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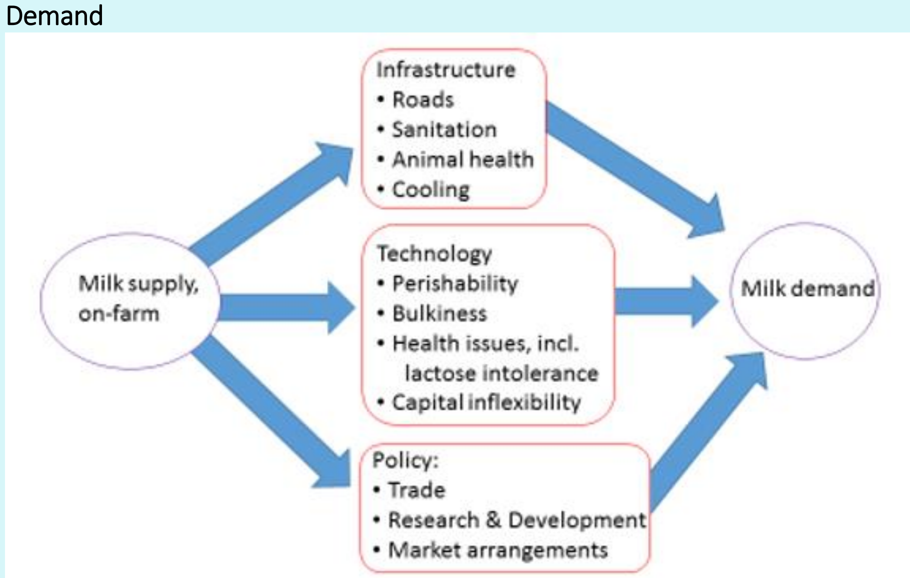
America’s Dairy Industry Facing Difficulties from Long-Running Structural Changes

David A. Hennessy and Hongli Feng

JEL Classifications: Q12, Q18
Keywords: Dairy farmers, Farm survey, Marketing orders, Milk industry organization

Figure 1. The Importance of the Interface between Dairy Supply and Dairy Demand



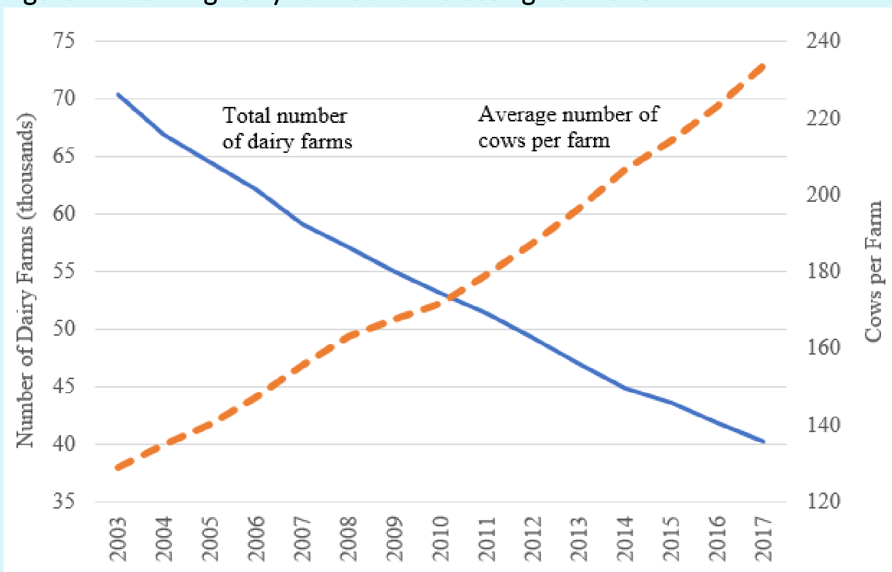
Trade in the market for cow’s milk has always been severely constrained by our understanding of the underlying biology needed to create and protect dairy products, by demand limitations related to tolerance and health implications, and by the state of economic infrastructure. Being close to a complete food, the potential demand for dairy produce has never been in question. As ruminants make good use of land unsuitable for cultivation and as, in any case, humans had learned to husband ruminants for meat production, bovine milk has never been limited in availability. Throughout history, as indeed today, the question has always been in bringing potential supply to potential demand. The primary product’s perishability and bulk has required that produce be either consumed or transformed immediately, and so locally. Production and transformation require long-term capital investments that leave investors vulnerable to both market vagaries and counterparties during bargaining. The story of dairying, therefore, has revolved around innovations in science and in pertinent economic infrastructure as well as formal arrangements to protect against market and bargaining situations. Figure 1 illustrates this connection, in which many of the impediments to dairy expansion have arisen at the interface between supply and demand. Topical market and policy issues have through time generally reflected the importance of the interface. This is as true today as it was a century ago.

The themes addressed in these papers are topical. The U.S. dairy industry has recently attracted national attention. The country as a whole lost over 10,000 licensed dairy farms in 2017. It is common to read news of dairy farms having to sell their milk cows and dealing with the consequences of losing their livelihood and tradition of lifestyle.

In the recent much-publicized renegotiation of the NAFTA trade agreement with Canada and Mexico, President Trump called dairy "a deal breaker." The newly re-drafted NAFTA (renamed USMCA) will, if approved by Congress, allow the American dairy industry somewhat easier access to the Canadian market. As with the sorts of problems regarding U.S. milk marketing arrangements that several of the papers in this theme discuss, the devil is in the details. It pertained to interactions between regulations and a technologically advanced product form, namely ultrafilter separation, which can reduce milk transportation and storage costs while enhancing processability and better meeting consumers' taste preferences.

However, a quick look at the dairy industry's evolution in recent years suggests that this hard-fought deal is unlikely to have a major impact on the difficult situations that many farmers currently face, which are merely manifestations of some long-running and continuous changes in the dairy industry. Over the past few decades, the dairy industry has consolidated, resulting in many fewer dairy farms and many more large farms, declining from nearly 650 thousand in 1970 to just over 40 thousand dairy farms in 2017 (see Figure 2 for recent trend). The median farm size increased nine-fold, from less than 100 cows per farm in the 1980s to about 900 per farm in 2012 according to the most recent available data (MacDonald, Cessna, and Mosheim, 2016).

Figure 2. Declining Dairy Farms and Increasing Farm Size



Source: The National Agricultural Statistics Service of the U.S. Department of Agriculture: https://www.nass.usda.gov/Quick_Stats/index.php.

While both butter and cheese can be made on-farm, centralized transformation has long been preferred to take advantage of scale and specialized knowledge. Since the early nineteenth century, innovations in transportation, storage, and refrigeration technologies (Goodwin, Grennes, and Craig, 2002) have allowed for exploitation of regional comparative advantage in supply and more efficient use of processing capital. The nineteenth and twentieth centuries also saw innovations in microbiology and chemistry, first to improve sanitation and later to enable the breakout of craft dairy products—such as yogurt and sour cream—to large-scale retail product and ingredients markets. The industry's growth then involved deepening capital investments and deepening economic dependencies between producers and processors.

Capital issues have always proven to be important in dairying as herd, building and equipment investments, together with start-up and exit costs, create inelastic supply responses to price declines (Halvorson 1955) and so a disposition toward supply gluts. Other capital investment issues are off-farm. Dependence on off-farm processing capacity as well as on local infrastructure to access this capacity and to bring transformed product to market have created needs for collective action on the part of dairy farmers. Although United States dairy production locations have shifted geographically, dairy farming in the United States remains clustered near processing capacity. Coordination and orderly marketing then become a concern because of dependencies and distrust between farmers and processors, whose interests may be aligned on developing a region's dairy sector but adversarial on the division of surplus. Further needs for collective action and regulatory involvement have surrounded quality measurement and sanitation issues (Olmstead and Rhode 2015). Since the 1930s dairy marketing has been under federal regulations for a variety of reasons to do with perishability, transportation costs, inelastic short run supply and price discrimination opportunities among milk uses.

In one way or another, the papers in this theme address capital investments and their consequences. Feng and coauthors survey Great Lakes dairy farmers about changes in herd size, capital investment, and labor input over the last few years and their future intentions in these regards. Their findings reveal that investments emphasize the replacement of labor; herd consolidation is likely to continue, with larger herds generally at the forefront; and smaller farmers in particular are pessimistic about the sector's market conditions. Because installed assets have few alternative uses, low prices are likely to persist when expansion depresses prices. This begs questions about coping strategies to survive until profitable conditions return.

Using a 10-year panel dataset of Minnesota dairy farmers, Mahnken and Hadrich address how individual farmers can cope with tight dairy margins through alternative income-management strategies intended to stabilize enterprise profits. These strategies vary from income diversification through the feed make-or-buy decision, insurance choices, and government support programs. Their research and the data-collection system that supports it point to the merits of a two-way, data-driven extension programs.

Stephenson and Nicholson consider whether, in light of transportation costs, current U.S. dairy industry production and processing investments are in the right places. Their spatially disaggregated optimization model accounts for transportation costs for milk assembly and product distribution. Their work confirms the economic fundamentals underlying the plight of milk producers in the Great Lakes region and of Michigan in particular. Although the area is well suited to milk production, transportation cost considerations require that this product be processed locally, and processors had until 2018 been reluctant to step forward.

In their inquiry into the plumbing and recent performance of milk marketing orders, Novakovic and Wolf explore why milk marketing orders in some parts of the country may exacerbate rather than mitigate market imbalances and may act as a deterrent to processing investments. Put simply, institutional processing cost parameters used in price formula calculations may be too high. Cooperatives that are committed to market all milk offered can only cover costs by reclassifying milk in a way that depresses prices paid and generates unused milk.

California's milk sector, which had its own regulated marketing order arrangements, has performed anemically for a decade, long before the 2014–2015 price downturn, in part because of rising production costs and in part because of adjustment elsewhere toward more competitive production structures. California has now entered the federal marketing order system. Sumner discusses the events leading up to this transition and analyzes the implications for California's milk sector. Impacts may be many given the differentiated nature of dairy product markets and detailed nature of marketing order features. These impacts may be positive for some, but they will not be large, because they do not alter the fundamentals of product supply and demand.

Where then will the future take the dairy sector structure? The crux of structural change is that a sector's prospects are not strongly tied to those of its participants. Hard science is likely remain in the driver's seat, with economic considerations defining the terrain and policy interventions seeking to level the bumps. Change will continue and it may continue to be wrenching, favoring consumers on the whole and some producers. This *Choices* theme deals with all of the above, although with emphasis on producers. But other forces, new and old, are coalescing. Butter substitutes consumed much political oxygen in the United States for decades, and milk substitutes are doing so now. The presence of substitutes will largely impact markets and production structure through overall pricing pressure. A second set of forces—having to do with such process attributes as animal welfare, organic traits, and One Health connections—may emerge to have more direct and more varied impacts on dairy markets and production structure.

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Author Information
David A. Hennessy (hennes64@msu.edu) is Professor and Elton R. Smith Chair in Food and Agricultural Policy, Department of Agriculture, Food, and Resource Economics, Michigan State University, East Lansing, MI.
Hongli Feng (hennes65@msu.edu) is Associate Professor, Department of Agriculture, Food, and Resource Economics, Michigan State University, East Lansing, MI.

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Dairy Sector Consolidation, Scale, Automation and Factor Biased Technical Change: Working through "Get Big or Get Out"

Hongli Feng, David A. Hennessy, Yanan Jia, Melissa G.S. McKendree, and Christopher A. Wolf

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Milk production in the United States has become increasingly concentrated among fewer herds. This consolidation has, as in other on-farm agricultural sectors, long been recognized (e.g., Drabenstott, 1994; MacDonald, Cessna, and Mosheim, 2016). According to USDA milk production reports (LMIC, 2018), the number of licensed dairy herds in the United States declined from 45,344 in 2014 to 40,219 in 2017, a 4% annual rate of decline over the period.

Large and small farms are, in aggregate, different in their output, production costs, and quality metrics. Significant scale economies exist in dairy production (Mosheim and Knox Lovell, 2009): larger herds are generally better positioned to attain quality standards as reflected by somatic cell count indicators (Norman, Walton, and Dürr, 2018) and technical inefficiency is a factor in exit decisions (Dong et al., 2016). Given the obstacles faced, smaller dairy farms generally have difficulty competing with larger farms unless they receive higher prices in specialty milk markets or have low opportunity costs of operator time.

Less well understood are the investment dynamics that precede both exit and expansion. In this article, we provide a snapshot of the dairy industry based on a survey of dairy farmers in a market environment of multiple continuous years of low milk prices and low milk profit margin. The survey allows us to analyze how farm size relates to dairy farmers' views of industry outlook and their decisions regarding expansion or contraction of herd size, labor, and capital as the industry adjusts to market pressures and emerging technological opportunities.

