ALTERNATIVE MARKETING STRATEGIES FOR FEEDER PIG FINISHERS:
FUTURES, OPTIONS, AND SIMPLE DECISION RULES

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Swine producers wishing to manage price risk or enhance their returns have available to them a wide range of marketing alternatives. These alternatives include, but are not limited to, futures contracts and options on futures contracts. Strategies incorporating these tools vary in complexity and expected outcome. Producers that have mastered the mechanics of these tools well enough to overcome the fear of using them are curious as to how each alternative fits into a strategic marketing plan. This paper will compare the effectiveness of several simple, but commonly used, option and hedging strategies for a hog finishing operation over a five-year period and summarize the results.

The example used for demonstration here is a special case of a feeder pig finisher who buys feeder pigs and sells finished hogs the first week of each month. It is analogous to a farrow to finish producer that farrows monthly and assumes that the cost of the pigs placed in the finishing barn is the opportunity cost of not selling the pigs as feeders. The data include 60 placement months, beginning with placement of pigs the first week of January 1986 and ending with hogs placed December 1990 that were sold the first week of April 1991.

Prices for inputs were set at placement time and were based on USDA cost of production series for a Corn Belt hog finishing operation (USDA, ERS). The exceptions were the feeder pig and finished hog prices. The Sioux Falls, South Dakota 40-50 pound feeder pig price and the Interior Iowa - Southern Minnesota U.S. 1-2 240-250 pound barrows and gilts price were used in the
2

Beginning with the April 1991 live hog contract, the size is 40,000 pounds or approximately 150 head of hogs.

For convenience, it is assumed that the producer is able to match production perfectly with contract size, i.e., sell exactly 30,000 pounds\(^1\) of hogs at one time to match a Chicago Mercantile Exchange (CME) contract. By doing so, all costs and returns can easily be reported in dollars per hundredweight ($/cwt.). The Wednesday closing quotations for CME live hog futures prices and options premiums were used. Cash prices are weekly average prices reported in *Livestock, Meat and Wool, Market News* (USDA, AMS). Basis estimates are a five-year rolling average for the first week of each month.

In this simplified example, the producer is assumed to place pigs the first Wednesday of the month and make a marketing decision based on observed market conditions. Unlike the real marketing world, the producer is assumed to maintain the original marketing decision for the entire feeding period and does not re-evaluate it each day. In addition, production (average daily gain, feed efficiency, and death loss) and input prices were assumed to be known at placement and, therefore, actual cost of gain (COG) equals projected COG.

However, even in this simplified example, futures and options strategies can be compared to each other and to the cash market. Several strategies were compared over the five-year period ranging from the simple to the

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\(^1\) Beginning with the April 1991 live hog contract, the size is 40,000 pounds or approximately 150 head of hogs.
complex. First, simple "no decision" strategies were compared. That is, no
decision is made but, rather, the same strategy is followed for every group of
hogs. Second, simple decision rules are established and followed that allow the
producer to make a decision at placement time based on an observed economic
factor (e.g., futures price or expected profit). Finally, a slightly more complex set
of decision rules are used to choose a marketing strategy. These decision rules
incorporated production costs, price objectives, price forecasts, risk objectives,
and an estimate of probable price outcomes into the decision. A complete
description of the marketing strategies and decision rules is given below.

Alternative marketing strategies

As mentioned earlier, all placement and marketing decisions are made on
Wednesday of the first week of the month. Futures prices are the Wednesday
closing price, cash prices are the weekly average price for that week. The basis
estimate is the five-year rolling average basis for each week, defined as the
weekly average cash price minus the weekly average price of the nearby futures
month at delivery.

"No decision" strategies

CASH This strategy assumes that the producer makes no marketing
decision. Pigs are placed the first week of each month and are sold in the cash
market four months later. The futures and option market are not used, and pigs
are always placed.
HEDGE - The producer automatically hedges the hogs in the appropriate contract month on the day the pigs are placed. The hedge is lifted the day the hogs are sold in the cash market. No decision is made; pigs are always placed and hedged in the futures market at the current futures price, regardless of profit or loss potential.

