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ABSTRACT

One of the most dramatic trends in American farm-structural change over the past several decades has been the industrialization of livestock production. Many now expect that dairying in the United States will be the next major livestock sector to succumb to the industrialization trend. This paper utilizes a multidimensional definition of industrialization to critically examine evidence for and against the dairy industrialization hypothesis. The authors find that while there is a persistent trend toward larger units of production, and a geographical shift towards states with more industrial-like farm operations, the penetration of industrial relations of production has occurred more slowly and incompletely than many have assumed. The paper concludes by noting how unique characteristics of the dairy sector help explain the uneven character of the industrialization process in the United States.

Introduction

One of the most dramatic trends in American farm-structural change over the past several decades has been the industrialization of livestock production. The rise of huge cattle feedlots in the Southern Great Plains, the establishment of contract broiler production, and the recent explosion of hog factories in the Middle Atlantic and Corn Belt states have been cited as paradigmatic examples for the process of transformation from a family farm-based system of agriculture to a more capitalist-industrial model. Now with the rapid rise of large-scale dairying in the Southern Plains, Mountain, and Pacific states, and the erosion of family-scale dairying in the Upper Midwest and Northeast, it has seemed apparent that dairying will be the next major livestock sector to succumb to the industrialization trend.

In this paper, we begin with a brief discussion of some of the shortcomings of prevailing usages of the concept of "industrialization." Then, using a multidimensional conceptualization of industrialization, we assess recent changes and likely trends in the U.S. dairy commodity sector. We argue that the apparent industrialization of the dairy sector is not an inexorable trend. In addition to industrialization of dairy production being far less advanced with respect to farm units of production, there is only modest farm-related industrialization at the commodity sector level. Dairy industrialization, to the extent it has occurred, has moved forward more unevenly and tentatively than has been the

case in other livestock sectors. We conclude by noting how distinctive characteristics of the U.S. dairy agri-food system may help explain the relatively slow and inconsistent dynamics of change in the production sector. Moreover, changing institutional arrangements appear to offer comparative advantages to traditional forms of dairying that may alter the path of structural change in the coming decades. In general, we argue that as useful as theories of industrialization and globalization can be, they tend to oversimplify processes of change at the farm level.

Livestock Industrialization: Theoretical Background

While very few thoughtful observers would dispute the fact that there is an ongoing tendency for livestock agriculture to exhibit "industrialization," it is useful to recall how this presumption departs so radically from the types of analyses that were dominant in the sociology and political economy of agriculture a decade or so ago. Ten years ago most observers of U.S. agriculture would have been obliged to see the dairy sector, and probably hogs as well, as prototypical outposts of (capitalized) family labor farming. Chayanovian Marxism — David Lehman's (1986) term for the types of neo-Marxist perspectives advanced by scholars such as Kautsky, Mann and Dickinson (1978; Mann, 1990), and Friedmann (1978) and by kindred scholars such as Salamon (1985) to explain the social bases of household forms of agricultural production — was dominant. Indeed, we can now see in retrospect that the priority given to Chayanovian-Marxist interpretations of the persistence of family labor farming was quite appropriate given the conditions of the mid-twentieth century. Midcentury was a period in which there was a very strong tendency toward convergence of national farming structures across the world toward the capitalized family-farm model (of relatively large, highly-commercialized, capital-intensive, family-proprietor, family-labor farms). Depeasantization (and consolidation of peasant plots into larger family-proprietor enterprises) occurred in some regions and countries, while devolution of estates and capitalist farms into family-proprietor farming operations occurred in others. It is significant that the prototypical capitalized family-labor farms that resulted from the twin processes of depeasantization/consolidation and devolution of estates tended to achieve intensification and diversification through combining crop and livestock production. But in the U.S., beginning in the 1960s but intensifying during the 1990s, there has been an extraordinary decline (typically five percent per year or more) in the numbers of farms producing livestock on a commercial basis — particularly the medium-scale, diversified crop-livestock farms run by family labor that were the focus of neo-Chayanovianism research. At the same time, there has been a breakneck pace of the formation of very large, industrial-type livestock production operations — a process which is largely complete in poultry meat, substantially complete in fed cattle, well underway in hogs, and apparently just underway but proceeding rapidly in dairy.

The nascent "industrialization" of dairy farming in the U.S., to the degree that it has occurred, is an interesting case with regard to how sociologists should conceptualize the political economy of agriculture in the late twentieth century. Historically, dairy farming has been at the heart of twentieth-century family farming (Pfeffer, 1983). Accordingly, dairying farming was given considerable attention during the 1980s and early 1990s heyday of the new rural sociology. On one hand, many analysts from the Chayanovian-Marxist school have often stressed how the distinctive characteristics of dairy farming — the seasonality of forage crop production, its labor intensity, its suitability for lower-quality land resources and the difficulties this presents to mechanization, its tendency to overproduction and cost-price squeeze — have reinforced dairying as a province of capitalized, but moderate-scale family-labor farmers.

And while some analysts have recognized the long history of large-scale, industrial-type capitalist dairy farming in the American Southwest and elsewhere, the tendency among analysts such as Gilbert and Akor (1988) was, at least implicitly, to see that the conditions that led to large-scale drylot dairying in California during the 1940s and after were fairly exceptional ones (e.g., the extremely high degree of land concentration, highly subsidized irrigation water for growing alfalfa, state-level milk marketing orders favorable to large farms). Analysts such as Gilbert and Akor have thus suggested that California and Wisconsin dairying are characterized by "divergence." In their view, the persistence of family dairy farming in the Upper Great Lakes states is very likely, and there is little reason to believe that there will be significant forces for structural convergence of California and Wisconsin dairy.

As suggested earlier, however, there have been some significant changes in rural-sociological and political-economic scholarship in the sociology of agriculture, as well as some critical changes in the organization of dairying farming, that have cast doubt on the validity of the kinds of analyses that Pfeffer (1983), Mooney (1988), and Gilbert and Akor (1988) have developed with respect to the U.S. dairy farming sector. First, for understandable and essentially sound reasons, there has been a decisive change in the emphases of political-economic analyses of the farm production sector. The shortcomings of neo-Chayanovianism have been recognized. Most importantly, there has been recognition of the important role played by global socioeconomic forces. Very significant traditions of scholarship on globalization, food regimes, agro-commodity chains, and so on have emerged (McMichael, 1994, 1996; Bonanno et al., 1994), and have displaced neo-Chayanovian and family-farmist perspectives that were so important to the new rural sociology. And, quite appropriately, there has been a deemphasis on explaining the structure of the farm sector as the sole or ultimate dependent variable of the sociology of agriculture (see Buttel, 1996, for a historical overview).

Second, stimulated as much or more by agro-food social movements as by social science scholarship, there has been a flood of attention over the past decade to the "industrialization" of agriculture.[4] Thus, nearly a decade ago Marty Strange (1988), then of the Center for Rural Affairs, stressed the rapidly growing role of "industrial agribusiness" farming. Likewise, Welsh (1996) has published an influential monograph on the *Industrial Reorganization of U.S. Agriculture* for the Wallace Institute for Alternative Agriculture. Both of these analysts have recognized that the industrialization of U.S. agriculture has proceeded most thoroughly and rapidly in the livestock sectors. Proponents (e.g., Urban, 1991) — and even a good many opponents (Lyson and Geisler, 1992) — of the industrialization trend have tended to conclude that it is more or less inevitable.

