Introduction

The past few decades have given birth to a rise in the success of the Western World, a region that has become synonymous with modernity, wealth, and power. Such an outlook emerged after two hundred years of rising global inequality, which can be observed in the comparison of one country’s wealth to another. The Western and Eastern worlds were developing at similar rates until 1820 when wealth indicators dramatically deviated. The prevalence of such a disparity is exemplified in today’s wealth disparity. Germany’s GDP per capita is ten times that of Vietnam, and Norway’s is sixty-four times that of Mozambique. Economists employ Gross Domestic Product per capita as a method of quantifying wealth variation, as it places every country, regardless of population size, on a similar playing field.

The greatest increase in wealth inequality occurred during the Second Industrial Revolution, between 1820 and 1870. This period also marked the advent of the development of transportation technology, which has come to be known as the Transportation Revolution. This revolution was a period in which passenger and commercial transportation became efficient, practical and integral to developed European countries. More broadly, it was a period of great societal transformation. The increase in production and communication that resulted from the Transportation Revolution laid the groundwork for immense GDP inequality. The era created the foundation for a period known as the Great Divergence, a time of vast international disparity, particularly the growth and development of Western regions in comparison to the relative stagnation of Eastern regions.

Historian Peter Sterns recognizes the existence of two prominent revolutions in human history: the Neolithic revolution and the Industrial Revolution. In expanding on such a point, Sterns states, “Both the Industrial Revolution and the Neolithic revolution brought fundamental change in how people worked, where they lived (settled communities rather than nomadic bands), then cities instead of rural communities and farms), what potential economic surplus was available, and how people could be supported around the world.” Thus, the transition from a hunter and gatherer society to an agrarian one was imperative in the creation of a complex society. An agricultural society yielded a food surplus, which enabled the need for less farmers and more craft specialization. This, in turn, led to the emergence of scientists, doctors, and artisans. The products and knowledge of these specialized craftsmen gave society wealth and power. The story of the divergence in inequality begins with Neolithic Revolution and culminates in the Industrial Revolution.

Historiography

Debate surrounding the time period of the Great Divergence exists, specifically as to when the divergence occurred between the developed regions of Europe and the developed regions of Asia. The two main schools of thought are those of the revisionists and the anti-revisionists. The revisionists believe that the divergence occurred late in human history, roughly around the 1800s. In contrast, the anti-revisionists argue that the divergence took place well before modernity. David Landes, an anti-revisionist historian, embraces the often-disregarded notion of Euro-centralism. Basing his argument on the idea that China’s totalitarian rule and lack of free-market inhibited the growth of the East, Landes’ attributes inherent government and cultural
differences as preventing Asia from experiencing economic growth. Such an argument, however, is factually incorrect. China did indeed possess a thriving free market where goods and ideas were easily transferable.\textsuperscript{2} Furthermore, revisionist Jack Goldstone attacks Landes’ argument by asserting that prior to 1800, the West and the East were on a comparable level of life expectancy and material living standard.

Kenneth Pomeranz furthers the Great Divergence debate with his revisionist perspective. Arguing that China and Western Europe experienced a similar economic progression until 1800, he models his argument on the development of European colonies and the steam engine’s role in coal production. The invention of the Newcomen steam engine proved imperative to the rise in wealth inequality. Unlike China, England’s coalmines were filled with water and would often flood. They required the engine to pump the water out of their damp mines. The pump eventually made coal extraction significantly less expensive. Coal was the most prominent energy resource of the era. It is often said that coal fueled the Industrial Revolution. Pomeranz examined the effect of the steam engine on the decreased cost of coal, heating, manufacturing, and even transportation.

This essay seeks to argue the following. First, the era most important to the takeoff of the great divergence is nearly half a century later than the period Pomeranz proposed. Careful analysis of GDP per capita divergence between different global regions has led me to such a conclusion. Second, the lasting takeoff in the Great Divergence occurred late in human history and was largely a product of the steam engine’s role in transportation. I argue that the application of the steam engine to transportation was imperative in the growing wealth inequality between the West and the East. Because of the immense wealth that the Transportation Revolution generated between 1820’s and 1870’s, it can be viewed as the takeoff of the Great Divergence. This wealth led to European global dominance from 1820-1870. I do not discredit the importance of coal production nor does Pomeranz discredit the importance of steam-powered transportation. We disagree on the hierarchy of significance.

