

## Using Investment Data To Supplement Cost Estimates

In the ARMS data, average costs of dairy production fall sharply as herd sizes increase. Econometric analyses of the data strongly suggest that there are scale economies in dairy production, and there is evidence that costs continue to fall as herd sizes pass 1,000 head. But the econometric studies differ in their estimates of the magnitude of scale economies, and hence of the driving forces behind the cost-size relationship. T&M attribute most of the large cost difference between large and small dairies to widespread inefficiency among small producers. M&L find more inefficiency among small producers, but also find that scale economies create substantial cost advantages for large dairies.

In addition, the 2000 ARMS dairy sample contained few farms with more than 2,000 cows. While it is much more extensive, the 2005 sample is also thin for very large sizes. As a result, the data cannot be used to provide reliable estimates of cost differences among very large dairy farms, and we cannot learn much about maximum efficient scale.

Because the ARMS data provide only limited observations for tracking costs among large operations, and because the econometric estimates offer conflicting estimates of the importance of scale economies, we supplemented the analyses by tracking capacity additions.

We use an approach known as a “survivor analysis” (Stigler, 1958), which is based on the assumption that owners will build new plants at sizes that realize the lowest costs for the era in which they are built (that is, for the existing technology and input prices). If that is true, then one ought to be able to infer the efficient range of plant sizes by analyzing the investment decisions made by operators of new plants. The approach does not require detailed cost information, but does require complete information on the size distribution of herds in each of several periods.

Fortunately, we have such information available from census of agriculture records (Appendix). We use data from the 1992, 1997, and 2002 censuses to analyze changes in the distribution of dairy farm sizes.<sup>15</sup> The total number of dairy cows fell from 9.5 million in 1992 to 9.1 million in 1997, where it remained in 2002 (table 7). But cows shifted to much larger farms. Farms with fewer than 200 milk cows accounted for 68 percent of all dairy cows in 1992, but lost nearly 2.5 million milk cows over the next 10 years as their share of total cow inventory fell to 44 percent. Meanwhile, farms with at least 1,000 cows gained over 1.7 million cows as their share of national inventory grew from 10 to 29 percent. Those investment decisions are entirely consistent with the COP findings (tables 3 and 4) that larger farms generally achieved economic profits (returns above the costs of capital), while farms with fewer than 500 cows incurred economic losses.

To learn more about behavior among large dairies, all farms with at least 1,000 milk cows were sorted into more detailed size classes, and size distributions for each census year were compared. Dairy farms with at least 1,000 cows added 653,000 dairy cows during 1992–97. Farms with 1,000–1,999

<sup>15</sup>The data in table 7 are drawn from censuses of agriculture, instead of the annual USDA/NASS surveys that underlie table 1. The census, conducted every 5 years, is less timely but more comprehensive.

head added 43 percent of that total, and farms with 2,000–2,999 head added another 28 percent (fig. 5). The remaining 29 percent of the added inventory, or 190,000 cows, was added by farms with at least 3,000 head. Large dairy farms in 1992–97 generally had between 1,000 and 3,000 cows.

The pattern changed sharply in 1997–2002. Large dairies as a group added over 1 million cows to their inventory, but nearly 70 percent (or 723,000 head) now went to farms with at least 3,000 head. Farms with at least 5,000 head added over 250,000 cows, four times more than the number added in 1992–97.

Investment in large new dairies is occurring in all major production regions, although the very largest still tend to be in the West (table 8). In 1992, there were only 15 dairy farms with at least 1,000 milk cows in traditional dairy States, compared with 483 in Western States. There were 976 large Western dairy farms by 2002, with farms of 3,000–10,000 head growing more prevalent. But the number of large dairy farms also expanded rapidly in traditional States as well, to 67 in 1997 and to 178 by 2002.

