

USDA'S COTTON PRICE FORECASTS: BACKGROUND AND METHODOLOGY**Carol Skelly****World Agricultural Outlook Board, U.S. Department of Agriculture
Washington, D.C.****Stephen MacDonald****Economic Research Service, U.S. Department of Agriculture
Washington, D.C.****Abstract**

USDA began publishing monthly forecasts of the marketing year average price received by farmers in June 2008, following elimination of a 79-year prohibition on the publication of price forecasts. This paper describes the concepts, information, and statistical methods used by USDA's Interagency Cotton Estimates Committee (ICEC) to make monthly price forecasts.

Background

The U.S. Department of Agriculture (USDA) began publishing cotton price forecasts for the first time in 79 years in June 2008. The price forecasts are included in the monthly *World Agricultural Supply and Demand Estimates (WASDE)*. A prohibition on cotton price publication began in 1929, following congressional hearings investigating a September 1927 price forecast that legislators believed triggered a market sell-off (see Townsend). The prohibition was lifted by the Food, Conservation, and Energy Act of 2008.

USDA forecasts the marketing year average price received by producers for upland cotton. Consistent with the other *WASDE* commodities, including wheat, corn, soybeans, and rice, the price is stated as a range in the early projection months in order to convey the considerable uncertainty around the price forecasts. USDA's Interagency Cotton Estimates Committee, which is responsible for the forecasts, follows a process to: (1) project a price midpoint; and (2) establish a price range. While it is possible for the forecast range to be asymmetrical around the price projection midpoint, this happens very rarely in practice. The price midpoint represents the price that is most likely to result from the supply-demand estimates included in the reporting month's updates. Likewise, the range represents the uncertainty associated with that particular month's estimates.

The ICEC utilizes current price information, market intelligence—including cotton futures prices—and statistical relationships to forecast the cotton farm price that appears each month in the *WASDE*. While each of these information sources and methods contributes value to the forecast, none by itself is deemed sufficient to determine the price projection. Thus, the Committee's forecast ultimately rests on the collective judgment of the members based on analysis of all of the available information. The purpose of this paper is to provide insights into the information sources and analysis the ICEC uses to make its monthly price projections.

Reporting Definition of the Marketing Year Average Price

The upland cotton marketing year average price, which is reported each month by the National Agricultural Statistics Service (NASS), is a price for all qualities of domestic upland cotton, weighted by the bales marketed. NASS defines the marketing year average price to be the purchase price FOB warehouse. That is, it includes transportation, storage and handling charges incurred up to the point that the cotton is removed from the warehouse for shipment. Prices are compiled, weighted, and reported at the State and national levels in the publication *Agricultural Prices*. The final marketing year average price (also referred to as the "farm price"), which is usually reported in the October that follows the end of the marketing year, is used by the Farm Services Agency to determine the counter-cyclical payment under the upland cotton farm program.

NASS estimates the price using a stratified sample of merchants and marketing cooperatives who buy cotton from producers. NASS selects buyers to be surveyed each year from the Agricultural Marketing Service's (AMS's) list of the entities who pay the cotton check-off fee for the national research and promotion program. Over the past five seasons, the NASS sample has typically represented about two-thirds of production. Merchants who buy options for redemption of CCC loans report the premium, or "equity" paid to the producer in the month the contract is made.

NASS provides similar, but more limited, reporting of extra long staple (ELS) cotton prices. The ICEC forecasts prices for upland cotton, rather than for all cotton, because the upland and ELS cotton markets are relatively independent and often do not follow the same trends. ELS is a specialty cotton with a well-defined niche market, and accounts for less than 5 percent of U.S. cotton production. Also, since the farm programs for the two types of cotton are structured differently, separate price reporting is needed for program purposes.

The ICEC monitors several different price series to obtain indications of current prices and direction, including recent farm prices, spot market prices as reported by AMS, Cotton Outlook's A-index, and futures prices from New York's Intercontinental Exchange (ICE).

