Risk and Reward: How do Farm Returns Stack Up? – Should Farm Managers Invest in the Stock Market?

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Introduction

Economic goals of an individual farm manager are a complex and often conflicting interaction between today's consumption (standard of living) and tomorrow's consumption (wealth generation). At two extremes, subsistence farms focus on current consumption and stock market investment focuses on wealth generation. Likely, the larger and more business-like that a farm becomes, the greater will be the need for analyses that address wealth generation issues as opposed to current consumption issues. This will be especially true as farms compete for outside capital, such as from off-farm family members or from totally outside sources.

Economists have devised alternative profit measures to better represent the consume-today vs. consume-tomorrow tradeoff. One well publicized measure is Net Farm Income (NFI), which is the dollar return to an operator's unpaid labor, management, and equity. As such, NFI is a better measure of consumption than it is of wealth generation. Because NFI confounds returns to labor, management, and equity, it is an especially poor measure for comparing profitability across differently sized farms. This is important as the profitability gap continues to widen between large commercial farms, operated by full-time farmers, and smaller farms, often operated by part-time farmers. Also, competing for capital means that potential investors must be able to compare the expected wealth generating capacity of a farm with that of other farms or other investments such as T-bills or the stock market. Profitability measures that gauge return on investment, such as return on equity (ROE), rather than NFI, are crucial to effect such comparisons.

Once a suitable return on investment measure, such as ROE, is agreed upon, many interesting questions naturally arise. What has been the historical ROE in production agriculture? How variable have those returns been? How does agriculture's profitability compare to that of other investments, such as the stock market? Are agricultural or stock market investments more risky? Would farm managers benefit, in terms of risk or profitability, from investing in both their farms and the stock market? Examining these questions is the focus of this paper.

Returns to Land

ROE data from farms are difficult to obtain, especially for large geographical areas and over many years. However, because land makes up a large portion of farm assets, returns to land investment should be a reasonable proxy for farm-level returns. Furthermore, land returns information is reasonably easy to obtain.

An annual return to a land investment typically has two components, rent and capital gains. In this

[1] Helpful comments from K-State agricultural economists Kevin Dhuyvetter and Allen Featherstone were especially important in preparing this paper. Additionally, Ph.D. candidate Christine Wilson is gratefully acknowledged for providing the stock price data for individual companies used in this analysis, and for taking the lead in preceding related K-State research and associated publications.

regard, land is similar to some common stocks, which have both dividends and capital gains or growth. Although typically positive, capital gains for either land or stock investments can be negative. Also like stock investment, because part of land's return is non-cash, it is often observed that land will rarely "cash flow." That is, unless a substantial downpayment is made on a land purchase, the rent typically will not cover the land's loan payments. Nonetheless, capital gain is a true wealth building return and should not be ignored.

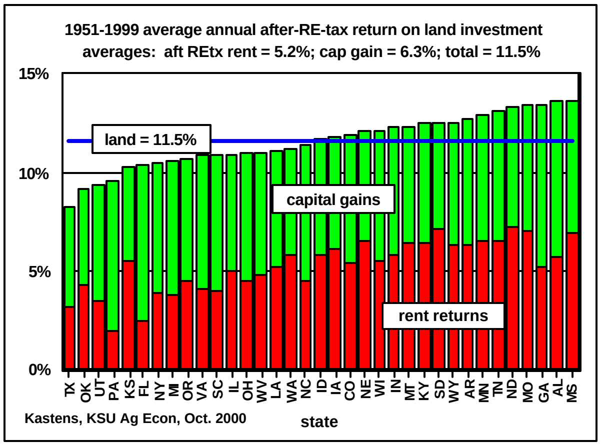

Figure 1

Based on information acquired from various USDA (U.S. Dept. of Agriculture) sources, along with a number of statistical interpolations as needed to accommodate missing data, figure 1 shows the average annual after-real-estate-tax (ARET) returns to land (rent to value), by state, over the 50-year period 1951-1999.[2] Because it is an annual cash expense, real estate tax was subtracted from rent. The 35 states in the figure are sorted by total return (ARET rent and capital gain). Over all 35 states and 50 years, ARET rent has averaged 5.2% annually and capital gains 6.3%, for a total average return to land of 11.5%.

Figure 1 shows that states vary substantially in their 50-year average annual returns. Although not shown, states also vary substantially in terms of real estate tax. On average, real estate tax has been 0.78% of land value ($0.78 per $100 of land value). Yet, 5 states have averaged over 1%: Iowa 1.04%, Illinois 1.13%, Michigan 1.87%, Minnesota 1.05%, and Nebraska 1.18%. Based on a statistical regression, the real estate tax to rent relationship can be generalized as follows. An increase of 1 percentage point (e.g., from 0.4% to 1.4%) in real estate taxes is associated with a 0.6 percentage point increase in before-real-estate-tax rent (a 0.4 percentage point decrease in ARET rent) and a 0.04 percentage point decrease in capital gains. Thus, the regression analysis shows that 60% of real estate taxes are likely capitalized into rent-to-value. Although not analyzed, this probably comes about chiefly by changes in land value (the denominator in the rent-to-value ratio) rather than by changes in cash rents – because there is little reason to assume tenants could afford to pay a higher cash rent merely because the land owner has to pay higher real estate taxes. In short, higher real estate tax rates likely lead to lower land values and thus higher observed (before-real-estate-tax) rent-to-value ratios.

[2] Depending upon data availability, returns to land were first selected on non-irrigated cropland, next on all cropland, and finally on all farm real estate (includes pasture and buildings).

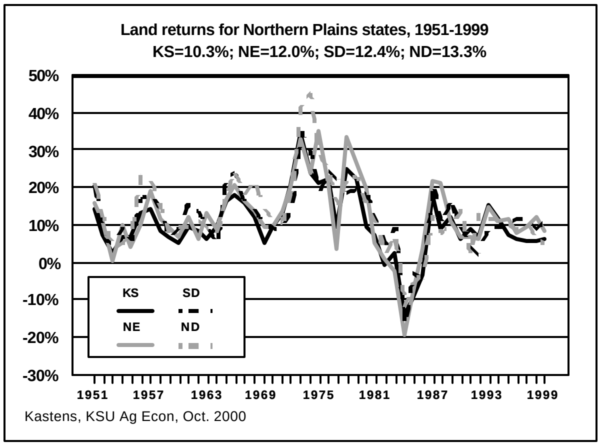

Figure 2

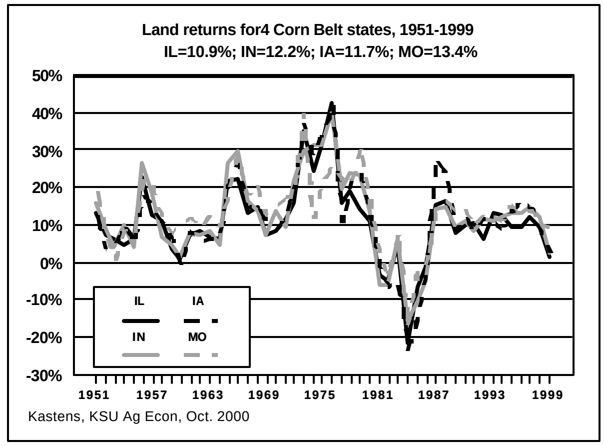

Figure 3

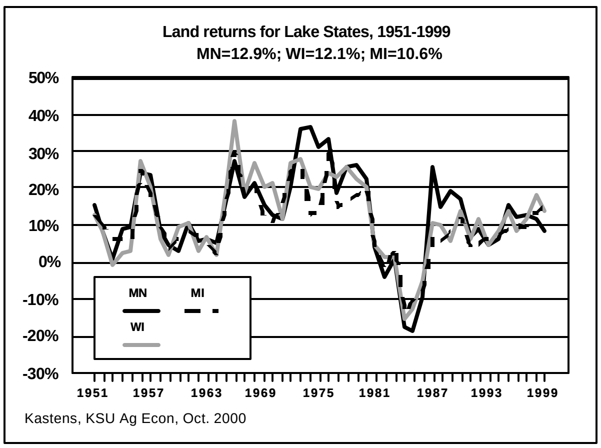

Figure 4

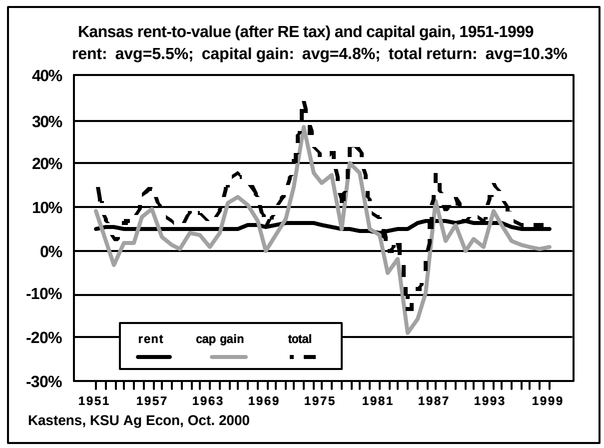

Figure 5

Figures 2, 3, and 4 expand the land returns across years for several states of interest. What is immediately obvious in the figures is that the land market is principally a national market. What affects land returns in one state one year tends to impact other states similarly in that year.

