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Food Cost Variations

Implications for the Food Stamp Program

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ABSTRACT

Differing supermarket prices and household purchase practices affect real food stamp benefits. Within cities, supermarket prices typically vary by up to 7 percent, with extremes of up to 25 percent. Price differences do not show regional patterns. Instead, price differences are store-specific and reflect store costs, neighborhood characteristics, and company strategies. Low-income households do not necessarily pay higher food prices. Actual household purchase practices differ from Government recommendations and raise household food costs by 5 to 8 percent over the cost of the recommended diet.

Keywords: Food Stamp Program, Thrifty Food Plan, supermarkets, food prices, Standard Metropolitan Statistical Areas

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SUMMARY

Differing supermarket prices and household purchase practices affect real food stamp benefits. Within cities, supermarket prices typically vary by up to 7 percent, with extremes of up to 25 percent. Price differences do not show regional patterns. Instead, they are store-specific, reflecting store costs, neighborhood characteristics, and company strategies. Low-income households do not necessarily pay higher prices. Actual household purchase practices differ from Government recommendations and raise household food costs 5 to 8 percent over the cost of the recommended diet.

Warehouse stores in our study had the lowest price indexes, falling 10-20 percent below conventional supermarkets. Warehouse store prices pressured competing conventional supermarkets to reduce their prices, on average, by 2-4 percent. A supermarket firm's extent of vertical integration also affected prices. Extensively integrated firms (those that own their buying and distributing facilities) had 2 percent lower price indexes than other supermarkets. Other cost factors, such as insurance costs, store access, and the amount of services offered, also affected store prices.

Indexes for the Government's Thrifty Food Plan (TFP) were higher in locations where high proportions of the population were without a car. Holding car-ownership constant, income was positively associated with food prices: higher income areas tended to pay higher prices for food.

Central city stores had higher prices than other stores in the Standard Metropolitan Statistical Areas (SMSA's) because of a clustering of high-cost stores (no vertical integration, high insurance, difficult access for stocking) in the central city. Income was not associated with the higher prices in central city stores because stores in the city's low-income neighborhoods did not have higher prices than elsewhere in the city. Food prices varied enough across stores to suggest that households with large food expenditures can benefit from comparison shopping.

This report compares the actual food purchase practices of food stamp households with those recommended in the Thrifty Food Plan. Actual consumption in some categories (particularly meat, poultry, and fish, and sugars and sweets) exceeded TFP recommendations, with lower actual purchases in other categories (particularly cereals; citrus fruit and vegetables; and milk, cheese, and ice cream). In 1982, actual consumption patterns raised the cost of a market basket of food by about 9.5 percent over the cost of what was recommended in the TFP market basket. However, 1983 revisions have moved the TFP allocation closer to actual purchase practices.

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Implications for the Food Stamp Program

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INTRODUCTION

Participation in food assistance programs has increased along with annual expenditures, which rose over $11 billion in 9 years, to 19 billion by 1985 (table 1). The Food Stamp Program (FSP), one of the largest food assistance programs administered by the Food and Nutrition Service (FNS), U.S. Department of Agriculture (USDA), has accounted for at least 61 percent of total food assistance expenditures since 1979.

Table 1--Total food assistance and Food Stamp Program expenditures, participation, and share of total expenditures 1/

Fiscal year (Oct.-Sept.)	Food Stamp Program: Average number of participants	Food Stamp Program: Total Federal cost 2/	Total food assistance program expenditures, including adminstrative costs	Food Stamp Program share
	Million persons	$Million 3/	$Million 3/	Percent
1976	17.0	5,146	7,667	67.1
1977	15.6	4,831	7,827	61.7
1978	14.4	4,802	8,312	57.8
1979	15.9	6,166	10,383	59.4
1980	19.2	8,354	13,408	62.3
1981	20.6	10,325	15,747	65.6
1982	20.3	10,851	15,589	63.1
1983	21.6	11,863	18,523	64.2
1984	20.9	11,595	18,819	61.6
1985	19.9	11,717	19,132	61.2

1/ Excludes Puerto Rico.
2/ Includes State matching funds and other costs, such as coupon printing.
3/ Rounded.

Sources: Computed through 1981 from tables 1, 1a, and 16 in (32), and computed for 1982-85 from tables A and B in (33). The 1985 data are preliminary.

This report examines if the differences in food prices across cities and FNS administrative regions are large enough for the Government to consider using regional price indices in allocating food stamp benefits. This report also explores what factors influence differences in food prices among supermarkets (within and among regions), especially factors relating to household purchase practices and the kind and location of supermarkets, paying special attention to food prices paid by households in low-income areas. Recognizing these factors can help households minimize food costs by becoming more effective buyers.

Determining the relative cost by area of a market basket combination of purchased food provides the figures needed to adjust the value of food stamps--perhaps to meet regional needs--thus making benefits more equitable and possibly saving program funds (the amount saved will depend on the regional distribution of participating households and the size of the regional cost variation).

This report examines if the Food Stamp Program is horizontally equitable (that is, equally needy households receive equal benefits), by analyzing participant purchase practices and market basket (combination of purchased foods) cost differences by supermarket (kind and location), Standard Metropolitan Statistical Area (SMSA), and FNS administrative region according to the Thrifty Food Plan (TFP, benchmark costs for specified households) and corresponding market basket costs for the TFP, adjusted according to what the USDA's Nationwide Food Consumption Survey (NFCS) showed participants actually bought.

PROGRAM-RELATED QUESTIONS

This report examines the FSP and its contribution to the participants' nutrition.1/ This report also examines market basket cost differences by kind and location of supermarket, and explains these differences among sample supermarkets.

Horizontal Equity Among FNS Administrative Regions

Horizontal equity requires that equally needy households receive equal benefits. Issuing equally valued food stamps to equally needy households does not guarantee equal purchasing power (real benefits). Households paying higher prices receive lower real benefits than those paying lower prices when food prices vary substantially among or within regions.2/ Rizek's statement represents a continuing concern over equity in FSP administration (29, pp. 59-60):

> Two types of "equity" might then be defined. The first...is the vertical shift of program participants' food purchasing power...the equal treatment of equals...Equal benefits made available to the equally needy.

1/ For additional evaluations of the FSP's effects on the economy, see (2, 6, 18, 21, 30) which treat eligibility regulations; the extent eligible households participate in (5, 8, 23); contribution to nutritional status in (12, 14, 25, 27); and the program's design and execution in (9, 10, 13, 15, 29). Underscored numbers in parentheses refer to literature cited in the References section.

2/ Administrative and economic regions are rarely coincidental with respect to economic composition or geographic boundaries. For FNS administrative regions, there is no evidence of coincidence for either.

By using specified food market baskets, where kinds and quantities of food are kept constant, prices paid is the single source of basket cost variation. To find if the Food Stamp Program is horizontally equitable across regions, this report examines:

- o If issuing the same food stamp dollar benefits to equally needy households within each of the seven FNS administrative regions results in real purchasing power equity across them, and

- o If continued reliance on national Bureau of Labor Statistics (BLS), U.S. Department of Labor, price indexes, to update benchmark expenditures data, yields horizontally equitable results.

Household Purchase Practices

The Food Stamp Program is designed to enhance the purchasing power of participating households enough for each household to buy foods for an adequate nutritional diet. The Government's Thrifty Food Plan (TFP) specifies 15 food groups that participants should include in their market basket, thereby providing nutritional guidance, sample budgets for food stamp beneficiaries, and a basis for allocating benefits. The BLS indexes are used to compute food stamp benefits.

Benchmark expenditures from food consumption surveys provided the cost of the TFP for specified household compositions (used to compute their food stamp benefits). A quadratic mathematical programming model provided the required economic constraints. Expenditures data are updated between benchmark years by applying BLS national food price indexes.3/ This study examines costs for the contiguous 48 States.

This report uses 1982 data and TFP quantities. In 1983 the TFP was revised. The 1983 revisions: transferred tomatoes and dark green and deep yellow vegetables to a newly created high-nutrition foods group; increased the allocation (pounds assigned) to the meat, poultry, and fish group; and decreased allocations assigned to other vegetables and fruit, fats and oils, sweets, other bakery products, and accessories. The 1983 revisions should not affect the relative 1982 relationships found across regions and SMSA's. But the revisions do have implications for the size of the 1982 difference in absolute cost between certain market baskets.

Data from the most recent (1977-78) NFCS allow comparisons between what the TFP suggests is an adequate diet and what the food stamp households actually purchased. Although differences exist in total pounds purchased and in the composition of the market baskets, we kept total pounds of food in each basket constant in order to focus on differences in the composition of baskets across the TFP's 15 food groups. Quantities purchased differed only in the allocation of food among the TFP's 15 food groups.

To compare basket costs, this report examines:

- o For the same weight of food purchased, did the food stamp households spend more when selecting among the 15 food groups according to their

3/ USDA's Human Nutrition Information Service (HNIS) reassigns the items composing its 15 TFP food groups to fit the food group codes used by BLS. HNIS then uses the BLS index to update the TFP's cost and value of food stamp benefits.

food preferences (NFCS market basket) than when buying the TFP market basket?

- Did the NFCS food market basket cost show the same geographic variation as in the TFP basket?

Kinds and Locations of Supermarkets

Earlier studies have compared prices of independent and chain stores located in high- and low-income areas, but these studies had very limited samples, with small numbers of communities, stores, and items (3, 22, 30, 35). None assessed the extent and impact of vertical integration.

For this portion of our study, the sample includes 322 supermarkets in 10 SMSA's, with varying degrees of vertical integration. Many are located outside the political boundaries of their principal central city and in varying sized communities, including several in villages. But,

- To what extent are the variations in TFP market basket cost associated with the degree of vertical integration of supermarkets?

- Are TFP costs higher in supermarkets located in the SMSA's principal central city than in those located in residual areas of the SMSA?

- Are TFP costs higher in stores in low-income neighborhoods than in other stores in the SMSA?

Market Basket Cost (Price) Variations Among Supermarkets

This cross-section study analyzes differences in food market basket costs for 322 supermarkets in 10 SMSA's.4/ The computed market basket values are weighted price indexes, ranging from 72.4 to 117.4 (100 represents each basket's national average cost). When analyzing market basket costs, we ascertain variation in indexes, identify variables which explain observed differences, and assess their comparative importance. The regression is not used for forecasting.

Most such structure-performance studies focused on establishing relationships between company profits and the market structures in which they operated (15).5/ Market structure variables were examined to determine whether they help explain observed differences. However, accounting profits may not adequately represent economic profits, and structural variables may reflect cost and price differences. This report directly analyzes pricing.

Economic theory provides only a broad guide to the selection of explanatory variables. Variable choices were determined by data availability, correspondence to theory, and use in the industry. Variables are categorized as specific to supermarkets (such as occupancy costs), components of the markets in which supermarkets operated (such as the number of supermarkets in same trading area), and

4/ Although the prices were collected three times, each about a month apart, the data were averaged to provide a single observation. The study is, therefore, cross-sectional, not longitudinal.

5/ Exceptions in food retailing are (6), which focuses on price differences and their link to market concentration in local Vermont markets, and (16), which analyzes price differences for stores in three chains in 35 SMSA's.

characteristics of patron households residing within the supermarket's immediate trading area (such as number of households with a car).

STATISTICAL PROCEDURES

This section presents the study's data base, statistical design, the market basket concept, and the basic procedures for computing food market basket indexes. See appendix 1 for quantitative illustrations.

Data Base

The prices collected for this study, and continuing USDA data collections, provided prices, wage rates, store services, building characteristics, total sales, food sales, and food stamp redemptions. Other data include socioeconomic characteristics for each zip code area in which a sample supermarket is located and burglary/theft insurance rates.6/ Additional sources were used for actuarial data relating to the cost of robbery/burglary insurance, utility and transportation costs, and so on.

Statistical Design

In 1975, 203 SMSA's had at least 150,000 people. The combined market share of total sales for the four largest retail food marketing firms (four-firm concentration) was computed for each of the 203 SMSA's. These SMSA's were then categorized by range of concentration: less than 40 percent, 40-49.9 percent, 50-59.9 percent, and at least 60 percent. Using this stratification, there were 44, 74, 47, and 38 SMSA's in the respective strata, from which 7 per stratum were selected randomly, yielding a sample of 28 SMSA's. The probability of selection from a concentration category was based on SMSA population. Each SMSA's supermarket universe included limited assortment, box, warehouse stores, and the typical supermarket. Convenience stores, delicatessens, and specialty foodstores were excluded from the sample.

Supermarkets in each SMSA were selected randomly from a list provided by Progressive Grocer (24). For each of an area's six leading firms, 1 supermarket was selected if the parent firm operated 1-4 stores within the SMSA, 2 were selected if it operated 5-10 stores, and 3 were selected if it operated at least 11. One additional supermarket also was selected for each of the remaining firms (not necessarily a multi-establishment firm) with at least 1 percent of market sales. Five more supermarkets were randomly chosen from all remaining

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6/ Under a contractual arrangement, the Claritas Corporation provided the socioeconomic characteristics for zip codes (4). One of their series was identified as zip quality score. Because this score combines economic and cultural characteristics such as type of profession, the series in this study has been renamed zip code area socioeconomic index. The burglary/theft insurance rates were obtained from the Federal Crime Insurance Program; and Tillinghast, Nelson, and Warren, Inc. Each supermarket's immediate trading area was defined as its zip code area. Resources were not available to precisely identify the total trading area for each sample supermarket. However, zip code areas typically are large enough to encompass residences of patrons who walk, and most who drive, to the to the supermarket.

firms, with no more than one per firm.7/ Thus, there were a minimum of 11 firms per SMSA in the sample.

Supermarkets in the 28-SMSA sample were used to make comparisons among metropolitan areas and FNS administrative regions.

The Market Baskets

The quantities of food purchased in a market basket serve as weights when computing a food cost index. Use of multiple market baskets permitted analysis for five- and two-person households with differing age and sex compositions. The two-member household had one male and one female, both age 65 and older. The five-member household had one male and one female between 20 and 54 years, one female age 12, one male age 17, and one child age 3 (data do not provide gender for children below 4 years old). The two-person household was chosen because about half of all food stamp households had one or two members during 1975-80. About 40 percent of all food stamp households had three to five members during this period (34). The five-person household was chosen because it assured multiple age and sex representation by including a young child and two older children.

Four market baskets were constructed for these household groupings (two for each household size). One basket represented the actual purchase patterns of food stamp households, as reported in the NFCS survey, while the other basket represented the TFP market basket specified by HNIS nutritionists. The TFP basket contained the pounds for each of the 15 food groups. The NFCS basket held equal total pounds as the TFP, but the distribution among food groups differed. Table 2 presents weekly pounds for each basket.

Procedures for computing each of the four baskets are identical. Cost differences among baskets reflect different weights assigned to food groups and different item selections made by households.

Comparing Market Baskets Among the 28 SMSA's and the 7 FNS Administrative Regions

The four market baskets were computed to compare horizontal equity among the seven FNS regions and their SMSA's. Additional procedures were used for supermarkets in the 10-SMSA sample to investigate cost differences among types and locations of supermarkets.

Procedure 1: Item Sampling for Collecting Prices in Each Supermarket

Items within brand categories (national, private label, generic, and unbranded) were priced in proportion to their relative importance among all items stocked by all U.S. supermarkets during the study period. Sales data for individual products were classified into detailed product subcategories containing only one container size, product type, and flavor. We then randomly selected individual subcategories with replacements, with the probability of selection based on the subcategories' share of sales. We then estimated the number of

7/ The sampling procedure provided replacement supermarkets for those refusing to participate, and for supermarkets which had ceased to be in business between the time Progressive Grocer's list was compiled, and the time the price survey was conducted.

items expected to be found in a typical supermarket. The item sampling in the subcategory proceeded at random until the target number of items was reached. Stratified sampling ensured the number of items for each supermarket department was proportional to the department's share of store sales. Field tests confirmed that subcategory descriptions contained only one type of product, flavor, or package size, and that the estimated item count met predetermined targets.

