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FARM PERFORMANCE AND MANAGEMENT STRATEGIES

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Abstract

This article emphasizes the strategic and operations aspects of managing a farm. In this article, farm management performance is analyzed based on yearly Illinois Farm Business Farm Management (FBFM) panel data across 9,831 farms from 1996 through 2014. The alpha scores (or skill estimates) for farm managers are analyzed to determine if most profitable farmers possess specific skills or knowledge against adverse events in a volatile environment. Farms are evaluated under different scenarios of management skill portfolios. Fundamental farm management basics are discussed in this study, including budgeting, production planning, financial analysis, financial management, investment analysis, and control management. We find substantial difference of farm management styles and performance efficiency in management skill portfolios. We also find evidence of most skilled farm managers are more efficient on both revenue side and costs side. The approaches used in this study also allow comparison among farms of different sizes and types. The activities of top farms can be replicated by poorer performers and the study provide a unique way for comparing the farm management styles and ability of most skilled farm managers to that of less skilled ones. The innovative method is framed by comparing business strategies and performance styles in the following aspects: production and operations planning, land management and control, and production costs evaluation. Farm managers will want to consult it as well to improve the effectiveness, objectivity, and success of their decisions.

Key words: *Skill, alpha, farm management, strategy.*
Jel Codes: *Q12, Q13, M11*

1. Introduction

Good management is a crucial factor in the success of any business. Farms are no exception. An underlying assumption by many in a number of studies of farm performance is that the best have different management styles and strategies (Sonka et al., 1989; Plumley & Hornbaker, 1991; Mishra et al., 1999).

To be successful, farm managers will make and execute the accurate decisions – it is very different from physical labor used in agriculture. The long-term direction of a farm is determined through strategic planning. This is because production agricultural in the United States and other countries is changing along the following lines: more mechanization, increasing farm size, continued adoption of new technologies, growing capital investment per worker, more borrowed or leased capital, new marketing alternatives, and increased business risk. These factors create new management problems, but also present new opportunities for managers with the right skills.

This study contribute to the farm performance literature in two ways. First, to examine the question whether most skilled farms have different management strategies and characteristics, the analysis constructs a comparative statistical way to compare individual farm alphas (or skill estimates). Statistical procedures are used to test for strategy difference and economic efficiency in farm performance using individual farm alphas over long-term horizons. Therefore, productive and effective management skills are not an unrevealed innate quality anymore; good management skills can be cultivated, developed and learned through farm performance investigations. Second, the study also provides statistical analysis to address the question of whether the economic efficiency of top managers is on the cost side, the revenue side, or both. Fundamental farm management basics are discussed, including budgeting, production planning, financial analysis, financial management, investment analysis, and control management. Farm managers will want to consult it to improve the effectiveness, objectivity, and success of their decisions.

In general, we find substantial difference of farm management styles and performance efficiency in management skill portfolios. We also find evidence of most skilled farm managers are more efficient both in resources being used and revenue being generated on farm assets. The approaches used in this study also allow comparison among farms of different sizes and types. The activities of top farms can be replicated by poorer performers and the study provide a unique way for comparing the farm management styles and ability of most skilled farm managers to that of less skilled ones.

The remainder of the study is as follows. Section 2 provides a review of the most relevant studies. Section 3 briefly describe the survivorship-bias-free data used in this study, and Section 4 discuss several potential key management performance measurements. Section 5 presents the efficiency measurement and examines the revenue and cost structure of farms. Section 6 summarizes the findings and conclusions.

2. Literature Review

A number of empirical studies have attempted to study the farm management strategies and performances. Researchers use different data sets and techniques attempting to prove the existence of farm operating strategies and to study their patterns in farm management. This section provides a review of the most relevant literature, and then reviews selected research employing methods of strategy detection that provide either direct or indirect evidence on farm management strategies.

Studies of farm performance and factors affecting management decisions have largely been embedded within one of two widely-used theoretical frameworks. Firstly, broadly neo-classical studies have attempted to understand variations in farm performance through resources to differences in the internal structure of farms (e.g., size and legal type) (Hall & LeVeen, 1978; Kislev & Peterson, 1996) and agency factors such as the level of human capital (Welch, 1970; Sumner & Leiby, 1987). The second set of studies, drawing on the writings of institutional economists, capture a farm's intuitional embeddedness (e.g., formal and informal rules, regulations and laws) (Williamson, 1988) and inter-organizational relationships (e.g., transaction costs) (Pollak, 1985) rather than merely internal structure of farms (Gorton & Davidova, 2004).

As long recognized, the problem of efficiency involves both technical and economic facets. Determination of the technically efficient farms provides the base for economic analysis. Many studies have identified that different approaches to improve economic efficiencies can be successful (Groot et al., 2006; Haji, 2007). For example, Groot et al. (2006) evaluate 45 commercial farms participating in regional nutrient management project for their farm management adjustments and effectiveness in terms of nitrogen use efficiency and economic performance. It is concluded that farms that were able to rapidly reduce fertilizer nitrogen input and establish a consistent farm management strategy were most successful in improving nitrogen use efficiency. Haji (2007) reveals that asset, off/non-farm income, farm size, extension visits and family size were the significant determinants of technical efficiency, whereas asset, crop diversification, consumption expenditures and farm size have significant impact on allocative and economic efficiencies.

A non-parametric mathematical programming method known as data envelopment analysis (DEA), which has become very popular in the management efficiency context (Charnes et al., 1978). Values in terms of prices, scales or costs has been introduced into applications to work towards finding farms which might have technical, scale, or allocative efficiency. (e.g., Thompson et al., 1990; Ali & Seiford, 1993; De Koeijer et al., 2002; Latruffe et al., 2005; Davidova & Latruffe, 2007). As a non-parametric method, DEA does not require or assume any functional relationship between the inputs and outputs. However, DEA is based on a deterministic approach, so all deviations from the frontier are attributed to inefficiencies. Thus, a certain bias of sample efficiency is possible (Gorton & Davidova, 2004). Given these issues, the focus of the current paper provides an application of the alpha score (Li & Paulson, 2014) in a non-parametric comparative statistical analysis of the effect of management decisions on estimates of management efficiency. This procedure enables consistent production strategies explaining alpha scores, while simultaneously producing benchmarks for high skilled managers and low skilled managers according to their efficiency scores.

The probably implicit choice for adoption of a strategy may be governed by agri-environmental conditions (soil quality, altitude, climate, rainfall and access to water) beyond the farmer's skills and objectives. An interesting question is raised whether agri-environmental factors are a curse or a blessing to a farm manager. Environmental factors have been seen as the unobservable variables from assessments of economic efficiency (Bhalla & Roy, 1988; Benjamin, 1995). However, to increase the value of farm output, management strategies are still needed. Regarding soil fertility, farmers need to increase high quality nutrient inputs at low cash and labor costs to the farmer. Shepherd and Soule (1998) designed a farm simulation model to assess the long-term impact of existing soil management strategies, on farm productivity, profitability and sustainability. The model links soil management practices, nutrient availability, plant and livestock productivity, and farm economics. Although most research determine that natural endowment or weather conditions can have direct influence on farm performance, they do not directly calculate if farm managers successfully profit from their farming skills or natural resource endowment.

While numerous studies have presumed that skill does lead to better performance and higher returns (Sonka et al., 1989; Plumley & Hornbaker, 1991; Mishra et al., 1999), the measurement of intrinsic skill has been conspicuously absent. The lack of attention in the literature to date is due in part to difficulties in developing suitable data series for farmers' financial performances in which measures of skill effects could likely be detected, and in controlling for non-operator influences, such as farm characteristics, in farm returns.

Urcola et al. (2004) use corn yield data from McLean County, Illinois to test whether farming skills influence yields with a focus on short-term performance. Their results support the hypothesis that farmer skill influences yields. The prior research's sample however, is limited to only one county in Illinois, which does not consider different regions of the state.

