Rankings of Risk Management Strategies
Combining Crop Insurance Products
and Marketing Positions

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Abstract

Farmers can choose from a wide selection of crop insurance products and marketing strategies. Combinations of these risk management tools have varying effects on the user's risk environment. Nine risk management strategies are ranked for their impacts on average returns, certainty equivalent returns, and risk premiums. The analysis is conducted using historical price and yield data for 1976 to 1999 in five Iowa counties. The results show the benefits of crop insurance in reducing revenue risk. Also, given that the producer will forward contract some of his or her crop, the combination of E-Markets' Decision Rules for Contracts (DRC) pricing tool and Crop Revenue Coverage (CRC) crop insurance receives the highest ranking.

RANKINGS OF RISK MANAGEMENT STRATEGIES COMBINING CROP INSURANCE PRODUCTS AND MARKETING POSITIONS

Farmers have a broad array of crop insurance products and innovative marketing strategies from which to choose. The vast array of choices can lead to confusion. The new crop insurance products and marketing strategies work in ways that are often poorly understood by both lay farmers and their advisors. This lack of understanding is a result of the complex interactions that can occur when crop insurance products are combined with marketing strategies. For example, a farmer that hedges 75 percent of expected production but does not buy crop insurance faces a far different risk environment than one who does buy crop insurance. Figure 1 displays an example of these different risk environments. It shows the distribution of revenues for a Boone County, Iowa, corn farm under three different risk management strategies. The three strategies are as follows:

1. Sell at harvest with no futures hedging or crop insurance (referred to as "Cash");

2. Sell at harvest with 75 percent of expected production hedged on the futures market, but no crop insurance (referred to as "Hedge"); and

3. Sell at harvest with a 75 percent hedge and a 75 percent Crop Revenue Coverage (CRC) crop insurance policy (referred to as "Hedge+CRC").

The graph shows that as components are added to the risk management strategy (moving from strategy 1 to strategy 2, then strategy 3), the probability of low revenues falls while the probability of mid-range revenues rises.

There is a need for an objective analysis of the risk management benefits that arise under different combinations of crop insurance products and marketing strategies. This analysis is needed by farmers as well as by the insurance and brokerage industries to help both buyers and sellers better understand farm-level risks under various combinations of risk management strategies.
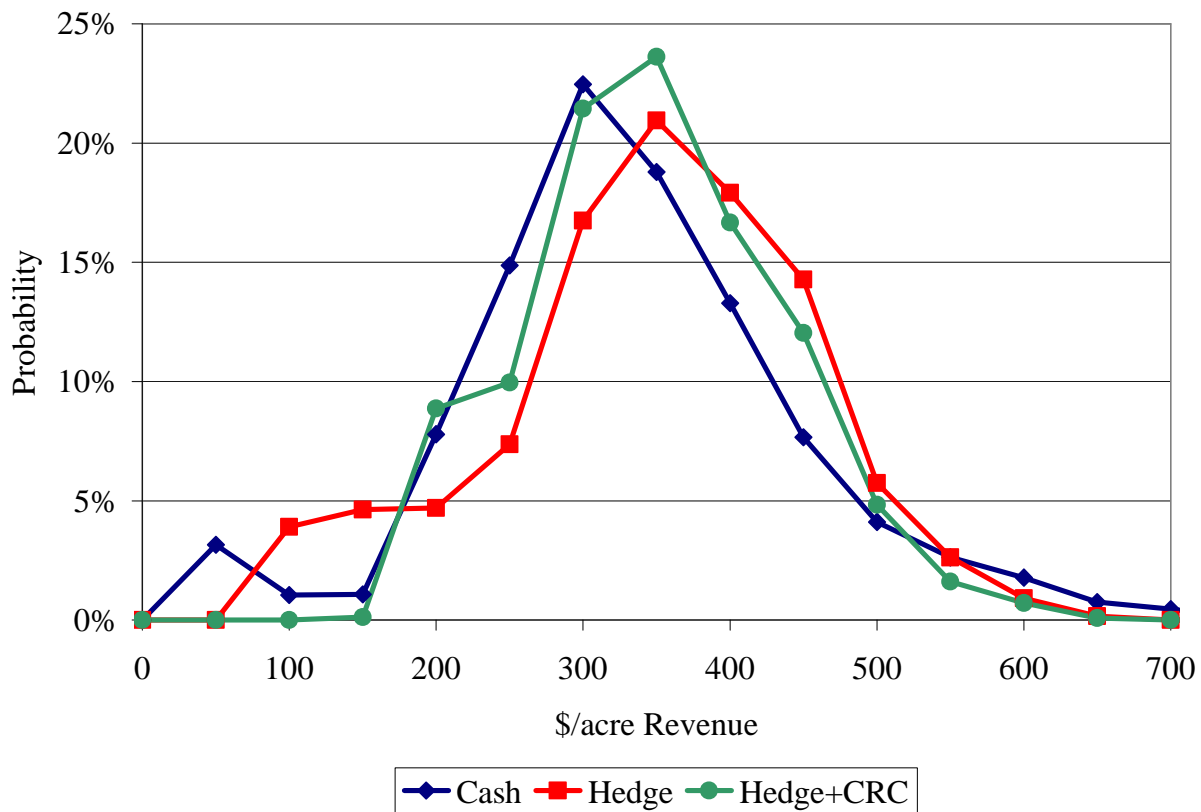
FIGURE 1. **Boone County, Iowa, corn farm revenue distributions**

Possible Techniques

There are two basic methods that can be used to determine the risk management benefits of alternative strategies. The first is to conduct a historical analysis and determine how a given strategy would have performed had it been employed in the past. Past prices and yields would be used to simulate the revenue outcomes that would have occurred on a number of farms in a number of counties under the alternative strategies. Each strategy would be ranked according to the risk management benefits that occur, on average, across all farms. A fundamental weakness with using history as a guide to determining the potential benefits of risk management strategies that will be used in the future is that we know that the distribution of future yields and prices will be different than the distribution of past yields and prices. This weakness is particularly important for

yields if a short time span is used to estimate the yield distribution. And one can always find price strategies that would have performed well in the past. But that is no guarantee that they work well in the future.

