IS BEING BOLD BETTER? INDUSTRY EXPECTATIONS OF USDA CORN AND SOYBEAN PRODUCTION ESTIMATES

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INTRODUCTION

- U.S. Department of Agriculture's (USDA) reports substantially impact commodity markets and lead to large movements in agricultural futures prices and volatility.
  (*Fortenbery and Sumner 1993; Karali 2012; Ying, Chen, and Dorfman 2019; Adjemian and Irwin 2020; Isengildina-Massa, Karali, and Irwin 2020, 2023*)
- The impact of these reports is generally calibrated through "**market**" expectations, which are commonly proxied by **industry surveys**.
- When these market expectations differ from the figures in USDA reports, so-called "market surprises," markets respond by pushing agricultural commodity futures prices upwards or downwards depending on the sign of the surprise.
- Because of their impact on commodity markets, USDA includes a comparison between their estimates and industry expectations in Agricultural Statistics Board Briefings after each report release.

BACKGROUND

- Numerous studies have utilized these surveys.
  - To analyze the characteristics of industry forecasts:
    (*Egelkraut et al. 2003; Good and Irwin 2006; Isengildina-Massa, Karali, and Irwin 2013, 2020*)
    - **Bias** : systematic under- or overestimation
    - **Rationality:** incorporation of all available information in the forecasts
    - **Efficiency** : no correlation between forecast errors and forecasts themselves
    - **Accuracy** : making smaller forecast errors relative to a base group

    (*Egelkraut et al. 2003; Good and Irwin 2006; Isengildina-Massa, Karali, and Irwin 2013, 2020*)
  - To measure the value and impact of USDA reports on commodity prices and volatility:
    (*Garcia et al. 1997; McKenzie 2008; Fernandez-Perez at al. 2019; Karali et al. 2019*)
    - **"Market" surprise:** the difference between USDA estimates and the median/mean of industry surveys
- However, psychological studies of forecasting behavior document that predictions made by individuals are also **subject to cognitive biases**.
  (*Tversky and Kahneman 1974; Campbell and Sharpe 2009*)
- Further, the resulting "market" surprise component contains **measurement errors** and the existence of cognitive biases would lead to a **bias in the surprise component**.
  (*Karali, Irwin, and Isengildina-Massa 2020*)
- Behavioral biases have been extensively studied for analysts' expectations for earnings-per-share (EPS) announcements of publicly traded companies and for macroeconomic indicators.
  (*Hong, Kubik, and Solomon 2000; Clement and Tse 2005; Hilary and Menzly 2006; Campbell and Sharpe 2009; Salamouris and Muradoglu 2010; Mira and Taylor 2011; Cen, Hilary, and Wei 2013; Nardi et al. 2022*)
- The attention to the behavioral aspects of industry forecasts of upcoming USDA reports has been limited, if any, most likely due to a lack of analyst- or firm-level forecast data.
- If analysts or firms participating in surveys make systematic forecast errors due to cognitive biases, then their forecasts and forecast errors become partly predictable and would provide financial market participants with profit opportunities.

OBJECTIVES

- To identify whether industry expectations of USDA reports are subject to cognitive biases and expand the previous literature beyond the basic statistical heuristics of unbiasedness, rationality, and efficiency.
- We focus on three cognitive biases widely studied in the finance and accounting literature:
  - **Herding** : Making a forecast that is close to the consensus
    vs.
    Boldness : Making a forecast largely deviating from the consensus
  - **Attribution:** Overconfidence in own forecasting skills as a consequence of prior successes
  - **Anchoring :** Basing forecasts on a reference point and making adjustments thereafter

METHODOLOGY

Are bold forecasts more or less accurate?

$$Accuracy\ Score_{it} = \alpha_i + \gamma_t + \beta\ Boldness\ Score_{it} + \varepsilon_{it}$$

$$Score_{it} = 100 - \left(\frac{Rank_{it} - 1}{Number\ of\ firms_t - 1}\right) \times 100$$

