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RETAIL SALES OF BROILERS AND MEAT

As Affected by Price, Display Area, and Newspaper Advertising

Marketing Economics Division
Economic Research Service

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UNITED STATES DEPARTMENT OF AGRICULTURE

PREFACE

This report completes the cooperative research conducted by the U. S. Department of Agriculture and the National Broiler Council in the summer and early fall of 1962. The initial report, "Increasing Broiler Sales Through Offering an Additional Cut and Recipe Materials," ERS-127, was issued in May 1963.

This report deals with the relationship of sales during the test to changes in price, display area, newspaper advertising, and the money customers spent in the store. These studies are part of the Department's continuing program of research to provide marketing groups and agricultural producers with information to aid in expanding the demand for agricultural products and increasing marketing efficiency.

The overall study was under the general direction of Peter L. Henderson, Market Development Branch, and R. J. Krueger, Research Director, National Broiler Council.

Albers Super Markets, a Division of Colonial Stores, Inc., Columbus, Ohio, and Liberal Markets, Inc., Dayton, Ohio, provided the test stores from which the data were obtained.

May 1964

SUMMARY

Sales data from a 6-week test in two Ohio cities were analyzed to determine the effects of week-to-week changes in prices and merchandising practices on broiler sales. Fluctuations in broiler tonnage in the 12 sample stores were found to be explainable chiefly by changes in broiler price, display area, and newspaper advertising. These sales practices were found to exert their greatest influence on broiler sales when all were used to feature broilers. Estimates were derived for the average effect on sales of changes in display area, price, and newspaper advertising. The average sales increase per store per week was estimated to be 875 pounds when the price was reduced 5 cents, 158 pounds for each 2 additional square feet of broiler display, and 225 pounds for each 25 square inches of newspaper advertising. In addition, .04 pound more broilers were sold for each dollar increase in total store sales.

Changes in display area, price, newspaper advertising, and total store volume accounted for 75 percent of the variation in broiler sales. The remaining variation was attributed to unmeasured and random influences.

Broilers were given 17 percent more display area, 58 square inches of newspaper advertising, and the leading broiler cut was reduced 29 percent in price as a special feature. Comparable changes were made in the featuring of pork, but beef was featured with more intensity. It was given 27 percent more display area, 111 square inches of newspaper advertising, and a reduction of 30 percent in the price of its leading cut when featured.

The gross dollar sales of the meat department and of the total store were measurably affected when beef was the featured item. But neither the gross dollar sales for the meat department nor the total store sales were changed when broilers were advertised by the retailer, even though pounds sold increased significantly. Further analyses revealed that this apparent paradox was due to the relative price level of beef and broilers. For example, during the study, sales of about 2 pounds of broilers (at 30 cents per pound) were required to generate the same dollar sales as 1 pound of beef (at 60 cents per pound).

When pork was featured, there was no measurable change in total dollar sales in the test stores, but pork was less intensively advertised and merchandised than beef.

RETAIL SALES OF BROILERS AND MEAT AS AFFECTED BY
PRICE, DISPLAY AREA, AND NEWSPAPER ADVERTISING

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BACKGROUND

Research was initiated in 1962, in some Ohio supermarkets, primarily to determine whether the addition of broiler quarter cuts (breast or leg with a portion of the back attached), had a favorable or detrimental effect on broiler sales. As reported in a publication on this study [1]/, broiler sales increased 16 percent when the quarter cut was offered as an addition to the regular broiler display.

The relationship of sales during the test to sales under normal merchandising practices is the basis for the present report. The analyses reported herein are concerned with the relationship: (1) Between pounds of broilers sold and the price, display size, and advertising linage given to broilers and certain other meats; and (2) between meat department sales (dollars) and the featuring of broilers, pork, turkey, stewing chickens, and beef in the test stores; and the featuring of broilers by competing stores. These comparisons were made without regard to the presence or absence of quarters. The findings indicate some of the practices that are successful in building volume both for a particular product and for the meat department.