Third, over the past decade there have emerged several dozen very large California-style dairies — with several thousand cows on each farm, drylot production systems (involving little or no crop production on the dairy farm premises), and several dozen hired laborers — outside of the traditional homelands of industrial dairying. A number of these farms have located in the Northern and Southern Great Plains region, which has not traditionally been a major dairy production area. New Mexico has registered the most rapid increase in dairy cows of any of the other American states for most years in the 1990s. Even in family farming heartlands such as Wisconsin and Minnesota there are reports in the state farm press virtually every week of dairy farms with a thousand or more cows that are being established through expansion or as new start-ups. Thus, finally, it is not surprising that we see important scholarly papers, such as the recent article by Lyson and Geisler (1992), that indicate that one of the essential processes of agricultural industrialization — the disappearance of the medium-sized

traditional dairy producer — is now well underway and that there is now movement toward a convergence between Sunbelt dairying on one hand, and Upper Great Lakes and Northeast dairying on the other.

In many ways the tendency in recent years in domestic agrarian political economy, in which analyses of globalization are now predominant, has been to de-emphasize farm-level analyses and to see that the most crucial aspect of farm-level processes of change is "industrialization." Though recognizing that there will be some variation in the rate and scope of the industrialization of on-farm production — and that some sectors will be insufficiently attractive to large-scale investments so that they will remain relegated to household forms of production — industrialization has now emerged as the most crucial concept for analyzing contemporary changes in on-farm production systems.

Conceptual Issues

The term industrialization has been widely used to refer to a range of structural changes taking place in a number of commodities. Even in Welsh's (1996) useful conceptual and empirical analysis of industrialization, the notion is portrayed as an overall structural tendency. We would argue, however, that not only does the concept of industrialization need to be disaggregated and unpacked, one cannot understand recent processes of change in the dairy production sector without doing so.

A useful point of departure for understanding the complexity of the industrialization process is to note that the notion of the industrialization of agriculture is based on three related, but distinct images of non-farm industry. The three analogies, one might note, are chosen as much for their ability to conceptualize agricultural changes in a pejorative light as for their analytical precision.

One such image, drawn from classical industrial sociology and from more informal notions about the nature of manufacturing facilities, is that of the farm-as-factory. The second image, drawn from the classical industrial organization literature or from related informal understandings of industrial concentration, is that of agricultural production sectors becoming concentrated economic sectors. The third image, drawn from the literatures on flexible specialization, globalization, and informal representations of these literatures, is that of the contemporary global, "flexibly specialized," "just-in-time" industrial sector or commodity chain. Each of the three analogies is useful, but somewhat limited. It is, for example, conceivable that some farms, much like other capitalist enterprises in the global agrofood system, can be organized much like the stereotypical factory. But to the degree that agrofood systems ultimately remain based on land and on natural production processes, there will be components of the agrofood system that are not organized along the lines of a classic factory system. Likewise, conceiving of farm production enterprises being restructured and linked in a manner comparable to Honda and Toyota greatly exaggerates the ability of the farming entrepreneur to control the (natural) conditions of production. Also, there are, quite simply, no agricultural production enterprises, or even commodity chains, whose structure and functioning mirror that of the paradigmatic globally-flexible firms like Honda and Toyota (Buttel, 1996). Even so, the analogies to factories, concentrated industrial sectors, and flexibly-specialized commodity systems can be useful points of departure, if used cautiously, since they highlight the fact that industrialization logically can be understood in terms of (1) characteristics of units of farm production, and (2) characteristics of agricultural commodity sectors and systems. Unfortunately, while industrialization logically pertains to both the characteristics of units of farm production and to characteristics of commodity

sectors, these two meanings have tended to be employed more or less interchangeably, and thus imprecisely and inconsistently.

Characteristics of Units of Production

There are four dimensions of industrialization of farm production from the vantage point of characteristics of farm production. First and foremost, industrialization is a concept utilized to depict scale, i.e., very large farm production units. Table 1 reports the proportion of U.S. farms within various livestock production sectors that had more than 1,000 "animal units" in 1992. Animal units are commonly used to compare operations producing different types of livestock and can be understood to represent the rough equivalent (in terms of manure production) of a mature beef cow. Table 1 also reports the proportion of total output generated by those very large operations. It is evident that a very small proportion of farms in all of these sectors has more than 1,000 animal units, yet these very large operations produce a significant share of total output (indeed, the majority of eggs and fed cattle come from these industrial-scale firms). In much of the popularized literature on industrial agriculture, the sheer size of farm units is considered to be adequate evidence of a structural transformation. Within dairying, the most common unit used to indicate scale is the size of the milking herd (usually including dry cows that have calved). For most observers, "industrial" scale dairies in the United States are those with over 500 (and commonly over 1000) cows in the herd. By contrast, most traditional family-scale dairy farms in the 1990s milk between 30 and 120 cows (a scale that can be managed adequately using primarily family labor).

A second dimension of industrialization at the farm-level involves the increasing separation of ownership, management, and labor functions on farms (Mooney, 1988). Family farms (the antithesis of industrial farms in most accounts) are defined by the strong integration of all three dimensions in a single person or family unit. By contrast, industrial farms (partly due their sheer size) are characterized by absentee ownership and investment, managers who have no ownership stake in the business, and a reliance on large and transient hired non-family labor force (often an ethnic minority). Third, farm-level industrialization is often conceptualized in terms of the use of particular technologies — especially sophisticated, factory-like, capital-intensive, and mechanized, labor-displacing production processes. Finally, industrialization is often defined in terms of highly specialized production in which not only is a single commodity produced, but typically that single commodity is confined to one particular stage of the production process (e.g., the huge specialized farrowing operations of Murphy Family Farms,[5] or the specialized hog finishing operations of Iowa Select).

Characteristics of the Commodity Sector

While the farm-level referents for industrialization are clearly important ones, it should be stressed that conceiving of industrialization as a process of change in the broader agrofood commodity sectors may be more useful in understanding how, why, and to what extent industrialization of farming is occurring. One commodity-sector-related aspect of industrialization — the concentration of production — is an obvious one. Family-farming systems are dominated by large numbers of relatively independent property-owning producers, none of which control a meaningful amount of market share. Industrial sectors are those which have a relatively small number of key actors who can exert significant influence over the supply, quality, and price of the commodity. As illustrated in Table 1 above, there is evidence of significant concentration in many U.S. livestock production sectors.

A second commodity-sector-level characteristic of industrialization is integration across

Table 1. Indicators of Concentration and Vertical Integration Across Livestock Production Sectors in the United States.

	Type of Commodity Produced					
	Fluid Milk	Hogs	Broilers	Eggs	Turkeys	Fed Cattle
Number of farms in the United States in 1992[1]	155,339	206,450	35,759	88,235	10,566	147,201
Percent of farming operations with more than 1000 animal units (A.U.s) in 1992[2]	0.6	1.2	3.9	0.7	1.0	0.6
Percent of livestock on operations with more than 1000 animal units (A.U.s) in 1992[2]	13.2	26.6	26.4	59.8	25.1	70.7
Percent of total output under marketing contracts[3]						
1960	95.0	0.0	1.0	13.5	16.0	10.0
1980	95.0	2.0	0.1	5.0	10.0	10.0
1993/94	95.0	2.0	0.0	2.0	5.0	11.4
Percent of total output under production contract or integrated ownership (combined)[3]						
1960	0.1	1.4	95.4	12.5	34.0	*n.a.*
1980	0.3	3.0	99.0	88.0	80.0	*n.a.*
1993/94	0.1	21.8	99.0	95.0	88.0	*n.a.*

Notes: [1] = Based on 1992 Census of Agriculture.

