US Industrialization Process in the Late XIX Century: The Natural Resource Endowment

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"At the beginning the combination of the land, a great natural resource to be exploited, together with a rapidly growing, *able* population, gave Americans a history of unprecedented overall economic growth".

Hughes & Cain, 1998, p.602.

INTRODUCTION

The purpose of this paper is to answer the question of in what ways did the available natural resource base influence American economic growth in the nineteenth century? and how did the relevant financial system evolve in response to the opportunities afforded by natural resource endowments? Consequently, since the question has been addressed two-fold, the paper will be divided in three logic and sequential sections. First a general overview of American economic growth in the XIX century is placed, then influence of abundant natural resources on US growth is discussed, and finally, the role of financial system – the case of J.P. Morgan & Co– is analysed.

The first part is introductive and gives a general overview of the American industrial "take-off" phase in the nineteenth century that place the bases for its performance as world leader. In that sense, the approach will be comparative, in relation to the other advanced countries of that period –United Kingdom, France, Germany and Sweden. The second part of the paper deals with the industrialization process in the US itself, which, as Swedish, it was closely related to natural resource endowments. The argument for this section is based on Nelson & Wright (1992) and Chandler (1990) articles, where they summarized the rise of mass production in the XIX century, especially the production of coal, iron, ore, copper, petroleum "and every other major industrial raw material of that era".

Furthermore, this section reveals that after a disappointing start, American natural resources become valuable, especially the case of cotton and manufacturing, based on simplicity of design, standardization, interchangeable parts, and long production runs, producing goods not noted for elegance but for practicality, utility

and cheapness. But, interest, the US disadvantages were related to the technological transfers, in which it lacked of tacit knowledge, and higher education was not important until after World War I. Last but not least, this section also stresses the importance of transports improvements in the US industry, where the innovation of the steamboat, the telegraphs and the transcontinental railroad network created a vast integrated market. The latter is an aspect that allowed American firms to operate at much greater scale (than did their counterparts in the United Kingdom and on the Continental Europe), and expand businesses and trade, which promoted large scale production and hence industrialization.

Finally the third part of the paper answers the question of how did the relevant financial system evolve in response to the opportunities afforded by natural resource endowments. The argument to answer this is based, among others, on Ramirez (1995) and De Long (1991) articles, on the role played, first by state banks fragmentation and then by private "investment clubs", in the promotion of industrial development in the late nineteenth century. As key elements this section of the paper analyses the role played by the few US private banks in that era, as well as the J.P. Morgan's expertise in resolving client firms financial problems by diminishing principal-agent and asymmetrical information problems. It may bear in mind that J.P. Morgan activities and expertise where first concentrated in railroad construction and then industrialization of firms. After that analysis, a brief conclusion is placed in order to link all the concepts and processes explained, that assisted the United States in its initial industrial and economic expansion.

