

## TECHNOLOGY, CULTURE AND ECONOMICS

### FACTORS IN THE “RISE OF THE WEST”

One of the abiding and most controversial debates of twentieth century history has been that surrounding the “rise of the West.” Undoubtedly by the end of the nineteenth century some nations of western Europe had achieved economic and military global dominance, yet was this the inevitable result of a particular combination of European traits that had spurred rapid industrialization in comparison with a backward Asia? Certainly, many historians have argued this “European exceptionalist” narrative. Only the culture and structure of the West, particularly “Western” capitalism, democracy, cultural attitudes to science, technology and religion and Western-style scientific, economic and educational institutions could lead to industrialization, sustained growth and rising standards of living. Moreover for “backward,” “failing” regions of the world to develop, they too would have to adopt western methods. However, in the last two decades, an alternative narrative has emerged. Rather than assuming the inevitability of western dominance, historians such as Kenneth Pomeranz and Andre Gunder Frank have argued that European success was by no means secure as late as 1800; conversely, neither was Asian “failure” pre-determined. Further, they argued that the factors Eurocentric historians have identified as essential might not have had any such effect. They posit instead that good fortune and good timing together with the exploitation of colonial resources proved crucial. However, their arguments, while providing valuable insights may not be sufficient. Certainly, analyzing the rise of the West within a global rather than a European-centered framework would seem crucial. Yet, they too often rely upon one or two factors to explain the western dominance of the last century and a half. Instead, the answer to the “rise of the West” appears to lie not with a single or even a double cause, but rather with a complex conjunction of global factors

– geographic, economic and technological – that allowed parts of western Europe to sustain growth in a manner not before seen.

In order to explain the “rise of the West,” it is necessary to first consider not only the nature of this “rise” but also of the West itself. Eurocentric scholars often appear to work on assumptions regarding both. These assumptions and the generalizations upon which they are based can lead to egregious errors and misrepresentations, just as the Eurocentric generalization of Asia as “The Orient,” has led to a dangerous misrepresentation of Asian history.<sup>1</sup>

To many Eurocentric historians, the endpoint of their narrative is clear. The “rise” that they analyze is the development of a western-style industrial economy and democracy. In sum, the achievement of “modernity.” Eric Jones, for instance, asks, “Why did economic growth and development begin in Europe?”<sup>2</sup> This is the wrong question. Working backwards from such an incorrect assumption predicates a European-centered solution. As Jack Goldstone demonstrates, both areas of Europe and China had achieved periods of considerable economic growth in the centuries preceding 1800, periods he terms “efflorescences.”<sup>3</sup> The question therefore, should be why such an efflorescence in late seventeenth century Britain did not falter but became self-sustaining and even accelerating.

The West is neither territorially bounded nor homogeneous; neither are conceptions of the West possible to fix in time. As Kenneth Pomeranz notes, by

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<sup>1</sup> Edward Said, *Orientalism* (New York: Vintage, 1979).

<sup>2</sup> Eric Jones, *The European Miracle: Environments, Economies and Geopolitics in the History of Europe and Asia*, 3<sup>rd</sup> edition (Cambridge: Cambridge University Press, 2003) xvii.

<sup>3</sup> Jack Goldstone, “Efflorescences and Economic Growth in World History: Rethinking the “Rise of the West” and the Industrial Revolution,” *Journal of World History* 13.2 (Fall 2002) 333.

1800 there were more similarities between the eastern and western extremes of Asia than differences; moreover, the most developed regions of Asia and Europe often resembled each other more than they resembled their own closer, yet less-developed neighbors.<sup>4</sup> Pomeranz reaches vital conclusions through the comparison of specific regions of China and Britain, for instance.<sup>5</sup> Conversely, European exceptionalists tend to analyze Europe or the West as a whole. This allows them to select regional data that supports their argument while ignoring other regions that might not fit so well within their model. Jones, for instance, compares marriage figures for Sweden and Finland in the 1750s to India in the 1931 to support his arguments for European-wide population control.<sup>6</sup> While data on other areas of Europe may be lacking, to extrapolate from such potentially unrepresentative studies is surely disingenuous. Similarly, Toby Huff implies that post-Reformation attitudes to science were uniform across Europe and led to European development.<sup>7</sup> Yet, other historians, particularly Goldstone, have differentiated sharply between scientific cultures of Britain and continental Europe.<sup>8</sup> However, the tendency to generalize is not limited to Eurocentrists alone. John Hobson uses data on the state bureaucracies of France and Germany to decry the “myth of the centralized and rational Western state.”<sup>9</sup> Yet by ignoring Britain, which had a centralized bureaucracy and which led industrial development of the nineteenth century, he demonstrates the same dubious methodology of those he criticizes. It is thus important then to acknowledge Europe or the

