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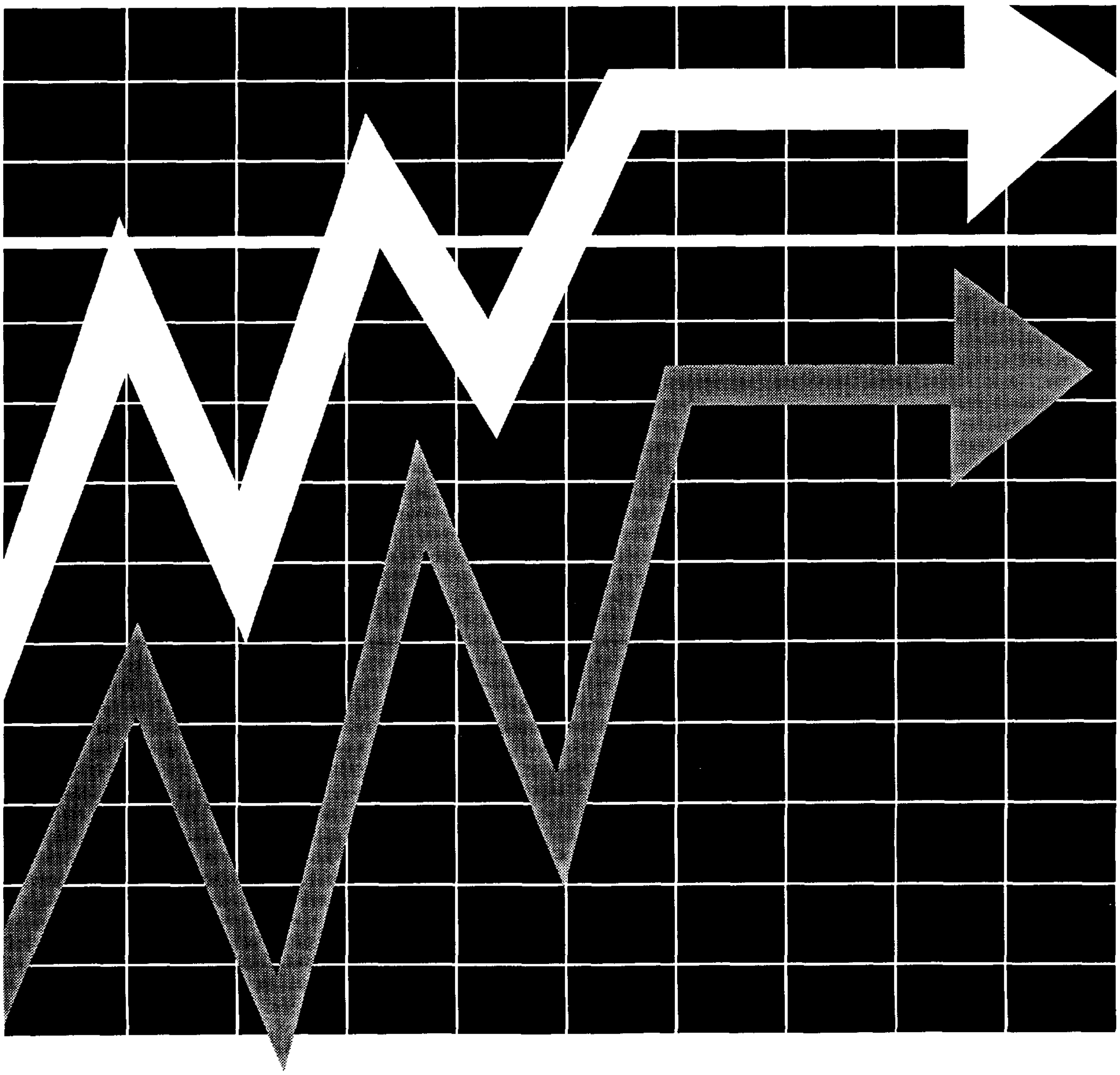
Changing Consumer Food Prices

A User's Guide to ERS Analyses

A.J. Reed, Kenneth Hanson,
Howard Elitzak, and Gerald Schluter



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Changing Consumer Food Prices: A User's Guide to ERS Analyses. By A.J. Reed, Kenneth Hanson, Howard Elitzak, and Gerald Schluter. Food and Consumer Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1862.