Buy out-of-the-money put option - These two strategies assume that the producer automatically buys a put option that is either one strike out-of-the-money (OTM1P) or two strikes out-of-the-money (OTM2P). No placement or hedging decisions are made. Purchasing the put option to set a price floor does not consider cost of production, only the current futures price.

Buy in-the-money put option - These two strategies assume that the producer automatically buys a put option that is either one strike in-the-money (ITM1P) or two strikes in-the-money (ITM2P). No placement or hedging decisions are made. Purchasing the put option to set a price floor does not consider cost of production, only the current futures price.

Sell out-of-the-money call option - These two strategies assume that the producer automatically sells a call option that is either one strike out-of-the-money (OTM1C) or two strikes out-of-the-money (OTM2C). No placement or hedging decisions are made. Selling the call option does set a price ceiling and collect a premium, but does not consider cost of production, only the current futures price.
Simple decision strategies

Hedge if $E(hedge \ price) > KK$ - Although no placement decision is made under this strategy (EHPKK), the hedging decision does depend on the current market level. Hogs are hedged if the expected hedge price (futures price adjusted for expected basis at delivery) exceeds $KK/cwt., where KK = 50, 52. If the futures market does not offer an expected hedge price of $KK or more the pigs are placed and sold in the cash market. This simple, one variable decision criteria attempts to "take the top out of the market" by hedging only at historically high prices.

Hedge if $E(profits) > L$ - This hedging decision (EHRL) depends on the current futures price and cost of production. The pigs are placed every month regardless of profit potential, but are hedged only if the expected profits exceed $L per hundredweight, where L = 4, 6. This one variable decision criteria is a form of an objective based marketing decision in that the producer will accept a targeted net return, $L per cwt., if it is available.

Buy put option to cover direct cost - This strategy (DCPUT) assumes that producers place pigs if it is possible to buy a put option to cover their estimated direct costs of production. If a put option, net premium, and commission cannot be found that covers direct costs, the pigs are hedged in the futures market if the expected hedge price exceeds direct cost. If direct costs cannot be covered with a put option or futures hedge, pigs are not placed and the producer has a loss
equal to overhead cost.

**Seasonal price forecast decision rules** - Under this marketing strategy (SEASON), the producer always places feeder pigs but uses a simple seasonal price forecast to choose between cash, futures, and options markets. The decision is based on expected changes in the market rather than on cost of production. The rules were selected arbitrarily, but reflect the expected probability of price change given the relationship between the current futures price and the forecasted price. In general, if the observed futures price at placement is much greater than forecast, place a hedge (rule #1), if it is within the forecast range, buy a put option to protect against lower prices but take advantage of higher prices (rule #2); and if the futures price is much lower than forecast, stay in the cash market on the assumption that prices will likely increase closer to their seasonal levels (rule #3). The decision rules are simple and involve only the expected hedge price (EHP), the seasonal forecast price (SFP), and the standard deviation (SD) of the forecast:

1. If \( EHP > SFP + 2 \times SD \) then hedge in the futures market,
2. If \( SFP + 2 \times SD < EHP > SFP - 2 \times SD \) then buy put option to cover direct cost,
3. If \( EHP < SFP - 2 \times SD \) the stay in cash market.

The seasonal forecast uses a ratio of monthly price indices and the cash price observed at placement time. The monthly index is the month's average price for barrows and gilts at the seven terminal markets divided by the annual
average price. The monthly index is averaged over the previous five years for each month and is updated annually to forecast for the coming year. The actual forecast price is the observed cash price at placement multiplied by the ratio of index for the month the hogs will be sold and divided by the index for the placement month. The standard deviation of the forecast is the standard deviation of the five-year average. Table 2 lists the monthly index and standard deviation used to forecast prices for 1990, as well as the SFP, EHP, and resulting marketing decision.

**Objective based marketing plan** - This strategy incorporates production costs, current prices, price expectations, the producer’s risk preference, and the opportunity cost of the placement and marketing decision. The producer is assumed to develop and follow an objective based marketing plan (OBMP) that arrives at a decision that is a function of observed variables at placement time. While the other strategies are constrained to make no decision or only one or two choices, this strategy will choose whether or not to place pigs and which marketing strategy to employ. The specific OBMP considered in this analysis is described in detail in the next section.

