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The Productivity Growth Pattern and Economic Depressions in the American Economy

If the pattern continues, a depression may begin in a few years.

The productivity growth rate in the nonfarm business sector accelerated around the year 2000. There was a similar period of acceleration in Great Britain in the 1820s and in the US in the 1830s, and another one in the US in the 1920s. These periods of productivity acceleration led to economic depressions. There were labor productivity growth dips around the 1890s and 1970s in the United States' economy that were also times of economic recession or depression. There obviously is a connection between the productivity growth dips and acceleration periods in the United States and economic depressions. An economic depressionary period is likely now, because the economy is following the economic pattern of the late 1920s very closely. This theory of economic depressions was developed in 1989, and has proved correct in its major predictions. The periods of productivity growth acceleration and of productivity growth dips are associated with economic depressions because during the acceleration periods industry focus switches from product to process innovation, and during the dips there are industrial revolutions involving the transition from senescent to nascent industry.

Productivity has grown in three major waves, with recessions or depressions at the troughs and at the points of acceleration. From 1995 to 2000, the productivity growth rate in the U.S. averaged 2.8%, which is about double the average rate during the preceding 22 years. Twice before in U.S. history, the productivity growth rate suddenly surged in a similar manner, and both of those periods of acceleration were followed a few years later by economic depressions. The common factor in these three periods of technological acceleration is that groups of major industries that emerged out of the industrial revolutions in U.S history reached a state of maturation in which products were standardized, few new major kinds products were innovated in these industries, and the focus was on process innovation.

There are two occasions when the U.S. productivity growth dipped to record lows, and there was a recession or depression on those occasions as well. The common factor in these two cases is that an industrial revolution was underway and a group of major industries emerged and replaced industries based on older technology.

Three Industrial Revolutions

There have been three periods of Industrial Revolution since the late 1700s. Each of these three periods of Industrial Revolution were followed about twenty years after the ending of the preceding depression when the industries that emerged from the revolution matured enough so that the competitive focus switched from product innovation to process innovation. Around the year 1800, major new industries began to change life and worker productivity first in Great Britain and the United States. The United States was a technological follower of Britain then, and so the industrial change lagged in the US by about a decade. Watt-type steam engine powered factories produced a variety of consumer and industrial products that spurred demand. Innovation of chemical products, tools and machinery, and the innovation of production method allowed rapid productivity growth starting around the year 1820 in Great Britain and around the year 1830 in the United States. Since the United States lagged Britain in technology, the productivity growth acceleration started a little later in the United States than in Britain.

Again at the turn of the 20th century, major new industries grew rapidly and replaced the older steam engine powered industries. There was a second industrial revolution that was comparable to the first one in scale. New sources of power replaced steam engines, and chemical, metallurgical, electrical, and telecommunications technology advanced rapidly. The electrical dynamo and the internal combustion engine were used to make automated machinery that were more powerful than those that were previously available. The technological innovation helped to cause another period of productivity growth acceleration that started about the year 1919.

Around the year 1980, the modern understanding of quanta and physics at the small scale made possible the rapid growth of the nuclear power industry and many electronics, biotechnology and computer industries. As competitors focused on process innovation, this third industrial revolution enabled a productivity growth acceleration which started about 1997. Computers, robots, and automated machinery are allowing businesses to replace both labor and service workers.

Three Waves of Growth

Labor productivity growth statistics show that there were productivity growth dips in the U.S. economy that occurred during the beginning of each of the industrial revolutions, around the years 1795, 1892, and 1980. From each of these three low points, productivity growth increased slowly until about two or three decades after the low points, when there have been sudden surges in productivity growth which are attributable to industrial maturation and the development of more efficient product manufacturing technology. The British economy had similar growth dips around the years 1795 and 1892, but after WWII the two economies' productivity growth statistics diverged.