Procedure 2: Computing the Weighted Mean TFP Food Price

All items were classed according to the TFP food groups, and all prices were converted to prices per pound. For example, the TFP food group 01 (milk,

Table 2--Weekly food purchases of five- and two-person households: Weights for TFP and NFCS market baskets

Household, code, and food group		TFP basket	NFCS basket
		Pounds	
Five-person household:			
01	Milk, cheese, and ice cream	41.60	36.89
02	Meat, poultry, and fish	10.54	20.02
03	Eggs	2.29	2.60
04	Dry beans, peas, and nuts	1.70	1.53
05	Potatoes, white (including processed potatoes such as chips)	7.73	6.91
06	Citrus fruit and tomatoes	8.02	5.03
07	Dark green,deep yellow vegetables	1.85	1.79
08	Other vegetables and fruit	16.40	22.36
09	Flour	3.71	3.59
10	Cereals (including pasta)	4.52	1.44
11	Bread	8.49	6.02
12	Other bakery products	4.83	3.95
13	Fats and oils (including butter)	3.41	1.53
14	Sugar and sweets	3.96	6.01
15	Accessories	6.10	5.48
	Total	125.15	125.15
Two-person household:			
01	Milk, cheese, and ice cream	11.23	13.27
02	Meat, poultry, and fish	4.29	7.20
03	Eggs	1.00	.95
04	Dry beans, peas, and nuts	.44	.54
05	Potatoes, white (including processed potatoes such as chips)	3.01	2.47
06	Citrus fruit and tomatoes	3.87	1.80
07	Dark green, deep yellow vegtables	1.11	.63
08	Other vegetables and fruit	7.50	8.05
09	Flour	1.48	1.30
10	Cereals (including pasta)	2.21	.49
11	Bread	3.20	2.16
12	Other bakery products	1.70	1.44
13	Fats and oils (including butter)	1.16	.54
14	Sugar and sweets	1.39	2.16
15	Accessories	1.39	1.98
	Total	44.98	44.98

cheese, and ice cream) contained items sold in gallons, quarts, and half pints. The price for a gallon of milk was converted to cents per pound by multiplying it by the conversion factor 0.1163 (app. table 3).

Procedure 3: Computing a Price-Relative Index for Each Item and Food Group

We needed to compute individual supermarket indexes for each item before computing the TFP because of missing items. Price comparisons of a basket of products becomes confounded when a supermarket fails to stock all the basket's items. If the basket prices are simply summed, the supermarket with the fewest items will probably have the smallest sum, regardless of its pricing policies. A common procedure for missing items is to impute the average price of the item in stores that carry it. We used an alternate approach. Rather than assume an average price, we assumed that the missing item would have been priced higher or lower than the average by the same proportion as the items that the supermarket carried. Therefore, prices were converted to price-relative indexes.

A price relative was the unit price (by pound, gallon, or quart) of a product (same brand type, package size, and flavor) in a single supermarket, divided by the all-supermarket average unit price for like items. The quotient multiplied by 100 yielded index units.

Procedure 4: Computing a Weighted Index for a Supermarket for a Specified TFP or NFCS

Table 3 computes the TFP index for a single supermarket. Column 1 represents the pounds of foods (1 week's quantity) for each food group stipulated by the TFP for a five-person household. Column 3 provides the data used to compute the TFP food group weights (col. 4), which were then applied to the price relative (col. 5) computed for procedure 3 above. The figures in column 4 result from dividing the individual food group figures of column 3 by their 15-food group total. For example, the weight for food group 01, milk, cheese, and ice cream (21.22/108.61), equals the 0.1954 appearing in column 4.8/ Column 6 presents the weighted individual food group value for the 15 TFP food groups. The column's total is the TFP index for an individual supermarket. For example, the 106.17 index means that this particular supermarket's market basket is 6.17 index points greater than the mean for all 28 SMSA's.

Procedure 5: Computing the SMSA Market Basket

Individual supermarket basket indexes must be combined to represent the entire SMSA; and SMSA indexes must be comparable with each other. SMSA averages are weighted averages of the individual firms, where each firm's weight is proportional to its share of market sales in the SMSA. The initial sample contained only firms, so weights for individual supermarkets of a leading firm equaled that firm's market share divided by the number of supermarkets the firm operates in that SMSA. For each sample supermarket's weight, we divided the combined market shares of nonleading firms' by the number of supermarkets selected to represent these firms.

8/ If a store did not stock an item for a price collection, then columns 3 and 4 were normalized by omitting the product of column 1 and column 2 [(1)(2)] in column 3, and dividing the adjusted sum into each of the other items. For example, when normalizing the meat, poultry, and fish group, 108.61 becomes 84.79, and the column 4 figure equals 0.2503 instead of 0.1954.

Table 3--Weights and prices used in computing a food market basket for a single supermarket

Plan, code, and food group	(1) Weight	(2) All-SMSA mean price	(3) [(1) (2)]	(4) (3) Item / (3) Total	(5) 28-SMSA-based price index, store A	(6) [(4) (5)]
Thrifty Food Plan:	Pounds	Dollars			Index	
01 Milk, cheese, and ice cream	41.60	0.51	21.22	0.1954	103	20.13
02 Meat, poultry, and fish	10.54	2.26	23.32	.2193	105	23.03
03 Eggs	2.29	.77	1.76	.0162	115	1.86
04 Dry beans, peas, and nuts	1.70	1.23	2.09	.0192	87	1.67
05 Potatoes, white (including chips)	7.73	.24	1.86	.0171	112	1.92
06 Citrus fruit and tomatoes	8.02	.86	6.90	.0635	109	6.92
07 Dark green, deep yellow vegetables	1.85	.65	1.20	.0110	150	1.65
08 Other vegetables and fruit	16.40	.88	14.43	.1329	101	13.42
09 Flour	3.71	.19	.70	.0064	90	.58
10 Cereals (including pastas)	4.52	.87	3.93	.0362	94	3.40
11 Bread	8.49	.47	3.99	.0367	110	4.04
12 Other bakery products	4.83	1.90	9.18	.0845	118	9.27
13 Fats and oils (including butter)	3.41	2.27	7.74	.0713	130	9.27
14 Sugar and sweets	3.96	.27	1.07	.0100	98	.98
15 Accessories	6.10	1.43	8.72	.0803	100	8.03
Total	125.15	NA	108.61	1.0000	NA	106.17
NFCS food stamp household proxy:						
01 Milk, cheese, and ice cream	36.89	.51	18.81	.1568	103	16.15
02 Meat, poultry, and fish	20.02	2.26	45.25	.3772	105	39.61
03 Eggs	2.60	.77	2.00	.0167	115	1.92
04 Dry beans, peas, and nuts	1.53	1.23	1.88	.0157	87	1.37
05 Potatoes, white (including chips)	6.91	.24	1.66	.0138	112	1.55
06 Citrus fruit and tomatoes	5.03	.86	4.33	.0361	109	3.93
07 Dark green, deep yellow vegetables	1.79	.65	1.16	.0097	150	1.45
08 Other vegetables and fruit	22.36	.88	19.68	.1640	101	16.56
09 Flour	3.59	.19	.68	.0057	90	.51
10 Cereals (including pasta)	1.44	.87	1.25	.0104	94	.98
11 Bread	6.02	.47	2.83	.0236	110	2.60
12 Other bakery products	3.95	1.90	7.51	.0626	118	7.39
13 Fats and oils (including butter)	1.53	2.27	3.47	.0289	130	3.76
14 Sugar and sweets	6.01	.27	1.62	.0135	98	1.32
15 Accessories	5.48	1.43	7.84	.0653	100	6.53
Total	125.15	NA	119.97	1.0000	NA	105.63

NA = Not applicable.

These individual supermarket weights were multiplied by the individual supermarket TFP index. The products, summed and then divided by the sum of the weights, yielded the SMSA index.

When supermarket A's index of 106.17 was weighted and combined with all other sample supermarkets of its SMSA, the SMSA index became 105.6. This index then may be compared with corresponding indexes for the other 28 SMSA's. The SMSA indexes also may be aggregated and averaged among FNS administrative regions for regional comparisons.

Comparing Supermarkets by Kind and Location

In 10 of the 28 sample SMSA's (10 with the highest sales), additional supermarkets were randomly selected from zip code areas where incomes of at least 20 percent of the households were at or below the poverty level. Each of the original and added supermarkets then was classified according to location and extent of functional integration (table 4). We started with 16 categories: 4 levels of vertical integration, 2 income levels, and 2 location categories (central city and residual SMSA). These were later collapsed to 12 categories.

Computational Procedures

To illustrate the assignment procedure used in allocating individual supermarkets to the cell among the 16 location and integration cells (table 4), consider a supermarket located outside the SMSA's central city, and in a zip code area with 20 percent or more households at or below the poverty level. This supermarket's firm owned neither buying nor distribution facilities. Characteristics of this supermarket match those of cell 9 (low-income, residual SMSA, without functional integration). Then consider a supermarket located in a zip code area with under 20 percent of its households at or below the poverty level in the SMSA's central city, whose parent firm owns multiple buying and

Table 4--Location and functional integration categories for supermarkets in each SMSA

Location in SMSA	Functional integration for self-provided facilities			
	None	Only buying	At least one buying and distributing	Multiple buying and distributing
			Cells	
Central city:				
Low income	1	2	3	4
Greater than low income	5	6	7	8
Residual SMSA:				
Low income	9	10	11	12
Greater than low income	13	14	15	16

distribution facilities. Characteristics of this supermarket match those of cell 8.

To classify supermarkets according to these 16 cells for the 10 SMSA's, the original weighting system was adjusted to incorporate the cell weights. The sum of the 16 cell weights was set at 100. The weight of each cell is the proportionate share of total supermarket sales made by its constituent supermarkets.

For example, assume cell 8 accounted for 30 percent of its SMSA's total supermarket sales. Assume there were six supermarkets in cell 8: one supermarket owned by a leading firm, another owned by a competing leading firm, and four remaining firms which were neither leading nor multi-establishment firms.9/ Sales of the first leading firm accounted for 60 percent of the cell's 30-percent share, sales of the second leading firm accounted for 30 percent, and the four remaining firms combined to account for 10 percent (note that the sum of the individual supermarkets' share of the cell's sales must equal 100).

Each supermarket's weight was a function of its firm's weight. Each firm always has a weight of 1, distributed evenly among its supermarkets. Therefore, both leading firm 1 and leading firm 2 of cell 8 had a weight of 1. The remaining firms were weighted as if they were linked to a single firm, so 1 was distributed evenly to each (because there were four firms, each of those supermarket's weight was 0.25).

From these figures, we obtained individual supermarket weights and applied them to the originally computed individual supermarket indexes (as described by the five procedures described above). The computation for the first leading firm was (0.60)10/ (1.0)11/ (0.30)12/ = 0.1800; for the second leading firm, (0.30) (1.0) (0.30) = 0.0900; and for each of the four remaining firms, (0.10) (0.25) (0.30) = 0.00750.

These weights then were applied to the individual supermarket indexes using procedures 1 through 5. Table 5 illustrates the computation for our hypothetical cell 8. The weighted index obtained is 107.78 (column 5). The weighted index for the supermarkets composing this cell averaged 7.8 index points higher than the mean for all supermarkets, irrespective of cell location.

PROGRAM-RELATED ANSWERS

We use cost differences for four food market baskets (TFP and NFCS for five- and two-person households) to assess the extent of horizontal equity among the seven FNS administrative regions, to compare household purchase practices, and to investigate the association between market basket costs and the kinds and locations of supermarkets. This discussion emphasizes the TFP five-person basket, while referring to the other baskets when important differences arise.

9/ In this context, any firm accounting for at least 10 percent of its cell's total supermarket sales was designated a leading firm in the stratum. In the initial sampling for the 28 SMSA's, any one of the six firms in rank order of sales was designated as a leading firm in the SMSA.

10/ Firm's proportionate share of cell weight.

11/ Sample supermarket's share of its firm's weight.

12/ Cell's proportionate share of total supermarket sales in its SMSA.

Table 5--Weighted index for hypothetical stratum, cell 8

(1) Stratum and supermarket	(2) Individual supermarket index	(3) Computed weights	(4) [(2) (3)]	(5) Weighted index: (4)/(3)
Central city:				
Lead firm 1	106.17	.1800	19.1106	NA
Lead firm 2	110.00	.0900	9.9000	NA
Greater than low-income:				
All other firms--				
3	115.00	.0075	.8625	NA
4	125.00	.0075	.9375	NA
5	100.00	.0075	.7520	NA
6	103.00	.0075	.7725	NA
Total	NA	.3000	32.3331	107.78

NA = Not applicable.

Horizontal Equity Among FNS Administrative Regions

Collecting separate price indexes for each FNS region will improve horizontal equity only if the separate regions have clearly different price levels. We are more likely to observe such differences in regional prices if store prices differ more across than within regions. This section explores the magnitude of such variations in price indexes within and across FNS regions.

Statistical Treatments and Results

Table 6 presents the TFP indexes by SMSA for the five- and two-person households. The five- and two-person baskets' ranges are each 15.4 percentage points, while the interquartile ranges, covering the 25th to the 75th percentiles in each sample SMSA, are 5.4 and 4.6 percentage points. Coefficients of variation are 3.8 percent for the five-person household and 3.6 percent for the two-person household.13/ While average price levels clearly differ across SMSA's, these variations fall far short of corresponding ranges found for durable goods and personal services (33).

Table 7 represents regional averages, taken across component SMSA's. The Northeast had the lowest regional average for the five- and two-person households (97.3 and 97.6), while the Southwest had the highest (103.9 and 103.6).

In comparing the five- and two-person baskets, each basket's national index costs serve as its index base and thus equal 100. Therefore, both baskets do

13/ A distribution's coefficient of variation is the mean's percentage of its standard deviation.

Table 6--TFP market basket cost indexes for five- and two-person households

FNS region and SMSA		Market basket cost: Five-person household	Market basket cost: Two-person household
		Index	
1	Boston, MA	98.2	98.7
	New York, NY	104.8	104.8
	Portland, ME	89.4	89.4
2	Paterson, NJ	101.0	101.6
	Jersey City, NJ	99.5	100.0
	Philadelphia, PA	95.3	96.0
	Pittsburgh, PA	101.7	102.4
	Huntington, WV	100.0	100.0
3	Atlanta, GA	104.6	104.1
	Ft. Lauderdale, FL	100.3	99.7
	Jackson, MS	104.5	103.8
	Miami, FL	94.4	93.9
4	Akron, OH	97.2	97.6
	Detroit, MI	103.0	102.5
	Madison, WI	95.8	96.3
	Youngstown,OH	95.6	96.0
	Evansville, IN	100.3	100.1
5	Albuquerque, NM	102.7	102.0
	Baton Rouge, LA	104.2	104.0
	Houston, TX	104.7	104.1
	Tulsa, OK	103.9	104.1
6	Denver, CO	103.1	102.7
	St. Louis, MO	98.4	98.4
	Springfield, MA	96.5	96.4
7	Las Vegas, NV	101.7	101.6
	Los Angeles, CA	101.0	100.9
	San Diego, CA	99.7	99.6
	Santa Cruz, CA	98.9	99.3

Table 7--Regional indexes for five- and two-person household TFP baskets

FNS region	Five-person household	Two-person household
	Index (nationwide average cost = 100.0)	
Northeast	97.33	97.63
Mid-Atlantic	99.50	100.00
Southeast	100.95	100.38
Midwest	98.38	98.50
Southwest	103.88	103.55
Mountain-Plains	99.33	99.17
West	100.33	100.35

not necessarily have identical absolute dollar average costs. The two-person household basket has fewer pounds of food than in the five-person basket, and the pounds were distributed differently among food groups. Therefore, five- and two-person baskets are compared by their relative variability across regions and SMSA's.

