Information Rigidity and Correcting Inefficiency in USDA's Commodity Forecasts

Stephen MacDonald
Economic Research Service/USDA stephenm@ers.usda.gov

Olga Isengildina-Massa
Clemson University olga123@clemson.edu

Selected Poster prepared for presentation at the Agricultural & Applied Economics Association's 2012 AAEA Annual Meeting, Seattle, Washington, August 12-14, 2012

Information Rigidity and Correcting Inefficiency in USDA's Commodity Forecasts

Stephen MacDonald ERS/USDA, Olga Isengildina-Massa, Clemson University

stephen@ers.usda.gov olga123@clemson.edu

Abstract: This study investigates the rationality of monthly revisions in annual forecasts of supply, demand and price for U.S. corn, cotton, soybeans, and wheat, published in the *World Agricultural Supply and Demand Estimates* over 1985/86 - 2010/11. The findings indicate that USDA's forecast revisions are not independent across months, and that forecasts are typically smoothed. Adjustment for smoothing in a subset of forecasts (1998/2000 – 2010/11) showed mixed results: significant improvements for soybean use forecasts, cotton exports, and a broad cross-section of forecasts published in October. However, accuracy deteriorated in some cases, particularly for late-season preliminary data revisions.

BACKGROUND

Volatility in world commodity markets heightens concerns about USDA's ability to reliably provide markets with information. Isengildina-Massa, MacDonald, and Xie (2012) examined USDA's cotton forecasts and found that the most pervasive rejection of efficiency across variables and countries occurred in tests of revision efficiency.

Goals of study:

a) Investigate the rationality of monthly revisions in WASDE annual forecasts for U.S. corn, cotton, soybeans, and wheat, published over 1985/86 - 2010/11.

b) Assess potential improvements in forecast accuracy resulting from correction of revision inefficiency in these forecasts.

Figure 1 illustrates the forecasting cycle for cotton. USDA's *World Agricultural Supply and Demand Estimates* forecasts are fixed-event forecasts: series of monthly forecasts of a year (t) terminal event. Each forecast is an update of the previous forecast, where i = 1, ... , I. WASDE generates 18 updates (revisions) within each marketing year. The years are t = 1(1985/86), …, 26 (2010/11). WASDE forecasts also have rolling-event characteristics as the forecasts with 18 (I-1) different horizons are available for 25 target dates (marketing years).

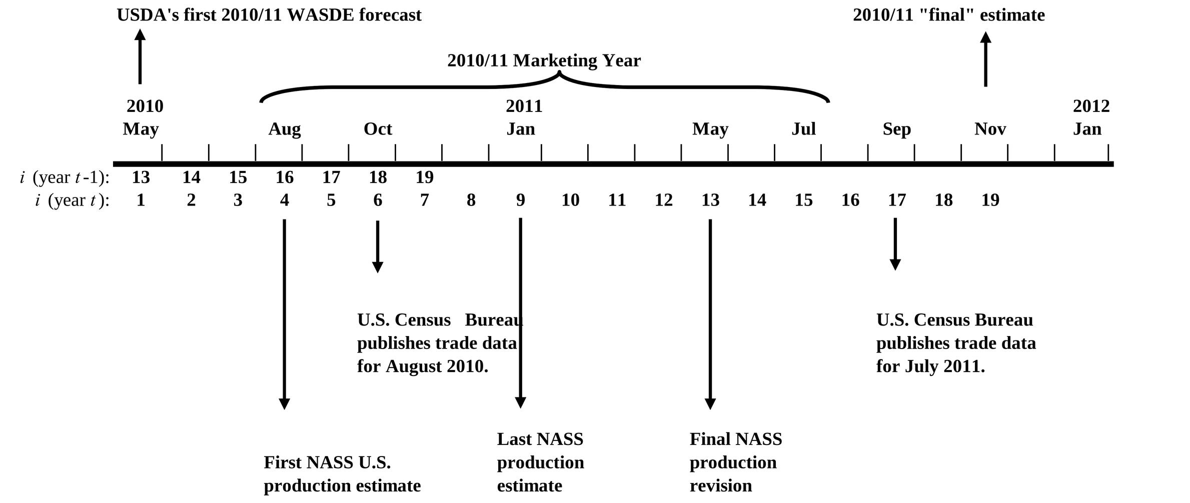

Figure 1. WASDE Forecasting Cycle for Cotton Relative to the 2010/11 U.S. Marketing Year.

