Cuban Agriculture: A Green and Red Revolution

By Lydia Zepeda

There is more to Cuba than fabulous cigars, 1950s cars, cheap rum, and music so infectious that even a Norwegian bachelor farmer will get up and dance to it. It also happens to be a showcase for policy transformation from industrialized agriculture to a greener, sustainable agriculture. Cuba has transformed its agriculture from a low productivity, highly subsidized, high input system to one that is more productive and greener, while removing subsidies. Urban agriculture, land reform, market reforms, and a complete reorientation of the university system all feature prominently in the policy reforms. Yet these green transformations are far from neo-liberalist; as one Cuban official told me, “We are, after all, Red.”

Looking Back

To understand how these changes came about, one must know something about Cuba’s history. From 1492 to 1898, it was a colony of Spain, whose rule was brutal even by Spanish standards. Both the native Taino people and the forest were annihilated to make way for large cattle and sugar farms in the hands of a few wealthy owners and worked by slaves. In 1895 Jose Marti, poet, journalist and beloved by Cubans as the father of their country, led an uprising against Spain. Although Marti was killed that same year, the uprising continued. In 1898, the United States entered into the Spanish-American war when the USS Maine mysteriously blew up in Havana harbor. Spain was easily defeated, and Cuba was under U.S. military rule from 1898 to 1902.

Over the next few decades, U.S. businesses and individuals acquired some of the best land, while the Platt Amendment permitted the U.S. military to intervene whenever U.S. interests were threatened, and U.S. marines were stationed in Cuba to protect U.S. interests. Sugar production continued to increase in importance at the expense of food production, which caused greater reliance on food imports. Wealth was concentrated in a few hands, and the vast majority of Cubans continued to live in poverty without access to land or incomes sufficient to feed their families.

On December 31, 1958, the Batista government was overthrown, and a socialist government took power. The expropriation of U.S. property in Cuba led to a U.S. policy of isolation. By 1960, the isolationist policies caused Fidel Castro to become “an accidental communist” and turn to the Soviet Bloc. By 1962, Cuba effectively was a Soviet satellite. Cuban agricultural policies followed the Soviet model—large monocultural state farms were highly mechanized and heavily reliant on chemical fertilizers and pesticides. Cuban agriculture used more fertilizer and nearly as many tractors per hectare as that of the United States. The Soviet Union subsi-
dized this industrial model by trading its oil, chemicals, and machinery for Cuban sugar at preferential rates.

Then, in 1989, the Berlin Wall fell. Almost overnight US$6 billion in Soviet subsidies to Cuba disappeared. At the same time, the U.S. trade embargo tightened, and Cuba was plunged into an economic crisis. Gross domestic product (GDP) shrank by 25% between 1989 and 1991. Cuba entered what is euphemistically called the “Special Period.” Special, indeed: Oil imports (and consequently fuel) fell by 50%; the availability of fertilizers and pesticides fell by 70%; food and other imports fell by 50%; and most devastatingly, calorie intake fell by 30%. Further exacerbating the economic crisis, in 1992 the United States passed the “Cuban Democracy Act,” which prohibited assistance to Cuba in the form of food, medicine, and medical supplies.

**Recent Reforms**

Faced with this crisis, Cuba radically changed the state sector in 1993; about 80% of the farmland was then held by the state and over half was turned over to workers in the form of cooperatives—UBPC (Basic Unit of Cooperative Production). Farmers lease state land *rent free* in perpetuity, in exchange for meeting production quotas. They may even bequeath the land, as long as it continues to be farmed. A 1994 reform permitted farmers to sell their excess production at farmers’ markets.

The reforms emphasized five basic principles. Foremost of these was a focus on agroecological technology, supported by the state/university research, education, and extensions system. There had been researchers, outreach specialists, and faculty devoted to agroecology before the crisis. The crisis not only brought them to the forefront, but universities, research centers, and agricultural policies were reoriented to make agroecology the dominant paradigm. To begin to understand the magnitude of this reorientation, imagine for a moment that your local college of agriculture reoriented its entire curriculum, research, and extension programs to agroecology. Pick yourself up off the floor, and now imagine that all the universities as well as all national agricultural policies in your country were reoriented to agroecology.

A second principle of the reform was land reform; state farms were transformed to cooperatives or broken into smaller private units, and anyone wishing to farm could do so rent free. In effect, a right-to-farm policy was implemented. A third principle of the reform was fair prices to farmers: Farmers can sell their excess production at farmers’ markets; average incomes of farmers are three times that of other workers in Cuba. A fourth principle of reform is an emphasis on local production in order to reduce transportation (and hence energy) costs. Urban agriculture, a key to this reform, produces nearly the recommended daily allowance of 300 grams per person of produce. The fifth principle of reform is farmer-to-farmer training as the backbone of the extension system.

**Impact of the Reforms**

What were the results of these reforms? Production of tubers and plantains tripled and vegetable production quadrupled between 1994 and 1999, while bean production increased by 60% and citrus by 110%. Potato production increased by 75%, and cereals increased by 83% between 1994 and 1998. Calorie intake rose to 2,580 per capita per day—just under the minimum recommended by the World Health Organization. This is despite Cuba being the second poorest country in the Americas.

The conversion of Cuba’s agriculture to more sustainable practices has focused on urban agriculture and domestic crops. Indeed, these practices seem to free up scarce chemicals for the traditional
export crop, sugar. Sugar continues to be produced in monoculture, but increasing amounts of organic sugar are being produced, largely for export.

Urban agricultural production climbed from negligible in 1994 to more than 600,000 metric tons in 2000. There are more than 200,000 urban farm plots ranging in size from a few meters to a hectare in size. Production practices rely on organic matter, vermiculture, raised beds, crop rotation, companion cropping, and biopesticides. Yields are between 6 and 30 kilos per square meter and are predominantly roots, tubers, and vegetables. A proposed project called Calle Parque (street parks) will extend urban agriculture and provide much-needed urban cooling by converting some streets in central Havana to parks and gardens.

The reforms have not yielded dramatic results for sugar, meat, or dairy, nor for traditional import crops (rice and beans). Cuba continues to rely on food imports, as it has since it was colonized. In 2000, Cuba imported US$141 million in rice, US$65 million in beans, and US$60 million in milk products. Cuba also imports about one million metric tons of feed grains, nearly a half million metric tons of soybeans, 100,000 metric tons of chicken and pork, as well as substantial amounts of cooking oil, soybean meal, and malt. Because of the U.S. embargo, Cuba has to buy these products from distant countries, adding on average 30% to the cost of food imports over what they would pay for U.S. products. For example, Cuba buys rice from India and China, dairy products from the European Union, grains from South America and Eastern Europe, and meat from Canada and Brazil.

Meat production and dairy production were hit particularly hard by the loss of subsidized Soviet feed and petroleum. The loss of petroleum meant that animal traction became a strategy to reduce reliance on farm machinery. Animal traction is also better for soil management, particularly given the smaller farm size after land was redistributed. However, the conversion to animal traction was impeded by lack of oxen and expertise. The solution was to prohibit slaughter of cattle without government permission (in order to build up the herd) and to create “schools” to train the oxen (and presumably farmers). More than 150,000 oxen have been trained at these schools, and pairs of working oxen are ubiquitous throughout Cuba. This dramatic transformation did not come without a cost—the availability of beef plummeted, and anyone caught illegally slaughtering cattle could spend up to 20 years in jail.

Policy Themes
This kind of policy solution—trading personal liberty for social goals—is common in Cuba. Not only cattle are managed as a national resource—the dean of an agricultural university in Cuba declared that “soil is a strategic national resource.” Intellectual property is also managed as a public resource. Cuban researchers are developing biotechnology applications for agriculture and medicine. However, the Cuban government prevents anyone from patenting discoveries funded by government research. Intellectual property developed with public funds is treated as a public resource.

Social equity is a clearly a higher priority for the Cuban government than personal liberty. Indeed, Cubans even share their poverty; living standards are uniformly low. Yet, despite being the second poorest country in the Americas, there is no widespread hunger; housing is generally free, if dilapidated and crowded; Cubans are one of the most educated populations in the world; and there is universal free health care. All Cubans have access to a basic (although minimal) diet through their ration card. Cubans supplement this with food they grow, barter for, or buy at farm stands, farmers’ markets, or dollar stores. Cubans spend about two thirds of their income on food, but not everyone has the same buying power. A 2000 Lexington Institute study found that it took the average Cuban on a government salary four days to earn...
enough money to buy a basket of food consisting of one pound each of pork, rice, and beans, two pounds of tomatoes, three limes, and a head of garlic. A retiree on a pension would need 7.2 days, and a private taxi driver in Havana would need 3.5 hours.

**Citizen Responses**

Cubans themselves have a range of responses to this situation. Some Cubans are dedicated to social equity and are pragmatic about the individual sacrifices required so that everyone has something to eat. Others are discontented, even resentful, feeling that they are underemployed given the level of (free) education that they have and could have a higher living standard under a capitalist system. No one says that the situation is easy, and the embargo (called a blockade in Cuba) is viewed by all as the primary barrier to improving the situation.

The Farm Bureau has made some headway with the State Department to allow some U.S. exports. Indeed, while in Havana, we bought Washington State Red Delicious apples (for 50 cents each!) at a dollar store. Cuba wants to buy U.S. farm products: rice, dairy products, feed grains, soybeans, meat, and poultry. However, it is unlikely they will be able to do so without some means of earning dollars, and their export products are sugar, citrus, tobacco, tropical fruits and vegetables, and seafood, which would compete with some U.S. producers.