Li and Paulson (2014) follow up to Urcola et al. (2004)'s work and examine the returns and farm management ability of Illinois farmers. The data used are from the same database as Urcola et al. (2004) which is the FBFM records from 1996 to 2014. They calculate profits and search for skill using rank correlation test and winner and loser test. The results show the distribution of profits over time is not random luck and all top rank farmers have persistent farming skills. Farmers who are more highly skilled can consistently earn higher returns than their lower skilled peers.

To conclude, the literature provides inconclusive evidence as to the existence of management skill. The most powerful evidence comes from profit measurements using yearly data from the farm performance records. Previous studies using this type of data are dated or suffer from limitations on the number of years analyzed or the inability to disentangle natural endowment or weather effects from skill-based farming strategies. The participants in FBFM records, which are basically homogeneous grain farms, provides the clearest way to develop an assessment of farm performance and their associated strategies. Therefore, it is crucial to constructing the management skill measure in a way that can control for farm characteristics and describe the level of managerial compensation by further factors beyond farm size and soil productivity, in particular by differences in managerial talents and quality.

3. Survivorship Bias

Evaluating farm performance using farm returns is extremely difficult. First, farm data sources suffer from self-selected reporting and survivorship bias. It is possible that farmers with low skills are naturally eliminated from our database as their farms go out of business. This might create substantial survivorship bias, leaving only highly skilled farmers who are able to maintain high returns through time. Survivorship bias would likely cause an overstatement of returns obtained by farmers, a consequence of tracking only farms that remain in business at the end of sample period. According to our analysis on the number of farms participating in FBFM records for different time horizons, most farms have participated less than 5 years in the records, and only a small fraction of farms exhibit long-term survivorship, indicating that most farms are short-term participants in the records.

Survivorship bias is an important issue in hedge fund and mutual fund research (Brown et al., 1992; Malkiel, 1995; Carhart, 1997; Carpenter & Lynch, 1999) since it is typical of mutual fund and hedge funds databases. However, our sample is, to our knowledge, the largest and most complete survivorship-biasfree farm database currently available. Table 1 presents summary statistics for all farms and different return histories (farms present for 5 years, 10 years, and in all years) for 1996-2014. The comparison of mean returns of all farms and different return histories implies that survivorship bias effects have no great differences in returns and costs. The average gross revenues range from $566.36 to $580.00, and the average operator and land returns range from $218.89 to $225.47. The average total non-land costs range from $347.47 to $355.53. The sample is stable with an average attrition rate of 18.1% and an average entry rate of 20.6%. According to a private conversation with FBFM specialist Bradley Zwilling, “if farms are FBFM cooperators, they are always in the data set, just not always certified useable.” So common reasons for the “attrition rate” would be that their farm has a critical error in the data and it is not certified useable. For instance, this could be due to not turning in their data, not have completing their records, etc. Urcola et al. (2004) use a similar database obtained from FBFM to study the effect of farmer skills on yields. The sample in their study is stable with an average attrition rate of 6.9% and an average entry rate of 5.8%. In addition, the comparison of mean yields of farmers present in all years and the whole group of farmers imply that survivorship bias effects can be considered negligible.

As a check on the representativeness of the sample, a number of previous studies compare the financial characteristics of farm management association members to a random sample of farms (Mueller, 1954; Olson & Tvedt, 1987; Gustafson et al., 1990; Andersson & Olson, 1996; Kuethe et al., 2014). The earliest published study by Mueller (1954) find that, compared to a random sample, managerial ability is not greatly different on farms in the FBFM service and record-keeping farms given equal basic resources, particularly farm size and soil quality.

Table 1. Summary Statistics from 1996 through 2014

	All Farms	5 Years	10 Years	All Years
Number of farms	9,831	4,106	2,242	227
Total acres per farm	984	1,017	1,066	1,343
Soil-productivity rating	79.51	79.64	79.28	77.28
Corn yield (bu/acre)	162.2	162.63	163.02	162.46
Corn price ($/bu)	3.18	3.18	3.2	3.22
Soybean yield (bu/acre)	48.75	48.96	49.25	49.37
Soybean price ($/bu)	6.04	6.19	6.51	7.48
Crop revenue ($/acre)	529.1	532.58	535.99	536.41
Other farm receipts ($/acre)	49.9	48.43	44.02	30.94
Gross revenue	**579.00**	**580.00**	**579.92**	**566.36**
($ per acre) Total direct costs	161.39	162.49	164.45	169.05
Soil fertility	67	67.36	68.18	71.68
Pesticides	36.28	36.4	36.62	36.75
Seed	45.79	46.22	46.92	48.29
Drying and storage	12.32	12.49	12.71	12.32
Total power and equipment costs	97.98	98.53	97.83	93.54
Machinery hire/lease	14.1	14	13.69	12.39
Utility	7.92	7.71	7.42	5.9
Machinery repairs	23.64	23.71	23.42	22.25
Fuel and oil	17.28	17.51	17.55	16.98
Light vehicle	3.14	3.06	2.99	2.29
Machinery depreciation	31.9	32.52	32.75	33.71
Total overhead costs	94.16	93.86	93.25	84.87
Hired labor	13.33	13.36	13.7	13.05
Building repair and rent	7.54	7.43	7.21	5.6
Building depreciation	7.08	6.96	6.74	5.86
Insurance	20.21	20.34	20.46	20.01
Miscellaneous	8.03	7.85	7.63	6.49
Interest (non-land)	37.97	37.9	37.48	33.84
Total non-land costs	**(353.53)**	**(354.89)**	**(355.53)**	**(347.47)**
Operator and land return	**225.47**	**225.11**	**224.4**	**218.89**

4. Comparative Farms

Farm families establish goals for themselves and their businesses based on their personal values, individual skills and interests, financial and physical resources, and economic and social conditions facing agriculture. They can choose to emphasize wider profit margins or higher volumes of production or to produce special services and products. After identifying and selecting strategies to help achieve their goals, farm operators employ tactical management to carry them out. Efficient farms which have the most similar characteristics and they should therefore provide examples of good operating practice for inefficient farms to emulate. However, the practices do not all contribute equally to the management efficiency. Some practices are more important than others. A significance test enables one to see which of the practices have been the bigger contributors.

This section is to identify strategies and characteristics of skilled farm managers. The broader strategy framework recognizes three levels of planning that have an effect on the farm performance. First, profitability analysis and enterprise budgeting can help to identify more profitable enterprises and develop a new whole-farm plan. The areas of profitability, liquidity, and solvency are closely related. Second, financial healthiness examination aims at determining the effect on the cash flow resulting from current debt and expansion. This procedure should help managers isolate and identify the causes of a financial problem quickly and systematically. Third, management patterns and strategies should be analyzed through the breakdown of the processes and sources.

4.1. Skill Portfolios: Two Approaches

Historically, there are two principle approaches to this, sometimes called cross-sectional regressions (the Fama-MacBeth method) and time-series regressions (the Fama-French method). In the context of the present study, construction of skill portfolios based on a non-intercept two-factor model involves two approaches. The first approach is to rank each farm manager based on alphas with the most skilled manager as the number one according to the Li and Paulson (2014) procedure. For each time period (e.g.: 1996-2014), the alpha is the residual excess ratio (derived from operator and land returns) left unexplained by the benchmark model using cross sectional regressions. The second approach is to compute the OLS-estimated alphas using the time series using the time series of yearly operator and land returns for each farm i.

For cross sectional regressions, the comparison of the composition of management skills is based on placing all farm managers into ten deciles for each of the sample year. The first step is to rank each farm manager based on alphas given that year with the most skilled manager as the number one. Then, the managers are sorted in descending rank order. The second step is to form yearly deciles of mangers based on manager’s skill ranking. The third step is to group the yearly skill portfolios by decile formed in step two and compute how the manager performed by key management measurements (profits, crop price, yields, operating costs, farm characteristics and financial conditions). The fourth step is to compute the difference in the key measurements between the top and bottom performing manager groups and test the null hypothesis: the difference between the top and bottom performing groups is zero. If the difference between the top and bottom groups is significantly different than zero using an appropriate statistical test, then the null hypothesis can be rejected and the conclusion is reached that top managers do have a different set of management skills and stand out amongst their peers.