The second method would be to conduct a forward-looking analysis by simulating what the risk management benefits would be if a farmer used alternative combinations of crop insurance products and marketing strategies in the future. This forward-looking analysis would be conducted using Monte Carlo simulation techniques to obtain yield and price draws from appropriate distributions and by using these draws to evaluate the performance of the different strategies. The advantage of this type of analysis is that it is free from the criticism that the data were "mined" to find an appropriate strategy or advantageous time period. The price distributions could be obtained from the futures and options markets, and the yield distributions could be estimated from historical yields.

Ideally, both methods would be used to conduct this analysis. The historical analysis is relatively easy to implement and it provides valuable insight into how different combinations of crop insurance products and marketing strategies complement or substitute for each other. The historical method also provides at least some guidance as to the relative benefits of alternative combinations. The disadvantage of the forward-looking analysis is that it is relatively difficult to implement, especially if daily price movements have to be evaluated.

We have been asked to examine various risk management strategies combining crop insurance policies, futures hedging, and E-Markets' Decision Rules for Contracts (DRC) pricing tools. Given the time frame for the analysis, we chose to conduct only the historical analysis at this time. If the opportunity arises, we will pursue the forward-looking analysis at a later date. First, we examine the Value at Risk (VAR) curves under each of the strategies. Next, three sets of rankings are created. They are based on average returns, certainty equivalent returns (CERs), and risk premiums. The average returns rankings look only at the average return under each strategy. The rankings based on CERs and risk premiums take the riskiness of each strategy into account. The CER rankings still depend on the average returns of the strategies, while the risk premium rankings can be thought of as independent from the average returns of the strategies.

Therefore, the risk premium rankings adjust somewhat for the fact that history randomly favors some strategies over others.

Details of Historical Analysis

The historical analysis is conducted over the period 1976 to 1999. The risk management benefits of alternative combinations of crop insurance products and marketing strategies are evaluated for 100 corn farms in each of five Iowa counties. The five counties are Boone, Cass, Sioux, Washington, and Wright. These counties have different historical price-yield correlations and yield risks.

Lack of adequate farm-level data necessitates that yields on the 100 farms in each county be simulated. The simulations are done such that for each year the average yield across the 100 farms equals the county average yield. The county average yields have been scaled so that the trend yield is the same for each year in the study. This maintains yield fluctuations around trend while balancing the effects of trend yields over time. If this scaling were not performed, then the more recent observations would carry more weight in the analysis since yields are trending upward. The amount of farm yield variability is calibrated so that the average indemnity paid from yield insurance at the 65 percent level from 1976 to 1999 across all farms is equal to the crop insurance premium for a farm with an actual production history yield equal to the scaled county average from 1976 to 1999. The prices used in the analysis are the actual historical prices.

Nine risk management strategies have been chosen for the analysis. (We use short, descriptive names to refer to the strategies. These names follow their descriptions below.) They are as follows:

1. Sell at harvest with no crop insurance ("Cash"),
2. Sell at harvest and purchase 75 percent Crop Revenue Coverage ("Cash+CRC"),
3. Sell at harvest and purchase 75 percent Revenue Assurance (RA) policy ("Cash+RA"),
4. Use DRC from March 15 to November 30 with no crop insurance ("DRC"),
5. Use DRC from March 15 to November 30 and purchase CRC ("DRC+CRC"),
6. Use DRC from March 15 to November 30 and purchase RA ("DRC+RA"),

7. Use futures hedge from March 15 to November 30 with no crop insurance ("Hedge"),

8. Use futures hedge from March 15 to November 30 and purchase CRC ("Hedge+CRC"), and

9. Use futures hedge from March 15 to November 30 and purchase RA ("Hedge+RA").

There are actually five tools in the DRC set. We examine one of these tools, the Market Index Forward. The Market Index Forward is a forward contracting tool that prices grain at the average price over the time period the tool is used. In our case, the DRC position prices grain at the average market price from March 15 to November 30 on the Chicago Board of Trade (CBOT) December corn futures contract. The Market Index Forward allows producers to choose the time period over which prices are averaged. For the current analysis, the specific dates are chosen to align the time periods for the crop insurance products and the DRC- Market Index Forward tool. The hedge and sale prices are also derived from the March 15 and November 30 prices on the CBOT December corn futures contract.

Figure 2 shows the paths for the March 15, November 30, and DRC prices over the period. On average, the March 15 price exceeded the November 30 price by 14 cents per bushel, while the DRC price was 8 cents per bushel higher. The efficient market hypothesis indicates that such differences should not be expected in the future. The historical analysis is predicated on the levels and timing of the prices; thus, the strategies involving DRC and hedging have an expected return advantage over harvest sales. Different timing on the placement and removal of the hedge or the timing of the DRC tool would possibly lead to different results.

