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THE EFFECT OF MARKET STRUCTURE ON
PRICE CHANGE FOR FOOD MANUFACTURING
PRODUCT CLASSES

by

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INTRODUCTION

Food price inflation has been a major policy issue during most of the postwar years. Food prices at both the processing and retailing levels have more than doubled since 1967. Market structure may constitute one factor which contributes to this rapid rise in food prices.

The concentrated, oligopolistic structure of some markets in the economy may introduce certain price rigidities. Governmental monetary and fiscal policies to combat inflation are rendered less effective if product prices are not responsive to decreases in aggregate demand. In other words, certain market structures may cause an inflationary bias to be built into the economy. Noncompetitive market structures may permit food processors and retailers to charge higher prices for their products than would be justified on the basis of rising costs of food production and marketing alone. If this structural thesis is correct, microeconomic inflation policies take on additional importance; antitrust policies become a possible inflation remedy.

Kahn (1975) offers one explanation of the mechanism whereby oligopolistic market structures generate inflation. The scenario suggests that oligopolists exhibit price catch-up behavior following periods of general inflation. Catch-up pricing applies additional inflationary pressure on the economy through a rise in prices and wages in oligopolistic industries. In turn, the rise in labor costs affects both oligopolistic and competitive prices. A higher general price level ensues from which all prices in the economy may again begin their cyclical ascent. In other words, the causal influence of market power on chronic or creeping inflation depends on various interdependencies among industrial sectors in the economy. As Kahn writes (1975, p. 266),

The solution must, I think, be sought in a series of relationships that are typically ignored... First, the structure of an industry--specifically, the degree and nature of competition in its product markets--influences the level of its own costs and their behavior over time. Second, when one industry produces inputs for others, its prices influence their costs. Third, and similarly, the wage bargains struck in one industry help determine the wages, hence the costs, of others. Fourth, and in a sense embracing the first three, the most important characteristic of the behavior of prices and wages in the economy at large is their interdependence: price determines wages, wages determine price.

The basic empirical question is whether foods produced in the more concentrated sectors have shown greater price rises than those foods produced in more competitive market structures. Although Kahn's theoretical argument for a positive relationship between concentration and price increase pertains most specifically to post-inflation catch-up periods, this creeping-inflation hypothesis has been empirically tested for many data sets, over many different time spans. See Beals (1975), Mueller (1974), or Kelton (1980) for a review of the administered-pricing literature. Based on the empirical results presented in this paper, it may be concluded that more concentrated markets do not show greater price increases than less concentrated markets for food and tobacco products. There is some evidence that increases in concentration lead to relative price increases. In addition, an important positive link between advertising intensity and price change is supported.

THE MODEL AND ADMINISTERED-PRICE HYPOTHESES

The model tested is based on the price-change equation developed by Weiss (1966) for an earlier test of the administered-price hypothesis. Weiss postulates that, controlling for unit labor cost change over time, unit materials cost change, and quantity change (as a proxy for change in demand), product price rise is positively related to market share concentration. Weiss finds a positive and statistically significant effect of concentration on price change for the period 1953 to 1959, using price

relatives for manufacturing industries developed by DePodwin and Selden (1963); the same empirical approach fails to support the creeping-inflation thesis for 1959 to 1963.

Besides this standard administered-pricing hypothesis, the model developed more fully below is designed to address three additional structural hypotheses, as yet ignored in the administered-pricing literature. In other words, Weiss's empirical framework is expanded to incorporate three additional structural variables besides market share concentration. These three hypotheses concern the effects of change in concentration, the level of advertising intensity, and change in advertising intensity on long-term price change. Each hypothesis is discussed in turn.

First, critics of the creeping-inflation hypothesis argue that there is not a strong theoretical reason why long-term price rises for oligopolistic markets should exceed those in competitive ones. Critics argue that the hypothesis' predictions are not theoretically grounded in terms of basic behavioral assumptions for the firm. Instead, stronger theoretical arguments and accumulated empirical evidence suggest a static structure-performance relationship. Controlling for cost differences among industries, one may expect a "higher product price," the higher the seller market share concentration. Alternatively, if one formulates a structural-change version of this hypothesis, the basic thesis is that if firms tend over time to produce in an increasingly concentrated oligopolistic environment, they will tend to increase their price-cost margin or rate of profit.

The structural-change hypothesis with respect to concentration and price-cost margins has been examined by Cowling and Waterson (1976). They find a significant and positive relationship between the two changes

for their sample of British industries. They argue as well that certain theoretical and statistical problems can be avoided by focusing on change in concentration instead of level:

When the theoretical model is spelled out it becomes obvious that some inter-industry relationships...are meaningless because of certain omitted variables. A prime example is the omission of the industry price elasticity of demand...However, if we shift our focus to changes in structure effecting changes in performance, then it may be reasonable to assume that the omitted-variables problem is less severe.
(Cowling and Waterson [1976, p. 267]).

Although their concern is with the concentration-margin relationship, the same argument may apply to administered-pricing questions.

The sole focus in the literature on the impact of structure on price change may be misplaced. A highly concentrated industry may be less of a policy concern with respect to inflation than one which is experiencing increasing concentration over time.

Secondly, a major purpose of this research is to examine the specific relationship between advertising effort (intensity) and price behavior over time. The focus on seller concentration only as representative of market power and discretion over price may be misleading. Previous studies involving the food and tobacco industries have established the importance of advertising as a structural characteristic. (See Rogers [1980], for example.) As a potential entry barrier, advertising intensity may be as indicative of ability to influence price as seller concentration. One hypothesis tested is that the greater the advertising effort of firms in a given product class, the greater their pricing discretion and the greater the increase in price over time.

A third hypothesis involves change in advertising intensity. An increase in intensity may have either a positive or negative impact on price change. A negative effect may be indicative of dynamic activity -- introduction of new products or generally a product "stage" of increasing differentiability. On the other hand, a positive impact on price change may be expected as products become increasingly heterogeneous. Thus, an ambiguous prediction is implied regarding the overall impact of an increase in advertising effort on price. The directional effect may depend on the period in question; the barrier-to-entry factor may increase in importance after an initial stage of product introduction.

In the following sections of this paper, these administered-pricing hypotheses are incorporated into an empirical model. In the next section, the specific variable formulation is discussed. Then, descriptive statistics and empirical results are presented, and general conclusions are drawn.

VARIABLE MEASUREMENT

The analysis is based on a cross-sectional sample of all product classes in the food and tobacco manufacturing groups (SIC groups 20 and 21) provided no serious definitional change occurs over the sample period and that cost, quantity, and other Census data are available.¹ Data include 59 observations for the period 1958 to 1977, and various subperiods. (See Appendix A for a list of observations.) The two primary data sources employed are the Census of Manufactures² and the Leading National Advertisers brand advertising data.³

In the remainder of this section, the dependent variable and the explanatory variables are discussed. Each variable is examined in turn, but first

it is convenient to express the basic data used to construct these variables in terms of the following symbol notation:

- VS_{it} = value of shipments of product class i in year t ;
 Q_{it} = physical quantity shipped of product class i in year t ;
 W_{it} = production-worker wage bill for product class i in year t ;
 CM_{it} = cost of materials for product class i in year t ;
 CR_{it} = four-firm market-share concentration ratio for product class i in year t ;
 TA_{it} = total measured-media advertising expenditure for product class i in year t ;
 TV_{it} = television advertising expenditure for product class i in year t ;⁴
 R_{it} = radio advertising expenditure for product class i in year t ;⁵
 N_{it} = newspaper advertising expenditure for product class i in year t ;
 O_{it} = outdoor advertising expenditure for product class i in year t ;
 M_{it} = magazine advertising expenditure for product class i in year t .

Percentage Product Class Price Change

Census implicit or average realized product class prices are measured as product class value of shipments divided by physical quantity shipped, or

$$(1) \quad P_{it} = VS_{it}/Q_{it},$$

where P_{it} is Census realized price of product class i at time t . In other words, a price is obtained by dividing value of shipments or " $P_{it} \times Q_{it}$ " by its quantity component. Since the Census reports physical quantities

for specific commodities (seven-digit products), construction of this measure depends upon the particular product class.⁶

The dependent variable of the regression analysis is the percentage change in price over some time period and is constructed as

$$(2) \quad \Delta P_i = (VS_{iT}/Q_{iT}) / (VS_{i0}/Q_{i0}) - 1,$$

where time 0 represents the initial year; time T, the final year. In general, the percentage change in price may be preferred statistically to a simple price ratio P_{iT}/P_{i0} as the dependent variable (see Beals [1975]), although it may be shown that, for this analysis, the coefficient estimates (excluding the constant term) are invariant with respect to this empirical decision, provided that certain explanatory variables are also expressed in percentage-change terms. (See Beals for a proof.) It is, of course, true that ΔP_i reflects not only implicit price changes of individual products within a product class but shifting weights among those products. The independent cost variables and structural-change variables (discussed below) also reflect these shifts. In constructing ΔP_i , it is assumed that a five-digit product class is a relevant unit of observation. Any product price change or shift in value over time becomes important insofar as it effects a change in average realized price for a product class as a whole.

