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Important differences between estimates of farm costs of production made by the Economic Research Service, U.S. Department of Agriculture (USDA) and those made by state entities for the same commodities are reported by Libbin and Torell in the Western Journal of Agricultural Economics (1990). In commenting on the differences, the authors note that the USDA has the resources to survey statewide random samples of farm producers and obtain comparable data from several states, giving them the advantage of economies of size in their analyses. They also have extensive experience in developing the concepts and methods, collecting the data, and making the cost of production analyses. State researchers, however, may have the advantage of knowledge of unique local conditions affecting the analysis and may thus obtain additional relevant information from their respondents.

Concerns about differences in cost of production methodologies are generating increased attention. At a recent USDA conference on cost of production methodology, the key issues of cost imputing and allocating centered around how data are gathered, how non-purchased inputs and capital are priced, and how land and joint costs are assigned (Ahearn and Vasavada, 1992).

Both the federal and state public agencies making the estimates and the users of their analyses stand to gain from improvements in cost estimates. In that spirit the authors report here our calculations of the farm costs of producing milk in an important dairy region in Wisconsin, because our estimates differ substantially from those of the USDA for the Upper Midwest, the region in which our study area lies. The total cash production expenses per hundredweight (cwt.) of milk were $9.08 in our southwestern Wisconsin study area, somewhat below the $10.14 in the USDA Upper Midwest study (Wisconsin, Minnesota, and Michigan). However, total economic costs of production in southwestern Wisconsin were well above those in the USDA study, $15.68 per cwt. compared to $12.02 per cwt.

In this report the authors search for the reasons for the divergence, e.g., differences in the populations that were studied, the methods of sampling and surveying the populations, the accounting concepts employed, and differences in assumptions or conditions imposed in the analysis. The authors first compare the dairy farm population in southwestern Wisconsin with the dairy farm population in the Upper Midwest, describe the surveys used to obtain the farm data, and discuss the accounting concepts that were followed. Then the authors present the calculated costs of production generated by the two systems, and comment on the observed differences. In the conclusions the authors discuss the implications of differences between local and aggregate data cost of production estimates and offer other factors that may be associated with differences among farmers in costs of producing milk.

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Comparability of the Populations Studied

In the analyses that follow, the authors compare the farm costs of producing milk for a sample of southwestern Wisconsin dairy farms with costs for a USDA sample drawn from dairy farms in Wisconsin, Minnesota, and Michigan. The purpose of the analysis is to identify possible differences in method or data that could cause differences in the calculated costs. However, the population from which the southwestern Wisconsin dairy farms were drawn is only a sub-part of the upper Midwest population from which the USDA sample was drawn. An initial question is whether or not that sub-population was sufficiently different from the three-state population of dairy farms to cause the observed differences in costs of production. The authors do not have conclusive tests, but the authors can compare important characteristics of the sample that was drawn in southwestern Wisconsin with the population characteristics of the population from which the USDA sample was drawn.

The southwestern Wisconsin data are from a random sample drawn from the farm population name list by the Wisconsin Agricultural Statistical Service (WASS), and were determined to validly represent the population from which they were drawn (Salant, et al., 1984). In table 1, the authors present descriptive statistics from the southwestern Wisconsin sample of dairy farms compared with 1987 Census of Agriculture data for all dairy farms in Wisconsin, Minnesota, and Michigan, the population from which the USDA sample was drawn.

Topography in southwestern Wisconsin is steeper and a larger proportion of farmland is in permanent pasture, woods, or wasteland than elsewhere in Wisconsin. Differences between the southwestern Wisconsin survey and Census data for Wisconsin in total farmland acres per farm, value of land and buildings, and gross sales per farm reflect the ecology. However, the sample farms were comparable with Wisconsin and Minnesota Census farms in crop acres per farm, dairy cows per farm, dairy sales per farm, production per cow, percentage of total farm sales from dairy products, and other relevant ways.

Dairy farms in Michigan tended to be larger and produce more milk per cow than those in Minnesota, Wisconsin, and in the southwestern Wisconsin sample. However, they made up less than one-tenth of the dairy farms in the three states (and presumably in the USDA sample). Thus, if there were differences in cost of production on the Michigan farms that were associated with their greater size and production, it would have had a relatively small impact on the USDA's average cost of production in the Upper Midwest.

The authors conclude that differences between farm characteristics in the southwestern Wisconsin sample and in the population included in the USDA Upper Midwest study are not great enough to have caused the observed differences in the farm costs of producing milk.

Table 1. Comparison of sample farms from the 1987 Wisconsin Family Farm Survey in southwestern Wisconsin with 1987 Census of Agriculture farms in the Upper Midwest

Item	Units	Farm Survey Southwestern Wisconsin	Upper Midwest Census Farms[1]		
			Wisconsin	Minnesota	Michigan
Dairy farms	number	231	34,812	14,334	5,199
Dairy cows per farm	number	45.4	47.9	43.4	61.8
Gross farm sales	dollars	78,207	92,741	85,975	126,858
Gross dairy sales	dollars	64,128	76,418	66,115	103,318
Dairy sales	percent	82	82	77	81
Production/cow[2]	lbs.	12,126	13,534	11,912	14,259
Dairy sales/cow	dollars	1,413	1,595	1,523	1,672
Total farmland	acres	327	275	291	378
Harvested cropland	acres	174	169	174	256
Pasture	acres	74	52	59	40
Land & buildings value	dollars	161,531	212,982	192,786	303,850
Machinery value	dollars	61,717	73,981	67,183	92,898
Feed purchased	dollars	11,616	12,756	12,960	19,393
Interest paid	dollars	8,932	8,007	7,090	9,951
Machine repairs	dollars	3,967	5,357	5,337	7,525
Hired farm labor	dollars	2,377	4,889	3,198	9,430
Harvested acres/cow	acres	3.9	3.5	4.0	4.1
Land value/cow	dollars	3,756	4,446	4,446	4,916
Hired labor/cow	dollars	43	102	73	153
Operator age	years	48	48	47	49
Operators working off farm	percent	19	25	25	26

[1] Source: State data are from the Census of Agriculture, Volume 1, Geographic Area Series, Part 22 (Michigan, May 1989), Part 23 (Minnesota, June 1989), and Part 49 (Wisconsin, March 1989). From Table 53 in each Part.

[2] USDA, 1987. Table 471.

Obtaining Dairy Farm Data

A second reason for divergence in results might be differences in sampling and data collection procedures. In this section, the authors discuss how information was gathered from farmers in the southwestern Wisconsin survey and in the USDA Farm Costs and Returns Surveys.

Southwestern Wisconsin Family Farm Survey The southwestern Wisconsin study area included eight counties in the unglaciated area of the state near the Mississippi River (Salant, 1984). The study area was initially selected as a part of a series of regional case studies to "represent" the upper North Central Region of the nation, for comparison with a case study of an agricultural region "representing" the mid-South (Salant, 1982). The USDA and land grant universities collaborated in the series of studies.

The southwestern Wisconsin data are from a random sample drawn from the farm population name list developed by the Wisconsin Agricultural Statistics Service (WASS). The population name list was known to be complete and current regarding dairy farmers, as it is updated regularly through comparisons with the name list of farmers that have met the herd health requirements for selling milk in the state. Each farm, regardless of size, had an equal probability of being selected in the random sample.

First interviewed in an early 1983 survey, the identical farm households were re-visited in a follow-up survey four years later. Of the original 529 farms in the 1983 sample, 400 were still farming in early 1987. Of those, 213 were farms on which more than half of the gross receipts came from the dairy enterprise. Those 213 dairy farms are the sample included in the present study. The data are for calendar year 1986.

Interviews were conducted at the place of residence of the respondent by the same experienced professional enumerators used by the Wisconsin Agricultural Statistics Service in collecting data for the USDA Farm Costs and Returns Survey. Interviews averaged about 90 minutes in duration. The questionnaires solicited data needed for studies of farm and nonfarm use of labor; farm production, sales, and expenses; assets, debts and financial position; farm and nonfarm sources of household income; conservation tillage and other farming practices; cost of producing milk, and other topics. Farm resource use, receipts, expenses, production, labor use, and financial data were collected for the entire farm business, not just for the dairy enterprise.

