Trends in U.S. Cotton Basis Since 2001

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Abstract

Price volatility in 2008 generated interest in underlying cotton cash and futures markets and highlighted the importance of market participants' expectations about basis changes over time in production, marketing, and hedging decisions. This analysis examines trends in average U.S. cotton basis and changes in the convergence of cash and futures prices as cotton futures contract expiration dates near between 2001 and 2008 to provide perspective for the average basis movements experienced in 2008. Though this analysis does not identify the factors leading to differences in average convergence paths since 2001, it finds that, while average cotton cash and futures prices converged in all years, the pattern in 2008 was significantly different from the other sample years.

Keywords: cotton, futures, spot prices, basis

Contents

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Introduction

As a reflection of an unpredictable world economy, commodity prices have become particularly volatile. One aspect of this volatility has been the periodic divergence of futures and cash markets from past relationships. As a result, the basis (i.e., the spread between futures contracts[1] prices and cash markets prices) has been even more unstable than the underlying prices. Futures markets serve the public good through price discovery, and the ability to hedge on this market is critical for cotton and textile producers around the world. The ability to predict basis is the key to effective hedging (Ferris, 1998), but during 2008, basis reached its widest span in a number of years, displaying unprecedented volatility. Other commodities demonstrate similar tendencies (Irwin, Garcia, and Good, 2007), but developments in cotton markets have received more limited attention by economists. This study examines the trends evident before 2008 and compares recent developments with these underlying trends.

The need to understand basis trends became apparent in 2008 as new farm legislation removed a longstanding prohibition against USDA's publishing cotton price forecasts (see box below). In its monthly *World Agricultural Supply and Demand Estimates* (WASDE) report, USDA publishes year-ahead forecasts of U.S. season-average farm prices for wheat, corn, and a number of other commodities. Contracts for many of these commodities are traded on U.S. futures exchanges, and the information from futures price performance is incorporated into the *WASDE* forecasts. In 2008, however, the unusual behavior of basis indicated that further investigation was necessary to fully benefit from futures market information and to support USDA's cotton price forecasting efforts.

[1] A futures contract is "an agreement to later buy or sell a commodity of a standardized amount and standardized minimum quality grade during a specific month under terms and conditions established by the federally designated contract market upon which trading is conducted at a price established in the trading pit." (Chicago Board of Trade, 1985)

Legislation Ends 79-Year Ban on Price Forecasts

Between 1929 and 2008, USDA was prohibited from publishing forecasts of cotton prices. The prohibition resulted from congressional hearings investigating a September 1927 USDA price forecast that was perceived to have triggered a market sell-off.

As a result of the prohibition, while USDA included price forecasts with its supply and demand estimates for 23 other commodities in its monthly *World Agricultural Supply and Demand Estimates* (*WASDE)* publication, only the cotton estimates did not include a price forecast—until June 2008.

Although prohibited from publishing a cotton price forecast, USDA has been making forecasts for many years, with dissemination restricted to internal and official use. The Economic Research Service has developed a number of models in recent years, demonstrating that cotton prices respond to shifts in U.S. and global supply and demand, to changes in China's exports and imports, to exchange rates, and to other macro-economic developments (MacDonald, 2006; Meyer, 1998; MacDonald, 1997). Additional work was undertaken to update these models in anticipation of the legislative change and to account for recent structural changes in world markets (Isengildina-Massa and MacDonald, 2009).

Data and Methods

The No. 2 cotton futures contract has been the world's key cotton price-setting instrument for over 100 years. While recent years have seen the appearance and increased use of futures markets in other countries—most notably, China's Zhengzhou Commodity Exchange (ZCE)—the IntercontinentalExchange (ICE) contract is still a crucial source of price discovery and the premier hedging instrument for U.S. cotton.

The ICE contract has the following specifications:

- U.S. origin cotton only
- Delivery points:

  Galveston, TX

  Houston, TX

  New Orleans, LA

  Memphis, TN

  Greenville/Spartanburg, SC
- Base grade:

  Staple length 34 (1–1/16")

  Strict Low Middling (color grade 41, leaf grade 4)
- Delivery months:

  March

  May July

  October

  December

Under the U.S. Cotton Futures Act (7 U.S. Code 15b), USDA's Agricultural Marketing Service (AMS) publishes daily spot quotations for cotton. In addition to reporting the price for the same base grade as ICE, AMS's Cotton and Tobacco Programs also reports premiums and discounts for additional grades. AMS reports an average spot price for the United States and quotations for the following regional markets:

- Southeast
- North Delta
- South Delta
- East Texas/Oklahoma
- West Texas
- Desert Southwest
- San Joaquin Valley

For this analysis, only the U.S. average spot quotation for the base grade was used to measure basis. The restriction to the average price for the entire United States may be questionable when analyzing basis behavior close

to contract expiration, given that certified stocks are not evenly distributed between delivery points, and that the grade of certified stocks may vary from the base grade.[2] The choice of the U.S. average as the spot quotation is a simplifying assumption that could be examined in future research, but the U.S. average provides a useful starting point.