Because producers may make demands on a marketing strategy, several different measurement criteria were used to compare the strategies. These measurements and comparisons are shown in Tables 3 and 4 and are the measurements taken over the entire 60 groups of hogs.
The average is the simple mean return per cwt. over all production, management, and marketing costs. The next measure is the standard deviation of the mean which is one measure of variability of returns. However, standard deviation measures both higher than average returns (the variability producers like) and below average returns (the variability producers do not like). This shortfall is particularly a problem when options are considered because they allow for higher returns while limiting lower returns. Therefore, the range of returns from minimum to maximum is also reported. This measure is of particular interest to those producers that can withstand a period of small or even slightly negative returns by accepting a lower return to labor and or management, but that cannot withstand a large sudden decline in returns. The final two measures also assess downside variability by reporting the percent of the sixty groups with a loss of $5 per cwt (overhead cost are $5 per cwt.) or more. The second measures the percent of groups that had negative returns of less than zero or revenue below total costs.

**Objective based marketing plan**

The OBMP should be tailored to each individual producer because each has different production costs, financial constraints, price objectives, and attitude toward risk. However, the key set of variables to consider is likely comparable for most producers. The OBMP selected here is arbitrary, but will serve as an example of how producers may construct their own.
The OBMP used in this analysis incorporates price and risk objectives set a priori by the producer, current market information about probable price changes, and available risk management tools to achieve the producer's objectives. The first step is to set price objectives based on the producer's expected cost of production given observed input prices at placement. Three price objectives were set. The first (P1) is equal to direct costs of production, the second (P2) equals total costs of production, and the third (P3) equals total costs plus $5/cwt.

Next, risk objectives are set. Two types of risks are addressed in this OBMP. The first is the risk of not covering direct costs of production, and is incorporated by placing a chance constraint on the probability of not achieving P1. Basically, this safety-first type constraint states that the producer wants to be, in this case, 80 percent sure that direct costs are covered. The second risk objective considered is the risk of foregoing higher prices by accepting one of the price objectives. In this example the producer does not want to give more than a 30 percent chance of higher prices if P3 is available.

The third step is to evaluate the opportunities and information provided by the market. The OPTIONS\textsuperscript{2} software program was used to access the probability of different price outcomes given observed market information. This software calculates the implied volatility of the futures price given option market

\footnote{OPTIONS software is available from the Distribution Center, Room 3 Coffey Hall, University of Minnesota, St. Paul, MN 55108.}
premiums, strike prices, interest rates, days to contract maturity, and the observed futures price. OPTIONS was run for each placement day and the probability of P1 and P3 were recorded.

The final step is to synthesize price and risk objectives, probable price outcomes generated by OPTIONS, and characteristics of alternative risk management tools into a set of decision rules. Although the following decision rules are somewhat arbitrary, they do incorporate observable market information and available management tools to achieve the producer's stated objectives.

1. If the probability that (P < P1) > 20 percent, then:
   (a) buy cheapest put option to achieve P1, else
   (b) hedge at the futures price, else
   (c) do not place pigs.

2. If probability (P > P3) < 30 percent, then:
   (a) sell highest premium call option to achieve P3.

3. If #1 is not violated and #2 is not possible, then:
   (a) place pigs, but stay in the cash market.

This three step procedure can easily be calculated by hand or with the aid of a microcomputer program. By using a microcomputer, more complex decision rules can be considered. For example, it may be possible to solve for the optimal strategy given the constrains imposed on the decision. Or, it's possible to generate a graphical comparison of simulated outcomes from alternative
strategies and allow the producer to choose among them. This type of software decision aids are feasible and practical, but beyond the scope of this paper.