Accurate figures for productivity growth in Great Britain and the United States during the 18th century and the early to middle parts of the 19th century are not available. Economists themselves disagree about the figures. However, the figures given by Crafts¹ for the British economy are widely recognized by economists. These figures show that output per capita grew at a flat rate of about .5 percent annually from the year 1760 to the

year 1820. The figures also show that the growth of output in the United Kingdom from the late 18th century to 1820 was a gradual process, but in the 1820s productivity growth accelerated to about 2 percent annually and stayed at this level until about 1870. We know that during the decades of the 1880s and the 1890s, Britain experienced a dip in productivity growth in which productivity growth was near zero. So there was a wave or surge of productivity growth in Britain lasting about 100 years from 1800 to 1900.

There was a similar wave of growth of American labor productivity during the 1800s. It started about 1830, a little later than that in Britain, because the US was a technological follower of Britain, and the wave of growth lasted a little longer, until about 1890. Per-capita GDP grew about .58 percent from 1800 to 1840. I am not aware of productivity growth statistics for this early period. The average annual growth rate for the productivity of American laborers during the twenty-year period from 1839 to 1859 was 1.3%. So it can be inferred that productivity growth in the U.S. accelerated during decade of the 1830s. From 1859 to 1879, it increased about 1.4% per year. From 1879 to 1899 it increased about .7% per year, reaching near zero during the decade of the 1890s.

Another wave of growth started in the U.S. around 1900 at the beginning of the second industrial revolution. From 1899 to 1919 the productivity of labor increased about 1.6% per year. Productivity increased about 2.2% per year on average during the period 1919 to 1939, and it reached a peak of 3.0% per year during the period 1939 to 1959. It again decreased to about 2% per year during the period 1959 to 1979. During the period 1973 to 1981, labor productivity increased about 1% per year.

A third wave of growth started about 1981. After the beginning of the present industrial revolution, labor productivity grew gradually until the 1990s. But about the year 1997, the major industries showed signs of maturity by the formation of oligopolies, and there was a sudden acceleration of productivity growth. From 1998 to 2005 the average annual rate of growth of output per man-hour in the nonfarm business sector was 3%. There is no indication that productivity growth will slow in the near future.

Cause of the Three Waves of Productivity Growth

The three waves of productivity growth are caused by the three industrial revolutions as industries emerged, matured, and ended. When industries emerge from an industrial revolution, the productivity growth rate is quite low. The productivity growth dips are due to the maturity of older industries and small size of the emerging industries based on newer technology. On the other hand, during the times of productivity growth acceleration, the companies in the newly dominant industries compete for market share and survival in an environment of standardized products and little innovation of major new kinds of products.

a) Causes of the Dips of Productivity Growth

The main causes for the dips are the senescence of the older industries and the small size of the emerging industries. Before the beginning of each of the industrial revolutions, the

technological innovation in the matured industries ended, which ended productivity growth. For example, Smeaton designed the last technological improvements to the Newcomen engine in 1770. As another example, in the American automotive, telephone, and steel industries around 1970, products and production methods were standardized and the technical details of the products changed little. This caused productivity growth to slow to almost zero in those industries and contributed to the overall productivity growth slowdown in the 1970s.

In each of the three revolutions, the older mature industries were replaced because technology progressed. For example, in Britain in about the year 1800, industries utilizing sources of power such as animals, wind, water and the Newcomen steam engine gave way to industries relying on steam engines like those designed by Watt. The last Newcomen engine to be used in Britain stopped operating in 1834. The Newcomen engines were inefficient and not useful for powering factory machinery. Major metallurgical, mining, chemical, textile, steam ship and locomotive industries developed that relied on the new Watt design of steam engine. Factories and companies in the matured industries closed, and labor left their jobs and traveled and retrained to work in new industries. Resources were taken from the older industries and placed in the newer ones.

A part of the process of senescence and replacement of older industries is that technological follower competitors have a chance to catch up to the leaders in those industries contributing to their closing in the most advanced economies. Around the years 1900 and 1980, the U.S. economy faced competition from technological follower economies that caught up during the slowdown of innovation in the matured industries. This convergence of technological level can be seen in the convergence of industrial labor productivity among advanced economies from 1963 to 1982.

