Examining Differences in Risk Adjusted Returns Among Farms

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Abstract

This study examines differences in risk adjusted returns among Kansas farms using data from 1996 to 2018. Risk adjusted returns were measured using variability and downside risk as measures of risk. The two measures of risk were significantly correlated. Risk adjusted return measures were also significantly correlated with farm size as measured using the value of farm production. Risk adjusted return measures computed in this article can be used to benchmark long-run financial performance.

INTRODUCTION

Performance measures such as return on assets, return on equity, and operating profit margin ratio are commonly used to benchmark farm financial performance. When evaluating financial performance over time it is prudent to adjust farm performance metrics for the risk associated with a farm's activities. Although widely used in corporate finance, risk adjusted performance measures have not been as commonly used when benchmarking farm financial performance.

Previous literature has documented the wide variability in long-run benchmarks among farms (e.g., Yeager and Langemeier, 2009; Langemeier, 2011; Langemeier, 2013). For example, Yeager and Langemeier (2009) indicated that the top 30% of farms in terms of overall efficiency had an average operating profit margin ratio of 21.2%, whereas the bottom 28% of farms had an average operating profit margin ratio of –2.4% during the 20-year period ending in 2007.

Previous studies have also explored factors related to risk, measured using variability and downside risk. Purdy, Langemeier, and Featherstone (1997) found a significant negative relationship between the variability in return on equity, debt to asset ratio, percentage of income derived from participation in government programs, and diversification between crop and livestock enterprises. Using the percentage of years with a negative return on equity as a measure of downside risk, Langemeier and Jones (2000) found a significant and negative relationship between downside risk and gross farm income, as well as a significant and positive relationship between downside risk and the debt to asset ratio, total expense ratio, operator age, and percentage of income derived from livestock production.

Studies that combine average financial performance with risk are lacking. Purdy, Langemeier, and Featherstone (1997) examined factors impacting the mean and variability in financial performance measured using return on equity. However, their study used two separate equations to examine the factors impacting risk and return, rather than combining risk and return into a single measure (i.e., risk adjusted return measure). Combining risk and return into a single measure is important for benchmarking.

The objective of this study is to examine differences in risk adjusted returns among Kansas farms using data from 1996 to 2018. Risk adjusted returns are computed using variability and downside risk as measures of risk. Risk adjusted returns for the sample of farms are related to farm size.

METHODS

The Sharpe ratio has been used extensively to measure risk adjusted returns in the corporate finance literature (Sharpe, 1966, 1994; Chen, He, and Zhang, 2011). The Sharpe ratio is closely related to the literature pertaining to the mean-variance efficient set, which minimizes variance subject to a given level of expected return (Barry and Baker, 1984). The Sharpe ratio measures the excess return (or risk premium) per unit of deviation in performance. As such, this measure takes into account the firm's or asset's return and risk as measured by the variability in excess returns. Specifically, the Sharpe ratio can be computed as follows:

$$\text{Sharpe Ratio} = E(X - R) / (Var(X - R))^{0.5}$$

where X represents firm performance, R is a benchmark index (e.g., risk-free rate of return), and E(X – R) is the expected excess return over the benchmark. The Sharpe ratio thus measures performance given the level of risk entailed. A higher Sharpe ratio is naturally preferred to a smaller ratio.

Downside risk is also extensively used to measure risk. Roy (1952), Markowitz (1959), and Selley (1984) argued that a firm or investor may prefer safety of the principal first and then set some minimum acceptable return that will preserve the principal. Thus, semi-variance replaces variance as the measure of risk. The Sortino ratio penalizes only those returns falling below a specified target (Sortino and Price, 1994; Chen, He, and Zhang, 2011). Specifically, the Sortino ratio is computed as follows:

$$\text{Sortino Ratio} = (R - T) / DR$$

where R represents actual performance of the firm, T is the target return, and DR is the target semi-deviation or downside risk. Downside risk can be measured as the annualized standard deviation of returns below the target or the square root of the probability-weighted squared below target returns. The latter measure was used in this paper. A higher Sortino ratio is naturally preferred to a smaller ratio. More information pertaining to the computation of the Sortino ratio can be found in Sortino and Price (1994) and Chen, He, and Zhang (2011).

Correlation coefficients are used to measure the strength of the relationship between two variables. Values range from –1 (strong negative relationship) to +1 (strong positive relationship). A negative relationship means that two variables tend to move in opposite directions, whereas a positive relationship means that two variables tend to move in the same direction. Correlation coefficients are computed to examine the relationships between the operating profit margin ratio, standard deviation of the operating profit margin ratio, Sharpe ratio, Sortino ratio, and value of farm production.