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<sup>4</sup> Kenneth Pomeranz, *The Great Divergence: China, Europe and the Making of the Modern World Economy* (Princeton: Princeton University Press, 2000), 38.

<sup>5</sup> *Ibid.*, *passim*

<sup>6</sup> Jones 17.

<sup>7</sup> Toby E. Huff, *The Rise of Early Modern Science: Islam, China and the West*, 2<sup>nd</sup> edition, (Cambridge: Cambridge University Press, 2003) 359.

<sup>8</sup> Jack A. Goldstone, “The Rise of the West – or Not? A Revision to Socio-economic History,” *Sociological Theory* 18.2 (July 2000) 184.

<sup>9</sup> John Hobson, *The Eastern Origins of Western Civilization* (Cambridge: Cambridge University Press, 2004), 284.

West, Asia or the Orient as constructs of the imagination, ideas rather than concrete entities. They are convenient labels, perhaps, but in order to truly analyze global changes in history, one must consider both more specifically and more globally.

Whatever one terms the western periphery of Eurasia, it is clear that in the centuries before 1500, it was an insignificant backwater compared to the thriving and technologically advanced lands to its east. By 1250 C.E., Janet Abu-Lughod argues, a “world system” had developed that linked Eurasia in a net of trade.<sup>10</sup> Yet even as merchants from the fairs of Champagne, from the city-states of the Italian peninsula and from Flanders tapped into this trading system, they were only islands of commerce amid a sea of agricultural manorialism. When compared to the urban centers of the Middle East or to the agricultural revolution that had swept Sung China, European achievements seem paltry.<sup>11</sup> Moreover, economic advances characterized as “western,” the innovations of the Italian city-states in banking and finances,<sup>12</sup> Abu-Lughod argues emerged rather in the Islamicate and in China.<sup>13</sup>

Andre Gunder Frank develops Abu-Lughod’s model further. While Abu-Lughod sees a break in the middle of the fourteenth century, Frank argues that no such discontinuity occurred. Trade continued within this world system, albeit with shifts in focus over time that Frank attributes to Kondratieff cycles.<sup>14</sup> At no time up through the eighteenth century, Frank argues, did Europeans dominate this system. Indeed, European merchants found it so difficult to export their products to unreceptive Asian markets that the majority of the

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<sup>10</sup> Janet L. Abu-Lughod, *Before European Hegemony: The World System A.D. 1250–1350* (Oxford: Oxford University Press, 1989) 3 and *passim*.

<sup>11</sup> Hobson 57.

<sup>12</sup> Alfred W. Crosby, *The Measure of Reality: Quantification in Western Europe 1250–1600*, Reprint edition (Cambridge: Cambridge University Press, 1997), 200.

<sup>13</sup> Abu-Lughod 67, 331.

<sup>14</sup> Andre Gunder Frank, *ReOrient: Global Economy in the Asian Age* (Berkeley: University of California Press, 1998), 248.

profits they earned came not from Europe-to-Asia exchanges but from the intra-Asia trade. Moreover, as a proportion of the intra-Asia trade, European involvement remained small compared with that of Asians until the eighteenth century.<sup>15</sup> Only the infusion of silver, obtained from the Americas, finally allowed Europeans to really gain any significant foothold in this world trade.

