EIC Market Reports Projection Procedure

Purpose and Executive Summary:

The Egg Industry Center (EIC) developed a new price projection model in order to improve the accuracy of our price projections. After conferencing with many of you at IPPE, we learned that you thought that was a good thing and so we made the change.

We have created this document to help users understand how our new projection procedure is estimated and provide some information of the expected accuracy level when tried using the years 2011-2014 information.

There is still a lot of room for improving the price projection accuracy, therefore we would really appreciate new ideas.

Projection Procedure:

The egg prices in the U.S. are subject to very high volatility and seasonal trends. Therefore, the EIC evaluated different ways to enhance our projection accuracy. We concluded that a "time series forecasting" model that accounts for "autocorrelation in residuals" was the one that achieved the best fit.

Suppose we want to estimate the Midwest Large White egg price at the month t (lets name it $\hat{A}t$).

The model basically works in 3 steps:

Step 1: Estimate the expected value of the price at month t without considering the "autocorrelation in the residuals" (let's name it y_t).
After trying very different variables and combinations we identified the following equation as the one that has a better fit and we can find projections for the independent variables:
$y = \beta_0 + \beta_1 * \text{EPD Jan} + \beta_2 * \text{EPD Feb} + \beta_3 * \text{EPD Mar} + \beta_4 * \text{EPD Apr} + \beta_5 * \text{EPD May} + \beta_6 * \text{EPD Jun} + \beta_7 * \text{EPD Jul} + \beta_8 * \text{EPD Aug} + \beta_9 * \text{EPD Sep} + \beta_{10} * \text{EPD Oct} + \beta_{11} * \text{EPD Nov} + \beta_{12} * \text{EPD Dec} + \beta_{13} * \text{Feed Price} + \beta_{14} * \text{CPI Food} + \beta_{15} * \text{Milk Price}$
where:

- β are the slope estimates
- EPD is the Eggs/Person/Day produced during each month, and it accounts for the seasonality of the demand for eggs (the future values for EPD are calculated from the EIC flock projections and a projection for rate of lay)
- Feed Price is the estimation of the feed cost for a corn-SBM diet, adjusted by season (the future prices of corn and SBM are obtained from the Chicago Mercantile Exchange (CME) using linear intrapolation for the months there is no trade)
- CPI Food is the consumer price index for all food and beverages
- Milk Price is the Class III milk price, adjusted by season (the future prices of milk are obtained from the CME)

This model represents an improvement from the indexes used before. A big part of all the past models' accuracy problem is the huge volatility of egg prices.

Step 2: the residuals from the previous regression are autocorrelated, therefore we had to find the equation that best reflects the level of autocorrelation we found there. This was reached by adjusting the following regression.