Abstract

USDA's Economic Research Service (ERS) uses different economic models to estimate the impact of higher input prices on consumer food prices. The present study compares three ERS models. In the first two models, neither consumers nor food producers respond to market prices. We refer to these two models as shortrun models. In the third model, both consumers and food producers respond to changing prices, and we refer to this model as a longrun model. Given published parameter estimates, we simulate the impact of a higher energy price on consumer food prices, and our empirical findings are consistent with our understanding of market responses. In the short run, we find that the full effect of an increase in the price of energy is fully (or nearly fully) passed on to consumers, because neither food producers nor consumers can immediately respond to changing prices. In the long run, however, the price response of food producers and consumers serves to mitigate the increase in consumer food prices.

Keywords: Price-spread model, input-output model, variable-proportions model, food prices, energy prices, input prices

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Summary

USDA's Economic Research Service (ERS) uses numerous economic models to analyze the relationship between changes in input prices and changes in consumer food prices. While the models were initially designed to address slightly different types of questions, different estimates of food price changes caused by the same input price change can confuse a user who is unaware of important differences in model structures. This study highlights the structural differences in three ERS models, and links the different price estimates to differences in model structures. This study compares the following three ERS models:

The price-spread model. ERS uses the 16-food-industry price-spread model to calculate estimates of the impact of changes in input prices on (at home) food prices. We classify the price-spread model as a shortrun model because consumers do not respond to retail price changes, and food producers do not alter input proportions despite changes in relative input prices. Furthermore, the output of each industry serves only as a final consumer food product.

The input-output model. Of the models compared in this study, the input-output model involves the most industry detail. It consists of 480 industries, 50 of which are food industries. The hallmark of any input-output framework is that the output of any industry could serve as both an input into another industry, and as a final consumer product. Nevertheless, the input-output model is classified as a shortrun model because, as with the price spread model, producers do not change input proportions as relative input prices change, and consumers do not adjust food purchases as retail prices change.

The variable-proportions model. This eight-market model accounts for both the price responses of consumers and the price responses of food producers. The variable-proportions model is a longrun model.

To assess the contribution of consumer and producer price responses on market-clearing retail food prices, we simulate an increase in the price of energy on the three models. In making comparisons across models, we controlled for obvious structural differences among the models. For example, to ensure the same magnitude of change is simulated across the models, we used the input-output model's estimate of the increase in the index of nonfarm input prices caused by a 100-percent exogenous increase in the price of crude oil. Also, to account for the different number of industries among the models, we compared the impact of the energy price increase on the average bundle of food in the three models.

The empirical findings confirm that, following an increase in the price of energy, the average price of food will increase more in the short run than it will in the long run. The difference is attributed to the feature that in the long run, consumers and producers respond to relevant market prices; whereas in the short run, they do not. Analysts can use the different ERS estimates to paint a mom complete picture of a food market's reaction to changing input prices than any one model alone can describe.

Changing Consumer Food Prices

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Introduction

In the United States, labor, energy, packaging, advertising, and transportation costs represent over 75 percent of the cost of food production. While the USDA is still asked why, for example, the retail price of steak could be unchanged as the farm price of cattle drops, it is increasingly asked what will happen to the retail price of food when energy prices increase or wages rise. The relationship between a change in an input price and its eventual impact on consumer food prices is often complicated and not easily understood. Yet the growing share of nonfarm inputs in today's food products makes the relationship between nonfarm input prices and consumer food prices an increasingly important one.

USDA's Economic Research Service (ERS) has developed three models that aid in understanding the relationship between changes in input prices and changes in retail food prices. This report discusses the structure of the three models. their uses, and their limitations.

ERS commonly uses its different models to address different questions.

