Testing for Store-Level Differences in Factors Affecting Item Movement of Prego and Ragu Spaghetti Sauces Using Point-Of-Sale Data

Seong-Cheon Seo and Oral Capps, Jr.

Using IRI Infoscan store-level data for Prego and Ragu brands of spaghetti sauces, estimates were obtained for own-price, cross-price, and advertising elasticities for Houston, TX and Dallas/Ft. Worth, TX markets via the use of a SUR (Seemingly Unrelated Regression) technique. As well, impacts of featuring, display, and free-standing inserts on movement of spaghetti sauces at the store level were obtained. Dynamics in item movement also were captured. Within a particular market for a given brand, coefficients of factors affecting movement of spaghetti sauce were different across stores.

The use of scanner data enables us to consider applications at the store-level rather than at more aggregate levels. Examples of such applications include evaluation of shelf space allocation; evaluation of advertising and promotion schemes; evaluation of new products; and estimation of price and total expenditure elasticities at the store-level. Our paper deals with two major tasks (1) analysis of store-level demand of two spaghetti sauce brands (Prego and Ragu) within particular markets (Houston, TX and Dallas/Ft. Worth, TX); and (2) testing for store-level differences in factors affecting item movement of the respective spaghetti sauces within the above markets. We also consider dynamic effects in store-level demand models. We carry out the aforementioned tasks through the use of SUR (Seemingly Unrelated Regression) which takes into account interactions across the different stores within a specific market.

On the matter of data, we employ IRI Infoscan data; we focus only on two different brands such as Prego and Ragu whose combined market shares in our sample are nearly 70 percent. The data are weekly, over the period of June 3, 1991 to May 31, 1992. This paper makes a contribution to the literature in the following ways: (1) little information exists pertaining to individual store-level demand on brands; (2) only a few previous studies have utilized data indigenous to the store-level.

As examples of previous research in the application of store-level data, Funk, Meilke, and Huff (1977) reported on the estimation of retail demand functions for beef for individual supermarket chains in the Toronto market. They derived price and advertising elasticities for beef using weekly data. As exhibited in Table 1, own-price elasticities associated with two supermarket chains in Toronto were −1.52 for Dominion and −5.97 percent for Food City. As well, the advertisement medium for beef was local newspapers. The advertisement elasticities were 0.12 and 0.15 respectively for the two food chains in the Toronto market.

McLaughlin and Lesser (1986) reported on the experiment of systematically varying prices and tracking subsequent movement of potatoes through the use of scanner data. With this approach, the researchers calculated appropriate store-specific demand elasticities based on data over a 42-week period from eight retail food stores in upstate New York. Retailers could make use of store-specific elasticities to assess impacts of promotional activity, to determine optimal space allocation and to develop sales management models. Based upon their price simulations, own-price elasticities varied from −1.42 to −1.75 re-

The authors are, respectively, Graduate Research Assistant and Professor in the Department of Agricultural Economics at Texas A&M University. The authors wish to acknowledge funding for this project from the National Institute for Commodity Promotion Research and Evaluation. Special recognition in this regard is due to Olan Forker and Harry Kaiser. The authors also wish to acknowledge Jeanne Livelsberger and Joe Kolano from Information Resources, Inc., for their assistance in providing us with the Infoscan data.

Table 1. Estimates of Own-Price and Advertisement Elasticities for Selected Products Using Scanner Data at Retail Level.

Product	Data Source	Researcher(s)	Elasticities			Advertisement Type
			Own-Price	Advertisement		
Beef (aggregate of 16 different cuts)	weekly/January 1974 to May 1975 two major supermarket chain stores	Funk, Meilke, and Huff				local newspaper advertisement (number of own beef ads)
	Dominion		-1.52	0.12		
	Food City		-5.97	0.15		
Potatoes	weekly/July 27, 1985 to May 5, 1986 8 retail food stores in upstate New York	McLaughlin and Lesser	-1.42 to -1.75[a]			
Meat Cuts	weekly/January 1986 to June 1987 43 stores from a retail food firm in Houston, TX	Capps				amount of print space given for the set of competing meat products in weekly advertising fliers (square centimeters)
Steak			-0.7242	0.0276		
Ground Beef			-0.1525	0.0331		
Roast Beef			-1.2737	0.0358		
Chicken			-0.6557	0.0350		
Pork Chops			-0.7005	0.0096		
Ham			0.3596	0.0251		
Pork Loin			-0.8279	0.0129		
Beef Cuts	weekly/January 1986 to November 1988 43 stores from a retail food firm in Houston, TX	Capps and Nayga				amount of print space given for beef product in the weekly advertisement fliers (square centimeters)
Brisket			-5.732	0.172		
Chuck			-2.902	0.097		
Ground			-1.209	0.040		
Loin			-1.897	0.060		
Rib			-2.146	0.059		
Round			-3.756	0.109		
AOB (All other beef)			-2.895	0.053		
Beef Cuts	weekly/May 21, 1988 to June 29, 1991 5 Kroger supermarkets in Knoxville, TN	Brooker, Eastwood, and Gray		GRPS	Newspaper	GRPS of TV and Radio Ads; newspaper refers to an index to account for characteristics of newspaper ads such as number of ads, page location, and the use of color
Ground			-1.16			
Roast			-1.55	0.07	0.008	
Steak			-1.01	0.77	0.030	
				0.06	-0.0005	