Nevertheless, it was in this ostensibly unfavorable “Early Modern” period, that the European exceptionalists identify the changes that they claim would lead inexorably to western dominance. Jones argues that the interplay of small, competing states within a particular environment enabled the development of new economic models that enabled the European nation states to prosper, unlike the “alien, imposed, military despotisms [...] the revenue pumps” of Asia.<sup>16</sup>

In particular, Jones avers that Europeans employed strategies to limit birthrates that led not only to better standards of living in Europe relative to Asia, but also in turn allowed the accumulation of capital. However, his argument falters on multiple points. Jones states, “Ordinary Europeans had better clothing, more varied food, more furniture and more household utensils”<sup>17</sup> Setting aside the vexed question of who constituted an “ordinary European,” he makes only a limited attempt to prove this statement, citing a single reference to another secondary source. In contrast, Kenneth Pomeranz, considering the same issue, not only provides data and detailed analysis of many different aspects of standards of living including birth rates, life expectancy, urbanization rates and food intake from multiple sources, but also demonstrates that in specific, comparable regions of Britain and Southern China, there was no substantial gap between standards of living.<sup>18</sup>

Neither does Jones demonstrate effectively that the types of capital that Europeans accumulated over the early modern period had any real effect. While admittedly Europeans had a higher *per capita* density of livestock than that found in China, for instance, China had no need for such high levels.<sup>19</sup> The Sung agricultural revolution had raised farm yields in China far above those in Europe, enabling the Chinese to substitute plant protein for that from livestock and still maintain a large and growing population.<sup>20</sup> Further, Chinese technological advances in ploughs and in water-based transport had enabled them to forgo European reliance upon animal-power.<sup>21</sup>

Jones also argues that Europe’s lack of natural disasters relative to China, and European responses to those disasters that did occur, enabled Europe to accumulate material capital.<sup>22</sup> Yet, again, Pomeranz queries the advantage that such capital might have brought. In China, although they did have more natural disasters, he notes that higher populations enabled the Chinese government to mobilize large workforces quickly to recover from such crises. Moreover, he argues that the initial move to proto-industrialization and full industrialization did not require large amounts of working capital but rather other factors had more of a limiting effect. The capital that not only Britain but also China had accrued would have been sufficient had these other factors not interfered.<sup>23</sup>

Capital accumulation alone, however, was not the only factor in the “European Miracle” according to Jones. He argues that the development of a market economy and the nation states system both also encouraged growth. In Europe alone, he argues, governments moved to an economic system that encouraged trade that they could tax, eschewed

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<sup>15</sup> Ibid., 180–181.

<sup>16</sup> Jones 229.

<sup>17</sup> Ibid, 5.

<sup>18</sup> Pomeranz, 35–41.

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<sup>19</sup> Jones, 14.

<sup>20</sup> Hobson, 57

<sup>21</sup> Hobson, 54, Pomeranz, 35

<sup>22</sup> Jones, 39.

<sup>23</sup> Pomeranz, 42

arbitrary seizures of land or property and reduced protectionism to allow free trade.

Rejecting the Asian trade as “splendid and trifling,” Jones posits that only Europe traded in bulk goods.<sup>24</sup> Yet, Abu-Lughod and Frank demonstrate that, while luxury goods did form an important strand of intra-Asian trade, to suggest that this trade was “trifling” is a misrepresentation. By the twelfth century, China was exporting huge quantities of pottery, for instance, while India exported textiles and rice.<sup>25</sup> This trade alone suggests that rather than despotic Asian potentates stifling trade through ill-judged policies, trade continued unabated. Moreover, Hobson notes that the “free trade” Jones so lauds was no such thing. Protectionism did not stop with the decline of the medieval guilds, but became government policy in much of Europe throughout the period.<sup>26</sup> Similarly, Pomeranz rejects Jones’ claims of a more “Smithian” European economy. He argues that Chinese peasants were more rather than less involved with the market than their British counterparts, producing more goods for sale and purchasing similar “luxury” products.<sup>27</sup> Jones’ narrative of European economic and trading superiority thus soon collapses into illusion.

