FS 01-09 January, 2001

MANAGING PRICE RISK IN COTTON PRODUCTION USING STRATEGIC ROLLOVER HEDGING

Steven C. Turner and Vahe Heboyan

FS 01-09 January, 2001

MANAGING PRISK RISK IN COTTON PRODUCTION USING STRATEGIC ROLLOVER HEDGING

Steven C. Turner and Vahe Heboyan (*)

Paper presented at

Southern Agricultural Economics Association

Annual Conference, Fort Worth, TX

January 29, 2001

(*) Professor and Graduate Research Assistant, respectively, Department of Agricultural and Applied Economics, The University of Georgia, 306 Conner Hall, Athens, GA 30602-7509; Phone: (706) 542 0856; Fax: (706) 542 0739; email: vheboyan@agecon.uga.edu

Dept. of Agricultural & Applied Economics
College of Agricultural & Environmental Sciences
The University of Georgia

MANAGING PRICE RISK IN COTTON PRODUCTION USING STRATEGIC ROLLOVER HEDGING

Steven C. Turner and Vahe Heboyan

Department of Agricultural and Applied Economics
University of Georgia
Athens, GA 30602-7509
vheboyan@agecon.uga.edu

ABSTRACT

Research on rollover hedging for agricultural commodities has focused on the consequences of using existing contracts to substitute for missing long-term contracts. It appears that some grains are candidates for rollover hedging while livestock is not. Cotton was analyzed to evaluate the effectiveness of rollover hedging from 1982 to 1999. This paper demonstrates that strategic rollover hedging can be used as a substitute for missing long-term futures market and increase expected returns in cotton production. The estimated results reported average returns of 62.22, 65.36, 75.80, 79.09, and 69.14 cents per pound for cash sale, single-year hedge, 5, 2.5, and 1% three-year strategic rollover hedging strategies, respectively. Thus, it appears returns for three-year strategic rollover hedging were about 20% higher than under the other two strategies.

Key Words: Strategic Rollover Hedging, Cotton, Price Risk Management

Managing Price Risk in Cotton Production Using Strategic Rollover Hedging

Steven C. Turner and Vahe Heboyan*

ABSTRACT

Research on rollover hedging for agricultural commodities has focused on the consequences of using existing contracts to substitute for missing long-term contracts. It appears that some grains are candidates for rollover hedging while livestock is not. Cotton was analyzed to evaluate the effectiveness of rollover hedging from 1982 to 1999. This paper demonstrates that strategic rollover hedging can be used as a substitute for missing long-term futures market and increase expected returns in cotton production. The estimated results reported average returns of 62.22, 65.36, 75.80, 79.09, and 69.14 cents per pound for cash sale, single-year hedge, 5, 2.5, and 1% three-year strategic rollover hedging strategies, respectively. Thus, it appears returns for three-year strategic rollover hedging were about 20% higher than under the other two strategies.

Key Words: Strategic Rollover Hedging, Cotton, Price Risk Management

---

* Associate Professor and Graduate Research Assistant, respectively, Department of Agricultural and Applied Economics, The University of Georgia, Athens, Georgia, 30602-7509.

Introduction

The large price volatility in major crops, such as corn and soybeans, puts pressure on grain producers' pricing decisions every season. The timing of hedging decisions is crucial. Sometimes, futures prices increase to historically high levels. These historical high prices give valuable pricing opportunities for producers. Producers may benefit from locking in high prices for several years' production, which will generate above average profits (Kenyon and Beckman, 1997).

In 1998, cotton prices increased from four-year lows to two year highs The October futures increased from a low 65.6 cents per pound in early April to 75.6 cents per pound on July 15, 1998. Some farmers in Mississippi and Arkansas took advantage of these favorable prices due to the unfavorable weather conditions in Texas and California, United States' two largest cotton-growing states. A drought destroyed a third of cotton fields in Texas causing an estimated loss in the amount of $500 million. Heavy rains delayed the Californian cotton harvest season by two months. As a result, these cotton growers faced the lowest crop since 1990 (Anderson, 1998).