The implicit price enjoys a number of advantages over its explicit Bureau of Labor Statistics (BLS) counterpart. Utilization of (1), the implicit price, mitigates the problem of the distinction between quoted and true transaction prices -- a problem which discourages reliance on BLS data. BLS price series cannot capture the practice of discounting and,

hence, do not represent necessarily the price actually paid for a product by its purchasers.

Thorp and Crowder, in one of the earliest empirical administered-pricing studies (1941, p. 339), write about an implicit price,

It reflects the actual per unit return on a manufactured product and avoids the fiction which surrounds nominal or quoted prices as used in the typical indexes...All sorts of rebates, special allowances, quantity discounts, cash discounts, freight absorption, and extras should tend, therefore, to be reflected in the realized figures reported to the Bureau of the Census by manufacturers.

Thus, a Census implicit price can be closer to "the" buyer transaction price than can a BLS explicit price.⁷ Neither BLS data nor Census data avoid the problem of quality-change measurement. If change in quality is related systematically to any of the structural variables in the model, the empirical results may be biased.

Percentage Unit Variable Cost Change

Two components of unit direct cost are calculated from Census figures: unit materials cost including the cost of the raw agricultural commodity, packaging cost, and fuel cost; and unit labor cost. These two costs represent major costs for food and tobacco processors.⁸ The cost variable is constructed as

$$(3) \quad \Delta UVC_i = \frac{(W_{iT} + CM_{iT})/Q_{iT} - 1}{(W_{i0} + CM_{i0})/Q_{i0}}$$

where W_{it} is the production-worker wage bill for product class i at time t ,

and CM_{it} is the cost of materials for i at t . The effect of ΔUVC_i on ΔP_i is assumed to be strongly positive. ΔUVC_i is considered statistically superior to introducing two separate cost variables -- unit labor cost (itself equal to the ratio of the hourly wage rate to quantity shipped per hour, one measure of hourly labor productivity) and unit materials cost -- since it avoids the multicollinearity problem which two separate cost variables cause. Further, ΔUVC_i implicitly weights materials and labor costs for each product class.

Percentage Quantity Change

The percentage change in physical quantity shipped of product class i is measured as

$$(4) \quad \Delta Q_i = Q_{iT}/Q_{i0} - 1.$$

ΔQ_i proxies change in demand for or supply of product class i . The inclusion of ΔQ_i as an explanatory variable is consistent with previous empirical studies in this area, although the directional effect of ΔQ_i on ΔP_i is not predicted a priori.

Weiss (1966, p. 179) essentially argues that, although ΔQ_i by itself is "of little explanatory value since output changes can reflect changes in demand or supply," it is a residual proxy for change in demand if cost variables are added to the price equation, representing the supply side. The potential simultaneity problem, however, in ΔP_i and ΔQ_i determination has not been adequately addressed in previous research, nor is it addressed in this study.

Product Class Advertising Intensity

All price-determination equations involve some measure of shifting cost and demand factors. The behavioral questions to be addressed concern

the impact of market structure and structural change on long-term realized price change. To date, empirical work concerning the administered-pricing question has relied almost exclusively on market-share concentration as a proxy for discretion over price. It is clear, however, that other market structural characteristics may also serve to determine a firm's power over price. Product differentiation as proxied by advertising intensity is particularly important for food and tobacco product classes. A producer of a differentiated product presumably can exercise more discretion over price than a producer of a more homogeneous product. Mueller and Rogers (1978) argue that the degree of advertising effort serves to distinguish between producer and consumer goods. If one envisioned a continuum of product classes from pure producer goods to pure consumer goods, advertising intensity would rise along this continuum.

Advertising intensity is computed as

$$(5) \quad A_{it} = TA_{it}/VS_{it}.$$

The variable is calculated for the years 1954, 1967, 1972, and 1977.⁹

A_{167} is considered as the relevant advertising variable for the long-term models, as well as for two shorter periods: 1963-1967 and 1967-1972.

A_{154} appears in the 1958-1963 analysis, and A_{172} , in the 1972-1977 estimation. A positive effect of A_{it} on ΔP_i is expected. In essence, the question of advertising's effect on price change is an administered-price hypothesis.

For some of the regressions of Tables 4 and 5, an attempt is made to measure separately the effects of electronic (television and radio) advertisity intensity, TVR, and print or other media (newspaper, outdoor, and magazine) advertising intensity, NOM. This approach follows Mueller

and Rogers (1980), with the general notion's being that structural implications vary by advertising medium. Thus,

$$(6) \quad TVR_{it} = (TV_{it} + R_{it})/VS_{it}; \text{ and}$$

$$(7) \quad NOM_{it} = (N_{it} + O_{it} + M_{it})/VS_{it}.$$

A positive effect of both TVR_{it} and NOM_{it} on ΔP_i is predicted a priori.

Both the TVR and NOM variables are constructed with 1967 advertising data.

Change in Advertising Intensity

As for the level of advertising intensity discussed above, two approaches are followed in constructing the change-in-advertising variable. First, for the relevant comparable media between $t = 0$ and $t = T$,

$$(8) \quad \Delta A_i = A_{iT} - A_{i0}.$$

Secondly, electronic media are distinguished from other media. In some of the regressions presented below, ΔTVR_i and ΔNM_i are employed, rather than ΔA_i , where

$$(9) \quad \Delta TVR_i = TVR_{iT} - TVR_{i0}; \text{ and}$$

$$(10) \quad \Delta NM_i = (N_{iT} + M_{iT})/VS_{iT} - (N_{i0} + M_{i0})/VS_{i0}.$$

ΔA_i , ΔTVR_i , and ΔNM_i are constructed with 1954 as time 0 (see footnote 9), and 1972 or 1977 as time T for the 1958-1972 or the 1958-1977 time period, respectively.

The directional effect of ΔA_i or ΔTVR_i and ΔNM_i on ΔP_i is not specified a priori. To the extent that an increase in advertising effort suggests a stronger entry barrier, a positive effect on price movement is hypothesized. One might expect a positive influence as well if ΔA_i is interpreted as a "cost-change" variable along with ΔUVC_i .

On the other hand, firms in markets which undergo changes in structure by increasing advertising effort may be introducing new products and actively engaging in price discounts. Thus, the relative strength of impact of the two effects is an empirical question, addressed in the next section.

Four-Firm Concentration Ratio

Four-firm concentration is the third structural variable considered. Market-share concentration is assumed to represent a firm's power over or discretion to influence price. A positive effect on ΔP_i is predicted, constituting a test of the creeping-inflation hypothesis in the administered-pricing literature. CR_{i67} is employed for the long-term regressions. For the shorter-term regressions, the initial year's concentration ratio is employed: CR_{i58} , CR_{i63} , CR_{i67} , or CR_{i72} .

The "national" concentration ratio tends to understate effective concentration for regional or local markets. Corrected concentration ratios that reflect an industry's geographic dispersion relative to national population dispersion can be employed at the four-digit level (see Parker and Connor [1978], for example). A binary-variable approach is used in this analysis which identifies the following product classes as essentially local or regional in character: 20240 (Ice cream and ices), 20261 (Bulk fluid milk and cream), 20262 (Packaged fluid milk and related products), 20263 (Cottage cheese, including bakers' cheese, pot cheese, and farmers' cheese), and 20511/20512 (Bread and rolls). This list is taken from Mueller (1979, p. 9). Assigning the binary variable D_i a value of 1 for the above five product classes permits determination of whether product class price change differs according to the national-local market distinction. To the extent that D_i serves to "correct" the national four-firm concentration ratio for a local or regional product class, the directional effect of D_i on ΔP_i should be the same as that of CR_{i4} , it.