Table 8 shows standard deviations of the food basket index distributions in and among regions. Each basket's standard deviations for five of the seven regions exceeded the average. A large portion of the total index variance occurs within regions.

The analysis of variance (ANOVA) confirms that there is no statistically significant difference among regions in the index value of the market baskets for five- and two-person households. ANOVA computations for each market basket produced F statistics of 1.20 (randomly occurs 34 out of 100 times) and 1.03 (randomly occurs 43 out of 100 times). We evaluated the findings at the 5-percent significance level; that is, statistically significant if the F statistic occurs by chance no more than 5 out of 100 times.14/

TFP indices differ among supermarkets and SMSA's, but not systematically among FNS administrative regions. That is, store prices vary more within regions and within SMSA's. Horizontal equity is unlikely to be advanced by substituting regional for national BLS price indexes, because regional effects were only a small portion of price differences among supermarkets and SMSA's.

Household Purchase Practices

This section examines purchase practices for the 1982 TFP and NFCS baskets. The HNIS 1983 revisions reduced the differences found in the 1982 five-person comparisons largely because the revisions included a 35.7-percent increase in the TFP pounds assigned to the meat, poultry, and fish group, thus bringing TFP allocation closer to that preferred by food stamp households in the NFCS.15/

There were important differences between the NFCS and TFP baskets among the 15 food groups. The TFP basket for five-person households allocated 41.60 pounds per week for the milk, cheese, and ice cream group, while the NFCS basket allocated 36.89 pounds. The TFP assigned 10.54 pounds per week for the meat, poultry, and fish group, while NFCS households chose 20.02 pounds, 89.9 percent over the TFP basket. Of the remaining 13 food groups, each of which exhibited

14/ Corresponding coefficient of variation and ANOVA computations were conducted for the NFCS five- and two-person market baskets. The coefficient of variation was 3.8, and the computed F statistic could occur by chance 24 out of 100 times.

15/ We used the 28-SMSA average price per pound for cost comparisons for each food group. This mean unit price for each food group was multiplied by the corresponding food group pounds to derive the food group cost. The sum of the costs for the 15 food groups equaled the basket cost, representing an overall 28-SMSA average. No regional comparisons were made for household purchase practices. Also, because this comparison did not use the HNIS quadratic program to determine the minimum cost of the baskets, these costs do not equal those used for determining the value of food stamps actually issued to five- and two-person households in 1982.

Table 8--Index variances within and among regions for the five- and two-person household TFP market basket

Region	Standard deviation from index mean: Five-person household	Standard deviation from index mean: Two-person household
	Percent	
Within region:		
Northeast	7.5	7.8
Mid-Atlantic	2.7	2.5
Southeast	4.9	4.7
Midwest	3.2	2.8
Southwest	.9	.9
Mountain Plains	4.7	3.2
Western	1.2	1.7
Among regions	2.2	1.9

some variation, citrus fruit and tomatoes and other fruit and vegetables (apples, cabbage, snap beans, and melons) differed the most. The TFP five-person household basket for citrus fruit and tomatoes had 37.3 percent more pounds than in the NFCS; the other fruit and vegetables had 36.3 percent fewer pounds than did the NFCS five-person household basket. The total SMSA average cost of the NFCS basket exceeded that of the TFP by 9.5 percent because of these different purchase patterns.

Household composition also affects TFP and NFCS baskets, and thus the basket costs. For the two-person household (two adults, age 65 and older), the TFP assigned 11.23 pounds for the milk, cheese, ice cream group. The NFCS's actual household preferences were 13.27 pounds, 18.2 percent more than in the TFP. For the meat, poultry, and fish food group, the two-person NFCS basket contained 67.8 percent more pounds, compared with 89.9 percent more in the five-person NFCS basket. The five-person NFCS household purchased 48.2 percent more pounds of sugar and sweets than the TFP basket allocated; the two-person NFCS household purchased 44.6 percent more. The NFCS two-person market basket cost 5.8 percent more than the corresponding TFP basket, compared with a 9.5 percent difference for the five-person households.

The NFCS household expenditures will vary from the TFP's specified food group pounds according to the composition of each food stamp household. However, data for the two- and five-person households provide a substantial range of food group selections, although not the extremes found in comparing a one-person household with the largest participating household. The data suggest that many participating food stamp households prefer to obtain their protein more from the meat, poultry, and fish group than from the milk, cheese, and ice cream food group (there may be excellent nutritional reasons for the differing NFCS choices. For example, black households prefer nondairy foods because of a greater incidence of lactose intolerance). Food stamp households purchased more from the other fruit and vegetables group than from citrus fruit and tomatoes.

The net cost of an NFCS basket of equal weight exceeds the TFP basket by 5.8-9.5 percent, depending on household composition.

Kinds and Locations of Supermarkets

Are food prices higher in central cities than in the suburbs? Do different types of supermarkets have different prices? This section calculates separate TFP and NFCS basket cost indexes for three types of supermarket locations and three categories of firm integration.16/

The data base consists of the expanded sample of supermarkets located in the 10-SMSA subset of the 28 SMSA's. The sample expansion in each of the 10 SMSA's consists of a random sample of additional supermarkets in low-income zip code areas in the principal central city's political boundaries of each of the 10 SMSA's. The *ex post* restratification assured unbiased estimates for each type of location and the survey of each supermarket's self-provided marketing functions. Strata weights were incorporated in the initial firm weight system used for the 28-SMSA sample because supermarkets from the primary sample (including several located in the low-income zip code areas) augmented the randomly added low-income area supermarkets.

Table 9 presents indexes that combine location with the extent of self-provided buying and distributing facilities. The stratum representing supermarkets in the central city (in low-income zip code areas, without any self-provision of buying offices and distribution centers) shows the mean index cost of the five-person household TFP basket was 101.6, 1.6 index points above the 28-SMSA national average cost. The corresponding NFCS basket was 100.9, 0.9 index point above the base.

Baskets cost more when bought from supermarkets in the central city than from supermarkets outside the city. The nonintegrated stores in greater than low-income central city locations, and extensively integrated stores in the residual SMSA stratum, had the greatest variation (7.7 percent) for the five-person household basket. The lowest variation (1.8 percent) was between the NFCS baskets from nonintegrated supermarkets in the low-income central city and the residual SMSA strata.

Table 9's mixed results dispute the conventional view that food purchased from supermarkets located in low-income areas always costs the most. The TFP and NFCS baskets purchased in nonintegrated supermarkets cost less in low-income

16/ A supermarket may be located in the central city of its SMSA, either in a low- or a higher than low-income zip code area; or in the residual SMSA, either in a low-income or a higher than low-income zip code area. However, there were only six low-income zip code areas in the residual SMSA, with one supermarket in each. These were disaggregated to compare indexes for all low-income zip code areas, regardless of geographic locations, with all higher than low-income zip code areas.

zip codes than elsewhere in the central city. While the inverse pertained to supermarkets with buying facilities, there was no difference between central city locations for supermarkets with both buying facilities and distribution centers.17/

Average basket costs are higher for all supermarkets in the central city than in the residual SMSA (table 10). Low-income areas in the city's political boundaries do not appear to have higher food prices. Table 10's indexes consolidate supermarkets in the central city with those in the residual SMSA.

The TFP and NFCS baskets purchased in central city supermarkets were 4.0 and 4.2 percent more costly than when bought in residual SMSA supermarkets. Higher costs of conducting business in a central city may heavily contribute to the basket cost differences between central city and residual SMSA supermarkets (tables 9 and 10). The following regression analyses examine individual supermarket basket indexes and specified business costs.

17/ There were 14 firms with self-supplied buying and distributing facilities that maintained supermarkets in low-income central city and residual SMSA locations. The average cost of the five-person NFCS basket purchased in seven low-income area supermarkets averaged 2.69 index points higher than in the area's residual SMSA locations. The reverse was true for the other seven firms, whose average basket cost was 1.17 index points more in the residual SMSA than in the low-income central city locations.

Seven of the 14 firms also maintained supermarkets in the greater than low-income areas of the central city. Three firms had average basket costs 2.82 index points higher in low-income areas than in all other central city locations. The reverse was true for the other four firms whose market basket cost averaged 1.87 index points lower in low-income locations in the central city than elsewhere in the city.

Table 9--Supermarket indexes combining location and functional integration

Geographic sectors and subsectors	Vertical integration 1/					
	None		Buying only		Buying and distributing	
	TFP	NFCS	TFP	NFCS	TFP	NFCS
	Index					
Central city:						
Low income	101.6	100.9	104.8	103.8	100.6	101.2
Greater than low income	104.6	104.6	102.5	103.1	101.0	101.2
Residual SMSA	99.1	99.1	99.6	99.5	96.9	96.9

1/Indexes are weighted aggregations of individual supermarkets within strata. The indexes represent costs for five-person household baskets.

Table 11 combines all low-income zip code area supermarkets and all supermarkets from greater than low-income zip code areas, regardless of location. Note that there were six low-income zip code areas located outside central cities. There was at least one representative supermarket from the six for each of the integration categories, although the extensive integration category accounted for 67 percent of the supermarkets in the low-income zip code areas outside the central city. One was a warehouse operation.

In each instance, these six low-income residual SMSA supermarkets' basket indexes for a five-person household were below the 28-SMSA national average cost, ranging from 95.7-99.1 for the TFP and 94.9-98.7 for the NFCS baskets.

Baskets purchased in low-income areas need not cost more than baskets purchased in higher income areas. The TFP basket index for all low-income locations was 1.5 percent lower than the index for all other supermarkets because the index included these six residual SMSA low-income supermarkets. The NFCS index was 1.3 percent lower for the low-income locations.

Table 12 compares the extent of functional integration, regardless of supermarket location. Baskets from supermarkets providing buying and distributing facilities cost 1.1 percent less in the TFP, and 2.0 percent less in the NFCS, compared with baskets bought in nonintegrated supermarkets. Baskets purchased from supermarkets with their own buying facilities and distribution centers also cost 1.6 and 2.6 percent less than baskets purchased from supermarkets providing only buying facilities. When location is not specifically identified, the extensively integrated supermarkets cost somewhat less.

Table 10--Supermarket basket indexes by locations: combined levels of functional integraton 1/

Location of supermarkets	Thrifty Food Plan	Nationwide Food Consumption Survey
	Index	
Central city	102.5	102.5
Residual SMSA	98.6	98.4

1/ Indexes represent the market basket cost of five-person households.

Table 11--Supermarket basket indexes for all low-income and greater than low-income zip code areas 1/

Location of supermarkets	Thrifty Food Plan	Nationwide Food Consumption Survey
	Index	
All low-income zip areas	99.4	99.9
All greater than low-income zip areas	100.9	101.2

1/ Indexes represent market basket costs for five-person households.

These data compare food costs for individual supermarkets, not firms. The mixed character of the data underline the reward shoppers can reap by learning their community's food markets and updating their knowledge. While food costs in residual SMSA supermarkets are more likely to be lower than when purchased elsewhere, there are numerous exceptions: some central city supermarkets are as low or lower than many competitors in the residual SMSA's. Within the central city, low-income area supermarkets may charge the same or lower prices than competitors in higher than low-income areas in the central city or in the residual SMSA's.

REGRESSION ANALYSIS OF SUPERMARKET PRICES

Among the 322 supermarkets in the 10 SMSA's selected for closer analysis, five-person household TFP baskets ranged from 72.4 to 117.4 (where 100 was the mean for the larger 28-SMSA sample), with a mean of 100.4 and a standard deviation of 6.1 percentage points.

In the previous section, regional variation accounted for little of the price variation among supermarkets. There is typically a wide range of price indexes even within SMSA's. This section uses a multiple regression analysis to examine the sources of variation in market basket indexes among individual supermarkets.

Economic theory provides a general guide to selecting regression variables; that that is, prices should be a function of marginal costs, competition, and demand factors. Because theory does not give close guidance on the precise form of the regression or specific variables, we had to choose among a variety of proxy variables and several regression specifications. We emphasize variables with important and robust statistical associations with price.

Dependent Variable

Any of the four market basket indexes could serve as the dependent variable. We chose the five-person TFP basket because the quantities for each food group in the basket remain constant over time. The five-person household basket also provides the broadest age and sex representation for participating households. In practice, the four indexes are highly correlated among supermarkets, so that regression results are not sensitive to the choice of dependent variable.

Table 12--Market basket indexes for supermarkets in combined locations, by extent of functional integration

Functional integration	Thrifty Food Plan	Nationwide Food Consumption Survey
	Index	
None	101.1	100.9
Buying only	101.6	101.5
Buying and distributing	99.0	98.9

Independent Variables

Independent (explanatory) variables relate to the operations of individual supermarkets, the extent of competition in the market areas, and the socio-economic characteristics of the pool of potential patrons.

Supermarket Variables

We obtained data depicting supermarket characteristics that may influence market basket costs.

Vertical Integration. Vertical integration of supermarkets may generate increased efficiencies, which are reflected in costs or merchandising practices. Integration may affect the supermarket's profits more than its prices; that is, lowered costs from the efficiencies may be taken, all or in part, as profit. The degree to which firms capture cost efficiencies as profits, pass them forward to consumers as lower prices or pass them back to suppliers as higher input prices, depends on the competitive environment.

We used dummy variables to distinguish two types of vertical integration. Partially integrated supermarkets own their buying offices but do not have central distribution centers; the partial integration variable takes on a value of 1 for those supermarkets, and 0 for all others. Fully integrated supermarkets are a part of firms that own buying offices and distribution centers; the full integration variable takes on a value of 1 for those supermarkets, and 0 for all others. Nonintegrated supermarkets have 0 values for each variable.

Insurance Costs. Precise security costs for each sample supermarket were impossible to obtain. Supermarkets that self-insure do not have accounting codes that would readily aggregate all security-related costs. Companies that insure with commercial firms may not choose to report small claims.

The insurance cost variable is a security index that denotes whether the supermarket's premium was higher, lower, or the same as the national average premium per $1,000 of burglary/robbery coverage (for $15,000 per instance). The figure was available only by zip code area. Therefore, each supermarket in the same zip code area had the same security index value. The incidence of loss by location is reflected in the index. The variable's sign is expected to be positive because higher cost should, over time, raise the market basket indexes.

Service Index. Adding services raises costs, but may encourage store loyalty. The four most costly onsite services (baking, meat, deli, and seafood) were given a weight of 2 in an index of services, while all other services (such as check cashing, bagging, and music) were weighted 1. The service index is the sum of weighted components. The sign is expected to be positive because increased patron loyalty to preferred services may offset patron sensitivity to price levels and changes.

Warehouse Supermarkets. Warehouse supermarkets conduct a high volume of business without many of the customary store services. Supermarkets identifying themselves as warehouse supermarkets were assigned a value of 1 for this dummy variable; otherwise, they were assigned 0. The sign should be negative because of the high volume and lower per unit costs in these stores.

Front-Door Stocking. Some supermarkets were built so that all deliveries go through the front door. This type of store was identified by a 0-1 dummy variable. The sign is expected to be positive because such facilities have higher handling costs.

