidence that Britain's comparative advantage was in the skills and competence of her workmen as much as in the characteristics of her entrepreneurs is above all that it imported technological ideas and exported machines and skilled workmen, even if there were legal restrictions on those exports.[35]. When it

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[33]Josiah Tucker, a keen contemporary observer, pointed out that "the Number of Workmen [in Britain] and their greater Experience excite the higher Emulation, and cause them to excel the Mechanics of other Countries in theses Sorts of Manufactures" (Tucker, 1758, p. 26). He must have thought of men like John Whitehurst, William Murdoch, Bryan Donkin, John Wilkinson, John Kay, Edward Troughton, not quite hall of fame inventors, but brilliant craftsmen. At Soho, on which a lot is known, the highly skilled "turners" were kept from the equally skilled fitters, and these men would require many years of apprenticeship and work as assistants (Roll, 1930, pp. 181-83).

[34]The French scientists and industrialists Jean-Antoine Chaptal noted that in many branches of manufacturing the British had become dominant, but that even after importing the machinery the French could not compete and sold at twice the price of the British because they lacked the immense details, the customs, and the "turns of hand" (dexterity) and that while the slow progress of industry could be accelerated by learned men, there was no substitute for experience (Chaptal, 1819, Vol. 2, pp. 430-31).

[35] The French political economist Jean-Baptiste Say, a keen observer of the economies of his time, noted in 1803 that "the enormous wealth of Britain is less owing to her own advances in scientific acquirements, high as she ranks in that department, as to the wonderful practical skills of her adventurers in the useful application of knowledge and the superiority of her workmen" (Say [1803], 1821 Vol. I, pp. 32-33.). Another Swiss visitor, De Saussure had noticed the same seventy-five years earlier: "English workmen are everywhere renowned, and justly. They work to perfection, and

imported an invention, such as the Jacquard loom or chlorine bleaching, it improved them by a sequence of microinventions. The British paper industry, for instance, imported the Frenchman Nicolas Robert's paper-making machinery, but British mechanics such as Bryan Donkin and Henry Fourdrinier made important improvements in it. An even more telling example is that of the reverberatory furnace, first described by Vanoccio Biringuccio in 1540 in glassblowing , and adopted in Britain in the early seventeenth century. By 1700, this device had been adapted successfully to non-ferrous metals by unknown British skilled workmen before its famous adaptation to iron-puddling.

What were the institutional causes of Britain's high level of competence? It had preciously little to do with institutions of formal education even if some of the dissenting academies were increasingly committed to teach practical skills. Instead, it was almost entirely the result of apprenticeships. It was the product of a process of human capital formation that relied precisely on the kind of trust that contracts would be honored even if the fine details of daily contact between master and apprentice were impossible to specify, much less monitor. Britain's increasingly weak guilds had little to do with this enforcement, and indeed there is ample evidence that in many cases the process went awry. Apprentices and masters at times brought court cases against one another, and only a portion of apprentices ever completed their service (Rushton, 1991; Wallis, 2006). Yet here it is the atypical that may have left us the records, not the typical, and while the courts provided some kind protection of last resort, the normal case was clearly for the contract to be carried out and most apprentices completed their terms. Those who did on average benefitted economically. Despite the fact that apprenticeship relationships lent themselves to opportunistic behavior (such as hold-up strategies by both master and apprentice, depending on the timing pattern of the training), the system served Britain well and supplied it with a layer of skilled artisans like no other because apprenticeship contracts were largely self-enforcing and efficient (Humphries, 2003).[36] Apprenticeship took place within a "traditional network of

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though not inventive, are capable of improving and of finishing most admirably what the French and Germans have invented" (de Saussure, 1902, p. 218, letter dated May 29, 1727). The great engineer John Farey, who wrote an important treatise on steam power, testified a century later that "the prevailing talent of English and Scotch people is to apply new ideas to use, and to bring such applications to perfection, but they do not imagine as much as foreigners."

[36]Local studies have concluded that in the eighteenth century while masters had an incentive and opportunities to exploit and abuse the young, few apparently did so (Rushton, 1991, p. 101). Reputation effects seem to have been important here, since apprentices without parents protecting them were in greater jeopardy of being in some way cheated by their masters.

friends, neighbours, co-religionists, and next of kin" (Humphries, 2007, p. 11).[37] The apprentices themselves had quite a few incentives to complete their contract: only an apprentice with a completed term received the right of settlement in a county, and in those areas and trades controlled by guilds, they were barred from practicing a trade if they did not complete their term.[38] This stricture was repealed in 1814, but the institution of apprenticeship survived. It was obviously to a large extent self-enforcing rather than dependent on the letter of the law or the power of the guild. In the later nineteenth century apprenticeship as an institution was weakened, yet it was sufficiently flexible to withstand the changes and survive until deep into the twentieth century. Apprenticeship was ideal to transmit the kind of tacit artisanal knowledge that was the essential component of competence. It was not perfect, but by all appearances it worked as a self-enforcing institution rather than as one that relied entirely on third party enforcement (though for the social norms to work, a recourse to legal action as a *pis aller* was necessary).