$\hat{e}_t = \alpha_0 + \alpha_1 * e_{t-1} + \alpha_2 * e_{t-2}$

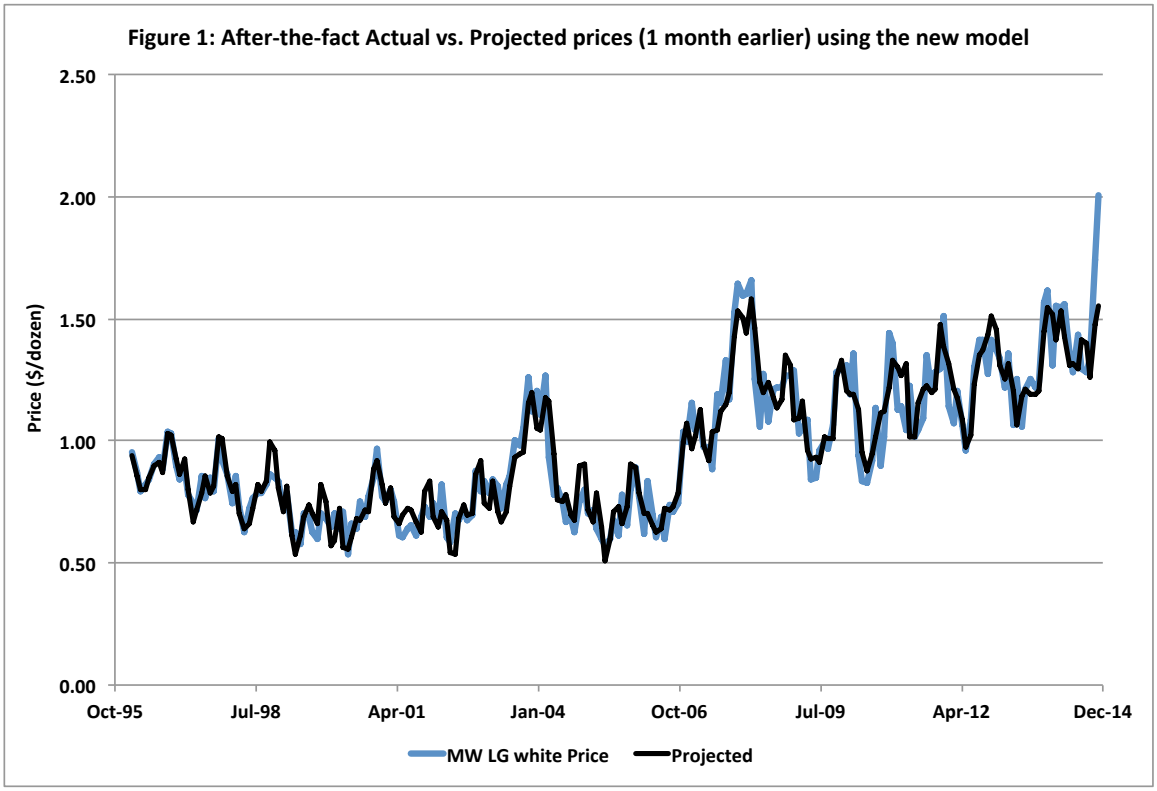
where:

- $\hat{e}_t$ is the estimated value of the residual for the month t
- e_{t-1} and e_{t-2} are the actual values of the residuals for the month *t-1 and t-2*
- α are slope estimates

Step 3: estimate the expected value of the price at month t ($\hat{A}_t$) after considering the "autocorrelation in the residuals", as the sum of $\hat{y}_t$ and $\hat{e}_t$.

$$\hat{A}_t = \hat{y}_t + \hat{e}_t$$

Figure 1 (below) illustrates how the Actual prices and the Projected prices (1 month before) relate "after the facts" as if we already knew the corn price, SBM price, milk price, and number of eggs produced per person per day for the month *t*. The correlation between the actual values (blue line) and the projected prices (black line) with "perfect" information on independent variables was high (0.94). Forty-one percent of the time the difference between the actual and the projected price was within range of 5 cents/dozen, and 70% of the time the difference between the actual and the projected price was within the range of 10 cents/dozen.



The reality is that at the time of making projections we don't have the actual values for these variables and we have projected values that are not completely accurate. The accuracy of these expected values tends to be lower as we try to project many months in advance. Also, the slope estimates of the model are different if we use previous data (for example from 1996 to 2010) to then project the years 2011-2014 prices.

Out-of-sample checking

To identify how well the model behaves out of sample, we developed the model using the 1996-2010 data and we checked the level of accuracy reached when projecting prices for the years 2011-2014. We expected to have some gains in accuracy if we try to project each quarter price instead of each month, so we checked the accuracy of projecting both. We measured the accuracy as the percentage of projected prices that fell within the ranges of 5, 10 and 15 cents/dozen actual price. The results are represented in figures 2, 3 and 4 respectively.

