Dynamics of Food Price Inflation

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A supply-shift concept of food price inflation is offered as an explanation of why food prices have increased in recent years. This view is consistent with cost-push theories of inflation.

The effects of higher farm product prices on food prices are analyzed using Pascal distributed lag models of the price adjustment process. Estimates are presented for 23 selected food products. The results indicate that higher farm prices are passed through to the retail level most quickly for food products which are not highly processed.

It is generally accepted that unanticipated changes in the rate of inflation impose costs on society. This argument has been convincingly made by Bach and Ando, Feldstein, Klein, and Ackley. In recent years, food price increases have been major components of unanticipated increases in the general inflation rate. The rate of food price inflation exceeded the inflation rate, as measured by the Consumer Price Index (CPI), by more than 1 percent in 1972, 8 percent in 1973, 3 percent in 1974, and 2 percent in 1978, while not being substantially below the general inflation rate in 1975 and 1977.[1] In this respect, and because food represents almost 20 percent of the CPI, higher food prices have been a basic source of imposed social costs.

The causes of inflation, and the method by which inflation is transmitted through the economic system, are two of the important recurring theoretical issues in modern economics. A supply-shift concept of food price inflation generally is offered as a fundamental explanation of why food prices have increased rapidly in recent years. This view is expressed by Hathaway, Johnson, and recently by Eckstein and Heien, who argue that government actions to reduce supplies of agricultural commodities and increased exports were major causes of the 1973 food price inflation. The same argument can be applied to the 1978 experience, when government acreage restrictions and increased exports were basic causes of the 10 percent increase in domestic food prices.[2]

A view of food price inflation as predominantly a supply-shift phenomenon is consistent with cost-push theories of inflation. In the food sector, this process occurs as follows. First, supply decreases as a consequence of bad weather or government regulation. This reduction leads to higher prices for raw agricultural commodities. Food manufacturing, processing, and distributing firms then purchase raw agricultural commodities at the higher market prices. Because of their oligopolistic structure, these firms are able to select the prices at which they sell. In response to higher prices for agricultural inputs, food manufacturers, processors, and distributors increase their selling prices, add-

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[1] In 1976, however, inflation in food prices was 2 percent less than the increase in the CPI.

[2] Note that an increase in exports of agricultural commodities leads to a backward shift in domestic food supply, supporting the supply-shift argument.

ing a mark-up which produces maximum profit. The adjustment process is not instantaneous, however. Lags in transportation, production, and final sale occur. After the appropriate time lags, increases in the cost of raw agricultural commodities "push up" retail food prices through a structural pricing mechanism.

The length of time before higher farm commodity prices "push up" retail prices is of much importance, both for policy analysis and for forecasting applications. The objective of this paper is to review the nature and causes of food price inflation, focusing on the dynamics of the farm to retail price adjustment process. An empirical model of food price inflation is developed as an analytical tool for this purpose. The model is a short-run, cost-push construction, and is based on the assumption that food manufacturing, processing, and distributing firms select prices for their products, and that the demand for food is relatively stable, shifting little from year to year.

Theoretical Preliminaries

The structure of the food manufacturing and processing industry is generally accepted as being oligopolistic. The Federal Trade Commission made this assertion more than 12 years ago, noting that 20 to 25 percent of all food manufacturing industries fall in Bain's "very highly concentrated oligopoly class." Five years later, Handy and Padberg described the food manufacturing industry as consisting of an "oligopoly core." Most recently, Mueller asserted that market power in food manufacturing and processing industries arises from both oligopoly power and "conglomerate power" (that derived from having control of massive quantities of resources) and concluded that "monopoly overcharges for food manufacturing appear even greater than those for food retailing."

The degree of market power concentrated in the food distributing industry (predominantly retail chains) is a more nebulous issue. Handy and Padberg conclude that consumers' desires for a variety of product-service combinations prevent food distributors from dominating most local markets, implying that market power in the food distributing industry is not a serious problem. Mueller disagrees with this assessment, noting that market concentration in the food distribution industry has increased since 1972. Much of Mueller's analysis, however, is based on market structure statistics which are sometimes imperfect; statistics showing increasing concentration do not necessarily imply a greater degree of market power, as is frequently implied. For example, in some cases, 4 firms may be more competitive than 8.

