Risk Management Strategies with Diversified Hog/Crop Production

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Years ago, when there were many small farms, farmers were encouraged to diversify. With today's larger operations, there is more specialization and greater concentration in agriculture. For example, the largest 10 broiler companies account for 70 percent of the production and processing (Schrader et al., 1997). Increasing specialization and concentration is also apparent in the hog industry. The long-run trend has been for smaller farms to leave the industry, and statistics show a dramatic shift to larger, more specialized units and greater geographical concentration in the production of hogs (Boehlje et al., 1997). However, there is still a significant percentage of producers, especially in the Midwest, who produce both crops and hogs.

There have also been changes in risk management tools available to producers. The 1996 Farm Bill removed most of the price supports on which farmers had relied. Risk bearing responsibilities have been shifted to individual producers. Because of the increased importance of risk management and the availability of new risk management tools, there is a need to understand the effects of alternative risk management strategies.

The objective of this research was to determine the effects of selected risk management strategies on hog and crop/hog farms. Previous research has analyzed the effectiveness of these strategies on crop operations or on livestock operations. However, there has been limited consideration of how risk management strategies may be affected by diversification on crop/livestock operations.

Model Description

An Excel-based simulation model utilizing @Risk was developed (Nydene, 1999). The twelve-month model was constructed to simulate gross returns less specified variable production costs, such as risk management and feed costs, for a farrow-to-finish hog operation and corn/soybean crop operation. A March through February period was chosen for the model because several of the risk management strategies must be implemented before March 15.

There are several major assumptions of the model. First, the model year is autonomous. Grain from the previous crop year and the current year are not carried into the next year. All futures positions are closed at the prevailing prices at the end of the model year. The hog enterprise is assumed to have an inventory at various phases of growth throughout the year, allowing hogs to be marketed every month. The parameters of the model are based upon a 1,000-acre farm located in Carroll County, Indiana with a 175-sow farrow-to-finish hog operation. This model farm can produce crops and livestock or just one of these products. Pork feed efficiency, monthly pork production, and crop yields are stochastic, simulating the variability associated with production.

Monthly prices are simulated according to the Markov Process with the futures prices assumed to be unbiased estimates of the cash prices (Wilmot, 1995). The simulated prices were correlated based on the correlations observed from the 1990-1996 period.

A total of 800 iterations are simulated for the March 1999 conditions. Results are evaluated using mean-variance criteria, the Sharpe Ratio, and "value at risk". The coefficient of variation is used to rank strategies by the mean-variance criteria. The Sharpe Ratio utilizes the mean-variance criteria with reference to a benchmark of an 8% return, which is an estimate of the cost of intermediate term debt. Finally, the "value at risk" is the average gross return at different probability levels and indicates the probability of falling short of that level (Babcock, 1997).

Risk Management Tools

This study considered use of futures and options contracts for the commodities produced, hedging of feed inputs, and various crop insurance alternatives. The basis for comparison is a "naïve" strategy, which does not utilize any of these risk management tools.

Futures Contracts: To hedge crops (HC), December and November contracts equal to expected production are sold at the March prices for corn and soybeans, respectively. In the expiration month, when the grains are sold on the spot market, these contracts are closed out. To hedge feed (HF), enough corn and soybean meal futures contracts to cover the expected feed usage are bought in March for each month of the year. These open contracts are sold at expiration when the feed is purchased. To hedge hogs (HH), futures contracts with expiration in six months (the expected marketing month) are sold when the pigs are farrowed. The futures positions are closed out when the hogs are sold.

Options: Put options are placed on corn and soybeans (CO) for their respective harvest months on March 1. The put options are placed at $0.10 and $0.25 below the current futures value for corn and soybeans, respectively. For hogs (HO), put options are placed at $2 below the current futures price for the expected production each month. All hog options are placed at the time of farrowing and expire within six months (the expected marketing month).

Crop Insurance: Three different crop insurance plans are analyzed. The actual production history (APH) insurance is based on historical yields of the individual farm. The premium per acre for the 75% level of coverage is based on the November and December futures prices in February for soybeans and corn, respectively.