PROCEDURE AND ANALYSIS

This report is based on data from 12 sample stores, 6 in Dayton, and 6 in Columbus, Ohio. The stores were selected with a view to obtaining a representation of consumers from all socio-economic groups. In each city, the sample stores were from a single supermarket organization, and all of them in a city featured the same items, at the same prices, during any given week. Consequently, sales practices were more repetitive among stores than would have been the case if stores of other organizations had been included in the sample.

Information on broiler poundage, meat department dollar sales, and store dollar sales was collected for six 1-week periods beginning August 20, 1962. Broiler sales volume was determined through weekly inventories of stocks and audits of receipts in the retail store. Information on concurrent display sizes, prices, and newspaper advertising was collected weekly for poultry and red meats (excluding lamb and veal) in the sample stores. In addition, news-

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[1]/ Brown, Sidney E. Increasing Broiler Sales Through Offering an Additional Cut and Recipe Materials. U. S. Dept. Agr., ERS-127, May 1963.

paper advertising of broilers done by local retailers other than the cooperating organization was recorded each week.

Weekly sales were related to changes in prices, display areas, and advertising by means of multiple regression analysis. This method enabled the measurement of the relationship between sales and any causal factor while holding the influence of other causal factors constant. 2/ In each instance, before comparisons were made between sales and the merchandising and advertising practices, the level of sales volume peculiar to any store (and city) was isolated and removed from the data. 3/

Broiler sales (pounds) per store per week were related to the following factors for which quantitative data were available:

1. Broiler display in square inches
2. Broiler newspaper advertising in square inches
3. Whole cut-up broiler price per pound (cents)
4. Whole bird broiler price per pound (cents)
5. Beef advertising weighted by price reduction
6. Pork advertising weighted by price reduction
7. Broiler advertising of competing stores weighted by price reduction from the normal price in test stores
8. Beef display in square inches
9. Pork display in square inches
10. Turkey advertising weighted by price reduction
11. Stewing chicken advertising weighted by price reduction
12. Total store dollar sales

Meat department and total store dollar sales were each related to the following factors:

1. Broiler advertising weighted by price reduction
2. Beef advertising weighted by price reduction
3. Pork advertising weighted by price reduction
4. Broiler advertising by competitors weighted by price reduction from the normal price in test stores

In some cases, advertising space was weighted by the extent of price reduction in order to reduce the number of variables that were analyzed simultaneously. This weighted factor, in effect, expressed the pulling power of a meat advertisement in terms of the size of the advertisement and the attractiveness of the sale price. The price weight for beef, pork, and broiler advertising for test stores was the extent to which the price of the leading cut advertised was reduced from the average price observed for the respective cut in

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2/ As stated earlier, offering quarters was found to be associated with increased broiler sales; however, the analyses discussed here were made without regard to the presence of quarters. Since half of the observations were with quarters and half without, the coefficients measured would be expected to be the average.

3/ See Appendix for a discussion of the procedures used in isolating influences associated with individual stores.

nonsales weeks. Price reduction for the leading cut only was used, again, for simplification and because the price reduction for one advertised cut was assumed to represent comparable price reductions for all advertised cuts of this meat. Prices of nonadvertised cuts were not brought into the analysis as these prices are generally constant from week-to-week, and the chances of relating small changes in price to sales variation is slight in an analysis of this type.

The weight for broiler advertisements by competitors was determined as the difference between the advertised prices and the prices in test stores. Broiler advertisements were analyzed for their impact on sales and it was assumed that customers who would be attracted away from test stores by these advertisements would use normal broiler prices in test stores as a reference. 4/

FINDINGS

Broiler Sales

Weekly fluctuations in broiler sales (pounds) were explained primarily by changes in price, display area, and newspaper advertising given to broilers (table 1). Sales were inversely related to changes in prices and directly related to changes in display space and newspaper advertising. Customer reaction to change in price was the most pronounced with an estimated 875 pounds more broilers being sold when price was lowered 5 cents, or 875 pounds less broilers being sold when price was raised 5 cents per pound. 5/ The sales response to 2 more square feet of broiler display area was 158 pounds, while each 25 square inches of newspaper advertising linage was associated with 225 pounds of broilers sold. Also, the results indicated that .04 pound of broilers was sold for each additional dollar of store sales. Total store sales were considered as an index of customer traffic and the purchasing power of consumers.

