PROCESS AND SUPPLY CHAIN EVOLUTION IN THE AMERICAN COTTON TEXTILE INDUSTRY

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ABSTRACT

Three major periods of change occurred within the American cotton textile industry from 1830 to the present: process evolution, growth and fragmentation, and consolidation. The infant industry in New England developed rapidly based on marked improvements in process technology. Following the Civil War, the nature of the industry’s markets changed from make-to-stock to make-to-order, resulting in a proliferation of mills in the southern states. In the twentieth century, the American textile industry underwent a period of consolidation, and experienced a degree of competition from foreign imports unprecedented in its history. However, many American firms continue to mimic the strategies which succeeded in earlier times, and have been unable to respond to the new criteria for success. Moreover, American firms have still not adapted

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to the fragmentation in its primary markets and channels of distribution which occurred at the turn of the century, while foreign competitors have been quick to develop strategies aimed at niche markets and solutions through advanced process technologies. This study examines the development of the American textile manufacturing industry, with the theme being that success in textile manufacturing is not determined by low wage rates.

Like many industries in the twentieth century, the textile industry has undergone drastic changes in the form of booms, stagnation, changing markets and increased global competition. Perhaps one of the most noticeable changes has been the relocation of an entire industry from its origins in New England to the southern states in the decades following the Civil War. Although the roots of the southward movement of the textile industry is often cited as the lower cost of labor in the South, many other forces were at work in inciting the changes. Today, this industry continues to shrink, due to major inroads being made by foreign competitors from Europe and the Pacific Rim. Despite advantages such as the proximity to raw cotton production and an established modern industrial base, the southern textile industry is steadily losing ground to overseas competitors. As in earlier periods of change, the primary reason cited for this relocation of the industry is the advantage of labor costs, which are typically lower in developing countries.

Although these premises have become popular in textile history, the facts generally fail to support them. This essay seeks to develop
a set of alternative explanations for the lack of sustained competitiveness by U.S. textile firms, by examining the pattern of industrial development in the period from 1830 to the present. We begin by describing the origins of the industry in New England, where the early mills excelled at improving productivity and enjoyed a period of sustained expansion and growth. Within these early water-powered mills, a series of ingenious technological process innovations significantly boosted both the output per spindle and quality of cloth produced in a matter of 50 years. The Civil War marked the end of this period of prosperity, bringing with it the blockading of Southern ports and a resulting cotton shortage. Following the war, a series of changes in both the market structure for textiles and the limits of the technology itself bred the dissolution of the New England mills and the movement of the industry to the South. The next transition in the industry was a process of consolidation and modernization, which focused on a traditional cost-reduction strategy aimed at increasing levels of imports from low-wage developing countries. However, this industry structure has proven itself unable to compete with foreign competitors, especially in domestic American markets.

Within the context of these events, the essay seeks to show that the primary reason for the lack of sustained competitiveness was not wage rates, as is commonly believed, but a lack of flexibility. Specifically, firms in the southern textile industry have continued to attempt to mimic the early successes achieved by their New England counterparts, by focusing on economies of scale through large runs of standard product. These policies have continued despite increasing signs of fragmentation in apparel markets which
began in the early part of the twentieth century. During this period apparel markets began to demand increasing variations in product types and volumes, with the result that a significant mismatch between the dominant processes evident in the American textile industry and the nature of their primary markets emerged. This gap was filled by foreign competitors, who became adept at quick changeovers, smaller runs, and increased responsiveness to market changes. The events leading to this current state of textile manufacturing in the United States are first described by examining the early evolution of the industry, its movement to the south, and finally in comparing recent data from domestic and foreign textile manufacturers.

I

Early American cotton manufacturing: the move from the the home to the factory

Prior to 1807 and well into the 1840’s, the majority of cotton cloth in America was produced by weavers and spinners who lived near or above their shops. Many merchants would purchase materials such as yarn or cloth and deliver them to workers in their homes, pick up the article upon completion, then sell it outright or on commission to other merchants. Most of the spinning and weaving of cloth was done by hand, and simple machines were used for carding. Between 1807–1815, the British placed embargoes and

2) Much of the information used in the section on process technology in New England was collected by the author through interviews and brochures provided by the Lowell National Historical Park and the Lowell Heritage State Park, 169 Merrimack Street, Lowell, Mass., in March 1992.
trade restrictions on cotton cloth, cutting off imports of thread and cloth. Rather than depriving consumers, this action only served to give birth to a strengthened textile industry in America! Because of the rise in demand and the growing American population, entrepreneurs convinced workers to move into central shops from their homes in order to consolidate production\textsuperscript{3}. These factories were the first manufacturing organizations in American history to employ more than 50 workers. The workers consisted chiefly of local families: children tended the machines while adults did much of the heavy work. By 1809 there were 62 spinning mills in operation. Weaving was still largely restricted to “putting out” in homes, as before.

