Cost of Production for Stanchion Versus Parlor Milking in New York

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ABSTRACT
Curves describing the unit cost of production by herd size were estimated separately for stanchion and parlor milking systems using empirical data for 1995 from 403 New York dairy farms. The least cost size for stanchion barns was 120 cows, for which the total cost of producing a hundredweight of milk was $13.86, or $1.00 less than the cost of producing milk using a parlor system with 120 cows. With more than 160 cows, milk was produced at a lower cost using a parlor rather than a stanchion system. Parlors have a minimum cost that is about $2.00 less than the minimum cost of the stanchion barns.

(Key words: milk production, cost, stanchion, parlor milking)

INTRODUCTION
Casual observation leads to the general inference that small dairy farms milk in stanchion barns, and large dairy farms milk in parlors. Parlors have large fixed costs, and it is reasonable to infer that a large throughput of cows is necessary to justify the capital expenditure. In contrast, stanchion barns are labor intensive, limiting their use to farms with fewer cows. If these observations and reasonings are correct, it would be useful to know the specific size at which a dairy farm should switch from stanchion to parlor milking. Even if stanchion barns are appropriate for smaller farms, it is not known whether the cost of production per unit of milk for a dairy using stanchions is greater or lower than a much larger dairy using a milking parlor. This knowledge would be invaluable in the debate on the future structure of dairy farms in the US because operations with the lowest cost of production predominate in a competitive industry (6).

The purpose of this paper is to estimate the unit cost of production for stanchion and parlor milking systems by herd size using empirical data for 1995 for dairy production from New York. Empirical cost curves, which show the cost of producing a hundred-weight of milk by size of the dairy operation, allow the determination of the most efficient milking system by farm size. Further, these curves allow the discernment of whether parlor barns or stanchion barns have a lower minimum cost of production.

Studies on the cost of production have a long tradition in the agricultural economics literature, and, through the years, the cost of production by size has been estimated for various commodities and regions of the US (3, 8). Most data analyses show an L-shaped curve: the cost per unit diminished significantly as size first increased, but then cost per unit became relatively flat for even larger units (2). Recent cost studies (1, 4) of dairy production have found lower unit costs with larger production units.

MATERIALS AND METHODS
The New York Dairy Farm Business Summary program (7) summarizes the financial and production status of individual dairy farms in the state of New York. For calendar year 1995, 403 farms participated in this program. Although the primary purpose of the project was to assist dairy farms in assessing their business to make changes and improvements, the data are also used for research purposes. Of the 403 farms analyzed, 191 used stanchion barns with pipelines to deliver the milk to the holding tank. The smallest of these stanchion farms had only 28 cows, and the largest had almost 400 cows; mean was 71 cows, median was 62, and standard deviation was 37. Another 13 farms used stanchions without a pipeline. These 13 farms were excluded in the analysis. Of the 199 farms that used parlor milking systems, 151 of those were identified as herringbone systems and 48 as other parlor systems. The smallest parlor barn had 37 cows, and the largest had over 2500 cows; mean was 224 cows, median was 62, and standard deviation was 37. Another 13 farms used stanchions without a pipeline. These 13 farms were excluded in the analysis. Of the 199 farms that used parlor milking systems, 151 of those were identified as herringbone systems and 48 as other parlor systems. The smallest parlor barn had 37 cows, and the largest had over 2500 cows; mean was 224 cows, median was 62, and standard deviation was 37. There is a large amount of overlap in size between the two types of milking systems, and many stanchion and parlors have 80 to 120 cows. This overlap makes determination of the cost structure of the two different milking systems even more pertinent.
The total production cost per hundredweight of milk was computed for individual farms (7). Total cost included all operating costs, depreciation, opportunity cost of equity capital, operator's labor and management, and the value of unpaid family labor and encompassed all of the operating, depreciation, and imput costs of producing milk. Over the long run, these total costs need to be met, although, in the short run, only operating (variable) costs need to be covered. Also available was the mean number of dairy cows that each farm milked during the year, which was used as the measure of farm size.

Ordinary least squares analysis was used to regress total production cost per hundredweight of milk on cow numbers. Third-degree polynomial curves for cost were fitted to the data for stanchion farms and then separately for parlor farms because fourth degree coefficients were statistically insignificant.

A cost curve rather than a cost function was estimated because price information had not been collected on these farms, except for an implicit milk price and wage rate. Even then, the variation of the wage rate was so large that it probably mostly reflected variations in labor quality across farms. A cost function would have been useful to allow determination of how the per unit cost of the milk systems would change as prices change. For instance, if parlors are more labor efficient than stanchions, then an increase in the price of labor would decrease the cost function of parlors relative to stanchion milking systems.

RESULTS AND DISCUSSION

Figures 1 and 2 are scatter diagrams of the total cost of production per hundredweight of milk for stanchion barns and parlor barns, respectively, by the number of cows. In both plots, the number of cows and costs for the largest 4 farms were not shown to prevent disclosure. Although there is significant scatter of these costs, the highest costs of production are found on the smaller farms. At the same time, some of the smallest farms have the lowest costs of production. This phenomenon suggests the concept of "survivorship" in cost of production (9); that is, only low cost producers survive over time, and many of them may become larger. Thus, although some smaller farms have large costs, none of the large farms have large costs.

