



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

**Using Private Risk Management Instruments to Manage Counter-Cyclical
Payment Risks Under the New Farm Bill**

John D. Anderson

Keith H. Coble

J. Corey Miller*

*Paper Presented at the NCR-134 Conference on Applied Commodity Price
Analysis, Forecasting, and Market Risk Management
St. Louis, Missouri, April 21-22, 2003*

Copyright 2003 by J.D. Anderson, K.H. Coble, and J.C. Miller. All rights reserved.
Readers may make verbatim copies of this document for non-commercial purposes by any
Means, provided that this copyright notice appears on all such copies.

* The authors are Assistant Extension Professor (anderson@agecon.msstate.edu), Associate Professor, and Research Associate in the Department of Agricultural Economics, Mississippi State University, respectively.

Using Private Risk Management Instruments to Manage Counter-cyclical Payment Risks Under the New Farm Bill

Practitioner's Abstract

This research evaluates whether or not hedging strategies using call options on New York Board of Trade cotton futures can be effectively used to protect the new counter-cyclical payment on cotton. Results indicate that some level of counter-cyclical payment hedging is optimal for risk averse decision makers. Optimal hedge ratios depend on planting time expectations of the marketing year average price as well as on what crop, if any, has been planted on the base acres receiving the counter-cyclical payment.

Keywords: Farm Policy, hedging, options, risk

Introduction

At least since Gardner's seminal article, the similarity of government policy instruments and market-based risk management tools such as futures and options has been well known. Work by Turvey and Baker also points out that deficiency payments are a substitute for hedging by farmers. Fixed decoupled payments, introduced by the Federal Agriculture Improvement and Reform (FAIR) Act of 1996, were a step toward more market-oriented policies (Collins and Glauber). Fixed-decoupled payments do not respond to price uncertainty, so they lack the option-like characteristics of the deficiency payment program they replaced. However, Hanson, Myers, and Hilker—as well as Adams, Betts, and Brorsen—note that the loan deficiency payment (LDP) program retained under the FAIR Act substitutes for forward pricing because of similarities to a free put option with a strike price equal to the loan rate. However, the loan program is distinct from a put option in that the quantity protected is not predetermined but equals actual production.

The Farm Security and Rural Investment Act (FSRIA) of 2002 became law when crop prices were lower than those that prevailed when the FAIR Act was approved. When these low crop prices began in the latter years of the FAIR Act, policymakers began looking for a program that could respond to low prices but also incorporate the popular decoupling of payments from acreage decisions. Counter-cyclical payments (CCPs) became the product of this environment. While they may have been a logical political compromise, CCPs also present program crop producers with a new entitlement that has a unique combination of characteristics relative to previous programs. First, CCPs vary with the Marketing Year Average (MYA) price rather than with posted county prices. Second, because of decoupling, payments may be made based on low prices for the base crop even if the producer has responded to market signals and planted another crop or no crop at all.¹ The yield used in the CCP calculation is distinct from the loan program because a predetermined base yield is used while the loan program pays on actual production. Lastly, the CCP by construction covers a range of price risks bounded from above and below.

¹ The exception has been the Flex Acres provisions of the 1990 Farm Bill that allowed up to 15 percent of payment acres to be planted to an alternative crop.

The evaluation of CCPs entails novel issues relative to past investigations of policy instruments. Glauber and Miranda demonstrate that a natural hedge exists between price and yield for many program crops and that this relationship has a profound effect on the degree of risk protection afforded by government price risk protection programs. They find that while coupled price protection programs may be highly correlated with price risk, they are less correlated with revenue shortfalls. Decoupled CCPs generate the possibility that when no crop or an alternative crop is planted, a quite different hedging relationship could occur between the policy instrument and the producer's risk.

Producers and market advisors are already recognizing that CCPs pose unique risk management decisions. Various proposals to 'hedge' these payments with market-based futures and option strategies have emerged where the MYA price is expected to rise (Anderson; Scott). For example, Anderson states:

The challenge in 'hedging' the counter-cyclical payment lies in estimating the futures price level and movement for the marketing season well in advance of a sustained price rally. . . . The practical approach to protecting the 52-cent trigger level for reducing the CCP is to first hedge using December and/or March calls.

However, these proposals differ regarding the value of hedging when planting the base crop versus another crop. Nonetheless, the irony of producers attempting to use market instruments to hedge the risk of losing government-provided risk protection perhaps illustrates the interaction of public policy and private risk markets as never before.

From an analytical perspective, this problem is unique in that the risk of CCP declines is bounded between the loan rate and the target price minus the direct payment rate. Thus, the counter-cyclical payment is analogous to an entitlement to a free put option against the MYA price with a strike price equal to the target price minus the direct payment less the value of a put with a strike equal to the loan rate. This protection is available on a fixed, predetermined quantity of the crop. Furthermore, the MYA price is a weighted average of national cash sales over a twelve-month period. Thus, attempts to hedge this risk will be complicated by basis risk and temporal complexity.

This paper specifically examines the nature of the new counter-cyclical payment program. In particular, we investigate the rationality of a risk-averse producer hedging the counter-cyclical payment. The decision of a representative Mississippi cotton-soybean farm is considered. The model constructed is unique in that hedging the MYA price potentially involves taking positions in multiple contract months. Our results show that a non-speculating risk-averse producer may rationally choose to hedge the CCP using call options. However, our results are specific to certain scenarios. In many cases our results directly contradict many of the strategies being proposed to producers.