Change in Concentration

The fourth and final structural variable in the model, with a positive directional effect predicted, is change in concentration. It is measured as

$$(11) \quad \Delta CR_i = CR_{iT} - CR_{i0}.$$

Time 0 corresponds to the initial year of the time period in question, and time T, to the final year. Testing for the significance of the coefficient for ΔCR_i essentially tests a structural-change version of the concentration-profit hypothesis discussed above. Price increases are expected to be higher for those product classes experiencing large increases in concentration than for those that are not.

On average, across the 59 product classes studied, four-firm market share concentration has risen for every subperiod except 1958 to 1963, where it fell by 0.14 percentage points (see Appendix C). The average rise from 1958 to 1972 is 2.86 percentage points; from 1958 to 1977, 4.58 percentage points. On average, food and tobacco industries are becoming more concentrated over time.

The variation in concentration change from 1958 to 1977, from a fall of 12 percentage points for processed pork and for sweetening syrups to a rise of 36 percentage points for malt beverages, itself may be explained in terms of previous structural effects (see Mueller and Rogers [1980]). These effects include change in entry barriers, including scale economy changes, and product differentiation. Thus, the variable ΔCR_i captures more than change in market share concentration, but also implicitly incorporates previous structural changes for a product class.

DESCRIPTIVE RESULTS

As mentioned above, this study focuses on the time period 1958 to 1977. The (BLS) food component of the consumer price index rose from 88.5 in 1958 to 192.2 in 1977, (following and contributing to the rise in the

consumer price index from 86.6 to 181.5 over the same period). The food price rise was not consistent over this time, however. From 1958 to 1963, retail food prices rose at an average annual rate of 1%; 1963 to 1967, 2%; 1967 to 1972, 5%; and 1972 to 1977, 11%. Thus, in the two earlier subperiods, food prices rose modestly, while chronic inflation has characterized the two later subperiods, with rapid inflation since 1972. Kahn's catch-up hypothesis, discussed above, would not be expected to hold necessarily in periods of continuous inflation.

The (BLS) processed foods component of the producer price index and the producer price index followed similar trends over the period 1958 to 1977, with relative price stability from 1958 to 1967, and chronic inflation from 1967 to 1977. The producer price index rose from 94.6 in 1958 to 119.1 in 1972 and 194.2 in 1977; the processed foods component rose from 91.8 in 1958 to 120.8 in 1972 and 186.1 in 1977. Table 1 presents unweighted average implicit producer price changes by major industry (three-digit) for various time periods. Across food and tobacco product classes, the average percentage price change is highest for the 1972 to 1977 period -- 66.2% -- rising (consistently) from -1.0% for 1958 to 1963, 8.9% for 1963 to 1967, and 17.2% for 1967 to 1972. This trend holds for each of the ten major industries included in Table 1, with two exceptions: beverages and tobacco manufactures, whose average 1958 to 1963 price rise exceeds their average 1963 to 1967 price rise. Both of these major industries have an unweighted average four-firm concentration which exceeds the sample average of 46.2. The beverage industry has average $CR_{67} = 56.9$; the tobacco manufactures industry, 63.8. This suggests an initial hypothesis that the 1950s did not provide a long

Table 1. Unweighted Average Percentage
Implicit Price Change by Major
Food or Tobacco Industry: Various Time Periods

Industry	n*	1958-63	1963-67	1967-72	1972-77	1958-72	1958-77
Meat Products	10	-.077	.106	.270	.401	.299	.798
Dairy Products	8	-.068	.180	.231	.695	.357	1.272
Canned and Preserved Fruits and Vegetables	8	.037	.094	.146	.589	.291	1.053
Grain Mill Products	4	.012	.119	.144	.503	.295	.971
Bakery Products	1	.040	.069	.166	.523	.297	.975
Sugar and Cofec- tionery Products	5	-.029	.086	.113	1.124	.173	1.372
Fats and Oils	5	-.064	.057	.149	1.122	.123	1.371
Beverages	8	.056	.048	.112	.459	.246	.793
Miscellaneous Food Preparations and Kindred Products	6	.023	.061	.212	.875	.305	1.424
Tobacco Manufactures	4	.049	.005	.051	.514	.134	.751
All Food and Tobacco	59	-.010	.089	.172	.662	.262	1.069

* number of observations by major industry.

enough postwar price catch-up period for all oligopolistic industries. This hypothesis is given additional support as well by the Table 6 regression results for the years 1958 to 1963.

Furthermore, the average long-term (1958 to 1977) price rise varies across major industries: from 75.1% for tobacco manufactures to 142.4% for miscellaneous food preparations. The average price increase across 59 food and tobacco product classes is 106.9%. Since both of the extreme industries not only have relatively high market-share concentration, but also relatively high advertising intensity, an "easy" market structural explanation of this extreme variation in price-change behavior is not possible.

However, in any case, the aggregate character of Table 1's data presentation precludes a careful analysis of the role of market structure in understanding long-term price behavior. Thus, it is appropriate to return to addressing the structural hypotheses discussed above at the level of the product class, for which structural characteristics may be more meaningful.

Tables 2 and 3 anticipate the empirical results presented in the next section. Table 2 shows average implicit long-term percentage price change for 59 food and tobacco product classes, as related to advertising intensity and change in intensity. Aside from 15 product classes, many of which could be labeled "producer goods" (e.g., the crude and once-refined oils), average long-term price rise is seen to be higher, the more differentiated the product class in terms of advertising intensity. On average, percentage price change rises from .7814 to 1.0745 to 1.2376 along a consumer-goods continuum from "low" to "medium" to "high" product differentiation.

Table 2. Unweighted Average 1958-77 Percentage
Implicit Price Change Broken Down
by Advertising Intensity and Change in
Advertising Intensity

(Frequencies in parentheses)

A \ ΔA			
	≤ 0.0	> 0.0	All Product Classes
0.0	1.1382 (15)	- (0)	1.1382 (15)
0.0 - 1.0000	0.7160 (9)	0.8795 (6)	0.7814 (15)
1.0001 - 3.0000	1.2380 (5)	0.9109 (5)	1.0745 (10)
> 3.0000	1.6254 (6)	1.0587 (13)	1.2376 (19)
All Product Classes	1.1274 (35)	0.9831 (24)	1.0687 (59)

The change in advertising intensity, on the other hand, is seen to be inversely related to price change. On average, those product classes with a fall (or no change) in comparable-media advertising intensity over the period 1954 to 1977 show a long-term price rise of 1.1274, compared to a .9831 average for those product classes experiencing an increase in advertising intensity. This result appears to hold for the moderately and highly differentiated product classes, and not for the low-differentiation category. For this latter category, the average price change is .7160 for product classes exhibiting a fall in advertising intensity, yet .8795 for those with a rise in intensity. Both pieces of evidence suggest an argument that a fall in advertising intensity for already differentiated products reflects a successful long-term advertising campaign and a more than proportional rise in sales or shipments value relative to the change in total advertising dollars. That this scenario does not hold for low product differentiation suggests perhaps that an "optimal" or successful advertising intensity has not been reached by firms in those product classes, so that a positive change in advertising intensity is associated with a larger average price increase than is a negative change in intensity.

Table 3's descriptive statistics also anticipate the regression results of the next section, but the suggested relationships are not as clear as in Table 2. Except for the eight product classes in the low - concentration category ($0 \leq CR_{67} < 25$), average percentage price change rises with four-firm market-share concentration. And, this result is supported in Appendix B by the positive simple correlation between CR and AP. However, as shown in the next section, the partial effect of CR on AP is estimated to be negative, when other factors are taken into account.

Table 3. Unweighted Average 1958-77 Percentage
Implicit Price Change Broken Down
by Four - Firm Concentration and Change in
Concentration

(Frequencies in parentheses)

CR \ Δ CR			
	≤ 0.0	> 0.0	All Product Classes
0 - 24	1.1637 (4)	1.1316 (4)	1.1477 (8)
25-49	0.8275 (11)	1.0844 (15)	0.9757 (26)
50-74	0.8662 (11)	1.4146 (8)	1.0971 (19)
75-100	1.3430 (3)	1.2099 (3)	1.2764 (6)
All Product Classes	0.9419 (29)	1.1913 (30)	1.0687 (59)

Table 3 also shows that, on average, a long-term (percentage-point) rise in concentration is associated with a higher price rise than a fall (or no change) in concentration. As Table 3 shows, though, this result is concentration-class dependent: i.e., it holds for the "moderately concentrated" product classes ($25 \leq CR_{87} < 75$). For both the very low - and very high-concentration classes, the average price rise is (slightly) higher for those product classes experiencing no change in or a long-term fall in market-share concentration.