Figure 5 shows the rent-to-value and capital gains for 1951-1999 for a single state, Kansas. The figure makes it clear that rent returns (as a percent of land value) are much more stable than are capital gains. That is not to say that cash rents themselves are stable. For example, figure 6 shows cash rents and land values for Kansas non-irrigated cropland from 1976 to 1999. That figure also reveals that cash rents and land values are highly correlated over time (correlation coefficient of 0.67). That is likely because favorable conditions in farming (increased farming profit), for example, cause farmers to bid up both cash rent and land values simultaneously.

Comparing Land to Stock Returns

For comparison, figure 7 is the same as figure 1 only it also shows a dividends-inclusive stock index, S&P 500. Over the 50-year period shown, investments in the stock market (an S&P 500 mutual fund) returned an average of 14.3% annually, compared to land returns of 11.5%. It is interesting to note that the "rent" (dividend) return for the stock market has averaged 4.0% annually vs. a 5.2% rent on land. On the other hand, capital gains have averaged 10.3% for the stock market vs. 6.3% for land.

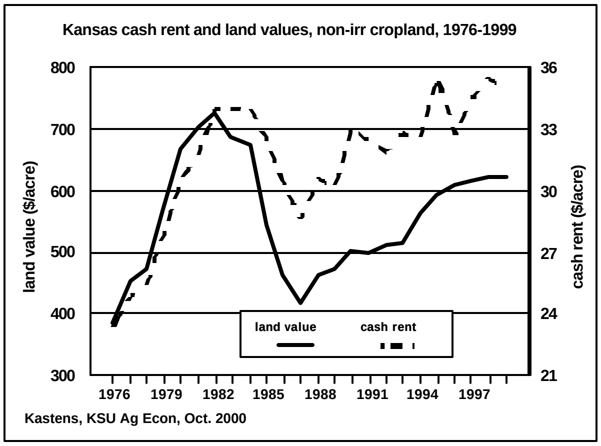

Figure 6

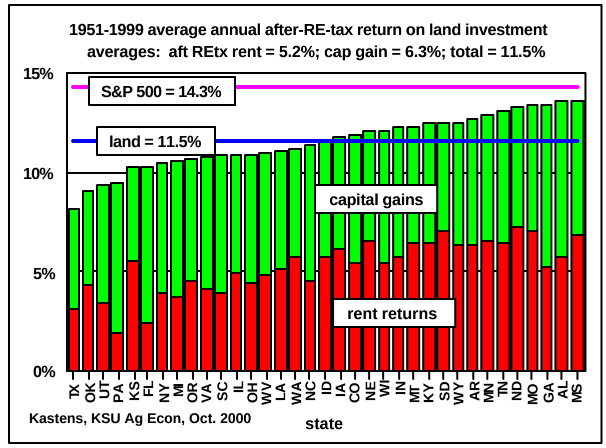

Figure 7

None of the returns shown in figure 7 account for income tax (not to be confused with real estate tax). That is, they are pre-tax returns. The "14.3% for stocks vs. 11.6% for land" comparison may require some adjustment when it is used to guide individual investor decisions. That is, decisions should be made based on after-tax calculations. More specifically, land rents may be reduced to 3.9% assuming an income tax rate of 25%, yet capital gain returns on land might be kept at 6.3% assuming capital gains taxes can be deferred indefinitely, ultimately leading to after-tax land returns of 10.2% – which might be compared to after-tax stock returns of 14.3 x .75 = 10.7%, assuming both dividends and capital gains on stocks are taxed at an annual rate of 25%. On the other hand, if the stock market investment is a tax-deferred retirement plan, where presumably, the taxes due on both dividends and gains might be deferred even across generations, then the relevant after-tax stock market return is effectively the 14.3% shown.

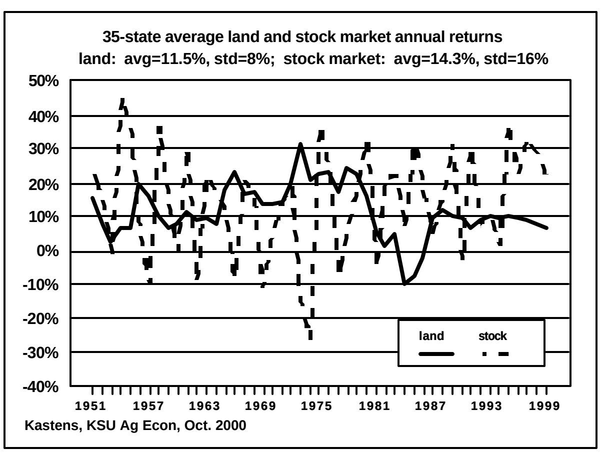

Figure 8

It is well known that observed market returns to investments demonstrate a tradeoff between risk and expected return. That is, an intrinsically more risky investment tends to have greater returns. Investors simply will not advance their capital to risky ventures unless they are "adequately" compensated. Market risk is often characterized by variability in returns: the greater the variability the greater the risk. Figure 8 compares the annual returns for a 35-state land portfolio (the returns underlying figure 1, with each state's returns weighted equally) to the annual returns associated with the stock market (the S&P fund). Clearly, the stock market investment is much more risky than the land investment. The sharp differences in the variability of returns across the two investments can be generalized by the standard deviation of returns, 16% for the stock market but only 8% for the land investment.[3] Given the differences in returns variability shown in figure 8, it should be expected that stock market returns are higher than land returns.

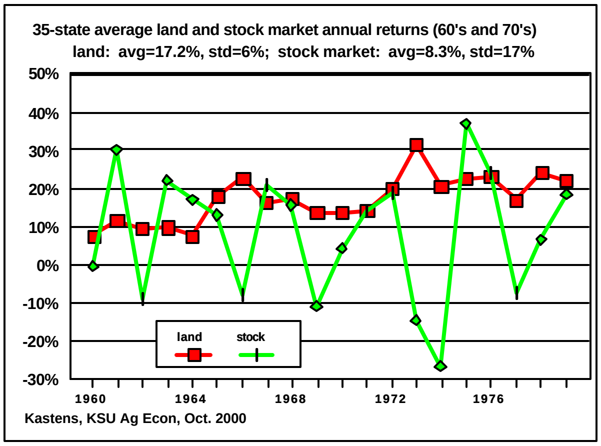

Figure 9

Are stock market returns always higher than land returns? Definitely not. Figure 9 compares land and stock market returns during the 1960s and 1970s. During that 20-year period average land returns (17.2%) were more than double the stock market returns (8.3%). Furthermore, despite the sharply higher returns to land during that time period, land investors did not seem to have to take on greater risk with land investment (standard deviation of 6%) than with stock investments (standard deviation of 17%). Consider the implication for a farm owner or investor who might have undertaken this same analysis or observed this figure in 1980. Assuming historical returns are indicative of future returns, that farm owner or investor likely would not be motivated to sell farm assets to buy stock.

Combining Land and Stock Investments

There are two important reasons that farm managers might consider owning common stocks or stock mutual funds: 1) to enhance profitability, and 2) to decrease risk. As shown in several figures (but not in figure 9), stock market returns do tend to outpace land returns, at least over sufficiently long periods of time. However, because the variability of annual stock returns is greater than that of land returns, and because figure 9 showed a relatively long period of time (20 years) where stock returns had been much lower than land returns, farm managers must carefully weigh the risk of actually obtaining the expected returns associated with the stock market.

