

Consumer Food Prices From The Ground Up

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Introduction

Large scale econometric models attempt to capture a significant amount of detail with respect to their applicable industry sector coverage. They do require a substantial commitment of resources both in monetary and temporal scales. In developing this level of detail it is possible to make comments on a number of issues of importance to decision makers, but at the same time, the detail involved can generate enough trees to make it difficult to recognize the economic forest.

This paper examines the performance of the modeling system maintained at the Food and Agricultural Policy Research Institute at the University of Missouri (FAPRI-Missouri) and its' ability to estimate consumer food prices and expenditures. The paper also examines the implied marketing margin behavior incorporated into the structure of the system. There is substantial detail in the modeling complex. While each level of the model is developed with attention to predictability and economic theory, relatively little effort in the past has looked at the overall performance of the model in a marketing margin context. Wohlgnant and Haidacher (1989) provide an excellent review of the literature related to studies of marketing margins and point out the importance of input substitutability, the supply responsiveness of the industry and other factors in evaluating the behavior of the markets at the farm and retail levels.

Background

The FAPRI-Missouri operates a large-scale econometric model of the United States food and agricultural sector as well as some international components, with our sister unit at Iowa

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consumer. The CPI model is broken into food at and away from home. Furthermore, food at home is subdivided into cereal and bakery products, meats, dairy, fruits and vegetables, and other prepared items including fats and oils, sugar and sweeteners, and non-alcoholic beverages. This data series contains the same components as the Bureau of Labor Statistics' CPI model.

Each component of the FAPRI CPI model is estimated using ordinary least squares over the 1986 to 1995 time period. It is important to note that the CPI model is essentially a linkage model and as such has no simultaneity. The simultaneous behavior of the industry and all of the dynamic behavior that exists in the markets takes place within the large scale econometric models. For example, beef, pork and chicken products each appear as substitutes for the other meats in their respective retail demand equations. Sugar demand at the wholesale level looks at all caloric sweeteners, not just the beet and cane markets. This forces the sugar markets to deal with corn sector changes as well. The commodity models are estimated utilizing three stage least squares and are solved simultaneously. The CPI models are then expressed as linkages from these simultaneous solutions.

The main forces driving the CPI model include rice, wheat, sugar and soybean oil prices, as well as high fructose corn syrup prices which are developed in the crops model. These are used in conjunction with wage rates and the producer price index for fuel and electrical power to obtain price linkage equations for rice, bread, sugar and margarine retail prices. In addition, beef, pork, broiler, turkey and egg retail prices obtained from the FAPRI livestock model and product prices from the dairy model drive their respective CPI components. Documentation of the CPI model, as well as the consumer expenditure model that attaches to the CPI model is contained in FAPRI-UMC #14-96.

the baseline production levels by making adjustments to corn yields. Each scenario has been evaluated separately. Exports are handled through reduced form export equations that mimic the behavior of the trade models maintained at Iowa State University. Table 2 displays the percentage change from baseline levels for the beef supply shock with table 3 giving the corn supply shock.

Beef Supply Adjustment

Moving from the farm level to retail for beef is the more straightforward example of the two selected. Note that supplies were adjusted so that the 5 percent change occurred, net of any herd or other beef supply adjustments. To illustrate the models cross-product behavior first consider the reduction in beef supplies. The 5 percent reduction moves the supply curve to the left, raising the price of beef. This higher price shifts demand for the other meats -- pork, broilers and turkeys -- to the right as well. These higher prices for the other meats shifts beef demand to the right, giving higher beef prices generating even larger rightward shifts in demand for the other meat products. This continues until an equilibrium is reached, generating retail meat prices that are 9.7 percent higher than the baseline in the first year, with the farm level prices of beef, pork and broilers up by 23, 9 and 6 percent respectively and the overall CPI for food increases by 2.7 percent. Note that some supply response has occurred in the broiler and pork sectors in the first year. Consequently the changes reflected here are not simple movements along the respective demand curves, but rather reflect the traces of the intersections of the supply and demand curves adjusting to the exogenous shock.

