Industry Structure and the Marketing of Synthetic Fibers

Amy L. Hardin
University of Delaware

In the decades following World War II, a revolution transformed our material surroundings. A wide range of goods was reformulated using organic chemicals and synthetic polymers. One aspect of this sweeping change, the growth of the synthetic fibers industry radically altered the pattern of American fiber use. While the consumption of all fibers rose, the share of natural fibers declined dramatically, making synthetic fibers ubiquitous. In 1940, the first full year of nylon production, the United States consumed a total of five billion pounds of fibers, of which 10% were cellulosic, rayon and acetate, and less than .1% were nylon. The consumption of all non-cellulosic synthetic fibers outpaced that of cellulosics in 1965 and reached four billion pounds in 1970. In 1980, out of total United States fiber consumption of 12 billion pounds, seven billion were synthetic and only three billion were natural [17]. In addition to vastly increasing the quantity of textile products available, synthetic fibers brought new qualities to and changed expectations of the performance of apparel, home furnishings, and industrial goods. Through synthetic fibers, the chemical revolution touched every life.

The direction and character of the synthetic fibers revolution were shaped by dynamic interaction among three groups: the companies that produced the new fibers and manipulated their properties; the manufacturers of textiles, textile products, home furnishings, and carpets; and consumers and their culture. As part of a larger work that examines this interaction, this paper will focus on the relationship between fiber makers and their textile industry customers and on how industry structure shaped the marketing of synthetic fibers. The new fibers bound integrated and diversified companies in the highly concentrated petrochemicals business to the fragmented and specialized textile trades.

The interdependence of two industries strikingly different in structure opens a number of questions. What were the structures of the synthetic fibers industry and the textile and textile products industry when synthetic fibers were introduced, and how did they change in the following years? How did leading fiber makers' strategies address the challenges posed by textile industry structure? What did fiber makers assume about the textile trades and consumers? How strong were fiber users in the textile trades in the face of an oligopolistic supplier? Here I present preliminary answers to such questions. My working hypothesis is that the synthetic fiber

BUSINESS AND ECONOMIC HISTORY, Second Series, Volume Nineteen, 1990.
 ISSN 0849-6825.

companies shaped their strategies to suit not only their own competitive context but also their desire to counteract the competitive pattern of the fragmented textile trades. During the 1960s intense price competition plagued fiber makers, who weakened relative to their customers in the textile trades. The larger textile firms drew strength from the experience of cooperative product development encouraged by fiber makers. Many marginal producers moved farther from fiber companies' control as stocks of fibers became more available when capacities and imports rose. Applying structural analysis to each industry will bring insights to the study of the life cycle of synthetic fibers.

A highly concentrated oligopoly characterized synthetic fibers manufacture. Concentration ratios from the census of manufactures confirm this concentration. In 1963, 14 companies produced the synthetic fibers most used in consumer goods, nylon, polyester, and acrylic. The four largest firms controlled 94% of total industry shipments by value. Although the degree of concentration declined somewhat over time, in 1977 the top four of 37 firms controlled 78% of total industry shipments [20]. Most fiber makers were petrochemical companies and were vertically integrated upstream from fiber polymerization and spinning, producing their own intermediate and primary materials and often their own feedstocks [15, 16]. As a rule, they did not integrate downstream, in part because of a reluctance to compete with customers and partly from the awareness that the processing of fibers into fabrics and other goods used different technology and skills and did not permit the same economies to which fiber makers were accustomed.

The economies of scale in fiber production existed primarily in the capital-intensive processes of polymerization and spinning [12]. However, the diversified chemical company that produced a large volume of several fibers benefited from economies in other areas as well, such as research and development, engineering, distribution, service, promotion, and sales--what Alfred Chandler and others have called economies of scope. These economies reinforced the high barriers to entry presented by proprietary technology in the early years of synthetic fiber production. Later, economies of scale remained important, although fiber technology became readily available at lower cost and many process innovations became available through licensing. The leading fiber makers dominated the market for a technologically sophisticated product line, in sharp contrast to those farther along in the textile products sequence.