Value at Risk Curves

The Value at Risk (VAR) curves show the probability that returns fall below a given level. For our analysis, we have computed the returns under each strategy for the 2,400 observations (24 years for 100 farms) for each county. The probability that returns fall below a given level is computed as the number of observations that the strategy returns
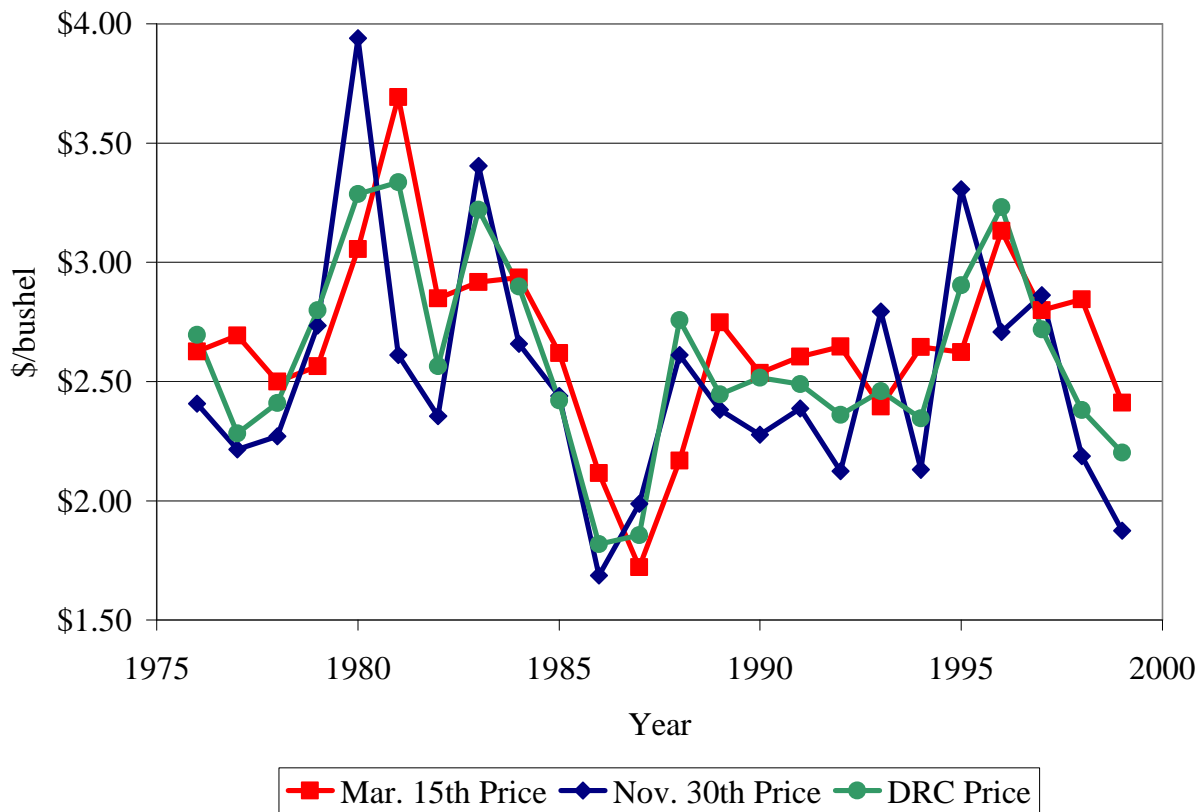
FIGURE 2. Market price paths

fall below the level divided by 2,400. Figures 3 to 7 show the VAR curves for the counties. The graphs are set to look at returns below $200 per acre. The curves show that the addition of crop insurance to a risk management strategy lowers the probability that returns are below $100 per acre. In four of the counties, there is roughly a 5 percent chance that returns are below $100 per acre when following the Cash, Hedge, or DRC strategies. When crop insurance is added to any of these strategies, the chance lowers to nearly zero. The exception is in Washington County. The three non-crop insurance strategies carry a 5 percent chance that returns are below $100 per acre. Adding crop insurance here lowers the chance to zero in most cases, except for the Hedge+RA strategy, which still has a 5 percent chance that returns are below $100 per acre.

At a $200 per acre threshold, there are several more differences among the county results. Boone County corn farmers face the lowest probabilities of returns below $200

FIGURE 3. Boone County VAR curves
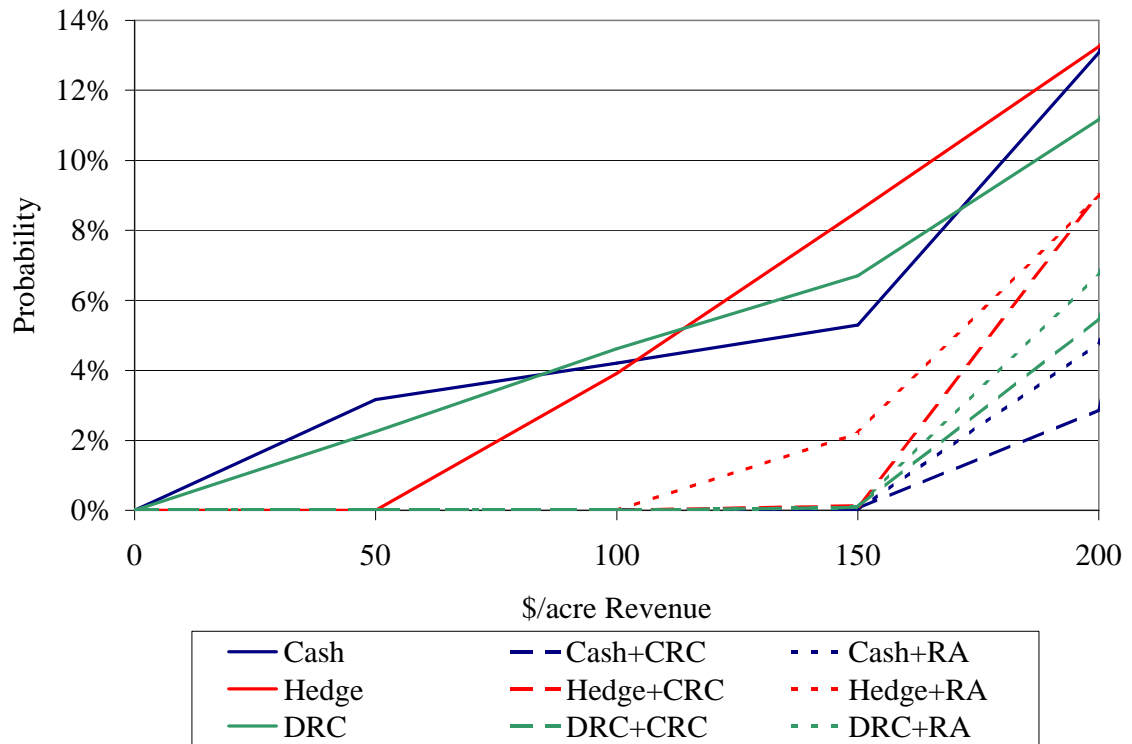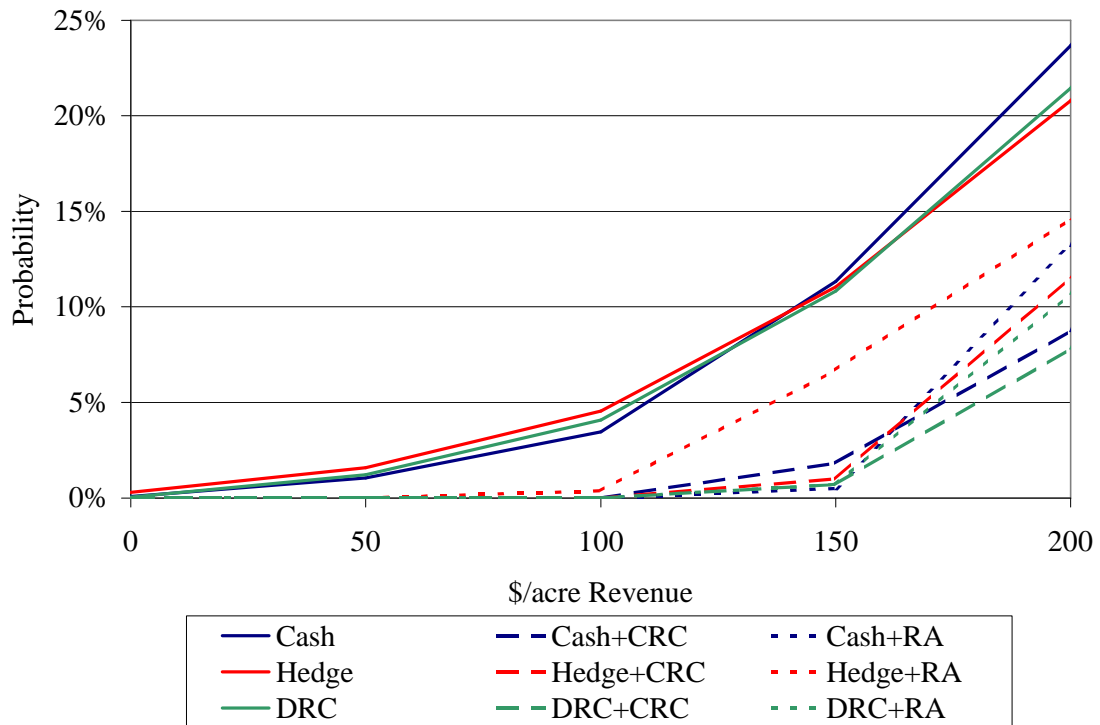

