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New Hedging Techniques to Reduce Cotton Price Risk

by
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The futures market provides an effective medium for mitigating price risk, but it sometimes functions imperfectly. This article illuminates these market imperfections and shows how to reduce price risk by avoiding them.

Commodity prices are notoriously volatile, which makes it difficult for agricultural producers to plan effectively. For example, at the beginning of the planting season in March 2001, the San Joaquin Valley (SJV) cotton price was $0.51 per pound. Growers who expected that price to persist would have been surprised when their product was only worth $0.36 in December of that year. This article illustrates how to protect against such price fluctuations using the futures market and how a futures hedging strategy that focuses on the fundamental value of cotton can further reduce price risk.

New York Board of Trade Cotton Futures

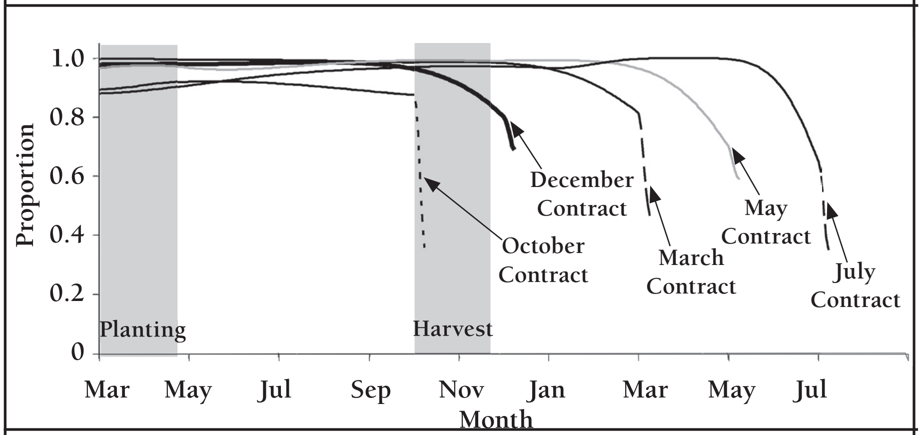
Futures contracts enable the purchase or sale of a commodity at a fixed price in a particular month in the future. For example, consider a California cotton grower. On March 1, 2001, this grower could have gone to the New York Board of Trade (NYBOT) and entered a futures contract to sell cotton in December of that year for $0.56 per pound. Growers holding such a contract can deliver the product to one of five locations: Galveston TX, Greenville SC, Houston TX, Memphis TN and New Orleans LA. These locations are all inconvenient for our California grower because of shipping costs and the availability of willing buyers in California.

Instead of delivering on the futures contract, our California grower could have canceled it by entering a futures contract to buy exactly the same quantity of cotton in December. On December 1, 2001, the futures price was $0.35. By effectively buying for $0.35 and selling for $0.56, the grower would have made a profit of $0.21 per pound. If this grower then sold in the SJV at the December market price of $0.36, the grower's revenue would have been 0.36 + 0.21 = $0.57 per pound, which only differs by $0.01 from the price that was expected when the grower first entered the futures contract in March.

This example shows a case where the cotton price decreased during the growing season, but the use of futures caused a grower's returns to be relatively unaffected. Instead, if cotton prices had increased in 2001 the grower would have been able to sell for a high price in the SJV but would have made a loss in the futures market, again ending up with revenue close to what was expected at planting time. Thus, using futures markets to hedge price risk enables growers to make decisions with better information about the likely outcomes from those decisions. In years when prices are high, growers could lock in those high prices at the time of planting and may choose to plant more acres. On the other hand, when futures prices are low, growers may choose to plant less cotton.

Also in this issue.........

Figure 1. Proportion of Future Price Variation Related to the Fundamental



Note: Curves generated using daily settlement prices on all NYBOT futures contracts traded between 1991 and 2000.

How Well Does the Futures Market Work?

In the preceding example, our grower's revenue differed by $0.01 from what was expected in March because the December SJV price was $0.36 and the December futures price was $0.35. This price difference is known as the *basis*; the most effective hedging strategies yield a basis as close as possible to zero as often as possible. The basis depends on how the SJV and futures prices each relate to the fundamental value of cotton at the delivery locations. The fundamental value is the market price that would exist if there were no costs of transporting cotton to the delivery locations and if there were always plenty of buyers and sellers in the market. Hedgers can reduce basis risk by choosing a futures contract that is closely related to the fundamental.

Because growers can choose to sell their product at the time when prices are highest, the prices of futures contracts for different delivery dates should move together. If the price on a particular futures contract does not move in step with the others, then this contract is not priced correctly and should not be used for hedging. To determine the extent to which futures prices move together within crop years, I used a dynamic statistical model. This model computes the proportion of the variation in futures prices that is associated with variation in the fundamental. Figure 1 presents this proportion for a typical crop year from the beginning of planting season through the end of the marketing season for each of the five annual NYBOT contracts.