The customers of fiber companies resided in fragmented trades. Fiber producers sold fibers primarily to the fabric-forming trades, including throwsters and spinners, weavers and knitters, thread mills, carpet mills, and the like. However, fiber makers also had to "sell" the performance and desirability of the synthetics to makers of apparel and home furnishings down the chain of production. These trades were far from uniform. In general, the apparel trades were more volatile and fragmented than the fabric-forming trades, and carpets and household products manufacturers were most likely to be vertically integrated. However, they shared certain general characteristics, including specialization and lack of vertical integration, low barriers to entry, and lack of concentration. The

appearance of large, integrated firms did not spur consolidation of whole specialties or integration of the whole industry. Heterogeneity within each specialty in terms of size, ownership, number of units in each firm, and the price level for which a firm produced, compounded the effects of diversity among the trades [19, pp. 12-16; 10, pp. 113-16; 2, p. 13; 3, pp. 132-34].

Concentration ratios from the census of manufactures again provide a rough sketch of the structure of the various textile trades. I surveyed the percentages of the total value of shipments accounted for by the four and eight largest companies in three fabric forming categories and four end-use categories: cotton and synthetic weaving mills; knit fabric; men's and boy's suits and coats; women's and misses' suits and coats; tufted carpets; and curtains and draperies. Some of these trades became steadily more concentrated. In others, the degree of concentration waxed and waned over time. The least concentrated of these trades was women's and misses' suits and coats, roughly representative of other women's apparel classes. The most concentrated sub-industry was the weaving of predominantly synthetic yarns. By 1963, the four largest of 277 firms accounted for 39% of the total shipments by value. This ratio remained little changed through the 1960s and 1970s. In 1977 the four largest of 267 firms accounted for 42% of shipments by value. The largest weavers clearly dwarfed most of their numerous rivals, yet they could not control the market. Other fabric-forming and textile products trades were much less concentrated [20].

The fragmentation of the textile and textile products industries was directly related to the nature of their products and their diffuse markets. Textile products were made to fit every price and income level, every taste and fashion, in every part of the country. This broad and varied market limited the benefits of economies of scale in many textile trades. The vagaries of fashion in apparel and home furnishings called for the manufacture of diverse products and frequent change in product lines. Retailers ranging from small, specialized stores to chain department stores made the link with consumers of textiles and textile products. Their judgments about the market, their patterns of purchasing and distribution undoubtedly created constraints within which the diverse textile trades operated [8, pp. 59, 64; 13, pp. 329-47].

The heterogeneity and specialization within the many textile sub-industries combined with exigencies in fiber manufacturing to produce the marketing approach of the leading fiber makers. I will focus here on the experience of the Du Pont Company. Although Du Pont, as the leading maker of synthetic fibers, was atypical, the company set the pace for those that followed.

Following World War II, the Du Pont Company faced a complex challenge in simultaneously expanding markets for nylon while commercializing its new acrylic and polyester fibers. The company had experienced the hazards of undifferentiated price competition in rayon in the 1930s and wanted to avoid a repetition in the synthetic fibers [9; 6, pp. 166-69]. However, the company also learned quickly that it could not replicate the rapid success of nylon in taking over the high-return hosiery market by securing similarly ideal markets for its new fibers. Du Pont managers decided to market acrylic and polyester fibers based on the subtle

property of resilience--recovery from wrinkles and crushing. Numerous organizational and technical problems challenged Du Pont as it sought to develop products and produce fibers in sufficient volume for testing in several markets at once [6, pp. 257-74, 387-413; 4, Pt. 1; 18]. Anticipation of competition shaped Du Pont's marketing strategy in the 1950s, and rivals followed Du Pont's lead.

Overall, a two-part problem faced Du Pont. The strongest competition for synthetic fibers came from natural fibers, chiefly cotton and wool, and rayon. These were less expensive than the new fibers. Consumers knew and appreciated their characteristics and their traditional forms. The fabric-forming trades were not only familiar with the properties of natural fibers but also were organized in specialties around fiber and fabric type, with specialized machinery, skills, chemicals, and markets. Du Pont thus needed to accelerate the learning process for both the textile trades and consumers to make the new fibers familiar and desirable in spite of their higher cost. Looking ahead, however, the company's textile fibers strategists expected competition in nylon and acrylic by the mid-1950s and in polyester by 1960 [1, pp. 124-26; 6, p. 439]. Their task was not simply to make people buy synthetic fibers but primarily to secure a strong market share for Du Pont and establish loyalty to its products. The company's message to textile trades and consumers would thus also have to identify the special properties and/or services associated with Du Pont brand names. Accomplishing the dual objectives of informing fiber users and securing market share required Du Pont to interact with diverse elements in the textile trades and to attempt to govern innovation and imitation in textile products.