The shock is applied as a one-time exogenous adjustment to supplies, with the out-year effects being handled directly by the modeling system. In the second and later years, the supply side of beef begins to respond with pork and broilers continuing their reaction to the higher prices.

To affect the supply shock, yields for corn were reduced by a sufficient quantity to reduce supplies by 10% from 1997 crop levels. Again, this was a one year shock with baseline levels of yields and other exogenous factors allowed to return to baseline levels for all subsequent years. The reduction in corn supplies generates first and second round effects similar to those observed for beef. For this shock however, there is essentially no supply response from the other crops in the first year. Consequently, the results are more aligned with the movement along the demand curves for the respective crops than was the case for the livestock shock. Further, recall the discussion related to the relationship between crop and calendar years. The impact tables are headed as calendar years, with the crop information related to the second calendar year of the crop marketing year. Corn prices effects are exhibited in the 1996/97 crop year which derive from stock-holding effects from the 1996 crop thereby raising demand for product in the 1996/97 crop year.

The immediate results associated with reducing supplies are higher (13.6 percent) corn prices the year in which the shock occurs. Similar to livestock the rise in prices generates an increase in the prices for other feed inputs, such as wheat or soybeans which in turn helps to pull demand for corn even further to the right. These effects show up in feed utilization as well as in the export market generating even higher corn prices higher than would be suggested simply by movement along the demand curve. This gives an implied net elasticity in the 0.73 range. In the first year, the livestock sector essentially acts as a shock-absorber to the food system. While corn prices would have risen by \$0.32 per bushel, the CPI for food is expected to rise by less than 0.5 percent.

In the following year, corn and other crop supplies adjust to the higher 1997/98 prices. This attracts land into corn production and away from other crops like soybeans and wheat. Note

assess for the crops example, a closer examination of the underlying data for beef suggests otherwise for the meat sector at least. The aggregate retail meat bundle for beef, pork, broilers and turkeys is expected to cost around \$1.75 per pound for 1997. The meat bundle price is expected to rise by 9.7 percent under the beef supply shock scenario, or \$0.17 per pound. Beef has a carcass to finish weigh ratio of 0.7, 100 pounds carcass weight producing roughly 70 pounds of finish weight product. The 5% reduction in beef supplies at the farm level gives a \$0.15 per pound change given the 1997 beef prices of \$0.656 per pound prices for finished animals. This would lead one to believe that the results suggested by the overall modeling system declines marginally at higher levels of demand. The difference between the two price changes in absolute terms however is viewed as being relatively small suggesting that the margin is likely constant to marginally decreasing with higher levels of demand.

It is important to note that these are first-year effects only. Longer term examination of the margin trends have not been developed at this date.

Conclusions

Moving from changes in farm prices through to changes in the CPI for food requires that a number of layers in the marketing chain be described. The modeling system maintained by FAPRI-Missouri attempts to provide information for a number of these levels, from crop production to the livestock sector, from the feedlot to the packer, from the packer to the retail shelf. This kind of system then allows one to describe the effects of changes at the farm level through to the consumer with the knowledge that many of the layers have at least been touched, and taken into account. While the relative change in the price of products at the farm level tends to be much larger than the relative change suggested at retail, this alone should not imply that the margins are expanding or decreasing between the retail and farm level as one moves along the