To summarize, it is the complementary relation between the human capital and the social capital that explains Britain's leadership in the Industrial Revolution. The economy that could produce the technical acumen to follow up on new ideas and turn them into an economic reality was also able to create a group of entrepreneurs to exploit it, people with the ability to take advantage of the opportunities that the inventors and the mechanics created. This relationship appears up in the many pairings of technical ability and businessmen. Boulton found his Watt, Clegg his Murdoch, Marshall his Murray, and Cooke his Wheatstone. These pairings were made possible by a network of information flows and personal relationships that made trust and cooperation *within a certain class of people* the default. Here, too, the importance of private order seem predominant, and while they, too, existed in the shadow of the law, the success of the institutions was determined by its self-enforcing properties.

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[37]Humphries (2007, pp. 22-23) recounts a number of cases in which disputes between master and apprentice were resolved by social and reputational pressures, many of them supported by the need of the master to maintain his social relations with the parents. Her sample of hundreds of autobiographical accounts of working class people, provides a unique picture of the centrality of apprenticeship in the intergenerational transfer of human capital.

[38]In 1777 the calico printers admitted that fewer than 10 percent of their workers had served because "the trade does not require that the men they employ should be brought up to it; common labourers are sufficient" (Mantoux, 1928, p. 453).

IV - Formal Political Institutions.

Despite the centrality of informal institutions in the argument above, the state was obviously a factor as well. How and why did British *formal* institutions help bring about an Industrial Revolution?

The issue in the premodern European economies was threefold: first, rents had to be protected from greedy and violent neighbors, both inside and outside the economy. For that reason, a third-party enforcer simultaneously charged with using its monopoly of violence to protect the economy from foreigners was essential. Second, this state itself should be prevented from expropriating so much of the rent that there is too little left to make it worthwhile to exert much effort, so its needs to be constrained somehow. Third, once in existence, the state eventually became the rule-writing body, and its control may be used by powerful "lobbies" to direct a larger part of the rents to them through non-market allocations. Solving these three problems simultaneously is hard, and few nations succeeded. Britain in the period 1700-1850 gradually came closer, though the process was still far from complete by 1850.

A large literature, inspired by North and Weingast, 1989, has drawn connection between formal institutions such as constraints on the executive and "rule of law" and economic development. Yet the precise connection between the events of the Glorious Revolution and the Industrial Revolution that followed more than half a century later remains murky. The supporting evidence used by North and Weingast, pointing to a decline in the interest rates paid by the State, has been called into question (Quinn, 2001; Sussman and Yafeh, 2003; Stasavage, 2007). But even if it was confirmed, it has never been made clear how improved borrowing conditions for the government in the first half of the eighteenth century led to technological breakthroughs more than half a century later. A further paradox appears when we compare the British with the Dutch experience. The 1688-89 revolution led to the importation of Dutch institutions and Dutch ideas (carried, in part, by the entourage of William III), and hence the experience of the two countries as the two most successful economies in the eighteenth century might be explained by these shared experiences. The problem, of course, is that the Dutch not only did not have an Industrial Revolution when Britain did, theirs was unusually late (Mokyr, 1976, 2000; Van Zanden, 1993; Van Zanden and Van Riel, 2004). Did the institutional experience of the two nations diverge at some later point? Or is the model simply incomplete?

The sole focus on the State as the source of social order, as I have argued above, may be

overemphasized. But the fundamental problem remains: an economy needs to protect rents if it is to generate them from cooperative and creative behavior. Formal institutions mattered in large part because the written formal rules and the court system established the second layer of economic cooperation when the first failed, or when conflicts needed to be resolved. More important, they wrote and rewrote the rules by which others played the economic game. The Glorious Revolution and the subsequent reforms established Parliament as a legitimate *meta-institution*: a body that could write laws that helped define the economic environment. It removed the contestability laws, regulations, and taxes, and had the power to repeal or amend rules that no longer worked or were recognized to be detrimental. What helped economies grow and sustain their growth was not just having the kind of institutions that were conducive to economic development, but also to have the kind of *agility* that allowed institutions to change when the environment changed. As a matter of principle, there are few features of institutions that are *invariably* suitable for growth; once we are beyond the platitudes such as "law and order are better than chaos and crime," the institutional requirements for economic growth themselves changed over time precisely because Smithian growth requires different institutions than Schumpeterian growth. It is hence not just important to judge whether an economy inherited from the past appropriate institutions that allowed it to grow, but also whether it had the flexibility to change and adapt them at relatively low cost when the need arose.

