Do Profitable Farms Remain Profitable? Probability of Switching between Profit Categories

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http://www.agmanager.info/farmmgt/finance/management/Profitability.pdf

Our overall goal was to report the probability of Kansas farms transitioning between profitability ranking categories. Specifically, we determine if farms in the higher profitability categories are more likely to remain in the current profitability category than the lower profitability categories. Substantially higher levels of persistence in the high profitability categories compared to the low profitability categories would indicate management, rather than luck, are leading to the difference between the two groups of farmers. In addition we emphasize the likelihood of farms in the highest profitability category transitioning to lowest profitability category in a single year; these results indicate how quickly farms switch from appearing profitable to being financially vulnerable.

Farms strive to maintain or improve their financial positions in the presence of controllable, uncontrollable, and random factors. Farms that are more profitable relative to their peers have a greater likelihood of succeeding in the long-run. These farms typically have a greater probability of earning a profit in bad years and will enjoy greater income in good years. By contrast, farms that are less profitable relative to their peers have a greater likelihood of becoming insolvent. These farms are less likely to earn a profit, and in a bad year could lose enough to exhaust their equity. An important question is whether a farm can improve, or at least maintain, its profitability ranking compared to other farms; and what the probabilities are that farms may switch to another profitability ranking. The probability of Kansas farms remaining in a specific profitability rank or switching to another ranking was evaluated using Kansas Farm Management Association (KFMA) data. The probability of transitioning between profitability ranks is important so that farmers and their advisors understand how quickly farms can switch from financial security to vulnerability.

When the probability that a farm remains in its current profitability ranking is higher than the probability that it switches to another profitability ranking, it is said to be persistent. If farm profitability is based on random luck, then farms will freely transition between profitability categories just as often as remaining in the current profitability category. Persistence is a desirable characteristic when a farm is in one of the higher profitability categories; and may be interpreted as the farm being managed with above average skills. However, a farm with better than average soils or in a region with higher annual rainfall amounts could also show persistence in the higher profitability categories relative to other farms. Conversely, persistence in the lower profitability categories is not a desirable characteristic; and can be attributed to poor farm management, poor soils, or annual rainfall that is less than adequate. The lack of persistence across all profitability categories indicates factors outside the control of the farmer.

Data and Methods

Persistence was tested on the 425 farms present in the Kansas Farm Management Association dataset for all years from 1994 through 2013. The KFMA databank is suitable for estimating transition probabilities due to the ample number of farms. Even when considering only farms that exist for all 20 years in the database, there were 425 farms available for analysis. The data were also subset for each of the six KFMA