[2] = Adapted from GAO, 1995:60; 1 A.U. is equivalent to 1.4 dairy cows, 1.0 beef cattle, 0.4 hogs, 0.02 turkeys, .01 ch

[3] = Adapted from Welsh, 1996:22-24.

segments of the commodity system. Integration can occur through *marketing contracts*, where producers agrees to sell their output to a processor or handler in advance, yet where the farmer retains managerial independence over how the animals are produced. Integration also occurs when producers sign *production contracts*, in which buyers exert some control over the inputs and production methods used to raise the livestock, and buyers often retain ownership of the animals throughout the production process. A more intensive form of integration that is particularly relevant to agricultural industrialization is that of *vertical integration* (e.g., processors integrating backwards into production directly or through franchising, producers integrating forwards into processing and marketing, or feed suppliers taking ownership of livestock and contracting with growers to raise them according to particular specifications). In hogs, where *horizontal integration* is more common, contracting has tended to consist of some very large "producers" contracting with other farmers to have their animals fed out under closely scrutinized conditions (Rhodes, 1995). Among the typical concomitants of contractual, vertical and horizontal integration is the loss of "open markets" for independent producers. Table 1 also illustrates the percent of total output that is produced under various contracting or integrated arrangements in the major livestock sectors.

The final commodity sector dimension of the industrialization of agricultural production is that of globalization of markets and of "regulation" (Bonanno and Constance, 1996). Increasing linkages to global trade in food products are a central characteristic of (and often an explanation for) an industrialized commodity sector. For example, increasing dependence on global trade can influence the evolution of U.S. domestic farm production sectors by forcing farmers to compete with low-cost countries, exposing farmers to new cycles of global price volatility, and — in some cases — constraining U.S. government efforts to regulate domestic production conditions (on environmental, economic, or social grounds) when they conflict with emerging codes of standards for international trade.

As we will stress below, analysis of the major patterns of change in the dairy commodity sector show that there has been modest levels of industrialization along some of the dimensions just discussed. For example, about 95 percent of fluid milk is produced under "marketing contracts" (Welsh, 1996:4). But it should be stressed that these marketing contracts consist almost entirely of agreements between farmers and their farmer-owned cooperatives that predated the livestock industrialization trend of the past few decades. It is also essential to recognize that the dairy production sector exhibits very low levels with respect to most other aspects of industrialization. This suggests that in the case of dairy production it is particularly critical to maintain a multidimensional conceptualization of industrialization, Industrialization should be treated in ways that transcend the indicators — particularly increased scale and growth in "corporate" dairy farming — that are typically stressed in arguments about how and why it is that dairying will become industrialized in a manner similar to the other major sectors of animal agriculture. This multidimensional conceptualization of industrialization will allow us to see that the changes that are occurring in the dairy production sector are neither monolithic, consistent, nor temporally or spatially even.

Evidence for Industrialization of U.S. Dairy Sector

As noted earlier, it has become increasingly common knowledge that the U.S. dairy sector is becoming industrialized and is following a path roughly comparable to that taken by the other major livestock sectors. In particular, there has been a great deal of fascination with growth in the numbers of very large dairy operations. For example, in the July 1995 issue of *Successful Farming* there was a lengthy feature article on the 20 largest American dairy farms (Looker,

1995). The article reported that Joseph Gallo Farms (Atwater, CA), owned by a relative of the famous winemaking family, is the nation's largest dairy operation, with about 14,500 cows and $50 million in gross sales. The nation's single largest milking facility is on Braum's Dairy Farm in Oklahoma, with 12,800 cows and a 200-cow milking parlor. The essential thrust of this article is that these mega-dairy farms are becoming much more common and are the wave of the future.

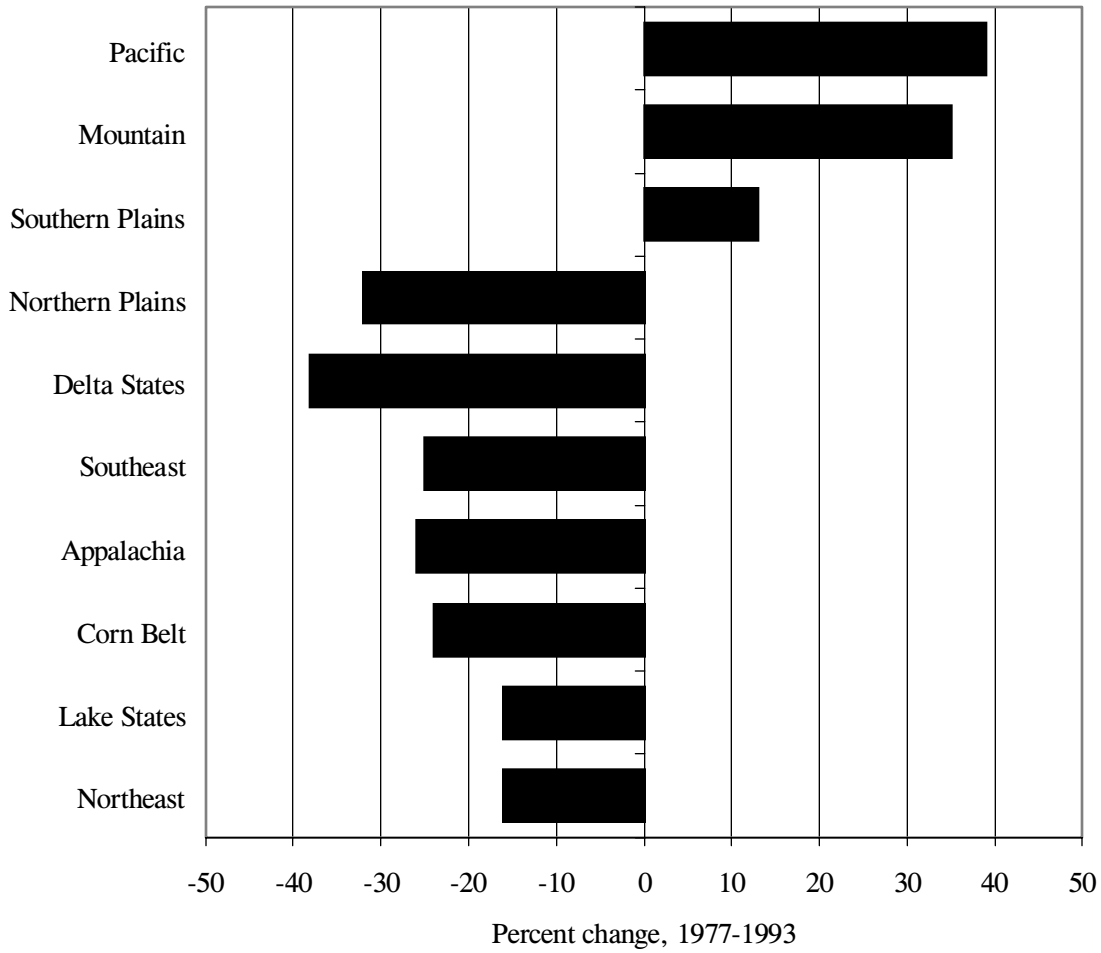
But beyond these anecdotal indicators of large-scale change in the dairy sector, there are a number of more systematic national-level data that seemingly buttress the notion of an ongoing industrialization trend in dairying. Many of the overall indicators of farm numbers, cow numbers, and milk production suggest that large dairy operations are becoming increasingly important to the U.S. dairy industry. Perez's (1994) ERS-USDA report, which itself leans toward an industrialization interpretation of dairy sector changes (though not in perjorative terms), provides one of the most comprehensive recent analyses of structural trends in dairying. She reports that there have been dramatic declines in the overall number of dairy farms in the United States (from about 402,000 in 1977 to 162,000 in the early 1990s). Despite the loss of farms and the fact that the number of milk cows declined significantly (from 10.9 million in 1977 to 9.7 million in 1993), aggregate U.S. production of milk actually increased by 23 percent because of technological change leading to increased milk yields. Importantly, milk cows and milk production have become rapidly concentrated among the largest herds. By 1993, nearly half of the U.S. dairy herd was concentrated on farms with 100 or more cows, compared to only about 30 percent of the U.S. dairy herd in 1978-80. Perez (1994) notes that while the traditional dairy states of the Northeast and Lake States are still significant milk production regions, there has been a dramatic regional shift in milk production from the traditional dairy belt to the old industrial dairy state (i.e., California), and especially to the emerging "industrial dairy states" of the West and Southwest (Washington, Idaho, Texas, and New Mexico). This regional restructuring of the dairy sector is portrayed in Figure 1 (Perez, 1994:9) and Table 2 (Perez, 1994:10-11).