**The Future**

What will the future bring? *Quien sabe.* Everyone expects political changes when Castro dies, but one must be mindful that there is an immense state communist system that permeates Cuban society. Many people benefit from this system, and Cubans are well aware of the example of the Soviet collapse and ensuing economic and social crisis in Russia. Regardless of what happens on the political level, it seems likely that Cuba will continue to promote agroecological practices and to expand urban agriculture simply because they are yielding results. The bad experiences with large agricultural operations, both before and after communism, make it unlikely that anyone could credibly promote a return to large, high-input operations as a matter of national policy.

The positive results that farmers, university researchers, and extension are getting from the transformation of Cuban agriculture will likely encourage them to continue to pursue sustainable practices whatever comes next. Cuban people are eating better and healthier than before, though things are far from perfect. However, the relevant comparison is to other Latin American countries; Cuba simply does not have the widespread hunger, destitution, and suffering that are commonplace in countries with much higher GDP per capita.

The extent of future success with sustainable agriculture will of course depend on what markets Cuban farmers will have access to and what types of competition they will face from imports. Although great strides have been made, Cuba will likely always be a food importer, and it will certainly be in Cuba’s interest to buy its imported meat, rice, beans, oil, soy, and dairy products as cheaply as possible. If the United States wants to supply these imports, it will need to negotiate a means for Cuba to earn the money to buy them. Removing the travel ban and permitting U.S. tourists would certainly yield more unity among U.S. agricultural interests than allowing importation of Cuban sugar, citrus, and tobacco. Whatever the future brings, one thing is certain: Cuba will continue to make some of the finest cigars and music in the world.

**For More Information**


Lydia Zepeda is a professor in the Department of Consumer Science and a Fellow at the Center for World Affairs and Global Economics, University of Wisconsin.
One of the more highly publicized news items of the recent Farm Bill debate was the realization that farmers who owned more land or produced a greater volume of program crops received more money than those who did not. Because farm payments are distributed largely on the basis of acreage or output and have been for decades, this sudden indignation seems surprising. A more important question might be whether or not the program did what it was purported to do—raise farm incomes for family farmers, protect them from massive losses in wealth, and “keep them on the land.” We can’t fully explore this topic in these few pages, but we can examine a few consequences of farm programs and changing economic conditions.

A Little History

Following the adoption of the 1996 Farm Bill, agriculture in the United States experienced two exceptionally good income years (1996 and 1997), the Russian and Asian financial crises, the devaluation of the Real and the emergence of Brazil as a competitive force, the collapse of the hog market in 1998 (and a more modest reprise in 2001), a major economic recession, the terrorist attacks of September 11, 2001, animal disease outbreaks in Europe, GMO-related market losses, and a number of other calamities. All this was accompanied by the grinding consolidation and integration that has almost become background noise in U.S. agriculture.

As it became apparent that the 1996 Farm Bill could not adjust to income shocks of this magnitude, in 1998 the federal government began a series of ad hoc emergency subsidies, ostensibly to shore up farm incomes. An unprecedented flow of federal subsidies poured into the farm sector. In 2002, the Farm Bill was revised again in part to automate the ad hoc subsidies and keep the money flowing.

So, with all of that, did we—the Great American Taxpayerate—do good with our multi-billion-dollar intervention? Let’s take a look—using Iowa as a case study.

In Figure 1, we show nominal net farm income for Iowa along with total government payments. (Keep in mind that government payments are included in net farm income.) Note the volatility of farm income over this period and the growing dependency on subsidies since 1997. During years when incomes would have been low in the absence of subsidies (1987, 1988, 1999, 2000, and 2001) the realized income levels were comparable with reasonably good income years (1990, 1992, and 1994).

What Farm-Level Panel Data Can Tell Us

Sectoral data doesn’t reveal much about how individual firms are impacted by or respond to changing economic conditions. To examine this issue, we assembled a panel data set of farms that are members of the Iowa Farm Business Association (a farmer-owned record-keeping service). Most of the 475 farms included in the panel would be considered large to very large family farms using the USDA’s typology (Hoppe & McDonald, 2001). The 1997 Ag Census reported that farms of this size comprised about 14% of the farm businesses in the state of Iowa and produced more than 60% of gross sales. In 2002, the panel average for gross sales was $260,000, the operator’s share (all land farmed less the landlord’s share of crop share leased land) of crop acres was slightly less than 700 acres, and the total labor supply averaged 1.5 person-years. Net
farm income was more than three times reported off-farm income from all sources.

We classified the farms into five equal groups based on their average financial performance from 1997 through 2002. Each group, or quintile, consists of the same farm businesses each year of the study. The financial performance measure, adjusted cash income (ACI), takes accrual net farm income, adds in off-farm income and depreciation, and subtracts family living expenditures. Adjusted cash income is a pre-tax term debt repayment margin and gives a more comprehensive measure of the farm household’s financial capacity than does farm income alone. If ACI is positive, the farm will first pay income taxes and use the remainder for principal payments on term debt, capital purchases or other investments. If ACI is negative, after taxes the farm will have to liquidate assets, borrow funds, or seek additional equity to cover the shortfall.

Figure 2 shows the average ACI for farms in each quintile from 1997–2002. For comparison, total government payments are shown next to ACI. Again, recall that ACI includes government payments. In addition, on the right axis we show the average return on assets (ROA) earned by farms in each quintile. The ROA is a relative measure of farm profitability that is not affected by financial structure or off-farm income. Farms in the top 20% significantly outperformed farms in the remaining groups. After the subsidies kicked in, in 1998, all but farms in the bottom two groups earned a positive ACI for the remaining four years. Note, too, that as financial performance declines, the dependence on farm subsidies increases—continuing in 2002 with the new Farm Bill provisions. The ROA shows the same temporal pattern for all farms, but we also see that the ROA declines along with decreasing ACI.

Average market value assets and liabilities are shown in Figure 3. The difference between assets and liabilities equals net worth. Note, first of all, that farms in the top 20% group controlled significantly more assets than did other farms in the panel. All but the bottom group showed a steady increase in asset values and liabilities over the six-year period. Farms in the top 20% experienced a nominal net worth gain of more than 35%. The bottom group showed a slight decrease in net worth—their asset values increased slightly, but liabilities increased somewhat more. On the right axis, we plot the average debt-to-asset (D/A) ratio for each quintile. In general, leverage and hence the risk exposure of farms increases with decreasing financial performance. With the exception of the top 20% of farms, leverage increased for all farms in the panel since 1977.
Figure 2. Adjusted cash income, government payments, and ROA, 1997-2002, by ACI quintile.

Figure 3. Average assets, liabilities, and debt-to-asset ratios, 1997-2003, by ACI quintile.
Figure 4 shows the changes in the farm type distribution between 1997 and 2002. For example, in 1997, 42% of the farms in the second quintile were classified as cash grain operations. By 2001, 56% were classified as cash grain farms or an increase of 14%. Because the definitions are based on sales composition, changes in farm type can be influenced by price changes as well as output changes. In general, the farm type changes for all farms tend to be away from a reliance on livestock enterprises to cash grain.

Absolute changes in labor and land are shown in Figure 5. Across the board, the operator share of land operated increased. This could result from land purchases, inheritance, increased land leasing or shifting share leases to cash leases. All farms shed labor during this period with the greatest absolute changes occurring in the bottom two groups. This may reflect the reduction in livestock production or increased reliance on off-farm work.

Finally, Figure 6 examines changes in investment in machinery and equipment and in breeding stock. All groups increased the value of their machinery and equipment inventories with farms in the top two quintiles increasing by 20–30%. All groups except the top 20% reduced breeding herd assets as well.

And the Conclusions Are...?

What can we learn about changes in farm and financial structure for this group of farmers since 1997?

• Larger farms certainly received more federal money than did the smaller ones—we knew this going in, and Figure 2 confirms our suspicions.

• Average net worth for all groups increased or remained relatively stable. This is, in part, the result of the role the subsidies played in maintaining positive ACIs and in supporting land values.

1. The definitions for the farm type categories are based on the composition of gross farm income (GFI). A farm is classified as cash grain if revenue from crops is greater than 95% of GFI, grain-livestock if revenue from crops is greater than 50% but less than 95% of GFI, hog farms if revenue from pork is greater than 50% of GFI, beef farms if revenue from beef is greater than 50% of GFI, or other (all farms not included in the previous categories).
Financial leverage increased for all groups except the top 20%.

Farms in the top 20% received the highest subsidies but (with the exception of 1998) would have earned a positive ACI without them.

The remaining 80% of farms in the panel were fully dependent on subsidies (with the exception of 2002). Their ACI would have been negative were it not for farm payments. And, as a consequence, their debt loads would have climbed rapidly—lenders permitting.

All farms in the panel, with the possible exception of the financially troubled bottom 20%, appear to be pursuing an expansion strategy.

**Figure 5.** Average land and labor change, 1997-2003, by ACI quintile.

**Figure 6.** Change in breeding livestock and machinery investment by ACI quintile, 1997-2003.
Land, machinery, and debt are all increasing. Does this imply that the farmers think the subsidies will last forever? On the other hand, are they trying to invest what they perceive as a windfall in capital assets?

- By varying degrees, most farms in the panel tilted toward cash grain and the subsidies and away from value-added livestock enterprises.