In 1813, Paul Moody and Francis Lowell built a power loom based on Lowell’s recollections of models he had observed on a trip in 1810 to Britain’s textile mills. This early example of “reverse-engineering” is remarkable, in that Lowell was able to reconstruct the loom purely from memory\textsuperscript{4}. The first mechanized weaving operation was installed by Lowell on the Charles River at Waltham, Massachusetts. He also combined this operation with a mechanized spinning operation, creating one of the first factories which integrated these two distinct processes under one roof with a full-time workforce paid not in supplies, but in cash wages. To build and repair the machines, another full-time workforce was employed to operate an in-house machine shop. These elements eventually evolved to become the Boston Manufacturing Company. After seven years of operation, the stockholders of this company received more


than 100 per cent return on their investment. By the end of the
decade, others had built similar mills on the Merrimack, Connecti-
cut, Passaic, and other surrounding rivers.\(^5\)

The location of such mills was determined primarily by their
source of power: moving water. The predominant choice of location
in the early 1800's was therefore southeastern New England, which
had a proliferation of small streams ideal for powering such mills.\(^6\)
These mills grew to become the ten largest corporations in the
United States at that time, capitalized at between $600,000 to
$1,000,000.

The largest congregation of mills was on the Merrimack River,
in a new town called Lowell (named after the same Lowell who
had devised the power loom). The first of these establishments,
formed in 1821, was the Lowell Manufacturing Company and the
Lowell Machine Shop, which became one of the country's largest
manufacturer of textile machinery. Initially, the water of the
Merrimack was diverted into the Pawtucket Canal, providing over
12,000 horsepower sufficient to power over 140 mills. As a number
of other mills set up operations in this location, including the
Suffolk Mills, Lawrence Mills, Hamilton and Appleton Mills, Boott
Cotton Mills, and the Massachusetts Mills, a number of supplementa-
ry canals were added to power the other mills, forming the first
industrial mill community. In other locations throughout New
England, the advantages of cheaply developed water power and
the ease of transportation provided by the tributaries was augmented
by the suitability of the climate for textile manufacture. Because


the Gulf Stream approached near enough to the North Atlantic coast, this prevented extremes of heat and cold and contributed humidity to the atmosphere. These conditions were ideal for cotton manufacture, and was influential in promoting industrial expansion in this vicinity. Although mechanical water power was later replaced by steam and hydroelectric power, the working turbines in some of the Suffolk and Boott mills in Lowell have been preserved and can still be observed in motion today.

Within these early mills, process improvements focused on expanding output and improving productivity. For the first time, all the processes of production were integrated under one roof. Water from the canals was diverted into a long cylinder which dropped about 13 feet and turned several large turbines. The turbines operated a gearing mechanism which turned a large central wheel. This wheel transmitted power through a system of leather belting to all the weaving and spinning operations on different floors of the mill\(^7\). Throttle-spinning and later ring-spinning frames replaced the slower mule spinning technique, which nevertheless continued to be used well into the twentieth century\(^8\).

The integration of the spinning and weaving processes under one roof, combined with investments in faster and newer technology such as throttle-spinning and ring-spinning frames, dramatically increased the velocity of output by over 50 per cent during this period\(^9\). An ingenious plant layout evolved as innovative changes within each stage of the operation took place.

\(^7\) Lowell National Historical Park and the Lowell Heritage State Park, Lowell, Mass.


\(^9\) Ibid.
Raw cotton in 500 pound bales were received on the bottom floor, and were picked and cleaned by machines to remove dirt which accumulated during travel. The cotton was then "lapped" onto wooden cylinders and carded in a drum into long straight rows of fiber "slivers". These slivers were stretched out in a "drawing" machine into still longer and thinner "rovings" of cotton. The rovings then went by elevator to the second floor, where they were spun into yarn on mule spinning or ring spinning machines.

The yarn was subsequently dressed-sized, brushed, and dried, and wrapped onto a lap or heavy bobbin, while the fill (undressed yarn) was wound on a different set of bobbins. The "dresser" was responsible for warping the thread, which consisted of putting up to 1300 threads from spools onto a "beam". This setup time took about an hour for each beam, and as such, production runs had to be in large enough quantities to justify the long setup task. The dresser had to be familiar with the style and type of cloth to be woven, as the method and technique of warping determined the pattern of cloth. The warp (dressed yarn) and the fill was sent to the third floor, where weaving machines wove the yarn into cloth. The weaver was responsible for watching over 2 looms (up to 1840) which wove the threads into cloth. The power loom consisted of two brackets which separated the thread into two planes forming a "shed". This machine could produce up to 70 yards of cloth per hour (about two inches every 15 seconds). Should a thread break, a run in the fabric was formed, (considered a defect). The solution in such cases was to tie the thread before the run became too large. The cloth was then moved to a different floor where it was dressed, then sent to the cloth room where it was trimmed,
measured and folded. Some of the cloth was subsequently bleached, dyed, and/or printed\(^{10}\), before packaging and shipping.

The role of plant manager was carried out by an individual known as the "mill agent". This person maintained close contact with the overseer on each floor and was able to watch over the flow of materials between floors. James Montgomery, a textile manager at an American mill of the period, describes the agent as an expert with a "thorough knowledge of the business in all its details"\(^{11}\). This agent was almost wholly concerned with the processes of production, and had to be adept in regulating the speed of the machines, in making changes to the qualities of the cotton and size of the yarn, and in repairing machines when required.

