Implications of Exit and Entry of Farm Firms in Agricultural Supply Analysis

By G. J. Conneman and D. H. Harrington

MUCH HAS BEEN WRITTEN in recent years concerning the exit of farms from agricultural production, and the pattern of growth of farm firms. The most overworked cliche is that there are "fewer but larger farms." As a generalization this is true. But there are actually two dynamic features to changes in the number of farm firms: exit and entry. One could brand this dichotomy as self-evident if the concept were unimportant from a research viewpoint. Exit and entry, if they occur, certainly affect the net changes in the number of farms and changes in total production. The change in the number of farms has a major effect on the results from the application of two widely used concepts in agricultural supply analysis studies: the representative farm concept and the Markov process concept. Too often agricultural supply analysis studies have not taken sufficient account of the dynamic nature of changes in supply as caused by both exit and entry of firms.

Purpose

The purpose of this paper is to review the phenomena of exit and entry, to examine the influence that exit and entry of firms have on the results obtained by using the Markov process and representative farm technique, and to suggest one method for obtaining appropriate data on exit and entry that would result in improved estimates of supply response.

Some Examples From Agricultural Economics Literature

Neither economic theory nor applied economic studies in agriculture adequately consider the subject of exit and entry of firms. Economic theory proclaims that an increase in demand for a product causes a chain of reactions which leads to profits, which subsequently leads to entry of firms. A decrease in demand is purported to have the opposite effect—an exit of firms from the industry. Both phenomena occur until long-run equilibrium is reestablished *(6)*.[1]

Many early studies in agriculture did not attempt to measure entry and exit when describing changes or making projections of change of the internal structure or their effect on aggregate production. Perhaps the earliest recognition of the problem of entry in agriculture was reported by Wilcox *(8)* when he pointed to an example in a hog study by O. V. Wells in 1933:

> The hopelessness of using a statistically determined modal group of farms as representative of the behavior of the entire group is suggested by a study by Wells. In studying farmers' response to price in hog production he found that 80 percent of the expected increase in farrowings in 1927 over 1926 was accounted for by men who had no sows that farrowed in 1926. The December pig survey in 1926 indicated that farrowings in 1927 would total 5.6 percent larger than in 1926. At the other extreme producers with more than 11 sows on an average expected to decrease their farrowings by a small percentage. Size of sow herd was an important factor associated with direction and amount of change in hog production on the individual farms from 1926 to 1927. The modal group of farms with respect to the size of their herd could not reflect these differences.

But beyond this example of Wells, scant attention has been given in the literature to entry and exit in agriculture. Kottke devoted an entire bulletin to exit and growth pattern of dairy farms in Connecticut but scarcely mentioned entry *(5)*. Researchers, although aware of the effects of both the exit and entry of farm firms, have not generally had good data on the number of entry farms and exit farms. Many data are not broken down by entry and exit farms, so most researchers have been forced to use the net change in farm numbers.

[1] Italic numbers in parentheses refer to items in the References, p. 44.

Empirical Investigation

Data from the Cornell Producer Panel of dairy farms from 1960 to 1964 are used to shed light on exit and entry *(2)*. A producer panel is a group of farmers questioned and revisited over a period of time to determine adjustments taking place. The panel consists of a random sample of small area segments which contain a 2.5 percent sample of the dairy farms in the New York milkshed area. This has been useful in analyzing the complex of factors associated with change in milk production on dairy farms.[2] Information was obtained from the panel not only on continuous producers but also on farms that went out of production (exit) and those that began production (entry). Thus, the full spectrum of changes in milk output was included.

An exit farm was a farm that was producing and delivering milk to market in June 1960 and that withdrew from milk production sometime between June 1960 and June 1964 and was not delivering milk in June 1964. A farm consolidated with another by rental or purchase was considered an exit farm, and the farm with which it was combined was considered to have expanded its resource base.