The sample data are appropriate for generalizing to the population of farms within that eight county study area. In addition, the counties included in the sample are similar to some 100 other counties in Wisconsin, Minnesota, and Michigan in matters of emphasis on dairy farming, relatively small farm size, and dependence on family labor (Salant, 1986). Information presented in table 1 suggests the extent to which the sample farms are similar to all dairy farms in the Upper Midwest.

USDA Farm Costs and Returns Survey The Secretary of Agriculture is required by the Congress through the Agriculture and Consumer Protection Act of 1973 to estimate annual costs of producing wheat, feed grains, cotton, and milk. The Economic Research Service, USDA carries out this responsibility and in addition estimates similar costs for a number of other commodities. The mandate was modified by additional legislation in 1977 and 1981. Costs of production have on occasion been used to adjust target prices for selected commodities in Federal farm programs, but have not been used for that purpose in dairy support programs.

The National Agricultural Statistics Service (NASS) of the USDA conducts the surveys. Beginning in 1985, NASS has used a multi-frame sample, choosing a sample from both a list frame of all the producers in a state and an area frame that provides a random set of land segments. The Farm Costs and Returns Survey is conducted each winter in 48 states with about 24,000 respondents nationwide. Some respondents are asked for cost of production information on one specific commodity, e.g., dairy farms were surveyed in 1986 for 1985 cost of production data. Each crop or livestock enterprise is surveyed only once in four years and costs are updated using recent prices and price indexes each year between surveys (McElroy, 1987).

Most farmers do not keep farm records by enterprises so the USDA uses a more indirect method to obtain enterprise data. The survey asks for information about size and type of equipment, hired and unpaid labor used on the farm and by the enterprise, milk marketing charges, artificial insemination and dairy performance testing fees, purchase and sale of dairy animals, depreciation, and receipts from the sale of milk and other dairy products (Agricultural Statistics Board, 1987, 1990). Prices received, prices paid for inputs, land value, rental rates and selected data from other sources are used in calculating costs of production. The USDA calculations reflect the average cost and returns of dairy production. National and regional estimates of milk production costs and returns are calculated annually.

The USDA presents their cost of production estimates as enterprise budgets that include all operator and landlord costs, i.e., as if the producer owned all the resources used in production of the commodity. The budgets are divided into gross value of production, cash expenses, and economic costs. They "are based on weighted-average estimates of all costs associated with a particular enterprise" (USDA, 1988, p. 1). The USDA indicates that these reports are "unique because all estimates are comparable across the Nation, and among production categories, livestock types, and years. The same methodology is used for all commodities and primary data collection in a given year. The data neither represent a specific producer nor are they economically engineered to be 'typical' of livestock operations. The data reflect the average costs and returns of milk and livestock production for producers" (USDA, ibid).

Methods and Rationale for Calculating Costs of Production

Most farms in the United States generate more than one product, but very few farmers keep separate farm enterprise records for each of those products. While gross receipts from the various crop or livestock enterprises are probably known, the distribution of purchased inputs, the use of farm machinery and equipment, and the allocation of farm labor among them is not.

Dairy farming and dairy farmers are no exception. While farms can be selected and limited to those on which the sale of milk is the dominant income source, there will still be other products. As a minimum there will be dairy cows culled from the milking herd for slaughter and calves born at the beginning of each lactation. Under Wisconsin conditions the sale of surplus feed crops or receipts from doing incidental custom farm operations for neighbors may also be included in gross receipts, for example. This means that ingenuity and care are required in using dairy farm data to determine the appropriate costs to assign to the production of milk. Various concepts have been developed to address these issues.

Prior Studies University researchers and extension specialists have developed and used various methods for determining milk production costs and returns. Techniques have been tested in Wisconsin over the last two decades by Kimball and Saupe (1970), Peterson and Cook (1972), and Klemme (1983). Similar research efforts in other colleges include analyses in Minnesota, Washington,

New Mexico and Arizona by Buxton, et al. (1985), in Pennsylvania by Grisley and Mascarenhas (1985), and in New York by Tauer and Belbase (1987).

Selected recent research in the USDA includes a definitive report on changes in the methodology and format for reporting costs of producing milk from 1975 to 1984 plus the empirical results (Betts, 1987), an explanation of the concepts and procedures used in cost of production studies (McElroy), empirical results for the nation and regions (Betts, 1989), (USDA, 1989), and production costs in seven major milk producing countries (Baker, et al.).

The technical efficiency of milk production, a related research topic, has been explored by Bravo-Ureta (1986), Alvarez, et al. (1988), and others. Recent reports on the financial conditions on selected dairy farms have been prepared by Schraufnagel and Clark (1990) and Jones (1991) for Wisconsin, and by extension faculty as annual farm record summaries in several other states.

Various criticisms of cost of production methods have been raised by production economists. Pasour (1980) argues that the cost of production is not a defensible basis for price supports. The cost calculations mask the problems of finding true opportunity costs of owned inputs while the methodology is independent of changing tastes and demand for the product. Nevertheless, cost of production studies continue to be an important policy and farm management tool in U.S. agriculture.

The authors now turn to the concept used in the southwestern Wisconsin study, the "single farm product" approach, and the concept used by the USDA in their cost of production studies, the "enterprise budget" approach.

Single Farm Product Approach Farm records in Wisconsin, as elsewhere, are kept primarily to facilitate the calculation and documentation of income for tax purposes. While exceptions occur in farm accounting and business analysis programs developed by Extension faculty at land grant universities, the expense categories used in most farm accounting systems are those needed to complete income tax forms (Frank, 1990). Farm expenses are rarely separated and recorded by enterprises, and this was the case with the farmers in the southwestern Wisconsin survey. A few farm expenses are unique to the dairy enterprise, such as dairy herd production testing fees and artificial insemination fees. But other than those exceptions, separate dairy enterprise data were not available from our respondents. Instead, data from the total farm business were obtained.

The basic strategy in the southwestern Wisconsin analysis was to convert all farm receipts into one product, hundredweight (cwt.) of "milk equivalents." With only one farm product, all cash costs and resource costs of the farm business can be charged to that one product. That is, total farm costs divided by the cwt. of milk equivalent produced on that farm gives the cost of producing a cwt. of milk equivalent.

The three basic equations used in converting total farm production costs into the cost per cwt. of milk equivalents are as follows:

Hundredweight of Milk Equivalents = Gross Farm Receipts divided by Price per Hundredweight Received by the Farmer

Total Farm Expenditures = Cash Farm Operating Costs, Depreciation, Opportunity Costs of Owned Capital and Unpaid Family Labor

Total Production Cost per Hundredweight = Total Farm Expenditures divided by Hundredweight of Milk Equivalents

Creating "hundredweights of milk equivalents" requires the assumption that the average cash and resource costs of producing one dollar of non-milk farm receipts are the same as the average cash and resource costs of producing one dollar of milk receipts. It is probably a reasonable assumption. With adequate knowledge, time, and consistency in production technology a farmer that is interested in income will organize the farm business so that the marginal returns would be the same wherever cash expenditures (or resources) were used in the farm business. That is, cash expenditures or resources would be allocated such that the marginal returns per dollar (or per unit of resources) would be the same in producing milk as they would be in every other activity generating receipts for the farm business.

While perfect knowledge and freedom from risk do not exist in the complex, uncertain environment in which farmers function, many farm decisions are made based on the marginal conditions, i.e., in consideration of added costs versus added returns, and of the alternative uses for the resources. Over time, farm businesses become structured in ways that reflect an awareness of resource use trade-offs and a preference for more income versus less. This supports the reasonableness of our assumption that dollars of farm inputs (and farm resources) are allocated among uses so that their added returns per unit are approximately the same wherever they are used.

If the assumption errs from reality, the damage to our estimates is likely small because the assumption applies only to receipts other than from milk. On average it applied to 18 percent of the sales on our sample dairy farms in the southwestern Wisconsin study. As dairy sales approach 100 percent of gross farm receipts, the impact of the assumption decreases. If only milk was produced on a farm, the assumption would not be needed and its degree of correctness would not be an issue.