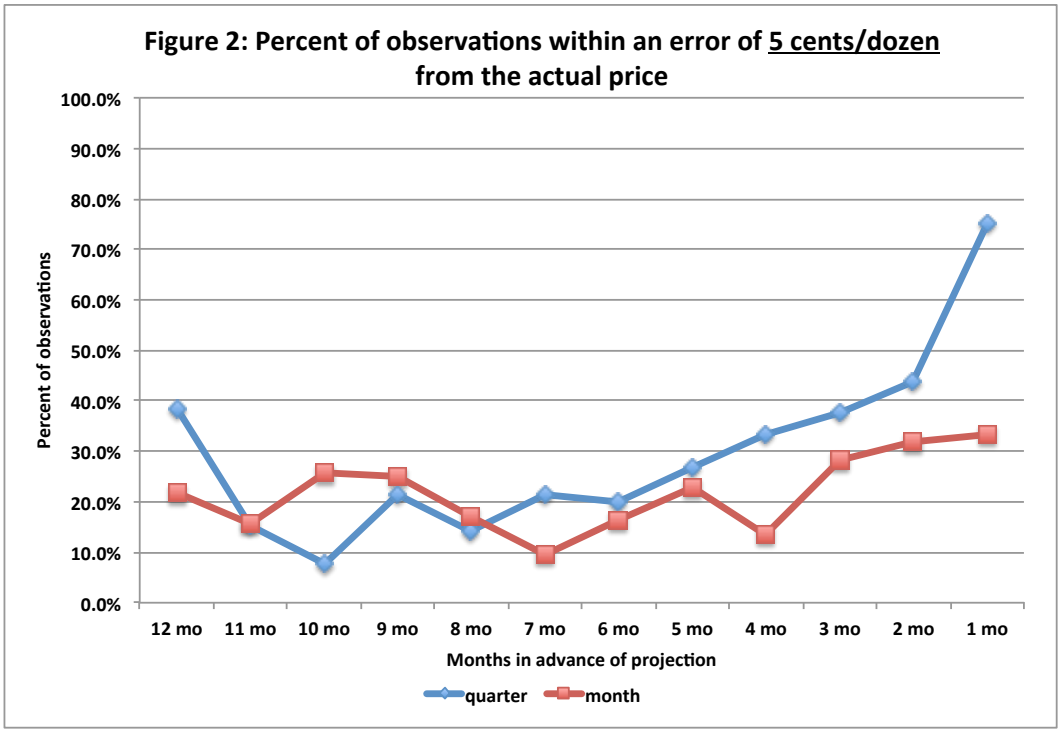


Figure 3: Percent of observations within an error of 10 cents/dozen from the actual price