It wasn’t pretty, and it probably wasn’t particularly efficient, but the farm subsidies received since 1997 appear to have carried vulnerable and generally smaller farm businesses through a difficult period. We did good with our farm programs. The offsetting outcome is that the inability to target or limit payments also resulted in gains in wealth and farm size for larger, well-positioned farm businesses. Some farmers did well. The social desirability of our efforts will likely be scrutinized once again when political attention returns to farm policy and the Doha Round.

For More Information


Robert W. Jolly is a professor of economics and Darnell Smith is an extension associate at Iowa State University. This journal paper of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa, Project No. IOW03558, was supported by Hatch Act and State of Iowa funds. Thanks to William Edwards, Sergio Lence, and Neil Harl for helpful comments on an earlier draft.
Brain drain, the out-migration of young, college-educated workers from the nation's rural areas, poses a serious threat to the social and economic vitality of rural America. Anecdotal accounts from the Midwest to Maine describe an exodus of young college graduates, lured away by big-city living and better-paying jobs. Yet, nationwide the number of college graduates has steadily increased over the past few decades. In fact, between 1970 and 2000, the share of the population over age 25 with a college education rose in every U.S. county but five.

The rising level of human capital, reflected in the increased share of the U.S. population with a college education, is an important trend. Recent studies have shown that capital and skilled labor are complements, so as advances in technology reduce the cost of capital, the demand for skilled workers increases. Other research suggests that the clustering of college-educated workers may have spillover effects, enhancing a region's productivity and the potential for economic growth. The trend has also implications for income inequality, because the wage gap between those with a college degree and those without is widening.

Is brain drain a reality? Are some parts of the country able to retain and attract college-educated workers at the expense of other regions? If so, how pervasive is the problem and what does it mean for rural areas?

Putting it in Perspective

Most recent studies of brain drain in the United States have concentrated on the migration patterns of recent college graduates—in particular on their first move after college. However, many college-educated workers face national job markets and enter professions in which experience is important for career advancement. Younger people may move away from home after finishing school in order to find suitable entry-level positions, or they may be attracted to the social environment of big cities. But as people age, they gain experience in their professions, their lifestyles change, and they may choose to move again. If we are to fully understand the forces shaping brain drain, we need to better understand the location of all college-educated workers, not just those in their twenties. This article uses U.S. Census data, shift-share analysis, and the concept of a “competitive share” to describe changes in the location of the nation's college-educated workforce from 1970 to 2000.

Figure 1 shows U.S. counties' competitive share for college-educated population as a percent of total population over age 25 from 1970 to 2000. For about 60% of the counties (shown in red), the competitive share is negative, indicating that the college graduate share is rising more slowly than the national average. Some general patterns are evident; in particular, the southern and western regions gained while the middle and northern regions lost. Figure 2 shows the average competitive share by U.S. Census Region. Three regions experienced a brain drain on average: East North Central (-1.3%), West North Central (-5.2%), and Middle Atlantic (-4.0%). In the Mountain and South Atlantic regions, the average competitive share is positive and quite large, which suggests these regions have a big advantage in attracting college-educated workers.

Defining Competitive Share

Shift-share analysis, as it is traditionally applied, allows for the measurement of a local economy's competitive share: the region's ability to capture an increasing share of a particular sector's employment growth. A positive competitive share indicates that the region has a particular advantage in attracting jobs in that sector relative to the rest of the nation. Similarly, a negative competitive share signals a relative disadvantage (Hustedde, Shaffer, & Pulver, 1996). By applying this technique to college-educated workers, the competitive share can be interpreted as the region's “brain gain” if positive or “brain drain” if negative.
The share of a county’s population that is college-educated may decline over time either because the college-educated population is decreasing relative to the overall population or because the overall population is increasing while the college-educated population remains stable. On average, counties that lost population over the past three decades also experienced brain drain, regardless of their regional location. In most regions, these counties accounted for a rather small proportion of the total number of counties. However, in the West North Central region, more than one third of the counties experienced population loss over this time. In the East North Central, West North Central, and Middle Atlantic regions, even counties with a growing population experienced a brain drain on average during this time period. In all cases, growing counties either lost less or gained more college-educated workers than shrinking counties.
Many accounts of brain drain describe the loss of educated youth from rural to metropolitan areas. Studies have shown that returns to skill and education are higher in urban areas, giving cities an advantage in attracting college-educated workers. Table 1 categorizes the average competitive share by 1983 Beale Code and by Census region. Beale codes classify counties along a rural-urban continuum based on the U.S. census as well as geographic proximity. In order to eliminate the region effect, the overall average for the region (shown in Figure 2) was subtracted from the county-type averages. This allows for within-region comparisons across county types.

Nationwide, all types of metropolitan counties enjoyed a brain gain on average, with major metropolitan areas gaining the most. On average, nonmetropolitan counties that were not adjacent to a metropolitan area fared the worst. Somewhat surprisingly, all rural counties enjoyed a brain gain on average. With the exception of New England, the major metropolitan areas enjoyed a relatively large brain gain in every region, while the nonmetropolitan, nonadjacent counties suffered brain drain. Rural counties gained on average in some regions and drained on average in others. However, three fourths of the nation’s rural counties are located in the West North Central, West South Central, East South Central, and South Atlantic regions, where the rural counties’ average competitive share was negative. The average competitive share for nonmetropolitan counties that were adjacent to a metropolitan area varies across regions, but is negative for six of the nine regions.

Rural area brain drain is a real trend. Absent regional effects, metropolitan areas have gained college-educated workers at the expense of nonmetropolitan and rural areas. In addition, brain drain goes hand in hand with population decline. Only 11% of counties lost population between 1970 and 2000; of these counties, 96% experienced brain drain and 95% were nonmetropolitan or rural. There are exceptions. Rural and no-metropolitan counties in the Mountain states, New England, Middle Atlantic, and East North Central regions have attracted college graduates on average, but most of the nation’s rural counties are not located in these regions.

### Plugging the Drain

A number of strategies for recruiting and retaining college graduates in the nation’s more rural states have been proposed in recent years. From tax incentives for science and technology graduates to letter-writing campaigns inviting former residents to return “home,” these policies are at best partially informed. Before truly effective approaches can be designed for attracting and retaining college-educated workers in the nation’s nonmetropolitan areas, a better understanding of the forces underlying brain drain is needed.

Most of the research on this question has focused on recent college graduates in the very short time period after graduation. In general these studies find that college educated individuals are

Table 1. Average competitive share by region and Beale Code, net of regional effect.

<table>
<thead>
<tr>
<th>Region</th>
<th>Major metro area</th>
<th>Metro area</th>
<th>Nonmetro, adjacent to metro</th>
<th>Nonmetro, not adjacent to metro</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>All regions</td>
<td>31.1%</td>
<td>7.5%</td>
<td>1.2%</td>
<td>-3.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>E. North Central</td>
<td>14.6%</td>
<td>-3.4%</td>
<td>-3.4%</td>
<td>-2.6%</td>
<td>3.7%</td>
</tr>
<tr>
<td>E. South Central</td>
<td>18.0%*</td>
<td>12.0%</td>
<td>-2.2%</td>
<td>-4.2%</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Middle Atlantic</td>
<td>2.2%</td>
<td>0.2%</td>
<td>-1.9%</td>
<td>-6.2%</td>
<td>9.7%*</td>
</tr>
<tr>
<td>Mountain</td>
<td>178.9%*</td>
<td>-1.6%</td>
<td>6.2%</td>
<td>-19.6%</td>
<td>8.9%</td>
</tr>
<tr>
<td>New England</td>
<td>-9.3%*</td>
<td>-2.5%</td>
<td>0.8%</td>
<td>1.3%</td>
<td>15.1%*</td>
</tr>
<tr>
<td>Pacific</td>
<td>12.2%</td>
<td>0.8%</td>
<td>-0.3%</td>
<td>-2.4%</td>
<td>-2.3%</td>
</tr>
<tr>
<td>South Atlantic</td>
<td>38.0%</td>
<td>5.5%</td>
<td>-3.7%</td>
<td>-11.5%</td>
<td>-5.7%</td>
</tr>
<tr>
<td>W. North Central</td>
<td>24.7%</td>
<td>6.7%</td>
<td>1.6%</td>
<td>-3.4%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>W. South Central</td>
<td>61.9%</td>
<td>5.8%</td>
<td>-2.5%</td>
<td>-8.2%</td>
<td>-3.5%</td>
</tr>
</tbody>
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*Fewer than ten counties are included in these averages.*
more likely to migrate from their home regions after completing school, drawn by higher returns to education in urban areas. They suggest that the economic conditions of the home region may influence migration decisions, but individual characteristics are more important for understanding who moves and who stays. If young, educated workers are moving into metropolitan areas to take advantage of higher returns to education, should we try to stop them?

Policies designed to keep rural area college graduates “home” when they would be better off somewhere else are clearly inefficient from society’s point of view. However, strategies to attract experienced college-educated workers may not be. The current debate over brain drain overlooks the possibility that individuals’ reasons for moving and their preferences for certain locations may change with age. Younger people move to take advantage of school and job opportunities. However, as people marry, have children, and acquire job experience, they may choose to relocate for “quality of life” reasons. There is little information about the motivations and choices of “reverse” migrants opting to relocate in mid-life. Policy makers should be concerned about the supply of all educated workers not just young educated workers.