An input-output (IO) model was designed to capture the structural dependencies among U.S. industries. For example, ERS would use its IO model to estimate the impact that changes to food assistance programs would have on food and nonfood industry prices.

A price-spread model provides industry estimates of changes in food prices without considering the industry's relationship with other industries. ERS might use its price-spread model to estimate the impact of rising wages on consumer beef prices.

A variable-proportions model is designed to link consumer demand to the responses of retail and farm prices. ERS uses its variable-proportions model to estimate the response of retail and farm prices to consumer purchases of different food products that contain a different mix of farm and nonfarm inputs. For example, ERS might use its variable-proportions model to explain how trends in consumer demand for more highly processed food products affect retail-to-farm price margins.

In this study, we use the different models to estimate the impact of a specific energy price increase on the average price consumers pay for food. We expected the models to provide different estimates because their structures differ and the parameters used to describe their structures differ. The models used in our comparison range from a structure of 480 food and nonfood industries and no consumer demand, to eight food industries and a complete system of consumer demand. The different model structures provide users with a more complete picture of retail food price responses than any one model could provide alone. In particular, our comparisons provide direct insight into the differences in the shortrun and the longrun behavior of consumers and food producers.

Consumers, Producers, and Price Determination

The responses of consumers and producers to changing market prices differentiate the three ERS models. In the first two models, only prices change. Food-producing firms (manufacturers, wholesalers, retailers) are assumed to keep production constant as input prices change, and consumers are assumed to keep purchases constant as retail food prices change. Given the absence of a price response by firms and consumers, we refer to these models as shortrun models. In the third model, however, both food producers and food consumers respond to changing prices, and we refer to it as the longrun model. To describe the essential features of the three models, we consider both the shortrun and the longrun impacts of a crude oil price increase on retail food prices.

Following an increase in the price of crude oil, energy prices facing food-producing firms will have risen ml-ative to the prices of other inputs used to produce food. In the short run, firms cannot adjust their input use. For example, suppose the machinery used by firms requires a fixed proportion of labor and energy. For a firm to reduce its proportion of energy to labor, it must either adjust the existing machinery, or acquire different machinery. In the short run, firms make neither of these adjustments. Furthermore, consumers will not yet have adjusted to any change in food prices caused by higher energy prices. In the short run, then, neither food consumption nor food production changes as higher energy prices raise the cost of producing a unit of food product (i.e., average cost).

If firms use the same proportions of inputs (fixed proportions) in the short run, and if consumers do not respond when retail prices change, the full increase in average cost caused by higher energy prices will be passed on to consumers in the form of higher food prices. The increase in average cost, and therefore the increase in retail food prices, depends solely on the importance of energy in the production of food. If production in one food industry is energy intensive, an increase in energy prices will lead to a relatively large increase in the industry's average cost, and a relatively large increase in shortrun retail food prices. If production in another food industry is less energy intensive, rising energy prices will have a smaller impact on that industry's retail price in the short run.

If the energy price increase persists, food prices will eventually reflect the price responses of consumers and producers, as well as higher average costs. In the long run, consumer and producer price responses mitigate the predicted shortrun retail price increases. Higher longrun energy prices will always mean higher costs per unit of food production (average costs) and will normally lead to higher consumer prices.[1] But the easier it is for an industry to substitute away from relatively more expensive energy inputs, the smaller is the increase in average cost, and the less upward pressure is exerted on consumer food prices. Furthermore, consumers respond to higher prices. By reducing their consumption of food products, consumers further mitigate the longrun impact of higher energy prices on retail food prices.