Perez notes that there are several very strong rationales for a continued shift of milk production to the (old and new) industrial dairy states. There is an ongoing movement of the nation's population, and hence of demand for milk and dairy products, to these regions. Industrial dairy states have some cost of production advantages over traditional dairy state producers. For example, industrial dairy producers achieve some efficiencies in housing and facilities because they do not need to house cows during harsh winters, and because drier climates involve fewer mud and waste-hauling problems than is the case in the traditional dairy belt. Some of the cost advantages are the direct result of federal or state policies, including federal milk marketing orders (which artificially inflate farmgate prices in many of the industrial dairy states) and irrigation subsidies (which allow for cheap alfalfa production in the arid west). Finally, as Perez (1994) and many other analysts suggest, there may be technical economies of scale that provide competitive advantages to states that have larger proportions of very large operations. The implication is that if the states in the traditional dairy belt are to retain their share of production, their scales of production and technologies — or, in other words, their degree of industrialization — must be greatly advanced so that they can compete with the industrial dairy states.

Evidence of Countertendencies, Resistance, and "Friction"

While each of these claims about the regional restructuring of dairy production contains an element of truth, we would argue that there are sound empirical and theoretical reasons to believe that the dairy production sector is not undergoing a pronounced "industrialization"

Figure 1: Percent Change in Milk Cow Inventory
1977-1993, By Census Region



Source: Adapted from Perez (1994:9)

Table 2: Regional Milk Production and Share of Total U.S. Production

	1980	1985	1990	1993
Production (mil. lbs.)				
Lake States	36,885	41,103	39,663	38,154
Pacific	17,853	22,114	27,118	29,747
Northeast	26,139	28,681	27,142	28,028
Corn Belt	15,880	16,877	17,037	16,389
Mountain	6,131	7,812	9,486	11,271
Appalachia	8,415	8,689	8,248	8,003
Southern Plains	4,735	5,151	6,784	7,167
Southeast	4,546	4,461	4,926	4,984
Northern Plains	5,253	5,489	5,404	4,762
Delta States	2,569	2,635	2,506	2,449
TOTAL	128,406	143,012	148,313	150,954
Share (percent)				
Lake States	28.7	28.7	26.7	25.3
Pacific	13.9	15.5	18.3	19.7
Northeast	20.4	20.1	18.3	18.6
Corn Belt	12.4	11.8	11.5	10.9
Mountain	4.8	5.5	6.4	7.5
Appalachia	6.6	6.1	5.6	5.3
Southern Plains	3.7	3.6	4.6	4.7
Southeast	3.5	3.1	3.3	3.3
Northern Plains	4.1	3.8	3.6	3.2
Delta States	2.0	1.8	1.7	1.6
TOTAL	100.0	100.0	100.0	100.0

Source: Adapted from Perez (1994:10-11)

trend. First, and of critical importance, is the fact that very few dairy production units assume a comprehensive industrial character. Dairy farms of the sort operated by Gallo, Hettinga, Aurora, and Braum are extremely rare. They are so rare, in fact, that data on their incidence cannot be reported because of census disclosure problems. Further, even the very largest of dairy farms are fairly small operations compared to, for example, Murphy Family Farms in the hog sector. Gross annual sales of the Joseph Gallo Farms is probably less than five percent that of Murphy Family Farms in hogs, and Decoster Farms in poultry and hogs.

Census of Agriculture data show that U.S. commercial dairy production is still dominated by relatively small units of production, most of whom receive the majority of their farm income from the sale of dairy products (See Table 3). During the 1980s, most of the dairy farms leaving the industry were smaller herds with significant non-dairy enterprises. Herd size has increased steadily, but generally not to the scale associated with industrial production. Importantly, the social relations of U.S. dairying remain distinctively non-industrial. While most dairy farms utilize modest amounts of hired labor — which has always been the case because of the seasonality and labor intensity of dairying — only a minority have any full-time hired help, and a significant portion of the hired labor working in the dairy sector is comprised of members of the operator's family. There is relatively little absentee ownership of dairy assets; most operators of dairy farms are full- or part-owners, and a majority of the land in dairy operations is owned by the person operating the farm. Sole-proprietor operations continue to predominate in the U.S. dairy sector, and there are very few nonfamily corporations (indeed their proportions *declined* during the 1980s). Farms that are owner-operated by a resident farm operator who does not work at an off-farm job remain the norm, though there is evidence that an increased proportion of dairy farm spouses have taken off-farm employment in recent years (Jackson-Smith, 1995).

Second, it is critical to keep the regional character of U.S. milk production in proper perspective. Perez's (1994) own data show that only 36.8 percent of milk production in the most recent year for which data were available (1993) was accounted for by the Southeast, Delta, Southern Plains, Mountain and Pacific states (where most industrial dairy production is located). The share of production in the family-farm regions — the Northeast, Lakes States, Corn Belt, and Northern Plains states — was 57.9 percent. Moreover, it is worth noting that expansion of production in the western and southwestern dairy areas did not come at the expense of the Northeast and Lakes States, but rather was compensated by sharper declines in cow numbers in the Corn Belt, Appalachia, the Northern Plains, and in the two southern regions (Southeast and Delta). Thus, the traditional dairy belt remains as a very significant dairy producing zone in the U.S.

Third, many common portrayals of structural change in the traditional dairy belt also exaggerate the pace, extent, and impacts of dairy industrialization there. The experience of structural change in Wisconsin typifies the sort of modest, non-industrial change that is occurring in dairying throughout this region. Average herd size in Wisconsin increased from about 40 cows in 1980 to just over 54 cows in 1995. Time-series observations indicate that most herd expansions that have occurred have been incremental growth on a moderate scale (say from 50 to 70 cows), and have as much to do with natural growth and contraction cycles of a family business lifecycle as with efforts to increase scale to respond to declining profit margins (Jackson-Smith and Barham, 1996). While herds as large as 1000 cows can be found, they represent the exception rather than the rule. Herds of 100 or more represented only 10 percent of farms, and had roughly a quarter of

Table 3. Structural Characteristics of U.S. Dairy Farms, U.S. Census of Agriculture, 1982 and 1992.