Furthermore, some rural areas are gaining college-educated workers. These areas tend to be “amenity-rich”—a quality research has shown is important for attracting highly skilled workers. Moreover, these areas may have additional resources that attract college-educated labor. For example, if capital and skilled labor are complements in production, variations in capital stock across rural areas might help explain these differences.

In a recent Choices article, Brian Whitacre and Bradford Mills report a substantial difference between metropolitan and nonmetropolitan areas regarding access to high-speed Internet service, whereas the difference in dial-up phone access is minimal. Although dial-up service may be sufficient for home use of the Internet, telecommuting requires faster connections. There is no correlation between brain drain and access to high-speed Internet service for metropolitan counties, because nearly all these counties have high-speed access. Among rural counties, however, variation in high-speed service is much greater. For these counties, the correlation coefficient between brain drain/gain and high-speed Internet access is 0.15. Although this relationship is not strong, it does suggest that some educated workers are attracted to or stay in more remote locations when they can access the urban labor market through the Internet. More careful analysis may overturn this result, or it may prove to be even more important than the simple correlation would suggest.

**Overall**

Brain drain is an important economic development concern. Higher levels of human capital are associated with higher levels of income, increased productivity, and economic growth. Although the majority of rural counties have fallen behind in attracting and retaining college-educated workers, other rural counties have not. This suggests that brain drain is not an inherent problem for rural counties, but something that might be overcome with properly designed, well-informed policies.

**For More Information**


Mills, Bradford, & Hazarika, Gautam. (2001). The migration of young adults from non-metropoli-


Georgeanne Artz is an extension program specialist at Iowa State University.
Food industry analysts are looking closely at the long-term viability of grocery wholesalers and the independent supermarkets they supply. Growing demand for food away from home has slowed supermarket industry growth. New competitive pressures are coming from other food service providers, convenience stores, and supercenters operated by mass merchants such as Wal-Mart and Target. Many believe independent retailers are vulnerable to these threats. New information technologies are helping lower supply chain costs through closer collaboration between retailers and suppliers. However, this collaboration may come easier in self-distributing chains, which own and operate both supermarkets and distribution centers.

Future success for the wholesaler-supplied supermarket industry will depend on how independent retailers adapt to changing market forces and on effective collaboration between stores and distribution centers. How well are independent retailers positioned to compete in their local markets? How well has the wholesaler-supplied system adopted new technologies and business practices? How does store-level performance of independent supermarkets compare with that of distributor-owned stores?

Data from the 2002 Supermarket Panel respond to these questions. The Panel is an annual survey of supermarkets by The Food Industry Center at the University of Minnesota (King, Jacobson, & Seltzer, 2002). The Panel collects detailed data on store characteristics, operating practices, and standard store performance measures for a random sample of the nearly 32,000 supermarkets in the United States. The 2002 Panel includes 866 stores located in 49 states. These stores reflect the wide range of store formats and ownership structures in the supermarket industry. Weighted responses from stores account for differences in sampling intensities and response rates across company sizes and regions. Thus, our results are representative of the industry.

Store and Market Characteristics

Table 1 profiles the store and market characteristics for wholesaler-supplied and self-distributing stores. The differences are striking. Although 46.1% of U.S. supermarkets are wholesaler-supplied, those stores account for only 32.3% of annual supermarket sales. On average, wholesaler-supplied stores are smaller and older than self-distributing stores; they are owned by much smaller companies. The median proportion of full-time workers is similar for the two groups, but wholesaler-supplied stores
are less likely to have a union workforce and have lower hourly payroll expenses. Wholesaler-supplied stores are also located in less-populated areas with lower median household incomes. Relatively low population density and household income are commonly associated with supercenter locations, and a higher percentage of stores in self-distributing groups do report that they face supercenter competition.

Management Practices

The Supermarket Panel collects detailed information on management practices in supply chain, human resources, quality assurance, and service offerings. Indices for each management area, ranging from zero to 100, measure each store’s progress toward “best practices.” Figure 1 indicates that wholesaler-supplied stores lag behind self-distributing stores in each area, especially for supply chain and quality assurance.

The supply chain index indicates a store’s readiness to promote efficiencies in logistics and inventory management that benefit retailers, distribution centers, and manufacturers. Its two major components are technology adoption and decision sharing. Wholesaler-supplied stores lag in supply chain technology adoption and are less likely to involve external parties in pricing, advertising, shelf space allocation, product merchandising, and promotions. This hampers collaboration with key suppliers, creating competitive disadvantages for both stores and distribution centers in the wholesaler-supplied system.

The large gap in mean scores for the quality assurance index reflects two major components. The first measures the use of formal methods for assessing customer satisfaction. The second measures adoption of safe food handling practices. Mean scores for food handling differ little for the two groups, but self-distributing stores are much more likely to use focus groups, customer surveys, and mystery shoppers to assess customer satisfaction. These formal practices may alert corporate management of self-distributing stores to changing consumer practices. However, companies that operate ten or fewer stores own most wholesaler-supplied stores. This makes it easier for corporate managers to have direct, informal contact with customers.

Differences in mean scores for human resources and service offerings are relatively small. They do not indicate competitive disadvantages for wholesaler-supplied stores. The human resource index has four components: (a) training for new employees, (b) training for key employees (e.g., the store manager and the scanning coordinator), (c) the ratio of full-time to part-time employees, and (d) the use of incentive compensation and noncash benefits to motivate employees. Wholesaler-supplied stores devote fewer resources to key employee training, are less likely to use incentive compensation, and offer fewer employee benefits.

The service offerings index measures adoption of 16 common services that range from bagging and customer self-scanning to teller banking and

Table 1. Profile of wholesaler-supplied and self-distributing stores.

<table>
<thead>
<tr>
<th></th>
<th>Wholesaler-supplied</th>
<th>Self-distributing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of stores represented</td>
<td>14,944</td>
<td>17,481</td>
</tr>
<tr>
<td>Aggregate annual sales ($ billion)</td>
<td>$148.8</td>
<td>$311.3</td>
</tr>
<tr>
<td>Store characteristics:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median selling area (sq. ft.)</td>
<td>18,000</td>
<td>38,000</td>
</tr>
<tr>
<td>Median weekly sales</td>
<td>$177,000</td>
<td>$300,000</td>
</tr>
<tr>
<td>Median sales per transaction</td>
<td>$17.50</td>
<td>$23.53</td>
</tr>
<tr>
<td>Median store age (years)</td>
<td>27</td>
<td>15</td>
</tr>
<tr>
<td>Mean ownership group size</td>
<td>20</td>
<td>922</td>
</tr>
<tr>
<td>Human resources:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion full-time employees</td>
<td>41.5</td>
<td>41.2</td>
</tr>
<tr>
<td>Percent with union workforce</td>
<td>18.7</td>
<td>45.1</td>
</tr>
<tr>
<td>Median hourly payroll expense</td>
<td>$10.26</td>
<td>$12.50</td>
</tr>
<tr>
<td>Labor intensity (weekly hr./sq. ft.)</td>
<td>68.6</td>
<td>63.2</td>
</tr>
<tr>
<td>Market characteristics:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median annual household income</td>
<td>$43,493</td>
<td>$45,473</td>
</tr>
<tr>
<td>Median population density (per sq. mi.)</td>
<td>224</td>
<td>658</td>
</tr>
<tr>
<td>Percent located in an SMSA</td>
<td>59.1</td>
<td>70.5</td>
</tr>
</tbody>
</table>

1. Labor intensity (measured by weekly labor hours per 1,000 square feet of selling area) is slightly higher in wholesaler-supplied stores.
videos. Although wholesaler-supplied stores are much less likely to offer newer services (such as gasoline sales, customer self-scanning, and Internet ordering), they are more likely to offer home delivery, post office, and mailing services. These differences probably reflect store adjustments to typical market characteristics and customer demographics.

**Store Performance**

The long-term viability of grocery wholesalers and the independent supermarkets they supply ultimately depends on store-level performance. On average, self-distributing stores are larger, newer, and located in more densely populated, higher income areas. They are also more progressive in adopting “best management practices,” but do these differences lead to superior performance?

Table 2 presents median values for six widely used supermarket performance measures. Although wholesaler-supplied and self-distributing stores differ importantly for two of these measures, the similarity in performance for the two groups is striking.

Weekly sales per square foot of selling area and annual inventory turns indicate average productivity for two key capital inputs in food retailing: shelf space and the inventory placed on store shelves. The median level for weekly sales per square foot is $1.15 higher for self-distributing stores. This could reflect more effective merchandising, higher advertising expenditures, or more space allocated to higher valued products. However, store occupancy costs are generally higher in densely populated, higher income areas where the self-distributing stores are more likely located. More intensive use of space may be a natural reaction to higher costs.

Proponents of new supply chain management practices believe more effective inventory management is an important benefit. Given the large gap between the two groups of stores in adoption of supply chain technologies and related business practices, the absence of a difference in median inventory turns is surprising. Although this may indicate overestimation of benefits, a more likely explanation is that inventory management gains have been larger in distribution centers than in stores.

Effective labor management is essential for a successful supermarket. Sales per labor hour and payroll as a percent of sales are widely used to measure average labor productivity. Median sales per labor hour are considerably higher for self-distributing stores. This higher productivity level is offset, however, by higher costs. As reported in Table 1, hourly payroll costs are more than 20% higher for self-distributing stores. The net effect is to equalize payroll as a percent of sales the two groups of stores.