Competition Variables

The extent of competition from other area firms will constrain a firm's ability to raise prices. It is difficult to specify the actual extent of competition because we do not know the true market area of any firm or supermarket. We tested two market concepts for competition among area supermarkets: one covers the entire SMSA, and the other covers individual zip code areas.

Competition Within the SMSA. Previous studies investigated the effects of concentration of supermarket firms within an SMSA, under the hypothesis that prices would be higher where concentration was greater (6, 16, 19, 23, 38). Our sample was poorly designed for this issue because we included only 10 (large) SMSA's. Analysis of all 28 SMSA's may yield more robust results. We calculated a Herfindahl concentration index for each SMSA and entered the measure in the regression analysis (see app. II). We do not place much confidence in the SMSA-level results because of the limited number of SMSA's.

Competition Within Zip Code Area. We know the number of supermarkets within each zip code area. There are diminishing competitive effects of store numbers: an additional supermarket in a zip code will likely affect competition in a monopoly area more than in an area with many supermarkets. To account for these effects, we measured competition in each zip code area by computing the reciprocal of the number of supermarkets in each zip code area. A monopoly (single supermarket in zip code area) was weighted 1, two supermarkets were valued 0.5, and three were valued 0.3. With an increasing number of supermarkets, the measure falls toward, but never reaches, 0. The index shows the greatest change when there are few supermarkets in a zip code area.

Warehouse Competition. A third variable reflects warehouse supermarkets' effects on pricing in nearby supermarkets. Warehouse store prices fall 10-25 percent below the average supermarket prices, so their presence may pressure nearby competitors. We determined whether there was a warehouse supermarket within a 5-mile radius of each sample supermarket. We then specified a dummy variable, nearby warehouse supermarket, equal to 1 if there was a nearby store, and 0 if not. The choice of 5 miles is arbitrary (note it does not imply that customers drive 5 miles to a supermarket, but rather sets the market area at 2.5 miles, halfway between the warehouse supermarket and another supermarket).

Patron Characteristics Variables

We obtained data depicting the characteristics of the population in each super market's immediate zip code area. Several socioeconomic variables in the data-set were highly correlated. Two variables were particularly important and robust: percentage of households without a car and socioeconomic status.

Percentage of Households Without a Car. Customers without regular access to a car face high costs of shopping outside the immediate trading area. Supermarkets in such areas likely face less competition than others because patron immobility shrinks a supermarket's trading area. We expect that the greater the proportion of households without a car, the higher the area's supermarket prices.

Socioeconomic Status. This statistic described each zip code area as equal to, higher, or lower than the U.S. norm of 50. This index combines four factors weighted in a socioeconomic status: income, years of education, home value, and occupation. Highest factor weights are assigned to 1980 incomes of greater than $25,000; at least 4 years of college; housing worth at least $30,000 in 1980; and a managerial or professional occupation.

We analyzed the effects of socioeconomic status on prices because of widespread concern that the poor pay higher food prices. However, it is not clear what sign to expect on this coefficient. The regression controls for several cost factors (vertical integration, front-door stocking, insurance, warehouse operations), and for immobility. If the poor pay more, but they do so because of immobility and high supermarket costs, the coefficient on socioeconomic status may reflect a pure influence of income, and may be positive if high-income shoppers have a more inelastic demand for food with respect to price. If the poor pay more, these several variables should help sort the reasons.

Deleted Variables

Several other variables were considered in the analysis but were dropped from the final regressions because they were nearly collinear with other variables, they were not nearly significant in early regressions, or they had a weak theoretical basis. For example, we attempted to construct data on transportation costs from agricultural production areas, but were dissatisfied with the data. True transportation costs vary widely with distance, commodity, season, and shipment size, and the available information is limited. Data on average hourly labor compensation at each supermarket was also deleted because compensation did not adequately reflect labor costs since the measure also varied directly with labor productivity. We also investigated the percentage of households below the poverty line, but that variable displayed near-perfect collinearity with the two retained demographic variables (the socioeconomic status and the percentage of households without a car).

Our data set includes the food stamp redemptions' share of total supermarket sales. However, store price and store food stamp policy, conditioned on area demographic variables, likely cause fluctuations in this variable, so it is not truly exogenous. We present related analyses of food stamp redemptions in later sections.

Several store-specific variables (occupancy costs, sales area, sales per square foot, use of electronic scanners, and location in a shopping center) had no statistical association with price in correlations and regressions.

Previous Analyses of Supermarket Price Differences

During 1960-80, several analysts attempted to identify the character and socioeconomic implications of the retail food industry's market structure and retailer sales practices. Holdren tried formulating the individual food retailer's demand and cost functions while analyzing the interaction of several elements (11). The Federal Trade Commission's (FTC) 1960 economic inquiry detailed the food retail industry's structure (38). Mueller and Garoian followed with a structural analysis that applied industrial organization concepts and included vertical, conglomerate, and horizontal integration (19). Nelson and Preston examined whether price-merchandising depended on the types of retail foodstores operating in local markets (22). The National Commission on Food Marketing studied all operational and structural dimensions of the food retailing industry (23).

Marion and others updated those efforts, and detailed the relationship of market structure to profits and prices (16). Marion's data base, however, was limited to three food retailing companies, although their individual retail establishments operated in 32 SMSA's. As a result, their sample cannot easily be applied to analyzing intrametropolitan differences in prices, to which our sample is best applied.

Cotterill investigated supermarket pricing for 35 supermarkets in 18 Vermont communities (6). His database is suited to analyzing the effect of market concentration on price, but it is not easily applied to intrametropolitan price differences because those rural communities are likely to be well-defined markets.

Although these earlier studies use some of the same variables found in our regression equation, the basic analysis differs. Most of the earlier studies (with the exceptions noted above) tested whether higher levels of market concentration in SMSA's yield company profits and consumer overcharges. This report studies individual supermarkets and factors that help explain variations among supermarkets' weighted price indexes, which represent the cost of specified market baskets. The report is specifically concerned with price differences across neighborhoods and communities within the SMSA's, as well as differences in average prices among SMSA's. No direct attention is paid to profit levels or costs of auxiliary central administrative offices.

While we recognize the relevance of many variables used in earlier studies (and where data were available, used them), we also added variables relating to individual supermarkets (such as the index of robbery and burglary insurance cost) and their immediate areas (such as the proportion of households without regular access to a motor vehicle).

Regression Results

Table 13 specifies the dependent variable and all continuous independent variables in natural logarithms. We also entered separate dummy location variables for each SMSA (Boston was the intercept) to account for unobserved location-specific costs. Appendix tables 12 and 13 report analyses in untransformed and semi-log specifications, with and without location dummies. Specifications were generally robust; and we will review the sensitivity of the coefficients as we proceed.

Because all continuous variables are specified in natural logarithms, coefficients contained in table 13, column 3, are elasticities, and show the percentage change in price when there are small percentage changes in the independent variable. Coefficients of dummy variables represent the percentage change from a one-unit change in the independent variable.

The adjusted R^2 statistic in table 13 was 0.6388. All but two variables were statistically significant: the computed t values occur due to chance fewer than 10 out of 100 times.

Explanatory Variables

Recall that this regression is based on cross-section, not longitudinal, data.

Vertical Integration. Partially integrated supermarkets own their buying offices, while extensively integrated supermarkets own buying offices and distribution centers. Market basket indexes of supermarkets with either extent of vertical integration averaged less than those of nonintegrated supermarkets. When combined into a single variable, the coefficient was negative, and the computed t value for the combined variable was 6.07.

Partially integrated supermarkets' prices were not significantly different from nonintegrated supermarkets. The extensively integrated supermarket's computed t value was statistically significant below the 5-percent level. The results were consistent across specifications. With repeated sampling, about 68 percent of the extensively integrated supermarkets' indexes averaged 1.6-2.8 percent lower than the indexes for the nonintegrated supermarkets, while about 95 percent averaged 1.06-3.3 percent lower.18/ The mean was 2.2 percent lower.

18/ In interpreting the range of the standard error (plus and minus), the average figure (68 out of 100 observations from repeated sampling) would fall within this range. Two standard errors would encompass reported sampling 95 out of 100 times.

Table 13--Regression analysis of differences among market basket indexes for 322 supermarkets in 10 SMSA's

Indedendent variables (1)	Form of data entry (2)	Parameter estimate of independent variable (3)	Parameter standard errors (4)	Probability of t value occurring by chance (larger) (5)
Intercept	Computed	4.1532	0.0875	0.0001
Partial integration	Dummy	-.0068	.0069	.3289
Extensive integration	Dummy	-.0217	.0057	.0002
Socioeconomic status score	Continuous	.0593	.0147	.0001
Insurance cost	Index	.0162	.0097	.0971
Services index	Index	.0180	.0084	.0325
Competition in zip code	Reciprocal 1/	.0078	.0036	.0314
Households without car	Percent	.0186	.0035	.0001
Warehouse supermarkets	Dummy	-.1532	.0143	.0001
Front-door stocking	Dummy	.0192	.0096	.0460
Atlanta, GA	Dummy 2/	.0865	.0114	.0001
Denver, CO	Dummy 2/	.0726	.0108	.0001
Detroit, MI	Dummy 2/	.0738	.0118	.0001
Houston, TX	Dummy 2/	.0835	.0116	.0001
Los Angeles, CA	Dummy 2/	.0383	.0102	.0002
New York, NY	Dummy 2/	.0604	.0102	.0001
Philadelphia, PA	Dummy 2/	.0148	.0102	.1448
Pittsburgh, PA	Dummy 2/	.0301	.0113	.0080
St. Louis, MO	Dummy 2/	.0361	.0105	.0007

1/ This variable's value equals the number of supermarkets in a specified zip code. If the area had a single supermarket, the value is 1.0; if 10, then 0.1, prior to conversion to natural logarithms.
2/ The SMSA's are dummy location variables. The dummy location variables are compared with Boston, MA, the lowest price level SMSA in the 10-SMSA subset, although not of the 28-SMSA national sample.

The data do not show whether all cost savings linked to vertical coordination were passed on to their patrons through lower prices. We can infer from the data that at least some cost savings resulted in lower prices.

Warehouse Supermarkets. Warehouse supermarkets provide neither the number of services nor the product selection usually offered by regular supermarkets. Warehouse supermarket operating costs appear lower. For example, we were able to calculate payroll's percentage of sales for 401 supermarkets in the 28-SMSA sample. The ratio for warehouse stores was 35 percent less than that for all chain supermarkets, even though average hourly compensation was only 15 percent less. With adjustments for lower warehouse store price levels, payroll per dollar of real volume was about 45 percent lower at warehouse stores.

Therefore, warehouse market basket indexes were expected to fall below those of all other supermarkets. Other variables held constant, warehouse prices fell 15.3 percent. The coefficient's 95-percent confidence level ranged from -12.5 percent to -18.1 percent. The results are insensitive to the choice of functional form.

The coefficients of correlation between warehouse supermarkets and the number of services they provide (-0.54), and between warehouse supermarkets and their cost of burglary/robbery insurance (-0.16), support the inference of lower costs of warehouse supermarkets. The computed t value in the case of each correlation cofficient could occur by chance 0.01 out of 100 times. Warehouse supermarket effects on the price levels of competing supermarkets are treated below by comparing the costs of warehouse supermarkets and the distance to their supermarket competition.

Insurance Costs. A supermarket's basket index will rise on average by 0.16 percent for each 10-percent increase in a supermarket's insurance index (a 10-percent increase in insurance costs will increase about 68 percent of the supermarkets' indexes by 0.07-0.26 percent, and will increase 95 percent of the supermarkets by 0-0.36 percent). The coefficient of insurance cost was higher, and had a larger t statistic in regressions without location dummies because of systematic differences in insurance costs across SMSA's (app. table 1).

High insurance premiums go with high-risk locations. Sixty-eight of the 322 supermarkets paid the highest premiums, and 62 of these were within the boundaries of the principal central city of their SMSA. However, because insurance accounts for a relatively small share of supermarket operating costs, variations in insurance costs hardly affect supermarket prices. Table 14 arranges the sample by ranges of the premium payments, income levels, and location.

While not all city or low-income locations are high risk, most supermarkets in a central city area pay higher insurance premiums than those outside the city's boundaries. In addition, each SMSA has its own unique characteristics with respect to its distribution of high-risk areas, which accounts for the significant change when location dummies are dropped. For example, Atlanta supermarkets all fell within the 70-140 insurance index range. New York and Philadelphia supermarkets fell into both extremes of less than 70 and over 140. New York and Philadelphia supermarkets with indexes less than 70 were primarily located outside the central city's boudaries. St. Louis, Detroit, and Pittsburgh had some supermarkets with indexes below 70, but none above 40. Those below 70 typically were outside of the central city's boundaries.

Service Index. Supermarkets provide their patrons with a wide array of services, including onsite baking facilities, check cashing, accepting utility bill payments, unit pricing, carryout service, and coupon redemptions, which raise their operating costs. Table 8's coefficients indicate that for each 10-percent increase in the service index, there will be, on average, an associated rise in market basket indexes of 0.18 percent. With repeated sampling, 68 percent of all observations will be between 0.07 and 0.26 percent, and 95 percent between 0.01 and 0.48 percent. A larger computed t value could occur by chance 3.3 out of 100 times. The distribution of service indexes varies systematically by SMSA. The coefficient is positive, but not statistically significant, in regressions without location dummies.

Front-Door Stocking. The sample incorporated supermarkets ranging from the newly constructed to the very old. Several older structures can be stocked only through their front door because they had no loading dock or special unloading facilities. Most were in older portions of an SMSA's central city.

Market basket indexes of supermarkets with front-door stocking averaged 1.92 percent higher than for all other supermarkets. With repeated sampling, 68 percent would have indexes 0.96-2.88 percent higher than all others, and 95 percent would have indexes 0-3.84 percent higher. A larger computed t value could occur by chance 4.6 out of 100 times.

Competition Within Zip Code Area. This variable assigns more importance to the disappearance of a single supermarket from a zip code area when there are fewer supermarkets in the area. When there are four supermarkets in a zip code area, if one disappears, the value of the reciprocal for that area changes from 0.25 for the four supermarkets to 0.33 for the remaining three, a 32-percent change. With 10 supermarkets in the zip code area, the disappearance of 1 drops the number to 9 and shifts the reciprocal value from 0.10 to 0.11, a 10-percent change. When expressed in logarithms, the variable ranges from a high of 0 for 1 supermarket, to -0.69 for 2, -1.61 for 5, and -2.30 for 10.

Table 13 shows a positive coefficient for the competition variable, indicating that for each 10-percent increase in the reciprocal value toward monopoly, market basket indexes increase on average 0.078 percent. With repeated sampling, about 68 percent of the observations will have an associated price index increase from 0.042 to 0.114 percent, and the price will increase 0.006-0.150 percent for 95 percent of the observations. The coefficient was statistically significant. A larger t value would occur by chance only 3.1 out of 100 times.

Although relevant, changes of 1 percent of a reciprocal are awkward to interpret. Table 15 translates the changes in reciprocals to percentage price changes relating to the departure of a single supermarket from zip code areas, with the stipulated number of supermarkets prior to the departure (a single supermarket in a zip code area represents 100). For example, a move from 2 to 1 supermarket would be associated with a 0.6-percent change in the index, from 3 to 2 supermarkets with 0.3 percent, from 5 to 3 with 0.2, and from 10 to 5 with 0.7. Note that as the numbers of supermarkets in a zip code area increase, the effect decreases until it becomes asymptotic. The coefficient was sensitive to functional form, and was not statistically significant when location dummies were dropped.

