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THE INDUSTRIALIZATION OF NEW ENGLAND: 1830 - 1880

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ABSTRACT

This paper surveys the economy of New England in the half-century following 1830. It begins by discussing reasons why manufacturing grew in the United States and especially in New England. The paper surveys the outputs of New England industry, particularly machine tools and textiles. It then discusses the inputs to industry. Women formed an important part of the New England labor force; the histories of Boston and Lowell illustrate the increasing urbanization of the labor force. Capital for industry was raised both through formal credit instruments (for large enterprises) and through local banks (for smaller ones).

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The Industrialization of New England: 1830-1880

In 1830, most New Englanders lived on farms and grew much of the food they ate. By 1880, most New Englanders lived in cities, worked for wages, and bought their food. How and why did this happen? It was not that the farmers of 1830 were outside markets, as Rothenberg has shown in her description of the years before 1830. It was instead due to a shift of many, many workers from agriculture to industry, with all the attendant changes in location and lifestyle that went with the change of work. We call this process Industrialization, and this essay will describe its manifestation in New England.

The transformation of the New England economy in the middle half century of the nineteenth century was comparable in scope and intensity to the Asian "miracles" of Korea and Taiwan in the half century since World War Two. In each case, a predominantly agricultural and rural society marked by older methods of production, transportation and communication, was replaced by a largely urban, industrial society utilizing the most modern methods of production, transportation and communication. The patterns of life were revolutionized as a result. (The United States as a whole had a similar but more gradual transformation.)

This essay describes this change in four parts. The first part examines the market in which these products were sold, labor was hired, and capital raised. It asks why industrialization happened in the United States, given its fabulous agricultural resources, and why industrialization came first to New England within the United States. The second part describes the process of industrialization. Industry in nineteenth-century New England, and particularly in Massachusetts, meant the cotton textile industry to contemporary observers. This industry accordingly deserves pride of place in any account of New England industrialization. (Many

other industrialization also started with cotton mills; this story resonates with theirs.) But the cotton industry is far from the whole story of industrialization. There were many other industries, ranging from boots and shoes to machine tools, that were important parts of industrialization and that need to be described as well. Industrialization was a general transformation of the whole economy.

The third and fourth parts of this essay describe the inputs to this industrial output, the factors of production, labor and capital. The third part portrays the lives of people who worked in the new mills and factories, where they came from and how they worked and lived. New England education provided an admirable labor force from native sons and daughters; it also transformed immigrants into productive citizens. The fourth part describes the process by which capital was accumulated to provide work for all these people. The growth of new cities like Lowell and Lawrence required massive investments, and these larger projects were only the tip of the investment iceberg. Resources needed to be concentrated for smaller firms as well, and New England banks developed a unique method of intermediation to accomplish this task..

Agriculture played a small and passive role in these developments, contrasting sharply with its central role in the New England economy before 1830. The admirable progress of American agriculture in these years took place largely outside New England, in the Mid-West and then on the Great Plains. The great expansion of agriculture and later mining in the West created opportunities for New England to play a role in transporting the agricultural surplus to Europe and in financing investments in the West, but they created hardship for New England agriculture. Agriculture in New England served largely as a labor reservoir for the industrialization of the next half century.

I

What led to this transformation of the New England Economy? What were the forces that set this radical change in process? One important factor is Anglo-American culture (Temin, 1997). The Puritans who settled New England long before industrialization created an environment in which new enterprises could flourish. This environment consisted partly of stable government with clear laws and a judicial process that allowed laws to adapt to new problems undreamed of by the legislators who wrote the laws. Also important was the region's commitment to education. This provided a numerous entrepreneurial class with access to the latest knowledge, and it also was reflected in the high educational level of the Lowell operatives and the creation of the Massachusetts Board of Education. New Englanders were well suited to take advantage of this favorable economic and legal environment. Nathan Appleton and Kirk Boott were not beloved by the cotton operatives who worked so hard for them in Lowell and other nearby cities, but they had the will and the skill to deploy large numbers of workers in the use of new technology. The synergy between the skill of industrial leaders and of the educated, hard-working operatives made for industrialization in New England.

In addition to the factors that were unique to New England, industrialization in this region was part of the development of the United States as a whole. New England benefitted from being part of this unified country--even though its cotton-textile industry suffered greatly during the challenge to this unity during the Civil War. New England gained in two ways. First, the legal framework that allowed investors to have confidence in long-run commitments was strengthened by the commonality of laws in different states. The Federal government did not engage in massive spending at this time, but it had an extremely important effect on economic

activity by creating uniform rules of conduct for business behavior. Second, New England could exploit its comparative advantage within the United States. People in New England could engage in the activities that they performed best in the confidence that their products could be traded for other goods that were more expensive to make in New England. The United States was important, therefore, for New England both as a federal government and as a free-trade area.

The patent system illustrates the advantage of being in the United States. Patents were provided for in the Constitution, and Congress constructed a patent immediately. The Patent Office, however, was only created in the time period considered here. Patents create property rights in new knowledge. The existence of these rights encourage all sorts of people to direct their energy toward the invention of new methods and products because they know that if their discoveries are valuable, they can reap the benefits. This apparently simple arrangement depends on a complex network of laws, administration (to keep track of patents), courts (to adjudicate conflicts and enforce the scope of patents), and commerce. The United States was not only an extensive national market for goods, but also for ideas. New England quickly leapt into the lead of patent activity, leading the nation in the number of patents granted per person throughout the first half of the nineteenth century (Sokoloff, 1988).

Even with these legal advantages, British visitors who observed industrial establishments in New England in the 1850s were amazed. The United States was an agricultural country, possessed of very productive farms. Labor on these farms was paid well and Americans were surprisingly tall and healthy as a result. How could fledgling industrial enterprises compete with established agriculture for labor? How could they attract workers as described above? The British visitors answered that "on account of the high price of labour the whole energy of the

people is directed in improving and inventing labour-saving machinery (Great Britain, 1854-55, p. 547)."

This statement has been discussed extensively in the century and a half since it was written. There are two problems. What did the visitors mean by "the high price of labor"? And what did they mean by "labor-saving machinery"? Both phrases, it turns out, are problematical. For example, a famous restatement of the British visitors' position said, "In any country where land is readily available in large quantities, labour is likely to be expensive (Rothbarth, 1946)." The British visitors and this analyst a century later argued that it would be hard to attract labor away from the prosperous American agriculture to work in industry.

One way to rephrase this observation is to say that the United States had a comparative advantage in agriculture. That is, there was so much good land in the United States that it made sense for the United States to produce and export wheat and raw cotton in return for manufactured imports. In fact, this argument says that the United States had so much good land that it should have specialized completely in agriculture; there was no sense in producing any other tradable good. All this, it should be remembered, is to describe the ante-bellum United States when most workers in the country were in fact agricultural--not the far more industrial United States of 1880 and later years.

This is a good argument. The United States had so much land per person compared to Europe that it could well have made sense for the United States to specialize completely in agriculture. If so, how can we explain the existence of industry? The British visitors said it was because of labor-saving machinery. Such machinery used few workers per machine and therefore could justify paying high wages to each worker. In the language of economics, a high

ratio of capital to labor raises wages. Higher wages in industry then would allow industry to attract workers from the prosperous American agriculture (Habakkuk, 1962).

This reasoning has sounded reasonable to generations of analysts, but it is wrong. When people discuss agriculture, they refer to the ratio of land to labor; when they discuss industry, the ratio of capital to labor. The result of this difference is that there are different meanings to the price of labor. In agriculture, this refers primarily to wages relative to rent on land; in industry, to wages relative to the return on capital, that is, the rate of interest. For any given technology, the industrial wage can only be high if the interest rate is low. In other words, there is a trade-off between wages and the return to capital--one can only be high if the other is low. Unfortunately for the simple theory, interest rates in the United States were equal to or higher than in Britain. It follows that industrial wages relative to the return on capital in the United States were not higher than in Britain. There was no more incentive to use labor-saving machinery in American than in Britain (Temin, 1966b).

How then did industry get its start in the United States? The argument assumes the same output prices and technology in the United States and Britain. One or both of these assumptions must have been inaccurate for the early United States. The first assumption was violated because the United States put a tariff on the most important industrial goods of the mid-nineteenth century: cotton textiles. The tariff was a response to the influx of English manufactured goods after the end of the 1812 War with Britain. It was designed to offset America's comparative advantage in agriculture and allow manufacturing to grow.

But it was not so simple to get a tariff on cotton textiles. Southern cotton growers sold most of their output on the English market, and they would not agree to anything that would

decrease the demand for English cotton textile products or that even might provoke retaliation. Francis Lowell, founder of the first integrated cotton spinning and weaving mill in America, therefore recommended a tariff of 25 percent. This was not high enough to keep out English imports and harm Southern planters. But Lowell also recommended that there be a minimum valuation of 25 cents per yard. In other words, all fabric worth less than 25 cents a yard would pay a duty of $6.25 a yard independent of its worth. The price of American cloth fell below ten cents a yard in the early 1820s and stayed that low or lower for the following decades. The tariff on cheap goods was completely prohibitive (Harley, 1992).