METHODOLOGY

To standardize for changing forecast size over time, errors and forecast revisions are examined in log percentage form. The forecast error and forecast revision are calculated as:

$$e_t^i = 100*\ln\left(\frac{y_t^i}{y_t}\right) \quad i=1,\ldots,I-1;\ t=1,\ldots,26 \qquad r_t^i = 100*\ln\left(\frac{y_t^i}{y_t^{i-1}}\right) \quad i=1,\ldots,I-1;\ t=1,\ldots,26$$

Weak form efficiency of fixed-event forecasts implies independence of forecast revisions (Nordhaus, 1987). According to Nordhaus, if forecasts are weak form efficient, revisions should follow a random walk.

This property is tested using the approach outlined in Isengildina, Irwin, and Good (2006b), with a time trend:

$$r_t^i = \lambda_1 r_t^{i-1} + \lambda_2 T + \varepsilon_t^i \quad i=1,\ldots,I;\ t=1,\ldots,26$$

The null hypothesis for efficiency in forecast revisions is $\lambda_1 = 0$. If $\lambda_1 > 0$, the forecasts are "smoothed" (partially based on previous revision). If $\lambda_1 < 0$, the forecasts are "jumpy" (partially offset previous revision)..

Test statistics for the entire forecasting cycle were estimated using panel least squares method with White cross-section correction in standard error calculation

An alternative measure of revision inefficiency also provides an adjustment parameter for a pending, as opposed to a past, revision. The first step is to estimate regressions of the form,

$$e_t^i = \gamma r_t^{i+1} + \varepsilon_t^i \quad i=1,\ldots,I;\ t=1,\ldots,26$$

Where γ=1 for an efficient forecast.

Simulation used estimated γ to adjust forecasts: USDA revisions multiplied by γ; then adjusted revision added to previous forecast. Note that this procedure only changes the intermediate path to satisfy efficiency. Coefficients estimated recursively, starting with 1985/86-1997/98 and used for out-of-sample correction of smoothing in the following year for the 1998/99-2010/11 forecasts.

RESULTS

Production, price, export, and ending stock forecast revisions are inefficient and smoothed for each commodity (Table 1). A 10% revision in month i is usually followed by a 2.6% revision in the same direction in month i+1 in cotton and soybean production forecasts. Domestic use forecasts are efficient for corn and wheat, and beginning stocks are forecast efficiently for corn and soybeans. Inefficiency takes the form of smoothing in every case, except the forecasts for feed and residual use of wheat.

Figures 2-3 show the values of inefficiency test coefficients on the monthly level that reject the null hypothesis of zero. Corn exports are smoothed mostly in the middle and later months of the forecasting cycle. Price smoothing for corn is largely in the middle of the cycle, but use estimate smoothing largely happens later. Cotton forecasts have smoothing for a number of variables in the middle of the cycle. For cotton production and ending stock estimates smoothing seems more frequent than it is for corn. USDA's wheat forecasts generally have less smoothing than those for other commodities. Soybean forecasts have more smoothing than the other commodities. The "jumpiness" in the wheat feed and residual forecast revisions is confined to only one month, August, in the late-season revisions.

Table 1--Estimated λ_1 for test of independence of forecast revisions for WASDE crop forecasts.[a]

Variable	Corn	Cotton	Soybeans	Wheat
Beginning stocks	0.075	0.214 ***	0.072	0.191 ***
(N)	156	156	390	156
Ending stocks	0.196 ***	0.203 ***	0.249 ***	0.105 *
(N)	356	416	130	390
Feed & residual	0.019			-0.101 ***
(N)	416			390
Food, seed, & industrial	0.104 **		0.030	0.068 *
(N)	390		390	390
Crush			0.353 ***	
(N)			416	
Price	0.149 **	0.156 ***	0.242 ***	0.308 ***
(N)	416	416	416	364
Production	0.301 ***	0.258 ***	0.267 ***	0.194 ***
(N)	260	260	182	182
Domestic use	0.075	0.321 ***	0.324 ***	0.004
(N)	416	416	416	390
Exports	0.399 ***	0.328 ***	0.328 ***	0.262 ***
(N)	416	390	390	338

Notes: r is forecast revision and T is a trend. Months 3 through 18 included for most variables. Forecast months included up to point where 1985-2010 MAPE = 0, which is earlier for production and earliest for beginning stocks. Regressions estimated using panel least squares with White heteroscedasticity correction. N is the number of observations. Single, double, and triple astericks (*, **,***) denote statistical significance at 10%, 5%, and 1%, respectively.

