Forecasting CPI Food Prices: An Assessment

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The Principle Paper Session of the 1997 American Agricultural Economics Association Annual Meeting in Toronto, Canada, brought together three consumer price index (CPI) food price forecasters: one from ERS, one private consultant, and one academic food price forecaster. Robert E. Young II from the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri, Annette Clauson from ERS, and John Urbanchuk from AUS Consultants presented papers at the session. The objective was to share economic models, methodologies, and techniques for predicting retail food price movements.

This paper summarizes the primary drivers of food prices by the forecasters, compares the forecasts for 1997 and 1998, and discusses three scenarios that the forecasters were asked to produce. One explanation for the wide range in food price forecasts in a given year by different forecasters is that they use different assumptions about the exogenous variables. Thus, the intent of using the three scenarios is to examine the impact of the models on forecasts given the same assumptions.

A Simple Description of the ERS Food Price Forecasting Process

We can best describe the forecasting methodology for food prices at ERS as a Delphi approach. First, individual commodity analysts come up with forecasts for demand and supply factors (quantities, prices, income, and international trade) for a commodity on the basis of some combination of rules of thumb, statistical analysis, and discussion with private and public industry experts and colleagues. The meats, poultry, and eggs analysts rely on balance sheet models containing inventories, stocks of animals in the biological cycle, exports, imports, consumption, and farm to wholesale to market prices. Fruits and vegetables analysts look at seasonal average prices, domestic production (accounting for weather- and disease-related losses), international trade, and known price margins from farm to wholesale to retail.

The forecasting process at ERS focuses mainly on the supply side of agriculture and begins there. The individual commodity analysts discuss their predictions with other ERS analysts of commodities that are substitutes or complements in the inputs at either the production or the food processing stage. An important purpose and outcome of this interaction among the ERS staff is (*a*) that they agree on the fundamental factors affecting food and agricultural markets and (*b*) that they use consistent assumptions in their predictions.

There is no formal econometric model for the entire process. The Delphi method is used to link farm prices, wholesale prices, and retail prices through two price margins. Spreads, or the margin between the wholesale and farmgate, reflect demand and supply pressures at the wholesale/processor level. The second margin reflects economic forces going from the processor to the retail level. Both margins are allowed to change on the basis of market information the analysts have regarding the interaction among the three prices. At this stage, the analysis becomes complicated because the forecasters are converting prices in dollars per pound to the CPI. Retail price markups can vary according to seasonal factors, the prices of poultry and beef, inflation, and marketing specials. The following is a simple function for the retail price and mark up:

$$\text{Retail Price} = \text{Markup} \times \text{Wholesale Price}$$

$$\text{Markup} = f(\text{Price of Substitutes, Specials, Seasons, Input Costs})$$

Wholesale prices are driven by the supply side (models), and retail prices are linked to the wholesale prices through the markup. In a crude

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sense, the food price prediction contains two components: the processor/wholesaler markup, which depends on a proportion above the farmgate price for commodities to incorporate transportation, labor, and other input costs, and the retailer markup for goods purchased from the processors/wholesalers. The latter stage seems to receive the least attention in the food price forecasts. The analysts at ERS and the other agencies seem to understand the retail marketing strategies but do not formally model them. Analysts at ERS have begun using univariate ARIMA and other simple time-series models as forecasting tools (see Denbaly et al. 1966).

A Simple Description of the FAPRI Food Price Forecasting Process

Researchers at FAPRI have developed a large-scale structural econometric model of U.S. agricultural production, consumption, and trade. The retail food price CPI models are linked to the structural model but do not feed back into information to the model. This is similar to the approach at ERS. The model combines economic factors, agricultural science, and biological processes in much the same way as the analysts at ERS. The structural model has been documented and is regularly updated to reflect market conditions, structural changes, and policy changes, such as the Federal Agricultural Improvement Act of 1996. The documentation and forecasts are made available to the public and reviewed by outside experts and academicians.

The food price CPI models are estimated by ordinary least squares (OLS) over the period 1986–95. They also make the documentation for these models public. The main explanatory variables in the food price CPI models are prices for wheat, rice, sugar, soybeans, and high-fructose corn syrup, as these are important inputs in food processing. In addition, industry wage rates and producer price indexes for fuel and electricity are used in several equations. Projections of livestock supplies and dairy product prices from the structural model are used in their respective CPI forecasts:

$$\text{CPI} = f(\text{Commodity Input Prices, Manufacturing Wages, Macrovariables})$$

The FAPRI model(s) incorporates time-series dynamic processes. The dynamics have (stable) cobweblike model features so that when a shock occurs the prices, the variable(s) of interest, will respond first in one direction and overshoot the baseline as they return to the long-run projection.

A Simple Description of the AUS Food Price Forecasting Process

The AUS is a private consulting firm based in Moorestown, New Jersey. The firm specializes in performing industry analyses and forecasting. The AUS price forecasting model has characteristics similar to both the ERS and the FAPRI models.