Results

The results of the "no decision" strategies are summarized in Table 3. The CASH strategy, the most commonly used strategy by producers, had the highest average return and is used as the standard of comparison for the others. Simply staying in the cash market on every group of hogs provided the producer with the highest average return, $3.24/cwt. It also had a wide range of returns from minimum to maximum over the five years considered, $28.25/cwt. (Figure 1). Only 6.7 percent of the groups placed in the five year period produced returns of less than -$5.00/cwt, i.e., returns below direct costs. However, 38.3 percent failed to cover all costs. This strong showing by CASH supports the empirical evidence that most producers stay in the cash market and do not use futures or options. More than likely, it also reflects the strong cash market during the observation period, 1986-1990. Three of the years saw prices over $60/cwt and, in general, the futures market underestimated the cash market.

The HEDGE strategy generated the lowest average return (-$0.59) and had a smaller standard deviation than CASH. However, the minimum return was nearly as poor as CASH, suggesting that the large loss was either due to a wide negative basis or that the hedge price was less than the expected cost of gain at placement and the hogs were hedged anyway (Figure 2). While hedging did not
prevent losses from downward price variability, it did prevent higher returns from upward price movement. The maximum return, $10.71/cwt, was $7.68/cwt. lower than the maximum received in the cash market. HEDGE produced the highest percentage of losses and returns below -$5.00/cwt. However, hedging produced higher returns than CASH in 28 percent of the groups, suggesting that it still may be a useful marketing tool.

The six option strategies considered provided comparable average returns that are better than hedging but not as high as staying in the cash market. However, they do differ on the range of returns and performance relative to the cash market. Buying puts generates higher average and maximum returns than does selling calls, but selling calls provides a minimum that is two to three dollars higher than buying puts (Figure 3). In fact, buying puts to create a price floor produces the worst minimum return. Thus, price floors are susceptible to the same basis risk as the cash market plus the premium must be paid, making the loss even larger.

Buying puts that are either two strikes in-the-money (ITM2P) or two strikes out-of-the-money (OTM2P) generates similar results (Figure 4). The two strike strategies have higher average returns than buying puts that are one strike either in or out of the money (ITM1P and OTM1P, respectively). The ITM2P strategy has the highest average return of the options strategies, $2.51/cwt, compared to $2.22, $1.73, and $1.69 for the OTM2P, OTM1P, and
ITM1P strategies, respectively. The minimum returns range from -$10.51 to -$11.46/cwt while the maximum returns are $18.29/cwt except for OTM1P which is $16.84. The percent of groups with returns less than -$5.00 was more than double the percent for CASH, but less than the 20 percent resulting from HEDGE. The percent of time that buying one of the put options considered here produces a return greater than CASH is positively related to the strike price purchased. The OTM2P beats CASH 6.7 percent of the time while the ITM2P returns were higher than CASH for 23.3 percent of the groups.

Selling out-of-the-money call options (OTM1C and OTM2C) produces lower average returns than buying puts. Although selling calls limits the upside potential (maximum returns of $11.27 and $10.47 for OTM1C and OTM2C, respectively), it provides more downside protection than buying puts because the premiums collected were added to cash returns. OTM1C had the highest minimum return of any strategy considered, -$7.46 per cwt. Call strategies produce fewer returns, less than -$5.00 than did put strategies, but generally more losses. In addition, OTM1C and OTM2C generated returns greater than CASH in 50 and 55 percent of the groups, respectively. Strategies that employ simple decision rules were also considered and can be compared to the no decision strategies. These results are summarized in Table 4. Two decision rules place hedges depending on the expected hedge price or the expected hedge return over total cost. The second decision rule strategy uses a put
option or a futures contract hedge to cover direct cost of production (DCPUT). The third strategy is the seasonal forecast decision rules (SEASON), and the final strategy is the objective based marketing plan (OBMP).

Of the decision rule strategies, the selective hedging strategies, EHP50, EHP52, EHR4, and EHR6, produce the highest average returns. In fact, EHP52 and EHR6 returns exceed the average return of the CASH strategy, $3.27 and $3.36, compared to $3.24. However, the minimum and maximum returns and the percent of groups with returns less than -$5 are identical to each other and to CASH. The percent of groups with negative returns vary from 36.7 percent to 40 percent. These selection criteria trigger the decision to hedge in the futures market relatively few times, 18.3 percent for EHP50 to 5.0 percent for EHR6, and seldom produce returns greater than the CASH strategy. It is interesting to note that these strategies, by design, rely only on the cash and futures market and do not use options.