Even though consumer price response is not included in the shortrun ERS models, the role of consumers in food price determination is not debatable. Many economists, however, feel that input substitution does not apply to food production, making the supply response of food producers very much debatable. Perhaps the issue is debated because the concept of input substitution is associated with food producers removing or adding farm ingredients to a food product as relative farm prices change. However, input substitution requires only that food industries vary their input *proportions* as relative input prices change. Even if the *level* of the farm input used in a food product is fixed, its proportion *can* change. A change in input proportions at the industry level reflects a change in the industry's willingness to pay for the input, and results in a change in input and output prices. For example, hamburgers consumed at home and hamburgers consumed away from home contain roughly the same level of farm ingredients, but because away-from-home hamburgers embody more nonfarm inputs (e.g., labor), the proportion of farm ingredients in away-from-home hamburgers is typically less than it is in at-home hamburgers. In the variable-proportions model, if farm prices rise relative to nonfarm prices, the beef industry can vary its input proportions by producing more hamburgers for away-from-home markets, or more generally can produce food products that require more processing (Wohlgenant and Haidacher, 1989). This issue is especially important in understanding longrun price determination of food markets and is central to any longrun analysis of the relationship between food prices and farm-level prices.[2]

Two of the models analyzed in this paper embody the above set of shortrun assumptions, and the third

[1]An increase in any input price will always lead to higher average costs. However, if an industry can substitute among inputs, the increment to the total cost of producing an additional unit of output (i.e., the industry's marginal cost) might fall under certain circumstances. In some cases, even if markets are perfectly competitive, an input price increase can lead to a retail price decrease (see Panzer and Willig).

[2]If the farm supply schedule is fixed and inelastic, farm price changes would be determined *entirely* by shifts in the industry's demand for farm ingredients. The greater the elasticity of the industry's demand for farm products, the smaller is the increase in the farm price caused by a given horizontal shift in farm demand. Greater substitution possibilities increase the elasticity of the industry's farm demand. Hence, if consumer demand expands and retail prices rise, the horizontal shift in the industry's farm demand will translate into an increase in farm prices that diminishes as substitution possibilities increase. Hence, simultaneously large retail price increases and small farm price increases are not sufficient evidence for oligopsony power.

Table 1--Main attributes of ERS models

Attribute	Variable proportions	Price spread	Input output
Consumers respond to changing retail prices	Yes	No	No
Food producers respond to changing input prices	Yes	No	No
Number of industries	8 food	16 food	480 (50 food)

embodies the above set of longrun assumptions. It is important that users of the models understand the qualifications placed on each model, and the assumptions made in computing each model's price impact estimate. In this way, the different estimates can be used more effectively.

Model Descriptions and Empirical Simulations

The three models ERS uses to predict the impact on the food CPI (Consumer Price Index) caused by a change in input price are termed the price-spread model, the input-output (IO) model, and the variable-proportions model.3 Aside from assuming that individual industries are perfectly competitive, the defining attributes of each model are summarized in table 1.

The price-spread model is a shortrun model with the following features or attributes: (i) consumers do not respond to changes in retail food prices; (ii) firms do not alter their input proportions when relative input prices change; and (iii) final food markets are aggregated into 16 separate industries. Attributes (i) and (ii) also define the IO model. The IO model, however, disaggregates the U.S. economy into 480 separate industries, 50 of which produce food products. The variable-proportions model is a longrun model and describes markets in which: (i) consumers respond to changes in retail food and nonfood prices; (ii) firms respond to changing input prices; and (iii) eight food industries comprise the model. It is not surprising that given the different model assumptions, the models' predictions of change in retail prices will differ. The question addressed in the remainder of this section is how the different attributes lead to different estimates of the impact of changing energy prices on consumer food prices.

The Price-Spread Model

The price-spread model is used to compute estimates of price changes of 16 components of the food CPI. Each firm in each of the 16 final food industries produces a single product by combining a farm commodity with a set of nonfarm inputs in fixed proportions. In the price-spread model, consumer demand is fixed for all levels of retail price. These simplifying assumptions reduce the computation of a food price estimate to an evaluation of an accounting-type formula. This formula states that the percentage change in the retail price is a weighted sum of percent changes in input prices, with cost shares (from 1982 IO tables) serving as weights, or

$$p_R^* = p_F^* s_F + p_x^* s_x \quad (1)$$

where s_F and s_x represent the cost shares of the farm and nonfarm inputs, respectively, and where p_R^*, p_F^*, p_x^* denote the percentage changes in the retail price, the farm price, and the aggregate nonfarm price, respectively. The variable p_x is the food marketing cost index (FMCI), or the average price of the aggregate nonfarm input. The above formula states that a l-percent increase in the FMCI leads to a percentage increase in the retail price equal to s_x, the cost share of the nonfarm input in food production.

