Factors Affecting Hedging Decisions

Using Evidence from the Cotton Industry

Olga Isengildina

and

M. Darren Hudson*

Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management
St. Louis, Missouri, April 23-24, 2001

*Post Doctoral Associate (Oisengildina@agecon.uga.edu), Department of Agricultural and Applied Economics, University of Georgia, and Assistant Professor (Hudson@agecon.msstate.edu), Department of Agricultural Economics, Mississippi State University

Factors Affecting Hedging Decisions Using Evidence from the Cotton Industry

Practitioner's Abstract

Few farmers utilize futures and options markets to price their crops despite significant educational efforts. This study seeks to analyze producer hedging behavior within the framework of the overall marketing behavior. Producer marketing behavior is modeled as a simultaneous choice between cash sales, cooperative marketing and forward contracts, and hedging. A multinomial logit model is used for empirical estimation using data from a survey administered to a sample of cotton producers from across the U.S. The most important factors that explain the use of forward pricing by cotton producers are producer preferences, farm size, use of crop insurance, risk aversion, income from government payments and off-farm income. Risk aversion, off-farm income, crop insurance and some producer perceptions are important in the choice of the form of forward pricing (direct hedging vs. cooperative marketing and forward contracts).

Keywords

Hedging behavior, futures hedging, indirect hedging, cotton marketing, multinomial logit model, marketing strategies

Introduction

U.S. farm commodity programs shifted course with the passage of the 1996 Federal Agriculture Improvement and Reform (FAIR) Act. The FAIR Act decreased much of the government's price support and exposed producers to a potentially greater degree of price risk than previously experienced. In the new risk management environment, Congress perceived a need to educate producers about various risk management tools. In 1998, the Risk Management Agency (RMA) funded over $3 million in educational grants to assist farmers and ranchers in becoming active risk managers (Ag. Fact Book, 1998). Despite significant efforts to educate farmers about risk management tools, few producers use these tools. Some recent surveys (Asplund, Forster, and Stout, 1989; and Goodwin and Schroeder, 1994) demonstrated that less than 10 percent of producers use hedging to manage their price risk (Table 1).

Previous studies outlined a number of factors that affect producers' hedging decisions. However, one limitation of the previous studies is that hedging was typically viewed in relative isolation and no account was taken of other marketing alternatives available to producers. That is, previous hedging studies typically viewed marketing as a dichotomy between cash sales and hedging with no consideration of alternative marketing methods. However, important countervailing forces may exist that affect the choice of a particular marketing strategy. That is, it may be argued that the choice of marketing strategy is not limited to the choice between

cash sales and forward pricing, but also includes the choice of the form in which forward pricing may take place. Producers may have significant motivations to use forward pricing. However, hedging with futures and options is not the only method of forward pricing. Other forms of forward pricing include forward contracting and marketing through pools. Substitution between alternative means of forward pricing may result in the lower use of hedging. Thus, it appears that the inclusion of the alternative marketing strategies may provide additional insight on producer hedging behavior.

The overall objective of this study is 1) to examine producer hedging behavior in the framework of their overall marketing behavior, 2) to determine the motivating factors in the choice of a primary marketing strategy by cotton producers, and 3) to identify the characteristics of cotton producers that are more likely to use direct hedging to forward price their crop. Marketing alternatives considered in this study include cash sales, indirect hedging and direct hedging. Cash sales consist of the transactions made in the cash market. Indirect hedging combines marketing through pools (cooperative marketing) and forward contracting. And direct hedging includes taking positions in the futures and/or options markets.

The remainder of the paper is organized as follows. The next section contains the conceptual framework, which includes the discussion of various marketing alternatives available to farmers, and factors that affect their marketing behavior. The research method used to analyze producer marketing behavior is addressed in the following section. Discussion of the data includes empirical evidence on the use of various marketing strategies based on the results of the producer survey conducted throughout cotton producing states. Finally, this paper presents the results of the analysis and concludes with possible implications and suggestions for future research.

Conceptual Framework

This study examines producer marketing behavior as producer's choice of a preferred marketing alternative, which is based on a set of producer characteristics:

$$\begin{aligned} \text{Choice} = f\,(&\text{Education, Training, RiskAversion, Leverage,} \\ &\text{Size, GovPayments, OffIncome, CrInsurance,} \\ &\text{Attitude1, Attitude2, Attitude3)} \end{aligned} \tag{1}$$

The dependent variable in this choice model reflects several marketing alternatives considered in this analysis: cash sales, cooperative marketing and forward pricing, and direct hedging. Selling a crop in the cash market is the most basic marketing tool available to farmers. This strategy is easy to use for producers and has significant liquidity advantages because the producer receives cash for his crop at the time of sale. However, marketing on a cash basis is often considered a risky alternative because a producer does not have any control over the market price and is fully exposed to market price changes that occur between the time of planting and sale. Alternatively, producers may use some form of forward pricing in order to

reduce their price risk exposure. Forms of forward pricing included in this analysis consist of forward contracting and marketing through pools (cooperatives) and hedging in the futures and options markets. Historically, these have been the most widely used forward pricing strategies; therefore, they should be representative of the marketing alternatives available to cotton producers.