	1982	1992
Number of Farms Selling Any Dairy Products	277,482	132,092
Number of SIC Code Dairy Operations[1]	164,472	113,412
Percent of Dairy Farms in SIC category	59.3	85.9
Farms by Milkcow Inventory (percent)		
Under 50	58.6	48.5
50 to 99	30.0	34.3
100 to 199	8.4	11.7
200 to 499	2.3	4.0
500 or more	0.6	1.5
Farms by Hired Labor Use (percent)		
Reported any hired labor expense	62.9	60.2
Reported full-time hired labor expense[2]	41.0	40.0
Farms by Tenure Status (percent)		
Full Owners	43.6	37.5
Full Tenants	10.2	11.3
Aggregate Proportion of land owned	69.6	65.5
Farms by Organizational Type (percent)		
Sole Proprietorship	81.9	80.7
Partnership	15.5	15.6
Family Corporation	2.5	3.5
Nonfamily Corporation	0.2	0.1
Principal Operator Characteristics		
Average Age (years)	47.4	49.0
Lives on Farm (percent)	94.7	93.1
Principal Occupation is Farming (percent)	92.7	92.4
Works at Off-Farm Job (percent)	23.0	20.3
Works more than 200 days off-farm (percent)	8.2	8.4

Notes:

[1] Farms whose main source of income is the sale of dairy products only (SIC code 024) All of the data in the remainder of the table refers only to SIC-code dairy farms.

[2] Includes workers who worked more than 150 days a year.

milk cows in 1995 (Wisconsin Agricultural Statistics Service, 1996), and changes in herd size distribution in recent years have been predominantly incremental and moderate (in fact, growth in average herd size in Wisconsin was much lower on an annual basis in the last 5 year period, compared to similar periods between 1950 and 1990). The most dynamic aspect of restructuring in Wisconsin is the net loss of dairy farms, which has averaged between 4 to 5 percent a year for well over a decade. While entry into dairying has slowed relative to its rate in the 1970s, it is striking that almost all of the young people who enter dairying in Wisconsin do so at modest scales of production (Barham et al., 1997), almost always involving herds of fewer than 100 cows using conventional stanchion barn housing, and are diversified crop-livestock enterprises producing most of their own feed with primarily family labor.

Fourth, it is becoming increasingly apparent in the traditional dairy belt that most state-of-the-art, capital-intensive dairy production technologies — total mixed ration (TMR) equipment, automated or computerized feeding systems, recombinant bovine somatotropin (rBST), full-confinement housing, contract heifer raising, and so on — are not only adopted on a limited basis (PATS, 1996; USDA-APHIS, 1997), but also appear to be viable for use on modest-scale farms that rely primarily on family labor. In addition, these "industrial-type" production technologies are not necessarily superior to alternative, low-capital technologies available to moderate-scale producers. In Wisconsin, for example, management intensive rotational grazing (MIRG) has been widely adopted by producers, and is now utilized by a larger percentage of Wisconsin dairy operators than is rBST (roughly 15 and 12 percent, respectively, in the spring of 1997). A range of studies have shown that MIRG farms can be economically competitive with larger confinement enterprises (Jackson-Smith et al., 1996). Most importantly, the competitiveness of MIRG as a production system increases the options for young people to enter dairying at a moderate scale with a modest level of capital investment; almost a third of new dairy entrants identified in the spring of 1996 reported the use of MIRG in Wisconsin (Barham et al., 1997).

Finally, it is worth noting that there is no small amount of social resistance to industrialization of dairying in much of the traditional dairy belt. Our own survey data from Wisconsin (Buttel and Jackson-Smith, 1997) show that dairy farm operators are highly opposed to public encouragement of industrial-type dairy operations and of large-scale expansion of livestock enterprises in general. There are a number of activist groups (National Raw Milk Pricing Association, MIRG networks, and rural public interest groups such as Wisconsin Rural Development Center, Minnesota Farmers Alliance, and Land Stewardship Project) that actively encourage family-scale dairying, and resist public policies and agricultural research and development programs that are perceived as subsidizing large dairy operations.

Explaining the Uneven Character and Pace of Industrialization

In order to make sense of the uneven process of industrialization across livestock sectors (and within the dairy sector itself), it is helpful to review the factors that have been linked to the industrialization process for other commodities. While the dairy sector is by no means insulated from the forces propelling the industrialization of livestock (and other agricultural commodities), we will demonstrate that a number of conditions within the dairy commodity chain appear to be distinctly unfavorable to thoroughgoing industrialization of dairy production, at least any time in the foreseeable future.

Technological Change and Economies of Scale

The most commonly held view of the industrialization process is that it occurs as part of a natural set of adjustments to a changing eco-

nomic environment. The impetus for change is typically a technological advance. Technological changes or breakthroughs are seen as leading to increased labor or capital efficiencies that can both decrease commodity product prices and generate pressures to increase the scale of operation in order to capture optimal economic returns. This so-called technological treadmill (Cochrane, 1993) is thought to force producers to choose between "getting big" or "getting out" as each successive innovation works its way through the sector.

Industrial-type agricultural production is also facilitated by technical or institutional innovations that minimize the inherent risks associated with biological systems and market volatility. To the degree that the farm production process can be routinized, systemized, and supply spread out evenly throughout the year, investment of nonfarm capital in agriculture is assumed to become more attractive (Mann and Dickenson, 1978). Increased understanding of biological processes within agriculture, particularly, have led to opportunities for industrial- or factory-like production processes within some agricultural subsectors (Boehlje, 1997). While intuitively attractive as a tool for explaining the dynamics of change in the farm sector, the technological model of industrialization has serious shortcomings. Certainly, it is not clear that removing technical barriers to large-scale or routinized production is a sufficient precondition for the industrialization of a commodity sector. Friedland et al. (1981), for example, have shown how the timing of adoption of mechanized harvesting equipment in California was conditioned by the relative cost and availability of cheap hired labor, on the level and stability of market prices, and on technological and institutional developments in the downstream commodity wholesaling and retailing sectors.

Within the dairy sector, the technologies that make large-scale dairying possible have been available to producers for decades. Using a number of innovations — automated milking equipment, labor-efficient parlor facilities, freestall housing, and total mixed ration feeding systems — dairy producers in the United States and elsewhere have built operations capable of milking well over 1,000 dairy cattle since the 1970s (Matulich, 1978). In recent years, herds as large as 10,000 to 12,000 cows at a single site are not unheard of. Parallel improvements in genetics, disease control, and so on have also been readily available for 20 or more years.

But despite the fact that essentially the entire technological package required for industrial-scale dairy farming has been in existence for two decades, relatively few extremely large units of production — with annual gross sales of $10 million annually — exist in the late 1990s. A key reason for this is the fact that all of the technologies mentioned above appear to be economically viable on relatively modest-scale operations (i.e., on farms with 250 to 500 milking cows, or even on farms with as few as 100 to 150 cows). For most producers, changes in technology have facilitated incremental growth in herds (a single family with part-time hired help can now easily milk 70 to 100 cows using modern techniques).