Percentage of Households Without a Car. This coefficient is a strong explanatory variable: positive, and highly significant in every specification. The demand elasticities of households without a car are probably more inelastic than those households with a less constrained choice of supermarkets.

On average, a 10-percent increase in the percentage of a zip code's households without a car increased the price index of supermarkets located there by 0.19 percent (table 14). With repeated sampling, about 68 percent of the index observations range from 0.15 to 2.2 percent, and 95 percent will range from 0.12 to 0.26 percent.

Socioeconomic Status. The socioeconomic status index is a weighted combination of level of household income, value of housing, years of education, and occupation/profession. A zip code area is more affluent when the score is above the U.S. norm of 50.

On average, for each 10-percent increase in the zip code area's score (holding other variables constant) the price index will rise by 0.59 percent. A larger t value would occur by chance 0.01 out of 100 times. With repeated sampling, 68 percent of the observations would range 0.45-0.74 percent, and 95 percent would range 0.30-0.89 percent. The size of the coefficient fell when location

Table 14--Risk insurance cost indexes for supermarkets, by location

Location in SMSA	Supermarkets	Risk insurance premium indexes		
		< 70	70-140	> 140
	Number	Percent		
Central city:				
Low income	86	12.3	52.8	34.9
Greater than low income	72	6.9	48.7	44.4
Outside central city:				
Low income	6	0	83.3	16.7
Greater than low income	158	29.7	67.1	3.2

Table 15--Association between the change in the number of supermarkets in a zip code area and the rise in the market basket index

Number of supermarkets in zip code area	Reciprocal of the number of supermarkets	Price index with monopoly = 100	Percentage decrease in market basket index with change in number of supermarkets
1	1.00	100.0	0.6
2	.50	99.4	.3
3	.33	99.1	.2
5	.25	98.9	.7
10	.10	98.2	NA

NA = Not applicable.

dummies were dropped, but the coefficient was positive and statistically significant in all specifications.

On average, low-income central city zip code areas have higher market basket index values than do suburban zip code areas, but the average difference is not large (table 9). A wide variation occurs across zip codes areas and their supermarkets. Several conflicting forces operate in the regression. First, price indexes are affected by several costs: higher insurance, front-door stocking, and no vertical integration are associated with higher prices. A combination of the three can raise prices 5-10 percent. If these supermarkets are concentrated in older and poorer central cities, average prices in those areas will increase. Second, mobility affects prices; assuming a price index of 100 with 5 percent of the households without a car (the 25th percentile value), the index rises to 103.7 as we move to the 75th percentile (38 percent of the households without a car). Nonmobility is negatively correlated with socioeconomic status, but it is not identical (the correlation between the two being -0.62 and -0.76 in log form). For example, New York has many neighborhoods with relatively high incomes and low car-ownership. Controlling for mobility, socioeconomic status has a positive and fairly strong effect on prices. If we assume a price index of 100 at the 25th percentile value of socioeconomic status, predicted prices rise to 102.4 as we move to the 75th percentile. Food prices to the poor may be higher because of restricted mobility and higher cost facilities.

Location. The coefficients of the SMSA's contained in table 13 show the extent each of the SMSA price indexes vary, on average, from Boston's. Philadelphia's index was not significantly greater than Boston's, but all others were. The coefficients indicate that average indexes in Pittsburgh, St. Louis, and Los Angeles were 3-4 percent above Boston's, while those in New York, Denver, Detroit, and Houston were 6-8 percent higher. Note that New York and Boston are in the same region (the Northeast), but have clearly different average indexes. Indexes may vary more within than among regions.

SMSA dummies control for unobserved cost and demand differences, but SMSA's also differ in their distributions for independent variables. For example, Boston has the most warehouse stores, while some SMSA's have none.

Competition with Nearby Warehouse Supermarkets. Warehouse supermarkets have sharply lower prices than other supermarkets, ranging from 10 to 20 percent, depending on the specification (a remarkable difference considering that large changes in other coefficients typically are associated with 1- to 4-percent changes in supermarket price indexes). Does this substantial warehouse effect affect the prices of competing supermarkets? If so, then the net effect of the entry of warehouse supermarkets may be much greater than implied by their modest number (only 14 of our sample stores are warehouse supermarkets, but there were additional warehouse supermarkets within 5 miles of our sample stores).

The data do not provide a definite idea of how far a warehouse supermarket's influence extends, and we did not determine the distance from each sample supermarket to the nearest warehouse supermarket. Our trading area encompassed a 5-mile radius around each warehouse supermarket in our 10 SMSA's (not just those warehouse supermarkets in our sample). All sample stores within the radius were treated as being near a warehouse supermarket. The choice of 5 miles does not imply that stores necessarily aim at customers 5 miles away; rather, they compete with stores 5 miles away for customers.

SMSA's differ systematically in warehouse-supermarket penetration. Some, such as New York and Houston, had no penetration (in the spring of 1982 when prices were sampled), while most supermarkets in Boston were within 5 miles of a warehouse supermarket. Because of the SMSA-specific nature of warehouse penetration, statistical results are sensitive to location dummies. There were no statistically significant effects of warehouse supermarkets stores on other stores' prices when we included location dummies in the regression.

Table 16, column (regression) 1, shows the results when we drop the location dummies. A nearby warehouse supermarket reduces the competing store's price index by 2.5 percent, on average, and the coefficient is highly significant. The coefficient's value is modest compared with the direct effect of warehouse supermarkets, but reasonably large compared with the effects of other variables (it may also have a large effect on store profits). We also included a dummy variable to account for SMSA's with no warehouse supermarkets. That coefficient is positive and statistically significant; average price levels in those SMSA's are 1.5 percent above stores in SMSA's with warehouse supermarkets that are not close, and 4 percent above stores competing with nearby warehouse supermarkets.

We included a Herfindahl index of concentration of supermarket firms in each SMSA in table 16, column 2. We cannot include the index in a regression with location dummies because the measure is SMSA-specific. The coefficient is positive and highly significant: each 10-percent increase in the Herfindahl measure is associated with an estimated 0.19-percent increase in the price level. However, recall that we have only 10 SMSA's, and the effect is dominated by Denver, which has relatively high concentration and prices. Therefore, we should not place great confidence in the result. But this section provides some evidence that competition from other supermarkets and firms, and especially from warehouse supermarkets, affects pricing.

<u>Food Stamp Redemptions/Total Food Sales (FSR/TS)</u>. FSR/TS was initially considered an independent variable that might help explain the variation in supermarket's five-person household TFP market basket indexes. However, the direction of causality likely goes from lower prices to increased food stamp patronage, rather than the reverse. FSR/TS is not truly exogenous.

The evidence supporting our decision to exclude this variable from the regression equation provides substantial insights into the purchase practices of food stamp households, although they are not conclusive. When competition prevails, and competing supermarkets are accessible to food stamp households, most respond by shopping in supermarkets with the lowest market basket indexes. Table 17 categorizes the 322 sample supermarkets by food stamp redemptions. Note that five supermarkets did not participate in the Food Stamp Program during the spring of 1982. Table 17 does not show strong links between high FSR/TS ratios and market basket indexes. The five supermarkets not participating in the Food Stamp Program had the highest averages.

If a positive link exists between FSR/TS and the level of the market basket indexes, the reported indexes should rise consistently from the lowest FSR/TS category to the highest (from less than 5 percent to 15 percent and more). If we call the lowest category rank 1, and the highest rank 4, then a consistent sequence is 1, 2, 3, and 4. But the actual sequence runs 2, 1, 4, 3. The Spearman coefficient of rank correlation was not statistically significant.

A second data set provides more insight. The 322-supermarkets sample, drawn from the 10 SMSA's, is distributed across 79 zip code areas because multiple

Table 16--Regression analyses of competition 1/

Independent variables	Parameter estimates with warehouse competition (1)	Parameter estimates with Herfindahl index (2)
Intercept	4.4000 (52.01)	4.3507 (52.57)
Partial integration	- .0023 (.31)	.0009 (.12)
Extensive integration	- .0156 (2.48)	- .0138 (2.26)
Socioeconomic status	.0264 (1.82)	.0469 (3.16)
Insurance cost	.0136 (1.82)	.0153 (2.10)
Services index	.0090 (.97)	.0074 (.83)
Store competition	.0023 (.61)	.0019 (.51)
Households without a car	.0083 (2.74)	.0136 (4.29)
Front-door stocking	.0184 (1.72)	.0211 (2.02)
Warehouse supermarket in area	-.1687 (10.70)	-.1696 (11.09)
Nearby warehouse supermarkets	-.0247 (3.78)	-.0201 (3.13)
No warehouse supermarkets in SMSA	.0150 (2.48)	.0194 (3.26)
SMSA competition	NA	.0186 (4.53)
R^2	.54	.57

NA = Not applicable.
1/ Numbers in parentheses in the data field are t statistics.

Table 17--FSR/TS ratios by ratio size and their associated mean market basket indexes

FSR/TS ratio categories	Supermarkets	Average FSR/TS ratio	TFP market basket index for five-person households
	Number	Percent	U.S. mean = 100
Not in 1982 FSP	5	NA	106.51
Less than 5 percent	212	1.44	101.11
5-9.99	44	7.11	98.71
10-14.99	19	12.74	102.17
15 percent and more	42	25.42	101.55
Total 1/	322	6.10	100.90

NA = Not applicable.
1/ Total includes the five supermarkets that did not participate in the FSP in 1982.

supermarkets are located in numerous zip code areas. Fifty-six zip code areas contained at least two supermarkets. For zip code areas with only two supermarkets, the one with the higher FSR/TS ratio was classified into one of four market basket index categories: the lowest market basket index, the highest market basket index, the same market basket index, and no basis for comparison (there was no price index because one of the two supermarkets was not in our sample). An additional category was used if the zip code area had more than two supermarkets; that is, the supermarket with the highest FSR/TS ratio also could have a mid-range price index.

Comparisons could not be made in 21 (37.5 percent) of the 56 zip code areas with multiple stores because the price index was not available if nonsample supermarkets were present. In 25 of the remaining 35 zip code areas, the supermarket with the highest FSR/TS ratio also had the lowest market basket index. Market basket indexes were identical in one zip code area, and the high FSR/TS supermarket had the high market basket index in nine zip code areas.

Table 19's classification system changes from a zip code area to a supermarket comparison, providing our best documentation of the number of competitors faced by each supermarket with a high ratio of FSR/TS.

Almost 86 percent of the supermarkets with FSR/TS ratios of at least 15 percent had at least one competitor in their trading area, and about 62 percent had at least five (table 19). Supermarkets with substantial food stamp patronage also tended to have at least one competitor. Where comparisons could be made, 71 percent of the supermarkets with the high FSR/TS ratios (table 18) had the low market basket price indexes. Most households shop in supermarkets with the lowest market basket indexes when competition prevails and competing supermarkets are accessible to food stamp households.

To what extent do food stamp households have access to competing supermarkets? About 56 of the 79 (71 percent) zip code areas in the 10-SMSA sample contained more than one supermarket (table 13). Thus, households in our 10-SMSA sample have some degree of buying power because of access to other supermarkets. About 29 percent of sample zip code areas had one supermarket, and the average market basket in these areas was 100.6, compared with 98.6 for those supermarkets in competitive zip code areas with the highest FSR/TS ratios.

IMPLICATIONS

Regional indexes would not improve administrative equity. The current use of a nationwide food market basket index to update the value of food stamps results in no significant inequities.

Food stamp households can lower their food expenditures for identical market baskets of food when they shop in warehouse supermarkets, in zip code areas with

Table 18--Zip code cross-classification: highest supermarket FSR/TS ratio, with market basket indexes

Price categories of highest FSR/TS supermarkets	Interpretations			
	Strict		Less constrained	
	Number	Percent	Number	Percent
Lowest price index	25	44.6	29	51.8
Highest price index	9	16.1	11	19.6
Middle price index	0	0	2	3.6
Identical price indexes	1	1.8	1	1.8
At least one supermarket for which price index was unavailable	21	37.5	13	23.2
Total	56	100.0	56	100.0

Table 19--Cross-classification between FSR/TS categories and number of supermarkets per zip code area

Number of stores in zip code area	FSR/TS ratios					
	10-14.9 percent		At least 15 percent		Total	
	Number	Percent	Number	Percent	Number	Percent
1	2	10.5	6	14.3	8	13.1
2-4	9	47.4	10	23.8	19	31.1
5-9	6	31.6	11	26.2	17	27.9
At least 10	2	10.5	15	35.7	17	27.9
Total	19	100.0	42	100.0	61	100.0

competing supermarkets, and in extensively integrated supermarkets outside the political boundaries of their SMSA's principal central city. (There are notable exceptions in each SMSA. Households must take their local market's structure and supermarket locations into account when establishing their shopping practices.)

Food stamp households can lower their food expenditures for the same total pounds of food by purchasing protein items only after comparing prices across different food groups.

Over time, the price structure reflects supermarkets' higher merchandising costs. Supermarkets that stock only through their front door, provide numerous services, and conduct their business in high-risk locations, charge higher prices. However, the same supermarket rarely experiences all three kinds of costs simultaneously. For example, supermarkets stocking only through the front door also, on average, provide fewer services than competitors with newer facilities.

Food stamp households need to review their shopping opportunities whenever there is a departure of a supermarket from a zip code area. The departure of a single supermarket from a trading area with few competitors, on average, will affect the trading area's level of price indexes more than a departure from a trading area with several competitors.

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APPENDIX I: COMPUTING MARKET BASKET INDEXES

The text describes the sample selection and the computational procedure so readers can understand how the study was conducted. This appendix further illustrates those methodological details.

Procedure 1: Item Sampling for Each Supermarket

A sampling procedure was devised to select a set of items which would represent each supermarket's pricing practices. The following guidelines were followed:

- Individual supermarkets typically carry over 10,000 food and nonfood items. Products were selected to represent the entire supermarket.

- Items were sampled in proportion to their category's share of total sales attributable to the universe of supermarkets. Items were classified either as unbranded (such as fresh strawberries) or as branded. If branded, they were identified as national, private label, manufacturers, or generic.

- Price comparisons across stores were limited to like items: the same product type, flavor, container size, and brand type.

- Random sampling was adopted for item selections.

- Food item samples were selected independently for each of the three waves of price collection. In each wave, each item was chosen from the full universe of items.

Sales data were obtained on a national level of individual products and were classified in detailed product subcategories, each containing a single container size, product type, and flavor. When a complete list of detailed product subcategories was developed, individual subcategories were randomly selected until the desired sample size was achieved. Enumerators were trained to price-check each item that met the selected subcategory description in every sample store (for example, this meant pricing each lettuce item stocked in the lettuce subcategory, such as iceberg, red and green leaf, Boston, and others).

We obtained sales data on detailed product categories in several steps. First, information about broad categories was obtained from the July 1981 issue of Chain Store Age Supermarkets (3). Next, these broad categories were disaggregated into subcategories from multiple data sources, including: A.C. Nielsen, USDA and other agency reports and data series, trade associations, publications, and in a few instances, counts made in supermarkets located in the greater Washington, DC area.1/ These subcategories were then selected by randomly drawing numbers between 0 and 100,000 with replacement (a computerized pseudo-random numbers generator was used for number generation). Then, subcategories of homogeneous products (with respect to type, color, flavor, and container size) were listed in decreasing order of size, based on their share of total sales in all supermarkets. Sale shares were then computed to the nearest thousandth and cumulated over all categories grouped by department (produce or dairy, for example) in the store. Detailed subcategories corresponding to the cumulative share of the categories were chosen. When a subcategory was selected, the number of items expected to be found in an average supermarket was estimated, and a sample selection proceeded until the target number of items was reached.