Changes in price, display area, newspaper linage, and dollars spent in the store (store sales) directly and in combination, accounted for 75 percent of the fluctuations in broiler sales from week-to-week. Almost one-third of the explained fluctuations could be attributed to the direct effect of these variables; that is, the effect of each changing while the other three remained unchanged. The combined influence, accounting for the rest of the explainable fluctuations, resulted from the impact of price, display area, advertising linage, and store

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4/ For information on weekly features versus aggregate broiler sales in a city, see: Gray, Leo, R. Retail Price Specials for Frying Chickens in Selected U. S. Cities, 1960-61. U. S. Dept. Agr., ERS-101, Jan. 1963.

5/ Price referred to here is for the whole cut-up bird. No additional sales variations were explained by the whole-bird price. This was as expected since prices for the various cuts are usually closely related.

Since price, as well as display area and advertising linage, were changed for several rather than for single units for a feature, coefficients for these variables are expressed here in terms of more than one unit.

Table 1.--Changes in broiler sales associated with changes in significant merchandising and promotional factors in 12 Ohio supermarkets, 6 weekly test periods, August 20-October 10, 1962

Factor	Weekly average per store	Poundage change in broiler sales associated with given changes in each factor (b value) 1/	Percentage of total variation in sales (lbs.) associated with observed variation in each factor (R²)
Whole cut-up price............	43.7¢ per lb.	-875 * per 5¢	14.2
Broiler display area..........	17.4 sq. ft.	+158 * per 2 sq. ft.	2.4
Newspaper advertising.........	23.6 sq. in.	+225 * per 25 sq. in.	4.4
Total store sales.............	2/	+ .04** per dollar	.7
Combined effects of above factors........			53.4
Other factors 3/ and experimental error..:			24.9
Total (corrected for store differences)..:			100

* Significant at the 99 percent confidence level.
** Significant at the 75 percent confidence level.
1/ A plus sign indicates an increase and a negative sign a decrease in broiler sales associated with given changes in the factor. For example, an addition of 2 sq. ft. to the 17.4 sq. ft. of broiler display space was accompanied by an increase of 158 lbs. in broiler sales per week.
2/ Weekly average sales for sample stores not given because of confidential nature of data.
3/ Other factors include variety of cuts, prices of parts, quality, and other variables not quantified in this analysis.

sales changing concurrently. This means that these merchandising factors had greater influence on sales when they were changed in conjunction with each other rather than when varied independently.

The extent to which the four significant factors explained fluctuations in broiler sales was evident from a comparison of observed weekly sales and predicted sales. Observed weekly sales did not differ significantly from predicted sales, based on the effect of changes in broiler price, display area, advertising, and store sales. This means that unmeasured influences (such as pay periods, effect of nonmeat features, quality and appearance of broilers, variety of cuts, etc.) that accounted for the 25 percent of unexplained sales fluctuations either exerted a random impact on sales or tended to counteract each other from week-to-week.

The model developed from the analysis to estimate sales per store per week was as follows:

> Broiler sales per store per week = 2,050 - 875 pounds for each 5-cent increase in price from the average weekly price (or 875 pounds for each 5-cent decrease) + 158 pounds for each 2 additional square feet of broiler display + 225 pounds for each additional 25 square inches of newspaper advertising for broilers + .04 pound for each additional dollar of total store sales per week + 170 pounds.

The plus or minus 170 pounds is the estimate of error to be expected in projected sales at or near the average values for price, etc. The error range of predicted sales for the equation would increase as the values for price, display space, advertising space, and store volume moved further from the average observed values of 43.7, 17.4, 23.6, and the average dollar sales per store per week, respectively. 6/

Application of Equation

Application of this equation to estimate average sales resulting from selected changes in price, display allocation, and newspaper advertising for broilers would be for a group rather than a single store and preferably in connection with a weekly feature for broilers. This equation could be used to give the average sales effect to be expected per store from changes in these factors. The weekly sales in stores ranged from $25,000 to $60,000 and in broiler volume from 1,500 to 3,400 pounds. Initial average price, display space, and newspaper advertising were about 43 cents, 17 square feet, and 24 square inches, respectively. In such cases, the management would use the equation to project the probable change in broiler sales per store resulting from specific changes in these factors as part of a weekly feature.