Energy is one of several nonfarm inputs used to produce food, and the price of energy is one of about 12 nonfarm input prices used to construct the FMCI (i.e., p_x). Suppose food is produced using a single farm input and a single aggregate, or representative nonfarm input with a price equal to the FMCI. If this single nonfarm input is, in turn, produced from individual nonfarm inputs in fixed proportions, the retail price formula given by equation 1 above can be extended directly to

[3] See Elitzak (1996) for the first; Hanson, Robinson, and Schluter (1993) for the second; and Wohlgenant and Haidacher (1989) for the third.

$$p_R^* = p_F^* s_F + p_x^* s_x = p_F^* s_F + \left(p_E^* s_E + \sum_{i=3}^{N} p_i^* s_i \right) s_x \qquad (2)$$

where s_E and s_i are the *nonfarm cost* shares of energy and the *ith* nonfarm input, and p_E^* and p_i^* are the percentage changes in energy and the other nonfarm input prices, respectively. The sum in the parentheses of equation 2 represents the percentage change in the FMCI (i.e., p_x^*), and the shares of each term serve as weights on the individual input prices.[4] Equation 2 states that the percentage increase in the consumer price of food is the weighted sum of the percentage change in the price of the farm ingredient, the energy price, and the other nonfarm input prices comprising the FMCI.

At this point, it is convenient to describe the main difference between the two ERS fixed-proportions models. The term, $p_E^* s_E$, in equation 2 is referred to as the *direct* effect because it denotes the energy cost increase incurred by producers of the aggregate marketing input.[5] The second term,

$$\sum_{i=3}^{N} c\, p_i^* s_i,$$

is referred to as the indirect effect because it measures the effect of energy price on the costs of other inputs used in producing the marketing input. For example, because energy is used to produce food packaging, the cost of packaging will rise with higher energy prices. In a typical price-spread model simulation, the indirect effects would be zero since the price of energy does not affect the price of other marketing inputs. In a typical IO model simulation, a change in the price of crude oil could affect the price of all other inputs used in the production of food.

Since we wish to impose the same exogenous change on the three models, however, we include the indirect effects of a crude oil price increase in all model simulations. In particular, we used the IO model's prediction of the percentage change in the FMCI caused by a doubling of the price of crude oil. The IO model simulation suggests that a doubling of the price of crude oil leads to a 1.106-percent increase in the FMCI. The 1.106-percent predicted increase in the FMCI is used in both the price spread and the variable-proportions model simulations.

Table 2--Price-spread model estimates of effect of energy price increase on consumer food prices

Item	(1) Wholesale share, s_x,	(2) Change in FMCI	(3) CPI weights	(4) Change in retail price, p_R^*
		Percent		Percent
Cereal and bakery products	.93	1.166	0.0920	1.03
Beef and veal	.51	1.106	0.6620	0.56
Pork	.66	1.106	0.0340	0.73
Other meats	.65	1.106	0.0260	0.72
Poultry	.58	1.106	0.0270	0.64
Fish and seafood	.60	1.106	0.0240	0.66
Eggs	.57	1.166	0.0100	0.63
Dairy products	.67	1.166	0.0740	0.74
Fresh fruit	.81	1.106	0.0460	0.90
Fresh vegetables	.77	1.166	0.0460	0.65
Processed fruit	.80	1.106	0.0210	0.66
Processed vegetables	.80	1.106	0.0166	0.66
Sugar and sweets	.74	1.106	0.0210	0.62
Fats and oils	.76	1.106	0.0160	0.64
Nonalcoholic beverages	.87	1.106	0.0500	0.96
other prepared food	.90	1.106	0.0660	1.00
Percentage change in the CPI for food at home				0.52

Source: USDA, Economic Research Service.

