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U.S. Milk Production Costs and Returns, 1993

An Economic Basebook

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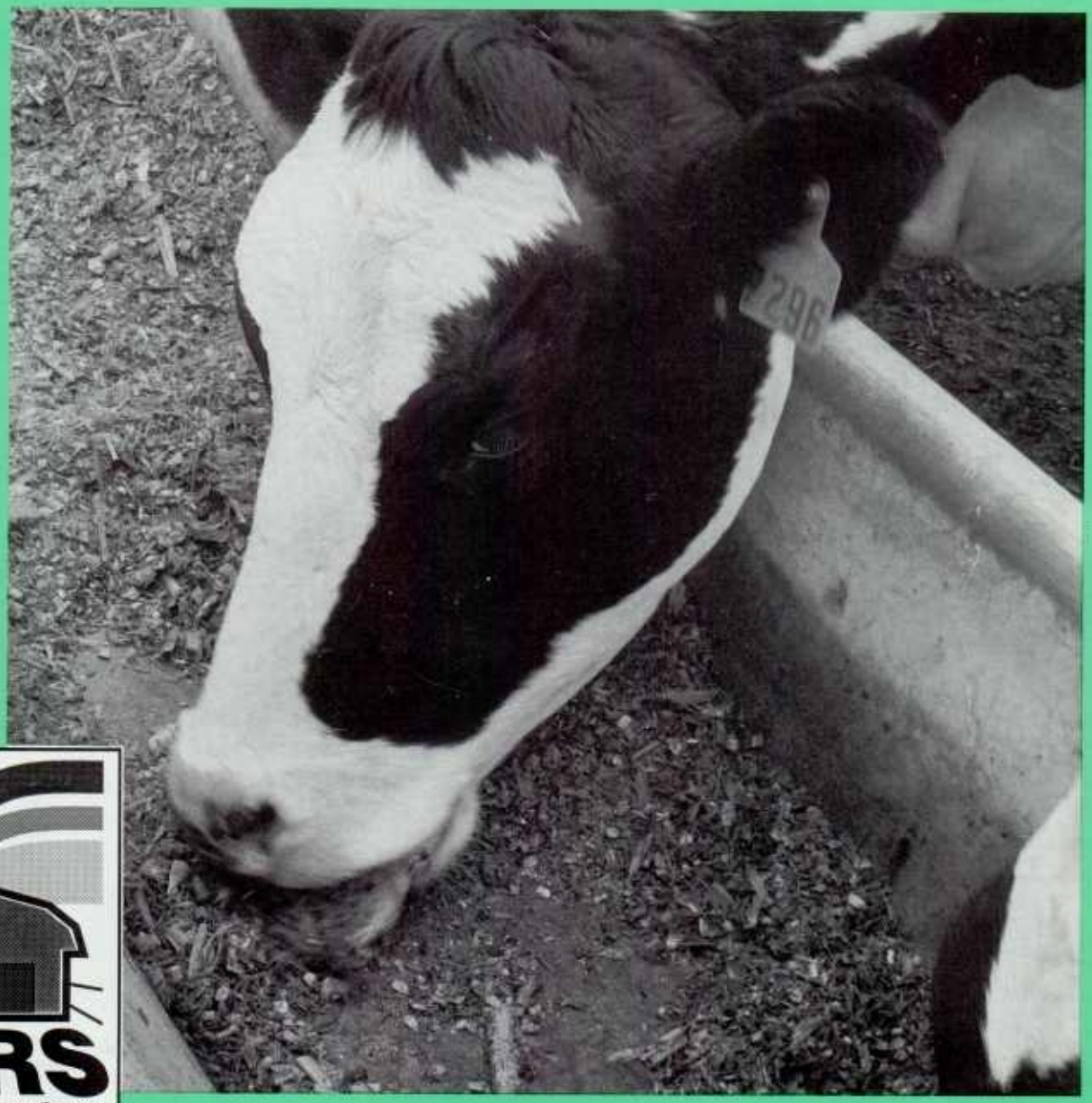

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U.S. Milk Production Costs and Returns, 1993: An Economic Basebook.
By Sara D. Short and William D. McBride. Rural Economy Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 732.

Abstract

The U.S. milk production industry experienced significant structural changes between 1955 and 1993. Fewer and larger operations have more and more come to characterize the industry. Data from the Farm Costs and Returns Survey show that cash and capital replacement costs of milk producers range from $5 to more than $25 per hundredweight of milk sold. Size of operation, animal performance, and milk production methods all distinguish low- from high-cost milk producers. However, differences in feed and labor efficiency have the greatest influence on milk production costs.

Keywords: Milk production, cost-of-production, Farm Costs and Returns Survey, farm characteristics.

Washington, DC 20005 May 1996

Contents

Summary

Feed and labor efficiency are the factors with the greatest potential to reduce U.S. milk production costs. Based on data from USDA's Farm Costs and Returns Survey, this report discusses issues resulting from the structural changes that have been occurring in the milk production industry—mainly trends toward fewer and larger operations. The survey found that while low-cost milk producers are distinguished from high-cost producers by size of operation, animal performance, and production methods, differences in feed and labor efficiency have the greatest influence on milk production costs. Improved feeding practices and modern housing and milking facilities would therefore likely be the best ways to reduce production costs.

The overall financial condition of low-cost producers is better than that of high-cost producers. Almost 80 percent of low-cost producers are classified as being in a favorable financial position, compared with 53 percent of high-cost producers. Many high-cost producers are in the marginal income category, indicating that while their debt/asset ratio is less than 0.40, net farm income during 1993 was negative. Higher feed costs, in conjunction with poorer animal performance, contributed to high-cost producers' negative net farm incomes.

Variable cash costs and fixed cash costs vary little among enterprise size groups, but total economic costs are significantly lower for the largest producers. Animal performance and input use efficiency increase with size, and fixed costs are spread over more units of output. Most of the advantages to increasing size of operation are obtained at herd sizes of 500 to 1,000 cows. Operations of this size are currently among the largest in the dairy industry, where the average herd size is only about 60 cows. With significant advantages accruing to much larger operations, the current trend toward fewer and larger milk production units will likely continue.

Milk producers in the West and South generally have larger dairy operations, which are more feed and labor efficient than those in the North. However, feed efficiency is an important factor influencing milk production costs in all areas. Economic incentives for expanding dairy operations appear to be prevalent in the South and West, while incentives for increasing productivity are more important in the North.

The financial condition of producers in the North and South was generally better than in the West in 1993. More than 70 percent of producers in the North and South are classified as being in a favorable position compared with only 53 percent in the West. The larger operations characteristic of the West are achieved by more debt financing than in the other areas.

The shift to specialized commercial dairy farms was made possible by technological advances (such as refrigerated bulk tanks, automatic milking systems, and computerized feeding systems) that substituted for labor. In addition, advances in genetics, feeding, health care, and overall management techniques led to impressive increases in milk output per cow.

Just 2 percent of the dairy farms represented in the survey have 300 or more cows, but these farms account for nearly 30 percent of milk sales. The 63 percent of dairy farms with 60 or fewer cows account for 26 percent of milk sales.

Glossary

Dairy farms represent those selected in USDA's 1993 Farm Costs and Returns Survey, Dairy Cost of Production version, and include only operations that were in business as a dairy during all of 1993.

Economic costs are long-term costs that reflect the production situation as if the operation fully owned all production inputs. These include opportunity costs for resources used in production.

Enterprise size categories are specified for dairy operations with number of dairy cows under 60; 60-119; 120-299; and 300 or more.

Feed cost includes costs for purchased grain and other feed additives and homegrown grain. Purchased grain and other feed additives are charged the price paid by each producer. Homegrown feed grains are charged the annual State-average market price for each type of grain. Homegrown pasture is valued at the rental rate for pasture land in each State. Homegrown silage and other harvested forages are valued at the market value reported by each operator in the FCRS.

Financial position describes the financial health of a farm business from a combination of income (net farm income) and solvency (debt/asset ratio) measures. Farms are categorized into one of four classes:

Favorable–positive income and debt/asset ratio less than 0.40. These farms are generally considered financially stable.

Marginal income–negative income and a debt/asset ratio less than 0.40. Periods of negative income may not pose financial difficulties if these farms are carrying a low debt load and can either borrow against equity or obtain income from off-farm sources.

Marginal solvency–positive income and a debt/asset ratio above 0.40. A high debt/asset ratio may be acceptable if these farms can generate enough income to service their debt and meet other financial obligations.

Vulnerable–negative income and a debt/asset ratio above 0.40. These farms are generally considered financially unstable.

Fixed cash costs must be paid regardless of whether or not production occurs.

High-cost producers are the 25 percent of milk producers with the highest total cash and capital replacement costs per hundredweight (cwt) of milk sold. Included are milk producers with costs of $18.25 or more per hundredweight of milk sold.

Low-cost producers are the 25 percent of milk producers with the lowest total cash and capital replacement costs per hundredweight of milk sold. Included are milk producers with costs of $13.00 or less per hundredweight of milk sold.

Major occupation is that occupation in which the operator reported the majority of his/her time spent during 1993.

Milk production regions:

Northeast production region includes New York, Pennsylvania, and Vermont.

Corn Belt production region includes Iowa, Missouri, and Ohio.

Upper Midwest production region includes Wisconsin, Minnesota, and Michigan.

Southeast production region includes Florida and Georgia.

Southern Plains production region includes Texas.

Pacific production region includes Arizona, California, and Washington.

Milk production areas:

North includes operations in the Northeast, Corn Belt, and Upper Midwest milk production regions.

South includes operations in the Southeast and Southern Plains milk production regions.

West includes operations in the Pacific milk production region.

Production specialty is the farm production classification that represents the largest portion of gross commodity receipts from the farm operation.

Sales class is an economic classification of farm size. The classification is based on gross receipts, including gross annual sales of crops, livestock, poultry, and products; miscellaneous agricultural products; and all Government payments of the farm operation.

Value of production is an estimate of the total value of all farm products produced on a farm, excluding the value of intermediate products such as corn fed to livestock.

Variable cash costs represent the costs of purchased inputs that are consumed in one production period. Variable costs depend on the chosen production practices, input quantities, and input prices.

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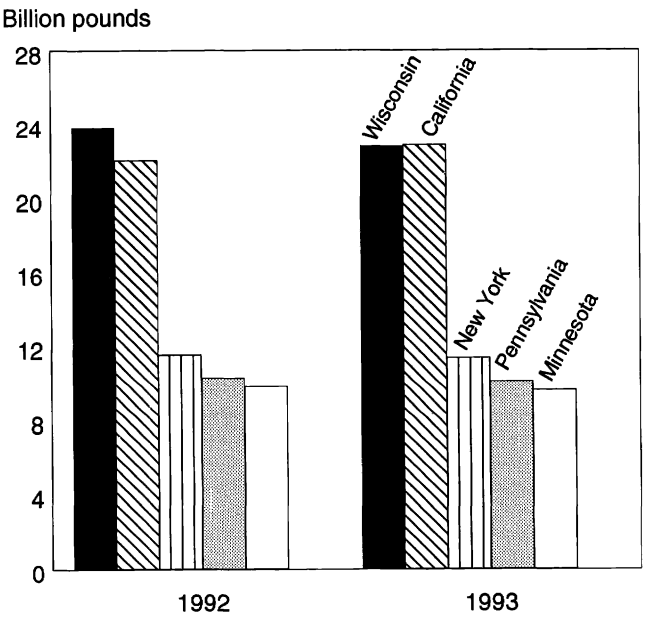
Introduction

In 1993, milk ranked third in market value among all U.S. agricultural commodities. Milk was produced in every State. However, over half of 1993's total milk production came from five States–California, Wisconsin, New York, Pennsylvania, and Minnesota (fig. 1), and more than two-thirds was produced in 10 States. California, the leading milk producer in 1993, accounted for 15 percent of U.S. production.

Figure 1
Milk production for top five States, 1992-93
California passed Wisconsin as the top milk producing State in 1993.



Source: Compiled by Economic Research Service from *Milk Production, Disposition, and Income 1994, Summary,* May 1995, National Agricultural Statistics Service, USDA.

Dairy farm numbers and cow numbers continued to decline, while total milk output and output per cow rose. According to the National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture (USDA), 159,450 operations in 1993 had at least 1 milk cow, compared with 2,763,000 farms in 1955. During the same period, total milk cow numbers declined from 21.044 million to 9.589 million, while total milk production rose from 122.95 billion pounds to 150.65 billion pounds. Annual milk production per cow almost tripled, rising from 5,842 pounds to 15,704 pounds per cow. Advances in genetics, feeding, health care, and overall management techniques led to this impressive increase in milk production per cow.

Changes in average herd size also were indicative of the structural changes taking place in milk production. The average number of cows per farm rose from 8 in 1955 to 60 in 1993. Urbanization and technological advances in milk production and marketing that substituted capital for labor (for example, refrigerated bulk tanks, automatic milking systems, and computerized feeding systems) provided incentives for the shift to specialized commercial farming enterprises.

Milk production grew in sections of the country outside the Upper Midwest and the Northeast. In 1993, California surpassed Wisconsin's milk production by about 100 million pounds. Arizona, Texas, and Florida also expanded milk production. Past regional population shifts, land and facilities costs, climate, the supply and quality of hay and forage, the availability of a labor supply, and opportunities to strictly specialize in managing and milking cows help explain the current location of milk production. Large drylot facilities of 1,000 cows or more, which are common in the West, benefit from

economies of both specialization and scale, which lead to reduced production costs.

This report examines the structure and economics of U.S. milk production by comparing production costs and selected production and farm characteristics among U.S. milk producers. The first part describes the methods and procedures used in milk costs and returns estimation. The second section is devoted to a distributional analysis of production costs by identifying and measuring sources of cost variation. The influence of size of operation on production costs and performance measures is explored in section 3. Section 4 examines regional differences among milk producers by comparing North, South, and West milk production areas.

Sections of this report include a comparison of group means and percents by various classifications. Comparisons of group means and percents were statistically tested for significant differences (see appendix A). T-statistics between groups for selected, but not all, items in each section are presented. The discussions in each section emphasize comparisons among groups only when means are significantly different at the 90-percent level.

Measuring Milk Enterprise Costs and Returns

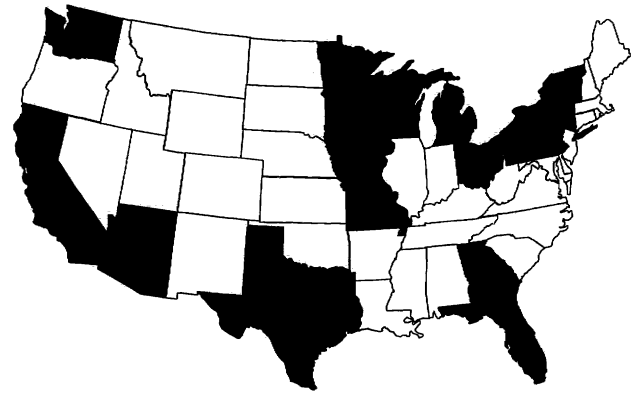
Milk production cost and return estimates are based on information obtained in USDA's 1993 Farm Costs and Returns Survey (FCRS) of U.S. milk producers. Cost and return estimates conform to the current USDA item definitions and structure of accounts.