The revisionist argument often stops short of crediting post 1820 advancements as a cause of the Great Divergence. Between 1820 and 1870, Western Europe’s Transportation Revolution propelled the dramatic rise of global inequality. The rapid advancement of steam powered transportation technology furthered the commercialization of the region. A lot of discourse on this era has been ignored in the context of the Great Divergence debate. Wealth statistics and noticeable technological transformation illustrated a powerful takeoff that coincides with the Transportation Revolution. Advanced transportation increased the interconnectivity of Western Europe. Along with the advancement of mechanized factories, this was one of the foremost factors that increased manufacturing throughout Western Europe. Access to cheap, fast, and reliable transportation resulted in an increase in manufacturer’s net profits. Before the expansion of the transportation systems, merchants who conducted large scale trade typically owned their own ships and exporting networks. The development of steam powered railroads and steamboats deconstructed this inefficient system and introduced advanced transportation that could be utilized by all.

Historian George Taylor asserts that the innovations in transportation improved the foundation of mobility and thus revolutionized how business was conducted.\textsuperscript{3} The increased ease of mobility effectively shrank the size of the developed Western countries, bringing customers and manufacturers closer together. The volume of transactions increased and thus commercialization thrived. Industrialists could reach more customers at a lower landing cost. The profitability led to the expansion of the factories, work force, customer networks, and production. Capitalism


\textsuperscript{3} George Rogers Taylor, \textit{The Transportation Revolution 1815-1860} (Armonk, NY: M. E. Sharpe, 1989), 12.
developed and Western European economies were booming. Regions in the East did not have access to a network of transportation and thus they did not have a trigger to commence comparable economic expansion. This led to immense GDP disparity.

In Catch Up: Developing Countries in the World Economy, Deepak Nayyar echo’s Taylor’s argument that the Transportation Revolution dramatically improved the economic landscape. However, he focuses his discourse on how the Revolution shaped the labor force. The means of transportation, “transformed the world economy by creating patterns of specialization in production associated with a division of labour through trade reinforced by the politics of imperialism.” Specialization in an economy leads to economic growth by means of an increase in production quantity, production quality, innovation, and a comparative advantage between trading nations. Specialization leads to an absolute advantage in the production of a specific good. Essentially, Western European countries were able to produce more goods than a competitor, using the same amount of resources. Those goods were then traded to the competitor using the new transportation technology.

Along with the Transportation Revolution, another sub revolution was the Communication Revolution. Robert Albion described the Communications Revolution as an era of rapid advancement of technology and usage of forms of communication. The increased communication came from the speed at which steamboats, trains, and the telegraph connected people. Snail mail, newspapers, and passenger travels increased the rate of communication in the Western world. The increased communication facilitated business transactions. A businessman was now able to take a day trip to a town 100 miles away, to secure a new client. This would have been unfeasible without the advent of fast and cheap transportation technology.

**The Introduction of the Steamship**

Thomas Newcomen’s invention of the steam engine in 1712 was imperative to the Transportation Revolution of 1820. The steam engine was originally used to pump water out of the damp coalmines in Europe. The development of the steam engine was a slow process. As Pomeranz noted, it took decades before the pump was efficient. However, because it was necessary to pump the water out of the coalmines, Europeans were forced to commit to an imperfect technology. Dependence forced the engine’s technological progression. Asia did not have damp mines like Europe and therefore had no practical use of an inefficient steam engine. Furthermore, because of the harsh European terrain, there was a pressing need to improve transportation. Thus, a significant amount of the infrastructure and technology was state sponsored. The government funding propelled Europe’s transportation revolution. After roughly 50 years of innovation in Europe, the steam engine developed to the point of transportation utility.

In 1783, Marquis Claude de Jouffroy built the first successful steam ship, Pyrocaphe. The first prototypes of steam powered ships fused modern engine technology with thousands of years of boating knowledge. The foundation of Pyrocaphe was a simple paddleboat sidewheel steamer. Except, instead of human rowers, the paddles were be powered by the steam engine. Prior to the invention of the steam engine, there had been thousands of miles of intricate canals built throughout Western Europe and the United States. Over land traveling was incredibly inefficient. It required a lot of money and time to transport goods throughout Europe with animal drawn wagons. Because this form of traveling was incredibly inefficient, city architects saw the benefit of moving to the reduced friction of water transportation. Horses on the side

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of the canal would pull the boat. Governments financed the canals. Canals were seen as necessities to provide an alternative for overland shipping. These canals were exclusively used for the transportation of manufactured goods.