But what does the market structure of food manufacturing, processing, and distributing industries have to do with food price inflation? A great deal, based on the relationship between industry pricing patterns and market structure. In oligopolistic industries, firms select selling prices. This contrasts with competitive markets in which firms take prices as given. A pricing structure in which firms can select prices is consistent with cost-plus pricing; that is, where firms add a profit mark-up to production costs. Increasing production costs in oligopolistic industries necessarily lead to cost-push inflation.

Cost-plus pricing is a major premise underlying Baumol's and Olivera's "structural" model of inflation. In this model, cost-push inflation occurs as wage rates increase. Firms are forced to pay higher wage rates and respond by passing on their increased costs to consumers. They can do this because of their oligopolistic structure. In the extreme short run, however, wage rates are fixed for food manufacturing, processing, and distributing industries, but raw agricultural commodity prices are variable. If cost-plus pricing is applied in these markets, given an oligopolistic structure, a structural model of food price inflation results. This model is the basis of the following analysis.

The Model

An underlying assumption of the discussion presented in this section is that firms can select selling prices in the food manufacturing, processing, and distributing industries. This does not imply a strictly oligopolistic structure, however, but admits the possibility of monopolistic competition. Nor does this assumption necessarily imply the existence of market power and excess profit in the food manufacturing, processing, and distributing industries. Oligopolies may compete, and profits converge to "normal" levels in the long run for monopolistic competitors.

For any type of market structure, the observed market price equals the sum of variable and fixed average costs (including normal profit), plus excess profit. Over time, a series of observed market prices represents firm pricing decisions based on production costs. In this respect, short-run food price generation can be represented as the process:

$$(1) \qquad \{p_t | p_t = \alpha + \gamma + \beta r_t + \xi_t\}$$

$t = 0, \ldots, T$

where p_t is the retail price of a particular food, r_t is the price of the basic raw agricultural commodity used in the food, α is the average fixed cost of production, γ is per unit excess profit ($\gamma = 0$ when the industry is competitive), β is a technological coefficient which transforms raw commodity input into food output, and ξ_t is stochastic excess profit per unit. The term βr_t represents average variable cost. Stochastic excess profit occurs when firms leave the industry or competitors discontinue competing product lines. Stochastic losses occur when new firms enter the industry or competition in some product lines increases. In general, the expected stochastic excess profit is zero, however.

In actuality, equation (1) is little more than a stochastic version of the price equals cost plus profit identity. Because there is more than one firm in the industry, however, the parameters of equation (1) are mean values since all firms possess different cost structures. Also, in the short run all firms in the industry may earn excess profits or have net losses because of unexpected changes in costs. For this reason, there is a stochastic excess profit component with zero expected value and the price equals cost plus profit equation is not strictly a deterministic identity.

System Dynamics

The stochastic process represented in equation (1) is purely discrete in that food prices in period t depend on the prices of raw agricultural commodities in t, stochastic excess profit in t, and parameter values. In real markets, however, inputs may be purchased in previous periods at different prices and stored for use in the current period. For example, packages of butter retailing for \$1.70 per pound this month, may have been purchased last month at \$1.50 per pound. This month's wholesale butter price of \$1.60 is not related to this month's retail price, however. In situations where there are lags in food manufacturing, processing, and distributing, a static representation like equation (1) is misspecified. Since lags occur between the purchase of raw farm inputs and the sale of finished food products at retail, a representation of the price-generating process must reflect these lags.

To allow for time lags in the price generation process, equation (1) is respecified as

$$(2) \qquad \{p_t \,|\, p_t = \theta + \beta \int_0^I \tau(i)\, r(t-i)\, di + \xi_t\}$$

$t = 0, \ldots, T$.

In this relation, the time function $\tau(i)$ assigns weights to raw agricultural commodity prices, $\theta = \alpha + \gamma$, and I is the lag horizon. Values of $\tau(i)$ are determined by past firm decisions concerning the optimal level of raw agricultural commodity inventories, transportation shipment intervals, and contractual arrangements.