![Figure 1](image-url)

**Table 2.** Median performance measures for wholesaler-supplied and self-distributing stores.

<table>
<thead>
<tr>
<th>Median performance measures</th>
<th>Wholesaler-supplied</th>
<th>Self-distributing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly sales per square foot of selling area</td>
<td>$7.14</td>
<td>$8.29</td>
</tr>
<tr>
<td>Annual inventory turns</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Sales per labor Hour</td>
<td>$100.00</td>
<td>$129.31</td>
</tr>
<tr>
<td>Payroll as a percent of sales</td>
<td>10</td>
<td>9.8</td>
</tr>
<tr>
<td>Gross profit as a percent of sales</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Annual percentage sales growth</td>
<td>1.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>
Cost of goods sold is the largest cost category for almost every supermarket operation. Therefore, gross profit—sales minus cost of goods sold—is a key driver of store profitability. Supply chain management can help stores increase gross profits in two ways. First, a store’s cost of goods sold may fall if its distribution center passes cost savings for inventory management and logistics on to the stores it supplies. Second, a store might boost sales by using store-level and vendor information to fine-tune product offerings and sell more high-margin products. Despite higher adoption rates for supply chain technologies and practices by self-distributing stores, median gross profit as a percent of sales is identical for the two groups. Gross margins in self-distributing stores also could be affected by corporate accounting, because the cost of goods sold is an internally determined transfer price. Nevertheless, this result runs counter to expectations.

Annual sales growth indicates a store’s competitive position in its local market. Median values for this performance measure are identical for the two store groups. This similarity in sales growth rates generally holds between the 10th and 90th percentiles. At the extremes, the wholesaler-supplied stores show less potential for sharp declines and more potential for larger increases in sales.

Looking to the Future

Is there a future for wholesaler-supplied supermarkets? Findings from the 2002 Supermarket Panel say yes. Wholesaler-supplied stores are different, but competitive. They are older, smaller, and have lower sales volumes, but also have lower costs for labor and store selling area. Because they are usually operated by smaller, locally owned companies, wholesaler-supplied stores may better adapt to their customers’ needs. Some analysts, including Supermarket News editorial director David Merrefield, attribute the recent unraveling of rapid growing supermarket chains to overemphasis on efficiency gains based on standardized operations and inattention to local marketing.

Despite these positive findings, the wholesaler-supplied system faces significant challenges.

- The first is disappearance of stores through attrition and acquisition. Based on estimates from the 2002 Supermarket Panel, 17.3% of self-distributing stores were built in the last five years, versus 6.4% for wholesaler-supplied stores. If older, outmoded stores are not replaced, the density of wholesaler-supplied networks will fall, and distribution costs are likely to rise.
- Second, distribution costs will also rise if wholesalers do not strengthen linkages with the stores they supply. This will require stronger incentives to adopt new practices, such as electronic invoicing and vendor-managed inventory, that improve system-wide efficiency but have little impact on store-level productivity.
- Finally, human capital development is especially difficult for wholesaler-supplied stores, where training resources and career advancement are often limited. Stronger linkages between wholesalers and stores are critical for achieving economies in employee training. They can also be the basis for career path development programs that will produce the next generation of independent store owners.

Firms throughout the food system are faced with decisions about coordinating vertically linked activities. This look at the retail component highlights both the fragility and the robustness of non-integrated supply chains. The answers to questions about vertical coordination will be complex and context specific.

For More Information


Robert P. King is a professor in the Department of Applied Economics at the University of Minnesota.
Despite being an entitlement criterion that farmers must meet in order to qualify for farm program payments, Conservation Compliance has largely disappeared as an issue during recent farm bill debates. The focus has been on using cost-share and incentive payments to encourage the adoption of environmentally friendly farming practices. Conservation Compliance, in contrast, denies certain farm program benefits (including income support payments) to farmers who convert a wetland into cropland or who farm highly erodible land without an approved conservation plan. Thus, Conservation Compliance uses the denial of government benefits to encourage environmentally friendly farming practices.

Thanks to sizeable federal deficits, Conservation Compliance may again become a major farm policy issue. The Office of Management and Budget recently forecast a 58% increase in gross federal debt by the end of fiscal year 2008, driven largely by cumulative federal deficits of $1.9 trillion over fiscal years 2003–2008. Deficits of this size may make Congress more willing to achieve farm environmental improvements by adding new requirements to Conservation Compliance. Doing so would allow them to reduce outlays for environmental cost-share and incentive payments to farmers. But will farmers—key farm policy actors—overwhelmingly oppose new compliance requirements? Opposition is expected due to the costs of meeting new requirements, including possible loss of farm program benefits.

Farmers’ views about Conservation Compliance requirements come from the 2001 National Agricultural, Food and Public Policy Preference Survey (Lubben, Simons, Bills, Meyer, & Novak, 2001). The specific question was: “Should farmers be required to do the following in order to receive farm program benefits: (a) plant 20-foot buffer strips along waterways; (b) plant cover crops after harvest; (c) use reduced-tillage cropping systems; or (d) use no-tillage cropping systems?” Before briefly discussing the survey methodology and presenting results, Conservation Compliance is discussed in greater detail. Conclusions and implications are drawn in the last section of the article.

HEL program success has two indicators: high acreage enrollment—in 1985, 86 of 91 million acres not in the CRP had NCRS approved plans—and reductions in erosion totaling about 791 million acres per year. Although not all this reduction is directly due to HEL Conservation Compliance, its size resembles the 1993 record high of nearly 700 tons of erosion reduction from the CRP. As a benchmark, total erosion from U.S. cropland was estimated in 1982 at 3.07 billion tons per year, implying that HEL compliance has reduced erosion by about 25%.

Ohio Survey

The Ohio farm operator survey was mailed to 1,500 Ohio farmers by the Ohio Agricultural Statistical Service during March and April of 2001. A stratified sampling procedure was used. The sampling strata were farms with sales of less than $100,000, $100,000 to $250,000, and more than $250,000. Farmers in the two larger sales strata were sampled at a higher rate to increase the likelihood of receiving a statistically significant number of responses from them. Useable surveys totaled...
Overview of Conservation Compliance

Conservation Compliance was enacted in the Farm Security Act of 1985 (Glaser, 1986). Farmers who wish to receive certain farm program benefits (a) cannot convert a wetland into cropland unless explicitly permitted to do so, usually by replacing the converted wetland; (b) cannot convert highly erodible land into cropland unless a pre-approved conservation plan is followed; and (c) cannot farm highly erodible cropland that was in production between 1981 and 1985 without following an approved conservation plan (Claassen, 2000). These three restrictions are commonly referred to as Swampbuster, Sodbuster, and Conservation Compliance, respectively. Noncompliance could lead to loss of price and income supports, disaster relief, loans, and access to the Conservation Reserve Program (Ribaudo, 2000).

Wetlands are identified using a combination of soil, vegetation, and hydrology characteristics associated with the inundation or saturation of soil by water under normal circumstances (Heimlich, Gadsby, Claassen, & Wiebe, 2000). Highly erodible soils erode at a rate equal to or greater than eight times the soil tolerance level, which is the maximum rate of erosion that can occur without hurting the soil’s productivity. Highly erodible lands (HEL) are in fields with at least one third or 50 acres (whichever is less) of highly erodible soils (Claassen, 2000). Consequently, of the 146 million acres classified as HEL by the Natural Resources Conservation Service (NRCS), 22 million acres are not highly erodible (Magleby, 2002).

Impacts of the Wetland and Sodbuster restrictions primarily occur by preventing land from coming into production. Using data from the 1997 National Resources Inventory, Claassen (2000) estimated that without compliance, 7–14 million acres of wetland and HEL could profitably be converted to crop production. The range represents low and high farm price scenarios. The midpoint of this estimate (10.5 million acres) is 3% of the 327 million acres planted to principal crops (essentially all crops except for fruits, vegetables, and tree nuts) in the United States during 2003 (USDA, 2003, p. 4).

HEL Conservation Compliance specifies the use of economically viable conservation systems that substantially reduce erosion. “Substantial” currently means a 75% reduction in erosion, but plans approved prior to July 1996 may require a smaller reduction. Conservation systems include one or more conservation practices, the most common being cropping sequences, crop residue use, and conservation tillage (Claassen, 2000).

Program benefits (see Figure 1). Forty-nine percent of the surveyed farmers agreed with requiring 20-foot buffer strips along waterways. However, support declined to 24% for requiring post-harvest cover crops and use of no-tillage practices.

Reduced tillage is often a part of residue management practices required by Conservation Compliance plans on HEL. Because the question asked on the survey did not restrict the practice to HEL, the responding farmers may believe this practice should be required on all lands, including those not highly erodible. The survey also did not ask whether the farmer was subject to Conservation Compliance. However, approximately half of the surveyed farmers reported that they participated in year 2000 commodity programs.

Future Compliance Directions?

Since enacted in 1985, Conservation Compliance has reduced soil erosion by more than any other current farm bill environmental program. It has made working lands an important part of post-1985 farm environmental policy. It has also made farm income supports a type of environmental payment by denying them to farmers who violate any of the three compliance practices. If the idea of multifunctionality is incorporated into the next international trade treaty, credit should be given to U.S. farm income support programs for the

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Farmer Views About Expanding Conservation Compliance

Fifty-six percent of the surveyed Ohio farm operators responded that farmers should be required to use reduced tillage practices in order to receive farm

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239, with a distribution of 86, 89, and 64 by increasing sales strata. Responses were expanded to population estimates by using the sampling weights.