Survey Design and Findings

We conducted a dairy producer survey between May and September 2017 that targeted three U.S. Great Lakes states: Michigan, Minnesota, and Wisconsin. In 2017, these states accounted for 24% of U.S. milk production (5% Michigan, 5% Minnesota, and 14% Wisconsin) and 23% of the U.S. milk cow herd (LMIC, 2018). We designed the survey, which was administered by Michigan State University's Office for Survey Research. The survey generated 710 completed questionnaires, of which 660 (112 web and 548 mail) were usable for this analysis. To put these numbers in perspective, there were about 16,300 registered dairy farms in the three states. Table 1 reports summary statistics for our sample.

Consistent with the relative sizes of the dairy industries in each state, 57% of the sample was from Wisconsin, 25% from Minnesota, and 18% from Michigan. Average herd size was 214 cows, but data were positively skewed, with a maximum of 11,000 cows. The majority of respondents, 66%, had herds with fewer than 100 cows, while 26% of herds had 101–500 cows, which we define as a medium-size herd. Only 8% of respondents fell in our large herd category, which we define as more than 500 cows. Most milk marketed from the sample went to conventional commoditized milk markets, but 55 farmers stated that most of their milk was sold in the organic market. Nearly 80% of the milk produced by our sample was marketed through a co-operative. Average yield per cow was 21,850 lb, 5.8% smaller than the U.S. 23 state average of 23,204 (LMIC, 2018).

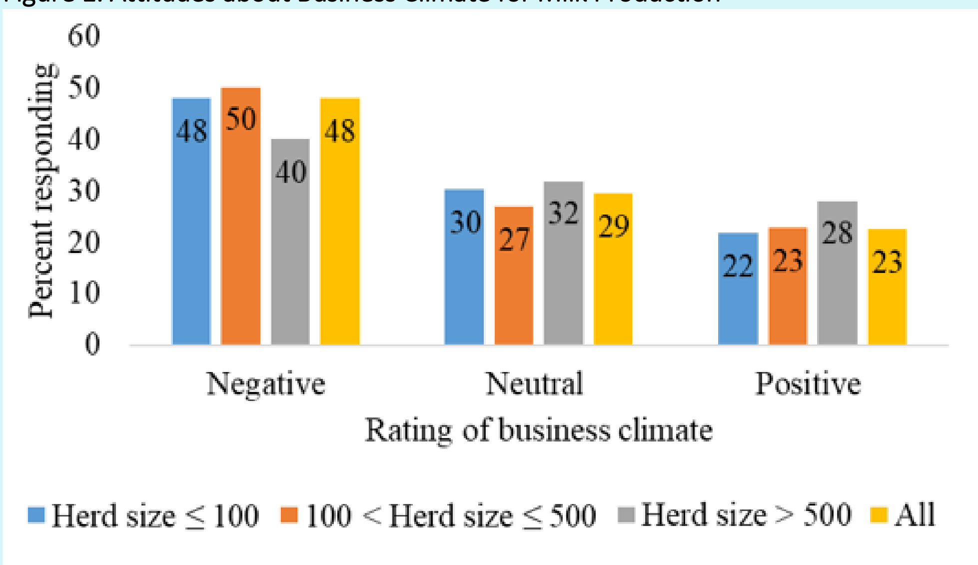
One question in the survey asked, “How would you assess the current business climate for milk production in your state?” Not surprisingly, given prices received at the time, views were generally pessimistic, with nearly half of respondents indicating negative views (Figure 1). Overall, respondents with small and medium-sized dairy herds were more pessimistic than those with larger herds. Nearly 30% of the sample stated they were neutral on the current business climate for milk production in their state, while less than one-fourth were positive. Further questions asked about herd size choices over the previous 3 years, intended herd size, enterprise

Table 1. Sample Summary Statistics

	Number Responding	Percentage Responding
Primary operation state		
Michigan	116	18%
Minnesota	166	25%
Wisconsin	379	57%
Primary operator education		
Less than high school	87	13%
High school	246	37%
Community college	240	36%
Bachelor’s degree	88	13%
Primary operator works on operation full time	608	94%

	Mean	Median	Std. D.	Min	Max
Operator age	53	55	13	19	88
Herd size	214	72	666	1	11,000
Annual yield per cow	21,850	22,000	5,648	8,000	50,000
Percentage of milk sales to conventional market	92	100	27	0	100
Percentage of milk marketed by cooperative	78	100	41	0	100

Figure 1. Attitudes about Business Climate for Milk Production



Notes: Negative includes those responding “negative” or “very negative” on the survey. Positive includes those responding “positive” or “very positive.”

employment, and building/equipment investment intentions over the next 3 years. Table 2 summarizes the responses.

Table 2. Change in Herd Size and Capital Investment in the Last 3 Years and Intention for the Next 3 Years

	Over Past 3 Years, Herd Size			
	Decreased by > 8%	Changed Little	Increased by > 8%	Total
Panel A: During next 3 year, you expect herd size to				
Decrease by > 8% (*N* = 91)	45%	12%	2%	14%
Mean herd size	58	109	76	89
Change little (*N* = 450)	36%	77%	62%	69%
Mean herd size	66	150	322	177
Increase by > 8% (*N* = 108)	19%	10%	36%	17%
Mean herd size	40	233	850	478
Total	11%	68%	21%	
No. of obs.	73	441	135	649
Panel B: During next 3 year, you expect average hours per week worked to				
Decrease by > 8% (*N* = 79)	34%	11%	8%	12%
Mean herd size	54	152	660	188
Change little (*N* = 516)	63%	84%	80%	81%
Mean herd size	60	151	475	210
Increase > 8% (*N* = 43)	3%	5%	13%	7%
Mean herd size	67	211	619	365
Total	11%	68%	21%	
No. of obs.	68	437	133	638
Panel C: During next 3 years, you expect to make major buildings or equipment investments				
Unlikely (*N* = 407)	81%	65%	46%	63%
Mean herd size	58	108	189	113
Likely (*N* = 207)	15%	29%	51%	32%
Mean herd size	54	270	799	430
Unsure (*N* = 32)	4%	6%	3%	5%
Mean herd size	46	75	513	127
Total	11%	68%	21%	
No. of obs.	72	440	134	646

Despite a challenging milk price situation and overall negative outlook, 21% of farmers among our survey respondents had increased herd size by more than 8% during the previous 3 years, while 17% expressed an intention to increase herd size by more than 8% during the subsequent 3 years. More responding farmers had increased herd size than had decreased herd size during the previous 3 years (21% vs. 11%). Of course, survivorship bias, in the form of nonresponse by recently exited farmers, inflates the first and deflates the second of these numbers. Looking forward, more farmers intended to expand than to contract herd size during the ensuing 3 years (17% vs. 14%). In general, expanding operations are usually larger (Table 2). There is a strong positive temporal autocorrelation in herd expansion/contraction choices (Panel A). Few farmers expect to expand hours worked, but the connection between these expectations and herd size trajectories is weak (Panels A and B). However, intended investments in buildings and equipment correlate strongly with herd size trajectories (Panel C). Overall, it appears that those farmers expanding herd size are underpinning this expansion through further capital investments and not through increased use of labor (Panels B and C).

As reported in Panel A, we interpret those who have contracted or intend to contract as very likely to leave dairy farming. Of the five categories in which the producer indicated either past or future intentions to decrease herd size (first column and first row of Panel A), only one category has mean herd size in excess of 100 cows. Respondents in this category saw little change over the prior 3 years and also expected to decrease in the 3 years to follow.

Table 3 shows that farmers with larger herd sizes were significantly more efficient (as measured by production per cow and by production per hour of labor). Median annual production per cow was 21,000, 25,000, and 28,000 lb for farms with small, medium, and large herds, respectively. We also considered output per unit of labor input. Specifically, we divided total annual milk production by total annual labor input. The operator and operator's family provide most of the labor on smaller operations, while labor was mostly hired on large operations. Table 3 also indicates that median quantity of milk per unit of labor on large farms was about 5 times that of small farms. These production efficiency advantages are a driving factor in the continued consolidation of the industry.

Table 3. Annual Yield per Cow and Yield per Hour

			Herd Size			
		Total	≤ 100	101–500	> 500	Organic
Annual yield per cow (thousand lb)	Mean	21.85	20.87	24.60	27.30	14.75
	10th percentile	14.60	15.00	19.00	21.00	9.76
	Median	22.00	21.00	25.00	28.00	14.00
	90th percentile	29.00	26.50	30.00	31.50	19.00
	Std. dev.	5.65	5.02	4.36	3.78	4.90
Yield per hour (lb/h)	50th percentile	233	190	395	1,174	113
	Std. dev.	1,849	171	394	5,438	86

"Get Big or Get Out" and Investment Bias toward Capital

Tables 2 and 3 point to two trends: One is diverging trajectories for different dairy herd scale categories in the three Great Lakes states. Data in Table 2 presage the eventual exit of most operations with smaller herd sizes, stasis among most operations in the middle, and future expansion concentrated among larger operations. Those middle-tier farms may not be safe, however. While we cannot find evidence that Earl Butz, the controversial former Secretary of Agriculture under Richard Nixon and Gerald Ford, ever asserted, "Get big or get out"—a phrase indelibly linked to him—he held firmly to the belief that farms that were not growing would eventually exit. Possible constraints on expansion for dairy farms of all sizes vary by location and can take many forms, including limited access to feed and forage, constricted local processing capacity, and manure disposal challenges. All else equal, however, as unit costs decline with scale, medium-sized operations may be unable to generate cash flow or access the loans needed to expand and lower cost structures.

The other trend is bias toward capital, rather than labor, in intended investments. To understand this tilt, some reflection on the investment environment is in order. One point, made previously by Sumner (2014) but still true as of writing, is that real capital costs are at historic lows, whereas all-inclusive labor costs have stagnated. Furthermore, production agriculture has become an increasingly technical field, requiring protracted human capital investments in skill development. Forming enduring employment connections with hired help interested in and well-positioned to acquire the requisite skills has been a continual source of woe for many operators.

A related point, also made by Sumner (2014), is the growing need for technical managerial skills increasingly similar in form to those valued in general economy businesses. In the case of dairying, larger enterprises require the financial, logistics, personnel, information technology (IT), and marketing skills associated with supporting what amounts to a small manufacturing plant. Beyond that, strong technical understanding of such matters as genetics, animal physiology, nutrition science, and microbiology present operators with further challenges. Table 4 reports community college or higher degree attainment by operation scale for different principal operator age cohorts. Those operating larger herds have generally had more extensive formal education. If the occupation is to compensate for the educational investments made and compete with available alternative occupations, then these managerial skills need to span an adequate breadth of resources.

Figure 2. Isoquants and Production under a Labor-Saving Technology Shift

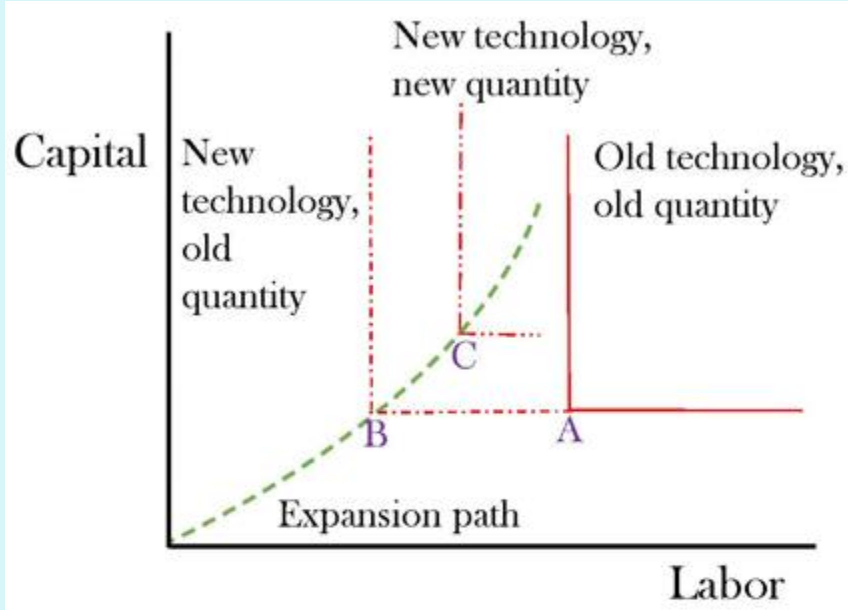


Table 4. Educational Attainment by Herd Size and Age, Respondents with Community College Education or More (percentage)

	Operator Age			
Herd Size	≤ 35	36–45	46–55	≥ 56
Small	41	41	36	47
Medium	75	80	63	53
Large	100	83	67	57

We turn now to the tilt in investments made. Figure 2 illustrates a stylized characterization of the assembled evidence. For simplicity, we assume in the figure that labor and capital combine in fixed proportions (i.e., as a Leontief technology). That is, for each capital investment level, there will be one corresponding amount of labor input to cost-effectively generate a milk production level. In an initial technology, the optimum (labor, capital) combination is given as point A, where the equilibrium profit-maximizing output is given as “old quantity.” Then a new labor-saving technology shifts the vertical arm inward to intersect the horizontal arm at point B. For reasons that we will elaborate on shortly, the expansion path (i.e., the green dashed line) for the new technology is assumed to bend from the origin toward the capital axis so that the capital-to-labor ratio increases as a firm expands production. Given lower costs upon moving from input combination A to combination B, the producer will find it optimal to expand along this path, and equilibrium settles at point C. As depicted, this point involves greater capital use and less labor use than at point A, although nothing precludes point C from being above and to right of point A. Our survey data reveal that for the three Great Lake States, production expands with use of more capital but no more labor.