Empirical Implementation

The empirical implementation of equation (2) is accomplished by substituting a discrete representation of the integral, specifying the food products to be considered, selecting an interval length for each t, and determining the number of observations to be used for estimation. A necessary condition for (2) to be a valid representation is that the time interval selected for analysis must be sufficiently short so that all input price levels are fixed, except raw agricultural commodity price levels. Monthly data are used for this reason, based on the supposition that variability in input prices, other than for raw commodity prices, does not affect retail food prices in the short run. Although this raises questions concerning whether information generated by the market on a monthly basis is consistent with the application (monthly variations in wage rates may affect the retail prices of some foods, for example), monthly price series are viewed as an adequate approximation. Monthly retail prices are assumed to vary around mean retail price trends which are long-run normal prices.

Empirically, equation (2) becomes

$$(3) \qquad p_t = \theta + \beta \sum_{i=o}^{I} \tau_i r_{t-i} + \xi_t \, .$$

This is a basic distributed lag model. It typically is estimated as a geometric lag model, or as a polynomial lag model (see Griliches for a review). From an analytical perspective, the polynomial lag model is more appropriate than the geometric lag model since it allows values of τ to first increase and then decline as $i - I$. The disadvantage with using a polynomial lag is that the length of lag and the degree of the polynomial must be specified prior to estimation. As an alternative, the Pascal lag model is used here.

The Pascal lag model was suggested originally by Solow, but has not been widely utilized in empirical studies because the parameters of the model must be estimated subject to nonlinear constraints. The special advantage of the Pascal lag model is that it allows the data to determine the length of lag, once the order of the distribution is specified.

The Pascal distribution is a flexible 2 parameter form which assumes the weights in equation (3) are defined as

$$(4) \qquad \tau_i = \binom{s+i-1}{i} (1-\lambda)^s \lambda^i$$

$i = 0, \ldots, I$.

where s and λ are parameters. Allowing s to equal unity gives a family of geometric lags. Allowing s to equal 2 produces a family of lags with values which increase initially and then decline as $i \rightarrow I$, depending on the value of λ. Higher values of s give more complex families of lags.

Allowing s to equal 2 gives τ's which are quadratic forms. By varying λ with s equal to 2, virtually any type of lag pattern can be generated (see figure 1). In addition, because quadratic Pascal lags can be considered as approximations to higher order Pascal lags, it is convenient to set s at 2 for analytical purposes.

Given a Pascal lag distribution with s equal to 2, the value of λ remains to be determined. This is the estimation problem. Setting s equal to 2 in relation (4) and substituting this expression into equation (3) gives

$$(5) \quad p_t = \theta + \beta \sum_{i=o}^{I} (i+1)(1-\lambda)^2 \lambda^i r_{t-i} + \xi_t$$

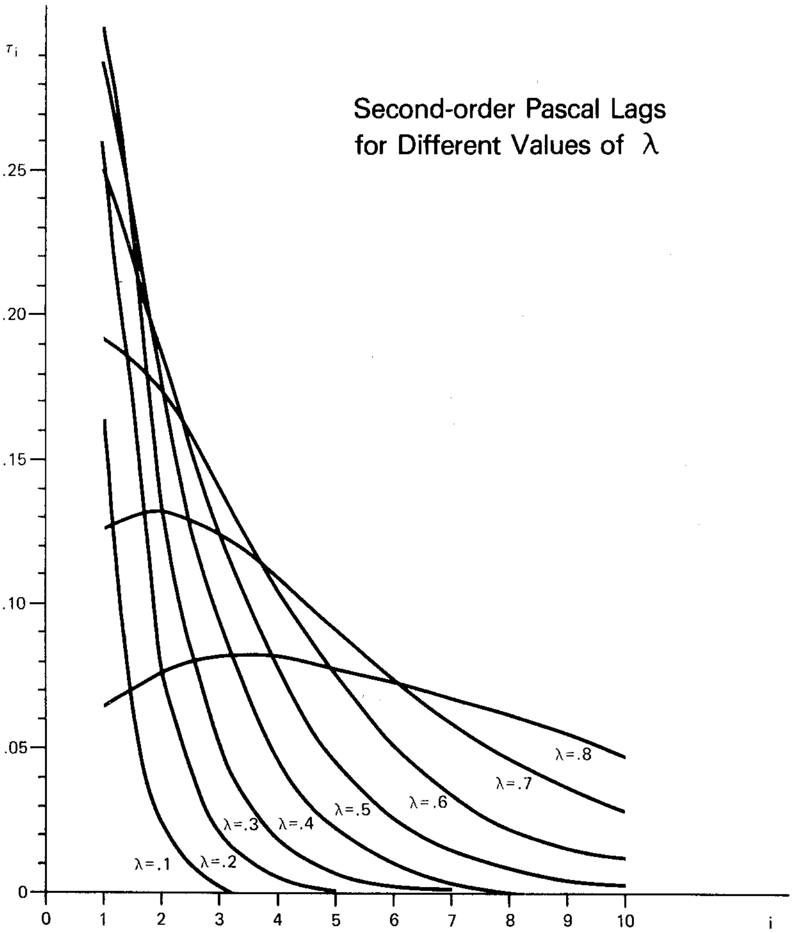
$t = 0, \ldots, T$.