In the decades of the 1890s and the 1970s, productivity growth was slow or nil in the mature industries at the beginning of industrial revolutions, but quite rapid in the nascent and rapidly expanding new industries. But because the new industries were only a small part of the economy, the overall economy registered slow productivity growth. During the industrial revolutions, this combination of slow growth in the senescent industries and small size of the emerging industries caused the periods of productivity growth stagnation.

b) Causes of the Productivity Growth Acceleration Periods

The productivity growth acceleration periods are attributable to the maturation of the three groups of industries about 20 or 30 years after the emergence of the industries from the depressionary period in which they formed. It is interesting that the process of maturation of the three groups of industries that developed about 80 or 100 years apart is similar. There is an apparent life cycle of these three groups of industries emerging from the industrial revolutions. During the maturation period, the competitive emphasis switches from product innovation, that is, the invention and marketing of products utilizing new technology, to process innovation, that is, the perfection of methods of mass

production of the standard products of each industry. At the beginning of an industrial revolution, there are competing companies or blocks of companies in each industry with differing standards for the same technology. For example, Westinghouse and Tesla competed with Edison for the market acceptance of AC or DC electricity production and distribution standards. People may remember that when VCRs were introduced, two blocs of electronics companies supported two competing standards, Betamax and VHS.

Oligopolies form during the maturation stage. Many companies may start in a newly developing industry, but by the maturation stage, the products available for sale in each industry are standardized, and oligopoly companies compete with each other for market share in their industry. Monopolies may form also, but in the United States, the governments have intervened to prevent them. During the periods of acceleration, the focus is on process innovation, not product innovation as at the beginning of each of the revolutions.

Oligopolies and monopolies develop in industries through corporate bankruptcies, mergers and acquisitions that in turn lead to labor layoffs. For example, there was a peak in the number of industrial and commercial failures in the late 1920s. The companies went bankrupt. For the four years from 1920-1923, the average number of industrial and commercial failures was 17,732 annually. In comparison, in the four years from 1926 to 1929, there were an average of 22,917 such failures annually. The average number of mergers and acquisitions in manufacturing and mining for the five years from 1920 to 1924 was 461, and from 1925 to 1929 was 917 – almost double.² The resulting labor layoffs and efficiencies of scale increased labor productivity greatly.

So labor productivity accelerates when industries mature and products are standardized, as happened in the 1830s, 1920s, and 1990s in the United States. Oligopolies form as businesses are driven from the market or acquired by competitors. Economies of scale allow the remaining workers to increase production, and seizure of the market allows businesses to afford to install automated machinery.

Historically, in the United States, annual productivity growth has peaked about two or three decades before the beginning of an industrial revolution, if one dates them at 1800, 1900, and 1980, and then slows to a trough at the beginning of the revolution. Due to the pattern of development of the three major groups of industries, there has been a secular pattern of three waves of productivity growth since 1800 in both economies.

Two Kinds of Depressionary Periods

There have been a major economic recession and an economic depression in the U.S. during the periods of industrial revolutions, and economic depressions during the periods of productivity growth acceleration. These two types of depressionary periods have alternated.

a) Causes of the Technological Acceleration Depressions

When innovation of novel demand-spurring products seems infeasible once an industry matures, companies in an oligopoly compete for market share via price competition, modeling, packaging and advertising of products, credit incentives and other ways. Their goal is to drive their competition from the market or buy them out. Increasing market share enables an oligopoly company to garner a greater advantage of economies of scale, decreasing product costs. Automated machinery and the perfection of mass production techniques enable management to substitute machinery for comparatively expensive human labor. Productivity increases substantially during these industrial maturation periods at the cost of workers' employment. Retained workers are given low pay compared to the value of the workers' production. Mergers and buyouts enable management to rid themselves of redundant technical and management personnel.