Neither too does Jones’ argument for institutional superiority survive close scrutiny. Jones maintains that decentralized nation states in Europe had significant advantages over Asian empires characterized by despotism and conspicuous consumption. The latter were inherently unstable, dedicated to the outward show of power rather than the growth of healthy economies. Certainly, the example he cites, Asaf-ud-daulah of Oudh in Mughal India appears to be a particularly egregious example of outrageous excess consumption.<sup>28</sup> Yet, one example does not prove a theory, especially when Jones makes no effort to demonstrate whether the

Oudh example was representative or an anomaly. Moreover, as Goldstone demonstrates, economic vitality occurred in “despotic” Imperial China in the eighteenth century, something that Jones’ theory should have precluded.<sup>29</sup>

Jones characterizes the structure of European institutions, both economic and political, as “corporate,” a means to achieve “unity in diversity.”<sup>30</sup> Toby Huff, focusing upon European science, also singles out European corporate structures as a key European advantage. He classifies corporations as legally defined entities with a common goal, independent of church and state that could transcend traditions and foster “progress.” In particular, the corporate universities that emerged from late medieval Europe enabled European scholars to move into new realms of possibility, explore new ideas and develop new theories of science. This, he maintains, allowed Europe alone to revolutionize science.<sup>31</sup>

Undoubtedly, institutions of learning did differ between Europe, the Islamicate and China. The classic madrasas of Islam were not the formal “institutions” of Europe. Formed through a *waqf*, an endowment document that described the purpose of the madrasa within the academic and religious society they had no formal faculty, no examinations, no set curriculum and no final qualifications to compare to the degrees conferred by the European universities.<sup>32</sup> Yet, Huff appears to both overstate these differences and to overemphasize any advantage European universities might have conferred. Huff argues that madrasas focused solely upon religious law and theology to the exclusion of the natural sciences and philosophy. While he admits that the loosely defined duties of the professors of the madrasas allowed them to teach whatever they pleased, he argues that there is no evidence to suggest that they strayed from the religious

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<sup>24</sup> Jones, 90.

<sup>25</sup> Abu Lughod 327, Frank, 91.

<sup>26</sup> Hobson, 287.

<sup>27</sup> Pomeranz, 88.

<sup>28</sup> Jones 109–110.

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<sup>29</sup> Goldstone “Efflorescences” 348.

<sup>30</sup> Jones, 110

<sup>31</sup> Huff, 340

<sup>32</sup> *Ibid.*, 77.

arts.<sup>33</sup> However, should this be the case, is it conceivable that medicine should reach an apex in the medieval period not in Europe but in the Islamic world?<sup>34</sup> Moreover, were Muslim scholars interested only in the Islamic arts, why did the European universities of the twelfth century receive their translations of Aristotle from Arabic sources?<sup>35</sup> As John Hobson argues strongly and Joel Mokyr grudgingly admits, Arabic scientists of the medieval period remained ahead of their European counterparts.<sup>36</sup> While the core of the teaching at madrasas remained Islamic law and theology, the lack of a formal curriculum and the freedom of the teachers may have encouraged rather than limited academic possibilities.

Huff also argues that the European structure of corporate universities and separate nation states also immunized scientists against pressures from the church and accusations of heresy.<sup>37</sup> That would have been a scant comfort to Giordano Bruno, whom the Catholic Church burnt at the stake for heresy in 1600, or for Galileo Galilei, whom the Church imprisoned for promulgating Copernican science in 1633. Even Copernicus, who escaped Church censure in his lifetime, delayed publication of his work on heliocentrism until the very end of his life.<sup>38</sup> Conversely, Huff provides no examples of Muslim scientists burned for their beliefs. Indeed, Michael Chamberlain argues that while Muslim scholars did face heresy charges, these usually arose as a result of struggles over status rather than over theory itself. The more notorious heretics received only imprisonment and even they were often able to resolve the situation within a few years by intercession of political allies or

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<sup>33</sup> Ibid, 150.

<sup>34</sup> Ibid., 167.

<sup>35</sup> Robert Bartlett, *The Making of Europe: Conquest, Colonization and Cultural Change 950–1350* (Princeton: Princeton University Press, 1993) 200.

<sup>36</sup> Hobson, 104 and *passim*, Joel Mokyr, *The Lever of Riches: Technological Creativity and Economic Progress* (Oxford: Oxford University Press, 1990), 39–41.