It was quite a trick to design a tariff that would not hurt English exporters of cotton textiles, yet would allow domestic producers to thrive. The key to this complex operation was in the quality of textiles made in the two countries. English producers made high-quality fabrics that were subject to a light duty and did not compete with the rougher American cloth. The textile mills of New England produced a rough cloth that sold for a low price. This cloth competed with imports from India, which were indeed excluded by the tariff. Lowell had threaded the needle by designing a tariff that would protect his industry while not harming the English industry or Southern planters (Temin, 1988).

Another reason why American industry got its start has to do with the quality of machinery used in New England, not simply the quantity. The visitors in the 1850s noted many machines that could not be found in England; the American System of Manufactures built on interchangeable parts was an American innovation. To the extent that Yankee ingenuity outran innovators in the home of the first Industrial Revolution around Manchester, England, this provided another reason for industry to prosper in ante-bellum America. The British visitors

may have meant better machinery rather than more machinery when they referred to labor-saving machinery. The second assumption of the labor-scarcity argument was inapplicable to the early United States, although the evidence is less clear than for the first (Temin, 1971).

There consequently are two reasons why the United States did not specialize completely in agriculture in the first half of the nineteenth century: the tariff on manufactures, principally cotton textiles, and technical change in America that increased the productivity of labor. The next question therefore is why New England? Why did industry take hold first in New England and only spread slowly to the rest of the country? The location and geography of New England helped. New England's coastal location made it possible to transport both raw cotton and manufactured cotton textiles cheaply by sail and steam. The rocky and hilly topography of New England created both good harbors for ships and falling water for power. But these characteristics were shared by other coastal regions of the early United States. The special quality of New England had to do with the high proportion of women employed in the cotton industry.

Agricultural production in New England did not use women very intensively. The primary crops were grains, hay and dairy products. Women were not used very much in their production--even in dairying. Southern agriculture based on cotton and tobacco used women more intensively, partly because of the labor requirements of these crops and partly because slave women had little choice about how hard to work. The result was that the wages of women relative to men were lower in the North than in the South. New England therefore had a cost advantage within the United States as a result of its extensive use of female operatives. The growth of industry in New England provided an opportunity for more women to work and raised

women's wages relative to men at the same time (Goldin and Sokoloff, 1982).

Industrialization came early to New England because the industry that has led industrialization in many countries, cotton textiles, could use women who were available in New England. The early cotton industry in England used children; later cotton industries in Asia used men. New England found its own way, using the highly educated and mobile young women of northern New England. One third of the employed workers in New England in 1860 were women, while only one-fifth of American workers as a whole were female (U. S. Census, 1863, p. 686, 742.)

Many other industries followed cotton textiles, but not all of them were as geographically concentrated within the United States. Steam engines, for example, were manufactured by skilled craftsmen who were found throughout the northern states. And since steam engines often needed adjustment and repair, it made sense to construct them where they would be used. The result was that each region of the country other than the South made most of the steam engines used there (Temin, 1966a).

New England therefore was both typical and atypical of regions in the United States. Typical because the laws of the United States applied to all regions. The tariff extended to North and South, and the validity of contracts extended from East to West. Atypical because local conditions made New England a leader in the progress toward an industrial economy. Both the machine tool industry and the cotton industry had their origins in this region.

II

London's Crystal Palace Exhibition in 1851 was designed to celebrate British manufacturing. But many American manufactures, of clocks, locks, and small arms, appeared to

be of even higher quality than the British--much to the surprise of the show's organizers. When the Americans planned an exhibit of their own in New York five years later, the British sent an interested delegation. The Americans--however skilled at manufacturing--were less organized than the British, and the visitors arrived to find the exhibition not yet open. They therefore traveled around New England and other adjacent regions of the United States to see what they could learn on their own.

Starting and ending their tour in Boston, the British delegation toured many factories with an emphasis on fire arms. They missed visiting Samuel Colt's new armory in Hartford because the Connecticut River had flooded it out, but they did see many other establishments. They were very impressed, and concluded:

> The contriving and making of machinery has become so common in this country, and so many heads and hands are at work with extraordinary energy, that unless the example is followed at home, notwithstanding the difference of wages, it is to be feared that American manufacturers will before long become exporters not only to foreign countries, but even to England, and should this occur, the blame must fall on the manufacturers of England, for want of energy in improving their machinery and applying it to special purposes (Great Britain, 1854-55, p. 631).

American manufacturers had created a production process known as the American System, based on the use of interchangeable parts. This practice made it possible for Americans to produce light manufactures in volumes and at prices unattainable in England. Chauncy Jerome, a Connecticut clock maker, used interchangeable parts to produce a one-day brass clock for less than fifty cents about 1840. He exported some to England in 1842. English customs reserved the right to confiscate goods at their invoice valuation to protect themselves against undervaluation. The clocks were clearly undervalued by English standards, and they were confiscated. This was fine for Jerome; he had sold his shipment at full price quickly and easily.

He sent another, larger load, which was duly confiscated. But when he sent a third, still larger load, the customs authorities dropped their English blinders and allowed it in (Roe, 1916).

The American System did not, however, emerge from the private economy. It began in arms production, at U. S. government armories. The first step was taken by Thomas Blanchard at the Springfield Armory in Massachusetts, who introduced a sequence of 16 special-purpose lathes and machines to make gun stocks out of sawn lumber. These lathes, which demonstrated the potential of the sequential use of special-purpose machines, were noted prominently by the English visitors in the 1850s. It had not occurred to the British visitors that the irregular shape of a gun stock could be made by machine. The Americans had solved this problem by using a series of 16 machines that together produced the complex shape.

The next step was taken by John Hall at the Harpers Ferry Armory. Hall realized that the problem in making interchangeable parts was to keep the gauges (patterns) used to make individual parts from getting worn away through use. The thousandth piece needed to be matched against a gauge that was the same as the gauge used for the first piece. But the action of comparing and filing parts to size gradually wore away the gauges, causing the pattern to "drift." Hall introduced a third level, gauges for the gauges. These would be kept safely away where they would not wear. They would be brought out only periodically to recalibrate the gauges used to size the actual production. The gauges used in production then only would vary within limits set by the time period between recalibrations, assuring interchangeability (Smith, 1977).

Samuel Colt used these methods in his private production of weapons. He patented his revolving method of making pistols in the 1830s and opened an armory to produce them in Hartford in 1855. This was the plant the British visitors did not see because of the flood. The

Civil War made Colt a very wealthy man, as might be imagined; he had the luck to have a new plant making the latest model firearms as the war broke out. Shortly after Colt's death in 1862, the Colt Company introduced its most famous product: the Colt .45 Peacemaker. It was the weapon of choice for most of the legends of the West, and it was made in New England (Hosley, 1996). Employed at the Colt works in Hartford were two men named Pratt and Whitney who started their own firm shortly before the Civil War. The firm of Pratt &Whitney, together with Brown & Sharpe of Providence, quickly became a national leader in the design and production of machine tools (Roe, 1916). They cooperated and interacted in many ways with related firms like the Corliss Steam Engine Company of Connecticut that made a famous patented steam engine.

These firms joined with others in and outside New England to create a fellowship of skilled machinists who visited and learned from each other. Visitors to firms like Brown & Sharpe had to show they belonged to this fellowship by engaging in technical talks or exhiting problem-solving abilities on the shop floor. But once accepted, vistors were given tours of the plant, talked to for hours, even invited home for dinner and the night. Solutions to technical problems were shared by the managers of the host plant in the expectation that they would be treated similarly in a visit they would make. This reciprocity was the key to the fellowship of machinery-firm managers and a potent force for the dissemination of knowledge. Philip Scranton noted that this open-door policy was common practice among machinery firms in the later nineteenth century, and that violations of the custom were criticized in the trade press the same way a lack of hospitality was scorned in desert cultures (Scranton, 1997, p. 30).

As these ideas spread from Connecticut to the rest of the economy, the ability of machines to make interchangeable parts increased over time. The early practice of the armories

proved hard to translate to industry, and Singer sewing machines continued to be numbered until late in the century to show the order in which they were made and therefore which parts would fit together (Hounshell, 1984, Appendix 2). But great progress had been made by the end of the period surveyed in this essay. As stated in the 1880 Census:

> Uniformity in gun-work was then, as now, a comparative term; but then it meant within a thirty-second of an inch or more, where now it means within half a thousandth of an inch. Then interchangeability may have signified a great deal of filing and fitting, and an uneven joint when fitted, where now it signifies slipping in a piece, turning a screw-driver, and having a close, even, fit (Fitch, 1883, p. 618).

Arms production and the American System of Manufacturing were important for the future of both New England and the United States as a whole. They laid the foundation for American industrial expansion in both the nineteenth and twentieth centuries. The center of production moved from Connecticut to New York and then to the industrial Mid-West, but the manufacturing methods built on the innovations made in New England.

