REFEREED ARTICLE

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Relative Profitability and Risk of Kansas Farms

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ABSTRACT

This study examined the relationship between return on equity for individual Kansas farms and the S&P 500 using data from 1996 to 2018. Return on equity was measured with and without the inclusion of capital gains on land. Results indicated that return on equity with capital gains on land adjusted for risk was 1.2 percent above S&P returns during the period. For most of the farms in the sample, the risk faced by individual farms was not related to risk incorporated into the S&P 500 index, suggesting that there are opportunities for farm operations to diversify their risk by investing in the stock market.

KEYWORDS: Return on Equity; Benchmarks; Risk Adjusted Returns

1. Introduction

In the corporate finance literature, a distinction is often made between systematic and unsystematic risk. Systematic or market risk corresponds to risk associated with economywide perils and for this reason is difficult to avoid. Unsystematic or unique risk reflects the fact that many perils that surround an individual investment or firm are specific to that investment or firm, and can thus be reduced through diversification.

The Capital Asset Pricing Model (CAPM) can be used to examine systematic and unsystematic risk (Fama, 1976; Barry and Baker, 1984). The CAPM model, described in more detail in the methods section below, computes alpha and beta values for individual investments or firms. A significant alpha value signifies that the return for a specific investment or firm differs from the returns for the market index (i.e., S&P index). Beta measures the sensitivity of an individual investment or firm to market movements. Investments with betas less than 1.0 tend to move in the same direction as the market index, but not as far. Investments with betas greater than 1.0 tend to have movements in returns that are greater than the overall movement of the market index.

A few previous studies have examined the relative profitability and risk of the agricultural sector. Daniels and Featherstone (2001) examined agricultural risk among U.S. states using the CAPM. Results suggested that profitability and risk varied among states. Tauer (2002) and Bigge and Langemeier (2004) examined the relative profitability and risk for New York and Kansas farms, respectively. Results documented a large difference in relative profitability among farms. For most of the farms, the risk experienced by individual farms was not significantly related to the market index. In other words, the beta values were not significantly different from zero.

Previous studies have been helpful in documenting the large differences in the profitability among farms and the low correlation between farm risk and the market index. However, these studies are quite dated and more importantly do not cover the post-2007 period in U.S. production agriculture, which is related to the rapid increase in ethanol production and exports of soybeans to China. Given the developments that have taken place since 2007, it would be useful to examine whether the results reported in previous studies have changed.

The objective of this study is to examine the relative profitability and risk of a sample of Kansas farms and the S&P 500. Measures are computed for each farm and compared among farms. Measures are also related to farm size.

2. Methods

The following regression can be used to estimate the CAPM model for each farm:

$$ROE_t - r_{ft} = \alpha + \beta(r_{mt} - r_{ft}) + e \qquad (1)$$

where ROE is return on equity at time t, r_f is the risk-free rate at time t, α is the alpha value, β is the beta value, r_m is the average rate of return on the market index at time t, and e is an error term.

ROE is computed with and without the inclusion of capital gains on land. ROE is computed in two different ways to account for the fact that ROE with capital gains

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on land is more comparable with the stock market and ROE without capital gains on land is widely used as a financial performance benchmark. ROE with capital gains on land is computed as follows:

$$ROE = (NFI - UNPAID + CGLAND)/NW \quad (2)$$

where NFI is accrual net farm income, UNPAID represents unpaid operator and family labor, CGLAND is the capital gain or loss on owned land, and NW is average farm net worth. Because it includes unpaid operator and family labor, return on equity can be readily compared among farms with various levels of hired and unpaid labor.

The one-year Treasury bill rate is used to represent the risk-free rate in equation (1). Rates are obtained from the Federal Reserve Bank of St. Louis. The S&P 500 index is used to represent the market index in equation (1).