If stock returns are not predictably much greater than land returns, and if year-to-year stock returns are much more variable than land returns, then it does not seem especially appropriate to recommend that farms consider stock investment – at least at first blush. However, another factor leads to reconsideration. That factor is that stock returns tend to be negatively correlated with land returns – at least for aggregate stock investments like the S&P fund depicted in the previous figures. Negative correlation means that stock returns tend to be high when land returns are low, and vice versa. A close look at figure 8 reveals many years when stock returns are low land returns are high. One such period is the 1960s and 1970s, which is depicted in figure 9. Conversely, figure 8 shows that in the 1950s,

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[3] Analytically, risk, or variability of returns, is typically characterized as statistical variance or standard deviation. For a random variable (here, a series of returns), variance is the average squared deviation of each observed value from the series average, or mean. Standard deviation is the square root of variance. In risk analysis, the mathematics often uses variance, but the presentation is often in terms of standard deviation – because standard deviation has intuitive appeal regarding probabilities of outcomes. For example, assuming a normal (the standard bell-shape) distribution, we can expect around 67% of single random outcomes to fall within a range bounded by the mean less one standard deviation and the mean plus one standard deviation. In short, using a standard deviation representation allows us to associate specific ranges of outcomes with probabilities.

1980s, and 1990s stock returns tended to be high whereas land returns were somewhat low. The correlation coefficient between the stock and land returns shown in figure 8 is -0.25.

Given a negative correlation, a combined stock and land portfolio can easily have less risk than either one individually, that is less year-to-year variability or a lower standard deviation of returns, relative to the least risky of the two investment. It should be noted, however, that reducing investment risk by constructing a land/stock portfolio rather than only a land investment does not strictly depend on negative correlation between land and stock returns, though, negative correlation tends to make the risk reduction much greater. It is not uncommon for a portfolio of two investments to have lower risk than the least risky of the two investments despite the two investments being positively correlated.

Reducing Risk through Stock Investment

How much stock should be added into a land/stock portfolio? That depends on how risk averse the investor is. An investor who is especially averse to risk will choose a portfolio with lower expected variability of returns, but lower expected returns as well, relative to an investor who is less risk averse. In constructing a portfolio around the land and stock returns discussed earlier, risk (standard deviation of portfolio returns) falls with each unit of added stock, up to a point, whereupon it rises again. Clearly, if the portfolio were 100% stock, then the portfolio risk (returns variability) would be identical to the risk associated with only a stock investment, which has already been shown to be substantially higher for stock investments than for land investments.

Unlike risk, which first falls then rises with increasing stock portions in the land/stock portfolio, expected portfolio return changes linearly over the 100% land to 100% stock portfolio possibilities. For example, a 50% land and 50% stock portfolio would have expected returns equal to the average of land-only and stock-only expected returns. An investor will choose the land/stock mixture whose expected returns and expected variability is most preferred – given that investor's risk perceptions. Note that portfolio selection is about choosing an expected risk/reward combination that is preferred, not about risk minimization. After all, ignoring inflation, risk minimization could be achieved by holding all owner equity as cash.

Essentially, there are two ways to consider adding stock to a land or farm investment, by borrowing money (the DEBT method) or by using equity (the EQUITY method). Of course, any combination of debt or equity capital might be used to purchase stock. However, understanding might be better fostered by considering the two methods individually.

The DEBT method assumes the farm borrows money to buy stock and pays additional interest on that debt accordingly. Algebraically, for every $1 of farm equity, some dollar amount, say *H*, is borrowed to buy that amount of stock. Then, using F to denote a farm's return on its equity, S to denote stock return on investment, I to denote an interest rate, and P1 to denote the portfolio returns to the farm's equity, we have $P1 = F + H(S-I)$. It should be noted that using the DEBT method to obtain a portfolio risk that is lower than either of the two underlying investments typically depends on negative correlation between the two series. Additionally, using the DEBT method for optimally selecting how much stock to add to a farm's investment portfolio may not be appropriate if a farm is already capital-constrained. That is, it may be inappropriate to assume a farm could always borrow the money required of the selected stock purchase – or any stock purchase for that matter.

Unlike the DEBT method, the EQUITY method assumes that farm equity is used to purchase stock. Essentially, the farm can be thought of as downsizing in order to incorporate stock into its investment portfolio (selling farm assets and buying stock).[4] With the EQUITY method, portfolio returns are depicted as P2 = (1-K)F + KS, where K is the portion of a farm's equity that is converted to stock investment (0<=K<=1).

All else equal, borrowing money adds risk. Thus land/stock portfolios selected based on the EQUITY method will typically have lower risk than those selected using the DEBT method. However, as noted, introducing investment diversification using the EQUITY method likely means downsizing a farm. If there are economies of size in farming, lost farming profitability associated with downsizing might more than offset profitability gains associated with investments otherwise expected to have greater returns than farm investments. Also, assuming economies of size, a farm may want to use its excess borrowing capacity to expand the farm rather than invest in stock – because the expanded farm's profitability might be greater than a portfolio's profitability.

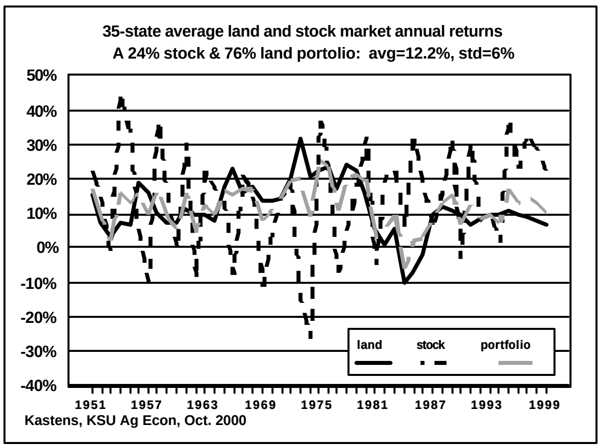

Figure 10

To gain some insight into how much risk might be reduced with a land/stock rather than a land-only portfolio, figure 10 adds a risk minimizing portfolio returns line to the figure 8 graph. Using the EQUITY method, the risk minimizing portfolio selection process resulted in a portfolio made up of 24% stock and 76% land. The portfolio returns standard deviation is 6%, which compares to standard deviations of 8% and 16%, for the land-only and stock-only returns, respectively, as shown in figure 8. Also, the portfolio's average return was 12.2%, which compares to average returns of 11.5% and 14.3%, for the land-only and stock-only investments, respectively. Using a change in standard deviation as an indicator of risk reduction associated with the portfolio, it can be said that risk was proportionately reduced by 25% – because a 6% standard deviation is 25% less than an 8% standard deviation. In figure 10, the risk reduction is especially apparent in the early to mid 1980s, when the portfolio mitigated the low returns associated with a land-only investment during that time.

Profitability for Actual Farms

Is land return, as asserted earlier, a reasonable proxy for return on equity for actual farms? Economic information from member farms in six Kansas Farm Management Associations (KFMA) was used to examine that issue. The KFMA data set is comprised of over 2,000 farms each year from 1973 through 1999. However, the number of farms used in any particular analysis may be substantially less due to missing data on some variables and especially due to imposing a requirement that the same farm must continuously be in the data set for an arbitrary time period. After-tax (i.e., income tax) return on

[4] For some farms it could be possible to purchase stock from equity without actually downsizing the farm. Specifically, the farm might consider renting rather than owning capital assets such as land and machinery. The supposed asset sale would free up cash for stock purchase. However, such "selling and renting back" activities are likely the exception rather than the norm among farms.

equity (ATROE) was judged to be the most reliable farm profitability measure that could be computed from the KFMA data. It was calculated as annual change in net worth divided by beginning-of-year net worth.[5]

Because most comparisons require a pre-income-tax profitability measure, a pre-tax ROE (PTROE) was approximated by dividing each farm's ATROE measure each year by 0.65. The 0.65 value assumes an average combined federal income tax, Kansas income tax, and self-employment tax rate of 35% or 0.35. Thus PTROE = ATROE/(1-0.35). Where desired, the reader can easily convert reported PTROE in this paper to the data-generated ATROE by multiplying it by 0.65.