<sup>37</sup> Huff, 210

<sup>38</sup> Ibid, 358.

by travel to another more receptive state.<sup>39</sup> Indeed, astronomical work of such Muslim polymaths as Nasir al-Din al-Tusi and Ibn al-Shatir both predate and undoubtedly influenced Copernicus.<sup>40</sup>

Similarly, the structural “disadvantages” of the Chinese system that Huff describes may have had less of an impact than Huff claims. In China, the educational system was based upon the teaching of classic literature in a formal setting for the purpose of passing examinations that would enable to graduate to enter bureaucratic service. Huff argues that this strangled all scientific development.<sup>41</sup> Yet as Hobson argues, like the Islamicate, China remained a technological innovator for centuries, diffusing knowledge outwards toward Europe. This is difficult to reconcile then with Huff. One answer may lie with Huff’s assumption that “modern” science was the only route to technological progress. As Mokyr argues, however, this is not necessarily the case. Indeed, even in “scientific” Europe, technological advances often came before anyone could explain the science upon which it was based.<sup>42</sup> This distinction seems to be an important one. An innovative China could have developed their new techniques in agriculture and manufacturing absent the science through a strong class of mechanics and craftsmen. Moreover, this class would not necessarily need the formal education of a university, thus removing the Chinese examination system as a deleterious factor.

Given the preeminence of Islamic and Chinese technology in the medieval and through the early modern period, the emergence of “modern” science in Europe through the structure of European society, in particular the universities, is thus clearly not the sole means of technological advancement. Alfred Crosby

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<sup>39</sup> Michael Chamberlain, *Knowledge and Social Practice in Medieval Damascus, 1190–1350*, Cambridge Studies in Islamic Civilization, David Morgan, ed. (Cambridge: Cambridge University Press, 1994, 2002) 171.

<sup>40</sup> Huff, 58.

<sup>41</sup> Ibid, 277.

<sup>42</sup> Mokyr, 167.

argues instead that it was a shift from qualitative to quantitative reasoning in Europe in the late Medieval and Early Modern periods that proved essential.<sup>43</sup> However, this theory too does not explain the technological creativity that China continued to show despite its “failure” to manifest such a shift. Clearly, either the Chinese evinced more quantitative reasoning that Crosby acknowledges or such reasoning was not a necessary factor in technological change.

Nevertheless, even if both modern European science and a quantitative mentality were not necessarily the only routes to improved technology, they may still have facilitated Europe’s particular path of development. Despite Europe’s slow and uncertain start relative to the rest of Eurasia, it did overtake Islam in the early modern period and some regions of Europe had reached Chinese levels of development by the eighteenth century.<sup>44</sup> Hobson attributes this advancement to European copying of Asian technology. In particular, many of the advancements that Mokyr attributes to Europe, Hobson argues originated in the East, traveling westwards in “resource portfolios” along the trade routes.<sup>45</sup> The Gutenberg movable-type printing press, undoubtedly one of the most important inventions of the early modern period, had precursors in Korea.<sup>46</sup> Similarly, the Chinese had used gunpowder not only for fireworks but also for weaponry half a century before Roger Bacon “discovered” gunpowder in 1267 and before the “invention” of the first European cannon in Florence in 1326.<sup>47</sup> Mokyr does acknowledge some such borrowing. He allows that paper, for instance, traveled from China via the Islamic world and that Islamic innovations in textiles strongly influenced

European production.<sup>48</sup> Nevertheless, he asserts that when Europe did borrow technological ideas from the East, “[it] never lost its capacity to improve upon and refine each others’ ideas [...] eventually surpassing the original ideas to the point where the original inventing society had to borrow its own ideas back.” Further, he claims that by 1200, “the economies of western Europe had absorbed most of what Islam and the Orient had to offer.”<sup>49</sup>

These two views, one of European backwardness and reliance upon Asian ideas, the other a narrative of exceptional European creativity, would seem irreconcilable. However, difficulties with both arguments suggest a truth somewhere in between the two. Hobson does make a good case for the technological diffusion of some ideas westwards from Asia, not only after 1200 but even up to the eighteenth century. Yet his evidence is primarily circumstantial. As such, it is highly suggestive but it is not irrefutable and does not preclude the possibility that Europeans independently invented some or even most of their technologies. Moreover, as Mokyr’s analysis of the weight of small innovations demonstrates, Europeans did not lack the ability to tinker and to innovate on their own, whether from an originally Asian base or from an original invention. Indeed, it is more reasonable to conclude that the small improvements in technology that together built into larger change were more localized rather than to assume every small change had to be transmitted over thousands of miles. Thus, technological creativity would appear to be not a uniquely European feature nor an Asian one but rather a universal.