Enterprise Budget Approach Recent empirical analyses of costs of production made by the USDA have been cited earlier. Betts' and McElroy's definitive reports include the USDA methods and rationale with helpful details on how the calculations were assembled. The basic strategy used in the USDA cost of production studies is to use data from their Farm Costs and Returns Surveys and other sources to calculate the total production cost for a unit of an enterprise. For example, in their dairy studies costs are calculated per dairy cow and per cwt. of milk.

In the enterprise budget approach the enterprise of interest is separated and isolated from the remainder of the farm business. This contrasts to the single farm product approach reported above in which the entire farm business is collapsed into one product. In the enterprise budget approach, how that enterprise performs by itself is the issue, e.g., how does the dairy cow enterprise perform? In the single farm product approach the issue relates more to how the dairy farm as a unit fares.

The differences in concepts leads to the following differences in how the budgets are structured under the two systems:

a) Home raised feed is charged to the dairy cow at market prices in the USDA budget, while the seed, fertilizer, fuel, labor, machinery, and land costs of producing the feed are included in the Wisconsin budgets.

b) A replacement springing cow is purchased in the USDA budget while the cost of raising replacement animals is included in the Wisconsin costs.

c) Land, machinery and equipment charges in the USDA budget include only the building site, the barn, and the dairy equipment. In the Wisconsin budgets all farm land and the full complement of crop machinery and livestock equipment is included.

d) Labor included in the USDA budgets includes only the direct labor connected with the dairy enterprise, while total farm labor is included in the Wisconsin budgets.

In addition to the above structural variations in the budgets that follow from the two contrasting concepts, there were other budget differences that pertain to pricing the resources used. They are discussed in the following sections on calculated costs of production.

Calculated Cash Costs and Returns

Employing techniques parallel to USDA cost of production tables (see Betts, 1989), the authors made use of the 1987 Wisconsin Farm Family Survey data to calculate farm costs of producing milk. Using the sample of 213 specialized dairy farms, relatively straightforward calculations of the variables relevant to milk production cost analysis were made. In table 2 and the following text the authors contrast them with the USDA calculations.

Receipts The USDA analysis of Upper Midwest milk production costs assumed a cow that produced 13,943 pounds of milk, valued at $12.10 per hundredweight. The sale of some fraction of a cull dairy cow, valued at $144 per cow and adding $1.13 per cwt. of milk, was included as a part of the dairy cow receipts.

In the Wisconsin analysis all farm receipts were converted to "milk equivalents" by dividing total farm receipts by the average price per cwt. received by the farmer for milk. Each farmer's average price of milk was calculated as gross sales of milk and dairy products divided by the cwt. of milk produced. For the 213 southwestern Wisconsin dairy farmers in the sample, that mean price was $12.12 per cwt. That was consistent with the $12.10 used by the USDA in their Upper Midwest study, and other USDA statistics showing average prices of milk sold that year of $12.16 in Wisconsin, $11.85 in Minnesota, and $12.63 in Michigan (USDA, 1987).

For the farms in the southwestern Wisconsin sample, total farm receipts averaged $78,207. Average production was 12,126 pounds of milk per cow, and milk sales accounted for 82 percent of total farm receipts. Calculated milk equivalents, total farm receipts divided by the average price of milk, averaged 6,453 cwt. of milk equivalents per farm. The cost per cwt. for each type of expense reported for the southwestern Wisconsin farms in table 2 were determined by dividing the average cost per farm by 6,453 hundredweight.

Cash Farm Operating Costs Cash farm operating costs are reported in the lower panel of table 2. Total cash farm operating costs for the USDA Upper Midwest dairy farms averaged $10.14 per cwt. of milk, compared to the southwestern Wisconsin sample farms average of $9.08 per cwt. of milk equivalents. Using direct costing methods, the USDA budgets include variable costs of the dairy enterprise such as veterinary services and medicines, Dairy Herd Improvement Association fees, and dairy assessments. The Wisconsin budget includes those items plus all other crop production and farming costs such as seed, fertilizer, lime, chemicals, and hired custom work.

Table 2. Milk production cash costs and returns per cwt., from the USDA Farm Costs and Returns Surveys for the upper Midwest and the Family Farm Survey in southwestern Wisconsin, 1986 data

Item	USDA Farm Costs & Returns Surveya/	Family Farm Survey Southwestern Wisconsin
Receipts per Cwt:		
Milk	$12.10	--
Cull Cow	1.13	--
Milk Equivalent	--	$12.12
Total	$13.23	$12.12
Cash Farm Operating Costs per Cwt.:		
Raised & Purchased Feed	$ 4.72	--
Purchased Feed	--	$ 1.77
Fuel and Utilities	.23	.77
Repairs	.45	.58
Hired Labor	.61	.66
Interest	1.57	1.31
Cash Rent	--	.28
Other Cash Dairy Operating Costs	2.56	.14
Other Cash Farm Operating Costs, Including Crop Production Costs	--	3.57
Total Cash Expense	$10.14	$ 9.08
Value of Production Less Cash Expenses	$ 3.09	$ 3.04

a/ Source: Economic Indicators of The Farm Sector. Costs of Production--Livestock and Dairy, 1988, Table 16, p.28.

The impact of the differing budget concepts begins to appear here. In the USDA budget the dairy cow enterprise was considered to be separate from all other farm activities. Thus, all feed was charged to the dairy cow at market prices whether raised on the dairy farm or not. Under those assumptions, feed costs totalled $4.72 per cwt. in the USDA budget. This is contrasted to $1.77 of purchased feed per cwt. of milk equivalents in the southwestern Wisconsin study. The cost of producing the remainder of the ration, the dairy feed produced and consumed on the farm, is partially reflected in the higher fuel costs, repairs, hired labor, cash rent, other cash farm operating costs (see table 2).

Total cash operating expenses were $9.08 per cwt. of milk equivalents in the system used in the southwestern Wisconsin budget. The USDA budget for the Upper Midwest totalled $10.14 per cwt. of milk (adjusted for the sale of a fraction of a cull cow). This suggests that on average the cash costs of raising feed for the dairy cow were less than the market price for that feed. However, as suggested below, the high amount of family labor involved in feed production may imply that the economic costs of raising feed are higher.

Under both budgets the value of production less cash operating costs exceeded three dollars per hundredweight. That residual is needed to cover required costs that are not a part of the cash operating costs. For example, the budgets include a cash cost for the relatively small amount of hired labor. However, the cost of food, shelter, clothing and all other needed living expenses for the unpaid (family) labor must be covered by that residual, unless the farm household has nonfarm sources of income. In addition, the cost of replacing dairy equipment and farm machinery as it wears out must be covered by that residual.

In the following section a method of addressing total economic costs of producing milk is presented using the southwestern Wisconsin and Upper Midwest data.

Calculation of Economic (Full Ownership) Costs of Production

The economic (or full ownership) costs of production are used by the USDA to allow "analysts to compare commodity returns across varying levels of equity and tenure" (McElroy, 1987). The process involves estimating the costs and returns that would be associated with the enterprise if the producer owned all resources free of debt.

Only the cash operating expenses that would be incurred by a full owner are included in this analysis, e.g., cash rent paid and interest paid are excluded as the producers are assumed to own all their land and use their own funds for operating expenses. An allowance for the replacement over time of operating capital such as dairy equipment, buildings, and machinery is included. A charge reflecting the opportunity cost of the funds tied up as farm operating expense, nonland capital, and in land ownership are imputed. The value of unpaid labor furnished to the production process is also imputed.

In concept, economic cost per unit of production "indicates the average break-even price needed to motivate producers to continue producing in the long run" (USDA, 1988). The usefulness of the application of the concept depends on how accurately the cash costs in the budgets fit the experiences of farmers in the area and how well the rates assigned for imputed costs reflect the perceptions and goals of the producers.

Additional differences appeared between the southwestern Wisconsin and USDA Upper Midwest budgets when economic (full ownership) costs were calculated (see table 3).