Background

The CCP is a third payment type in addition to direct payments and loan deficiency payments, which existed in the previous farm bill. CCPs are variable because they depend on the marketing

year average (MYA) commodity price calculated over the twelve-month period beginning at harvest. Estimates of the MYA price may change as cash prices change during the marketing year. CCPs are decoupled because they are paid on contract acreage and a defined payment yield, rather than on the farm's actual current production. The CCP is calculated as follows:

$$(1) \quad CCP = [Target\ Price - Direct\ Payment\ Rate - (higher\ of\ Loan\ Rate\ or\ MYA\ Price)] \times 0.85 \times Base\ Acres \times Base\ Yield$$

A \$65,000 per person, per year payment limit applies on the CCP; however, the three-entity rule effectively doubles this limit. Given the calculation for the CCP, it will be maximized when the MYA price is at or below the loan rate. For cotton, the loan rate (\$0.52 per pound) plus the direct payment rate (\$0.0667 per pound) results in an effective price of \$0.5867 per pound. The difference between this effective price and the target price (\$0.724 per pound) is \$0.1373 per pound, the maximum possible CCP on cotton. As the MYA price rises above the loan rate, the effective price increases. When the MYA price reaches \$0.6573 per pound the CCP becomes zero because at that price, the effective price equals the target price (\$0.6573 + \$0.0667 = \$0.724).

As previously discussed, a payment that is both variable and decoupled may present landowners and producers with something of a dilemma. The actual amount of the CCP will not be known until after the end of the marketing year—well over a year from the time when planting decisions are made. A significant increase in the MYA price could occur between planting and the end of the following marketing year, reducing or even eliminating the anticipated CCP—making the MYA price a primary concern in developing strategies to protect the CCP.

Other less obvious considerations include what contract month to use in protecting the CCP. Contract months for cotton futures and options on the New York Board of Trade (NYBOT) include March, May, July, October, and December. The bulk of cotton marketing takes place from November through January. Prices in these months will thus have the greatest influence on the MYA price. Figure 1 indicates the percentage of U.S. cotton production marketed each month along with the corresponding monthly average market prices.

It seems logical, then, to focus efforts to protect the CCP on the December futures contract; however, it is important to recognize that using the December contract exclusively will leave no protection in subsequent months. Multiple contracts (or options on multiple contracts) may potentially be used in a CCP protection strategy. If multiple contracts are used, the base holder must decide how large a position to take in each contract month. Basing the size of futures market positions on the seasonal pattern of cotton marketings makes intuitive sense; however, practical considerations may make such a strategy difficult. For example, at the time planting decisions are being made, options on the following year's May and July contracts would be expensive due to the time value of options so far from contract maturity, assuming options could even be purchased that far in advance. Options on futures contracts more than one year from maturity are often very thinly traded.

The Market Year Average Price

In considering strategies to protect the CCP, it is important to understand the MYA price, how it is calculated, and how it affects the CCP. The MYA price is meant to represent a weighted average of sales for a crop at the point of first sale. It excludes any value added to the crop by processing, and reflects either the cash price received by producers or the contracted price at delivery. Contract sales are counted in the month when delivery actually takes place. The MYA price does not include government payments and is adjusted for quality factors.

MYA price information is obtained by the National Agricultural Statistic Service (NASS) through a stratified sample of crop buyers. NASS collects data on both the quantity purchased and the prices paid for the crop. Sampling techniques are used so that not all buyers are surveyed each year. However, a set of buyers is drawn for a particular crop year and then surveyed once a month for the entire marketing year. The calculation for a monthly average price is based on weighting factors derived from the quantities purchased by each individual buyer surveyed. The MYA price for the entire marketing year is then weighted by the quantity of sales that occur in each month. For example, if 20 percent of the sales for the entire marketing year occur in the harvest month, then the price observed in that month will be given a weight of 0.20.

The effect of the seasonal crop marketing percentages on the MYA is clear: prices occurring during peak marketing periods will have the greatest impact on the MYA. For cotton, seasonal price lows in the cotton market tend to occur in January or February—shortly after the peak in crop marketings. The information on these prices would indicate that the MYA price should generally be lower than a simple average of monthly prices. This is because lower prices will tend to receive more weight in the calculation of the MYA because of the pattern of crop marketings. In fact, from 1975-76 through 2000-01, MYA prices for cotton have been about \$0.004 per pound below the simple average of monthly prices.

Basis and Basis Risk

As with a hedge on an actual commodity, basis is an important consideration. The CCP, however, is not influenced by the local cash price but rather by the national MYA price. Figure 2 shows the basis or difference between the NYBOT December cotton futures contract (at contract maturity) and the MYA price for cotton—calculated as the cash price minus the futures price.

Note in this figure that in the period from 1975 to 2001, basis ranged from about -\$0.16 to \$0.03. On average, the basis was about -\$0.055. As in any hedging situation, changes in basis will impact the effectiveness of any CCP protection strategy using futures or options. Consequently, a CCP protection strategy using futures and/or options on futures, like essentially all other hedges, will not provide perfect protection—variability in basis must be considered.

There are a couple of additional points to consider in protecting the CCP. First, the effect of payment limits should not be dismissed. Regardless of base production or MYA price expectations, CCPs to any individual are capped at \$65,000 (\$130,000 under the three-entity rule). This may affect the size of the position that a base holder would want to take in the futures market. Second, whether base holders using the futures market to protect the CCP will be treated

as hedgers or speculators is unknown. Margin requirements on futures positions are greater for speculators than for hedgers

Literature Review

As previously noted, Gardner was among the first to characterize non-recourse loan support prices as a put option. The free government put option in the form of support prices had real economic value to producers because these transfers from the government were approximately equal to the price of put options required to sell an annual crop at the loan level. The study by Glauber and Miranda also examines the marketing loan program as well as the deficiency payment program, since both programs create a floor under price. Their concern is the impact of these programs on the “natural hedge,” which for many crops can protect producers from changes in yield. Glauber and Miranda found many counties where these programs destabilized revenues. While such programs may achieve their goal of stabilizing price, they undermine the natural hedge.

Turvey and Baker found that farm programs affect the demand for futures and options, specifically decreasing their use in the presence of loan rates and target prices. The use of futures and options may be underestimated by considering exposure to the market alone to the exclusion of participation in farm programs. In their study of deficiency payments, Adams, Betts, and Brorsen found them to be of no greater value than hedging in reducing post-harvest risk, and that deficiency payments can actually increase risk when grain is sold at harvest. Selling at harvest was found to be the best strategy for some producers, based on high opportunity cost, storage cost, or risk aversion, but many producers increased their use of futures and options when the benefits of deficiency payments were decreased. By viewing the marketing loan program of the FAIR Act as an implicit put option, Hanson, Myers, and Hilker found reason for risk averse producers to use futures and options—specifically selling puts—to further reduce risk, while still participating in the loan program. Additionally, they found that the presence of yield and basis risk necessitates the use of futures and options in order to achieve the optimal hedge position.