The two main purposes of hedging are (1) to reduce the volatility of returns, and (2) to lock in a favorable price when the opportunity comes (Gardner, 1989). In the last decade cotton production has increased dramatically in the southeastern United States. Consequently, price risk management has again become important. Threfore, the objectives of this paper are: (1) to analyze alternative marketing strategies for U.S. cotton producers; (2) to examine their potential use for improving profitability of cotton production; (3) and particularly, examine sequential rollover and strategic hedging strategies to protect cotton producers against price variability and reduce price risk.

Literature Review

The futures and option markets provide powerful tools for managing commodity price risk. Many authors have examined using futures contracts to hedge against price variability.

The absence of long term price insurance in agricultural production and substantial variation of prices over the years necessitates looking for alternative marketing strategies to substitute for missing long term price management.

Gardner (1989) examined price risk management opportunities for corn, cotton, and soybeans using rollover-hedging techniques from 1972 to 1987. Based on the comparisons of the expected returns and variances of the alternative strategies, Gardner made the following suggestions:

a. In the absence of bias or trends in futures prices, using sequential rollover hedging techniques yields the same expected returns as cash sales, annual future sales, or a multi-year futures contract. But the transaction costs are higher for sequential rollover hedging.
b. In a long chronology of routine hedges, the ability of hedging technique to reduce the variance of returns is not predictable, and sequential rollover hedges are the most unpredictable.
c. With respect to the ability to lock in a price for any given n-year period, rollover hedging techniques are more predictable.

His findings suggest that rollover-hedging techniques would be effective as an initial price for a three to six year period but would be ineffective in routine rollover hedging over a series of successive three to six year periods.

Huang et al. (1994) extended Gardner's routine rollover hedges that were executed irregardless of price levels by assuming producers would only hedge if prices were favorable. They developed strategies that would use seven years historical price distributions to define and determine favorability. Expected returns were computed for corn, soybeans, and feeder cattle three and five year hedges for the 1982-1991 period. They found both three and five year rollover hedging to be profitable for corn and soybeans but not for feeder cattle.

Kim and Conley (1995) examined rollover hedges for corn, soybeans, and wheat from 1973 to 1992. They found a four-year hedge to generate the highest returns for all three commodities.

Kenyon and Beckman (1997) also examined rollover hedging applied to corn and soybeans using data from 1974 to 1993. Results again confirmed the profitability of rollover hedging in these markets. They suggest, "future research should focus on individual commodity characteristics and market dynamics that determine whether or not these strategies will be successful in the long run" (p. 933).

French and Turner (1990) assumed that producers would hedge long term only if prices are "favorable," tried selective rollover hedging as a practical mechanism to increase average returns. A selective hedging decision rule based on EX ANTE information was developed and examined. They utilized the distribution of futures prices to identify opportunities to lock in a favorable price above the average multi-year price over an extended time period. The hedger would take advantage of the volatility of futures prices and enter into futures contracts when prices are at the upper tail of the

distribution of multi-year futures prices. In their paper, French and Turner used 1, 2.5, 5, 7.5, and 10% of the upper tail of the distribution.

Data

Two kinds of data for cotton are used in the paper. Cotton average monthly cash prices at Memphis, Tennessee (cents/ lb.) for 1981-1997 are obtained from Datastream International Ltd. Prices for 1998 and 1999 are obtained from the Wall Street Journal. December futures prices for cotton from 1974 to 1999 are used in this paper. The data are obtained from PROPHET database (Prophet, 1999) and the Wall Street Journal.

Distribution

In order to develop multiple-year pricing strategies we first of all need to determine the historical futures price distributions. In this paper we used daily closing December Cotton futures prices for 1974-1999.

Seven years of historical, daily, futures prices are used to develop a distribution. For example, 1974-1980 data are used to determine whether to hedge in 1981 or not. Each following year, the oldest year's data is deleted from the distribution and the newest year's data is added. Thus, a moving seven-year distribution is used in the analysis.

Table 1 shows summery statistics for the futures price distributions. The table also reports the exact futures prices associated with the top 5, 2.5, and 1% levels of historical distributions.