Explanatory variables hypothesized to influence the choice of a primary marketing strategy may be summarized in three categories: (1) characteristics of the farm operator and the farm: operator's human capital, farm size and financial condition; (2) operator use of alternative risk-reduction techniques: diversification of farm enterprises, participation in government commodity programs, and the use of crop insurance; and (3) non-economic factors. The first set of determinants was advanced by the proponents of the technology adoption literature (Wozniak, 1984; Huffman, 1980; and Khaldi, 1975). Adoption theory is relevant for producer marketing decisions because the producer is faced with a choice of whether to use a conventional method of selling the crop in the cash market, or to adopt one of the alternative forward pricing techniques. Education and marketing-specific training are used as a proxy for human capital and innovative ability/willingness to adopt alternative marketing methods. Education and hours of marketing training are expected to be directly related to the use of forward pricing strategies because higher levels of human capital are likely to facilitate successful use of these instruments.

Level of risk aversion was included to measure the potential effects of different levels of risk preference. The impact of risk aversion on the choice of marketing strategy depends on the producer's perception about the risk reducing qualities of this strategy. If forward pricing is expected to reduce risk, this variable will have a positive effect on the use of forward pricing techniques. Similarly, if cash marketing is expected to increase risk, this variable will have a negative impact on the choice of cash sales.

Economies of size are often associated with forward pricing (Tronstad, 1991; Goodwin and Schroeder, 1994; Asplund, Forster, and Stout, 1989). Previous research suggests that learning about alternative marketing strategies have significant lumpy costs. Because larger farms can spread these lumpy costs over more production and enjoy a potentially larger net price enhancement per unit of production, they are more likely to use these alternative marketing strategies. Similar arguments can be made regarding the use of futures and options contracts because such strategies may involve using particular equipment necessary to obtain market information, subscriptions to market information and market advisory services, and transactions costs associated with trading activities. Additionally, some large farms often employ hired labor, which means that managers may have more time to devote to the marketing function and combine both production and marketing duties (this factor is particularly important for some labor intensive commodities, such as cotton). This variable is expected to have a positive effect on the use of forward pricing, consistent with the economies of size hypothesis.

Financial characteristics of the farm have also been shown to play a role in the use of forward pricing techniques. One of the most important components of the financial characteristics of the farm is leverage (Brorsen, 1995; Turvey and Baker, 1989; Collins, 1997). This study uses long-term debt-to-asset ratio as a proxy for leverage. It is hypothesized that this is a more general measure of leverage because it excludes the short-term component that varies from year to year depending on the capital needs for operating expenses. Optimal hedge models suggest a positive impact of leverage on the use of forward pricing because forward pricing may provide an additional source of liquidity. However, Asplund, Forster, and Stout (1989) argue that leverage and forward pricing may be negatively correlated if a farm operator's use of debt and leverage indicates his lack of risk aversion. This relationship may indicate producer's lack of desire to reduce risk through forward pricing. This argument creates some ambiguity on the expected sign of leverage.

A second set of variables is included to reflect the interaction of marketing methods with other factors that affect income risk. Forward pricing is not the only method of risk reduction. Alternative methods considered in this analysis include obtaining income from off farm sources, participating in government commodity programs, and purchasing crop insurance. If off-farm income is considered within the risk-balancing framework (Turvey, 1989; Gabriel and Baker, 1980), it is expected to substitute for hedging. This proposition suggests an inverse relationship between off-farm income and hedging. However, as Asplund, Forster, and Stout (1989) point out, off-farm work activities by farm family members may be complementary to hedging if they are used as a response to income/price variability. In this case, the use of forward pricing and off-farm income may be positively correlated because both would be used as strategies to reduce risk.

Participation in government commodity programs is another alternative way to reduce risk exposure. The majority of the previous literature (Turvey and Baker, 1990; Sakong, Hayes, and Hallam, 1993; Hanson, Myers, and Hilker, 1999) suggest an inverse relationship between government programs and forward pricing because government programs, in essence, provide a free put option for a producer. Other studies (Featherstone et al., 1988; Collins, 1985; Gabriel and Baker, 1980) have analyzed the impact of government programs from the risk-balancing standpoint. These authors argued that risk reducing and income augmenting policies may induce choices that increase financial risk (i.e., higher leverage). If leverage is directly related to hedging (as suggested by Turvey and Baker, 1990; Collins, 1997; and Brorsen, 1995), these findings suggest an indirect positive effect of government payments on forward pricing. Thus, the total impact of government payments consists of a negative direct impact and a positive indirect impact. Because the magnitude of these effects is not known, the direction of the total impact is ambiguous.

Another alternative to minimize risk is crop insurance. The effects of the crop insurance on forward pricing decisions have not been studied extensively. Coble, Heifner and Zuniga (2000) observed that yield insurance products exhibit complementary relationship with hedging, while revenue insurance products act as substitutes to hedging at some levels of

coverage. Therefore, the direction of the impact of this variable is ambiguous because it depends on the type of the insurance purchased and the level of coverage.