The final three strategies attempt to incorporate more information and more alternatives into the marketing decision. However, at least for the time period considered, the more encompassing decision rules produce lower average returns with comparable minimum and maximum returns.

The DCPUT strategy that purchases a put option to cover direct cost generates the second lowest average return behind HEDGE, has a minimum return only $0.17 higher than CASH and $4.69 below the direct cost it was
supposed to protect, and fails to cover direct cost 15 percent of the time. A portion of these disappointing results can be attributed to the contingency plan of hedging in the futures market if a put option, adjusted for premium, cannot be purchased to cover direct cost. Five of the 60 groups were hedged and in four months no pigs were placed because direct cost could not be hedged. The minimum return of -$9.69 results from a hedge in which the basis is $6.20 more negative than had been expected. Thus, at placement, a -$3.49 return is anticipated, $1.51 over direct costs, but a -$9.69 return is realized.

The seasonal forecast decision rule (SEASON) produced an average return of $2.31 and was comparable to alternative strategies by the other measures. SEASON attempts to out-forecast the futures market by basing marketing decisions on expected changes in futures prices regardless of production costs. As a result, 15 percent of groups fail to cover direct costs. This strategy is in the cash market 23.3 percent of the time and generated returns greater than CASH on 8.3 percent of the groups (Figure 1).

The objective based management plan (OBMP) as a set of decision rules provides an average return of $2. The minimum and maximum returns are identical to the CASH strategy, but it has slightly more groups with returns less than $0 and -$5 than does CASH. The OBMP holds a cash position on 18.3 percent of the groups but produces higher returns than CASH on a third of the groups (Figure 1). Although this strategy does produce some favorable
results, it is important to recognize that the outcomes are unique to the particular set of decisions chosen. Another set of decision criteria would have produced different outcomes.

One ailment that all of the strategies suffered from is basis risk. Futures contracts and options on futures contracts do nothing to reduce or eliminate basis risk. As Figure 5 shows, the Interior Iowa, Southern Minnesota basis for the first week of the month is quite variable for the time period considered. The five-year rolling average estimate of the basis used in this analysis underestimates the actual basis variability. Decisions based on the expected basis, therefore, may not produce the expected results. In particular, strategies using futures or options produces greater than expected losses due to a poorer than expected basis.

Another interesting question to consider is whether one strategy has an advantage over another during a particular time of the year. That is, is there a strategy of choice depending on the placement month? Although there are several measures by which to compare strategies, returns averaged over the five years for each placement month will be used as the yardstick here. If one strategy dominates the others, it can be evaluated by other measures before making a final decision.

The CASH strategy produces the highest over all returns, is the strategy of choice from November through April, and is slightly better than the others in
June (Figure 6). However, it is dominated by at least one strategy in the remaining months. Buying a put option that is two strikes-in-the-money produces higher returns for pigs placed in May and September (Figure 6). Selling a call option that is two strikes out-of-the-money produces the highest average returns in July, August, and October, although the results are nearly identical to the OBMP in those months (Figures 6 and 7). Notice that no strategy produces positive returns on average for pigs placed in August, and that buying a put two strikes in-the-money is the worst strategy in August even though it is the best one in May and September.

**Summary**

Alternative marketing strategies available to hog producers were compared for monthly placement of feeder pigs during the 1986-1990 time period. The analysis assumed that 45 pound feeder pigs were placed the first Wednesday of the month and were finished to 240 pounds and sold four months later on the first Wednesday of the month. Marketing decisions were made at placement and were not evaluate and/or changed during the feeding period. Production was assumed known and input cost were set at placement time

The results are likely dependent on the time period studied. Three of the five years (1986, 1987 and 1990) posted record or near record prices in the cash market. As a result, simply selling hogs in the cash market at slaughter produced average produced average returns that were exceeded only slightly by selective hedging strategies. Measures of downside risk (minimum return, frequency of returns below direct cost and frequency of negative return)
indicated that the cash marketing strategy is no worse than other more complicated strategies for protecting against downside risk.