Of the prices considered, spot market prices are the most closely correlated with farm prices. Spot and farm prices differ in the following respects: (1) spot prices represent transactions for prompt shipment based on information that AMS gathers from local market buyers, sellers, and the Seam, whereas farm price reporting may capture cotton that has been sold by farmers but not yet moved into marketing channels; (2) spot price reporting is for specified qualities, while farm price reporting is for all qualities; (3) spot prices are FOB car or truck, including bale compression and any brokerage charges, whereas the farm price is FOB warehouse and does not include compression and brokerage charges; and (4) spot prices are reported each day and thus are more current than NASS price reporting, which publishes the price and weight for the previous month at the end of each month. Despite the differences between the two series, the five-year average premium of monthly spot prices (base grade) compared with monthly farm prices for the period 2003/04 through 2007/08 was 1.7 cents per pound. The additional handling charges included in spot prices likely account for most of the premium.

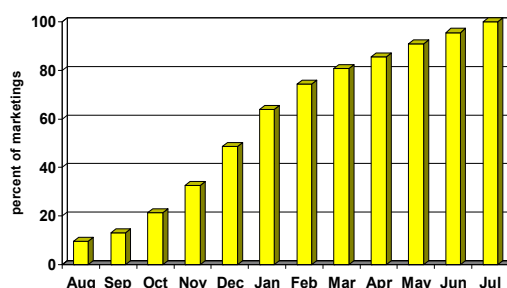
The graph displays the price fluctuations for No. 1 Yellow Peruvian. The 'Spot' price (red line) starts at approximately 55 cents/lb. in August 1999, peaks at nearly 70 cents/lb. in November, and then fluctuates between 40 and 60 cents/lb. until May 2000. The 'Farm' price (blue line) starts lower at about 46 cents/lb., peaks at 69 cents/lb. in November, and generally follows the spot price but at a lower level, ending at 60 cents/lb. in May 2000. Both prices show a significant dip in early 2000, with spot prices reaching a low of 40 cents/lb. and farm prices reaching 39 cents/lb. in February.

Month	Spot (cents/lb.)	Farm (cents/lb.)
Aug 1999	55	46
Sep 1999	58	58
Oct 1999	69	69
Nov 1999	68	69
Dec 1999	65	65
Jan 2000	68	62
Feb 2000	60	60
Mar 2000	58	61
Apr 2000	45	52
May 2000	48	48
Jun 2000	42	41
Jul 2000	45	42
Aug 2000	50	44
Sep 2000	48	42
Oct 2000	45	44
Nov 2000	52	48
Dec 2000	48	48
Jan 2001	53	50
Feb 2001	48	48
Mar 2001	47	47
Apr 2001	45	46
May 2001	48	47
Jun 2001	45	46
Jul 2001	47	48
Aug 2001	50	49
Sep 2001	58	55
Oct 2001	54	52
Nov 2001	59	58
Dec 2001	60	59
Jan 2002	65	62
Feb 2002	68	65
Mar 2002	60	60
Apr 2002	63	60
May 2002	60	60

Farm prices themselves contribute information as the marketing year advances and the actual reported monthly prices are incorporated into the estimate. Since the late fall and winter months carry heavier weights, about half of

the farm price value is usually determined by the end of December (data available in the January *Agricultural Prices*) and about 80 percent by the end of March (data available in the April *Agricultural Prices*).

NASS Cotton Price Weights
Cumulative by Month based on 5-Year Average
2003/04 – 2007/08



Analysis of Futures Prices

While spot prices give a timely indication of current transactions, futures prices provide more intelligence about market direction. Since spot prices tend to follow the nearby futures contract, examination of nearby futures offers little additional information. The later contracts, however, reflect the collective judgment of market participants about future cotton values. In addition, to the extent that cotton is forward-priced based on futures contracts, futures prices have a direct bearing on the farm price that is ultimately realized by producers and reported to NASS.

The factors affecting prices are wide-ranging and ever-changing. Often, the best efforts of economists to anticipate these factors and their changing relationships are overwhelmed by events, particularly when forecasting in relatively short time horizons. Actual participants in the market are guided to equilibrium by these forces regardless of their awareness of the mechanisms and events involved. Prices on the U.S. futures market are therefore an important source of information about the likely level of the season-average U.S. upland farm price early in the season and before the season. One simple way of using this information that is objective, replicable, and efficient is to determine the past relationship between a certain month's average of either the December contract (or the nearby contract earlier in the year) and the season-average price. Regressing the futures price on the season-average price over the last decade or so objectively determines the relationship, and this estimated relationship can be applied to the current year's futures price data to derive a forecast for the current year.