Indeed, the economic research literature provides conflicting evidence for real economies of scale in dairying, and it is unclear just how much of an imperative there is in the sector to grow to an industrial-type scale. Moschini (1988; 1990) used multiproduct cost-function models and found positive returns to scale for most Ontario dairy farms. Kumbacher et al. (1989) found that all Utah dairy herds appeared to be economically inefficient, but that larger firms were less inefficient than smaller ones. Meanwhile, Hoch (1976) used a production function approach but found little convincing evidence of long-run returns to scale among California dairies. In Wisconsin, farm financial records from over 900 dairy farms revealed that basic costs per hundredweight were only slightly lower for the largest firms in the sample, and

that there was tremendous variation at all levels of scale, suggesting that it was possible to be economically efficient (or inefficient) at both 50- or 500-cow operations (Frank and Vanderlin, 1995; Frank, 1997). Within dairying, there is also evidence of significant diseconomies of scale that are associated with labor incentive and monitoring problems typical of very large operations (Reinhardt and Bartlett, 1989; Kramer, 1977).

While there is little doubt that there has been a significant technological dimension to structural change in dairying and that industrialization at the level of the individual farm tends to require use of a cluster of "modern" technologies, there is ample evidence that structural change in dairying is not merely a technologically-driven process. New technologies have clearly facilitated much of the growth in scale and herd size, but have done so within bounds that can be accommodated on a family-labor and family-proprietorship basis.[6] Dairy animals are particularly sensitive to skilled management, and the difficulties of care and monitoring of dairy animals on large operations by hired workers place major limits on how far and how fast dairy industrialization at the level of the individual farm can proceed. Further, it is characteristic of dairy agriculture that production technologies tend to involve large sunk costs that both discourage investments in new technologies and discourage abandonment of older technological systems. As an example, a modern 12-cow milking parlor might involve an investment of $50,000 or more, but because it cannot be moved or sold apart from the rest of the farming operation it would depreciate by half or more the day after it is installed. There is also emerging evidence that one of the advantages of MIRG technology relative to the capital-intensive confinement package is that intensive grazing systems tend to minimize very significantly the high-sunk-cost, low-salvage-value investments that discourage technological change in conventional dairying in the traditional dairy belt. The important point about structural change in the dairy production sector is thus that it may be facilitated by technological change but is much more fundamentally a product of social relations.

Consumer Demands

As noted by Welsh (1996) in his review of the literature on industrialization of agriculture, there have been a variety of claims by proponents of agricultural industrialization that consumer demands have been a driving force behind the push for industrial-style production in the poultry and pork sectors. Specifically, many have argued that livestock commodity chains have begun to undergo restructuring in response to a consumer-driven imperative to shift from production of mass commodities to a system geared to be responsive to retail consumer preferences (e.g., for lean, cheap, consistent product). Most small- or mid-sized livestock producers are argued to be unable to provide a steady supply of their products throughout the year. An open-market system combined with a farm sector dominated by decentralized family producers using technologies that are accommodated to weather and natural biological rhythms is thought to contribute to the traditionally strong seasonal fluctuations in the supply and quality of livestock products.

Many observers have therefore argued that integration between producers and the processors/wholesalers/retailers is necessary to ensure market signals are transmitted from the consumer of livestock products back to the original producers (Drabenstott, 1994). Larger, highly automated production systems with centralized managerial control are seen are more capable of providing the quality control, routinization, and systemization required to produce more consistent products. Thus, contractual integration combined with technologies and management systems that insulate the production process from natural vagaries and seasonal rhythms are seen to be necessary to meet consumer demands for consistency and quality (Boehlje, 1997).

This is not to argue that the downstream consumption segments of agricultural commodity chains are unimportant in shaping structural change in livestock production systems. It is essential, however, to distinguish between household and institutional consumers. As Welsh (1996) has demonstrated, there is precious little evidence that individual consumer preferences have significant effects on the tendency toward industrialization. The real engines behind the perceived consumer preferences for consistency are the demands of packers, processors, and retailers — that is, "institutional consumers." Further, packers and processors can affect the structure of livestock enterprises in ways that transcend quality and consistency considerations. In the case of the pork sector, for example, the new geography of industrial pork production has been shaped by the preoccupation of packers and processors to locate in "right-to-work" states (e.g., North Carolina, Iowa) and to disinvest or abandon production in closed-shop union states such as Illinois and Wisconsin.

In dairy, individual or institutional consumer preferences and consistent year-round supply do not appear to be important factors that would drive a process of industrialization. For one thing, fluid milk remains the prototypical undifferentiated commodity, and even multiple component pricing (MCP) appears to have played an insignificant role in influencing the structure of dairy operations. Most other major dairy products (butter, cheese, and ice cream) are also relatively undifferentiated commodities, and most discernable product differences among them have little to do with the characteristics of the raw milk they originated from.[7] While milk production can fluctuate somewhat with seasonal conditions, most dairy farms — in contrast to other small- and medium-scale livestock enterprises — sell their products daily throughout the year. As a result, there is little advantage (in terms of consistent and reliable supply) to procuring raw milk from industrial-scale operations.

Finally, value-added opportunities in the U.S. dairy sector have been quite limited, and imported specialty products have tended to dominate this market. To the degree that specialty cheeses are becoming a growing segment of the U.S. dairy products industry, cooperatives catering to family-scale producers are more likely to be involved than the mega-dairy operations of the new industrial dairy states. One might argue, in fact, that reorienting the sector from a commodity-based to a marketing-based industry may lead in directions that could provide opportunities for non-industrial dairy production.

Institutional and Policy Environment

It is well appreciated that market outcomes, farm structural trends, and dynamics of technological change in livestock production are often shaped by policies and other institutions (Cochrane, 1993). Tax policies, for example, may either encourage or discourage capital investment. Federal commodity programs have also influenced the prices farmers receive for their products and pay for their (feed) inputs. Environmental programs and policies set the standards (or lack of them) for farmer environmental behaviors, and labor and immigration policies can seriously affect supply of low-cost farm labor. In many cases, local labor market conditions can be critical to regional patterns of investment in large-scale, industrial-type livestock production.

A number of analysts have documented how growth in industrial dairy states has been driven, in part, by the public policy environment (Gilbert and Akor, 1988; Jesse, 1995). In a typical dairy operation about one-third or more of the cost of production is feed. The availability of inexpensive grain and forage have been critical to the establishment of "drylot" dairy operations of the sort that have led the dairy boom in the new industrial dairy states. Federal commodity programs have led to relatively stable and declining real feed grain prices, while heavily

subsidized irrigation water has made it possible to produce inexpensive and high quality alfalfa hay in the semi-arid areas of the West and Southwest. The availability of relatively cheap labor in the Sunbelt dairy states has also played a major role.

Unlike other livestock sectors, the dynamics of investment and structural change in dairying are critically affected by federal dairy price policies. Since the 1930s, dairy policy has tended to discriminate against the traditional dairy states because the federal milk marketing order system guarantees higher fluid milk prices in states located farthest from the price "basing point" in Eau Claire, Wisconsin. State pricing systems in California, in particular, have allowed producers to benefit from higher milk marketing order prices only available in their state, while also maintaining the ability to dump surplus milk through government purchase programs designed to protect the federal milk price floor. While higher fluid prices lead to higher "blend" prices actually received by farmers in many cases, they also allow manufacturing plants to pay artificially low prices for manufacturing grade milk (about two-thirds of the milk sold in the U.S. goes into the non-fluid milk chain). The result has been a gradual shift in manufacturing capacity to the South and Southwest over the last decade.