In the textile trades, new developments in style, design, finish, or colorways generally came from vertically integrated companies, those large enough to support some research and development, or high-end, high-fashion firms. When not the product of an integrated firm, innovation often resulted from the collaboration of a number of firms in the production sequence. Imitations, or "knock-offs," eventually made innovations available at every level of price or fashion. Trade associations, through meetings and publications, and textile schools often spread word of new techniques and products [8, p. 61]. Du Pont's fiber marketing program had both to exploit and to counteract this pattern of innovation and often disorderly imitation while at the same time being informative for diverse textile trades and consumers and building a large market share. Efforts to meet these complex goals came to be organized around principles that evolved from experience with rayon and nylon. In spite of such rules, important dilemmas arose in attempting to satisfy diverse goals.

Developments in one product category--men's suits--in the 1950s will demonstrate Du Pont's fiber marketing strategy. Although men's apparel sectors were more concentrated than other apparel trades, this example is useful in showing the evolution of the fiber maker's strategy. Based on the property of resilience, blends with wool were a remarkable success for polyester, although wash-and-wear blends with cotton for shirts soon became more important.

Du Pont marketing managers selected men's suits as the primary target for both Dacron polyester and Orlon acrylic in apparel. The steps the company took to introduce synthetic fibers into suits constituted a fibers marketing policy with general principles. Du Pont would: develop fabric blends and know their characteristics; work directly with mills as they developed their own fabrics; join with mills to inform cutters and retailers; and aim advertisements, publicity, and product information at consumer education. Du Pont worked with mills, converters, cutters, and retailers to make sure that trial items met high quality standards. Du Pont's advertising further supported those mills willing to experiment with the new fibers, creating a demand for finished products by informing consumers not only of their special characteristics but also of their makers. Fabric development by Du Pont provided substitute experience for the mills, a knowledge base that reduced risks.

Having chosen men's suitings as a market for Orlon and Dacron, Du Pont sought out leading textile and suit makers, highly respected for quality work and yet willing to risk experimentation with a new material. Several companies were selected to produce suits of both 100% synthetic fibers and wool blends: Princeton Worsted Mills and Witty Brothers collaborated on suits made of 100% spun Dacron staple; Deering-Milliken and Hart, Schaffner, and Marx made Dacron/wool blends; Dan River Mills and Haspel Brothers made seersucker suits of a mixture of Orlon filament yarn and cotton. Du Pont provided technical assistance at all stages of manufacturing, including carding and other processing steps, dyeing procedures, and the effects of heat, pressure, and time in pressing and tailoring. Du Pont had gleaned much of this information from prior tests in which fibers were spun and woven in the company's laboratories, tailored into garments, and wear-tested by staff members. Tests such as these enabled the company to resolve expected problems such as dyeing colorfast dark shades and brought attention to unforeseen difficulties such as the pilling of 100% synthetic fiber fabrics. Du Pont shared this information not only to make sales of its fibers possible but also to assure a high quality product that would give consumers a good first impression of the fibers.

Du Pont made follow-up surveys of purchasers of suits, gathering information on reasons for purchase and the type of wear suits received as well as reasons for satisfaction or dissatisfaction. The surveys showed an overwhelming preference for blends over 100% synthetic fabrics. Also, washability in a suit was important to only a few buyers, diminishing the value of 100% synthetic fiber or Orlon/cotton fabrics.

Du Pont drew on the results of the surveys in its national advertising campaigns directed at the textile trades and consumers. The company informed the trades of consumers' preference for blends of synthetic fibers and wool, pointed out the benefits of Du Pont promotional support, and praised the firms that pioneered. Advertisements told consumers who made the suits, introduced their properties as "carefree" or "practical fashion," and offered men the opportunity to look "fresh" without looking "careless." Target groups were thus informed that synthetic fibers were successful and that Du Pont was behind them, whether as purveyor of scientific miracles or as source of technical and sales support.