A Model of Producer Risk with Counter-Cyclical Payments

We examine the behavior of a farmer provided with CCPs and the opportunity to hedge using options. The farmer is assumed to maximize expected utility according to a von Neumann-Morgenstern utility function defined over end-of-season wealth $U(W)$ and that is strictly increasing, concave, and twice continuously differentiable. The decision variable of interest in this study is h , the quantity of call options to purchase. The producer is assumed to calculate the expected utility as the probability-weighted expectation of ending wealth $EU(W_i)$ across all possible outcomes.

In this model parameters of the commodity program include the target price, P_i^T , the loan rate, P_i^L , and the direct payment rate, D_i . Three random price variables—harvest time crop price, P_i^H , futures price, P_i^F , and market year average price, P_i^M —each are defined over a finite interval $\left[\underline{P}_i^k, \overline{P}_i^k \right]$ where k denotes the price variable. Ending wealth including a CCP can be

partitioned into three scenarios defined according to where P_i^M falls relative to P_i^L , and $P_i^T - D_i$.² That is, the CCP is at its maximum when $P_i^M < P_i^L$, it declines as P_i^M increases up to $P_i^T - D_i$, where the CCP becomes zero for all higher values of P_i^M . Three ending wealth scenarios, W_1 through W_3 , may be defined.

If $P_i^M < P_i^L$,

$$(2) \quad W_1 = W_0 + A_j[P_j^H Y_j - C(Y)_j] + h_i(\delta(P_i^F - P_i^S) - R_i) + 0.85(P_i^T - P_i^L - D_i)\bar{A}_i\bar{Y}_i.$$

Initial wealth is represented by W_0 . To reflect the possibility that the producer may plant a crop j instead of the farm program crop i , random farm yield is denoted by Y_j , and defined over the bounds $[0, \bar{Y}_j]$; however, we allow $i = j$. A concave cost function is denoted $C(Y)_j$, and crop planted acres are denoted by A_j . The quantity of the crop program base hedged with a call option is h_i , with P_i^S denoting the strike price and P_i^F the futures price underlying the option contract. The indicator variable, δ , is one if the call option is in the money ($P_i^F > P_i^S$); otherwise, δ is zero. The option premium per unit, R_i , is assumed unbiased, implying that $E(P_i^F > P_i^S) - R_i = 0$. Following Benninga, Eldor, and Zilcha, cash prices and MYA prices are assumed linear functions of futures price such that $P_i^H = \alpha_0 + \alpha_1 P_i^F + \varepsilon_i$ and $P_i^M = \beta_0 + \beta_1 P_i^F + \theta_i$ where $E[\varepsilon_i] = E[\theta_i] = 0$ and are independent of P_i^F , P_i^M , and Y_j . The CCP is at its maximum anytime $P_i^M < P_i^L$. In this case, the payment per unit of production will be 85 percent of the difference between P_i^T and the sum of P_i^L and D_i . To determine the total CCP, this product is multiplied by program base acres and base yield, as represented by \bar{A}_i and \bar{Y}_i , respectively.

If $P_i^M < P_i^T - D_i$,

$$(3) \quad W_2 = W_0 + A_j[P_j^H Y_j - C(Y)_j] + h_i(\delta(P_i^F - P_i^S) - R_i) + 0.85(P_i^T - P_i^M - D_i)\bar{A}_i\bar{Y}_i.$$

In this scenario the CCP declines from the maximum level as P_i^M is subtracted from P_i^T , rather than P_i^L .

If $P_i^M > P_i^T - D_i$,

² The loan deficiency payment is omitted here for the sake of clarity. However, it is not ignored in our further analysis.

$$(4) \quad W_3 = W_0 + A_j [P_j^H Y_j - C(Y)_j] + h_i (\delta(P_i^F - P_i^S) - R_i).$$

In this result, P_i^M increases to a level where the CCP goes to zero and the producer is left with market returns and the value of the call option, if any.

The first order conditions for utility maximization for the producer given a strike price may then be written:

$$(5) \quad E[U'(W_1) \{\delta(P_i^F - P_i^S) - R_i\}] + E[U'(W_2) \{\delta(P_i^F - P_i^S) - R_i\}] + E[U'(W_3) \{\delta(P_i^F - P_i^S) - R_i\}] = 0$$

Data and Methods

Stochastic simulation is used to evaluate the impact on expected utility of hedging the cotton CCP with call options on the New York Board of Trade's (NYBOT) December cotton futures contract. Simulated prices and yields are used to calculate CCPs, net returns to hedging the CCP, net returns from crop production, and loan deficiency payments on the crop produced. Production of cotton, soybeans, a mix of cotton and soybeans, and no crop on cotton base acres are examined in this study. A constant relative risk aversion (CRRA) utility function is then used to calculate a certainty equivalent (CE) for the set of simulated returns. A numerical search procedure is used to solve for the CE maximizing hedge ratio.

Price data forming the basis of the simulation model consist of February (i.e., planting time)³ average prices and average prices for the month prior to expiration on NYBOT cotton futures; the national marketing year average price (MYA) of cotton (USDA-NASS); and November (i.e., harvest time) cotton and soybean national average cash prices (USDA-NASS). Table 1 describes the price data used in this study. Yield data consist of county-level cotton and soybean yield data for Bolivar County, Mississippi. These county level data were de-trended and the variability expanded to be consistent with farm-level yield variability. (See Zuniga for additional information on the expansion of yield variability from county to farm level.) All price data are annual from 1975-76 through 2001-02; yield data are annual from 1970 through 2001.