Hedging strategies that used either futures or put options paled by comparison to the cash market in terms of average returns. In addition, these strategies also failed to prevent losses from declining prices as they are designed due primarily to basis variability. The continuous hedge strategy also may have hedged in a loss at placement time in addition to suffering an unfavorable basis change. Strategies that purchased a put option often resulted in losses larger than cash because a premium is paid in addition to a poor basis.

Option strategies that sold call options to collect premiums produced the highest minimum returns but also the lowest maximum returns. Selling call options generated lower average returns than buying put options, had a lower frequency of losses and returns less than direct costs, and a higher frequency of returns greater than the cash market.

Although the "no decision" strategies produced admirable results, an argument can still be made for strategies that incorporate additional information and actually make a marketing decision. These decisions were based either on the current futures price or expected returns from the decision. The selective hedging strategies seldom called for a hedge, but generated higher average returns than staying only in the cash market. The remaining measures were comparable, if not identical, because these strategies maintained a cash position on more than 80 percent of the groups.
The strategy to place feeder pigs only when a put option can be purchased or a futures hedge placed that covers direct cost produced relatively low average returns and a minimum and maximum comparable to the cash market strategy. It also had a relatively high frequency of negative returns. Particularly disappointing was the frequency of returns below direct costs as the strategy was designed to prevent such an event.

The strategy which employed a simple seasonal forecast of expected prices and compared the forecast to futures market prices worked well. Average returns were approximately a dollar lower than cash returns and the other measures were comparable to the cash strategy. Although the seasonal forecast does incorporate expected price changes, it does not account for production cost. Also, the results of this strategy are not strictly an indication of the validity of a seasonal forecast, but depend also on the rather arbitrary decision rules stemming from the forecast.

Likewise, the outcome of the objective based marketing plan are less of a reflection of the OPTIONS program and more of a result of the decision criteria selected. Average returns generated by this strategy were lower than the cash market, the top two option strategies, and the seasonal forecast, but higher than the others. In addition, minimum and maximum returns and frequency of unfavorable returns were comparable to the cash market. While this strategy maintained a cash position on only 18.3 percent of the groups, it produced
returns higher than the cash market on one third of all groups.

Although the cash market strategy generated the highest overall average returns, the preferred strategy appears to depend on placement month. Feeder pigs placed in the months November through April produced higher returns in the cash market. However, buying a put option that is two strikes in-the-money provided higher average returns for May and September placements. Selling a call option that is two strikes out-of-the-money and the objective based marketing plan had higher average returns in July, August, and October. These results suggest that producers who only place and sell hogs once or twice a year may benefit from some strategy other than the cash market depending on the placement month. Producers that are in the market every month and have their risks spread over time may prefer the cash strategy.

Ultimately, the strategy chosen depends upon the producer’s particular needs and the market environment at the time. This research suggests that while the cash market provided the highest average returns, other marketing and risk management tools can be beneficial if used properly and if the basis is adequately predicted. The "best" decision will likely change over time, underscoring the importance that producers actually make a decision on each group of animals rather than relying solely on the "no decision" strategy.
Table 1. Feeder Pig Finishing Budget and Example for December 1990

<table>
<thead>
<tr>
<th>Input</th>
<th>Per Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeder pig @ 45 lbs.</td>
<td></td>
<td>$53.00</td>
</tr>
<tr>
<td>Death loss</td>
<td>3.00%</td>
<td>1.59</td>
</tr>
<tr>
<td>Interest on pig (4 months)</td>
<td>11.87%</td>
<td>2.10</td>
</tr>
<tr>
<td>Corn 10.7 2 bu.</td>
<td>$2.18</td>
<td>23.33</td>
</tr>
<tr>
<td>Supplement 1.23 cwt.</td>
<td>15.00</td>
<td>18.45</td>
</tr>
<tr>
<td>Labor and management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2 * 1.3 hr * wage)</td>
<td>5.10</td>
<td>13.26</td>
</tr>
<tr>
<td>Trucking</td>
<td>3.00</td>
<td></td>
</tr>
<tr>
<td>Vet and medicine</td>
<td></td>
<td>3.05</td>
</tr>
<tr>
<td>Power and depreciation</td>
<td></td>
<td>7.44</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td>0.76</td>
</tr>
</tbody>
</table>

| Output                             |          |            |
| Market hog @ 240 lbs.              | 51.75    | 124.20     |
| Net return over all cost           |          | -1.78      |