This expression can be rewritten as

$$(6) \quad p_t = \theta + \beta (1-\lambda)^2 (r_t + 2\lambda r_{t-1} + 3\lambda^2 r_{t-2} + \ldots + (I+1)\lambda^I r_{t-I}) + \xi_t.$$

Lagging this relation one period and multiplying by -2λ gives

$$(7) \quad -2\lambda p_{t-1} = -2\lambda\theta + \beta(1-\lambda)^2 (-2\lambda r_{t-1} - 4\lambda^2 r_{t-2} - 6\lambda^3 r_{t-3} - \ldots) - 2\lambda \xi_{t-1}.$$



Lagging equation (6) 2 periods and multiplying by λ^2 gives

$$(8) \quad \lambda^2 p_{t-2} = \theta\lambda^2 + \beta(1-\lambda)^2 (\lambda^2 r_{t-2} + 2\lambda^3 r_{t-3} + 3\lambda^4 r_{t-4} + \ldots) + \lambda^2 \xi_{t-2}.$$

Summing (6), (7), and (8) gives

$$(9) \quad p_t = \theta(1-\lambda)^2 + \beta(1-\lambda)^2 r_t + 2\lambda p_{t-1} - \lambda^2 p_{t-2} + \mu_t$$

where $\mu_t = \xi_t - 2\lambda\xi_{t-1} + \lambda^2\xi_{t-2}$. This is a second-order moving average process. Since λ appears uniquely in 2 parameters, equation (9) is overidentified with a nonlinear restriction. Direct estimation of this equation by ordinary least squares would, of course, give ambiguous estimates of λ. To overcome this problem, the sum of squares of error are minimized, subject to the nonlinear constraint on the λ's in equation (9).

Estimation

Equation (9) is estimated for each of 23 major food products. Included foods were selected on the basis of their relative importance in the CPI for Food, on the basis of their importance in the diet, and on the basis of data availability.[3] Monthly data from January 1973 to December 1977 were in-

[3]The included food products represent about 35 percent of the foods included in the CPI.

cluded, giving a total of 60 observations for each equation. Retail prices consisted of BLS monthly indices, actual price series collected by the USDA, or major market prices in the case of processed agricultural commodities like soybean oil. Data sources and definitions are presented in the Appendix.

Because equation (9) is overidentified, estimation was accomplished by minimizing the sum of squares of error with respect to the parameters, subject to the nonlinear constraint that λ in the third term of equation (9) equals λ in the fourth term of the equation. This was done by iterating on values for λ using restricted least squares estimation, until a minimum sum of squares of error was obtained.[4] The resulting estimates of θ, β, and λ, as well as the computed minimum sum of squares of error did not generally differ more than several percentage points from corresponding ordinary least squares estimates, but did satisfy the nonlinear constraint.