Cash Expenses Excluding Interest and Rent Cash operating expenses in table 3 are the same as reported in table 2 except for the exclusion of cash costs of interest ($1.31 per cwt.) and rent ($.28 per cwt.). They are excluded because the analysis assumes that all resources are owned debt free by the producer. The USDA Upper Midwest cash expenses remain higher than the southwestern Wisconsin costs, consistent with all their feed being charged to the dairy cow at market price instead of at cost of production, as noted earlier. The distribution of the sample farmers in terms of cash operating expenses is shown in figure 1.

Capital Replacement (Depreciation) Costs Replacement of equipment and machinery is a cash cost of continuing the farming enterprise in the long run. However, replacement can often be deferred from low income years until financial conditions are favorable. In the budgets, annual average replacement costs are imputed to reflect the necessity of replacing capital items over time for the farm business to continue in operation.

Capital replacement costs in the USDA Upper Midwest budget were $2.05 per cwt. of milk, well above the $.61 per cwt. of milk equivalents in the southwestern Wisconsin budget. Some of the difference is because dairy cows were considered to be purchased (not farm raised) in the USDA analysis, and costs of dairy cows, equipment, and machinery were based on current acquisition prices. In the USDA budgets capital replacements were calculated to "represent a charge sufficient to maintain the machinery or livestock investment and production capacity through time" (McElroy, 1987).

In the Wisconsin analysis, straight line replacement (depreciation) was estimated to be six percent of the current market value of all farm machinery, trucks, and cars, a rate which was consistent with Extension farm record analyses and observed farmer practices. Replacement was not charged against dairy cows as the cost of raising replacement cows had already been included in the total farm costs in the budgets. The imputed annual replacement costs for the southwestern Wisconsin sample farms averaged $.61 per cwt. of milk equivalent.

FIG. 1. CASH OPERATING COSTS OF PRODUCING MILK, SOUTHWESTERN WISCONSIN, 1986

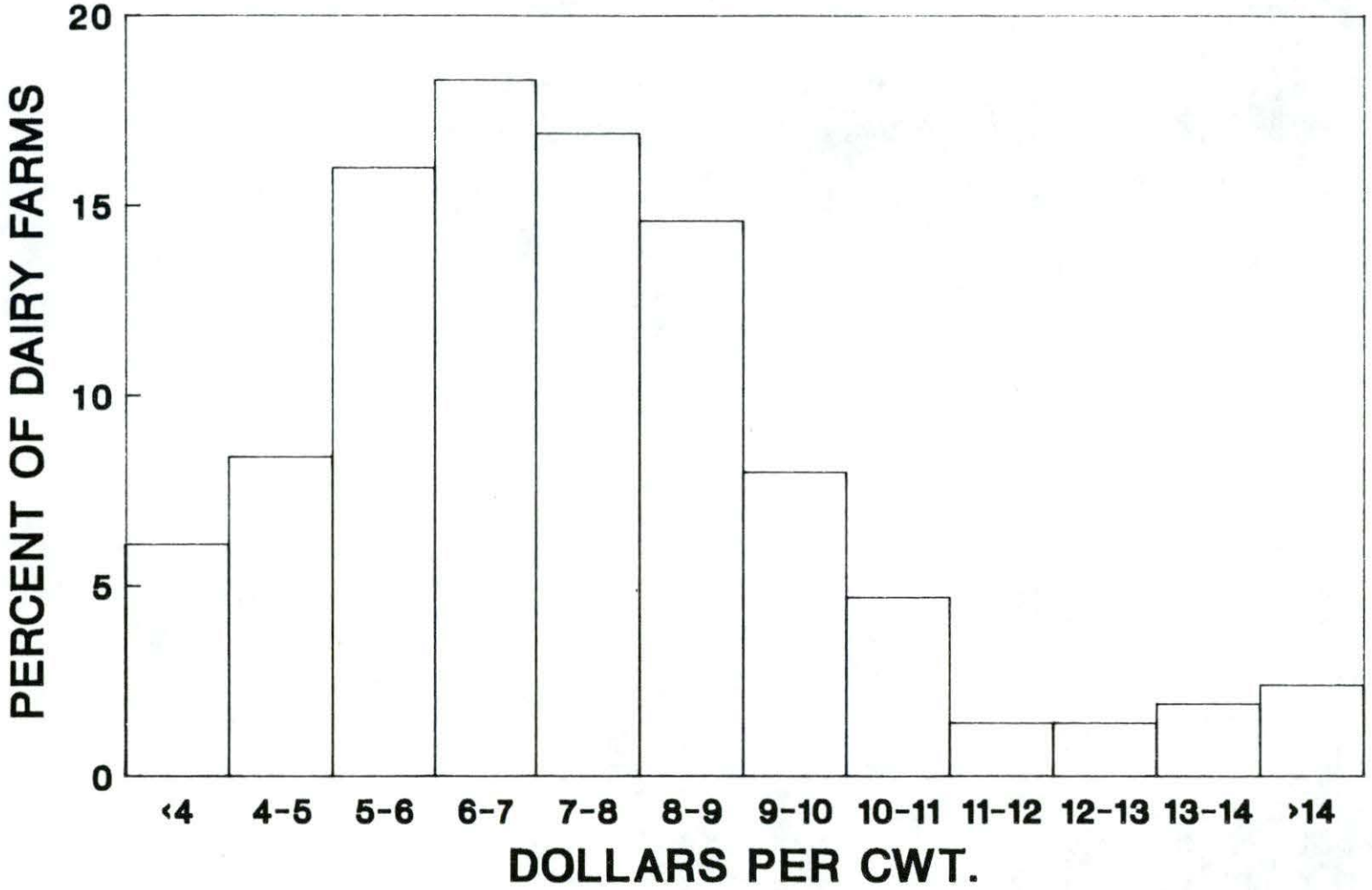


Table 3. Economic (full ownership) milk production costs and returns per cwt., from the USDA Farm Costs and Returns Surveys for the Upper Midwest and the Family Farm Survey in southwestern Wisconsin, 1986 data

Item	USDA Farm Costs & Returns Survey[a/]	Family Farm Survey Southwestern Wisconsin
Receipts per Cwt.:		
Milk	$12.10	--
Cull Cow	1.13	--
Milk Equivalent	--	$12.12
Total	$13.23	$12.12
Economic (Full Ownership) Costs per Cwt.:		
Cash Expense Excluding Interest & Rent	$ 8.57	$ 7.49
Capital Replacement (or Depreciation)	$ 2.05	$ .61
Allocated Returns to Owned Inputs:		
Operating Capital	$ .05	$ .15
Machinery, Equipment & Livestock	$ .65	$ 1.62
Land and Buildings	$ .10	$ 1.72
Unpaid Operator & Family Labor	$ .60	$ 4.19
Total Economic Costs	$12.02	$15.78
Residual Returns to Management & Risk	$ 1.21	Loss ($ 3.66)

a/ Source: Economic Indicators of The Farm Sector. Costs of Production--Livestock and Dairy, 1988, Table 16, p. 28.

Allocated Returns to Owned Inputs Producers have financial assets tied up in the farm business during part of the year as operating capital and for the entire year in equipment, machinery, livestock, buildings, and land. In calculating economic (full ownership) costs all assets were assumed to be owned debt free by the producer. "Allocated returns" is a means of imputing some reward to the producer for the use of their assets by the dairy enterprise. The earnings of those assets, had they been converted to their best alternative use, represents their opportunity cost to the dairy enterprise.

Dairy operating expenses such as purchased feed are usually converted to milk and sold in a relatively short time, i.e., the capital is not tied up for the entire year as is the case with machinery and buildings. In the USDA calculation of the opportunity cost for such operating expenses, variable expenses were multiplied by the fraction of the year they were used times the interest rate for six-month U.S. Treasury bills of 6.92 percent. In the southwestern Wisconsin study the operating costs were assumed to be tied up for six months and the opportunity cost rate of six percent was used, to reflect the returns from a nonfarm investment. This imputed return to operating capital was $.05 per cwt. of milk in the USDA analysis and $.15 per cwt. of milk equivalents in the southwestern Wisconsin budget. The difference is partly because whole farm inputs such as seed, fuel, and fertilizer are tied up longer before being harvested as feed and sold as milk than are inputs purchased for direct use by the dairy cow enterprise.