At the time, however, machine tools were less visible parts of the New England economy than other industries because they were small, as they always are. The region's largest industry, the manufacture of cotton textiles, also was the largest industry--that is, it employed the most workers--in the United States as a whole. The second-largest industry in New England was the manufacture of boots and shoes. It too was a large industry nationally and also concentrated in New England. Other important industrial employers were important to New England and the country as a whole because they were geographically more dispersed. The manufacture of men's clothing and of sawn lumber were important throughout this period; iron foundries and machine shops became important by its end (U. S. Census, 1865, pp.677-86, 733-42 ; U. S. Census, 1883, pp. 9-14).

The industry that produced cotton cloth in New England grew by using totally new techniques to produce a traditional product. Actually, cloth is a traditional product, but cheap cotton cloth was an innovation of the nineteenth century. Wool was the traditional fabric of home production in temperate climates. Cotton only became a feasible alternative when transportation improved to make it economical to bring cotton from warmer climates where it was grown to temperate climates where it was made into cloth. It also needed the cotton gin, invented by New England's Eli Whitney in the previous period, to clean the raw cotton. And the new technology used to produce cotton cloth appeared to work better with cotton than with wool.

The new techniques of the cotton industry were a blend of old and new. The machines themselves were copies of British machines made initially by Francis Lowell from his memory of visiting English factories. In this sense, the British observers were accurate when they assumed that British and American technology was the same. But the organization of work was uniquely American. If we include management in our concept of technology, then the British visitors were wrong not to emphasize the way in which the machines were used in New England. The resulting industry was able to export cotton cloth to the United States as whole, taking advantage of the free-trade area created by disallowing tariffs between states. New England had a comparative advantage within the United States in the production of cotton cloth, deriving from the availability of cheap transport, power, and educated young women.

The first column of Table 1 shows the share of cotton cloth production by Massachusetts, Rhode Island, New Hampshire, and New England at the beginning, middle and end of our period. The states are ranked by the yards of cloth produced. Massachusetts led the other states in cotton cloth production by a wide margin in 1831. Adding the other New England states

reveals that almost three-quarters of the national production of cotton cloth was located in this region. The cotton industry was not only the largest industry in New England; it was virtually unique to New England in the United States.

This geographic concentration in New England was maintained in the following half-century. The second column of Table 1 shows that New England retained its dominance in cotton production on the eve of the Civil War. And the third column shows that the cotton industry was even more geographically concentrated after the war. Both Massachusetts and New England produced a larger share of cotton cloth than before the Civil War, although Rhode Island and New Hampshire did not. In the half century considered here, there were strong forces concentrating the cotton industry in New England and even further in Massachusetts.

The birth of this industry and the innovations that gave it life preceded 1830 and have been described in the previous essay. Francis Lowell and Nathan Appleton were key figures in the early history; but Lowell died in 1817, and Appleton was elected to Congress in 1930. They were both gone by the beginning of the period surveyed here. The phenomenal growth of the cotton industry was the result of investments and improvements made over many years. One of the most important innovations was the exploitation of water power from the Merrimack River. The city of Lowell was established in the 1820s at an existing dam in the river, and more and more mills were built in subsequent years to use the power generated by the flowing and falling water. Kirk Boott was the superintendent of several mills in Lowell and the prime architect of the city's internal organization. Although Boott was disliked at the time and has a bad reputation now, he died in 1837, while the initial arrangements for staffing the mills at Lowell were working well.

The ability of one dam to power many mills created conditions that economists describe as economies of scale. One could put a single water wheel in a large river and generate power for a single mill, as the Romans put water wheels in the Arno to grind flour. One also could find a small stream and dam it to take advantage of potential as well as kinetic energy--to use an overshot instead of an undershot wheel. But it was more efficient to build a dam across a substantial river like the Merrimack and construct canals that would take the water to a variety of mills who shared the investment in the dam. The dam itself is an example of what economists call a lumpy investment; the benefits came from the whole dam, not independently from each part of it.

The result of this economy of scale was to induce entrepreneurs thinking of opening a new mill to think seriously about building their mills in Lowell. They did not think of abstract concepts of course, but rather that power could be purchased more cheaply in Lowell than elsewhere. The Locks and Canal Company of Lowell was able to offer these good terms because of its--for the time--large scale. The city of Lowell accordingly grew rapidly as cotton production grew. For it was not enough to build mills for workers to be in during the day, houses in which they spent the night and Sunday had to be constructed as well. The particular way this was accomplished in Lowell will be described in the next part.

The dam at Lowell generated only a limited amount of power. The cotton industry expanded rapidly as its costs fell and demand grew. Soon there was need of more power than Locks and Canals had to sell. The proprietors of the Lowell dam therefore decided to build another dam further upstream and duplicate the results they had achieved in Lowell. Taking another name from a family prominent in the cotton industry, the new town was named

Lawrence. It was established in the 1840s and grew rapidly in the following years.

The output of cotton cloth increased at a rate of about five percent a year from 1830 to the Civil War. The price of cotton cloth fell at this time relative to other prices at a rate of one and one-third percent a year. This combination of rising output and falling price implies that the supply of cotton cloth was increasing faster than the demand (Zevin, 1971). The demand for cotton was responsive to price because cotton textiles were lighter than wool, they could be dyed and printed more easily, and they could be washed more easily. But even so, the improvements in productive capacity and methods were more important in explaining the rapid growth of cotton production.

Cotton cloth made in New England was sold throughout the United States. New England both imported its raw material and exported almost all its product. Not all the output was exported, of course, because some cotton cloth was consumed in New England. But less than 15 percent of the national population and probably therefore of national consumption was in New England, while three-quarters of production was performed there. The majority of cotton textiles consumed outside New England were exports from New England. One could make an even stronger statement about the Colt .45 Peacemaker made in Connecticut for sale in the West.

Machinery for the mills of Lowell and Lawrence was built primarily by the Locks and Canal Company of Lowell. Although this company earned over half its operating profits in 1838 from the sale of cotton spinning and weaving machinery, it had other sources of income as well. It was the owner of the land on which the mills at Lowell were built and received rent from them. It also had branched out into making the other dominant machine of the ante-bellum economy, steam engines, earning more revenue from this new activity than from its traditional renting

activity. Unlike the products of the cotton mills themselves, the machinery and engines built at Lowell were sold primarily in New England. The proportion of sales made in Lowell declined however from virtually all in 1830 to about one quarter in 1880. Southern states provided a market almost as large as Lowell by this latter date, foreshadowing the future history of the cotton industry (Gibb, 1950, pp. 98, 243).

The New England boot and shoe industry had a complex relationship with the cotton textile industry. Before 1850 shoes and boots were made primarily in people's houses or in "ten footers," workshops built onto them. The outwork system of boot and shoe production contrasted sharply with the factory work of cotton mills. Women worked at home making shoes, but in Lowell or other mill towns making cloth. Working women at mid-century sharply preferred the latter. One woman who made transition wrote back that she soon would be skilled and earning good wages: "By and by. . .[I] shall have twice a much as though I were binding shoes. I guess you [won't] catch me to do that little thing again, not I! You cannot think how funny it seems to have some money (Blewett, 1988, p. 44)."

Although factory production acted to draw women out of home production, it also attracted women into domestic production. The mills at Lowell and Lawrence produced attractive cloth which women wanted to buy, and they bound shoes and wove palm-leaf hats to earn money to buy factory-made cloth. This complex relationship endured throughout the ante-bellum years; it is hard to know if the pull into outwork was stronger than the pull out of it. The balance of forces was changed after 1850 due to another interaction between cotton and shoes. The Singer sewing machine was adapted to sew leather around mid-century, leading shoes to be produced in factories of their own where the sewing machines were powered by steam. The boot

and shoe industry increasingly provided factory employment for women that competed with the cotton factory work and for men as well as women (Blewett, 1988, pp. 44-45, 97).

Despite these differences, the boot and shoe industry was comparable to the cotton industry in many ways. It was concentrated in Massachusetts and New England throughout this period. We do not know the location of shoe production at the beginning of the period, because the early Census did not collect adequate manufacturing data and the prevalence of outwork made it hard for others to gather data by themselves. In addition, since there were no political issues involved parallel to the tariff on cotton imports from Britain, people did not make the effort to collect data on boots and shoes. By 1860, 60 percent of American boot and shoe production (by value) was made in New England; 50 percent, in Massachusetts alone. As with cotton cloth, these shares increased by 1880 to 67 and 58 percent. The two industries were roughly the same size in the value of their product and the number of workers they employed. Women were important in both industries, although the proportion of female boot and shoe workers fell more rapidly over time. Half the workers in cotton textiles were women in 1880, down from 60 percent in 1860. But only one quarter of boot and shoe workers were women in both 1860 and 1880, down from earlier years (U. S. Census, 1865; U. S. Census, 1883).