Results

Table 1 presents the results of estimating relation (9) for each of 23 food products. Estimated parameters are presented for each equation, as well as the value of λ which produced a minimum sum of squares of error. Also presented are estimated mean time lags (in months), defined as

$$(10) \qquad \eta = \sum_{i=0}^{I} i\tau_i / \sum_{i=o}^{I} \tau_i ,$$

and Godfrey $\mathcal{L}$ statistics as tests of whether the moving average process represented by equation (9) is first or second-order autoregressive.

[4]The values of λ were set equal to zero initially, and then increased by increments of .01 until λ reached unity for each food product. That λ resulting in the minimum error sum of squares was selected as optimal. This procedure was necessary to distinguish between local and global optima. Generally, 3 to 4 local optima were detected for each food product using this procedure. Values of λ less than zero and greater than unity were also evaluated.

A review of the information presented in Table 1 indicates that farm price increases are transmitted to the retail level more slowly for highly processed food products than for food products which require little processing prior to consumption. Meat, poultry, eggs, milk, and sugar all have relatively short mean lags, generally 1 or 2 months. In contrast, butter, cheese, other processed dairy products, cooking oil, margarine, shortening, salad dressing, peanut butter, cookies, and chocolate bars all have relatively long mean time lags, up to 6 months in some cases. Food products in this latter group are all highly processed, some undergoing complete physical transformation before being sold at retail.

The estimated values for θ and β are highly significant statistically for most food products. The adequacy of tests associated with these statistics depends on whether the estimated standard errors of θ and β are biased, which would be the case if the moving average error terms are autoregressive. To assess the possibility of autoregression, Godfrey $\mathcal{L}$ statistics were estimated under the null hypotheses of first and second-order autoregression for the moving average error term. The resulting statistics have chi-square distributions with I degrees of freedom. The critical X^2 value for first-order autocorrelation at the 1 percent level of significance is 6.63. For second-order autocorrelation, the critical chi-square value at the 1 percent level of significance is 9.21. Estimated values of $\mathcal{L}$ for first-order autocorrelation are represented as $\mathcal{L}_1$ in the table, while estimated values of $\mathcal{L}$ for second-order autocorrelation are represented as $\mathcal{L}_2$. Since some $\hat{\mathcal{L}_1}$ and $\hat{\mathcal{L}_2}$ values exceed their critical levels, it is apparent that some of the standard errors presented in Table 1 are biased and should be interpreted accordingly.

Regarding the stability properties of the estimated equations for each food product, a necessary and sufficient condition for stability is that the eigenvalues of the lagged dependent variables have moduli less than unity. This implies that as long as $0<|\lambda|<1$, the estimated relations are stable. Since all estimated λ satisfy this requirement, it is apparent that the estimated equations represent stable stochastic processes.[5]

Dynamic Multipliers

Although the mean time lags presented in Table 1 provide a useful summary of the response of retail food prices to changes in lagged farm prices, the distribution of these responses also is important. Table 2 presents impact, interim, and total multiplier elasticities for the 23 food products considered in this study. These elasticities are based on derived Goldberger multipliers for each equation, evaluated at the mean sample level. Each multiplier is defined as

$$(11) \qquad \rho dp_t \;/\; dr_{t-j} = \rho\beta\tau_j$$

where ρ is the mean sample ratio of the raw farm commodity price to the retail food price. Setting j equal to zero produces an impact elasticity indicating the percentage change in retail food prices given a one percent increase in raw agricultural commodity price in the current period. For other values of j, interim elasticities are produced. These give the current effects on retail food prices of one percent increases in raw agricultural commodity prices j periods ago. The total effect on retail food prices of a one percent increase in raw agricultural commodity prices in the current period is obtained by summation:

$$(12) \qquad \rho \sum_{j=o}^{\infty} dp_t/dr_{t-j} = \rho\beta \sum_{j=o}^{\infty} \tau_j$$

This total multiplier elasticity is presented in the extreme right-hand column of the table.

A review of the information presented in Table 2 indicates that the largest impact and near-immediate effects of farm price increases occur for foods with relatively short mean time lags; that is, those foods which require relatively little processing prior to consumption. Increases in farm prices for commodities used in highly processed foods have their largest effects after 3 or 4 months. For example, a one percent increase in the price of soybean oil leads to .04 percent increase in the price of margarine this month, .06 percent next month, and .07 percent in the next 2 months. In addition, indications are that the total effects of increases in raw farm prices are closely related to the farm value as a percent of retail cost. Those products for which farm value is a small percentage of retail cost (bread, salad dressing, cookies, chocolate bars, for example) have relatively small total multiplier elasticities.