In order to account for trends and non-linearities in the data, the price levels can be converted to their natural logs, and the prices for each year expressed as a difference from the previous year's season-average price. If the futures price averaged over one month in a given year $t = ICE_t$, and the season average price = $Actual_t$, then the model expressing the relationship would be:

$$\ln (Actual_t) - \ln (Actual_{t-1}) = \beta_0 + \beta_1 [\ln (ICE_t) - \ln (Actual_{t-1})] + \varepsilon_t.$$

Estimating this relationship using data from 1992-2003 enables one to forecast the season-average price between 2004 and 2007 within one standard error every year. Using November data (November's average of the December futures contract), the root mean squared error of the model during 2004-07 is 2.7 cents, and its maximum error was 4.0 cents. However, the errors have tended to grow over this period. USDA's December 2008 forecast midpoint of 46 cents per pound is 6.8 cents higher than the forecast implied by this model.

USDA/Clemson Model

USDA and Clemson University undertook a study of the relationship between the supply and demand of cotton and the price of upland cotton in the United States (see Isengildina and MacDonald). The goal was to derive a simple relationship that could be used to forecast the season average farm price that corresponded to expectations about

world and U.S. cotton production and consumption during the coming year. A review of demand theory suggested that the traditional stocks-to-use model should be augmented by explicitly considering supply. The model was also expanded to include the impact of changing farm policies in the United States and changing farm and trade policies in China.

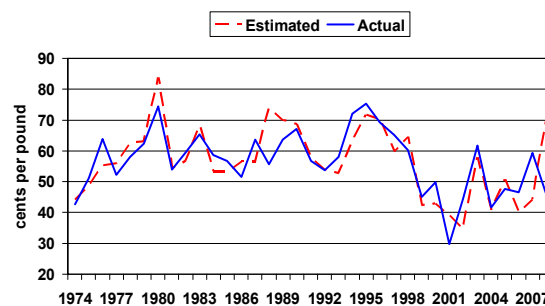
Statistical testing of this model revealed that the structure of the U.S. cotton market changed significantly around 1999. This period coincided with the transition of the United States cotton industry from primarily marketing its cotton domestically to primarily marketing its cotton on world export markets. This change was in part a function of the phase-out of the Multifibre Arrangement (MFA) that led to the rise of China as the world's preeminent textile producer and cotton importer. China significantly reformed its cotton policy late in 1999, reform that lagged changes in grain policy by several years. A variable was added to the model to enable it to bridge the pre- and post-1999 market regimes. This variable was world supply (minus China, but adjusted for China's net imports). With this change statistical testing of the model indicated structural stability.

The new model forecasts the annual percent change in the real price of cotton as a function of:

Percent change in the U.S. upland stocks/use ratio,
 Percent change in U.S. upland supply,
 Absolute change in China's net imports (as a share of world consumption) from the previous 2-years' average,
 Cotton covered by the loan program on July 31 (as a share of U.S. use), and
 Percent change in world (excluding China) supply (adjusted for China's net trade).

Using current estimates of world supply and demand, this model produces estimates for prices over the last 5 years that are of comparable accuracy to USDA's unpublished forecasts for the July preceding the beginning of the marketing year. This holds true even if the model's parameters are estimated with data that only extends through 2002, an unusual degree of stability for such a forecasting model.