The third set of variables included in this analysis is non-economic variables. The limited significance of some previous empirical studies of hedging has led some authors (Musser, Patrick and Eckman, 1996) to suggest that there may be a large random component associated with forward pricing or some alternative non-economic explanation**.** Shapiro and Brorsen (1988) found that the most important factor related to hedging in their study was farmers perception of whether hedging can increase income stability. Furthermore, Pennings and Leuthold (2000) found that farmers' behavioral attitudes related to market orientation, risk exposure, market performance, and entrepreneurial behavior played an important role in their use of futures contracts. Therefore, several variables measuring producer perceptions of various marketing strategies were included in this analysis.

One of the non-economic variables included in this study reflected producer assessment of their personal marketing skills. It is hypothesized that producers with perceived high level of marketing abilities would be more comfortable using futures and options. A variable reflecting producer's personal preferences for various marketing channels was also included in this analysis. Finally, a variable intended to measure producer perceptions of market efficiency was included. If producers believe that markets are efficient, there should be no consistent premiums to market timing strategies. Otherwise, premiums would exist and act as an additional motivation to using forward pricing. These variables were introduced in the form of responses to Likert-scale questions. These responses were coded such that the strongest agreement received a highest value and strongest disagreement received a lowest value.

Empirical Model and Estimation Procedure

Because the choice of a primary marketing strategy is mostly discrete (as most farmers use a single marketing channel), a multinomial logit model was used for estimation. The estimated model had a following functional form:

$$\begin{aligned}\text{Prob (Choice} = j) = {} & \beta_0 + \beta_1 * \text{Education} + \beta_2 * \text{Training} + \\ & \beta_3 * \text{RiskAversion} + \beta_4 * \text{Leverage} + \beta_5 * \text{Size} + \\ & \beta_6 * \text{GovPayments} + \beta_7 * \text{OffIncome} + \beta_8 * \text{CrInsurance} + \\ & \beta_9 * \text{Attitude1} + \beta_{10} * \text{Attitude2} + \beta_{11} * \text{Attitude3} + \varepsilon\end{aligned} \tag{2}$$

Where the choice parameter *j* is 0 if the majority of the crop was sold in the cash market, is1 if most of the crop was marketed through a pool or a forward contract, and equal 2 if most of the crop was priced through futures and/or options markets.

Marketing through pools and forward contracting is combined in this analysis because these two strategies contain the features of indirect hedging. That is, when producers sell their

crop through pools or forward contracts, they do not directly take a position in the futures/options markets. Rather, the other party that entered into this contractual agreement with producer likely hedges this purchase and the producer thereby receives the benefits of the hedge indirectly. According to pool regulations and many forward contracts, a producer under these arrangements is guaranteed a minimum price without forfeiting the opportunity to obtain a higher price, if it becomes available. Another reason for combining marketing through pools and forward contracting is the statistical qualities of the model to be estimated. Within a multinomial logit model, the number of parameters proliferates with the number of choices (Greene, 1997). Therefore, similar strategies were combined to conserve degrees of freedom.

Taking a position in the futures and/or options markets is combined under a direct hedging option because these tools, although different, have many similar characteristics. It is important to note that the direct hedging option included all positions taken by producers in the futures and options markets, which include both hedging and speculation. No distinction between hedging and speculation was made in this study. Independent variables included in the empirical model are defined in Table 2.

The empirical model is estimated using a multinomial logit technique. The multinomial logit model is a general extension of a binomial logit model because it permits estimation of qualitative choice when more than two alternatives are involved. A general form of a multinomial logit model is given by:

$$\Pr ob(Yi = j) = \frac{e^{Zj}}{\sum_{k=0}^{j} e^{Zk}} \tag{3}$$

Where there are J alternative choices, $Zj = b_j' x_i$, $Zk = b_k' x_i$ (Greene, 1997). The model estimates are used to determine the probability of choice j, given x_i. Equation 3 is estimated using the maximum likelihood procedures, which yield consistent and efficient parameter estimators (Pindyck and Rubinfeld, 1991).

The model implies that J log-odds ratios can be computed:

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = a + \sum x_i'(b_j - b_k) + Ei \tag{4}$$

Where P_{ij} is the probability that the ith cotton producer will choose a jth marketing strategy, ln P_{ij}/P_{ik} is the natural log of the probability of choice j relative to the probability of choice k, a is the intercept, x is a matix of producer i's characteristics, b is a matrix of parameters that reflect the impact of changes in x on the probability of choosing jth or kth marketing strategy, and Ei is the normally distributed error term with its mean equal to zero. However, coefficient estimates of this model are difficult to interpret. Greene points out that there is at least some potential for confusion, because for any particular x_k, $\partial P_j / \partial x_k$ need not have the same sign as b_{jk}, as can be seen from equation (3).