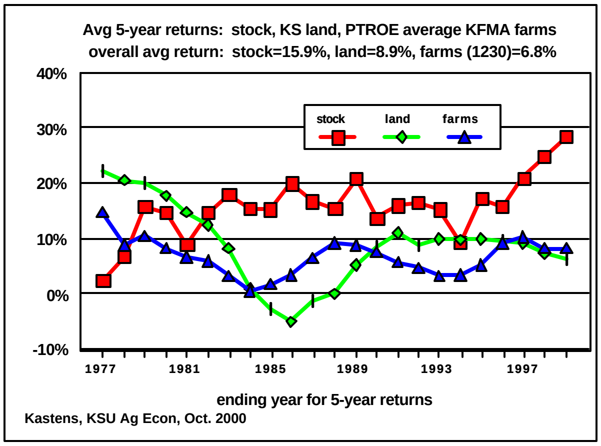

Figure 11

In using historical returns and their variability to make inferences about expected (future) returns and their variability, the length of time to consider in an historical time period is potentially an important issue. In general, long historical series are believed more reliable for inferences than are short series. That, of course, was the reason for including 50 years in a number of the analyses presented in the first part of this paper. In reality, however, an analysis often must proceed without a long historical data set. To gain some insight into this issue, figure 11 displays historical 5-year average returns for the stock market (the S&P fund), Kansas land values, and the across-farms average PTROE for a number of KFMA farms. The exact number of KFMA farms underlying any one data point in figure 11 ranged from 1,070 farms for the 1983-1987 5-year average returns computed in 1987, to 1,517 farms for the 1976-1980 5-year average returns computed in 1980, and averaged 1,230 farms over the entire 1977-1999 analysis period reported in figure 11.

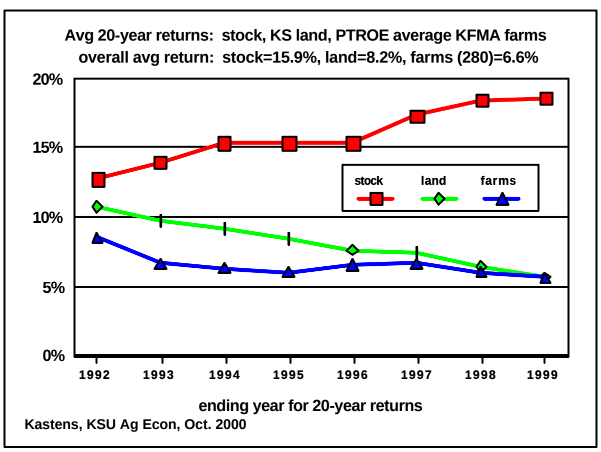

Figure 12

Two observations in figure 11 are worth noting. First, overall average farm returns (6.8%) are somewhat lower than land returns (8.9%) which are substantially lower than stock returns (15.9%). Second, relying upon 5-year returns to make inferences about the future is probably questionable. For example, a 5-year analysis completed in 1977 might cause a farmer to expect future land returns to be much greater than farm returns which are expected to be much greater than stock returns.

Examining 20-year rather than 5-year returns (figure

[5] This research adjusted historical KFMA machinery inventory values to ensure a consistent market-valuation-based series for each farm. Land values for farms were adjusted each year in between the every-5-year KFMA land revaluations. Also, KFMA calculates ROE as essentially accrual net income divided by average equity, which in empirical settings as this, will not equate with the ATROE or PTROE calculated here. Thus, care must be taken in comparing numbers reported in this research with official KFMA summary publications.

12) does not alter the relative relationships between stock, land, and farm returns. Farm returns are still somewhat lower than land returns. Why might farm returns be lower than land returns? One possibility is that the better, more profitable farms are more dominant in the land buying/renting market, which is consistent with the idea that the better farms grow more over time. Figure 13 shows 20-year stock and land returns against PTROE for the most profitable third of the KFMA farms (most profitable judged by ranking 20-year average PTROE of KFMA farms). The figure shows that this highly profitable group of farms has been generating returns that are substantially higher than average land returns and hence closer to stock returns.

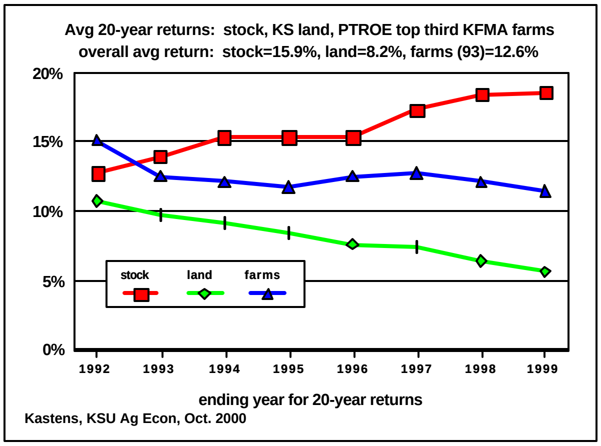

Figure 13

Figure 13 suggests that the most profitable farms should not be expected to benefit largely, in terms of profitability, by purchasing stock. Ignoring the last three (1997-1999) record-breaking years for the stock market (which especially brought up those 20-year returns), as one might do if he believed that period to be an anomaly, the average difference in stock and farm returns shown in figure 13 is only 1.7%. On the other hand, ignoring the 1992 data points as well – which, for farms, contained the extremely profitable 1973 year in the underlying 20-year average – resulted in an average difference in stock and farm returns of 2.8%.

Figures 11 through 13 described either 5-year or 20-year returns. By way of summary it should be noted that, over the entire 1973-1999 period, average (avg) annual returns and standard deviation of annual returns (std) were as follows: Kansas farm portfolio (138 farms), avg 8.3% std 10.5%; Kansas land portfolio, avg 10.1% std 10.7%; and S&P fund, avg 15.2% std 16.7%. For a Kansas "top third" farm portfolio (46 farms), returns averaged 13.9% and the standard deviation was 14.8% during the 1973-1999 period.

Systematic and Unsystematic Risk

When similar investments are aggregated into an investment portfolio made up of an equal amount of money invested in each of the underlying investments, variability of year-to-year returns generally falls. That is, it is generally less risky to simultaneously invest in many farms than in a single farm, in a hypothetical "Kansas land" portfolio than in a single parcel, in an S&P index fund than in a single company's common stock. This is a statement of systematic risk and unsystematic risk. As a further word example, an individual farm experiences year-to-year variability due to unsystematic events such as low crop yields induced by local weather (e.g., hail). However, it also experiences year-to-year variability due to systematic events that impact all farms such as year-to-year changes in government policy or in the overall U.S. and world economies (e.g., interest rates, government farm program policies, world grain supplies). In that regard, the 10.5% standard deviation of annual returns for the Kansas farm portfolio reported in the previous section is a measure of systematic risk associated with Kansas farms.

How risky are individual Kansas farms? Some insight can be gained by observing the across-farms average of the across-years standard deviation of individual farms' annual returns. For the 138 farms making up the Kansas farm portfolio, the average (across 138 individual measures of standard deviation of 1973-1999 annual returns) standard deviation of returns is 22.2%. When that value is compared to the 10.5% standard deviation of annual returns for the Kansas farm portfolio reported in the previous section, it loosely implies an unsystematic risk for Kansas farms of 11.7%, which is 22.2%-10.5%. Similarly, for the 46 farms comprising the “top third” Kansas farm portfolio, the average standard deviation of returns was 30.0%. When compared to the 14.8% standard deviation of annual returns for the “top third” Kansas farm portfolio reported in the previous section, this value implies an unsystematic risk of 15.2%, which is 30.0%-14.8%.

Figure 10, which showed annual returns for Kansas land, an S&P fund, and a risk minimizing portfolio comprised of land and S&P investments, hinted at the amount of risk that might be reduced for Kansas farms by diversifying their investments into the stock market. However, in that variability of Kansas land returns is a proxy for only the systematic risk associated with farming, it could be that individual farms have greater potential to reduce risk through stock inclusion than suggested in figure 10.

Farm Returns and Stock Returns

Up to now, all stock comparisons in this paper involved the S&P index. Although it is possible to purchase a mutual fund that mimics that index, farm managers may wish to consider investing in specific agriculture-related stocks. More to the point, farm managers wonder if they might effectively vertically integrate their farms downstream, by purchasing stock in food processing and retailing companies for example, or upstream, by purchasing stock in agricultural input-providing companies for example.

Interest by farm managers in stock investment is part of a larger interest in farm-level participation in value added activities. Likely, that interest has increased in recent years because of continually widening farm-to-retail margins. In particular, farm managers wonder if the “only a few pennies worth of wheat” in a loaf of bread or a box of Wheaties is an indication that the bread- or Wheaties-making company might be garnering “excessive” profits that might be captured at the farm level through common stock ownership in such companies. Whether such “excessive” profits are due to a company’s superior management, its being a technology leader, or its exertion of market power (tendency to behave like a monopoly) is perhaps less relevant than an assessment of whether a company’s profits are actually excessive given their risk, and whether “perceived as excessive” profits are expected to persist into the future. If a company’s profits are expected to persist, they can be captured through common stock ownership. As always, some insight might be gained by an examination of historical returns associated with companies of interest.