The U.S. Department of Agriculture's (USDA) Economic Research Service (ERS) annually estimates production costs and returns of major field crops and livestock enterprises (USDA, ERS, 1994). These estimates are for production operations regardless of resource ownership, and include operator, landlord, and contractor costs and returns. The estimates reflect average production practices, yields, animal performance, and prices paid and received by farmers each year. Costs can vary widely among individual farmers due to differences in location, size, input use, and production practices. This variability means that costs and returns for individual farmers may differ considerably from the average estimates presented. Consequently, users should be aware of the objectives and procedures used in constructing the USDA estimates.

Figure 2

States surveyed in the 1993 FCRS of milk producers

Farmers surveyed in the States shown represented 75 percent of total U.S. milk production in 1993.



Source: Economic Research Service, USDA.

Data Sources

Production cost estimates are based on information obtained from the Farm Costs and Returns Survey (FCRS), conducted annually by ERS and USDA's National Agricultural Statistics Service (NASS). Each year, multiple versions of the FCRS are conducted, including an indepth, whole-farm version and commodity cost-of-production (COP) versions. While all versions include questions about whole-farm income and expenses, each COP version gathers detailed information about input use and machinery, building, and equipment use, and production costs of an individual enterprise. Because of survey costs, USDA cannot undertake detailed surveys of every commodity each year. Thus, the FCRS covers each commodity on a rotating basis about every 5 years.

Data used in this report are obtained from the dairy cost-of-production version of the 1993 FCRS. Milk producers in 15 States were included in the survey (fig. 2). The FCRS uses a multiframe stratified sample in which each farm surveyed represents a number of similar farms. The 695 respondents to the dairy version of the 1993 FCRS represented 105,230 farms and an annual average milk cow inventory of 8.103 million head (85 percent of the December 31, 1993, average milk cow inventory) *(Cattle Report,* USDA, NASS, Feb. 1995).

Farms surveyed in the 1993 FCRS were chosen from a NASS list of known milk producers and had to have been in business as a dairy during all of 1993. The

Figure 3

Approaches used to estimate milk cost-of-production items

The choice among alternative approaches for cost-of-production estimation is dictated by the type and availability of data and economic theory, among other considerations.

Direct	Indirect costing	Allocating whole-farm expenses	Valuing quantities of inputs	Combination of approaches
Purchased feed	Capital replacement	General farm overhead	Homegrown feed	Other nonland capital
Milk and livestock hauling	Repairs	Interest	Unpaid labor	Operating capital
Custom services and supplies	Fuel, lubrication, and electricity	Taxes and insurance	Land	
Artificial insemination				
Veterinary and medicine				
Bedding and litter				
Marketing				
Hired labor				
DHIA fees				
Assessments				

Source: Economic Research Service, USDA.

primary purpose of the survey of milk operations is to collect information used to estimate the average cost of milk production for the United States and various milk production regions (see glossary).

Approaches to Cost Estimation

USDA uses four general approaches to estimate commodity production costs: direct costing, allocation of whole-farm costs, valuing of input quantities, and indirect costing (fig. 3).

Direct costing is simply summarizing survey responses to questions about the total amount paid for selected inputs. This method is best suited for estimating components of variable costs. For milk producers, direct costing is used to estimate costs of purchased feed items, milk and livestock hauling, artificial insemination, veterinary and medicine, bedding and litter, marketing, custom services and supplies, hired labor, Dairy Herd Improvement Association (DHIA) fees, and Government assessments.

Indirect costing involves the combination of survey information and engineering formulas. Detailed information is collected regarding the machinery, buildings, and equipment used in production. The data include hours of use, age, and type and size of machinery, building, and equipment items. For milk producers, this information is used to support equations of technical relationships that describe machinery, building, and equipment replacement costs; fuel, lubrication, and electricity costs; and repair costs. Engineering formulas are modified periodically to reflect technological change.

Allocating whole-farm expenses occurs for inputs that are not specifically associated with production of a particular commodity, including general farm overhead items, interest, property taxes, and insurance. Expenses incurred by the whole farm for these inputs are allocated to the milk enterprise based on the share of total value of farm production attributed to milk.

Valuing quantities of inputs requires survey data of the physical quantities of inputs used in production. For milk producers, this approach is used for estimating costs of homegrown feed items, unpaid labor, and land. Quantities of homegrown feed grains fed to dairy cows are valued at market prices. Homegrown pasture is valued at rental rates for pasture land. Homegrown silage and other harvested forages are valued at the market value reported by each operator in the FCRS. Unpaid labor and land costs are estimated by valuing the survey quantities used for milk production according to resource rental rates.

Components of economic costs including operating and nonland capital are estimated using a combination of these approaches. Operating capital cost is the cost of carrying variable expenses through the production period. Nonland capital is the cost of capital invested in nonland assets used in milk production, such as machinery, buildings, equipment, and breeding stock.

Structure of Accounts

Milk production cost and return estimates in this report conform to the current USDA item definitions and structure of accounts. Milk cost and return estimates are presented in the form of a commodity account that lists gross value of production, variable cash expenses, fixed cash expenses, economic costs, and two measures of returns. The estimates were developed from measurements of costs and returns during the 1993 calendar year, and are presented both per hundredweight (cwt) of milk sold and per cow.

Gross value of production. Gross value of milk production includes the value of milk marketings, the value of cattle marketings, and other income from the dairy enterprise. Milk sales are valued at annual prices in each State. Annual prices received for 100 pounds of milk by State are obtained from *Agricultural Prices* (USDA, NASS). Cull and breeding stock sales are valued at reported sale prices in the FCRS.

Other income from milk production includes: (1) the nutrient value of manure production; (2) income from renting or leasing dairy stock to other operations; (3) co-op patronage dividends associated with the dairy; and (4) income received from assessment rebates, refunds, and other dairy-related payments. The nutrient content of estimated annual manure production is valued using annual prices for nitrogen, phosphorus, and potassium in each State.

Variable cash expenses. Variable cash expenses are incurred only if production takes place. Feed is the largest component of variable cash expenses on dairy operations. Six categories are defined: concentrates, byproducts, liquid whey, hay, silage, and pasture and other forage. Costs of purchased feed items are taken directly from the FCRS. Quantities of homegrown feed grains are valued according to annual average prices received by farmers in each State obtained from *Agricultural Prices* (USDA, NASS). Homegrown pasture is valued using the rental rate of pasture land in each State from *Land Values* (USDA, ERS). Costs of homegrown silage and other harvested forages are taken directly from market rates reported in the FCRS.

Costs of other variable cash expenses–including milk and livestock hauling, artificial insemination, veterinary and medicine, bedding and litter, marketing, custom services and supplies, hired labor, DHIA fees, and Government assessments–are taken directly from the FCRS. Engineering formulas are used to estimate the cost of fuel, lube, and electricity; and repairs.

Fixed cash expenses. Fixed cash expenses must be paid regardless of whether or not production occurs. Fixed expenses include general farm overhead, taxes, insurance, and interest on loans. Overhead costs consist of expenses for utilities (excluding water and electricity for irrigation), farm shop and other supplies, accounting and legal fees, blanket insurance policies, fence maintenance and repair, motor vehicle registration, maintenance of farm roads and ditches, and any other general expenses attributable to the farm business. Taxes are those for real estate and personal property and not Federal or State income taxes. Insurance includes crop and livestock insurance other than Federal crop insurance and the farm share of motor vehicles' liability and blanket insurance policies. Interest expenses include finance charges and service fees for loans on machinery, the farm share of motor vehicles, purchases of inputs, land contracts, mortgages, and any other loan secured by real estate.

Unlike variable cash expenses, fixed costs associated with the dairy enterprise are more difficult to obtain directly from farmer surveys, such as the FCRS. Most of these items are purchased for the farm as a whole, paid for or billed to the farm in a lump sum, or used in a wide range of farming activities. Consequently, these input costs must be divided among farm enterprises based on an allocation rule. Fixed cash expenses are allocated to the dairy enterprise based on the share of total value of farm production attributed to the dairy enterprise.

Economic (full-ownership) costs. Economic costs are long-term costs that reflect the production situation as if the operation fully owned all production inputs. An opportunity cost is calculated for all capital inputs and land, whether owned, rented, or financed. Economic costs include variable cash expenses, general farm overhead, taxes and insurance, capital replacement, an imputed cost of capital invested in the production process, unpaid labor, and land.

Capital replacement cost represents a charge sufficient to maintain production capacity through time. Information is collected in the FCRS to determine capital assets used in milk production, including their size, age, and hours used. These data are combined with current price information and engineering coefficients developed by the American Society of Agricultural Engineers. An annual capital

replacement charge is computed by dividing the current purchase price less salvage value of each capital asset by years of life. Capital replacement includes a charge for purchased breeding stock, but not for replacement stock raised on the farm because costs of raising these replacements are included in other items of the account.

Opportunity costs are imputed from values of capital, land, and unpaid labor in alternative uses. The cost of operating capital is the cost of carrying input expenses from the time they are incurred until they are paid, assumed to be 2 months for dairy operations. Operating capital costs are imputed using the 6-month U.S. Treasury bill rate. The cost of having capital invested in farm machinery, buildings, equipment, and breeding stock (nonland capital) is measured using the longrun rate of return to agricultural production assets from current income. Land cost includes a charge for land used as building sites and for manure storage. Land is valued at its rental value minus real estate taxes. The value of unpaid labor is imputed using the wage rate for agricultural workers. Any additional value of unpaid labor, such as for management and entrepreneurial skill, is treated as a residual return.

Gross value of production less selected costs. Two returns are included in each account. Gross value of production less cash expenses is the net cash return that measures the shortrun cashflow position. Gross value of production less economic costs is the residual returns to management and risk that measures the longrun position of the enterprise.

Distribution of Milk Production Costs

Size of operation, animal performance, and milk production methods all distinguish low- from high-cost milk producers. However, differences in feed and labor efficiency have the greatest influence on milk production costs.

Average costs of production represent a single point on the distribution of production costs and provide only limited information about the economic performance of U.S. milk producers. Considerable production cost variability exists among milk producers. Analysis of the entire cost of production distribution enables the identification of sources of cost differences among producers, such as the effects of various farm organizations and management practices.

Production costs used in the distributional analysis include estimated cash costs and capital replacement cost. Cash costs represent actual out-of-pocket expenses incurred for milk production during 1993. Capital replacement cost represents a charge sufficient to maintain the production capacity of machinery, buildings, equipment, and depreciable breeding stock through time. Replacement costs may be postponed in any given year, but ultimately must be paid for the operation to remain in business. Other economic costs represent opportunity costs of resources that are not as easily measured at the farm-level, and thus are excluded from this analysis.

Two procedures are used to examine the cost of production distribution of milk producers. First, estimated production costs per hundredweight of milk sold are ranked from lowest to highest to form a weighted cumulative distribution at the national level. The cumulative distribution is divided into quartiles with the bottom quartile representing the lowest-cost milk producers, and the top quartile representing the highest-cost milk producers. Sources of cost differences among producers are identified by comparing the farm structural and performance characteristics of low- and high-cost producers. The statistical difference in mean estimates for low- and high-cost producers is tested using a t-statistic (see appendix A).

The relationship between costs of production and farm structural and performance characteristics is further tested using regression analysis. Multivariate regression analysis is used to examine the combined effect of key variables on production costs. To measure the extent to which each characteristic influenced production costs, the sample variation of production cost is decomposed into the portion attributable to each characteristic (see appendix B).

Low- and High-Cost Milk Producers

Twenty-five percent of dairy farms surveyed had cash and capital replacement costs per hundredweight of milk sold at $13.00 or less in 1993. These relatively low-cost producers accounted for over 43 percent of total milk sales (table 1). High-cost producers, with cash and capital replacement costs of $18.25 or more per hundredweight of milk sold, accounted for only 14 percent of total milk sales (fig. 4).

Low-cost producers have significantly larger dairy operations than high-cost producers. Milk cow inventory on low-cost operations is more than twice that of high-cost producers (120 versus 54). Farm acres operated are lower for low-cost producers, but

Table 1–Characteristics of FCRS farms with low- and high-cost dairy operations, 1993

Low-cost producers are larger and more feed- and labor-efficient than high-cost producers. More modern facilities likely contribute to the better performance of low-cost producers.

Item	Unit	Low-cost producers	High-cost producers	t-statistic
Share of FCRS dairy:				
Farms	*Percent*	25	25	na
Milk sales	*Percent*	43	14	na
Output per cow	*Pounds*	17,404	12,165	10.05**
Average milk cow inventory	*Head*	120	54	2.41**
Feed efficiency	*Pounds per cwt of milk sold*	149	297	9.65**
	Pounds per cow	25,336	31,478	5.68**
Labor efficiency	*Hours per cwt of milk sold*	0.19	0.48	1.66*
	Hours per cow	33.08	55.12	56.68
Financial position:[1]				
Favorable	*Percent of farms*	79	53	3.64**
Marginal income	*Percent of farms*	13	37	3.93**
Marginal solvency	*Percent of farms*	8	10	0.24
Vulnerable	*Percent of farms*	0	3	1.15
Housing facilities:[1]				
Stanchion/tie stall barns	*Percent of capacity*	16	33	4.78**
Drylot corrals	*Percent of capacity*	43	10	4.47**
Milking facilities:[1]				
Herringbone parlors	*Percent of capacity*	40	20	2.47**
Barns with pipeline	*Percent of capacity*	38	57	2.05**
Total feed cost	*Dollars per cwt of milk sold*	5.66	10.51	10.00**
Total economic costs	*Dollars per cwt of milk sold*	11.78	24.89	18.22**

[1] Data may not sum due to rounding.

** significantly different at the 5-percent level; * significantly different at the 10-percent level.

na = not applicable.

Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

the average farm value of production is nearly three times that of high-cost producers. In addition, 57 percent of high-cost producers have farm sales less than $100,000, while 65 percent of low-cost producers have farm sales above $100,000. Both low- and high-cost producers are highly specialized in milk production, with more than 80 percent of the value of farm products derived from milk production.

Almost 45 percent of producers located in the Pacific milk production region (see glossary) are in the low-cost group (fig. 5). This is a region with larger enterprises that purchase most, if not all, inputs needed for milk production. The Upper Midwest has the highest proportion of high-cost producers.

The overall financial condition of low-cost producers is better than that of high-cost producers. Almost 80 percent of low-cost producers are classified as being in a favorable financial position (see glossary), compared with 53 percent of high-cost producers. Many high-cost producers are in the marginal income category, indicating that while their debt/asset ratio is less than 0.40, net farm income during 1993 was negative (see glossary). Higher feed costs, in conjunction with poorer animal performance among high-cost producers, contributed to the negative net farm income.

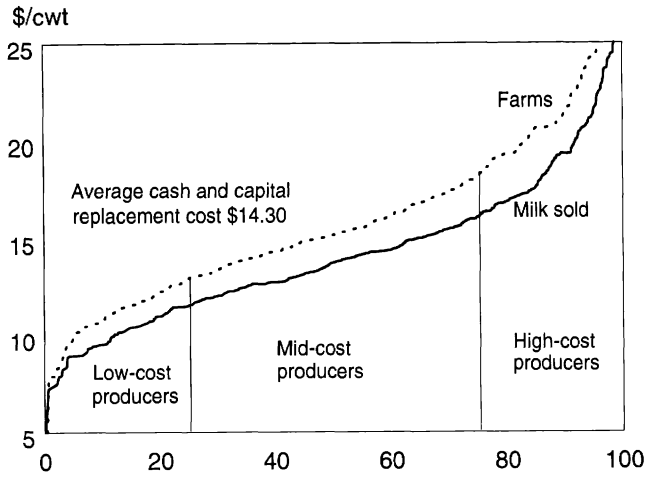
Most operator characteristics are similar between low- and high-cost dairy operations. Operators of farms in both groups are experienced milk producers with at least 22 years spent as the operator of the 1993 dairy operation. Operator age, education level, and farm organization are also similar between these groups. Nearly all producers in both groups consider farming their major occupation.

