

## **Structure of the U.S. Wheat Supply Chain**

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by

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There are five market classes of wheat in the United States. These are hard red winter, hard red spring, soft red winter, white, and durum (Harwood, Leath, and Heid, 1989). According to Harwood, Leath, and Heid (1989), hard red winter and hard red spring wheats are used mainly in the production of breads and rolls and are grown primarily in the plains region of the United States. The largest producers of hard wheats are North Dakota and Kansas (Harwood, Leath, and Heid, 1989). Several attributes of wheat are important to millers, bakers, and ultimately end consumers. Some of these quality attributes are influenced by management practices while others are primarily influenced by climatic or natural conditions.

Competitive forces are changing the structure of industries that encompass the wheat supply chain. Elevators are increasingly using multiple-railcar shipments, increasing their emphasis on volume and throughput. Flour mills are shifting locations, increasing plant size, investing in technology, and developing strategic alliances with customers. In transportation, mergers among Class I railroad carriers have contributed to further consolidation, price incentives continue for multiple-railcar movements over long distances, and innovations in forward-pricing mechanisms continue to evolve. Consolidation and acquisition of the largest bakeries, changing procurement practices, increasing deployment of new technologies, increasing plant size, increased research and product development efforts, and improving efficiency of distribution practices are all forces taking shape in the baking industry. These trends have implications for wheat producers as well as the economies of rural states.

This paper is organized around three stages or links in the wheat value chain: elevators, milling, and baking. Each of these links represents an important economic activity within the supply chain.

Although heavily intertwined, each link competes in a unique economic environment. The discussion for each link centers on structure and competitiveness of industries in each of the links.

## **ELEVATORS**

The first link in the supply chain, elevators, serve two primary purposes. First, they provide a mechanism for accumulating and combining the production of several individual wheat producers (farmers). Second, this link provides storage because wheat is a seasonal commodity. In essence, the elevator activity is solely a logistical function. As a result, this activity is particularly impacted by transportation. Elevators also provide numerous additional services including cleaning (removing non-wheat matter), inspection (identifying and measuring various quality attributes), and blending (combining portions of wheat with differing quality attributes to attain a certain specification in that attribute).

Dramatic changes in infrastructure have impacted the grain handling and transportation system in the United States. Most of this change has occurred since 1980. Important factors impacting this change include the widespread adoption of multiple railcar grain rates, rail line abandonment, energy considerations, and technological advances (Ming and Wilson, 1983). As a result of these forces, considerable economic pressure is exerted on the elevator industry to attain efficiencies in both transportation and handling. An economic incentive exists for the development of large elevators, commonly referred to as subterminals, capable of loading and transporting grain in multiple-railcar shipments or what the industry refers to as “unit trains” (Ming and Wilson, 1983).

## Industry Structure

The production of grain and the development of country elevators were directly influenced by the development of the railroad network.<sup>1</sup> In turn, the success of country elevators expanded the development of the railroad network, particularly branchlines. Country elevators were often located within a few miles of each other along the rail line as producers could not transport large quantities of grain large distances in the “horse-and-wagon” era (Ming and Wilson, 1983).

The original structure of the industry was determined largely by constraints on the inbound movement of grain. As these constraints were lifted over time, size economies exerted more influence on the structure of the industry. The replacement of the “horse-and-wagon” era with the development and subsequent improvement of motor vehicles and road networks began an unending trend that has had substantial implications for the elevator industry, including fewer and larger elevators (Ming and Wilson, 1983). In 1923, North Dakota had 1,832 country elevators, by 1965 there were 789, and in 1981 there were 592 (Ming and Wilson, 1983). Although the number of elevators continued to decline to 425 in 1994, the rate of decline appears to have slowed (Andreson, Young, and Vachal, 1994). Over this same time span, the average elevator’s trade area increased substantially as did average storage capacity (Ming and Wilson, 1983). These trends are not unique to country elevators in North Dakota but have occurred throughout wheat producing areas of the United States.