T-tests are used to determine whether there were significant differences between the average and standard deviation of the operating profit margin ratio, Sharpe ratio, and Sortino ratio among farm size quartiles measured using value of farm production as a measure of farm size. Significant differences would be indicative of economies of scale and/or competitive advantage among the farm size quartiles.

DATA

The data used in this study came from the Kansas Farm Management Association (KFMA) databank. Specifically, KFMA farms with continuous data from 1996 to 2018 were used in the analysis. A total of 140 farms had continuous data over this time period.

The average and standard deviation of the operating profit margin ratio, Sharpe ratio, and Sortino ratio are summarized in Table 1. The operating profit margin ratio was computed by adding interest expense and subtracting unpaid operator and family labor from net farm income, then dividing the result by value of farm production. The average operating profit margin was 0.024 or 2.4%. Approximately 26.4% of the farms had an operating profit margin ratio that was less than zero. The long-run average operating profit margin typically ranges from 10% to 15%. As noted by Yeager and Langemeier (2009), the top quartile in terms of financial performance had an operating profit margin above 20%. Approximately 35.7% (6.4%) of the sample farms had an operating profit margin ratio above 10% (20%) during the 1996 to 2018 period.

The average value of farm production for the sample of farms was $395,481. The first quartile had an average value of farm production below $205,000. The second and third quartiles had a value of farm production between $205,000 and $296,000, and $296,000 and $497,000, respectively. The fourth quartile, the farms with the largest value of farm production, had an average value of farm production that was greater than $497,000. The average value of farm production for farms in the fourth quartile was $817,572.

A benchmark index of zero was used to compute the Sharpe ratio. An operating profit margin of zero would fully cover unpaid operator and family labor. With this assumption, the Sharpe ratio was computed by dividing the average operating profit margin ratio for each farm by the standard deviation of the operating profit margin ratio for each farm. The average Sharpe ratio was 0.355 with a standard deviation of 0.702. Approximately 26.4% of the farms had a negative operating profit margin ratio and Sharpe ratio.

A target return of zero was used to compute the Sortino ratio. This target return assumes that farms are interested in covering unpaid operator and family labor in the long run. Using this target return, the Sortino ratio was computed by dividing the operating profit margin ratio by the square root of the probability-weighted squared below target returns. The average Sortino ratio was 3.69.

The relatively large standard deviations for the Sharpe and Sortino ratios reflect the large dispersion of these ratios among the sample of farms. Just as key long-run benchmark measures vary significantly among farms (Yeager and Langemeier, 2009), risk adjusted return measures vary significantly among farms.

RESULTS

Table 2 reports the correlation coefficients between the average and standard deviation of the operating profit margin ratio, Sharpe ratio, Sortino ratio, and value of farm production. All of the coefficients in the table are statistically significant except for the relationship between the standard deviation of the operating profit margin ratio and the Sortino ratio. Given the fact that the Sortino ratio is based on downside risk rather than variability, the low correlation between the standard deviation of the operating profit margin ratio and the Sortino ratio is not surprising.

There was a strong negative relationship between the average operating profit margin ratio and its standard deviation. This result is consistent with previous research pertaining to economies of scale (e.g., Langemeier, 2013), which found the variability of financial performance to be higher for small farms than it is for large farms. The correlation between the average and standard deviation of the operating profit margin ratio and Sharpe ratio is higher than the correlation for the Sortino ratio. The correlation coefficient between the Sharpe ratio and Sortino ratio was highly significant with a coefficient value of 0.586. Finally, farm size, as measured with value of farm production, is strongly correlated with the operating profit margin and the two risk adjusted return measures.

Though not shown in Table 2, benchmark values or average values for the top quartile in terms of the operating profit margin ratio, Sharpe ratio, and Sortino ratio were computed. The 30 farms in the top quartile in terms of both the operating profit margin ratio and Sharpe ratio had an average profit margin of 0.1893 and an average Sharpe ratio of 1.31. The 28 farms that had an operating profit margin ratio and Sortino ratio in the top quartile for each measure had an average profit margin of 0.1888 and an average Sortino ratio of 16.7. Finally, the 33 farms that were in the top quartile in terms of both risk adjusted return measures had a Sharpe ratio of 1.26 and a Sortino ratio of 14.6. It is important to note that approximately 94.3% of the farms (33 out of 35 farms) that were in the top quartiles for the two risk adjusted return measures were in the top quartile for both measures.