The labor-reduction effect of increasing automation can be seen in the growing differential between labor productivity and wages in the 1910s and 1920s, just as there is a similar effect now, when productivity is rising about 3 percent or more per year on average, but wage growth has stagnated. From 1923 to 1929, manufacturing output per person increased 32%, but wages grew 8 percent. This economic feature of high productivity growth but slow wage growth was also experienced in the productivity growth acceleration period in the 1800s in Great Britain. By automating production, from 1820, at the beginning of the acceleration period, to 1845, which was just after the period the British then called the "Great Depression," the net output of British industry increased 40 percent, and the wage bill increased only 5 percent.³ During this period from 1820 to 1845, hundreds of thousands of English hand-loom weavers had to sell their production at increasingly lower prices because automated steam-power looms were being constructed that could produce textile material more efficiently. As the number of automated machines increased, the prices fell, until finally hundreds of thousands lost this manual labor employment.

In order to establish themselves in an oligopoly industry, corporations and businesses have historically taken remarkably high debt to finance the construction of efficient factories, buy out or drive out competitors, and market their products. For example, the time of highest American corporate debt outstanding, subtracting total corporate saving, as a ratio of total GDP in the United States during the period 1917-1970, except during the Great Depression itself, was in the years immediately before the Great Depression.⁴

For these reasons, economic depressions arose out of the productivity growth acceleration periods of the maturation of each group of major industries. The availability of novel standardized consumer goods at a price consumers could afford and the availability of easy credit allowed high consumption demand during the period of the "boom" periods of the 1920s in the United States, the 1830s in the United States, and the 1820s in Britain. For example, in the United States, the consumer debt load relative to the total GNP was higher during the 1920s just before the Great Depression than at any other time from 1917 to 1970, except during the Great Depression itself. Both the corporations and the consumers carried a higher debt load and had low savings. Their debt obligations strained and weakened them.

In “Technological Acceleration and the Great Depression,” Waters⁵⁶ explained how the rise of the consumer credit industry in the US, the availability of a number of important novel consumer durables such as radios and automobiles at affordable prices, and the innovative credit financing techniques introduced by banks, corporations, and retailers resulted in the financial crises and bank failures of the Great Depression. Rapid productivity growth led to disemployment of labor, as described by Ester Fano⁷ in several articles. The pause of the introduction of major new kinds of products in the various industries by the late 1920s caused a drop in consumer demand. The consumers faced heavy and increasing debt obligations and had increasingly unsure prospects for employment, and their rate of pay stayed steady; so once a worker in the 1920s had bought a consumer durable such as a car or a home radio, he saw less need to buy another one. The utility of an additional product did not outweigh the costs to his mind.⁸

b) Causes of the Industrial Revolution Depressions

There were also two economic depressions and a major recession in the US economy around the years 1790-1800, 1880-1900, and 1970-1985. Production and consumption dropped for a period of about a decade or two. For example, people who lived during the recessions of the 1970s and early 1980s will remember the closure of “rust belt” factories in the Northern States and the emergence of Japan, European countries, and the NICs. During the period of little innovation in the mature industries, these countries were able to catch up technologically and capture market share. Workers moved to the South and West and great emphasis was placed on “worker retraining” programs in corporations and in educational institutions. Government programs were funded to help workers to retrain to use the new computer technologies and find other employment. During this time, United States companies became technological leaders in the computer and electronics based industries and a number of other new industrial fields.

People see that an industrial revolution and technological acceleration period are both associated with depressions, but that the depressions have quite different natures. The depressions at the beginning of an industrial revolution have low productivity growth rates, in fact the lowest growth rates in the economic history of the US. The economies were in a transition from senescent to new industry. But the depressions during the maturation stage of a group of industries of an industrial revolution show high and rapidly increasing productivity growth – productivity growth acceleration. Newly emergent industries dominated the economies of the technologically advanced countries, and oligopolies were developing and producing standardized products. Of the two kinds of depressionary periods, those occurring in the mid-life of such groups of industries are more severe.