Regression results are shown in Table 1 and plotted in Figures 1 and 2. The adjusted $R^2$ value is only 0.13 for the stanchion cost and 0.22 for the parlor cost, which indicates a large variation among farms even when number of cows is the same. This disparity is important because the plotted curves are only for average farms, and, although at a certain quantity of cows, stanchions may have lower average cost than parlors to produce a hundredweight of milk or vice versa, the result might be quite different for any individual dairy farm. The null hypothesis of equal coefficients between the stanchion and parlor equations was rejected with the Chow test ($F = 6.35; P = 0.0001$). The Chow test determines whether splitting the total data file into stanchion and parlor subsets reduces the total sum of squares.

The least cost size for the stanchion milking system was 120 cows for which the total cost of producing a hundredweight of milk was $13.86. This amount was almost $1.00 less than the $14.80 required to produce milk using a parlor system with 120 cows. With more than 120 cows, the cost of producing milk increased for the stanchion barn but continued to decrease for the parlor until costs became equal at $14.38 with 160 cows. Beyond 160 cows, milk production was cheaper with the parlor than with the stanchion.
Parlors have a minimum cost of $11.80 at about 725 cows, which is more than $2.00 lower than the minimum cost of producing milk in stanchions.

If a farm has fewer than 160 cows, it appears that a stanchion barn should be used, yet there are many parlors in the data file that have fewer than 160 cows. Even if the average cost structure of these farms is greater than the cost of a stanchion, these parlors can still be justified. First, results are for average farms, and individual farms may have cost structures that are different from those of average farms. Second, one major justification for parlors is that they make more efficient use of labor and can be less physically demanding on milkers. The farmers themselves are often milkers, and they might logically be expected to opt for a milking system that is not as strenuous. Third, on average, these farms increase in size each year. Eventually most would reach the size where the parlor is the least cost milking system. Many have decided to go to these systems before the critical size of 160 cows is reached. Finally, the costs presented are for the economic environment of 1995. A different year of data might shift the cost curves.

Because data were differentiated by herringbone and other parlors, separate cost equations could be estimated for these two parlor groups. These equations are also shown in Table 1. The specific parlor type in the category of other parlors was not surveyed but probably consists mostly of parallel design units, and many of those likely have complex control and monitoring systems. A Chow test did not reject the null hypothesis that the coefficients of the herringbone and other parlors are equal ($F = 0.66; P = 0.62$). Both appear statistically to have similar cost structures.

### CONCLUSIONS

The results clearly show that small stanchion barns have lower cost than milking parlors on farms of similar size. However, for farms that have 160 cows, parlors are more cost efficient, and eventually parlors have a minimum cost that is $2.00 lower than stanchion barns. This relationship between size and cost has led many to predict the demise of the small dairy farm. Indeed, from 1985 through 1993, the number of New York dairy farms with fewer than 30 cows decreased 48%, and the number of New York dairy farms with more than 100 cows increased 3% (5). However, the data also illustrate that small stanchion dairy farms exist that have a lower cost of production per hundredweight than the larger parlor milking farms. These smaller dairy farms can survive, although many of their higher cost neighbors will not.

### ACKNOWLEDGMENTS

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### REFERENCES


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**Table 1. Estimated cost curves for various milking systems.**

<table>
<thead>
<tr>
<th></th>
<th>Stanchion</th>
<th>All parlors</th>
<th>Herringbone</th>
<th>Other</th>
</tr>
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<tbody>
<tr>
<td>Intercept</td>
<td>22.09</td>
<td>16.32</td>
<td>16.80</td>
<td>16.68</td>
</tr>
<tr>
<td>($t$ stat.)</td>
<td>(15.52)</td>
<td>(46.37)</td>
<td>(29.41)</td>
<td>(23.21)</td>
</tr>
<tr>
<td>Cows</td>
<td>-0.1579</td>
<td>-0.0142</td>
<td>-0.0210</td>
<td>-0.0156</td>
</tr>
<tr>
<td>($t$ stat.)</td>
<td>(-3.99)</td>
<td>(-5.57)</td>
<td>(-3.63)</td>
<td>(-3.27)</td>
</tr>
<tr>
<td>(Cows)$^2$</td>
<td>0.0000917</td>
<td>0.0000134</td>
<td>0.0000339</td>
<td>0.0000146</td>
</tr>
<tr>
<td>($t$ stat.)</td>
<td>(3.12)</td>
<td>(5.57)</td>
<td>(2.28)</td>
<td>(2.35)</td>
</tr>
<tr>
<td>(Cows)$^3$</td>
<td>-0.00000144</td>
<td>-0.0000000333</td>
<td>-0.0000000174</td>
<td>-0.00000000333</td>
</tr>
<tr>
<td>($t$ stat.)</td>
<td>(-2.70)</td>
<td>(-2.89)</td>
<td>(-1.79)</td>
<td>(-1.98)</td>
</tr>
<tr>
<td>Observations</td>
<td>191</td>
<td>199</td>
<td>151</td>
<td>48</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.13</td>
<td>0.22</td>
<td>0.20</td>
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</tr>
</tbody>
</table>

$^1$The $t$ statistics are in parentheses.