Unit labor costs in milk production come in many forms. In recent times, insurance, administration and documentation cost categories have assumed increased importance as costs of employment. While smaller farms may retain comparative advantages in some cost categories, larger farms will likely be better able to gain favorable terms when providing insurance and can more readily justify the administrative costs of hiring and retention. Nonetheless, the increasing costs of labor in general combined with the growing availability of less physically challenging jobs have led producers to substitute capital for labor.

The history of agriculture is replete with labor-saving innovations, but labor has retained its worth in large part because it is more flexible than capital inputs when dealing with weather and biological uncertainties. The advent of confinement and developments in animal physiology, pharmacology, and genetics have gradually promoted process controls in ways similar to that in which technology developments led the blacksmith's forge to be replaced first with foundries and then with factories. When inputs are uniform then stationary, pre-set machines can more readily be used to meet animal needs and harvest produce. Farmers sought cows with similar genetics and fed them common rations so that housing, feeding, and manure management investments were well-adapted to all and labor-substituting investments could expand more deeply into production operations. Similarly, investments that limit nature's encroachments into production also favor the substitution of capital for labor, whose advantage in addressing these encroachments has assumed reduced value. We will discuss shortly how more recent innovations may have changed this demand for uniform inputs.

By and large, capital investments have significant fixed cost components. Sources of these fixed cost components include installation costs and the human capital investment that accompanies a new technology. To the extent that uniformity-enhancing technologies generate opportunities for on-farm capital investments, they will also tend to increase production scale (Hennessy and Wang, 2012). To the extent that more uniform on-farm inputs generate more uniform farm-gate outputs in terms of milk constituents, uniformity-promoting technologies may have similar effects in processing. Consistency in farm-gate milk outputs will generate higher yields during downstream physical and biochemical processing. Lower unit costs in processing will in turn enhance incentives to append further processing steps and to articulate product markets. As demand grows for highly processed dairy products, investment signals will guide firms toward adopting more of these uniformity-enhancing on-farm technologies at the expense of labor, possibly increasing farm-level fixed costs.

Labor and Smart Capital

A wrinkle in this line of thought is that recent IT innovations have allowed for adaptation even in the face of non-uniformities, as in individualizing feeding regimes and adjusting for weather conditions. The expanding role of information in capital intensive animal agriculture has long been recognized (see, e.g., Boehlje, 1996), but penetration has been steady and not drastic. For certain applications, our view is that, as of 2018, adoption thresholds are being reached that suggest thicker markets, lower prices, and more reliable performance for many technological advancements in dairy. Many of these will become essential technologies on competitive dairy farms. Critical technologies to substitute for the non-uniformities that humans so capably manage are fast computing, laser guidance, electronic sensors, and cheap chemical diagnostics suitable for rough conditions. Robotic milking machines, for instance, provide low-stress, cow-specific udder washing and milking and also real-time analysis of milk before it enters bulk tanks. The machines are animal-welfare friendly in the sense that the cow partly chooses her own milking schedule.

Interestingly, and by contrast with the automated feeding systems that are now entering use on larger farms, robotic milking machines first found a niche among smaller farms in continental Northern Europe and only began to gain acceptance among larger farms around 2017. The more enthusiastic adoption for smaller herds may be because the hired labor input comes with scale economies and also because, in comparison with paid laborers, smaller owner–operators have the capacity and incentives to work with the robotic machine. Furthermore, versions of the technology are portable and readily scale up or down. This scaling observation underscores a cautionary note about the presumption that capital investments universally promote larger production scale. As an innovation matures, thoughtful innovation and, even more so, reliability can lead to smaller, more flexible equipment, just as the personal computer replaced the mainframe in most office uses. Many smaller operators in food and beverage markets, including brewing, have found opportunities to scale down capital inputs to efficiently produce the volumes that a highly differentiated market will bear.

As Sauer and Latacz-Lohmann (2015) noted, the wealth of information that such sensor-intensive milking, housing, and feeding system instruments generate warrants emphasis. While this class of machines substitutes for adaptable physical labor, it also generates potential premiums for adaptable management inputs. Furthermore, the information becomes more valuable in large herd settings because cows bear electronic tags. In larger herds, individual records can be more reliably compared with reference benchmark records for such purposes as feed adjustments, lameness detection (e.g., through monitoring hoof fall data on a metal plate), mastitis detection and precise diagnosis (e.g., through monitoring quality and flow from each quarter), estrus detection, and culling decisions. As has also become true with precision field-cropping technologies, informal experimental approaches to evaluating production practices are enabled and producers are accumulating privately held knowledge banks for the purposes of developing operational rules of thumb. These producers generally use formal research findings as just one, typically minor, point of guidance for their decisions.

In light of its deepening role in production and service sectors, macroeconomists are increasingly concerned about the economy-level impacts of automation on labor demand. One recent insight by Acemoglu and Restrepo (2018) is to replace factor-augmenting views of how IT innovations affect factor productivity with a task-focused view that better reflects empirical evidence on how labor demand is affected by automation. They model labor and capital as perfect substitutes in completing specific tasks but allow how these tasks aggregate to determine factor interactions. When more menial tasks are more amenable to programming, then these will be automated first, labor share in output will decline, and demand for capital will increase. The approach emphasizes automation's value in factor-saving and also readily admits insights on bias in how factors are saved. The framework resonates well with much of what is happening on dairy farms. However, the models are silent on how these technologies shift demands for managerial cognition. Measurement and real-time adaptation activities are less necessary, but opportunities have opened up for assessing and processing the emerging large volumes of data recorded during production. A gap in the literature is that current economic models omit roles for automation in dynamic learning about production processes. As currently posed, this class of models can provide only a limited set of insights into how automation is reshaping dairy milk production.

Concluding Remarks

When margins are tight in a commoditized market with innovative input providers, the need to be cost competitive is intense. Given cash flow realities and technological scale economies, a point may come when the competitiveness problem resolves to either expanding or exiting. We report survey findings on the views of U.S. Great Lakes state milk producers regarding their difficult production environment and how they are struggling to adapt. Many are in the process of exiting, while others have committed to expand as a cost management strategy. The expansion will favor capital inputs over labor inputs so that employment on the remaining farms will not notably increase and overall on-farm employment in the sector will decrease. In many senses, features of this trajectory should be familiar. For instance, 18th-century textile manufacture was a very labor intensive, rural, small-scale activity. The processes involved lent themselves to automation, and indeed the Jacquard loom's control system inspired the first rumblings of computational science. On-farm milk production is only partly down the path on which a reductionist scientific analysis of its parts may generate technologies that both reduce costs and open possibilities for further innovation. To quote Disney's *Peter Pan*, "All this has happened before, and it will all happen again." But this time it is happening in milk production.

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Author Information
Hongli Feng (hennes65@msu.edu) is Associate Professor, Department of Agriculture, Food, and Resource Economics, Michigan State University, East Lansing, MI.
David A. Hennessy (hennes64@msu.edu) is Professor and Elton R. Smith Chair in Food and Agricultural Policy, Department of Agriculture, Food, and Resource Economics, Michigan State University, East Lansing, MI.
Yanan Jia (jiayana1@msu.edu) is Graduate Student, Department of Agriculture, Food, and Resource Economics, Michigan State University, East Lansing, MI.
Melissa G.S. McKendree (mckend14@ msu.edu) is Assistant Professor, Department of Agriculture, Food, and Resource Economics, Michigan State University, East Lansing, MI.
Christopher A. Wolf (wolfch@msu.edu) is Professor, Department of Agriculture, Food, and Resource Economics, Michigan State University, East Lansing, MI.
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Does Revenue Diversification Improve Small and Medium-Sized Dairy Farm Profitability?

Curtis L. Mahnken and Joleen C. Hadrich
JEL Classifications: Q12, Q14
Keywords: milk price volatility, FINBIN, adjusted net-farm-income ratio

Dairy farmers are well acquainted with managing volatile input and output prices. In the past 5 years, dairy farms experienced record high milk prices in 2014 followed by devastatingly low milk prices. In Minnesota, farms that contribute financial information to the FINBIN farm financial database reported the lowest average accrual net farm income, $407, in 2009, while the same sample reported an all-time average high of $236,544 just 5 years later in 2014 (FINBIN, 2018a). Even though cow-level milk production has increased since 2007 (FINBIN, 2018b); consolidation and a rapid increase in the average number of cows per farm are commonplace in the industry, as evidenced by the total number of U.S. licensed dairy farms, which decreased from 59,135 in 2007 (USDA, 2008) to 40,219 in 2017 (USDA, 2018a).

Regardless of changing farm structure, dairy farmers today know that commodity prices are projected to be depressed for several more years (USDA, 2018b). Low prices are not conducive to generational farm transition plans, replacing or updating equipment, or exploring innovative technology adoption. This has caused many dairy farmers to ask, "Is it financially sustainable to remain in the dairy industry at my operation's current herd size?" More specifically, dairy farmers are trying to determine whether now is an appropriate time to expand, consolidate, or exit the industry. However, these are not the only options. Many small to medium-sized dairy farms in the Upper Midwest have revisited diversification strategies incorporating alternative revenue sources into their farm operation to stabilize whole farm profitability, meet debt obligations, and provide cash flow for family living expenses. Examples of alternative revenue sources to combat volatile milk prices include crop income, custom work, crop insurance, government program payments, and off-farm income. This analysis uses 11 years of consecutive financial data from Minnesota dairy farms to examine how revenue diversification strategies have been implemented and affected the financial success of dairy farms from 2007 to 2017.

Data

Farm-level data were collected through collaboration between the University of Minnesota's Center for Farm Financial Management (CFFM) and the Minnesota Farm Business Management (FBM) Association. Minnesota farm managers work with FBM educators through the Minnesota State College and University system and the Southwest Farm Business Management Association in conjunction with University of Minnesota Extension to improve record keeping throughout the farming year to facilitate farm management and financial decisions. FBM educators work with farm managers to complete and interpret accrual farm financial statements and enterprise-level analyses for their farm. These farm-level accrual data are then shared with the University of Minnesota's CFFM to be aggregated with data from other farms through the FINBIN farm financial database, which is publicly available at an aggregate level (https://finbin.umn.edu/). In 2017, over 2,300 Minnesota farms, including 406 dairy farms, supplied data to the FINBIN database as members of the FBM association. These represent approximately 12.5% of Minnesota dairy farms (USDA, 2018a). In the FINBIN database, dairy farms are defined as farms generating 70% or more of total income from dairy sales. A subset of dairy farms are diversified with crop enterprises, and less than 70% of their gross revenue comes directly from dairy; these farmers were also included in the analysis to capture revenue diversification through crop production. In total, 84 small and medium-sized Minnesota dairy farms supplied data to FINBIN consecutively from 2007 to 2017. These farms form the basis of the data used in this analysis.

Revenue Sources and Diversification

A dairy farm has several sources of revenue, including milk, cull cows, replacement heifers, bull calves, and crop sales. On average, dairy-related sales generated about 78.5% of total gross revenue for the 84 farms in our sample, with a range from 72.5% in 2009 to 81.9% in 2008. From 2007 to 2017, the average herd size for the sample increased from 145 cows in 2007 to 167 cows in 2017, with the highest average (174 cows) reported in 2012. Milk production efficiency continues to improve, with an average of 22,205 lb/cow in 2017, a 7% increase since 2007. Dairy income per cow ranged from less than $3,000/cow to over $5,200/cow, with an average of $3,945/cow.

While the majority of a dairy farm's gross revenue is generated from dairy-related sources, approximately 75% of the dairy farms in this study reported crop income. Crop acreage increased approximately 19%, from an average of 432 acres in 2007 to 513 acres in 2017. This reflects increasing acreage for homegrown feed for the dairy, additional land for manure management, and creating a potential new revenue stream through grain sales. Increasing a dairy's crop acreage requires the farm manager to consider the trade-off between crop production for feed usage versus selling grain crops. This decision is not an easy one since decreasing feed reserves may result in later feed purchases at a potentially higher cost due to crop failure or weather events. Jointly, additional acreage provides the option for future expansion, if that is the farm manager's goal.

