Defining Good Farm Management

Economically, a well-managed farm is one that consistently makes greater profits than similarly structured neighboring farms. Because external macroeconomic factors, such as prices, often affect an entire industry, it is important to compare profits relative to other industry participants as opposed to profits in absolute levels. Thus, even during especially good or especially bad times for the industry as a whole, individual management differences can still be identified. However, because random, localized events, such as weather, often mask differences or similarities in management, it is important to observe profit differences among farms that persist over time.

In the context of crop production management, an operator could be more profitable than his neighbors for a number of reasons. Perhaps he tends to get higher crop yields. Or perhaps he is a better marketer and consistently gets higher crop prices. Maybe he does a better job of controlling costs than his neighbors. Or, does the more profitable manager do a better job of determining when and how to adopt new agricultural technologies such as less tillage? Other questions also arise. Are profitable operators especially good at one thing? Or, are they better than average at a number of tasks? How easy is it to be better than average at cutting costs or increasing crop prices? How are profits impacted by having input costs that are 10% lower than average? This paper addresses questions such as these in an empirical study of Kansas farms from 1989-1998.

Description of the Study

The Department of Agricultural Economics at Kansas State University maintains an historical economic database of financial records from Kansas farms that are members of one of six regional farm management associations. The database is often referred to as KMAR, for Kansas Management, Analysis, and Research. Records from farms continuously enrolled from 1989-1998 comprise the principle data used in this study (over 1,000 farms). The KMAR data were augmented with data from other sources as needed (see Nivens, Kastens and Dhuyvetter for additional detail).

Goals of this study involved quantifying the following basic management measures:

a) In dollars per cropped acre, how much greater (less) was each farm’s cropping enterprise profit than that of the average farm in that KMAR region that year? This measure of economic profits equaled zero for the average farm in a region for a given year. Thus, negative values imply lower, and positive values higher, than average profits.
b) For each major crop (wheat, corn, grain sorghum, soybeans, alfalfa) raised each year, what was a farm’s yield as a percent of the county average for that year? What was the average of that measure across all crops raised by that farm for each year, where the average was a weighted average (by number of acres of each crop), so that crops with larger acreages on a farm are given more weight in the yield performance measure? This index provided a measure of yield superiority, with negative values implying lower than expected yields and positive values higher than expected yields.

c) As a percentage, how much higher/lower were crop input costs for a farm in some year relative to what was expected in the region for similar cropping programs in that year? This index provided a measure as to whether or not a producer was low cost relative to other producers. Negative values imply lower than expected costs and positive values imply higher than expected costs.

d) For the important crops raised each year, as a percentage, how much higher/lower was the overall crop value compared to what was expected based on other farms in the county raising the same crop mix and having the same crop yields? This provided a general measure of pricing superiority/inferiority (Is the producer a relatively good marketer?). Negative values imply lower than expected prices and positive values higher than expected prices.

e) Compared to the average farm in the region that year, how far ahead or behind was each farm in adopting one important technology in Kansas substituting herbicides for machinery and labor costs?

The tillage technology index used in this research is referred to as “less-tillage” to avoid being confused with the terms “reduced-tillage” or “no-till.” The measure, computed for each farm each year, measured the tradeoffs between herbicides and tillage (and crop labor).  

\[
\text{less - till index} = \frac{\text{herbicide expense}}{\text{herbicide expense} + (\text{crop labor and crop machinery operation expense})}
\]

1 A farmer’s involvement in less-tillage practices is not typically all-or-none. Often only a part of the farm is no-tilled, or only in some years, or only with some crops, or only for some tillage operations. Thus, it is most difficult to label one farmer as a no-tiller and another as a conventional farmer. What is needed is some measure of the extent tillage is used that covers the continuum from moldboard plowing to 100% herbicide-based weed control and seedbed preparation. Then, the impact of that less-tillage measure on profitability could provide the answers needed. But, farm profitability is affected by more than the decision to adopt less tillage; other management characteristics might be equally important, as might be luck or land quality or weather. To properly understand the relationship between no-till and profitability, it is important to identify the impact of less tillage on profitability after other important profitability-determining factors are accounted for. After all, no-till adoption is essentially a management issue similar to marketing or cost control.
The less-till index increases in value as herbicide expenditures increase relative to crop labor and machinery expenditures. With 0 herbicide expense the index equals 0 and if labor and machinery costs were 0 the index would equal +1. The index value would tend to be small and likely never even 0.5 because crop labor and machinery operating costs typically exceed herbicide costs. The less-till index is an intermediate step in determining how far ahead (or behind) a farm is, relative to its neighbors, in terms of less-tillage adoption.