The marginal effects of the attributes on probabilities of choice are determined by differentiating equation 3:

$$d_j = \frac{\partial P_j}{\partial x_i} = P_j \left[b_j - \sum_{k=0}^{j} P_k b_k \right] = P_j \left[b_j - \overline{b} \right] \quad (5)$$

Therefore, every subvector of b enters every marginal effect, both through the probabilities and through the weighted average that appears in d_j. These marginal effects are computed from the parameter estimates and used in the discussion of model results.

Data

The data for this study is obtained from a mail survey, which was administered during the spring and early summer of 2000 throughout the cotton growing states of the U.S. The questionnaire elicited cross sectional data for 1999 crop year. Respondents of the survey represented a random sample of cotton producers in the respective states. The survey generated about seven percent response rate, which resulted in 108 usable observations. The survey data were tested for a possible presence of the non-response bias using the "wave" technique (Ratneshwar and Stewart, 1989). Although no statistical evidence of the non-response bias in the sample was detected, the small sample size is a source of concern.

According to the survey data, in 1999, farm operations had an average of 1,459 acres of land, which included cotton as well as other enterprises. Producers owned about 38 percent of this farmland. These farm operations had an average market value of farm assets of $837,000, with about 40 percent in the 100,000 to 599,999 category. These were relatively large farms compared to national averages across all farms of 487 acres of land per farm and $507,426 of market value of assets (1997 Census of Agriculture). The average age of the participants of the survey was 50.5 years. This is similar to the participants of Asplund, Forster, and Stout's (1989) survey (51 years) and to the national average of 54.3 years reported by 1997 Census of Agriculture. Summary statistics of the independent variables used in empirical estimation are presented in Table 2.

The survey reveals that about 22 percent of producers sold most of their crop in the cash market, about 62 percent used indirect hedging strategies and about 16 percent of cotton producers used futures and options markets to price most of their crop in 1999 (Figure1). The survey also demonstrates that about 65 percent of cotton producers marketed their cotton through a single marketing channel. The other 35 percent of producers utilized some combination of several marketing strategies, typically marketing the majority of their crop through one primary source. Therefore, the discrete choice modeling approach taken in this study to analyze marketing behavior of cotton producers appears justified.

Estimation Results

Overall, the estimated model is highly significant in explaining producers' selection of preferred marketing strategies with a Chi-squared value of 75, which is statistically significant at the 0.01 level. Another measure of the goodness of fit is the model's likelihood ratio index, which was equal to 0.62. This measure is somewhat analogous to the R-squared in the conventional regression models (Greene, 1997). Another indication of the goodness of fit is the model's predictive power. The predictive power of the model is examined by comparing the actual choices of the primary marketing strategies to the ones predicted by the model. The model correctly predicted about 78 percent of marketing choices for the sample of producers used in this analysis. The model correctly predicted about 63 percent of the cash sales, 88 percent of indirect hedging, and about 59 percent of direct hedging observations as a primary marketing tool. Thus, the predictive power of the model appears satisfactory.

The results of model estimation are presented in Table 3. Estimated coefficients of the multinomial logit model reflect the effect of changes in independent variables on the log of the ratios of the probabilities (equation 4). Thus, coefficients presented in Table 3 reflect the effect of changes in independent variables on the probability of selecting indirect hedging (pools or forward contracts) or direct hedging (with futures and/or options) relative to a base scenario of selling cotton in the cash market (choice *k* in equation 4).

The results indicate that the probability of selecting indirect hedging over cash selling is directly related to farm size and agreement with Attitude1 ("A marketing pool nets me a higher price than I can get myself") and Attitude2 ("I prefer to use other means of risk management rather than hedging"), and inversely related to income from government payments and off-farm income. The probability of selecting direct hedging over cash sales is directly related to risk aversion, farm size, and purchases of additional levels of crop insurance, and inversely related to income from government payments and agreement with Attitude2.

Because estimated coefficients of the multinomial logit model are somewhat difficult to interpret, another set of results is presented in the form of marginal effects evaluated at the means of independent variables (Table 4). Marginal effects denote the effect of a change in the independent variable on the probability of choice in dependent variable (equation 5). The marginal effects demonstrate that, at the means of all independent variables, the probability of choosing cash sales is 14 percent, the probability of choosing indirect hedging is 78 percent, and the probability of choosing direct hedging as a primary marketing tool is 8 percent. Thus, the model overestimated the probability of choosing indirect hedging, and underestimated the probability of choosing cash sales and direct hedging as primary marketing tools.

Table 4 illustrates that the probability of choosing cash sales as a primary marketing strategy is directly related to off-farm income, and income from government payments, and inversely related to agreement with Attitude1 and farm size. Risk aversion, crop insurance, and agreement with Attitude1 are marginally significant (at 20 percent level) and inversely

related to the probability of choosing cash sales. The probability of choosing indirect hedging as a primary marketing strategy is positively affected by agreement with Attitude1 and Attitude2, and negatively affected by off-farm income and income from government payments. The choice of direct hedging is negatively correlated with agreement with Attitude1 and Attitude2. Farm size and crop insurance are marginally significant (at 20 percent level) and have a positive effect on the probability of choosing direct hedging.