**Actual and Estimated Prices for
 USDA/Clemson Model
 1974-2008**



However, the model's forecasts for 2008/09 have been consistently higher this year than prices indicated by futures markets and cash markets in the United States and abroad; the model forecast is 70 cents per pound based on the *WASDE* estimates as of December 2008. The discrepancy may be the result of an error in the model; alternatively, it may suggest that USDA's projections of supply and demand – which are key variables in the model – have been too optimistic. A recent problem has been the lagged response of macro-economic forecasters to the unfolding global crisis. Over the last 6 months, the best estimates of U.S. and world economic activity from academic, government, intergovernmental organizations, and most non-government organizations have overstated economic growth. USDA's ICEC, which relies on these macro-economic forecasts to project demand, has progressively reduced its estimates of world cotton demand, U.S. exports, and farm prices. This problem illustrates that the model may have utility in evaluating the consistency of USDA's supply and demand estimates with other types of market intelligence, especially current price behavior.

ICAC's A-Index Model

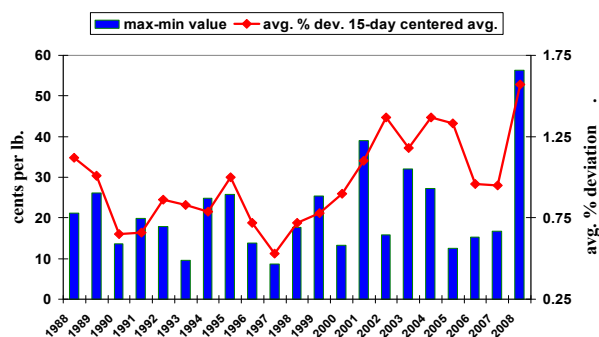
As noted above, there is a correlation between the annual average A-index and the marketing year average farm price. The International Cotton Advisory Committee (ICAC) has developed a model which it uses to make a monthly projection of the season average A-index (see ICAC). In addition to the other methods used, the ICEC considers the ICAC model results in making its monthly U.S. farm price determination. USDA also reviews the results of its own A-Index forecasting model (MacDonald). While trends and forecasts in the A-Index provide useful information for forecasting the season-average price, two caveats are important. One is that models do forecast imperfectly, so that the true A-Index for the coming year is still unknown. The other is that the relationship between the A-Index and the U.S. upland farm price can vary significantly. Thus, there are two sources of uncertainty when trying to interpret what a forecast of the A-Index suggests for the year's upland price.

Recent Issues with Market Volatility and Basis

Recent developments in the cotton futures market have complicated the task of forecasting cotton farm prices. The December 2008 futures contract was the most volatile in more than 20 years (and perhaps ever) both with respect to the overall change in the closing value (a difference of 56 cents per pound from highest to lowest over 16 months) and the day-to-day variation in prices. The causes of the volatility are not well understood, but possible factors include increased speculative interest in the ICE cotton futures contract, changes in exchange trading rules, and uncertainty, especially with respect to plummeting demand, resulting from the severe worldwide recession.

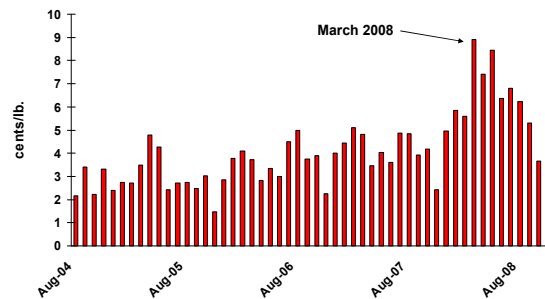
2008 Cotton Futures Highest Volatility

(Daily Close 1988-2008 December Contracts
from July 15 – end of trading (16 months))



Market volatility has also been reflected in the basis between nearby futures and spot prices. The monthly average basis, which ranged between 2-5 cents per pound historically, rose to nearly 6 cents in January 2008, peaked at nearly 9 cents in March 2008, and then returned to more normal levels in the late fall. The fluctuating basis indicated a divergence of futures and cash values and reduced the utility of the futures contracts as a predictor of farm prices.