An entry farm was a farm on which no milk was produced in June 1960 but which came into milk production between June 1960 and June 1964 and was producing milk in June 1964.

An active or continuous farm was a farm unit on which milk was produced continuously during 1960-64. A farm on which there was a change of operator, but with an interruption of 3 months or less in milk production, was considered as having been in continuous production during the entire period.

The total amount of milk produced on a sample of farms in the New York milkshed area between the 1960 and 1964 production periods increased from 400 to 430 million pounds (table 1). The increase in milk from farms that came into production was not enough to offset the reduction in milk produced on farms that went out of production. Continuous farms increased total output by 59 million pounds. Entry farms added 9 million pounds to total milk production. Exit farms accounted for a decrease of nearly 38 million pounds. Milk production increased 17.0 percent on farms in continuous production (those active during the entire period). Considering both continuous and exit farms, total production increased 5.3 percent. However, considering continuous, exit and entry farms, milk output on all farms included in the panel increased by 7.5 percent.

Table 1.–Change in milk output by continuity of production on farm, 1,658 dairy farms, New York-New Jersey milkshed area, 1960 to 1964

Farms classed by continuity of production	Number of farms	Milk production		Change in milk production	
		1960	1964		
	Farms	*Mil. lb.*	*Mil. lb.*	*Mil. lb.*	*Percent*
Continuous . .	1,265	346	405	+59	+17.0
Exit	335	52	14	-38	–
Entry	58	2	11	+9	–
All farms . .	1,658	400	430	+30	+7.5

Milk production on the entry farms in 1964 accounted for 2.6 percent of total production in that year. This illustrates the importance of both exit and entry farms in analyzing changes in milk production over time. Failure to include both entries and exits gives an inaccurate estimate of changes in total production.

Special characteristics of the Northeast dairy area may make entry and exit more of a research problem there than in other areas of the country. Dairy farming is less closely tied to land resources than many other types of agriculture. Urban penetration and idle cropland are both significant sources of change in the land base of the Northeast dairy area. Thus, good aggregate estimates of resource use are more difficult to obtain in the Northeast than may be true elsewhere.

Entry, Exit, and the Representative Farm Concept

Basically, the representative farm approach to supply analysis consists of selecting or constructing a farm to represent each distinct situation in an area or region, deriving supply functions for these farms, and aggregating the individual supply functions to provide an estimate of the aggregate supply for the area or region. The usual method of constructing a representative farm by the average resource method is to divide the farms into categories or relatively homogeneous groups according to specified classification or sort factors. The factors used are those believed to be most closely related to production response. The most frequently used factors for classifying dairy farms into groups have been such conventional resources as land, labor, number of cows, stall capacity of barn, and capital. In this aggregation of

[2] The New York milkshed area covers parts of six States: New York, New Jersey, Pennsylvania, Maryland, Delaware, and Vermont.

individual supply functions, the weighting factor is based on the original number of farms in each group in the base period.

Exit and entry have important implications for the changing resource base in representative farm studies. This is illustrated for the Eastern Plateau region of New York in table 2. Representative farm groups were set up for the Eastern Plateau region with crop (tillable) acres and stall capacity as sort factors. Overall, the number of sample farms producing milk in this region decreased from 174 to 137 between 1960 and 1964. This represented a net decrease of 37 farms, or 21 percent. The net change was the result of 47 sample farms going out of production and 10 farms coming into production. If the sample had not allowed for entry, the rate of decline in the number of farms would have been estimated at 27 percent, resulting in an error of 6 percentage points.

The rate of exit and entry, and thus the net changes in the number of farms, varied by representative farm groups. The net rate of change varied from zero (Medium-Extensive group) to a decline of 47 percent (Very Small group). Furthermore, the proportion of total farms that each group made up varied according to whether the original number of farms was considered, the number of farms including only exits, or the number taking both exit and entry into account. For example, the Very Small group represented 8.6 percent of the total number of farms in 1960, but only 5.8 percent in 1964. Thus, differential rates of exit and entry between groups reduce the accuracy of the approach of ex post facto adjustment of representative farm groups by an aggregate rate of change. With producer panel data one can improve on the ex post facto method of adjustment.