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improved environmental performance resulting from Conservation Compliance.

Adding new requirements to Conservation Compliance was not completely opposed by the surveyed Ohio farmers. Half of the respondents supported requiring reduced tillage and buffer strips in order to receive farm program payments. This level of support suggests that in a budget deficit environment, farmers might accept these two Conservation Compliance practices in exchange for not cutting farm income supports. The new compliance requirements could satisfy society's desire for improved environmental performance by farmers while permitting reductions in cost-share and incentive payment programs.

A key question is why Ohio farmers are more willing to support reduced tillage and buffer strips than no-tillage and cover crops as Conservation Compliance requirements. A reasonable hypothesis is that farmers will be more supportive when policies intrude less on farm management decisions. Buffer strips might apply to a limited subset of fields and portions of fields, whereas cover crops probably would apply to the entire field. Thus, requiring reduced tillage and buffer strips in exchange for farm program benefits intrudes less on existing farming practices than requiring no-tillage and cover crops.

Intrusiveness on farmer decision making can decline for many reasons. Technological change can improve the economic feasibility of an environmentally friendly farming practice. An example is improved no-till drills in the late 1980s and early 1990s. Changes in farmers' attitudes may make them more willing to implement a conservation practice. Cost-share and incentive programs can create awareness of an environmentally friendly farming practice, leading to large-scale adoption of the practice.

As adoption of environmentally friendly farming practices spreads, and as new technologies emerge, policy makers should consider whether the revisions in Conservation Compliance reflect these changes. This question becomes more important in a period of large federal budget deficits.

For More Information


Carl Zulauf is the McCormick Professor of Agricultural Marketing and Policy and Brent Sohngen is an associate professor in the Department of Agricultural, Environmental, and Development Economics at Ohio State University; Lindsey Hoskinson is a financial services officer at Farm Credit Services of Mid-America; and Allan Lines is a professor in the Department of Agricultural, Environmental, and Development Economics at Ohio State University.
Inflation-adjusted farm prices and farm-wholesale marketing margins for beef and pork have declined over several decades. For example, from 1970 to 1998, real slaughter steer and hog prices declined by 50% and 66%, respectively, while real beef and pork farm-wholesale (FW) marketing margins declined by 57% and 65%, respectively (Figures 1 and 2). These changes have been attributed to declining retail demand, increased red meat and poultry supplies, and increased meat packer concentration (Azzam & Anderson, 1996; Purcell, 1989). However, technological change may also contribute to declines in real farm prices and FW margins.

Technological change in the food processing industry has increased rapidly over the past several decades. The major drivers have been changing relative prices, increasing competitive pressures from globalized markets, improving transportation and logistics infrastructures, evolving information systems, and increasing consumer demands for quality-differentiated products (Antle, 1999; Brester, Schroeder, & Mintert, 1997). In theory, technological change in a competitive food processing industry should reduce unit production costs, consumer prices, and marketing margins while increasing farm output prices.

Our study focuses on the effects of changing meat packer and farm-level technologies on real beef and pork farm-wholesale marketing margins and on livestock prices. Results indicate cost savings from meatpacking technologies increase real livestock prices, while technological changes at the farm level reduce real livestock prices. On balance, the positive effect from meatpacking technology outweighs the negative effect of farm-level technological change.

**Price and Margin Study**

For livestock producers, farm prices and FW margins are closely connected. Cost changes that affect FW margins in the meatpacking sector may lead to changes in farm-level prices. Alternatively, changes in farm supplies that change livestock prices can influence FW margins. Overall, primary (i.e., consumer) demand, farm supplies, marketing costs, market power of agribusiness firms, and international trade are known to affect farm prices and margins. Technological change may also influence livestock prices and FW margins.

Previous studies on technological change in the livestock-meat industry have generally focused on meatpacking and its relationship to market concentration. Increases in meatpacker concentration reflect both scale economies and technological change. MacDonald, Ollinger, Nelson, and Handy (2000) estimated the influence of scale economies on meatpacking cost functions with the use of time trends as proxies for technological change. Some studies on meatpacker concentration and livestock prices have also used time trends as proxies for technology. Still others assumed that technological change was subsumed by measures of market concentration. Thus, the effects of technological change and market concentration have not been clearly distinguished.

We focus on factors contributing to long-term declines in real slaughter prices and FW margins in beef and pork over the 1970–1998 period (Brester & Marsh, 2001). Technological change and other
supply-demand factors were considered. Technological change was measured at three levels: (a) *meatpacking*—output per employee hour in beef and pork slaughtering; (b) *livestock finishing*—percent of cattle feeding firms with capacities greater than 16,000 head and the percent of hog firms with sow inventories exceeding 500 head; and (c) *farm-level productivity*—average dressed weights of steers, heifers, and hogs. Sector competition should make farm prices and margins responsive to the level and source of technological change. For example, changes in technology at the farm versus meatpacker levels could yield opposite impacts on FW margins and livestock prices.

### Importance of Technology

Technological changes and increasing scale economies have led to significant market concentration in the beef and pork meatpacking industry. Between 1970 and 1998, the four-firm steer and heifer slaughter concentration ratio increased from 21.0 to 80.0, and the hog slaughter concentration ratio increased from 32.0 to 53.0 (concentration ratios have changed little since 1998).

Technological developments vary in type and scope. In the beef industry, breeding genetics, animal health and nutrition, and other management practices have increased calf-crop percentages, calf weaning weights, and dressed weights of steers and heifers. Similarly, pig litters and pigs saved per litter have grown in size, and hogs have been fed to heavier slaughter weights while maintaining relatively lean carcasses.

In livestock finishing, technological changes have reflected increased capital intensity, improved health and feed nutrition management, and electronic information systems. These developments have led to increased livestock feed conversion and slaughter weights consistent with quality and yield grades desired by meat packers.

Technological changes in meatpacking include new capital equipment, processing and handling methods, and evolving infrastructure and information systems. These changes have increased labor productivity and lowered unit costs of slaughtering and processing (Duewer & Nelson, 1991). Figure 3 shows that labor productivity, measured by the index of output per employee hour (1987 = 100) in meat packing increased from 57.7 in 1970 to 103.8
in 1998, or nearly 80%. From 1998 to 2000, labor productivity is estimated to have increased about 0.80% annually (United States Department of Labor, 2003).

Impacts of Technology on Margins

National and regional studies have shown that increased meat packer concentration has not significantly distorted livestock or meat prices largely because meat packers (especially in beef) have faced persistent excess capacity (Azzam & Anderson, 1996; Azzam & Schroeter, 1995; Morrison-Paul, 2001). The result has been more aggressive pricing of slaughter animals and boxed meat outputs.

Our study (Brester & Marsh, 2001) suggests that cost savings from new technology in meatpacking have significantly lowered FW margins. A 1% increase in meatpacker productivity reduces real FW beef and pork margins decline by 1.85% and 1.43%, respectively. Thus, the 80% increase in labor productivity in meatpacking from 1970 to 1998 reduced real FW beef and pork margins by 34.9 cents/lb (147.8%) and 42.6 cents/lb (114.3%), respectively.

The other technology variables—firm finishing size and farm-level productivity—affected the beef margin but not the pork margin. Increases in feedlot size tended to increase beef FW margins. One explanation for this result is that technological change has reduced unit costs of feeding cattle, increased fed cattle weights, and ultimately reduced fed cattle prices. In addition, larger feedlots may be selling more of their higher quality cattle on value-based contracts. With the remaining cattle sold in cash markets, the fed cattle prices used to calculate FW margins may be lower because of increased value-based marketing.

Increased farm-level technology has also increased marketing margins because genetic advances have increased weaning weights. Increased weaning weights are partially responsible for heavier fed cattle—many of which receive significant price discounts because of lower quality and meat yields. A 1% increase in average dressed weights of cattle (steers and heifers) increases the beef margin by 2.8%. Taken together, these results indicate that meat packer technology has dominated farm technology in yielding lower margins over time. To illustrate, from 1970 to 1998, the 18.2% increase in dressed weights of cattle increased the margins by 51.5% or 12.1 cents. During the same period, the 80% increase in meat packer output per employee reduced the margin by 147.8% or 34.9 cents—yielding a net margin reduction of 22.8 cents.

Impacts of Technology on Livestock Prices

Our results indicate that improvements in meatpacking technology, combined with increased market concentration, positively affected slaughter cattle and hog prices. For example, a 1% increase in the productivity index increased cattle and hog prices by 0.17% and 0.34%, respectively. Thus, packer cost savings have reduced farm-wholesale margins and increased producer livestock prices through increased input demand. Livestock finishing technology did not affect beef or pork slaughter prices. However, a 1% increase in carcass weights generated by farm technologies reduces slaughter cattle prices by 0.6%.

The changes in farm-level and meat packer technologies in the beef sector provide an interesting comparison. Data from 1970 to 1998 show increases in farm technology for beef of 18.2% and in meatpacker productivity of 80.0%. Our findings translate these productivity gains into an increased slaughter steer price of $8.85/cwt (13.6%) for packer technology and a decreased slaughter price of $7.12/cwt (10.9%) for farm technology. Thus, the effect of meatpacker productivity offset that of farm-level productivity for a net gain in slaughter cattle price of $1.73/cwt (2.7%) and a relative decline in the FW margin for beef.