The technological creativity that some in western Europe demonstrated did however enable them to reach and surpass Chinese technological prowess in the late eighteenth and early nineteenth century. Pomeranz acknowledges that by 1750 although the

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<sup>43</sup> Alfred W. Crosby, *The Measure of Reality: Quantification in Western Europe 1250–1600*, Reprint edition (Cambridge: Cambridge University Press, 1997).

<sup>44</sup> Huff, *passim* and Pomeranz, 44.

<sup>45</sup> Hobson, 118. See also David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press, 2004) 370.

<sup>46</sup> Hobson 185

<sup>47</sup> Hobson 186–87.

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<sup>48</sup> Mokyr, 41.

<sup>49</sup> Mokyr, 44.

*average* level of technology and related productivity in China and Europe was broadly comparable, “the best available technological deployed [in specific regions of Europe] for various important factors were already the world’s best.”<sup>50</sup> This clearly requires an explanation. Pomeranz rejects the essentialist arguments characterized by Huff or Crosby. Indeed, if structural differences or quantitative mentality cannot alone explain technological change before 1750, then it is unreasonable for them suddenly to explain alone the rapid burst of western European inventions after 1750. The arguments of Huff and Crosby seem predicated upon the narrative of the European technological advance as a long, continuous, inevitable march to supremacy from 1500 onwards. The apparent disjunction in the eighteenth century does not rule out the possibility that scientific institutions and quantitative reasoning were involved. Indeed, Pomeranz acknowledges the possible importance of the “scientific revolution” in Britain.<sup>51</sup> Still, it does suggest that other factors were involved and that the picture was more nuanced. Moreover, Huff and Crosby both analyze Europe as a whole, or at least western Europe. Indeed, Crosby makes much of Italian quantitative reasoning with regard to painting and bookkeeping.<sup>52</sup> Yet, Pomeranz makes clear that while Britain, the Netherlands and parts of Northern France were technological advanced, the same was not true of other parts of Europe.

Pomeranz explains the advancement of British technology beyond that of China as the result of the proximity of coal. He argues that the vast coalfields of northern China were far from the main industrialized region of the Lower Yangzi and from the craftsman who lived and worked there. In contrast, British coal reserves were proximal to the core industrial areas and thus to the technological expertise of local craftsmen.

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<sup>50</sup> Pomeranz 44.

<sup>51</sup> Ibid, 44.

<sup>52</sup> Crosby, chapters 9–10.

The nature of British mines and this availability of craftsmen appears to have spurred technological advances, including the steam engine, which then filtered into other industries and aided in the mechanization of the nineteenth centuries. Further, the very remote and inaccessible nature of the Chinese mines made it economically unviable to exploit them while any alternatives remained in the South.<sup>53</sup> Thus, he argues, there was little incentive to relocate craftsmen to the North or to develop better mining technologies. However, while this appears to be a compelling theory, it is not sufficient to explain the nineteenth century British technological efflorescence. While Pomeranz avers that the North was the primary source of Chinese coal, he does not acknowledge other, smaller coal reserves in southern China that could have provided the boost to technology he associates with coal in Britain. Additionally, he does not address the reserves of coal located in other regions of Europe besides Britain. If this thesis were sufficient, then surely German craftsmen in the Ruhr valley would have produced as many technological innovations linked to coal as the British did? Yet Germany did not begin to industrialize until decades after Britain.<sup>54</sup>

Goldstone maintains that the differences between Britain and continental Europe are explained not solely by coal but also by the role of a peculiarly British “engine culture” that emerged only in eighteenth century Britain.<sup>55</sup> Unlike continental Europe, which concentrated upon theoretical science, British scientists and technologists focused upon experimentation and practical applications. This, Goldstone argues, gave them a distinctive edge in technological innovation and subsequent industrialization over their neighbors and over China. While this argument may be appealing, however, it is not conclusive. Certainly, a mechanical culture seems to have prevailed in Britain, yet

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<sup>53</sup> Pomeranz, 62.

<sup>54</sup> Mokyr, 239.