Whaling was another industry concentrated in New England, and even further, in New Bedford. It was a large employer, although its labor force was exclusively male, reaching its peak just before the Civil War. Whale oil, the primary product of the industry, was used for illumination, demand for which rose as people left farms for more urban and literate activities. Whales also furnished lubricants and whale bones for women's clothing. The introduction of petroleum products in the 1850s reduced the demand for whale oil and lubricants, starting a

decline from which the New Bedford industry did not recover. Only the demand for whalebone stays kept American whaling in business after the Civil War (Davis, Gallman and Gleiter, 1997).

There were many other industries that grew in New England during these years as well, although none as concentrated in this region as cotton, shoes and whaling. The region grew with the national economy, based on the educated labor force of New England. By the end of the period when we have data to make a comparison, labor productivity in American industry was twice as high as in Britain. This might have been due to greater capital intensity, as the British visitors speculated, but it was not. The ratio of capital to labor was no higher in the United States than in Britain. It follows that total factor productivity was twice as high in America as in Britain. Better machines, and organization, rather than more machines. This may have been true before then as well, but we do not have enough data to know (Broadberry, 1997, p. 106).

People in 1830 traveled around and transported goods over land on foot, horseback or wagons. Sea transport went by sail. Information traveled the same way as people and goods. There were steamboats on the Hudson and Mississippi Rivers by then, but not in New England. These time-honored means of transport went at their traditional paces, making travel and communication slow and often arduous. Newspapers reported events elsewhere in the United States that were days old; events in Europe that were weeks old.

This changed dramatically in the next half century. The instantaneous communication that we are used to today has its origin in this period. Transport also became faster, easier and more regular, although not up to the modern standard of air travel. Communication within the United States was vastly speeded by the introduction of the telegraph in the 1840s. Spreading rapidly during the next two decades, it provided a way for business communication to travel

instantaneously from city to city. Messengers, like the young Andrew Carnegie in Pittsburgh, carried messages between the telegraph and business offices. With the laying of a cable under the Atlantic Ocean by the Great Eastern--the largest steamship of its day--in 1866, this web of communication was extended to London and Europe. Newspapers in 1880 were as up to date as they are today. Former Postmaster General Amos Kendall asserted in 1847 that the telegraph had reduced the time needed to transact business between Boston and Richmond by "four entire days (DuBoff, 1983, p. 263)."

Within New England, telegraph wires followed railroads. One use of the telegraph was to schedule trains so that railroads could run with only a single track for trains in both directions. "Single tracking" was a typical American innovation that saved capital costs. Michael Chevalier, traveling in America in 1834, noted that, "The railroad from Boston to Providence is in active progress; the work goes on *à l'Américaine*, that is to say, rapidly (Chevalier 1839, p. 84)." The New England railroad net was constructed rapidly in the 1840s, and New England was knit together at mid-century far more closely than a generation earlier. Henry Thoreau, celebrating the pure life in the wilderness on his farm at Walden in the mid-1840s, saw the train go by (Thoreau, 1950, p. 110).

New York was emerging as the primary point of entry for American imports of British manufactures and of exit for exports of Western agricultural products, eclipsing its rivals, Philadelphia to the south and Boston to the north. The Erie Canal opened in 1825 and provided far cheaper transport across the mountain barrier to the Mississippi Valley than had ever existed before. Boston fought back by constructing railroad links to the West to attract through traffic to its port. Its first effort, the Western Railroad, offered a connection to the Erie Canal at Albany.

But although the route across New England to Boston and then across the ocean was more direct than down the Hudson to New York, it was also more expensive. Railroad transport was more expensive than canals in general, and the Western Railroad had to navigate a hilly terrain in addition. Boston's second effort was to construct a railroad link to the St. Lawrence River and by-pass the Erie Canal entirely. This had a certain political charm as defiance of New York's Erie Canal; it made little economic sense. Despite a smoother grade than the Western, this route too had high costs deriving from the need for a railway link (Fishlow, 1966, pp. 240-41).

At the same time that railroads knit New England together and revolutionized overland transportation, clipper ships and then steamboats did the same for ocean transport. Clipper ships were among the most beautiful agents of commerce ever built--their acres of billowing sails were designed to catch all possible wind and speed the ships to China and back. The *Flying Cloud*, built by Donald McKay in East Boston, was the most beautiful, fast, and famous clipper ship. It tied the record of 89 days from New York to San Francisco twice, making an average speed of 10 miles and hour. And since it was built in Boston, the *Flying Cloud's* success led to the following ditty being shouted in New York:

> Wide-awake Down-Easters,
> No-mistake Down-Easters,
> Old Massachusetts will carry the day (Lubbock, 1922, pp. 69-76)!

Clipper ships had a short and dramatic appearance on the historical stage, being used primarily from the 1830s through the 1850s. Demand for these highly specialized "tall ships" was fading when the opening of the Suez Canal in 1869 allowed less expensive ships to do their job as well (National Geographic Society, 1962). Much less pedestrian, but more important in the long run, steamboats began in this period to make regularly scheduled trips between Boston and New York

and between Boston and England. Steam engines had revolutionized ocean transport as well as land transport by 1880.

Steam engines were not only useful for transportation. They also powered factories and mills throughout America. These engines were made locally, as the sales of Lowell's Locks and Canal Company suggests. In New England around 1840, for example, 260 of the 304 stationary steam engines whose origins we know were made in New England, and only five steam engines were imported from New England. Almost all the imported steam engines came from New York, closely adjacent to New England. The skills needed to construct a steam engine that worked clearly had spread throughout the northern United States by the start of this period (Temin, 1966). These skills diffused widely, while the ability to produce cotton textiles efficiently from southern cotton appears to have been restricted largely to New England in this period.

III

This explosion of manufacturing activity changed New Englanders' lives in many ways. In the first instance, the new products that emerged from cotton mills and shoe factories allowed people to dress themselves and their houses in ways that could be only imagined before. The new modes of transportation allowed these same people to move easily and quickly within New England and beyond. The railroad and steamships also brought products to the region in undreamed of variety. Even though the price of cotton goods was falling relative to other prices, the prices of other goods were falling too: western grain became available in New England at ever more favorable prices.

Through another route, the new industries created work for New Englanders. The

expansion of production needed an expanding work force to produce it. Workers were attracted from the countryside to mill and factory towns by high factory wages. They were pushed from their farms as well by competition from western farms. Cheaper transportation allowed New England to exploit its comparative advantage in the production of textiles and other industrial products. Phrased differently, men and women chose to work in factories instead of on farms because they could use factory wages to buy goods produced at those factories and imported from other regions more cheaply than they could produce them themselves. The variety of goods that could be purchased far exceeded the variety that could be grown from the hard New England ground, and higher income in New England was accompanied by a vast increase in the spice of life known as variety.

With a change in work came a change in dwelling place; urbanization was a dominant characteristic of this half-century. Figure 1 shows the proportion of people living in urban areas in Massachusetts, New England and the United States as a whole. It can be seen easily that the transition from the countryside to the city was most advanced and most rapid in Massachusetts. The transition to an urban civilization in New England was almost as rapid as in Korea and Taiwan in the last half of the twentieth century. These countries, of course, are independent; they are not a region within a larger country. The data on the United States therefore reminds us both how unusual New England, and especially Massachusetts, was in this period and that New England industrialization was stimulated and encouraged as part of the stable, prosperous United States.

This process of urbanization can be seen clearly in the experiences of Boston, New England's largest city, and Lowell, the center of New England's largest industry. Boston grew

from 60,000 to 360,000 inhabitants in the half-century from 1830 to 1880, while Lowell grew from 6,000 to 60,000 (Dublin, 1994, p. 155; Eno, 1976, p. 255). Lowell grew faster, but Boston was larger. Lowell also was a one-industry town, while Boston was a metropolis with varied activities and an active port. The story of Lowell highlights the role of women in early New England industrialization, while Boston's labor force was more typical of the region as a whole. The largest employer of both men and women in Boston throughout most of this period was the production of men's clothing, although foundries and machine shops employed more men by 1880. Other large urban industries were printing and publishing, furniture, women's clothing, and--after the Civil War--slaughtering and meat packing (U. S. Census, 1865; U. S. Census, 1883).

Boston in 1830 was the fourth largest city in the United States, behind New York, Philadelphia and Baltimore. It was the third largest port, behind New York and New Orleans, linked to coastal cities both north and south of it by semi-weekly packet (that is, scheduled) ships in warm weather. It was situated on a narrow peninsula which had given good access to the city in previous years by the dominant mode of European transportation--water--and protected it from natives who might have attacked by land. The city expanded by filling land in what is now downtown Boston, producing a virtual island city connected to the mainland by only a narrow neck (Knights, 1971, pp. 11-13).

The neck that connected Boston and the rest of Massachusetts ran along what is now Washington St. Several bridges were added to the north in the early 19th century, and a dam was built along what is now Beacon Street in 1821. The purpose of the dam was to create a tidal pool in what was known as Back Bay to provide power for mills of all sorts. This scheme proved less

than fully successful, for, as we have seen, the rapidly expanding cotton industry drew its power from the Merrimack River instead of the tides. In the 1830s, Back Bay was cris-crossed by two railroads running diagonally across the tidal flats, crossing near today's Back Bay Railroad Station.