The appropriate statistical test in this case is Wilcoxon signed-rank test, a nonparametric test that is well-specified and among the most powerful in their comparison of several predictability tests for mutual funds and agricultural futures markets (Carpenter & Lynch, 1999; Aulerich et al., 2013). The Wilcoxon signed-rank test is used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ (Wilcoxon, 1945). It can be used as an alternative to the paired Student’s t-test, t-test for matched pairs, or the t-test for dependent samples when the population cannot be assumed to be normally distributed (Lowry, 2014).

The deviation analysis is also included in each table in italic. In each year, the deviation is calculated based on the difference between the value of the key comparable variable (profits, crop price, yields, operating costs, farm characteristics and financial conditions) and its mean for all farms within a county given that year. In this specification, the yearly county-level average was selected to minimize the impacts of geography and weather on returns (e.g.: good vs. bad weather, superior vs. inferior growing conditions). Also, the use of the county average benchmark is to control for systematic effects that affect all farms within a county in one specific year. Therefore, it removes systemic effects that might impact every farmer peer group in a given year. The deviations can "fix" the time effect, which will offer more compelling evidence addressing the management style question. The sign of the deviation reports the direction of that difference (e.g., the deviation is positive when a farm's certain key outcome exceeds the yearly county benchmark, which is the mean outcome in that year), while the magnitude of the value indicates the size of the difference. Also, a percentage deviation is calculated for robustness check. Note that the percentage deviation has no units: we divided the absolute deviation by the mean, so the units canceled.

For time-series regressions, time-series data for each farm i are used to estimate the intercept i using same two-factor model as for the cross sectional regressions for that farm. In this case, we obtain a single alpha score for each farm manager and form deciles of managers based on alpha ranking. The first step is to rank each farm manager based on alpha scores with the most skilled manager as the number one. Then, the managers are sorted in descending rank order. The second step is to form deciles of mangers based on manager's skill ranking. The third step is to use the deciles of managers formed in step two and compute how the manager performed by key management measurements (profits, crop price, yields, operating costs, farm characteristics and financial conditions). The fourth step is to compute the difference in the key measurements between the top and bottom performing manager groups and test the null hypothesis: the difference between the top and bottom performing groups is zero.

A subset including only the farms present for more than 10 years was constructed (see table 2). This subset includes a total of 4,157 farm-level observations for each variable. T-test is applied for each farm. Over the entire sample period, 1,636 farms have significantly positive alphas, which is around 40% of the total farm number; there are 685 farms with negative alphas taking up to 16% of total farms. After constructing a managerial return measure in a way that controls for farm characteristics by further factors beyond farm size and soil productivity, only 263 farms have significantly positive alphas, which is 6% of total farms; and the number of farms with negative alpha increases to 2,414 with the percentage of 58%. The adjusted measure describes the level of managerial return by differences in managerial talents and quality beyond natural resource endowment. It shows that the mean (positive) is to the right of the median (negative) and the distribution of alpha is right-skewed, indicating that the right tail is longer; the mass of the distribution is concentrated on the left of the distribution. High value of kurtosis arise in the circumstance where the probability mass is concentrated around the mean and occasional values far from the mean.

The skill portfolios based on cross sectional regressions by year can be considered as short term (year to year) performance rankings, while the skill portfolios based on time series regression with at least 10 years of data can be referred to as long term performance rankings. The intent is to provide intuition as to if the different approach gives different answers.

Table 2. Alpha Estimates for Farms with 10 More Years of Data Available

Panel A: Excess Ratio Regression	
Number of farms with usable data	4,157
Number of farms with significantly positive alpha	1,636
Percentage of farms with significantly positive alpha	39.35%
Number of farms with non-significant alpha	1,836
Percentage of farms with non-significant alpha	44.17%
Number of farms with significantly negative alpha	685
Percentage of farms with significantly negative alpha	16.48%
Panel B: Excess Ratio Regression Adjusted by Farm Characteristics	
Number of farms with usable data	4,157
Number of farms with significantly positive alpha	263
Percentage of farms with significantly positive alpha	6.32%
Number of farms with non-significant alpha	1,621
Percentage of farms with non-significant alpha	54.39%
Number of farms with significantly negative alpha	2,414
Percentage of farms with significantly negative alpha	58.07%
Panel C: Alpha Distributions (Adjusted by Farms Characteristics)	
Number of farms with usable data	4,157
Number of farms with positive alpha	1,917
Number of farms with negative alpha	2,240
Mean	21.6
10th percentile	-462.14
25th percentile	-105.85
50th percentile	-7.36
75th percentile	97.67
90th percentile	452.91
Shapiro-Wilk test of normality (p-value)	0.00
Skewness	33.18
Kurtosis	2342.67

Note: t-test is applied for each farm across more than 10-year-period observations.

4.2. Profitability

Two measures of a farm's profitability are used in measuring the farm's ability to generate operator's share management income. For cross sectional regressions, which is also referred to as short-term performance results, table 3 displays the operator and land return and management return for each skill portfolio in Panel A. The top skill decile is 10 and is formed based on alpha rankings. More skilled farm managers can earn higher net farm income. Column (1) in table 3 shows that the average operator and land return for the top decile of farm managers from 1996 to 2014 is $352.40/acre, which is $308/acre more than the bottom farms, averaging $17.04/acre. Column (2) shows that most skilled farm managers record the highest management returns, averaging $203.81/acre, while the bottom farms record the lowest, averaging -$202.90/acre. The difference is $406.71/acre. Column (3) and (4) present a simple monotonic relationship between alpha and profitability, which is not surprising because alpha is estimated by using operator and land returns measure. Column (5) and (6) calculate the percentage deviations, which is equal to the absolute deviation divided by the mean. Patterns shown in percentage deviations confirm with the previous absolute deviations that most skilled managers show better profit making capacity and the top/bottom deciles have greater influence than the intermediate deciles.

Table 3. Short-term (Cross-sectional Regression) Profitability Evaluation, 1996-2014

Panel A: Profitability for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	OpRet	MgtRet	*OpRet1*	*MgtRet1*	*OpRet2 %*	*MgtRet2 %*
	($/acre)	($/acre)				
1	17.04	-136.68	-164.85	-175.41	-341.2	-1652.56
2	100.34	-44.6	-80.37	-82.32	-258.95	-765.03
3	135.96	-10.31	-46.14	-48.32	-62.96	-317.3
4	156.63	11.93	-25.01	-25.25	-50.32	-256.31
5	178.08	33.93	-3.17	-2.1	52.01	9.97
6	195.03	51.12	14.53	15.58	138.34	164.27
7	213.2	68.22	32.69	34.11	34.29	375.13
8	235.59	91.07	53.79	56.13	139.53	405.45
9	261.13	117.81	79.35	82.28	88.05	790.94
10(Best)	325.4	184.86	139.89	146.06	262.69	1252.04
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	OpRet	MgtRet	*OpRet1*	*MgtRet1*	*OpRet2 %*	*MgtRet2 %*
	($/acre)	($/acre)				
Top vs Bottom 10%	308.36 (0.00)	321.54 (0.00)	304.74 (0.00)	321.47 (0.00)	603.89 (0.00)	2904.6 (0.00)
Top vs Bottom 20%	234.6 (0.00)	242.01 (0.00)	232.26 (0.00)	243.07 (0.00)	475.4 (0.00)	2230.71 (0.00)
Top vs Bottom 30%	189.62 (0.00)	195.14 (0.00)	188.16 (0.00)	196.87 (0.00)	384.46 (0.00)	1728.14 (0.00)
Top vs Bottom 40%	156.35 (0.00)	160.43 (0.00)	155.54 (0.00)	162.49 (0.00)	309.5 (0.00)	1453.98 (0.00)
Top vs Bottom 50%	128.48 (0.00)	131.79 (0.00)	127.98 (0.00)	133.54 (0.00)	264.89 (0.00)	1194.15 (0.00)

Note: Wilcoxon p-value in parenthesis.