Assets in equipment, machinery, livestock, buildings, and land were allocated to the dairy enterprise or dairy farm for the entire year. It is not clear how they were valued in the USDA budgets except that they were not valued at current acquisition prices. It is clear, however, that the USDA considers the opportunity cost value of the assets equal to the long-run rate or return in agricultural assets. In the study year, the annual rate of return was based on the 10 year average rate of return to production assets in the agricultural sector, about two percent in the study year (McElroy, 1987). The USDA analysis assumed that the best alternative use for capital invested on a farm was constrained to alternatives elsewhere in the agricultural sector. Under the conditions of the USDA study, the opportunity cost of the fixed capital totalled $.65 per cwt. of milk for capital in machinery, equipment, and livestock and $.10 per cwt. for land.

Comparable calculations for the southwestern Wisconsin dairy farms were $1.62 and $1.72, respectively. Differences were partly because a) Wisconsin assets were valued at current market price, and b) the USDA investment was only for dairy buildings, equipment and the barnyards in contrast to the entire dairy farm and complete set of farm machinery in Wisconsin. More importantly, the analysis of southwestern Wisconsin dairy farms assumed that farm capital could be converted to nonfarm assets. They could be converted and invested outside the farming sector, all transaction costs and contingent liability for tax on capital gains be paid, and still yield six percent return, in contrast to about two percent in the USDA study.

Alternatively, several analysts suggest that land charges should be imputed at the going rental rate (Miller, in Ahearn and Vasavada, 1992). However, whole farm land rentals for cash are infrequent in the zone of the Wisconsin study. The USDA does report that for the tracts that were rented, land rents were about 6.7 percent of the land value (USDA, 1987). Land values in the Wisconsin survey were based on the farmers' perceptions of market value, checked against county averages for 1983 and 1987. Thus, our use of six percent of the land value as the opportunity cost of the asset gave a result that was consistent with the concept of using the rental rate.

Unpaid Operator and Family Labor Imputation of costs for unpaid family labor has generated extensive debate in the theoretical and policy-oriented literature. The concerns center on how to value the hours of family and operator labor and which hours of work should be counted (Sumner, in Ahearn and Vasavada, 1992). While some authors argue that family and operator hours should be given the same value as hired labor is paid, other writers support using the off-farm wage rates as the best means to capture the opportunity cost of the farmer's time. Those supporting the use of hired wage rates state that farm family members do not have skills for off-farm work (Ross, ibid). Yet many times hired and operator labor are not substitutes, and families indeed have alternative employment opportunities off the farm (Summer and Hallberg, ibid). Labor's share of costs probably will be higher if the off-farm, not the hired, rates are used (Huffman, ibid).

In the USDA Farm Costs and Returns Survey, the farmer was first asked on the average how many hours per week they (the operator) did farm work during each month of the year. The same question was asked for the combined effort of all other unpaid farm workers. Next, they were asked what percent of the total operator hours and what percent of the hours of the other unpaid workers were used in the dairy enterprise (Agricultural Statistics Board, 1990). This permitted calculation of the total unpaid hours for the dairy enterprise, per cow (16.83 hours) and per cwt. of milk produced (0.12 hours). Unpaid operator, family and other labor was valued by the USDA at the annual average hourly wage rate for "all hired farm workers" plus the employer's share of social security taxes, taken from secondary data sources (USDA, 1988). In 1986 that rate was $5.00 per hour, resulting in an estimated $84.15 unpaid labor costs per cow per year and $.60 per cwt. of milk produced.

The wage rates earned by household members in local off-farm employment in the southwestern Wisconsin study area were used as the opportunity cost for unpaid family labor on the farm in the Wisconsin analysis. Information concerning the hours of farm work by each household member age 16 and older were obtained during the on farm interview. The observed off-farm wage rates of farm operators (most of whom were male) and spouses of farm operators varied by years of formal education completed. Operators in the study averaged 11.7 years of formal education and were assigned a wage rate of $7.00 per hour. This was consistent with the observed wage rate of $6.95 for operators that had completed 11 or fewer years of schooling and $8.29 per hour for high school graduates. Observed off-farm wage rates for spouses were $3.68 and $5.83 for 11 years or less and 12 years of education, respectively. Wages for other adults in the household varied by years of schooling, age, and gender of the worker and most fell between three and six dollars per hour. Spouses and all other adults were assigned $4.00 per hour as the opportunity cost for their hours worked on the farm.

There were forty farms in the survey on which family members were paid for their work on the farm, and their average hourly rate was about $4.00. Wages paid by farm operators to other adults on their own farm must be viewed with caution, however. In some case, the wage rates are market transactions and reflect the contribution of the employee to the income of the farm business. However, there are opportunities for such transactions to instead be only a shifting of income among family members to reduce income tax liability.

The opportunity cost wage rates were applied to the hours the family members reported they had worked on the farm, but limited to 2000 hours for any person, the maximum they could have worked in full-time employment in an off-farm job. Given that all of the farm revenue was converted to milk equivalents, all operator and family labor hours were attributable to the dairy enterprise. These totalled $4.19 per cwt. of milk equivalent, in contrast to the $.60 per cwt. of milk in the USDA analysis.

A major part, but not all of this difference was because the southwestern Wisconsin dairy farm study included hours for the entire farm operation including crop production, while the USDA Upper Midwest study included only the direct labor for caring for the dairy cow. In the southwestern Wisconsin study, total labor per dairy cow was calculated as total household farm labor divided by the number of milking and dry cows, and averaged 114.9 hours per year. This total included the direct labor for caring for the milking herd and young stock, plus labor to produce the feed for the dairy herd, hauling manure, and general farm upkeep. A recent study of Massachusetts family dairy farms showed an average of 115.3 labor hours per cow per year on the same basis (Lass and Gempesaw, 1990).

These survey data appear reasonable compared with an earlier time-and-motion study of the direct labor involved with the dairy herd in seven Wisconsin dairy herds (Morosov, et al., 1970). Morosov measured the per cow time for the direct operations connected with milking, distributing feed, cleaning buildings and lots, caring for calves, and miscellaneous tasks such as record keeping and examining cows. He found the minimum of these direct hours per cow to be 39 per year for one 270 cow herd milked in a herringbone parlor, while a second 87 cow herd milked in a parlor required 57 hours per cow. Two other herds milked in parlors had 60 and 53 cows respectively, that required 73 and 80 hours per cow. There were three herds ranging in size from 40 to 58 cows that were milked in stanchion barns and requiring from 58 to 86 hours per cow per year. The herds in the Morosov case studies used dairy barn technology that is still the norm in Wisconsin today. His data on direct time spent with the dairy herd support the reasonableness of the southwestern Wisconsin whole farm data, and raise questions about the USDA estimates of only 16.83 hours per cow per year (Betts, 1989; Davenport, 1986).