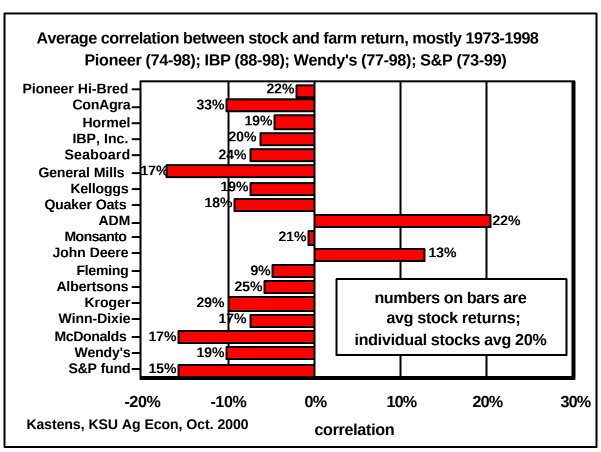

Figure 14

As an indication of the potential for stocks to increase profitability or reduce farm investment risk, figure 14 displays the average (across KFMA farms) correlation between various stock returns and farm returns. Strongly negative correlations have the greatest potential to reduce farm risk. Thus, the S&P series appears to have nearly as much potential as any of the stocks. On the other hand, stocks such as John Deere and ADM appear to have much less potential because they are positively correlated with farm returns.

Most of the individual stocks in figure 14 displayed substantially higher returns than the market (S&P). That is, the average return reported on the 17 individual-stock bars was around 20.2%, which was substantially higher than a comparably constructed S&P average of 15.4%. Ignoring risk, it is easy to see why these agricultural companies' historical returns might be viewed as "high" relative to either those of the stock market as a whole or to those of agricultural land or farm investments.

Given that including stock of the individual companies listed in figure 14 in a farm/stock portfolio might reduce expected farm-only risk as well as substantially increase expected farm-only profits, such individual stock investments should be especially appealing to farm managers – perhaps even more so than investment in an S&P fund. As always, however, the farm manager must assess whether the historical stock returns associated with companies listed in figure 14, especially those with shorter time series, are reliable indicators of future profitability of those firms.

Table 1. Investment Portfolio Information for KFMA Farm and Stock Returns, All Available Farms

company	no. of farms	avg mean of farm return %	avg std of farm return %	avg mean of stock return %	avg std of stock return %	avg % of stock in min risk portolio %	avg risk reduction in min risk portfolio %[a]	% of farms with cor(roe, stk)>0 %	% of risky farms %[b]
Pioneer Hi-Bred (74-98)	197	6.7	20.6	21.9	28.8	32	20	45	19
ConAgra (73-98)	148	8.1	22.6	32.7	54.1	17	12	24	1
Hormel (73-98)	148	8.1	22.6	19.0	21.6	47	31	41	47
IBP, Inc. (88-98)	704	6.6	23.5	20.2	28.5	36	25	42	27
Seaboard (73-98)	148	8.1	22.6	23.5	35.2	29	19	32	11
General Mills (73-98)	148	8.1	22.6	16.5	23.1	45	34	20	41
Kelloggs (73-98)	148	8.1	22.6	18.8	27.0	39	26	30	24
Quaker Oats (73-98)	148	8.1	22.6	18.4	34.3	30	21	29	12
ADM (73-98)	148	8.1	22.6	21.8	43.1	17	7	89	7
Monsanto (73-98)	148	8.1	22.6	20.8	31.9	32	19	42	16
John Deere (73-98)	148	8.1	22.6	13.3	30.0	33	16	78	19
Fleming Foods (73-98)	148	8.1	22.6	8.6	25.0	41	27	37	30
Albertsons (73-98)	148	8.1	22.6	25.4	22.3	46	30	39	43
Kroger (73-98)	148	8.1	22.6	28.7	32.4	32	22	24	15
Winn-Dixie (73-98)	148	8.1	22.6	17.0	30.7	34	22	30	19
McDonalds (73-98)	148	8.1	22.6	17.5	31.6	34	25	17	16
Wendy's (77-98)	255	6.5	21.2	18.6	33.8	28	20	34	14
S&P fund (73-99)	138	8.3	22.2	15.2	16.7	57	42	19	68

[a] Risk reduction is defined as [1-std(portfolio returns)/std(farm returns)]*100.
[b] A risky farm is one whose std(farm returns) over the analyzed time period is greater than the std(stock returns).

Table 2. Investment Portfolio Information for KFMA Farm and Stock Returns, Top 1/3 (PTROE-wise) of Farms

company	no. of farms	avg mean of farm return %	avg std of farm return %	avg mean of stock return %	avg std of stock return %	avg % of stock in min risk portolio %	avg risk reduction in min risk portfolio %[a]	% of farms with cor(roe, stk)>0 %	% of risky farms %[b]
Pioneer Hi-Bred (74-98)	66	11.8	27.8	21.9	28.8	44	26	52	38
ConAgra (73-98)	50	13.9	29.4	32.7	54.1	25	17	24	4
Hormel (73-98)	50	13.9	29.4	19.0	21.6	60	39	40	74
IBP, Inc. (88-98)	235	15.6	34.4	20.2	28.5	53	35	47	53
Seaboard (73-98)	50	13.9	29.4	23.5	35.2	40	26	32	24
General Mills (73-98)	50	13.9	29.4	16.5	23.1	56	42	16	68
Kelloggs (73-98)	50	13.9	29.4	18.8	27.0	51	34	34	48
Quaker Oats (73-98)	50	13.9	29.4	18.4	34.3	42	28	22	26
ADM (73-98)	50	13.9	29.4	21.8	43.1	26	12	86	16
Monsanto (73-98)	50	13.9	29.4	20.8	31.9	44	26	42	34
John Deere (73-98)	50	13.9	29.4	13.3	30.0	46	23	78	40
Fleming Foods (73-98)	50	13.9	29.4	8.6	25.0	53	35	36	58
Albertsons (73-98)	50	13.9	29.4	25.4	22.3	58	39	40	70
Kroger (73-98)	50	13.9	29.4	28.7	32.4	44	29	24	32
Winn-Dixie (73-98)	50	13.9	29.4	17.0	30.7	45	29	38	40
McDonalds (73-98)	50	13.9	29.4	17.5	31.6	45	32	16	34
Wendy's (77-98)	85	12.1	28.6	18.6	33.8	40	28	27	28
S&P fund (73-99)	46	13.9	30.0	15.2	16.7	70	53	20	91

[a] Risk reduction is defined as [1-std(portfolio returns)/std(farm returns)]*100.
[b] A risky farm is one whose std(farm returns) over the analyzed time period is greater than the std(stock returns).

Table 1 provides additional detail for considering various companies' stocks in a farm/stock portfolio. As an example to aid understanding the values in the table, here is a description of the 20.6% reported in the top (Pioneer Hi-Bred) row of the "avg std of farm return" column. First, the standard deviation for the 25 annual farm returns over 1974-1998 was computed for each of the 197 farms. Next, these 197 values were averaged to give 20.6%. The 20.6% value is interpreted as the expected standard deviation of 1974-1998 returns for a typical or random farm.

Although the returns for the individual companies in table 1 were analyzed over different time periods than the S&P fund's returns, it is easy to see in the "avg std of stock return" column that S&P fund returns tend to be substantially less variable than the returns for individual stocks. If the 17 individual companies of table 1 can be considered representative of firms comprising the S&P index, then this is an indication of systematic vs. unsystematic risk in the stock market.

Each of the values in the "avg mean of stock return" column is higher – often much higher – than the comparable (same-row) value in the "avg mean of farm return" column, which suggests that including these stocks in a farm/stock portfolio will certainly enhance expected farm-only profits, at least for many farms. Nonetheless, some stocks had much lower returns than others (e.g., Fleming Foods at 8.6%).

Choosing the amount of stock to include in a farm/stock portfolio is about selecting the preferred combination of expected risk and expected reward. Although more detail about this process in a farm/S&P portfolio setting will be conveyed in a later section of this paper, some insight into how the individual stocks in table 1 might behave in a farm/stock portfolio can be gained from examining characteristics of the minimum variance (risk) portfolio that are reported in table 1. The minimum risk farm/stock portfolio is the one which, by using the EQUITY method, chooses the portion of a farm's equity that, when invested in the stock in question, will minimize the risk associated with that stock's farm/stock portfolio.