Low milk prices and an increased percentage of revenue generated from crop sales seem to go hand-in-hand. In 2009, dairy farmers in our sample received the lowest average milk price at $14.28/cwt and reported the largest percentage of crop revenue at 17.5% of total revenue sources. For many dairy farmers, selling excess crops was an appropriate method to sustain the operation given low milk prices. Having a diversified operation allowed them to rely on other revenue sources as it benefited their operation. Across the study period (2007–2017), crop sales generated approximately 13.3% of dairy farms' gross revenue.

Crop insurance and government payments should not be considered a main source of revenue generation for a farm. However, dairy farms participated in both programs depending on their current situation. Crop insurance has an associated cost but provides protection against unanticipated weather events and other crop failures. Government program payments provide another source of dairy revenue through such programs as the Milk Income Loss Contract Program (MILC) or, most recently, the Margin Protection Program (MPP). While all farms in the sample reported some level of revenue generation from insurance or government program payments, these revenue sources accounted for approximately 2% or less of gross revenue.

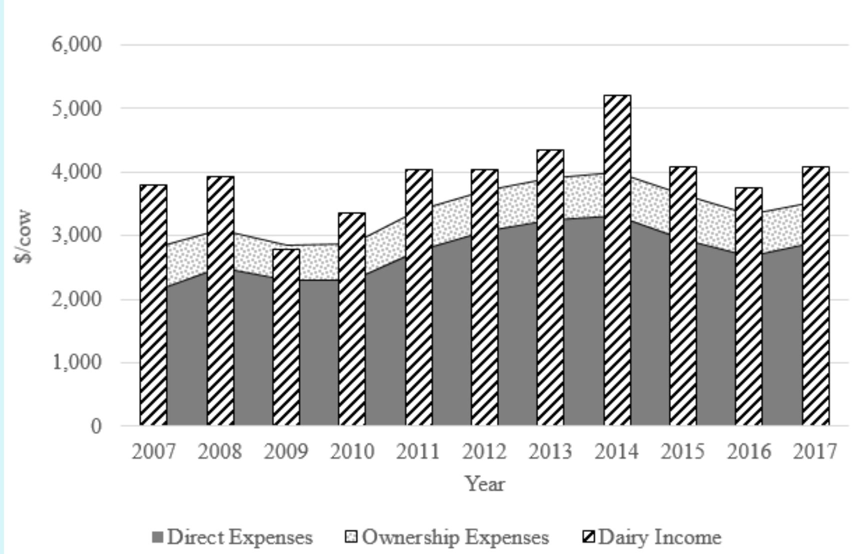
Dairy farms reported that approximately 8%–9% of total revenue was generated through other income sources, including market livestock income, custom work, contract income, patronage and dividends, cash from hedging accounts, and "other income" as defined by the farmer. From 2007 to 2017, this number has remained fairly constant, indicating that the composition of these other income sources has not changed much. The underlying need and purpose for revenue diversification is to cover farm expenses. As dairy-related revenue has fallen, finding alternative revenue sources to cover the gap between revenue and expenses has become a top priority.

Dairy Margins

Feed costs are approximately 80% of total operating expenses for the dairy enterprise. Feed costs include corn, alfalfa hay, corn silage, haylage, and protein, vitamins, and minerals. The majority of Minnesota dairy farms reported homegrown feed, which is included in the feed cost calculation by totaling the amount of feed fed valued at the current feedstuff market price. The remaining operating expenses for the dairy operation include veterinary expenses, breeding fees, supplies, marketing, fuel and oil, repairs, and operating interest. Total operating expenses per cow increased 57% from 2007 ($2,112) to 2014 ($3,315), but most recently these costs have decreased (Figure 1). Ownership expenses—which include hired labor, building leases, utilities, interest and depreciation—averaged approximately $635/cow and varied little between 2007 and 2017.

For a dairy farm to remain profitable, it must be able to cover short-run operating expenses. Comparing average dairy farm revenue to operating expenses in this sample demonstrates that the average farm is able to cover its operating expenses each year and, in most years, cover ownership expenses as well. However, the margin between total expenses and dairy income decreased from $1,010/cow in 2007 to $541/cow in 2017 (Figure 1). In the past 11 years, the dairy margin has been below $500/cow six times, with a negative margin of −$69.15/cow in 2009. Most recently, in 2017, the average margin was $541/cow, which results in approximately $75,740 in potential returns to farm labor and management for an average herd of 140 dairy cows. This amount is used to cover family living expenses, health insurance, and other equity or investment priorities for the dairy farm.

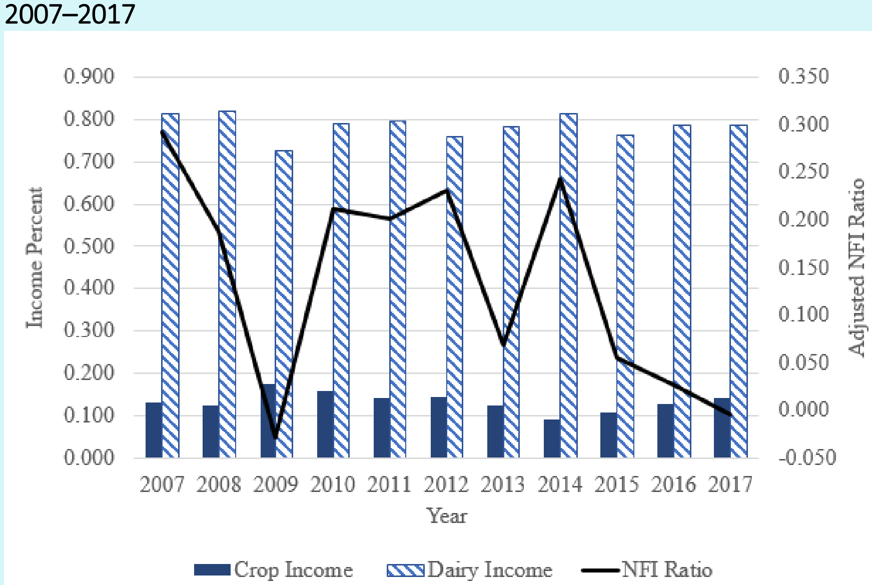
Figure 1. Nominal Minnesota Dairy Margin per Cow ($/cow) for 84 Dairy Farms in Sample, 2007–2017



What Defines Financial Success?

Defining the characteristics of successful farmers that allow them to reach and maintain a higher level of performance is a routine question asked by Extension educators, agricultural economists, farmers, and the agricultural professionals who support farmers. One measure typically used to define a farm's success, accrual net farm income (NFI), captures the monetary returns to an operator's unpaid labor and management. However, this measure can be highly dependent on farm size and economies of scale and size. To standardize across herd sizes, we use the adjusted NFI ratio, which measures how efficiently a farm converts its gross farm revenue into a financial return. For this study, we adjust the denominator of the NFI ratio by using value of farm production (VFP) rather than gross revenue. VFP is an accrual-adjusted calculation that measures the composition of output produced on a farm for that particular year.

Figure 2. Crop and Dairy Income Levels Compared to Adjusted NFI Ratio, 2007–2017



From 2007 to 2017, the adjusted NFI ratio averaged 13.5%, suggesting that for every $1 of VFP generated, $0.135 was retained at the farm level as a return to the operator's unpaid labor and management. This average adjusted NFI ratio had two identifiable levels or averages prior to and after 2012 (Figure 2). Specifically, the adjusted NFI ratio averaged 18.2% from 2007 to 2012 and decreased to 7.8% between 2012 and 2017. The most alarming observation after 2012 (with the exception of 2014) is the persistent downward trend in the adjusted NFI ratio, which coincides with increased herd sizes, improved dairy cow efficiency, and increased crop acreage.

Successful dairy farms, defined as those with higher adjusted NFI ratios, capitalized on high commodity prices when they occurred. For example, dairy farms that increased crop acreage after 2009 were able to build equity with crop capacity, which later translated to growing their dairy herd when dairy prices increased in 2014. Having the flexibility to transfer labor and assets between the two enterprises does come at a cost, with increased total farm operating expenses associated with cropping systems. Diversified revenue sources allow farms to navigate lower prices by stabilizing revenue at a whole-farm level, but flexibility with farm management decisions plays an important role in the farm successfully balancing its limited resources.

Observations and Discussion

In this analysis, we observed that small and medium-sized dairy farms participating in the Minnesota FBM program for 11 consecutive years increased their herd size and crop acres operated. These successful small and medium-sized dairy farms used revenue diversification to build equity through grain sales, which contributed to herd expansion efforts. Increasing farm size, through animals or crops, increases overall demands on the farm manager, with management time being one of the most limiting factors. Specifically, this analysis shows that even in low milk price years, the average Minnesota dairy farm that participated in FBM reported a positive return in 10 of the past 11 years. Dairy farmers who participated in FBM have indicated that they changed their cropping rotation to plant soybeans and corn for grain sales when it was cheaper for them to buy feed (e.g. corn silage and hay) than to raise their own. These farmers also indicated that they would not have made this change on their own; the outside perspective provided by participating in FBM helped them think through the potential benefits and downfalls of their revenue diversification strategy. The dairy farms in our sample that had existing infrastructure with machinery and equipment, land availability, labor, and knowledge related to crop production made this revenue diversification strategy work. We cannot put a specific value on the benefit associated with FBM programs, but this analysis demonstrates that there is positive value associated with obtaining an outside perspective when making financial decisions. It could be argued that high-profit years are the most vital to build equity and enhance the farm's financial security. While farm prices remain uncertain, the collaboration between state level FBM programs and Extension is a valuable resource for evaluating diversification strategies for small to medium-sized dairy farms to survive the predicted tight margins in the short run.

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Author Information
Curtis L. Mahnken (cmahnken@umn.edu) is Associate Extension Professor, Center for Farm Financial Management, Department of Applied Economics, University of Minnesota, St. Paul, MN.
Joleen C. Hadrich (jhadrich@umn.edu) is Associate Professor and Extension Economist, Department of Applied Economics, University of Minnesota, St. Paul, MN.
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Regional Values for Milk Are Changing

Mark W. Stephenson and Charles F. Nicholson
JEL Classifications: C61, Q13
Keywords: Dairy, Milk prices, Optimization, Regional, Price surface

U.S. dairy farmers are into the fourth year of relatively low milk prices. Competition for export markets with the European Union (EU) is partly to blame. Milk supplies in the EU have expanded since 2015, when production quotas were dropped. More recently, concerns over retaliatory tariffs from Mexico and China, our first and third largest customers for dairy exports, have contributed to continued price pressure. Changes in U.S. regional milk supplies, demand for dairy products, and processing capacity have compounded the cyclical nature of farm milk prices.

In 2016, the top five milk-producing states were California, Wisconsin, New York, Idaho, and Michigan. Since 2014, California has lost 2.5 billion pounds of milk production and Wisconsin has gained 2.5 billion pounds. Idaho is up by about 750 million pounds, but New York is up even more, at 1.2 billion pounds, and Michigan is up 1.6 billion pounds. Gains in the Great Lakes states have more than offset losses in the West.

Michigan has doubled its milk production since 2000. The state has unique features, including an almost ideal climate for the modern high-producing dairy cow. Evidence of this is that Michigan has the highest productivity of any state, with milk per cow yields of more than 26,000 lbs/year. But the growth in milk production has not been accompanied by growth in the capacity of plants to process that milk. And the peninsular geography of the state has meant that milk must travel long distances around the Great Lakes to find a processing home. Wisconsin, which has also had plentiful milk supplies, has received much of the excess Michigan production.

More milk in the Great Lakes states has consequences. For example, Michigan's all milk price, which was almost equal to the U.S. average in 2014, had fallen to the lowest in the nation in 2017. We use a spatial model of the U.S. dairy industry to help understand how changes in the spatial distribution of milk production have affected the relative value of milk in different regions.

The U.S. Dairy Sector Simulator

The U.S. Dairy Sector Simulator (USDSS) is a highly detailed mathematical spatial optimization model that at its core solves a fairly practical problem: how to i) get milk from dairy farms to plants to be processed into various dairy products and ii) distribute those products to consumers in the most efficient way possible (see Nicholson et al., 2015). The model takes the total milk supply, plant locations, product mix, and product demand as they existed for a given month. The solution indicates how best to move that farm milk to plants via the existing road network, process milk into final and intermediate products, and distribute the finished products to consumers.