Differences in animal performance are critical in determining whether producers are low- or high-cost.

Figure 4

Cumulative distribution of cash and capital replacement costs per hundredweight of milk sold, 1993

Cash and capital replacement costs range from $5 to more than $25.

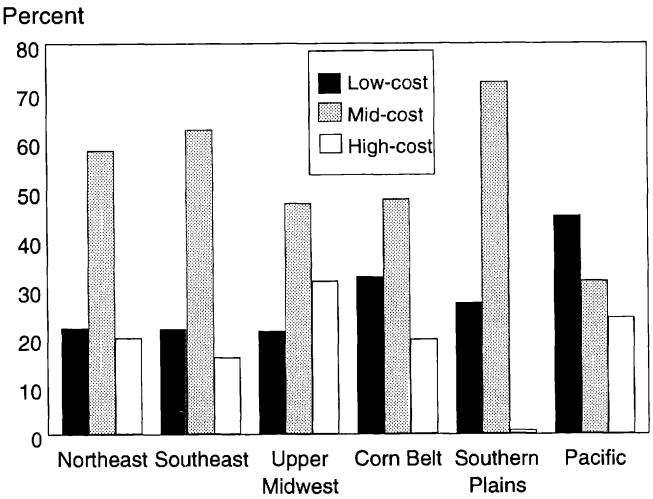


Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Figure 5

Distribution of cost groups by region, 1993

Proportionally more low-cost producers are located in the Pacific region.



Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey.

Output per cow on low-cost farms averages 17,404 pounds, versus 12,165 pounds on high-cost farms. As a result, low-cost producers average some $700 more in cash receipts from the sale of milk for each milk cow in the milking herd. Low-cost producers fed 149 pounds of feed per hundredweight of milk sold, compared with 297 pounds by high-cost producers. Greater feed efficiency on the part of low-cost producers results from both more output per cow, and from less feed fed per cow. High-cost producers fed more than 31,000 pounds of feed per cow, compared with 25,336 pounds for low-cost producers. The general ration formulation fed by low- and high- cost producers is much the same. Thus, differences in feed efficiency can likely be attributed to better management of feeding systems and higher performance genetics. Because of greater feed use, average total feed costs on high-cost operations are almost double that on low-cost farms, $10.51 vs. $5.66 per hundredweight of milk sold. Low-cost producers are also more labor-efficient than high-cost producers, using 0.19 total labor hour per hundredweight of milk sold and 33 hours per cow, compared with 0.48 total hour per hundredweight of milk sold and 55 hours per cow on high-cost operations. High-cost operations use more hired labor.

Low-cost producers more often use drylot corrals for housing milk cows. Forty-three percent of the housing capacity on low-cost operations is in drylot corrals compared with only 10 percent on high-cost farms. More of the housing capacity on high-cost operations is in various types of barns. Although drylot corrals are generally less expensive to build, dairy operations in the Upper Midwest and Northeast must invest in facilities that protect the herds from cold winter temperatures. Drylot corrals are more prominent in States where temperatures remain relatively warm all year.

Forty percent of the milking capacity on low-cost operations is in herringbone parlors, compared with only 20 percent on high-cost farms. More of the milking capacity on high-cost operations is in barns with pipelines. Low-cost producers operated their milking facilities significantly longer than high-cost producers. However, by investing resources in more efficient milking facilities, low-cost producers spend less time per cow milking their larger herds. Because low-cost producers generate more milk than high-cost producers, low-cost producers have significantly more milk pickups per day despite having greater onfarm milk storage capacity. Low-cost producers also make more use of newer technology, including automatic takeoffs, udder washers, and manure-handling facilities (particularly lagoons and pits).

The per-hundredweight value of milk sold and cattle sold are significantly higher on high-cost operations.

A large number of high-cost operations are located in regions where producers receive higher milk prices. However, per cow, low-cost producers have a significantly higher value of milk production and cattle sold. Total milk production, milk production per cow, and cow numbers are much higher on low-cost operations, thereby providing these operations with a much higher gross value of dairy production.

Average variable cash expenses are about $9 per hundredweight of milk sold for low-cost producers, almost half of the $16.28 for high-cost producers. The majority of cost savings is attributed to lower feed costs. Per-cow variable costs are also significantly lower for low-cost producers. In addition to lower variable costs, significantly lower machinery and equipment costs for capital replacement account for most of the economic cost savings on low-cost operations. Total economic costs are over $13 less per hundredweight of milk sold and almost $1,000 less per cow for low-cost producers. Furthermore, low-cost operations are the only group to achieve positive residual returns to management and risk ($1.86 per hundredweight of milk sold and $318.51 per cow).

Influence of Farm Structural and Performance Characteristics

The influence of selected variables on the cash and capital replacement costs (per hundredweight of milk sold) of U.S. milk producers is analyzed using regression analysis. Results of the cost distribution analysis are the basis for choosing explanatory variables in the regression analysis. Decomposing the sample variation of cash and capital replacement costs into the portion attributable to each explanatory variable provides a measure of each variable's influence on milk production costs (see appendix A).

One expects the size of the dairy operation, as measured by number of dairy cows, to be inversely related to production costs. Larger operations and those more specialized in dairy production typically have lower unit costs because costs of fixed inputs, such as for machinery, buildings, and equipment can be spread over more units of output. Milk production per cow is used as a measure of animal performance. Operations that have higher levels of output per cow should also have lower unit costs.

Production costs should increase as both feed and labor use, measured as physical units per hundredweight of milk sold, increase. Feed cost accounts for the largest share of milk production costs and total unit costs will likely rise as feed consumption rises.

The effect of farm financial condition on production costs is examined by including the farm debt-to-asset ratio. Farms with more debt relative to assets may have higher costs than others due to greater interest payments. However, dairy farms with more debt relative to assets are often larger operations and may have lower production costs than others because of the size advantages.

Farm operator characteristics considered include major occupation, education, and experience. Major occupation is defined as that job, farming or otherwise, on which the farm operator spent the majority of time during 1993. Farm operators whose major occupation is farming are expected to have lower production costs than others. Education is expected to be associated with lower unit production costs. Education is measured using binary variables for each of three groups: (1) operators not graduating from high school; (2) operators completing high school, but not college; and, (3) operators completing college. Experience is measured as the number of years that the operator has been the operator of the dairy operation. Production costs should decline with experience as producers learn and develop managerial skills. Likewise, costs should be lower for those producers who keep detailed milk enterprise records than for other producers.

Results of the regression analysis. Regression coefficients and t-statistics for milk producers are presented in table 2. The estimated coefficients describe the change in production costs from a unit change in each of the structural and performance variables. The t-statistics indicate which of the estimated coefficients are significantly different from zero at the selected level of significance. With the exception of education, estimated coefficients are significant and have their expected sign. Size, feed efficiency, labor efficiency, output per cow, education, and farm debt-to-asset ratio all significantly influence milk production costs.

Alternative functional forms of the cost-size relationship were estimated using the dairy data, and a quadratic form was found to best describe the relationship (see appendix A). Over a majority of the range of operation sizes in the FCRS data, cash and capital replacement costs tend to decline with size at a decreasing rate (fig. 6). A substantial cost reduction occurs as herd size increases to about 3,000 cows. Costs decline from about $20 per hundredweight of

Table 2–Regression estimates of the unit cost equation for milk producers, 1993

Size, feed efficiency, labor efficiency, output per cow, operator education, and farm debt-to-asset ratio all significantly influence milk production costs.

Variable	Unit	Coefficient estimate	t-statistic
Intercept	*na*	20.4416	
Size	*Average number milk cows*	-0.0016	-2.16**
	Average number milk cows squared	0.0000002	2.77**
Feed efficiency	*Pounds fed per cwt of milk sold*	0.0261	8.42**
Labor efficiency	*Hours per cwt of milk sold*	2.5974	1.94**
Output per cow	*Pounds*	-0.0003	-3.62**
Specialization	*Percent of total value of production*	-0.0534	-1.08
Major occupation	*1=farming; 0=otherwise*	0.6644	0.48
Education	*1=less than high school; 0=otherwise*	-3.1890	-2.01**
	1=high school graduate; 0=otherwise	-1.9532	-1.38
Experience	*years operator of dairy operation*	-0.0346	-1.56
Cost of production records	*1=kept; 0=not kept*	-0.2541	-0.27
Farm debt-to-assets	*Ratio*	1.5778	2.09**
F		18.52**	
R^2		0.52	

** = significant at 5% level. na = not applicable.
Source: Economic Research Service, USDA.

milk sold on operations with 100 cows, to about $19 on operations with 1,000 cows, to around $17.50 on operations with 3,000 cows.

The positive sign on the feed and labor efficiency variables indicate that milk production costs per hundredweight increase as more units of each input are required. Each additional pound of feed adds about 3 cents to the cost; an additional hour of labor increases costs by $2.60.

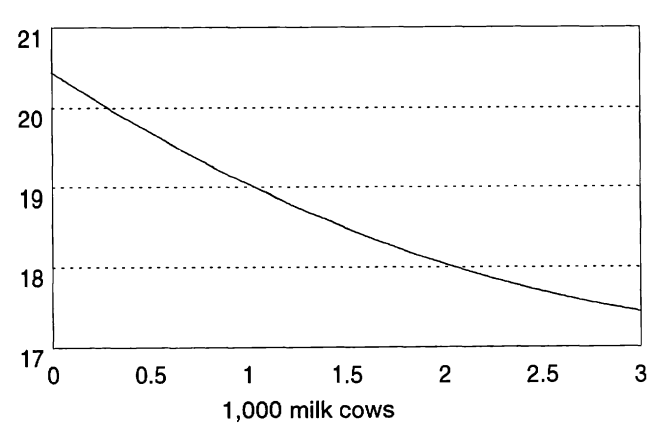
Increasing the productivity of cows lowers production costs. Costs decline by about 3 cents for each additional 100 pounds of milk produced per cow. Thus, increasing output by about 5,000 pounds per cow (the difference between low- and high-cost producers) lowers milk production costs by about $1.50 per hundredweight.

Other significant variables are farm debt-to-asset ratio and education. Greater farm debt-to-asset ratio raises milk production costs by increasing interest expenses. Contrary to expectations, operators with less education have lower production costs. Production costs are estimated to be less for producers not graduating from college than for college graduates. These producers likely are older, have been in the dairy business longer, and have retired more of the debt associated with the dairy operation.

Figure 6

Estimated relationship between cash and capital replacement cost and size of dairy operation, 1993

Cash and capital replacement costs tend to decline with size at a decreasing rate.



Source: Economic Research Service, USDA.

Table 3–Contribution of factors to unit cost variation for milk producers, 1993

Feed efficiency has the greatest individual effect on unit cost variation of dairy farms, accounting for 60 percent of variance effects. Therefore, it appears that the greatest reduction in production costs can be obtained by efforts to improve feed efficiency.

Variable	Unit	Variance effect	Percent of variance effect
Size	*Average number of milk cows*	0.0854	0.58
	Average number of milk cows squared	0.0344	0.23
Feed efficiency	*Pounds fed per cwt of milk sold*	8.8949	60.26
Labor efficiency	*Hours per cwt of milk sold*	1.1001	7.45
Output per cow	*Pounds*	1.4352	9.72
Specialization in milk production	*Percent of total farm value of production*	0.0780	0.53
Major occupation	*1=farming; 0=otherwise*	0.0208	0.14
Education	*1=less than high school; 0=otherwise*	1.9798	13.41
	1=high school graduate; 0=otherwise	0.8453	5.73
Experience	*years operator of dairy operation*	0.1856	1.26
Cost-of-production records	*1=kept; 0=not kept*	0.0090	0.06
Farm debt-to-assets	*Ratio*	0.0927	0.63

Source: Economic Research Service, USDA.

Results of the unit cost decomposition. Unit cost variation can be decomposed into the variance effects of each explanatory variable (table 3). Variance effects indicate the amount of variation in unit costs that can be attributed to each explanatory variable. The percent of total variance effects for each explanatory variable indicates the extent that each variable alone contributes to unit cost variation, relative to other variables.

Among all variables, feed efficiency has the greatest individual effect on unit cost variation, accounting for 60 percent of the variance effects. Feed and labor efficiency and output per cow together account for 77 percent of total variance effects. Besides education, the other variables contribute little to total variance effects.

Conclusions. A regression model examining cost variation among a cross-section of U.S. milk producers explains 52 percent of the variation in total cash and capital replacement costs. This finding suggests that milk production is influenced by many variables that can be controlled, to some degree, by producers. Consequently, measures taken to improve operators' management skills will likely have a positive influence on dairy enterprises.

Feed efficiency is the most important factor influencing production cost among milk producers. This finding suggests that the greatest reductions in production costs can be obtained by efforts to improve feed efficiency. Improvements in feed efficiency may result from the adoption of more efficient management techniques, which deal with herd composition, feeding practices, genetics, and reducing animal stress, along with investment in modern housing and milking facilities.

Improving labor efficiency and animal productivity also appear to be methods of lowering production costs. Labor efficiency can be improved by investing in modern housing and milking facilities and other labor-saving equipment. Continued genetic improvement and use of man-made proteins, such as rbST, may be used to increase productivity.

Size Relationships in Milk Production

Variable cash costs and fixed cash costs vary little among enterprise size groups, but economic costs are significantly lower for the largest milk producers. Most physical and economic advantages of size occur on operations with 500 to 1,000 cows.

USDA reported that in 1993 more than 50 percent of U.S. cow numbers were concentrated in operations with 100 or more milk cows (*Milk Production*, June 1994). In addition, operations with 100 or more cows showed a positive growth rate for both number of farms and milk cows between 1988 and 1993, while the number of smaller operations declined. Still, in

Table 4–Characteristics of FCRS dairy farms with alternative sizes[1]

Larger dairy operations produce more milk per cow, have greater feed and labor efficiency, and have lower economic costs.

Item	Unit	Number milk cows			
		< 60	60-119	120-299	300 or more
Share of FCRS dairy:					
Farms	*Percent*	63	26	9	2
Milk sales	*Percent*	26	25	21	29
Average milk cow inventory	*Head*	34	78	166	818
Output per cow	*Pounds*	14,662	15,069	16,835	17,243
t-stat (fewer than 60 milk cows)		-	(0.82)	(3.60**)	(4.66**)
t-stat (60-119 milk cows)		-		(2.89**)	(3.86**)
t-stat (120-299 milk cows)		-	-		(0.62)
Feed efficiency	*Pounds/cwt milk sold*	210	217	186	161
t-stat (fewer than 60 milk cows)		-	(0.68)	(1.69**)	(4.46**)
t-stat (60-119 milk cows)		-		(2.16**)	(4.95**)
t-stat (120-299 milk cows)		-	-		(1.75**)
Labor efficiency	*Hours/cwt milk sold*	0.51	0.36	0.23	0.13
t-stat (fewer than 60 milk cows)		-	(6.47**)	(10.91**)	(14.87**)
t-stat (60-119 milk cows)		-	(5.36**)	(9.71**)	
t-stat (120-299 milk cows)		-	-	(4.05**)	
Total economic costs	*Dollars/cwt milk sold*	18.94	17.34	14.39	12.55
t-stat (fewer than 60 milk cows)		-	(2.08**)	(6.32**)	(6.86**)
t-stat (60-119 milk cows)		-		(4.27**)	(5.27**)
t-stat (120-299 milk cows)		-	-		(2.13**)

[1] Size is measured as average number of milk cows on farms during 1993. ** = significantly different at the 5-percent level. Source: Economic Research Service, USDA.