Crop Revenue Coverage (CRC) is similar to the APH coverage, but it also protects against declines in prices of corn and soybeans from spring levels of the harvest time futures prices. The yield coverage of the CRC is similar to APH, and it is assumed both the corn and soybeans were covered at the 75% level.

Finally, the Group Risk Plan (GRP) insurance is included. Unlike the APH, the expected county yield is used to calculate the coverage level. Indemnity payments, if any, are based on the actual county yield rather than the yield of an individual producer. An 85% trigger yield of this insurance is modeled for both corn and soybeans.

Hog Farm Results

Hedging Feed: Although this strategy (HF) results in a relatively high mean return, there is a very high variance (Table 1). There are other strategies that provide the same or higher levels of returns with less variance. Furthermore, the hedge feed strategy shifts the lower tail of the gross return distribution to the left of the naïve strategy distribution.

Hedging Hogs: This strategy (HH) provides a mean gross return that is slightly lower than the naïve strategy, with a reduced variance. With this strategy, the price received is determined six months prior to marketing, and this alleviates some of the volatility associated with strictly cash marketing, as uncertainty increases with time. For example, when the December futures contract is sold in July, the only volatility associated with the December futures prices is the futures volatility between March and July. When pricing on the cash market, the cash December prices contain all the volatility from March through December.

Hog Options: This strategy (HO) produces a mean gross return that is slightly less than the hedging hog strategy and a variance that is slightly higher. The difference in the commission costs of options compared to futures helps explain the lowered mean of gross returns. Futures hedges cost $50 per round turn, while options are assigned a cost of $75 per option. Options also differ from hedges as there is a premium for the option. Unlike futures hedges, options do not limit upward movement and this leads to the increased level of variance in gross return. This strategy is also consistent with theory as it shifts the lower tail of the gross return distribution to the right.

Combined Strategies: When considering a combination of strategies, hedging both feed and hogs (HF HH) was the top rated strategy. This strategy also removes a significant portion of the lower tail of the revenue distribution. At the 5% probability level, the hedge hog/hedge feed strategy has a value at risk which is greater than the naïve strategy by approximately $15,000. The effectiveness of the hedge hog/hedge feed strategy is an example of how a combination of strategies may produce better results than individual strategies. Essentially, this strategy reduces the variance of the return by pricing all the feed and hogs in March at the futures prices that are available at that time. The hedge hog/hedge feed strategy is the top strategy for three of the five years analyzed according to the Sharpe Ratio.

Diversified Hog/Crop Farm Results

Diversification can be examined through the combination of the crop/hog enterprises. As modeled, this only captures the diversification effects on returns minus feed and risk management costs. Diversification tends to average the coefficients of variation of the two separate enterprises. Addition of a hog enterprise to an existing crop enterprise increases variability, but the addition of a crop enterprise can have significant positive effects to an existing hog operation. To analyze the effect of diversification on the lower tail of the return distribution, the value “at risk” at the five-percent level was standardized by dividing it by the mean gross return. The values for the naïve strategies of the crop, hog, and crop/hog farm are 72.8%, 62.2%, and 74.5%, respectively. This suggests that the diversification shifts the lower tail of the distribution to the right, reducing the chances of extremely low returns. Thus, there are

limited risk management benefits of diversification when compared to a non-diversified farm operation.

Diversification also has a limited effect on the rankings of risk management strategies. There are few changes in the rankings of the individual risk management strategies for the non-diversified and diversified farms. The risk management tools in the individual enterprise and diversified enterprise situations are ranked in the same basic order by the Sharpe Ratio. (Sensitivity analysis performed using the correlations of crop and hog prices for the 1980's, which are distinctly different from the 1990's, also produced similar results.)

Crop/Hog Farm Combination Strategies: One of the most interesting results from this study is the effect of combining risk management tools. By using more than one risk management tool, a producer may be able to reduce more risk than with just one tool. Fourteen different combination strategies for the diversified farm are listed in the lower half of Table 2.