In 1801, William Symington had the idea of increasing the efficiency of canal transportation by replacing the horse with the steam engine. “He adapted the boat for the reception of a steam engine, and thereafter he assisted to place the steam engine into the boat, previous to its removal to the Forth & Clyde canal.”

Eventually steamboats dominated the canal waters, making the landing cost for manufacturers significantly cheaper. In the United States, the Eerie Canal provided manufacturers and merchants with an efficient transportation network. The industry of goods production became much more profitable and therefore grew exponentially. The steamboat was a contributor to the boom in the manufacturing industry. The manufacturing industry’s output in relation to national income saw an increase from one fifth in 1770 to one third in 1831. Efficient transportation helped facilitate commercialization by decreasing costs and increasing the reach of manufactures. Small towns in remote areas of England began to feature train stations. The simple addition of a train station opened the town to trade. Transactions increased and the GDP per capita rose.

The Introduction of Rail Locomotion

Soon after the establishment of the steamboats, rail locomotion was invented. Richard Trevithick built the first railway steam train in the 1804. Often the person who is remembered in history is not who invents the technology but rather who develops the critical improvements to make it a practical device. This trend is applicable to the locomotive and the famous train designer, George Stephenson. Stephenson was a prominent Englishman who built inner-city public railway lines. He became

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9 Samuel Smiles and Robert Stephenson, The Life of George Stephenson, Railway Engineer (Columbus, OH: Follett, Foster, 1859).
of railroad track to transport people and goods throughout the region.  

Historians have debated the reason for the lack of implementation of rail locomotive in Asian regions. Gregory Clark and Robert Feenstra argued that the source of the divergence was the difference in efficiencies of economies. Developed European countries were able to dramatically improve the steamboat and railroad’s efficiency, whereas Asian countries were not. It is true that the technology was available to Asian countries but the reason why trains and steamboats didn’t develop was not because of efficiency problems. Rather, it was because there was indifference toward the technology. Western imperialism and trade networks brought a wealth of knowledge into the Asian countries. India was under British rule through the East India Company and there were countless trade routes that connected Western Europe to China and Japan. Railroad technology could have been implemented if it was practical and desired. The lack of railroads in Asia was not because of efficiency problems rather it was because Asian countries did not have the resources or the vision to see the practicality of the system.

**The Great Divergence**

To quantify the argument on when the Great Divergence occurred, economists and historians use GDP per capita. Easterly and Levine argued that the first Industrial Revolution, did not show nearly as much inequality between countries compared to between 1820-1870. While there was a noticeable inequality gap during the pre 1820 period, the most significant takeoff of exponential inequality growth occurred after 1820 (See Figure 1). Perhaps even more revealing is the rate of GDP growth per capita in Figure 2. The table explicitly shows how between 1500 and 1820 the rate of GDP growth was only .14 in Western Europe. Between 1820 and 1870 the rate ballooned to .98. In Asia, the GDP per capita rate failed to advance whatsoever.

![World Per Capita GDP (1600-1870)](image)

Many historians have debated the authenticity of GDP per capita statistics. Before modern technology, GDP per capita was incredibly hard to calculate. George Taylor writes, “unfortunately, accurate measurement of this growth in wealth and income is rendered impossible by the lack of adequate statistical records. Yet on the basis of the data available, estimates have been made which, although subject to substantial error, are worthy of brief notice.”

Especially with the statistics in Asia, historians argue whether the numbers are reliable. Some argue they are too high and others

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argue they are too low. The numbers may never be calculated to the exact amount but the data allows us to construct a narrative behind the inequality.

The Transportation Revolution occurred between 1820 and 1870. During this time, steamboats and trains began to be used for practical use at remarkably high levels. Correlation does not always mean causation and the GDP growth during that half-century was a product of many variables. However, the effect that steam powered transportation had on industrial manufacturing was instrumental in the growth of GDP disparity. Manufacturing benefitted immensely from transportation. Transportation allowed for manufacturers to reach more customers at a cheaper rate. In 1865, the freight rate per ton mile was one-twentieth the freight rate in 1700. The road freight rate of shillings per ton mile in 1800 was priced at .1 shillings. Furthermore, there was a consistent schedule and a high guarantee that products would arrive at the destination safely. Farmers and manufacturers could ship their finished products to distant cities. These benefits dramatically increased profits. As a result, industrialists expanded and produced more. The greater production meant a greater GDP per capita and thus a greater global wealth inequality.