The 1, 2.5, and 5^{th} percentile in the distribution are used as a futures market entry signal. For example, the producer will enter into futures contract on the date when

December cotton futures price is above 80.9, 88.3, and 91.01 cents per pound for 5, 2.5, and 1 percentile distributions, respectively. The contracts are closed at harvest and rolled over. Table 2 reports the years associated with favorable futures market entry conditions, entry price, and the entry date.

For strategic rollover hedging the producer can experience large losses if futures prices increase significantly after entering the production hedge for several years. In order to prevent this, an pre-harvest exit rule is adopted. According to that rule the producer will lift the hedge if prices increase by more than 5% of the entry price.

Pricing Procedures

In our paper we assume that the producer is expected to harvest 50,000 pounds of cotton each year. We will use this assumption to implement our designed strategies: cash sale at harvest, single year hedging, and strategic three-year rollover hedging. The first scenario will take place at harvest time of each year by selling the crop at the cash market price. For this we chose monthly cash prices at Memphis. The second scenario (single year hedging) will be implemented by entering into futures contracts (sell) on May 10 or the first following available date of each year and exiting at the time when the crop is sold in the cash market. May 10 represents the first release by USDA of production information. For the rest of the analysis we will use November 15 or the first following available date of each year as exit date for futures contracts. The producer will take positions for three-year strategic rollover hedging in those years which are favorable for hedging (Table 2). For example, assume the strategy is implemented for year 1981. On August 25, 1980 the producer will sell three cotton December 1981 futures contracts. At

harvest in 1981, the three December 1981 contracts would be offset, and two December 1982 contracts would be sold. At harvest in 1982, the two December 1982 contracts would be offset, and a December 1983 contract would be sold and then at harvest in 1983 it would be bought back. According to the established rule, the producer will lift the hedge if prices increase by more than 5% of the entry price. Then when prices decline to the initial level new positions would be taken in the futures market, as it is describe above. Later we will analyze these three strategies based on their effectiveness. If market conditions are favorable in consecutive years (in our case 1994-1996) we assume that maximum of three of the same contracts may be purchased.

Cotton Single-Year Hedging Results

The results of the strategies are illustrated in Table 3. The second column of the table represents the price that the producer gets selling the crop in the cash market at harvest. The results show that the returns to the producer are volatile due to the cash price volatility in 1981-1999.

The third column illustrates the net prices that the producer locks in using single year hedging. Single-year hedge is implemented as it was discussed above. The producer entered into futures contract on May 10 of each year and lifted the contract at the time when the crop was sold. For most of the years the single-year hedge provides higher returns to the producer compare to cash sale. The higher return (i.e. returns in the years that were higher than the comparing strategy) single-year strategies provide in average 14% higher returns in comparison to cash sale.

Cotton Strategic Three-Year Rollover Hedging Results

Columns 4-6 of table 3 illustrate results for strategic three-year rollover hedge at 5, 2.5, and 1-percentile levels of distribution. The three-year 5% strategy is implemented in 1981, 1991, 1994, 1995, and 1996. The three-year 2.5 % strategy is implemented in 1991, 1994, 1995, and 1996, and the 1% strategy is exercised in 1994 and 1995. The net and average prices by strategy are reported in columns 4-6 in table 3. For most of the cases the three-year strategic rollover hedge provides higher returns to the producer than previous two strategies. Results show that the higher return three-year strategies provide in average 40.64, 33.55, and 6.58% higher returns in comparison to cash sale for 5, 2.5, and 1% levels, respectively. In respect to single year hedge, three-year strategic rollover hedge provides 25.43, 17.17, and 5.51% higher returns for the 5, 2.5, and 1% levels, respectively.

Conclusions and Discussion

Based on the estimated results, both single-year and three-year strategic rollover hedges improve producer returns but they are associated with higher risk. The average returns for the three strategies for the exercised periods show that single-year and three-year strategic rollover hedges yield higher returns than a cash sale at harvest.