The factors that showed no measurable impact on broiler sales also are worthy of note. Neither the advertising (weighted by the amount of price reduction) nor the amount of display area given individually to beef and pork

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6/ Weekly average sales for sample stores are not given because of the confidential nature of the data.

caused a reduction in broiler sales. In other words, pounds sold per unit of broiler display area and at a particular price were not directly influenced by the amount of newspaper linage or display area given to beef or pork. However, available retail display area is relatively fixed and the space available to nonfeatured items is largely influenced by the meats featured. A featuring of beef or pork thus affected the amount of space available for broilers, even though it did not change the rate of broiler sales per unit of display.

Lack of measurable response in broiler sales in test stores also was found for broiler features of competing retailers, and for the three instances of turkey and stewing chicken advertising in the test stores.

Store and Meat Department Dollar Sales

The beef advertising factor was the only meat feature analyzed that significantly affected the gross dollar sales. Both store and department sales (in dollars) increased significantly when beef was featured, but sales were not measurably affected when pork or broilers were featured.

The relative frequency of beef features (table 2) compared with those for other meats did not account for beef alone showing a significant relationship to the increase in dollar volume. Comparisons were for net sales increases per feature relative to nonfeature weeks. While the combination of advertising, greater display, and substantial price reduction likely had a tremendous affect on the tonnage of items featured, both tonnage and price level determined the department's gross dollar sales increase per feature. For example, it would require sales of two pounds of chicken at 30 cents to yield the same dollar gross as sales of one pound of beef at 60 cents. Consequently, based on a similar tonnage increase in sales, a beef feature would show considerably greater dollar gross than broilers. 7/ Furthermore, during this study, beef was featured more intensively than broilers or pork (table 2).

The increase in total store sales during a specific feature would result both from increased dollar volume accrued in the meat department and from the purchases of any additional customers attracted to the store by the feature.

The lack of any measurable change in meat department and store dollar sales when broilers were featured by the test stores or competing stores indicated that these features had no substantial influence on loyalty of shoppers. This could mean that regular customers who were most price conscious buy broilers at "sale" or feature prices in test stores to satisfy both their immediate needs and to store until the next feature. It could also mean that since broiler prices are low relative to red meats, that price reductions accompanying a feature are not sufficient to cause a significant number of customers to switch stores just to buy broilers for variety when their regular store is featuring another meat. Further, specifically designed research is needed to determine the influence on customer loyalty of the frequency and other aspects of retailer advertising of specific items.

7/ No effort was made in this study to analyze net returns to the retailer from the various featurings of meat.

Table 2.--Weekly features of meat in 12 sample stores of 2 retail food organizations in Dayton and Columbus, Ohio, during six 1-week test periods, August 20-October 10, 1962

Meats	Features offered in the 6 weeks	Average linage per feature 1/	Average percentage price was reduced for leading cut advertised	Average display area per store during feature	Increase in display over non-feature weeks
	Number	Square inches	Percent	Square feet	Percent
Broilers............	5	58	29	20	21
Beef...............	8	111	2/ 30	48	28
Pork...............	6	56	27	29	18
Turkey.............	2	79	37	13	138
Stewing chicken....	1	52	14	4.6	151

1/ Pictorial illustrations included in measurement of advertisement.
2/ Three of the 8 beef features included baby beef with chuck and ground meat priced at 39¢ per pound. Price reductions were computed from regular baby beef prices.

APPENDIX

Procedure for applying the multiple regression technique to derive coefficients like those reported from this study can be easily located in standard statistical text books. Methods for refining these estimates by removing the influence of subclass or store differences will not be as readily found. For this reason, a brief discussion is provided here to show how data can be corrected for sales differences that are associated with sampling units or time intervals, but not with the particular quantitative variables under study.