[a] $r_t^i = \lambda_1 r_t^{i-1} + \lambda_2 T + \varepsilon_t^i$

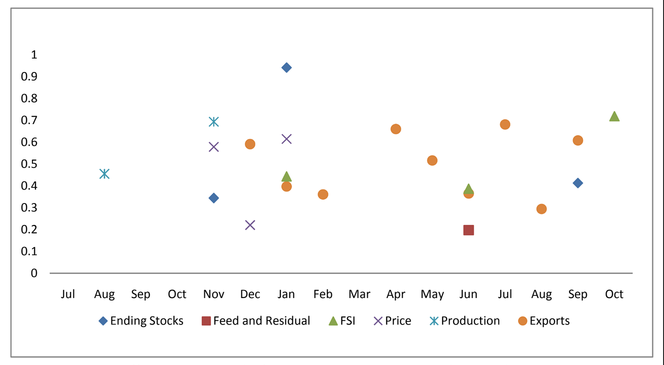

Figure 2. Revision Efficiency Test Results for USDA Corn Forecasts, 1984/85-2010/11

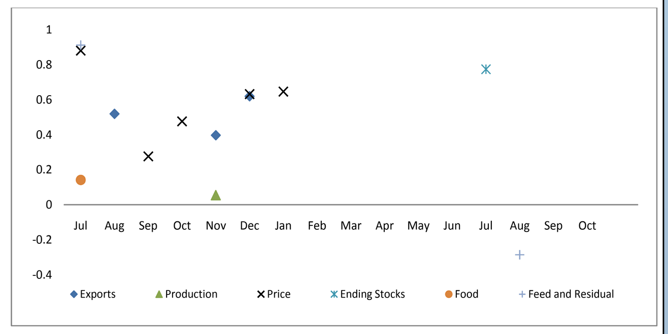

Figure 3. Revision Efficiency Test Results for USDA Wheat Forecasts, 1984/85-2010/11

Simulations of correction for smoothing yielded mixed results with respect to accuracy (tables 2-3). Improvements are evident for cotton exports & ending stocks: soybeans to lesser extent. A broad cross-section of forecasts published in October have lower MAPE in the simulations. However, accuracy deteriorated in some cases, liker late-season preliminary data revisions for wheat and corn.

Table 2--Simulated change in accuracy, cotton forecasts, 1998-2010

Month	Beg. St.	Produc.	Use	Exports	Ending St.	Price
	MAPE decline (percentage points)					
June	0	0	0	0	0	0.6
July	0.4	0	0	0	0	0
Aug	-0.7	0	0	0.7	0	0
Sep	0	0	0	0	0	0
Oct	0	0.6	0.8	1.6	4.9	2.2
Nov	0	0.5	0	0	0	-0.7
Dec	0	0.1	0	0.1	0.9	0
Jan	0	0.0	0	1.2	2.7	0
Feb	0	0	0	0	-0.3	0
Mar	0	0	0	1.2	0	0.3
Apr	0	0.0	-0.1	0	0.0	0
May	0	--	0	0.2	0.3	-1.7
June	0	--	0	0	0	0
July	--	--	0	0.4	-0.7	0
Aug	--	--	0	-0.1	-0.7	0.1
Sep	--	--	0	0	0	0

Recursive estimation of $e^i_t = \gamma r_t^{i+1} + \varepsilon^i_t$ used to calculate adjustment factor. When year's estimated γ differs from 1 at 5 percent significance,, the revision in the following year is adjusted by multiplying the published revision by γ and adjusted forecasts are calculated by adding the adjusted revision.

Table 3 --Simulated change in accuracy, soybean forecasts, 1998-2010

Month	Beg. St.	Produc.	Crush	Exports	Use	Ending St.	Price
	MAPE decline (percentage points)						
June	0	0	0	0	0	0	0
July	0	0	0	-0.9	0	0	0
Aug	0	0	0	-0.2	0	0	0
Sep	-0.4	0	0	0	0	0	0
Oct	0	0.4	0.4	1.2	0.0	4.8	0.9
Nov	0	0	0	-0.5	0	0	0
Dec	0	0	0	0.4	0	-0.5	-1.6
Jan	--	0	0	-0.9	0	0	-0.7
Feb	--	0	-0.4	0	-0.2	0	-0.4
Mar	--	0	0	0	0	0	0.2
Apr	--	0	-0.4	0.2	0.2	2.4	0.0
May	--	0	0.0	0.1	0.0	0.9	0
June	--	0	0	0	0	0	-0.1
July	--	0	0.2	0.2	0	0	0
Aug	--	0	0.1	0.0	0	-0.4	0
Sep	--	0	0	0.0	0	-0.7	0

Recursive estimation of $e^i_t = \gamma r_t^{i+1} + \varepsilon^i_t$ used to calculate adjustment factor. When year's estimated γ differs from 1 at 5 percent significance,, the revision in the following year is adjusted by multiplying the published revision by γ and adjusted forecasts are calculated by adding the adjusted revision.