Responsibility for the output, quality and style of the cloth was usually the duty of the "selling agent". The selling agent was also responsible for all decisions regarding the procurement of cotton, since the grade of cotton purchased was a factor in determining the quality of cloth produced. These selling agents represented a simple and direct interface between market demand and production scheduling. Customer orders were directly transformed into purchase orders for cotton and subsequently into planned production. The types of cloth produced were somewhat limited, however, by the processes available to manufacture them. Moreover, almost 80 percent of cloth produced during this period was considered "staple", whereas special knits and wovens during this period were more often imported from Britain. This degree of standardization within the domestic and international market made the job of the selling

\(^{10}\) Chandler, *Visible Hand*, 68.
\(^{11}\) Ibid., 69.
agent much easier, as the majority of cloth could be produced on a ‘make-to-stock’ basis.

The outbreak of the Civil War brought an increase in excise taxes on a series of operations in New England. Thus, cloth which was spun, woven, dyed and finished in the same factory was taxed only once, while otherwise identical goods made by independent establishments were taxed three times. These taxes had the effect of encouraging the further concentration of production in the larger establishments, and reducing the amount of work distributed to independent shops. This period of consolidation led to still greater degrees of mechanization.

II

Civil war and growth in the south

Up until the Civil War, the southern states produced the majority of the industry’s supply of raw cotton, shipped by boat to British and New England ports for manufacture. The bulk of cotton purchases were from southern plantations, which generally had fewer than 100 slaves. After 1850, the processes of agriculture were changed by new technologies which eliminated the labor intensity of cotton picking. When the South seceded, major ports such as Charleston, South Carolina, were blockaded by the Federal navy, and the major global source of raw cotton was cut off. This had a disastrous effect on Great Britain’s textile industry, while the Northern states somehow managed to survive the shortage. Overproduction occurring due to the rapid expansion of productive

13) Ibid., 100–107.
capacity prior to the war had increased inventories of finished cloth. In addition, American spinners had anticipated a short crop the following year, and had increased their inventories of cotton\textsuperscript{14}, which were sufficient to last for the first year of the war. Near the end of the war, however, New England manufacturers began to import cotton from India, China, and other cotton-producing countries. The cotton shortage also provoked efforts to adopt processes that reduced waste in the manufacture of cotton products. These efforts were described by a New England spinner, who noted that:

\begin{quote}
It is remarkable how well some of us succeeded; and this success during the high price of cotton strongly tempts us to continue working waste, even when the price of cotton becomes moderate\textsuperscript{15}.
\end{quote}

The cotton shortage also provoked product innovation within the mills. The development of “fibrilia”, a cotton-wool blend, was used for some time, and the substitution of woolen and linen cloth for cotton became more commonplace.

Despite the shortages, several firms maintained their work force for the duration of the war. For instance, in Lowell in January of 1864 not a single cotton spindle was in motion\textsuperscript{16}. In anticipation of the expected demand which would occur after the war, mill owners were rebuilding and enlarging their establishments using the existing workforce. The manufacturers to some extent felt an obligation to support their hands and get some return for doing

\textsuperscript{14} Ibid., 27.
\textsuperscript{16} \textit{Scientific American}, Vol. X, No. 19, Jan. 9, 1864.
The manufacture of hosiery, wool, and other knit goods was encouraged by the heavy demand for these items to support the Northern armies, and promoted heavy expansion in these textile industries. Wool was procured in large quantities from Australia, Argentina, and Canada. Again, the net effect was the concentration of these industries in the New England states.

The Civil War had a disastrous effect on southern industry. The naval blockades hindered the procurement of materials needed to supply their armies. The major resource lacking in the south during this period was mechanical equipment, skilled labor, and other requirements for large scale manufacturing integration. As a result the majority of southern textile production during the war occurred in small factories and in households. The state of material procurement was opposite to the situation in the north. A major shortage of wool occurred, and factories were forced to substitute cotton or a variety of bizarre fibers, including a combination wool-cowhair fiber. In some cases, wool products were stripped from domestic households for use by the armies.

Near the end of the Civil War, a significant portion of southern textile capacity was destroyed by federal raiders such as Sherman and Grant. Much of the cotton machinery remaining after the raids was either worn out or irreplaceable. Labor was also scarce, as the working population had been severely depleted by the drafts.

18) Ibid., 41.
22) *The Index*, Vol. IV, (May 12, 1864), 301.
Following the war, the south gradually recovered from its state of depression and began the substitution of paid for slave labor. The cotton trade was dislocated for a short while, followed by a period of re-development of railroad and telegraph networks, and the emergence of efficient markets and systems of distribution\(^{23}\). The first cotton exchange was formed in New York in 1869, followed by another in New Orleans in 1871. Much of the re-development of southern industry occurred entirely in the vicinity of the cotton fields, in the states of Virginia, Tennessee, the Carolinas, Georgia, Alabama, and Mississippi. Small mill villages sprang up near the fields, which used primarily local white labor in producing cotton cloth. Despite the increasing numbers of spindles in the south, northern manufacturers were skeptical as to the possibility of establishing a successful large-scale industry in the cotton states, and believed the southern spinners were handicapped by an unfavorable climate, high rates of insurance and interest, and careless, apathetic, and indolent employees, who made labor costs higher than in New England\(^{24}\). Nevertheless, the number of spindles in the south continued to grow in the now highly price-sensitive cotton textile market. Southern cotton farmers began to view the manufacturers with a less hostile eye than before, as the number of mills in this region continued to grow into the twentieth century\(^{25}\).