For this study, we collected futures data for the 5 delivery months closest to contract expiration between 2002 and 2007. The earliest contract we examined expired in March 2003 and the latest expired in December 2008. For each contract, we used data for the last 200 trading days before expiration. The earliest data used in this study were from May 15, 2002, for the March 2003 contract, and the latest data were from December 5, 2008, for the December 2008 contract.

This initial examination of trends was confined to descriptive statistics for these contracts and estimation of a simple relationship between basis[3] levels and time. While a number of factors might determine basis, including the cost of storage, interest rates, and delivery options (Hranaiova and Tomek, 2002; Williams, 2001), these factors can be simplified into an expectation of convergence. If:

$$\text{Basis: } B_{it} = Futures_{it} - Cash_t \,, \qquad \text{(equation 1)}$$

where $Futures_{it}$ is the closing price on day t of the ICE contract expiring in month i.

Then,

$$B_{it} = \alpha + \beta_1 \, Exp_{it} + \varepsilon_{it} \,, \qquad \text{(equation 2)}$$

where Exp_{it} is the number of days remaining until the contract expires. The impact of storage costs and interest rates is a function of time until expiration, so this parsimonious specification is useful, with the expectation that $\beta_1 > 0$. If convergence were perfect, then $E(\alpha) = 0$, but delivery options and the cost of arbitrage mean a nonzero α is still consistent with basis convergence.

To determine if basis can be described as rising or falling from year to year during the 2002-2008 period, we estimated a slightly modified version of equation 2:

$$B_{it} = \alpha + \beta_1 \, Exp_{it} + \beta_2 \, Year_{it} + \varepsilon_{it} \,, \qquad \text{(equation 3)}$$

where $Year_{it}$ is the year the contract expires. Specifying the passage of time in this manner avoided collinearity between the days to expiration and the trend variable that would arise if it also represented the discrete passage of time from one trading day to the next within a given contract. Thus, for a given contract i (e.g., March), if the estimated value of $\beta_2 > 0$, then between 2002 and 2008 the average basis on any given trading day tended to rise from one year to the next. If $\beta_1 > 0$, then the contract for month i tended toward convergence during 2002-2008.

This study undertakes one further adjustment, separately analyzing basis behavior before and after the first notice day.[4] Figure 1 shows the basis of

[2] USDA's AMS classes all cotton tendered for delivery on U.S. futures contracts. The quality of all cotton in certified stocks must be at least at the base grade, but it can meet this grade and still face a discount for being from an earlier crop year. Stocks at delivery points farther from ports or consuming regions are also less valuable. Alternatively, the quality of certified stocks can exceed base grade, adding further uncertainty to the expected basis at the expiration of any particular contract.

[3] Basis is most often defined as the difference between the price of a particular futures contract and a cash price at a specific location (Chicago Board of Trade). This study follows the convention used in AMS's monthly publication, *Cotton Price Statistics,* and uses a national average cash price (USDA/AMS). The use of an average basis masks many local influences, but provides a more convenient means for examining broad changes in basis patterns over time.