In Panel B, table 3 displays the difference between top and bottom deciles for the profitability measures and deciles test results. The difference of operator and land returns between the top and bottom decile is $308.36/acre which is significantly different from zero. Top managers have an average management return of $321.54 higher than the bottom 10%. The statistical significance of the test result that top and bottom managers performances differ prevails in every portfolio of liquidity measurements. The results are also presented for comparisons of the top and bottom 20%, 30%, 40% and 50%. The findings persist even when we expand the size of the deciles, but the differences in magnitude decline. This suggests that the top/bottom deciles have greater influence than the intermediate deciles. In sum, the top 10% of managers tend to show substantial profit making capacity in financial conditions.

Table 4 demonstrates similar results for time series regressions. An interesting pattern arise that both absolute deviations and percentage deviations are smaller compared to table 3. The results are also compared between the top and bottom manager performance in Panel B. For example, all differences between the top and bottom 10% farms show smaller values. The long-term performance deviations shrink compared to short-term performances indicating that farms that achieve consistent performance over longer term show more stability due to persistent skill, while it is more volatile for average farms to survive from year to year due to luck, bad weather, microeconomic condition changes, disease, etc.

Table 4. Long-term (Time-series Regression) Profitability Evaluation, 1996-2014

Panel A: Profitability for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	OpRet	MgtRet	*OpRet1*	*MgtRet1*	*OpRet2 %*	*MgtRet2 %*
	($/acre) 59.55	($/acre) -89.56	- 130.78	-137.69	-105.76	-1185.01
2	116.92	-27.73	-69.25	-70.99	-52.51	-617.79
3	148.41	2.48	-41.9	-43.43	-220.19	-270.25
4	168.79	24.34	-20.93	-22.49	-14.09	-254.29
5	180.12	36.94	-3.45	-4.01	269.12	-15.35
6	193.69	49.93	8.74	9.89	-74.72	72.18
7	216.3	72.27	25.46	26.74	22.46	204.84
8	236.59	91.97	48.76	49.62	37.33	394.49
9	259.98	115.63	68.35	71.36	53.28	579.79
10(Best)	310.13	169.76	116.22	122.28	86.17	1102.63
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	OpRet	MgtRet	*OpRet1*	*MgtRet1*	*OpRet2 %*	*MgtRet2 %*
Top vs Bottom 10%	($/acre) 250.58 (0.00)	($/acre) 259.32 (0.00)	247 (0.00)	259.98 (0.00)	191.93 (0.00)	2287.65 (0.00)
Top vs Bottom 20%	196.85 (0.00)	201.38 (0.00)	192.34 (0.00)	201.21 (0.00)	148.91 (0.00)	1742.91 (0.00)
Top vs Bottom 30%	160.66 (0.00)	164.11 (0.00)	158.48 (0.00)	165.19 (0.00)	185.07 (0.00)	1383.82 (0.00)
Top vs Bottom 40%	132.34 (0.00)	135.04 (0.00)	130.43 (0.00)	136.17 (0.00)	147.95 (0.00)	1152.34 (0.00)
Top vs Bottom 50%	108.6 (0.00)	110.63 (0.00)	106.79 (0.00)	111.73 (0.00)	49.66 (0.00)	939.45 (0.00)

Note: Wilcoxon p-value in parenthesis.

The financial performance results are due to superior skills in the top decile and high profits gained by them. However, poor returns or low net farm income can have many causes. The farm may not be large enough to generate the level of production needed for an adequate income. Fixed costs such as machinery and building depreciation, interest, and general farm overhead costs should be evaluated. Poor returns may be due to low physical efficiency, low selling prices, and/or high input costs. This needs a comprehensive examination of strategies, both in terms of the propensity of farm managers with certain characteristics and their ability to make profits relative to their peers.

4.3 Revenue Composition: Crop Yields and Prices

The revenue includes all cash and noncash revenue from the crop. The accuracy of the projected profit for the enterprise depend on the accurate estimates of yields and prices. Projected yield is based on historical yields. For a budget for a long term planning for the enterprise, the appropriate selling price depends on a review of historical prices.

Table 5. Short-term (Cross-sectional Regression) Crop Yields, 1996-2014

Panel A: Yields for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	YieldCorn	YieldSoy	$yield_{c1}$	$yield_{s1}$	$yield_{c2}$ %	$yield_{s2}$ %
	(bushel/acre) 152.18	(bushel/acre) 47.00	-8.59	-2.49	-5.83	-5.25
2	155.10	48.22	-5.96	-1.20	-3.79	-2.58
3	157.79	48.52	-3.49	-0.88	-2.32	-1.85
4	160.02	49.18	-1.55	-0.37	-0.90	-0.73
5	161.77	49.40	-0.27	-0.07	-0.20	-0.08
6	162.87	49.66	1.50	0.24	0.99	0.51
7	164.13	50.15	2.31	0.56	1.52	1.19
8	166.39	50.53	3.74	0.84	2.40	1.75
9	167.58	51.10	5.01	1.37	3.32	2.86
10(Best)	170.72	52.02	7.33	2.02	4.84	4.20
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	YieldCorn (bushel/acre)	YieldSoy (bushel/acre)	$yield_{c1}$	$yield_{s1}$	$yield_{c2}$ %	$yield_{s2}$ %
Top vs Bottom 10%	18.54 (0.00)	5.02 (0.00)	15.92 (0.00)	4.51 (0.00)	10.67 (0.00)	9.45 (0.00)
Top vs Bottom 20%	15.51 (0.00)	3.95 (0.00)	13.44 (0.00)	3.54 (0.00)	8.89 (0.00)	7.45 (0.00)
Top vs Bottom 30%	13.20 (0.00)	3.30 (0.00)	11.37 (0.00)	2.93 (0.00)	7.50 (0.00)	6.16 (0.00)
Top vs Bottom 40%	10.93 (0.00)	2.72 (0.00)	9.49 (0.00)	2.43 (0.00)	6.23 (0.00)	5.1 (0.00)
Top vs Bottom 50%	8.97 (0.00)	2.23 (0.00)	7.95 (0.00)	2.01 (0.00)	5.22 (0.00)	4.20 (0.00)

Note: Wilcoxon p-value in parenthesis.

Illinois agriculture is based largely on crop production, especially corn and soybeans. Illinois ranked the first in the nation in soybean production with over 547 million bushels produced in 2014.1 It produced the second greatest amount of corn in 2014 with 2.34 billion bushels.2 Year-to-year variation in farm revenue are related to the growing season, crop yields, grain prices, and acres in high-cash value crops. Too much rainfall and too dry season in certain parts of the state can directly affect crop yields. Table 5 shows the crop yields on a yearly basis. The average corn yield for Illinois farms range from 170.72 bushels/acre for the top skilled farmers to 152.18 bushels/acre for the bottom ones. Soybean yields from 1996 through 2014 are reported from 47.00 bushels/acre for the bottom farmers to 52.02 bushels/acre for the top farmers.

Table 6 shows the crop yields for Illinois farms participating in the FBFM program for more than 10 years. The average corn yield for Illinois farms range from 170.04 bushels/acre for the top skilled farmers to 153.42 bushels/acre for the bottom ones. Soybean yields from 1996 through 2014 are reported from 47.39 bushels/acre for the bottom farmers to 51.84 bushels/acre for the top farmers. Results suggest that most skilled farm operators average highest crop yields. Corn yields on the recordkeeping farms averaged 6 to 15 percent above average for all Illinois farms.