Entry, Exit, and the Markov Process Concept

The Markov process is a technique applicable to studying and projecting changes in the number and size distribution of certain variables over time. It is a stochastic process in which the probability of the outcome of the next event or trial depends only on the state of the system prior to the event *(4)*. It is assumed that a population can be classified into "states" or "groups." Knowledge of the state of the system at any point in time and the probabilities associated with change provide a basis for projecting the outcome of one or more future events if the basic Markov conditions hold. The process states the probabilities of change from one state to another through time. This process of change is described by a matrix of transition probabilities. Thus, it is a method of describing and analyzing the cross currents of change over time—exit, entry, growth, decline—in a systematic way. It provides a method o

Table 2.—Change in number of dairy farms classified by resource group, Eastern Plateau region, New York State, 1960 to 1964

Description	Land and housing capacity group		Number of farms in 1960	Changes between 1960 and 1964		Number of farms in 1964	Net change 1960-64	Proportion of total number of farms in:		
	Crop acres[a]	Stalls[b]		Exit	Entry			1960	1964 considering only exit	1964 considering both exit and entry
							Percent	*Percent of total*		
Very small	1 - 32	1 - 24	15	8	1	8	-47	8.6	5.6	5.8
Very small–intensive	1 - 32	25 - 39	8	1	0	7	-12	4.6	5.6	5.1
Small	33 - 66	1 - 24	23	11	1	13	-43	13.2	9.4	9.5
Small–intensive	33 - 66	25 - 39	27	8	2	21	-22	15.5	15.0	15.3
Small–very intensive	33 - 66	40+	6	2	0	4	-33	3.5	3.1	2.9
Small–extensive	67 -134	1 - 24	10	1	0	9	-10	5.7	7.1	6.6
Medium	67 -134	25 - 39	30	8	2	24	-20	17.2	17.3	17.5
Medium–intensive	67 -134	40+	32	3	0	29	- 9	18.4	22.8	21.2
Medium–extensive	135+	25 - 39	6	2	2	6	0	3.5	3.1	4.4
Large	135+	40+	17	3	2	16	- 6	9.8	11.0	11.7
Total	–	–	174	47	10	137	-21	100.0	100.0	100.0

[a] Number of crop acres operated (owned plus rented).

[b] Number of stalls refers to the number of stanchions or ties for mature cows in conventional barns, and the cow capacity of loose or free stall barns.

projecting this pattern of change into the future to arrive at a projection of numbers as well as distributions in the future.

In most of the research studies using this technique the general procedure has been to observe some pattern of change over time, to determine the transition probabilities during this period of time, and on the basis of this past pattern of change, to project future change *(1, 3, 5, 7)*. The key assumption in the use of the Markov process is that the pattern of shift from one category to another exhibited in the past will continue into the future—constant transition probabilities—and that past changes are an important determinant of future changes.

The importance of entry and exit to the crosscurrents of change in the number of dairy farms in New York State is shown in table 3. This simplified and compressed[3] transition matrix illustrates the exit and entry problems on dairy farms. The first column shows the herd size classes and the second column the number of herds in each size class in 1960. The remaining columns show how the herds in each size class in 1960 were distributed by size class in 1964. For example, there were 36,100 farms with 1 to 49 cows in 1960. Of this number, 8,480 had gone out of business by 1964, 25, 620 stayed in the same category, 1,920 increased to 50 to 99 cows, and 80 increased to 100 or more cows. There were 1,600 entries into dairying between 1960 and 1964 from farms that had been idle at the beginning of the period. Of this number, 1,520 had 1 to 49 cows, and 80 had 50 to 99 cows (table 3, first row). The *last row* in the table indicates the number of farms in each size class in 1964.