Du Pont believed that information was vital for the successful introduction of synthetic fibers into such products as suits (and shirts). Textile trades and consumers lacked experience with synthetic fibers, and the company feared that untutored textile and apparel makers would attempt simply to substitute the new fibers into established production patterns, experiencing frustration as they turned out poor goods, and that consumers' high expectations of products made of synthetic fibers would be disappointed easily. Although it gave the most desirable attributes to textile products, blending promised to exacerbate such problems. For textile firms, the subtleties of blending posed a greater technical challenge and required a willingness and an ability to experiment. In an era without textile product labeling, blends muddied consumers' shopping decisions. Technical and product information was thus a key part of Du Pont's product in the 1950s.

The successful introduction of the Dacron/wool blend suit (and the Dacron/cotton blend shirt) raised several dilemmas for Du Pont. Some, such as the conflict between supplying fibers to expand proven end uses and the goal of developing new uses, were eased by eventual increases in fiber production. Resolving other dilemmas required a balance of openness and control. For example, the company desired high volume production and widespread use in order to exploit economies of scale but wanted to cultivate a reputation for high quality and command a high price. During the 1950s, Du Pont achieved this balance through the restrictive aspects of cooperation with textile and textile products makers: licensing the use of trademarks; setting quality standards; specifying the ratios of Du Pont synthetic fibers in blends with cotton, wool, and rayon. Du Pont controlled information rather than dispensing it liberally.

These restrictions gave Du Pont a certain amount of control over the diffusion of its fibers during the 1950s as the company repeated the development process exemplified by men's suits and fostered the development and testing of many other products. While Du Pont spread information about its fibers to the textile trades and consumers through advertisements, articles in trade periodicals and women's magazines, and contacts in professional organizations, the company also believed it would establish some brand loyalty among all fiber users. However, the restrictive stick that Du Pont teamed with the information carrot was limited in its effectiveness by the extent of competition in synthetic fibers. The challenge to Du Pont's dominant position in the 1960s changed the terms on which it could sell fibers.

Through the 1950s the textile trades remained weak relative to fiber makers. There were few suppliers of the high-demand synthetics and many textile firms required technical assistance. By the 1960s, however, the number of fiber producers and the quantity of fibers available increased, and knowledge of fiber processing became diffused. Nylon first showed signs of glut and price cutting in the textile recession of 1958. Overcapacity and rising imports brought similar woes to polyester by 1965. The synthetic fiber industry became haunted by overcapacity: new firms entered what appeared to be a profitable business in the midst of a textile boom, establishing large plants; existing firms expanded capacities to reduce unit costs; process developments increased the productivity of existing facilities.

Although demand rose rapidly, capacity grew faster. Chemical engineering firms made synthetic fiber technology available to a range of prospective producers, including large petrochemical and chemical process companies that entered on a relatively large scale, a handful of large textile and rubber companies that set up relatively small captive fiber plants, and nations seeking to restrict imports and establish textile industries. Production outside the United States grew faster within the United States, and imports contributed to the glut in the United States [4, Pt. III; 3, p. 66-81]. Whereas Du Pont and its first competitors had pursued a strategy of product differentiation, many imports and new domestically-produced fibers were unbranded. By the mid-1960s surpluses made price competition the rule in commodity grades of all the synthetic fibers. Economies of scale remained important in protecting the market shares of the larger companies, such as Du Pont, Monsanto, and Celanese.

Changes in the textile trades increased the challenge in selling branded fibers. In most trade specialties the number of firms and operating plants decreased during the 1960s, reflecting slight increases in concentration. Able to operate on a larger scale, big companies such as Burlington, Dan River Mills, or Cone Mills took advantage of greater predictability of fiber supply and characteristics afforded by the synthetics and in distribution of textile products through growing national chains. Although such firms became textile giants, most textile producers remained small and marginal. Together, both ends of the textile spectrum were strengthened in the new fiber market. Once the knowledge of how to process the synthetic fibers became widespread, price sensitive marginal firms eagerly purchased unbranded fibers. Large firms, now often taking a leading role in new product development and marketing their own brand names, were also willing to shop for the right combination of price and properties in the fibers they bought. Two apparel developments of the 1960s illustrate the relative decline of fiber makers' power. Both permanent press processes for shirts and other apparel and double knit men's suitings originated in the textile trades. Although one succeeded and one failed, both exacerbated competition within the synthetic fiber industry.