Conclusions

Changes in meat packing technology in a highly concentrated industry have reduced the real farm-wholesale marketing margins for beef and pork and increased real slaughter prices for cattle and hogs. Apparently, competition in meatpacking during our sample period was large enough to transfer cost savings to producers through increased demand for livestock inputs. Conversely, changes in farm-level technology have contributed to declines in real farm prices—especially in beef. These estimates account for the impact of other factors such as changes in meat supplies, by-product values, feed
costs, food marketing costs, and consumer expenditures.

For livestock producers, the benefits of cost-saving technologies come through the price, quantity, and income effects of changes in supply and demand. In this case, new biotechnology and information technology may further expand livestock supplies and put downward pressure on real livestock prices. Farm income would then depend on demand factors, including increasing retail demand and the continuation of the past benefits arising from new meatpacking technology on margins and prices.

Technological changes have significantly influenced marketing margins and livestock prices. The above results are estimated assuming ceterus paribus conditions. That is, although the positive effects of meatpacking technology on livestock prices have exceeded the negative effects of farm-level technology, real livestock prices have declined over the past several decades. These overall declines are attributable to a variety of other supply and demand factors.

For More Information


*John M. Marsh and Gary W. Brester are professors in the Department of Agricultural Economics, Montana State University.*
Commodity loans are one of the major domestic farm support programs in the United States. They have existed in various forms since the 1930s. Primarily covering major field crops, these programs have addressed different policy goals over time, including price and income support, price stability, and short-term financing.

Beginning in the mid-1980s, commodity loan programs for major field crops added marketing loans to existing nonrecourse loan provisions. Marketing loans began in 1986 for rice and cotton, in 1991 for soybeans and other oilseeds, and in 1993 for wheat and feed grains. Marketing loans no longer provide price support or price stability; however, the loan program continues to provide short-term liquidity to farmers and income support when market prices are low.

This article analyzes potential effects on commodity markets of fixing loan rates in the 2002 Farm Act compared to basing loan rates on past market prices. The marketing loan program is first summarized, followed by discussion of an acreage response model that includes marketing loan benefits when applicable. Simulated plantings of major field crops then are presented under alternative loan rate scenarios.

Overview of Marketing Loans

The 2002 Farm Act governs U.S. agricultural programs through 2007. Marketing loan provisions were continued under the new law. However, in contrast to previous legislation, commodity loan rates for each year are specified in the 2002 Farm Act, thereby eliminating discretionary authority provided to the Secretary of Agriculture by the 1996 Farm Act and earlier legislation for setting loan rates using market-price-based formulas.

Discretionary authority in setting loan rates was used during 1986-95. Market-price-based formulas were used under the 1996 Farm Act only in setting the 1996 loan rate for soybeans. Eliminating discretionary authority for setting loan rates is potentially important if commodity prices fall to low levels during the years covered by the 2002 Farm Act. Zulauf and Wright (2001) noted for 2000 and 2001—years when formula loan rates were not used—that “the marketing loan rate structure is beginning to drive planting decisions. The result is policy-induced inefficiency.” They indicate that “inflexible policies only heighten problems by delaying needed adjustments,” and conclude “annual adjustment of marketing loan rates based on changes in market prices... could address this problem.”

Loan rates in the 2002 Farm Act were established annually through 2007 at designated levels. Rates were raised for most crops covered under the previous legislation, except for reduced rates on soybeans and unchanged rates for rice. New marketing loan provisions were included for peanuts, wool, mohair, dry edible peas, lentils, and small chickpeas. Additionally, the U.S. Department of Agriculture (USDA) introduced different loan rates for five classes of wheat.

These loans benefit producers of eligible commodities through loan deficiency payments and marketing loan gains when market prices are low. Marketing loans also reduce revenue risk due to price variability.

Farmers may receive a loan from the government at a commodity-specific loan rate by pledging as collateral their production of the commodity. They may repay the loan at a lower repayment rate during the loan period whenever market prices are low.
32

CHOICES 4th Quarter 2003

**Marketing Loan Impacts Under Alternative Loan Rates**

Under the 1996 Farm Act, loan rates for corn, wheat, soybeans, and upland cotton could be set using 85% of a five-year “olympic” average of farm-level prices (omitting the highest price and the lowest price from the average). Legislated maximums below the loan rate, resulting in a marketing loan gain to farmers. Alternatively, farmers of commodities covered by the loan programs (except extra-long staple cotton) may choose to receive marketing loan benefits through direct loan deficiency payments (LDP). The LDP rate is equivalent to the marketing loan gain that farmers could obtain for production placed under loan (Westcott & Price, 2001).

Marketing loans add to farmers’ returns in the acreage response model when crop prices are low. Historically, marketing loans have enabled farmers, on average, to attain per-unit revenues above the loan rate. Many farmers use a two-step marketing procedure: They receive program benefits when prices are seasonally low and then sell their crop later when prices have risen (Westcott & Price, 2001). The resulting “marketing loan bonus” increased average revenues for corn to about $0.20 a bushel above the loan rate in 2000 and 2001. Marketing loans thus provide a floor for farmers’ expectations of per-unit revenues in subsequent years that exceeds the loan rate. This policy effect is represented in the model by defining the producer incentive price as the higher of the lagged market price or the current loan rate augmented by the additional marketing-loan-facilitated per-unit revenue.

### Table 1. Alternative loan rate assumptions, 2001 market conditions.

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<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>2.80</td>
<td>2.43</td>
<td>2.43</td>
</tr>
<tr>
<td>Corn</td>
<td>1.98</td>
<td>1.76</td>
<td>1.76</td>
</tr>
<tr>
<td>Soybeans</td>
<td>5.00</td>
<td>4.92</td>
<td>4.62</td>
</tr>
</tbody>
</table>

<sup>a</sup> Soybean loan rate at 1996 farm act legislative floor.

<sup>b</sup> Assumes no floor for soybean loan rate.

Other assumptions in the model include a “marketing loan bonus” of 20 cents a bushel for corn, 25 cents a bushel for soybeans, and 35 cents a bushel for wheat above their respective loan rates, based on 2000 and 2001 crop-year results.

Acreage Response Modeling System

To assess the implications of fixing loan rates in the 2002 Farm Act, a USDA-ERS model was used to simulate planting choices of farmers under the loan rate alternatives. The model covers eight major field crops and uses expected net returns to estimate acreage allocations among crops.

The model incorporates a modified version of the estimated elasticities from Lin et al. (2000). According to that study, full planting flexibility under the 1996 Farm Act and subsequent farm legislation allowed a greater responsiveness of plantings to market prices than in the past. Nonetheless, despite the increases in own-price and cross-price responsiveness of planting decisions, individual responses have partly offsetting effects on aggregate acreage responsiveness, keeping it relatively small.

Marketing loans add to farmers’ returns in the acreage response model when crop prices are low. Historically, marketing loans have enabled farmers, on average, to attain per-unit revenues above the loan rate. Many farmers use a two-step marketing procedure: They receive program benefits when prices are seasonally low and then sell their crop later when prices have risen (Westcott & Price, 2001). The resulting “marketing loan bonus” increased average revenues for corn to about $0.20 a bushel above the loan rate in 2000 and 2001. Marketing loans thus provide a floor for farmers’ expectations of per-unit revenues in subsequent years that exceeds the loan rate. This policy effect is represented in the model by defining the producer incentive price as the higher of the lagged market price or the current loan rate augmented by the additional marketing-loan-facilitated per-unit revenue.

Alternative Loan Rate Scenarios

To illustrate the potential market impacts of having preset, fixed loan rates under the 2002 Farm Act, acreage impacts from the ERS model are derived for alternative loan specifications in a low-price market setting. The analysis is conducted for 2001 planting decisions, using a plausible set of assumptions for yields, costs, and plantings for 2001, and lagged (2000) market prices from the USDA’s February 2001 baseline (United States Department of Agriculture Office of the Chief Economist, 2001).

Three scenarios are defined. The base scenario for fixed loan rates at 2002 and 2003 levels is shown in Table 1 (first column) for corn, wheat, and soybeans. The second scenario assumes that loan rates for 2001 crops were based on the formulas in the 1996 Farm Act, yielding a legislative floor rate for soybeans of $4.92 per bushel. In the third scenario, the soybean loan rate floor under the 1996 Farm Act is relaxed, resulting in a formula-based rate of $4.62 a bushel.

Loan Rate Impacts on Plantings

The simulation results in Table 2 reflect the relationship between marketing loans and planting decisions using scenario 1 as the base. In scenario 2, with formula-based loan rates and the minimum rate for soybeans under the 1996 Farm Act of $4.92...
a bushel, total plantings for the eight major field crops are reduced by 2.8 million acres. Importantly, the loan rate floor for soybeans keeps the change in that loan rate relatively small compared to those for competing crops, such as corn. Consequently, soybean acreage increases by about 1.2 million acres, reflecting a cross-commodity shift away from relatively lower return crops.

In scenario 3, removing the soybean rate floor reduces the soybean loan rate by an additional $0.30 per bushel, while loan rates for other crops are unchanged. Compared to scenario 2, soybean plantings fall by 0.9 million acres, with some of that acreage switching to other crops. Corn plantings, for example, increase 0.5 million acres over scenario 2 levels. Overall marketing loan benefits are lower in this scenario, so aggregate plantings are 0.4 million acres less than in scenario 2, with the 8-crop total now reduced by about 3.2 million acres.