The object of this analysis was to determine the influence of selected merchandising factors on broiler sales within individual stores; that is, explain the variation in sales from week-to-week within stores rather than between stores. It was recognized that sales volumes differ among retail food stores despite their similarity in size, surroundings, and merchandising practices. Without removal, such differences, whatever their causes, would be confounded with the derived estimates of the sales effect of quantitative variables (merchandising and promotional practices) under study. Consequently, coefficients (quantitative estimates of sales effects) were purposely refined to reflect only sales associated with these factors within each of the stores so they would be more applicable to the standard supermarket.

This refinement was accomplished by correcting the data for the variation associated with each test store. The residual sum squares and sum products were then partitioned by the components that showed significance and into random error. This correction provided that the particular sales levels of a sample store would not be confounded with estimated sales effects of price and advertising linage change, both of which were common to all stores in each city. Display area and dollar sales volume, which differed among stores, were also analyzed relative to the mean display area and volume of each store during the 6 weeks and not from the overall mean of all 12 stores.

The correction for recognized subclass differences can be accomplished in several ways. If desk calculators are to be used, covariance corrections can be made for the variations associated with each subclass, or stores in this case, and the multiple regression analysis made on the residual sums of squares and cross products. 1/ The same refinement can be accomplished on electronic computers by a program that will compute the deviations from subclass means and likewise run the analysis on residual sums. Either method will make corrections for all subclasses.

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1/ Snedecor, George W., Statistical Methods. Ames, Iowa, State College Press, pp. 427-428, 1956, or Henderson, Peter L., Brown, Sidney E., and Hind, James F. Nonquantified Adjustment of Seasonality in Time Series Data, accepted for publication in a forthcoming issue of the Jour. Adver. Res.

The use of "dummy" or "zero-one" variables for subclasses 2/ will make the same corrections provided that in the program all subclass variables are treated as significant. This method has the advantage of yielding coefficients for each subclass or the extent that each subclass differs from the overall mean, if there is a desire to identify the sales level of each subclass. However, without the restriction that all subclass "dummies" be treated as significant, only subclasses that are significantly different would be isolated. Coefficients for quantitative variables will then not be the same as for the first two methods since there will be confounding of nonsignificant subclass variables.

In the study reported here, the sales level characteristic of each store were considered important from the standpoint of obtaining estimates of the influence of merchandising practices on sales within the stores. Thus, the regression equation took the form of:

$$Y_{ij} = \bar{y} + S_j + b_1 (X_{1ij} - \bar{x}_1) + b_2 (X_{2ij} - \bar{x}_2) \ldots$$
$$\ldots + b_n (X_{nij} - \bar{x}_n) \pm Z$$

where sales, y, in the ith week and the jth store is a function of the mean sales, $\bar{y}$, of all stores in the sample plus the constant term, S, for the sales level peculiar to the jth store plus the regression coefficient, b_1, times deviation of the observed value of the X_1 variable in the ith week and j^{th} store from the mean value of this variable for all stores plus the corresponding contributions of the changes in each of the other important sales practices, 2-n, and plus or minus the random error term Z.

While it was not the objective of this study to report the amounts by which stores differed in volumes, the S terms, these values have been removed from the equation, hence removed from the estimates of the relationships between sales and selected sales practices within stores.

The desk calculator method was used in this study to partition the direct and combined effects of the 4 variables found to be significant by electronic computers. The percentage of broiler sales variation explained by each significant merchandising and advertising variable was obtained by inverting the matrix four times and placing each significant variable last in one of these inversions. Thus, each variable was individually adjusted for the covariance of the other significant variables, which had preceded it. The difference between the total variation in sales explained by the regression analysis and the sums of individual contributions is an estimate of amount of variation explained by the joint action of the significant factors.

In this case, it was more practical to obtain direct efforts by this means than to construct a special electronic computer program for this purpose.

2/ Tomek, William G. Using Zero-One Variables with Time Series Data in Regression Equations. Jour. Farm Econ. Vol. 45. No. 4, Nov. 1963, pp. 814-822.

Suits, Daniel B. Use of Dummy Variables in Regression Equations. Jour. Amer. Statis. Assoc. Dec. 1957, pp. 548-551.