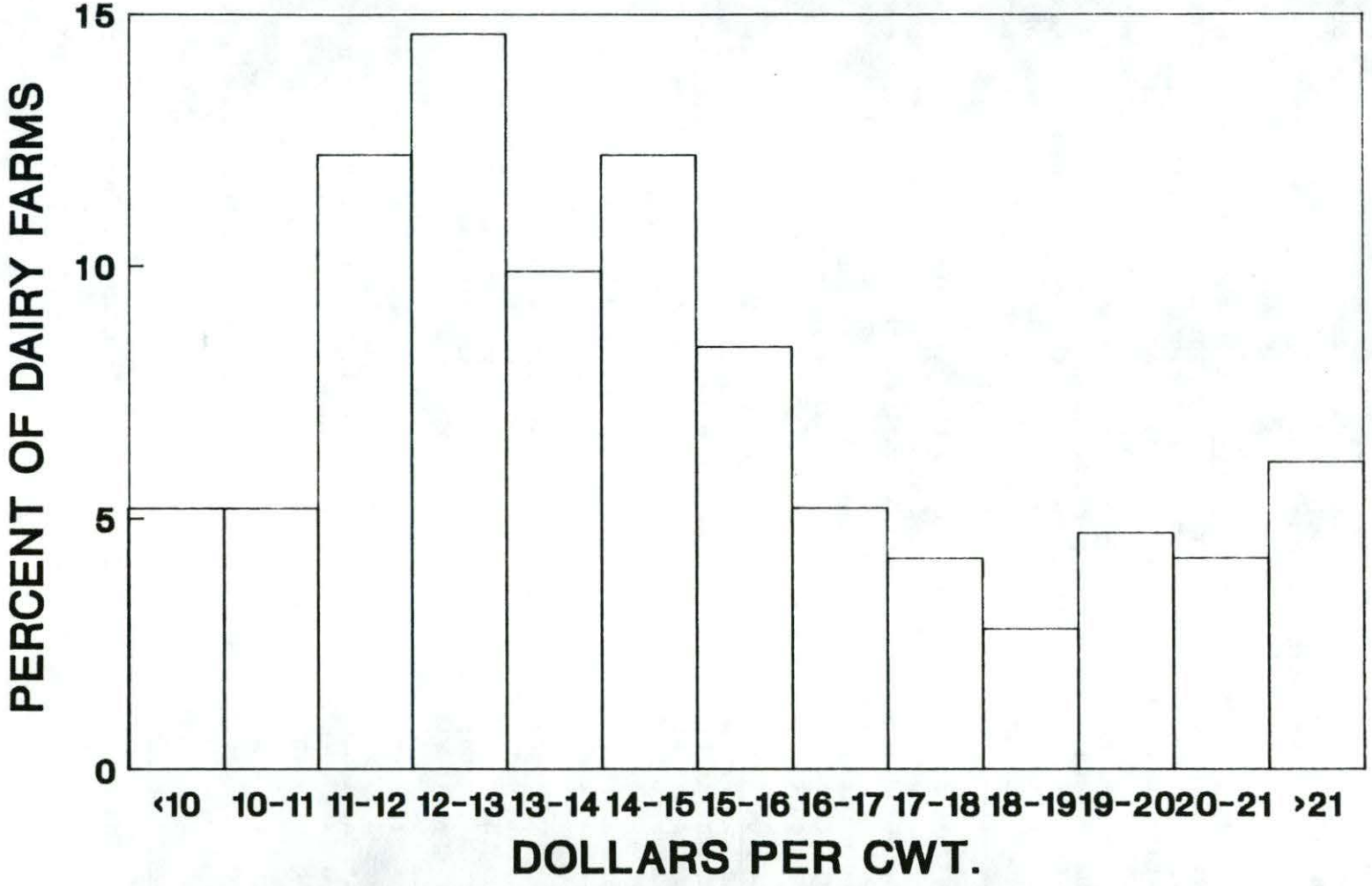
A second source of difference in the allocated returns to the unpaid operator labor were in the wage rates used, $5.00 in the USDA study and $7.00 in the southwestern Wisconsin study. In the USDA study the wage rate of hired farm workers was used, with the notion that any return to the management component of the operator's labor input would show up in the residual for risk and management. In the Wisconsin study, the wage rate is the observed opportunity cost of the operator not working off the farm, based on the concurrent experience of peers in the southwestern Wisconsin study area that did work off the farm. As Huffman (1991) writes: "The USDA substantially underestimates both the hours and the wage or cost of farm work; the main problems with the new ERS methodology (to ask farmers about the hours of labor performed on farm) are i) farmers exclude the amount of time allocated to management in the form of marketing and ii) farmers may not know very well the hours worked by hired labor when this labor is obtained through contractors.."

Interpretation of the Economic (Full Ownership) Costs of Production

As reported in table 3, the total economic (full ownership) costs of production were $12.02 per cwt. in the USDA study of the Upper Midwest and $15.78 per cwt. in the southwestern Wisconsin study. The distribution of the sample farms in terms of total economic costs is shown in figure 2.

The Residual Compared with the receipts, these costs left a positive residual return of $1.21 per cwt. to "management and risk" in the USDA analysis. The negative return of $3.66 per cwt. in the southwestern Wisconsin analysis must be interpreted differently, however. In that study the "management" input had already been included implicitly in assigning a charge of $7.00 per hour for the operators' hours of farm work, instead of the $4.00 per hour charged for persons that provided only "labor."

FIG. 2. TOTAL ECONOMIC COSTS OF PRODUCING MILK, SOUTHWESTERN WISCONSIN, 1986



The negative residual of $3.66 per cwt. can be considered to be a measure of how much more the economy would have preferred that some resources allocated to the production of milk would have instead been put to alternative uses in the nonfarm economy. In this analysis the land, labor, management, and capital used on the southwestern Wisconsin dairy farms were "charged" their nonfarm opportunity cost rates. That is, other entities in the nonfarm economy would have been willing to employ them and would have been able to pay them more than they earned on the dairy farm with milk at the observed price. The differential between what could have been earned in the nonfarm economy versus what was earned on the southwestern Wisconsin dairy farms producing milk is the equivalent of $3.66 for every hundredweight of milk produced.

Components of Total Economic Costs Across the 213 southwestern Wisconsin dairy farms, the total production cost per hundredweight had a mean of $15.78 with a standard deviation of $5.52, including all the imputed costs. At $7.49 average cost per cwt., the cash operating expenses (especially feed) were the largest component of production costs. The average amount of purchased feed, at $252 per cow per year in the Wisconsin sample, was moderate compared to USDA budgets showing $386 per cow in the Upper Midwest region (Davenport, 1986). At $4.19 per cwt., the opportunity cost of labor was the second largest cost. Other economic costs were the opportunity cost of owned capital that accounted for $3.49 per cwt., while depreciation or replacement of capital was $.61 in the Wisconsin study.

Among the USDA sample farms the cash farm operating expenses were also the largest component of production costs, at $8.57 per cwt., but in contrast with the southwestern Wisconsin analysis the unpaid labor costs were the smallest component and averaged $.60 per cwt. The opportunity cost of owned inputs was $.80 per cwt., compared to $3.49 for the southwestern Wisconsin dairy farms. Depreciation or capital replacement was $2.05 in the USDA study, compared to $.61 in southwestern Wisconsin.

Costs vs. Price in Southwestern Wisconsin Total economic costs for the southwestern Wisconsin dairy farmers had a mean of $15.78 per cwt. The midpoint in the range of costs (the median) was $14.13, with about one-half the farmers with total economic costs less than that and one-half with costs greater than that level (see figure 3). Twenty-four percent of the sample farmers covered total economic costs, i.e., they and their resources earned at least as much as dairy farmers as they could have earned in their nonfarm alternatives at the observed price of milk.

The remaining 76 percent of the sample dairy farmers did not cover total economic costs with the 1986 price of milk at $12.12 per cwt. This does not mean that they are "going out of business" but only that they could have earned greater economic returns in nonfarm alternatives, given the price that society was willing to pay for milk at that time.