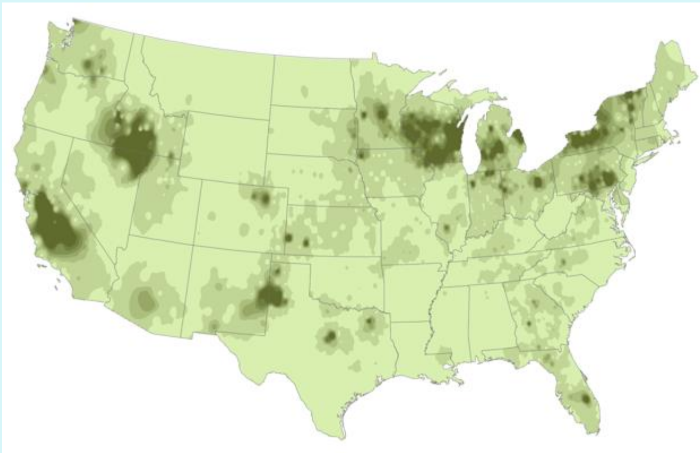
The Milk Supply Data

The USDSS has significant data needs, including the amounts and composition of farm milk and dairy products consumed, disaggregated by U.S. regions and accounting for imports and exports. To represent the U.S. milk supply, we use county estimates of milk production and composition where possible (as in California and Wisconsin). Where those data are not available, we use state values and estimate county-level milk production using Agricultural Census and Federal Milk Marketing Order (FMMO) data. Figure 1 shows the density of milk production in the 48 contiguous states. Milk supplies are represented by 231 supply points.

Dairy Product Demand Data

The USDSS model is comprehensive and includes all sources and uses of milk and dairy components in the United States. The current structure includes 19 final and 18 intermediate product categories—such as cream, condensed skim milk, nonfat dry milk—which can be used in the further manufacture of other final dairy products such as cheese or ice cream. Final products include fluid milk, yogurt, and cheese, which satisfy domestic consumption (by individuals, food service, and other food manufacturers) or export sales. Dairy products have different component requirements, and some product component values differ by region For example, California's lower-fat fluid milk is fortified with skim milk solids per state regulations.

Figure 1. Density of U.S. Milk Supply, Pounds per Square Mile, 2016.



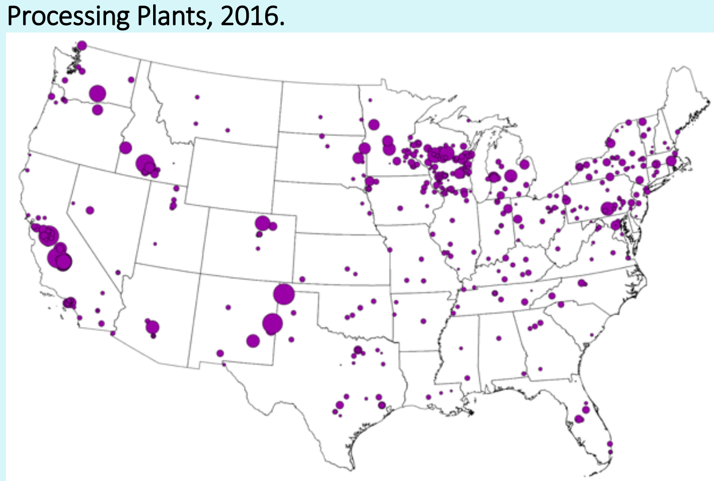
Source: USDA-NASS, AMS, 2017.

A variety of data sources are used to determine per capita demand for dairy products. The U.S. Department of Agriculture Economic Research Service (ERS) reports calculations for some dairy product demands, and other values—such as "route dispositions," delivery to retail or wholesale outlets—are determined from FMMO reports. County-level demands are calculated based on per capita demand and population and then aggregated to 424 demand locations.

Dairy Plants Data

We maintain an extensive database that includes 1,167 dairy plant locations and products processed in the United States. Of these plants, we have processing volume estimates for more than 500 of the most significant plants (Figure 2), which account for more than 95% of U.S. milk supply. As milk supply and demand locations are aggregated, so too are dairy plants, which are represented at 281 locations in the USDSS.

Figure 2. Location and Estimated Milk Intake of U.S. Dairy Processing Plants, 2016.



Source: Private Data, 2017.

The USDSS tracks and accounts for multiple product components. Plant locations are constrained to process only the products that we know to be manufactured at those sites. For instance, a fluid milk plant location cannot process cheese. However, a fluid milk plant with excess butterfat can send cream to a butter churn, ice cream plant, or other manufacturing facility with need of the cream. Of course, sending cream from a fluid plant also sends nonfat solids to the receiving plant requiring, somewhat more raw milk than would be necessary to meet only fluid needs.

Imports, Exports, and Changes in Stocks

USDSS uses import and export information for 34 U.S. port districts. Imported and exported products exactly match those reported in the months modeled. Some dairy products are storable and this is accounted for in the model by observed changes in stocks during the months modeled.

Transportation Costs

A road network of actual road mileage connects all of the supply, demand, plant, and trade locations in the model. About 200,000 possible road routes connect the 628 USDSS locations. States also have differing gross vehicle weight (GVW) limits, which restrict the size of loads shipping raw milk or finished products that can be transferred between some states. These limits are also represented within the model. Most states have an 80,000 lb GVW limit, but others have GVW limits of up to 164,000 lbs. The most limiting state along a route becomes the GVW restriction in the USDSS. The ability to haul greater GVWs reduces the cost of transporting raw milk and products.

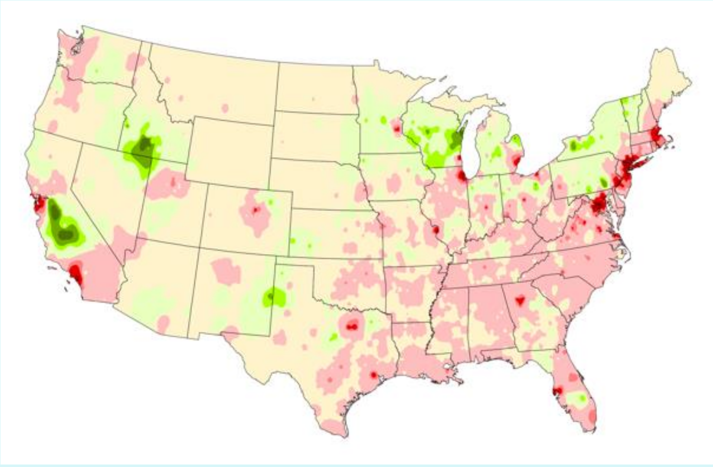
We calculate transportation costs for raw milk assembly, inter-plant movements of bulk products (cream, skim milk, condensed skim milk, etc.), and final products, both refrigerated and non-refrigerated, for all of the 200,000 possible routes. These transportation costs are updated to reflect changes in equipment, fuel, and labor costs for 2014 and 2016. The USDSS also reflects regional variations in fuel and labor costs, depending on the point of origin for a transportation movement. Transportation costs are an important driver of model outcomes, and as is other information, are calculated for each month for which the model is used.

Types of Model Solutions

The model's purpose—referred to as the "primal solution"—is to find the least-cost combination of assembling milk from farms to plants, processing the final and intermediate dairy products, and distributing them to meet domestic and export demand while respecting the many constraints imposed. The primal solution describes the physical flows of product through the dairy supply chain.

A simplified way of looking at the problem is to show the country's regions of relative surplus and deficit. Figure 3 illustrates the difference between milk production and the demand for milk used in all dairy products at the county level. Shades of green represent regions of surplus, while red areas are deficit. Tan-colored spaces are relatively balanced.

Figure 3. Density of U.S. Milk Surplus and Deficit, Pounds per Square Mile, 2016.



Source: USDA-NASS, ERS, BLS, 2017.

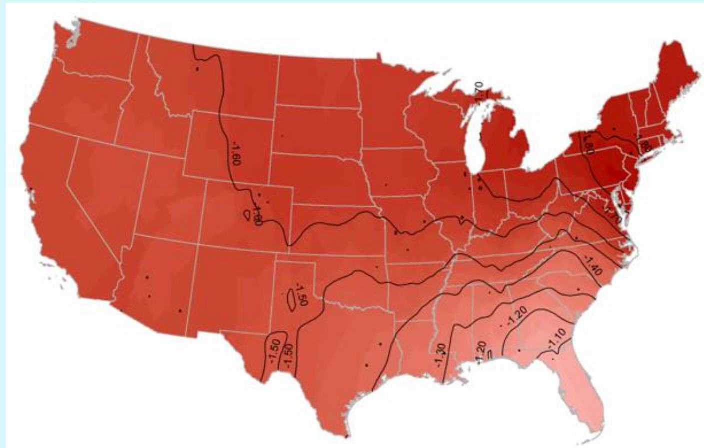
Not surprisingly, the most milk-deficit regions of the United States are the heavily populated areas from Boston south to Washington, D.C., and between Los Angeles and San Francisco. The entire Southeast has a general deficit of milk. The Great Lakes states have regions of surplus, as do California and Idaho. The model, like the actual supply chain, must move milk from farms through plants and dairy products to consumers to meet all demands for final dairy products.

An optimization model also provides something known as the "dual solution," which represents the relative monetary values of milk and dairy products at each model location. The primal (physical) and the dual (monetary) solutions are different ways of looking at the same outcome. In fact, the dual values are often called “shadow prices” because they reflect physical movements. The dual values let us measure how regional values of milk have changed over time.

The Dual Solution

Dairy trade had a large influence on world milk prices from 2014 to 2016. In, 2014, milk prices were very high as China purchased more dairy products than ever before and shorted world stocks of product. By 2016, the world had begun to respond to those demand signals and increased milk supplies, only to find China’s purchases retreating. But we can abstract from the world influences to focus on regional changes within the United States.

Figure 4. Change in the Spatial Value of Farm Milk, 2014 to 2016.



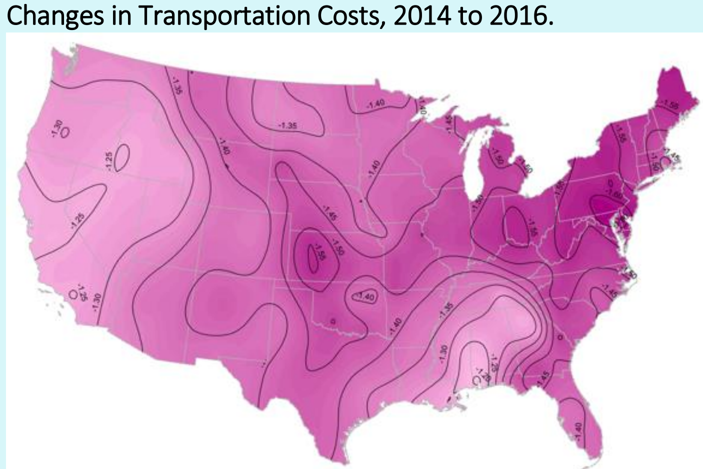
Source: Change in dual values at farm supply points from USDSS Model simulations for March 2014 and March 2016, 2018.

Figure 4 maps changes in regional farm milk values as calculated by the USDSS from March 2014 to March 2016. The Southeast, and particularly Florida, saw very little change in the farm value of milk, while an arc from Texas through the Northeast saw relatively larger declines in value. Even the Far West saw relatively smaller impacts on milk values during this 2-year period. To better understand why milk values changed (see Figure 4), we can partition the changes into the impacts of transportation costs and the impacts of supply and demand factors.

Transportation Impacts

The transportation costs necessary to assemble and deliver products through a supply chain can be significant. For instance, it can cost about $0.10 to transport a pound of cheese from California to the Southeast, and this affects the relative value of farm milk across the country. From 2014 to 2016 however, the cost of freight declined, largely because fuel costs were lower and the average truck was modestly more fuel efficient.

Figure 5. Change in the Spatial Value of Farm Milk Due to Changes in Transportation Costs, 2014 to 2016.



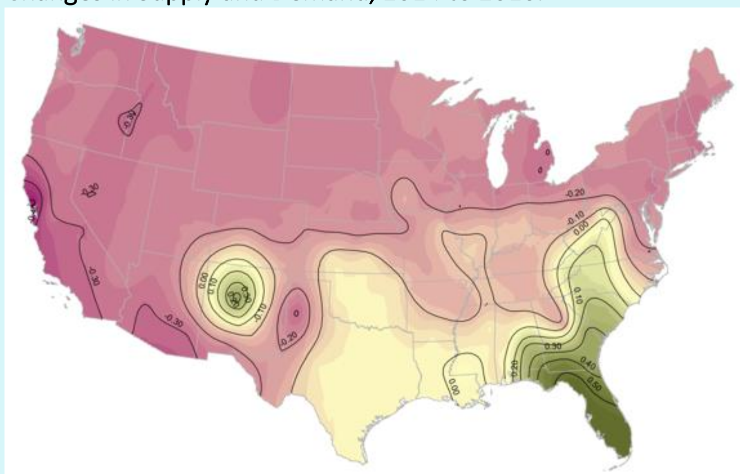
Source: Change in dual values at farm supply points for March 2014 with 2014 transportation costs and 2016 transportation from USDSS model simulations, 2018.

Figure 5 shows that changes in transportation costs had varying effects across U.S. regions. In the Southeast, the lower costs of transportation of 2016 meant that it was less costly to bring milk and dairy products into the region than it had been in 2014. This pushed farm milk values down in that milk-deficit region. However, the largely milk-surplus region of the West was able to push dairy products into distant regions at lower costs, effectively improving milk values there. The change in transportation costs had a neutral impact in a band from New Mexico through northern Michigan.

