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How Accurate are the USDA's Baseline Projections?

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Background

- USDA's statistical agencies such as NASS and ERS provide forecasts of agricultural production, prices, trade, uses, inventories, and farm income.
- USDA forecasts such as Farm Income Forecasts and WASDE forecasts are eagerly awaited by stakeholders.
- A number of previous studies suggest that many USDA forecasts are biased and/or inefficient.
- Bora, Katchova, and Kuethé (2020) show that asymmetric loss functions can rationalize these USDA forecasts.

USDA Long-Run Agricultural Baseline Projections

- The USDA baseline projections describe the factors influencing agricultural markets for the next decade, and include projections of commodity prices, production, global agricultural trade and farm income.
- A conditional scenario that serves as a basis for comparison of alternative policies, and for analysing market developments, subject to assumptions.
- Important for understanding the status of the economy several quarters or years from the current year.
- Used for formulating policy such as preparing the President's budget and program allocations.
- As the projections are available for next 10 years, a relevant question is how long these projections stay informative.

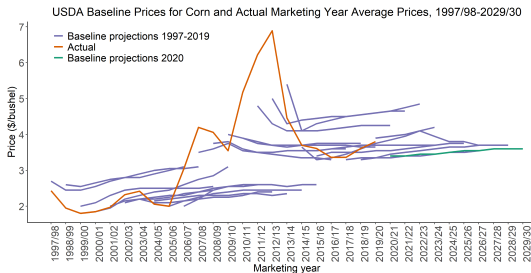
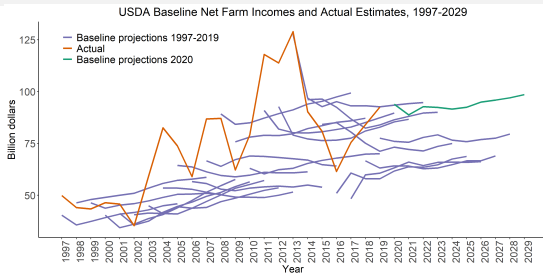
Evaluating USDA Baseline Projections

- **Previous Literature:**
 - ▶ Despite their importance in shaping agricultural policy, USDA's baseline projections have not been rigorously evaluated in the literature.
 - ▶ Traditional tests of assessing predictive content usually compares the actual forecast with some "naive" forecasts.
 - ▶ Path forecasts are when the forecaster predicts a set of values for multiple horizons. Forecast accuracy tests of path forecasts take into account the dynamics along the forecast path across the horizon, and typically follow a joint approach (Martinez, 2020).
- **Our study:**
 - ▶ We use a novel method that compares mean-squared forecast error with the unconditional variance of the target variable.
 - ▶ This method sidesteps the requirement of a "naive benchmark," as only the forecasts and the actual values are need for evaluation.
 - ▶ We calculate the largest informative forecast horizon for key baseline variables.
- **We find that:**
 - ▶ The baseline projections are barely informative beyond a year or two years ahead.

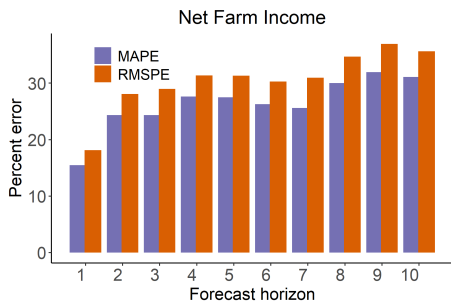
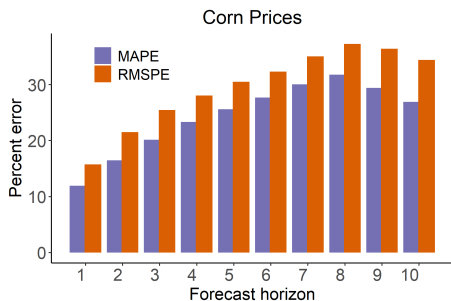
Data and Notations

- USDA baseline projections are available since 1997, and updated in February of each year.
- Data set includes the actual estimates for the previous year, nowcast (the projection for the current year), and projections for the next 10 years.
- Our analysis is focused on two main projections tables:
 - ▶ farm sector income, and
 - ▶ prices of three commodities: corn, soybeans, and wheat.
- Definitions:
 - ▶ $\{Y_{1+h}, Y_{2+h}, \dots, Y_{T+h}\}$ denote the set of T observed actual values corresponding to model forecasts $\hat{Y}_{t+h|t}$, $t = 1, 2, \dots, T$ at time t (h =forecast horizon).
 - ▶ $\{\hat{Y}_{1+h}, \hat{Y}_{2+h}, \dots, \hat{Y}_{T+h}\}$ denote the set of h -step ahead forecasts.