A structural econometric model is used to project agricultural supplies and demand, then a set of single-equation models is used to explain the primary determinants of food price inflation. The model is based on research at AUS on the relationships found between commodity price movements and consumer food price inflation and on the work of Blomberg and Harris. As in the models of other forecasters, increases in rice and wheat prices at the farmgate cause increases in cereals and bakery products. Increases in all-milk prices have positive impacts on the dairy product price index. Corn, rice, soybeans, and other grains have direct and indirect effects on consumer food price inflation. To the extent that households consume these commodities, they have a direct effect, but changes in these commodity prices are also important determinants of supplies and prices for meat, poultry, and eggs. There is no feedback between retail prices or CPI and the structural model. The AUS has developed a model explaining the (inverse of) farm-to-retail price margin as a function of macroeconomic variables, such as average hourly earnings of production workers:

$$\frac{\text{Farm Value}}{\text{Retail Cost}} = f(\text{Average Hourly Earnings})$$

Their model finds a significant negative relationship between earnings and the farm-to-retail costs; this reflects the increasing and strong influence of labor costs in the value added of food processing. Interest rates are explanatory variables in several models as well. The model tracks the movements and trends of the price margin very well, except for the commodity price shocks in 1974, 1975, 1989, and 1990.

Table 1. Baseline Consumer Food Price Percentage Change Forecasts

	ERS		AUS		FAPRI		ARIMA	
Food Item	1997	1998	1997	1998	1997	1998	1997	1998
All food	2.7	2.1	2.9	2.7	1.0	2.4	3.0	2.5
Food away from home	2.9	2.8	2.8	3.0	1.0	2.2	3.1	2.7
Food at home	2.3	1.9	2.6	2.6	1.0	2.5	3.1	2.5
Meats	2.8	1.4	2.7	3.1	0.3	4.2	2.6	0.8
Beef and veal	1.7	2.2	2.1	3.4	2.2	9.1	0.9	−0.2
Pork	4.7	0.1	2.8	0.4	2.7	0.1	5.0	2.6
Other meats	2.5	1.4	—	—	—	—	2.9	0.7
Poultry	2.6	2.8	0.6	2.1	−0.7	0.4	2.2	−0.4
Fish and seafood	3.3	2.8	3.5	5.0	2.4	2.6	2.9	3.0
Eggs	0.0	5.5	−3.4	0.5	−21.7	4.9	0.0	2.3
Dairy products	2.0	−0.6	−0.5	0.7	−3.7	−0.2	2.9	−0.1
Fats and oils	1.6	1.4	−1.0	1.8	−1.4	−0.4	1.5	1.8
Fruits and vegetables	1.0	3.2	4.0	4.5	2.4	2.5	3.4	3.9
Fresh fruits and vegetables	0.1	3.9	—	—	—	—	2.4	0.7
Fresh fruits	−0.3	3.9	—	—	—	—	4.7	2.1
Fresh vegetables	0.7	3.9	—	—	—	—	1.7	6.2
Processed fruits and vegetables	2.8	1.6	—	—	—	—	3.2	2.3
Processed fruits	3.1	2.0	—	—	—	—	2.1	0.2
Processed vegetables	2.7	0.9	—	—	—	—	3.1	2.8
Sugar and sweets	2.7	2.0	3.0	3.5	−2.3	−0.9	2.5	2.3
Cereals and bakery products	2.1	1.9	−0.3	−1.0	4.1	2.9	2.7	3.3
Nonalcoholic beverages	5.9	2.5	2.5	3.0	−0.6	−0.2	1.3	1.7
Other prepared foods	3.4	3.1	3.0	3.5	2.3	2.2	3.5	2.8

Baseline Forecasts or Projections

Table 1 shows the baseline consumer price percentage change forecasts in 1997 and 1998 for ERS, FAPRI, and AUS and from ARIMA models used by ERS. The baseline represents the forecast by each organization based on its own assumptions about the agricultural and macroeconomic environment. These predictions were made using information that was available through May 1997. The forecasts provided by AUS and FAPRI were in levels and were converted to annual growth rates.

The ERS predicts that the price of all (retail) food items will rise 2.7% (the ARIMA model predicts 3.0%) in 1997. The AUS has a slightly higher inflation prediction of 2.9% for the all-food items. The lowest inflation prediction is by FAPRI at 1.0%; this may be explained by the greater volatility of the individual food categories. All-food price inflation in 1998 is expected to decline to 2.1% (ERS), 2.7% (AUS), and 2.5% (ERS ARIMA). The FAPRI predicts that inflation will increase from 1% to the historical average of the last seven years of 2.4%. The changes in inflation between 1997 and 1998 are driven primarily by the change in the food-at-home item prediction by all the forecasts.

The Three Forecast Scenarios

In the first scenario, the supply of beef is reduced by 5% net of any herd or other beef supply adjustments in 1997. The shock to supplies is a one-time event. All the forecasters examine the impact in a general equilibrium sense. As the supply of beef falls, the price rises and quantity demanded declines. Consumers respond to the higher beef prices in part by purchasing pork and poultry, causing their demand to increase raising their respective prices.