During the later ante-bellum years, the road along what is now Beacon Street offered another way west from the city and a handsome drive with water on both sides. The press of population and the discomfort of having the tidal basin dry out twice a day created pressure to fill in the Back Bay and many plans for doing so. A city plan of 1856 created the Back Bay we see today with its broad Commonwealth Avenue and regular cross streets. A museum of natural history was built on Berkeley Street during the Civil War in a building that still stands today (housing a men's clothing store). The Massachusetts Institute of Technology was incorporated in 1861 adjoining the museum of natural history.

Back Bay was filled in during the next two decades using the railroad and the newly-invented steam shovel. The whole Back Bay was ready for building by 1880 and remained a defined example of Victorian town planning bounded on the east by the Public Garden, on the north by the Charles River, on the west by marshes that were later drained to make the Fenway, and on the south by railroad tracks running diagonally relative to the streets of Back Bay. Boston was unusual among large American cities in having to expand its land area as its population grew (Whitehill, 1959).

The expansion of Lowell was completely different. In contrast to the varied occupational base of Boston's residents, Lowell's inhabitants derived their income from cotton mills. In further contrast with the long history of Boston before the 19th century, Lowell was a new town

created in the 1820s by a small group of Boston merchants and manufacturers. Lowell was to embody the solution to two problems of the nascent cotton textile industry. The rapid expansion of production needed more power than could be obtained from the sluggish Charles River at the location of the first mill in Waltham. And the mills needed labor to run the mules and looms that produced yarn and cloth.

The problem of power was solved by purchasing land and water rights at the falls on the Merrimack River and establishing the town of Lowell. The labor problem was compounded by the low opinion of industrial activities in the predominantly agricultural society and the poor reputation of earlier workers. The solution in Rhode Island followed a British pattern and employed whole families, using children in the mills. The Lowell solution was to use a succession of unmarried farm-girls.

These girls were available for several reasons. Agriculture in New England employed women less than agriculture in other regions, the new cotton technology was reducing the demand for spinning and weaving work done at home, and British farm-girls typically had left their families before marriage to be servants in other households. The plan was to employ these young women for a few years only, making them only transient residents of Lowell. But it was not a simple matter to attract them to Lowell. The anticipated large number of girls needed to be housed and supervised in a way different from the problem of supervising a single servant. The town of Lowell would have to contain adequate housing for the workers as well as the cotton mills.

The initial plan of Lowell was to approximate an ideal factory town. The mills would be near the river from which they drew power. Housing would be just behind them, bounded by a

main street, and the rest of the town would be across the main street. The main street would separate the industrial part of the town, including carefully planned mills and housing, from the bourgeois part that would grow without central planning. This plan, however, was predicated on a straight river. Although this plan was used in Manchester, VT, in the 1830s, it could not be used directly in Lowell for the simple reason that the Merrimack River turned sharply just below the dam.

The resulting plan of Lowell contained the division between its planned and unplanned halves, but the division was nowhere near as straight nor as visible as in the ideal plan. The mills were situated near the river, either parallel or perpendicular to it. The standard mill was 150 feet long and 40 feet wide, four stories high, and contained approximately 6,000 spindles on which cotton was spun. Housing for the girls operating these spindles was built directly adjacent to the mills in respectable housing. But since the girls spent 12 hours a day, six days a week, in the mills, the boarding houses were little more than dormitories.

Michael Chevalier, visiting from France in the 1830's, saw Lowell through European eyes:

> Lowell, with its steeple-crowned factories, resembles a Spanish town with its convents; but with this difference, that in Lowell you meet no rags nor Madonnas, and that the nuns of Lowell, instead of working sacred hearts, spin and weave cotton. Lowell is not amusing, but it is neat, decent, peaceable, and sage (Chevalier, 1839, p. 143).

The town was rigidly hierarchical, with the corporations and its leaders at the top. The workers were differentiated sharply from them and confined to their repetitive houses. But while the buildings revealed a sharp distinction, the people inhabiting them did not, at least at first. The workers who passed through Lowell typically worked there for about four years on their way

to live lives shaped by the larger world. The rigid hierarchy of Lowell was one stage among several they passed through. Only after mid-century, when the temporary labor of Yankee girls was replaced by the more permanent labor of Irish and French Canadian immigrants, did the hierarchical structure of Lowell's buildings mirror--and help create--a social structure as well (Coolidge, 1942). As a historian of the period has said, "Lowell was never an 'Eden,' but as the place where American women first had a chance to earn an independent living, and where the American Industrial Revolution began, the Lowell Experiment marked the beginning of a long road (Zaroulis, 1976, p. 126)."

Even after the passing of the original, transitory labor system, the workers in Lowell factories were far different than their counterparts in England. Anthony Trollope, visiting Lowell early in the Civil War, made the comparison:

> They [Lowell operatives] are not only better dressed, cleaner, and better mounted in every respect than the girls employed at manufactories in England, but they are so infinitely superior as to make a stranger immediately perceive that some very strong cause must have created the difference (Trollope, 1951, p. 247).

Women were an important, even critical, part of New England industrialization, which was built on the use of their previously underutilized labor. The early stages of industrialization offered women an economic independence that was unique to this period of time. There was work in the home for both unmarried and married women, and work outside the home for unmarried women. Only now, and in very different ways, are women again achieving economic independence, this time more thoroughly and less connected to their marital state.

Table 2 provides a picture of the changing fortunes of Massachusetts women during this period. In 1837, almost two-thirds of women who earned wages were working in their own

homes. This outwork was part of a system known as the putting-out system in England. Initially a merchant, or putter-outer, brought raw materials to women's houses and came again to reclaim the finished product. Later women purchased the raw material at a local store and sold the product there as well.

The products made at home in Massachusetts differed sharply from the textile products made in eighteenth-century English households. The most important products were palm-leaf hats and straw bonnets. The women wove and braided split palm leaves into hats. Martha Alexander, for example, braided 341 hats in the 45 months before she was married in 1834. She braided 162 hats in the next two years, maintaining her pre-wedding pace (Dublin, 1994, p. 68). Half of the women earning wages at the beginning of this period earned their wages by braiding hats. This work however vanished completely after the Civil War.

The other important source of outwork employed only about one-fourth of the number of women employed braiding hats. This was the boot and shoe industry, in which women bound, that is, sewed the lining into shoes and the uppers together. This source of outwork also disappeared as industrialization advanced. The sewing machine was adapted to use with leather around mid-century, and outwork was transformed into factory labor. Women were employed in these factories, but not in the proportion that they worked in the cotton textile industry.

After domestic work, the next most important employment of Massachusetts women in the 1830s was the cotton textile industry. Unlike braiding hats at home, work in the cotton mills was for unmarried women alone. Less than a quarter of working women worked in the cotton industry at any time, but they worked there for only a short time, and a far greater proportion of women passed through the cotton mills. The textile industry became a more important source of

women's work during this period, and the composition of the female workforce changed. Women began to work in the mills for longer periods, not for only a few years. These long-term operatives were not Yankee girls accumulating their dowries; they were immigrants from Ireland and French Canada. The cotton mills were very different places to work at the beginning and end of the period described here.

Domestic service always offered some employment for women. In the years after the Civil War, it offered the most opportunities for women as outwork declined. One-third of Massachusetts women, and one-half of women in the United States as a whole, who earned wages worked in domestic service in 1870. (This national proportion was cut in half by 1900.) The needle trades offered another outlet for women as outwork declined. While employment in textiles and shoes centered in Lowell and Lynn, domestic and garment work was located most often in Boston (Gamber, 1997).

The experience of Mary Paul echoed that of many women in the years after 1830 who left the farm for factory work in the textile industry. Born in 1830 in Vermont, Mary left home at 15 to work as a farm servant in a nearby town. Not liking the work, she left to live with relatives and to appeal to her father for permission to Lowell or similar place. She arrived in Lowell in 1845 and worked in the cotton mills for the next four years, and at other jobs in Lowell until 1857 when she married the son of a former boardinghouse keeper in Lowell. Mary Paul Guild moved to Lynn with her husband and had two sons in the next five years. Her work in the cotton mills was only temporary, but it set in motion a permanent move from the country to the city (Dublin, 1994, pp. 77-79).

The farmers' daughters lived in boardinghouses while they worked in Lowell. They

wrote articles in the magazine of the cotton workers, *The Lowell Offering*, that expressed their happiness and justified their move from the farm. Susan Brown, in her eight months working as a weaver in Lowell in 1843, spent half of her earnings on food and lodging at a boardinghouse. She recorded purchases in her diary for another quarter of her income, attended 15 plays, concerts and lectures, and had a two-day excursion to Boston. She may have saved a bit or sent some money home, but she used most of her earnings having what appears to have been a good time (Dublin, 1994, p. 99).