Stratified sampling ensured the number of sampled items in each department was proportional to the department's share of store sales. Once detailed product subcategories had been identified, field checks were made to assure that the subcategory descriptions did not contain more than one type of product, flavor, or container size. Size variation was permitted in a few instances (for instance, 42- and 48-ounce cans of shortening). Field observations also ensured that estimated item counts met the predetermined targets.

Independent samples were drawn for each of three waves of price collection, spread over about 3 months. Price indexes for the three waves were averaged together to reduce the influence of temporary market aberrations. By using independent item samples for each wave, each wave represents a complete replication of price-measurement procedures. Averaging reduced the influence of temporary events and data errors on our estimates of price levels for the sample firms.

Meat and produce departments posed special enumeration problems. Meat selection was complicated because supermarkets frequently use different names for identical cuts of fresh meat. We established broad categories (such as boneless beef roasts and ground beef) because enumerators could not correctly identify all retail cuts. Random selections within these categories were made according to the procedures detailed above. For meat, enumerators recorded the name, grade, and price of each meat item that fell within the broad category. Alphabetized listings contained the most popular names, and enumerators recorded any additional cut names.

The completed listings were reviewed by a meat nomenclature expert from the National Livestock and Meat Board, who classified the data using homogeneous product subcategories identified in the Board's 1973 Uniform Retail Meat Identity Standards (20). Several products that he was unable to classify were deleted from the survey.

Because the size of fresh fruit and vegetable items influences the price per pound charged, enumerators were trained to measure the diameter of fruit, such as apples, oranges, grapefruit, and assign unique product codes for the different diameters. Thus, comparisons by price per pound included items of like size.

1/ The A. C. Nielsen Corporation, Chicago, IL, provided most of the figures for product shares of total store sales, including special tabulations by packaging size (1).

Procedure 2: Computing a Weighted Mean TFP Food Group Price

Appendix table 1 presents the conversion factors used for food group 01, milk, cheese, and ice cream, to derive price per pound for all items not initially reported per pound. Analogous procedures were used for each of the other food groups when necessary. The computed price per pound for each item required additional steps to convert item prices to a TFP food group price.

The following illustrations use hypothetical data 2/ and are based on the assumptions that each of the 28 SMSA's had all of the items selected for the item sample, and that each supermarket stocked each of these sample items. The first assumption is reasonable, but the second is not because all supermarkets do not stock all items. However, the missing data problem was resolved with a normalizing procedure.

Column 0, appendix table 2, reports the unit in which the item price was recorded in the supermarkets. Column 1 represents the converted price per pound resulting from the application of appendix table 1's conversion factors.

Expenditure-based brand 3/ weights then were converted to a quantity base by removing the portion of the expenditures due to price differences among the brand types (these adjustments are described in appendix table 2, columns 1, 1A, 2, and 2A). The all-brand average unit price then was calculated using these weights (columns 3 and 4).

The next step was to convert the expenditure-based product category weights to quantity-based weights (app. table 2, columns 5, 5A, and 5B).4/ Using these quantity weights, all-brand average unit prices for the sample product categories were averaged to obtain a value for each TFP product category (app. table 2, column 6). The TFP product categories were averaged using quantity weights used in the TFP, to obtain the U.S. average unit price for the TFP food groups, computing each independently (app. table 2, columns 7-9).

These quantity-based TFP food group average prices then were transcribed in column 2, appendix table 4, and multiplied by the quantities specified by the TFP (column 1), to obtain expenditures based on quantity weights that could be used to aggregate price-relative indexes for the TFP- and NFCS-adjusted market baskets.

Appendix table 3 aggregates each supermarket's index values for each brand type in detailed product categories sampled into averages for food groups (as defined in the TFP and NFCS baskets). The output from appendix table 3, column 9, is inserted in column 5 of text table 3.

2/ The numbers are hypothetical because, except for columns containing the weights, the data are not empirical observations. The data were arbitrarily inserted to explain the procedure.

3/ Brand weights were derived by determining the share of U.S. sales by each brand type (national, private label, generic, and unbranded).

4/ Column 5's USDA sample selection weights represent the number of times the item (such as whole milk, gallon) was randomly chosen in the three waves of sample selection. Whole milk was randomly chosen in each of the three waves, and hence, has the weight of 3, whereas white milk, 1/2 gallon, was randomly selected once and has the weight of 1.

Appendix table 1--Milk, cheese, and ice cream food group: Product codes and conversion ratios for computing price per pound

Product and pound equivalents	Conversion factors 1/
Whole milk:	
8.6 lbs. = 1 gal.	0.1163
4.3 lbs. = 1/2 gal.	.2326
2.15 lbs. = 1 qt.	.4651
Whole milk, chocolate flavored:	
2.2 lbs. = 1 qt.	.4545
Lowfat milk:	
8.63 lbs. = 1 gal.	.1159
4.32 lbs. = 1/2 gal.	.2317
Cottage cheese:	
1 lb. = 16 oz.	106.0000
Processed American cheese products:	
1 lb. = 16 oz.	16.0000
American cheese, natural:	
1 lb. = 16 oz.	16.0000
Sour cream dip:	
1 lb. = 16 oz.	16.0000

1/ Enumerated prices were converted to unit prices (such as per gallon, quart, or ounce) and then multiplied by the conversion factors to obtain prices per pound.

Appendix table 2--How weighted-average unit prices are aggregated into the Thrifty Food Plan's food groups: Milk, cheese, and ice cream group

TFP product category, brand type, and container size	(1) 28-SMSA price per pound	(1A) Brand type weight adjustment factor 1/	(2) Brand type expenditure weight	(2A) Adjusted brand type quantity weight 2/	(3) [(1)(2)] 3/	(4) Weighted price for USDA sample category 4/	(5) USDA sample selection weights 5/
Whole milk:							
White milk (gallon)--							
National brands	0.280	1.000	0.20	0.200	0.056		
Private label	.260	1.077	.75	.808	.210		
Generic label	.230	1.217	.05	.061	.014		
All-brands average						0.2619	1
White milk (1/2 gallon)--							
National brands	.299	1.000	.30	.300	.090		
Private label	.264	1.133	.70	.793	.209		
Generic label	—	—	—	—	—		
All-brands average						.2736	1
White milk (quart)--							
National brands	.310	1.000	.80	.800	.248		
Private label	.290	1.069	.20	.214	.062		
Generic label	—	—	—	—	—	.3060	1
All-brands average							
Chocolate milk (quart)--							
National brands	.330	1.000	.40	.400	.132		
Private label	.310	1.065	.60	.639	.639		
Generic label	—	—	—	—	—		
All-brands average						.3176	1
Lowfat milk:							
White milk, 1% fat (gallon)--							
National brands	.250	1.000	.20	.200	.050		
Private label	.220	1.136	.75	.852	.187		
Generic label	.180	1.389	.05	.069	.012		
All-brands average						.2221	2
White milk, skim (1/2 gallon)--							
National brands	.250	1.000	.25	.250	.062		
Private label	.230	1.087	.73	.794	.183		
Generic label	.200	1.250	.02	.025	.005		
All-brands average						.2339	1
Processed cheese:							
Processed American cheese products (12 ounces)--1/							
National brands	1.80	1.000	.65	.650	1.170		
Private label	1.70	1.059	.30	.318	.541		
Generic label	1.50	1.200	.05	.060	.090		
All-brands average						1.7519	3
Processed American cheese products (less than 12 ounces)--1/							
National brands	1.75	1.000	.75	.750	1.312		
Private label	1.68	1.042	.20	.208	.349		
Generic label	1.40	1.250	.05	.062	.087		
All-brands average						1.7137	2
Processed American cheese food (12 ounces)--							
National brands	1.69	1.000	0.80	0.800	1.352		
Private label	1.55	1.090	.16	.174	.270		
Generic label	1.45	1.166	.04	.047	.068		
All brands average						1.6552	1
Natural cheese:							
Brick cheese, prepackaged (8-9 ounces)--3/							
National brands	2.50	1.000	.70	.700	1.750		
Private label	2.35	1.064	.25	.266	.625		
Generic label	2.30	1.087	.05	.054	.124		
All-brands average						2.4500	3
Sour cream dip:							
Sour cream dip with bacon and horseradish flavor (8-15 ounces)--4/							
National brand	1.60	1.000	.80	.800	1.280		
Private label	1.55	1.032	.20	.206	.319		
Generic label	—	—	—	—	--		
All-brands average						1.5895	1
Cottage cheese:							
Cottage cheese, lowfat (17-32 ounces)--5/							
National brands	.90	1.000	.40	.400	.360		
Private label	.85	1.059	.55	.582	.495		
Generic label	.80	1.125	.05	.056	.045		
All-brands average						.3671	1
TFP food group mean							

-- = Not applicable.

1/ Column 1A adjusts the expenditure weights of column 2 to an equivalent quantity weight basis by taking the brand type with the highest price within each brand group, and dividing it by prices of the other brand types. For example, for whole milk sold in gallons, 0.23 and 0.26 are divided into 0.28 to derive 1.217 and 1.077, weight adjustment factors for the brand types.

2/ Column 2A equals column 1A multiplied by column 2.

3/ Column 3 equals column 1 multiplied by column 2A.

4/ Column 4 is computed by dividing each group sum in column 3 by the corresponding sum of brand type weights from column 2A. For example, the weighted price for whole milk sold in gallons is 0.28/1.069 = 0.2619.

5/ This weight is the number of times an item from the product category was selected in the random sampling procedure for each wave. That is, the item was randomly selected in each of the three waves when its weight was 3.

Continued--

Appendix table 2--How weighted-average unit prices are aggregated into the Thrifty Food Plan's food groups: Milk, cheese, and ice cream group--Continued

TFP product category, brand type, and container size	(5A) Weight adjustment factor 6/	(5B) USDA adjusted sample quantity weight 7/	(6) Weighted mean price for TFP 8/	(7) TFP quantity weight 9/	(8) [(6) (7)]	(9) Weighted mean price for TFP food group
Whole milk:						
White milk (gallon)--						
National brands						
Private label						
Generic label						
All-brands average	1.2127	3.6381				
White milk (1/2 gallon)--						
National brands						
Private label						
Generic label						
All-brands average	1.1608	1.1608				
White milk (quart)--						
National brands						
Private label						
Generic label						
All-brands average	1.0379	1.0379				
Chocolate milk (quart)--						
National brands						
Private label						
Generic label						
All-brands average	1.0000	1.0000	0.2727	8.2490	2.2990	
Lowfat milk:						
White milk, 1% fat (gallon)--						
National brands						
Private label						
Generic label						
All-brands average	1.0531	2.1062				
White milk, skim (1/2 gallon)--						
National brands						
Private label						
Generic label						
All-brands average	1.0000	1.0000	.2259	.4280	.0967	
Processed cheese:						
Processed American cheese products (12 ounces)--1/						
National brands						
Generic label						
All-brands average	1.0000	3.0000				
Processed American cheese products (less than 12 ounces)--1/						
National brands						
Private label						
Generic label						
All-brands average	1.0223	2.0446				
Processed American cheese food (12 ounces)--						
National brands						
Private label						
Generic label						
All-brands average	1.0584	1.0584	1.7223	0.5760	0.9920	
Natural cheese:						
Brick cheese, prepackaged (8-9 ounces)--3/						
National brands						
Private label						
Generic label						
All-brands average	1.0000	1.0000	2.4500	.6550	1.6048	
Sour cream dip:						
Sour cream dip with bacon and horseradish flavor (8-15 ounces)--4/						
National brand						
Private label						
Generic label						
All-brands average	1.0000	1.0000	1.5895	.0130	.0207	
Cottage cheese:						
Cottage cheese, lowfat (17-32 ounces)--5/						
National brands						
Private label						
Generic label						
All-brands average	1.0000	1.0000	.8671	.1260	.1093	
TFP food group mean						0.510

6/ For the weight adjustment factor of each TFP product category, divide the highest USDA category price in column 4 by the other USDA category prices in column 4. For example, the weight adjustment for whole milk sold in gallons, half gallons, and quarts, and chocolate milk sold in quarts are 0.3176/0.2619 = 1.2127; 0.3176/0.2736 = 1.1608; 0.3176/0.3060 = 1.0379; 0.3176/0.3176 = 1.000.

7/ Column 5B equals column 5 multiplied by column 5A.

8/ Column 6 is computed by multiplying column 4 by column 5B, and summing for each product category, such as whole milk. Then divide this total by the sum of corresponding weights (column 5B). The weighted mean price for whole milk in TFP supermarkets is [(0.2619) (3.6381) + (0.2736) (1.1608) + (0.306) (1.0379) + (0.3176) (1.0000)]/(3.6381 + 1.1608 + 1.0379 + 1.0000) = 0.2787.

9/ Weights provided by HNIS from the TFP give relative importance to TFP product categories as used by HNIS in their TFP cost computations.

10/ Dividing the sum of column 8 by the sum of column 7 gives the TFP mean price, in this illustration, for the TFP milk, cheese, and ice cream food group. Corresponding computations are then made for each of the other TFP food groups.

Appendix table 3--How the price index is calculated for Thrifty Food Plan food groups: Milk, cheese, and ice cream group (for one supermarket)

TFP product category, brand type, and container size	(1) Price: index: 1/	(2) Brand type weight 2/	(3) [(1)(2)]: 3/	(4) Weighted mean index for USDA sample category 4/	(5) USDA sample selection weight 5/	(6) Weighted mean for TFP component: 6/	(7) TFP expenditure weights	(8) [(6)(7)]: 7/	(9) Weighted mean for TFP food group 8/
Whole milk:									
White milk (gallon)--									
National brands	105	0.20	21.00						
Private label	110	.75	82.50						
Generic label	107	.05	5.35						
All-brands average				108.9	3				
Whole milk (1/2 gallon)--									
National brands	95	.30	28.50						
Private label	97	.70	67.90						
Generic label	--	--	--						
All-brands average				96.4	2				
White milk (quart)--									
National brands	101	.30	30.30						
Private label	99	.70	69.30						
Generic label	--	--	--						
All-brands average				99.6	1				
Chocolate milk (quart)--									
National brands	101	.40	40.40						
Private label	116	.60	69.60						
Generic label	-	-							
All-brands average				110.0	1	104.2	8.2490	859.6	
Lowfat milk:									
White milk, 1% fat (gallon)--									
National brands	110	.20	22.00						
Private label	90	.75	67.50						
Generic label	96	.05	4.80	94.3	2				
All-brands average									
White milk, skim (1/2 gallon)--									
National brands	83	.25	20.75						
Private label	93	.73	67.89						
Generic label	103	.02	2.06						
All-brands average				90.7	1	93.1	.4280	39.9	
Processed cheese:									
Processed American cheese products (12 ounces)--9/									
National brands	96	.65	62.40						
Private label	111	.30	33.30						
Generic label	112	.05	5.60						
All-brands average				101.3	3				
Processed American cheese products (less than 12 ounces)--9/									
National brands	99	.75	74.25						
Private label	115	.20	23.00						
Generic label	110	.05	5.50						
All-brands average				102.8	2				
Processed American cheese food (12 ounces)--9/									
National brands	101	.80	80.80						
Private label	112	.16	17.92						
Generic label	102	.04	4.08						
All-brands average				102.8	1	102.0	.5760	58.8	
Natural cheese:									
Brick cheese prepackaged (8-9 ounces)--9/									
National brands	100	.70	70.00						
Private label	104	.25	26.00						
Generic label	109	.05	5.45						
All-brands average				101.5	3	101.5	.6550	66.5	
Sour cream dip:									
Sour cream dip, bacon with horse-radish flavor (8-15 ounces)--9/									
National brands	91	.80	72.80						
Private label	88	.20	17.60						
Generic label	--	--	--						
All-brands average				90.4	1	90.4	.0130	1.2	
Cottage cheese:									
Cottage cheese lowfat (17-32 ounces)--9/									
National brands	87	.40	34.80						
Private label	94	.55	51.70						
Generic label	90	.05	4.50						
All-brands average				91.0	1	91.0	.1260	11.5	
TFP food group mean									103

-- = Not applicable.