The distribution of alpha and beta values obtained using equation (1) for the return on equity with and without capital gains, as well as the difference in alpha and beta values between the two return on equity measures, will be summarized. T-tests will be used to determine whether there were significant differences between the average return on equity with capital gains, alpha values, and beta values among farm size quartiles measured using value of farm production as a measure of farm size. Significant differences in the return on equity and alpha values would be indicative of economies of scale and/or competitive advantage among farm size quartiles.

3. 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 the time period.

The average and standard deviation of the return on equity measures, the return on the S&P 500 index, the return on T-bills, and value of farm production are summarized in table 1. As noted above in equation (2), the return on equity with capital gains was computed by subtracting unpaid operator and family labor and adding capital gains on land from net farm income and dividing the result by average net worth. The average return on equity with capital gains was 0.0381 or 3.81 percent. Approximately 15.0 percent of the farms had a negative average return on equity. The average return on T-bills and the S&P 500 index were 0.0218 and 0.0827, respectively. The standard deviation of the rate of return for the S&P 500 index was substantially higher than the standard deviations for the rates of return on farm equity and the rate of return on T-Bills.

The average value of farm production for the sample of farms was $395,481.[1] 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.

[1] At the time of this writing (late July 2020), $US1 was approximately equivalent to £0.77 and €0.85.

Table 1: Summary Statistics for Rates of Return and Farm Characteristics

Variable	Average	Standard Deviation
Rate of Return on Farm Equity		
With Capital Gains	0.0381	0.0946
Without Capital Gains	0.0089	0.0978
Rate of Return on S&P 500	0.0827	0.1454
Rate of Return on T-Bills	0.0218	0.0208
Value of Farm Production	395,481	329,644

4. Results

Table 2 presents the distribution of alpha values resulting from the estimation of equation (1) for each return on equity measure. Return on equity with capital gains is more analogous to comparisons between individual investments and the S&P 500 index, because of this the discussion below focuses on this measure. It is important to note that the alpha values in table 2 represent risk adjusted returns, so they account for the both average and standard deviation of rates of return. The average alpha value for the entire sample was 0.012. This suggests that on average the risk adjusted farm return was 1.2 percent above the return for the S&P 500 index. Approximately 42.1 percent of the farms had an alpha value that was significantly different from zero. The average alpha value for these farms was 0.018. Of the farms with an alpha value that was significantly different from zero, 16 farms had a negative alpha value. The average alpha value for these farms was -0.135. An alpha less than zero indicates that the farms are earning a risk adjusted return that is lower than the return for the benchmark, the S&P 500 index. The average alpha value for the 43 farms with a significant and positive alpha value was 0.075. The farms with a positive alpha value are earning a higher risk adjusted return than the S&P 500 index. Clearly, the farms with a significant and positive alpha value were performing extremely well during the sample period. The wide dispersion in relative profitability, as signified by the alpha values in table 2, is consistent with previous literature (e.g., Purdy et al., 1997; Tauer, 2002; Bigge and Langemeier, 2004; Yeager and Langemeier, 2009; Langemeier, 2011; Langemeier, 2013; Key, 2019).

The beta values resulting from the estimation of equation (1) indicate how risky a farm was relative to the market (i.e., S&P 500 index). Table 3 presents the range of beta values for return on equity with and without capital gains. The average beta value using return on equity with capital gains as the performance measure was 0.064. However, only 9 out of the 140 farms had a beta value that was significantly different from zero. None of the farms with a significant beta value had a beta value that was greater than one. A beta value less than one indicates that the risk of the farm was less than the risk of the market. The low beta values obtained in this study suggest that systematic risk was low for the individual farms, and that there are potential diversification

opportunities between production agriculture and the stock market. The average beta value in this study was consistent with the average value of 0.10 obtained by Baker et al. (2014) in their study of Indiana farmland, and with the average (0.068) obtained by Bigge and Langemeier (2004) using a sample of Kansas farms with performance data spanning the 1982 to 2001 period.