\(^{24}\) Ibid., 401.

\(^{25}\) Ibid., 417.
III

*Industry fragmentation and southern dominance*

Following the war, the New England states of Massachusetts, Rhode Island, New Hampshire, Pennsylvania, Connecticut, and Maine continued to dominate, spinning almost 75 per cent of the national cotton manufacture\(^{28}\). Although there were no major improvements in textile machinery during this period, smaller improvements such as smaller wooden bobbins increased the efficiency of production\(^{27}\). The growth of cotton manufacturing resulted in a decline in prices, which led to further cuts in wages\(^{29}\), some as large as 25 per cent. An increasing proportion of worldwide cotton spinning began in Asia during this period, although production growth was checked by the recession in 1873.

Continuous improvements in American spinning machinery such as the frame spindle further increased the speed of spinning cotton. Electricity was introduced to cotton mills, replacing gas and petroleum lighting. Electricity was also used to power the elevators in the multi-level mills. During this period a significant change in mill layout occurred which still prevails today\(^{29}\). Heavier machines at higher speeds were more adaptable to one story buildings, which were also safer for employees and were cheaper to heat, light and maintain\(^{30}\). In some cases, the new mills were built across streams with the wheel at the center and a line of shafting extending 100

\(^{26}\) Ibid., 101.
\(^{28}\) *Scientific American*, Vol. XVII (July 20, 1867).
\(^{29}\) Clark, *History of Manufactures*, 388.
to 150 feet in either direction. Later, water power was replaced by steam using the same arrangement. With the introduction of turbine water wheels and high-power steam engines, restrictions on ground area were eliminated, and longer lower spinning and weaving rooms evolved\(^{31}\). These changes were the first in a series of events which would permanently alter the nature of the American textile industry.

By 1878, the first union of cotton workers was formed in New England in response to a series of wage cuts. Over the next three decades, a string of strikes and labor disputes occurred in all of the New England mill towns. In 1912, striking workers were granted a 10 per cent wage increase. Shortly after World War I, profits of the manufacturers suffered increasingly from competition from the southern textile mills, many of which were built by the same companies owning mills in New England. At the same time, the quality of cloth made in the New England mills began to decrease. An English expert reported that the fabric made in the United States were inferior to those of Lancashire, and that there were as many faults in one yard of American cotton as in a whole piece of English cotton\(^{32}\). Between 1929 and 1957, all of the mills were shut down, and cities such as Lowell slid into a period of economic decline.

The movement of the textile industry after the Civil War from New England to the southern states is a well-known fact in Ame-

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\(^{33}\) C. T. Murchison, *King Cotton is Sick* (Chapel Hill, NC, 1930), 29.
rican business history. This rapid nature of this transition during the years of 1880–1929 are shown in Figures 1 and 2\textsuperscript{33}). By 1890, the south spun nearly one-fourth of all the cotton manufactured in the country. During the period from 1893 to 1914, the thirteen southern states had increased mill consumption of cotton by 400 per cent, while the rest of the country had increased cotton consumption by only 57 per cent\textsuperscript{34)}. By the end of this period, cotton consumption in the southern mills (3 million bales) had surpassed the northern mills (2.5 million bales).

The new mills congregated in cities such as Charlotte, North Carolina, Greenville and Columbia, South Carolina, and Atlanta, Georgia. A number of these mills were branch establishments of the New England mills, such as those established by the Massachusetts mill, the Dwight Manufacturing Company, and the Merrimac Company. The southern advantage during this period was primarily in the production of coarse plain fabrics for export. Conversely, the northern mills converted more and more to the production of fine cloth, such as prints, twills, satins and fancy woven, napped and pile fabrics. Several major process improvements in weaving were also implemented at a quicker rate in the southern mills. The Northrop loom embodied two major changes: a filling-changing mechanism which automatically replaced exhausted shuttles, and a perfected warp-stopping device that stopped the loom instantly when a single warp thread broke\textsuperscript{35}). The improvements also enabled a single worker to attend up to twenty-four looms instead of eight.

\textsuperscript{34)} Manufacturers' Record, Vol. LXVI, (Sept. 17, 1914), 39–49.
A common explanation for the industry transition during this period is the advantage of lower wages and operating costs prevalent in the south. While this may have been true to a certain extent at the turn of the century in the case of the coarser fabrics, there existed several studies by the end of the 1920's which disputed this claim. For instance, a study by Paul H. Douglas of the University of Chicago in 1930 found that the rate of growth in the wage rates of cotton compared to other industries was not significantly different. Another argument cites that wage differentials were compensated for by the fact that the bulk of the cloth produced in the south during the 1920's was coarser and of a lower quality (i.e. sheetings, print cloth, shirtings, gingham, denims, and drills), whereas the fancy voiles and crepes produced in New England required highly skilled workers who merited the higher wages. Further, when the average number of hours per worker, the southern rent gratuity, and the higher cost of living in the north were accounted for, the wage differential was almost negligible for the year of 1928. Surprisingly, freight charges on both raw cotton and finished goods were not appreciably lower for the two regions, providing no advantage for the south in terms of proximity to cheaper raw material. Differences due to the cost of power and lower taxes in the south were also not appreciably higher.