The way Britain's political system worked in the eighteenth century gave the country an agility not found elsewhere. After 1750 Parliament increasingly became concerned with its need to solve coordination- and other potential market-failures and assumed new responsibilities, as indicated by its role in agricultural reforms, transportation, research (in limited areas), the regulation of weights and measures, the protection of innovators from violent resistance to new technology, and eventually with spillover effects from industrialization such as urban public health and child labor. It is this agility that gave Britain what North has called adaptive efficiency that other societies lacked to the same extent. Although some enlightened monarchs on the continent were able to introduce reforms into the formal institutions of their state in the second half of the eighteenth century, most of those introduced before 1789 did not survive as more conservative ministers or successors revoked them. In the end, the Continent needed revolution and war to attain a structure that Britain had achieved over the eighteenth century without bloodshed and upheaval.It has been tempting to link the

political changes of 1688-89 to subsequent changes. The Glorious Revolution once and for all solved the commitment problem: it created a set of constraints on the executive that in the words of one recent author (Dam, 2006, p. 85) took care of the predatory ruler problem. The Bill of Rights of 1689 was followed by a string of Laws that established Parliament once and for all as the institution that wrote the rules and had the power to change other institutions.[39] Parliament acquired legitimacy in the sense that when it changed the rules, even the losers in these actions would not deny its right to do so and had a responsibility to comply.[40] At the same time, Parliament was the body that had the capacity of being receptive to both the changing needs of the economy and the changing ideology and beliefs of its elite, and change the rules of the economic game accordingly. It could imbue the British polity with the most important institution needed for economic change: institutional agility and adaptability, or in North's term, adaptive efficiency.

There is no obvious reason to infer that establishing Parliament as "the place where absolute despotic power, which must in all governments reside somewhere, is entrusted" as Blackstone noted in 1765 (1765-69, Book 1, ch.2, section III) was to be a key to economic progress. After all, the newly-found power of Parliament could have been (and was to a considerable extent) abused by special-interest legislation that served distributive coalitions. But parliamentary power meant that changes occurred increasingly from the top down, even if the initiative came from below. Changes in the beliefs at the top eventually affected the entire country. During the entire period under discussion, British Parliament changed British laws in accordance with what its members viewed as their own interests and Britain's perceived needs. Their idea of the national interest, however, was not invariant to the elite's ideology, which became increasingly liberal after

[39]Legislation in the 1690s and early 1700s eliminated the royal prerogative as a form of legislation and abolished the King's right to absolve certain individuals of certain laws. Other legislation established Parliamentary oversight on government spending and a "civil list" that specified what royal funds would be spent on. Parliament ensured that it met regularly and an Act of Settlement assured that Parliament maintained control over the royal succession. The Act of Settlement of 1701 also established an independent judiciary, in which judges were appointed for life and could only be removed if convicted of a felony or impeached. Whether or not that really established a full "rule of law" (Dam, 2006, p. 85) on the ground remains controversial.

[40]As one historian notes, "a reverence for Parliament became an increasingly important part of élite attitudes and a vital part of élite patriotism...the knowledge that the institution they served was ... efficient [and] by the standards of the time not obstructive reassured British patricians of their polity's superiority... There is evidence that even lower down the social scale Parliament inspired respect" (Colley, 1992, pp. 50, 52).

1760 under the influence of Enlightenment authors.[41] Parliament made the enclosure of land in recalcitrant areas possible simply by passing a set of Bills of Enclosure. It solved the coordination problems inherent in having local interests collaborate in building canals and roads by passing Turnpike Acts. It supported entrepreneurs and innovators against technologically conservative interests and those protecting their rents. It awarded pensions and prizes to inventors who had solved a problem of national importance such as determining longitude at sea and mechanical cotton-spinning.

In the decades after the Glorious Revolution, the overall level of energy and efficiency with which Parliament did its work increased steeply. The total number of acts passed during the rules of Charles II and James II was 564, or 20 per annum. In the 25 years between the Bill of Rights and the Hanoverian ascension (1689-1714), this number increased to 1,752 or 70 per annum; by the period 1760-1800 it rose to 8,351 or 209 per annum (Hoppit,1996, p. 117). It should be stressed that this legislation was mostly serving narrow and special (mostly local) interests, or serving some national rent-seeking lobby. "Specific" legislation directed at a particular place or institution remained between two thirds and three quarters of all acts throughout the period 1688-1800 (Hoppit, 1996, p. 117). The legal historian Maitland felt that "one is inclined to call the [eighteenth] century the century of privilegia. [Parliament] seems afraid to rise to the dignity of a general proposition... it deals with this common and that marriage" (Maitland, 1911, p. 393). Yet over the course of the eighteenth century this started to change, and rent-seeking attempts by local and national interests started slowly to run into resistance. Many special interest groups' legislated privileges, monopolies, exclusions, the limitations on labor mobility, occupational choice, and barriers to technological innovation found themselves on the defensive as the eighteenth century wore on and the more free-market ideas of the Enlightenment began to sink in. It was a very different Parliament in 1774 that tossed out the Calicot Act — a shameless piece of special interest legislation benefitting the wool and silk industry — from the one that had passed it in 1721 (Mokyr and Nye, 2007). After 1780, Parliament increasingly used its powers to make selected dents in the rent-seeking machinery of the ancient regime under the platform of making the economy more efficient and streamlined. Parliament, rather than a venal institution that awarded the rights to the highest bidder, in the late eighteenth century was becoming the arbitrator of disputes between special interest groups.

[41]For examples of such influences, see Mokyr 2006c.