$Rank_{it}$ for accuracy score: the ranking of the absolute forecast error, $|FE_{it}|$, from the smallest to the largest
$Rank_{it}$ for boldness score: the ranking of the absolute forecast deviation, $|FDEV_{it}|$, from the largest to the smallest

$$FE_{it} = 100 \times \frac{(Actual_t - Forecast_{it})}{Actual_t} \quad \text{and} \quad FDEV_{it} = 100 \times \frac{(Forecast_{it} - Forecast_{-i,t})}{Forecast_{-i,t}}$$

$Actual_t$: the actual USDA value in year *t*
$Forecast_{it}$: the forecast made by firm *i* in year *t*
$Forecast_{-i,t}$: the median of the forecasts made by other firms (excluding firm *i*) in year *t*

What increases the likelihood of making bold forecasts?

$$\mathbb{I}\left[Boldness\ Score_{it}^{Top\ 5\%}\right] = \Phi\left(\alpha_i + \gamma_t + \theta\ Accuracy\ Score_{i,t-1} + \delta\ Experience_{it}\right)$$

$\mathbb{I}[\cdot]$: an indicator for being in the top 5th percentile of the boldness score distribution in year *t*
$\Phi(\cdot)$: the cumulative distribution function of the logistic distribution
$Experience_{it}$: the running total of years a company provides forecasts

What makes firms deviate more than others in making forecasts?

$$|FDEV_{it}| = \alpha_i + \gamma_t + \psi|FDEV_{i,t-1}| + \phi|FE_{i,t-1}| + \delta\ Experience_{it} + \lambda\ Freq_{it} + \varepsilon_{it}$$

$Freq_{it}$: the number of times a firm's absolute forecast error was below the median of other firms' forecast errors (i.e., superior forecast) in the last three periods
$Freq_{it} = Count\left(|FE_{i,t-j}| < |FE_{-i,t-j}|\right),\ j = 1, 2, 3$

What increases forecast inaccuracy?

$$|FE_{it}| = \alpha_i + \gamma_t + \phi|FE_{i,t-1}| + \beta\ Boldness\ Score_{it} + \delta\ Experience_{it} + \lambda\ Freq_{it} + \varepsilon_{it}$$

Do firms base their current forecasts on an anchor?

$$FE_{it} = \alpha_i + \gamma_t + \varphi\ Deviation\ from\ Anchor_t + \varepsilon_{it}$$

Deviation from anchor = $100 \times \frac{(Forecast_{it} - Anchor_t)}{Anchor_t}$

$Anchor_t$: the initial starting point, for which we assign four different measures:

$$Anchor\ 1_t = Actual_{t-1} \qquad Anchor\ 2_t = \frac{1}{3}\sum_{j=1}^{3} Actual_{t-j}$$
$$Anchor\ 3_t = median\left(Forecast_{\forall i,t-1}\right) \qquad Anchor\ 4_t = median\left(Forecast_{-i,t-1}\right)$$

DATA

- **Crop Production** report: the most widely watched USDA reports, prepared and published by the National Agricultural Statistical Service (NASS) of USDA.
  - Survey-based estimates of yield and production for major crops consistent with growing cycles.
  - Focus on **corn and soybeans** as they constitute a major part of the U.S. agriculture and trade.
  - The first report that contains corn and soybean yield and production data is issued in **August**.
- **Unique and proprietary data of firm-level expectations** for upcoming USDA corn and soybean production estimates:
  - The majority of the companies in our data set participate in surveys conducted by news agencies, such as Bloomberg or Thomson Reuters.
  - The firms provide forecasts for crop production, crop yield, planted acreage, and stocks for corn, soybean, and wheat varieties.
  - Some companies disappear from the dataset in the early 2000s (the earliest in 2002) and some enter the dataset rather late (the latest in 2012).
  - To avoid basing our analysis on a panel dataset in which some firms do not overlap with others, or have only one common time period, we exclude the firms without forecasts after 2010.
  - We additionally exclude any firm with less than ten observations in the remaining sample.
  - The resulting dataset is an unbalanced panel, where the number of firms in a given year ranges from 9 to 24 , with an average of 15.3 firms over 30 years.
- The sample period is from 1992 to 2021.