EMPIRICAL RESULTS

Employing the variables discussed above, the following model as well as some model variations are estimated by ordinary least squares (OLS):¹⁰

$$(12) \quad \Delta P_i = \beta_0 + \beta_1 \Delta UVC_i + \beta_2 \Delta Q_i + \beta_3 A_i + \beta_4 \Delta A_i + \\ \beta_5 CR_i + \beta_6 \Delta CR_i + \beta_7 D_i + \epsilon_i,$$

where ϵ_i is a stochastic error term. The linear specification of the model is consistent with previous empirical studies as well as with the target-return or cost-plus pricing model.

It is convenient to discuss separately results for the two longer time periods studied, as well as for individual shorter time spans. The results presented in the three subsections below seem to complement each other and reinforce the dual conclusions that the strength of effect of market structure on pricing behavior is time-period-dependent but that the directional influences of structural characteristics do not generally

depend on the specific years examined.

1958 to 1972

Coefficient estimates are presented in Table 4 for the period 1958 to 1972, before the rapid inflationary period 1972 to 1977. A correlation matrix may be found in Appendix B. Descriptive statistics are presented in Appendix C. Some of the structural correlations must be noted specifically. In particular, A_{67} and CR_{67} have a simple correlation of .536; and ΔCR and ΔA are also positively correlated, though not as strongly, with correlation coefficients of .241 and .398 for 1958-1972 and 1958-1977, respectively.

The first six regressions represent estimations of the full model, including a test of the creeping inflation hypothesis (i.e., the effects of A_i and CR_i) and of the structural-change hypothesis (i.e., the effects of ΔA_i and ΔCR_i). Each equation varies slightly depending upon the measurement of advertising intensity and the change in advertising intensity over time: i.e., depending upon whether television and radio advertising is distinguished from other advertising. The seventh and eighth regressions essentially test the creeping inflation hypothesis alone, while the ninth regression presents the results from testing the structural-change hypothesis alone.

As postulated above, the percentage change in unit variable cost has exerted a strong positive influence on price change over time. Its estimated coefficient is consistently significant at the 1% level. It was postulated that physical quantity change would either have a positive or negative effect on price change over time depending on the relative strengths of its "demand" and "supply" effects. Table 4 indicates that quantity change inversely affects price change, implying a stronger "supply" effect. The coefficient is generally significant at the 10% level, except

Table 4. Regression Results: 1958-72
(t - statistics in parentheses)

Constant	ΔUVC	ΔQ	A	TVR	NOM	ΔA	ΔTVR	ΔNM	CR	ΔCR	D	R ²	F
.3626	.1747 ^a (4.3464)	-.0875 ^c (-1.8114)	.0289 ^a (3.2255)			-.0790 ^b (-2.3704)			-.0039 (-2.2410)	.0067 ^b (2.3171)	-.0991 (-.9778)	.5026	7.3617 ^a
.3664	.1739 ^a (4.2843)	-.0872 ^c (-1.7886)		.0314 ^a (2.7461)	.0236 ^c (1.3671)	-.0753 ^b (-2.1436)			-.0040 (-2.2503)	.0064 ^b (2.0943)	-.1008 (-.9849)	.5039	6.3479 ^a
.3624	.1730 ^a (4.3009)	-.0928 ^c (-1.9071)	.0288 ^a (3.2145)				.0601 (1.5418)	.1085 ^b (2.3983)	-.0040 (-2.2579)	.0061 ^b (2.0582)	-.0984 (-.9701)	.5120	6.5561 ^a
.3638	.1728 ^a (4.2486)	-.0925 ^c (-1.8799)		.0297 ^a (2.5612)	.0268 ^c (1.5199)		.0595 (1.4950)	.1061 ^b (2.1550)	-.0040 (-2.2318)	.0060 ^b (1.9455)	-.0990 (-.9659)	.5121	5.7150 ^a
.3540	.1724 ^a (4.2617)	-.0933 ^c (-1.8706)	.0275 ^a (2.9333)				.0085 (.1378)	-.1205 ^b (-2.1328)	-.0040 (-2.1982)	.0041 (1.2530)	-.0943 (-.9397)	.5079	5.9344 ^{a*}
.3547	.1720 ^a (4.1887)	-.0931 ^c (-1.8442)		.0284 ^b (2.1436)	.0262 ^c (1.4412)		.0080 (.1265)	-.1172 ^c (-1.7213)	-.0040 (-2.1760)	.0040 (1.2133)	-.0946 (-.9327)	.5080	5.1622 ^{a*}
.3455	.1875 ^a (4.4195)	-.0861 ^c (-1.7050)	.0305 ^a (3.2252)						-.0035 (-1.9108)		-.1111 (-1.0359)	.4140	7.4900 ^a
.3623	.1825 ^a (4.3182)	-.0852 ^c (-1.6994)		.0395 ^a (3.4379)	.0107 (.6213)				-.0039 (-2.1164)		-.1152 (-1.0821)	.4341	6.6479 ^a
.2230	.1773 ^a (4.1101)	-.0565 (-1.1136)				-.0739 ^b (-2.0950)				.0080 ^a (2.5944)		.3921	8.7084 ^a

* Food product classes only. Four tobacco product classes are omitted.

^a Significant at the 1% level (for one - or two-tail test).

^b Significant at the 5% level (for one - or two-tail test).

^c Significant at the 10% level (for one - or two-tail test).

for the ninth regression, where the coefficient estimate is insignificant. The local-regional binary variable is not statistically significant. The bread and fluid milk products for which D_1 takes on the value of 1 have had less of a price increase than the "national" product classes, although not significantly less.¹¹

With respect to the group of four structural variables, the directional relationships are generally as expected, although the standard administered-price hypothesis is not supported. The effect of advertising intensity on long-term price change is positive and significant at the 1% level of significance. The barrier-to-entry effect of advertising in the food manufacturing industries may indeed allow producers gradually to increase realized price. Subject to being upheld in subsequent investigations, the result suggests that product price change is influenced by market structure and that a new structure-performance relationship may be established -- between advertising effort and price rise. One would not be justified in arguing, solely on the basis of this result, that advertising is a cause of inflation, since this conclusion requires reasoning about a macroeconomic problem from product-specific results. Nevertheless, advertising's statistically significant effect on price change is interesting in its own right. If a link exists between concentration and price change, it has proved difficult to establish in empirical studies, and analyzing other structural influences on price behavior, such as advertising intensity's effect, may be an appropriate line of further research of administered-pricing questions.¹²

The results of the second, fourth, sixth, and eighth regressions show that the strength (not direction) of effect of advertising effort

on price change depends upon the advertising media considered. It is advertising intensity with electronic media which exerts the strongest influence on product price change. As Mueller and Rogers argue (1980, p. 91),

Since television advertising generally is the most effective media (and for large firms facing numerous buyers has the lowest cost per potential buyer) for the creation of product differentiation in consumer goods industries, it is hypothesized that television will have a different impact on industrial structure than will other forms of advertising.

The results in Table 4 support this contention that distinct media have different impacts on market structure or firm behavior. Whereas Mueller and Rogers find a negative effect of other advertising intensity on long-term concentration change, non-television-and-radio advertising effort seems to exert a positive (and, except for the eighth regression, significant at the 10% level) influence on price change. Thus, one concludes that product differentiation and long-term price increase are "achievable" through either electronic or printed advertising, although the former exerts a "statistically stronger" influence.

The significantly negative effect of the change in (comparable media) advertising intensity seems to argue against a rising-entry-barrier effect of increasing advertising effort over time. As briefly mentioned above, it may be that a long-term fall in advertising intensity actually depicts a successful advertising campaign in which food sales or shipments have risen tremendously over time, allowing food prices to rise while advertising per dollar of sales declines. For example, consider breakfast cereals. This product class has shown an implicit percentage price rise of 61.5% from 1958 to 1972, (compared to a 26.2% rise for all food and tobacco product classes), yet a long-term fall in comparable-media

advertising effort from 7.76% of value of shipments in 1954 to 6.57% in 1972. In absolute terms, total advertising expenditures in the cereal industry rose from \$25,676,000 in 1954 to \$61,434,400 in 1972, but sales rose even more over that period, from \$331,000,000 to \$934,600,000. (In 1977, this advertising intensity for cereals was 7.20%, with total comparable-media advertising of \$132,057,000 and value of shipments of \$1,832,900,000)

The third through sixth regressions suggest that, as was true for the level of advertising intensity, the effect of change in advertising intensity depends upon the media considered. The negative relationship is less pronounced for television and radio advertising intensity change, implying a stronger structural or barrier-to-entry effect. In fact, if the four tobacco product classes are omitted from the analysis (based on the argument that the ban on cigarette television advertising essentially disqualifies these observations), then one observes a directional change. (see Table 4, fifth and sixth regressions). The effect of an increase in television and radio advertising effort on price rise is now positive -- but insignificant.