FIGURE 4. Cass County VAR curves
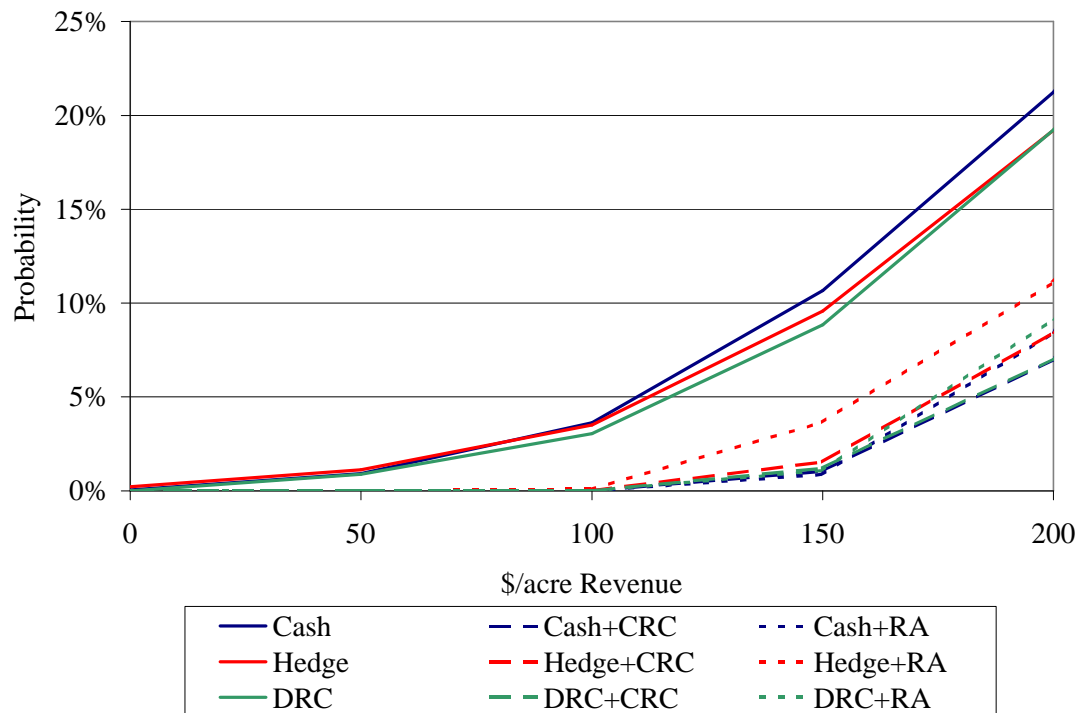
FIGURE 5. Sioux County VAR curves
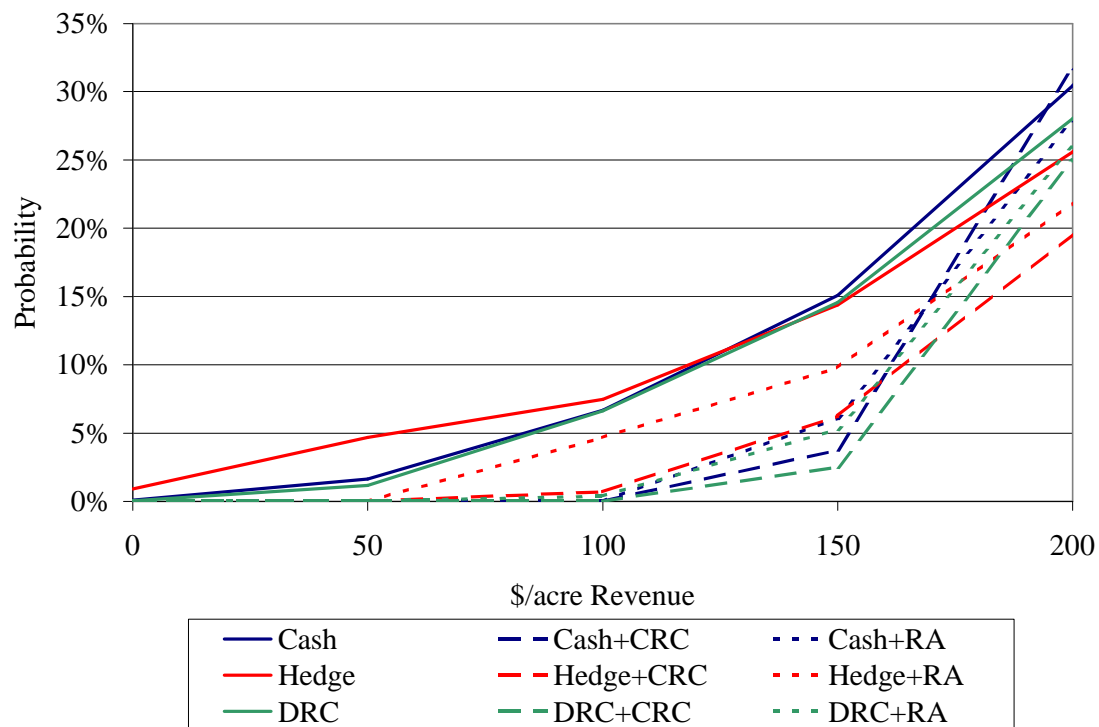
FIGURE 6. Washington County VAR curves
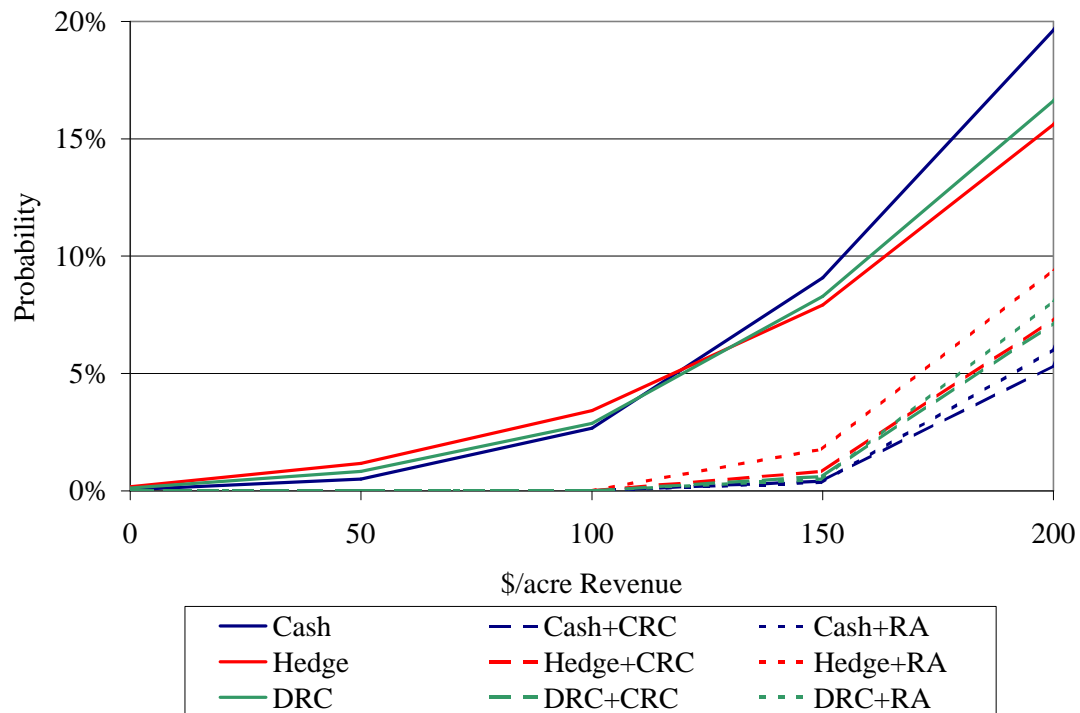
FIGURE 7. Wright County VAR curves