A total of 5,000 price and yield observations are simulated. Yields are simulated by randomly drawing from the empirical distribution. Prices are simulated by adapting a procedure outlined by Naylor et al., which uses information in the covariance matrix to correlate random variables from a multivariate normal distribution. This procedure utilizes the mathematical relationship between standard normal deviates and multivariate normal deviates. (For a detailed explanation and justification, see Krzanowski, pp. 204-205. For additional applications of the procedure see Clements, Mapp, and Eidman; Trapp; and Anderson and Zeuli.) Specifically, if \mathbf{z} is an $n \times 1$ vector of standard normal deviates, $\boldsymbol{\mu}$ is any $n \times 1$ vector, and \mathbf{A} is any $m \times n$ matrix of rank $n \leq m$, then

$$(6) \quad \mathbf{x} = \boldsymbol{\mu} + \mathbf{A}\mathbf{z}, \text{ and}$$

$$(7) \quad \mathbf{x} \sim N_n(\boldsymbol{\mu}, \mathbf{AA}').$$

In the context of simulating correlated random variables from a normal distribution with known parameters, the coefficients of the \mathbf{A} matrix are derived by a Cholesky decomposition of the covariance matrix () for the variables in question. These coefficients can then be used along with mean values and randomly generated standard normal deviates to create correlated observations as follows:

$$(8) \quad \mathbf{C} = \bar{\mathbf{C}} + \mathbf{AR},$$

where \mathbf{C} is an $n \times 1$ vector of random correlated observations generated by the simulation, $\bar{\mathbf{C}}$ is an $n \times 1$ vector of expected values for the variables being generated, \mathbf{A} is an $m \times n$ matrix of coefficients derived from the covariance matrix, and \mathbf{R} is an $n \times 1$ matrix of random standard normal deviates.

In order to generate log-normally distributed prices, the ratio of the February average price of the December cotton futures contract to each of the other prices is calculated. (Again, price series used in this study in addition to the February price of the December cotton futures contract include February prices on each of the other cotton futures contracts, the price at expiration of each cotton contract, the cotton MYA price, and the November cash price for cotton and soybeans.) The natural log of these ratios is then taken. Specifically,

$$(9) \quad PR_{ij} = \ln(FEBCTZ_i/P_{ij}),$$

where PR_{ij} is the natural log of a price ratio, $FEBCTZ_i$ is the i th observation of the February average price of the December cotton futures contract, and P_{ij} is the i th observation of price series j . This operation results in twelve series of normally distributed price ratios that can be simulated using the procedure described above.

Transforming the price data in this manner permits the development of a model in which the planting time December futures price for the base crop (in this case, cotton) can be treated as a known quantity. Other prices can then be calculated from the planting time December futures price by substituting the futures price and a simulated price ratio into Equation 9 and solving for P_{ij} . These prices, along with simulated yields, are used to calculate the cotton CCP, hedging returns, crop returns, and loan deficiency payments. To calculate the CCP, a cotton base of 1,000 acres with a program yield of 850 pounds per acre is assumed. To estimate net returns to crop production, cost of production is assumed to be \$450 per acre for cotton and \$75 per acre for soybeans (Mississippi State University).

Figure 3 provides a flowchart describing the structure of the simulation model. For a given planting time futures price, crop mix, and risk aversion level, model results indicate the hedge ratio (as a percent of base production) that maximizes the producer's certainty equivalent. This approach is consistent with the problem facing producers and landowners—who must

³ Cotton planting does not actually begin in February; however, decisions about what to plant are generally made at that time if not earlier. For this reason, the February price is more relevant in the context of this particular problem than a price from April, when planting would actually be occurring.

decide based on planting time price expectations what, if anything, to plant on base acres and what action to take, if any, to protect any expected CCP. Certainty equivalents are calculated using a constant relative risk aversion (CRRA) utility function. The CRRA utility function is represented mathematically as

$$(10) \quad E(U)_r = \sum_{i=1}^n \omega_i \frac{W_i^{1-r}}{1-r}, r \neq 1$$

or

$$(11) \quad E(U)_r = \sum_{i=1}^n \omega_i \ln(W_i), r = 1,$$

where $W_i = W_0 + NR_i$, r is a risk aversion coefficient, and ω_i is the weight associated with each observation i . Simulated ending wealth is represented by W_i , and initial wealth is represented by W_0 . Initial wealth is assumed to be \$250,000. NR_i represents total net returns and includes returns from crop production, hedging returns, counter-cyclical payments and loan deficiency payments. Utility values are calculated for risk aversion coefficients 1 and 2, with $r=1$ representing slight and $r=2$ representing moderate risk aversion.

By inverting Equation 10 or 11, certainty equivalents (CE) can be calculated at each hedge ratio. The CE represents the lowest sure price for which a decision maker would be willing to sell a risky prospect (Hardaker, Huirne, and Anderson). For any two alternatives i and j (in this case, alternative hedge ratios), if $CE_i > CE_j$, then alternative i is preferred to j .

Purchasing call options on the December cotton futures contract (CTZ) is investigated as the primary means of protecting anticipated CCPs. A simple decision rule is used to establish a strike price for the purchased call options. If the planting time futures price is above 57.80 cents per lb (i.e., the loan rate of 52.00 cents per lb plus the expected basis of 5.80 cents per lb), a strike price of 57.80 cents is selected. If the planting time futures price is above 57.80 cents per lb, the option is purchased at the money. This decision rule takes into account the fact that the CCP does not begin to decline until the MYA price rises above the loan rate. Thus, there is no need to protect against price increases until the MYA price equals the loan rate.

A fair options premium (i.e., a zero net return premium) is determined by calculating the net returns to a free call option and then dividing this net return by the pounds hedged. A transaction fee of 0.05 cents per cwt (\$25 per option) is charged on each round turn.

It is hypothesized that the optimal hedge ratio will be highest when the planting time futures price implies a MYA that is close to the loan rate. As expected prices decline below the loan rate, the hedge ratio should decline along with the probability of a price increase reducing the CCP. Alternatively, as prices increase above the target price, the likelihood of receiving any CCP declines and so hedging becomes irrelevant.