Implications

The results indicate that increases in raw agricultural commodity prices are quickly passed through the food manufacturing, processing, and distribution system. The rate of transmission depends on the effort necessary to produce the final food product. Changes in raw commodity prices affect the retail prices of perishable products quickly, while changes in the prices of raw agricultural commodities used in highly processed food products have their greatest effect on retail prices only after several months.

The existence of lags in time before raw agricultural commodity prices affect retail prices has important implications concerning the use of various statistical measures produced by the USDA. Currently, the USDA publishes farm to retail price spread data for major CPI food groups on a monthly basis, and cost components for these spreads on an annual basis. Although these data are primarily descriptive, efforts are often made to use these statistics for analytical purposes.

A major problem with the use of USDA price spread and cost component statistics for analytical purposes is that no lags are built into the construction of the series. For example, the monthly farm to retail price spread for meat is constructed using retail and farm

[5]Further, if it is accepted that farm price increases cause retail food price increases, which is a major assumption in this study, consistency and stability require that $0<\lambda<1$. Since all estimated λ satisfy this requirement, all estimated equations are consistent as well as dynamically stable.

TABLE 1. Estimates of Distributed Lags for Selected Food Products[a]

Food	$\theta(1-\hat{\lambda})^2$	$\hat{\beta}(1-\hat{\lambda})^2$	$\hat{\lambda}$	$\hat{\eta}$	R^2	$\hat{\ell}_1$	$\hat{\ell}_2$
Beef	29.00 (3.70)	.69 (.09)	.41	1.39	.84	2.95	3.23
Hamburger	26.56 (3.00)	.52 (.11)	.51	2.07	.87	4.36	4.52
Pork	12.49 (3.78)	1.02 (.09)	.45	1.64	.95	.08	1.04
Sausage	7.55 (4.09)	.82 (.10)	.55	2.43	.96	.24	.72
Bacon	−2.71 (5.14)	1.29 (.12)	.48	1.84	.95	.04	.07
Porkchops	36.20 (5.20)	1.19 (.12)	.29	.82	.88	5.03	9.16
Chicken	40.0 (7.2)	4.46 (.30)	.04	.08	.82	.55	.82
Eggs	12.4 (6.2)	2.04 (.11)	.13	.30	.90	.62	.66
Bread	2.01 (.21)	.11 (.06)	.74	4.97	.98	5.06	19.44
Milk	7.07 (.71)	1.18 (.08)	.53	2.25	.99	4.52	14.29
Skim milk	1.74 (.40)	.43 (.04)	.64	3.45	.99	8.88	9.06
Butter	−1.99 3.40	1.72 (.38)	.66	3.72	.97	3.22	3.82
Cheese	.77 (.80)	1.27 (.09)	.61	3.07	.99	.30	.42

TABLE 1. (Continued)

Canned milk	−.03 (.22)	.18 (.03)	.78	5.67	.99	1.59	2.64
Ice cream	1.30 (1.77)	.66 (.20)	.76	5.32	.99	23.9	35.82
Cooking oil	3.00 (.74)	.12 (.03)	.69	4.16	.98	1.48	3.64
Shortening	7.09 (2.14)	.35 (.08)	.69	4.16	.98	4.40	18.93
Margarine	1.49 (.46)	.09 (.02)	.74	4.97	.99	.71	2.59
Salad dressing	2.15 (.55)	.02 (.02)	.85	6.94	.99	14.30	19.67
Peanut butter	−2.10 (1.84)	89.10 (9.80)	.60	2.95	.99	19.10	56.92
Sugar	7.72 (3.05)	1.64 (.14)	.45	1.64	.97	7.27	7.63
Cookies	4.81 (.72)	.05 (.03)	.76	5.32	.99	16.43	23.64
Chocolate bars	.28 (.06)	.20[b] (.29)[b]	.84	6.76	.99	.06	.23