Using the EQUITY method to select the stock portion of a farm/stock portfolio that minimizes risk resulted in average stock portions ranging from 17% (ConAgra and ADM) to 57% for the S&P fund (see the "avg % of stock in min risk portfolio" column). Remember that these reported stock portions are averages across many farms; stock portions selected for individual farms ranged widely. Although investments in firms such as ADM substantially increase expected profits (investing 100% of a farm's equity in ADM would result in expected returns of 21.8%), they do not appear to have much potential to reduce risk. That is, the minimum risk farm/ADM portfolio, which involved 17% of the total equity invested in ADM and 83% in the farm, reduced the farm-only risk by only 7% (the "avg risk reduction..." column), roughly implying a typical drop in the standard deviation of farm returns from 22.6% to 21.0%, which is 22.6%(1-0.07).

The propensity for a particular stock investment to reduce risk for individual farms is based partly on the tendency for that stock's returns (over time) to be negatively correlated with individual farm returns over time and partly on the tendency for that stock's returns to have less variability than the variability associated with farm returns. In the case of ADM, 89% of the 148 farms considered in the analysis had 1973-1998 returns that were positively correlated with ADM returns over the same time period (see the "% of farms with cor(roe,stk)>0" column). Additionally, ADM returns were more risky than farm returns for 93% of the 148 farms analyzed (see the "% of risky farms" column). Thus, it should not be surprising that investment in ADM stock has little potential to reduce risk at the farm level.

More intuitively, because ADM tends to be profitable in years when farms are profitable, and vice versa, it makes little sense to invest in ADM to reduce risk – though it could be most appropriate to invest in ADM to enhance farm profitability through vertical integration.

In the "avg risk reduction" column it is easy to see that the S&P fund had the greatest potential to decrease farm risk, albeit at a high level (57%) of stock inclusion. This should not be surprising in that only 19% (lowest value in that column) of the 138 farms analyzed had 1973-1999 returns that were positively correlated with S&P returns for the same time period. Moreover, 68% (highest value in that column) of the 138 farms had 1973-1999 returns that were more risky than S&P returns. However, expected profitability associated with the S&P fund is typically much lower than most of the individual stocks considered in table 1 (see the "avg mean of stock return" column).

That table 1 showed 68% of the farms to have more variable returns than those of an S&P fund suggests that an S&P fund would make a good candidate for inclusion in a farm/stock portfolio, especially if an important goal is to reduce risk. Furthermore, the S&P fund, since it is so broad, would likely be more predictable over time. With individual companies like Albertsons, whose historical returns were among the highest in table 1, there is always a question about how long it might be able to beat the market as much as it had in the 26-year period examined. In fact, a quick look at a stock market web site will reveal that the Albertsons stock price had dropped more than 50% during 1999, a time period not reported in this analysis.

Table 2 shows the same information as table 1 only it considers the "top third" of farms – as ranked by PTROE over the time period associated with a particular stock. As indicated earlier, these highly profitable farms, at 13.9% 1973-1999 PTROE, had substantially higher returns than those underlying table 1 (8.3% PTROE). But, they also had higher risk (a 30.0% standard deviation of 1973-1999 returns vs. 22.2% for the farms underlying table 1). Thus, compared to the "all farms" of table 1, for this group of farms it was "easier" for the risk minimizing procedure to reduce farm risk with stock inclusion. For example, on average, minimizing risk by including the S&P fund would have reduced risk by 53%, which compares to 42% in table 1.

Unlike in table 1, for the highly profitable farms of table 2, including stocks such as John Deere or Fleming Foods would have diminished portfolio returns over farm-only returns for a typical farm. Nonetheless, considering the generally higher stock returns than farm returns reported in table 2, and considering the substantial risk reduction potential reported there as well, it is likely that this class of highly profitable farms should also be able to benefit from considering a farm/stock portfolio.

Trading Off Risk and Profit

Along with expected profitability measures, tables 1 and 2 reported characteristics of a risk minimizing framework for stock amount selection, as opposed to considering optimizing some combination of risk and profit. In actual application, a farm would want to consider the full range of profit/risk combinations afforded by a particular stock investment. In this part of the research, 1973-1999 returns were considered for the same two groups of farms underlying tables 1 and 2. Namely, the 138 farms used in the S&P row of table 1 were used to make inferences about mid-profit farms, and the 46 farms used in the S&P row of table 2 were used to make inferences about high-profit farms. Only one stock investment was considered, the S&P fund. However, unlike the analyses in tables 1 and 2, this section considered purchasing stock for building a farm/stock portfolio with debt (the DEBT method) as well as with equity (the EQUITY method).

In this section, with the EQUITY method, all risk and profit possibilities are considered for each farm as that farm converts incremental portions of its equity to an S&P fund – ranging from 0% of its equity to 100% of its equity. Then, at each stock portion point, the risk and profit measures for all of the relevant farms are averaged in order to generalize the results into graphical presentations. Thus, each displayed figure can be though of as first being constructed for each farm, and then aggregated to the average figure shown.

In this section, with the DEBT method, all risk and profit possibilities are considered for each farm as that farm purchases incremental amounts of stock, with new debt, for each portion of existing farm equity. Arbitrarily, we considered stock purchases ranging from $0 for each $1 worth of farm equity to only $1 for each $1 of farm equity. At the high end, a farm that had started with no debt would have an overall portfolio consisting of 50% stock assets and 50% farm assets, along with an ending debt to assets ratio of 50%. On the other hand, at the high end, a farm that had started with 60% equity and 40% debt (a 40% debt to assets ratio) would end up with an overall portfolio consisting of 37.5% stock assets (60/[60+40+60]) and 62.5% farm assets, along with an ending debt to assets ratio of 62.5%.

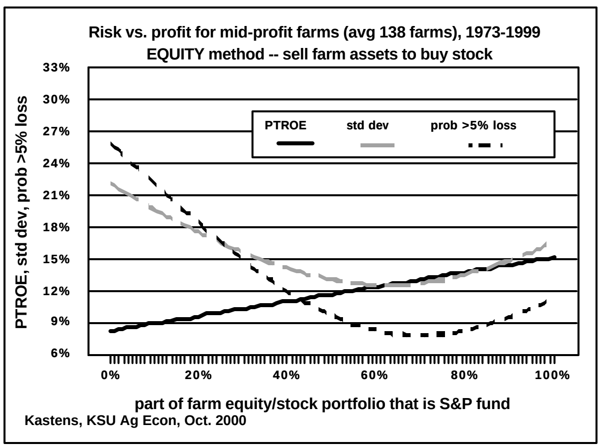

Figure 15

Figure 15 depicts the relationship between risk and profitability for mid-profit farms across different levels of S&P investment using the EQUITY method. Profitability is defined as PTROE of portfolio returns. Risk is shown two ways, first, as standard deviation of the 27 years' portfolio returns (referred to here as the SD risk measure), and second, as the probability of a 5% or greater loss in owner equity in any one year (referred to as the P5 risk measure).

The two measures of risk considered in figure 15 are not equivalent. The SD risk measure presumes that an investor is interested in variability about the average or expected return. The P5 risk measure presumes that an investor is interested in the probability of acquiring a particular undesirable return, here <= -5%. If standard deviation were constant across ever higher expected returns, the probability of a particular loss (here 5% or more) would still continue to fall as expected returns increased – because it is an ever larger drop from the expected returns to the -5% loss. Of course, if expected returns were constant across different portfolios, the portfolio that minimized risk according to the SD measure would be the same one that minimized risk according to the P5 measure.

Figure 15 makes it clear that risk is reduced nearly linearly with small amounts of stock investment. Eventually, however, it takes more and more stock to reduce risk by the same amount, until risk reaches a minimum point. On average, for the mid-profit farms represented in figure 15, risk was minimized when the stock investment made up either 63% or 70% of the total farm/stock portfolio, respectively, depending on whether the SD or P5 risk measure was used. With increases in stock investment after the minimum risk point, risk once again rises. Unlike the risk measures, profitability rises linearly throughout, with each incremental portion of stock causing returns to rise by the same amount. In the array of possibilities depicted in figure 15, the farm manager would want to choose an amount of stock that leads to the risk/return relationship he finds most desirable.