The FAPRI predicts that meat prices will increase by the most; retail meat prices will increase by 9.7% in 1997 rather than 0.3% as in the base case. Beef prices will rise by 23% (2.2%), pork by 9% (2.7%), and poultry by 6% (−0.7%). The numbers given in parentheses represent the baseline projections for the forecasters. The AUS forecasts that meat item inflation will more than double, from 2.7% to 5.9%. The respective price increases for beef, pork, and poultry will be 5.5% (2.0%), 3.5% (3.2%), and 0.6% (−1.1%). Actual values for the price effects were not given by ERS, but its analysis suggested that the increases in retail meat prices and the change from the baseline would not be above those predicted by AUS.

The impact of a decline in corn production of 10% in the 1997–98 crop year in the second scenario is more complex and leads to richer indirect effects. The shock to supplies is a one-time event. All the forecasters examine the impact in a general equilibrium sense. The direct impact on the consumer is marginal; the primary effects are through the livestock and processed foods components.

In the year of the shock, there is no supply response by other crops and planting does increase in the second year. As in the case of beef, the decline in corn production raises corn prices and increases other feed input prices as substitution takes place. The effect of the greater utilization of the other feed inputs, such as wheat and soybeans, reduces the impact of the decline in corn supply. The FAPRI modelers refer to this response as a shock absorber. Consequently, they predict a 0.26% increase in meat prices in 1997 above the baseline to a 0.6% increase for the year. In 1998 they predict a larger increase of 1.3% over the baseline to 5.5%. The AUS predicts marginally higher price increases above the baseline for meats, 2.7%–2.9% in 1997 and 3.1%–3.2% in 1998. The predicted impacts from ERS are more in line with those of AUS.

In 1998 corn supplies increase in response to the higher prices, and other feed input supplies decrease as less land is available because of the acreage devoted to corn production. Within two to three years, the proportion of land devoted to the particular crops returns to the baseline as prices and quantities adjust. The net effect in the FAPRI forecasts is to increase cereal and bakery products price increases 0.2% in 1997 and 0.3% in 1998 above the baseline. The AUS prediction for cereal and bakery products prices is unchanged in 1997 but does increase by 0.2% in 1998 above the baseline. Analysts at ERS predict marginal impacts on cereal and bakery products prices, but no values were given. All three forecasters suggested that a shock to wheat, rice, or soybeans would affect the cereal and bakery products more than the corn supply shock. All the forecasters hypothesized that reduced corn supplies would affect sugars and sweets prices and components of the nonalcoholic beverages item, but none could detect an impact in their models.

The last scenario examines the impact of a 5% increase in manufacturing wages in 1997 and 1998 above the baseline projections. It differs from the previous two in that it tries to capture the importance of the nonfarm component in retail food prices. The first two looked at adverse supply shocks in agricultural commodities. Urbanchuk shows that the average farm value as a percentage of the retail cost has declined from 44% in 1974 to 25% in 1996. He found a strong positive correlation between the retail cost index and the manufacturing wage index.

The AUS predicts that aggregate food prices will increase by 0.5%–3.5% in 1997 and almost 1% in 1998 to 3.6%. This is driven primarily by the food-away-from-home item; there are only small changes in the food-at-home item. The analysis from ERS suggested that their forecast would be for smaller increase than AUS. The FAPRI forecast predicts that aggregate prices will increase by 0.5% and 0.7% above the baseline projections in 1997 and 1998, respectively. The impact of higher wages is essentially the same across food consumed at home and away from home; this is different from AUS and ERS. In addition, they do not forecast much change for individual categories. The AUS predicts a large impact on cereal and bakery products of 7.8% in both years because of the high value-added labor input in these products. Prices for meats rise by more than 1% in 1998 above the baseline. Thereafter, the prediction returns to the baseline projections.

Conclusions

The forecasters have similar intuition on the primary drivers of food price movements, but the FAPRI model appears to have been the most sensitive to the scenarios explored by the forecasters. Commodity prices at the farmgate and the labor costs and energy prices of the wholesalers and food processors are used to predict (movements in) the retail food price item. The predictions are linked to larger formal and informal models of agricultural markets through the economics of commodity/food price transmission mechanisms. There is no feedback from the CPI food prices to the larger models. All three forecasters identified the food-away-from-home CPI as the most difficult to model and predict because it is a composite good that contains several items.

The forecasts, and especially the spread of the forecasts, for certain food price items provide important information to analysts and policy makers. They reflect the differences in emphasis, intuition, and modeling techniques of the forecasters. The real value of the spread is that it can be used as a tool regarding the uncertainty of price movements (Joutz, Stekler). Policy makers typically demand a single number. Forecasters and analysts can provide such a number, but they need to make policy makers aware of the relative uncertainty attached to a forecast (Abraham). For example, a forecast of a 1% increase in prices versus a 3% increase in prices for the Food Stamp Program budget yields a difference of half a billion dollars.

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