* Livestock prices are from Livestock, Meat and Wool Market News; the feeder pig price is the Sioux Falls, S.D. 40-50 pound price; and the market hog price is the Interior Iowa Southern - Minnesota barrows and gilts U.S. 1-2, 240-250 pounds. Other input prices are from USDA budgets for Corn Belt hog finishing operations reported in the Livestock and Poultry Situation and Outlook Report.
Table 2. Seasonal Forecast Example for 1990

<table>
<thead>
<tr>
<th>Month</th>
<th>Index</th>
<th>SD</th>
<th>SFP</th>
<th>EHP</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>0.9332</td>
<td>0.0550</td>
<td>46.36</td>
<td>41.99</td>
<td>Buy put option</td>
</tr>
<tr>
<td>February</td>
<td>0.9405</td>
<td>0.0819</td>
<td>42.52</td>
<td>44.31</td>
<td>Buy put option</td>
</tr>
<tr>
<td>March</td>
<td>0.9186</td>
<td>0.0676</td>
<td>47.80</td>
<td>45.64</td>
<td>Buy put option</td>
</tr>
<tr>
<td>April</td>
<td>0.9222</td>
<td>0.0881</td>
<td>43.00</td>
<td>44.36</td>
<td>Buy put option</td>
</tr>
<tr>
<td>May</td>
<td>1.0459</td>
<td>0.0901</td>
<td>52.60</td>
<td>43.70</td>
<td>Buy put option</td>
</tr>
<tr>
<td>June</td>
<td>1.1058</td>
<td>0.0462</td>
<td>56.46</td>
<td>50.29</td>
<td>Stay in cash</td>
</tr>
<tr>
<td>July</td>
<td>1.1312</td>
<td>0.0546</td>
<td>62.72</td>
<td>56.47</td>
<td>Stay in cash</td>
</tr>
<tr>
<td>August</td>
<td>1.0722</td>
<td>0.1263</td>
<td>61.65</td>
<td>58.18</td>
<td>Buy put option</td>
</tr>
<tr>
<td>September</td>
<td>1.0443</td>
<td>0.0629</td>
<td>59.17</td>
<td>47.83</td>
<td>Buy put option</td>
</tr>
<tr>
<td>October</td>
<td>1.0097</td>
<td>0.0621</td>
<td>58.25</td>
<td>49.10</td>
<td>Buy put option</td>
</tr>
<tr>
<td>November</td>
<td>0.9276</td>
<td>0.1025</td>
<td>52.92</td>
<td>51.50</td>
<td>Buy put option</td>
</tr>
<tr>
<td>December</td>
<td>0.9488</td>
<td>0.1066</td>
<td>54.04</td>
<td>52.75</td>
<td>Buy put option</td>
</tr>
</tbody>
</table>

Index = Five-year average of monthly price relative to annual average price.
SD = Standard deviation of the index mean.
SFP = Seasonal forecast price.
EHP = Expected hedge price (futures + expected basis).
Table 3. Net Return Over Total Costs From "No Decision" Market Strategies

<table>
<thead>
<tr>
<th></th>
<th>CASH</th>
<th>HEDGE</th>
<th>OTM2P</th>
<th>OTM1P</th>
<th>ITM1P</th>
<th>ITM2P</th>
<th>OTM1C</th>
<th>OTM2C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average return</td>
<td>$ 3.24</td>
<td>$-0.59</td>
<td>$ 2.22</td>
<td>$ 1.73</td>
<td>$ 1.69</td>
<td>$ 2.51</td>
<td>$ 1.23</td>
<td>$ 1.66</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>6.71</td>
<td>4.69</td>
<td>6.78</td>
<td>6.71</td>
<td>6.75</td>
<td>6.54</td>
<td>4.37</td>
<td>4.49</td>
</tr>
<tr>
<td>Maximum return</td>
<td>18.39</td>
<td>10.71</td>
<td>18.29</td>
<td>16.84</td>
<td>18.29</td>
<td>18.29</td>
<td>11.27</td>
<td>10.47</td>
</tr>
</tbody>
</table>