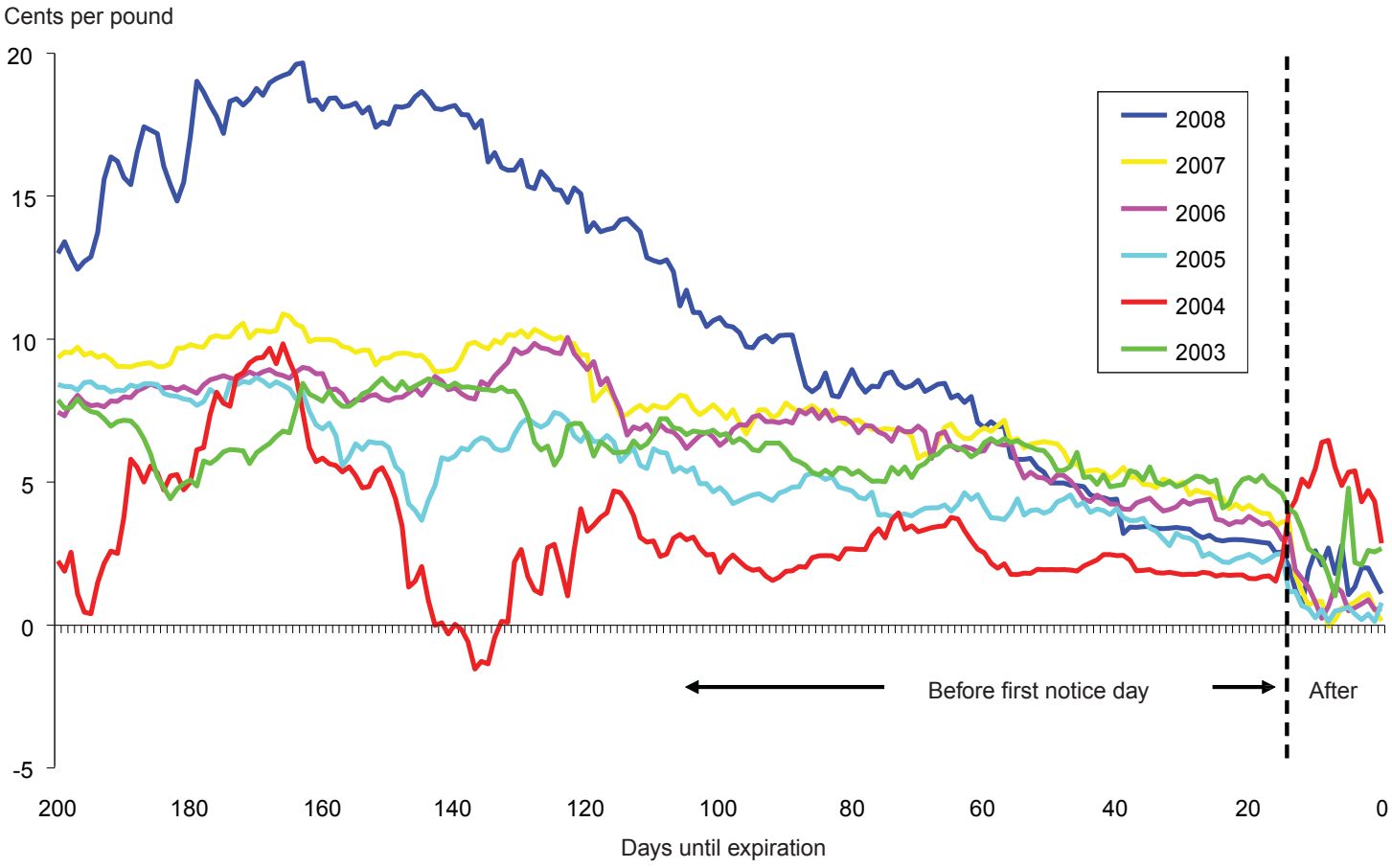
[4] First notice day is, "the first day on which notices of intent to deliver the commodity in fulfillment of a given month's futures contract can be made by the seller to the clearinghouse and by the clearinghouse to a buyer." (Chicago Board of Trade, 1985)

the December contract between 2003 and 2008 during the last 200 trading days up to expiration and illustrates why a separate analysis was necessary. Shortly after the 20th day prior to expiration, the basis entered a period of behavior distinctly different from the preceding days. A sharp decline was evident for most years, although 2004 stands out with a sharp increase at the same point in the contract's life. The prospect of delivery altered the behavior of the basis trends significantly, adding volatility. While this study does not attempt to determine the causes of the basis trends, different factors are clearly at work before and after the first notice day, necessitating that the two periods be studied separately.[5]

[5] The variances of the two models' error terms ("before" and "after") dif- fered at either the 1-percent level (for the December, May, July, and October contracts) or the 5-percent level (for the March contract).

Figure 1

December cotton contracts' basis, 2003-2008



Sources: ERS calculations based on data from Thomson/Reuters Datastream and USDA Agricultural Marketing Service, Cotton and Tobacco Programs.