RESULTS

Table 1. Accuracy of Bold Forecasts

Dep. var.: Accuracy Score	Corn				Soybeans			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Boldness Score	-0.237***				-0.302***			
Top 5% Boldness Score		-21.047***		-20.541***		-22.080***		-20.671***
Bottom 5% Boldness Score			6.187*	3.955			15.614***	13.686***

Bold forecasts are less accurate.

Table 2. Likelihood of Making Bold Forecasts

Dep. var.: Top 5% Boldness Score	Corn				Soybeans			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Prior Accuracy Score	0.007				0.010*			
Prior Accuracy Rank		-0.062				-0.055*		
Prior Top 5% Accuracy Score			0.145				1.219***	
Prior Bottom 5% Accuracy Score				-0.077				-0.919
Experience	-0.068	-0.068	-0.071	-0.072	-0.030	-0.036	-0.024	-0.029

Prior accuracy increases the likelihood of making bold soybean forecasts.

Table 3. Determinants of Forecast Deviation

Dep. var.: Absolute Forecast Deviation	Corn		Soybeans	
	(1)	(2)	(1)	(2)
Prior Absolute Forecast Deviation	-0.037	-0.103	-0.032	-0.296**
Prior Absolute Forecast Error	0.004	0.024	-0.023	0.240
Prior Accuracy Score		0.001		0.012*
Prior Boldness Score		0.003		0.010**
Experience	0.102**	0.104**	-0.078*	-0.064
Prior Success Frequency	0.235***	0.240***	0.016	-0.012

More experienced firms deviate more from the consensus for both crops, prior success leads to bolder corn forecasts.

Table 4. Determinants of Forecast Inaccuracy

Dep. var.: Absolute Forecast Error	Corn				Soybeans			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Prior Absolute Forecast Error	-0.150***	-0.148***			-0.042	-0.040		
Prior Accuracy Score			0.006**				0.003	
Boldness Score	0.012***		0.012***		0.014***		0.014***	
Prior Accuracy Rank				-0.036**				-0.022
Prior Boldness Rank				-0.063***				-0.074***
Top 5% Boldness Score		1.485***				1.617***		
Experience	0.086**	0.102**	0.078**	0.083**	-0.077	-0.100	-0.075	-0.084
Prior Success Frequency	0.101	0.130	0.070	0.089	0.127	0.134	0.093	0.080

Inaccuracy increases with bold forecasts for both crops.

Table 5. Anchoring Bias

Dep. var.: Forecast Error	Corn				Soybeans			
Deviation from	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Anchor 1	-0.111***				0.009			
Anchor 2		-0.150***				0.085***		
Anchor 3			-0.107***				0.040***	
Anchor 4				-0.107***				0.041***

Anchoring in soybeans, reverse anchoring in corn.

CONCLUSIONS

- We add to the literature on the value and impact of USDA reports by providing the first evidence of cognitive biases in industry forecasts that are widely used to represent market expectations.
- We show that "bold" forecasts are less accurate compared to herding forecasts.
  - Substantially deviating from the herd does not pay off when it comes to crop production forecasts.
- Our analysis also reveals that corn and soybean production forecasts display different behavioral biases even though the same companies make those forecasts.
  - Corn forecasts exhibit attribution bias with prior success leading firms to make bolder production forecasts but no statistical evidence for such a bias in soybean forecasts.
  - Soybean forecasts exhibit anchoring bias, suggesting that the analysts anchor their forecasts to a reference point and make adjustments from that initial value but corn forecasts display a reverse anchoring, with adjustments to the anchoring value made in the opposite direction.
  - More experienced firms make bolder forecasts for corn but herding forecasts for soybeans.
  - These differences in the features of corn and soybean forecasts highlight the challenges in making production forecasts for crops with different growing cycles.
- Our study suggests that industry expectations need to be adjusted for these cognitive biases by developing an econometric method to decompose the surprise measure of USDA reports into expected and unexpected components to use either in the analysis of price and volatility reactions to reports or in devising profitable trading strategies around USDA report releases.