Just as the results of Table 4 imply that advertising intensity is an important structural variable for food manufacturing products, they also imply that the traditional creeping-inflation hypothesis is not supported.¹³ In fact, the estimated model indicates that the higher the level of concentration, the smaller the price change.¹⁴ This particular result is time-period-dependent as implied by most postwar administered-pricing studies, by the results presented in the next two subsections, and by Kahn's argument discussed in the introduction.

It seems that it is not a high level of concentration which impacts positively on long-term implicit price change; it is a high (percentage-point) change in concentration which positively affects percentage price change. Table 4, in other words, suggests support for a positive relationship between concentration and price-cost margins, or for the structural-change version of this standard hypothesis. Over a long enough time period, if firms tend to produce in markets experiencing increases in concentration, their prices will increase more than for firms in markets which do not exhibit such a rise in concentration. This is perhaps the theoretically most pleasing result, since microeconomic theory expects a higher price-cost margin for a monopolistic than a competitive firm. This positive relationship between concentration change and price change does not support the creeping-inflation hypothesis as developed by Means (1939) or later by DePodwin and Selden (1963) and Weiss (1966). Again, however, the result suggests that structural influences on price change may be more complex than previously assumed in administered-price studies.

The structural scenario implied by these results is consistent with other research on food manufacturing industries. Rogers (1980) has argued that the change in advertising intensity over time is an important factor in determining structural change of market power as measured by the percentage point change in the four-firm concentration ratio. If one temporal sequence is $\Delta A_i \rightarrow \Delta CR_i \rightarrow \Delta P_i$, then for any point-to-point cross-sectional study, the partial effect of ΔA_i on ΔP_i may be negative,

but previous changes in advertising effort may also be affecting ΔP_i through their impact on market concentration.¹⁵

In an attempt to understand this causal structure, additional empirical results are obtained by including a structural - change interaction term $\Delta A \Delta CR$, obtained by multiplying change in concentration by change in advertising intensity. The first regression's revised results are presented below, with t-statistics in parentheses. To the extent that ΔA interacts with or helps to cause ΔCR for a food product class, one expects a positive "barrier-to-entry" effect on ΔP :

$$\begin{aligned} \Delta P = & .369 + .176^a \Delta UVC - .091^c \Delta Q + .030^a A - .111^a \Delta A \\ & (4.465) \quad (-1.920) \quad (3.396) \quad (-2.922) \\ & -.004 CR + .005^b \Delta CR - .103 D + .007^c \Delta A \Delta CR, R^2 = .53. \\ & (-2.445) \quad (1.778) \quad (-1.033) \quad (1.667) \end{aligned}$$

The estimated coefficient for the structural-change interaction term is positive and significant, despite relatively high simple correlation coefficients between ΔA and $\Delta A \Delta CR$ and between ΔCR and $\Delta A \Delta CR$: 0.547 and 0.369, respectively. In other words, the higher ΔA is, the greater the positive impact of ΔCR on ΔP .

1958 to 1977

When the analysis is extended for five years, most of 1958-to-1972 empirical conclusions are supported, as seen in Table 5. It is the purpose of this subsection to discuss briefly the results for the longer time span, emphasizing the few altered conclusions from the time horizon extension. Table 5 shows the estimated coefficients for nine 1958-to-1977 regressions, which correspond to the nine regressions of Table 4. (A correlation matrix may be found in Appendix B; descriptive statistics, in Appendix C.)

Table 5. Regression Results: 1958-77
(t - statistics in parentheses)

Constant	ΔUVC	ΔQ	A	TVR	NOM	ΔA	ΔTVR	ΔNM	CR	ΔCR	D	R ²	F
.9546	.1938 ^a (3.9811)	-.1075 (-1.5113)	.0347 ^b (1.6763)			-.1989 ^b (-2.1385)			-.0030 (-.7752)	.0129 ^b (2.2698)	-.1598 (-.7450)	.4394	5.7109 ^a
.9732	.1913 ^a (3.9056)	-.1097 (-1.5359)		.0438 ^b (1.8267)	.0086 (.2145)	-.1734 ^c (-1.7470)			-.0032 (-.8355)	.0115 ^b (1.9282)	-.1685 (-.7817)	.4458	5.0281 ^a
.9626	.1837 ^a (3.7405)	-.1223 ^c (-1.7041)	.0313 ^c (1.5030)				-.1509 (-1.5013)	-.2501 ^b (-2.4633)	-.0029 (-.7603)	.0119 ^b (2.0732)	-.1557 (-.7294)	.4558	5.2343 ^a
.9708	.1836 ^a (3.7055)	-.1218 ^c (-1.6814)		.0360 ^c (1.4325)	.0190 (.4583)		-.1437 (-1.3892)	-.2321 ^b (-2.0174)	-.0030 (-.7842)	.0113 ^b (1.8892)	-.1604 (-.7436)	.4571	4.5840 ^a
.9753	.1670 ^a (3.3177)	-.1518 ^c (-1.9837)	.0297 (1.2625)				-.1057 (-.8526)	-.1961 ^c (-1.7847)	-.0020 (-.4899)	.0106 ^b (1.7438)	-.1656 (-.7765)	.4451	4.6129 ^{a*}
.9920	.1636 ^a (3.2297)	-.1523 ^c (-1.9837)		.0471 ^c (1.5050)	-.0009 (0.0000)		-.1088 (-.8746)	-.1298 (-.9602)	-.0020 (-.4930)	.0097 ^c (1.5662)	-.1778 (-.8295)	.4538	4.1546 ^{a*}
.9145	.2165 ^a (4.3034)	-.1089 (-1.5323)	.0200 (1.0266)						-.0015 (-.3912)		-.1964 (-.8820)	.3587	5.9294 ^a
.9672	.2057 ^a (4.1260)	-.1115 (-1.5944)		.0433 ^b (1.8314)	-.0305 (-.8556)				-.0025 (-.6519)		-.2083 (-.9508)	.3918	5.5840 ^a
.8611	.2018 ^a (4.1878)	-.0989 (-1.3982)				-.1335 (-1.5799)				.0131 ^b (2.3126)		.4010	9.0366 ^a

* Food product classes only. Four tobacco product classes are omitted.

^a Significant at the 1% level (for one-or two-tail test).

^b Significant at the 5% level (for one-or two-tail test).

^c Significant at the 10% level (for one-or two-tail test).

One general point is that the R^2 and F- statistics are lower for the longer time period. Less of the total variation in price change is explained by the independent variables for the longer time span, 1958 to 1977. Nevertheless, the directions and "strengths" of variable influence are generally the same as for 1958 to 1972.

The most striking difference between the results of Table 4 and Table 5 is that the coefficient estimate for CR_i is not significant for 1958 to 1977. The other structural conclusions remain essentially unaltered from the previous subsection. Concentration change still exerts a positive and significant effect on price change, as does advertising intensity (except for Table 5's fifth and seventh regressions). Furthermore, separating television and radio advertising from print media advertising leads to the same conclusion as in Table 4. The "strongest" positive effect on price change is achieved by television and radio advertising effort. The estimated coefficient for other advertising intensity is insignificant for all regressions in Table 5. Finally, the conclusion drawn above with respect to change in advertising intensity is unchanged. An increase in advertising effort is shown still to exert a negative and significant influence on long-term price change, with this negative effect's being "strongest" for change in nonelectronic advertising intensity.

In summary, these initial results from a test of four administered-price hypotheses imply that although unit cost change over time may be the most important influence on price change, structural variables are not unimportant. The results argue that advertising intensity is an important explanatory variable. Its omission in many administered-pricing studies may have placed too great an explanatory burden on four-firm concentration alone. High advertising intensity may permit even greater pricing discretion than high concentration. The results suggest that

studies examining the relationship between structure and price performance should not focus on level alone but should focus as well on structural change over time, especially on the change in market share concentration.

Shorter-Term Price Change

Finally, Table 6 shows results from shorter-period regression analysis,¹⁶ for which the 1958 to 1977 time period is divided into four subperiods for additional temporal detail: 1958 to 1963, 1963 to 1967, 1967 to 1972, and 1972 to 1977. (Again, descriptive statistics are presented in Appendix C. Appendix D presents results from ordinary-least-squares regressions.)