Prior to harvest, the December, March, May and July contracts all move closely with the fundamental, as indicated by the curves in Figure 1 being close to one for these contracts during this period. The October contract performs the worst of all and is thus an inferior hedging tool. After harvest, the December, March, May and July contracts perform well until about two months before delivery when they begin to deviate from the fundamental. Such deviations arise just before delivery because of the high cost of transporting cotton for delivery at short notice and because there tend to be fewer traders in the market at this time. A small number of traders implies that hedgers are unlikely to find someone in the market who is willing to trade with them at the fundamental price. Thus, a California grower who intends to sell locally should cancel out a futures position at least two months before the contract comes to delivery.

Hedging Strategy Performance

Suppose that growers make four hedging decisions each year depending on whether they intend to sell in December, March, May or July. At the beginning of planting,

Figure 2: Hedging Example: Dec 2000-March 2001

The best hedging strategy is the one that yields revenue the closest to the expected selling price. In December 2000, the expected March 2001 price was $0.676 per pound.

Traditional Hedge (uses March 01 futures contract)

Dec 00	Mar 01
0.676	0.531

Futures Profit	(0.676 – 0.531)	0.145
SJV Selling Price		0.508
Total Revenue		0.653
Prediction Error		-3.4%

Fundamental Hedge (uses May 01 futures contract)

Dec 00	Mar 01	May 01
0.690	0.538	

Futures Profit	(0.690 – 0.538)	0.152
SJV Selling Price		0.508
Total Revenue		0.660
Prediction Error		-2.4%

the grower decides how to hedge cotton to be sold after the harvest in December. This type of hedge is known as a production hedge. In December, March and May, a grower decides how to hedge cotton for sale in March, May and July. These latter three hedges are known as storage hedges.

In each of the 12 years from 1992-2003, I compared a hedging strategy that minimizes deviations from the fundamental to the alternatives of (a) not hedging, and (b) traditional hedging. I calculated the percentage difference between revenue received in each year and the price that was expected at the time the hedging decision was made. I refer to these percentage differences as prediction errors. These prediction errors average close to zero for all three hedging strategies.

Table 1. Performance of Three Hedging Strategies for SJV Growers

	Production	*Storage*		
	Planting–Dec.	Dec.–Mar	Mar–May	May–July
Standard Deviation of Prediction Errors				
No Hedge	15.0	17.3	14.9	14.9
Traditional	7.3	6.8	6.2	7.1
Fundamental	6.8	6.3	6.3	
Largest Prediction Error				
No Hedge	–35.7	–38.5	–24.7	–31.8
Traditional	–12.8	–13.2	–11.3	–10.3
Fundamental	–10.4	11.8	–9.4	

Note: SJV prices are USDA market news prices and futures prices are settlement prices on the 1st day of the relevant month. Planting is defined as March 1.

Traditional hedging uses the futures contract that comes to delivery in the month a grower intends to sell. Based on the information in Figure 1, fundamental hedging uses the next contract that comes to delivery after the intended month of sale. Figure 2 illustrates traditional and fundamental hedges for a grower storing cotton between December 2000 and March 2001. Relative to the expected March 2001 price of $0.676, the fundamental hedge generates a 2.4 percent prediction error, which is smaller than the 3.4 percent error of the traditional hedge.

The most effective hedging strategies are those with the most prediction errors close to zero. I measured closeness to zero by the standard deviation of the prediction error around its mean value and by the largest prediction error in the 12-year period. These measures are presented in Table 1. To interpret the standard deviations, we can use the statistical rule of thumb that in approximately one out of every three years, the prediction error will exceed the standard deviation. For example, for growers who do not choose to hedge production, one third of prediction errors are likely to be greater than 15 percent.

Table 1 shows that traditional hedging markedly reduces price risk relative to not hedging. The standard deviation for production hedging is 7.3 percent compared to 15 percent for a strategy of no hedging. Similarly the standard deviation for the traditional storage hedge is less than half as much as the standard deviation for no hedging. The worst year for those who did not hedge during production resulted in a 35.7 percent prediction error. In contrast, the worst year for traditional hedgers generated a 12.8 percent prediction error. The storage hedges show similar performance improvements.

The fundamental hedging strategy causes further reductions in the standard deviation of the prediction errors. For the production hedge and the first storage hedge, the standard deviation drops by 0.5 when fundamental hedging is used instead of traditional hedging, although it increases slightly for the second storage hedge. The largest prediction errors for the fundamental hedging are all smaller than for traditional hedging; the worst year for fundamental production hedging resulted in a 10.4 percent error compared to 12.8 percent for traditional hedging. Fundamental hedging cannot be used for the May to July storage period because the July contract is the last one in the crop year.

Conclusion

In two out of every three years, a fundamental production hedger will receive revenue within 6.8 percent of what was expected at planting time. For post-harvest storage, two out of every three years will yield revenue within 6.3 percent of what was expected at the beginning of the storage period. The fundamental hedging strategy improves upon traditional hedging by allowing a grower to avoid imperfections in the futures market close to the delivery month.

For details on the dynamic statistical model that generated Figure 1, the author recommends the following reading:

Smith, A. (2004), "Partially Overlapping Time Series: A New Model for Volatility Dynamics in Commodity Futures," available at http://asmith.ucdavis.edu.

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