Land values for most of the years during the sample period increased. Thus, we would expect the alpha values obtained using return on equity with capital gains to be higher than the alpha values obtained without the inclusion of capital gains. The beta estimates for the two return on equity measures would not necessarily be either lower or higher than one another. Table 4 presents the difference in the alpha and beta estimates between the two return on equity measures. The difference was computed by subtracting the alpha and beta values for return on equity without capital gains from those obtained for return on equity with capital gains. The average difference in the alpha and beta values was 0.027 and 0.038, respectively. A vast majority of the differences were positive. Thus, including capital gains in return on equity measures increases relative profitability and risk.

Table 5 presents the average return on equity with capital gains, alpha values, and beta values by farm size quartile. Entries within a column with an unlike letter are statistically different at the 5 percent level. Return on equity with capital gains (ROECG) was significantly higher for the third and fourth farm size quartiles than it was for the first and second quartiles. More importantly, the alpha values for the fourth quartile were significantly higher than the alpha values for the first and second quartile, signifying the presence of economies of size and/or competitive advantage for the larger farms. It is important to note that return on equity and the alpha values are not measuring the same thing. Unlike return on equity, the alpha value is measuring return adjusted for risk. As such, comparisons of the alpha values across farm size quartiles are more pertinent. The beta values among the farm size quartiles were not significantly different from one another. Thus, the low beta value result obtained when examining all farms holds for each farm size quartile.

Table 2: Alpha Values for 140 Kansas Farms

Value	Without Capital Gains	With Capital Gains
Less than -0.20	8	8
-0.20 to -0.15	2	1
-0.15 to -0.10	6	3
-0.10 to -0.05	15	8
-0.05 to 0.00	43	25
0.00 to 0.05	44	56
0.05 to 0.10	18	29
0.10 to 0.15	1	6
0.15 to 0.20	0	0
Greater than 0.20	3	4

Table 3: Beta Values for 140 Kansas Farms

Value	Without Capital Gains	With Capital Gains
Less than -0.20	9	8
-0.20 to -0.15	8	5
-0.15 to -0.10	9	7
-0.10 to -0.05	13	9
-0.05 to 0.00	11	9
0.00 to 0.05	29	16
0.05 to 0.10	20	23
0.10 to 0.15	11	18
0.15 to 0.20	8	14
0.20 to 0.25	4	10
Greater than 0.25	18	21

Table 4: Difference in Alpha and Beta Values between ROE Measures[1]

Value	Alpha Values	Beta Values
Less than 0.00	2	9
0.00 to 0.01	20	18
0.01 to 0.02	33	7
0.02 to 0.03	37	12
0.03 to 0.04	22	18
0.04 to 0.05	14	19
0.05 to 0.06	5	25
0.06 to 0.07	2	6
Greater than 0.07	5	26

[1]The difference was computed by subtracting the values obtained using return on equity without capital gains from the values obtained using return on equity with capital gains.

5. Conclusions and Implications

This study examined the relationship between return on equity for individual Kansas farms and the S&P 500. Though the average rate of return on farm equity was substantially lower than the average rate of return for the S&P 500 index, after adjusted for risk, the rate of return for the sample of farms was comparable to that of the S&P 500 index. On average, return on equity with the inclusion of capital gains adjusted for risk for the sample of farms was 1.2 percent higher than the S&P 500. However, there was substantial variability in risk adjusted rates of return between farms, and approximately one-third of the farms had a risk adjusted rate of return that was lower than the S&P 500. For most of the farms in the

Table 5: Average Return on Equity (with Capital Gains), Alpha, and Beta by Farm Size Category[1]

Farm Size Category	ROECG	Alpha	Beta
First Quartile (VFP < $205,000)	-0.0120 a	-0.0315 a	-0.0372 a
Second Quartile ($205,000 < VFP < $296,000)	0.0222 a, b	-0.0102 a	0.1754 a
Third Quartile ($296,000 < VFP < $497,000)	0.0565 b, c	0.0339 a, b	0.0135 a
Fourth Quartile (VFP > $497,000)	0.0855 c	0.0573 b	0.1058 a

[1]Entries within a column with an unlike letter are statistically different at the 5 percent level.

sample, individual farm risk was not related to the risk associated with investing in the S&P 500.