With respect to planting decisions, it is hypothesized that when cotton is planted on cotton base, the optimal hedge ratio will be close to zero since any price changes affecting the

CCP will have an offsetting effect on the value of the crop. On the other hand, if no crop is grown on the cotton base, the hedge ratio could be quite high since price changes affecting the CCP will not be offset by changes in crop value. When an alternative crop is grown on the base, the hedge ratio will depend on the correlation between prices of the base and alternative crops. The higher that correlation, the lower the optimal hedge ratio for the CCP. Regardless of what is grown on the base, the fact that yield risk is zero (since base acres and program yields are known with certainty) will mitigate in favor of a higher optimal hedge ratio.

Results

Optimal CCP hedge ratios were determined for the purchase of call options on the December cotton futures contract (CTZ). Since producers have the flexibility to plant any other program crop on cotton base acres, the effect of planting decisions on the optimal hedge ratio was examined. Optimal CCP hedge ratios were estimated for cotton, soybeans, a 50-50 mix of cotton and soybeans, and no crop planted on cotton base.

As mentioned, in the numerical simulation used in this study, the planting time price of CTZ is treated as a known quantity, and the optimal hedge ratio should be expected to vary with the level of this price. Figures 4 and 5 plot optimal hedge ratios at a series of alternative February prices on CTZ. Figure 4 assumes a risk aversion coefficient of $r=1$ (slight risk aversion), and figure 5 assumes a risk aversion coefficient of $r=2$ (moderate risk aversion). Results of the numerical simulation basically conform to the hypotheses outlined earlier. For all cropping alternatives, the optimal hedge ratio is zero at a sufficiently low price. Hedge ratios initially increase as the February price of CTZ increases, reaching a maximum at a February price of CTZ that is about equal to the loan rate. As prices continue increasing, the optimal hedge ratio declines to zero.

The highest optimal hedge ratio occurs, as expected, when no crop is planted on cotton base. Hedge ratios for soybeans on cotton base and 50-50 cotton and soybeans on cotton base are lower than for no crop but still follow the same basic pattern in relation to the February price of CTZ. For a slightly risk averse decision maker ($r = 1$), the optimal hedge ratio for cotton on cotton base is zero at any February price of CTZ. For a moderately risk averse decision maker ($r = 2$), a small amount of hedging is optimal at a February price of CTZ near the cotton loan rate.

Simulation was conducted to determine how the use of additional contract months would affect the optimal hedge ratio. Figure 6 illustrates optimal CCP hedge ratios for no crop on cotton base with the futures market position distributed across different contract months. The legend in this figure indicates what percentage of the futures market position associated with a given hedge ratio is taken in a given contract month. Distributing a futures position across contract months based on average monthly crop marketing percentages results in optimal hedge ratios that are not much different from simply using the December contract. Distributing the position across the October and December contracts did increase optimal hedge ratios but only slightly. When hedging using a single month, use of the December contract resulted in higher optimal hedge ratios than use of either October or March contracts.

Implications and Conclusions

The fact that farmers are, in some cases, being advised to “hedge” their government-provided price protection using market-based futures instruments must surely be one of the most surprising consequences of the 2002 Farm Bill. Results of this study do provide some justification for this development, indicating that under a fairly wide variety of circumstances related to expected prices, planting decisions, and decision-maker risk preferences, it is rational for producers to use futures instruments to hedge at least a portion of the CCP. On the other hand, these results indicate that the level of hedging that is optimal for most producers (at least using call options on the NYBOT) is probably much less than is currently being advised. Certainly when the base crop is planted on base acres, any significant level of CCP hedging makes little sense.⁴ In short, results of this study indicate that market advisors should be cautious in advising CCP hedges.

Aside from these implications for producers and their marketing consultants, results of this study have some important implications for policy makers. CCPs are technically decoupled so that landowners do not have to plant the base crop in order to receive a CCP. If low prices are expected for the base crop, a producer can plant an alternative crop (or no crop at all) while still receiving a CCP on the base crop. The dilemma for a producer is that if prices on the base crop rise, the CCP can decline (or disappear altogether). In this case, the producer will not get a CCP and also will not have a crop to sell at the higher market price. This situation represents a fairly strong incentive for landowners to plant the base crop on their base acres, calling into question whether or not CCP payments are truly decoupled. To the extent that producers can protect the CCP by some means other than planting the base crop, the CCP can be considered effectively decoupled. Results of this study indicate that producers do have some ability to protect the CCP using options, though that protection is by no means perfect.

Decoupling is an important issue because if the CCP is not effectively decoupled, then the program could have an unintended impact on the production of program crops. Moreover, the issue of decoupling remains important in international trade negotiations. If CCPs are perceived as distorting production, they will count toward the \$19.1 billion dollar cap on such payments under WTO rules.

Additional research is needed to extend the evaluation of CCP hedging strategies to other program crops. Further, the existence of CCPs and desire of producers to protect expected CCPs while maintaining full planting flexibility raises the possibility of developing some market-based instruments specifically designed to address CCP risk. Whether or not such instruments could be developed and whether or not producers and landowners would adopt the use of such instruments are topics for further research.

⁴ Indeed, a producer taking a long position in the futures market to protect the CCP on the base crop would likely also be inclined to take a short position in the same market to protect the cash crop. This obviously sub-optimal behavior stems from an attempt to optimize the individual components of total returns rather than simply optimizing total returns directly.

Table 1. Prices Used to Develop Simulation Model to Evaluate Cotton CCP Hedging with Call Options

Description of Price Series	Mean	Std. Dev.
Feb average price of Oct cotton futures	66.21	9.85
Nov average price of Oct cotton futures	64.84	13.51
Feb average of Dec cotton futures	65.23	8.93
Nov average of Dec cotton futures	64.80	12.49
Feb (planting year) average of Mar cotton futures	67.32	12.09
Feb (marketing year) average of Mar cotton futures	67.11	13.69
Feb average of May cotton futures	68.01	11.86
Apr average of May cotton futures	68.36	15.60
Feb average of Jul cotton futures	68.42	11.43
Jun average of Jul cotton futures	69.77	14.93
Cotton MYA price	59.00	10.31
National average Nov cotton cash price	60.35	10.49
National average Nov Soybean price	5.83	1.08

Note: cotton prices in cents/lb; soybean prices in \$/bu.