[a]Standard errors are presented in parentheses.
[b]Multiply by 10^{-2}

Table 2. Impact, Interim, and Total Multiplier Elasticities for Selected Food Products

Food	0	1	2	3	4	5	6	7	8	9	∞
Beef	.17	.14	.09	.05	.02	.01	.01	.00	.00	.00	.50
Hamburger	.08	.08	.06	.04	.03	.02	.01	.01	.00	.00	.35
Pork	.23	.21	.14	.09	.05	.03	.01	.01	.00	.00	.78
Sausage	.17	.19	.16	.11	.08	.05	.03	.02	.01	.01	.85
Bacon	.28	.27	.20	.13	.08	.04	.02	.01	.01	.00	1.05
Porkchops	.30	.17	.08	.03	.01	.00	.00	.00	.00	.00	.59
Chicken	.67	.05	.00	.00	.00	.00	.00	.00	.00	.00	.73
Eggs	.69	.18	.04	.01	.00	.00	.00	.00	.00	.00	.92
Bread	.01	.02	.02	.02	.02	.01	.01	.01	.01	.01	.15
Milk	.13	.14	.11	.08	.05	.03	.02	.01	.01	.00	.60
Skim milk	.09	.11	.11	.09	.08	.06	.05	.03	.02	.02	.69
Butter	.14	.18	.18	.16	.13	.10	.08	.06	.04	.03	1.18
Cheese	.14	.18	.16	.13	.10	.07	.05	.04	.02	.02	.96
Canned milk	.05	.08	.10	.10	.10	.09	.08	.07	.06	.06	1.00
Ice cream	.05	.08	.09	.09	.08	.08	.07	.06	.05	.04	.82
Cooking oil	.04	.06	.06	.06	.05	.04	.03	.03	.02	.02	.47
Shortening	.06	.08	.08	.07	.06	.05	.04	.03	.03	.02	.59
Margarine	.04	.06	.07	.07	.06	.06	.05	.04	.03	.03	.60
Salad dressing	.00	.01	.01	.01	.01	.01	.01	.01	.01	.01	.20
Peanut butter	.09	.11	.10	.08	.06	.04	.03	.02	.01	.01	.56
Sugar	.20	.18	.12	.07	.04	.02	.01	.01	.00	.00	.65
Cookies	.01	.01	.02	.02	.02	.01	.01	.01	.01	.01	.17
Chocolate bars	.00	.00	.01	.01	.01	.01	.01	.01	.01	.01	.12

prices for the same month. The results of this study indicate that there is clearly a mean lag of more than a month before retail meat prices increase as a consequence of increases at the farm level. The valid comparison is of current retail price with lagged farm value. For this reason, reported USDA price spread and cost component statistics are biased, the bias being greatest for those food products with the longest farm to retail lag.[6]

The results of this study are also important with regard to food price forecasting methodology. The explanatory power of most of the equations presented in Table 1 is extremely high. Given the one-way causality postulated in the model, monthly forecasts of retail food prices should be fairly accurate since only farm price and lagged retail prices are required to make forecasts. Quarterly forecasts can also be made using equation (9). These might prove highly accurate in cases where the mean monthly lag is relatively lengthy. Most quarterly food price forecasts are made utilizing reduced form supply and demand representations which assume competition as the appropriate market structure. This may be an unrealistic assumption, and a test of the relative forecasting ability of the two approaches would prove interesting.[7]

A final implication of this study concerns the ability of the government to control food price inflation. Currently, large transfers to the agricultural sector are made each year through various government programs designed to provide higher prices to farmers. The results of this study imply that higher farm prices are passed through directly to consumers at the retail level. In this respect, the costs of agricultural programs are actually greater than reported government expenditures; that is, higher retail food prices impose additional costs on consumers. For this reason, it is apparent that government programs which increase the prices of raw agricultural commodities are inflationary, since higher farm prices imply higher retail food prices. Control of farm prices would allow control of food price inflation in the short run.

Conclusion

This paper has reviewed the nature of food price inflation utilizing a discrete dynamic model of cost-push inflation. The lag structure of the model was approximated as a second-order Pascal distribution. This type of distributed lag model has a major advantage over the conventional polynomial lag model in that the data determine the length of the lag structure.