Table 7

**Changes in cow inventory, by farm size, 1992-2002**

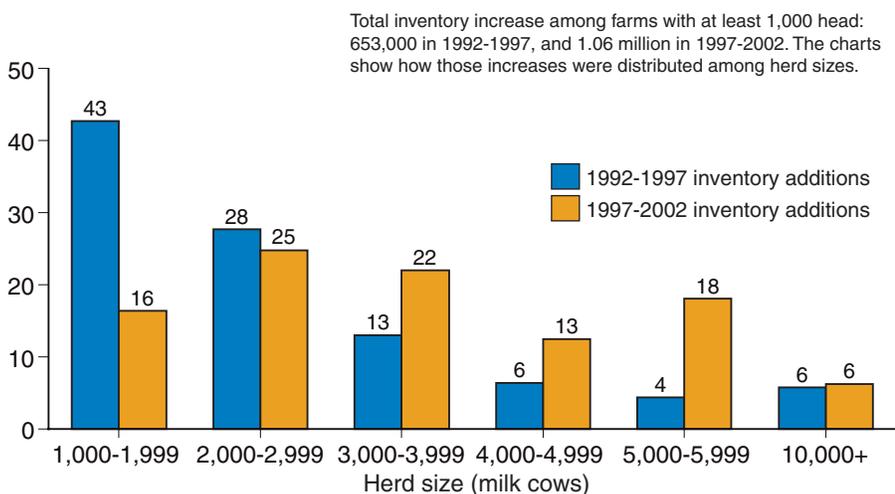
Herd size	Number of milk cows (1,000)			Change, 1992-2002 (1,000)	
	1992	1997	2002	1992-1997	1997-2002
0-199	6,497	5,186	4,028	-1,311	-1,168
200-499	1,302	1,395	1,336	+93	-59
500-999	756	924	1,115	+168	+191
>999	937	1,590	2,651	+653	+1,071
All farms	9,492	9,095	9,130	-397	+35

Source: Census of agriculture, for reported years. Herd size refers to all dairy cows on an enterprise, including dry cows but excluding calves, heifers, and bulls.

Figure 5

**Inventory additions shifted to farms with over 3,000 head after 1997**

Percent of inventory increase



Source: Census of agriculture farm records.

The data show sharp shifts of new capacity to very large dairies, with 3,000 to 10,000 head, and a slackening of investment in dairies with 1,000–3,000 head.<sup>16</sup> The capacity shifts mirror the data on exit expectations among large dairies, where 28 percent of those with 1,000-2,000 head expect to cease production within 10 years. This shift also suggests that there may have been constraints on dairy farm size (diseconomies of scale), but that those constraints have loosened in the last 10 years.<sup>17</sup>

<sup>16</sup>The very largest dairy farms may encompass several “pods” with barns and a milking facility for 2,000–3,000 cows in each.

<sup>17</sup>How big are the largest dairy farms? Eight farms in the 2002 census had over 10,000 milk cows, compared with 4 in 1997 and 1 in 1992. A farm in Indiana advertises that it has (in 2007) 30,000 milk cows in 10 pods on its site.

Table 8

**Large dairy farms, by region and size class**

Region and herd size	1992	1997	2002
<i>Number of dairy farms</i>			
<b>Western dairy States</b>			
1,000-1,999 cows	401	545	606
2,000-2,999 cows	60	132	197
3,000-3,999 cows	9	40	94
4,000-4,999 cows	8	16	40
5,000 or more cows	5	12	39
<b>Traditional dairy States</b>			
1,000-1,999 cows	12	59	135
2,000-2,999 cows	3	7	27
3,000-3,999 cows	0	1	12
4,000 or more cows	0	0	4
<b>Other States</b>			
1,000-1,999 cows	37	50	54
2,000-2,999 cows	10	7	25
3,000-3,999 cows	5	8	9
4,000-4,999 cows	1	3	4
5,000 or more cows	3	3	8

Source: ERS tabulations, from census of agriculture microdata.

Western dairy States: AZ, CA, CO, ID, MT, NV, NM, OR, TX, UT, WA, and WY.

Traditional dairy States: CT, DE, IA, IL, IN, MA, MD, ME, MI, MN, MO, NH, NJ, NY, PA, OH, RI, VT, and WI.

Other States: AK, AL, AR, GA, FL, HI, KS, KY, LA, MS, NC, ND, NE, OK, SC, SD, TN, VA, and WV.