Although the number of elevator firms has diminished dramatically, the industry can still be described as extremely competitive. Elevator ownership is a mixture of privately held and farmer-

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<sup>1</sup>Country elevators are the initial receiving point for grain produced by local farmers and are located within the production area (Bangsund, Sell, and Leistritz, 1994).

owned cooperative firms. Farmer-owned cooperatives substantially outnumber privately held elevators. Profit maximization is often not a sole objective of these cooperative firms. This behavior preserves excess capacity and fosters low profitability. Additionally, the switching cost of elevator suppliers, farmer producers, is limited to the difference in transportation costs between competing elevators.<sup>2</sup> Similarly, grain buyers have a large number of homogenous elevator suppliers from which to purchase grain with the only switching cost again being transportation. Finally, no single firm or small group of firms appears to dominate the elevator industry. In the 1993 to 1994 marketing year, North Dakota's largest 10 elevator firms controlled less than 20 percent of the total grain handled (Andreson, Young, and Vachal, 1994).

## MILLING

The second link in the wheat supply chain is milling. Milling is a process of grinding and sifting wheat into flour and millfeeds (Harwood, Leath, and Heid, 1989). Flour is an ingredient in baked-goods destined for human consumption while millfeeds are sold as animal feed.

The U.S. milling industry has experienced many changes within the last few decades. A major change occurring is a trend towards larger firms and increased concentration (Wilson, 1995). A result of this is fewer, high capacity firms exploiting economies of scale. This has made it difficult for small mills to compete. In addition, large mills are increasing the level of automation and incorporating new technologies to improve plant efficiency (Harwood, Leath, and Heid, 1989). In addition to economies

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<sup>2</sup>Switching costs are one-time costs incurred by either buyers or suppliers resulting from either party switching to an alternative, or competitor, to the original buyer or supplier (Porter, 1980).

of scale, these large firms are increasing capacity utilization. Furthermore, they are marketing specialized products for particular market niches with an objective to differentiate products and increase profits (Harwood, Leath, and Heid, 1989).

A positive trend for the industry has been increased consumer demand for flour products. In 1987, per capita consumption in the United States was 128 pounds, up dramatically from the 1960s and 1970s (Harwood, Leath, and Heid, 1989). This trend can be attributed to increased health concerns, the introduction of more flour-based products, and higher consumption of fast foods containing wheat flour. Although flour exports have historically been a relatively small percentage of demand, they do provide an important source of revenue for some millers. From 1980 through 1987, exports averaged about 8 percent of total flour demand or disappearance (Harwood, Leath, and Heid, 1989).

### **Industry Structure**

As previously mentioned, the structure of the wheat flour milling industry has changed greatly in the last few decades. This industry segment is typical of the structural dynamics confronting other segments of the agricultural processing industry (Wilson, 1995). Flour milling accounts for over 90 percent of domestic wheat processing use (Harwood, Leath, and Heid, 1989). The primary product is wheat flour for baking, while by-products are used for such things as livestock feed, pet food, and industrial applications.

The number of wheat flour mills in the U.S. was 204 in 1990, down from 280 in 1974 (Wilson, 1995). However, industry capacity rose 22 percent over approximately the same period (Harwood, Leath, and Heid, 1989). In addition, the number of mills operated by each firm increased from 1.7 to



2.2, with average firm capacity more than doubling (Wilson, 1995). These and other milling industry statistics are reported in Table 1.

**Table 1. Flour milling industry statistics**

CHARACTERISTICS	YEAR		
	1974	1980	1990
Mills:			
Number	280	255	204
Average Capacity (cwt/day)	3,541	4,212	5,937
Firms:			
Number	161	140	95
Average Capacity (cwt)	6,158	7,672	12,534
Average Number of Mills	1.7	1.8	2.2
Percent with Multiple Mills	37%	42%	58%

Adapted from Sosland Companies Inc., *Milling Directory & Buyer's Guide*, Merriam, KS: Sosland Publishing Company, (Selected Years).

Due to changes in rail transportation, new mills have usually been built near population centers. Historically, mills were located near wheat growing areas. This shift in location has decreased the number of mills in Southern and Midwestern states during the 1980s while increasing mill numbers in large population areas throughout the country.

There were two technological changes that account for this change in transportation cost. First, the introduction of multiple-car or unit train technology. This provided a transportation cost incentive for shipping larger quantities at one time. However, since individual bakers do not require large quantities of flour or desire to hold large quantities of flour inventory, shipments of flour generally do not

take advantage of these pricing mechanisms. As a result, it is feasible for large quantities of wheat to be shipped to a mill located near flour demand even though the milling process is a weight-losing activity.

A second innovation was enhanced hopper car technology that reduced costs of bulk wheat shipments.

In addition to these technological changes, a pricing mechanism known as “transit” was gradually eliminated. Transit allowed a shipment of wheat to stop en route and be milled into flour.