In examining the individual period results, there are few directional estimates (i.e., positive or negative effects) which differ from the long-term results previously discussed -- an argument certainly for general relationship stability. Unit variable cost change exerts a positive and statistically significant effect on price change for each of the four time periods; quantity change, a negative effect on price change; and the local-regional binary variable, a negative (but generally insignificant) effect.

However, there are important exceptions to this general conclusion of invariability, and a study of the separate time periods does allow additional insight into the structural factors influencing price change.¹⁷ Table 6 results strongly support the temporal dependence of the creeping-inflation hypothesis as discussed above. Regression estimates show that concentration exerts an (insignificantly) positive effect on price change during the 1958 to 1963 "catch-up period" as well as during the rapid inflation from 1972 to 1977. However, concentration's effect is "slightly"

Table 6, Seemingly Unrelated Regressions: Four Time Periods
(t-statistics in parentheses)

Time Period	Constant	AUVC	AQ	A	CR	ACR	D	R ^{2,d}
1958-63	-.0078	.2454 ^a (3.9301)	-.0737 (-1.1556)	.0134 ^c (1.4036)	.0003 (.3764)		-.0421 (-.8942)	.2984
	-.0135	.2578 ^a (4.2340)	-.0804 (-1.3069)	.0104 (1.1209)	.0005 (.6964)	.0048 ^b (1.9719)	-.0368 (-.8150)	.3593
1963-67	.0996	.2670 ^a (5.2319)	-.1932 ^a (-3.5900)	.0087 ^a (2.6881)	-.0009 (-1.5858)		-.0132 (-.3588)	.6385
	.0679	.2612 ^a (5.4605)	-.1970 ^a (-3.9104)	.0079 ^a (2.5875)	-.0004 (-.6074)	.0056 ^a (3.0303)	-.0040 (-.1148)	.6815
1967-72	.2627	.4107 ^a (7.8717)	-.2012 ^a (-3.1091)	.0119 ^a (2.5965)	-.0036 (-4.0823)		-.0990 ^c (-1.9361)	.6054
	.2588	.4075 ^a (7.7642)	-.1858 ^a (-2.8348)	.0118 ^a (2.5230)	-.0035 (-3.8127)	-.0013 (-.4592)	-.1022 ^c (-1.9291)	.6055
1972-77	.3189	.5112 ^a (6.8892)	-.3969 ^b (-2.5292)	-.0293 (-1.6774)	.0015 (.6236)		-.0459 (-.3435)	.5802
	.3225	.5088 ^a (6.8285)	-.4054 ^b (-2.5881)	-.0296 (-1.6983)	.0013 (.5726)	.0028 (.4036)	-.0457 (-.3407)	.5819

^aSignificant at the 1% level (for one-or two-tail test).

^bSignificant at the 5% level (for one-or two-tail test).

^cSignificant at the 10% level (for one-or two-tail test).

^dFrom OLS regressions.

negative during the period 1963 to 1967 (a period of modest food price increase), and strongly negative from 1967 to 1972. The effect of short-term concentration change on price change is estimated to be positive and statistically significant only for the earliest two (noninflationary) time periods: 1958 to 1963 and 1963 to 1967. (It is interesting that these five year periods are long enough to observe any structural change effects.) Finally, advertising intensity's effect seems to be strongest for the two middle periods, and exerts actually a negative influence on price change for the latest period.

One last observation is that both the R^2 and F- statistics seem much lower for the earliest time period, 1958 to 1963, than for any of the later three periods. The entire model fits the data "better," then, for the later periods relative to the earliest years.

CONCLUSIONS

Based on the empirical results from the preceding analysis, it may be argued that the structural-change (administered-price) hypothesis is supported for food and tobacco manufacturing product classes. Controlling for unit cost and physical quantity change, the greater the increase in four-firm concentration, the greater the realized price increase.

The results indicate that the two structural level variables affect price change in opposite ways. The negative impact of the level of concentration on price change is consistent with almost all postwar creeping-inflation studies at the four- or five-digit level of analysis. However, the partial effect of the level of advertising intensity is positive and significant.

The results suggest generally that structural variables are important in determining long-term price behavior but that the dynamics are more complex than the usual "high-concentration-large-price-increase" hypothesis. Product differentiation cannot be ignored as a structural variable, nor can structural change be ignored. The main policy implication from this research is that at least as far as creeping inflation is concerned, the focus should be on preventing dynamic increases in market power.

FOOTNOTES

- 1 Most previous administered - pricing studies have been undertaken at the industry or four-digit level. Due to five-digit availability or comparability problems, 2065 (Confectionary products), 2074 (Cottonseed oil mills), 2075 (Soybean oil mills), 2082 (Malt beverages), 2095 (Roasted coffee), and 2141 (Tobacco stemming and redrying) are substituted as observations in the regression analysis. 20164 (Other poultry, small game), 20210 (Butter), 20513 to 20517 (Sweet bread-type products), 20923, and 20970 (Manufactured ice) are omitted due to data problems as well. (See Rogers [1980].) The following pairs of product classes are combined into one market due either to being indistinguishable for the consumer or to unavailable separate historical data: 20116 and 20136; 20117 and 20137; 20118 and 20138; 20161 and 20162; 20511 and 20512; and 20620 and 20630. 20860 (Bottled and canned soft drinks) uses 20873 concentration data (see Mueller and Rogers [1978]). Since selectivity criteria have been the subject of some debate in the literature (see Beals [1975]), a binary variable is introduced in initial empirical work (not significant in any of the regressions) to capture broadly the notion of potential outliers. As suggested by Blair (1974), these product classes are 20231, 20620, 20630, 2074, and 2075. Moreover, 20119 and 20264 are omitted due to lack of comparability between cost and realized price data.
- 2 The cost, shipments, and physical quantity data for various years are found in Volume II, Industry Statistics, in the following two basic tables: "General Statistics for Establishments, by Industry Specialization and Primary Product Class Specialization" and "Products and Product Classes -- Quantity and Value of Shipments by All Producers."
- 3 The basic 1967 advertising data were prepared by the late Robert Bailey of the Federal Trade Commission, who assigned a five-digit SIC number to LNA advertising data. The 1954, 1972, and 1977 data are similarly prepared, but by R. Rogers and research assistants for the Food System Research Group, University of Wisconsin-Madison.
- 4 Depending on the context of use of TV_{it}, spot television advertising expenditure is or is not included. It is included in constructing the advertising level variable. To ensure comparable media for 1958 to 1972 or 1958 to 1977 intensity change, however, it is not included.
- 5 See footnote 4. This same argument applies to spot radio advertising intensity.
- 6 In general, quantities are reported for food and tobacco product classes: a distinct advantage for a study involving these two groups as opposed to other manufacturing sectors. When physical quantity data are lacking for some of the products within a product class, or when units of measurement differ among products, a quantity-estimation or a product-deletion procedure is employed. Deleted seven-digit products (from quantity-change, shipments-change, and implicit price-change calculations only) by 1972 SIC code are 2023300, 2033665, 2033861, 2033800, 2062075, 2074400, 2075100, 2079100, 20824 (all), 2084043, 2084081, 2084085, 2084000, 2084002, 2085165, 2085100, and 2085300.

Physical quantities are estimated for other seven-digit products for various years. All estimates are based on the shipments-quantity relationship for the other seven-digit products. When cases were the unit of measurement, it was assumed that they could be added. 20323, 20333, 20335, 20336, and 20860 have quantity measured in cases.

7

Further, since cost data availability constrains the observation set, the additional constraint of BLS data availability severely restricts the sample size. Finally, since both cost and market-structure or concentration data are based on the Census of Manufactures, the data-matching problem is lessened if Census implicit price data are used. As product weights shift within a product class, price and cost totals are derived from shifting product emphasis accordingly if Census price data are involved. One problem with implicit prices, however, is that V_{it} and Q_{it} form the dependent variable as well as occur in some of the explanatory variables. As Weiss (1966, p. 179) argues, this problem may inflate the value of R^2 but should not alter empirical conclusions with respect to the effect of concentration on price change.

The calculated Pearson correlation coefficients between Census and BLS measures of ΔP , for 40 product classes for which comparable data are available (identified in Appendix A), are as follows:

Time Period	Correlation Coefficient
1972-1977	.7979**
1967-1972	.3471*
1963-1967	.6625**
1958-1963	.6377**
1958-1977	.6030**
1958-1972	.6339**

**Significant at the 1% level.

*Significant at the 5% level.