Table 3 conveys the relationship between the operating profit margin ratio, Sharpe ratio, Sortino ratio, and farm size. Column entries in Table 3 with an unlike letter after the numbers signify that the values are significantly different at the 5% level. Similar to results presented in other studies (e.g., Yeager and Langemeier, 2009), there was a wide difference in the profit margins between farm size quartiles. The average profit margin for farms in the smallest farm size quartile was –0.180. In contrast, the profit margin for farms in the largest farm size quartile was 0.140. Similarly, there were large differences in the Sharpe and Sortino ratios among the farm size quartiles. The Sharpe ratio for the smallest farm size quartile was negative, whereas the Sharpe ratio for the largest farm size quartile was 0.895. There was even more dispersion in the Sortino ratio among farm size quartiles. Because of this, even though the averages are quite different, the Sortino ratios for the second, third, and fourth quartiles in terms of farm size are not statistically different from one another.

CONCLUSIONS AND IMPLICATIONS

This article extends the work conducted by previous authors pertaining to financial performance benchmarks by accounting for return and risk in the computation of performance metrics. Specifically, this article examines differences in risk adjusted returns for Kansas farms using data from 1996 to 2018. Risk adjusted returns were computed using both a risk measure that accounts for variability of returns (i.e., the Sharpe ratio) and a risk measure that accounts for downside risk (i.e., the Sortino ratio). The two risk adjusted return measures were highly correlated with one another and with the average profit margin ratio. Farms that were in the top quartile in terms of both the Sharpe ratio and Sortino ratio had average ratios of 1.26 and 14.6, respectively. These values can be used to benchmark long-run financial performance.

Both the Sharpe ratio and Sortino ratio were significantly and positively related to farm size as measured using value of farm production. This can be shown by contrasting the measures for the smallest farm size quartile to those of the largest farm size quartile. The average Sharpe ratio (Sortino ratio) for the first and fourth farm size quartiles were –0.300 (–0.1) and 0.895 (9.3), respectively.

This study focuses on risk adjusted return measures pertaining to the operating profit margin ratio. The analysis in this paper could be easily modified to examine risk adjusted return measures for other key performance metrics such as the asset turnover ratio, return on assets, and return on equity.

What are the implications of this study for benchmarking? In addition to financial performance, individual farms are often concerned about the riskiness of financial performance over time (i.e., they are risk averse). It is imperative that individual farms first compute financial performance benchmarks using averages (e.g., average operating profit margin). Once a baseline of these benchmarks is created, it would be possible to create risk adjusted benchmarks similar to those illustrated in this study.

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Table 1. Rates of Return and Farm Characteristics

Variable	Average	Standard Deviation
Operating Profit Margin Ratio	0.0240	0.2115
Sharpe Ratio	0.3551	0.7022
Sortino Ratio	3.6884	14.1834
Value of Farm Production	$395,481	$329,644

Table 2. Correlation Coefficients Between Risk Adjusted Return Measures

Variable	Average Operating Profit Margin	Standard Deviation of Operating Profit Margin	Sharpe Ratio	Sortino Ratio	Value of Farm Production
Average Operating Profit Margin Ratio	1.000				
Standard Deviation of Operating Profit Margin	−0.847	1.000			
Sharpe Ratio	0.755	−0.490	1.000		
Sortino Ratio	0.259	−0.180	0.586	1.000	
Value of Farm Production	0.419	−0.287	0.556	0.396	1.000

Note: All of the coefficients are significant at the 1% level except for the relationship between the standard deviation of operating profit margin and the Sortino ratio.

Table 3. Average Operating Profit Margin, Sharpe Ratio, and Sortino Ratio by Farm Size Category

Farm Size Category	Average Operating Profit Margin	Standard Deviation of Operating Profit Margin	Sharpe Ratio	Sortino Ratio
First Quartile (Value of Farm Production < $205,000)	−0.1796 a	0.3736 a	−0.3002 a	−0.130 a
Second Quartile ($205,000 < Value of Farm Production < $296,000)	0.0379 b	0.2182 b	0.2158 b	1.830 a,b
Third Quartile ($296,000 < Value of Farm Production < $497,000)	0.0973 c	0.1959 b,c	0.6102 c	3.776 a,b
Fourth Quartile (Value of Farm Production > $497,000)	0.1403 d	0.1807 c	0.8945 d	9.278 b

Note: Column entries with an unlike letter after the number signify that the values are significantly different at the 5% level.