It is clear that these farm girls were fully literate. They knew far more than how to read and write the amount needed for factory employment. Some of the young ladies wrote and produced *The Lowell Offering*, a collection of essays by and about their experiences. Some of them also, as just noted, went to plays, concerts and lectures--not the activities of barely literate people. New England education prepared the ground for Industrialization.

Children spent relatively little time in school in the early nineteenth century. There were thousands of schoolhouses in the countryside and even more tutorial efforts in individual houses. But learning to read and write was squeezed into myriad other activities ranging from church to farm to household. A coalition of moral reformers reconceptualized the role of schools in the 1830s and 1840s. These reformers realized that children were subjected to influences from their various activities and distinguished the role of schools from other influences. They invented public schools as a way to cope with the transformation of work from agriculture to industry and of residence from rural to urban and of the student body from native-born to (partially) immigrant. This movement began in New England and spread to the rest of the country over the next century. Public schools in the eyes of these reformers would be crucibles from which

children would emerge free of provincialism and endowed with civic values and moral gyroscopes. For Anglo-American children, public schools would provide a civic vocabulary, patriotic disposition, and political knowledge. Public schools also would initiate immigrant children into the Anglo-American cultural and political culture (Finkelstein, 1989, p. 18).

Schools changed their physical appearance in pursuit of these goals. In earlier, part-time schools, students sat on benches around the periphery of the room, surrounding a central space with a stove and a teacher. Students could observe each other while remaining roughly equidistant from the stove. They stood before the teacher to say their lessons and they often chanted their lessons in choral form. The group learning setting subordinated the written word to the spoken sociability of the community.

This structure changed first in New England cities and towns, spread to the countryside and to the rest of the country. Benches were replaced by school desks. And students no longer sat in a sort of circle, but in rows facing in the same direction. First came the two-seat desk, preserving a residue to the communal nature of the earlier school. The single desk followed, isolating the student in his or her pedagogical activity. Individual study of books rather than communal proclamation of moral sentiments became the norm. Age stratification increased. Grades replaced corporeal punishment, report cards supplanted spelling exhibitions, manufactured pens replaced goose quills. Schools as we know them spread over New England in this period (Finkelstein, 1991).

The public-school movement was led by a fierce New Englander. Horace Mann grew up in rural Franklin, Massachusetts, helping his mother braid palm-leaf hats and learning a stern Calvinism. He was the first Secretary of the Massachusetts Board of Education, serving from

1837 to 1848 when he succeeded John Quincy Adams in the United States House of Representatives and turned his attention to the abolition of slavery. His annual reports to the Board of Education had great influence in their day and still are classic statements of the value and function of education today. The fifth annual report in 1842 explored the relationship between education and the economy.

Mann stated clearly that the goals of education in his mind were broad and that the economic benefit of education was the least of them. He recognized however that the economic argument was needed to convince others, less high minded than he, to support education in their towns and cities. He therefore described the economic benefit of education with his customary vigor. He surveyed employers in Massachusetts about the work done by educated and uneducated employees. He concluded,

> [T]he result of the investigation is a most astonishing superiority, in productive power, on the part of the educated over the uneducated laborer. . . . In great establishments, and among large bodies of laboring men, where all services are rated according to their pecuniary value; where there are no extrinsic circumstances to bind a man down to a fixed position, after he has shown a capacity to rise above it; where, indeed, men pass by each other, ascending or descending in their grades of labor, just as easily and certainly as particles of water of different degrees of temperature glide by each other,--there it is found as an almost invariable fact, other things being equal, that those who have been blessed with a good common-school education rise to a higher and higher point in the kinds of labor performed, and also in the rate of wages paid, while the ignorant sink like dregs, and are always found at the bottom (Mann, 1891, Vol III, pp. 96-97).

The recruitment of Yankee girls to work in the Lowell mills ended at mid-century. The construction of Lowell in the 1820s had used Irish labor, and there were many Irish families still in Lowell twenty years later. As cotton production revived in the 1840s, after the recession that followed the 1837 financial crisis (to be described below), mill owners decided to allow Irish women to work in the mills. This change in policy coincided with the Irish famine and

subsequent emigration of many Irish to America. The mill owners found they could hire as many Irish workers as they wanted and did not need to recruit young women from the countryside. And since the Irish families lived in Lowell, there was no reason to maintain the boardinghouse system in which the Yankee girls had lived apart from their families. *The Lowell Offering* ceased publication in 1845. Lowell after mid-century was a very different place to live and work than before (Mitchell, 1988, p. 92; Dalzell, 1987, p. 68).

The boot and shoe industry in Lynn offered a very different experience for women than the cotton industry centered in Lowell. Many women working in Lynn before the Civil War had been born there, and most married and settled there. Women's work in Lynn typically was done at home by women resident in Lynn, as opposed to the factory work done by migrants in Lowell. And while most workers in Lowell were women, women in Lynn worked among male workers who attached the uppers made by women to the soles.

The shoe industry was transformed first by the application of the sewing machine to shoemaking, which increased the efficiency of the female outworkers in the 1850s. Then, a decade later, the McKay stitching machine (actually invented by Lyman Blake of Massachusetts) made factory production of the entire shoe efficient, ending the demand for outwork and sharply reducing the demand for women workers. In Lynn, the proportion of women employed in the boot and shoe industry declined from half in the 1830s to 40 percent in the 1860s. But while most workers in Lynn worked in the shoe industry, less than one-fifth of the boots and shoes made in Massachusetts were made in Lynn. For the state as a whole, the proportion of women employed in the shoe industry fell from two-fifths in the 1830s to one-quarter at the end of the Civil War industry boom (Faler, 1981, p. 147).

Teachers were women in this period. They never were a large proportion of employed people in New England or even of employed women, as shown in Table 2. But teachers taught on average longer than women in other occupations. This average was composed of two quite different groups. Those teachers who followed teaching by marriage taught on average about four years, the same length of time that women typically worked in the cotton mills. But a large proportion of teachers did not marry. Twice as many teachers remained single than the average New England woman after the Civil War (30 percent as opposed to 15). These single teachers taught on average a dozen years, bringing up the average tenure of teachers (Dublin, 1994, p. 218).

Men of course worked in a whole variety of jobs. The largest employers of men in 1860 were boots and shoes, cotton goods, woollen goods, and whaling (U. S. Census, 1865). The result of the Industrialization described in the last section was that there were always new jobs to be filled. And this pressure on labor not only brought new workers into New England, it also raised the wages of workers in New England. Real wages, that is, wages divided by the cost of living, rose about one percent a year on average during this period. The increases were fastest at the beginning and end of the period and lower in the middle when the Civil War and associated dislocations decreased the demand for labor. Real wages in New England were higher than in Europe, as the British visitors noted, drawing immigrants from Europe. They were not higher, however, than those in the Midwest, and many people migrated to the West as a result (Coelho and Shepherd, 1976).

Work in non-cotton manufacturing often was done under what was known as the contract system. Workers typically worked 11 or 12 hours a day, six days a week. But they did not work

at standardized jobs typified by the modern assembly line. Instead, workers were paid their wage to fulfill orders that were allocated to them. They could use assistants, but had to pay them from their own pay. They could decide how and often where to produce the order. Workers signed written contracts for large orders, but smaller orders--the "peanut trade"--were handled verbally. Workers had a lot of independence *within* the factory (Gibb, 1950, p. 217). The 1880 Census celebrated this system in the manufacture of sewing machines even as the author commented on its passing:

> The system of employing head machinists by piece-work or contract may almost be esteemed a germinant principle in the development of special machinery and a higher productive efficiency in the manufacture; but works are now very commonly conducted under salaried foremen, some classes of operatives working by the piece and some by the day (Fitch, 1883, p. 650).

Prosperity in New England was based on rising wages. The rest of the national economy was growing as well, and this region was not unusual in its economic growth. It was unusual however in leading the pack. New England was a rich region throughout this period. In 1840, the earliest time for which such an estimate can be made, per capita income in New England was well above (25 percent) the national average. The Middle Atlantic region was roughly the same, so New Englanders would not have appeared better off than their immediate neighbors to the west and south. Both of these wealthy regions had higher average incomes than regions to the west. In 1880, the relative income in New England had maintained its lead over the national average. But the Middle Atlantic region had grown even faster, increasing the gap between its income and the national average. In New England, the lead over the national average was due mostly to the region's lead in Industrialization, as opposed to having higher wages in any given occupation (Easterlin, 1960).

IV

These industries did not employ all these workers in isolation. Workers needed machinery to operate and houses to live in. New machines needed to be housed in new factories, and new products needed to be transported to market. Investment was the key to the exploitation of new technology. And just as labor was forthcoming from New England farms, capital was forthcoming from prior mercantile activity. But, unlike labor, capital invested in new ventures replenished itself and grew, to be invested again in the same or other activities.

As elsewhere, the capital market in early industrial New England operated differently for large and small companies. Large companies, like the cotton mills of Lowell, were well known to potential investors. People looking for investments consequently did not need individual information about the identity of the managers or the specific nature of the business. They could get information from standard sources like newspapers and publications of the company, and they were willing to purchase standardized securities that are the antecedents of our stocks and bonds today.