Except for the 1967-1972 coefficient which is significant at the 5% level, all coefficients are significant at the 1% level. See Weiss (1977) for a correlation analysis among three price change measures.

Since the BLS product class data series is available for the study from 1967 to 1977 only and for a limited number of classes, remaining explicit price data are constructed by matching a Census five-digit product class with the product group (preferably) or single product which is considered to be the "best match" given BLS data availability. The means, minima, and maxima for the two data sources are reported below for 40 product classes:

Time Period	Census			BLS		
	Mean	Low	High	Mean	Low	High
1972-1977	0.629	0.019	2.021	0.610	-0.072	1.680
1967-1972	0.157	-0.272	0.543	0.181	-0.226	0.667
1963-1967	0.096	-0.118	0.411	0.087	-0.113	0.337
1958-1963	-0.007	-0.258	0.248	-0.018	-0.319	0.304
1958-1977	1.030	-0.196	2.448	0.998	0.273	3.420
1958-1972	0.265	-0.376	1.134	0.259	-0.264	1.244

These descriptive statistics generally support the high correlation between Census implicit price change and BLS-measured change. The Census data, however, record a higher average inflation rate than BLS data for the latest period, 1972 to 1977, and a lower rate than BLS data for 1967 to 1972.

- 8 It must be noted that total cost data are computed on a product class basis, while quantity data are on a commodity-whenever-made basis. Capital costs are not considered.
- 9 I am indebted to R. Rogers who has invested much effort in developing these data sets. Due to the LNA collection procedure, 1958 and 1963 advertising data by five-digit SIC code could not be developed from this source.
- 10 Deleting 11 "middle" observations from the sample, ranked by 1967 value of shipments, to render the test more powerful, the following table shows the results (F-ratios) for the Goldfield-Quandt test for heteroscedasticity:

1958-1972	1958-1977
1.8607	1.8385

These calculated F-statistics (for the first regressions of Tables 4 and 5) result from a test of the null hypothesis that small product classes measured by value of shipments (1967) have the same residual variance as large product classes. The null hypothesis cannot be rejected (at the 10% level) for either time period.

- 11 Including both a CR-slope and-intercept dummy produces the following alternate first regression results, with t-statistics in parentheses:

$$\begin{aligned}
 \Delta P = & .340 + .182^a \Delta UVC - .075 \Delta Q \\
 & (4.561) \quad (-1.543) \\
 & + .028^a - .078^b \Delta A - .004 CR \\
 & (3.196) \quad (-2.364) \quad (-2.059) \\
 & + .006^b \Delta CR + .534 D - .023 CRD, R^2 = .53, \\
 & (2.096) \quad (1.309) \quad (-1.601)
 \end{aligned}$$

where CRD is the four-firm concentration ratio multiplied by the local-regional binary variable. In comparing this estimated regression with Table 4 results, one can note that estimates and significance levels, especially for the structural variables, are essentially unaltered. (It does, however, seem as though the five product classes of regional character have a higher price-change intercept, and lower slope coefficient than "national" product classes, although neither binary-variable coefficient estimate is significant at the .05 level.) Only the binary intercept term is included in the remaining regressions.

- 12 Empirical results for the first and second regressions are altered slightly if product class advertising intensity is measured by A_{154} as opposed to A_{167} . Multicollinearity becomes a problem with the simple correlation coefficient between A_{154} and ΔA equal to $-.333$, and the relative influences of electronic media (TVR_{154}) and print media (NM_{154}) are reversed, with t-statistics in parentheses:

$$\begin{aligned}
 1. \quad \Delta P &= .348 + .181^a \Delta UVC - .079 \Delta Q \\
 &\quad (4.379) \quad (-1.601) \\
 &+ .060^a A - .046 \Delta A - .004 CR \\
 &\quad (2.661) \quad (-1.255) \quad (-1.928) \\
 &+ .007^a \Delta CR - .093 D, \quad R^2 = .47 \\
 &\quad (2.391) \quad (-.894) \\
 \\
 2. \quad \Delta P &= .341 + .182^a \Delta UVC - .081 \Delta Q \\
 &\quad (4.369) \quad (-1.630) \\
 &+ .044 TVR + .077^b NM - .047 \Delta A \\
 &\quad (1.211) \quad (2.100) \quad (-1.283) \\
 &- .003 CR + .007^a \Delta CR - .089 D, \quad R^2 = .48. \\
 &\quad (-1.851) \quad (2.413) \quad (-.849)
 \end{aligned}$$

These results indicate the relative importance of the print media in a firm's advertising mix in 1954 relative to more electronic media advertising in that mix by 1967.

- 13 See appendix B to note the low correlations between ΔCR_i and CR_i and between ΔA_i and A_i .
- 14 Empirical results for the first and second regressions are not altered if CR is measured as the mean concentration ratio across time periods, nor are they altered if CR_{158} is employed. The latter measure, though, introduces multicollinearity; the simple correlation coefficient between CR_{58} and ΔCR is -0.299 .
- 15 The potential lagged impact of an increase in advertising intensity is considered briefly by measuring ΔA over the period 1954 to 1967 instead of 1954 to 1972. The first and second regressions' implications essentially do not change, with one exception: the effect of ΔA on ΔP is now estimated to be negative, but insignificant.
- 16 These are system-estimation results. Since one might postulate that product class error terms are correlated across time periods, a seemingly unrelated regression strategy may be most appropriate. (Results from seemingly unrelated regressions do not differ in their essentials from OLS results, found in Appendix D.)
- 17 ΔA_i is not included as a structural variable in the short-term regressions. Since A_i can be calculated only for the years 1954, 1967, 1972, and 1977, there is no obvious ΔA_i calculation for 1958 to 1963 or for 1963 to 1967.

APPENDIX A

Observations Used in Regression Analysis

1972 SIC Code	Product Class Name
<hr/>	
20111	Beef, not canned or made into sausage
20112	Veal, not canned or made into sausage
20113	Lamb and mutton, not canned or made into sausage
20114	Pork, fresh and frozen
20116a	Pork, processed (not canned or made into sausage)
20117b,i	Sausage and similar products (not canned)
20118c,i	Canned meats containing 20 percent or more meat
20161 ^d	Young chickens, including broilers, fryers, roasters, capons
20163	Turkeys
20172	Liquid, dried and frozen eggs
20231	Dry milk products
20232	Canned milk products (consumer type cans)
20233i	Concentrated milk, shipped in bulk
20234i	Ice cream mix and ice milk mix
20240	Ice cream and ices
20261i	Bulk fluid milk and cream
20262	Packaged fluid milk and related products
20263i	Cottage cheese
20323	Canned dry beans
20333i	Canned hominy and mushrooms
20335	Canned vegetable juices
20336	Catsup and other tomato sauces
20338	Jams, jellies, preserves
20352	Pickles and other pickle products
20353i	Meat sauces (except tomato)
20372	Frozen vegetables
20430i	Cereal breakfast foods
20440	Milled rice and byproducts
20460	Wet corn milling
20471i	Dog and cat food
20511e	Bread and rolls
20620 ^f	Refined cane and beet sugar and byproducts
20650 ^{h,i}	Confectionery products
20661	Chocolate coatings
20668g	Other chocolate and cocoa products
20670	Chewing gum and chewing gum base
20740 ^h	Cottonseed oil mills
20750 ^h	Soybean oil mills

APPENDIX A (Continued)

Observations Used in Regression Analysis

1972 SIC Code	Product Class Name
<hr/>	
20771	Grease and inedible tallow
20772 ⁱ	Meat meal and tankage
20791	Shortening and cooking oil
20820 ^h	Malt beverages
20830 ⁱ	Malt and malt byproducts
20840	Wines, brandy and brandy spirits
20851 ⁱ	Distilled liquor, except brandy
20853	Bottled liquors, except brandy
20860	Bottled and canned soft drinks
20872 ⁱ	Liquid beverage bases
20874	Other flavoring agents (except chocolate syrups)
20950 ^{h,i}	Roasted coffee
20980	Macaroni, spaghetti, noodles
20991 ⁱ	Desserts (ready-to-mix)
20992 ⁱ	Chips
20993	Sweetening syrups and molasses
20994 ⁱ	Baking powder and yeast
21110	Cigarettes
21210	Cigars
21310	Chewing and smoking tobacco and snuff
21410 ^h	Tobacco stemming and redrying

^aRepresents 20116 + 20136.