Associations (see Figure 1 for map of Kansas KFMA Associations). Each KFMA Association differed by number of farms; ranging from a high of 165 in the Southeast Association to a low of 18 in the Northwest Association (Figure 2 presents the number of farms for each KFMA Association).
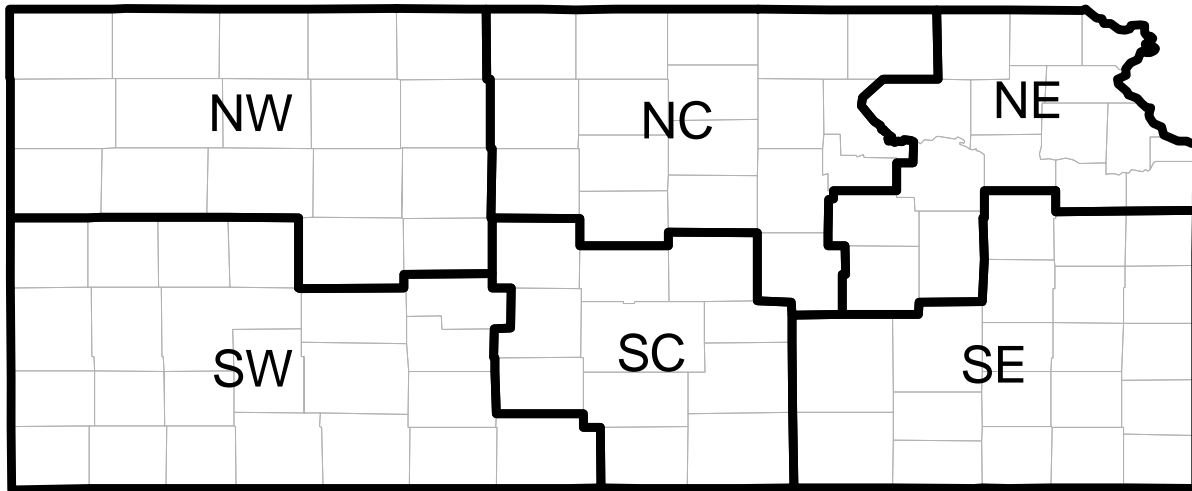
Figure 1. Map of KFMA regions within Kansas
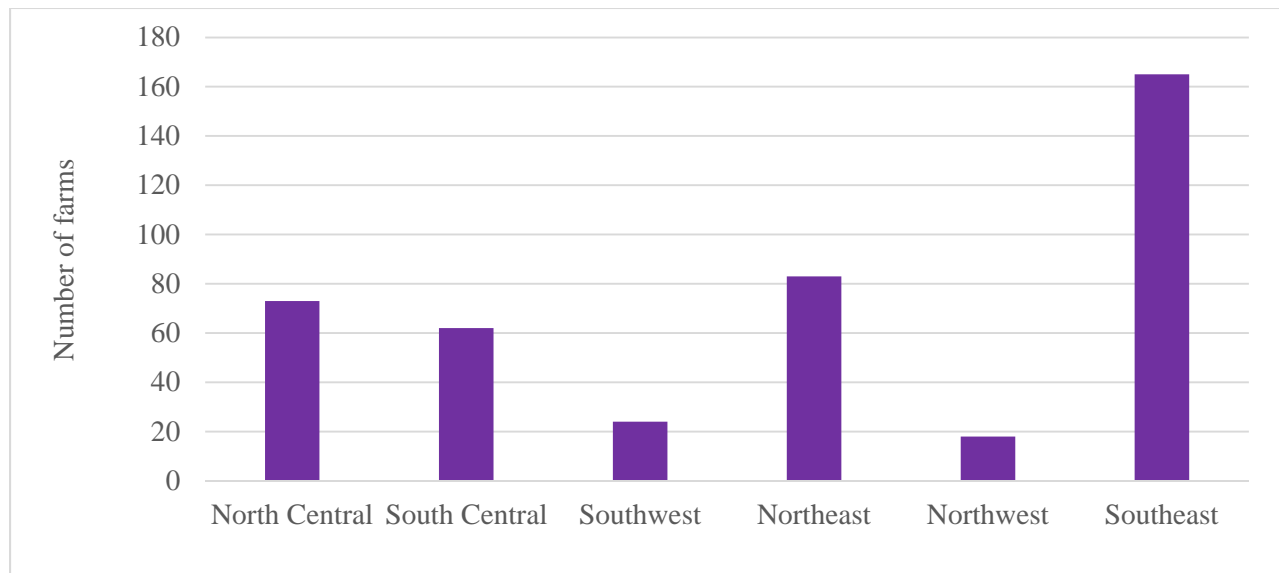
Figure 2. Number of Farms by KFMA Association

Accrual per acre annual net farm income (NFI) was calculated for each farm for each of the 20 years. For each year, farms were ranked in order of NFI and then evenly assigned to one of five profitability categories, or quintiles, such that each category contained 20% of all farms. These quintiles were named Quintile 1 to Quintile 5. Quintile 1 contains the top 20% of farms with respect to the highest NFI, farms with 20th to 40th percentile NFI were assigned to Quintile 2, and so on with the lowest 20% NFI farms assigned to Quintile 5. All farms were reassigned each year based on NFI rankings; therefore a given farm may change from any one quintile to any other quintile from year to year. Only farms that were in the dataset the entire 20-year timeframe were used for the analysis. The probability of transitioning from one quintile to any other quintile was estimated using the 1994 to 2013 KFMA dataset.

Each year the percentage of farms that stayed in the same quintile or moved to another were calculated. Therefore, each of the 425 farms contributed 19 observations over the 20-year period. From this, probabilities were calculated that in any given year a farm would stay in the same profitability quintile or change to a different quintile.

Results

Of the 425 farms in the databank, 289 or nearly two-thirds were ranked in Quintile 1 at least once (Table 1). Substantially more farms were ranked in the lowest four quintiles at least once. The highest number of farms visiting any quintile occurred in Quintile 3 with 390 or 92% of farms. Two farms remained in the Quintile 1 in all 20 years. The most number of times a given farm was in Quintiles 2, 3, or 4 was 13 or 14. Some farms remained in Quintile 5 for 19 of the 20-year period. Although fewer farms persistently visited Quintiles 1 and 5, at least a few farms remained in these top and bottom profitability categories longer than in the middle three quintiles.