Small firms, whether just starting out or in some specialized activity, did not have this wide appeal. There were too many small companies even then for a potential investor in Boston to learn about all of them, and they were too small to generate the kind of standardized information that an organized market demanded. Investors in these companies needed to have information that could only be gotten in some more intensive way--to know someone in the business or have some kind of small-scale institutional contact that would assure them of the quality of their investment.

This split still exists today. The stock market lists many companies, but still only a small

subset of all companies in the United States. Large companies can be listed on one of the exchanges and be traded easily. But many other companies are too small to be traded actively or to generate the needed information for the market and must search out capital without the benefit of this organized market. They find resources through families, friends, banks, and venture capitalists. These two parts of the capital market are distinct, but they are linked together to form one market. Firms that succeed and get larger can go from the informal to the more formal market; investors can go back and forth between the markets depending on their knowledge, tastes or opportunities. While it is necessary to describe both methods of raising capital, they are two parts of a single market.

The initial investments in the cotton textile industry were made by New England merchants from Boston and Salem in an informal market. These men had earned great fortunes of the day from trade with Europe, the Caribbean and China. This trade was halted by the Embargo of 1808 that led to the War of 1812 with Britain, and these merchants looked for a domestic outlet for their capital. The nascent cotton industry fit the bill. The pattern of Boston merchant families investing in cotton mills was familiar by 1830.

The cotton industry had grown substantially by 1830, and the companies started by these merchants had a track record of continuous dividend payments. New companies could draw on the established power resources of Lowell and the history of profits of the older companies to attract investors. The cotton mills therefore had moved from the informal to the formal capital market. Their shares were traded, albeit nowhere near as frequently as the shares of companies today, and the owners of these shares were recorded. The historical record contains the names of the people who furnished capital to the cotton industry. These names can be used to find from

other sources who the investors were, that is, what their occupations were.

New cotton textile firms could issue shares for public subscription by 1830. Half of the shares were bought by merchants, following the tradition of the early informal sources of capital for the cotton industry. The major part of this half (35 percent) came from merchants outside the cotton industry, following tradition. But some (15 percent) came from cotton merchants. The industry was beginning to earn profits for its participants that could be reinvested. The continuation of the initial sources of capital is clearly visible, but these sources account for only half of the capital raised in the initial capital offering of later new companies.

Lots of other types of people--unrelated to the cotton industry--invested in cotton mills after 1830. Professional people, people and firms engaged in non-cotton manufacturing or artisan activities, and financiers all invested in cotton firms. In addition to these people, some shares were held by financial institutions, adding another layer of intermediation to the capital market. Women also appear on the roster of people owning shares of companies and subscribing to shares of newly-formed companies, and trustees owned an increasingly large share of these firms' stock. On the eve of the Civil War, women and trustees owned one-quarter of the equity of cotton textile firms in Massachusetts. The profitability of the cotton industry and the stability of investments in cotton firms made them a suitable investment for widows and orphans (Davis, 1958).

These firms also could borrow on the markets for short-term loans established to finance trade. They raised almost all their initial capital from selling shares. (In the terminology of today, they were not levered at all.) Over time the share of equity in their total assets declined somewhat, but only from 90 percent to 60 or 70 percent (Davis, 1967). Cotton firms borrowed

from different sources depending on the loans' duration. Short-term loans, those for less than one year, came primarily from commercial banks. Loans longer than one year came from savings banks and trust companies; the financial institutions had specialized even then to supply different kinds of capital. Individuals were a more important source of long-term loans than short-term, but they supplied less than one quarter of even total long-term loans. As the cotton mills grew larger and more numerous, financial institutions grew also to serve their needs for loans. While each firm raised capital in many different ways, the financial institutions specialized to provide mostly one form of capital asset (Davis, 1960).

The owners of cotton mills looked also for investments outside the cotton industry. There were no mutual funds in the mid-nineteenth century, and investors had to find varied investments to reduce their risks (to diversify their portfolios in our modern jargon). It is unlikely that these men thought in these twentieth century terms, but they acted as if they did. Despite the continuing prosperity of the cotton industry, the owners of these firms looked actively for other areas in which to invest. Even though the cotton industry was stable, it did have rough times in the early 1840s after the financial crisis of 1837 and in the early 1860s when the Civil War interrupted the flow of Southern cotton to New England.

New England investors found many outlets for their capital; Nathan Appleton, the cotton pioneer and politician, purchased a fine house for his daughter on "Tory Row" in Cambridge on the occasion of her marriage to a Harvard professor, Henry Wadsworth Longfellow. (The imposing house on Brattle Street is operated by the Park Service and can be visited today.) But the most popular opportunity emerged in new railroad companies. In the early 1830s, railroads represented a new technology, as the cotton industry had been over a decade before. Boston

investors rushed into this new activity. The first railroad lines were intimately connected to the cotton industry. The Boston and Lowell brought cotton goods to Boston. The Boston and Providence shortened the route from Boston to New York and beyond by avoiding the long trip around Cape Cod. These railroads were joined by the attempt to reach the Hudson River and the Erie Canal over land from Boston. The Boston and Worcester was continued by the Western Railroad that went from Worcester to Albany. But while the latter had rough terrain as noted above, the former ran over smooth ground and paid at least a six percent dividend every year from 1837 to 1867 when it merged with the latter (Salsbury, 1967, p. 245).

Railroads were built throughout New England in the 1840s. The cotton masters were joined by more merchants as trouble in China made them look for other activities. Conflict between the British and the Chinese over opium and the extent to which Westerners could trade with China led to the Opium War of 1839-42. Boston merchants turned away from international trade in the 1830s and 1840s as their fathers had done during the Embargo and the War of 1812. The China trade did not employ many people in New England, but it was an important source of investment capital.

Enthusiasm for railroads was expressed by the Reverend R. C. Waterston in an 1845 poem:

> *Here magic Art her mighty power reveals,*
> *Moves the slow beam, and plies her thousand wheels;*
> *Through ponderous looms the rapid shuttle flies,*
> *And weaves the web which shines with varied dyes;*
> *Here, gliding cars, like shooting meteors run,*
> *The mighty shuttle binding States in one* (Johnson and Supple, 1967, p. 81)!

The slow beam refers to the walking beam of Watt steam engines, used here to refer to steam

locomotion even though locomotives used high-pressure steam engines that lacked walking beams. Waterston goes on to make an elaborate analogy between the shuttle of the power loom going back and forth across the warp threads and the steam train going back and forth along its tracks.

Boston investors also began to look outside New England during the 1840s and 1850s, to railroads in Ohio, Michigan and Illinois. The investors in western railroads included Nathan Appleton, Patrick T. Jackson and John E. Thayer from the cotton industry as well as John P. Cushing, John M. Forbes and Thomas H. Perkins from the China trade (Johnson and Supple, p. 83). Just as the New England railroads had opened up the interior and connected disparate bodies of water, these early Midwestern railroads provided outlets for farms in the interior of these states and connected the Great Lakes with each other and the Mississippi River system. Ohio railroads linked Lake Erie with the Ohio River; the Michigan Central linked Lake Erie with Lake Michigan, and the Illinois Central linked Chicago with the Ohio. The Chicago, Burlington and Quincy linked Lake Michigan with the Mississippi River itself.

During and after the Civil War, railroads pushed across the continent to the Pacific. And Boston investors were prominent investors in the trans-continental railroads. Oakes and Oliver Ames of North Easton, MA, led a group of Boston investors into the Union Pacific, earning fabulous profits which in turn generated a famous Congressional investigation into their propriety (Fogel, 1964). These investors differed from their New England predecessors in railroads by the source of their capital. Industrialization had progressed in New England by the Civil War to generate profits in a variety of activities, not simply trade or cotton. The Ames brothers were manufacturers of shovels and tools.

These new investors joined the older New England investors led by Forbes in the construction and financial manipulation of western railroads. New Englanders were presidents and major investors during the 1870s (and beyond) of the Union Pacific, the "Burlington" (as the C. B. and Q. was called), and the Atcheson, Topeka and Santa Fe. Through the latter railroad, Boston investors were instrumental in the development of Kansas after the Civil War (Johnson and Supple, 1967).

The accounts of these large investors, operating through established financial markets, should not blind us to the investments of myriad smaller investors. For these railroad financiers represented only the tip of a large investment iceberg. There were many investments in smaller firms and industries, and in smaller New England cities and towns, that are an equally important part of New England history. These smaller, local investments were financed largely by banks. Banks in the nineteenth century were not like banks today, and their behavior during the mid-nineteenth century was an important factor in the Industrialization of New England. Banks were precluded from engaging in inter-state activity and even from having branches at that time. The result was that there were very many small banks. In 1830, there were 172 banks in New England; by 1860, 505.