As the number of mills in the U.S. has fallen, the industry has also become more concentrated. The top four firms in the industry controlled 70 percent of capacity in 1992, up from 34 percent in 1974 (Wilson, 1995). In addition, ownership of milling companies has changed drastically from the early 1970s. Traditionally, single-plant firms have dominated the industry. Furthermore, these firms were typically small family-owned and -managed operations. This has given way to an industry increasingly dominated by large multi-plant corporations. For example, ConAgra, the largest flour miller in the U.S., expanded its capacity from 88,300 hundredweight in 1973 to 270,000 hundredweight by 1988 (Harwood, Leath, and Heid, 1989). Much of this capacity was gained through acquisition of existing structures as opposed to new construction. These large multi-plant firms often have agribusiness interests other than milling, including prepared foods, restaurant holdings, grain merchandising, and feed manufacturing, among others.

The acquisition of flour mills often allows these firms to become more vertically integrated. Interestingly, the reasons for this are not clear. While some firms may be able to reduce costs through better communication and improved scheduling, this has not always the case. The milling operations of several agribusiness firms have been sold off because of high risk and low profits (Harwood, Leath, and Heid, 1989).

## BAKING

The final stage in the wheat supply chain is the baking activity. Flour is a principal ingredient in the manufacture and production of bakery goods.

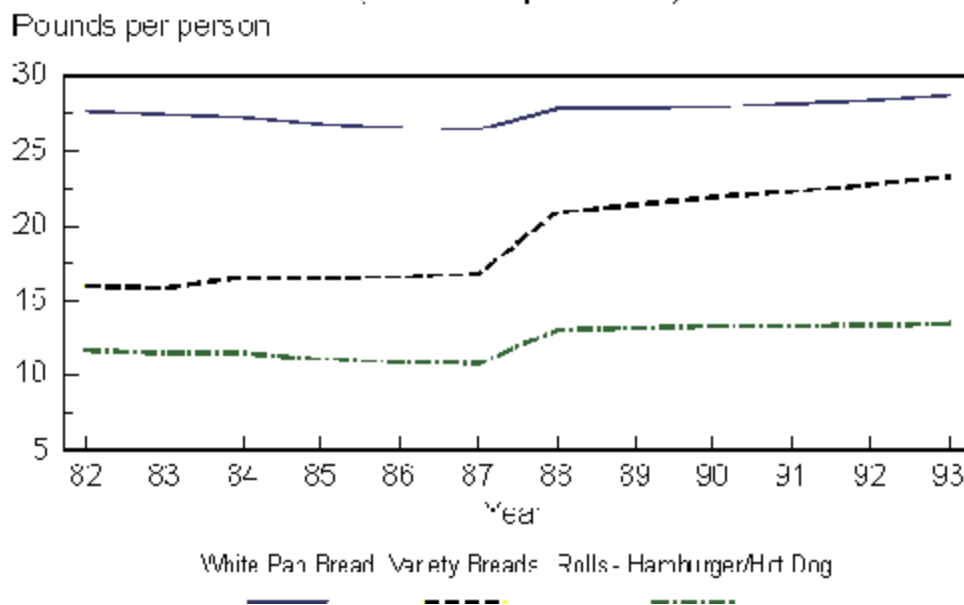
The domestic wholesale baking industry uses 70 percent of the flour produced by domestic flour mills (Harwood, Leath, and Heid, 1989). Other major uses of flour include macaroni and spaghetti (9 percent) and blended and prepared flour packages (6 percent) (Harwood, Leath, and Heid, 1989). The wholesale baking industry is composed of manufacturers of bread, cake, and related products and cookie and cracker manufacturers. The bread and cake segment of the bakery industry consumes three times the flour consumed by the cookie and cracker segment (Harwood, Leath, and Heid, 1989). Wheat flour represented 26 percent of the value of all ingredients purchased by bread and cake wholesale bakeries in 1992 (U.S. Dept of Commerce, 1995).

In 1992, there were approximately 3,150 wholesale bakery plants in the United States (U.S. Dept of Commerce, 1995). The majority (2,539) were classified as bread and cake bakeries while cookie and cracker (441) and frozen non-bread bakery products (172) complete the industry (U.S. Dept of Commerce, 1995). The differences in plant numbers between segments can best be explained by the perishability of each segment's products. Since bread and cake products are more perishable than either cookie and cracker products or frozen products, bread and cake plants are more locally oriented (Harwood, Leath, and Heid, 1989).