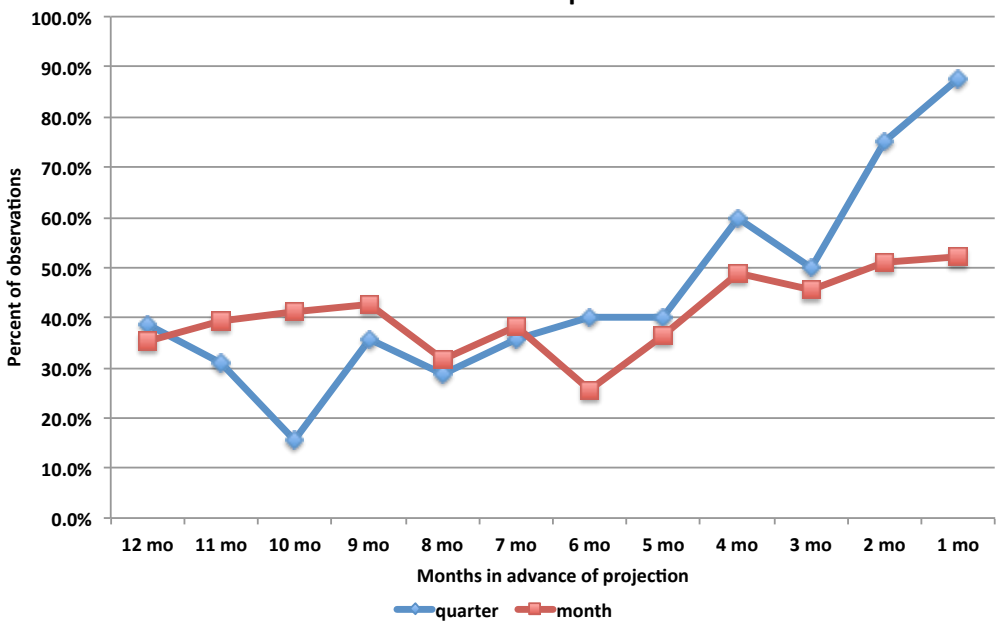
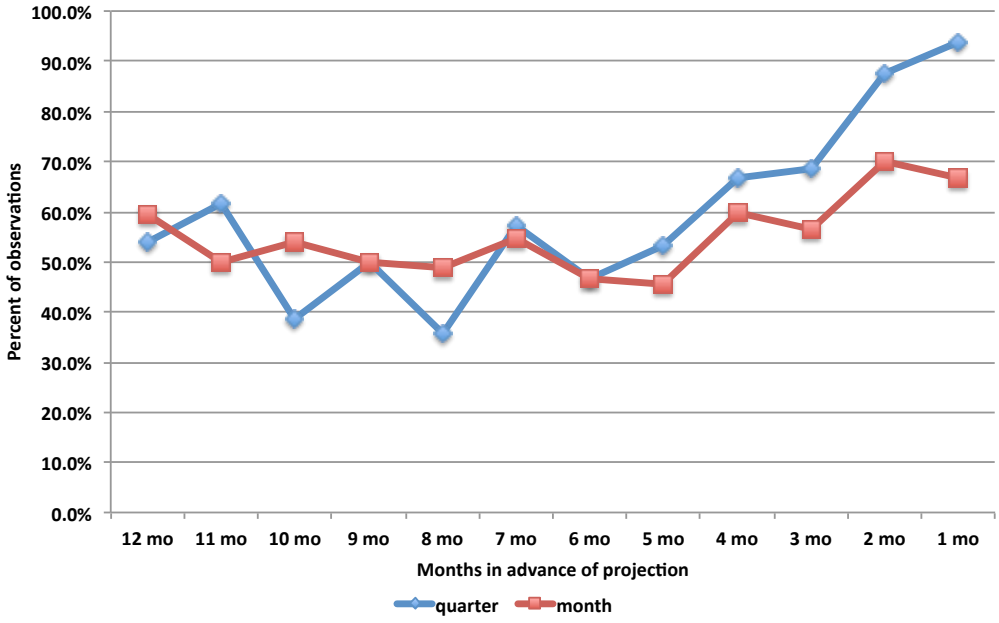


Figure 4: Percent of observations within an error of 15 cents/dozen from the actual price



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The out-of-sample projections show we can actually improve the accuracy if we start reporting projections for each quarter rather than for each month. Therefore after consulting with some industry leaders about their preferences (more accuracy for each quarter vs. less accuracy for each month) the decision was made to start reporting projections for each of the next four quarters.

Please note that even though the out-of-sample accuracy gives us a good idea of what kind of errors to expect; there will be times when the industry will see projections that are better or worse than the ones in this sample.

Point estimates to use in the year 2015 **(UPDATED on March 2, 2015)**

After checking out-of-sample, we ran the model again to estimate the slope values to use in 2015, this time using al the data from 1996 to 2014. And these are the corresponding values for both equations.

Equation 1 (R^2=0.77):
$\hat{y}$ = 1.3099 - 2.5271 * EPD Jan - 2.6238 * EPD Feb - 2.4993 * EPD Mar - 2.6885 * EPD Apr - 2.8704 * EPD May - 2.8296 * EPD Jun - 2.7402 * EPD Jul - 2.6692 * EPD Aug - 2.6771 * EPD Sep - 2.6543 * EPD Oct - 2.3456 * EPD Nov - 2.3118 * EPD Dec + 0.0013 * Feed Price + 0.0048 * CPI Food + 0.0231 * Milk Price

Equation 2 (R^2=0.45):
$\hat{e}_t = 0.0023 + 0.4957 * e_{t-1} + 0.2843 * e_{t-2}$

The price of the "U.S. unprocessed eggs on farm (all sizes) – EXCLUDING CALIFORNIA" (*NestRunPrice*) is projected from the projected "Midwest Large White" egg price ($\hat{A}_t$) based on the last 10-year linear relationship between these 2 prices
$NestRunPrice_t = 0.9418 * \hat{A}_t - 0.3511$ $R^2 = 0.9960$

If you have further questions, please contact me at any time.

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