Between 1820 and 1870 the gross stock of machinery and equipment grew in the UK from $1,943 million to $10,786 million (1990 relative dollars)\(^\text{17}\). Between 1820 and 1870 commodity exports grew in the UK from $1,125 million to $12,237 million (1990 relative dollars). Japan showed negligible growth in that time frame. These statistics illustrated that commercialization was thriving in Western Europe. New industrial machines and capitalism helped facilitate commercialization. However, it was the transportation of goods that made the expansion of production in goods and factories possible.

The industrial growth in England was not particularly impressive until other European countries began to industrialize. Alexander Gerschenkron argued that the beginning of British industrialization, in the 1750’s, was a long process with slow growth. He claimed that the British economy did not see high growth rates until other European follower economies began industrializing in the nineteenth century. Trains and steamboats made for a more interconnected Europe, where countries could trade with each other with ease. Therefore, when other European countries developed, the British were able to import and export their goods via transports at a greater rate. Thus, GDP per capita increased dramatically. Transportation was the conduit of industrial trade.

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17 Maddison, *Contours of the World Economy*.

Another outcome of the Transportation Revolution was the increased communications. This increase led to what historian Robert Albion claimed was, the Communications Revolution. "The 'Communication Revolution'... "Widened the horizons of every community, partly through the rapid dissemination of news and partly through breaking down provincialism with new facilities for travel".\(^{19}\) Along with the telegraph, steamboats and trains allowed for greater interaction between distant people. Letters and people traveled faster and more often. This meant the population was exposed to more knowledge and different experiences. In addition to a more educated population, it increased the communication of potential business partners. Businessmen could easily travel 200 miles in one day to close a new account. The more interconnected world meant more industrial and commercialized growth.

In developed Asian countries advance technology and railroads did exist but people and businesses were not dependent on it. Although it was not a direct detriment to economies, the lack of efficient communication contributed to the region's fall in relative wealth. In countries like England, France, and the United States, the railroad lines went through suburban and remote areas, creating an early form of commuting.\(^{20}\) Commuting introduced the sharing of knowledge and an increase in national communication. Asia did not have railroads and thus did not have this communication. A statesman's visit to a different region took days to reach his destination, whereas in Western Europe the trip could have been completed within one day. Countryside families did not find reasons to relocate to cities and work in industrial factors, whereas in Western Europe they did.

In European countries, the railroads and steamboats shaped centralization. Railroads encouraged people in the countryside to take jobs in cities. Conversely, the technology paved the way for city dwellers to interact with the countryside. Centralization gave the British parliament more power and thus their collection of taxes increased. Between 1820 and 1870 the amount of taxes collected from income and capital increased from less than 1 to nearly 10 million (10% of all taxes collected.)\(^{21}\) Before 1820, England almost exclusively collected revenue from indirect taxes such as (sales tax). The increase capital helped fund armies, military technologies, and industrial infrastructure, all of which increased the wealth and influence of Britain. China's government had a history of centralization but without the transportation technology, the country remained distant. Local governments held enormous influence. However, it was federal not local governments that funded national armies.

The increased ability to collect taxes played a role in turning the English army into a global power. As displayed in the First Opium War, The English army was far more superior to the Chinese army. The war, which took place between 1839-1842, illustrated the disparity in army strength. Over the three years of fighting, England was able to enter enemy territory with an army of 19,000 and defeat the Qing army of 200,000. The loss came down to the disparity in weaponry between armies. England could afford to arm their soldiers with the newest and most powerful weapons and ships whereas China did not have the resources to provide the same.\(^{22}\)

The take off in the Great Divergence occurred between 1820 and 1870. During this time, Western Europe's Transportation Revolution helped facilitate enormous GDP per capita inequality; steamboats and trains encouraged manufacturing and industrial monopolies. For a greatly reduced price, manufacturers were able to send their products to the far reaches of the world. In addition, the increased communication allowed knowledge sharing to thrive. Increased transportation and communication gave way to a more centralized Western European government that was able to better

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\(^{21}\) Public Revenue Breakdown, (UK : Central Government and Local Authorities for 1825).

fund the country’s infrastructure and the military. With more wealth and stronger armies in Western Europe, the world’s power was fully secured in Western Europe.

**Bibliography**