Current Conditions

There has been news recently that wage growth in the United States has slowed, though productivity growth is very high. Workers are being displaced as business people emphasize utilization of robotic, computer, and automation technology, and as oligopolies in each of the major industries are competing for market share. Since the

“Internet bubble” popped a few years ago, programmers have had to find employment in other fields, usually getting less pay. They are facing both foreign competition in the form of outsourcing of software engineering to countries such as India and the saturation of the market for websites and software. Software engineers are even automating software production by various techniques. This increases computer programmers’ productivity, but programmers will face more difficulty finding employment in their field. Service industry personnel are increasingly finding that computers are displacing them from the tasks they used to perform manually, such as cashiering at checkout stands in stores and supermarkets. Automated machinery and powerful testing and analysis software is displacing technical workers and scientists.

Since 2000, labor productivity has increased about 20 percent, but wages have not grown as rapidly. A large segment of the workforce faces disemployment due to competition from workers in other countries, substitution of automation, and the increased economy of scale as oligopolies form in the major industries of the present technological revolution, which is based on the utilization of quantum-mechanical concepts.

We know that there were economic depressions following the two prior periods of productivity growth like this one in the 1830s and 1840s and the 1930s and 1940s in both Great Britain and the United States. Productivity growth rates have suddenly increased to more than 3% percent annually. Now about 30 years after the beginning of the present industrial revolution, the major industries are showing the signs of maturity in the formation of oligopolies, reducing their workforce, and in the increase of productivity growth.

2005 and 2006 were record years for mergers and acquisitions in the US economy. Total American consumer debt reached 2.2 trillion dollars in 2005, up from 1 trillion in 1994. Mergers and acquisitions are at the highest level since the Great Depression. 2005 was a record year for personal bankruptcies, and wage growth has stagnated, while the personal savings rate in the US went below zero in 2005 for the first time since the Great Depression. Total corporate debt that has financed the corporate drive for market share and for corporate survival is the highest since the Great Depression. As in the late 1920s, job growth is low and wage growth is slow. If the trend of increasing productivity growth by disemploying workers through automation, corporate bankruptcies, mergers and acquisitions continues, and if wage growth continues to stagnate, these will be signals that another depressionary period may be imminent.

Figure 1

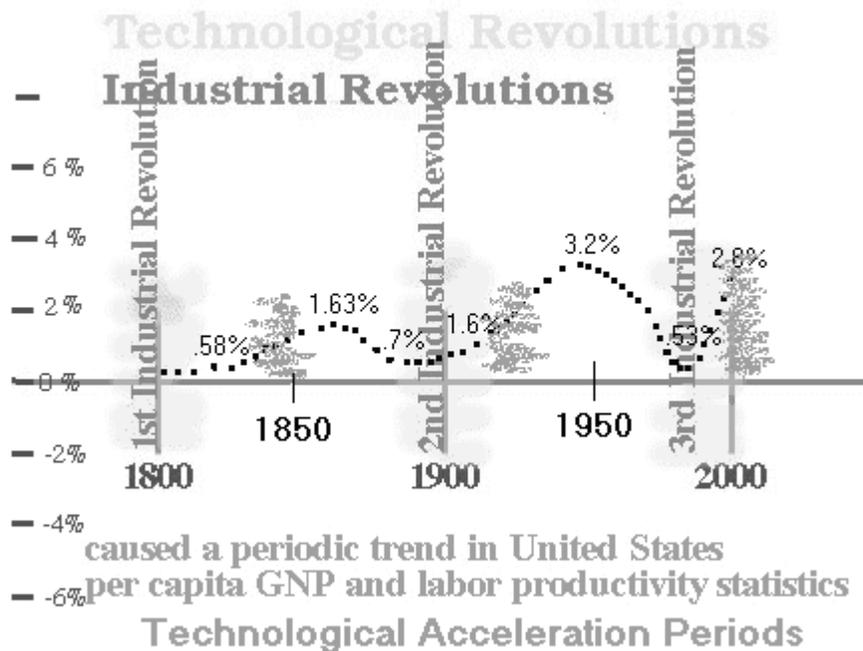


Fig. 1. There have been two full waves of productivity growth in the U.S. economy. Each industrial revolution created a dip in the productivity growth rate. During the times called "technological acceleration" periods when productivity growth accelerates (the dark shaded regions), there have been economic depressions in the US economy associated with rapidly rising productivity growth rates. There were also depressions or severe depressions during the dips. This figure shows why depressionary times have had a long-term periodicity in the US economy.