The New England banks were knit together before the Civil War in the "Suffolk System." Banks were able to issue their own notes, which were like cashier's or certified checks are today. That is, they were liabilities of the bank itself, not of individual depositors. Checks, which are individual rather than bank liabilities, were not used widely until late in the nineteenth century. Banks promised to pay specie, that is, gold or silver coin, for their notes on demand.

One problem that arose in this system was how large reserves of specie a bank needed to

have to redeem its notes. The bank did not earn any interest on specie, and it had an incentive to issue as many notes as it could on the basis of whatever specie it had. It had the incentive to hope that holders of its notes would not bring them back to the bank--and to issue many, many notes as a result. The Suffolk Bank in Boston, founded by the same men who had founded the cotton industry, set out to offset this natural inclination of other banks (Dalzell, 1987, p. 95f). The Suffolk Bank offered to redeem the notes of any New England bank, not just its own, at par. Since many bank notes traveled to Boston in payment for goods made or imported in the city, the Suffolk Bank had many takers on this offer. It then went to individual banks, asked them to maintain deposits at the Suffolk Bank, and threatened to bring large bunches of notes back to the banks for redemption without warning if they did not. The banks complied, and their notes circulated at or near par throughout New England as a result.

Notes are bank liabilities; the most important bank assets are loans. These were the investments that financed the expansion of industrial activity throughout New England. And loans from New England banks in the mid-nineteenth century most often were made to the banks own directors. Instead of the arms-length banking that we know today, New England banking at that time was dominated by "insider lending." Bank directors were not running what we now call a financial intermediary, they were raising capital for themselves.

How could this be? Such a system is ripe for abuse. There does not appear to be any reason for a person not related to the bank directors to deposit money in the bank. And yet banks multiplied and grew throughout New England. The key to understanding this paradox is that this "insider lending" was attractive to the banks' depositors and investors. They knew who the bank was lending to, and they were willing to make loans on the directors' reputations.

Instead of deposits, banks raised their capital in the form of shares; people held bank shares instead of bank deposits. Unlike today's banks in which capital is a minor liability, New England banks had roughly half their liabilities in the form of shares, that is, bank capital (Lamoreaux, 1994, p. 65). People were investing in banks as a way of investing in the enterprises started and operated by the bank directors. The banks were more like an investment club than a bank of today.

Bank investment then provided a way for entrepreneurs to tap the savings of New Englanders for industrial investment. Bank directors were constrained from abusing this system by other bank directors and by the social pressures of the towns in which they lived. A small industrialist lived on his reputation, and he generally--not always--wanted to maintain his reputation to be able to borrow again in the future. The multitude of banks meant also that banks were competing each other in the sale of bank shares, and this competition created another incentive for directors to restrain themselves to good business practice (Lamoreaux, 1994).

Banks loaned to directors (and others) in one of two ways. The first was commercial paper, used to finance trade. Cotton from the mills of Lowell often took a year to sell in some distant city. The cotton mill would use commercial paper from a bank to borrow money to hold these goods in the long interval from manufacture to sale. Other products had similar delays, although probably not as long since they were not made in New England for the whole country. The second way a bank loaned was with accommodation loans, which had no specified use. These loans were used to finance production and the expansion of factories. Nominally written for three or six months, accommodation loans often were renewed over and over again to become long-term loans in the guise of short-term notes.

This system worked well in the years surrounding the Civil War, but it was breaking down by 1880. New England had become more integrated with the rest of the country, and investments were being made further from any bank's location. The role of reputation was diminished in the arms-length business of making loans at a distance. Most loans no longer went to directors, and the network of information that had made bank shares desirable before could not operate on a regional or national scale. Banks suffered as well in the depressed conditions that followed the financial crash of 1873, and the system of "insider lending" that had been so useful for New England faded away.

Although the banking system worked well over the whole period surveyed here, it had problems in the short run. There were bank panics periodically as people became frightened about the safety of their banks, most notably in the 1830s and the 1870s. The problem of the 1830s began far away in China in the same conflicts that led to the Opium Wars and drove China merchants to invest domestically. As a result of the conflict, Americans traded less with the Chinese, and the silver normally sent to China to pay for silks and tea stayed in the United States. This silver then entered into the monetary base of the United States, that is, was added to the existing specie reserves of banks. Banks could issue more notes and make more loans as a result, and prices rose sharply in the 1830s.

As prices rose, so did imports as they became cheap relative to goods produced at home. The United States financed these added imports by borrowing from England, the preeminent capital exporter of the nineteenth century. In 1836, the Bank of England became alarmed about the amount that British merchants were lending to America and raised its discount rate in an effort to stop the lending. The Bank of England was successful, but the strain of this contraction-

-not unlike the reduction of loans to Thailand, Korea and Indonesia in 1997--led to massive bank failures and then deflation in the United States. The end of the 1830s and beginning of the 1840s were difficult times for American banks and businessmen (Temin, 1969).

The American economy was far different in the 1870s. Railroads had tied the country together, and the extension of railroad investment created an opportunity for fraud. These investments were made over long distances on a national stage where the reputational constraints of New England banks was not operative. A speculative bubble burst in 1873 involving Jay Cooke, a prominent financier of the Civil War, and banks failed again. As in the 1830s, bank failures were followed by deflation and economic difficulty, although the pace of economic growth hardly faltered in the 1870s.

The railroad and the telegraph had knit the regions of the country closer together in the half-century surveyed here. Cotton goods, shoes, and revolvers were exported from New England by railroad, and capital was sent from New England to the West by telegraph. Railroads remained the dominant means of overland transport for another half century, but the telegraph began to be supplanted by the telephone in the 1880s. On April 25, 1877, Alexander Graham Bell went to Lowell to demonstrate his new invention. He tapped his telephone into the telegraph wire to Boston where his assistant was waiting. On Bell's order from Lowell, his assistant transmitted "America" and other patriotic songs back to Lowell (Dugan, 1976, p. 249). It was a fore-runner of the next stage in the economic history of New England at the birthplace of the stage just ending.

Figure 1

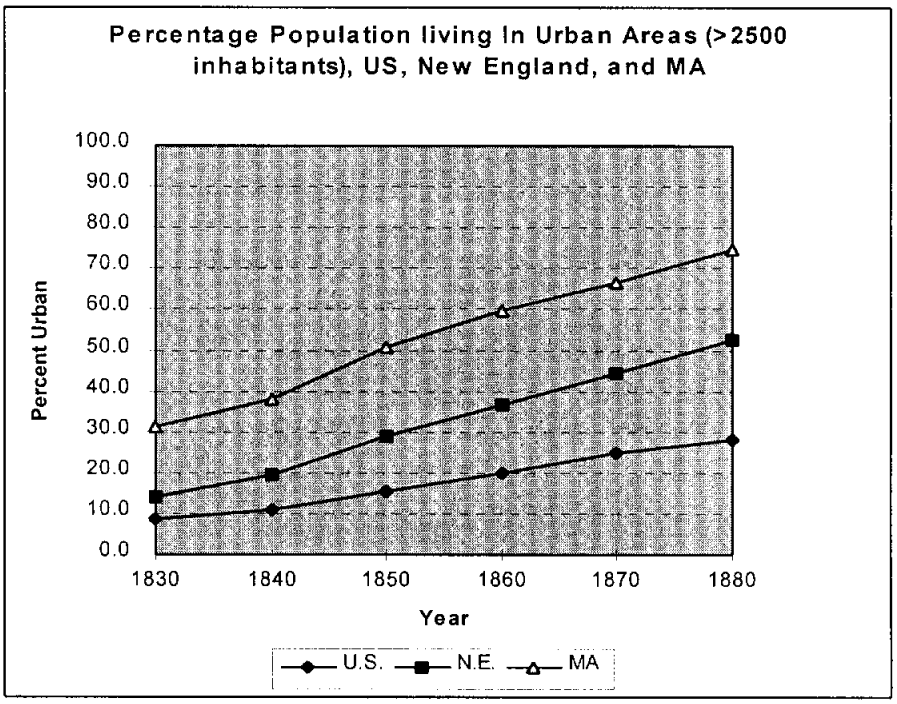
Percentage Population living In Urban Areas (>2500 inhabitants), US, New England, and MA
Percent Urban
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1830
1840
1850
1860
1870
1880
Year
U.S.
N.E.
MA

Table 1

Cotton Textile Output

(millions of yards of cloth, percent)

	1831		1860		1880	
	million yards	share (percent)	million yards	share (percent)	million yards	share (percent)
MA	79	35	415	36	971	43
RI	37	16	148	13	264	12
NH	29	13	152	13	244	11
NE	163	71	857	75	1813	80
US	230	100	1148	100	2273	100

Sources: Temin (1988); U. S. Census (1865), p. Xxi; U. S. Census (1883), p.

Table 2

Occupational Distribution of Wage-Earning Women in Massachusetts

(percent)

	1837	1870
Palm-Leaf Hats	49	-
Textiles	17	26
Boots and Shoes	14	5
Domestic Service	12	34
Teaching	4	5
Men's and Women's Clothing	3	18
Other	1	12

Source: Dublin (1994), pp. 20, 22.

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