The structural model utilized in this study differs considerably from the structural models postulated in other studies of monthly food price behavior. Most previous efforts have utilized behavioral models based on demand and supply representations (for examples see Nelson and Spreen; Myers, Havlicek, and Henderson; Lamm; and Moriak and Logan). The model used here also differs substantially from monthly distributed lag models constructed by Heien and the Council on Wage and Price Stability in studies designed to evaluate the responsiveness of wholesale and retail food prices to changes in raw agricultural commodity prices and wage rates.[8]

[6]Barrowman and others, and the Comptroller General have previously suggested the existence of this bias.

[7]Following Naylor, validations of the 23 estimated equations were performed using 6 months of data beyond the sample period used for estimation. Mean absolute errors ranged from 0.9 percent for milk, skim milk, and peanut butter to 7.8 percent for margarine. Of the 23 generated time paths, 14 produced Theil inequality coefficients less than unity.

[8]Heien asserts that variations in wage rates affect monthly retail prices and includes wages as an explanatory variable in his model. Wage rates do not vary significantly from month to month like raw agricultural commodity prices, however. For this reason, Heien obtains a measure of the correlation between wages and retail food prices resulting from general inflation instead of a causality measure. Even so, results presented by Heien (and also those of the Council on Wage and Price Stability) do not differ substantially from results given here.

Of course, the model presented here is a highly simplified representation of a complex process. As a model of food price inflation, it allows no explicit role for monetary expansion, except in so far as monetary expansion might lead to higher raw agricultural commodity prices which cause higher retail food prices. Also, the model is a short-run construction. In the long run, increases in wages, prices of packaging materials, equipment depreciation charges, and costs of other inputs would cause food prices to increase. A more satisfactory approach might allow an integration of these long run considerations. In addition, an implicit assumption of the model is that declines and increases in farm prices are passed through to the retail level with the same lag. This may not be the case in reality.

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APPENDIX. Sources of Data

Food Product	Dependent Variable	Independent Variable
Beef	CPI for beef and veal, 1967 = 100	Price of choice steers, Omaha, cents/pound
Hamburger	CPI for hamburger 1967 = 100	Price of utility cows, Omaha, cents/pound
Pork	CPI for pork, 1967 = 100	Price of barrows and gilts, 7 leading markets, cents/pound
Sausage	CPI for sausage, 1967 = 100	" "
Bacon	CPI for bacon, 1967 = 100	" "
Porkchops	CPI for porkchops, 1967 = 100	" "
Chicken	CPI for chicken, 1967 = 100	Price of broilers, average received by farmers, cents/pound
Eggs	CPI for eggs, 1967 = 100	Price of eggs, average received by farmers, dollars/dozen
Bread	Average retail price for white bread, cents/pound	Price of wheat, average received by farmers, dollars/bushel
Milk	Average retail prices, leading cities, cents/half-gallon	Price of milk received by farmers, cents/pound
Skim milk	Average retail price, leading cities, cents/quart	" "
Butter	Average retail price, leading cities, cents/pound	" "
Cheese	Average retail price for American processed cheese cents/half pound	" "
Canned milk	Average retail price for canned evaporated milk, leading cities, cents/14.5 ounce can	" "
Ice cream	Average retail price, leading cities, cents/half gallon	" "
Cooking oil	Average retail price, leading cities, cents/pound	Price of soybean oil, crude, Decatur, cents/pound

APPENDIX. Sources of Data — Continued

Food Product	Dependent Variable	Independent Variable
Shortening	Average retail price for shortening other than lard, leading cities, cents/pound	" "
Margarine	Average retail price, leading cities, cents/pound	" "
Salad dressing	Average retail price of Italian salad dressing, leading cities cents/pound	" "
Peanut butter	Average retail price, leading cities, cents/pound	Price of peanuts received by farmers cents/pound
Sugar	Average retail price for granulated sugar, cents/5 pounds	Price of raw sugar New York spot market, cents/pound
Cookies	Average retail price of cream sandwich cookies, cents/pound	" "
Chocolate bars	Average retail price, cents/ ounce	" "