As limited as farm-level industrialization of dairy production has been, much of the industrialization that has occurred can be attributed to this combination of public policies. A cursory look at contemporary political trends, however, also suggests that several key components of this institutional environment could well be decisively reversed in the near future. For example, publicly-subsidized irrigated alfalfa production is a sufficiently outrageous example of "corporate welfare" so that several projects devoted primarily to irrigated alfalfa production in the Western states were placed on a bipartisan Congressional "corporate welfare hit list" in the spring of 1997. There is also a tremendous amount of regionally-based grassroots activism lobbying against the inequities of the federal dairy program (especially the milk marketing order system). If the institutional structure that has supported industrial dairies in the West begins to crumble, the traditional dairy belt, particularly the Upper Midwest, may be better positioned to exploit a number of the comparative advantages they have — rainfed feed production, relatively inexpensive land, a substantial infrastructure of dairy manufacturing plants.

Perhaps the biggest threat to industrial dairying looming on the horizon is the possibility of stringent environmental regulation of livestock manure. In dairy, as in livestock production in general, manure disposal can potentially be a very significant constraint on scale. The biological character of dairying under intensive confinement practices is that while a great deal of phosphorus is brought on to the farm in the form of grains and forage — and often even fertilizers — virtually no phosphorus leaves the farm in milk and cattle. Phosphorus will therefore tend to build up over time, creating the potential for serious surface and groundwater pollution problems (Sharpley, 1996). Where environmental laws are stringent and strictly enforced, significant investments will be required to manage livestock wastes in an environmentally satisfactory manner. In some situations, these investments may not make sense, particularly on the largest enterprises which typically have an inadequate land base for effective on-site disposal (Frame, 1997). Animal manure odors and pollution also tend to generate local resistance to industrial-type livestock production facilities which can lead to ordinances or laws that restrict the siting of industrial-scale operations (Lasley, 1997; Buttel and Jackson-Smith, 1997).

In a related fashion, perhaps the most significant wild card relating to animal manure and farm-level industrialization concerns the fact that industrial livestock facilities, particularly in

the states with low rainfall, are premised on volatilization of the nitrogen and organic matter components of manure. Manure, in other words, is essentially disposed of rather than utilized as a soil amendment. It is not impossible that rising fertilizer prices or environmental policy will provide a strong incentive to take into account the nutrient and soil amendment value of livestock manures. This may well lend competitive advantages to firms that are capable of utilizing their manures in their own crop rotations.

"Globalization" of Markets

The globalization imperative or juggernaut, depending upon one's point of view, is often viewed as critical determinant of why the livestock production sectors and the upstream and downstream components of their commodity systems are undergoing restructuring. The creation of global-scale markets or the development of cross-border commodity chains or complexes may contribute to farm-level industrialization processes through the generalization of market competition or of product standards.

Table 4 reports data we have computed from USDA statistical sources on the export share of production and import share of consumption (defined as "domestic disappearance") for 1970, 1975, 1980, 1985, 1990, and 1995 (with forecast data for 1997) for four important livestock commodities: beef and veal, pork, chicken, and cheese. Data were computed on the basis of metric tons of product in order to control for changes in commodity prices and inflation over time. Cheese was chosen to represent the dairy sector in terms of production, disappearance, imports, and exports because cheese dominates world dairy trade in both volume and value, and because it is not appropriate to sum the tons of a changing mix of the total amount of exported and imported dairy commodities over time. We take the export share of domestic production and the import share of domestic consumption/ "disappearance" to be indicators of the degree of globalization — or integration with world markets — of the U.S. livestock production and consumption sectors.

The results show that the cheese sector — and, by extension, U.S. dairy production as a whole — is not nearly as integrated into world markets as are the other major livestock sectors. There has been a steep increase, for example, in the export share of domestic production of beef and veal from 1970 to 1995 (0.13 percent and 7.13 percent, respectively), while the import share of disappearance of beef and veal has remained relatively stable at a relatively high level (5.74 and 8.13 percent, respectively). The data also show a tremendous surge in the export share of domestic production of chicken between 1970 and 1995 (2.15 and 15.77 percent, respectively). Imports of chicken have been so low that the government has only recently reported data. While pork is not yet as globalized as beef and veal and chicken, the data in Table 4 show rapid growth in the export share of domestic pork production since 1990. Preliminary data for all three meat commodities suggest rapid growth in both imports and exports in the last few years, presumably linked to the liberalization of international trade.

The data concerning U.S. trade in cheese exhibit trends quite different from those of the other three commodities. The export share of domestic production of cheese has remained trivial over time, having never approached 1.0 percent of domestic production. The import share of cheese consumption is currently substantial (4.67 percent in 1995), but the data in Table 2 show that the import share of domestic consumption of cheese has decreased over every five-year interval since 1970. In addition, the most significant dairy product — fluid milk — scarcely enters long-distance trade channels. It would thus appear that if we measure globalization as we have done, there is, if anything, a trend toward decreased globalization of dairy production and consumption.

Table 4: U.S. Production and Trade in Major Livestock Commodities, 1970-1997

Year	Production	Exports	Export Share	Disappearance	Imports	Import Share
			(metric tons)			
			Beef and Veal			
1970	10,114,896	13,278	0.13%	10,675,295	612,420	5.74%
1975	11,284,741	20,693	0.18%	11,931,880	596,353	5.00%
1980	10,010,445	59,503	0.59%	10,890,100	684,997	6.29%
1985	11,009,537	109,528	0.99%	11,832,879	658,753	5.57%
1990	10,476,839	347,708	3.32%	11,060,854	762,737	6.90%
1995	11,585,322	826,000	7.13%	11,726,390	953,915	8.13%
1997*	11,486,376	869,664	7.57%	11,680,745	1,063,124	9.10%
			Pork			
1970	6,675,295	26,674	0.40%	6,658,038	157,691	2.37%
1975	5,349,228	91,153	1.70%	5,349,228	148,389	2.77%
1980	7,546,322	84,218	1.12%	7,646,685	196,591	2.57%
1985	6,724,342	40,723	0.61%	7,204,814	423,844	5.88%
1990	6,972,752	82,187	1.18%	7,280,200	344,208	4.73%
1995	8,096,253	349,723	4.32%	8,066,769	301,188	3.73%
1997*	7,777,475	665,304	8.55%	7,955,041	274,750	3.45%
			Chicken			
1970	3,843,778	82,652	2.15%	3,737,057	0	0.00%
1975	4,006,812	123,978	3.09%	3,910,082	0	0.00%
1980	5,499,092	354,678	6.45%	5,146,685	0	0.00%
1985	6,378,292	198,910	3.12%	6,164,850	0	0.00%
1990	8,607,175	530,427	6.16%	8,066,303	0	0.00%
1995	11,486,437	1,811,213	15.77%	9,631,679	0	0.00%
1997*	12,356,948	2,198,002	17.79%	10,133,969	1,817	0.02%
			Cheese[1]			
1970	999,500	3,055	0.31%	1,069,482	73,000	6.83%
1975	1,268,000	3,879	0.31%	1,414,623	81,413	5.76%
1980	1,790,000	5,715	0.32%	1,833,333	104,850	5.72%
1985	2,279,000	15,695	0.69%	2,498,183	137,216	5.49%
1990	2,739,000	11,885	0.43%	2,829,700	137,086	4.84%
1995	3,138,000	28,000	0.89%	3,274,000	153,000	4.67%
1997*	3,330,000	35,000	1.05%	3,445,000	155,000	4.50%

Source: USDA Agricultural Statistics

* Forecast

[1] = Cheese is used to ensure consistency across all years (since mix of dairy products shifts between different products each year. For comparison, FAO estimates suggest that roughly 2.5 percent of production of milk and all milk products were exported, while 5.6 percent were imported in 1995.