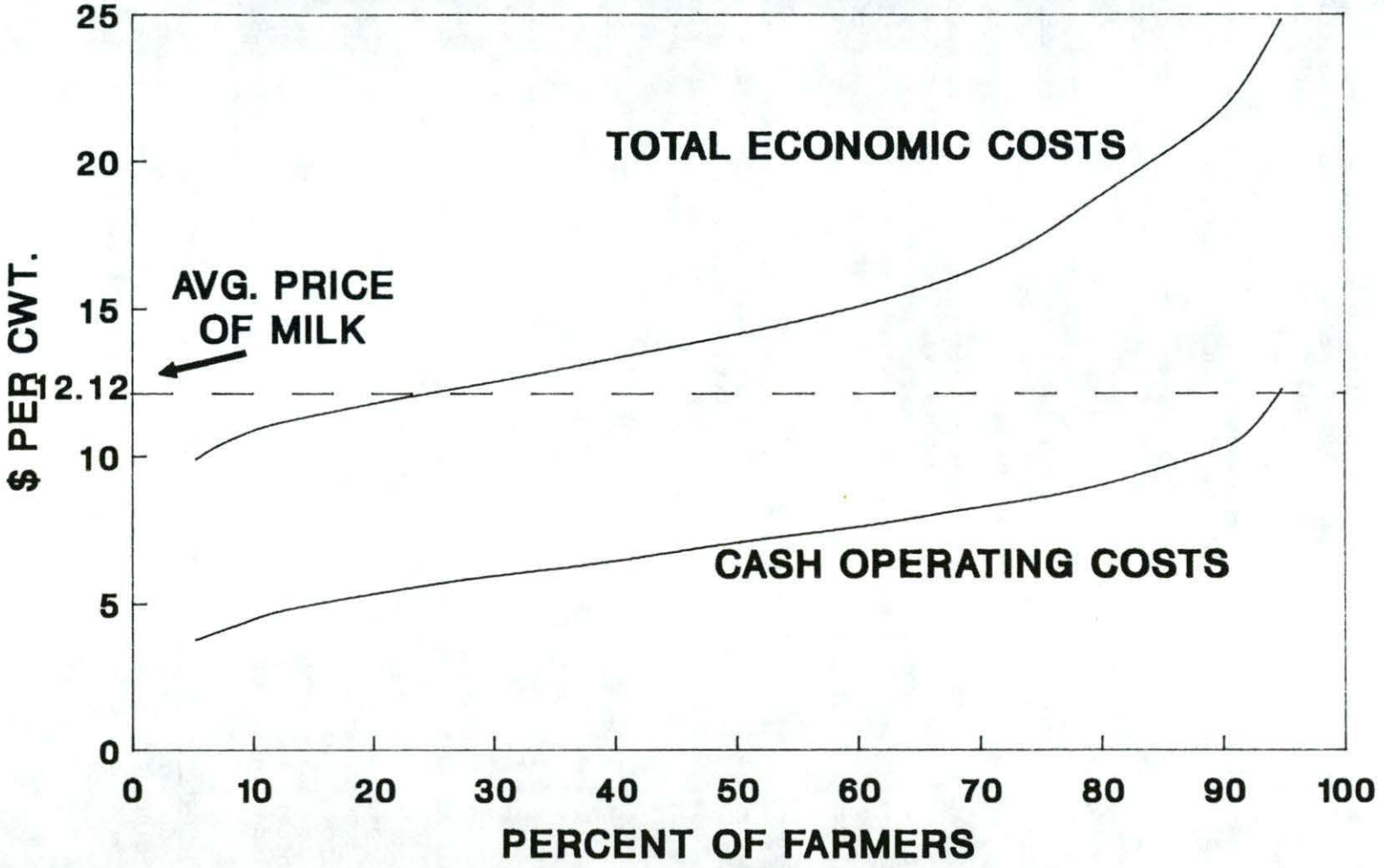
In contrast, cash operating costs averaged $7.49 per cwt. and were covered by 94 percent of the southwestern Wisconsin dairy farmers in 1986. That is, about six percent of the sample farmers had cash farm receipts that were less than their cash farm expenses. In addition, about 12 percent had cash operating costs greater than $10.00 per cwt.

The median cash operating cost was $7.14 per cwt., i.e., half the producers had cost above and half had costs below that midpoint dividing line.

Summary and Conclusions

The economic costs of production from the southwestern Wisconsin dairy farm survey were 30 percent higher than the USDA calculations for the Upper Midwest region for the same year. The large difference is important,

FIG. 3. DISTRIBUTION OF FARMERS BY CASH OPERATING COSTS AND TOTAL ECONOMIC COSTS OF PRODUCING MILK, SOUTHWESTERN WISCONSIN, 1986



particularly because the Wisconsin results demonstrate a negative residual return on average, whereas the USDA report would conclude that on average farmers operate profitably. Identifying the differences in costs, documenting a valid perspective on costs, and interpreting the costs are important for public policy reasons and for farm decision making.

While the calculations for establishing the farm price of milk within the federal dairy support policy does not explicitly consider the farmers' costs of producing milk, the political process of creating the dairy legislation draws on evidence supporting the need for such legislation. Differences in farm costs of production among the major producing areas within the United States also has relevance in the domestic policy debate over the artificial barriers to regional trade in dairy products.

Valid cost of production estimates are important to agriculture in the private sector as well. Cost of production reports provide farm decision makers with additional information about their competitors and are useful planning information for the agricultural credit and farm input industries that service producers' needs. However, individual dairy farm business analyses focused on profitability, liquidity and solvency probably address the information needs of individual farm producers and their farm advisors more directly than do industry cost of production studies.

What, then, are the sources of differences between the two estimates presented here? Is one estimate more "valid" than the other? How might the results be interpreted? After comparing the methods and results of the region-wide ERS data and the state-level Wisconsin survey, it appears that crucial differences arise in allocation of costs and calculations of capital replacement, land, and labor.

Sampling and Data Collection It seems unlikely that the sampling schemes or differences in the populations that were sampled could have caused the observed differences in costs. The similarities in the major relevant characteristics between the southwestern Wisconsin sample of dairy farms and the Upper Midwest population of dairy farms reported in table 1 supports, but does not establish in a statistically measurable way, this assertion.

Differences in Concepts The USDA analysis utilized an "enterprise budget" approach to production costs in contrast to the "single farm product" approach used in the southwestern Wisconsin study in which the entire farm business was collapsed into one product. In the enterprise budget approach the issue is how the dairy cow enterprise fares while in the single farm product approach the focus is on the dairy farm as a unit.

The differences in concepts leads to differences in the budgets as a) home raised feed is charged to the dairy cow at market prices in the USDA budget, while the seed, fertilizer, fuel, labor, machinery, and land costs of producing the feed show up in the Wisconsin budgets; b) the replacement springing cow is purchased in the USDA budget while the cost of raising replacement animals is included in the Wisconsin costs; c) land, machinery and equipment charges in the USDA budget include only the building site, the barn, and the dairy equipment vs. all farm land and the full complement of crop machinery and livestock equipment in the Wisconsin study; and d) labor included in the USDA budgets includes only the direct labor connected with the dairy enterprise, while total farm labor is included in the Wisconsin budgets.

Cash Operating Expenses Using direct costing methods, the USDA budgets include variable costs of the dairy enterprise such as veterinary services and medicines, Dairy Herd Improvement Association fees, and dairy assessments. The Wisconsin budget includes those items plus all other crop production and farming costs such as seed, fertilizer, lime, chemicals, and hired custom work.Most dairy farms in the Upper Midwest produce the majority of the feed

consumed by the dairy enterprise and crop production and dairying are integrated. Raising the crops and selling them off the farm for "market prices" likely is not feasible because of the large quantity of forage material to be transported and the lack of well established markets. Hence, it is nearly impossible to separate the dairy production per se from other farm products (such as oats, grains, and feed). This study attempts to reconcile the problem by converting all farm income to milk equivalents.

Capital Replacement (Depreciation) Annual replacement costs were imputed to reflect the need to replace capital items over time for the farm business to continue in operation. Capital replacement costs in the USDA Upper Midwest budget included purchase price of replacement dairy cows, dairy equipment, and dairy machinery based on current acquisition prices, representing "a charge sufficient to maintain the machinery or livestock investment and production capacity through time." In the Wisconsin analysis, straight line replacement (depreciation) was estimated to be six percent of the current market value of all farm machinery, trucks, and cars, consistent observed farmer practices. The cost of raising replacement dairy cows was instead included in the total farm operating costs in the budgets. While most farmers near retirement do not replace their machinery and equipment and the "replacement cost of equipment and machinery" is not a cash cost for them, this adjustment was made in neither budget.

Allocated Returns to Owned Assets (Nonfarm Opportunity Costs) In the USDA calculation of the opportunity costs for operating expenses, variable expenses were multiplied by the fraction of the year they were used times the interest rate for six-month U.S. Treasury bills of 6.92 percent. In the southwestern Wisconsin study the operating costs were assumed to be tied up for six months and the opportunity cost rate of six percent was used, to reflect the returns from a comparable-risk nonfarm investment. The difference is partly because whole farm inputs such as seed, fuel, and fertilizer are tied up longer before being harvested as feed and sold as milk than are inputs purchased for direct use by the dairy cow enterprise.

It is not clear how equipment, machinery, livestock, buildings, and land were valued in the USDA budgets except that they were not valued at current acquisition prices. The USDA used the long-run rate of return in agricultural assets, about two percent, as the opportunity cost rate. Differences with the southwestern Wisconsin dairy farm study were that Wisconsin assets were valued at current market price, they included the entire dairy farm and complete set of farm machinery, and they recognized that farm capital could be converted to nonfarm assets and earn those nonfarm rates of return.