Table 4--Simulated change in accuracy, corn forecasts, 1998-2010

Month	Beg. St.	Produc.	Feed & Res.	Food, seed & indust.	Exports	Use	Ending St.	Price
	MAPE decline (percentage points)							
June	-0.8	0	0	0	0	0	0	0
July	-0.8	0	0	0	0	0.0	-0.2	0
Aug	0	0	0	0	0	0	0	0
Sep	-0.3	0	0	-0.4	0	0	-3.8	0
Oct	0.0	-0.2	1.3	1.0	1.3	0.3	1.9	0.7
Nov	0	0.1	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	-0.9
Jan	--	0	0	0	0	0	0	0
Feb	--	0	0	0	0	0	-1.3	0
Mar	--	0	0	0	0.4	0	0	0
Apr	--	0	0	0	-0.1	-0.1	0	0
May	--	--	0	0	-0.4	-0.1	-0.9	0
June	--	--	0	0	-0.2	0	-1.3	-0.4
July	--	--	0	0	0	0	-0.7	0
Aug	--	--	0	0	0.0	0	0	0
Sep	--	--	0	0.0	0	-0.1	0	-0.1

Recursive estimation of $e^i_t = \gamma r_t^{i+1} + \varepsilon^i_t$ used to calculate adjustment factor. When year's estimated γ differs from 1 at 5 percent significance,, the revision in the following year is adjusted by multiplying the published revision by γ and adjusted forecasts are calculated by adding the adjusted revision.

Table 5 --Simulated change in accuracy, wheat forecasts, 1998-2010

Month	Beg. St.	Produc.	Food	Feed & Res.	Exports	Use	Ending St.	Price
	MAPE decline (percentage points)							
June	-0.2	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0	0
Aug	0	0.1	0	0	0	0	0	0
Sep	0	-0.1	0	0	0	0	0	0
Oct	0	0.1	1.3	1.5	4.2	1.2	1.0	1.0
Nov	0	0	0	0	0	-1.1	0	0
Dec	0	0	0	0	0	0.0	0	0
Jan	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0
Apr	0	0	0	0	-0.1	0	0	0
May	0	0	0	-0.3	0	0	0.0	-0.1
June	0	0	0	0	0	-0.2	0	-0.4
July	0	0	0	0	-1.1	0	0	0
Aug	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0

Recursive estimation of $e^i_t = \gamma r_t^{i+1} + \varepsilon^i_t$ used to calculate adjustment factor. When year's estimated γ differs from 1 at 5 percent significance,, the revision in the following year is adjusted by multiplying the published revision by γ and adjusted forecasts are calculated by adding the adjusted revision.

CONCLUSIONS

The endemic nature of revision inefficiency in the form of smoothing raises an interesting question: does USDA consciously pursue a "conservative" forecasting approach? Alternatively, does the consensus nature of USDA's forecasting process lend itself to the sluggish incorporation of new information even in the absence a conscious policy? Coibon and Gordonichenko (2012) develop several theoretical models that show how various forms of information rigidity result in consensus forecasts of panels of forecasters that adjust to innovations slowly. A correction strategy for responding to the forecast inefficiency might be independent of its ultimate source, but exploration of inefficiencies sources and correction may best be combined. The widespread evidence of smoothing suggests that forecast accuracy could be improved if this inefficiency is corrected. However, our simulations of correction for smoothing yielded mixed results with respect to accuracy. This finding highlights the challenges with correction for smoothing.

BIBLIOGRAPHY

Coibion O. & Y. Gordonichenko, 2012. "What Can Survey Forecasts Tell Us About Information Rigidities?," *Journal of Political Economy*, 120(1): 116-159.

Isengildina, O., Irwin, S., & D Good, 2006. "Are Revisions to USDA Crop Production Forecasts Smoothed?" *Amer. J. Agr. Econ.*, 88:1091-1104.

Isengildina, O., MacDonald, S. and R. Xie, 2012. "A Comprehensive Evaluation of USDA Cotton Forecasts." *Journal of Agricultural and Resource Economics* 37(1): 98-113.

Nordhaus, W.D., 1987. "Forecasting Efficiency: Concepts and Applications." *Rev. Econ. and Statis*. 69:667-674.

Any opinions, findings, conclusions, or recommendations expressed are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.