Table 3.—Change in number of dairy farms in New York State, by size of herd, 1960 to 1964

Size class in 1960 (number of cows)	Number of farms in 1960	Size class in 1964 (number of cows)			
		0	1-49	50-99	100+
		Number of farms			
0	Entry farms →	1,520	80	0	
1-49	36,100	8,480	25,620	1,920	80
50-99	3,700	240	780	2,460	220
100+	380	0	0	80	300
		Exit farms ↓			
Total farms (1960).	40,180	8,720	27,920	4,540	600
			Total farms (1964)=33,060		

A substantial number of farms were in the same size category in 1964 as in 1960. In the 50 to 99 size category, 2,460 out of 3,700 farms remained in the same category in 1964 as in 1960. The number of farms remaining in the same category during the whole period is shown along the diagonal in the table. Small farms (1 to 49 cows) went out of dairying at a faster rate than large farms. Of the 36,100 original farms having 1 to 49 cows, 8,480 or 23.5 percent were no longer in dairying in 1964.

Projections based on the Markov process techniques are influenced by both the initial distribution at the base date and by the transition probabilities. In table 3, 8,720 out of 40,180 farms in production in 1960 had gone out of production by 1964. This is a *gross* rate of decline of 21.7 percent. In the same time period, 1,600 farms or 4.0 percent had come into production, resulting in a *net* rate of decline of 17.7 percent (7,120 net exit farms out of 40,180 farms). Had the Cornell Producer Panel ignored entry of farms, the estimated rate of decline would have been the gross rate. Furthermore, the number and distribution of farms between size groups in 1964 would have been 4.8 percent lower (31,460 estimated farms vs. 33,060 actual farms). Therefore, to fail to take account of entry farms would have greatly biased both the 1964 distribution and the transition probabilities. The effects of such biases are cumulative in the Markov chain projection technique; thus, the errors rapidly build to unmanageable proportions.[4]

Summary and Implications

Data from the Cornell Producer Panel of dairy farms in the New York milkshed area indicate the importance of exit and entry of dairy farms during 1960-64. Nearly 3 percent of the milk produced in 1964 came from farms that entered production after 1960. The rate of exit and entry varied by resource group of the type commonly used in representative farm studies. Furthermore, in New York State, expansion of the 2.5 percent sample to approximate the State total and analysis in a Markov matrix context showed that nearly 22 percent of the farms in 1960 exited and that nearly 5 percent of

[3] In the analysis of changes in the Cornell Producer Panel, size class intervals of 5 to 10 cows were used.

[4] The results when using Markov processes are greatly influenced by different assumptions as to exit and entry of firms. See: B. F. Stanton and L. Kettunen, Potential Entrants and Projections of Markov Process Analysis, Jour. Farm Econ., vol. 49, Aug. 1967, p. 633-642.

the farms in dairy production in 1964 had entered during the intervening period.

Exits and entries of this magnitude, and their differences by size and resource groups have important implications for both Markov process analysis and for the changing resource base in representative farm studies. The data on exit and entry of dairy farms in the New York milkshed area and New York State point to the need for a method to explicitly handle exit and entry in the design for collection and analysis of data. In data collection, a producer panel is one such technique. The distinguishing feature of the research design of the Cornell Producer Panel is that "farms" (producing units) rather than "farmers" were the sampling units. The panel was based on an area sample. All dairy farms and all other nondairy farms that fell within the segment area were enumerated. Area segments made it possible for farms which were not producing milk at the outset to enter the sample later. Segments also allowed the measurement of the effects of farm consolidation.

Secondary sources of data frequently employ panel designs in which the same units are included in repeated samplings. These sources can furnish estimates of entry and exit provided the individual detail is available in addition to the aggregate data.

Estimates of supply response could be improved if accurate data were available on the numbers of farms that enter the industry, leave the industry, and continue in the industry. The producer panel is a good method for obtaining these data.

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