1993, these larger production units accounted for less than 15 percent of all milk operations.

Advances in technology over the last 25 years, both in production and marketing, have allowed dairy operations to become more efficient (in terms of quantities, mixture, and quality of input use) and more specialized enterprises. For example, the use of innovations that substitute capital for labor (such as automatic milking machines, computerized feeding and monitoring systems, and mechanized feed and forage handling) has, in general, raised the minimum economically feasible size of an operation, increased achievable economies of size, and focused management skills on milk production. The release of labor for other work, either on or off the farm, is also made possible by the substitution of capital for labor.

The analyses in this section attempt to examine how farm characteristics, animal performance, and production costs vary with size of the dairy operation. Two procedures are used to examine the influence of size on the dairy industry. First, milk producers are divided into four size groups by milk cow numbers. Differences among producers in the various size groups are examined by comparing farm structural and performance characteristics, and milk production costs among the groups. The statistical difference in mean estimates for producers in each size group is tested using a t-statistic (see appendix A).

Second, multivariate regression analysis is used to examine how physical and economic performance vary with size of operation. Forms of the relationships are examined using alternative specifications of the regression equations (see appendix A).

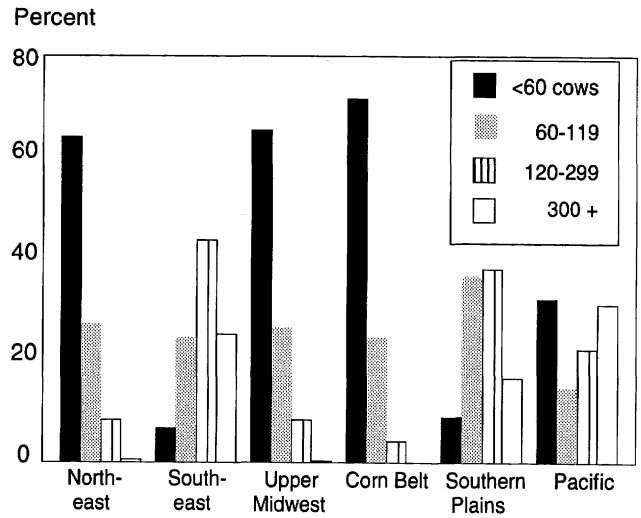
Alternative Sizes of Milk Operations

Two percent of FCRS dairy farms have 300 or more milk cows, but these farms account for nearly 30 percent of milk sales (table 4). The 63 percent of dairy farms with 60 or fewer milk cows account for 26 percent of milk sales.

Figure 7

Distribution of size groups by region, 1993

The Pacific and the Southeast have the greatest proportion of large producers.



Source: Compiled by Economic Research Service from the 1993 Farm Costs and Returns Survey, USDA.

The largest dairy operations (300 or more milk cows) have an average inventory of 818 cows and nearly all have at least $250,000 in gross farm revenue. In contrast, farms with the smallest dairy operations have an average inventory of only 34 milk cows. Almost half of these smaller farms have gross revenues of $40,000 to $99,999, while 20 percent have gross earnings of less than $40,000.

Milk producers in the two smallest size groups operate more financially sound businesses than the two larger groups of producers. More than 70 percent of producers with fewer than 60 milk cows and with 60-119 milk cows are in a favorable financial position. About 18 percent of producers in the three smaller size groups are in a marginal income category, indicating farm income during 1993 was negative, while only 8 percent of the largest producers are in this financial position. Almost 35 percent of the largest dairy farms are classified as either marginally solvent or vulnerable, the result of a debt-to-asset ratio above 0.40. Producers who are marginally solvent can remain financially viable as long as they generate sufficient income to service their debt and meet other expenses they incurred in 1993. Vulnerable producers must generate adequate income in 1994 and succeeding years to remain viable.

The majority of milk producers in the Northeast, Upper Midwest, and Corn Belt have fewer than 60 cows (fig. 7). Thirty-one percent of producers in the Pacific region are in the largest size group (300 or more milk cows), while 16 percent of those in Southern Plains are in this size group. These two regions have the greatest number of large producers, which is indicative of the recent growth in milk production that has characterized the West and South (see glossary).

Cows on the largest farms produce an average of about 2,500 pounds more a year than milk cows on the smallest farms. Feed and labor efficiency among milk producers also improves significantly with size of the operation (table 4). The largest producers require nearly 50 pounds less feed and one-fourth the labor for each 100 pounds of milk sold than do the smallest producers. Greater feed and labor efficiency by larger producers may be due to herd composition; better genetics; ration composition; more intensive feed management; newer, more modern facilities; and a better climate. Feed rations fed are significantly different as operation size increases, with smaller operations feeding less concentrates and more roughage. Also, a majority of the grain and forage fed on operations with fewer than 300 cows is homegrown, common on smaller operations in the Northeast and Upper Midwest production regions that devote labor and management, capital, and land to feed production.

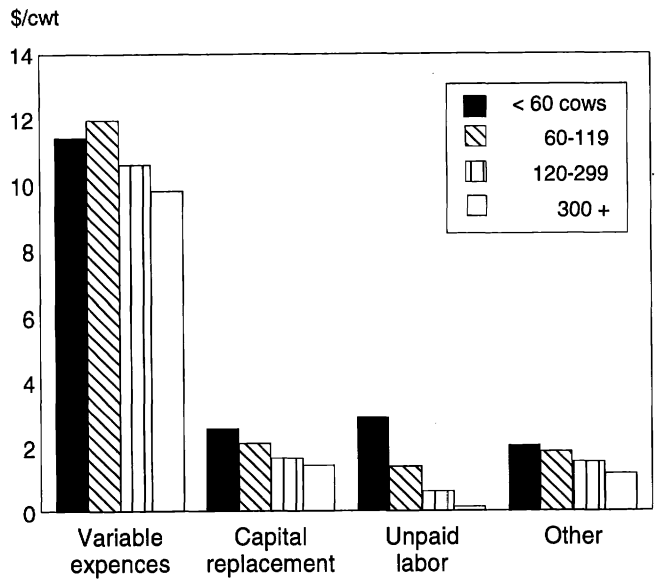
Almost 70 percent of the cow housing capacity on the largest farms is in drylot corrals, compared with only 6 percent on the smallest farms. Housing of this type is more appropriate on the larger farms located in the warmer States of California, Arizona, and Texas. More modern milking facilities (primarily herringbone parlors) in use by larger producers also contribute to improvements in labor efficiency with size of operation. The number of times cows are milked is much the same across size groups, but the hours milking systems are operated are significantly different. Milking systems are much more intensely utilized among larger producers, operating 16 hours per day compared with only 4 hours on the smallest farms. Milk pickups per day increase substantially with size even though larger operations have greater onfarm milk storage capacity. Larger operations also make more use of manure handling facilities (particularly lagoons and pits), more modern feed and manure handling equipment, automatic takeoffs, udder washers, and computerized milking and feeding systems.

The value of milk sold (per cwt) is significantly lower on operations with 120 or more milk cows. Many operations in these size groups are located in regions

Figure 8

Distribution of production costs by size group, 1993

Total economic costs on the largest farms are $6 less than for the smallest farms.



Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

where producers receive lower milk prices, partly as a result of Federal and/or State pricing policies. Operations with 120 or more milk cows have significantly higher milk sales per cow, primarily due to the greater productivity of the milking herd.

Total economic costs are significantly lower for producers in the largest size group (fig. 8). Total economic costs on the largest farms are almost $13.00 per hundredweight of milk sold, $6 less than for the smallest farms. Total economic costs on the largest farms are about $600 less per cow than for the smallest farms. Much of the lower costs among larger producers can be attributed to investments in machinery, buildings, and equipment being spread over more units of output. Significantly lower costs for producers with 300 cows or more suggest that cost reduction attributable to size, as measured with the FCRS data, is obtained on operations expanding to at least 300 cows, and possibly more. Residual returns to management and risk are positive only for the two larger size groups.

Performance Variability With Size of Operation

Regression analysis is used to examine how physical and economic performance of the dairy operation varies with size of operation. Selected variables are related to size using linear, reciprocal, and quadratic functional forms (see appendix A). The estimated equations reported in table 5 reflect the functional forms that best fit each relationship according to goodness-of-fit measures and significance of the estimated coefficients.

The F-statistic of each estimated equation is used to evaluate the relationships. While t-statistics are used to test whether individual coefficient estimates are significantly different from zero, the F-statistic can be used to test whether any of the explanatory variables affect the dependent variable. In some cases, individual effects of variables may not be significant (insignificant t-statistics), but their combined effects are significant (significant F-statistic), especially if the explanatory variables are highly correlated (Kmenta, 1986, p. 415). F-statistics and individual coefficient estimates are significant in most estimated equations relating size to selected performance measures.

Physical performance. A reciprocal form best describes the relationship between output per cow and size of operation among U.S. milk producers. Output per cow increases with size, approaching 16,562 pounds (table 5). In general, improvements in feeding management and genetics go hand in hand on larger operations, and the role of management becomes increasingly vital as more cows are added to the herd. However, a large part of the increase in output per cow occurs at about 120 milk cows. Output per cow is estimated at about 16,000 pounds on 120-cow operations, increasing to about 16,400 pounds on 500 cow operations, and 16,540 on 3,000-cow operations (fig. 9).

A quadratic form best describes the relationship between feed efficiency and size. Feed efficiency improves as size increases and reaches a maximum (that is, pounds of feed used per hundredweight reached a minimum) for operations with about 4,990 cows. This size operation is more common in the Southern Plains and the Pacific milk production regions. Estimated feed use per hundredweight declines from about 216 pounds on 100-cow operations to about 160 pounds on 1,000-cow operations to less than 80 pounds on 3,000-cow operations (fig. 10).

Labor efficiency is best related to size using a reciprocal form. Hours of labor per hundredweight of milk sold decline with size, approaching 0.15 hour. Most of the labor savings from larger operations are

Table 5–Regression estimates relating selected performance measures to size of the dairy operation, 1993

The relationship between most physical and economic performance measures and size is best described using a nonlinear form with either a reciprocal or quadratic term. F-statistics and t-statistics in all estimated equations are significant.

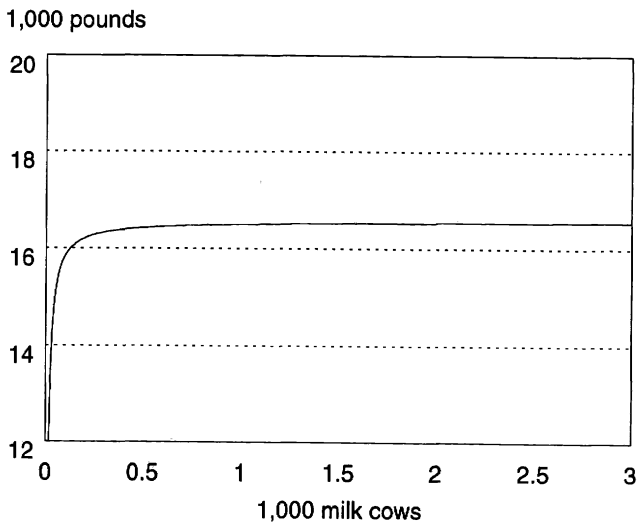
Performance measure	Regression intercept	Coefficient on linear term	Coefficient on reciprocal term	Coefficient on quadratic term	F-statistic
Physical:					
Output per cow in pounds	16,562.2397 (38.72)**	na	-69,335.5125 (-3.81)**	na	14.50**
Pounds of feed per cwt of milk sold	223.1852 (25.81)**	-0.0698 (-2.81)**	na	0.000007 (2.51)**	4.72**
Hours of labor per cwt of milk sold	0.1549 (2.23)**	na	14.7280 (4.24)**	na	17.97**
Economic:					
Feed cost per cwt of milk sold	7.7035 (33.23)**	-0.0013 (-1.95)**	na	0.0000002 (2.02)**	2.05**
Farm debt-to-asset ratio	0.2303 (12.04)**	na	-2.3976 (-3.08)**	na	9.47**
Fixed-to-total cash cost ratio	0.1266 (26.66)**	-0.000018 (-2.09)**	na	na	4.39**

na = not applicable.
Numbers in parentheses are t-statistic. ** = significantly different at the 5-percent level.
Source: Economic Research Service, USDA.

Figure 9

Estimated relationship between output per cow and size of operation, 1993

Output per cow increases with size of operation.

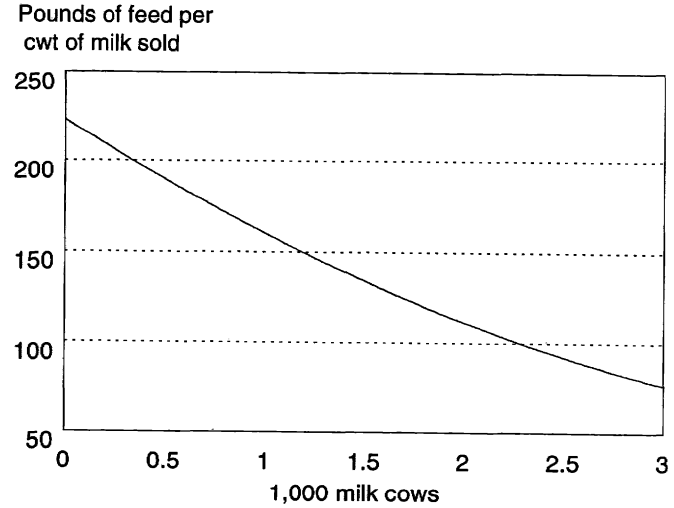


Source: Economic Research Service, USDA.

Figure 10

Estimated relationship between feed efficiency and size of dairy operation, 1993

Feed efficiency improves as size increases.

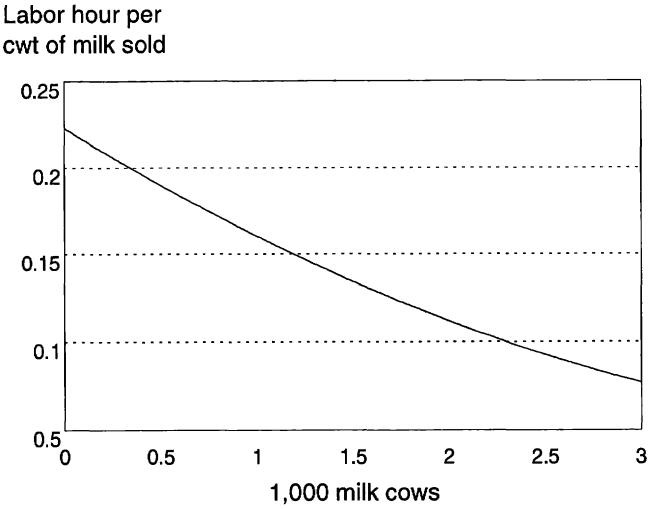


Source: Economic Research Service, USDA.

Figure 11

Estimated relationship between labor efficiency and size of dairy operation, 1993

Most labor savings are obtained at about 500 cows.