AMERICAN ECONOMIC GROWTH IN THE XIX CENTURY

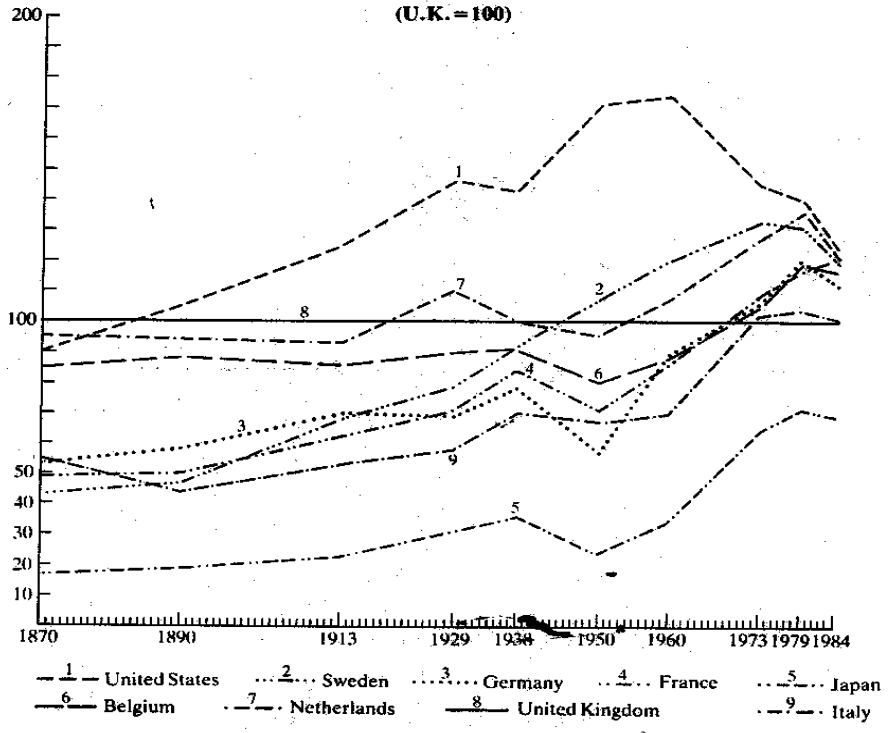
The exceptional rate of growth of the United States in the XIX century, which lead it to catch-up with the Europeans leaders, especially the United Kingdom, and subsequently, to position as a world leader, may be related with the rapid assimilation of modern machines and tools of production. Contrary to the case of Germany, for example [1], American economic growth was first devoted to the so-called 'light industry', as textiles, leather and foodstuff-producing, and later on, with the advancement of transportation and communication, came the development of 'heavy industry', with the construction of railroads, steam-boats, and the parallel coal, iron and steel-making industries, as well as the distribution and commercialisation of goods. In fact, as Hughes and Cain (1998, p.200) singled out when explaining the direction of change in American manufacture, by "1913 [America] made 31.9 million metric tons of crude steel, compared with 35.5 for all Western Europe; it [USA] minded 517 million metric tons of coal, compared with their [Europe] 493 million"

In addition, as Feinstein (1988, p.1) remarkably singled out, by the "1880s businessmen and politicians in Britain were already acutely aware that the economic prosperity and political status the first industrial nation had enjoyed for almost a century was being challenged with steadily increasing effect". In this case the United States as follower was catching-up and forging ahead in the industrial led, turning

[1] According to Alexander Gerschenkron (1962), German prior the outbreak of World War I, was essentially focused on coal mining, iron – and steel-making, electrical and general engineering, and heavy chemical output as spheres of production. Meanwhile the textile, leather, and foodstuff processing industries remained in the fringes of the banks' interests. "It was heavy rather than industry to which production was devoted" (p.15).

economic and political activities towards the new huge economy that emerged from the other side of the Atlantic. An important example of this growth pattern can be seen from figure 1[2], which shows the record of productivity, of nine countries, as it has evolved from the 1870s to the 1980s. If we look at, say, the first 40 years, it can be noted the rapid evolution of the US from a backward economy to a forged-ahead one. It shows the changes over time in terms of GDP per hour worked. As Nelson and Wright argued, "during the quarter century following World War II, the United States was the world's most productive economy by virtually any measure (1992, p.1931), a lead that had started in the previous years, and guide the US to reach differences of around 30 to 50 percent over the other advanced industrial nations. Moreover, in the early XX century, "total national income in the United States was twice as large as that of the UK … per capita income had also surpassed that of Great Britain and was well ahead of continental Europe" (Nelson & Wright, 1992, p.1940).

FIGURE 1
Real GDP per hour worked
Nine Countries, 1870–1984
(U.K. = 100)



While it is true that Nelson and Wright play down the importance of university-based research in the XIX century American growth (arguing that significance came mainly after 1940), prior to the turn of the century, and emulating German research university system[3], some Americans were involved in high level

[2] This graph shows the changes over time in their relative standing in terms of GDP per hour worked for all nine countries. A semi-logarithmic scale is used, and differences in the slope of the lines thus reflect the excess of growth rates in the other countries over those of the United Kingdom (Feinstein, 1988)