<sup>55</sup> Goldstone, “Efflorescences,” 367

Goldstone does not differentiate between clear cause and effect. While a mechanistic culture might have encouraged technological innovation, the proximity and utility of coal might conversely have promoted a limited mechanistic culture in Britain towards more widespread acceptance.

Pomeranz, however also does not suggest that coal alone was sufficient. Rather, he argues that access to resources from colonies also proved vital. By 1800, he notes that intensive use of the environment of both China and parts of Western Europe had created critical problems to further growth of either economy. Deforestation and consequential erosion, soil denudation and changes in weather patterns were beginning to have an impact not only upon land use but also upon labor patterns and productivity.<sup>56</sup> Further, in neither the Western European nor the Chinese “core” areas could Smithian economics provide complete relief from this ecological constraint.

While both China and Britain had the same blockages and thus the same incentives to attempt to transcend them with technology, only Britain followed the technological route. China, in contrast, used labor-intensive land management techniques. Given that China had previously shown no shortage of technological expertise – indeed they had pioneered earlier technological solutions to productivity problems in many fields<sup>57</sup> – the explanation had to lie elsewhere. In addition to access to cheap coal in Britain, which provided vital energy that depleted forests could no longer provide, bulk goods, produced by coercion and slavery in the colonies, could continue to supply industry without drawing upon increasingly scarce and fragile land in Europe itself. China, by contrast, had no such “ghost acreage” and raw goods for industry had to compete with food products for the use of land.<sup>58</sup> Without such colonial resources, China had to

increasingly rely upon labor to maintain its productivity while in those regions of Europe with colonies, especially Britain, labor remained free to move into industrial factories. China therefore entered a trap in which it did not have the free labor to industrialize and then, in turn, it could not then use industrial technology to free up labor from the land.

Again, however, this is not alone sufficient explanation for industrialization. Britain was not the only colonial power. Indeed, it was not the first either in the Americas or in Asia. Spain and Portugal dominated early colonization of the Americas while the Portuguese and the Dutch pioneered (limited) Asian colonies.<sup>59</sup> In addition, by 1800, France claimed considerable overseas possessions. Yet none of these states industrialized before Britain. Thus, rather than coal, colonies or a mechanistic culture being sufficient in themselves, the conjunction of all three in one place – Britain – appears to have been crucial in eighteenth century technological development. Only Britain had the proximity to coal, access to colonies and the mechanical culture that enabled it to break free of the ecological trap.

A new picture thus begins to emerge of technological development in Eurasia over the past millennium. The clear superiority of Chinese technology for much of this period and the early flowering of Islamic science and medicine demonstrate that neither European-style corporate educational and economic institutions nor a pan-European quantitative mentality were sufficient in themselves or together to explain the technological rise of the West. However, neither was Europe a mere technological sponge for Asian ideas. Rather, inventions arose across Eurasia in a variety of cultures and diffused outwards from core areas to the peripheries along trade routes. Sometimes, this diffusion could be extremely slow, but by 1750, the two peripheries of Eurasia had comparable levels of technology. Between 1750 and 1850, however, Britain

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<sup>56</sup> Pomeranz, 239.

<sup>57</sup> Ibid, 45–46.

<sup>58</sup> Ghost acreage is also discussed in Jones, chapter 4.

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<sup>59</sup> Hobson, 167, 156



flared into innovative life facilitated by a particular variant of the scientific mentality – the mechanical culture – combined with its proximity to coal and access to colonies.

Once industrialization had begun in Britain, it ultimately spread to other regions of Europe. Jones claims that this spread was the inevitable result of proximity and inter-state rivalry.<sup>60</sup> This theory, however, does not explain the great disparity between other nations such as Denmark and Germany in their uptake of the new technology. Nor does it explain why states abutting Europe, such as the Ottoman Empire, should also industrialize late. Indeed, David Christian's argument that packets of knowledge traveled worldwide, disseminating new ideas and techniques, suggests that not only Europe but the rest of the world should have seized upon the new technology relatively quickly, given the ever-diminishing travel times between the extremities of Eurasia.<sup>61</sup> Yet, the rest of the world did not industrialize before the twentieth century. It might appear that this was the result of structural blockages on the part of Asia, yet there had been no great structural changes between the periods of technological innovation in China and their later "failure." The conclusion must be then that institutional structure or governmental will was not lacking in the non-industrialized world. Nations such as France and Germany had the accessible coal and colonial resources and were able to draw upon and develop technical knowledge from Britain to industrialize rapidly. Those states with neither coal nor colonies, including China and Denmark, remained caught within the labor-intensive trap until such technology emerged in the twentieth century that enabled it to break the cycle.<sup>62</sup>