Two political phenomena were at the center of this process. One was the centralization of rent-seeking and lobbying. By allowing growing domestic market integration (through turnpike and canal bills, for instance), Parliament oversaw the gradual disappearance of local monopolies. By the late eighteenth century, Prime Minister William Pitt refused to meddle in local matters, which were "large areas of policy in which ministers and party politicians need not involve themselves" (Langford, 1991, p. 205). Rent-seeking and redistribution remained an essential part of the Hanoverian state until the closing years of the eighteenth century, but it became more nation-wide and coordinated. Mercantilist practices had been mostly part of a complex rent-seeking alliance between crown and mercantile interests (Ekelund and Tollison, 1997). Once centralized, however, the process was more amenable to changes from the top down (Mokyr and Nye, 2007). The striking fact is that the Industrial Revolution was accompanied, on the whole, by a growing liberalization of economic activity. The incidence of exclusionary restrictions and privileges and other forms of rent-seeking in the British economy began to decline in the second half of the eighteenth century, and while the process was both slow and uneven, the trend was unmistakable (Rubinstein, 1983). When it was complete, by the second third of the nineteenth century, the British economy was as free of redistributional institutions as any economy can ever hope to be.

A further way how the state mattered in subsequent economic development is the matter of British public finance and Empire. As is well-recognized, the British fiscal system, based on the combination of excise taxes and government borrowing, was far sounder than elsewhere (Brewer, 1989; O'Brien 1988, 2002; Stasavage, 2003). North &Weingast's influential paper argued that the reforms of 1689 created a healthy institutional foundation of British public finance. The connection of this reform to subsequent economic development is, however, not clear. Its importance of the formal state after 1700is largely for what it did not do: despite the high taxes, the British state did not expropriate the surplus created by economic growth to threaten the incentives of those who created it. They could do so because taxes, while at times exorbitant, were relatively neutral and did not affect the efficiency of the economy too much. It is unclear how fiscal soundness through high excise taxes contributed materially to the Industrial Revolution, but clearly compared to what could have been, it did not get too much in the way.

Why and how did redistribution fall on hard times in Europe during and after the Industrial

Revolution? There is no good theory that explains why "grabbing hands" slowly become weaker but it clearly did in this period. Part of the reason must have been that these institutions had been very much part of the zero-sum mentality of the pre-enlightenment world, and the notion that exclusionary rents were on the whole Pareto-dominated did not come naturally to most actors, either on the giving or the receiving end of rent-generating privileges. The areas against which British (and continental) policy makers particularly aimed their arrows were monopolies, subsidies, labor market restrictions, tariffs, poor relief, and price controls. By 1850, much of this regulatory machinery had been dismantled. Foreign trade, too, was regarded differently with eighteenth century enlightenment thought foreshadowing the insights of political economy.[42] The growing influence of the beneficial effects of trade promulgated by Smith and Ricardo made their mark on policy makers (Grampp, 1987; Mokyr, 2006).[43]

Enlightenment- induced changes in ideology and beliefs on the part of policy makers in charge of writing the rules played a central role in the American and French Revolutions, as well as the various reforms attempted in various European nations before 1789 (Scott, 1990). Reforms in Britain did not always come easy even if they did not require a Bastille. The liberal reforms of the 1780s (including the Eden treaty with France in 1786) made room for the more conservative and reactionary 1790s and early1800s, when war with Revolutionary France caused a retrenchment. But it was *reculer pour mieux sauter*. After Waterloo, the reform movement picked up steam led by both Whigs and so-called liberal Tories, and within a few decades had dismantled much of the remaining rent-seeking apparatus. Thus, the Statute of Artificers was abolished in 1814, the enumeration clauses (that forced British colonial goods to be shipped to third markets through Britain) in the Navigation Acts were repealed in 1822, the monopoly of the East India company was ended by two parliamentary acts in 1813 and 1833, the law prohibiting the emigration of artisans was repealed in 1824, the export prohibition on machinery was weakened in 1824 and repealed in 1843, the Bubble Act

[42]Thus Jean-François Melon, a friend of Montesquieu's, wrote in the 1730s that the "the spirit of commerce and of polity are inseparable... the spirit of conquest and the spirit of commerce mutually exclude each other in a nation" and added that it was commerce, not violence that supplied the "wisdom for preservation" (Melon, 1738, pp. 136-39).

[43]Kindleberger (1978, p. 52) who admits that in some cases "free trade is the hypocrisy of the export interest" felt that "in the English case it was more a view of a world at peace, with cosmopolitan interests served as well as national."

thrown out in 1825.[44] Other exclusionary arrangements that fell out of favor were serfdom and colonial slavery, prohibitions restricting the use of certain kinds of machinery, usury laws (repealed as late as 1854 but rarely enforced long before), and similar rent-seeking relics. As Nye (2007) has argued, protection was the last vestige of privilege and the ancient regime economy to go. By the middle of the nineteenth century, it is hard to find many instances of the kind of age-of-mercantilism rent-seeking that still predominated in 1721 when Robert Walpole became the first Prime Minister.