Results and Discussion

Figure 2 illustrates the basis calculated for the contracts examined in this study, plus additional contracts expiring in 2001, 2002, and 2009 to add an additional year and to show five contracts at any point in time. The inclusion of the 2009 contracts trading during 2008 emphasized the impact of that year's events on basis. While the basis on the December 2008 contract was higher than any previous basis since 2001, the March 2009 and May 2009 contracts were even higher. Figure 2 also indicates that the contracts tend toward convergence, since basis tends to fall over time. However, testing the parameters of equation 3 is necessary to determine if this tendency is significant, and if it tends to change over time (table 1). Finally, figure 2 also suggests that basis has tended to rise from year to year, at least since 2005. As with convergence, estimating equation 3 allows us to objectively test this hypothesis (table 2).

Table 1 summarizes the trends evident within the lifetime of each contract as determined by estimating equation 3. Consistently across the expiration months, the basis declined about 0.02 cent per day until the first notice day (once any trends were accounted for). The October contract was an exception, declining half as much, but showed the lowest average open interest among the five contracts. The value of β_1 was the same, regardless of whether the sample was estimated through 2007 or 2008.

The behavior of the contracts for different expiration months diverged significantly in the period after the first notice day. The May contract did not appear to converge, with β_1 estimated as zero. The July contract also

Table 1
Estimated daily convergence (β_1)

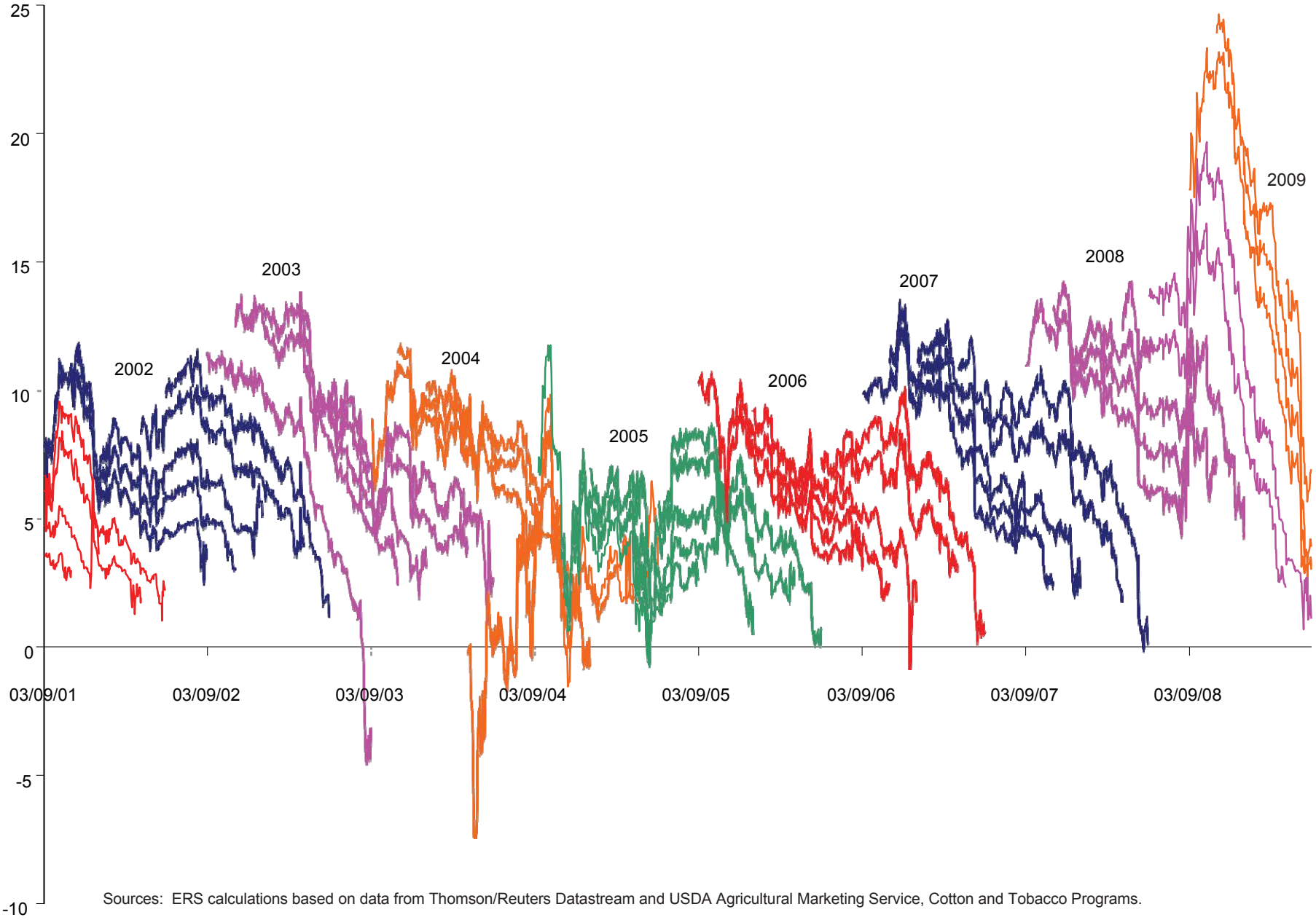
Contract month	Before or after first notice	Year sample ends	
		2007	2008
		Cents per day	
March	Before	0.02	0.02
	After	0.08	**0.04**
May	Before	0.02	0.02
	After	**0.00**	**0.00**
July	Before	0.02	0.02
	After	**0.04**	**0.04**
October	Before	0.01	0.01
	After	0.04	0.04
December	Before	0.02	0.02
	After	0.05	0.05

