Forecasting Expected Counter-Cyclical Payment Rates

In designing a model to estimate expected counter-cyclical payment rates, we modified a procedure that is used to analyze a special class of options—specifically, those with payments based on an average price. Option pricing theory and methods are appropriate for estimating counter-cyclical payment rates because the returns from buying a put option at the effective target price and selling a put option at the national loan rate equals the counter-cyclical payment rate[7] (app. A).

The option pricing procedure used requires only four variables: two policy variables and two market variables. The two policy variables are the effective target price (target price minus direct payment) and the national loan rate. The two market variables are the USDA-WASDE marketing-year average price forecast and its variability (app. B). All but forecast variability are provided. Forecast variability must be estimated.

Analysts typically use two approaches to estimate price variability for use in option pricing models. One approach uses option trading data to estimate expected price variability. The other uses time series price data to estimate historical price variability.

We designed an alternative approach that estimates the variability of marketing-year average price forecast errors. The forecast errors were calculated by subtracting USDA-WASDE forecasts from USDA, NASS reported price outcomes. The forecast errors measure the variability of price outcomes about price expectations (app. C). The forecasts were taken from the October and February WASDE reports for marketing years 1980 through 2004, and they reflect the midpoints of the USDA-WASDE projected price ranges.[8]

As the marketing year progresses, uncertainty about the (eventual) marketing-year average price lessens. Thus, estimates of forecast variability are considerably lower in February than in October (table 3). The focus of this analysis, however, is not comparing the forecast variability estimates, but examining and comparing the effects of forecast variability on the level and variability of counter-cyclical payment rates.

Using the forecast variability estimates, we estimated the relationships between forecasted marketing-year average prices and expected counter-cyclical

[7]A put option provides price protection by providing a payment equal to its strike price minus the price being protected when its outcome is less than the strike price.

[8]USDA, FSA uses midpoint price forecasts in estimating counter-cyclical payments. This choice is not mandated by legislation.

Table 3
Variability of WASDE forecast errors of marketing-year average price—marketing years 1980-2004

Commodity	October variability	February variability
Corn	0.08	0.04
Oats	0.07	0.03
Sorghum	0.08	0.05
Soybeans	0.08	0.04
Rice	0.12	0.07
Wheat	0.04	0.02

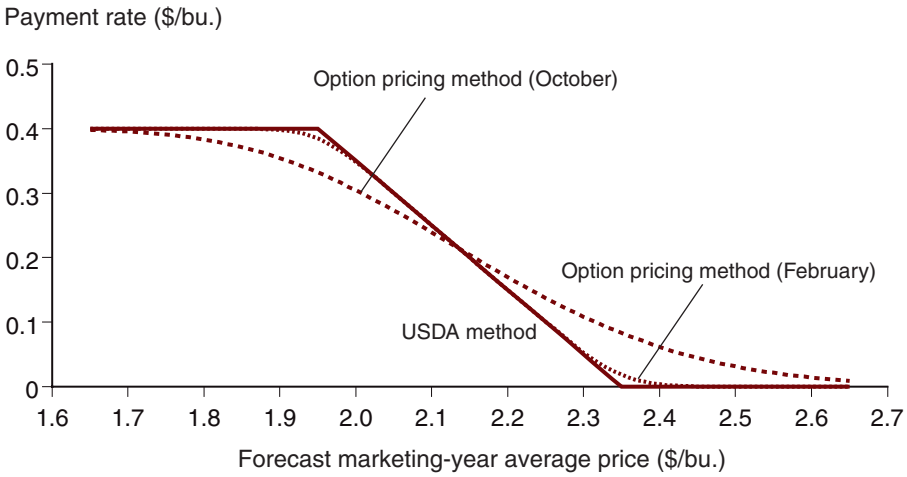
Source: Prepared by USDA, Economic Research Service using WASDE forecast errors.

payment rates for corn, wheat, soybeans, and rice (figs. 2, 3, 4, 5). Data for the solid lines (USDA method) were obtained by calculating the counter-cyclical payment rate using equation 1 at 1-cent intervals for forecasted marketing-year average prices. The leftward kink in each solid line in figures 2 through 5 occurs at the national loan rate, and the rightward kink occurs at the effective target price. The levels for the national loan rates and target prices in figures 2 through 5 are the 2004-07 crop year levels (see table 1).