Baseline projections for net farm income and corn price



MAPE and RMSPE by horizon



Testing for Predictive Content in the Baseline Projections

- Set Up:
 - ▶ Actual values Y_t are generated by a stationary process $\{Y_t\}$.
 - ▶ Forecasts $\hat{Y}_{t+h|t}$, $t = 1, 2, \dots, T$ are realizations of a forecast generating process $\{Y_{t+h|t}^\theta\}$, (θ is a model parameter).
- Hypothesis testing about whether the baseline projections at horizon h are informative (Breitung and Knüppel, 2020):

$$H_0 : E(Y_{t+h} - \hat{Y}_{t+h|t})^2 \geq E(Y_{t+h} - \mu)^2, \text{ for } h > h^* \text{ and } t \in \{1, \dots, T\} \quad (1)$$

$$H_1 : E(Y_{t+h} - \hat{Y}_{t+h|t})^2 < E(Y_{t+h} - \mu)^2 \quad (2)$$

where, $\mu = E(Y_t)$ is the unconditional mean.

- Hypothesis testing about whether the conditional mean is constant within the sample:

$$H_0 : E(Y_{t+h}|I_t) = \mu_{h,t} = \mu, \text{ for } h > h^* \text{ and } t \in \{1, \dots, T\} \quad (3)$$

where, I_t is the information set at time t .

- The maximum informative forecast horizon is $h^* = h_{min} - 1$ where h_{min} is the smallest horizon for which the null hypothesis is not rejected.

Testing for Predictive Content in the Baseline Projections

- These hypotheses can be tested in a Mincer-Zarnowitz regression:

$$Y_{t+h} = \alpha_h + \beta_h \hat{Y}_{t+h|t} + \nu_{t+h} \quad (4)$$

- No information hypothesis: $H_0 : \beta_h \geq 0.5$, $H_1 : \beta_h < 0.5$.
- Constant mean hypothesis: $H_0 : \beta_h = 0$.
- LM test statistic is constructed as,

$$\tau_a = \frac{1}{\hat{\omega}_a \sqrt{T}} \sum_{t=1}^n a_t$$

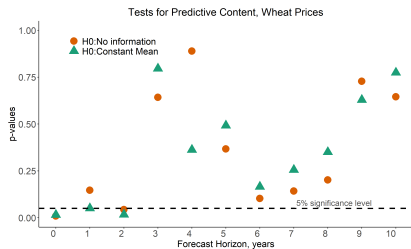
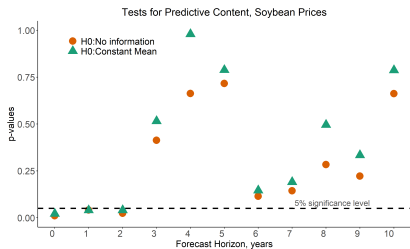
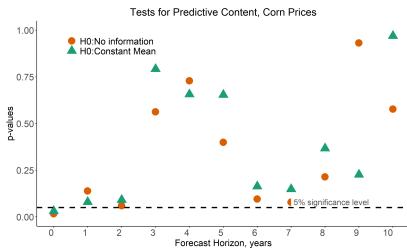
$$a_t = \left[Y_{t+h} - \bar{Y}^h - 0.5(\hat{Y}_{t+h|t} - \bar{Y}_h) \right] (\hat{Y}_{t+h|t} - \bar{Y}_h) \text{ for } H_0 : \beta_h = 0.5$$

$$a_t = (Y_{t+h} - \bar{Y}^h)(\hat{Y}_{t+h|t} - \bar{Y}_h) \text{ for } H_0 : \beta_h = 0$$

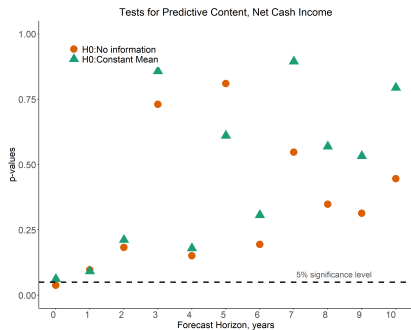
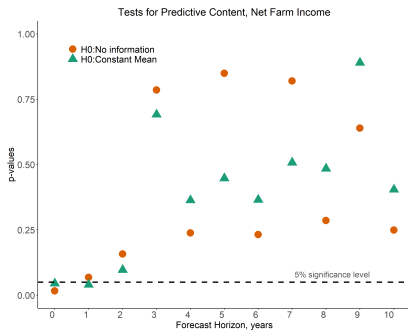
where, $\hat{\omega}^2$ is a consistent estimator of the long-run variance of a_t .

- The LM-statistic has a standard normal distribution.

Predictive Content for Commodity Price Projections



Predictive Content for Farm Income



Maximum Informative Forecast Horizon

Table 1: Maximum informative forecast horizons for selected variables

	Variable	No information test	Constant Mean test
Corn	Price	0	0
	Yield		
	Acreage		
Soybean	Price	2	2
	Yield	0	
	Acreage	0	
Wheat	Price	0	0
	Yield	0	0
	Acreage	1	1
Farm Income	Net farm income	0	1
	Net cash income	0	
	Crop receipts	0	
	Livestock receipts	0	0
	Govt. payments	0	
	Cash expenses	0	

Notes: h* calculated at 5% significance level

Conclusions and Implications

- The information content of the USDA baseline projections diminishes after the nowcast of the current year.
- Even in the best case scenarios, the projections remain informative only up to two to three years ahead and become uninformative after that.
- These results inform USDA forecasters who create these baseline projections.

Questions?

Please email Siddhartha Bora at bora.19@osu.edu.

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