Supply and Demand Impacts

The Southeast continued to lose significant amounts of milk, contracting the supply, and the population continued to grow, expanding demand in the region. Figure 6 shows that both of these supply and demand pressures had a positive effect on regional farm milk prices. However, the combined negative effect of transportation almost exactly offset the positive effect of supply and demand, leading to almost no change in farm milk values.

Figure 6. Change in the Spatial Value of Farm Milk Due to Changes in Supply and Demand, 2014 to 2016.



Source: Change in dual values at farm supply points based on difference between March 2014 with 2016 transportation costs and March 2016 values from USDSS model simulations, 2018. NOTE: Includes changes in both domestic and export demand.

As in the Southeast, the heavy milk-deficit regions of the Atlantic Coast from New York City to Washington, D.C., experienced a negative farm milk price impact due to lower costs of transportation. Nearby milk surpluses in Pennsylvania, New York, and Vermont—coupled with almost no population growth in the region—reinforced the negative farm milk value resulting from changes in supply and demand. This led to significant declines in farm milk values.

Final Thoughts

Major changes in U.S. farm milk prices may occur for many reasons. Exports can have a large impact, as they did in 2014 by raising milk prices significantly and in 2016 when loss of foreign sales kept prices at relatively low levels. This impact may be described as affecting the "level" of U.S. milk prices. But domestic changes in regional supply, demand, and transportation costs can also affect farm milk values. These impacts might be described as changing the "tilt" of prices across the country. Both level and tilt factors have been at play in the last few years as dairy farms struggle to accommodate the combined impacts on farm milk prices. Regulated FMMO milk prices for Classes II through IV are identical across the country. Changes in regional values must be accommodated by changes in the unregulated premiums paid in different regions above the Federal Order minimum prices.

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Author Information
Mark W. Stephenson (mwstephenson@wisc.edu) is Director of Dairy Policy Analysis, College of Agricultural and Life Sciences, University of Wisconsin, Madison, WI.
Charles F. Nicholson (c.nicholson@cornell.edu) is Adjunct Associate Professor, Dyson School of Applied Economics and Management, Cornell University, Ithaca, NY.

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Disorderly Marketing in the Twenty-First Century U.S. Dairy Industry

Andrew M. Novakovic and Christopher A. Wolf

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Dairy farmers across the United States are dealing with financial stress from several consecutive years of low farm milk prices. Farm stress has been exacerbated in traditional dairy-producing regions in the Midwest and Northeast by a relative lack of dairy-processing capacity, which has led to disappearing farm premiums, increased milk hauling and marketing costs, and—in some periods—dumping milk that has no better marketing outlet.

Federal Milk Marketing Orders were created in the 1930s to ensure an adequate supply of fluid-quality milk production and encourage transport to deficit regions. Orders regulate farm-level markets for milk primarily through a complex system of minimum prices applied to the buyers of farm milk according to the products manufactured. Four classes of milk are defined by the end use: Class I relates to milk beverages; Class II includes milk used for value-added soft dairy products such as yogurt and ice cream; Class III is for milk used to make cheese and whey; and Class IV is butter, non-fat dry milk, and other skim milk products. Minimum prices that processors must pay for each of these product classes are derived from wholesale product prices adjusted for yield and manufacturing costs. Farmers, or their marketing cooperatives, must receive a weighted average of these four prices, with adjustments for milk composition.

One key justification for Federal Milk Marketing Orders was to promote “orderly marketing” and stability in farm prices through efficient distribution and utilization of milk. This article examines the current state of U.S. milk marketing, focusing on states and regions experiencing milk marketing issues.

Milk Market Coordination

Four innate characteristics of milk production and dairy farming make marketing a unique challenge: i) daily harvesting, ii) perishability, iii) bulkiness, and iv) asset fixity.

Milk is produced and harvested every day of the year. Add to this the challenge of perishability and you get a product that must be sold and delivered at least every other day. Indeed, for very large farms it is not unusual to begin the transportation process just after milk is cooled following each milking, which may be three times each day.

Just as perishability negates real-time opportunities for farmers to explore marketing options, the bulkiness of milk limits farmers’ ability to explore alternative customers. While dairy markets are widely recognized as being national—or even international—in terms of price discovery, this does not mean that individual farmers have realistic marketing opportunities outside of a day’s truck drive.

This relative lack of storability and transportability creates an urgency in milk marketing that is far different from, for example, grain growers, who harvest their product over a small window of time but can realistically market that product over the ensuing year.

The last marketing challenge is created by asset fixity. Many of a dairy farm's productive assets—beginning with the cow but including milking parlors, cow barns, calf hutches, and so on—have little salvage value outside of dairy farming. Thus, dairy farmers face a commitment to milking cows that results in a supply that is not easy to turn off and seldom economic to dial back, while at the same time creating a marketing environment that has high search costs with narrow feasible opportunities.

A good deal of the milk marketing system, including government price regulation, has evolved to mitigate the economic ramifications of milk and milk production characteristics. One of these system attributes is cooperative marketing. Another is government-enforced classified pricing and pooling, realized through the Federal Milk Marketing Order system.[1]

For over 100 years, an overwhelming majority of dairy farmers have chosen to market their milk through cooperatives. Today, cooperatives handle about 82% of the milk produced in the United States, with about two-thirds of U.S. production marketed through cooperatives that also have their own dairy processing operations (Liebrand, 2012). A distinctive feature of cooperative marketing is that farmers do not contract the sale of a certain amount of milk at a certain price at a certain time or period; rather farmers enter a membership agreement in which they agree to certain dues or other financial commitments in exchange for a guaranteed milk market and a promise to achieve the highest return possible, with a time commitment that is often—for all practical purposes—indefinite.

Price regulation, in particular classified pricing and pooling, has become a critical and defining feature of milk markets and the economic coordination mechanisms that keep them in balance. Classified pricing is a price discrimination mechanism that charges different levels of minimum farm prices for milk based on the demand characteristics of a customer's downstream product sector. The logic of the system is essentially to charge the highest prices in the most demand-inelastic product markets—beverage milk products in particular—and let the overall market for farm milk clear in its lowest valued, more elastic uses. Although other product sectors can play a role, plants producing butter and non-fat dry milk—butter/powder plants—are generally recognized as the primary agents for market clearing functions. It is also the case that dairy cooperatives produce and market 75% or more of the U.S. production of these two basic commodities (Liebrand, 2012).

Coordinating daily, seasonal, and cyclical milk production with demand has always been a role and particular challenge for dairy cooperatives. Although milk production in the aggregate is predictable, small changes in volume can have potent price effects. Moreover, changes in consumption are seldom aligned with the natural dynamics of milk production.

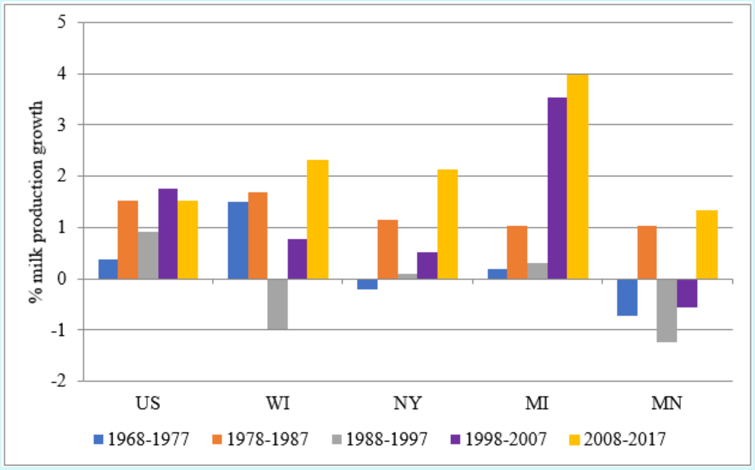
Cows tend to produce more milk in the spring, following a natural calving cycle and the availability of fresh forages. Sales of dairy products have several seasonal patterns. For example, butter and cheese consumption peak during the winter holiday season, while beverage milk consumption is heavily influenced by school calendars. Matching production and usage over the course of a year is referred to as *seasonal balancing*. Milk is produced daily, but not all processing facilities operate every day. Often there is a planned shut-down for a weekend or holiday. Sometimes weather or a mechanical event causes an unplanned shut-down. This puts the onus on cooperatives to do what is called *daily balancing*, and it is one of the reasons why cooperatives became processors of simple, storable commodities such as butter and milk powder. *Cyclical balancing* is driven by the need to expand processing capacity to accommodate milk production growth and, particularly, deviations from longer-term trends.

Dumping and Distressed Milk Sales

In recent years, dairy markets in many states have been unusually roiled by a severe form of market coordination failure that has resulted in significant dumping of milk that cannot find a profitable outlet on a particular day in a particular location. The causes of this are rooted in i) the market economics of this period, ii) a failure of the regulatory system, and iii) an unintended consequence of the seemingly unlimited cooperative guarantee of market security.

A number of factors led to higher-than-trend growth in the traditional milk production areas around the Great Lakes in the last 10 years. During this period, prices for corn and other grains and oilseeds settled into a new, higher equilibrium following the stimulus of ethanol mandates; at the same time, milk prices gained altitude in response to those increased grain prices. The result of this inelegant economic dynamic was a greater-than-normal increase in milk production, especially in areas where the dominant dairy farming system used primarily homegrown feeds. Figure 1 displays the average annual growth in milk production over a 50-year period from 1968 through 2017, in decade increments. Milk production growth in "traditional" dairy states in the Midwest and Northeast languished for several decades and was then followed in the last decade by a revitalization of the milk production growth rate. Michigan milk production in particular grew at a rate more than twice the U.S. average for the past couple of decades.

Figure 1. Average Annual Growth in Milk Production, United States and Selected States



Source: U.S. Department of Agriculture (2016).

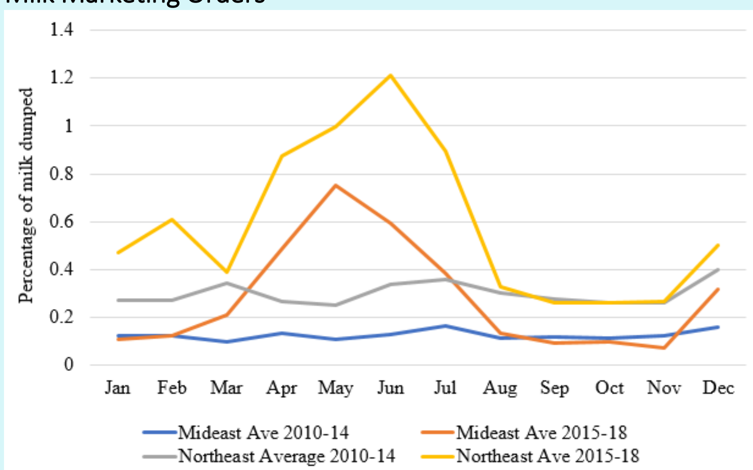
The past decade also coincides with competitive market conditions that have resulted in rather severe reductions in per capita sales of beverage milk products, which represent both the highest valued use and a large share of total milk sales. It also is a period during which the United States enjoyed considerable success in gaining shares of foreign markets, but these markets are inherently more volatile than domestic markets (Yonkers, 2011), resulting in ups and downs in sales opportunities that further challenge the market-balancing responsibilities of cooperatives.

Lastly, there has been a failure to make changes to federal order pricing formulae that might have encouraged investment in milk-processing facilities to encourage processing capacity would keep pace with production growth. Since 2000, federal order class prices have been calculated by adjusting wholesale prices for four basic dairy commodities (butter, powder, cheese, and dry whey), which represent about half of U.S. dairy product processing. The adjustments use average yields and costs of processing to determine a price for farm milk that processors of those Class III and IV products should be able to afford given their output prices. Any system that attributes a single value to the prices received or paid by the heterogeneous network of dairy processors across the United States makes several bold assumptions. The logic of this system was based on the fact that class prices are minimums, meaning that processors can pay higher prices if firm economics or market conditions warrant. As is always the case, the risk with minimum prices lies in setting them too high. This can occur when the processing-cost factors used in the class price formulae, the so-called make allowances, are too low. Make allowances are fixed by regulation and cannot be changed except upon significant evidence presented at a formal administrative hearing, then accepted by the U.S. Department of Agriculture and ultimately approved by the dairy farmers who fall under its regulation. Current make allowances were established in 2007. Increases in the prices of processing inputs increase manufacturing costs, whereas improvements in productivity lower costs. Although the evidence tends to be anecdotal, it appears that in the last 10 years, increases in input prices have been the dominant factor. This is also supported by statements of manufacturers that it is unprofitable to invest in new or improved facilities. Producers certainly have made and continue to make investments in new plants and plant renovations, but it is also equally clear that processing capacity is stretched and at times overmatched by milk production.