Permanent press extended the wash-and-wear developments of the 1950s. In addition to the Dacron/cotton shirt, other wash-and-wear products included all-cotton and Dacron/cotton shirts treated with resins. Most of these had disappointed consumers: seams puckered and frayed, shirts yellowed in the wash, many felt stiff, all still needed ironing. Appliance manufacturers joined weavers, finishers, apparel makers, fiber companies, and Cotton Council researchers in seeking the ideal combination of flatness in large areas, permanent creases where desired, smooth seams and a pleasing "hand" or feel in machine-washable garments. Permanent press apparel emerged from the trades in 1964. Koret of California, a sportswear manufacturer, developed the "delayed cure" process in which resins were applied to flat fabric and sensitized; then completed garments were cured in ovens after pressing. Koret licensed its process, while other firms, including Cone Mills, Dan River Mills, and Wamsutta Mills, introduced their own variations on the sequence of processing steps.

All permanent press processes worked best with blends of polyester and cotton. While fiber makers participated in the development and refinement of permanent press processes, they did not direct it. Permanent press greatly increased demand for polyester in apparel and household goods, attracting entrants to the fiber business and aggravating competitive pressures. When the prices of polyester staple began to fall, however, many turned to the manufacture of filament yarns for double knits.

Polyester double knits resulted from two developments. First, European machine-builders introduced machines that interknitted two strands of yarn in intricate stitches to produce a stable fabric with appealing body and texture. Then, Celanese developed a heat-stabilized textured filament yarn. Crimped and then set by reheating, the new yarn did not stretch, shrink, or cause distortions in knits as had other textured yarns. Textured filament yarns reduced the cost of double knits. The new fabrics became popular in women's wear in the mid-1960s, riding the fashion for bright colors and geometric patterns.

Success of double knits brought new entrants to both the fiber industry and the knitting trade. Large weavers started integrated knitting operations and established knitters expanded into double knits. Although economies of scale existed in double knits, entry costs were not prohibitive for small knitters [5, 7, 11]. However, the boom masked problems as many small producers and recent entrants converted nylon yarn capacity to polyester yarn to recoup losses. By the late 1960s the market for polyester double knits in women's wear began to wane and knitters began a search for new markets.

Tailored men's wear had always been the most conservative and concentrated of apparel trades. Retailers and fashion designers, pushing for change, proposed introducing double knits to bring increased comfort and freedom of movement as well as wrinkle resistance and a variety of patterns to men's wear. However, for double knits to succeed in men's wear, they had to satisfy the high standards of men's wear cutters and retailers for the yard goods delivered to them. Fiber makers such as Du Pont and Celanese resisted the idea of double knit men's wear, recognizing the inherent contradiction in forcing a fabric construction suited to rapid fashion change into the staid men's wear mold. However, the companies tested and developed yarns, and advocated the use of yarns that combined wool with specialty polyester filament.

Although the first double knits of all-polyester and combinations with wool succeeded, a number of factors conspired against long-term growth. Much more double knitting capacity was in coarser women's wear gauges and more filament yarn capacity in commodity grades than in the fine gauges and specialty yarns needed for men's wear. When the price of wool rose, wool disappeared from all but the most expensive men's wear, and double knitted 100% polyester fabrics became common. The leisure suit, introduced as a casual, loose form of suit that simplified construction for men's wear makers, absorbed much of the glut of inappropriate double knit men's wear fabrics. As consumers became more familiar with double knits and their problems--hot and clammy, easily snagged or melted, not alterable--they rejected them in favor of traditional fabrics. In the end,

double knits grew to a much greater volume than fiber makers like Du Pont predicted, but what one editor of a trade periodical called the "industrial behavior pattern"[14] of opportunistic knitters highlighted the contradictions that the conservative fiber makers had hoped to minimize by advocating combination yarns.