Unpaid Labor A major source of divergence between the Wisconsin survey estimate of $15.78 per hundredweight total economic costs of milk production and the USDA estimate of $12.02 per hundredweight lies in the different accounting of the household labor hours imputed. The issue of labor valuation is a source of debate among agricultural economists. Underestimation of labor leads to policy statements about the continued profitability of farming that may mask the economic reality.

Farm labor hours must be carefully enumerated, and the 16.8 hours of direct labor used by the USDA for the dairy cow enterprise seems unrealistic from a producer's perspective and inconsistent with earlier time and motion studies. In addition, the USDA used the hired farm worker wage rate as a charge for operator dairy labor with a return to the management function being included with risk as a residual. The Wisconsin study included total farm hours, not just the dairy cow enterprise hours, and charged $7.00 per hour for the labor and management of the farm operator. This rate was the local nonfarm wage rate and it is argued that such rates are the relevant signal to farm operators and farm household members regarding their nonfarm employment opportunity costs.

References Cited

Agricultural Statistics Board, National Agricultural Statistics Service, U.S. Department of Agriculture. 1986 Farm Costs and Returns Survey. Form Approved. O.M.B. Number 0535-0125. Expiration Date October 31, 1987.

Agricultural Statistics Board, National Agricultural Statistics Service, U.S. Department of Agriculture. 1989 Farm Costs and Returns Survey, Dairy. Form Approved. O.M.B. Number 0535-0125. Expiration Date October 31, 1990.

Ahearn, M., R. Dubman, and G. Hanson. "Financial Performance of Specialized Dairy Farms." Agricultural Information Bulletin No. 519, ERS, USDA. Washington, DC. July 1987.

Ahearn, M., and U. Vasavada, eds. Costs and Returns for Agricultural Commodities: Advances in Concepts and Measurement. Boulder: Westview Press, 1992.

Alvarez, A., J. Belknap, and W. Saupe. "Efficiency and Resource Allocation in Agriculture: Measures from a Production Function Applied to Dairy Farms in Northern Spain," Staff Paper No. 264, Department of Agricultural Economics, University of Wisconsin-Madison. January 1987.

Baker, Derek et al. "Estimates of the Costs of Producing Milk in Seven Major Milk-Producing Countries, 1986". Commodity Economics Division, ERS, USDA. Washington, DC. August 1990.

Bentley, S. and W. Saupe. "Exits from Farming in Southwestern Wisconsin, 1982-86." Agricultural Economics Report No. 631. ERS, USDA. Washington, DC. February 1990.

Betts, C. "Cost of Producing Milk." USDA, Dairy Situation and Outlook Report. USDA. Washington, DC. 1989.

Betts, C. "Cost of Producing Milk, 1975-84." Agricultural Economic Report Number 569, ERS, USDA. Washington, DC. February 1987.

Bravo-Ureta, B. "Technical Efficiency Measures for Dairy Farms Based on a Probabilistic Frontier Function Model." Canadian Journal of Agricultural Economics, 34(4), p. 339-415, 1986.

Buxton, B. and H. Jensen. "Economies of Size in Dairy Farming." Agricultural Experiment Station Bulletin 448. University of Minnesota. 1968.

Buxton, B., T. McGuckin, R. Selley and G. Willett. "Milk Production: A Four-State Earnings Comparison." Agricultural Economics Report 528. ERS, USDA. Washington, DC. 1985.

Davenport, G. "State-Level Costs of Production - 1986". Staff Report AGES880122. ERS, USDA. Washington, DC. March 1987.

Frank, Gary F. Agricultural Accounting and Information Systems: User's Guide. Department of Agricultural Economics, University of Wisconsin-Madison\Extension. November 1990.

Grisley, W. and J. Mascarenhas. "Operating Cost Efficiency on Pennsylvania Dairy Farms". Northeastern Journal of Agricultural and Resource Economics, 14(1), p. 88-95. 1985.

Huffman, W. "Costs and Returns: A Perspective on Estimating Costs of Human Capital Services and More." Chapter 18 in Ahearn and Vasavada. 1992.

Jesse, E. "The Relationship Between Milk Production per Cow and Herd Size in Wisconsin." Marketing and Policy Briefing Paper No. 15 Dept. of Agricultural Economics, University of Wisconsin-Madison. July 1987.

Jones, Bruce. "Potential for Financial Stress in Wisconsin Dairy Farms in 1991". Managing the Farm, Volume 24, No. 1. Dept. of Agricultural Economics, University of Wisconsin-Madison. January 28, 1991.

Kimball, N. and W. Saupe. "Cost of Producing Milk on Selected Wisconsin Dairy Farms." Research Report 61. Research Division, College of Agricultural and Life Sciences, University of Wisconsin-Madison. 1970.

Klemme, R. "Estimating and Interpreting Dairy Production Costs and Cash Flow Requirements." Economic Issues. Number 82. Dept. of Agricultural Economics, University of Wisconsin-Madison. November 1983.

Lass, D. and C. Gempesaw. "The Optimality of Input Allocation by Massachusetts Dairy Producers." Working Paper, Dept. of Resource Economics, University of Massachusetts, Amherst. 1989.

Libbin, J. and L. Torell. "A Comparison of State and USDA Cost and Return Estimates." Western Journal of Agricultural Economics, 15(2), p. 300-309. 1990.

McElroy, Robert G. "Major Statistical Series of the U.S. Department of Agriculture, Volume 12: Costs of Production." Agriculture Handbook No. 671. ERS, USDA. pp. 1-4. September 1987.

Miller, T. "How Economic Theory Should Guide What We Measure." Chapter 19 in Ahearn and Vasavada. 1992.

Morosov, N. et al. "Labor Requirements of Seven Wisconsin Dairy Herds." Research Report 16. Cooperative Extension Programs, University Extension, University of Wisconsin. 1970.

Pasour, E. C. "Cost of Production: A Defensible Basis for Agricultural Price Supports?." American Journal of Agricultural Economics, pp. 244-48. May 1980.

Peterson, G. and H. Cook. "Size and Costs of Production on Wisconsin Farms Producing Grade A or Grade B Milk" Staff Paper No. 52. Dept. of Agricultural Economics, University of Wisconsin-Madison. October 1972.

Ross, C. "Comments" in Ahearn and Vasvada. 1992.

Salant, Priscilla. "Family Farms in Mississippi-Tennessee Sand Clay Hills: Survey Highlights." ERS Staff Report AGES820412. ERS, USDA. April 1982.

Salant, Priscilla, et.al. "Highlights from the 1983 Wisconsin Family Farm Survey." R3294. College of Agricultural and Life Sciences, University of Wisconsin-Madison. December 1984.

Salant, Priscilla, et. al. "Farm Viability: Results of the USDA Family Farm Surveys." Rural Development Research Report No. 60. ERS, USDA. July 1986.

Schraufnagel, S. and P. Clark. "Dairy Farm Financial Parameters." Managing the Farm, Volume 23, No. 1. Dept. of Agricultural Economics, University of Wisconsin-Madison. February 28, 1990.

Sumner, D. "Human Capital Issues in Measuring Costs of Production." Chapter 17 in Ahearn and Vasavada. 1992.

Tauer, L. and K. Belbase. "Technical Efficiency of New York Dairy Farms." Northeastern Journal of Agricultural and Resource Economics. 16(1), pp. 10-16. 1987.

U.S. Department of Agriculture. Agricultural Statistics 1987. Table 474. U.S. Government Printing Office, Washington, DC. 1987.

U.S. Department of Agriculture. Economic Research Service and National Agricultural Statistics Service. "Economic Indicators of the Farm Sector, Costs of Production - Livestock and Dairy, 1988." Washington, DC.

U.S. Department of Commerce, Bureau of the Census. "1987 Census of Agriculture." Volume 1, Part 22. Michigan, State and County Data. May 1989.

U.S. Department of Commerce, Bureau of the Census. "1987 Census of Agriculture." Volume 1, Part 23. Minnesota, State and County Data. June 1989.

U.S. Department of Commerce, Bureau of the Census. "1987 Census of Agriculture." Volume 1, Part 49. Wisconsin, State and County Data. March 1989.