Table 6. Long-term (Time-series Regression) Crop Yields, 1996-2014

Panel A: Yields for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	YieldCorn	YieldSoy	$yield_{c1}$	$yield_{s1}$	$yield_{c2}$ %	$yield_{s2}$ %
	(bushel/acre) 153.42	(bushel/acre) 47.39	-7.58	-2.14	-5.05	-2.14
2	156.03	47.95	-4.65	-1.35	-3.07	-1.35
3	158.05	48.78	-3.54	-0.97	-2.42	-0.97
4	160.17	49.30	-1.43	-0.26	-0.75	-0.26
5	160.38	49.46	-0.25	0.16	-0.33	0.16
6	161.77	49.35	0.27	-0.12	0.03	-0.12
7	163.81	50.27	1.80	0.62	1.25	0.62
8	166.43	50.75	4.01	1.03	2.64	1.03
9	167.89	51.37	4.46	1.26	2.98	1.26
10(Best)	170.04	51.84	6.97	1.79	4.77	1.79
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	YieldCorn (bushel/acre)	YieldSoy (bushel/acre)	$yield_{c1}$	$yield_{s1}$	$yield_{c2}$ %	$yield_{s2}$ %
Top vs Bottom 10%	16.62 (0.00)	4.45 (0.00)	14.55 (0.00)	3.92 (0.00)	9.82 (0.00)	8.28 (0.00)
Top vs Bottom 20%	14.24 (0.00)	3.94 (0.00)	11.84 (0.00)	3.27 (0.00)	7.94 (0.00)	6.93 (0.00)
Top vs Bottom 30%	12.29 (0.00)	3.28 (0.00)	10.41 (0.00)	2.85 (0.00)	6.98 (0.00)	6.06 (0.00)
Top vs Bottom 40%	10.13 (0.00)	2.7 (0.00)	8.61 (0.00)	2.35 (0.00)	5.73 (0.00)	5 (0.00)
Top vs Bottom 50%	8.38 (0.00)	2.14 (0.00)	7.00 (0.00)	1.83 (0.00)	4.66 (0.00)	3.90 (0.00)

Note: Wilcoxon p-value in parenthesis.

The average marketing year prices for corn and soybeans can vary from year to year with cyclical movements. Sales for corn and soybeans have been divided between old crop and new crop sales. For example, if prices received for old crop sold in one year are below their inventory prices, it will result in a negative marketing margin and lower crop returns. If prices received for new crop are high enough then crops may not be eligible for loan deficiency payments or/and producers not receive a countercyclical payment. Table 7 reports the average marketing year prices received for both new crop and old crop sold during shorter periods. Corn prices (new crop) received for most skilled farmers average $3.08, which is 13 cents higher than least skilled ones. Corn prices (old crop) received for the top farmers average $3.19, which is 10 cents higher than the least skilled ones. Soybeans (new crop) are sold for $7.70 to $7.92 during the same period. Soybean prices (old crop) received for the top farmers average $7.99, which is 18 cents higher than the bottom ones.

Table 8 reports the average marketing year prices received for both new crop and old crop sold during longer periods. Corn prices (new crop) received for most skilled farmers during 1996 to 2014 average $3.28, which is 11 cents higher than least skilled ones. Corn prices (old crop) received for the top farmers average $3.36, which is 7 cents higher than the least skilled ones. Soybeans (new crop) are sold for $7.83 to $8.05 during the same period. Soybean prices (old crop) received for the top farmers average $8.19, which is 18 cents higher than the bottom ones. In sum, most successful farmers receive higher crop prices and reveal better marketing skills.

The crop yields results show much more consistency between the management skill and the crop yields. For example, there is a monotonic relationship between the skill and yield outcomes (see columns (1) and (2)). In addition, the deviations are smaller for long term performers than short term survivors (see columns (3) and (6)). However, the results for crop prices may vary. The deviation deduction pattern does not agree with the previous findings. This suggests a potential interesting hypothesis that the skill persistence may be driven more by the yield effect than by the price effect. It is equivalent to say that crop yields are the dominating factor determining long term performance.

One of the focus on yield and price levels is to choose the commodity programs under the 2014 Farm Bill. Differences in expected payments between Agricultural Risk Coverage - County Coverage (ARC-CO) and Price Loss Coverage (PLC) will be an important factor when making the program choice decisions offered under the 2014 Farm Bill. Realization of Market Year Average prices and county yields from 2014 through 2018 will affect differences in payments (Schnitkey, 2015). One strategy is to choose ARC-CO on some farms and PLC on other farms, splitting protection between a revenue program whose guarantee will change over time and a target price program with a fixed reference price.

4.4 Farm Characteristics

Table 9 and 10 present the farm characteristics that are associated with operating skills. In sum, long term farm characteristics show relative smaller deviations in column (3)-(6). More skilled farm managers operate on farms that have a high soil productivity. However, the farm size held by the farm operator can have a nonlinear relationship with management skill. For example, the most skilled farmers control relatively smaller land size compared to mid-ranked farmers. The size of the farm business has been shown to decrease with the level of risk aversion (Boumtje et al., 2001). A reduction in farm size can be a means of coping with the risky nature of the agricultural business. Too little land may mean the business is too small to fully use other resources. At the other extreme, too much land may require borrowing a large amount of money, cause serious cash flow problems, and overextend the operator's management and machinery capacity. Either situation can result in financial stress and eventual failure of the business.

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Table 7. Short-term (Cross-sectional Regression) Prices Received, 1996-2014

Panel A: Prices for each decile												
	(1)	(2)	(3)	(4)	(5)	(6)	-7	(8)	(9)	(10)	(11)	(12)
Decile	PriceNewCorn	PriceOldCorn	PriceNewSoy	PriceOldSoy	*pnc1*	*poc1*	*pns1*	*pos1*	*pnc2 %*	*poc2 %*	*pns2 %*	*pos2 %*
	($/bushel) 3.08	($/bushel) 3.19	($/bushel) 7.72	($/bushel) 7.81	-0.06	-0.04		-0.07	-1.80	-1.42	-0.62	-1.12
2	3.09	3.20	7.71	7.82	-0.04	-0.02	-0.05	-0.06	-1.23	-0.65	-0.57	-0.77
3	3.10	3.20	7.70	7.84	-0.03	-0.02	-0.07	-0.04	-0.90	-0.71	-0.90	-0.47
4	3.11	3.21	7.72	7.90	-0.03	-0.01	-0.04	0.03	-0.83	-0.29	-0.50	0.29
5	3.12	3.22	7.76	7.89	-0.01	0.00	-0.01	0.00	-0.35	-0.14	-0.11	0.01
6	3.13	3.23	7.75	7.87	0.00	0.00	-0.02	-0.01	0.10	0.12	-0.09	-0.14
7	3.15	3.21	7.78	7.89	0.01	0.00	0.01	0.02	0.47	0.02	0.19	0.36
8	3.16	3.24	7.79	7.87	0.03	0.02	0.02	0.00	0.87	0.77	0.26	0.12
9	3.20	3.25	7.83	7.90	0.06	0.03	0.06	0.02	1.72	0.97	0.69	0.44
10(Best)	3.21	3.26	7.92	7.99	0.07	0.05	0.14	0.11	1.96	1.33	1.66	1.29
Panel B: Deciles test results												
	(1)	(2)	(3)	(4)	(5)	(6)	-7	(8)	(9)	(10)	(11)	(12)
Decile	PriceNewCorn	PriceOldCorn	PriceNewSoy	PriceOldSoy	*pnc1*	*poc1*	*pns1*	*pos1*	*pnc2 %*	*poc2 %*	*pns2 %*	*pos2 %*
Top vs Bottom 10%	($/bushel) 0.13 (0.00)	($/bushel) 0.08 (0.00)	($/bushel) 0.19 (0.00)	($/bushel) 0.18 (0.00)	0.13 (0.00)	0.09 (0.00)	(0.00)	0.18 (0.00)	3.76 (0.00)	2.74 (0.00)	2.28 (0.00)	2.41 (0.00)
Top vs Bottom 20%	0.12 (0.00)	0.06 (0.00)	0.15 (0.00)	0.13 (0.00)	0.13 (0.00)	0.07 (0.00)	0.15 (0.00)	0.13 (0.00)	3.36 (0.00)	2.19 (0.00)	1.77 (0.00)	1.81 (0.00)
Top vs Bottom 30%	0.10 (0.00)	0.05 (0.00)	0.13 (0.00)	0.10 (0.00)	0.10 (0.00)	0.06 (0.00)	0.14 (0.00)	0.10 (0.00)	2.83 (0.00)	1.95 (0.00)	1.56 (0.00)	1.40 (0.00)
Top vs Bottom 40%	0.08 (0.00)	0.04 (0.00)	0.12 (0.00)	0.07 (0.00)	0.09 (0.00)	0.05 (0.00)	0.11 (0.00)	0.08 (0.00)	2.45 (0.00)	1.54 (0.00)	1.34 (0.00)	1.07 (0.00)
Top vs Bottom 50%	0.07 (0.00)	0.03 (0.00)	0.09 (0.00)	0.05 (0.00)	0.07 (0.00)	0.04 (0.00)	0.09 (0.00)	0.06 (0.00)	2.05 (0.00)	1.28 (0.00)	1.08 (0.00)	0.83 (0.00)

Note: Wilcoxon p-value in parenthesis.