1/ The index numbers were provided by the Grinnell-Handy computations (x).

2/ Column 2 is from column 2, table 2.

3/ Column 3 is the product of columns 1 and 2.

4/ Column 4 represents the sum of column 3 for each product category.

5/ Column 5 is from column 5, table 2.

6/ Column 7 is from column 7, table 2.

7/ Column 8 is the product of columns 6 and 7.

8/ Column 9 is the sum of column 8 divided by the sum of column 7, for each TFP food group.

Appendix table 3's column 0 is the unit in which the item was priced in the supermarket. Column 1 is the computed price-relative unit.

Procedure 3: Computing Price-Relative Index for Each TFP Item/Food Group

Column 2 in appendix table 3 repeats column 2, appendix table 2.5/ Columm 3 follows the same computational procedure but the results differ because figures in appendix table 3, column 1, are price relatives and not prices per pound.

Column 5 in appendix table 3 repeats column 5, appendix 2. The same may be said for column 7. The procedures identified for columns 6, 8, and 9 are the same procedures adopted for the same columns in appendix table 2.

Procedure 4: Computing Weighted Index for Each Supermarket

Column 1 in text table 3 represents the pounds of food for a week that the TFP proposes for a family of five. Column 2 represents the all-SMSA average unit price carried forward from appendix table 2 (for example, for the TFP food group 01, the unit price is 0.51 cent). Column 3 represents the product of columns 1 and 2. The sum of column 8 divided into each of its component items provides the data in column 4. Column 5 represents the price relative carried forward from appendix table 3 (103 for TFP food group 01). Column 6 represents the product of columns 4 and 5 and contributes each of the 15 TFP food groups to the total supermarket TFP index for each supermarket (computed independently for each sample supermarket).6/

The only difference between the TFP and the NFCS basket is that the latter, while having the same total 125.15 pounds for the five-person household for a week, has the 15 food groups proportionate to the total pounds used by food stamp households.

5/ Appendix table 3 carries forward the assumption and example of a supermarket that stocks at least one item for each brand type. Whenever a supermarket stocks fewer than the three brand types, a normalization procedure is required to compute the all-brand average appearing in column 4. This involves dividing the sum of the product(s) computed under column 3 by the sum of the brand type weights under column 2.

For example, assume that instead of stocking all three brands, the supermarket stocked only national brands (NB), and generics (G). Without normalization (in this illustration), the all-brand average would have been (26.35/1), which is incorrect. Here, (26.35/.25) is correct.

Brand type stocked and container size	(1) Price index	(2) Brand weight	(3) [(1)(2)]	(4) Weighted-mean index
Whole milk:				
White (gallon)--				
National brand	105.0	0.20	21.00	
Private label				
Generic	107.0	.05	5.35	
All-brand average				105.4

6/ The index is computed independently for each of the three pricing waves. For use in regression analyses, the three waves are combined and an equally weighted combined index for each supermarket serves as the dependent variable.

Procedure 5: Computing an SMSA Market Basket Index

Additional adjustments are required to combine the individual supermarket indexes to represent the total SMSA. Only supermarkets chosen in the initial 28-SMSA sampling are used to make the 28-SMSA comparisons. This initial sample provides valid inferences without including the additional low-income supermarkets, which are used in the more intensive study of food prices in low-income neighborhoods.

The original sampling plan was structured so that individual firms may be aggregated to obtain an average for the SMSA in which each is located. Each sample store has a weight proportional to its share of market sales. For the 28-SMSA analysis, sampling was done by firm so that each supermarket selected for a leading firm has a weight equal to that firm's market share divided by the number of supermarkets operated by the firm in that SMSA. The combined market shares of nonleading firms are divided by the number of supermarkets selected to represent nonleading firms, to obtain each supermarket's sample weight. Appendix table 4 computes supermarket sample weights.

Appendix table 5 applies table 4's results (column 3) when computing the summary index for a single SMSA. Corresponding steps were followed for each of the 28 SMSA's. Column 1, appendix table 5, identifies sample supermarkets owned by each specified company (firm), except that supermarkets listed for all others are operated by different firms. Column 2 presents the individual market basket price index for each supermarket, and is carried forward from in the total in text table 4, column 6.

The weight developed for each supermarket of each firm, as a result of the computations for appendix table 4, has been repeated in column 3. Column 4 represents the product of columns 2 and 3. The sum of column 4 divided by the sum of column 3 is the combined mean market basket index for a single SMSA (column 5).

Appendix table 4--Sample supermarket weights (hypothetical data)

Firm rank	Supermarkets in SMSA	Share of market sales	Supermarkets in sample	Sample weight per supermarket
	Number	Percent	Number	Weight
1	51	27	3	9.00
2	60	15	3	5.00
3	27	12	3	4.00
4	11	10	3	3.33
5	10	9	2	4.50
6	3	2	1	2.00
All others	150	25	5	5.00

Procedure 6: Computing Location and Integration Stratum Indexes

Market basket indexes, used to compare supermarket prices in the 28 SMSA's by their location within an SMSA and the extent of their functional integration, required additional weight adjustments. Extra low-income location supermarkets were drawn at random from 10 of the 28 SMSA's for adequate representation. It

Appendix table 5--Hypothetical index from procedure 5 for one SMSA

(1)	(2)	(3)	(4)	(5)
Firm and supermarkets in sample	Computed index carried forward 1/	Sample weight	[(2)(3)]	(4) / (5)
1:				
a	106.17	9	955.53	
b	105.00	9	945.00	
c	110.00	9	990.00	
2:				
d	99.00	5	495.00	
e	90.00	5	450.00	
f	95.00	5	475.00	
3:				
g	110.00	4	440.00	
h	100.00	4	400.00	
i	90.00	4	360.00	
4:				
j	120.00	3.33	399.60	
k	110.00	3.33	366.30	
l	135.00	3.33	449.55	
5:				
m	102.00	4.50	459.00	
n	105.00	4.50	472.50	
6:				
o	105.00	2	210.00	
All others:				
p	130.00	5	650.00	
q	140.00	5	700.00	
r	99.00	5	495.00	
s	95.00	5	475.00	
t	115.00	5	575.00	
Total	NA	100.00	10,562.48	105.62

NA = Not applicable.

1/ The index for each supermarket was computed and reported as the total of column 6 in text table 4.

also was necessary to restratify ex post to assure that unbiased estimates were obtained for each type of location and extent of functional integration stratum. The new strata weights were incorporated into the firm weight system described above. All stores from the primary sample were included together with the added low-income area supermarkets.

Stratum Identification and Supermarket Classification

Appendix table 6 presents the 16 strata into which any supermarket could fall when classified by location and functional integration characteristics. There are four locations and four integrational possibilities which, when combined, result in the 16-cell structure. Within the boundaries of the principal central city, a supermarket may be in either a low-income (CC/LI) or a greater than low-income (CC/GTLI) zip code area.7/ Likewise, outside of the central city's boundaries (called residual SMSA or RSMSA) a supermarket may be in either income category. In terms of integration, a supermarket may operate neither a buying office nor distribution center (nonintegrated (NI)); operate at least one buying office (partially integrated (PI)); operate at least one buying office and one distribution center (substantially integrated (SI)); or operate multiple buying offices and distribution centers (fully integrated (FI)).

Appendix table 6 contains the number of supermarkets within each stratum, when the 322 sample supermarkets were distributed by location and integration categories. Few low-income area supermarkets are outside of the political boundaries of the central city. Therefore, we had to consolidate cells. Also, differences between substantially and fully integrated supermarkets were unimportant; thus these cells were also consolidated and classified as extensively integrated. Even so, this 16 strata example shows how the weighting procedure was used. Consolidation to 12 strata occurred only after all 16 strata had been derived and quantitative results studied.

7/ Zip code areas were classified using 1980 Census of Population data (4). If a zip code area had at least 20 percent of its component households at or below the poverty income level, it was treated as a low-income area.

Appendix table 6--Composition of 10-SMSA expanded sample with randomly selected low-income area supermarkets

Location sectors	Functional integration of supermarkets				
	None	Partial	Substantial	Full	Total
	Number				
Central city:					
Low income	35	23	5	23	86
Greater than low income	16	13	14	33	76
Residual SMSA:					
Low income	1	1	1	3	6
Greater than low income	33	25	32	64	154
Total	85	62	52	123	322

Calculating Sample Weights for Individual Supermarkets

The total number of supermarkets constituting each income and location integration stratum was summed to obtain stratum weights, consisting of the stratum's share of total supermarket sales for its SMSA. For example, the central city, greater than low-income, full integration (CC/GTLI/FI) stratum, includes the supermarkets of two leading firms and four nonleading firms (app. tables 7 and 8). Both of the leading firms in our example have only one supermarket located in this CC/GTLI/FI stratum, in the central city boundaries. Leading firm 1 has a supermarket, coded 110602, and leading firm 2 has a supermarket, coded 110703. The residual four sample firms (supermarkets) in this stratum are nonleading

Appendix table 7--Hypothetical supermarket SMSA assignment by location and functional integration 1/

Location sectors	Functional integration of supermarkets			
	None	Partial	Substantial	Full
	Number			
Central city:				
Low income	114401	114801	112345	110301
	114501		112346	110302
	114601			110401
	114901			110502
				110503
				110504
				110509
Greater than low income	113701	113201	113456	110602
	113901	113201	113467	110703
	113001			118901
	113801			117901
				116901
				115901
Residual SMSA:				
Low income	114001	113601	113570	110202
	114002	113601		110203
	114002			
	114007			
	114008			
	114009			
	114010			
	114013	114560	113570	110901
Greater than low income	114014	114670		110902
	114015			
	114016			

1/In this hypothetical illustration, no effort was made to include an identical number of supermarkets in a cell that would match the number of supermarkets in the corresponding cell in appendix table 6. Once consolidated, the combined substantial and fully integrated categories were called extensively integrated.

Appendix table 8--Sample weights for individual central city supermarkets, hypothetical example for the one SMSA

Location-integration strata, firms, and sample supermarket 1/	Location-integration strata weight 2/ (1)	Firm share of stratum weight (2)	Sample supermarket's share of -- Firm weight (3)	Sample supermarket's share of -- SMSA sales 3/ (4)
CC/LI/NI	0.060			
Firm 1		0.20		
Supermarket 1			1.000	0.01200
Firm 2		.18		
Supermarket 2			1.000	.01080
Firm 3		.12		
Supermarket 1			.500	.00360
Supermarket 2			.500	.00360
Remaining firms		.50		
Supermarket 1			.200	.00600
Supermarket 2			.200	.00600
Supermarket 3			.200	.00600
Supermarket 4			.200	.00600
Supermarket 5			.200	.00600
CC/LI/PI	.015			
Firm 1		.42		
Supermarket 1			.333	.00210
Supermarket 2			.333	.00210
Supermarket 3			.333	.00210
Firm 2		.18		
Supermarket 1			1.000	.00270
Firm 3		.15		
Supermarket 1			1.000	.00225
Firm 4		.10		
Supermarket 1			1.000	.00150
Remaining firms		.15		
Supermarket 1			.50	.00113
Supermarket 2			.50	.00113
CC/LI/SI	.025			
Firm 1		.35		
Supermarket 1			1.000	.00880
Firm 2		.33		
Supermarket 1			1.000	.00830
Remaining firms		.32		
Supermarket 1			.250	.00800
Supermarket 2			.250	.00800
Supermarket 3			.250	.00800
Supermarket 4			.250	.00800
CC/LI/FI	.0675			
Firm 1		.40		
Supermarket 1			.500	.01350
Supermarket 2			.500	.01350
Firm 2		.25		
Supermarket 1			1.000	.01688
Firm 3		.35		
Supermarket 1			.250	.00591
Supermarket 2			.250	.00591
Supermarket 3			.250	.00591
Supermarket 4			.250	.00591
CC/GTLI/NI	.0300			
Firm 1		.65		
Supermarket 1			1.000	.01950
Firm 2		.30		
Supermarket 1			1.000	.00900
Remaining firms		.05		
Supermarket 1			.500	.00075
Supermarket 2			.500	.00075
CC/GTLI/PI	.0525			
Firm 1		.50		
Supermarket 1			1.000	.02625
Firm 2		.50		
Supermarket 1			.500	.01313
Supermarket 2			.500	.01313
CC/GTLI/SI	.2625			
Firm 1		.50		
Supermarket 1			1.000	.13125
Firm 2		.50		
Supermarket 1			1.000	.13125
CC/GTLI/FI	.3000			
Firm 1		.60		
Supermarket 1			1.000	.18000
Firm 2		.30		
Supermarket 1			1.000	.09000
Remaining firms		.10		
Supermarket 1			.25	.00750
Supermarket 2			.25	.00750
Supermarket 3			.25	.00750
Supermarket 4			.25	.00750

1/ Firms with at least 10 percent of sales in column 2, and all firms with 2 or more sample supermarkets in a stratum area, are listed separately in the computer. All others are included in remaining firms. The remaining firms' share of sales in a stratum is divided equally among the remaining sample supermarkets.

2/ Percentage of total SMSA supermarket sales.

3/ Values in column 4 were calculated by multiplying supermarkets' share of firm weight (col. 3), by firm share of stratum weight (col. 2); the product was then multiplied by the stratum's share of SMSA sales (column 1 = Location-integration strata weight).

firms, have only one supermarket each, and are coded 118901, 117901, 116901, and 115901. A firm is treated as a leading firm only if its sales represent at least 10 percent of the total stratum sales.

The sum of each SMSA's strata shares must equal 100 percent. Within each stratum, the share of total stratum sales of component firms must also sum to 100 percent. In this illustration (app. table 8), which covers only the central city portion of the SMSA, the share of SMSA sales of the strata composing this portion totals 81.25 percent, the residual 18.75 percent being accounted for by the strata that constitutes the RSMSA. The total RSMSA strata shares would not have exceeded 18.75 percent of the total SMSA sales for this illustration if we had included the RSMSA portion in this example.

In our illustration (limited to the central city portion of the SMSA and the CC/GTLI/FI stratum), the stratum accounts for 30 percent of total supermarket sales of the SMSA (column 1). Within the CC/GTLI/FI stratum, leading firm 1 accounts for 60 percent of this stratum's total supermarket sales; leading firm 2, 30 percent; and the residual four firms, 10 percent in total (column 2). Column 3 allocates the share among supermarkets of the same firm. Leading firm 1 has one supermarket in this stratum, so its weight is 1. The same applies to leading firm 2. The four remaining nonleading firms equally distribute their aggregate of 10 percent, or 0.25 for each firm's weight (column 3).

The weight for each supermarket (its share of SMSA sales) is reported in column 4, appendix table 8, and computed by multiplying column 2 by column 3, and then by column 1. Thus, for leading firm 1, (0.60) (1.000) (0.30) equals 0.18; for leading firm 2, (0.30) (1.000) (0.3000) equals 0.0900; and for each of the remaining supermarkets, (0.10) (0.25) (0.3000) equals 0.00750. The sum for this stratum's supermarkets must equal 0.3000.