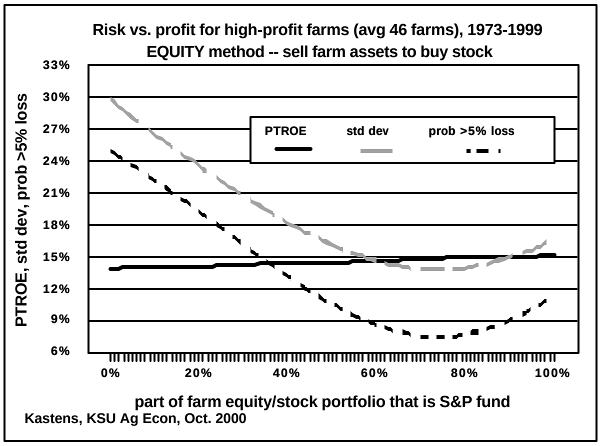

Figure 16

Figure 16 shows the same information as figure 15, only for the high-profit farms rather than the mid-profit farms. For these highly profitable farms, expected increases in profitability associated with stock investment are much smaller than for the mid-profit farms of figure 15. Across the 46 high-profit farms, the average maximum increase in profitability (at 100% of equity invested in the S&P fund) was only 1.3% (15.2% for the S&P fund less a 13.9% average for the farms). Although not shown, a substantial number of the 46 farms likely *decreased* profitability by including stock in their portfolios.

Despite stock investment only marginally changing expected returns for the high-profit farms in figure 16, substantial risk reduction did appear to prevail. On average, farms would be able to reduce the probability of a 5% or greater loss in equity from 25% (1 year in 4) to less than 8% (1 year in 13) as stock investment goes from 0% of equity to 74% of equity at the P5 risk minimizing point.

Figures 17 and 18 show the impacts of stock portfolio selection on risk and profitability for the mid- and high-profit farms, respectively. In these figures, stock is considered to be purchased with new debt (the DEBT method). Thus, in this analysis there is no presumption of downsizing a farm to purchase stock. Although, there is a presumption of increasing the debt to assets ratio as stock purchases increase.[6]

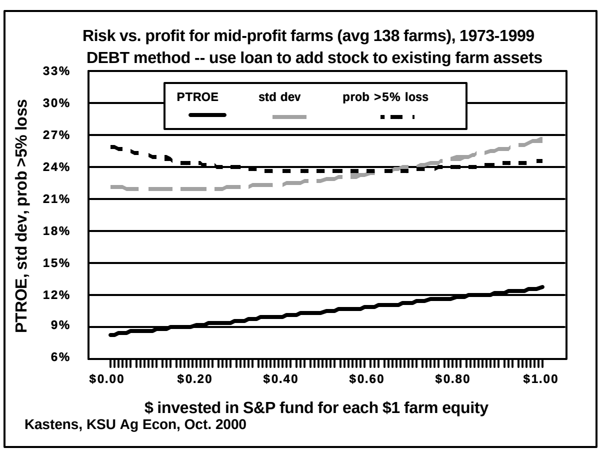

Figure 17

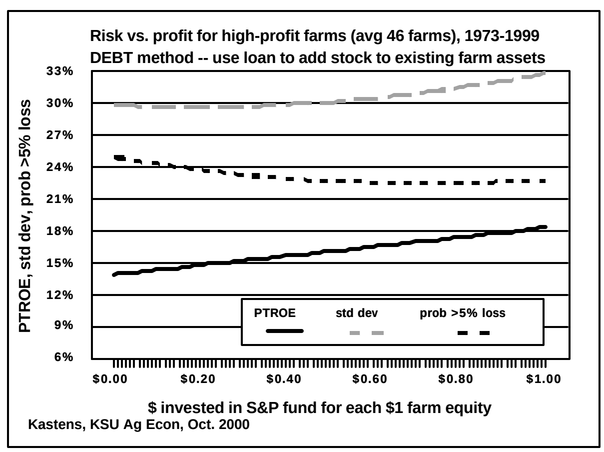

Figure 18

[6] In this analysis, the interest rates charged on the stock-related debt were taken to be the annual U.S. non-real-estate farm loan interest rates reported in issues of the Federal Reserve Bank's *Agricultural Finance Databook*. Over the 1973-1999 time period, those annual interest rates averaged 10.8%.

Relative to figures 15 and 16, figures 17 and 18 show little to no risk reduction associated with increased stock purchasing. However, for both mid- and high-profit farms, expected returns rise the same amount with increased stock purchases. That is, at $1 of stock purchased for every $1 of farm equity, portfolio returns are 4.4 percentage points higher than farm-only returns – for both mid- and high-profit farms. That 4.4% is the difference between average stock returns (15.2%) and average borrowing rates (10.8%) over the 1973-1999 time period.

Because portfolio risk impacts associated with stock investment appear small when stock is purchased with new debt (figures 17 and 18), the decision to purchase stock with debt should be based primarily on two factors. First, are stock returns expected to be higher than interest rates? Second, does the farm have excess borrowing capacity? If the answer to these two questions is yes, then a third question arises. Would investment in farm-expanding farm assets garner greater returns than investing in the stock market? Interestingly, despite stock investments likely having lower cash returns (dividends) than farm asset investments such as land (rent), servicing stock-related debt should be as easy as farm-related debt because it is easy to sell off units of an S&P fund.

Retiring Debt Instead of Buying Stock

A common way for farms to reduce risk is to reduce debt. Given that risk is often lower with farm/stock portfolios than with farm-only investments, it may be interesting to compare the risk reducing aspects of debt reduction with those of farm/stock portfolio construction. To begin this comparison, we collected the debt to assets series (across time) for each of the farms in our analyses. The overall average debt to assets ratio was 21% and 23%, for the mid- and high-profit farms, respectively. By using the farm bank interest rate series described earlier, pre-tax return on assets (PTROA) could be calculated for each farm each year. The PTROA series was then held constant each year while alternative percentages of debt reduction were used to simulate resultant PTROE values.

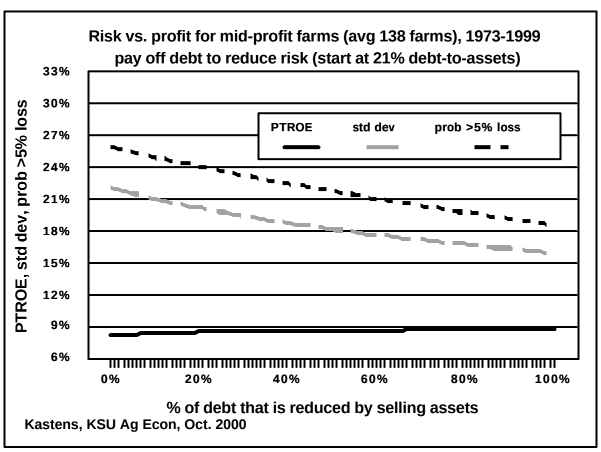

Figure 19

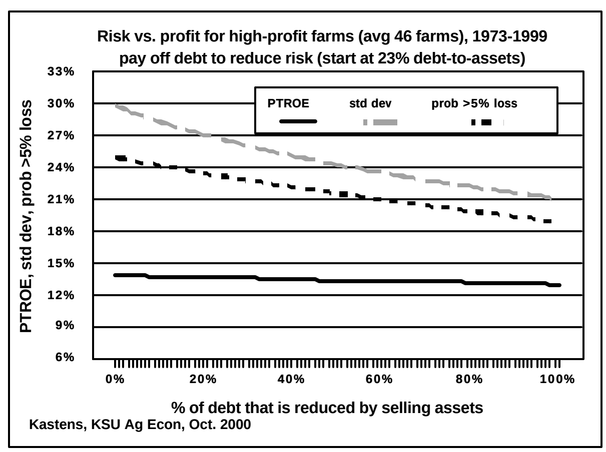

Figure 20

Figure 19 depicts the impact of debt reduction on risk and profit for the mid-profit farms. For the mid-profit farms in figure 19, 100% debt reduction is comparable to the 21% stock-inclusion point of figure 15 – because the farm might have paid off all debt rather than purchased that amount of stock. The 21% stock-inclusion risk was 17.4% by the SD measure and 18.2% by the P5 measure in figure 15.

The portfolio profitability associated with that 21% stock-inclusion point was 9.7%. The comparable 100% debt-reduction risk was 16.1% by the SD measure and 18.7% by the P5 measure in figure 19. The comparable 100% debt-reduction profitability in figure 19 was 8.8%. Notice that profitability rose with debt reduction for the mid-profit farms because they were generally not profitable enough to generate a positive return to debt.

Figure 20 is the high-profit farms counterpart to figure 19. For the high-profit farms in figure 20, 100% debt reduction is comparable to the 23%-stock-inclusion point of figure 16. The 23% stock-inclusion risk was 22.9% by the SD measure and 18.5% by the P5 measure in figure 16. The portfolio profitability associated with that 23% stock-inclusion was 14.2%. The comparable 100% debt-reduction risk was 21.2% by the SD measure and 19.0% by the P5 measure in figure 20. The comparable 100% debt-reduction profitability in figure 20 was 13.0%. Profitability fell with debt reduction for the high-profit farms because they were generally profitable enough to generate a positive return to their debt.