The conducted analysis has yielded the following results for the years 1981-1999. The cash sale strategy yielded average returns of $0.6222/ lb. with a standard deviation of $0.0997. A single year hedging strategy yielded average returns of $0.6536/ lb. with a standard deviation of $0.1097. For the three-year strategic rollover hedging strategy the average prices were $0.7580, 0.7909, and 0.6914/ lb. with a standard deviation of

$0.2135, 0.1814, and 0.1059 for 5, 2.5, and 1% levels, respectively. Thus, it appears returns for three-year strategic rollover hedging were about 20% higher than under the other two strategies.

This paper provides evidence for future research on using strategic rollover hedging strategies as price risk management mechanisms. The high volatility in futures prices may be used to lock in favorable prices over a multiyear period. Further research may also be used to determine other storable and non-storable commodities that are appropriate for strategic rollover hedging.

Table 1. December Cotton Futures Price Distributions, 1981-1999

Year	*Contracts Included*	*Number of observations*	*Price at 1% upper tail of distribution*	*Price at 2.5% upper tail of distribution*	*Price at 5% upper tail of distribution*	*Mean for the period*
1981	1974-80	2578	91.01	88.30	80.90	61.92
1982	1975-81	2570	91.01	88.30	84.27	65.21
1983	1976-82	2555	91.01	88.35	84.27	68.36
1984	1977-83	2554	91.01	88.35	84.10	69.71
1985	1978-84	2554	91.01	88.35	84.10	71.06
1986	1979-85	2540	91.16	88.35	84.10	71.73
1987	1980-86	2560	91.01	88.35	84.10	68.86
1988	1981-87	2572	84.55	83.56	82.20	66.29
1989	1982-88	2587	80.70	79.82	78.50	63.87
1990	1983-89	2592	80.65	79.47	77.31	62.82
1991	1984-90	2593	77.30	75.96	75.33	62.07
1992	1985-91	2591	76.63	75.45	74.42	61.36
1993	1986-92	2605	76.49	75.44	74.42	60.89
1994	1987-93	2606	76.49	75.44	74.42	62.89
1995	1988-94	2610	76.20	75.36	74.34	64.22
1996	1989-95	2605	86.43	82.86	78.95	66.49
1997	1990-96	2601	86.43	83.53	80.54	68.26
1998	1991-97	2725	86.36	83.19	80.43	69.58
1999	1992-98	2850	86.20	82.98	80.12	70.54

Table 2. Futures Market Entry Opportunities for Strategic Rollover Hedging for 1981-1999

Year	*Cont-racts Included*	*Price at 5% upper tail of distribution*	*Entry price for 5% Distribution (Date)*	*Price at 2.5% upper tail of distribution*	*Entry price for 2.5% Distribution (Date)*	*Price at 1% upper tail of distribu-tion*	*Entry price for 1% Distribution (Date)*	*Mean for the period*
1981	1974-80	80.90	81.49 (80/08/25)	88.30	na*	91.01	na	61.92
1982	1975-81	84.27	na	88.30	na	91.01	na	65.21
1983	1976-82	84.27	na	88.35	na	91.01	na	68.36
1984	1977-83	84.10	na	88.35	na	91.01	na	69.71
1985	1978-84	84.10	na	88.35	na	91.01	na	71.06
1986	1979-85	84.10	na	88.35	na	91.16	na	71.73
1987	1980-86	84.10	na	88.35	na	91.01	na	68.86
1988	1981-87	82.20	na	83.56	na	84.55	na	66.29
1989	1982-88	78.50	na	79.82	na	80.70	na	63.87
1990	1983-89	77.31	na	79.47	na	80.65	na	62.82
1991	1984-90	75.33	75.90 (91/05/20)	75.96	76.05 (91/05/21)	77.30	na	62.07
1992	1985-91	74.42	na	75.45	na	76.63	na	61.36
1993	1986-92	74.42	na	75.44	na	76.49	na	60.89
1994	1987-93	74.42	74.47 (94/05/06)	75.44	75.94 (94/05/25)	76.49	76.56 (94/06/03)	62.89
1995	1988-94	74.34	74.45 (95/01/06)	75.36	75.64 (95/02/16)	76.20	76.35 (95/02/21)	64.22
1996	1989-95	78.95	79.43 (96/02/26)	82.86	83.56 (96/05/01)	86.43	na	66.49
1997	1990-96	80.54	na	83.53	na	86.43	na	68.26
1998	1991-97	80.43	na	83.19	na	86.36	na	69.58
1999	1992-98	80.12	na	82.98	na	86.20	na	70.54