The dairy industry in the United States appears to be is primarily a domestic market. Domestic dairy prices remain protected from international competition since trade liberalization agreements have thus far tended to bypass the dairy sector. Similarly, shifting international standards for dairy products have yet to play a significant role in debates over possible regulation of dairy production practices (as they have, to a greater to degree, with U.S. beef, poultry, and pork production). It is plausible, of course, that the future might hold some significant changes in the institutional character of global trade in dairy products. For example, the expansion of the European Union might create pressure for "reforms" in Europe, which would precipitate declines in domestic protection elsewhere and possibly open new markets for U.S. dairy products (USDA, 1997). But for the foreseeable future, the dairy production sector will be far less subject to the generalization of global competition or of global product standards than are the other major livestock sectors. The globalization impetus to "industrialization" is thus likely to be less important.

Market Concentration among Buyers of Raw Commodities (and Pressures to Vertically Integrate)

Previous research on the farm-level industrialization of poultry, feedlot cattle, and pork has demonstrated that market restructuring has generally preceded and contributed to the development of industrial-type production facilities (Heffernan and Constance, 1994). Concentration among the packing and meat processing industries has been such that there have been growing pressures on the federal government to address concerns about market concentration and access (USDA, 1996).

In dairying, however, there has generally been relatively little problem with access to markets. In most of the major dairy regions there are a number of cooperatives and other milk handlers that tend to compete to some degree for members/patrons. There are, of course, some very significant marketing-related issues in dairy. The key marketing issues, however, revolve around volume premiums to and preferential treatment of large producers and around the fairness of the federal milk marketing order system and the "Northeast Compact." There is virtually no direct investment in dairying by feed suppliers, processors, and other agribusiness firms.

Cooperatives purchase the vast bulk of fluid milk and a sizable share (25 percent) of manufacturing grade milk from dairy farmers. Dominance by milk cooperatives is, in fact, likely to be one of the major long-term forces militating against farm- and commodity-sectoral industrialization in dairy. One of the core principles of cooperative organization is the fact that there is considerable pressure on cooperative managers to keep individual producers in business. Second, the fact that cooperatives preceded the forces for livestock industrialization over the past few decades suggests that co-ops have essentially preempted the space that might otherwise have been filled through contracting or other forms of vertical integration and market coordination.

Concluding Remarks

We have aimed to present evidence that while U.S. dairying is undergoing significant restructuring, an omnibus or undifferentiated concept of industrialization is not a very useful way to depict these changes. Industrialization of dairy production has been only very partial, and very uneven. It is also by no means a sturdy or inevitable trend, since it has been based on a variety of factors — "corporate welfare" in the form of subsidized irrigation water for producing alfalfa, avoidance of the long-term potential for pollution problems, the waste of valuable animal manure, and so on — that are subject to change. Family-scales of production do not appear to suffer from significant technical economies of scale. The Great Lakes dairy

heartland, in fact, would appear to have some significant advantages over the West, Southwest, and Great Plains states which counteract some of the Great Lakes states' competitive disadvantages. Management Intensive Rotational Grazing and other low-investment, low-cost production practices represent alternative approaches that are particularly well suited to family-scale operators in the traditional dairy belt who are lacking in access to capital.

Our argument is that the U.S. dairy production sector is not yet undergoing a pronounced industrialization trend — certainly when compared to hogs, poultry, or fed cattle — and is unlikely to do so in the future. The evidence suggests that industrial-style units of production (at the farm level), and industrial relations of production (at the sectoral level), and globally-linked industrial processing and distribution food chains have yet to emerge as the dominant actors in the dairy economy. We have outlined a series of distinctive characteristics of the dairy commodity chain which help us understand why industrialization has been slow to penetrate this particular sector.

At the same time, it would be inaccurate to say that neo-Chayanovian family-scale dairy farms are thriving in the 1990s. In fact, the net exit rate (exiters - enterers / total farms) among dairy farmers is very high, much as is the case for the other major livestock sectors. The net exit rate in Wisconsin dairying this past year, for example, is approximately 7 percent on an annualized basis. Small and mid-sized family dairy farms have been particularly likely to exit. Much of this surge in net exit rates over the last 15 years is accounted for by a substantial decrease in the rate at which young farmers have been entering dairy farming (Jackson-Smith, 1995). Dairy prices have declined by over 50 percent in real terms, and are now considerably lower in even nominal terms than they were in 1980. Dairying is now more Hobbesian than it is Chayanovian.

Even so, neo-Chayanovianism contains a certain kernel of truth that should be recognized as we move forward theoretically in the sociology and political economy of agriculture and empirically in the study of dairy commodity systems. Even the most "industrialized" commodity systems are premised on non-industrial production (or on forms of production that are accommodated to but cannot transcend natural production processes; Goodman et al., 1987). Vertically coordinated broiler production, for example, is inconceivable without cheap feedgrains produced by family/household producers upstream in the commodity system. Second, and an observation particularly germane to dairying, is the fact that family systems of production may not be quite as efficient as "industrial-type" ones — but they do not need to be. Family producers can persist even if they do not receive the average rate of profit or above. Industrial producers, by contrast, are likely to behave essentially as portfolio managers, and thus be prepared to move their money capital somewhere else if it is not performing at the average rate of profit in agriculture. Family producers do have a good many of the other competitive advantages and can undertake many of the strategies — squeezing household consumption during difficult times, deploying family members in the farm labor on a flexible basis, part-time farming — described by the neo-Chayanovians (Reinhardt and Barlett, 1989). Capitalized family-scale dairy producers can also access MIRG and other low-capital technologies which can help them survive. They may also be best able to organize themselves — or to be organized by cooperatives or other milk handlers — for production of relatively high-value specialty dairy products. Our theoretical perspectives thus need to recognize that both agrarian structure in the traditional sense — that is, farm structure — as well as in the more contemporary sense — of commodity systems/chains/regimes and globalization — are equally important.

Endnotes

[1] Revised version of a paper originally presented at the annual meetings of RC-40, Research Committee on the Sociology of Agriculture, International Sociological Association, and the Rural Sociological Society, Toronto, August 17, 1997.

[2] Associate Director, Program on Agricultural Technology Studies, and Faculty Associate, Department of Rural Sociology, University of Wisconsin-Madison.

[3] Co-Director, Program on Agricultural Technology Studies, and Professor of Rural Sociology and Environmental Studies, University of Wisconsin-Madison.

[4] The focus on industrialization of animal agriculture, both in terms of social resistance and research, was very strongly propelled by various segments of the sustainable agriculture movement (including sustainable agriculture groups and researchers working on the umbrella of the regional SARE programs).

[5] Murphy Family Farms is a family-owned and managed business that contracts industrial-scale hog production out on a large number of hog farms throughout North Carolina and increasingly in the midwest.

[6] Many of the apparent economies of scale in dairying are pecuniary economies (e.g., volume premiums). It is also essential not to confuse economies of scale in dairying, which are modest, with economies of scope (increased scale and sales volume aimed at increasing the mass but not the rate of profit).

[7] Certainly, whether milk comes from a 50-cow traditional stanchion barn or a 5,000 cow parlor facility has little bearing on the composition or quality of the raw product, as long as both enterprises meet the criteria for selling Grade A milk.

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