Data for the dashed lines (option pricing method) were obtained by solving the option pricing model in appendix B at 1-cent intervals for forecasted prices. These calculations account for forecast variability. The range for the forecasted price begins below the national loan rate and extends above the effective target price.

Figure 2

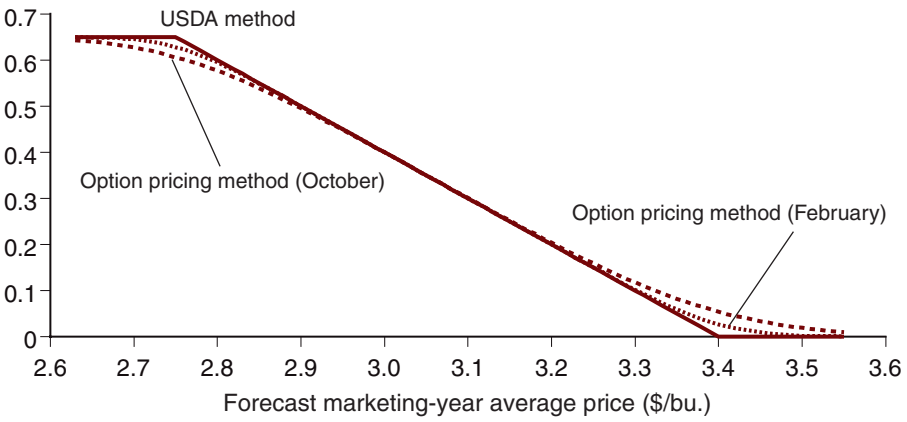
Expected counter-cyclical payment rates for corn



Source: Prepared by USDA, Economic Research Service using WASDE corn forecast errors and the 2004-2007 corn national loan rate and effective target price.

Figure 3

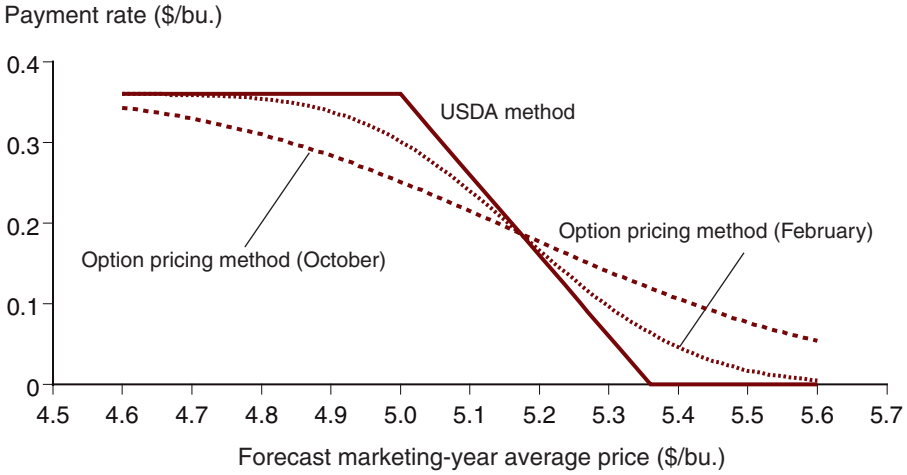
Expected counter-cyclical payment rates for wheat



Source: Prepared by USDA, Economic Research Service using WASDE wheat forecast errors and the 2004-2007 wheat national loan rate and effective target price.

Figure 4

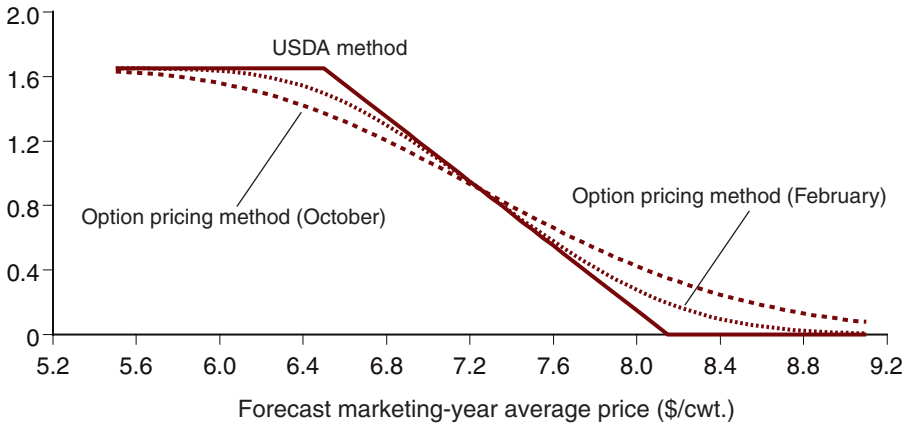
Expected counter-cyclical payment rates for soybeans