per acre with a range between 2.5 to 13 percent. Washington County corn farmers face the highest with a range between 19 to 32 percent. Most of this difference is due to the difference in average county yields. Boone County has an average corn yield of 143 bushels per acre, while Washington County has an average of 125 bushels per acre. In all of the counties except Washington, the strategies with crop insurance perform better in avoiding low returns than the strategies without crop insurance. Also, the graphs show that as the target return changes, the ordering of the strategies changes. At the $100 per acre target in Wright County, the Hedge strategy, followed by the DRC and Cash strategies, has the highest probability of having lower returns. At the $200 per acre target, the Cash strategy has the highest, followed by DRC and Hedge.

Average Return Rankings

Table 1 has the rankings based on the per acre average returns for each strategy for each county. The values for the average returns, CERs, and risk premiums are given in

TABLE 1. Rankings based on average returns

Rank	Boone	Cass	Sioux	Washington	Wright
1	Hedge+RA	Hedge+RA	Hedge+RA	Hedge+RA	Hedge+RA
2	Hedge+CRC	Hedge+CRC	Hedge+CRC	Hedge+CRC	Hedge+CRC
3	Hedge	DRC+RA	DRC+RA	Hedge	DRC+RA
4	DRC+RA	DRC+CRC	DRC+CRC	DRC+RA	DRC+CRC
5	DRC+CRC	Hedge	Hedge	DRC+CRC	Hedge
6	DRC	DRC	Cash+RA	DRC	DRC
7	Cash+RA	Cash+RA	DRC	Cash+RA	Cash+RA
8	Cash+CRC	Cash+CRC	Cash+CRC	Cash+CRC	Cash+CRC
9	Cash	Cash	Cash	Cash	Cash

Table A.1. Average returns ranged from $310.23 under the Cash strategy in Washington County to $382.19 under the Hedge+RA strategy in Wright County. As can be seen, the rankings are very similar across counties. This is expected since the same prices are used for each county. Thus, the differences in ranking follow from the timing and size of yield events in the county. Boone and Washington counties have the same rankings, as do Cass and Wright counties. The general pattern is for the strategies involving hedging to be ranked higher, followed by the DRC and harvest sale strategies. This pattern follows the price averages discussed above. Also, strategies involving RA and CRC are ranked higher than strategies with no crop insurance. The premium subsidies on the crop insurance products drive this result. Average returns do not indicate the riskiness of the strategy. One way to examine the riskiness of the strategies is to look at the standard deviations of the returns. The standard deviation quantifies the spread among returns, a larger standard deviation indicating that returns are more variable. The standard deviations of returns reported in Table A.1 show that there is substantial riskiness involved in all of the strategies. The standard deviations range from $84.94 for Hedge+CRC in Boone County to $134.99 for Cash in Sioux County.