Table 2 summarizes the steps involved in using the price-spread model to compute an estimate of the effect of a 100-percent increase in the price of crude oil on the CPI for food at home. The nonfarm cost share is reported in column 1, and the 1.106-percent figure reported in column 2 is taken from the IO model simulation. Column 3 is the product of columns 1 and 2, and represents the percentage change in the retail price of each industry. Column 4 reports the Bureau of Labor Statistics (BLS) expenditure weight associated with each at-home food industry. Multiplying each entry in column 3 with the corresponding entry in column 4, and summing, gives the percentage change in the CPI for food at home. The price-spread model implies that a doubling of the price of crude oil will cause the CPI for food at home to rise by approximately 0.52 percent.

[4] The weights are the same weights used to compute the FMCI.

[5] $s_x p_E^* s_E$ is the direct effect of the energy price increase on the average cost of producing the food product.

The Input-Output Model

The IO model is both more detailed and more general than the price-spread model. It replaces the 16 food industries of the price-spread model with 50 food and 430 nonfood industries.[6] Unlike the price-spread model, the output of each of the 480 industries also serve as input to each of the industries. Because of its detail, and because it incorporates cross-industry production relationships, the IO model incorporates the indirect effects in its predictions. Despite the greater detail, the attributes of the IO model are basically the same as those of the price-spread model (table 1).

Because its economic structure is very similar to that of the price-spread model, systems of equations resembling equation 2 form the basis of the IO model. Computing the impact of a change in a single input price (crude oil) on all food prices involves solving this system of equations for endogenous price changes.[7] For example, the ERS system includes 480 linear price equations similar to equation 2 with shares provided by 1987 IO accounts. To simulate the impact of a doubling of the price of crude oil price, the crude oil price equation is eliminated, its percentage increase is set to 100, and the system is solved for the remaining 479 percentage price changes. The results are aggregated to 13 CPI food-at-home components, and are reported in table 3. The particular aggregation comes close to matching the 16-industry aggregation of the price-spread model.

Table 3-Input-output estimates of effect of energy price increase on consumer food prices

Item	CPI weight	Change in retail price, p_R*
		Percent
CPI food aggregate:	1.000	1.49
Food at home	0.527	1.82
Food away from home	0.473	1.13
Food at home:	1.000	1.62
Cereal and bakery products	0.157	1.67
Meat	0.162	1.96
Poultry	0.047	2.01
Dairy products	0.115	1.99
Fish and seafood	0.014	2.26
Eggs	0.010	2.47
Fresh fruits and nuts	0.024	2.37
Fresh vegetables	0.036	1.91
Processed fruit and vegetables	0.095	1.69
Sugar and sweets	0.064	1.62
Fats and oils	0.007	2.28
Nonalcoholic beverages	0.105	1.63
Other prepared food	0.143	1.57
Percentage change in the CPI for food at home		1.82

Source: USDA, Economic Research Service.

The first three rows of table 3 suggest that a doubling of the crude oil price leads to a 1.49-percent increase in aggregate food prices, with a 1.82-percent increase in the price of food consumed at home, and a 1.13-percent increase in the price of food consumed away from home. The remaining rows of table 3 summarize the impact estimates on 13 aggregated food industries.

The Variable-Proportions Model

While it is beyond the scope of this paper to derive the basic equations of the variable-proportions model, the derivation is straightforward, and the restrictions implied by theory are easy to impose. The equations are based on profit maximization of food marketing firms (i.e., retail, wholesale, and manufacturing firms) in a competitive market,[8] market clearing in the farm and retail markets, and exogenous farm commodities that are inelastically supplied to the food industries. From this structure emerges a pair of (quasi) reduced-form equations. The first equation relates the industry's retail price to the price of one marketing or nonfarm input, the exogenous farm supply, and the shift in consumer demand. The second equation relates the industry's farm price to the same three variables. While the model could be expanded to include more than one marketing input, only a single, aggregate marketing input is included here. In particular, we use the FMCI as the price of the aggregate nonfarm input. This restricted specification rules out the possibility of

[6] Of the 480 industries in the IO model, 47 are processed food industries and 15 are farm commodity industries. Three of the farm commodities are consumed by households as unprocessed food items. These are eggs, fresh fruits. and vegetables.