The Hanoverian state did one more thing with great energy: it conducted foreign policy. In the eighteenth century this was a "blue-water" policy in the service of Empire driven by hostility toward its colonial competitors. The debate on the exact impact of the British Empire on the economy is still unresolved. But on the path to a more modern economy driven by technological progress, Empire was a distraction, not a factor, the expenditures on the navy and the army a cost, not a benefit. The enormous public debt in Britain was incurred to pay for expensive wars and colonial ventures rather than to fund infrastructure. While some scholars (e.g., O'Brien, 2002, 2007; Ormrod, 2002) strongly feel that these hard-fisted policies materially contributed to the Industrial Revolution, others have found such an inference had to accept (Harley, 2004). The mechanisms proposed linking Britain's Imperial policies to the Industrial Revolution have not been really persuasive despite continuous attempts to show such connections. If Adam Smith and modern economic historians turn out to be correct in their assessment, it may well turn out to be that the fiscal structures set up by the Glorious Revolution were largely engaged in paying for a gigantic white elephant.

Mercantilist ideologies viewed economic international relations as something close to a zero sum game, in which aggressive foreign policies were believed to pay off economically. Britain's good fortune was that its political institutions prevented these costly misadventures from ruining the economy altogether (as it did to a greater extent in its Continental competitors). A direct connection between the sound public finance that formed the basis of Britain's political success and the technological progress of the Industrial Revolution seems, however, far from obvious. It must be cast in terms of things that did not happen but could have (such

[44]As Harris (2000) has shown, the Bubble Act was primarily used as an exclusionary tool by incumbents to reduce entry and competition.

as a total collapse of public finance of the kind that brought about the French Revolution). Taxation was heavily skewed toward excises on middle-class goods, which may well have created a more favorable set of incentives for potential entrepreneurs who knew that they would be able to keep their profits and not have to share them with the tax collector.

British Parliament, then, was an agency that helped channel Enlightenment ideas into the realm of political action. It hardly needs to be pointed out that this change was slow, the result of a protracted struggle, hard-fought bargaining, and that victory was far from inexorable. Until at least the mid eighteenth century, Parliament was in many ways a corrupt body, manipulated by special interests driven by rent-seeking and mercantilist ideology and some of that corruption remained in place at least till the 1832 reforms (Rubinstein, 1983). But because it had the power to rewrite the rules that applied to others, Parliament could adapt to changing needs and beliefs what was good for the nation, as well as for them. It remains an unanswered question why a body dominated by landlords would allow legislation that eventually undermined their *de facto* power base. Acemoglu-Johnson-Robinson rightly claim that the reforms were motivated by the fear that the masses could have used their *de facto* power and rebelled. Whether that threat was credible is not altogether clear. Parliament seems to have had no qualms in using violence to quell organized protests and riots. It is also the case that many of the men in power believed for a long time that reforms were good for the nation and that they would be able to profit from the changing economy (Hilton, 1979).

To sum up, what is most striking is what did *not* happen. The state may have had the theoretical capability to be more predatory and repressive, but was generally constrained from doing so. Taxes, while heavy in the eighteenth century and even more so during the French Wars, were levied primarily on consumption of the middle classes, whereas landowners (who had the political power to block progress) saw their relative tax burden lighten and entrepreneurs had no real worry that the government would in some way expropriate their profits. The Industrial Revolution began to generate large surpluses and profits for entrepreneurs and those who owned the resources they needed, though their exact timing and magnitude are not quite clear. These surpluses could have readily been expropriated by the powerful political factions that controlled British government, and used for their own benefit or perhaps to bankroll colonial adventures. Nothing of the sort happened. Once the distractions of the Napoleonic Wars were over, the income tax was

abolished with great glee, and real government spending per capita was sharply contracted.[45] After Waterloo a more liberal creed began to replace the mercantilist instincts that had still ruled during much of the Hanoverian years. Neither the British government nor powerful special interests had more than a nibble from the gains that improving technology generated.

V- Institutions, Politics, and Economic Progress

Why did sustained growth not occur more often and in more places before the nineteenth century? One standard argument is that technology was constrained by the poor understanding of the fundamental principles of the natural regularities that made certain technologies work (Mokyr, 2002). The alternative argument is one of negative feedback. In one version, Malthusian dynamics undid any gains in technology, institutions, and even favorable environmental shocks (Clark, 2007).To that, however, we should add the underappreciated problem of negative institutional feedback and institutional inertia, which held back pre-industrial societies. Jones (1988) has gone so far as to argue that growth might well have been the normal state in pre-industrial societies had not institutional blockages again and again terminated it.

Before 1800 economic growth was more of a regional than a national phenomenon; throughout the pre-industrial past there were some areas and cities that did well for a variety of reasons. Such local wealth gave rise to two kinds of negative institutional feedback: *internal* feedback, in which local priests, rulers, and powerful strongmen tried to extricate the rents for their own use and *external* feedback, generated by strong but poor neighbors or more remote predators. One way or another, regions that did well through trade or manufacturing attracted someone's greed and envy. Time and again, prosperous regions in Germany, Central Europe, the Low Countries, and Northern Italy, had their wealth physically destroyed through war, their trade impeded by tariffs, navigation acts, and privateers, or were forced to spend crippling amounts on defense. Either way, predatory warfare, continental and colonial, remained the rule during much of the eighteenth century and a direct outgrowth of the zero-sum ideology that underlay Mercantilist-Cameralist policies. In this world growth, in an almost dialectical way, generated the mechanisms that undid it. After the defeat of

[45] Total government gross income went from a peak of £ 69.2m in 1817 to a trough of £56.3m in 1854. The national debt peaked at £ 844 m in 1819 and then fell to £ 774m in 1854. Nominal GDP went from £ 322m in 1821 to £ 718m in 1854, thus reducing per capita taxation by 57 percent and national indebtedness by 59 percent.