Table 8. Long-term (Time-series Regression) Prices Received, 1996-2014

Panel A: Prices for each decile												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Decile	PriceNewCorn	PriceOldCorn	PriceNewSoy	PriceOldSoy	*pnc1*	*poc1*	*pns1*	*pos1*	*pnc2 %*	*poc2 %*	*pns2 %*	*pos2 %*
	($/bushel)	($/bushel)	($/bushel)	($/bushel)								
	3.14	3.29	7.90	8.01	-0.06	-0.05		-0.08	-1.79	-1.35	-0.48	-1.21
2	3.17	3.30	7.83	8.05	-0.03	-0.02	-0.08	-0.05	-1.15	-0.67	-0.76	-0.62
3	3.17	3.31	7.83	8.06	-0.03	-0.02	-0.08	-0.03	-1.07	-0.58	-0.87	-0.22
4	3.20	3.34	7.88	8.09	-0.01	0.00	-0.03	-0.01	-0.29	-0.47	-0.27	-0.10
5	3.21	3.31	7.87	8.12	-0.01	-0.01	-0.02	0.02	-0.19	-0.18	-0.24	0.14
6	3.19	3.35	7.90	8.12	-0.01	0.02	-0.02	0.00	0.00	0.57	-0.19	0.11
7	3.19	3.31	7.88	8.08	0.00	-0.01	0	0.00	-0.01	-0.08	0.07	0.09
8	3.24	3.34	7.94	8.09	0.03	0.02	0.03	0.01	0.87	0.63	0.34	0.24
9	3.25	3.34	7.99	8.13	0.06	0.03	0.09	0.04	1.64	1.05	1.08	0.64
10(Best)	3.28	3.36	8.05	8.19	0.07	0.03	0.12	0.09	2.01	1.10	1.33	0.95
Panel B: Deciles test results												
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Decile	PriceNewCorn	PriceOldCorn	PriceNewSoy	PriceOldSoy	*pnc1*	*poc1*	*pns1*	*pos1*	*pnc2 %*	*poc2 %*	*pns2 %*	*pos2 %*
	($/bushel)	($/bushel)	($/bushel)	($/bushel)								
Top vs Bottom 10%	0.14	0.07	0.15	0.17	0.13	0.08		0.17	3.8	2.45	1.82	2.16
	-0.01	-0.14	-0.11	-0.15	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 20%	0.11	0.06	0.16	0.13	0.11	0.07	0.15	0.13	3.3	2.08	1.83	1.71
	0	-0.09	-0.03	-0.07	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 30%	0.09	0.05	0.14	0.10	0.09	0.06	0.14	0.10	2.85	1.80	1.62	1.29
	0	-0.07	-0.02	-0.1	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 40%	0.07	0.03	0.11	0.07	0.04	0.03	0.11	0.08	2.2	1.44	1.3	1.02
	0	-0.09	-0.05	-0.13	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 50%	0.05	0.03	0.09	0.06	0.06	0.04	0.09	0.06	1.80	1.31	1.05	0.81
	-0.01	-0.08	-0.07	-0.15	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: Wilcoxon p-value in parenthesis.

Table 9. Short-term (Cross-sectional Regression) Farm Characteristics, 1996-2014

Panel A: Farm size and soil quality for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	Size	SPR	*size₁*	*spr₁*	*size₂ %*	*spr₂ %*
	(acre) 924.12	76.11	-199.01	-2.09	-20.46	-2.64
2	1054.53	77.22	-68.68	-1.29	-7.50	-1.32
3	1116.73	78.15	-10.16	-0.81	-1.93	-0.90
4	1118.82	79.23	5.40	-0.60	0.66	-0.52
5	1168.49	79.43	54.39	-0.19	5.02	0.02
6	1149.52	80.29	58.75	0.37	6.21	0.55
7	1162.54	80.62	75.03	0.43	7.27	0.72
8	1142.57	81.15	62.96	0.72	6.54	1.14
9	1128.38	81.08	56.84	1.08	6.03	1.38
10(Best)	1021.88	82.57	-35.09	2.38	-1.79	1.58
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	Size (acre)	SPR	*size₁*	*spr₁*	*size₂ %*	*spr₂ %*
Top vs Bottom 10%	97.77 (0.00)	6.46 (0.00)	163.92 (0.00)	4.48 (0.00)	18.67 (0.00)	4.22 (0.00)
Top vs Bottom 20%	85.99 (0.00)	5.16 (0.00)	144.88 (0.00)	3.42 (0.00)	16.11 (0.00)	3.46 (0.00)
Top vs Bottom 30%	65.96 (0.00)	4.44 (0.00)	120.98 (0.00)	2.79 (0.00)	13.56 (0.00)	2.99 (0.00)
Top vs Bottom 40%	60.44 (0.00)	3.68 (0.00)	108.18 (0.00)	2.35 (0.00)	11.83 (0.00)	2.55 (0.00)
Top vs Bottom 50%	44.57 (0.00)	3.11 (0.00)	87.43 (0.00)	1.99 (0.00)	9.70 (0.00)	2.15 (0.00)

Note: Wilcoxon p-value in parenthesis.

Table 10. Long-term (Time-series Regression) Farm Characteristics, 1996-2014

Panel A: Farm size and soil quality for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	Size	SPR	$size_1$	spr_1	$size_2$ %	spr_2 %
(acre)	1145.36	76.53	-169.18	-1.32	-15.68	-1.63
2	1227.15	76.99	-81.72	-0.96	-7.51	-1.23
3	1268.56	78.18	-42.79	-0.62	-3.95	-0.79
4	1308.83	78.02	-13.88	-0.26	-1.23	-0.32
5	1341.00	78.20	43.93	-0.26	3.11	-0.32
6	1270.99	79.31	48.99	0.11	4.67	0.07
7	1317.76	79.53	60.49	0.18	5.04	0.25
8	1313.28	80.17	52.26	0.76	5.24	0.95
9	1277.44	81.64	52.42	0.79	5.02	1.00
10(Best)	1266.12	82.05	50.53	1.60	5.40	2.02
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	Size	SPR	$size_1$	spr_1	$size_2$ %	spr_2 %
	(acre)					
Top vs Bottom 10%	120.76 (0.00)	5.53 (0.00)	219.71 (0.00)	2.92 (0.00)	21.08 (0.00)	3.65 (0.00)
Top vs Bottom 20%	85.7 (0.00)	5.09 (0.00)	177.1 (0.00)	2.33 (0.00)	16.82 (0.00)	2.94 (0.00)
Top vs Bottom 30%	72.06 (0.00)	4.06 (0.00)	149.78 (0.00)	2.01 (0.00)	14.28 (0.00)	2.54 (0.00)
Top vs Bottom 40%	56.34 (0.00)	3.42 (0.00)	130.96 (0.00)	1.62 (0.00)	12.28 (0.00)	2.05 (0.00)
Top vs Bottom 50%	31.09 (0.00)	2.96 (0.00)	105.81 (0.00)	1.37 (0.00)	10.14 (0.00)	1.72 (0.00)

Note: Wilcoxon p-value in parenthesis.