[3] The German research university system was first advanced by Bayer, circa 1860, with the employment of a large quantity of chemists graduated from German universities, and the instalment of

scientific and technological research and invention programmes. In that sense, it is relevant to recall the managerial practices of the great minds in the United States, as Edison and Coolidge, whose inventions and "effective use of organized research and development paved the way for scientifically trained people to use varied methodologies, to advance science, technology, and commercial interests together" (Reich, 1987, p. 341). For example, Edison's invention of the lamp was accompanied by the development and promotion of an entire system of generating, distributing, consuming and measuring electric power. In that sense, Edison "directed a team effort that produced a working lamp in one year and an entire commercial electric system in four" (Reich, 1987, p.343), in a complete innovative process of research, development, manufacturing, finance, promotion, publicity and politics, to lay conduits in the first generating station in New York in 1882. Edison's innovation was vital in the American and world-wide industrialization process, in the sense that it provided for the first time a source of lighting and power that "altered urban living and transportation; by changing the ways of the workplace; and by giving rise to new industrial methods such as electrolytic processes for producing copper and other materials" (Chandler, 1990, p.134).

Finally, it may be also said, that American manufacturing industry, benefited greatly from overseas entrepreneurs. In that sense, "the United States borrowed all it could from Europe" (Hughes & Cain, 1998, p.202), specially from the English, who in the spread of the Industrial Revolution travelled to America and settle down factories, such as the Brothers Schofield (who built wool carding machinery driven by waterpower); the Scots Henry Burden (responsible for crucial innovations); the Welsh David Thomas (who first introduced anthracite iron smelting); and the Scots Andrew Carnegie, among others. The important argument to take from this is that Native Americans gain expertise from Europeans, improving their mechanical abilities, schooling and literacy at the elementary level.[4]

INFLUENCE OF ABUNDANT NATURAL RESOURCES ON US GROWTH

There is no doubt the American economy had a privileged endowment of natural resources. If we compare the size of the country, it becomes clear: while the US territory covers 9,629,091 km^2, together, the UK, France, Sweden and Germany holds just 1,594,808 square kilometres. In addition, in comparing the US with other countries, the reader may bear in mind that, relative to population, the US had a usually rich resource base; indeed, it was short on labour and long on raw material[5]. In that sense, the US industrialization process, especially, in the late XIX century, was concealed mainly to its large access to natural resources and to the world's largest domestic market. Furthermore, and as explained before, it reflected the large private and public investments in research and development, as scientific and technical education (Nelson & Wright, 1992).

Moreover, considering the national technologies and the technological leadership of European countries in the nineteenth century, the difference with the

laboratories research centres in conjunction with prestige universities. See Meyer-Thurow, 1982, and Lenoir, 1998.

[4] For a thorough examination of the influence of overseas entrepreneurs in American Industrial Process, see Hughes & Cain (1998), especially chapter 11.

[5] Idem.

American was related to the latter special conditions of cheap resources (land), high wage rates, and large markets[6]. Hence, these characteristics induced to high labour productivity, large-scale, capital-intensive methods of production that became known as particularly American (Nelson & Wright 1992). Having said that, while Sweden also based its industrialization process in the abundance of natural resource and its educated population, the difference with the United States is found in the size of the domestic market, where Americans clearly had an advantage in both, extension and population.

Another fact that explains the growth of the US in late nineteenth century is what Chandler (1990) called 'the logic of managerial enterprise'. According to this argument, the technologically advanced and capital-intensive American industries were characterized by a dual economic principle. They operated as economies of scale and economies of scope[7], and hence with the abundant natural resources of the country and the development of communication means, such as railroads, the telegraph and steamboats "made possible to speed goods and messages through an entire economy for the first time" (Chandler, 1990, p.132). Allowing large plants to became, quickly, in producers of chemicals, food-processed packages, agricultural machinery, and other high technological industries of the late nineteenth century.