References

- Adams, B.D., S. Betts, B.W. Brorsen. "Effects of Reduced Government Deficiency Payments on Post-Harvest Wheat Marketing Strategies." *Journal of Futures Markets* 20(2000): 243-263.
- Anderson, C.G. "Maximizing Returns Under the New Farm Program." In *Proceedings of the 2003 Beltwide Cotton Conference*, January 6-10, 2003, Nashville, Tennessee. National Cotton Council. Memphis, Tennessee: 2003.
- Anderson, J.D. and K.A. Zeuli. "The Revenue Risk of Value-Based Pricing for Fed Cattle: a Simulation of Grid vs. Average Pricing." *International Food and Agribusiness Management Review* 4(2001): 275-286.
- Benninga, S., R. Eldor, and I. Zilcha. "Optimal Hedging in the Futures Market Under Price Uncertainty." *Economic Letters* 13, Nos. 2-3(1983): 141-45.
- Clements, A.M., H.P. Mapp, and V.R. Eidman. "A Procedure for Correlating Events in Farm Firm Simulation Models." Stillwater, Oklahoma: Oklahoma State University, Experiment Station Bulletin T-131, 1971.
- Collins, K.J. and G.W. Glauber. "Will Policy Changes Usher in a New Era of Increased Agricultural Market Variability?" *Choices* 2nd Quarter 1998.
- Glauber, J.W. and M.J. Miranda. "Price Stabilization, Revenue Stabilization, and the Natural Hedge." Columbus, OH: The Ohio State University, Department of Agricultural, Environmental, and Development Economics, 1996. Photocopied.
- 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(1999): 449-459.
- Hardaker, J.B., R.B.M. Huirne, and J.R. Anderson. *Coping with Risk in Agriculture*. CAB International. New York: 1997.
- Krzanowski, W. J. *Principles of Multivariate Analysis: A User's Perspective*. Oxford University Press. New York: 1988.
- Mississippi State University. Delta 2003 Planning Budgets. Budget Report 2002-010. Mississippi State University Department of Agricultural Economics. Starkville, Mississippi: December 2002.
- Naylor, T.H., J.L. Balintfy, D.S. Burdick, and K. Chu. *Computer Simulation Techniques*. John Wiley and Sons, Inc. New York: 1966.

- Scott, S.H. "Protect the Counter-Cyclical Payment." *Delta Farm Press*, March 14, 2003, p. 22-23.
- Trapp, J.N. "Simulation and Systems Modeling." Pp. 128-188 in L. Tweeten, ed., *Agricultural Policy Analysis Tools for Economic Development*. Westview Press. Boulder, Colorado: 1989.
- 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.
- USDA-NASS. *Agricultural Prices*. Washington DC: Various Issues, 1975-2002.
- Zuniga, M.G. "Evaluation of New and Traditional Risk Management Tools in U.S. Agricultural Sector." M.S. Thesis. Department of Agricultural Economics, Mississippi State University, Starkville, Mississippi: 2001.