^bRepresents 20117 + 20137.

^cRepresents 20118 + 20138.

^dRepresents 20161 + 20162.

^eRepresents 20511 + 20512.

^fRepresents 20620 + 20630.

^gRepresents 20668 + 20998.

^hFour-digit observation.

ⁱOmitted from correlation analysis of Footnote 7.

APPENDIX B
Correlation Matrices for Long-Term Regressions

	ΔP	ΔUVC	ΔQ	A	TVR	NOM	ΔA	ΔTVR	ΔNM	CR	ΔCR	D
1958-1972												
ΔP	1.000											
ΔUVC	.527	1.000										
ΔQ	-.254	-.293	1.000									
A	.278	.013	.119	1.000								
TVR	.326	.061	.073	.888	1.000							
NOM	.028	-.079	.127	.593	.157	1.000						
ΔA	-.276	-.182	.210	-.027	-.146	.198	1.000					
ΔTVR	-.092	-.123	.250	.034	.033	.017	.712	1.000				
ΔNM	-.264	-.096	-.022	-.078	-.240	.252	.486	-.268	1.000			
CR	.049	.066	-.068	.536	.541	.204	-.169	-.094	-.116	1.000		
ΔCR	.184	-.047	.200	.139	.213	-.074	.241	.338	-.089	.019	1.000	
D	-.059	.052	-.147	-.175	-.158	-.100	-.035	-.066	.035	-.300	-.135	1.000

APPENDIX B (Continued)
Correlation Matrices For Long-Term Regressions

	ΔP	ΔUVC	ΔQ	A	TVR	NOM	ΔA	ΔTVR	ΔNM	CR	ΔCR	D
1958 - 1977												
ΔP	1.000											
ΔUVC	.561	1.000										
ΔQ	-.309	-.317	1.000									
A	.131	.058	.127	1.000								
TVR	.232	.120	.097	.888	1.000							
NOM	-.125	-.085	.103	.593	.157	1.000						
ΔA	-.227	-.188	.338	.351	.186	.428	1.000					
ΔTVR	.070	.018	.308	.335	.374	.064	.570	1.000				
ΔNM	-.304	-.206	-.022	-.040	-.247	.348	.329	-.588	1.000			
CR	.117	.141	.026	.536	.541	.204	-.054	.063	-.126	1.000		
ΔCR	.156	.007	.256	.129	.190	-.055	.398	.367	-.030	-.010	1.000	
D	-.069	.023	-.165	-.175	-.158	-.100	-.095	-.118	.042	-.300	-.160	1.000

APPENDIX C
Descriptive Statistics For Variables
Used in Regression Analysis

Variable Abbreviation	Mean	Standard Deviation	Minimum Value	Maximum Value
1958 - 1972				
ΔP	0.262	0.269	-0.376	1.134
ΔUVC	0.317	0.698	-0.652	4.150
ΔQ	0.555	0.605	-0.654	2.981
A	2.548	3.606	0.000	14.971
TVR	1.860	2.940	0.000	13.972
NOM	0.688	1.678	0.000	12.499
ΔA	0.116	0.853	-1.457	3.366
ΔTVR	0.213	0.774	-3.174	2.815
ΔNM	-0.098	0.622	-1.574	2.538
CR	46.237	19.066	15.000	89.000
ΔCR	2.864	9.716	-14.000	24.000
D	0.085	0.281	0.000	1.000

APPENDIX C (Continued)
Descriptive Statistics For Variables
Used in Regression Analysis

Variable Abbreviation	Mean	Standard Deviation	Minimum Value	Maximum Value
1958 - 1977				
ΔP	1.069	0.535	-0.196	2.586
ΔUVC	1.223	1.250	-0.655	6.287
ΔQ	0.695	0.893	-0.551	3.969
A	2.548	3.606	0.000	14.971
TVR	1.860	2.940	0.000	13.972
NOM	0.688	1.678	0.000	12.499
ΔA	0.227	0.760	-1.302	2.841
ΔTVR	0.364	0.888	-3.178	2.916
ΔNM	-0.137	0.772	-2.398	2.963
CR	46.237	19.066	15.000	89.000
ΔCR	4.576	11.047	-12.000	36.000
D	0.085	0.281	0.000	1.000

APPENDIX C (Continued)
Descriptive Statistics For Variables
Used in Regression Analysis

Variable Abbreviation	Mean	Standard Deviation	Minimum Value	Maximum Value
1958 - 1963				
ΔP	-0.010	0.115	-0.307	0.248
ΔUVC	-0.036	0.201	-0.423	0.631
ΔQ	0.215	0.202	-0.221	0.974
A_{54}	0.920	1.552	0.000	7.757
CR_{58}	44.881	19.858	12.000	89.000
ΔCR	-0.136	5.050	-13.000	11.000
D	0.085	0.281	0.000	1.000
1963 - 1967				
ΔP	0.089	0.123	-0.318	0.411
ΔUVC	0.120	0.231	-0.493	0.700
ΔQ	0.112	0.218	-0.395	1.175
A_{67}	2.548	3.606	0.000	14.971
CR_{63}	44.746	20.156	14.000	89.000
ΔCR	1.492	5.161	-10.000	14.000
D	0.085	0.281	0.000	1.000

APPENDIX C (Continued)
Descriptive Statistics For Variables
Used in Regression Analysis

Variable Abbreviation	Mean	Standard Deviation	Minimum Value	Maximum Value
1967 - 1972				
ΔP	0.172	0.167	-0.272	0.641
ΔUVC	0.189	0.267	-0.343	1.169
ΔQ	0.128	0.219	-0.491	0.840
A_{67}	2.548	3.606	0.000	14.971
CR 67	46.237	19.066	15.000	89.000
ΔCR	1.508	5.244	-10.000	12.000
D	0.085	0.281	0.000	1.000
1972 - 1977				
ΔP	0.662	0.414	0.019	2.021
ΔUVC	0.688	0.507	-0.552	2.761
ΔQ	0.064	0.235	-0.444	0.803
A_{72}	1.676	2.355	0.000	9.673
CR 72	47.746	19.325	16.000	89.000
ΔCR	1.712	5.045	-11.000	14.000
D	0.085	0.281	0.000	1.000

APPENDIX D

Ordinary Least Squares Regression Results: Four Time Periods (t - statistics in parentheses)

Time Period	Constant	AUVC	ΔQ	A	CR	ΔCR	D	R ²	F
1958-63	-.0064	.2293 ^a (3.3517)	-.0730 (-1.0459)	.0165 ^c (1.6152)	.0002 (.2214)		-.0419 (-.8432)	.2984	4.5083 ^a
	-.0090	.2527 ^a (3.7802)	-.0848 (-1.2562)	.0126 (1.2621)	.0004 (.4970)	.0059 ^b (2.2224)	-.0368 (-.7668)	.3593	4.8594 ^a
1963-67	.0993	.2669 ^a (4.8983)	-.1936 ^a (-3.3672)	.0084 ^a (2.4572)	-.0009 (-1.4612)		-.0134 (-.3450)	.6385	18.7224 ^a
	.0687	.2598 ^a (5.0247)	-.1959 ^a (-3.5950)	.0077 ^b (2.3755)	-.0004 (-.5683)	.0053 ^a (2.6510)	-.0040 (-.1095)	.6815	18.5477 ^a
1967-72	.2555	.3884 ^a (6.8641)	-.1803 ^b (-2.5659)	.0117 ^b (2.3910)	-.0034 (-3.6414)		-.0945 ^c (-1.7567)	.6054	16.2620 ^a
	.2534	.3893 ^a (6.7788)	-.1818 ^b (-2.5332)	.0115 ^b (2.2950)	-.0033 (-3.4460)	.0004 (.1378)	-.0924 (-1.6404)	.6055	13.3042 ^a
1972-77	.3426	.5190 ^a (6.5815)	-.4467 ^b (-2.6790)	-.0280 (-1.5133)	.0009 (.3619)		-.0618 (-1.4393)	.5802	14.6481 ^a
	.3304	.5232 ^a (6.5428)	-.4452 ^b (-2.6492)	-.0280 (-1.5057)	.0009 (.3821)	.0034 (.4604)	-.0541 (-1.3782)	.5819	12.0608 ^a

^aSignificant at the 1% level (for one-or two-tail test).

^bSignificant at the 5% level (for one-or two-tail test).

^cSignificant at the 10% level (for one-or two-tail test).

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