The statistical significance of the marginal effects of some variables discussed above was fairly low because of the small sample size. However, the relationships revealed by these marginal effects are consistent with those identified by parameter estimates. Also, these relationships are consistent with theory and support the hypotheses proposed in the conceptual framework. Therefore marginally significant variables are included in the discussion.

Agreement with Attitude1 is significant in the choice of all selected marketing strategies. This question is designed to measure producer perceptions of their marketing abilities relative to the pools. Only 16 percent of producers rate their marketing abilities higher than that of the pools. Consequently, this variable indicates that because producers do not think highly of their personal marketing abilities, they prefer to purchase marketing services from pools. These results also suggest that the belief that marketing pools obtain higher prices for their members makes them more attractive than alternative marketing strategies. These price premiums may be associated with better marketing practices as well as other advantages of marketing through a pool, which may include quantity and quality premiums resulting from marketing larger lots and/or better combinations of quality as well as savings on transaction costs, including manager's time and money allocated on collecting market information, and additional liquidity available at harvest time when crop is relinquished to a pool.

Agreement with Attitude2 ("I prefer to use other means of risk management rather than hedging") is also significant in the choice of all selected marketing strategies. This variable indicates the effect of producer preferences on his/her marketing decisions. The marginal effects of this variable indicate that a one unit increase in the level of agreement with Attitude2 results in a six percent decrease in the probability of choosing cash sales, an 11 percent decrease in the probability of choosing direct hedging, and an 18 percent increase in the probability of choosing indirect hedging as a primary marketing tool. This evidence suggests that the preferred marketing choice of cotton producers is indirect hedging (this category is primarily composed of pool sales, but forward contracting is also an important marketing method).

Percent off-farm income is significant in the choice of cash sales and indirect hedging as primary marketing tools. It appears that producers that have a large share of their total income coming from off-farm sources may be less inclined to use indirect hedging and more likely to choose cash sales as their primary marketing tool. This result is consistent with Shapiro and Brorsen's (1988) findings. This evidence suggests that drawing income from

diversified sources substitutes for the use of forward pricing methods, indirect hedging in particular. This result also provides evidence for the risk-reducing characteristics of off-farm income.

According to the marginal effects, income from government payments is directly related to the probability of choosing cash sales and inversely related to the probability of choosing indirect hedging as a primary marketing tool. Parameter estimates also suggest that income from government payments had a negative impact on the probability of choice of direct hedging as a primary marketing strategy. These results confirm the hypothesis about risk-reducing properties of government payments, and suggest that because producers' income is protected in part by government payments, they are less inclined to use forward pricing strategies and more likely to choose cash sales as their primary marketing tool.

Cotton acreage, included as a measure of farm size, is negatively related to the probability of choosing cash sales and positively related to the probability of choosing direct hedging as a primary marketing method. This evidence supports the economies of size hypothesis, which is consistent with the previous studies (Goodwin and Schroeder, 1994; Asplund, Forster, and Stout, 1989; and Shapiro and Brorsen, 1988).

Producers that purchased additional crop insurance above the minimal level required to remain eligible for government payments are 11 percent more likely to choose cash sales and 9 percent more likely to choose direct hedging as their primary marketing tool. This finding indicates a complimentary relationship between crop insurance and the use of direct hedging. About 80 percent of the sample of producers in this analysis purchased MPCI, which is a yield insurance product. Thus, this result is consistent with Coble, Heifner, and Zuniga's (2000) findings, that indicate a complimentary relationship between yield insurance products and direct hedging. This result may also imply that producers who purchase crop insurance are generally more risk averse, therefore they are more likely to use forward pricing techniques such as hedging.

Coefficients suggest that risk aversion is positively associated with the probability of choosing direct hedging as a primary marketing strategy. According to marginal effects, risk aversion is also marginally significant in influencing the probability of choosing cash sales as a primary marketing strategy. The signs of the estimated coefficients suggest that risk aversion leads producers away from cash sales to alternative marketing strategies, direct hedging in particular. These findings are consistent with expectations and imply that producers consider cash sales a relatively risky method of marketing. They also confirm the view that forward pricing (direct hedging in particular) is used as a risk reducing marketing method.

This analysis found no evidence that level of producer education, marketing specific training, long-term debt, and agreement with Attitude3 ("I believe that market timing strategies can increase revenues") have significant impact on hedging behavior. The lack of significance of marketing specific training is consistent with Shapiro and Brorsen's (1988) findings. This

evidence implies that additional marketing specific training is not effective in altering producer marketing practices.

Levels of formal education and leverage are also insignificant in determining the choice of a primary marketing strategy by cotton farmers. This result contradicts previous studies by Shapiro and Brorsen (1988), Goodwin and Schroeder (1994), and Asplund, Forster, and Stout (1989). This result may be caused by the measurement limitations of the variables used in this study. Another variable that is not statistically significant in the estimated model is the agreement with Attitude3 ("I believe that market timing strategies can increase revenues"). Considering that 78 percent of respondents agreed or strongly agreed with this statement, this finding suggests that price premiums expected from market timing strategies are not strong motivators of producer marketing behavior. This outcome could have resulted from the fact that few producers believe in their individual marketing abilities (only 16 percent of producers disagreed with Attitude1 "A marketing pool nets me a higher price than I can get myself").