The story of the marketing of synthetic fibers is one of interplay of the concentrated structure of the fiber industry and the heterogeneity of the textile trades. On one hand, the diffuse and fragmented market for and the very newness of synthetic fibers required the product differentiation strategies of Du Pont and other leading fiber makers, as the synthetic fibers were eased into the existing complex of textile technology. The development of the wool blend suit illustrates the ways in which costly and labor-intensive marketing efforts worked to open new markets and introduce new products. On the other hand, certain aspects of their strategies were intended to counteract the competitive pattern of the textile trades and may have fostered the growth of some textile firms. If indeed the fiber makers had been able to sell to a more concentrated and technically astute textile industry, their task would have been simpler and their costs lower. Ultimately, however, the textile trades remained fragmented and intensely competitive, resulting in a combination of textile giants and dwarves that necessitated and yet limited fiber makers' efforts to control the use of synthetics.

The fiber industry reached technological and competitive maturity in the 1960s with price competition and overcapacity characteristic of petrochemicals and predictable according to the product life cycle model. However, although minimizing costs became more important for gaining and securing market share, product development and technical and promotional assistance represented high costs that could not be reduced in spite of their declining value as sales tools. The fiasco of the double knit men's suit points out how the diffuse textile fibers market exacerbated the effects of price competition, weakening fiber makers relative to textile firms able to buy fibers readily if not to develop their own products. The bind of the largest fiber makers in the 1960s and early 1970s may not be fully understood without studying their customers in the textile trades as well.

The structure of the textile industry was important in shaping and in undermining fiber makers' marketing strategies. However, this paper leaves some questions about the textile trades answered incompletely or not at all. I believe that fiber makers' efforts to counteract the competitive pattern of the textile and textile products trades combined with the predictability of quality, quantity available, and price of the fibers themselves to reinforce an ongoing trend toward integration and consolidation in some textile trades. What was the source of this trend? What were its limits? On what basis did textile companies compete? What was the role of the retailers who distributed textile products? I will continue to explore these questions.

References

1. Dan J. Forrestal, *Faith, Hope and $5000* (New York, 1977).
2. Fariborz Ghadar, William H. Davidson, and Charles S. Feigenoff, *U.S. Industrial Competitiveness: The Case of the Textile and Apparel Industries* (Lexington, 1987).
3. Amy L. Hardin, "Miracle Fiber to Commodity: Polyester, 1950-1975" M.A. thesis, University of Delaware, 1988.
4. D.F. Holmes, *History of the Du Pont Textile Fibers Department* typescript (Wilmington, DE, 1980).
5. "Hosiery Firm Insures Its Stability by Entering Doubleknit Market," *Textile World*, 116 (April 1966), 47-48.
6. David A.Hounshell, and John Kenly Smith, Jr., *Science and Corporate Strategy: Du Pont R&D, 1902-1980* (Cambridge, MA, 1988).
7. "How a Small Double-Knit Mill Got into Production--Fast," *Textile World*, 112 (October 1962), 83.
8. Jeannette A. Jarnow and Beatrice Judelle, *Inside the Fashion Business* (New York, 1965).
9. Jesse W. Markham, *Competition in the Rayon Industry* (Cambridge, MA, 1952).
10. Richard Paul Olsen, *The Textile Industry: An Industry Analysis Approach to Operations Management* (Lexington, 1978).
11. Frank Paul, "Hosiery Mills Add Double Knits," *Textile Industries*, 127 (April 1963), 68-71.
12. "Polyester Fiber Processes Going Continuous", *Chemical and Engineering News*, 43 (6 December 1965), 44-45.
13. Philip Scranton, *Figured Tapestry* (Cambridge, MA, 1989).
14. Leon E. Seidel, "Obit for a Stuffed Shirt," *Textile Industries*, 135 (December 1971), 67.
15. Peter H. Spitz, *Petrochemicals: Rise of an Industry* (New York, 1988).
16. Robert Stobaugh, *Innovation and Competition: The Global Management of Petrochemical Plants* (Boston, 1988).
17. *Textile Organon*, 52 (1981).
18. D.M. Thornton, "Progress Report on Fiber V," 24 February 1949, typescript, Rutledge Scrapbook, Dacron, v. 1, 1946-1958, No. 595, Du Pont Company Records, Series II, Part 2, Hagley Museum and Library.
19. Brian Toyne, Jeffrey S. Arpan, Andy H. Barnett, David A. Ricks, Terence A. Shimp, *et al., The Global Textile Industry* (London, 1984).
20. U.S. Bureau of the Census, Census of Manufactures, Concentration Ratios in Manufacturing, 1963, 1967, 1972, 1977, 1982.