36) P. Douglas, Real Wages in the United States (New York, 1930), 205.
37) Murchison, King Cotton is Sick, 18.
38) Ibid., 36-40.
40) G. S. Harris, The Textile World (July 23, 1927).
In fact, the southern movement of the cotton textile industry was an indirect response to a fundamental shift in the apparel market. Merchant converters, located in New York’s Worth Street, were increasingly demanding a greater variety of cloths due to the increasing fickleness of the fashion industry. Prior to the First World War, at least 80 per cent of the industry’s output was “staple” in character, in that few variations in the characteristics of these cloths existed. Following the war, only about 20 per cent of textile products were considered staple. Decisions regarding the thickness, weight, fragility, sheerness, colors, surfaces, and patterns of textiles required were all made within the bottleneck of firms in the New York fashion industry at a rapid and decisive rate. Once made, such decisions then passed through an increasingly fragmented network of middlemen, including yarn merchants, merchant converters, industrial consumers, commission men and brokers, wholesalers, cutting trades, and retailers (see Figure 3)\(^\text{41}\). Each of the entities shown in Figure 3 operated independently, and in so doing increased the chaotic and speculative nature of transactions within the distribution network. Each transaction by independent merchants suddenly became fraught with uncertainty and risk.

In this chaotic value-chain, the first problem occurred between the yarn and cloth producing stage. Mills during this period were equipped to produce only one general classification of yarns, due to the inability of the technology to accommodate changes in the quality and count of the yarns produced. This required the maintenance of a specialized group of yarn merchants and brokers who

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41) Murchison, *King Cotton Is Sick*, 51.
Figure 3 - Value Chain in the American Cotton Textile Industry (Murchison)
provided the knitting and weaving mills with the type of yarn favored by markets during that season\textsuperscript{42}. These markets were often highly speculative, leading to a code of trade practices issued by the Cotton Textile Institute in 1927. Nevertheless, this code did not ease matters.

Further down the distribution network were the converters, who purchased the "gray" goods and who ordered the actual styling carried out by a group of "finishers". This position was likewise laden with peril, since converters who purchased materials from mills in advance of orders assumed a greater degree of risk, due to the fluctuating price of cotton which was wildly erratic during this period\textsuperscript{43}. Since cotton constituted at least two-thirds of the cost of manufacture, this led to greater use of hand-to-mouth and hedging practices at different levels within the network. For instance, in the case of a marked shortage in cotton, prices would rise, sending the mills to buy up any cotton available and enlarge the output of cloth. Converters, jobbers, garment manufacturers, speculators, and large buyers would then rush to place orders for goods before the price advances reached their maximum, resulting in overloaded warehouses and inflated inventories. This would then lead to a reverse price movement, and still more erratic swings in production and orders\textsuperscript{44}.

The net effect of these changes was that the entire cotton textile industry changed from one which was previously "make-to-stock" to one which was largely "make-to-order". The manufacturing

\textsuperscript{42} Ibid., 52.
\textsuperscript{44} Murchison, \textit{King Cotton Is Sick}, 74–75.
base was ill-prepared for such a change. The lack of flexibility within the manufacturing infrastructure to adjust first to the changing requirements in the type of cloth manufactured, and second to the fragmented market and distribution channels which were maladjusted to the erratic cost of cotton, led to a situation of over-production. While the flexibility in clothing markets continued to increase, cotton manufacturers were unable to respond in the same fashion. This in turn led to an increasing number of small independent mills starting up in the south, each focused on producing a narrow style of cloth prevalent in the market at the time. Since the startup costs for a mill during this period were not extreme and the costs of capital fairly reasonable, a large number of entrepreneurs built mills with high hopes of finding a niche in an ever-changing market. Such efforts were doomed for failure. As Dr. Murchison pointed out in his study of 1930, the new, small mills

...cannot produce a product which is unique, they cannot use machinery which is not standardized, they cannot resort to methods which are not generally known. The only permanent advantage which one spinning mill has over another can scarcely be other than fortuitous in character, consisting of such things as a particularly cheap labor supply, or a low initial cost of construction, or a management which is shrewd in its cotton market operations. ...In general, the closer a group to the final distributing process, the less the degree of danger from those forces over which it has no control.45)

This pattern continued for a number of years into the Second World War. During this period, a greater tendency towards hand-

45) Ibid., 75.
to-mouth buying on the part of jobbers, retailers, and garment makers forced the northern mills to produce in smaller quantities\cite{48} and eventually to shut down their operations.