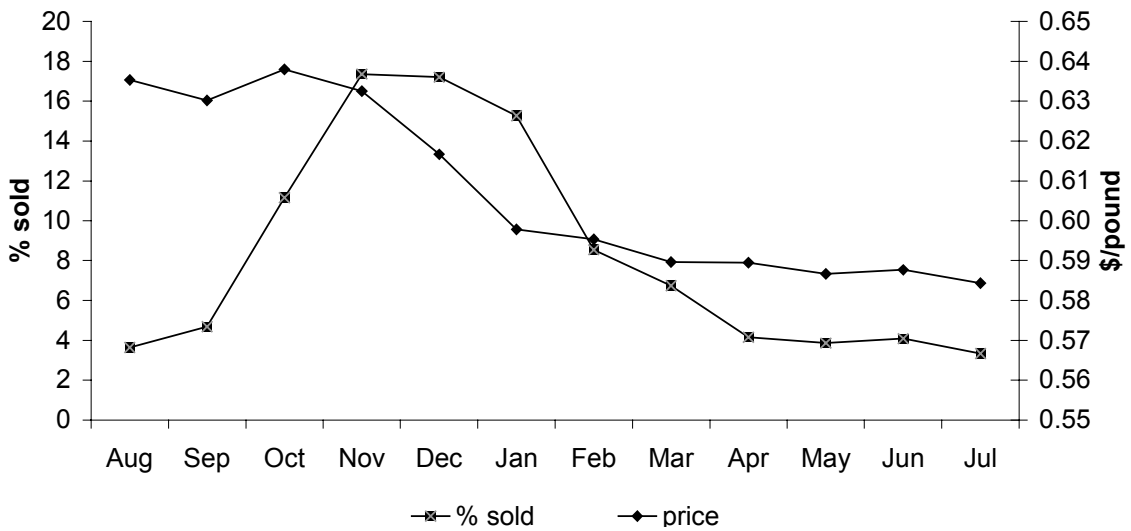


Figure 1. Average monthly cotton prices and marketings: 1995/96 – 2001/02

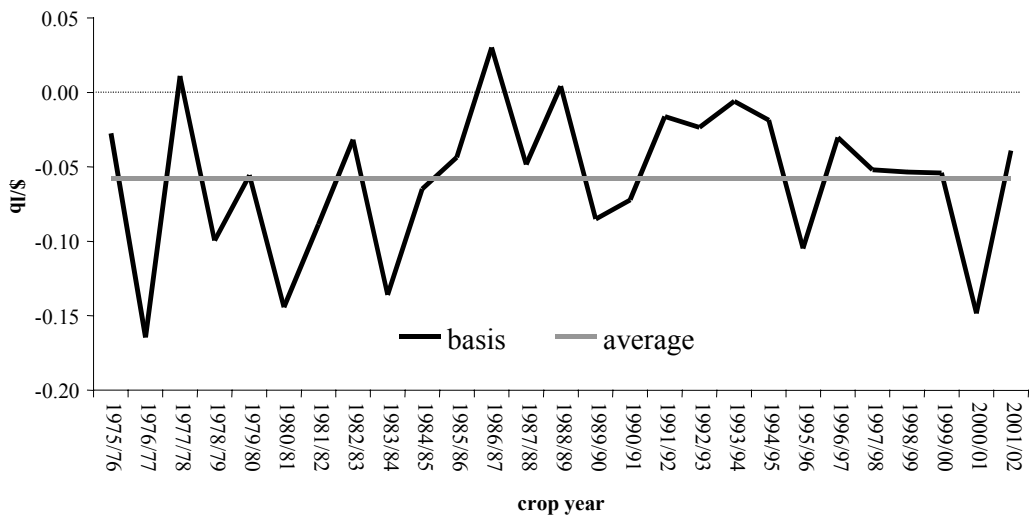


Figure 2. Basis between NYBOT Dec Cotton and U.S. MYA price

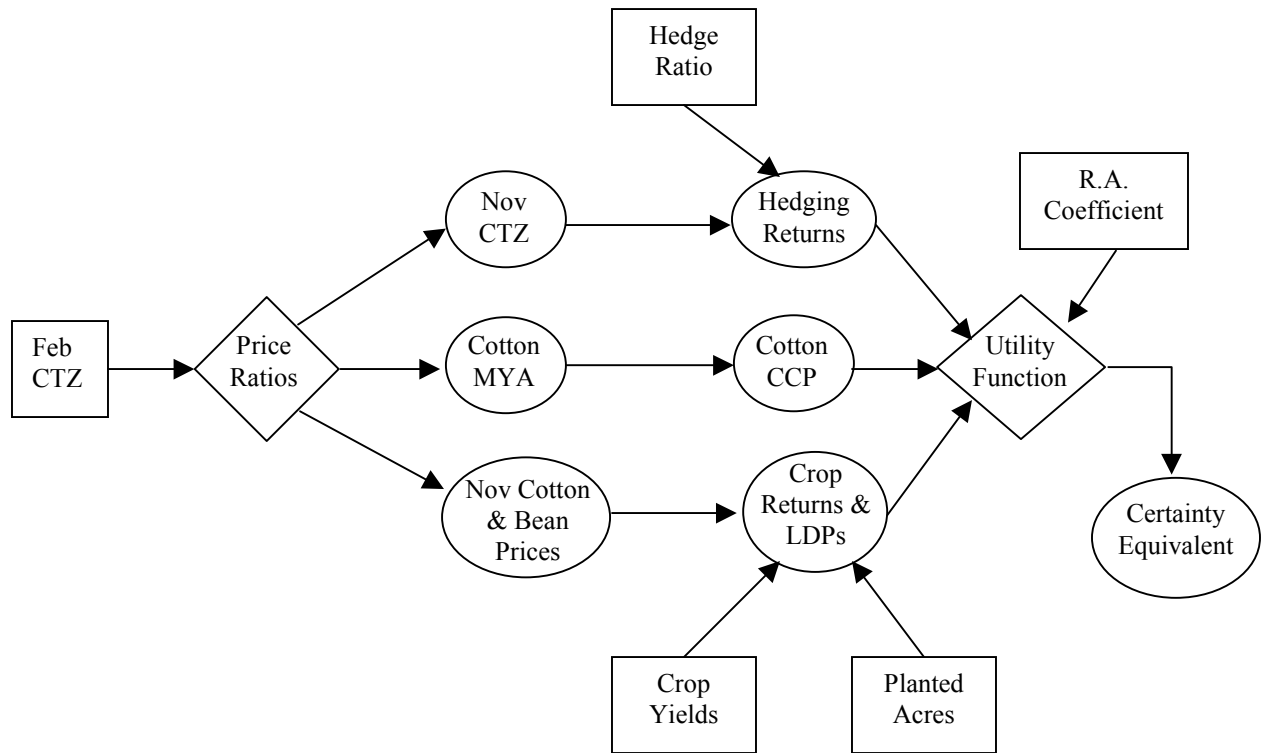


Figure 3. Structure of simulation model to evaluate cotton CCP protection strategies

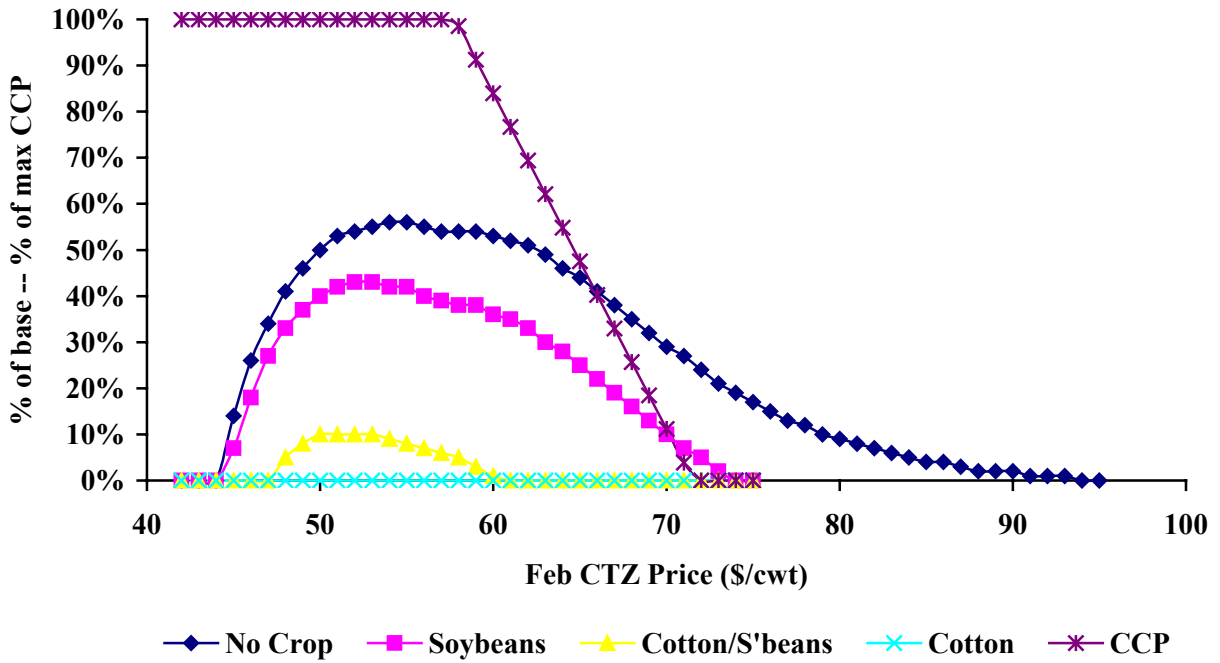


Figure 4. Optimal CCP hedge ratios for a slightly risk averse decision maker ($r = 1$) assuming different planting decisions