For both the mid-profit and the high-profit farms, it appears that risk reduction might just as well take place with debt reduction as with construction of a farm/stock portfolio. Moreover, the profitability difference between 100% debt reduction and a comparable stock-inclusion rate was only 0.9 and 1.2 percentage points for the mid-profit and high-profit farms, respectively. Given that, it should not be too surprising if we do not find that farm managers tend to hold a great deal of stock in their investment portfolios.

Whether farm managers consider paying down debt to reduce risk, or purchasing stock to enhance profitability or reduce risk, they would be wise to consider the implications for farm size. Unless innovative ways for maintaining farm size with less equity requirements are developed (such as selling land and renting it back), or equity capital is attracted from outside sources, purchasing stock with equity implies downsizing a farm. Similarly, purchasing stock with debt should be weighed against using that debt to expand the farm.

Recent work at Kansas State University suggests that, after accounting for important management characteristics such as superiority/inferiority in the areas of crop yields, prices, and costs, and in the areas of technology adoption as well, a substantial profitability premium exists for those farms that are larger than average farms in the area. In particular, the reported $0.22/acre increased profitability associated with each 1% a farm is larger than average might translate to an increase in return on equity of 0.08 percentage points.[7] More specifically, downsizing a farm by 25% to purchase stock might mean a reduction in farming returns of 2 percentage points, say from 8.3% to 6.3% for the mid-profit farms. Combining that 6.3% return (at 75% of the portfolio) with a 15.2% return for the S&P fund (at 25% of the portfolio), leads to a total return of 8.5%, which is close to the 8.3% return for the mid-profit farms that did not purchase stock. The same comparison involving high-profit farms would lead to portfolio profits that are 1.2 percentage points *lower* than farm-only returns.

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[7] Assuming an average land value of $600/acre in Kansas, and that 60% of operated land in Kansas is rented, implies that the owner has $240 of land assets for each acre operated. Adding to that, an amount equal to $150/acre to cover machinery and other assets, implies a total asset valuation of $390/acre operated. Assuming a 30% debt to assets ratio, this comes to $273 equity per acre operated. Finally, $0.22/$273 = 0.0008, or 0.08%. For details, contact Kastens.

Summary

Over the last 50 years (1951-1999), returns to a broad-based stock investment portfolio, such as an S&P fund, have been somewhat higher than returns to a broad-based agricultural land investment portfolio, such as one that holds land in 35 different states of the U.S. – 14.3% annually for stock vs. 11.5% for agricultural land. However, stock returns have been decidedly more variable than land returns – 16% standard deviation of stock returns across years vs. only 8% for land. Moreover, land returns have outpaced stock returns for fairly long periods of time in history, for example during the 1960s and 1970s, when land returns were 17.2% annually but stock returns only 8.3%. The cash portion of the annual returns has averaged 4.0% for the stock market (dividends) and 5.2% for land (rents). The capital gain portion of the annual returns has averaged 10.3% for the stock market vs. 6.3% for land.

Simultaneously investing in both agricultural land and the stock market often can increase profitability and reduce risk compared to investing in only land. For example, a risk minimizing investment portfolio comprised of an S&P fund at 24% of the total investment and a 35-state land portfolio at 76% of the total investment had average annual returns of 12.2% over the last 50 years and a standard deviation of annual returns equal to 6%, which compares to average annual returns of 11.5% and a standard deviation of annual returns equal to 8% for a land-only portfolio.

Comparing average (avg) annual farm returns (return on equity) and standard deviation (std) of annual returns for a portfolio of Kansas farms over the 27-year period 1973-1999 to comparable Kansas farm land and stock market (S&P fund) returns resulted in the following: farm returns, avg 8.3% std 10.5%; land returns, avg 10.1% std 10.7%; and stock market returns, avg 15.2% std 16.7%; indicating that farm returns have been somewhat lower than land returns which have been substantially lower than stock market returns. However, for a portfolio comprised of the most profitable third of those Kansas farms, returns averaged 13.9% (standard deviation of 14.8%), which was decidedly more profitable than land returns but still lower than stock market returns. As seen by the standard deviations, variability of farm portfolio returns has been similar to that of a land portfolio but substantially less than the variability of stock market returns.

Returns for individual Kansas farms tend to be decidedly more variable than returns to a portfolio of Kansas farms – an average standard deviation of returns of 22.2% for the individual farms vs. a 10.5% standard deviation of returns associated with a Kansas farm portfolio. This indicates a systematic risk of 10.5% associated with Kansas farms and an unsystematic risk of 11.7%.

Simulating various Kansas farm investment/stock investment portfolios, which considered 17 different agriculture-related companies, and also an S&P fund, revealed the following. First, with most of the associated time periods comprised of the years 1973-1998, the agriculture-related stocks performed substantially better than the overall market, as represented by the S&P fund. Second, generally any of the individual stocks could have been combined with farm investments in a portfolio that increased profitability and reduced risk. On average, the risk minimizing farm/stock portfolios selected in the analysis included 35% stock and 65% farm investments. The broad-based S&P fund topped all of the 17 individual stocks in terms of being able to reduce risk the most (42% risk reduction with the S&P fund vs. 23% risk reduction, on average, for the 17 individual stocks).

Returns from 138 mid-profit and 46 high-profit Kansas farms were simulated to examine risk and profit relationships as the farms invested more heavily in the stock market. Using farm equity to purchase stock, where a farm was presumed to downsize the farm by selling assets with which to purchase stock, thereby holding debt to assets constant, resulted in the following. On average, portfolio returns could be increased a maximum of 6.9 and 1.3 percentage points, for mid- and high-profit farms respectively, as stock inclusion went to 100% in farm/stock portfolios. On average, the probability of a 5% or greater equity loss fell from 26% to 8% as stock inclusion reached a risk minimizing point of 70% for the mid-profit farms, and fell from 25% to 8% as stock inclusion reached a risk minimizing point of 74% for the high-profit farms.

Where a farm was presumed to use debt funds to purchase stock, thereby maintaining farm size but increasing debt to assets ratios, resulted in the following. For both mid- and high-profit farms, profits rose by the same amount, which was determined by how much stock returns outpace interest rates. In this study, 1973-1999 stock returns averaged 15.2% and interest rates 10.8%, leading to a 4.4 percentage point average gain in returns when stock purchases reached $1 for every $1 of farm equity. For both classes of farms, however, risk was reduced only minimally by purchasing stock with debt.

Considering debt reduction as a risk reducing strategy was shown to be almost identical to using farm equity to purchase stock – at least in terms of risk reduction – for both the mid- and high-profit farms. When completely paying off debt was compared to stock purchases of the same amount, the portfolio approach did result in slightly higher profits than did the debt elimination process: 0.9 percentage points higher for the mid-profit farms and 1.2 percentage points higher for the high-profit farms.

Should farm managers invest in the stock market? The answer is often no if it means taking on more debt to do so. Which farms are most likely to benefit from stock market investment? Those which are low- to mid-profit with no debt. That low-profit no-debt farms would benefit is likely a statement that such farms are either hobby farms or that they will probably diminish anyway. Simply put, such farms would probably be better off (at least economically) if they had their capital invested elsewhere. Which farms are least likely to benefit from stock market investment? High-debt farms and high-profit farms. If the reason for stock market investing is principally risk reduction, it appears that paying down debt will accomplish the same task, while giving up only small amounts of profit. Especially high-profit farms, by definition, will not find stock market returns sufficiently attractive.

In considering stock investment for a farm, three reminders are probably in order. First, stock market returns are highly variable and especially the returns for individual stocks. Future stock returns could be substantially different than those observed in this analysis. A repeat of the investment relationships observed in the 1960s and 1970s would vastly alter the favoring-the-stock-market analysis reported here. Merely including the year 2000 in this analysis would likely diminish the stock market's favor. Second, stock market investment often downsizes a farm from its current size or from what it might be. Farm managers should carefully consider what the impact of that downsizing might be on the farm's profitability, independently of the expected stock market returns. Third, if economies of size are an issue, might farms look outside traditional channels for suppliers of equity capital? That way, farm managers could acquire the gains in profitability and in risk reduction often wrought by diversification of farm investments into the stock market – without the negative impacts associated with downsizing a farm.