If the rise to technological dominance of some nations of Europe in the nineteenth century is thus explicable as the result of the conjunction of coal,

colonies and mechanistic culture, historians do not necessarily accept that this technological dominance alone led inexorably to economic dominance. Mokyr does aver that the relative surge of the Western economies was the result of "Schumpeterian" growth through technical change. The increase in the "stock of human knowledge" led to the development and expansion of technologies that allowed the efficient production of more and better products and improved utilization of existing resources.<sup>63</sup> However, Mokyr's assertion that China during the Manchu period was able to maintain economic growth without significant technological progress does not sit easily with a straight correlation between technology and economics.<sup>64</sup> Goldstone also clearly sees Schumpeterian growth as critical to the periodic efflorescences in Eurasia. Certainly, while the sharp economic growth he analyzes in High Medieval northern Europe did not involve industrialization it did involve technological advancement in agriculture.<sup>65</sup> Similarly, he identifies British industrialization as the means to begin and to sustain its nineteenth century surge.<sup>66</sup> However, again Pomeranz demonstrates that economic growth continued in China even while it began to lose ground on British technology.<sup>67</sup>

As noted above, Jones asserts the critical importance of "Smithian," free market economics to the rise of the West.<sup>68</sup> Yet clearly neither is a pure Smithian explanation adequate. Frank and Abu-Lughod's elucidation of Asian early commercial dominance, Hobson's noting of nineteenth century British protectionism or Pomeranz's demonstration of Manchu Chinese "Smithian" economics each suggests that commercial growth was not alone sufficient. However, while not sufficient, some measure of commercial

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<sup>60</sup> Jones, 119.

<sup>61</sup> Christian, 370.

<sup>62</sup> Pomeranz, 297.

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<sup>63</sup> Mokyr, 6.

<sup>64</sup> *Ibid.*, 219.

<sup>65</sup> Goldstone, "Efflorescences," 347.

<sup>66</sup> *Ibid.*, 354–55.

<sup>67</sup> Pomeranz, 44.

<sup>68</sup> Jones, 85 and *passim*.

growth seems a necessary factor. Without such growth in the market, however incremental, the improvement of productivity through rapid technological change would not be economically rational. Moreover, although Pomeranz notes that technological change required only limited capital, it did require *some* capital.<sup>69</sup> Profits from commerce may have provided the vital difference between the profits required to maintain a manufacturing business and those required to develop one. Indeed, Hobson argues that profits from coercive colonial trade provided European colonial powers with a small but significant edge over non-colonial Asian states.<sup>70</sup>

Thus, while neither Smithian nor Schumpeterian growth alone was sufficient it appears that a combination of the two together was necessary for economic growth. Smithian growth, contrary to Jones' claims, occurred not only a uniquely favored and structurally superior West, but across Eurasia. Similarly, colonial commerce may have facilitated such growth, but it did not preclude growth elsewhere. When confronted by ecological blockages however, it took technological growth on top of this Smithian growth to enable the sustained and accelerating economic growth of Britain and later other sections of western Europe.

The rise of the West, therefore, cannot be attributed to a single factor, whether a uniquely favorable environment for commerce, institutions that promoted unique scientific or technological achievement or to an exceptional "European" culture that thought and acted in new and advantageous ways. Neither should one conclude that the rise of the West was inevitable or predicated upon developments that stretch back into the medieval period. Instead, some – but not all – states of north western Europe were only able to break free from crushing ecological problems in the nineteenth century through a very specific global conjunction of available coal, colonial resources and

technical expertise – itself a product of global "borrowing", localized innovation and a mechanical culture – that, together with investment from global commerce allowed continued growth beyond that of other states that did not share such a fortunate conjunction.

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<sup>69</sup> Pomeranz, 42.

<sup>70</sup> Hobson, 266–271.