Table 1. Distribution of 425 KFMA farms by quintiles over time (1994 to 2013)

|	Number farms visiting quintile at least once	Maximum number of times that an individual farm visits quintile
Quintile 1	289	20
Quintile 2	360	13
Quintile 3	390	14
Quintile 4	383	14
Quintile 5	352	19

The transition probabilities for all 425 KFMA farms ranked across quintiles are presented in Table 2 and graphically represented in Figure 3. The values on the principal diagonal indicate the probability that a farm will remain in their current quintile, with other values indicating the likelihood of them transitioning into a different quintile. For example, farms initially in Quintile 1 are likely to remain in Quintile 1 about half the time (probability equal to 0.52). Similarly, farms in Quintile 5 have a moderate chance (probability = 0.42) of remaining in the lowest profitability category. There is a slight chance (probability = 0.09) that

a farm in Quintile 1 in a given year can transition to Quintile 5 the next year. Likewise, there is a similar chance (probability = 0.07) that a farm can transition from Quintile 5 to Quintile 1 within one year.

Table 2. NFI ranked by quintile transition probabilities, all KFMA associations, N=425

	1	2	3	4	5
1	**0.52**	0.20	0.12	0.08	0.09
2	0.23	**0.29**	0.22	0.16	0.11
3	0.11	0.23	**0.27**	0.24	0.16
4	0.07	0.15	0.24	**0.30**	0.24
5	0.07	0.12	0.16	0.23	**0.42**

The highest values in each row indicates whether farms are likely to remain in their current quintile rather than switching to another quintile (highest probability bolded for emphasis). When the highest value in each row corresponds to values along the principal diagonal from upper left to lower right, i.e. the probability of beginning in and remaining in the same quintile, then persistence is expected. When the highest values in each row are not along the principal diagonal then persistence is not expected and may be considered instable. Even when transition probabilities are persistent, an individual farm may transition from any quintile to any other quintile from one year to the next; as signified by the absence of zeros in the transition probability tables.
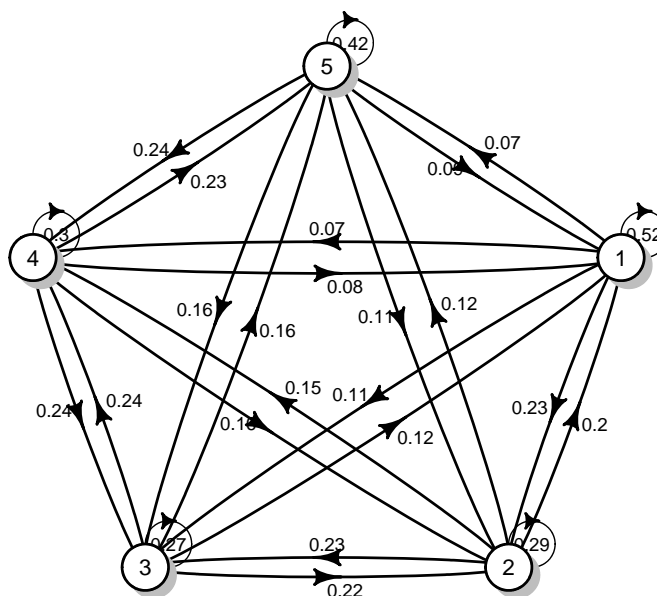
Figure 3. Probability network graph, NFI ranked by quintile transition probabilities, all KFMA associations, N=425

In Table 2, it should be noted that the second and third highest transition probabilities are immediately next to the principal diagonal indicating that when farms switch between profitability categories they are likely to transition one quintile higher or lower rather than jump across multiple profitability categories.

When considering only the farms located within individual KFMA associations some similarities and differences exist compared to Kansas-level results. These relationships varied between different regions in Kansas, as shown by the six different KFMA associations in Tables 3 through 8. Similar to the Kansas-level results, farms in North Central Association were persistent with respect to their tendency of remaining in their current quintile (Table 3). Farms in the highest and lowest profitability categories are more likely to remain in the current quintile than the middle three quintiles. As with the Kansas-level results, farms in North Central Association can transition from Quintile 1 to the Quintile 5 in one year (probability = 0.07).

Table 3. NFI ranked by quintile transition probabilities, KFMA North Central Association, N=73

	1	2	3	4	5
1	**0.50**	0.21	0.12	0.10	0.07
2	0.21	**0.27**	0.24	0.17	0.12
3	0.13	0.22	**0.29**	0.24	0.11
4	0.09	0.16	0.19	**0.29**	0.26
5	0.06	0.13	0.13	0.23	**0.45**

The South Central Association differed from the Kansas-level results in that the transition probabilities along the principal diagonal were not the highest in each row (Table 4). Although farms in the highest and lowest quintiles were likely to remain in the current quintile, the remaining quintiles did not have the expected persistence. The transition probabilities of switching form Quintile 1 to Quintile 5 (probability = 0.06) were similar to Kansas-level results.