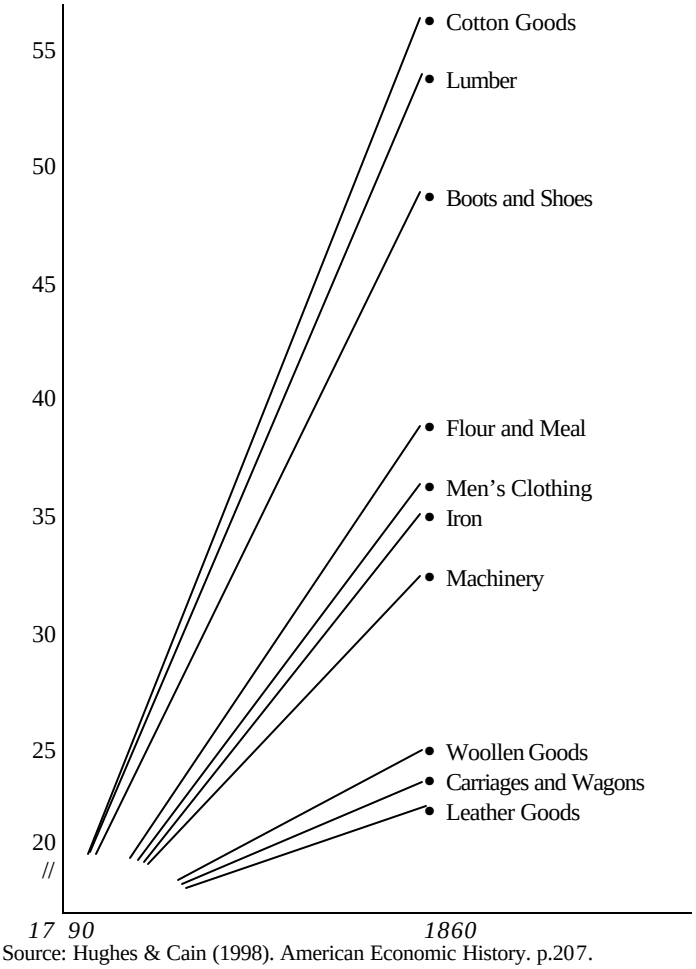
Furthermore, it might be also noted that precious metals, which, once found, tended to dominate mineral extraction at the expense of everything else, and curiously, were only found late in America's economic development. Some economists (Chandler, Nelson & Wright, and De Long) have argued that when precious metals (i.e., oil in the twentieth century) are found too easily, too early, subsequent economic growth is stunted and distorted. Also, it was European, especially British growth that made the basic commodities of North America (like cotton and textiles) particularly valuable. But American ability to assimilate foreign technology, or even improve on it (like the cotton gin), was also relevant and became even more important over time as described previously.

Finally, when thinking about American natural resource endowment, it is important to consider the ability of its citizens to innovate. Besides the large resources at their disposal, they chose industrial processes of scope, adding more value to the resources they inherited; an indigenous ability to innovate is particularly important in situations where tacit knowledge is critical, and in the case of the USA, in the late XIX century there were not as much academic centres and universities as were in Europe or Germany in particular. For example, to make a technology like steel production work, Americans got useful insights into seeing exactly how Europeans did it, but successful steel production required that European methods be altered to fit local American conditions (e.g. the precise chemical composition of local ores and coal, etc.). Early in the nineteenth century, Europeans knew what worked for their particular local resources, but did not know why. In contrast, by the end of the XIX

[6] The careful reader may be wondering why wage rate were high. Well, the argument is that since land was abundant and cheap, urban entrepreneurs and firms, had to hire workers at high prices, profitable enough, to prevent them to migrate to the rural areas.

[7] Economies of scales refers to the economics principle that large plants can produce at a lower cost than smaller competitors, because the cost per unit falls as the volume of outputs rises. Meanwhile, economies of scope, refers when large plants can use many of the same raw and semi-finished materials and intermediate production processes to make a variety of different products (Chandler, 1990).

Figure 2. United States: The Course of Growth by Value Added



Source: Hughes & Cain (1998). American Economic History. p.207.

century, the chemistry of steel making had been largely worked out and tacit knowledge of local conditions became less important, hence Americans could know why things worked and could therefore tell what they could expect from any given inputs of coal and ore and how they could change production methods to suit what they had on hand.

In addition, it is important to note that in the case of wood (particularly abundant compared with other materials, for example) it was widely used for houses, tools, furniture and transport equipment. As a matter of fact, "in 1860 American per capita wood consumption was five times hat of England and Wales" (Hughes & Cain, 1998, p.206). More than that, also in 1860, the lumber industry was second only to cotton textiles in creation of value added and market value, as figure 2 shows.

ROLE OF FINANCIAL SYSTEM – J.P. MORGAN & Co.