Cotton Monthly Basis
 (= Nearby Futures Minus the Spot Market Average)
 August 2004 through November 2008

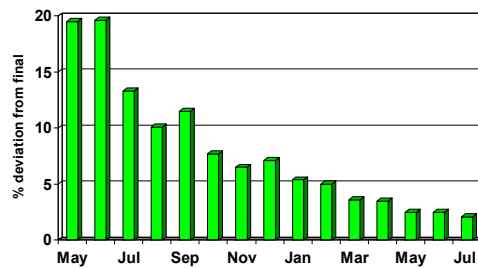


How Ranges are Forecast

The forecasting of price ranges in the *WASDE* poses several dilemmas. In evaluating USDA's price range intervals for corn, soybeans, and wheat, Isengildina-Massa, Irwin, and Good (2007) found that: (1) forecast intervals have relatively low hit rates; (2) forecast intervals do not necessarily reflect the shape of the underlying price distribution; and (3) confidence levels associated with the forecast intervals are not specified. Part of the difficulty is that there are two types of uncertainty surrounding USDA's price forecasts. The first is the forecast error around a particular set of supply-demand outcomes. The second type is the uncertainty associated with the supply-demand variables themselves, which change from month to month, often significantly. Even with respect to price outcomes for a particular set of supply/demand variables, the errors associated with various statistical models are relatively large. For example, the USDA/Clemson model described above has a 90-percent confidence interval of ± 14.7 cents/lb. (1974-2002 average). However, since USDA relies on multiple methods to forecast prices, the accuracy of the forecasts is not necessarily reflected in the confidence interval of a single model.

Information relevant to the price forecast improves as the season progresses, both with respect to the forecasting of supply and demand and the knowledge of actual prices, as NASS publishes monthly farm prices and the associated weights. Isengildina-Massa, Irwin, and Good (2007) proposed several statistical methods for developing ranges for corn, soybean, and wheat prices based on analysis of historical errors in the monthly forecasts. The cotton ICEC has not adopted these specific methods; however, it has thus far used the historical average accuracy of USDA's monthly forecasts as a guide for setting forecast ranges. (Although cotton price forecasts have only been published since June 2008, the ICEC has made price forecasts for internal use for many years.) The following chart shows the average percentage deviation ($\pm$) of USDA's monthly forecast when compared with the final NASS price over the past 10 marketing years.

10-Year Average Differences (+/-) by Month USDA Price Forecast v. Final



Conclusion

Publication of USDA price forecasts began in June 2008 under difficult circumstances due to the rapid deterioration in world economic conditions, which has severely impacted textile and cotton demand. The mid-point of USDA's price forecast range has fallen from 65 cents per pound in June to 46 cents per pound in December, likely the largest 6-month decline since the ICEC began forecasting prices. While ICEC members hope that continued close attention to market information and refinement of statistical methods will improve USDA's forecasts over time, recent events show the extent to which uncertain market conditions can affect price outcomes.

References

Goreux, Louis, Plastina, Alejandro, Gruere, Armelle, and Yi Cao, (2007), "The New ICAC Cotton Price Forecasting Model," *Cotton: Review of the World Situation*, International Cotton Advisory Committee July-August 2007.

Hoffman, Linwood (2005), "Forecasting the Counter-Cyclical Payment Rater for U.S. Corn: An Application of the Futures Price Forecasting Model," *Outlook Report No. FDS05a01*, Economic Research Service, U.S. Department of Agriculture.

Isengildina-Massa, Olga, Scott H. Irwin, and Darrel L. Good. "Empirical Confidence Intervals for WASDE Forecasts of Corn, Soybean, and Wheat Prices," Final Research Report to the Economic Research Service and World Agricultural Outlook Board, U.S. Department of Agriculture, December 2007.

Isengildina, Olga, Scott H. Irwin, and Darrel L. Good. "Evaluation of USDA Interval Forecasts of Corn and Soybean Prices," *American Journal of Agricultural Economics*, 84:990-1004.

Isengildina, Olga and Stephen MacDonald (forthcoming), "Cotton Prices and the World Cotton Market: Forecasting and Structural Change," Economic Research Service, U.S. Department of Agriculture.

MacDonald, Stephen (1997), "Forecasting World Cotton Prices," *The Ninth Federal Forecasters Conference—Papers and Proceedings*, National Center for Educational Statistics, U.S. Department of Education.

Townsend, Terry, 1987. "This was a High-powered Projectile to the Vitals of the Industry—Why USDA Does Not Forecast Cotton Prices," *1987 Proceedings of the Cotton Beltwide Conferences*, National Cotton Council.