Table 4. NFI ranked by quintile transition probabilities, KFMA South Central Association, N=62

	1	2	3	4	5
1	**0.61**	0.20	0.09	0.04	0.06
2	0.21	0.23	**0.26**	0.15	0.15
3	0.10	**0.35**	0.10	0.25	0.21
4	0.12	0.12	0.14	0.27	**0.35**
5	0.06	0.08	0.18	0.25	**0.42**

The Southwest Association also differed from Kansas-level results (Table 5). The highest and lowest profitability categories were persistent while the remaining three profitability categories were unstable. The probabilities of transitioning between Quintile 1 to Quintile 5 (probability = 0.20) and Quintile 5 to Quintile 1 (probability = 0.23) were much higher than Kansas-level results.

Table 5. NFI ranked by quintile transition probabilities, KFMA Southwest Association, N=24

	1	2	3	4	5
1	**0.38**	0.15	0.11	0.16	0.20
2	0.22	0.21	0.19	**0.24**	0.14
3	0.23	**0.25**	0.24	0.14	0.14
4	0.13	0.15	0.22	0.21	**0.29**
5	0.23	0.12	0.14	0.25	**0.26**

The Northeast Association results were similar to Kansas level results (Table 6). The transition probabilities indicate persistence. The probability of transitioning from Quintile 1 to Quintile 5 (probability = 0.11) was slightly higher than the Kansas-level probabilities.

Table 6. NFI ranked by quintile transition probabilities, KFMA Northeast Association, N=83

	1	2	3	4	5
1	**0.50**	0.22	0.11	0.07	0.11
2	0.21	**0.31**	0.25	0.13	0.10
3	0.13	0.20	**0.28**	0.26	0.13
4	0.07	0.14	0.21	**0.34**	0.24
5	0.09	0.11	0.15	0.21	**0.44**

The Northwest Association has the fewest number of observations of all associations (N=18) however the transition probabilities indicate persistence (Table 7). Unlike Kansas-level results, the second and third highest transition probabilities were not adjacent to the principal diagonal. The probability of transitioning from Quintile 1 to Quintile 5 (probability = 0.19) or Quintile 5 to Quintile 1 (probability = 0.19) were nearly 20%, about twice as high as for the Kansas-level results.

Table 7. NFI ranked by quintile transition probabilities, KFMA Northwest Association, N=18

	1	2	3	4	5
1	**0.43**	0.17	0.09	0.12	0.19
2	0.21	**0.32**	0.21	0.17	0.10
3	0.12	0.15	**0.32**	0.18	0.22
4	0.13	0.17	0.20	**0.32**	0.17
5	0.19	0.11	0.13	0.23	**0.34**

The transition probabilities for the Southeast Association were similar to the Kansas-level results (Table 8). Transition probability indicated persistence. The probability of transitioning from Quintile 1 to Quintile 5 (probability = 0.07) or Quintile 5 to Quintile 1 (probability = 0.06) were similar to Kansas-level results.

Table 8. NFI ranked by quintile transition probabilities, KFMA Southeast Association, N=165

	1	2	3	4	5
1	**0.55**	0.22	0.10	0.06	0.07
2	0.23	**0.29**	0.22	0.14	0.12
3	0.10	0.22	**0.30**	0.22	0.16
4	0.07	0.12	0.22	**0.34**	0.25
5	0.06	0.13	0.16	0.23	**0.43**

Summary and Conclusions

A 20-year KFMA dataset was used to estimate transition probabilities for five profitability categories. Results indicated that farms tend to persist in their current profitability category, suggesting that operator skill and/or quality of farmland dominates random factors. In general, the transition probabilities were greater for the highest and lowest profitability categories than the three middle quintiles. That being said, switching from highest probability categories to the lowest profitability categories still occurred between 5 to 20% of the time within one year.

Southwest and South Central Associations did not exhibit strong persistence compared to the remaining four KFMA associations and Kansas-level results. In addition, persistence was indicated by the transition probabilities especially among the largest sample sizes. Persistence was not evident in South Central Association and Southwest Association potentially due to smaller number of farms and prevalence of diversified enterprises. Given the risk management aspect of diversification, it was expected that farms with both crops and livestock production would not persist at the top profitability ranking but frequently switch between quintiles.