[7] Actually, ERS's IO model consists of price *level* rather than percentage change equations. Percentage changes are *actually* computed from two simulations—one in which the price of crude oil is set to its base level, and one in which it is doubled.

[8] A statistical test did not refute perfect competition for eight food industries (Wohlgenant and Haidacher, 1989). Unpublished results of a different and more refined test also could not reject perfect competition for the beef and pork industries.

any inferior marketing inputs.[9]

The coefficients of the retail and farm price equations are estimated using price and quantity data for eight food industries. The estimates are then used to compute a final reduced-form flexibility that accounts for shifts in consumer demand across industries.[10] The eight estimates of the retail price flexibility associated with the FMCI are reported in column 1 of table 4. Column 3 reports the estimate of the percentage increase in the retail price for each of the eight food industries caused by a 1.106-percent increase in the FMCI (column 2). Column 4 weights each industry's impact by the appropriate BLS expenditure weight. The sum of the entries of column 4 represents the estimate of the percentage change in the CPI for food at home. The results suggest that a 100-percent increase in the price of crude oil leads to a 0.269-percent increase in the CPI for food at home.

The variable-proportions model describes longrun relationships among consumer food prices and the prices of inputs used to produce food. By relaxing shortrun restrictions, the variable-proportions model is quipped to explain three features of input price and consumer food price relationships commonly observed in data. First, it has been observed that input price increases do not always lead to higher consumer food prices. The mitigating effects of firms' changing their input proportions and consumers* responding to changing consumer level prices can lead to retail price increases that are usually smaller than the full-cost pass-through predicted by the fixed-proportions models.[11] Second, it has been observed that retail price changes for some products are associated with retail price changes for other products. In the variable-proportions model, consumers respond to all retail food prices, so for example, purchases of beef are affected not only by the price of beef, but also by the price of poultry and by the prices for all other goods. If rising energy costs faced by poultry manufacturers lead to higher consumer poultry prices, retail beef prices may also rise if consumers substitute beef for poultry and expand the demand for beef. Third, in the variable-proportions model, the rising price of energy affects not only the price of food through industry supply; it also affects farm price through the derived demand for farm ingredients.[12]

Table 44--Variable-proportions model estimate of energy price increase on consumer food prices

Food item	(1) FMCI flexibility	(2) Change in FMCI	(3) CPI weight	(4) Change in retail price, p_R
		Percent		*Percent*
Beef and veal	0.302	1.166	0.062	0.335
Pork	0.407	1.106	0.034	0.450
Poultry	0.204	1.106	0.027	0.225
Eggs	0.762	1.106	0.010	0.643
Dairy	0.939	1.106	0.074	1.036
Processed fruit and vegetables	0.999	1.106	0.037	1.105
Fresh fruit	0.996	1.106	0.045	1.102
Fresh vegetables	1.021	1.106	0.045	1.129
Percentage change in the CPI for food at home:				0.269

Source: USDA, Economic Research Service.

A User's Guide to the Results

The empirical results presented above suggest energy prices will have a relatively small but positive impact on the average price that consumers pay for food. The simulations suggest that a doubling of crude oil prices would raise average food prices in competitive food markets by as much as 1.82 percent in the short run, and by 0.27 percent in the long run. Furthermore, the simulations provide the user with shortrun and longrun impact estimates of retail prices for individual food

[9]In an as yet unpublished study, Wohlgenant disaggregated the nonfarm inputs into labor, packaging, transportation, and energy, and found evidence of inferior factors of production.

[10]The FMCI retail price flexibilities reported in column 1 of table 4 were obtained from the simulation results reported in Wohlgenant (1994). These estimates differ from earlier estimates reported by Wohlgenant and Haidacher (1989) because the homogeneity restriction is imposed differently.

