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Reasons for the Great Divergence between European and Asian Economic Growth in the Eighteenth Century

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Abstract

In 2018 Broadberry, Guan, and Li produced new estimates comparing GDP per capita in advanced parts of Europe and China. This data shows that the Great Divergence started ca. 1700, well before the technological changes associated with the Industrial Revolution. This paper seeks to explain this divergence in the growth experience, highlighting the role of the agricultural revolution and early adoption of coal by, most notably, Britain.

'The causes of the wealth and poverty of nations - the grand object of all enquires in Political Economy' – so wrote Malthus in an 1817 letter to Ricardo (Landes, 1998, preface). Since then, a rich theoretical and empirical literature debating the mechanisms and timing of Northwestern Europe's divergence from Asia has blossomed with wide-reaching implications; particularly for current development policy (Juhasz & Steinwender, 2024). This essay will work off the basis that the Great Divergence describes the emerging gap in productivity and living standards between advanced Europe and Asia (Pomeranz, 2000; Broadberry & Zhai 2023, p.2). Quantitatively the measurement tool used to determine the magnitude and timing of this divergence is GDP per capita, which will hence form the empirical basis of this analysis.

New data from Broadberry, Guan, and Li (2018) suggests the Great Divergence began ca.1700; a century earlier than the previously theorized 1800 proposed by Pomeranz's Californian school (Pomeranz, 2000). Pinpointing the exact timing of the divergence remains challenging due to the territorial expansion of the Qing dynasty resulting in poor economic data for the period 1620-90. Nonetheless, it appears likely that China and Britain had a comparable GDP per capita ca.1650 at around $1000, however by 1700 the emergence of the Great Divergence was already evident, with Britain's GDP per capita rising by roughly 50% to $1,563 in 1700, whilst China's stagnated. It must be noted however, that the leading region of China, the Yangtze Delta, was perhaps as much as 75% richer than China on average and hence only notably began diverging from Britain and the Netherlands post-1700. This gap too becomes more apparent as the 18th century wears on, with Britain's growth persisting and GDP per head reaching $1,710 by 1750 and $2,080 by the turn of the 19th century (Broadberry et al., 2015; Walker, 2014). China, on the other hand, saw GDP per capita figures slump to $749 in 1750 and merely $654 by 1800.

Thus, this essay will elucidate the mechanisms, which will be defined as high-level processes which contribute towards the Divergence, of coal exploitation and agricultural advancement. These are the two key mechanisms to understanding northwest Europe's, with a specific focus upon Britain's, visible divergence from China ca.1700 as well as their persistent, yet differing, growth paths throughout the 18th century.

Proximately, the Divergence occurs because Britain achieved proto-industrialisation at an earlier than previously believed date. To gain a deeper understanding as to the causes of this, a Malthusian analysis can be employed.

Malthus (1798) sets out his thesis as follows: he believes humans are lustful and if given the opportunity will reproduce as much as possible. Naturally, if this continues inter-generationally, population will grow geometrically. However, Malthus argues output only grows linearly. This is echoed by Ricardo (1817) who argues with each additional worker, marginal returns from a fixed supply of land diminish. Thus, Malthus concludes, that if left unchecked, population growth will outpace the increase in the supply of food, ending in living standards and population collapse.

Before looking further, it is first necessary to take note of the comparative demography of the two nations. From 1650-1700 England's population remained constant, however due to inaccurate data, we can only glean that China's population was at a similar level in 1620 and 1700, likely with a significant dip in between due to war. However, over the 18th century, the population in England rises from 5.2 million to nearly 9 million (Wrigley et al., 1997, p.614-615). Over the same period, the Chinese population over doubles, from 138 million to 342 million (Broadberry, Guan & Li 2018, p.986, 995).
Evidently, Britain manages to escape the Malthusian trap, having explosive population growth alongside GDP per capita growth, whilst China suffers the same collapsing living standards that plague organic economies throughout time (Reuveny, 2012). Consequently, the mechanisms by which Britain circumvents this seemingly logically infallible trap will explain the basis of the Great Divergence.

The first mechanism lies in the harnessing of coal as a thermal energy source instead of increasingly expensive wood, as famously outlined by Pomeranz (2000). Britain had substantial coal deposits, particularly in the northeast, which were shipped down the east coast in large quantities by 1700 to London (Flinn, 1984, p.26-7). China, on the other hand, despite having vast deposits in the north and northwest, had its economic hub situated further south, which faced steep transportation costs to obtain northern coal and contained merely 1.8% of China's coal reserves itself (Pomeranz, 2000, p.62-3). Moreover, the average energy density of Britain's coal was greater making it a more efficient source of energy per unit burnt (Mill and Holliday, 1998; Smil 1988, p.32). Naturally, this meant coal was more efficient and profitable to use in Britain than in China. Allen (2009a, p.83) calculates the price of energy in Beijing to be nearly double that of London and twelve times that of Newcastle and argues more broadly that factor prices guide and drive British economic growth.