For each Kansas Farm Management region, the less-till index was statistically regressed on years, 1989-98, to estimate the typical rate of adoption over the years (refer to Nivens, Kastens and Dhuyvetter for additional detail). The index and related statistical models made it possible to determine: (a) if a region’s reliance on herbicides over tillage was greater or smaller relative to other regions; (b) if a region was adopting less-tillage faster or slower than other regions over the time period studied; and (c) how far ahead or behind was each farm, on average, compared to the average farm in that region? After quantifying the management measures described above, the effect yield, cost, price, and technology adoption had on profitability was established in statistical models.

Results of the Farm Management Study

The first question to answer is, How persistent were the five management measures: profits, yields, costs, prices, and less-till adoption? This was determined by averaging a management measure’s annual values for a farm over the 1989-98 period and testing whether this average measure was statistically different from 0 (from the average or typical farm).

Statistical significance is important for establishing confidence in the results. Using the profit per acre variable as an example, consider farm A, which is assumed to have this annual profit stream over 5 years: {-80, 200, -50, 300, -270}. The average annual profit for farm A is $20/acre. What would you expect farm A’s profit to be in year 6? Although your best guess is $20/acre you would not have much confidence in that prediction. With the large variability displayed in farm A’s profits it can easily be shown that its $20/acre profit is not statistically different from 0. Now consider farm B whose profit stream is {-5, 30, 20, 25, 30}. Like farm A, farm B’s average profit is also $20/acre. Now, however, it is much easier to understand why farm B’s profit is $20/acre rather than farm A because farm B has less variability. 

2 Machinery operation expense is defined as the crop share (as opposed to livestock share) of: machinery repairs, gas-fuel-oil, farm auto expense, motor vehicle depreciation, and machinery-equipment depreciation; plus crop machine hire expense; plus an opportunity interest charge on crop machinery investment; minus machine work income. To that value is added the crop share of labor (operator, hired, and unpaid family labor).
have confidence in a $20 prediction for year 6. In this case, the $20 average is statistically
different from 0. Thus, farm B’s profits are said to be substantially more persistent than farm
A’s. It is much easier to believe that farm B’s manager has the management skills necessary to
make positive profits of $20/acre. On the other hand, it appears farm A’s $20/acre profits might
chiefly be due to chance.

Based on around 1,000 farms tested, figure 1 shows persistence of management traits by
reporting the percent of farms whose 1989-98 average management measure was statistically
different from 0 (from the average farm in that area). With nearly 60 percent of the farms
statistically different from 0, less-till technology adoption (Tech) is shown to be highly persistent
among farmers. That is, producers tend to be consistently fast or slow adopters, not jumping
about from year to year. The next most persistent management measure is cost, followed by
profit, where nearly 50 percent of the farms were persistently better or worse than their neighbors
on average. A smaller number (34%) of farms were significantly better or worse at yields than
their neighbors. This should not be too surprising given that crop yields are so weather
dependent. The least persistent management measure is prices, where only 23 percent of the
farms were significantly higher or lower than average.

For farms wishing to differentiate
themselves from their neighbors, figure 1
suggests which management aspects should
be the easiest ones to focus on those with
the greatest persistence. For example, it
should be relatively easy for a farm to set
itself off from its neighbors, presumably to
make more profit, by being an especially
early or especially late adopter of the less-
tillage technology. We know that because so
many farms have demonstrated they can do
it. On the other hand, the low persistence on
price management suggests it will be
especially difficult for a farm to become
better at achieving higher prices than its cohorts. But, the appropriate effort expended to achieve
higher prices depends on the potential payoff, which is discussed later.
How variable are the management measures? Table 1 reports the average value in the high third and low third of each measure. For each measure the middle third centers near zero.

Table 1. Variability of Management Measures: Average Value in High and Low Thirds.

<table>
<thead>
<tr>
<th>Measure</th>
<th>High Third</th>
<th>Low Third</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit</td>
<td>+$76/acre</td>
<td>- $79/acre</td>
</tr>
<tr>
<td>Yield</td>
<td>+16 percent</td>
<td>- 16 percent</td>
</tr>
<tr>
<td>Cost</td>
<td>+31 percent</td>
<td>- 25 percent</td>
</tr>
<tr>
<td>Price</td>
<td>+8 percent</td>
<td>- 8 percent</td>
</tr>
<tr>
<td>Less-till technology adoption</td>
<td>+14 years</td>
<td>- 13 years</td>
</tr>
</tbody>
</table>

Table 1 shows a seemingly wide range of profitability for the high profit and low profit group. The least-cost third of farms have costs per acre that are around 25 percent lower than average costs. The top third for crop yields have 16 percent higher yields than average. Figure 1 showed that it would likely be difficult to become a superior price manager. Table 1 shows that even those who are good at pricing (the top third) get prices only 8 percent higher than average. In general, each value in table 1 is expected to have the same likelihood of occurrence. That is, it should be as easy to get 25% lower costs as it is to get 8% higher prices. If we assume that the typical price just breaks even, then it is certainly more profitable to be a superior cost manager. Like figure 1, table 1 suggests that producers should focus on cost and yield ahead of price (i.e., a 25% reduction in cost is more profitable than an 8% increase in price).