With a diversified farm operation, hedging appears in many of the strategies which are the highest ranked according to the Sharpe Ratio and coefficient of variation. The APH/hedge hog/hedge crop/hedge feed strategy is the highest ranked. This strategy increases the value at risk at the 5 and 10% levels by over $20,000 in comparison to the naïve strategy. Hedges, which effectively pre-price the hogs (HH) and crops (HC), along with crop insurance to protect crop yields are key factors in reducing variability.

Importance of Risk Management

When evaluating risk management tools, the effect that risk management tools have on the utility of the producers should be considered. To analyze this effect, differences were found between the natural log utility of the top ranked and the naïve strategies from the 1999 simulated data. A z-test was performed to determine how many observations would be necessary to determine that the differences between the outcomes of the risk management strategies are significantly different at the 95% level of confidence. In essence, this tests how many years a producer would have to follow the top ranked strategy to be 95% confident of receiving a level of utility significantly greater than that derived from the naïve strategy. This test indicates that 227 observations would be necessary to prove the strategies differ significantly. In other words, a producer would have to follow the strategy 227 years in order to be 95 percent confident of an improvement over the naïve strategy. This suggests that, given the model specifications, the risk management strategies considered in this study have very little effect on the utility of a risk averse individual.

Conclusions

There are several major points from this research. First, combining risk management strategies was shown to increase the effectiveness for both the diversified and the single enterprise operations. Combinations of tools work to reduce variability for various aspects of the operation. It can be concluded that, if it is the objective of the producer to reduce variability of returns, he or she must combine several risk management tools.

Second, the diversification of enterprises, at least between crops and hogs, has limited risk reducing benefits. The mean-variance criterion and values at risk in the lower tail of the

return distribution support these results. Overall, it can be concluded that there are some benefits of a diversified hog/crop operation, but they are mainly limited to the extreme lower tail of the distribution of gross returns.

Finally, the marketing and insurance tools analyzed, although considered important, have very little effect on the overall utility of the producers. Over 200 years would be required in order for the effects of alternative risk management strategies to have a statistically significant effect on the utility level of a risk averse producer. Thus, the importance of choosing among the operating strategies considered in this study to manage risk might be overemphasized.

References

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Table 1. Hog enterprise strategy, means, standard deviations, rankings and value at risk for 1999.

Strategy	Mean	Standard Deviation	Coefficient of Variation Ranking	Sharpe Ratio Ranking	5% Value at Risk	10% Value at Risk
Naïve	281387	78136	5	5	175161	188450
HF	280990	83824	6	6	164011	183526
HH	280053	55555	2	2	193464	206793
HO	278840	66338	3	3	185814	197623
HF HO	278443	70498	4	4	180900	193703
HF HH	279656	55307	1	1	196250	203862

Table 2. Diversified crop/hog enterprise strategy, means, standard deviations, and rankings for 1999.

Strategy	Mean	Standard Deviation	Coefficient of Variation Ranking	Sharpe Ratio Ranking	5% Value at Risk	10% Value at Risk
Naïve	588696	104661	20	19	438826	460849
APH	581983	103685	21	20	434612	457356
CRC	579828	102560	19	21	436327	457515
GRP	584779	104142	22	22	432175	455271
HF	588299	111876	23	23	423479	454616
HO	586150	93084	14	13	446350	473880
HH	587363	77225	6	3	460997	487826
HC	587154	82226	10	8	454482	482762
CO	585318	97911	16	15	444985	467541
AHP HC	580441	80773	9	10	450846	477034
AHP CO	578605	96781	15	17	441403	464031
GRP HC	580237	81317	11	11	449280	475479
GRP CO	578401	97273	17	18	438206	462586
APH HO	579437	91905	13	14	444364	470008
APH HH	580650	75730	5	5	458409	483210
HC HH	585820	75613	3	2	463907	486646
HC HF	586757	85242	12	12	451823	479460
HF HH	586966	81101	8	7	460759	481636
HF HO	585753	99373	18	16	441289	466384
APH HC HH	579108	73859	2	4	473018	504011
APH HC HO	577895	75098	4	6	458371	490065
APH HC HH HF	578711	70869	1	1	457672	497778
CRC HF HH	578098	78746	7	9	458261	478302