Certainty Equivalent Returns

Each of the risk management strategies will impact farmer welfare. Examining certainty equivalent returns (CERs) is one approach to explore the size of the impact. The CER represents the amount a person would take to avoid a certain risk. For example, if a person were given a choice between $10 for certain or a lottery with a 10 percent chance

of receiving $100 (and a 90 percent chance of receiving nothing) and chose the certain $10, then that person's CER for the risk in that lottery is less than or equal to $10. Different people have different CERs. Risk-loving people would require a larger certain amount (more than $10) to be persuaded not to choose the lottery. Risk-averse people would accept a smaller certain amount (less than $10) to be persuaded not to choose the lottery. Insurance is somewhat based on CERs. The insured is willing to pay a certain amount (the premium) to avoid the possibility of a larger loss. To examine the effects of the risk management strategies on farmer welfare, CERs with and without the strategies in place are computed.

To calculate CERs, risk preferences are assumed to be constant absolute risk aversion (CARA) in form and three levels of risk aversion are chosen. The form of the CARA utility function employed is

$$U(Y(R)) = 1 - \exp(-\lambda Y(R)). \tag{1}$$

where Y is the farmer's income, R is the farmer's revenue, and λ is the risk aversion coefficient. The farmer's expected utility over the revenue distribution,

$$\int_0^\infty (1 - \exp(-\lambda Y(R))) p(R) dR = E[U] \tag{2}$$

where p(R) represents the probability density function for revenue, which is required to calculate the CER. The definition of the CER is that it is the certain income that generated the same utility as the risky endeavor. Thus,

$$\int_0^\infty (1 - \exp(-\lambda Y(R))) p(R) dR = 1 - \exp(-\lambda CER) \tag{3}$$

which implies that

$$CER = -(\ln(1 - E[U]))/\lambda . \tag{4}$$

In each of the counties, the base strategy is assumed to be the Cash strategy. Revenue averages and standard deviations are reported in Table A.1. Risk aversion coefficients are set to achieve risk premiums of 10, 25, and 50 percent of the standard deviation of revenue. This range of risk premiums is chosen to cover plausible levels of risk aversion.

Table 2 displays the CER rankings for the various strategies in each county. At the 10 percent risk premium level, as with the average return rankings, strategies involving hedging are ranked higher than those with harvest sales or DRC, and strategies involving crop insurance are ranked higher than those without insurance. The rankings shift as the level of risk aversion increases. Over all of the counties at the 10 percent risk premium level, Hedge+RA has the highest CER, followed by Hedge+CRC, DRC+RA, and DRC+CRC. At the 50 percent risk premium level, Hedge+CRC has the highest CER, followed by DRC+CRC, DRC+RA, and Hedge+RA. The strategies with crop insurance have CER values $30 to $40 higher than the strategies without crop insurance at the 50

TABLE 2. Rankings based on Certainty Equivalent Returns

Rank	CER Rankings with Risk Premiums at			CER Rankings with Risk Premiums at		
	10%	25%	50%	10%	25%	50%
	Boone County			**Cass County**		
1	Hedge+RA	Hedge+CRC	Hedge+CRC	Hedge+RA	Hedge+CRC	Hedge+CRC
2	Hedge+CRC	Hedge+RA	DRC+CRC	Hedge+CRC	Hedge+RA	DRC+CRC
3	DRC+RA	DRC+RA	DRC+RA	DRC+RA	DRC+CRC	DRC+RA
4	Hedge	DRC+CRC	Hedge+RA	DRC+CRC	DRC+RA	Hedge+RA
5	DRC+CRC	Hedge	Cash+CRC	Hedge	Cash+RA	Cash+CRC
6	DRC	Cash+RA	Cash+RA	Cash+RA	Cash+CRC	Cash+RA
7	Cash+RA	Cash+CRC	Hedge	Cash+CRC	Hedge	Hedge
8	Cash+CRC	DRC	DRC	DRC	DRC	DRC
9	Cash	Cash	Cash	Cash	Cash	Cash
	Sioux County			**Washington County**		
1	Hedge+RA	Hedge+CRC	Hedge+CRC	Hedge+CRC	Hedge+CRC	Hedge+CRC
2	Hedge+CRC	Hedge+RA	DRC+CRC	Hedge+RA	Hedge+RA	DRC+CRC
3	DRC+RA	DRC+RA	DRC+RA	DRC+CRC	DRC+CRC	DRC+RA
4	DRC+CRC	DRC+CRC	Hedge+RA	DRC+RA	DRC+RA	Cash+CRC
5	Hedge	Cash+RA	Cash+CRC	Hedge	Cash+CRC	Hedge+RA
6	Cash+RA	Cash+CRC	Cash+RA	DRC	Cash+RA	Cash+RA
7	Cash+CRC	Hedge	Hedge	Cash+RA	Hedge	DRC
8	DRC	DRC	DRC	Cash+CRC	DRC	Cash
9	Cash	Cash	Cash	Cash	Cash	Hedge
	Wright County					
1	Hedge+RA	Hedge+CRC	Hedge+CRC			
2	Hedge+CRC	Hedge+RA	DRC+CRC			
3	DRC+RA	DRC+CRC	Hedge+RA			
4	DRC+CRC	DRC+RA	DRC+RA			
5	Hedge	Cash+RA	Cash+CRC			
6	Cash+RA	Cash+CRC	Cash+RA			
7	Cash+CRC	Hedge	Hedge			
8	DRC	DRC	DRC			
9	Cash	Cash	Cash			

percent risk premium level. These differences shrink to $3 to $4 at the 10 percent risk premium level. One of the disadvantages of using CERs in this type of analysis is that the results are affected by differences in the average returns. In this case, because the prices for hedging and DRC are on average higher than the harvest price, strategies involving hedging and DRC have an advantage based on this historical relationship. The efficient market hypothesis indicates that these three prices should have the same average (assuming no other additional information is known at the time). Thus, a forward-looking analysis might have different results.