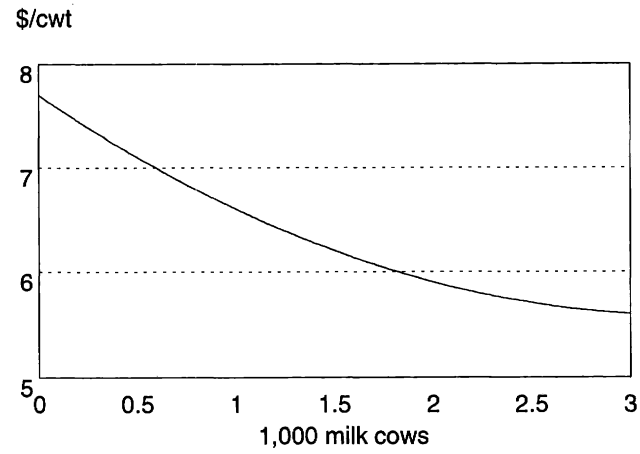


Source: Economic Research Service, USDA.

Figure 12

Estimated relationship between feed cost and size of dairy operation, 1993

Estimated feed costs reach a minimum of $5.59 as size reaches 3,250 cows.



Source: Economic Research Service, USDA.

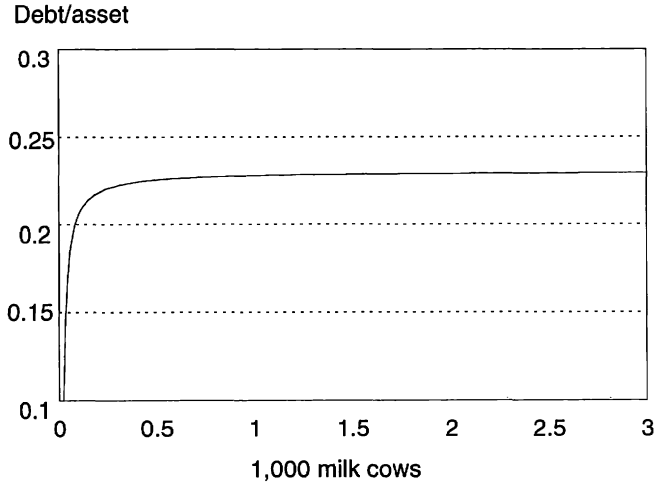
obtained at about 500 cows, but labor use is substantially reduced up to about 3,000 cows (fig. 11). About 0.18 hour of labor per hundredweight of milk sold is estimated for 500-cow operations, about 0.17 hour on 1,000-cow operations, and about 0.06 hour on operations with 3,000 cows.

Economic performance. A quadratic form is used to describe the feed cost-size relationship, with estimated feed cost declining to a minimum of $5.59 per hundredweight of milk sold as size increases to 3,250 cows. Estimated feed costs are about $7.50 per hundredweight of milk sold on 100-cow operations, declining to about $6.60 on 1,000-cow operations, and reaching $5.60 at 3,000 cows (fig. 12). The feed cost-size relationship is closely related to that of feed efficiency and size.

Figure 13

Estimated relationship between debt-to-asset ratio and size of dairy operation, 1993

As size of operation increases, debt-to-asset ratio approaches 0.23.



Source: Economic Research Service, USDA.

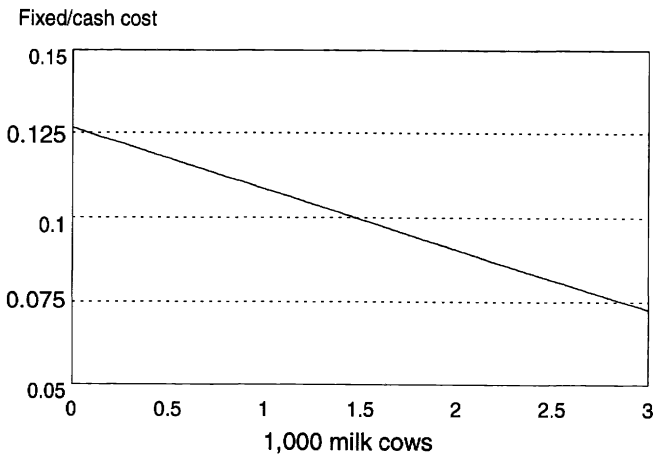
Farm debt-to-asset ratio is related to size of dairy operation using a reciprocal form. The ratio of debt to assets approaches 0.23 as size increases (fig. 13). Greater debt is incurred by larger operations to support expansion of capacity and improvements in existing facilities and equipment. In general, larger operations incur a greater debt because of their demonstrated ability to earn the income required to repay the debt.

The relationship between the fixed-to-total cash cost ratio and size is described with a linear form (fig. 14). Fixed cash costs per hundredweight of milk sold account for a decreasing share of total cash costs as size increases. About 12 percent of cash costs are fixed on operations with 100 milk cows, declining to

Figure 14

Estimated relationship between fixed-to-total cash cost ratio and size of dairy operation, 1993

Fixed cash costs account for a decreasing share of total cash costs as size increases.



Source: Economic Research Service, USDA.

less than 11 percent at 1,000 cows, and less than 7 percent on 3,000-cow operations.

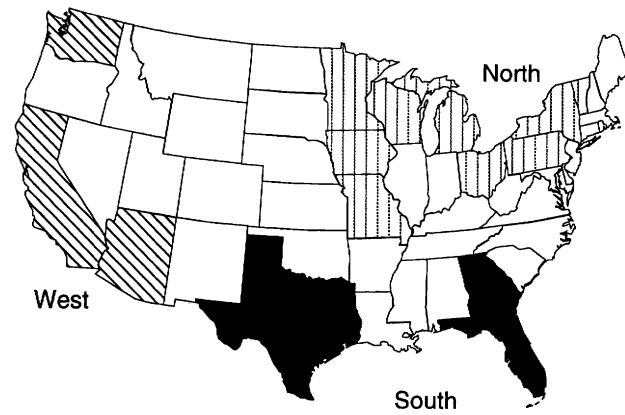
Conclusions. The relationship between most physical and economic performance measures and size is best described using a nonlinear form with either a reciprocal or quadratic term. Output per cow and debt-to-asset ratio increase with size. Pounds of feed fed, hours of labor used, feed costs, and the fixed-to-total cash cost ratio per hundredweight of milk sold generally decrease with size.

Performance measures for the most part improve as size increases, indicating that several advantages accrue to larger operations. Animal performance and input use efficiency increase with size, and fixed costs are spread over more units of output on larger operations. Most of the advantages to increasing size of operation are obtained at 500-1,000 cows. Operations of this size are currently among the largest in the dairy industry, where the average herd size is only about 60 cows. With significant advantages accruing to much larger operations, the current trend toward fewer and larger milk production units will likely continue.

Figure 15

North, South, and West production areas

Ninety-two percent of dairy operations surveyed in1993 were in the North.



Source: Economic Research Service, USDA.

Differences in Milk Production by Location

Milk producers in the South and West have much larger dairy operations that are more feed- and labor-efficient than those in the North. Economic incentives for expanding dairy operations appear to be prevalent in the South and West, while incentives for increasing productivity are more important in the North.

U.S. milk production in 1993 reached almost 151 billion pounds (*Milk Production*, NASS, USDA), more than a 20-percent increase in 16 years. However, industry growth was not uniform throughout the United States. Production in Arizona, California, Florida, Pennsylvania, Texas, and Washington grew much faster than the national average during the same period. For example, Arizona's milk production more than doubled. In contrast, milk production in New York, Vermont, Georgia, Michigan, Minnesota, Wisconsin, Iowa, Missouri, and Ohio did not keep pace with increases in U.S. production. Production in Minnesota increased by only 2 percent, while Missouri's declined by 3 percent. Population growth in the West and South created an increasing demand for locally produced milk (Perez, 1994). A milder climate in these two areas also provided incentives for the expansion of milk production (Fallert, 1985; Fallert, Blayney, and Miller, 1990; Fallert, Weimar, and Crawford, 1993).

Table 6–Characteristics of FCRS dairy farms in the North, South, and West[1], 1993

Milk producers in the South and West are more efficient than producers in the North. Pounds of feed fed and hours of labor used per hundredweight of milk sold are significantly lower.

Item	Unit	North	South	West
Share of FCRS dairy:				
Farms	*Percent*	92	3	5
Milk sales	*Percent*	65	8	27
Average milk cow inventory	*Head*	56	250	345
Output per cow	*Pounds*	15,487	14,497	17,464
t-stat (North)		-	(1.80)*	(3.63)**
t-stat (South)		-	-	(4.42)**
Feed efficiency	*Pounds per cwt of milk sold*	211	154	158
t-stat (North)		-	(4.57)**	(4.98)**
t-stat (South)		-	-	(0.30)
Labor efficiency	*Hours per cwt of milk sold*	0.38	0.27	0.12
t-stat (North)		-	(5.69)*	(12.19)*
t-stat (South)		-	-	(7.84)*
Total economic costs	*Dollars per cwt of milk sold*	17.20	16.28	12.09
t-stat (North)		-	(0.72)	(4.26)*
t-stat (South)		-	-	(4.56)*

[1] North–Northeast, Corn Belt, and Upper Midwest milk production regions. South–Southern Plains and Southeast milk production regions. West–Pacific milk production region. * = significantly different at the 10-percent level. ** = significantly different at the 5-percent level. Source: Economic Research Service, USDA.

The North includes New York, Vermont, Pennsylvania (Northeast milk production region); Michigan, Minnesota, Wisconsin (Upper Midwest region); Iowa, Missouri, and Ohio (Corn Belt region) (fig. 15). This area accounted for 92 percent of the dairy operations surveyed in 1993 and for 65 percent of total U.S. milk sales. The South includes Florida, Georgia (Southeast region); and Texas (Southern Plains region). Only 3 percent of the surveyed farms are in this area, but they accounted for almost 10 percent of total U.S. milk sales in 1993. The West includes Arizona, California, and Washington (Pacific region), where 5 percent of FCRS dairy farms accounted for 27 percent of sales. This analysis compares farm structural and performance characteristics and milk production costs among the production areas. The statistical difference of means estimated for producers in each area is tested using a t-statistic (see appendix A).

Regression analysis is also used to examine the relationship between costs of production and farm structural and performance characteristics in each area. The unit cost equation estimated previously for all U.S. milk producers is estimated for producers in each area. The sample variation of production cost is also decomposed into the portion attributable to each characteristic.

North, South, and West Production Areas

Structural differences in milk production were apparent among the production areas in 1993. The South and West are characterized by operations with an average of 250 or more dairy cows, while the North has mostly smaller operations with an average of 56 milk cows (table 6). Fifty and 63 percent of farms in the South and West, respectively, have sales of $250,000 or more, while only 10 percent of farms in the North have sales at that level. However, in terms of total acres operated, dairy farms in the West are much smaller than in the North and South.

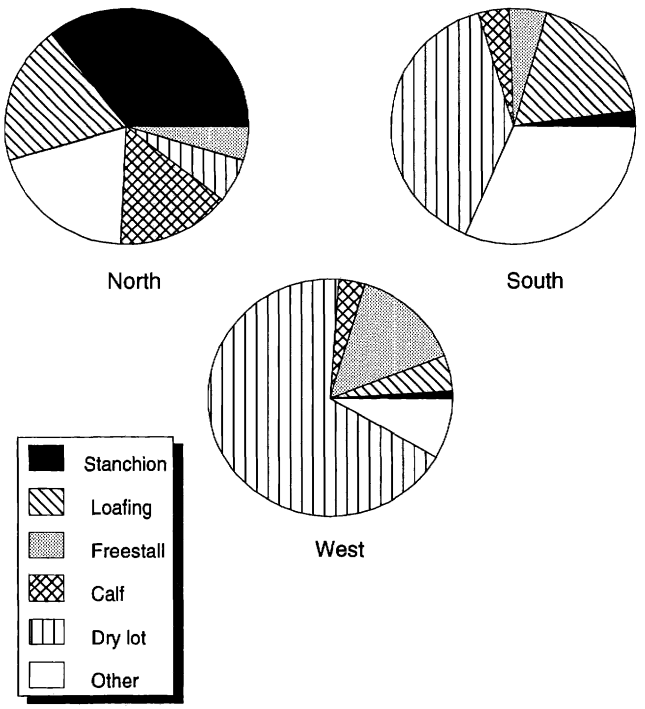
The financial condition of producers in the North and South was generally better than that in the West in 1993. More than 70 percent of producers in the North and South are classified as being in a favorable position (see glossary), compared with only 53 percent in the West. About 30 percent of producers in the West are in the marginal income category, indicating that while their debt/asset ratio is less than 0.40, farm income during 1993 was negative. The larger operations characteristic of the West are achieved by more debt financing than in the other areas. The debt-to-asset ratio of 0.30 in the West is significantly higher than in the other areas.

Operator age and education level are much the same for producers in each area. However, operators in the

Figure 16

Distribution of housing capacity by area, 1993

The milder climate in the West allows for 68 percent of housing capacity to be in drylot corrals.



Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

North have more years of experience than operators in the South and West. Producers in all three areas consider farming their major occupation.

Output per cow is highest in the West and lowest in the South. Heat and humidity in the South may reduce output per cow. However, overall feed efficiency per hundredweight of milk sold is better on farms in the South and West, where less than 160 pounds of feed per hundredweight of milk sold are fed, compared with 211 pounds in the North. Producers in the South and West do not have to deal with the harshness of subfreezing temperatures that may reduce feed efficiency. Consequently, 68 percent of housing capacity in the West is in drylot corrals, compared with only 6 percent in the North (fig. 16). The ration formulation fed by producers in the South is mainly made up of equal parts of concentrates (more than half of which is homegrown) and roughage, which apparently leads to the South's higher level of feed efficiency than in the North, and higher feed costs than in the North or West.

Dairy enterprises in the West are more labor-efficient than producers in the North and South. Only 0.12 total labor hour per hundredweight of milk sold and 20 hours per cow are used in the West. Producers in the North use more than 50 percent more labor. Farms in the South and West make greater use of herringbone milking parlors, which contribute to less labor hours used per hundredweight of milk sold than in the North. However, because milk cow inventories are so much smaller in the North, dairy farmers spend significantly less time operating milking systems. Even though farms in the South and West have greater onfarm milk storage capacity, milk pickups per day are more frequent than in the North.

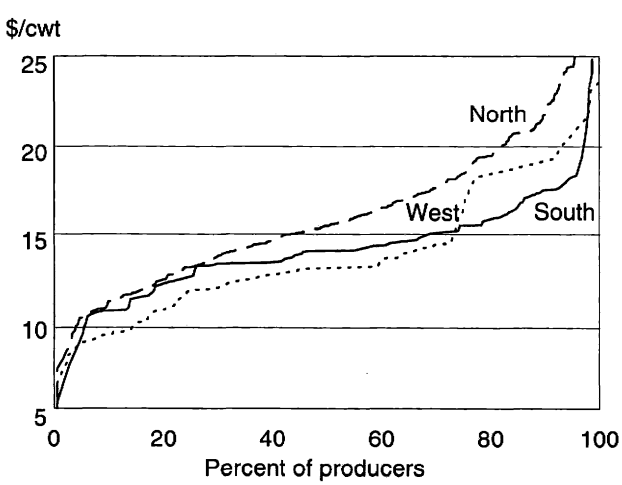
Despite the greater feed efficiency among producers in the South and West, total feed cost per hundredweight of milk sold is lower in the North than the South and not different from that in the West. However, total feed cost per cow is much the same among the three areas. Producers in the North use more homegrown grains (78 percent of grain fed), hay and straw (91 percent of hay and straw fed), and silage (98 percent of silage fed). Producers in the South and West spend more on purchased feed.