* Not appropriate for market entry due to unavailability of entry prices as decided earlier

Table 3. Estimated Results from Different Strategies (for 50,000 lb. of Cotton to be harvested on November 15th of each year) for 1981-1999

Year	*Cash Sale*[a]	*Single Year Hedging*[b]	*SRH*[e] *5%*	*SRH 2.5%*	*SRH 1%*
1981	60.70	77.95	118.27 (85.12)[c]	ne[d]	ne
1982	58.13	67.66	74.49 (85.12)	ne	ne
1983	74.77	70.00	62.27 (85.12)	ne	ne
1984	63.17	76.18	ne	ne	ne
1985	56.72	60.98	ne	ne	ne
1986	43.30	32.86	ne	ne	ne
1987	63.47	61.10	ne	ne	ne
1988	52.75	55.21	ne	ne	ne
1989	70.07	65.23	ne	ne	ne
1990	68.29	62.58	ne	ne	ne
1991	55.83	70.16	110.37 (75.92)	110.82 (76.07)	ne
1992	49.93	54.68	63.39 (75.92)	63.39 (76.07)	ne
1993	56.67	59.18	54.00 (75.92)	54.00 (76.07)	ne
1994	68.94	68.76	68.55 (70.20)	72.96 (80.90)	74.82 (69.14)
1995	83.33	75.73	50.07 (70.20)	75.86 (80.90)	53.37 (69.14)
1996	70.22	80.07	74.81 (70.20)	98.10 (80.90)	72.62 (69.14)
1997	70.27	74.12	81.23 (70.20)	81.23 (80.90)	75.75 (69.14)
1998	66.56	70.73	76.34 (70.20)	76.34 (80.90)	ne
1999	49.06	58.70	ne	ne	ne

[a] Data for 1981-1997 are obtained from Datastream International Ltd. They represent November average monthly cotton cash prices at Memphis, Tennessee (cents/lb.). Prices for 1998 and 1999 are obtained from *Wall Street Journal*.

[b] The price locked in using single-year hedging (cents/lb.). December 1981-1998 futures quotations are obtained from Prophet database, and December 1999 quotation is obtained from *Wall Street Journal*.

[c] The value in the parenthesis represents the average for three- to five-year rollover hedge (depending on the consequence; for this example, it is the average for 1981-1983 rollover hedge).

[d] The strategy is not exercised.

[e] Strategic rollover hedging.

References

Anderson, S. “Why Cotton Farmers Are in Tangle.” Business Week, No. 3588, July 27, 1998.

Datastream International Ltd., 1998.

French, N. R. and S. C. Turner. “Futures Price Volatility and Opportunities for Selective Rollover Hedging: The Case of Soybeans,” Unpublished manuscript, University of Georgia, Athens, 1990.

Gardner, B. L. “Rollover Hedging and Missing Futures Markets.” *American Journal of Agricultural Economics*, 71 (1989): 311-318.

Huang, B., Turner, S. C., and Houston, J. E. “Pricing Agricultural Commodities Using Strategic Rollover Hedging,” unpublished manuscript, University of Georgia, Athens, 1994.

Kim, H. S., and Conley, D. M. “Long-Term Hedging Possibilities for Corn, Soybeans, and Wheat,” Selected paper for the annual meeting of the Southern Agricultural Economics Association, New Orleans, LA, 1995.

Kenyon, D. E, and Beckman, C. V. “Multiple-Year Pricing Strategies for Corn and Soybeans.” *The Journal of Futures and Options Markets*, 17 (December 1997): 909-934.

Prophet. “Historical Futures Data- All Markets, 1959-present,” Prophet Financial Systems, Inc., 1999. http://www.ProphetFinance.com .

Wall Street Journal. “Futures Prices.” *The Wall Street Journal*, November 15, 1999.

_____. “Cash Prices. ” *The Wall Street Journal,”* November 16, 1998 and November 15, 1999.