Finally it is important to recapitulate how could the new entrepreneurs and businessmen finance their industry, in that sense, this last part of my argument on US economic growth, deals on the relevant financial system that evolved in response to the opportunities afforded by natural resource endowments. The financial system of the new industrial nation originated and evolved in particular and unusual circumstances in the "take-off" stage of modernization in the 19th. Century. Bank formation boomed, and it became a desirable business. Indeed by 1810 there were 88 state-chartered banks, by 1820 more than 300, and by 1860, 1562 sate banks existed, and moreover, it is estimated that probably 10,000 different kinds of paper money were afloat. After all, there was no Central Bank in the USA from 1837 to 1914, which allowed for this unusual fragmentation in small banks spread all over the country (Hughes & Cain, 1998).

Having said that, the role played by few US private banks in that era, in the promotion of industrial development, suggest that the relationship between that largest private corporate finance (J.P. Morgan & Co) and their partner client firms, partially resolved the latter's financial problems by diminishing principal-agent and asymmetrical information problems (Ramirez, 1995). It may bear in mind that J.P. Morgan activities and expertise where first concentrated in railroad construction (as well as steel production) and then industrialization of firms. Moreover, as an economist's perspective on financial capitalism argue, at the end of the 19th Century, the United States saw the heyday of financial capitalism, where "securities issues … and the investment banking business … were concentrated in the hands of a very few investment bankers – of which the partnership of J.P. Morgan & Co. was by far the largest and most prominent – who played substantial roles on corporate boards of directors" (De Long, 1991, p.205). In addition, Morgan's earlier developments and expertise, positioned his company in an extremely advantageous position to finance selected industries in strategic areas (railroads, steel, oil, cotton), in obtaining funds from London and Paris. Which as explain by Hughes and Cain can be summarised as follows:

> "Early in his carrier, Pierpont [J.P. Morgan], together with his father, had helped the young Andrew Carnegie sell Pennsylvania Railroad stocks in London. In 1900 that kindness was repaid when Carnegie turned over his affairs in Carnegie Steel to Morgan for $500 million. The formation of the United States Steel Corporation was underway with that transaction, quarterbacked by Morgan" (1998, p.239).

Furthermore, in an econometric exercise Ramirez (1995) tested the hypothesis that J.P. Morgan's men add liquidity to its affiliates. For that purpose, he compared Morgan and non-Morgan firms, using number of firms, gross capital and gross investment, gross sales, free cash flows, market values of equity, stock of liquid assets and book value of obligations as descriptive variables. As a result, he shows that companies "not affiliated to the House of Morgan were liquidity constrained" (p.661). This, in short means that Morgan Corporation assisted efficiently in providing internal funds to finance capital expenditures to its affiliated firms, while companies not affiliated with Morgan depended more on internal funds to finance their investment expenditures.

Finally, while it is important to stress the role of banks in diminishing principal-agent problems and the asymmetrical distribution of information, the reader may bear in mind that problems of market power remained in the credit markets, as De Long (1991) in particular argues. But, such an analysis, despite it deserves some consideration regarding their impact and long-term significance, is just beyond the scope of this paper. Although, I may sympathise with Davis (1966) when he argues, the American financial system of the 19th century (and beyond) was far from perfect (although one might also argue that it was gradually and erratically becoming less imperfect as it evolved through time[8]).

[8] See Calomiris, Charles (1995), for a comparison of American financial sector (weaknesses and strengths) in the late 19th Century with the German.

CONCLUDING COMMENT

I should emphasize in conclusion that the unusually successful American economic growth of the late nineteenth century was characterized by the abundant natural resource endowment it inherited. Furthermore, the innovation and entrepreneurial skills of some native Americans, such as Edison and Coolidge, as well as with the assistant of overseas immigrants (British mainly), shed light in the new entrepreneurial class that fostered the economic growth and the industrial "take-off" stage of American history.

Furthermore, the role played by the unprecedented fragmentation of state banks and the spread of paper money since the mid 1800s, spurred capital investment and hence made available production resources for the establishment of new industries in almost the whole territory. A phenomenon that is highly correlated with the role-played by the few big private banks, commonly called "investment clubs". The latter, with J.P. Morgan & Co. as pioneer and leader, allowed heavy industries, such as steel, oil and railroads to "add liquidity" to its activities, and hence raise the industrialization potential of the economy. Because, as Hughes and Cain (1998) argued, it was the combination of land, natural resources, a rapidly growing population, which gave Americans a history of unprecedented overall economic growth.

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