**Policy Implications**

Commodity loan rates affect producers’ acreage decisions, because the income support provided through marketing loans is based on current production and prices. The 2002 Farm Act eliminated discretionary authority for the Secretary of Agricult-

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<tbody>
<tr>
<td>Wheat</td>
<td>63.1</td>
<td>61.4</td>
<td>61.5</td>
</tr>
<tr>
<td></td>
<td>(-1.7)</td>
<td>(-1.6)</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td>79.5</td>
<td>78.0</td>
<td>78.5</td>
</tr>
<tr>
<td></td>
<td>(-1.5)</td>
<td>(-1.0)</td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>73.5</td>
<td>74.7</td>
<td>73.8</td>
</tr>
<tr>
<td></td>
<td>(1.2)</td>
<td>(0.3)</td>
<td></td>
</tr>
<tr>
<td>3-crop total</td>
<td>216.1</td>
<td>214.1</td>
<td>213.7</td>
</tr>
<tr>
<td></td>
<td>(-2.0)</td>
<td>(-2.4)</td>
<td></td>
</tr>
<tr>
<td>8-crop total</td>
<td>254.7</td>
<td>251.9</td>
<td>251.5</td>
</tr>
<tr>
<td></td>
<td>(-2.8)</td>
<td>(-3.2)</td>
<td></td>
</tr>
</tbody>
</table>

Numbers in parentheses are differences from the 2002 farm act fixed loan rate scenario. The acreage estimates for the 2002 farm act scenario were derived as an alternative to the projected 2001 plantings in the 2001 USDA baseline.

These results indicate that fixing loan rates above market-price-based, formula loan rates could retain marginal land in production and alter cropping mixes, resulting in “policy-induced inefficiency.” Although formula loan rates may also distort production choices if they prevent market price signals from being transmitted to producers, commodity loan rates that reflect past market prices would be economically more efficient in farmers’ planting decisions and acreage allocations.

**For More Information**


Paul C. Westcott is an agricultural economist with the United States Department of Agriculture Economic Research Service. The views expressed here are those of the author and do not necessarily reflect the views of USDA.
The vast majority of the milk produced in the United States moves through dairy cooperatives. Cooperatives, in conjunction with federal marketing orders, have attempted to implement seasonal pricing plans to minimize the variability of seasonal milk production and provide consumers with a stable and fresh supply of fluid milk and dairy products. However, in spite of these attempts, U.S. dairy marketing cooperatives in general, and Florida cooperatives in particular, continue to struggle with seasonal supply and demand imbalances. This inefficiency is expensive to both the producer and the consumer.

This article presents the dimensions of the seasonality problem, summarizes the performance of a voluntary seasonal pricing plan in Florida, and suggests potential improvements of these plans in the future.

Florida and U.S. Milk Seasonality

Milk production varies throughout the year. In 2002, U.S. monthly milk production exceeded the monthly average (Index = 1.0) for the five-month period of February through June, whereas for the remaining months the monthly milk production was below the monthly average (Figure 1). In general, the opposite is true for consumption. Consequently, national seasonality in both production and consumption continue to result in periods of market imbalance; Florida's seasonality is even greater (Figure 2).

In Florida, moderate temperatures in the spring help to promote monthly production at levels 15% above the monthly average in 1992, whereas summer heat contributes to production levels 17% below the monthly average (Figure 2). At the same time, the demand for milk varies seasonally, resulting in monthly supply and demand imbalances.

Consequently, Florida dairy cooperatives must export bulk fluid milk early in the year and then import milk a few months or even weeks later. Due to the nature of “full supply” contracts with milk processors, Florida dairy cooperatives incur transportation costs for both the importing and exporting of fluid milk. Other areas of the country tend to experience similar imbalances.

Given the size and type of market, little, if anything, can be done to bring consumption into synch with production. A more likely course of action would be to bring production in line with consumption. The problem of output coordination with the changes in seasonal demand could be dealt with by using production controls (quotas) or with price incentives. Numerous issues, such as implementation and administration as well as the likelihood of capitalization of benefits into the quotas, preclude the use of production controls. Price incentives are more likely to be successful.

In January 1993 the milk marketing cooperatives in Florida implemented a seasonal pricing plan to reduce the variability in seasonal production. The plan provided an incentive for dairy farmers to change their patterns of production so as to produce less milk during the surplus months and more during the deficit months. By achieving this objective, the cost associated with importing and exporting milk would be reduced.

The seasonal pricing plan was in place from January 1993 through December 1995. Due to little influence on seasonality, Florida cooperatives voted to eliminate the seasonal pricing plan after three years. However, upon closer examination,
although the plan was not successful, it lacked full participation by the cooperatives’ membership.

**Cost of Importing and Exporting**

In 1992—the year before the pricing plan began—significant amounts of fluid milk moved into and out of Florida. Because of transportation and procurement costs, imported milk costs cooperatives more than milk produced in Florida, whereas exported milk results in a price returned to producers below the price received in Florida. To illustrate, for the five-month July–November period in 1992, Florida cooperatives imported 110.5 million pounds of milk at a total cost of $20.2 million (Table 1) for an average price paid of $18.25 per hundredweight. For the remaining seven months (January–June and December), Florida cooperatives exported 122.1 million pounds of milk at a return of only $11.7 million net of transportation costs for an average price received by producers of $9.59 per hundredweight (Lawson, Kilmer, & Nubern, 1994).

**The Pricing Plan and Participation**

The seasonal pricing plan was intended to have individual farmers change their production patterns in order to reduce the seasonality and cut the costs associated with imports and exports. Each farm’s production in the three highest producing months (March, April, and May) was summed and divided by the total number of days in these three months to give a per day base production. The premium per hundredweight was paid in the lowest production and highest importing months (August, September, and October), when the average daily production in any of these months was greater than 75% of that farm’s daily base production in March, April, and May.

Production data from January 1992 through October 1995 was collected from 68 of a possible 307 dairy farmers that belonged to the cooperatives. All farmers included in the data set produced each year from 1992 through 1995 and were Dairy Herd Improvement Associate members. For the three years beginning in 1993, 37%, 40%, and 47% of the 68 farms participated in the pricing plan (Washington, Lawson, & Kilmer, 2000).

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**Table 1. Actual and estimated Florida dairy cooperative milk imports and exports for 1992.**

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Assuming seasonality of pricing plan participating farms</th>
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<tbody>
<tr>
<td><strong>1,000 pounds</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk imports</td>
<td>110,518</td>
<td>85,593</td>
</tr>
<tr>
<td>Milk exports</td>
<td>122,095</td>
<td>95,392</td>
</tr>
<tr>
<td><strong>Dollars</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of imports</td>
<td>20,166,809</td>
<td>15,658,664</td>
</tr>
<tr>
<td>Value of exports</td>
<td>11,711,289</td>
<td>9,173,476</td>
</tr>
</tbody>
</table>
The Plan That Failed?

The plan was not effective in reducing the seasonality of production for the 68 farms. In fact, seasonality appeared to increase marginally over the time period of the plan. However, upon closer inspection the voluntary nature of the pricing plan likely caused it to fail.

Although the plan was unsuccessful, overall, comparing seasonality on farms that participated in the plan versus nonparticipants shows a different outcome. Results indicate that participants in the seasonal pricing plan reduced output seasonality in each year (1993–1995) by as much as 20% (Figure 3; for details see Washington, Lawson, & Kilmer, 2000). In contrast, nonparticipants experienced increases in seasonality each year by as much as 32%.

These results were supported by the farms' actual production (Washington, Kilmer, & Weldon, 2002). Participating and nonparticipating farmers showed no differences in the seasonal use of production practices in 1992. However, a different story emerges after implementation of the seasonal pricing plan. Proportion of cows milking, milk production per cow, calving rates, and other production practices differed in some or all three years. In each case, the seasonal use of the production practices was less seasonal (i.e., smaller) for participating farms compared to non-participating farms. This reduced the degree of seasonality in milk production for participating farms compared to non-participating farms.

Consequently, the seasonality of those that participated in the pricing plan decreased compared to 1992, while the seasonality of those nonparticipating producers clearly worsened (Figure 4). The increased seasonality for nonparticipants dampened or overshadowed the pricing plan’s effectiveness.

Table 1 indicates the potential benefits under full participation. Using the actual production and consumption data for 1992, but imposing the seasonality index for pricing plan participants from Figure 4, generates the comparisons in Table 1. If in 1992 all the cooperative producers had experienced the average seasonality of participating farms, and assuming prices and consumption were unchanged, imported milk needs would decline by 24.9 million pounds to 85.6 million pounds. The reduced imports would cost $15.7 million or $4.5 million less. Similarly, milk exported would have decreased from 122.1 to 95.4 million pounds as production became less seasonal.

Implications for Dairy Policy

Seasonality of milk production remains a problem for Florida and the United States. An effective seasonal pricing plan can provide the incentive for dairy farmers to reduce seasonality in production. Such a plan for cooperatives would require either mandatory participation of all cooperative members or a penalty for excess seasonal variability. This policy would do away with the incentive for nonparticipants to overproduce in order to make up for reduced production by participants. Seasonal pricing plans can be implemented through the federal marketing order system; however, initiating and implementing a plan would be more timely and
flexible if implemented through milk marketing cooperatives. Milk marketing cooperatives can administer and adapt the plans more quickly than the federal marketing order system.

For More Information


Richard N. Weldon is an associate professor in the Department of Food and Resource Economics, University of Florida. Andrew A. Washington is an assistant professor in the Department of Economics, Southern University, Baton Rouge. Richard L. Kilmer is a professor in the Department of Food and Resource Economics, University of Florida.