[11]In variable-proportions models with multiple nonfarm inputs, some inputs could be inferior. If an input is inferior, an increase in its price results in a decrease in its marginal cost of production. Under certain conditions, the increase in the price of an inferior input could lead to a *decline* in consumer-level food prices,

[12]There are two stylized facts about farm and food price data that can be explained within a perfect competition assumption in the variable-proportions model, but cannot be explained in either the price spread or the IO models. First, the assumption that an industry substitutes among inputs when relative input prices change explains the observation that higher retail-to-farm price margins are associated with higher priced final food products. Second, the input substitution and nonidentical assumption.3 account for a negative correlation between an input price and an output price (Panzer and Willing, 1970). Evidently, this counterintuitive result is commonly observed in food industry data (Wohlgenant 1994).

products. The results in tables 2 through 4 provide the user with an understanding how changes in energy prices affect consumer food prices.

The estimates reported in tables 2 and 3 reflect the shortrun reaction of food markets to higher energy prices. In the short run, food-producing firms will not yet have reacted to higher energy prices, and will keep input proportions constant. Furthermore, consumers will not have adjusted food purchases to any changes in retail prices. In the short run, the market equilibrium results presented in table 2 represent the direct energy price pass-through to consumers, and the results presented in table 3 represent the full energy price pass-through to consumers. In both cases, the retail food prices of the most energy-intensive industries are most affected by the increase in energy prices.

The user interested in longrun price impacts, however, is referred to table 4. The estimates reported in table 4 represent industry responses to relative input price changes that persist over time. Some firms respond by exiting the industry; the firms that remain will reduce their input proportions of more expensive energy inputs. By altering input proportions, the firms incur smaller increases in (average and marginal) costs than they would have experienced had proportions remained fixed. In addition, the results in table 4 reflect consumer responses to relative food price changes. In the long run, consumers substitute among food products, and in doing so, shift their demand for individual food products. Economic theory states that the impact on the price of the *average* food product will be more sensitive to an energy price increase in the short run than in the long run. Our results are consistent with theory because they suggest that the average food price will rise by 1.82 percent in the short run, and by only 0.27 percent in the long run.

It is important to caution the user that, in our case, the relatively large shortrun impacts and the relatively small longrun impacts predicted by theory apply only to the *average* price of food and *not* to industry components of the food CPI. The results presented in tables 2 and 4, for example, suggest the longrun impact of higher energy prices exceed the shortrun impacts for five components of the food CPI. The apparent inconsistency is resolved by noting that consumer demand for food components in our models is stable in the short run but not in the long run. Hence, *any* relationship between shortrun and longrun impacts on component prices is consistent with theory. It is only for the *average* bundle of food products for which both shortrun and longrun consumer demand is stable; and it is only for the impacts on the average price of food in the short and long runs for which the theory applies. It is comforting to note that even though the number of food industries varies greatly among the models, the relatively large shortrun impacts, and the relatively small longrun impacts on the *average* price of food predicted by our models are consistent with theory.

Table 5--Summary of model attributes and impact estimates

Attribute	Variable proportions	Price spread	Input output
Time frame	Long run	Short run	Short run
Consumers respond to changing retail prices	Yes	No	No
Food producers respond to changing input prices	Yes	No	No
Number of industries	Few (8)	Few (16)	Many (480)
Types of industries	Food	Food	Food and nonfood
Effect of crude oil price doubling on CPI for food at home	+0.27%	+0.52%	+1.82%

Source: USDA, Economic Research Service.

This report suggests that to correctly use the impact estimates provided by ERS requires a user first to consider whether it is the shortrun or the longrun impacts that are the most appropriate for the question at hand. For questions regarding permanent policy changes, such as reforms to farm policy, estimates of the longrun impacts presented above are more appropriate. However, users attempting to predict the impact of a temporary exogenous price change, such as an oil price shock, would find the shortrun price impacts presented above more appropriate.

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