Furthermore, Britain's continued adaption and innovation of grates, hearths and chimneys allowed for coal's widespread and rapid adoption and this, coupled with the invention of the Newcomen steam pump in 1712 only further contributed to coal's rising production and use (Hatcher, 1993, p.409, 458). On the other hand, China failed to innovate the technology required to ventilate their mines and bring down costs, hence being unable to utilise coal on a wider scale.

Consequently, whilst China's coal consumption remained low, coal as a percentage of total energy use in Britain rose from 10.9% in the 1560s to 49.7% from 1700-9 and climbed further to 79% by 1800-9 (Wrigley, 2010, p.37). Already, by 1700, Wrigley (2010 p.39) provides a conservative estimate that the 2.2 million tons of coal consumed per year in England would have required an equivalent 2 to 3 million acres of woodland to supply the same amount of energy, rising to 11 million acres by 1800 – a third of Britain's landmass. Therefore, coal added to ghost acres, acting as a mechanism to circumnavigate the issue of a fixed amount of land constraining energy capacity.

This contributed to GDP per capita growth in two distinct manners. Proto-industrialisation is the principal channel. The increased availability of cheap energy provided the basis for the growth of energy-intensive industries in the secondary sector; with just north of 40% of the secondary's sector contribution to GDP coming from metals, construction, beer, malt and sugar refinement come 1700 (Broadberry et al., 2015, p.13; Hatcher, 1993, p.419). Additionally, 33% of total coal usage was industrial in 1650 rising to 39% by 1700. This figure continued to climb through subsequent centuries, reaching 61% by 1855 (Malanima, 2016, p88; Hatcher, 2003, p.501; Flinn, 1984, p.26-27, 252, 303-304). Relevantly, the secondary sector in Britain grew at 0.89% per annum in the lead-up to 1700, constituting approximately 60% of the rise in GDP (Broadberry et al., 2012, p.34-35). Given the data above, we can establish that around 25% (0.41x0.6) of the rise in GDP per capita in the runup to the emergence of the Great Divergence was due to energy-intensive manufacturing – only possible through the increased exploitation of coal. Naturally, this only becomes more pronounced post-1700 as a higher quantity and proportion of coal flows to manufacturing.

Urbanisation too is intimately linked to development and GDP growth (Bairoch, 1988; World Bank, 2009; Wrigley, 1985; 2006; 2010). Coal contributes to explaining the increase in the urbanisation rate from 8% ca.1600 to 16% ca.1700 by sustaining the living standards of those living in cities, primarily by being used for heating and cooking (Wrigley, 2018, p.18). Without coal, London alone would have required 1.5 tons of firewood per person in 1700 for domestic and industrial purposes – an unsustainable figure (Wrigley, 2010, p.39).

By not adopting coal, China fell into the Malthusian trap of diminishing returns resulting in a collapse of living standards. Without cheap, abundant energy, China was unable to industrialise and transition to a more productive economy. Industry constituted less than 10% of China's economy as late as 1840 and, under the Qing dynasty, China saw her urbanisation rate fall from 11-12% to just 7% by the late 18th century (Broadberry, Guan & Li, 2018, p. 973; Xu, van Leeuwen & van Zanden, 2018, p.322). Tellingly, China only industrialised from the 1950s, with coal a central feature of Mao's five-year plan (Smil, 1988, p.85).

Despite coal's undeniable importance, growing a population whilst simultaneously growing manufacturing and services as a proportion of the workforce can only be achieved through the second mechanism of agricultural productivity advancements.

Over the 17th and 18th centuries, northwest Europe, particularly the Netherlands and Britain, saw an explosion of agricultural productivity known as the agricultural revolution (Allen, 2009b, p.530). Net cereal yields in Britain rose 125% per acre over the period, providing more crops for consumption and also additional food for animals, which in turn reached a larger average size therefore increasing the quantity of available meat (Wrigley, 2010, p.29). Estimates lie in the region of roughly a tripling of beef production from 1600 to 1800. Mokyr (2009, p.173) goes as far as to claim that by 1700 British farming was 'as good as … anywhere.' Furthermore, food output rises approximately in line with the growing population over the next 150 years, with trade only playing a more significant role only towards 1800 (Overton, 1996, p.75; Findlay & O'Rouke, 2007).

China, by contrast, struggled in no small part due to a population doubling from 1700 to 1760, negative land per capita growth, and fundamentally a lack of productivity growth to sustain living standards – a classic case of the Malthusian trap (Broadberry, Guan, Li 2018 p.995; Broadberry & Zhai 2023, p.19-20, 25). Huang (2002) lays out this theory of involution, highlighting that the more labour-intensive agricultural system in China made her more vulnerable to diminishing returns as the population rose.