Figure 2 depicts changes in less-till index values over time by Kansas Farm Management region. To some extent, index levels indicate crop mixes in regions. For example, the less-till index value is highest in NE Kansas, where soybeans, sorghum, and corn (crops that typically require herbicides) largely dominate over wheat. In SC Kansas, where wheat largely dominates, the index value is lowest throughout the time period. The slopes, or steepness, of the lines in figure 2 are of more interest than the levels as they indicate the speed of less-till adoption. NW Kansas, followed closely by SW and SE Kansas, displayed the fastest adoption rates. By 1998, NW Kansas was second only to NE Kansas in use of herbicides relative to tillage after beginning in 1989, along with SW and SC Kansas, near the study’s index lows. The fast adoption rates in western Kansas correspond to the ongoing transition from wheat-fallow cropping systems to wheat-row crop-fallow systems in that area. Not surprisingly, profits associated with less-till adoption have generally been larger in western Kansas than in other regions (see the economics chapters of K-State’s No-
Table 1 shows that the fastest adopters of less-till are 14 years ahead of their neighbors and those in the slowest third are 13 years behind their neighbors. This does not imply that it would take an average producer 14 years to catch up with the fastest third. For example, a farm that went from average tillage practices to 100% no-till in only a year or two would likely reach the top end of the fast adopting third in that short time period.

Figure 1 showed persistence across time for each of the different management traits. Are farms also persistent across traits? That is, are low cost farms also high yield farms, etc.? Table 2 addresses that issue. High profit and rapid adoption of less-till are seen to be highly related in the left data column of the table. That is, over half (50.9%) of the most profitable farms (those in the top third, profit-wise) were also among the most rapid third of less-till adopters. Further, only 14.7% of those in the high profit group were slow adopters (in the slowest third). Had less-till adoption been only randomly associated with profitability we would expect these values to be around 33.3%. Based on that, other values in the profit column suggest that high profit is next most associated with high yields, followed by low cost, and last by high prices.

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3 In figure 2, measures of early adoption for individual farms are determined by the horizontal distance into the future or past where an individual farm’s index intersects the line for that region. For example, a farm in NE Kansas whose index value was 0.12 in 1989 was about 2 years “ahead” of its neighbors because the NE line did not reach 0.12 until 1991. On the other hand, a NE Kansas farm that had an index value of 0.12 in 1996 was considered to be 5 years “behind” its neighbors. Because of the overall slow adoption pace, farms which are principally no-till are calculated to be many years ahead of the average producers.
Table 2. Persistence Across Management Traits (expected value is 33.3% at random).

<table>
<thead>
<tr>
<th>This Percent is in the . . .</th>
<th>Highest Third of Profit</th>
<th>Highest Third of Yield</th>
<th>Lowest Third of Cost</th>
<th>Highest Third of Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yields:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest Third</td>
<td>46.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest Third</td>
<td>20.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest Third</td>
<td>41.3%</td>
<td>35.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest Third</td>
<td>24.0%</td>
<td>29.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prices:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest Third</td>
<td>36.4%</td>
<td>35.6%</td>
<td>27.3%</td>
<td>33.5%</td>
</tr>
<tr>
<td>Lowest Third</td>
<td>23.4%</td>
<td>30.9%</td>
<td>40.6%</td>
<td></td>
</tr>
<tr>
<td>Less-till Adoption:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fastest Third</td>
<td>50.9%</td>
<td>43.1%</td>
<td>36.3%</td>
<td>33.5%</td>
</tr>
<tr>
<td>Slowest Third</td>
<td>14.7%</td>
<td>22.9%</td>
<td>31.8%</td>
<td>31.3%</td>
</tr>
</tbody>
</table>

Looking across the less-till adoption row it appears that rapid adoption of less-till is associated with both higher yields and lower costs. That is, good yield or cost managers tend to be rapid adopters of less-till. Interestingly, slightly more than a third (35.6%) of those in the high yield category are also in the low cost category. Apparently, acquiring high yields depends on using superior combinations of inputs and not merely on using more inputs.