Percent of groups with returns

<table>
<thead>
<tr>
<th></th>
<th>Less than -$5</th>
<th>Less than $0</th>
<th>Greater than cash only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6.7%</td>
<td>38.3%</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>20.0%</td>
<td>55.0%</td>
<td>28.0%</td>
</tr>
<tr>
<td></td>
<td>11.7%</td>
<td>38.3%</td>
<td>6.7%</td>
</tr>
<tr>
<td></td>
<td>13.3%</td>
<td>43.3%</td>
<td>10.0%</td>
</tr>
<tr>
<td></td>
<td>15.0%</td>
<td>41.7%</td>
<td>23.3%</td>
</tr>
<tr>
<td></td>
<td>10.0%</td>
<td>36.7%</td>
<td>50.0%</td>
</tr>
<tr>
<td></td>
<td>8.3%</td>
<td>45.0%</td>
<td>55.0%</td>
</tr>
<tr>
<td></td>
<td>6.7%</td>
<td>38.3%</td>
<td></td>
</tr>
</tbody>
</table>

OTMX Put = Buy a put option X strikes out of the money.
ITMX Put = Buy a put option X strikes in the money.
OTMX Call = Sell a call option X strikes out of the money.
Table 4. Net Return Over Total Costs From Simple Decision Rules Strategies

<table>
<thead>
<tr>
<th></th>
<th>EHP50</th>
<th>EHP52</th>
<th>EHR4</th>
<th>EHR6</th>
<th>DCPUT</th>
<th>SEASON</th>
<th>OBMP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average return</strong></td>
<td>$2.98</td>
<td>$3.27</td>
<td>$3.16</td>
<td>$3.36</td>
<td>$1.56</td>
<td>$2.21</td>
<td>$2.00</td>
</tr>
<tr>
<td><strong>Standard deviation</strong></td>
<td>6.58</td>
<td>6.70</td>
<td>6.80</td>
<td>6.77</td>
<td>6.33</td>
<td>6.62</td>
<td>6.25</td>
</tr>
<tr>
<td><strong>Maximum return</strong></td>
<td>18.39</td>
<td>18.39</td>
<td>18.39</td>
<td>18.39</td>
<td>17.17</td>
<td>17.17</td>
<td>18.17</td>
</tr>
</tbody>
</table>

Percent of groups with returns

<table>
<thead>
<tr>
<th></th>
<th>Less than -$5</th>
<th>Less than $0</th>
<th>Greater than cash only</th>
<th>Cash position (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EHPKK</strong></td>
<td>6.7%</td>
<td>36.7%</td>
<td>5.0%</td>
<td>81.7%</td>
</tr>
<tr>
<td><strong>EHRL</strong></td>
<td>6.7%</td>
<td>40.0%</td>
<td>3.3%</td>
<td>88.3%</td>
</tr>
<tr>
<td><strong>DCPUT</strong></td>
<td>6.7%</td>
<td>38.3%</td>
<td>3.3%</td>
<td>88.3%</td>
</tr>
<tr>
<td><strong>SEASON</strong></td>
<td>15.0%</td>
<td>45.0%</td>
<td>1.7%</td>
<td>95.0%</td>
</tr>
<tr>
<td><strong>OBMP</strong></td>
<td>8.3%</td>
<td>41.7%</td>
<td>16.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>8.3%</td>
<td>43.3%</td>
<td>23.3%</td>
<td>8.3%</td>
</tr>
<tr>
<td></td>
<td>18.3%</td>
<td></td>
<td>33.3%</td>
<td>18.3%</td>
</tr>
</tbody>
</table>

**EHPKK** = Hedge if the expected hedge price is greater than $KK.
**EHRL** = Hedge if the expected return is greater than $L.
**DCPUT** = Buy put to cover direct cost.
**SEASON** = Seasonal price forecast decision rule.
**OBMP** = Objective based marketing plan.