Notes: All estimates of β_1 were significant at the 1-percent level, except for the five figures in bold. The July contract's after the first notice days estimates were significant at the 10-percent level.

Figure 2

Basis: ICE futures–AMS U.S. average spot (250 days until expiration)

Cents per pound



Sources: ERS calculations based on data from Thomson/Reuters Datastream and USDA Agricultural Marketing Service, Cotton and Tobacco Programs.

may not converge. While the July contract's estimated parameter for β_1 was not particularly different from the estimates for the October or December contracts, it was not significantly different from zero at the 5-percent level (it was significantly different at the 10-percent level). The December contract's basis declined 0.05 cent per day after the first notice, and October declined by 0.04 cent. The March contract's estimated β_1 through 2007, at 0.08 cent per day, was not significantly different from zero when 2008 was included in the sample. Figure 2 illustrates how in 2008 convergence after the first notice day was severly disrupted for the March-July contracts. Basis at expiration for these contracts was substantially higher than for almost any other contract studied in this report, averaging 6.0 cents per pound compared with 2.2 cents per pound for all other contracts during 2003-08.

Table 2 summarizes the trends in these contracts' basis during 2002-2008. These results varied more from contract to contract and sample to sample than did the estimated degrees of convergence. In the period before the first notice day, and using data through 2007, basis tended to fall for the May and July contracts and rise for the October and December contracts. After the first notice day, however, basis tended to fall for the May, October, and December contracts, but rise significantly for the March contract. While the December basis tended to rise 0.7 cent per year before the first notice and fall 0.7 cent per year after the first notice, the March contract tended to rise 1.7 cents per year after the first notice.

Extending the sample into 2008, however, alters many of the results. Every contract exhibited a significant tendency to rise with the full sample during the period prior to the first notice day. The March, May, and July contracts

Table 2
Estimated annual change in basis starting in 2002 (β_2)

Contract month	Before or after first notice	Year sample ends	
		2007	2008
		Cents per year	
March	Before	**0.00**	0.38
	After	1.70	1.47
May	Before	-0.39	0.17
	After	-0.35	0.26
July	Before	-0.25	0.42
	After	**0.17**	0.60
October	Before	0.55	1.13
	After	-0.27	-0.21
December	Before	0.69	1.21
	After	-0.70	-0.43

Notes: All estimates of β_2 were significant at the 1-percent level, except for the two figures in bold. The July contract after first notice day's estimate with data through 2007 was significant at the 10-percent level.

also had a significant tendency to rise in the period after the first notice day. In contrast, October and December showed rising basis before the first notice and falling basis after the first notice. December differed in that both periods had higher estimates of basis change over time, about 0.5 cent per year before and 0.3 cent per year after the first notice day. October was notably higher only before the first notice day.

An alternative specification of the model highlights how the 2002-08 period included years of distinctive basis behavior, as well as tendencies that persisted from year to year. Equation 3 can be specified as a fixed-effects model with dummy variables for each year:

$$B_{it} = \alpha + \beta_1 Exp_{it} + \sum_{y=2002}^{2008} \beta_{2y} D_{iy} + \varepsilon_{it} \qquad \text{(equation 4)}$$

When equation 4 is estimated for some of the models, the estimated value of $\beta_{2,2008}$ suggests 2008 was an outlier for some expiration months. Similarly, stability testing (using the Quandt-Andrews Breakpoint Test) indicates that structural breaks were present for some models.