4.5 Financial Status: Liquidity, Solvency, and Efficiency

Liquidity is an assessment of a farm's ability to meet current cash-flow needs. The amount of working capital (the difference between current assets and current liabilities) and the current ratio (current assets divided by current liabilities) are two measures of liquidity. Table 11 displays the short term working capital and current ratio for each skill portfolio in Panel A. The top skill decile is 10 and is formed based on alpha rankings. Columns (1) and (2) show that the average amount of working capital of the top decile farms from 1996 through 2014 is $266,296, while the bottom decile farms record the lowest, averaging $116,129. Current ratios range from 462 % for the farms in decile 8 to 1778 % for the top farms. Table 12 displays the long term working capital and current ratio. Columns (1) and (2) show that the average amount of working capital of the top decile farms is $281,650, while the bottom decile farms record the lowest, averaging $88,847. Current ratios range from 290 % for the farms in decile 8 to 2437 % for the top farms. The most skilled farms recorded the highest current ratio, which demonstrates the healthiness of their financial conditions.

Table 11. Short-term (Cross-sectional Regression) Liquidity Evaluation, 1996-2014

Panel A: Liquidity for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	WorkingCapital ($)	CurrentRatio	wc_1	cr_1	wc_2 %	cr_2 %
	116,129	16.65	-78,515	6.35	-40.31	-92.01
2	136,031	6.70	-62,454	-1.62	-40.86	26.18
3	152,043	5.49	-35,922	-3.42	-52.69	0.03
4	189,224	8.36	-5,487	-1.26	-19.57	-6.51
5	177,419	7.03	-11,343	-1.56	7.35	-7.08
6	185,980	7.50	1,935	-2.38	3.52	-3.34
7	218,914	12.11	33,310	0.53	13.49	2.41
8	217,720	4.62	29,605	-2.94	9.57	16.45
9	241,363	8.96	54,910	-0.23	41.83	37.43
10(Best)	266,296	17.78	75,522	7.15	78.99	27.70
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	WorkingCapital ($)	CurrentRatio	wc_1	cr_1	wc_2 %	cr_2 %
Top vs Bottom 10%	150,166	1.12	154,037	0.8	119.31	119.7
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 20%	127,735	1.65	135,688	1.29	100.89	65.82
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 30%	107,036	0.79	112,300	1.00	87.94	49.37
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 40%	87,721	1.53	93,947	0.93	74.22	39.25
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Top vs Bottom 50%	71,856	1.31	77,794	0.58	58.63	32.13
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: Wilcoxon p-value in parenthesis.

Table 12. Long-term (Time-series Regression) Liquidity Evaluation, 1996-2014

Panel A: Liquidity for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	WorkingCapital	CurrentRatio	wc_1	cr_1	wc_2 %	cr_2 %
	($) 88,847	11.69	-125,674	0.00	-63.84	-22.53
2	186,549	3.59	-15,910	-5.71	-28.38	-0.81
3	168,628	2.90	-39,444	-5.42	-1.94	-10.86
4	195,299	3.02	-17,375	-6.30	-14.73	-12.35
5	167,486	7.93	8,514	2.73	-4.90	4.09
6	265,100	5.72	4,538	-2.48	-35.23	-3.55
7	200,257	17.97	22,869	5.19	25.96	10.61
8	207,668	3.05	35,148	-1.68	14.66	2.21
9	250,799	8.31	52,470	2.84	50.56	8.22
10(Best)	281,650	24.37	82,579	11.36	62.79	26.95
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	WorkingCapital	CurrentRatio	wc_1	cr_1	wc_2 %	cr_2 %
Top vs Bottom 10%	($) 192,802 (0.00)	12.68 (0.00)	208,254 (0.00)	11.36 (0.00)	126.62 (0.00)	49.48 (0.00)
Top vs Bottom 20%	129,069 (0.00)	8.43 (0.00)	138,982 (0.00)	9.8 (0.00)	102.96 (0.00)	29.23 (0.00)
Top vs Bottom 30%	98,843 (0.00)	5.61 (0.00)	117,416 (0.00)	7.74 (0.00)	74.04 (0.00)	23.78 (0.00)
Top vs Bottom 40%	75,544 (0.00)	7.94 (0.00)	98,292 (0.00)	8.66 (0.00)	65.76 (0.00)	23.57 (0.00)
Top vs Bottom 50%	80,137 (0.00)	5.88 (0.00)	77,866 (0.00)	5.88 (0.00)	46.28 (0.00)	17.32 (0.00)

In Panel B, table 11 displays the difference between top and bottom deciles for the short term liquidity measures and deciles test results. The difference of working capitals between the top and bottom decile is $150,166 which is significantly different from zero. Top managers have an average current ratio of 112% higher than the bottom 10%. Table 11 displays the difference between top and bottom deciles for the long term liquidity measures. The difference of working capitals between the top and bottom decile is $192,802 which is significantly different from zero. Top managers have an average current ratio of 1268% higher than the bottom 10%. The statistical significance of the test result that top and bottom manager's performances differ prevails in every portfolio of liquidity measurements.

The results are also presented for comparisons of the top and bottom 20%, 30%, 40% and 50%. The findings persist even when we expand the size of the deciles, but the differences in magnitude decline. This suggests that the top/bottom deciles have greater influence than the intermediate deciles. In sum, the top 10% of managers tend to show substantial liquidity in financial conditions.

Table 13. Short-term (Cross-sectional Regression) Solvency Evaluation, 1996-2014

Panel A: Solvency for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	D/E	D/A	d/e_1	d/a_1	d/e_2 %	d/a_2 %
	(%)	(%)				
	87	34.65	16	0.78	13.38	0.32
2	77	34.58	12	1.03	10.04	3.52
3	75	34.59	-8	0.49	12.85	2.81
4	63	33.98	-9	0.74	-11.97	1.87
5	57	34.44	-22	0.83	-24.82	2.63
6	63	32.78	-1	-0.14	6.46	0.23
7	97	33.23	-17	-0.34	2.80	-0.83
8	69	34.24	-1	0.84	0.37	2.71
9	71	32.20	4	-1.59	-0.16	-4.28
10(Best)	61	30.65	-8	-2.68	-9.43	-9.07
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	D/E	D/A	d/e_1	d/a_1	d/e_2 %	d/a_2 %
	(%)	(%)				
Top vs Bottom 10%	-25.26	-4.00	-24.42	-3.46	-22.81	-9.39
	(0.02)	(0.01)	(0.14)	(0.02)	(0.03)	(0.01)
Top vs Bottom 20%	-15.58	-3.19	-16.30	-3.04	-16.49	-8.57
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Top vs Bottom 30%	-12.40	-2.24	-8.58	-1.90	-15.15	-5.74
	(0.01)	(0.01)	(0.03)	(0.01)	(0.00)	(0.00)
Top vs Bottom 40%	-0.90	-1.87	-0.03	-1.69	-7.68	-4.98
	(0.01)	0.00	(0.05)	0.00	(0.01)	0.00
Top vs Bottom 50%	0.43	-1.82	4.03	-1.55	0.07	-4.46
	(0.00)	(0.00)	(0.06)	(0.00)	(0.01)	(0.00)

Note: Wilcoxon p-value in parenthesis.

Solvency is a measure of the farm's overall financial strength and risk-taking ability. It refers to the value of assets owned by the business compared to the amount of liability, or the relation between debt and equity capital. The increasing farmland values and farm and non-farm incomes have boosted farm's ability to meet family living demands and retire term debt. The debt-to-farm equity and debt-to-farm asset indictors show how debt capital is combined with equity capital. Smaller values are preferred, and the ratios will approach to zero as liability approach zero. Large values result from small equity, which means an increasing chance of insolvency. This is useful in looking at the risk exposure of the business. Table 13 presents the short term results. Column (1) shows that the average debt-to-farm equity percentage range from 61.28% for the top farms to 86.54% for the bottom farms. Column (2) shows that the average debt-to-farm asset percentage range from 30.65% for the top farms to 34.65% for the bottom farms. Table 14 shows that the average long term debt-to-farm equity percentage range from 52.59% for the top farms to 75.47% for the bottom farms. The average debt-to-farm asset percentage range from 27.77% for the top farms to 35.59% for the bottom farms. In sum, the top decile of managers tend to show substantial solvency in financial conditions.