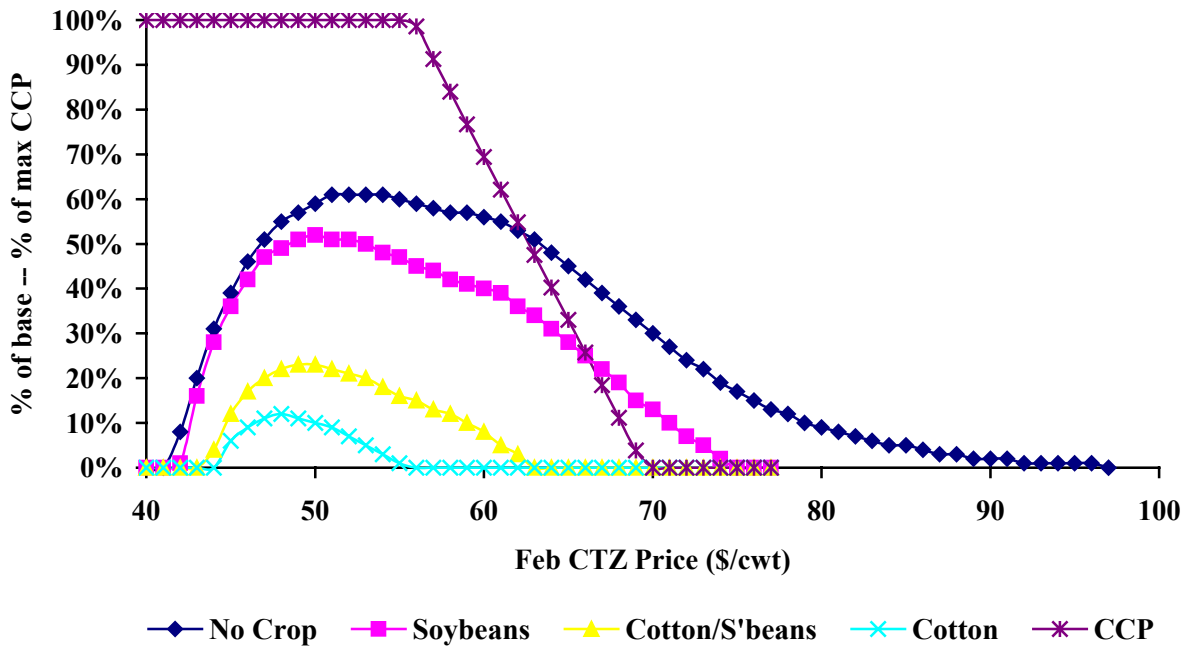
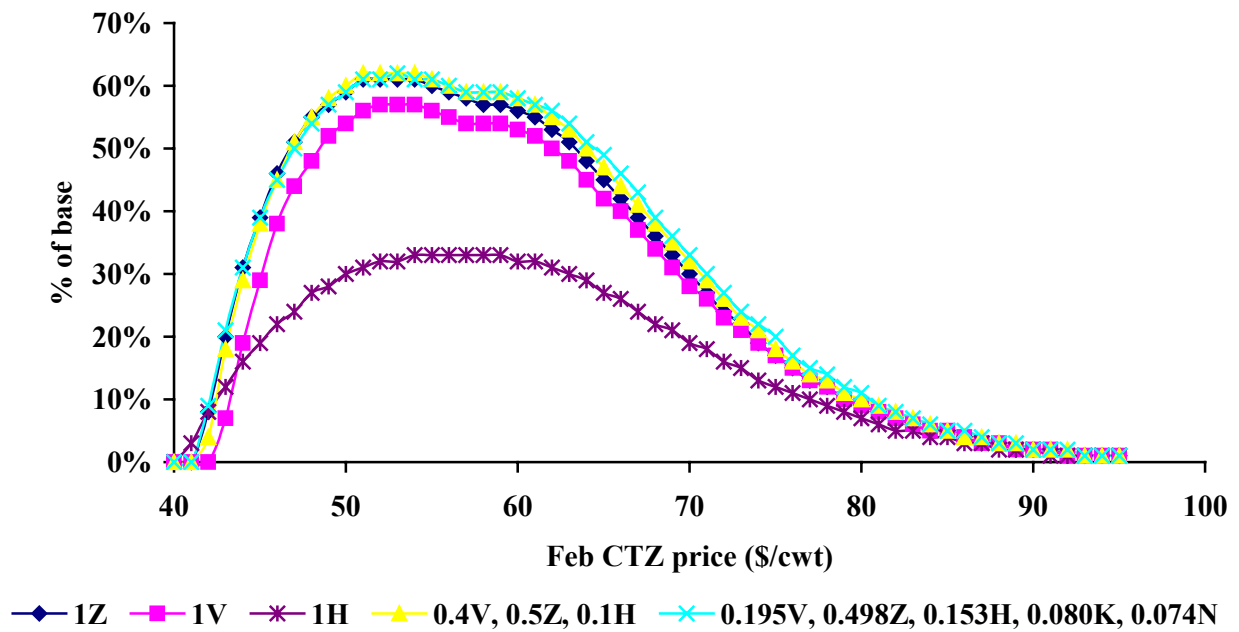


Figure 5. Optimal CCP hedge ratios for a moderately risk averse decision maker ($r = 2$) assuming different planting decisions



Note: H = Mar, K = May, N = July, V = Oct, and Z = Dec

Figure 6. Optimal CCP hedge ratios using multiple contract months for a moderately risk averse decision maker ($r = 2$) assuming no crop planted on cotton base