Table 1. - Baseline Consumer Price Indices for Food

	1997	1998	1999	2000	2001	2002
	(1982-84=100)					
FOOD	154.7	158.4	161.8	166.4	171.3	174.2
Food at Home	155.7	159.6	163.2	167.9	173.1	176.0
Cereal and Bakery	181.2	186.5	191.8	201.7	211.6	219.1
Meat	145.1	151.3	156.4	163.5	170.7	171.6
Beef	137.2	150.3	160.6	169.3	177.2	176.3
Pork	152.0	152.2	153.7	165.3	177.4	179.6
Poult	151.2	151.8	151.8	152.0	151.9	151.6
Eggs	115.4	121.2	122.6	128.5	138.0	138.9
Fish	177.2	181.8	186.6	191.6	196.6	201.8
Dairy	136.6	136.3	136.3	134.5	135.2	135.9
Milk	136.6	136.5	136.8	135.5	136.5	137.4
Cheese	141.7	141.3	140.8	137.6	138.0	138.6
Ice Cream	140.2	139.6	139.5	137.6	138.0	138.5
Other Dairy (inc. butter)	129.1	128.9	128.9	129.0	128.9	128.9
Fruit and Vegetables	188.1	192.8	197.8	202.9	208.2	213.5
Other Food At Home	143.5	144.7	146.1	147.6	149.3	151.1
Sugar and Sweets	140.3	139.0	139.8	140.8	141.9	143.0
Fats and Oils	138.5	137.9	138.6	139.2	141.2	143.5
Other Prepared Items	159.7	163.3	166.0	168.8	171.7	174.7
Non-alc. Beverages	127.7	127.4	127.6	127.8	128.1	128.4
Food Away From Home	154.1	157.5	160.7	164.9	169.5	172.2
Commodity Prices						
(Note crop prices are for crop year beginning)						
Corn Farm Price (\$/bu)	2.37	2.36	2.42	2.44	2.55	2.61
Wheat Farm Price (\$/bu)	3.38	3.30	3.63	3.63	3.78	3.78
Soybean Oil Price (\$/cwt)	22.34	21.08	20.55	20.93	21.25	22.24
Beef Nebraska Direct Price (\$/cwt)	65.63	70.20	75.18	79.41	82.31	78.50
Pork Barrow & Gilt Price (\$/cwt)	53.81	46.36	42.04	45.42	49.03	46.08
Chicken 12 City Wholesale Price (cents/lb.)	57.73	56.88	57.16	58.21	58.87	58.28
All Milk Price (\$/cwt)	13.69	13.53	13.39	13.00	12.98	13.01

Table 3. - Impacts of 10% Decline in Corn Production in 1997/98 Crop Year

	1997	1998	1999	2000	2001	2002
	Percent Change					
FOOD	0.11%	0.44%	0.35%	0.15%	-0.04%	-0.11%
Food at Home	0.11%	0.46%	0.36%	0.15%	-0.04%	-0.11%
Cereal and Bakery	0.20%	0.29%	0.12%	-0.01%	-0.02%	-0.01%
Meat	0.26%	1.32%	1.06%	0.40%	-0.19%	-0.40%
Dairy	0.05%	0.38%	0.32%	0.20%	0.12%	0.07%
Fruit and Vegetables	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other Food At Home	-0.00%	-0.00%	0.02%	0.08%	0.03%	0.00%
Food Away From Home	0.10%	0.42%	0.32%	0.14%	-0.04%	-0.10%
Commodity Prices						
(Note crop prices are for crop year beginning)						
Corn Farm Price	1.12%	13.55%	1.19%	-0.22%	-0.12%	0.05%
Wheat Farm Price	0.17%	2.33%	2.02%	-0.05%	-0.11%	-0.13%
Soybean Oil Price	-0.07%	-0.23%	3.73%	1.79%	0.16%	0.02%
Beef Nebraska Direct Price	0.17%	2.16%	1.40%	0.46%	-0.60%	-0.99%
Pork Barrow & Gilt Price	0.26%	2.04%	2.76%	1.69%	-0.11%	-1.02%
Chicken 12 City Whsle Price	0.50%	1.95%	1.23%	0.50%	0.00%	-0.16%
All Milk Price	0.00%	-0.00%	-0.00%	-0.01%	-0.00%	0.01%