In aggregate, these supermarket weights can be used for evaluating index values of any desired group of stores in an SMSA. SMSA aggregates have been averaged with other SMSA's, with each SMSA weighted equally (app. table 9).

Appendix table 9--Adjusted-weight hypothetical stratum index

Stratum and supermarket	Individual supermarket index from column 6, text table 3		Weights computed using procedure in column 4, appendix table 8	[(3)(4)]	(5)/(4)
	Supermarket	Index			
(1)	(2)	(3)	(4)	(5)	(6)
Central city supermarkets (CC/GTLI/FI):	110602	106.17	0.1800	19.1106	
	110703	110.00	.0900	9.9000	
	118901	115.00	.0075	.8625	
	117901	125.00	.0075	.9375	
	116901	100.00	.0075	.7500	
	115101	103.00	.0075	.7725	
Total	NA	NA	0.3000	32.3331	107.78

NA = Not applicable.

To compute the hypothetical average five-person household TFP basket price (cost) index for greater than low-income, full integration supermarkets for the central city portion of all 10 SMSA's, the weighted mean would be computed for each SMSA as indicated above, the results summed and then divided by 10.

For example, appendix table 9 reports the adjusted weighted index for the CC/GTLI/FI supermarkets for the central city for one SMSA. Column 3 is obtained by transcribing the index value computed for each supermarket from text table 3 (computed individually for each supermarket). Column 4 consists of the computed weights transcribed from appendix table 8. Column 5 is derived by multiplying columns 3 and 4. Column 6 represents the sum of column 5 divided by the sum of column 4. This is the hypothetical adjusted stratum weight for a single SMSA.

In turn, the 10-SMSA aggregates can be summed and divided by 10 to obtain the adjusted-weight index for the combined SMSA's. To compute the average five-person TFP basket index for the greater than low-income full integration stratum for the central city portion of the 10 SMSA'S (our hypothetical illustration), appendix table 10, column 1, identifies each of the SMSA'S; column 2 represents the weighted stratum index computed for each, and reported by each SMSA in appendix table 9. Then the sum of column 2, appendix table 10, divided by 10, equals the 10-SMSA adjusted-weight index for this stratum, or 113.68.

APPENDIX II: ADDITIONAL REGRESSION ANALYSES

In the initial regression equation, variables were not transformed to natural logarithms, and no locational dummies were entered. Also, several variables in the initial regression were later dropped. Appendix table 11 contains the coefficients computed with the initial regression comparison. The coefficients do not account for curvilinear associations and certain statistical problems uncovered after the initial analysis.

Appendix table 10--10-SMSA adjusted-weight hypothetical index for central city (greater than low-income, full integration strata)

SMSA (1)	Stratum (2)	10-SMSA adjusted-weight index in (2) / 10 (3)
Atlanta, GA	107.78	
Boston, MA	110.00	
Denver, CO	115.89	
Detroit, MI	130.24	
Houston, TX	102.00	
Los Angeles, CA	124.90	
New York, NY	145.00	
Philadelphia, PA	100.00	
Pittsburgh, PA	100.00	
St. Louis, MO	101.00	
Total	1136.81	113.68

Variables Excluded Prior to Final Model Treatment

Five considerations were involved when excluding variables: reassessment of quality and relevance of data series, statistical significance, correctness of sign, multicollinearity, and alternative available variables.

Total Compensation

Data were collected by firm. Multi-establishment companies reported a single data set, composed of hourly wages and fringe benefits for their company, rather than one for each establishment. Multi-establishment firms located in the same SMSA (particularly leading firms) tend to have similar union contracts. Therefore, there are relatively minor variations in calculated compensation among chains in the same SMSA, even when fringe benefits are included.

Differences in compensation per hour do not necessarily indicate differences in actual labor costs per unit of output because of differences in productivity.

Appendix table 11--Initial regression equation explaining differences among price indexes for 322 supermarkets in 10 SMSA's

Independent variables	Adjusted R^2 = 0.5423			
	Form of entry	Parameter estimates	Standard errors	Probability of t
(1)	(2)	(3)	(4)	(5)
Intercept	Computed	102.6001	3.1959	0.0001
Partial integration	Dummy	- .6970	.7752	.3693
Extensive integration	Dummy	-1.2972	.7741	.0948
Total compensation	Dollars per hour	- .0094	.1049	.9286
Insurance cost	Index	.0182	.0077	.0191
Occupancy cost	Index	.0015	.0084	.8576
Sales area	Index	.0000	.0000	.2720
Sales per square foot	Dollars	.0008	.0013	.5293
Services index	Index	.0013	.0123	.9142
Warehouse supermarkets	Dummy	-16.2608	1.4168	.0001
Front-door stocking	Dummy	1.7734	1.0676	.0977
Food stamp redemptions/sales	Percent	- .1626	.0457	.0004
Electronic scanning	Dummy	- .3223	.6571	.6241
Transportation costs	Index	- .1191	.0277	.0001
Firm in shopping center	Dummy	- .4676	.5103	.3602
Herfindahl index	Index	.0000	.0005	.9671
Store market share in zip code	Percent	- .0331	.0916	.0920
Reciprocal of number of supermarkets in zip code	Reciprocal	3.1695	2.1189	.1358
Socioeconomic status	Index	.1106	.0277	.0001
Households without car	Percent	.0907	.0227	.0001
Households at or below poverty income level	Percent	.1067	.0509	.0367

For example, we calculated payroll as a percentage of total sales for another subsample of supermarkets in the 28 SMSA's (those with available data). Warehouse supermarkets had average compensation that was 15 percent below the average for all chains, but payroll per dollar of sales was 35 percent lower. With adjustments for different price levels, payroll per dollar of real volume was 45 percent lower at warehouse supermarkets. We suspected that the owner's time and compensation were not fully included in labor costs at many independent supermarkets. As a result, labor costs may not be represented adequately by total compensation. Compensation, therefore, may not have a strong effect on price.

Occupancy Cost

We derived proxy estimates from four sources because field collection was not successful (28, 31, 36, 37). ERS staff created a combined occupancy cost index. The 28 SMSA-wide mean was the base. Across the 28 SMSA's, the index mean of 222.9 had a relatively modest standard deviation of 51.2. The derived indexes do not appear to adequately reflect real estate costs for individual supermarkets in metropolitan areas. At the firm level, the proxy data were more questionable than those generated for total compensation. At best, these data reflected variations among the 28 SMSA's and, in a few instances, in parts of SMSA's where they were serviced by different utility companies.

Sales Area

These data were collected by the Pinkerton company following ERS measurement instructions. The variable was included to pick up any link between price index levels and supermarket economies of size. If prices reflected measurable economies of size, the sign should be negative. As square footage increased, the level of the market basket indexes would decrease.

The mean square footage was 16,587, and the standard error amounted to 9,675 square feet. The estimated coefficient was small and not statistically significant. The computed t value could have occurred due to chance 27 out of 100 times. There was some weak evidence of collinearity. For example, square footage is related to the following with simple r's: socioeconomic status, 0.39; households without a car, -0.46; and percent of households at or below the poverty income line, -0.41.

Sales Per Square Foot

This variable measures turnover; with greater turnover, supermarket costs should fall. The sign was expected to be negative, indicating that as turnover increased (costs decrease), the market basket index would fall. Sales per square foot varied widely from $196.67 to $1,711.98. The coefficient was 0.0008, and the associated computed t value could occur by chance 53 out of 100 times. The simple r relating sales per square foot to the market basket index was -0.07. While the sign was correct, a larger computed t value could occur due to chance 20 out of 100 times. There was no available alternative variable.

Electronic Scanning

This dummy variable was inserted to capture the amount of the variation among market basket indexes that might be associated with the use of scanners. The expected sign was negative.

Scanners usually are introduced gradually. It is rare for a firm to simultaneously equip each of its establishments. We do not know what proportion of scanner-equipped firms in the same SMSA were completely equipped. It is possible that the cost savings (or some of them) associated with scanning are not passed to patrons until all establishments of the firm are equipped and the firm has had some operating experience.

While the negative sign was consistent with the theoretical expectation, a larger computed t value could occur due to chance 62 out of 100 times. The simple correlation coefficient between the scanning dummy and the supermarkets' market basket index was negative, but the -0.06 coefficient indicated a weak association, and that coefficient's computed t value could have occurred by chance 27 out of 100 times. This variable was excluded because of its weak association.

Transportation Costs

Because transportation costs represent a high proportion of the cost of dairy, meat products, and produce, an effort was made to derive transportation cost variations among SMSA's. ERS staff constructed an index to quantify such inter-SMSA variations. It was computed independently for dairy, produce, and meat products and then combined in an aggregate index, weighted according to the relative sales importance of each commodity group within supermarkets. We did not differentiate among firms or establishments in individual SMSA's.

All data were converted to index units where the 28-SMSA average equaled 100. These indexes were averaged using weights reflecting each product's share of total supermarket sales, without regard to the differences in the importance of transportation costs across commodities.

The initial regression equation's results had statistical inconsistencies. The coefficient's negative sign (app. table 11) conflicts with economic theory and observations. Therefore, the data used to construct the variables were reviewed along with the variable's links to other independent variables specified in the initial equation, and to the total market basket and supermarket department indexes.

The transportation index had three components, dairy, meat, and produce, but the dairy component dominated the index because of its large intermetropolitan differences. The dairy component was based on the distance of the SMSA from Wisconsin, the leading dairy producer. We felt that this was a poor proxy for actual dairy transportation costs, because of the local nature of the industry.

The transportation cost index did not vary across stores in an SMSA. Therefore, a variety of broad SMSA-specific differences unrelated to transportation costs appear to influence this index. We captured those differences by including dummy variables for each SMSA, so we dropped the transportation variable and included the SMSA dummies.

Firms in Shopping Centers

This dummy variable's coefficient was not statistically significant. Following the initial treatment, a tabulation was made to identify the characteristics of firms located in shopping centers. One hundred and fifty-five (48.1 percent) of the 322 supermarkets constituting the 10 SMSA's were in shopping centers, and most were extensively integrated.

Earlier data showed that the extensively integrated supermarkets generally had lower market basket indexes than did other supermarkets. The low coefficient and lack of statistical significance for the shopping center dummy may be linked in part to the strength of the extensively integrated variable; that is, both should relate to the same link. This variable was, therefore, deleted.

Each Supermarket's Sales and Total Sales of All Supermarkets in Same Zip Code Area

Market shares are widely used measures of market power, but the theoretical support for their use is weak. They are insensitive to the number and relative size of competitors, which are the usual focus of theories of competition. Both competition variables (market share and the reciprocal of the number of supermarkets in each zip code area) were incorporated in the initial regression comparison. However, the sign on market share was not stable; it was negative when the reciprocal measure was also included and positive when it was not. The two competition measures were highly correlated ($r = 0.8$). Market share was dropped from the final regression analysis in view of the correlation between the two, the instability of the share coefficients value, and the theoretical weakness of the measure.

Households At or Below the Poverty Income Level

This measure was almost completely accounted for by zip code socioeconomic status score and the percentage of households without a car. The multiple correlation coefficient, reflecting the association among the variables, was 0.97. This socioeconomic status score is a somewhat more powerful measure of socioeconomic conditions than is the poverty income level. The socioeconomic status score was used, and the poverty income measure was excluded.

Alternative Regressions

Appendix tables 12 and 13 provide additional regression results for comparisons of alternative specifications. The regressions of appendix table 12 include dummy variables for each SMSA, while appendix table 13 excludes them. Several alternative transformations of the variables are used in each table. For example, column 1 in appendix table 12, the dependent variable, and all continuous independent variables are in natural logarithms; the only difference from the regression reported in appendix table 13 is the exclusion of SMSA dummies. Variables are not transformed to logarithms in the right-hand columns of appendix tables 12 and 13, while semi-log regression results are reported in the other columns. The results are generally robust to variable transformations, while some coefficients are sensitive to the inclusion of SMSA dummies. Specific differences are discussed in the text.

Appendix table 12--Market basket index regressions, without location dummies

Independent variables	Specifications 1/ Log-log (1)	Natural-log (2)	Log-natural (3)	Natural-log (4)
Intercept	4.3246	74.83	4.4832	94.38
	(48.88)	(8.71)	(92.42)	(47.09)
Partial integration	-.0057	-.42	-.0090	-.706
	(.72)	(.54)	(1.14)	(.92)
Extensive integration	-.0177	-1.71	-.0176	-1.614
	(2.69)	(2.63)	(2.72)	(2.53)
Socioeconomic status	.0344	3.64	.0007	.076
	(2.24)	(2.40)	(3.02)	(3.20)
Insurance cost	.0217	2.04	.0002	.019
	(2.78)	(2.65)	(2.60)	(2.43)
Services index	.0092	.36	.0146	.005
	(.94)	(.37)	(1.48)	(.47)
Competition	-.0032	-.35	-.0031	-.589
	(.81)	(.31)	(.79)	(.53)
Households without car	.0079	.82	.0006	.064
	(2.46)	(2.58)	(3.99)	(4.00)
Warehouse supermarket	-.1901	-17.42	-.1817	-17.160
	(11.69)	(10.85)	(11.21)	(11.84)
Front-door stocking	.0204	2.11	.0146	1.463
	(1.80)	(1.89)	(1.29)	(1.31)
R^2	.49	.45	.51	.47

1/ The first term in each column's heading refers to the dependent variable, and the second refers to the continuous independent variables. Numbers in parentheses in the data field are t statistics.

Appendix table 13--Additional market basket index regressions, with location dummies

Independent variables	Specifications 1/		
	Natural-log (1)	Log-natural (2)	Natural-natural (3)
Intercept	56.20	4.4872	54.36
	(6.53)	(200.86)	(6.34)
Partial integration	-.58	-.0073	-.614
	(.86)	(1.05)	(.90)
Extensive integration	-2.11	-.0183	-2.09
	(3.78)	(3.23)	(3.75)
Socioeconomic status	6.33	.0008	6.33
	(4.38)	(3.39)	(4.37)
Insurance cost	1.44	.0001	1.47
	(1.50)	(1.33)	(1.54)
Services index	1.30	.0002	1.32
	(1.57)	(1.58)	(1.60)
Competition	.77	.0161	2.00
	(2.15)	(1.56)	(2.00)
Households without a car	1.93	.0009	1.89
	(5.64)	(5.11)	(5.54)
Warehouse store	-13.75	-.1609	-13.73
	(9.80)	(12.23)	(9.78)
Front-door stocking	1.93	.0134	1.86
	(2.05)	(1.38)	(1.98)
Atlanta, GA	8.77	.0750	8.71
	(7.85)	(6.90)	(7.81)
Denver, CO	7.29	.0696	7.30
	(6.84)	(6.43)	(6.84)
Detroit, MI	7.24	.0655	7.15
	(6.23)	(5.69)	(6.17)
Houston, TX	8.47	.0724	8.40
	(7.40)	(6.56)	(7.35)
Los Angeles, CA	3.84	.0376	3.85
	(3.81)	(3.67)	(3.81)
New York, NY	6.04	.0453	5.84
	(6.03)	(4.29)	(5.94)
Philadelphia, PA	1.64	.0091	1.67
	(1.64)	(.90)	(1.66)
Pittsburgh, PA	3.02	.0295	2.99
	(2.72)	(2.57)	(2.69)
St. Louis, MO	3.74	.0262	3.70
	(3.61)	(2.53)	(3.57)
R^2	.61	.63	.61

1/ The first term in each column's heading refers to the dependent variable, and the second refers to the continuous independent variable. Numbers in parentheses in the data field are t statistics.

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