IV

*Industry consolidation and foreign competition*

Following the First World War, the southern states were manufacturing at least twice the quantity of woven goods produced in New England, including sheetings, print cloth, denims, drills, toweling, ticking, and cotton worsteds. The southern mills continued to produce the coarser cloths which were now enjoying brisk sales in exports to China and East Africa\cite{47}, as well as an increasing proportion of the finer cloths. Demand for cotton rose dramatically during the Second World War and again briefly during the Korean War, but the continual decline in the number of spindles in New England, from 5.2 million in 1940, to 3.2 million in 1949, and to 1.5 million in 1957 spelled final defeat for cotton production in these northern states\cite{48}.

The Second World War prompted an increasing amount of vertical integration within the industry, both forward and backward. The once fragmented industry structure could no longer operate efficiently given the instability and variety of demand, and an increasing number of smaller mills acquired centralized owners during the following two decades. Commission houses, converters and industrial users integrated backwards and purchased mills to

\begin{itemize}
\item \cite{47} Clark, *History of Manufactures*, Vol. III, 188.
\item \cite{49} Jack Blicksilver, *Cotton Manufacturing in the Southeast: An Historical*
insure themselves of a steady flow of cloth as the seller's market became increasingly competitive\(^{49}\). This development was encouraged by the fact that the federal government awarded contracts primarily to those companies which were large enough to produce great quantities of cloth in accordance with specifications and time schedules\(^{50}\). There was also some forward integration, as some cloth manufacturers such as Burlington Mills moved into the finishing field\(^{51}\).

This pattern of increased consolidation continued after the war, partly as a result of the declining consumption of cotton due to the competition of synthetic and other fibers such as rayon and silk in the garment industry. While the quality of rayon steadily improved (i.e. its ability to take dyes, stretch and resist shrinkage), its price advantage over cotton also improved. Rayon gradually increased its relative position in total textile consumption from 13.5 per cent in 1946 to 21.3 per cent in 1955. Other textiles such as nylon and Dacron also continued to make gains\(^{52}\).

In response to these challenges, the cotton manufacturing industry underwent a sweeping mill modernization program in the years following 1945. Opening and picking departments improved, high speed drawing and combing and large package roving frames were introduced, superior drafting systems and mechanical cleaners

\(^{49}\) Analysis, Studies in Business and Economics, Bulletin, Number 5, (Georgia State College of Business Administration, Atlanta, GA, 1959), 153.

\(^{50}\) W. S. Woytinsky and E. S. Woytinsky, World Population and Production: Trends and Outlook (New York, NY, 1953), 1072.


were developed, and larger looms were built. The general trend in this new machinery was toward still higher speeds, labor savings and lower rates of material spoilage. Increased automation and electronics also provided greater and more timely feedback to operators\textsuperscript{53}.

The necessity for technological process revitalization also served to favor the large, integrated producer over the smaller competitors. As the Massachusetts Special commission pointed out in 1950:

> The smaller manufacturer is less able to keep abreast of technical challenges, unprepared to follow the innovations of a chemical or electronic character, and has little or no access to tested information. There is no facility available which would provide him with adequate overall knowledge on the trends within the industry. He must rely on word of mouth, communication and releases through news channels. There are few resources available for aiding him in trying out new ideas and fabrics or in studying the opportunities for new markets. Competition has insulated manufacturers from one another so that they are unable to meet the onrush of technical and commercial change.\textsuperscript{54}

These trends put more and more pressure on the smaller manufactures and increased the speed of consolidation within the industry. Not only were the larger concerns able to garner sufficient capital to adopt the new technology, including research and promotion, but their size also facilitated the development of direct customer relations and opened the door to greater flexibility by enabling producers to diversify their product line and hedge against

\textsuperscript{53} Blicksilver, \textit{Cotton Manufacturing in the Southeast}, 163.

\textsuperscript{54} Commonwealth of Massachusetts, House of Representatives, Document No. 2590, Report of the Special Commission relative to the textile industry and to prevent the removal thereof from the commonwealth, May 12, 1950 (Boston, Mass., 1950), 37.

\textsuperscript{55} Blicksilver, \textit{Cotton Manufacturing in the Southeast}, 166.
the unstable demand mix from year to year. For instance, 42 principal interests in the south owned 419 mills and accounted for 58 per cent of the total southern textile employment by the late 1940's. Between 1945 and 1955 companies such as Burlington Mills and M. Lowenstein and Sons had increased their assets nine-fold through acquisitions, and by 1955 the combined spindles of the four largest cotton textile producers rose from 10.7 per cent of the industry's total to 16.8 per cent. In South Carolina alone, 15 companies employed two-thirds of the textile workers in the state and operated two-thirds of the spindles. By 1988, just over one-fourth of U. S. sales came from the 12 largest producers, led by Burlington Industries, Miliken, and J. P. Stevens. The remaining three-quarters of domestic production came from small and medium-size plants, composed of 450 weaving, 500 knitting, and between 300 and 400 tufting mills, located mostly in the Southeast.

Despite the increased rate of consolidation within the industry, American mills have been unable to respond to the growing numbers of foreign competitors and the increasingly diversified requirements of major apparel markets within the last three decades. Since 1960, American textile firms have experienced a continual reduction in employment and an increasing negative trade balance.