Summary and Conclusions

This study is designed to analyze producer hedging decisions in the context of their overall marketing behavior. This approach involves examination of producer marketing behavior as a choice between alternative marketing strategies (cash sales, indirect hedging, and direct hedging). This study extends the previous models of hedging behavior by overcoming the dichotomy of forward pricing versus cash sales. This analysis disaggregates forward pricing decisions into direct (futures and options) and indirect (pools and forward contracts) hedging and examines all three marketing alternatives simultaneously. The results of the multinomial logit model estimation suggest that, at the means of independent variables, the probability of choice of cash sales is 14 percent, the probability of choosing indirect hedging is 78 percent, and the probability of choosing direct hedging as a primary marketing tool is 8 percent. These results appear to perform well in explaing the empirical evidence reported in the previous studies (Table 1) and the results of the survey reported in this study (Figure 1). The findings of this study highlight the importance of indirect hedging for cotton marketing, marketing through pools in particular. About 50 percent of cotton producers marketed their cotton through pools. Such a high share of marketing through pools is not typical for other commodities and may reflect some unique aspects of cotton marketing including economic and non-economic factors.

Disaggregation of forward pricing into direct and indirect hedging alternatives permitted determination of the specific impacts of motivating factors on the choice of particular marketing alternatives. For example, purchases of additional levels of crop insurance and risk aversion were significant for direct hedging decisions but not for indirect hedging decisions. Similarly, off-farm income had a significant influence on the indirect hedging decisions, but not on direct hedging decisions.

The results of a multinomial logit model identified a number of factors that affect the probability of choosing one of the selected marketing strategies by cotton producers. The most important factors that explain the use of forward pricing by cotton producers are producer preferences, farm size, crop insurance, risk aversion, income from government payments and off-farm income. To the extent that the sample is representative, this study provides some interesting implications. For example, producer preferences were one of the most important factors affecting hedging behavior (consistent with Shapiro and Brorsen, 1988), while some economic variables were not statistically significant.

This study also identified certain producer characteristics, which increase the probability of choice of certain marketing strategies. For example, owners of large farms, producers that are more risk averse, individuals that purchased additional levels of crop insurance, farmers that receive a fairly small share of their income in the form of government payments and those who did not indicate any personal preference of other forms of risk management and don't believe in price premiums associated with marketing through pools will be more likely to use direct hedging as their primary strategy. These results can be used by educators to better tailor their training programs to the specific needs of the audiences they address. Targeting learning about other forms of marketing such as pools and forward contracts, in addition to futures/options, also appears warranted given the conditions and preferences expressed by producers.

Another set of results may be of interest to policy makers. This study reveals a negative impact of income from government programs on the use of forward pricing techniques. This finding suggests that as long as government payments remain in place, producer use of forward pricing is likely to remain low. Since the passage of the 1996 FAIR Act, Congress discussed the need to assist farmers and ranchers in becoming active risk managers. Numerous grants have been funded to support educational programs focusing on various risk management tools including crop insurance and futures and options. However, efforts to support producer's income and encourage use of futures and options appear contradictory based on the evidence presented in this study as well as prior theoretical models.

References

Agriculture Fact Book 1998: Chapter 7-D. (http://www.usda.gov/news/pubs/fbook98/ch7d.htm.) Accessed 6/19/00.

Asplund, N.M., D.L. Forster, and T.T. Stout. "Farmers' Use of Forward Contracting and Hedging." *Review of Futures Markets*, 8 (1989): 24-37.

Brorsen, B.W. "Optimal Hedge Ratios with Risk-Neutral Producers and Nonlinear Borrowing Costs." *American Journal of Agricultural Economics* 77 (1995): 174-181.

Coble, K.H., Heifner, R.G., and M. Zuniga. "Implications of Crop Yield and Revenue Insurance for Producer hedging Demand." *Working Paper*, Department of Agricultural Economics, Mississippi State University, 2000.

Collins, R.A. "Expected Utility, Debt-Equity Structure, and Risk Balancing." *American Journal of Agricultural Economics* 67 (1985): 627-629.

Collins, R.A. "Toward a Positive Economic Theory of Hedging." *American Journal of Agricultural Economics* 79 (1997): 488-499.

Featherstone, A.M., C.B. Moss, T.G. Baker, and P.V. Preckel. "The Theoretical Effects of Farm Policies on Optimal Leverage and the Probability of Equity Losses." *American Journal of Agricultural Economics* 70 (1988): 572-579.

Gabriel, S.C., and C.B. Baker. "Concepts of Business and Financial Risk." *American Journal of Agricultural Economics* 62 (1980): 560-564.

Goodwin, B.K., and T.C. Schroeder. "Human Capital, Producer Education Programs, and the Adoption of Forward Pricing Methods." *American Journal of Agricultural Economics* 76 (1994): 936-947.