Can the effects of management traits be quantified? For example, can we establish how much more profitable a farm manager was who was in the top third of a management trait compared to if he were only at the average? To accomplish this, a statistical model was constructed that measures the effect each management trait has on profitability, holding all other traits constant. Although the only technology adoption variable explicitly considered was less-till, other technologies might also be important in explaining profitability. Consequently, because technology adoption can often be measured by farm size (larger farms tend to be those which adopt new technologies), our statistical model also included a variable of excess crop acres (the percent of acres greater or less than the regional average).

Table 3 reports the impact of the various management values on profit per acre. The left side of the table reports how marginal changes in management impacted profitability for the farms in this study. A 1 percent increase in yields resulted in farm profits rising by $0.68/acre. Also, being 1 year ahead of the average farm in a region in terms of less-till adoption resulted in increased profits of $0.97/acre. A 1 percent increase in farm size is associated with a $0.19/acre increase in profit, indicating economies of size in crop production. In the statistical model underlying table 3 price was the only factor whose impact on profitability was not significantly
different from 0. That it happens to be negative is not particularly relevant because we have little confidence that it is anything besides 0.

Table 3. Impact on Profit per Acre of Management Traits.

<table>
<thead>
<tr>
<th>This Change</th>
<th>Marginal Results in This Change in Profit/acre</th>
<th>Best Third Results in This Change in Profit/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ń</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A 1% Increase in Yields</td>
<td>$0.68*</td>
<td>A 16% Increase in Yields $10.88*</td>
</tr>
<tr>
<td>A 1% Decrease in Costs</td>
<td>$0.78*</td>
<td>A 25% Decrease in Costs $19.50*</td>
</tr>
<tr>
<td>A 1% Increase in Prices</td>
<td>-$0.11</td>
<td>An 8% Increase in Prices -$0.88</td>
</tr>
<tr>
<td>A 1 year Increase in Speed of Less-till Adoption</td>
<td>$0.97*</td>
<td>A 14 year Increase in Speed of Less-till Adoption $13.58*</td>
</tr>
<tr>
<td>A 1% Increase in Farm Size above Avg.</td>
<td>$0.19*</td>
<td></td>
</tr>
</tbody>
</table>

* denotes significantly different than 0 at the 95% confidence level

The left side of table 3 does not address whether it is easier to get a 1% increase in yields or a 1% reduction in costs. One way to examine this is to look back at table 1 at the values associated with being in the top third of a management category rather than at its mean. Roughly, it should be as easy to be in the top third of one category as another. Thus, the right side of table 3 reports the effects of those larger changes on profits. For example, going from a farm with average yields to the average of those in the top third implies 16 percent higher yields, which implies $10.88/acre higher profits. Clearly, being in the lowest third cost-wise is the most important management trait, followed next by speed of less-till adoption, and then by being in the top third yield-wise. The impact of being in the top third price-wise, at -$0.88/acre, was not statistically different from 0.

The results of tables 1-3 confirm that farm operators who wish to improve profitability by improving management might do well to focus less on price and more on costs, technology, and yields. It was especially surprising to see that being ahead of average in terms of less-till adoption had that much impact on profits.

Interestingly, completing this study’s analysis using only 1987-96 data showed that the fastest adopters of less-till were 17 years ahead of average farms during that time period. The resultant profit increase was $16.27/acre (against a profit increase associated with being in the low cost category for that time period of $20.57/acre). As agricultural technologies are adopted, farms are less able to differentiate themselves from their neighbors and associated profits disappear because they are bid into land prices. Being one year ahead of one’s neighbors in terms of speed of technology adoption is especially important when a technology is quite new (assuming it is not a passing fad). After the newness has worn off, the benefit of being one year ahead of one’s neighbors is smaller. Of course, there is likely diminishing returns to specific
areas of management. That is, farms that are already superior in all areas except price may need to focus on improving price.

Summary

A study of about 1,000 farms in Kansas over 1989-1998 revealed that farmers are most able to differentiate themselves from their neighbors in terms of costs and technology adoption, followed next by yields, and last by prices. Consequently, being in the low cost third of a region’s farms was substantially more important than being in the high price third. In all regions of Kansas farms have been expanding herbicide expenditures relative to machinery operation expenditures, indicating the adoption of less-till practices. Less-till adoption has been especially rapid in western Kansas, likely due to yield-enhancing moisture retention from less tillage. Of farms in the top third of profits, 50 percent were also in the most rapid third of less-till adopters, indicating a strong relationship between farm profitability and early adoption of less-till. As a profit-maximizing management goal, being ahead of one’s neighbors in adopting less-till ranked second in importance to being a low-cost operator. It ranked more important than managing for high yields, which ranked more important than seeking high prices.

References


Kansas Farm Management Guides. Department of Agricultural Economics. Kansas State University.

No-Till Handbook. To be released in January 2000 by the Cooperative Extension Service of Kansas State University, Manhattan Kansas.