Among other cost items, fuel costs, repair costs, and fixed costs are significantly lower on farms in the West because producers can spread these costs over more units of output. Total variable, cash, and

Figure 17

Regional cumulative distribution of milk cash and capital replacement costs

Milk producers in the South and West have a cost advantage over producers in the North.



Source: Compiled by Economic Research Service from the 1993 Farm Costs and Returns Survey. USDA.

Table 7–Regression estimates of the unit cost equation for milk producers in each production area, 1993

Feed and labor efficiency are important determinants of unit production costs in all areas, while size of operation is important in the South and West and output per cow is important in the North. The relationship between production costs and selected variables is much the same in the South and West, but differs from that in the North.

Variable[1]	Coefficient estimates			t-statistics between areas		
	North	South	West	North/ South	North/ West	South/ West
Intercept	20.59656342**	31.88369070	14.95678730	-0.57	1.06	1.28
Size	0.00927310	-0.00123134*	-0.00201290**	1.85*	1.91*	0.89
Size squared	-0.00001313	0.00000009*	0.00000016**	-1.99**	-1.88*	-1.37
Feed efficiency	0.02606456**	0.02515643**	0.02161590**	0.15	0.90	0.54
Labor efficiency	2.61956745*	8.82726409**	9.15461661**	-1.82*	-2.77**	0.09
Output per cow	-0.00032271**	-0.00004398	-0.00000685	-2.13**	-2.46**	-0.27
Specialization	-0.04850406	-0.28760309	0.03563691	1.08	-0.93	-1.37
Major occupation	0.47958646	0.81040356	0.20919966	-0.17	-1.52	-1.33
$Education_1$	-3.19799523*	-0.05859942	-3.96447481**	-1.49	0.38	2.76**
$Education_2$	-2.15135094	0.63519869	-0.91450185	-1.45	-0.69	1.25
Experience	-0.03688696	-0.01012102	-0.04112235	-0.61	0.12	0.71
Cost-of-production records	-0.56573185	1.18485603*	-1.35377107	-1.41	0.54	2.15**
Farm debt-to-assets	1.62070614*	3.04154466**	1.31576767	-0.98	0.20	0.97
F	10.82**	51.17**	14.48**			
R^2	0.52	0.52	0.70			

[1] Units for each variable are the same as those in table 3. ** = significant at the 5-percent level; * = significant at the 10-percent level.
Source: Economic Research Service, USDA.

economic costs of production are significantly higher in the North and South than in the West. The West is the only area with a positive residual return to management and risk.

Milk producers in the South and West have a cost advantage over producers in the North (fig. 17). Almost 40 percent of Western and over 25 percent of Southern milk producers have cash and capital replacement costs less than $12.50 per hundredweight of milk sold, compared with about 20 percent in the North. With milk prices averaging $13.10 in the North, $14.40 in the South, and $12.52 in the West during 1993 (*Milk Production, Disposition, and Income 1994 Summary*, NASS, USDA), milk producers in the West and South were better able to cover cash and capital replacement costs than producers in the North.

Influence of Farm Structural and Performance Characteristics by Area

Regression analysis is used to test the influence of selected variables on the cash and capital replacement costs per hundredweight in each production area. Variables of the unit cost equation estimated for the U.S. dairy industry are also used for regressions in each area. Structural differences between production areas are identified by testing for differences between the coefficients estimated for each area. A t-statistic for testing the equivalency of two regressions is used to measure structural differences (see appendix A). To examine the relative importance of each variable within and among areas, the sample variation of cash and capital replacement costs is decomposed into the portion attributable to each explanatory variable.

Results of the regression analysis. Regression coefficients and an indication of their significance for milk production in each area are presented in table 7. Also included in the table are t-statistics that test for structural differences among the areas. These t-statistics indicate whether the estimated coefficients in an area are different from the estimated coefficients in other areas. For example, the t-statistic between the North and South concerning the coefficients on size shows a significant difference. This means that the influence of size on production costs is different in the North than in the South.

Table 8–Contribution of factors to unit cost variation for milk producers by production area, 1993

Feed efficiency has the greatest individual effect on unit cost variation among producers in the North, but labor efficiency is more important in the South and West.

Variable[1]	Percent of variance effects		
	North	South	West
		Percent	
Size	1.21	6.77	8.25
Size squared	0.72	3.33	3.31
Feed efficiency	57.43	23.52	27.31
Labor efficiency	7.39	37.77	31.32
Output per cow	11.45	0.22	0.01
Specialization	0.42	20.31	0.11
Major occupation	0.07	0.46	1.19
$Education_1$	12.65	0.01	22.68
$Education_2$	6.46	1.09	1.32
Experience	1.32	0.11	2.14
Cost of production records	0.28	2.80	1.59
Farm debt-to-assets	0.59	3.60	0.77

[1] Units for each variable are the same as those in table 3.
Source: Economic Research Service, USDA.

A quadratic form is used to describe the relationship between size of operation and production costs. The estimated coefficients on size and its quadratic term are significant in the South and West but not in the North. Production costs do not appear to vary by size of operation in the North, but decline toward a minimum in the South and West. This minimum cash and capital replacement cost is estimated to occur on operations exceeding 6,000 cows. Also, the influence of operation size on unit production costs is significantly different between the North and other areas, but not between the South and West.

The influence of feed efficiency on unit production cost is significant within all production areas, but does not differ among the areas. This means that feed efficiency affects milk production costs in much the same way regardless of where the milk is produced. Each additional pound of feed required for 100 pounds of milk sold adds about 2-3 cents to production costs. In contrast, the influence of labor efficiency on production costs is also significant within all production areas, but differs among areas. An additional hour of labor required for 100 pounds of milk sold adds about the same amount, $9, to unit production costs in the South and West. However, another hour of labor adds less than $3 to costs in the North.

Milk production per cow significantly affects production costs in the North, but not in other areas. For each additional 100 pounds of milk production per cow, unit costs decline by about 3 cents on dairy operations in the North. This effect is significantly greater than that in the South and West.

Among other variables, farm operators in the North and West who did not graduate from high school have lower milk production costs than those who graduated from college. Also, farm operators in the South who kept records about the dairy operation have higher costs than others. These results are counter to prior expectations that more education and dairy recordkeeping lowers production costs. The effect of education and recordkeeping on production costs may be confounded by that of age. Older operators are less likely to have graduated from college and to keep detailed production records. However, older operators typically have been in the dairy business much longer and may have lower production costs because more of the debt required for financing the dairy operation has been retired. Higher debt-to-asset ratios result in higher production costs on farm operations in both the North and South.

Results of the unit cost decomposition. Table 8 shows results of the unit cost decomposition for each production area. The percent of total variance effects for each explanatory variable indicates the extent that each variable alone contributed to unit cost variation, relative to other variables. They also show a variable's relative contribution to unit cost variation among production areas.

Feed efficiency has the greatest individual effect on the unit cost variation of producers in the North, accounting for 57 percent of variance effects. Output per cow is also an important determinant of unit cost variation, accounting for 11 percent of variance effects. In contrast to the North, labor efficiency has the greatest individual effect on South and West operations, accounting for about a third of variance effects in both areas. Feed efficiency comprises about 25 percent and size about 10 percent of variance effects in these areas.

Conclusions. Regression models relating several farm structural and performance characteristics to milk cost of production explain 52 percent of the variation in cash and capital replacement costs in the North and South, and 70 percent in the West. This

finding suggests that several variables controlled to some degree by milk producers are important determinants of milk production costs. Consequently, measures taken to improve operators' management skills will likely serve to lower unit production costs.

Feed efficiency is an important factor influencing milk production costs in all areas, and its impact on costs appears to be much the same in all areas. This finding suggests that production costs can be substantially reduced by efforts to improve feed efficiency, and that the extent of the cost reduction is much the same regardless of where the operation is located. Improvements in feed efficiency may result from introducing improved genetics into the herd, and from better feed and herd health management. In the North, feed efficiency has the greatest individual effect on production costs. Both improving feed efficiency and increasing output per cow are likely means by which producers in the North can lower production costs.

Improving labor efficiency will lower production costs significantly more in the South and West than in the North. Labor efficiency can be improved by investments in labor-saving (and often capital-intensive) technologies used for milk production, such as modern milking parlors and feed and manure handling equipment. Within the South and West areas, labor efficiency has the greatest individual effect on production costs. Among the cost-reducing options available to producers in the South and West, improving labor efficiency is the most attractive. Also, increasing size of operation appears to be another method to lower production costs among South and West producers.

Overall, economic incentives for larger, more technologically advanced dairy operations appear to be much more prevalent in the South and West than in the North. A milder climate in South and West may allow producers to expand their operations with less investment than in the North. Expanding production in the North requires greater investment in facilities that house cows during the harsher winter months. Greater economic incentives for producers in the North appear to be for improving productivity within the existing range of facility sizes.

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Appendix A: Statistical Procedures

Testing for Statistical Differences

The statistical difference between mean estimates for various groups of U.S. milk producers are tested using a t-statistic. The null and alternative hypotheses to be tested are:

$$H_O: \bullet_1 = \bullet_2$$

$$H_A: \bullet_1 \neq \bullet_2$$

where $\bullet_1$ is the population mean of group 1 and $\bullet_2$ is the population mean of group 2. Evidence allowing rejection of the null hypothesis indicates a significant difference between population means of farms in the two groups. The t-statistic used for hypothesis testing is (see Kmenta, 1986, p. 137 and 145):

$$t \sim \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{VAR(\bar{X}_1) + VAR(\bar{X}_2)}}$$

where X_1 and X_2 are sample means, and $VAR(X_1)$ and $VAR(X_2)$ are variance estimates of the sample means.[1] If the estimated t-statistic exceeds the critical-t value for the chosen level of significance then the null hypothesis can be rejected and the group means are deemed significantly different.[2] At a 5-percent level of significance, this means that from infinite samples of both populations, only 5 percent of the time would the estimates lead to an incorrect rejection of the null hypothesis.

Decomposing Cost Variation

The statistical association between cost of production and several farm structural and performance characteristics is tested using a regression equation. The empirical model for cost of production is:

$$y_i = \alpha + X_i\beta' + \epsilon_i$$

where y_i is the unit production cost of the i^{th} individual, and x_i is a vector of farm structural and performance characteristics assumed to influence production costs. The error term, ϵ_i, is assumed to have the usual desirable properties. Parameters of the model, α and β', are estimated using weighted least squares.

The measure of production cost variation is the variance of unit production cost, y_i. The variance of unit production cost can be expressed as the sum of the variation explained by the model and the variation in the error term:

$$\sigma_y^2 = \beta'\Sigma\beta + \sigma_\epsilon^2$$

---

[1]The FCRS uses a multiframe stratified sample. The formula used to compute variance estimates of sample means from FCRS data can be found in Dillard, 1993.

[2]For the sample sizes used in this study, the critical-t value for a 5-percent level of significance is 1.96 and for a 10-percent level of significance is 1.65.

where β' is a vector of parameter estimates, Σ is the variance-covariance matrix of explanatory variables, and σ^2_ϵ is the residual variation. To measure the extent to which each explanatory variable influences the variation of production costs, the sample variation can be decomposed into its various components (Kmenta, 1986, p.410). Consider a partition of $x_i = [x_{1i}\ x_{2i}]$, with the corresponding partition $\beta = [\beta_1\ \beta_2]$. The variance of unit production cost can be written as:

$$\sigma^2_y = \beta'_1\Sigma_{11}\beta_1 + \beta'_2\Sigma_{22}\beta_2 + 2\beta'_1\Sigma_{12}\beta_2 + \sigma^2_\epsilon$$

where Σ_{11} and Σ_{22} are matrices of variances for x_{1i} and x_{2i}, and Σ_{12} is the matrix of covariances between x_{1i} and x_{2i}. The first term on the right-hand side represents the amount of variation in unit production cost that can be attributed solely to x_{1i}; the second term is the variation in unit production cost explained solely by x_{2i} (variance effects). The third term arises from the covariance of x_{1i} and x_{2i} and cannot be separated into parts due only to x_{1i} or only to x_{2i}, but is attributed to the influence of the two groups of variables together (covariance effects).

Alternative Specifications of the Regression Equations

Three alternative specifications of regression equations are used to examine the various relationships presented in this report--linear, reciprocal, and quadratic.

The most commonly used and easiest to interpret is the linear form:

$$Y = \alpha + \beta X$$

Estimated parameters of this equation, α and β, indicate the intercept and slope, respectively, of the estimated equation. The estimate of β describes the unit change in Y with a unit change in X.

The reciprocal form is expressed as:

$$Y = \alpha + \beta\frac{1}{X}$$

The intercept estimate of the reciprocal form, α, represents the value of Y that is approached as X grows infinitely large. The estimate of β describes the unit change in Y with a unit change in 1/X. If β is negative, α represents a maximum value that is approached from below but never reached. Conversely, a positive value of β implies that α is a minimum that is approached from above but never reached.

The quadratic form includes the linear term plus a squared term:

$$Y = \alpha + \beta X + \delta X^2$$

The estimated value of α represents the intercept. The estimate of β describes the unit change in Y with a unit change in X and δ describes the unit change in Y with a unit change in X^2. If both β and δ are positive (negative), Y increases (decreases) at an increasing rate with X. If β is positive and δ is negative, Y increases at a decreasing rate and eventually reaches a maximum. Likewise, if β is negative and δ is positive, Y decreases at a decreasing rate and eventually reaches a minimum. The level at which a maximum or minimum occurs can be identified by setting the first derivative of the estimated equation to zero and solving for the value of X.

Test of Equivalency of Two Regressions

Statistical testing for a difference between coefficients of two regressions is used to compare the unit cost equation estimated for each dairy production area. If the North and South are to be compared, separate regressions are estimated for each area with the model:

$$y = \alpha_0 + \sum_{k=1}^{m} \alpha_k X_k + \epsilon$$

where the α are parameters to be estimated, ϵ is the error term, and m is the number of explanatory variables. Data for farms in these areas are then combined. A dummy variable D is constructed with D=1 if the dairy operation is located in the North, D=0 otherwise. The regression model is then specified as:

$$y = \alpha_0 + \sum_{k=1}^{m} \alpha_k X_k + \delta_0 D + \sum_{k=1}^{m} \delta_k X_k D + \epsilon$$

where the α and δ are parameters to be estimated, ϵ is the error term, and m is the number of explanatory variables. Coefficients estimated with the dummy variables, $_0$ through δ_m, measure the difference of the intercept (δ_0) and slopes of each variable (δ_1-δ_m) between the two areas. Therefore, t-statistics on the estimated coefficients, δ_0 through δ_m, indicate whether the estimated coefficients on each variable in the separate regressions for each area are significantly different.