56) Barkin, 406.
58) Barkin, 402.
(see Figures 4 and 5)\(^6^0\). During the period of 1974 to 1984, imports of cotton fabrics climbed from 267 millions to 463 million pounds, while U. S. exports dropped from 70 percent (to 65 million pounds). Apparel imports have gone from 2 percent in 1963 to 50 percent today\(^6^1\).

In response to this barrage of imports, the United States established an intricate set of quotas and tariffs known as the Multi-Fiber Arrangement (MFA) in the early 1980's. The U. S. quota system separated textile products into 75 different categories, which imposed tariffs of up to 25 percent on textile and clothing. Nevertheless, imports of most quota items rose at a rate of more than 6 percent per year between 1981 and 1986, largely because foreign competitors were quick to develop new fibers which had not yet been categorized. Other developed countries were quick to adopt protectionist policies as well. European quotas between 1981 and 1986 reduced imports by 5 percent overall. In Japan, tariffs were much lower than those in the United States, but a network of informal but tight links among the various segments of that industry made it very difficult for foreigners to penetrate the market\(^6^2\). These "hidden" bureaucratic barriers appeared to be very effective during the 1980's.

Nevertheless, it is apparent that stronger import policies have

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62) Ibid., 293.
Figure 4 - Employment - U. S. Cotton Textiles

Figure 5 - U. S. Trade Balance - Textiles
not been the key to industry growth in the modern era. Countries such as West Germany and Italy which have experienced high import penetration continue to enjoy successful market growth, and exports have risen during the 1980's. However, these exports are aimed at niche markets, which include high value-added products, in which design, quality, and rapid adjustment to fashion trends is critical. For instance, companies such as Italy's Tessile and Japan's Melbo have adopted niche production strategies aimed at increasing their flexibility to accommodate smaller lot sizes and quicker changeover times. This has allowed these firms to be more responsive to fashion trends, and Melbo is planning for the day when customers can submit a special order specifying the fabric, size, style and delivery date for a suit! This has been accomplished largely through intensive automation strategies which focus on greater worker education and product and process development.

In contrast, the U. S. modernization programs tended to focus on investing in large scale equipment, with the goal of cost reduction rather than increased flexibility. These systems were designed to eliminate labor content and produce large runs. For instance, the Textile/Clothing Technology corporation is focused on automating individual operations with larger production runs. Production runs at firms such as Milliken and Dan River were 12,000 to 20,000 yards, compared with typical lot sizes of 3,000 yards for export and 1,000 yards for domestic consumption at Japanese manufacturers\(^\text{63}\).

The American textile industry strategy, aimed at competing with the increasing numbers of foreign competitors, has proven

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63) Ibid., 298.
to be largely unsuccessful. While southern mills continued to focus on large scale production of standardized products with the objective of deriving economies of scale, Italian, German, and Japanese firms have focused on small lot production, and on integrating their demand management and logistics planning with the major apparel markets. A survey of textile firms in 1988 revealed some of these differences\(^{64}\). Selected data from textile firms in the U. S., Europe, Korea, and Japan were collected and are shown in Table 1. The large size of the American firms is apparent, a result of the consolidation which took place in the previous two decades. However, the dysfunctional nature of the low-cost strategy is evident when comparing the ratio of sales to employees across firms from these countries. U. S. firms have fallen far behind all three countries in productivity, and are running far below their potential capacity, despite the increased investment in labor-saving machines. In addition, the need for reinvestment in modern flexible equipment is apparent in comparing the ratio of equipment investment per worker. Particularly in the older southern mills, one is likely to see much of the equipment purchased in the post-WWII years, which relies on low-skilled labor for its operation. Finally, the lack of competitiveness is most apparent in comparing net exports as a percentage of sales. European and Korean textile manufacturers are by far the biggest exporters, yet both U. S. and Japanese firms have the lowest percentage of exports. Ironically, these two countries

\(^{64}\) These data were acquired through the Global Manufacturing Research Group, Kenan-Flagler School of Business, The University of North Carolina at Chapel Hill. Details of the survey used in acquiring the data are described in Clay Whybark, and Boo-Ho Rho, “A Worldwide Survey of Manufacturing Practices”, Discussion Paper #2, Indiana Center for Global Business, 1988.
Table 1  International Textile Industry Performance Data (1988)

<table>
<thead>
<tr>
<th></th>
<th>Employees</th>
<th>Sales / Employee (‘000’s $)</th>
<th>Capacity Utilization</th>
<th>Equip $ / worker (‘000)</th>
<th>Exports as % of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>U. S.</td>
<td>667</td>
<td>3.5</td>
<td>76%</td>
<td>0.01</td>
<td>3.5</td>
</tr>
<tr>
<td>Europe</td>
<td>531</td>
<td>23.5</td>
<td>75</td>
<td>0.21</td>
<td>23.5</td>
</tr>
<tr>
<td>Korea</td>
<td>484</td>
<td>36</td>
<td>86</td>
<td>14</td>
<td>39.7</td>
</tr>
<tr>
<td>Japan</td>
<td>72</td>
<td>258</td>
<td>85</td>
<td>106</td>
<td>1.2</td>
</tr>
</tbody>
</table>

have had the strongest import trade restrictions in textiles during the 1980’s.