Napoleon, such predatory wars within Europe became rare, although Europeans obviously did not include non-western nations in their more enlightened approach to foreign policy. Whether the century of the Pax Britannica was entirely attributable to a new and less aggressive political outlook in Europe or the result of a new balance of power is unclear, but the few wars fought on European soil after 1815 (or elsewhere in the world between European colonial powers) were less predatory, destructive, and costly to the industrializing powers. As a result, the fruits of economic growth were not wasted on military spending and wars until the disasters of 1914 and beyond.

The other blockage to economic progress before the Industrial Revolution was resistance by vested interests, who had large fixed capital invested in the technological and political status quo. Acemoglu, Johnson, and Robinson (2005) raise a central question: if the income distributions in all societies were closely associated with the distribution of political power, why would anyone in a position to block change ever agree to give it up? In Britain, the landed classes had traditionally controlled much of Parliament, after 1688 in an informal coalition with the resurgent mercantile interests. Both of these groups had a lot to gain from maintaining the status quo in which mercantilist measures channeled rents to merchants and shipping interests and landlords received bounties on farm exports. How did this cosy arrangement slip between their fingers in the nineteenth century? In terms of political economy, the astonishing fact remains that the coalition that controlled parliament until deep in the nineteenth century, the large landlords and the merchant-financial elite, did not block the process that was to end their grip on power. Indeed, in a series of measures starting in the early 1820s and culminating in the great reform acts of 1829 and 1832, they opened the political process and provided increased political power to groups that had previously been excluded from de iure power.

Part of the answer must simply be that nobody saw it coming: the technological innovations of the Industrial Revolution transformed the British economy to a degree that was completely unforeseeable in the mid eighteenth century. Part of the answer was that the old coalition was given a soft landing, and that eventual losers were compensated and bribed to cooperate: the Corn Laws were renewed in 1815 to maintain the income of those classes in a position to block economic reforms and some of the old arrangements were phased out gingerly and gradually. A third part of the answer is that the old landowning class benefitted from the development, in part because of the continued rise in rents until 1815, but also because many of them were

able to profit from the rise in value of urban properties, mining areas, and other real estate.[46] Economic losers who were not political losers, as Acemoglu-Johnson-Robinson (2005, p. 435) maintain, would have been able to redistribute the incremental income to themselves if they retained political power. Indeed, the powerful British political elite did so, at least for a transition period long enough to absorb the shock and weaken their resistance. Finally, of course, there was the fear of rebellion. Commercial and industrial interests acquired *de facto* power during the Industrial Revolution, and obviously at some point those who wrote the rules had to heed their desires. Acemoglu and Robinson (2006, p. 350) argue that the concessions made after 1832 (they had actually started in the mid 1820s, with the repeal of the Combination Acts), were in large part motivated by a desire to pre-empt a rebellion or the need to repress it violently. Such pre-emptive action seems plausible (the British had closely followed the unfolding events in Paris in 1830), and it is clear that the Reform Crisis of 1831-32, including the rather serious Bristol riots in October 1831, was instrumental in bringing about reform (Stevenson, 1979, p. 221).

But the exact magnitude of the threat to overthrow the existing order remains unknown. The modest scale of British political riots, and the poor coordination between different groups suggests that the likelihood of success was never overriding. The reforms enfranchised the middle classes, but did little for the unskilled working poor, the displaced domestic workers, and paupers. Archer (2000, p. 93) concludes that the middle classes were as fearful of a violent revolution as any hard-line conservative. The Chartist movement, which was largely middle class and which in its early stages prompted a few outbreaks of local violence, actually followed rather than preceded the 1832 electoral reforms and led to no further franchise enlargements.[47] The year 1848 passed by relatively peacefully in Britain. On the other hand, any serious threat to the existing order would have been suppressed harshly. During the biggest threats, in the late 1790s and early 1800s, the government clamped down hard on dissidents through both legal and violent methods.

A separate role for changing ideology among the ruling elites therefore cannot be dismissed. The

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[46]Rubinstein's rather heroic estimate of landed and non-landed millionaires and half millionaires dying between 1809 and 1859 shows 179 landed millionaires vs. 10 non-landed millionaires, and 338 landed half-millionaires as compared to 54 non-landed ones (1981, pp. 60-65). As Rubinstein (ibid., p. 61) remarks, "an observer entering a room full of Britain's 200 wealthiest men in 1825 might be forgiven for thinking that the Industrial Revolution had not occurred."

[47]William Lovett's Charter dated from 1838 and fizzled out after 1848, twenty tears before the next big electoral reform. The most serious outbreak of violence was the 1838 Newport riot that left fifteen people dead.

impact of liberal political economy, the Enlightenment's proudest offspring, on many of the policymakers of the epoch is too easy to document to ignore. The dominant figure in the "liberal Tory" government of Lord Liverpool of the 1820s was William Huskisson, an avowed Smithian, who passed a series of tariff reductions and was instrumental in re-energizing the reform movement in the 1820s.[48] The Enlightenment led to the more extreme radical reform movement of the 1820s in which ideologues like Joseph Hume and Francis Place fought for reform legislation informed and inspired by Political Economy as they interpreted it. The astonishing historical fact is not that such radicals were tolerated (though Place was dubbed "a bad man" for his outrageous advocacy of contraceptives; he himself sired sixteen children), but how successful they eventually proved to be in implementing their liberal programs.