Although per-capita consumption of flour has been increasing, this trend has not carried into wholesale bakery products (Harwood, Leath, and Heid, 1989). With the exception of variety breads

and bagels, consumption of bakery products has remained flat throughout the 1980s (Figures 1 and 2). In general, the consumption of higher value products, including certain cookies, select crackers, and variety breads, has increased while consumption of lower value products, including white bread, decreased through the 1980s (Harwood, Leath, and Heid, 1989). The rate of white bread consumption appears to have returned during the 1990s to what it was before the downturn in the 1980s. Harwood, Leath, and Heid (1989) attribute these trends to the increasing popularity of in-store bakeries which offer the consumer convenience, service, and variety. To compete with in-store bakeries, wholesale bakers are increasing their efficiency and exploiting economies of scale.

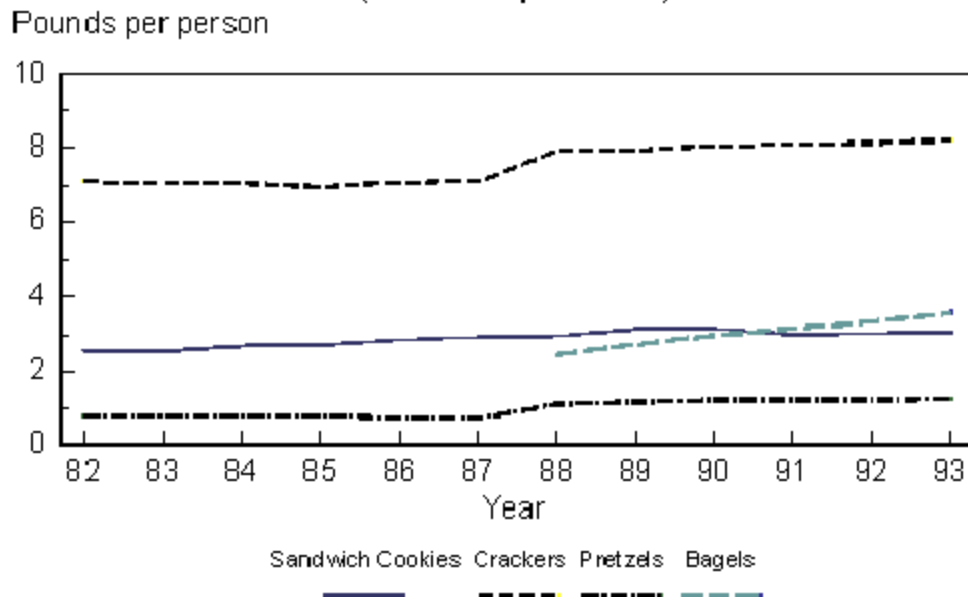
## Per Capita Consumption of Bread and Related Products (selected products)



**Figure 1.** Per capita consumption of white pan bread, variety bread, and hamburger and hot dog rolls from 1982 to 1993.

Adapted from U.S. Department of Commerce, International Trade Administration, *1988 U.S. Industrial Outlook* and *1992 U.S. Industrial Outlook*, Washington, DC: U.S. Government Printing Office, 1988 and 1992, respectively.

## Per Capita Consumption of Cookies and Crackers (selected products)



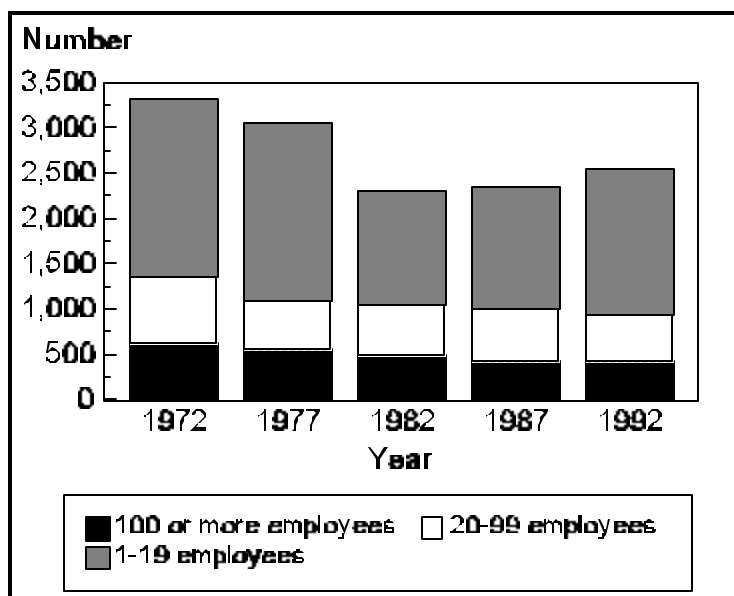
**Figure 2.** Per capita consumption of sandwich cookies, crackers (excluding pretzels), pretzels, and bagels for 1982 through 1993.