Appendix table 1--Characteristics of FCRS farms with low-, mid-, and high-cost dairy operations, 1993

Item	Unit	Low-cost producers	Mid-cost producers	High-cost producers
Share of FCRS dairy:				
Farms	percent	25	50	25
Milk sales	percent	43	43	14
Size:				
Total operated acreage	acres	292	326	376
Sales class[1]-				
$0-$39,999	percent of farms	11	11	16
$40,000-$99,999	percent of farms	24	31	41
$100,000-$249,999	percent of farms	42	44	38
$250,000 or more	percent of farms	23	14	5
Milk production value	dollars	251,759	134,452	85,092
Farm production value	dollars	278,465	150.971	99,533
Average milk cow inventory	head	120	66	54
Financial position:[1]				
Favorable	percent of farms	79	75	53
Marginal income	percent of farms	13	9	37
Marginal solvency	percent of farms	8	10	7
Vulnerable	percent of farms	0	5	3
Farm debt-to-assets	ratio	0.21	0.17	0.14
Milk production regions:[1]				
Northeast	percent of farms	22	58	20
Southeast	percent of farms	22	62	16
Upper Midwest	percent of farms	21	47	32
Corn Belt	percent of farms	32	48	20
Southern Plains	percent of farms	27	72	1
Pacific	percent of farms	45	32	23
Major occupation:				
Farming	percent of farms	93	97	94
Other	percent of farms	7	3	6
Farm organization:[1]				
Individual	percent of farms	76	87	83
Partnership	percent of farms	20	11	13
Corporations or cooperatives	percent of farms	5	1	4
Operator age:[1]				
Less than 35 years	percent of farms	7	9	12
35 to 49 years	percent of farms	40	46	42
50-64 years	percent of farms	43	36	34
65 years or more	percent of farms	10	8	13
Experience in milk production:				
Operator of 1993 operation	years	23	21	22
Work on any operation	years	35	31	33
Operator education:[1]				
Less than high school	percent of farms	29	27	22
Completed high school	percent of farms	53	47	51
Attended college	percent of farms	12	19	21
Completed college	percent of farms	7	7	6

[1]Data may not sum due to rounding.
Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 2--Performance and production practices of FCRS farms with low-, mid-, and high-cost dairy operations, 1993

Item	Unit	Low-cost producers	Mid-cost producers	High-cost producers
Output per cow	pounds	17,404	16,006	12,165
Feed efficiency:[1]				
Concentrates and grain	pounds per cwt of milk sold	42	56	68
Hay and straw	pounds per cwt of milk sold	33	36	54
Silage	pounds per cwt of milk sold	67	101	158
Other	pounds per cwt of milk sold	7	11	17
Total	pounds per cwt of milk sold	149	203	297
Feed efficiency	pounds per cow	25,336	31,478	35,155
Feed ration:[1]				
Roughage	percent	67	68	71
Concentrates	percent	28	27	23
Pasture	percent	1	2	3
Other	percent	4	3	3
Homegrown feed:				
Grain	percent of grain fed	44	70	81
Hay and straw	percent of hay and straw fed	42	76	84
Silage	percent of silage fed	74	95	91
Labor efficiency:[1]				
Paid labor	hours per cwt of milk sold	0.08	0.13	0.15
Unpaid labor	hours per cwt of milk sold	0.11	0.22	0.33
Total	hours per cwt of milk sold	0.19	0.36	0.48
Labor efficiency	hours per cow	33.08	55.12	56.68
Housing facilities:[1]				
Stanchion/tie stall barns	percent of capacity	16	31	33
Loafing barns/loose housing	percent of capacity	9	19	21
Freestall barns	percent of capacity	15	20	18
Calf barns	percent of capacity	12	12	13
Dry lot corrals	percent of capacity	43	11	10
Other	percent of capacity	6	8	8
Milking facilities:[1]				
Herringbone parlors	percent of capacity	40	27	20
Parallel parlors	percent of capacity	4	4	7
Polygon parlors	percent of capacity	0	1	0
Carousel parlors	percent of capacity	0	0	1
Other parlors	percent of capacity	8	9	3
Barns with pipeline	percent of capacity	38	50	57
Pail/buckets	percent of capacity	10	11	12
Times cows milked	times/day	2.03	2.03	2.00
Hours milking system operational	hours	5.20	4.60	4.19
Times milk picked up:[1]				
Once a day	percent of farms	28	23	11
Every other day	percent of farms	69	77	89
More than once a day	percent of farms	2	1	0
Capacity of milk tanks/silos	gallons	1,164	999	743

[1]Data may not sum due to rounding.
Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 3A--Cash costs and returns of milk production on FCRS farms with low-, mid-, and high-cost dairy operations, per cwt of milk sold, 1993

Item	Low-cost producers	Mid-cost producers	High-cost producers
		Dollars per cwt of milk sold	
Gross value of production:			
Milk	12.34	13.09	13.17
Cattle	0.91	1.19	1.25
Other income	0.40	0.42	0.98
Total, gross value of production	13.65	14.70	15.40
Cash expenses:			
Feed--			
Concentrates	2.83	3.87	5.02
By-products	0.23	0.19	0.22
Liquid whey	0.05	0.13	0.19
Hay	1.53	1.49	2.09
Silage	0.92	1.51	2.79
Pasture and other forage	0.10	0.09	0.20
Total feed cost	5.66	7.28	10.51
Other--			
Hauling	0.32	0.45	0.48
Artificial insemination	0.12	0.13	0.17
Veterinary and medicine	0.25	0.39	0.49
Bedding and litter	0.10	0.24	0.40
Marketing	0.34	0.31	0.36
Custom services and supplies	0.30	0.40	0.58
Fuel, lube, and electricity	0.30	0.51	1.10
Repairs	0.48	0.80	1.13
Hired labor	0.50	0.82	0.84
DHIA fees	0.06	0.07	0.08
Dairy assessment	0.14	0.14	0.14
Total, variable cash expenses	8.57	11.54	16.28
General farm overhead	0.28	0.54	0.90
Taxes and insurance	0.17	0.27	0.47
Interest	0.54	0.77	1.12
Total, fixed cash expenses	0.99	1.58	2.49
Total, cash expenses	9.56	13.12	18.77
Gross value of production less cash expenses	4.09	1.58	-3.37

Appendix table 3B--Economic costs and returns of milk production on FCRS farms with low-, mid-, and high-cost dairy operations, per cwt of milk sold, 1993

Item	Low-cost producers	Mid-cost producers	High-cost producers
		Dollars per cwt of milk sold	
Gross value of production:			
Milk	12.34	13.09	13.17
Cattle	0.91	1.19	1.25
Other income	0.40	0.42	0.98
Total, gross value of production	13.65	14.70	15.40
Economic (full ownership) costs:			
Variable cash expenses	8.57	11.54	16.28
General farm overhead	0.28	0.54	0.90
Taxes and insurance	0.17	0.27	0.47
Capital replacement	1.38	2.04	3.38
Operating capital	0.04	0.06	0.08
Other nonland capital	0.58	0.90	1.59
Land	0.00	0.01	0.01
Unpaid labor	0.77	1.48	2.18
Total, economic (full-ownership) costs	11.79	16.84	24.89
Residual returns to management and risk	1.86	-2.14	-9.49

Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 4A--Cash costs and returns of milk production on FCRS farms with low-, mid-, and high-cost dairy operations, per cow, 1993

Item	Low-cost producers	Mid-cost producers	High-cost producers
		Dollars per cow	
Gross value of production:			
Milk	2,101.90	2,030.11	1,558.49
Cattle	154.92	184.89	148.33
Other income	68.05	64.53	116.16
Total, gross value of production	2,324.87	2,279.53	1,822.98
Cash expenses:			
Feed--			
Concentrates	481.64	600.66	594.02
By-products	39.90	29.40	26.25
Liquid whey	8.72	19.46	22.31
Hay	260.82	231.52	247.85
Silage	156.50	234.22	330.29
Pasture and other forage	16.81	14.56	23.39
Total feed cost	964.39	1,129.82	1,244.11
Other--			
Hauling	54.34	69.78	57.35
Artificial insemination	20.04	20.39	20.26
Veterinary and medicine	41.80	60.02	58.49
Bedding and litter	16.53	37.08	46.79
Marketing	57.74	48.48	42.91
Custom services and supplies	50.81	62.30	68.30
Fuel, lube, and electricity	50.88	78.94	130.22
Repairs	82.34	123.49	133.57
Hired labor	84.47	127.70	99.81
DHIA fees	9.84	11.63	8.99
Dairy assessment	24.49	22.30	17.02
Total, variable cash expenses	1,457.67	1,791.93	1,927.82
General farm overhead	46.91	83.65	106.19
Taxes and insurance	28.93	42.18	55.67
Interest	92.29	120.01	132.70
Total, fixed cash expenses	168.13	245.84	294.56
Total, cash expenses	1,625.80	2,037.77	2,222.38
Gross value of production less cash expenses	699.07	241.76	-399.40

Appendix table 4B-- Economic costs and returns of milk production on FCRS farms with low-, mid- and high-cost dairy operations, per cow, 1993

Item	Low-cost producers	Mid-cost producers	High-cost producers
		Dollars per cow	
Gross value of production:			
Milk	2,101.90	2,030.11	1,558.49
Cattle	154.92	184.89	148.33
Other income	68.05	64.53	116.16
Total, gross value of production	2,324.87	2,279.53	1,822.98
Economic (full ownership) costs:			
Variable cash expenses	1,457.67	1,791.93	1,927.82
General farm overhead	46.91	83.65	106.19
Taxes and insurance	28.93	42.18	55.67
Capital replacement	235.44	315.91	399.88
Operating capital	7.58	9.32	10.02
Other nonland capital	98.32	139.95	187.79
Land	0.80	0.92	1.01
Unpaid labor	130.71	230.04	257.71
Total, economic (full-ownership) costs	2,006.36	2,613.90	2,946.09
Residual returns to management and risk	318.51	-334.37	-1,123.11

Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 5--Characteristics of FCRS farms with alternative sizes[1] of dairy operations, 1993

Item	Unit	Fewer than 60 milk cows	60-119 milk cows	120-299 milk cows	300 milk cows or more
Share of FCRS dairy:[2]					
Farms	percent	63	26	9	2
Milk sales	percent	26	25	21	29
Size:					
Total operated acreage	acres	226	455	631	575
Sales class[2]-					
$0-$39,999	percent of farms	19	1	0	0
$40,000-$99,999	percent of farms	50	35	0	0
$100,000-$249,999	percent of farms	30	88	8	3
$250,000 or more	percent of farms	2	8	92	97
Milk production value	dollars	63,885	147,384	348,996	1,706,915
Farm production value	dollars	71,894	167,343	390,219	1,896,790
Average milk cow inventory	head	34	78	166	818
Financial position:[2]					
Favorable	percent of farms	73	72	58	58
Marginal income	percent of farms	17	18	17	8
Marginal solvency	percent of farms	8	7	14	26
Vulnerable	percent of farms	2	3	12	8
Farm debt-to-assets	ratio	0.14	0.15	0.20	0.32
Milk production regions:[2]					
Northeast	percent of farms	64	27	8	1
Southeast	percent of farms	7	24	44	25
Upper Midwest	percent of farms	65	26	8	0
Corn Belt	percent of farms	72	24	4	0
Southern Plains	percent of farms	9	37	38	16
Pacific	percent of farms	32	15	22	31
Major occupation:					
Farming	percent of farms	93	99	98	95
Other	percent of farms	7	1	2	5
Farm organization:[2]					
Individual	percent of farms	91	78	50	54
Partnership	percent of farms	8	16	42	32
Corporations and cooperatives	percent of farms	1	5	8	13
Operator age:[2]					
Fewer than 35 years	percent of farms	10	6	7	21
35-49 years	percent of farms	40	52	42	38
50-64 years	percent of farms	37	35	46	29
65 years or more	percent of farms	12	7	5	12
Experience in milk production:					
Operator of 1993 operation	years	22	22	21	17
Work on any operation	years	32	34	35	28
Operator education:[2]					
Less than high school	percent of farms	32	15	23	13
Completed high school	percent of farms	46	58	46	42
Attended college	percent of farms	17	19	16	26
Completed college	percent of farms	5	7	15	20

[1]Size is measured as average number of milk cows on farms during 1993.
[2]Data may not sum due to rounding.
Source: Compiled from Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 6--Performance and production practices of FCRS farms with alternative sizes[1] of dairy operations, 1993

Item	Unit	Fewer than 60 milk cows	60-119 milk cows	120-299 milk cows	300 milk cows or more
Output per cow	pounds	14,662	15,069	16,835	17,243
Feed efficiency:[2]					
Concentrates and grain	pounds per cwt of milk sold	51	56	52	47
Hay and straw	pounds per cwt of milk sold	47	38	27	35
Silage	pounds per cwt of milk sold	103	117	97	65
Other	pounds per cwt of milk sold	9	5	10	14
Total	pounds per cwt of milk sold	210	217	186	161
Feed efficiency	pounds per cow	29,882	31,455	30,325	27,417
Feed ration:[2]					
Roughage	percent	71	72	67	62
Concentrates	percent	24	26	28	29
Pasture	percent	3	1	1	2
Other	percent	1	2	5	7
Homegrown feed:					
Grain	percent of grain fed	80	80	65	15
Hay and straw	percent of hay and straw fed	88	88	64	14
Silage	percent of silage fed	97	97	93	53
Labor efficiency:[2]					
Paid labor	hours per cwt of milk sold	0.08	0.15	0.14	0.11
Unpaid labor	hours per cwt of milk sold	0.43	0.21	0.09	0.02
Total	hours per cwt of milk sold	0.51	0.36	0.23	0.13
Labor efficiency	hours per cow	72.50	51.52	37.37	21.47
Housing facilities:[2]					
Stanchion/tie stall barns	percent of capacity	47	33	12	1
Loafing barns/loose housing	percent of capacity	22	16	15	6
Freestall barns	percent of capacity	11	23	30	12
Calf barns	percent of capacity	11	15	20	3
Dry lot corrals	percent of capacity	6	6	17	69
Other	percent of capacity	4	7	8	9
Milking facilities:[2]					
Herringbone parlors	percent of capacity	5	37	52	74
Parallel parlors	percent of capacity	4	4	4	7
Polygon parlors	percent of capacity	0	0	1	1
Carousel parlors	percent of capacity	0	0	0	0
Other parlors	percent of capacity	6	5	11	14
Barns with pipeline	percent of capacity	61	52	31	4
Pail/buckets	percent of capacity	23	1	0	0
Times cows milked	times/day	2	2	2	2
Hours milking system operational	hours	4	5	8	16
Times milk picked up:[2]					
Once a day	percent of farms	12	33	44	60
Every other day	percent of farms	88	67	55	16
More than once a day	percent of farms	0	0	1	25
Capacity of milk tanks/silos	gallons	577	1,153	1,920	5,875

[1]Size is measured as average number of milk cows on farms during 1993.
[2]Data may not sum due to rounding.
Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 7A--Cash costs and returns of milk production on FCRS farms with alternative sizes[1] of dairy operations, per cwt of milk sold, 1993

Item	Fewer than 60 milk cows	60-119 milk cows	120-299 milk cows	300 milk cows or more
		Dollars per cwt of milk sold		
Gross value of production:				
Milk	13.03	13.01	12.92	12.25
Cattle	1.22	1.10	1.11	0.91
Other income	0.41	0.66	0.41	0.46
Total, gross value of production	14.66	14.77	14.44	13.62
Cash expenses:				
Feed--				
Concentrates	3.49	4.13	3.58	3.20
By-products	0.04	0.04	0.26	0.48
Liquid whey	0.14	0.15	0.09	0.04
Hay	1.79	1.52	0.95	1.94
Silage	1.67	1.76	1.42	0.94
Pasture and other forage	0.15	0.09	0.06	0.12
Total feed cost	7.28	7.69	6.36	6.72
Other--				
Hauling	0.44	0.38	0.39	0.38
Artificial insemination	0.16	0.15	0.12	0.10
Veterinary and medicine	0.41	0.36	0.40	0.22
Bedding and litter	0.34	0.21	0.24	0.04
Marketing	0.32	0.31	0.31	0.37
Custom services and supplies	0.41	0.41	0.34	0.36
Fuel, lube, and electricity	0.69	0.57	0.50	0.26
Repairs	0.88	0.88	0.77	0.35
Hired labor	0.27	0.76	0.94	0.81
DHIA fees	0.07	0.08	0.07	0.06
Dairy assessment	0.14	0.14	0.14	0.14
Total, variable cash expenses	11.41	11.94	10.58	9.81
General farm overhead	0.58	0.52	0.48	0.34
Taxes and insurance	0.34	0.33	0.24	0.13
Interest	0.82	0.76	0.75	0.58
Total, fixed cash expenses	1.74	1.61	1.47	1.05
Total, cash expenses	13.15	13.55	12.05	10.86
Gross value of production less cash expenses	1.51	1.21	2.39	2.76

[1]Size is measured as average number of milk cows on farms during 1993.