Table 14. Long-term (Time-series Regression) Solvency Evaluation, 1996-2014

Panel A: Solvency for each decile						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	D/E	D/A	d/e_1	d/a_1	d/e_2 %	d/a_2 %
	(%) 75	(%) 35.59	7	2.94	16.89	12.60
2	70	33.75	0	0.70	-2.00	3.60
3	75	34.85	6	1.57	6.95	4.47
4	75	34.32	9	1.79	10.08	7.32
5	102	36.88	3	-0.13	-1.90	-2.04
6	52	29.17	-4	-0.71	-4.22	-2.15
7	59	30.52	-1	-1.09	-2.27	-4.84
8	69	33.73	-1	0.50	1.17	1.81
9	63	31.29	-5	-1.45	-4.75	-5.63
10(Best)	53	27.77	-14	-4.39	-21.31	-16.20
Panel B: Deciles test results						
	(1)	(2)	(3)	(4)	(5)	(6)
Decile	D/E	D/A	d/e_1	d/a_1	d/e_2 %	d/a_2 %
Top vs Bottom 10%	(%) -22.88 (0.00)	(%) -7.82 (0.00)	-21.08 (0.01)	-7.32 (0.00)	-38.20 (0.00)	-28.80 (0.00)
Top vs Bottom 20%	-14.91 (0.00)	-5.12 -0.01	-12.95 (0.00)	-4.72 -0.01	-20.45 (0.00)	-18.97 (0.00)
Top vs Bottom 30%	-11.83 (0.00)	-3.76 (0.00)	-11.08 (0.01)	-3.49 (0.00)	-15.50 (0.00)	-13.48 (0.00)
Top vs Bottom 40%	-12.73 (0.00)	-3.78 (0.00)	-10.72 (0.01)	-3.34 (0.00)	-14.70 (0.00)	-13.15 (0.00)
Top vs Bottom 50%	-19.98 (0.00)	-4.56 (0.00)	-9.99 (0.01)	-2.79 (0.00)	-12.25 (0.00)	-10.56 (0.00)

Note: Wilcoxon p-value in parenthesis.

Some managers are able to generate more production or use fewer resources than their neighbors because they use their resources more efficiently. A general definition for efficiency is the quantity or value of production achieved per unit of resource employed. If a comparison with other farms with a budget goal shows that an operation has an adequate volume of resources but is not reaching its production goals, then some resources are not being used efficiently. A farm business may use many type of resources, so there are different ways to measure both economic and physical efficiency.

The "farm debt crisis" from 1983 to 1987 provided evidence that the farm record-keeping methods and financial analyses of that time were often inadequate or underused. Following the debt crisis, farm financial education increased, leading to growth in the number of available books, farm record systems, and services, but the new methods were generally not standardized, In 1989, the Farm Financial Standards Task Force (FFSTF) was formed to address accounting and record keeping problems on farms and ranches. Subsequently, they changed their names to the Farm Financial Standards Council (FFSC). In 2006, the FFSC developed a report concerning management accounting guidelines for agricultural producers. This section of selected financial efficiency measurements follow the financial accounting recommendations of the FFSC. One of the important purposes of this section is to analyze if management skills are embodied on the cost side, the revenue side, or both.

The first measure is the asset turnover ratio, which measures how efficiently capital invested in farm assets is being used. It is useful in measuring the farm's ability to utilize assets to generate income. This ratio is found by dividing the gross revenue generated by the market value of total farm assets.

For a short term perspective, we find that the average asset turnover ratio for the top 10% farms is 0.51 indicates that gross revenue for one year was equal to 51 percent of the total capital invested in the business. At this rate, it would take around 2 years to produce agricultural products with a value equal to the total assets. The asset turnover ratio will vary by farm type. The average asset turnover ratio for the bottom 10% farms is 0.30 indicates that gross revenue for one year was equal to 30 percent of the total capital invested in the business. At this rate, it would take more than 3 years to produce agricultural products with a value equal to the total assets. For a long-run perspective, table 22 shows that the average asset turnover ratio for the top 10% farms is 0.52, while the average ratio for the bottom 10% farms is 0.34. Long term asset turnover ratios have smaller deviations compared to short term ones.

The average asset turnover ratio for the whole sample period from 1996 to 2014 on all northern Illinois grain farms (located north of a line from Kankakee to Moline) is 43.61%. Operators on farms in central Illinois has 19-year average asset turnover ratio of 44.21%. Central Illinois occupies the area between the Kankakee-Moline line in the north and the Motatton-Alton line in the south. The figure for asset turnover ratio varies considerably with the location and type of farm. For the same period from 1996 through 2014 grain farms, operators in southern Illinois average 34.71% for asset turnover ratio. Southern Illinois farms have an average soil productivity index equal to 58, compared with an average of 81 for northern Illinois farms and 86 for central Illinois farms. Better growing conditions in the northern and central Illinois have led to larger earnings from crops.

The second measure of financial efficiency is the operational expense ratio, which is recommended to show what percent of gross revenue went for operating expenses. The operating expense ratio is computed by dividing total operating expenses (excluding depreciation) by gross revenue. Operating expenses – annual cash outlays for the no depreciable items - include fertilizer, pesticides, seeds (including homegrown seeds), machinery repairs, machinery hire and lease, fuel and oil, farm share of electricity, telephone, and light vehicle expenses, building repairs and rents, drying and storage, hired labor, livestock expenses, taxes, insurance, and miscellaneous expenses. The interest paid is not included because an interest charge is made on the operator's total farm investment.

We find that the short term average operating expense ratio for the bottom 10% farms (89%) is significantly higher than the top 10% farms (52%) and the short term average operating expense ratio for the bottom 10% farms (80%) is significantly higher than the top 10% farms (53%). Long term operating expense ratios provide smaller deviations compared to short term ones.

The average operating expense ratio for the whole sample period from 1996 to 2014 on all northern Illinois grain farms is 68.47%. Operators on farms in central Illinois had 19-year average operating expense ratio of 66.35%. For the same period from 1996 through 2014 grain farms, operators in southern Illinois averaged 68.70% for asset turnover ratio. Better growing conditions in the central Illinois have led to lower costs.

5. Conclusions

This study emphasizes the strategic and operations aspects of managing a farm. In general, we find substantial difference of farm management styles and performance efficiency in management skill portfolios. We also find evidence of most skilled farm managers are more efficient on both revenue side and costs side. With regards to time periods, the weight of the evidence points to the persistence in management styles and decisions for a subset of farm managers who are long term participants in the sample. The approaches used in this study also allow comparison among farms of different sizes and types. The activities of top farms can be replicated by poorer performers and the study provide a unique way for comparing the farm management styles and ability of most skilled farm managers to that of less skilled ones.

The innovative method is framed by comparing business strategies and performance styles in the following aspects: production and operations planning, land management and control, and production costs evaluation. Farm managers will want to consult it as well to improve the effectiveness, objectivity, and success of their decisions. It offers a guidance for farmer's strategic planning to evaluate, choose, and implement the business strategies that best fit the farm. Future studies can focus on decision making beyond the traditional microeconomic analysis-decision making under risk and the development of scenarios to understand the impact of an uncertain future.

In this study, we did not study farm manager's preferences by performing traditional cross-sectional regressions across farms of management skill on a variety of characteristics due to complicated nonlinearity, endogeneity and multicollinearity problems. The sample used in the analysis consists mainly grain farms. The future studies can expend the analysis by focusing on the economy of scope across different types of farm enterprises. Moreover, future farm operators have to balance their personal goals for an independent lifestyle, financial security, and rural living against societal concerns about food safety, environmental quality, and agrarian values.

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