The lack of adequate dairy-processing capacity is demonstrated by the increased frequency of milk dumping, especially in the Northeast and Mideast order areas. Often referred to as “dump” or “dumped” milk, this situation occurs in small amounts normally for a variety of reasons. If a farmer inadvertently includes milk from a cow that has been treated with antibiotics, it will be discovered, but perhaps not before it contaminates the daily milk delivery, the truck tank on which the farm’s milk was loaded, or even the plant silo into which the tank was pumped. In this case, all the contaminated milk is disqualified from use, but the federal order will allow it to be priced at the lowest use class and included in the pool pricing calculations for all milk. Plants that receive contaminated milk will identify the source and stiff penalties will typically apply, including recovery of the cost of all milk that was ultimately contaminated, but this is a separate transaction from the order blend price calculation. Other common examples of dump milk include pick-up vehicle accidents, weather events that prevent timely pick-up, and plant closures due to maintenance or other events. This sort of thing is generally recognized as normal and part of the cost of doing business.

Classified pricing assigns prices to producer milk based on its end use. When milk cannot be used by a dairy processor but otherwise qualifies as milk associated with the order, it is assigned to the “lowest use class.” Meaning this dumped milk will have a value equal to the lowest class price for the applicable month, which is usually Class III or Class IV. This allows such milk to be counted as “delivered” and subject to the pooling provisions of the order. Farmers who produce milk that is assigned to the lowest use class remain eligible to receive the blend price for that order.

Figure 2. Percentage of Milk Dumped, Mideast and Northeast Milk Marketing Orders



The phenomenon of milk dumping is illustrated in Figure 2 using data from the Northeast (NY, VT, NH, MA, CT, RI, NJ, PA, DE, MD, and VA) and Mideast (MI, IN, OH, portions of PA, KY, and WV) orders, which have had the highest amounts of dumping in recent years. The average share of milk dumped monthly from 2010 to 2014 is compared to the average amount of milk dumped from 2015 to 2018. As the figure reveals, the typical percentage of milk dumped is 0.1% to 0.15% in the Mideast, but in recent years has spiked to as much as 0.75%. Similarly, the average in the Northeast order was 0.2% to 0.3% but has often averaged two to five times that level in the past 4 years.

Dumping at the levels observed in the Northeast and Mideast orders is unusual, but the phenomenon referred to as “distressed” milk sales is not. Dumping is the extreme case of farm milk not being able to find a customer at a price that yields a positive return above the direct cost of delivery. More common is the situation in which a cooperative finds it has milk it cannot market to its normal customers, so it offers it for sale at a discounted price, usually deeply discounted to half or less of the applicable minimum price. Sometimes the discounted sale can be made to a regular customer, but often the milk must be moved to a nearby region, typically taken by another cooperative. Because this milk is delivered and sold, even at a discount, it is not accounted for separately by federal orders.[2] Thus, we have no public information on the volumes of distressed milk sales. The high-water mark for dumped milk in the last few years may be a reasonable measure of a typical volume of distressed milk sales.

Causes of Milk Market Disruptions

Several explanations have been offered for the recent, unusually large levels of milk dumping. Above-trend increases in production are assuredly the beginning of an explanation. The rather dramatic decline in Class I sales in the Northeast in particular is also a major contributing factor, as some fluid plants have closed altogether and others have reduced purchases. This has left farm suppliers without a market and put cooperatives in the position of attempting to fulfill their guarantee of a market outlet with no available, profitable outlet. When the next best available outlet is too distant to justify shipment, milk is disposed of, usually dumped in farm manure handling systems. All milk that is produced by a cooperative member receives a price. However, when milk dumping occurs cooperatives are forced to "re-blend" the payments for the 98% of milk actually sold across 100% of the milk they buy this results in a price paid to farmers that is often below the minimum blend price announced by the order.

Michigan, part of the Mideast order, has been averaging farm milk prices of $1–$1.50/cwt below their historic relationship to U.S. and surrounding state prices. In the past couple of years Michigan farm milk prices have been among the lowest in the United States. The resulting financial stress has increased the exit of dairy farms and recently, in 2018, resulted in slowing state milk production. In New York, which is in the Northeast order, some farmers have been left without any market alternative and have exited. For other farmers, it was more or less business as usual, although with lower or no market premiums. Members of the cooperative that were left with the primary chore of balancing the market saw lower farm milk prices, similar to the Michigan experience. Of course, this also occurred during a period in which market prices for milk were generally below average and resulted in historically low returns for many farmers.

Not surprisingly, many dairy farmers and market participants saw milk being dumped and wondered why someone, maybe a beleaguered cooperative in particular, was not building a processing plant to absorb this excess milk production. There are a couple of reasons why new processing capacity has been slow to match increased production. The bulges in distressed or dumped milk are hardly uniform throughout the year (Figure 2). It is not obvious what plant would have marketing opportunities in the spring flush and in December. Absent that, the answer is often simply a butter/powder balancing plant that can manufacture a commodity product at a relatively low cost and store product until it can be sold. The proposition for butter is encouraging, inasmuch as sales are strong for butter and other cream-rich products. The problem is that market prices for non-fat dry milk and related protein powders are often barely sufficient to return a profit to existing plants, much less justify plant investment. Herein lies the conundrum of make allowances that do not adjust to reflect higher manufacturing costs. A higher make allowance would lower the price of milk relative to the wholesale price for non-fat dry milk and other commodities. While this would be encouraging news for manufacturers, it would be quite unwelcome news to farmers, who are already enduring a long period of below-average prices. When the manufacturer is a cooperative, there is a paralyzing conflict of interest as to how best represent the economic interests of their farmer owners.

Cooperatives are stretched to honor their commitment to guarantee a market for all milk produced by members. This has resulted in a number of cooperatives closing their membership to new applicants or developing various pricing schemes to try to discourage expansion by existing members. These moves are decidedly unpopular with most farmers, who prize their right to run their businesses as they see fit. Although calls to adjust the make allowances in federal pricing formulae are starting to be voiced, this remains a challenging proposition for cooperatives, which must convince farmers to support an action that will lower their minimum farm price just to make it feasible to build manufacturing plants that may well have low profit performance. At best, this would have the effect of lowering every farmer's price a bit and reducing or avoiding the re-blending deductions that are costliest to market-balancing cooperatives.

In this environment, the marketing system that performed well over the last several decades is struggling with the multiple problems of too much milk production, declining sales of Class I milk, insufficient balancing-plant capacity, displaced farmers, and an extended period of low milk prices. This situation is calling into question the longstanding gospel of guaranteed markets for members of dairy cooperatives and the practical ability of a ponderous regulatory system to respond to a more rapidly changing market environment.

For More Information

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[1] As noted in a recent article (Novakovic and Wolf, 2016), with the addition of California in November 2018, the Federal Milk Marketing Order system will regulate about 82% of U.S. milk production.

[2] Although counted as producer milk received by a regulated plant, distressed milk can be sold at a discount because cooperatives are generally not bound to price minimums. In some cases, this milk may not be pooled milk.

Author Information
Andrew M. Novakovic (a.novakovic@cornell.edu) is E.V. Baker Professor of Agricultural Economics, Charles H. Dyson School of Applied Economics and Management, Cornell University, Ithaca, NY.
Christopher A. Wolf (wolfch@msu.edu) is Professor, Department of Agricultural, Food and Resource Economics, Michigan State University, East Lansing, MI.

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New California Milk Marketing Regulations Will Not Change Economic Fundamentals

Daniel A. Sumner

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Federal regulation of milk prices began in 1933 as a central program in President Roosevelt's New Deal agricultural policy (Sumner and Wilson, 2000). However, after the Supreme Court ruled that many features of New Deal programs were unconstitutional, California enacted a milk price policy in the Young Act of 1935. California adopted the main features of the price regulations that the court had said exceeded federal authority under the Commerce Clause to regulate commerce within a state. California retained its California Milk Marketing Order (CMMO) for more than 8 decades, despite the creation of a Federal Milk Marketing Order (FMMO) system under legislation later in the 1930s (Sumner and Wilson, 2000). This long-standing policy ended in 2018 with a vote to create a California Order as a part of the FMMO system administered by the U.S. Department of Agriculture (USDA).

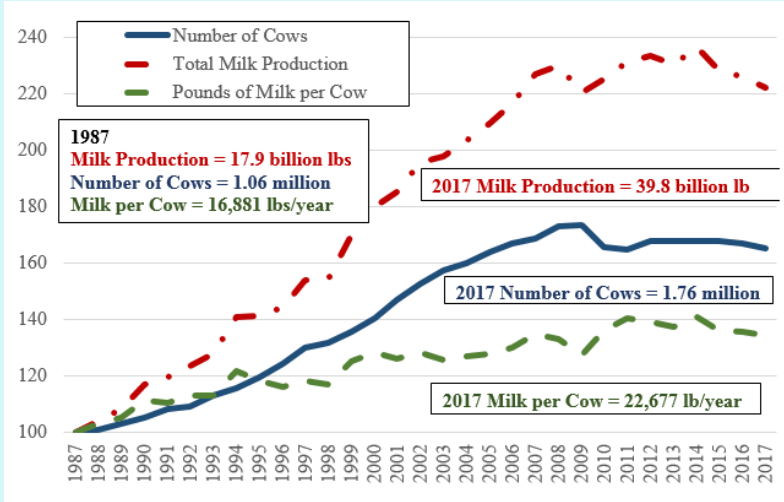
California is an important component of the US dairy situation and outlook because California remains the largest dairy-producing state in the United States, accounting for about 18.5% of U.S. milk production, down from a high of over 20% (USDA, 2018). With California dairy consumption making up about 12% of the U.S. total, California ships milk products to the rest of the United States and the world. Milk remains the largest California farm commodity by revenue (still slightly above almonds), and milk is central to the economy of the Central Valley. The dairy industry purchases locally-produced by-products and forage and supplies raw milk to the local dairy processing industry (see data from California Department of Food and Agriculture (CDFA), https://www.cdfa.ca.gov/dairy/dairystats_annual.html and from USDA, https://data.ers.usda.gov/reports.aspx?ID=17845).

In the following sections, I review the economic drivers of this historic shift in milk price policy, outline some economically important differences between the new California FMMO and the program it replaced, and explain some major economic implications of the policy change. My main findings may be stated succinctly. First, with economic stress on dairy farmers nationally (and in many other countries), California milk producers became especially concerned about low prices in the state relative to prices in many other regions of the country. Second, the federal price formulas will likely yield higher minimum prices for milk used for cheese, while federal rules will allow processors that had been required to participate under California rules, to opt out if they find doing so to be advantageous. Third, because the new federal regulations do not change the supply and demand fundamentals for milk production in California, there seems little scope for the federal order to cause major increases in milk prices compared to the California program that it replaced.

The Situation and Outlook Leading to the Shift to Federal Marketing Regulations

By all accounts, the California and federal marketing order systems were similar in their goals, regulatory measures, and impacts for a full 8 decades. The California order began as an attempt to implement federal policy locally to meet Supreme Court demands. That it continued for 80 years, rather than being folded into the federal system in the 1930s, mainly reflects the fact that there seemed to be no compelling reason for a change once the system was up and running. The biggest difference in the two was simply whether regulatory oversight was provided by Sacramento or Washington, DC. Over the decades, both the FMMO system and its California counterpart evolved; certain features (some details and some more basic) have been different all along. Nonetheless, the stimulus for the shift was not any specific feature of the California order but rather dissatisfaction with milk prices in California (and globally) and the perception that the California order did not do enough to protect farmers compared to policy in other parts of the country.

Figure 1. The Evolution of California Dairy over Three Decades



Source: California Department of Food and Agriculture, Dairy Division (https://www.cdfa.ca.gov/dairy/dairystats_annual.html), and U.S Department of Agriculture (2018).

To characterize briefly what drove disaffection within California, Figure 1 considers the evolution of the industry over the past 30 years. The number of cows rose by 73%, production per cow rose by 35%, and milk production grew by a remarkable 130% in the 2 decades after 1987. But that has all come to an abrupt halt. In the last decade, milk production has been flat, cow numbers have declined, and milk production per cow has grown just slightly. An industry that had become used to remarkable growth now recognizes that it faces—at best—stagnation.

As the California dairy industry reversed its decades of growth and stagnated or declined, the rest of the United States has seen a very different picture of progress: Milk production per cow has grown steadily, the number of cows has stabilized and even grown slightly, so that total milk production rose, offsetting the fall in California.

Table 1. Number of Cows, Milk per Cow, and Milk Price, across States

	Cows (millions)	Milk per Cow (lb/year)	All Milk Price ($/cwt)
2007			
California	1.79	22,728	18.05
Wisconsin	1.25	19,341	19.30
Idaho	0.50	23,006	17.80
2017			
California	1.76	22,677	16.50
Wisconsin	1.28	23,688	18.10
Idaho	0.60	24,378	17.20
Percentage increase, 2007–2017			
California	−2%	0%	−9%
Wisconsin	3%	22%	−6%
Idaho	20%	6%	−3%

Source: U.S Department of Agriculture (2018).