Appendix table 7B--Economic costs and returns of milk production on FCRS farms with alternative sizes[1] of dairy operations, per cwt of milk sold, 1993

Item	Fewer than 60 milk cows	60-119 milk cows	120-299 milk cows	300 milk cows or more
		Dollars per cwt of milk sold		
Gross value of production:				
Milk	13.03	13.01	12.92	12.25
Cattle	1.22	1.10	1.11	0.91
Other income	0.41	0.66	0.41	0.46
Total, gross value of production	14.66	14.77	14.44	13.62
Economic (full ownership) costs:				
Variable cash expenses	11.41	11.94	10.58	9.81
General farm overhead	0.58	0.52	0.48	0.34
Taxes and insurance	0.34	0.33	0.24	0.13
Capital replacement	2.56	2.12	1.65	1.43
Operating capital	0.06	0.06	0.06	0.05
Other nonland capital	1.07	0.94	0.76	0.66
Land	0.01	0.01	0.00	0.00
Unpaid labor	2.91	1.40	0.63	0.14
Total, economic (full-ownership) costs	18.96	17.32	14.40	12.56
Residual returns to management and risk	-4.30	-2.55	0.04	1.06

[1]Size is measured as average number of milk cows on farms during 1993.

Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 8A--Cash costs and returns of milk production on FCRS farms with alternative sizes[1] of dairy operations, per cow, 1993

Item	Fewer than 60 milk cows	60-119 milk cows	120-299 milk cows	300 milk cows or more
		Dollars per cow		
Gross value of production:				
Milk	1,858.66	1,887.81	2,106.22	2,086.53
Cattle	174.55	159.79	181.23	154.30
Other income	58.47	95.87	67.56	77.80
Total, gross value of production	2,091.68	2,143.47	2,355.01	2,318.63
Cash expenses:				
Feed--				
Concentrates	497.38	598.73	583.30	544.56
By-products	5.84	6.49	43.02	80.93
Liquid whey	20.17	21.04	14.67	6.61
Hay	254.92	220.04	154.34	329.96
Silage	238.02	256.07	232.05	159.34
Pasture and other forage	21.81	13.64	10.08	20.37
Total feed cost	1,038.14	1,116.01	1,037.46	1,141.77
Other--				
Hauling	63.09	55.37	63.74	64.41
Artificial insemination	22.43	21.78	19.95	16.52
Veterinary and medicine	59.15	52.03	64.69	37.27
Bedding and litter	47.94	29.79	39.53	6.85
Marketing	45.44	45.40	49.83	63.84
Custom services and supplies	58.44	60.16	54.65	61.21
Fuel, lube, and electricity	98.66	83.36	82.31	43.84
Repairs	125.77	128.29	125.58	60.23
Hired labor	39.22	110.25	152.58	138.30
DHIA fees	9.85	11.74	10.73	9.63
Dairy assessment	20.51	20.87	23.44	24.50
Total, variable cash expenses	1,628.64	1,735.05	1,724.49	1,668.37
General farm overhead	82.84	75.43	77.69	57.70
Taxes and insurance	48.24	47.84	38.43	22.23
Interest	117.54	110.12	122.53	97.95
Total, fixed cash expenses	248.63	233.39	238.65	177.88
Total, cash expenses	1,877.27	1,968.44	1,963.14	1,846.25
Gross value of production less cash expenses	214.41	175.03	391.87	472.38

[1]Size is measured as average number of milk cows on farms during 1993.

Appendix table 8B--Economic costs and returns of milk production on FCRS farms with alternative sizes[1] of dairy operations, per cow, 1993

Item	Fewer than 60 milk cows	60-119 milk cows	120-299 milk cows	300 milk cows or more
		Dollars per cow		
Gross value of production:				
Milk	1,858.66	1,887.81	2,106.22	2,086.53
Cattle	174.55	159.79	181.23	154.30
Other income	58.47	95.87	67.56	77.80
Total, gross value of production	2,091.68	2,143.47	2,355.01	2,318.63
Economic (full ownership) costs:				
Variable cash expenses	1,628.64	1,735.05	1,724.49	1,668.37
General farm overhead	82.84	75.43	77.69	57.70
Taxes and insurance	48.24	47.84	38.43	22.23
Capital replacement	364.53	306.97	269.67	244.10
Operating capital	8.47	9.02	8.97	8.68
Other nonland capital	152.52	136.41	123.28	112.83
Land	1.39	0.85	0.66	0.56
Unpaid labor	414.59	203.76	102.61	23.65
Total, economic (full-ownership) costs	2,701.22	2,515.33	2,345.80	2,138.12
Residual returns to management and risk	-609.54	-371.86	9.21	180.51

[1]Size is measured as average number of milk cows on farms during 1993.

Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 9--Characteristics of FCRS dairy farms in the North, South, and West[1], 1993

Item	Unit	North	South	West
Share of FCRS dairy:				
Farms	percent	92	3	5
Milk sales	percent	65	8	27
Size:				
Total operated acreage	acres	334	488	174
Sales class[2]-				
$0-$39,999	percent of farms	13	0	5
$40,000-$99,999	percent of farms	33	5	30
$100,000-$249,999	percent of farms	44	32	15
$250,000 or more	percent of farms	10	63	50
Milk production value	dollars	109,187	505,086	697,753
Farm production value	dollars	123,225	559,598	775,522
Milk cow inventory:				
Beginning	head	56	248	341
Ending	head	56	253	349
Financial position:[2]				
Favorable	percent of farms	72	73	53
Marginal income	percent of farms	16	14	29
Marginal solvency	percent of farms	8	10	15
Vulnerable	percent of farms	4	3	3
Farm debt-to-asset	ratio	0.16	0.19	0.30
Major occupation:				
Farming	percent of farms	95	93	98
Other	percent of farms	5	7	2
Farm organization:[2]				
Individual	percent of farms	85	77	59
Partnership	percent of farms	13	17	34
Corporations or cooperatives	percent of farms	3	6	7
Operator age:[2]				
Less than 35 years	percent of farms	9	16	15
35 to 49 years	percent of farms	43	47	42
50-64 years	percent of farms	37	36	35
65 years or more	percent of farms	10	2	8
Experience in milk production:				
Operator of 1993 operation	years	22	17	18
Work on any operation	years	33	25	38
Operator education:[2]				
Less than high school	percent of farms	26	16	33
Completed high school	percent of farms	50	36	43
Attended college	percent of farms	18	24	17
Completed college	percent of farms	6	24	8

[1]North-Upper Midwest, Northeast and Corn Belt regions; South-Southern Plains and Southeast regions; West-Pacific region.
[2]Data may not sum due to rounding.
Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 10--Performance and production practices of FCRS dairy farms in the North, South, and West[1], 1993

Item	Unit	North	South	West
Output per cow	pounds	15,487	14,497	17,464
Feed efficiency:[3]				
Concentrates and grain	pounds per cwt of milk sold	52	72	42
Hay and straw	pounds per cwt of milk sold	37	34	40
Silage	pounds per cwt of milk sold	115	38	62
Other	pounds per cwt of milk sold	8	11	14
Total	pounds per cwt of milk sold	212	155	158
Feed efficiency	pounds per cow	31,669	22,029	27,243
Feed ration:[1]				
Roughage	percent	72	47	65
Concentrates	percent	25	47	27
Pasture	percent	1	0	3
Other	percent	2	7	6
Homegrown feed:				
Grain	percent of grain fed	78	14	4
Hay and straw	percent of hay and straw fed	91	39	12
Silage	percent of silage fed	98	55	46
Labor efficiency:[3]				
Paid labor	hours per cwt of milk sold	0.12	0.19	0.07
Unpaid labor	hours per cwt of milk sold	0.26	0.08	0.04
Total	hours per cwt of milk sold	0.38	0.27	0.12
Labor efficiency	hours per cow	57.34	38.81	20.22
Housing facilities:[3]				
Stanchion/tie stall barns	percent of capacity	35	2	1
Loafing barns/loose housing	percent of capacity	19	18	5
Freestall barns	percent of capacity	20	5	15
Calf barns	percent of capacity	15	4	3
Dry lot corrals	percent of capacity	6	39	68
Other	percent of capacity	5	31	8
Milking facilities:[3]				
Herringbone parlors	percent of capacity	22	66	61
Parallel parlors	percent of capacity	3	10	15
Polygon parlors	percent of capacity	0	0	1
Carousel parlors	percent of capacity	0	0	0
Other parlors	percent of capacity	5	11	20
Barns with pipeline	percent of capacity	57	14	2
Pail/buckets	percent of capacity	13	0	0
Times cows milked	times/day	2	2	2
Hours milking system operational	hours	4	9	9
Times milk picked up:[1]				
Once a day	percent of farms	20	33	33
Every other day	percent of farms	80	66	55
More than once a day	percent of farms	0	2	12

[1]North-Upper Midwest, Northeast, and Corn Belt regions; South-Southern Plains and Southeast regions; West-Pacific region.
[3]Data may not sum due to rounding.
Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 11A--Cash costs and returns of milk production on FCRS dairy farms in the North, South, and West[1], per cwt of milk sold, 1993

Item	North	South	West
	Dollars per cwt of milk sold		
Gross value of production:			
Milk	13.03	14.11	11.74
Cattle	1.18	1.16	0.82
Other income	0.50	0.36	0.49
Total, gross value of production	14.71	15.63	13.05
Cash expenses:			
Feed--			
Concentrates	3.66	5.30	2.84
By-products	0.11	0.32	0.43
Liquid whey	0.14	0.02	0.04
Hay	1.37	1.32	2.22
Silage	1.77	0.51	0.89
Pasture and other forage	0.09	0.09	0.17
Total feed cost	7.14	7.56	6.59
Other--			
Hauling	0.39	0.66	0.34
Artificial insemination	0.15	0.07	0.10
Veterinary and medicine	0.42	0.28	0.17
Bedding and litter	0.29	0.00	0.04
Marketing	0.31	0.33	0.39
Custom services and supplies	0.39	0.40	0.35
Fuel, lube, and electricity	0.60	0.41	0.27
Repairs	0.91	0.48	0.28
Hired labor	0.66	1.17	0.60
Total, variable cash expenses	11.47	11.55	9.33
General farm overhead	0.54	0.49	0.30
Taxes and insurance	0.32	0.21	0.10
Interest	0.82	0.51	0.54
Total, fixed cash expenses	1.68	1.21	0.95
Total, cash expenses	13.15	12.76	10.28
Gross value of production less cash expenses	1.56	2.87	2.77

[1] North-Upper Midwest, Northeast, and Corn Belt regions; South-Southern Plains and Southeast regions; West-Pacific region.

Appendix table 11B--Economic costs and returns of milk production on FCRS dairy farms in the North, South, and West[1], per cwt of milk sold, 1993

Item	North	South	West
	Dollars per cwt of milk sold		
Gross value of production:			
Milk	13.03	14.11	11.74
Cattle	1.18	1.16	0.82
Other income	0.50	0.36	0.49
Total, gross value of production	14.71	15.63	13.05
Economic (full ownership) costs:			
Variable cash expenses	11.47	11.55	9.33
General farm overhead	0.54	0.49	0.30
Taxes and insurance	0.32	0.21	0.10
Capital replacement	2.13	2.24	1.36
Operating capital	0.06	0.06	0.05
Other nonland capital	0.91	1.19	0.61
Land	0.01	0.00	0.01
Unpaid labor	1.76	0.51	0.32
Total, economic (full-ownership) costs	17.20	16.26	12.08
Residual returns to management and risk	-2.49	-0.63	0.97

[1] North-Upper Midwest, Northeast, and Corn Belt regions; South-Southern Plains and Southeast regions; West-Pacific region.
Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.

Appendix table 12A--Cash costs and returns of milk production on FCRS dairy farms in the North, South, and West[1], per cow, 1993

Item	North	South	West
		Dollars per cow	
Gross value of production:			
Milk	1,951.96	2,017.14	2,020.49
Cattle	176.06	165.57	140.77
Other income	74.88	52.13	84.42
Total, gross value of production	2,202.90	2,234.84	2,245.68
Cash expenses:			
Feed--			
Concentrates	547.94	757.32	489.16
By-products	16.19	46.40	74.83
Liquid whey	20.87	3.17	6.28
Hay	205.29	188.02	381.89
Silage	264.94	73.07	153.97
Pasture and other forage	264.94	73.07	153.97
Total feed cost	1,068.37	1,080.75	1,135.63
Other--			
Hauling	58.24	94.95	58.06
Artificial insemination	22.79	9.91	16.99
Veterinary and medicine	62.37	40.36	29.97
Bedding and litter	43.39	0.31	7.03
Marketing	45.91	47.75	66.99
Custom services and supplies	58.44	57.81	60.53
Fuel, lube, and electricity	90.30	58.03	47.33
Repairs	136.62	69.09	47.58
Hired labor	98.26	167.55	103.62
DHIA fees	11.19	6.48	9.94
Dairy assessment	21.54	20.55	24.75
Total, variable cash expenses	1,717.42	1,653.54	1,608.42
General farm overhead	81.22	70.13	52.31
Taxes and insurance	48.58	29.79	17.32
Interest	123.04	73.19	93.50
Total, fixed cash expenses	252.84	173.11	163.13
Total, cash expenses	1,970.26	1,826.65	1,771.55
Gross value of production less cash expenses	232.64	408.19	474.13

[1] North-Upper Midwest, Northeast, and Corn Belt regions; South-Southern Plains and Southeast regions; West-Pacific region.

Appendix table 12B--Economic costs and returns of milk production on FCRS dairy farms in the North, South, and West[1], per cow, 1993

Item	North	South	West
		Dollars per cow	
Gross value of production:			
Milk	1,951.96	2,017.14	2,020.49
Cattle	176.06	165.57	140.77
Other income	74.88	52.13	84.42
Total, gross value of production	2,202.90	2,234.84	2,245.68
Economic (full ownership) costs:			
Variable cash expenses	1,717.42	1,653.54	1,608.42
General farm overhead	81.22	70.13	52.31
Taxes and insurance	48.58	29.79	17.32
Capital replacement	319.71	320.31	234.48
Operating capital	8.93	8.60	8.36
Other nonland capital	136.92	170.22	104.43
Land	0.91	0.31	1.05
Unpaid labor	263.00	73.13	55.57
Total, economic (full-ownership) costs	2,576.69	2,326.03	2,081.94
Residual returns to management and risk	-373.79	-91.19	163.74

[1] North-Upper Midwest, Northeast, and Corn Belt regions; South-Southern Plains and Southeast regions; West-Pacific regions.
Source: Compiled by Economic Research Service from 1993 Farm Costs and Returns Survey, USDA.