Britain primarily underwent this agricultural revolution from ca.1600-1800 through the adoption of new techniques and continued innovation, perhaps underpinned by institutions more conducive to growth (Wrigley, 2006; Overton, 1996; Acemoglu, 2005; 2012; Mokyr, 2009; 2016). Crop rotations coupled with the use of legumes played a central role. By rotating crops, the nitrogenous content of soil is restored meaning fallowing as a percentage of land fell from 36% to 16% (Wrigley, 2006, p.440). The Norfolk rotation was introduced in the Netherlands in the mid-17th century and was rapidly adopted in Britain with half of British farmers using turnips by 1710 (Mokyr, 2009, p.172). Moreover, the volume of arable land rose from 10 million acres in 1600 to 11.5 million acres by 1800, facilitated by the reduced demand for wood given the adoption of coal (Allen, 2004, p. 104).

In terms of animal production, the technique of selective breeding was employed to improve the quality of farm animals (Wrigley, 2006, p.438). Horse-related innovations, principally the seed drill in 1701 and horse hoeing in 1715, were also instrumental in continued rising productivity, with the horse supplanting the ox near completely by the early 1700s (Wrigley, 2006, p.445; Broadberry et al., 2015, p.111).

Focusing on national accounting, agricultural productivity growth contributed through three channels. First, it allowed for the shift of workers from the primary sector to the secondary sector in the 17th century and increasingly the tertiary sector in the 18th century, which grew on average at 0.89% per annum from 1700-1800, as fewer people were required to produce food (Broadberry et al., 2012, p.34). This channel is further supported by the Cambridge Group's new data on the sectoral makeup of Britain. The percentage of male workers in agriculture plummets from 63.8% in 1601 to 45.3% in 1701 and falls further to 39.4% by 1800 and in the secondary sector, those figures are 28%, 41.7% and 42% respectively (Keibek, 2017, p.152). The proportion of the male workforce in the tertiary sector also increases from 11.5% to 15.3% between 1700 and 1800. Given that the manufacturing and service sectors had roughly double the productivity of the agricultural sector, improved agriculture (and coal) acted as the mechanism to facilitate this shift and thus began the Great Divergence (Broadberry et al., 2012, p.35; 2015, p.195.) This is reflected in recent papers which have revised Total Factor Productivity figures upwards, suggesting that productivity growth began in 1600 increasing at 2% per decade and constituted a substantial proportion of GDP per capita growth (Bouscasse, Nakamura & Steinsson, 2025, p.835; Broadberry & Zhai, 2023, p.23)

Second, agriculture supplies the raw materials that key industries in the secondary sector rely upon. Textiles and leather goods constituted 55.4% of Industrial output from 1722-27. Of this, 34% required leather as an input whilst the remainder of textiles were predominantly wool based (Broadberry et al., 2015, p.132, 144). To meet rising demand for textiles, the quantity of sheep rose sharply by an estimated 40% from 1650-1700 with an even greater increase in wool weight of two thirds over the same period; additionally, the output of hides in lbs doubled from the 1650s to the 1750s (Broadberry et al., 2015, p.106, 112). Consequently, around half of industrial output was directly reliant on inputs from the growing agricultural industry ca.1700 and would not have been tenable without agriculture's growth.

Finally, the rise in agricultural output itself contributes to growth. From 1650-1700 agricultural output grew by 0.41% a year, contributing toward approximately one sixth of GDP per capita growth due to England's stagnant population (Broadberry et al., 2012, p.34). Beyond 1700, agriculture's direct contribution to rising GDP per capita is negligible as output was merely rising in line with population and hence contributed primarily through the two channels previously outlined.

In totality, approximately three quarters of manufactured produce in Britain was directly reliant upon agriculture and coal c.1700 for vital inputs. This is particularly significant given that roughly half of Britain's GDP growth comes from industry between 1650 and 1750 (Broadberry et al., 2012, p.34, 35). Additionally, although perhaps more indirectly, coal and food were the necessary fuels for rapid urbanisation, without which, the growth of the secondary and tertiary sectors would have been greatly diminished. Even more fundamentally, both coal and the agricultural revolution were necessary to overcome the shackles imposed by the Malthusian constraint. Ultimately, China, like other economies of old, failed to break free from these chains and were therefore unable to achieve sustained rising living standards.

Thus this essay has empirically demonstrated that coal and agricultural advancements were the fundamental drivers behind the diverging growth paths of advanced Europe (particularly Britain) and China ca.1700; hence explaining why the gap between the two regions was already so pronounced by the time of Malthus' note to Ricardo.

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