The ideological background of the post-1820 reforms should not be oversimplified. We can distinguish at least three enlightenment-inspired reform movements that were quite different in emphases and goals. Political economy and ideology differed not only on how and when mercantilism should be dismantled, but also on the fate of colonies and internal regulation. In addition to the pure Smithians, whose main guiding principle was the strong complementarity of peace, prosperity and free trade, there were the so-called Christian political economists, who combined the logic of Enlightenment with the resurgent evangelical religion. This school helped convert the landed elites to believe in freer trade, even if their worldview was more nationalistic and cyclical that the eighteenth century Scottish Enlightenment movement had hoped for (Howe, 2002). Boyd Hilton (1977) has maintained that beside Enlightenment there was "atonement", a religious reaction to Jacobinism that inspired some writers to support free trade for its intrinsic moral view. On their left were Ricardians and Benthamites, whose belief in free trade was more extreme and who implied that the landed aristocracy, on whose behalf the Corn Laws had passed, was essentially parasitic. Yet in the end these ideas were all elaborations and variations on the ideas of eighteenth century Enlightenment intellectuals, and the institutional support for the emergence of the liberal market economy in the first half

[48]Huskisson "zealously and consistently subscribed to the theories of Adam Smith. Smith's teaching, reflected in practically every reform in the twenties" (Brady, 1967, p. 133). Equally well-documented is the enormous influence that Wealth of Nations had on other policy makers, especially after Dugald Stewart, Smith's successor at Edinburgh, turned the book into a fountainhead of wisdom (Herman, 2001, pp. 229-30; see also Rothschild, 2001). Among Stewart's pupils were two future Prime Ministers, Palmerston and John Russell. His program was to remove all state support and protection for manufacturing and agriculture.

of the nineteenth century cannot be imagined without them.[49]

The other potentially important institutional impediment to the Industrial Revolution was resistance by the interests most directly affected by the technological changes affecting various industries after 1750. Resistance to new technology by organized or unorganized workers was a major issue in the eighteenth century and remained so during the Industrial Revolution. The groups that were on the losing end were above all domestic-industry workers who were being out-competed by factories, artisans of various levels of skills whose human capital was threatened by obsolescence, and small-scale farmers, the victims of the enclosure movement. These groups had access to a variety of effective means that were a times quite successful: from peaceful petitions to Parliament to legal strikes, to illegal rioting and machine-breaking, skilled and semi-skilled workers found ways to signal their disapproval. Many of these struggles had short term or local effects, and may well slowed-down the path of technological change in some regions.[50] The struggle over "employment" can be seen in part as one over the sunk cost in specific human capital, and in part over threatened local market power. In fact, if there was ever a serious chance of popular uprising (Acemoglu and Robinson's *de facto* power), this may have been it. But the state did not make many concessions; it cracked down mercilessly on rioters, siding unilaterally with innovating employers.

In the 1790s and early 1800s the world was inevitably viewed by British policy makers in harsher terms than the peaceful harmony between cooperative nations that Enlightenment writers dreamed about. The implication of this new outlook was that in a hostile world Britain could not afford to pass on technological opportunities and supported employers against workers. In 1806, a Committee was appointed to decide the complaints of the West Country clothiers into the new gig mills that they felt threatened their livelihood. E.P. Thompson (1963, p. 528) feels that "it would be a sad understatement to say that the men's witnesses before the 1806 Committee met with a frosty reception." It is telling that the final report of the committee was written

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[49]Even the aristocratic Whigs led by Earl Grey, the architect of the successful Reform Act of 1832, were motivated by a mixture of "fear of revolution, a natural desire to consolidate their power, and — above all — their own brand of patriotism" (Colley, 1992, p. 345).

[50]Thus, in Wiltshire, shearmen through the "Wiltshire outrages" of 1802 were able to prevent the introduction of gig mills until after 1815; the machinery destroyed during the Luddite riots took some years to replace; and as late as 1830, the Captain Swing riots delayed the introduction of agricultural machinery into the South of England by many years. Randall (1991, p. 289) feels that the resistance, at least in some areas, gave the artisans "many extra years respite."

by William Wilberforce, M.P., better known for his successful moral campaign against the slave trade. As the biography written by his sons recalls, Wilberforce had to mediate between the valuable men "of small capital who, with the aid of their own families, prepared the goods at home" and "enterprising capitalists." He laid down the "clear principles on which trade must be conducted" (Wilberforce, 1838, Vol. 3, pp. 263-67). These principles supported the employers' rights without any hesitation. There can be no doubt that the concern about foreign competition was the main motive of the men in power to refuse the demands of the anti-innovation lobbies.[51] While the *Report* piously reiterated its conventional recognition of the "merits and value of the domestic system," it also felt that the "apprehensions about it being rooted out by the Factory System were *at present at least* wholly without foundation" (Great Britain, 1806, p. 10, emph. added). Above all, however, Wilberforce and his colleagues regarded as gospel that "the right of every man to employ [his] Capital according to his own discretion... is one of those privileges every Briton considers his birthright" (p. 12). The resistance movement went underground, but with enough determination and force on the part of the State, it had little chance to prevail. The people in power had made up their minds — the eighteenth century was over.