The behavior of cotton markets is complex, and the simple models used here do not encompass more than a small range of patterns that exist in futures or spot prices. This preliminary investigation, however, suggests that within the variability observed in these markets, certain patterns tended to prevail, including an increase in basis.

Conclusions

The examination of the average U.S. cotton basis provides a strong initial indication that 2008 U.S. cotton basis convergence patterns were statistically different from cotton basis convergence patterns experienced since 2001. However, the use of an average measure prohibits the identification of factors in the cash or futures markets that may have led to changes in 2008 convergence patterns. While additional research is needed to better understand the proximate and superseding causes of changing basis trends, these changes have important implications for USDA price forecasting and the use of basis to help make production, forwarding pricing, hedging, and storage decisions.

A simple model suggests that, for most expiration months, the basis for the U.S. cotton futures contract tended to converge. It also suggests that, for the most important contract, December, the trend has been toward higher basis during much of the last year of the contract's life. The increase from one year to the next in basis during the period before the first notice day, combined with a tendency to decline in the period after the first notice, suggests that, in recent years, convergence became more pronounced late in the life of the contract. Including 2008 in this analysis tends to raise estimated basis trends. In some cases (May and July), the year-to-year trend changed so much that it went from a declining trend to a positive trend.

Basis behavior has implications for USDA's price forecasting. While price forecasting models that rely on forecasts of supply and demand as independent variables are of crucial importance to USDA forecasters, futures prices are a key source of information as well. More complete knowledge of the patterns and trends in futures prices will ensure that USDA analysts can provide the best forecasts to guide policymakers and private-sector decisionmakers.

Basis changes affect the use of futures markets by traditional hedgers. Producers or consumers using futures contracts to offset price movements may find their risk management strategies undermined by an unexpected basis change. Parties with contracts based on futures prices may also face the risk of a shifting basis. While this analysis demonstrated that average U.S. cotton cash and futures prices converge, the study also found a statistically significant increase in basis in recent years. The narrowing of the average U.S. cotton basis in the summer of 2008 was a positive trend to some, but highlighted the continued volatility in cotton basis patterns and the difficulty faced by market participants who rely on historical basis patterns to make sound decisions.

References

Chicago Board of Trade. Commodity Trading Manual, 1985.

Ferris, John N. Agricultural Prices and Commodity Market Analysis, Boston: McGraw-Hill, 1998.

Hrannaiova, J., and W. Tomek. "Role of Delivery Options in Basis Convergence," The Journal of Futures Markets 22(8): 783-809, 2001.

Irwin, S., P. Garcia, and D. Good. The Performance of Chicago Board of Trade Corn, Soybean, and Wheat Futures Contracts After Recent Changes in Speculative Limits, University of Illinois at Urbana-Champaign, May 2007, http://www.farmdoc.uiuc.edu/irwin/research/CBOTFuturesPerformance.pdf.

Isengildina-Massa, O., and S. MacDonald. U.S. Cotton Prices and the World Cotton Market: Forecasting and Structural Change, Agricultural and Applied Economics Association's Annual Meeting, Milwaukee, WI, July 26-8, 2009.

MacDonald, Stephen. Forecasting World Cotton Prices, The Ninth Federal Forecasters Conference—Papers and Proceedings, National Center for Educational Statistics, U.S. Department of Education, 1997. http://www1.va.gov/vhareorg/ffc/PandP/FFC1997.pdf

MacDonald, Stephen. Cotton Price Forecasting and Structural Change, The 15th Federal Forecasters Conference—Papers and Proceedings, Veterans Health Administration, U.S. Department of Veterans Affairs, 2006. http://www1.va.gov/vhareorg/ffc/PandP/FFC2006.pdf

Meyer, L.A. "Factors Affecting the U.S. Farm Price of Upland Cotton," Cotton and Wool Situation and Outlook, CWS-1998, U.S. Department of Agriculture, Economic Research Service, pp. 16-22, November 1998, http://www.ers.usda.gov/briefing/cotton/pdf/cws1998CottonFarmPrice.pdf.

U.S. Department of Agriculture, Agricultural Marketing Service, Cotton and Tobacco Program. 2009. Cotton Price Statistics, Vol. 90, No. 10.

Williams, J. "Commodity Futures and Options," Handbook of Agricultural Economics, Volume 1b: Marketing, Distribution, and Consumers, B.L. Gardner and G.C. Rausser (Eds.), (pp. 745-816). Amsterdam: Elsevier Science B.V., 2001.