Risk Premiums

One way to remove the average returns effect is to examine the results based on risk premiums, instead of the CERs. Risk premiums are not affected by differences in average returns (i.e., they are not affected by the addition or subtraction of a constant to the returns). To see this, examine one formula for the risk premium. The risk premium for a strategy is equal to the difference between the average return under the strategy and the CER for the strategy. Adding $10 to every return would add $10 to both the average return and the CER, but the risk premium would not change.

Table 3 displays the strategy rankings by the risk premiums. For these rankings, lower-risk premiums receive higher rankings. Strategies involving crop insurance are still ranked higher than those without insurance. However, strategies involving hedging are now ranked lower than those with harvest sales or DRC. The rankings shift as the level of risk aversion increases, but the shifts are not as numerous. Over all of the counties at the 10 percent risk premium level, DRC+CRC has the lowest risk premium, followed by Cash+CRC, Hedge+CRC, DRC+RA, Cash+RA, Hedge+RA, DRC, Cash, and Hedge. At the 50 percent risk premium level, Cash+CRC has the lowest risk premium, followed by DRC+CRC, Cash+RA, Hedge+CRC, DRC+RA, Hedge+RA, Cash, DRC, and Hedge.

TABLE 3. Rankings based on risk premiums

Rank	Risk Premium Rankings with Risk Premiums at			Risk Premium Rankings with Risk Premiums at		
	10%	25%	50%	10%	25%	50%
	Boone County			**Cass County**		
1	DRC+CRC	DRC+CRC	DRC+CRC	Cash+CRC	Cash+CRC	Cash+CRC
2	Hedge+CRC	Hedge+CRC	Cash+CRC	DRC+CRC	DRC+CRC	DRC+CRC
3	DRC+RA	Cash+CRC	Cash+RA	Cash+RA	Cash+RA	Cash+RA
4	Cash+CRC	DRC+RA	Hedge+CRC	Hedge+CRC	Hedge+CRC	Hedge+CRC
5	Hedge+RA	Cash+RA	DRC+RA	DRC+RA	DRC+RA	DRC+RA
6	Cash+RA	Hedge+RA	Hedge+RA	Hedge+RA	Hedge+RA	Hedge+RA
7	Hedge	Hedge	Hedge	Cash	Cash	Cash
8	DRC	DRC	Cash	DRC	DRC	DRC
9	Cash	Cash	DRC	Hedge	Hedge	Hedge
	Sioux County			**Washington County**		
1	DRC+CRC	DRC+CRC	Cash+CRC	DRC+CRC	Cash+CRC	Cash+CRC
2	Cash+CRC	Cash+CRC	DRC+CRC	Cash+CRC	DRC+CRC	DRC+CRC
3	Hedge+CRC	DRC+RA	Cash+RA	Hedge+CRC	Cash+RA	Cash+RA
4	DRC+RA	Hedge+CRC	DRC+RA	Cash+RA	Hedge+CRC	Hedge+CRC
5	Cash+RA	Cash+RA	Hedge+CRC	DRC+RA	DRC+RA	DRC+RA
6	Hedge+RA	Hedge+RA	Hedge+RA	Hedge+RA	Hedge+RA	Hedge+RA
7	DRC	DRC	DRC	Cash	Cash	Cash
8	Cash	Cash	Cash	DRC	DRC	DRC
9	Hedge	Hedge	Hedge	Hedge	Hedge	Hedge
	Wright County					
1	DRC+CRC	DRC+CRC	Cash+CRC			
2	Hedge+CRC	Cash+CRC	DRC+CRC			
3	Cash+CRC	Hedge+CRC	Cash+RA			
4	DRC+RA	Cash+RA	Hedge+CRC			
5	Cash+RA	DRC+RA	DRC+RA			
6	Hedge+RA	Hedge+RA	Hedge+RA			
7	DRC	Cash	Cash			
8	Cash	DRC	DRC			
9	Hedge	Hedge	Hedge			

Discussion

This analysis confirms that the first step corn farmers should take to reduce risk is to buy crop insurance. Both RA and CRC dramatically reduce the probability that low revenue will occur.

If a farmer typically forward contracts then the results indicate that the appropriate crop insurance product to purchase is CRC because it pays out extra indemnities in years in which the hedging farmer does not have the bushels to deliver and price has increased.

Whether a farmer is better off hedging on the futures market or using a DRC offered by E-markets is less certain. This historical analysis indicates that a fixed rule of hedging on March 15 would yield a higher average return than the DRC, although there is no reason to believe that this would be the case in the future.

Adjusting for this average return advantage, the DRC and CRC strategy has a lower risk premium in all the scenarios examined. The dominance of this strategy is due to the decreased risk offered by the DRC relative to the hedge. As shown in Figure 1, the hedge has higher highs and lower lows than the DRC. Thus a risk-averse producer would prefer the DRC to a single hedge.

This analysis may also understate the advantage of DRC relative to the hedge because we assume that the hedge is put on in the same date each year (March 15) and not taken off until November 30 each year. In reality, hedgers will typically trade more often than this scenario, an activity that tends not to change average returns but increases risk.

Conclusions

This analysis ranks the performance of alternative risk management strategies, assuming that they were used over the period 1977 to 1999. The rankings are based on expected return, certainty equation return, and risk premium. The latter is most useful to adjust the historical pattern that late winter corn hedges would have yielded a higher harvest price than the DRC, which, in turn, would have yielded a higher harvest price than simply selling at harvest.

The results indicated that crop insurance is the best risk management tool available for crop farmers. If a farmer wants to market a crop before harvest, then the DRC-CRC combination would have provided the best risk management benefits.