Adapted from U.S. Department of Commerce, International Trade Administration, *1988 U.S. Industrial Outlook* and *1992 U.S. Industrial Outlook*, Washington, DC: U.S. Government Printing Office, 1988 and 1992, respectively.

### **Industry Structure**

The wholesale bakery industry is undergoing rapid changes. A consolidation of large bakeries with diversified agricultural firms has linked bakeries more closely to other food processing activities, increasing marketing strengths and capital available to the bakery industry (Harwood, Leath, and Heid, 1989).

Additionally, the number of plants producing bread and cake products is changing. From 1972 to 1982, the number of plants decreased as larger firms took advantage of size economies and smaller firms exited the industry (Harwood, Leath, and Heid, 1989). However, as Figure 3 shows, in both the 1987 and 1992 Census of Manufactures the number of plants increased (U.S. Dept of Commerce, 1995). This increase has primarily occurred in plants with fewer than 20 employees (U.S. Dept of Commerce, 1995). The implications of this are not clear. An increase associated with the growth of in-store bakeries may imply grocery stores are further eroding the wholesale “bread” market with niche products perceived by consumers to be superior. Alternatively, this growth may be the result of facilities exchanging capital for labor. Therefore, number of employees may be less important as an indicator of output or size. This may imply that smaller bakeries, in terms of employment, may now be able to compete more effectively with larger wholesale bakeries by exploiting recent technological advancements than they could prior to the 1987 Census of Manufactures.



**Figure 3.** The number of bread and cake plants by number of employees.

Adapted from Sosland Publishing Company, "Baking Company, Plant Totals Increase Again." *Milling and Baking News*, vol. 74 n. 11, May 16, 1995, pp 28-30.

Although large plants, those employing more than 100 persons, have declined in number, their share of the total market has remained stable. In the 1992 Census of Manufactures, firms with more than 100 employees were responsible for approximately 87 percent of the total bread and cake market compared to 81 percent in 1977, 86 percent in 1982, and 86 percent in 1987 (U.S. Dept of Commerce, 1995; Harwood, Leath, and Heid, 1989; U.S. Dept of Commerce, 1993).

The ownership of every major wholesale bakery, whether in the bread and cake segment or the cookie and cracker segment, has changed in the last few decades (Harwood, Leath, and Heid, 1989). Furthermore, Harwood, Leath, and Heid (1989) indicate that many of these changes occurred since 1982 and involved large, diverse food-oriented firms. These large firms have introduced financial, managerial, and marketing resources previously not available to the bakery industry (Harwood, Leath,



and Heid, 1989). This has worked to increase operational efficiencies, new product development, and deployment of new technologies.

Advances in transportation and logistics technologies have had a similar effect on the bread and cake segment as on the elevator industry. The development and continued improvement of the road network and motor vehicles, combined with technologies that have diminished product perishability, have extended the geographic scope of firms in the bread and cake segment (Harwood, Leath, and Heid, 1989). Since there is a tradeoff between product distribution and plant size, relative decreases in product distribution costs would allow firms to increase their plant size and market area to exploit additional economies of scale.

## **SUMMARY**

Competitive forces are changing the structure of industries that encompass the wheat supply chain. Elevators are increasingly using multiple-railcar shipments, increasing their emphasis on volume and throughput. Flour mills are shifting locations, increasing plant size, investing in technology, and developing strategic alliances with customers. In transportation, mergers among Class I railroad carriers have contributed to further consolidation. Price incentives continue for multiple-railcar movements over long distances, and innovations in forward-pricing mechanisms continue to evolve. Consolidation and acquisition of the largest bakeries, changing procurement practices, increasing deployment of new technologies, increasing plant size, increased research and product development efforts, and improving efficiency of distribution practices are all forces taking shape in the bakery industry.

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