Greene, W.H. *Econometric Analysis*. Third edition, Prentice Hall, NJ, 1997.

Hanson, S. D., R.J. Myers, and J.H. Hilker. "Hedging with Futures and Options under a Truncated Cash Price Distribution." *Journal of Agricultural and Applied Economics* 31, 3 (1999): 449-459.

Huffman, W. E. "Farm and Off-Farm Work Decisions: The Role of Human Capital," *Review of Economics and Statistics* 62 (1980): 14-23.

Khaldi, N. "Education and Allocative Efficiency in U.S. Agriculture," *American Journal of Agricultural Economics* 57 (1975): 650-657.

Musser, W.N., G.F. Patrick, and D.T. Eckman. "Risk and Grain Marketing Behavior of Large-Scale Farmers." *Review of Agricultural Economics* 18 (1996): 65-77.

Patrick, G.F., W.N. Musser, and D.T. Eckman. "Forward Marketing Practices and Attitudes of Large-Scale Midwestern Grain Producers." *Review of Agricultural Economics* 20 (1998): 38-53.

Pennings, J.M.E., and R.M. Leuthold. "The Role of Farmers' Behavioral Attitudes and Heterogeneity in Futures Contracts Usage." *American Journal of Agricultural Economics* 82 (2000): 908-919.

Pindyck, R.S., and Rubinfeld, D.L. *Econometric Models and Economic Forecasts*. Third edition, McGraw-Hill, Inc., 1991.

Ratneshwar, S., and D. Stewart. "Research Nonresponse in Mail Surveys: An Integrative Review." *Applied Marketing Research* 29, 3 (1989): 37-46.

Saking, Y., D.J. Hayes, and A. Hallam. "Hedging Production Risk with Options." *American Journal of Agricultural Economics* 75 (1993): 408-415.

Shapiro, B.I.,, and B.W. Brorsen. "Factors Influencing Farmers = Decisions of Whether or Not to Hedge." *North Central Journal of Agricultural Economics* 10 (1988): 145-53.

Tronstad, R. "The Effects of Firm Size and Production Cost Levels on Dynamically Optimal after-tax Cotton Storage and Hedging Decisions." *Southern Journal of Agricultural Economics* (1991): 165-179.

Turvey, C.G., and T.G. Baker. "Optimal Hedging under Alternative Capital Structures and Risk Aversion." *Canadian Journal of Agricultural Economics* 37 (1989): 135-143.

Turvey, C. G., and T.G. Baker. "A Farm-Level Financial Analysis of Farmers' Use of Futures and Options Under Alternative Farm Programs." *American Journal of Agricultural Economics* 72 (1990): 946-957.

Turvey, C. G. "The Relationship between Hedging with Futures and the Financing Function of Farm Management." *Canadian Journal of Agricultural Economics* 37 (1989): 629-638.

Wozniak, G.D. "The Adoption of Interrelated Innovations: A Human Capital Approach." *Review of Economics and Statistics* 66 (1984): 70-79.

Figure 1. Cotton Producer's Use of Selected Marketing Strategies.

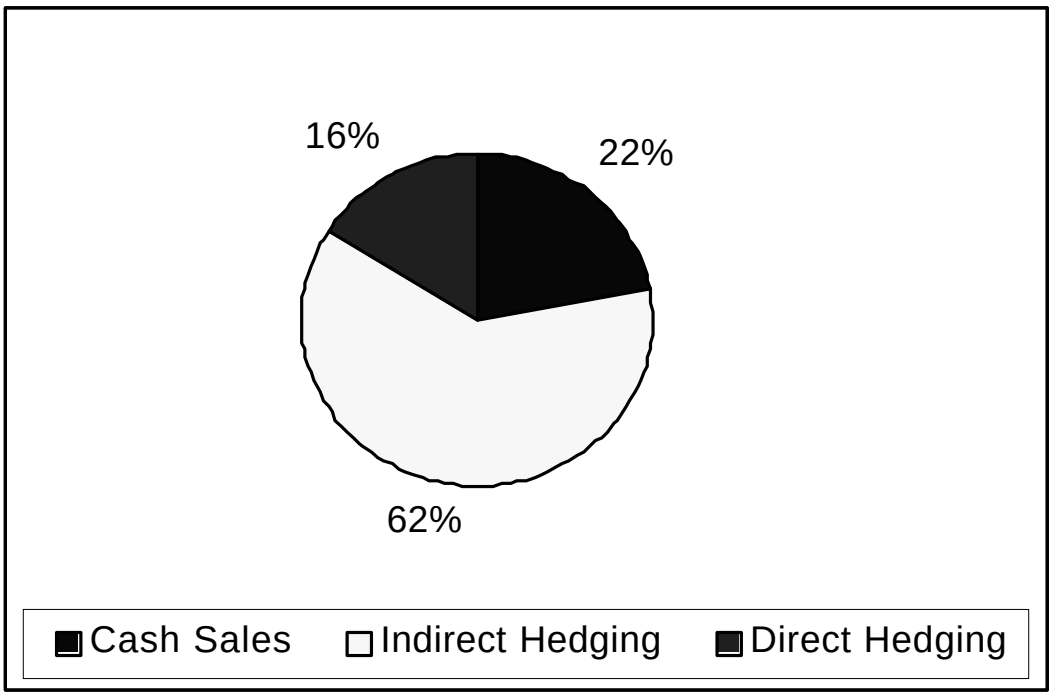

Table 1. Empirical Futures Use.