An obvious extension of the analysis is to adopt the efficient market hypothesis and conduct a forward-looking analysis that would estimate the expected risk management benefit, rather than the historical risk management benefit. This would then lead to a ranking free of historical bias. But, of course, this prospective analysis would be valuable only to the extent that the efficient market hypothesis is valid.

Appendix

Risk Management Strategy Results

TABLE A.1. Per acre returns, CERs, and risk premiums

Strategy	Returns		CERs with Risk Premiums at			Risk Premiums at		
	Average	Std Dev	10%	25%	50%	10%	25%	50%
Boone County								
Cash	$357.73	$112.67	$346.47	$329.26	$290.30	$11.26	$28.48	$67.44
Cash+CRC	$358.81	$91.97	$351.68	$342.27	$326.62	$7.13	$16.53	$32.19
Cash+RA	$361.07	$94.66	$353.49	$343.37	$326.18	$7.58	$17.70	$34.89
Hedge	$373.30	$105.29	$363.12	$346.58	$308.98	$10.17	$26.71	$64.31
Hedge+CRC	$374.37	$84.94	$367.98	$358.45	$339.26	$6.39	$15.92	$35.11
Hedge+RA	$376.64	$89.64	$369.43	$358.33	$334.43	$7.20	$18.31	$42.21
DRC	$366.86	$107.72	$356.26	$338.99	$297.59	$10.60	$27.88	$69.27
DRC+CRC	$367.94	$85.23	$361.64	$352.78	$336.66	$6.29	$15.16	$31.28
DRC+RA	$370.20	$88.77	$363.32	$353.45	$334.77	$6.88	$16.75	$35.43
Cass County								
Cash	$335.40	$114.01	$323.96	$307.14	$274.79	$11.44	$28.26	$60.61
Cash+CRC	$342.16	$91.05	$335.07	$325.37	$308.90	$7.09	$16.78	$33.26
Cash+RA	$343.41	$94.06	$335.84	$325.50	$308.00	$7.57	$17.91	$35.40
Hedge	$350.20	$119.43	$337.48	$318.15	$279.20	$12.72	$32.05	$71.00
Hedge+CRC	$356.95	$95.84	$349.02	$337.87	$318.00	$7.94	$19.09	$38.96
Hedge+RA	$358.21	$102.06	$349.10	$335.93	$311.30	$9.11	$22.27	$46.90
DRC	$344.08	$116.28	$332.09	$314.16	$278.78	$11.99	$29.92	$65.30
DRC+CRC	$350.84	$92.28	$343.53	$333.46	$316.16	$7.31	$17.37	$34.68
DRC+RA	$352.09	$97.10	$343.95	$332.59	$312.67	$8.14	$19.50	$39.41
Sioux County								
Cash	$355.21	$134.99	$342.22	$323.65	$290.74	$13.00	$31.57	$64.47
Cash+CRC	$362.43	$111.96	$353.75	$342.29	$324.55	$8.68	$20.14	$37.88
Cash+RA	$364.42	$114.59	$355.32	$343.26	$324.55	$9.10	$21.16	$39.88
Hedge	$370.73	$133.84	$357.60	$337.75	$300.49	$13.13	$32.98	$70.24
Hedge+CRC	$377.94	$110.50	$369.21	$356.79	$335.50	$8.73	$21.16	$42.45
Hedge+RA	$379.94	$115.60	$370.30	$356.27	$331.28	$9.64	$23.67	$48.66
DRC	$364.32	$131.05	$351.88	$333.57	$300.24	$12.44	$30.75	$64.08
DRC+CRC	$371.53	$107.89	$363.32	$352.02	$333.62	$8.21	$19.51	$37.91
DRC+RA	$373.53	$111.72	$364.68	$352.39	$332.06	$8.84	$21.14	$41.47

TABLE A.1. Continued

Strategy	Returns		CERs with Risk Premiums at			Risk Premiums at		
	Average	Std Dev	10%	25%	50%	10%	25%	50%
			Washington County					
Cash	$310.23	$115.18	$298.89	$283.13	$254.74	$11.34	$27.10	$55.48
Cash+CRC	$313.89	$94.71	$306.48	$297.05	$282.37	$7.41	$16.85	$31.52
Cash+RA	$314.73	$98.83	$306.64	$296.25	$279.99	$8.10	$18.48	$34.75
Hedge	$323.85	$119.80	$310.98	$291.09	$250.30	$12.87	$32.76	$73.55
Hedge+CRC	$327.52	$94.90	$319.78	$309.02	$290.27	$7.74	$18.50	$37.24
Hedge+RA	$328.36	$102.44	$319.21	$306.06	$281.87	$9.14	$22.30	$46.48
DRC	$318.22	$114.39	$306.80	$290.32	$259.98	$11.42	$27.90	$58.24
DRC+CRC	$321.89	$92.52	$314.65	$304.98	$289.15	$7.24	$16.91	$32.74
DRC+RA	$322.73	$97.92	$314.57	$303.54	$285.24	$8.15	$19.18	$37.49
			Wright County					
Cash	$358.57	$127.49	$346.12	$328.54	$296.15	$12.45	$30.03	$62.43
Cash+CRC	$365.10	$106.12	$356.72	$345.73	$328.01	$8.38	$19.37	$37.10
Cash+RA	$366.52	$108.53	$357.75	$346.23	$327.67	$8.77	$20.29	$38.85
Hedge	$374.25	$127.23	$361.55	$342.62	$304.80	$12.69	$31.63	$69.45
Hedge+CRC	$380.78	$104.89	$372.40	$360.82	$340.50	$8.38	$19.96	$40.28
Hedge+RA	$382.19	$109.74	$372.94	$359.85	$335.85	$9.25	$22.35	$46.34
DRC	$367.77	$126.29	$355.36	$337.20	$302.04	$12.41	$30.56	$65.72
DRC+CRC	$374.30	$103.68	$366.19	$355.24	$336.86	$8.11	$19.06	$37.43
DRC+RA	$375.72	$107.46	$366.96	$354.99	$334.47	$8.75	$20.72	$41.24