Leading up to the shift to the California FMMO, California's position relative to other major dairy states became controversial. Compared to major competitor states Wisconsin and Idaho, California lost ground in all dimensions over the past decade (Table 1). It is remarkable that after decades of dairy productivity, California milk per cow is now relatively low compared to that of other major dairy states.

Two changes (not shown in Figure 1 or Table 1) are important to highlight. First, dairy farms have been much larger in California than in other major dairy regions. While farm consolidation has continued in California, it has occurred more rapidly in other regions. The typical size of dairy farms in states such as Wisconsin (or especially Michigan), while still much smaller than typical in California, have captured substantial scale economies. Second, milk processors have also consolidated, especially through mergers and acquisitions of milk-processing cooperatives. Two of these cooperatives, Dairy Farmers of America (based in Missouri) and Land O'Lakes (based in Minnesota), are national. Their California membership accounts for a substantial share (about 40%) of milk produced in California, and they are major processors of dry milk powder and butter in California.

While there are many reasons for decline in the California share of national milk production, one factor has been increasing costs of production and lower milk prices that have not kept up with costs. California prices fell by 9% (in nominal terms) over 2007–2017, compared to 6% in Wisconsin and 3% in Idaho. The world dairy situation over the past decade has been characterized by severe fluctuations in feed prices and milk prices that have placed the industry under stress almost everywhere.

Challenges in California include processing costs, which had been lower than those in most competitor regions but are now higher in California. Moreover, California milk processing tends to be more concentrated among the lower-priced generic products for which price premiums are unavailable. These processing problems are reflected in lack of investment. For example, recent data reported in *Cheese Market News* indicated that only one of the 27 major new milk processing plants from 2017 to 2020 is or will be in California (McCully, 2018). Other major dairy production regions that have attracted several new plants produce less milk than California

Milk Marketing Order Basics

Milk marketing orders have many complex features and do more than regulate prices. As a price policy however, two central features are first, setting minimum prices paid by milk processors that depend on their end-use product, and second pooling or blending the revenue from milk sold for different end uses. These features imply that farmers receive a weighted average of the minimum prices that does not depend on the end use of their milk. The government does not regulate the amount of milk produced and marketed, and milk buyers may pay premiums above the government-set minimums. These over-order premiums are not pooled and provide a direct incentive to farms (or their cooperatives) to contract with a particular processor. Therefore, revenue from the "pool" does not include all milk revenue received by producers, and the weighted average of minimum prices is not equal to the actual price received by producers (Ahn and Sumner, 2009).

In line with simple economic models, the marketing order pricing rules generate price discrimination gains when higher prices are set for milk with end uses that tend to have less elastic demand functions. In practice, marketing orders set higher minimum prices for milk used for beverage and other fluid products that have more localized markets because of high transport costs. Some of the gains from price discrimination are lost through the higher marginal cost of additional production created by the price incentives. This additional milk is diverted to make more highly processed products, which depresses prices received for milk used for products, such as butter, dry milk power, whey, and cheese, which are shipped farther.

The Process of Changing Milk Marketing Rules

The process of establishing or modifying a federal marketing order is an elaborate, formal legal procedure that requires many steps and takes several years. The process to create the new California order began formally with a proposal from a group of dairy farmer cooperatives in early 2015 (Table 2), after a severe collapse in milk prices that occurred in 2014. Even earlier, during the period of low milk prices in 2012 and 2013, California farm groups had agitated for changes in the CMMO that they hoped would raise minimum prices, but the changes they had proposed were not implemented. Much of 2015 was spent gathering additional proposals, evaluating their likely impact, and engaging in public hearings that lasted for months. With the information they collected, the USDA spent 2016 preparing its recommendation, which was released in early 2017 with the updated impact analysis.

More public comments were received and evaluated and the final decision and another update of the USDA impact analysis were published in March 2018. At that stage, the final marketing order was put to a vote.

Voting itself was anticlimactic. Cooperatives are allowed to vote on behalf of their members in a "block voting" procedure; in this case, the three large cooperatives, which controlled 80% of the votes, had already publicized their support for the new federal order. The positive vote was announced in June 2018 and the final order will be fully operational on November 1, 2018. The full record is available at www.ams.usda.gov/caorder. The *Federal Register* notice is available at www.federalregister.gov/documents/2018/06/08/2018-12245/marketing-orders-milk-in-california.

Table 2. Timeline of California Federal Milk Marketing Order (FMMO)

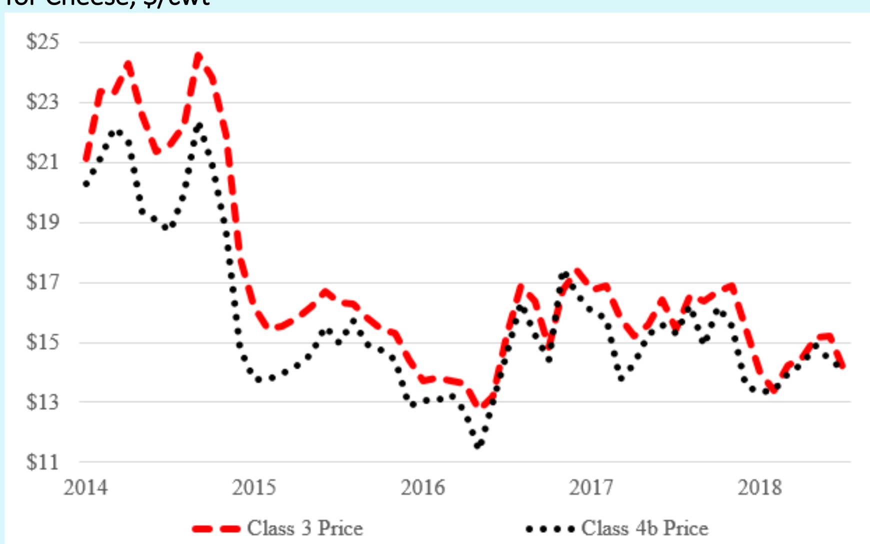
Date	Event
Feb. 2015	Formal proposal by cooperatives for a California FMMO
Apr.	Additional proposals received
Aug.	Preliminary regulatory impact analysis of proposals
Sept. to Nov.	Hearings on California proposals
Feb. 2017	Recommended decision on published
Feb.	Regulatory impact analysis of recommended decision
May	Deadline for public comments on recommended decision
Feb. 2018	Update on status, delay to await a Supreme Court decision
Mar.	Final decision published in *Federal Register*
Mar.	Regulatory impact analysis of final decision
May	Deadline to receive producer ballots
June	Announcement of producer approval and publication of final rule.
Oct.	Implementation of California FMMO.
Nov. 1 2018	Deadline for producers to be in compliance

Source: U.S., Department of Agriculture, Agricultural Marketing Service (https://www.ams.usda.gov/rules-regulations/moa/dairy/ca)

Main Changes in Economically Important Features of the New California Regulations

Three main changes may affect producer prices and marketing. The first is procedural: Under the California system, price regulations and other features of the CMMO could be adjusted periodically, sometimes monthly, with a relatively simple process whereby petitioners could request a public hearing before the CDFA, with a judgement rendered within a month or two. Thus, the California order could adjust pricing rules in response to unexpected, temporary

Figure 2. Comparison of Regulated Minimum Farm Price Paid for Milk Used for Cheese, $/cwt



Sources: CDFA, California Dairy Review October 2018 and earlier issues (https://www.cdfa.ca.gov/dairy/uploader/postings/dairyreview/Default.aspx) and USDA, AMS (https://www.ams.usda.gov/mnreports/dymclassprices.pdf).

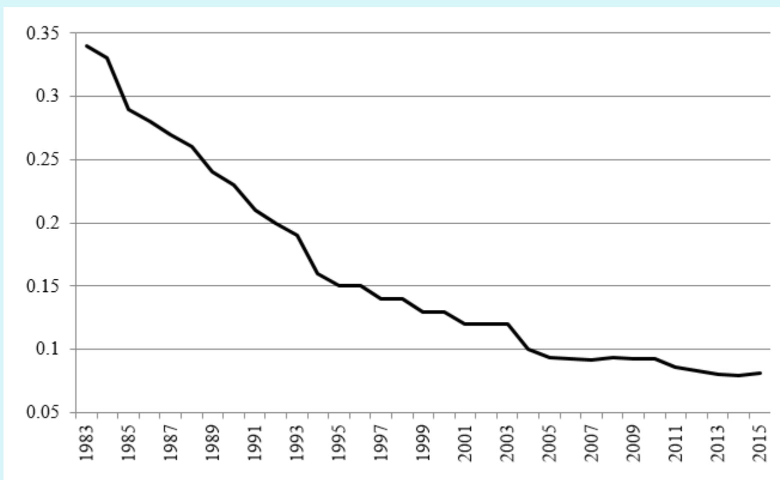
market conditions. Federal order changes take years and are not designed to respond to temporary shifts in costs or demand.

The FMMO will include some adjustments in how product and milk component categories are defined (such as combining frozen and soft products into a new class II and separating non-fat milk into protein and other non-fat solids). But the second significant change will be that the federal order is likely to impose a higher minimum price for milk used for cheese. Most observers expect a higher minimum price for Class III milk compared to California Class 4b milk because the federal order is likely to attribute more value to whey, which is a marketable by-product from cheese making. In recent years, the CMMO formula led to a lower California minimum farm price of milk used for cheese (Class 4b) than the comparable federal minimum price (Class III) (Figure 2). This difference in minimum prices was one of the motivators for the shift to the federal order. If the past is any guide, the shift to federal rules is likely to raise this minimum price of “cheese milk” by a few percent.

The third change that may prove to be economically significant is that the federal rules allow milk processing plants (other than plants making Class I products) to periodically exit and re-enter the pool pricing system. The California rules generally required mandatory participation among major milk processors. Of course, milk processors must compete for farm milk, so if they pay less for milk than their competitors they would not attract raw milk deliveries and would cease to operate. However, in some circumstances, a processor may gain from contracting for prices directly with the farms (or cooperatives) that deliver milk to their plants.

Since milk used for Class I products has a higher minimum prices, a higher proportion of these products in the pool generally raises the pool price above the regulated minimum price of milk used for cheese. But in places like California, where the Class I differential is low and the share of milk used for Class I products is low (less than 8% for milk fat and less than 14% for non-fat, based on CDFA data reported in Figure 3), the gain from pooling with Class I milk is small. This farm price gain can be easily offset by typical over-order premiums paid by cheese processors and other favorable contract features used to attract farm deliveries.

Figure 3. Ratio of Fat Used for Class 1 Products to Total Milk Fat Production in California



Source: California Department of Food and Agriculture, Dairy Division.

Economic and Marketing Implications

Neither the California milk pricing regulations nor the federal regulations that replace them alter the underlying market relationships that determine milk supply, demand or price (Sumner and Wolf, 1996). California remains an exporter of processed milk products that must compete on national and international markets. Despite a large population, California has a low share of milk used for beverage and other Class I uses. These factors, plus the facts that processed products made in California tend to be generic and processing costs are no longer low by national or world standards, mean that the average farm price of milk in California (the regulated minimums, plus over-order premiums and the prices for milk outside the order) will remain low compared to the U.S. national average. The change in how the government sets regulated minimum prices cannot change this supply–demand balance.

California producers that deliver milk to processors that remain in the order could gain from a closer link to national minimum prices of milk used for processed products. That—plus the likelihood that much of the Class III (cheese) milk, which tends to have a low minimum price, will leave the order—may raise the marketing order pool price.

There may be shifts in prospects among processors within and across end-use classes as they adapt to the new system. Some may leave the marketing order and create new price contracts that producers find attractive or find useful risk management tools that had not been available under the CMMO or the new FMMO. Other processors may find the price necessary to attract milk will rise. All of these changes seem marginal relative to the main result that farm milk receipts seem unlikely to change much.

One potential implication of the shift to the new FMMO is that pricing and similar operations may become more convenient or effective for the large national cooperatives that operate under the FMMO umbrella in almost all other important milk-producing regions. These cooperatives may be able to streamline operations and use their new volume in the federal order advantageously in national discussions about regulations. Cooperatives are not regulated in what they must pay their members, so competition drives those payments. Adding California to the FMMO system may make pricing considerations more similar to those in other major dairy regions.

Because California is a major milk-producing region, the shift to a federal order has garnered national attention. Despite this interest, little about the economics of milk production or marketing outside of California seems likely to change. If the price of milk changes little within California, production of milk and milk products will not change much either. Milk producers, buyers, and consumers nationwide will be unlikely to notice much change.

For More Information

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Author Information

Daniel A. Sumner (dasumner@ucdavis.edu) is the Frank H. Buck, Jr. Distinguished Professor, Department of Agricultural and Resource Economics, University of California, Davis, CA; and the Director of the University of California Agricultural Issues Center.