Authors	Location	Year	Commodity	Fut. Use (% of producers)
Asplund, Forster and Stout	Ohio	1987	Crop	7.00
Goodwin and Schroeder	Kansas	1992	Wheat	5.91
			Corn	10.73
			Sorghum	1.84
			Soybeans	5.22
Patrick, Musser, Eckman	Indiana	1995	Soybeans	8.10
			Corn	16.2

Table 2. Summary Statistics for Variables Used in the Empirical Estimation.

Variable	Definition	Mean	Standard Deviation
Education	1 = less than high school, 2 = high school diploma or GED, 3 = college, and 4 = graduate school	2.71	0.70
Training	Hours of training attended	4.73	9.73
RiskAversion	Self-assessment of the willingness to take risks relative to others on a scale from 1 to 10 with 10 being the most risky	5.72	1.96
Leverage	The proportion of the market value of the farm assets that was borrowed in 1999	0.18	0.20
Size	Cotton acres (thousands)	0.74	0.68
GovPayments	Percent gross farm income from government payments[a]	0.27	0.15
OffIncome	Off-farm income/gross farm income	0.20	0.25
CrInsurance	1 if producer bought additional levels of crop insurance above CAT coverage, 0 otherwise	0.64	0.48
Attitude1	A marketing pool nets me a higher price than I can get myself[b]	3.48	1.08
Attitude2	I prefer to use other means of risk management rather than hedging[b]	3.59	0.91
Attitude3	I believe that market timing strategies can increase revenues[b]	3.91	0.69

[a] Includes disaster payments, loan deficiency payments, producer option payments, and AMTA (transfer) payments.
[b] Likert-scale questions from 1 to 5 with 5 indicating the highest level of agreement.

Table 3. Maximum Likelihood Estimates of the Probability of Using Indirect Hedging and Direct Hedging Relative to the Base Scenario of Selling Cotton in the Cash Market.[a]

	Indirect Hedging	Direct Hedging
Intercept	-7.919***	-3.342
	(3.176)	(4.229)
Education	0.330	0.340
	(0.437)	(0.626)
Training	0.060	0.024
	(0.070)	(0.073)
RiskAversion	0.204	0.375**
	(0.162)	(0.231)
Leverage	0.170	2.180
	(1.636)	(2.210)
Size	1.360*	2.018***
	(0.887)	(0.978)
GovPayments	-5.545***	-5.708*
	(2.422)	(3.640)
OffIncome	-2.971***	0.647
	(1.390)	(1.358)
CrInsurance	0.821	1.967**
	(0.683)	(1.129)
Attitude1	0.958***	0.139
	(0.338)	(0.463)
Attitude2	0.680**	-0.940**
	(0.402)	(0.492)
Attitude3	0.527	0.266
	(0.447)	(0.642)
Chi-squared	74.824***	
Likelihood ratio index	0.62	

[a]Numbers in parentheses are asymptotical standard errors. The *, **, and *** indicate coefficients asymptotically significant at 15, 10, and 5 percent levels, respectively.

Table 4. Marginal Effects of Market Strategy Choice Model Evaluated at the Means of Independent Variables.[a]

	Cash	Indirect Hedging	Direct Hedging
Intercept	0.910***	-1.157***	0.247
	(0.399)	(0.495)	(0.280)
Education	-0.040	0.036	0.004
	(0.053)	(0.066)	(0.040)
Training	-0.007	0.009	-0.002
	(0.008)	(0.008)	(0.002)
RiskAversion	-0.027	0.118	0.015
	(0.020)	(0.025)	(0.015)
Leverage	-0.433	-0.106	0.149
	(0.195)	(0.236)	(0.139)
Size	-0.173**	0.109	0.064
	(0.093)	(0.099)	(0.047)
GovPayments	0.675***	-0.601*	-0.075
	(0.309)	(0.386)	(0.237)
OffIncome	0.335**	-0.472***	0.137
	(0.181)	(0.238)	(0.116)
CrInsurance	-0.113	0.019	0.093
	(0.086)	(0.107)	(0.070)
Attitude1	-0.107***	0.156***	-0.049*
	(0.044)	(0.052)	(0.031)
Attitude2	-0.064	0.176***	-0.111***
	(0.049)	(0.066)	(0.043)
Attitude3	-0.061	0.074	-0.013
	(0.052)	(0.067)	(0.041)
P of choice at mean	0.141	0.779	0.080
Actual Choice	24	67	17
Correctly Predicted	15	59	10

[a]Numbers in parentheses are asymptotical standard errors. The *, **, and *** indicate coefficients asymptotically significant at 15, 10, and 5 percent levels, respectively.