The return adjusted for risk, as measured with the alpha value for each farm, was significantly higher for the largest farm size category than it was for the two smallest farm size quartiles. Moreover, the average difference in alpha values among the farm size quartiles was large. The smallest farm size quartile had an average alpha value of -0.031. The alpha value for the largest farm size quartile was 0.057. In contrast to the alpha value results, the beta values for the farm size quartiles were not significantly different from one another.

Bigge and Langemeier (2004) conducted a similar analysis to that in this paper using an earlier time period (i.e., 1982 to 2001). The relative risk results in this study were very consistent with those reported in Bigge and Langemeier (2004). Beta values are less than one, indicating that systematic risk is relatively low. However, relative profitability for the sample of farms in this study, which used data from 1996 to 2018, was much higher (-0.081 compared to 0.012) than it was in Bigge and Langemeier (2004). Given that the sample period used in the Bigge and Langemeier (2004) study included the mid-1980s, a period of financial stress in U.S. agriculture, and excluded the post-2007 U.S. ethanol boom, the lower alpha values reported in Bigge and Langemeier (2004) are not that surprising.

The results in this study have important implications for farm performance benchmarking. There are a substantial proportion of farms that have risk adjusted returns that are higher than the returns for the S&P 500 index. However, there are farms that have performance that is significantly below market returns. In fact, of the farms that have significant alpha values, 16 of the 59 farms had a negative alpha value, an indication of below market returns. The wide difference in relative profitability documented in this study illustrates the importance of benchmarking farm performance.

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REFERENCES

Barry, P.J. and Baker, C.B. Financial Responses to Risk in Agriculture. in *Risk Management in Agriculture*, edited P.J. Barry. Ames, Iowa: Iowa State University, 1984.

Baker, T., Boehlje, M. and Langemeier, M. Farmland: Is it Currently Priced as an Attractive Investment? *American Journal of Agricultural Economics*. 96(October 2014):1321-1333. (https://doi.org/10.1093/ajae/aau037)

Bigge, H.M. and Langemeier, M.R. Relative Profitability and Risk of Kansas Farms and S&P 500. *Journal of the American Society Farm Managers and Rural Appraisers*. 67(2004): 57-63.

Daniels, M.S. and Featherstone, A.M. Assessing Agricultural Risk among States. *Journal of the American Society of Farm Managers and Rural Appraisers*. 65(2001):107-114.

Fama, E.F. *Foundations of Finance*. New York: Basic Books, 1976.

Federal Reserve Bank of St. *Louis*. http://fred.stlouis.org/.

Key, N. Do Most U.S. Farms Really Lose Money? *Journal of Agricultural and Applied Economics*. 51(November 2019): 646-663. (https://doi.org/10.1017/aae.2019.26)

Langemeier, M. Financial Performance Configurations. *International Journal of Agricultural Management*. 1(July 2011): 40-42.

Langemeier, M. Measuring Economies of Size with Expense Ratios. *Journal of the American Society of Farm Managers*. 76(2013):222-235.

Purdy, B.M., Langemeier, M.R. and Featherstone, A.M. Financial Performance, Risk, and Specialization. *Journal of Agricultural and Applied Economics*. 29(July 1997):149-161. (https://doi.org/10.1017/S107407080000763X)

Tauer, L.W. Estimating Risk-Adjusted Interest Rates for Dairy Farms. *Agricultural Finance Review*. 62(Spring 2002):59-68. (https://doi.org/10.1108/00214880280001129)

Yeager, E. and Langemeier, M. Measuring Sustained Competitive Advantage for a Sample of Kansas Farms. *Journal of the American Society of Farm Managers and Rural Appraisers*. 72(2009):112-123.