There are other answers to question why the lower classes, both the working and the indigent poor, did not rebel more. British institutions provided something no other state did, a mandatory outdoor poor-relief system that remained in force until 1834. Its net effects on industrialization remains a matter of dispute (Solar, 1995). The poor law provided a big carrot next to a large stick of violent suppression and achieved its main goal, namely domestic order. The British government, more than in any other state West of the Elbe river, was able to keep its laboring poor in their place. The Poor Law, by providing the poorest workers with a safety net and thus reducing the need to cling to land at all costs, contributed to the creation of a proletariat needed for the factories and the railroad. It also helped in smoothing the labor supply both cyclically and seasonally. In addition, the poor law supported the practice of so-called pauper apprenticeships. The provision

[51]The language used by the committee is telling: "If Parliament had acted on such principles [on which the use of these particular machines is objected to] 50 years ago, the Woollen Manufacture would never have attained to half its present size...its Augmentation is principally to be ascribed to the general spirit of enterprize and industry among a free and enlightened people... It is likewise an important consideration...that we are at this day surrounded by powerful and civilized Nations, who are intent on cultivating their Manufactures and pushing their Commerce" and specifically mentioned the worrisome evidence of such an establishment being set up in Paris. See Great Britain, *B.P.P.* 1806 No. 3 ("Select Committee on State of Woollen Manufacture of England"), p. 7.

of young factory workers from workhouses run by local Poor Law guardians provided an important source of unskilled labor for the factories, especially in rural and small-town mills before 1800.[52] All the same, the magnitude of these effects is hard to ascertain and in all probability was second order.

VI: Conclusion

What were the institutional origins of the Industrial Revolution? As argued, this question only makes sense if we distinguish the "big question" (why Europe?) from the "small question" (why Britain?).We should emphasize that the differences between Britain and its European competitors was one of degree and of timing. The question is what kind of institutional environment, formal and informal, was most fertile to the successful sprouting of the seeds of the Industrial Revolution? The commercial environment and incentives that institutions created for the innovators and entrepreneurs who made the Industrial Revolution may have been central to Britain's leadership, even if they are harder to observe and measure than differences in the availability of coal. In part, its success was due to adaptive flexibility: the formal institutions of the British polity, rather than being "right" or "wrong," proved to be sufficiently agile to change with the changing needs of the economy. Eventually, many of these advantages that gave Britain its lead were weakened and the lead that it had in the Industrial Revolution was lost. To the extent that the Enlightenment and its political and economic effects were important, other European nations could take equal advantage of them.

The solution to "the commitment problem" after 1688 and the role of Parliament in constraining the executive have been at the center of the literature until now. We need, however, to be concerned with a wider set of issues than just the matter of "who shall guard the guardian." In part, the answer to the question of economic success in this age is about the informal social norms that defined the cultural beliefs of the elites, and allowed market exchange and innovation to operate in a regime of low transactions costs and reasonably self-enforcing norms of what Greif has called private-order contract-enforcement institutions. Hence, we need to consider the cultural beliefs of the political and technological elites. Cooperative behavior and trust based on gentlemanly codes allowed not just market exchange to operate but also created opportunities for new tech-

[52] Some of the transactions between Poor Law authorities and mill owners resembled the slave trade; e.g., the purchase of seventy children from the parish of Clerkenwell by Samuel Oldknow in 1796 (Mantoux, 1928, p. 411).

nology by allowing partnerships between inventors and entrepreneurship, and by providing Britain with a large contingent of highly skilled and dexterous craftsmen through well-functioning apprenticeships.

Institutional analysis is an important component of the emergence of modern economic growth and not just its continuation at later because the British Industrial Revolution occurred in a society that overcame successfully and at comparatively low cost the institutional obstacles to sustained economic growth in earlier times. Technological inertia, negative feedback, and opportunistic behavior at both the micro- and the macro level were gradually overcome in Britain in the century after the Glorious Revolution. In addition, formal institutions, above all the changing role and orientation of Parliament, complemented the changes in informal institutions, to create an unexpected confluence of factors and circumstances that created the British Industrial Revolution. Enlightenment ideas, through a variety of mechanisms, influenced decision makers and legislators, hence real outcomes.

Assessing the "importance" of institutions relative to other factors such as geography or demography assumes a separability that may be ahistorical. The synergy created by the interaction between the growth of useful knowledge in the eighteenth century and the formal and informal institutions that emerged side-by-side suggests a strong complementarity. With just technological progress but no institutional change, the process would have hit barriers that would have aborted the take-off, as in nineteenth century Russia. Had there been only better institutions, but no technological advances, the system would have similarly run out of steam and asymptoted off into a new stationary state (Mokyr 2006a). Sustainable and continuous economic growth needed both.

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