Another important trend not evident in these statistics is the difference in inter-firm linkages. The American textile industry has never really evolved in its approach to information-sharing within the fragmented distribution network which formed earlier in its history. For instance, one textile-firm manager related a chance meeting with an executive from a menswear manufacturer, who expressed an interest in the mill’s special features and services. The mill’s sales agent had never discussed the mill’s production options with the menswear manufacturer, simply because he considered price as the only order-winner within the market. In contrast, German, Italian, and Japanese textile firms have established informal and contractual relationships between firms throughout the textile value-chain.

A set of interviews with purchasing managers in three southern mills provided three distinct examples of the types of supply relationships which currently exist within the American textile industry: 1) vertical integration, 2) open market bidding and 3) a partnership approach.

65) Made in America, 299.
In the first case, a textile finishing plant was acquired by an upstream spinning and weaving concern in the 1950's. Woven cotton was thus received by the finishing plant from the upstream plant every morning. Despite the close organizational ties between the two operations, the finishing plant manager complained that the relationship was often tenuous and prone to managerial disagreements. For instance, the weaving plant was experiencing a series of production problems, resulting in deliveries of greige cloth of the wrong fiber count and thickness. Another problem was the dumping of woven cloth at the finishing plant when there existed no corresponding customer orders. This had led to a proliferation of inventory at the finishing plant which the plant manager was attempting to reduce. The two entities, despite their organizational linkages, were clearly disjoint in their operations, and were frequently at odds. Further, both plants were focused on producing high volume, standardized goods. Only a minority of the hourly-paid workers in the plant had completed high school, and there existed no training program to further their technical education.

In the second case, a small hosiery manufacturer maintained an essentially adversarial, open market relationship with its suppliers of cotton. Over a dozen suppliers were used, with five suppliers accounting for 70 per cent of the total volume purchased. Several critical quality problems had occurred, yet the firm continued to use the same supply base. No long-term contracts had been established, and suppliers were contacted on an order-by-order basis. The prevalent managerial attitude at this plant was that supply base reduction would expose the firm to the whims of the market, and that cotton shortages would inevitable lead to plant shutdowns.
Nevertheless, the open market policy had resulted in critical delivery problems: deliveries were late 50 percent of the time, often because forecasted requirements were not shared with suppliers in advance. A given supplier, realizing that they were a single source within a pool, had few incentives to improve delivery performance. The workforce and environment was very similar to the first finishing plant described earlier.

Finally, the purchasing manager in a small hosiery mill visited described the plant’s interface with its three cotton suppliers as a “handshake” relationship. Because cotton availability was so critical to plant operations, these suppliers would frequently update their information regarding quality and delivery times on shipments. During a shortage of cotton in the early 1980’s (due to failed crops), the plant was nevertheless able to obtain reserved shipments of cotton. This occurred despite the fact that the plant was a small concern within each supplier’s market, and was a function of the trust developed between buyer and supplier. This type of relationship was also witnessed at a large apparel manufacturer, which purchased large quantities of cotton through approved suppliers and then completed all stages of production. Workers in these environments were observed to be highly skilled, well-paid, and often underwent training programs. These plants had also invested in modern equipment with shorter changeover times, and were able to easily customize their products on short notice.

This latter form of supply relationship has been observed to promote the greatest flexibility in these markets. Many American textile firms are beginning to change, in joining such efforts as the Quick Response Program, designed to improve information
flow, standardize recording systems, and improve turnaround time. The goal of these programs is to cut the typical 66-week cycle from fiber to retail in the United States to 21 weeks. The success of this program remains to be seen.

V

The events described in this paper serve to identify three major periods of change within the American cotton textile industry: process evolution, growth and fragmentation, and consolidation. The first began in the nineteenth century, as the infant industry in New England developed rapidly based on marked improvements in process technology. Despite the downfall of these early water powered mills, there are several notable features which made them unique in the history of textile manufacture. First, they relied on technological innovation, in adopting new spinning technologies such as throstle-spinning, while the less effective mule-spinning machines continued to be employed in Britain well into the twentieth century. Second, the integration of processes was the first effort at promoting speed in operations. The integrated layout, combined with the increased throughput rates of the new spinning and weaving processes, afforded massive improvements in output and productivity, while reducing work-in-process inventories.

The second phase of transition occurred from 1880 to 1930. During this period, the nature of the industry’s market changed from make-to-stock to one which was almost entirely make-to-order, as a result of the trends in clothing retail markets. The inflexibility of the process technology to accommodate these markets, as well as the fluctuating price of cotton during this period, led to frag-
mentation of the supply and distribution networks. This in turn led to an increasing number of small, new, highly focused mills in the south. Ultimately, these changes spelled out the demise of the New England mills.

Finally, the industry entered a phase of consolidation and vertical integration following the Second World War. Nevertheless, over three-quarters of existing mills are small plants of fewer than 100 workers. These mills have increasingly been experiencing stiff price competition from lower wage producers and niche market competition from other developed countries. Responses to this competition have ranged from renewed efforts at vertical integration, open market bidding, and partnering relationships with critical suppliers. The future of American textile producers will surely rely on the efficient management of these linkages throughout the supply chain.

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