Source: Prepared by USDA, Economic Research Service using WASDE soybean forecast errors and the 2004-2007 soybean national loan rate and effective target price.

Figure 5

Expected counter-cyclical payment rates for rice



Source: Prepared by USDA, Economic Research Service using WASDE rice forecast errors and the 2004-2007 rice national loan rate and effective target price.

The vertical difference between a dashed and solid line in figures 2 through 5 is called time value in the options pricing literature.[9] Here, time value indicates the extent of bias (for a given price forecast) when projections of the counter-cyclical payment rate do not take account of forecast variability:[10]

- If time value is positive (dashed line above solid line), a projection based simply on the forecast marketing-year average price entails *negative bias*. That is, the counter-cyclical rate is underestimated.
- If time value is negative (dashed line below solid line), a projection based simply on the forecast marketing-year average price entails *positive bias*. That is, the counter-cyclical rate is overestimated.

[9]When applied to options, time value is derived as the difference between two values: the current option premium, and its intrinsic value (the buyer's return from immediate exercise). Time value is computed similarly in our context—as the difference between two values—with the added complexity that time value can be either positive or negative due to the characteristics of counter-cyclical payments (see appendix D for details).

[10]In our context, time value equals the value of expected counter-cyclical payments when forecast variability is taken into account (indicated by dashed line) *minus* the value of the payment implied by the current forecast of the marketing-year average price (indicated by solid line).

When time value is positive, the expectation is that the counter-cyclical payment will rise relative to the estimate based simply on the current marketing-year price forecast. In the options pricing literature, positive time value is interpreted as the expected reward for waiting.[11] Conversely, when time value is negative, the expectation is that the counter-cyclical payment will fall relative to the estimate based simply on the current price forecast. We interpret negative time value as the penalty for not being able to receive the counter-cyclical payment immediately based on the current marketing year price forecast.

Forecast variability has a large influence on the expected counter-cyclical payment rate. This can be seen by examining the differences between the solid lines and dashed lines for corn, soybeans, and rice. The differences are much larger for October than for February, reflecting the much larger forecast variability for October (see table 3). The differences are much smaller for wheat in part because October is the fifth month of the wheat marketing year while October is the second month of the marketing year for corn and soybeans and the third month of the marketing year for rice. Forecast variability declines as less time remains in the marketing year.

October time values can be large for soybeans and rice. For soybeans, estimated maximum positive and negative time values are +12 and -11 cents per bushel. For rice, the corresponding estimates are +35 and -28 cents per cwt. (+20 cents and -16 cents per bushel).

Maximum October time values are smaller for wheat and corn. For wheat, the maximum time values are +6 and -5 cents per bushel. For corn, the maximum time values are +8 and -7 cents per bushel. The smaller time values for wheat are due to lower forecast variability. Those for corn are due to lower price levels.

Not considering positive time value (bias) reduces advance partial payment levels and their frequency. No advance partial payments are made when forecasted price is greater than the effective target price, although the expected counter-cyclical payment rate can be large. Not considering positive time value also reduces producer repayment levels and frequency. This may be considered as beneficial to producers.

Not considering positive time value underestimates USDA budget cost. One policy choice is to continue not accounting for positive time value in calculating advance partial payments but to account for it in estimating the budgetary cost of counter-cyclical payments.

Not considering negative time value has opposite effects. Producer advance partial payments and repayment frequencies are increased, and expected budgetary costs are overestimated.

[11]In the context of options pricing, time value reflects the chance of a favorable price movement prior to option expiration. High time value discourages immediate exercise.