Conclusion

If the economic situation follows the pattern of the period around 1930 in the United States and the 1830s in Britain, then we may expect that the disemployment of labor, the resulting drop in consumption demand, and associated financial troubles for both the producers and consumers will bring about a major recession or a depression in the next few years. Just as a farmer knows the seasons and when water, sunlight, and optimal temperature are available and works accordingly, so people should look to the past to some extent to understand how the economic future is likely to be, and plan their work accordingly.

Historically, the labor productivity in the United States has grown in three waves that have a periodicity of about 80 to 90 years. There have been economic depressions or recessions during both the periods of the troughs and during the periods of productivity growth acceleration that may be called periods of "technological acceleration." These depressions understandably happen due to the effects on American labor of the economic events associated with the two stages of industrial development of industrial revolution and technological acceleration. During times of transition of major industry during

industrial revolutions, workers are disemployed by foreign competition, the end of mature industries, and the disinvestment of capital from obsolete technology. During times of technological acceleration, the maturation of the major industries creates oligopolies that compete for market share and focus on process innovation in order to increase productivity, substituting machinery for human labor. The engendered economies of scale and automation of production disemploys labor, but also increases corporate indebtedness. Consumers enticed to borrow to finance their purchases of products have taken on relatively high debts loads and face debt repayment in an environment of increasing competition for jobs, and cut back on their purchases. Demand for the available standardized products becomes satiated, and the resulting drop in demand and associated consumer and corporate bankruptcies and bank failures have led to economic depressions. If the economy follows the past pattern, another depression may develop within the next few years.

¹ N. Crafts, *British Economic Growth During the Industrial Revolution*, New York, Oxford University Press, 1985.

² Data from *Statistical Abstracts of the U.S.* as compiled by Phil Hyde on www.timesharing.com.

³ Hobsbawm, *Industry and Empire*, New York, 1968, 1969. p. 69.

⁴ This is a result of my calculations using the tables in U. S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition*, Washington D. C., 1975: series X 398 for net private debt at end of year; series F 1 for G.N.P. in current prices; and for private saving, series F 543 for personal saving excluding consumer durables plus series F 549 for corporate saving for the period 1916 - 1945 and series F 552 for gross private saving for the period 1946 - 1970.

⁵ Joseph Paul Waters, *Technological Acceleration and the Great Depression*, New York, Arno Press, 1972, 1977.

⁶ Most of the reasoning for depressions during the middle of technological periods in this paper was adduced from Waters' explanation for the specific case of the 1930s U.S. depression. His book contained explanations for the depression that were previously suggested by long wave theorists such as Schumpeter. Waters' theory is applicable to a general pattern of technological progress. Two other causal factors don't seem to be discussed in his book: the effect of automation on employment during the maturing phase of industrial development as expounded in the life-cycle of industry theory and the effect of satisfaction of consumer demand for types of products.

⁷ Ester Fano, "Technical Progress as a Destabilizing Factor and as an Agent of Recovery in the United States between the Two World Wars," *History and Technology*, 3, no. 3, 263 (1987).

⁸The theory for depressionary periods during times of industrial maturation was originally based partly on Waters' ideas, along with the ideas of Kondratiev, Schumpeter, Christopher Freeman and Robert Ayres and other more recent writers, such as those who contributed articles to the book, *Long Waves in the World Economy* that was edited by Christopher Freeman. Later writers, except Rick Szostak, have not cited Waters' work, which seems odd to me. Ester Fano's papers well substantiated this theory and Water's ideas. Fano's papers, one of which I cite in this article, describe and document the increasing unemployment in the U.S. during the 1920s and 1930s due to increasing automation. Fano does not cite

Waters, though the two authors express similar ideas. R. U. Ayres, *The Next Industrial Revolution: Reviving Industry Through Innovation*, Cambridge, Massachusetts, 1984.