[a] Different elasticities based upon the different price simulation in stores.

spectively. They did not account for any type of advertisement in their analysis.

Capps (1989) and Capps and Nayga (1991) estimated demand relationships for various meat products using weekly data from 43 supermarkets from a leading chain in Houston. In the Capps (1989) study, price and advertisement elasticities with respect to different meat cuts were estimated. Also Capps accounted for advertisement effort to promote different meat cuts in the food

firm using amount of print space given to the individual meat cuts in weekly fliers. Most own-price elasticities were in the inelastic range except for roast beef. However, the own-price elasticity associated with ham was positive rather than negative. All elasticities of newspaper advertisement are positive, and ranged from 0.0096 (Pork Chops) to 0.0358 (Roast Beef). In Capps and Nayga (1991) study, the same source of data was used as in the Capps study except for the expanded time frame and different commodities such as beef cuts rather than meat cuts. Also, they accounted for advertisement effort in the same way, using the amount of print space given for beef products in weekly advertisement fliers. In this analysis, all own-price elasticities were in the elastic range from -1.209 (Ground Beef) to -5.732 (Brisket). As well, the advertisement elasticities ranged from 0.040 (Ground Beef) to 0.172 (Brisket).

Brooker, Eastwood and Gray (1994) also analyzed the demand for selected beef cuts using weekly scanner data from five supermarkets of a chain store in Knoxville. They accounted for advertisement by using gross rating points (GRPS) and by developing an index of newspaper advertisement. This index took into account number of advertisements, page location, and the use of color. The beef cuts were ground, roast, and steak. All own-price elasticities were elastic and most advertisement elasticities were positive, except for the newspaper advertisement of steak.

All these studies used weekly scanner data, and with the exception of the McLaughlin and Lesser work, all products analyzed were meat cuts. Further, except for the work of McLaughlin and Lesser, all of the aforementioned studies accounted for advertising effort. The most common measure of advertising effort was the amount of print space in weekly fliers. Brooker, Eastwood, and Gray considered both TV advertisement and newspaper advertisement in their research. In this paper, we attempt to build on these previous works, illustrating how to use IRI data to investigate store-level variability of price and advertising elasticities for two brands of spaghetti sauces. This information is especially important in empirical analysis of pricing and promotion strategies for individual store managers and perhaps also for manufacturers.

Model Development

We apply SUR based upon individual store level data with respect to two different major brands (Prego and Ragu) in two markets: the Houston market and Dallas/Ft. Worth market. For each of the markets, there are two SUR models with respect to all stores for the Prego brand and for the Ragu brand. The dependent variable in each model corresponds to the units of spaghetti sauce sold per week. The explanatory variables are the following: (1) own and competitor prices (Prego or Ragu) within a store; (2) use of displays within the store and featuring in newspaper fliers by the store; (3) face value of free-standing inserts (coupons); (4) TV advertising dollar expenditure; (5) seasonality; (6) a weighted price for the brand in competing stores; and (7) allowance for dynamic effects via a lagged dependent variable.

Holdren (pp.117-123) provides the conceptual framework for this analysis. Attention is centered on multi-product retail demand functions. According to Holdren (p.123) "the multiple product retail demand function can be characterized by $q_i = f_i(p_1, p_2 \ldots, p_n, a_1, a_2, \ldots, a_m)$, where the q's represent quantity variables expressed in appropriate units, the p's represent price variables, and a's represent attributes of retailer's non-price offer variation. Advertising, sales promotion activities, hours open, and customer service are concrete examples of non price offer variation." Funk, Meilke, and Huff augment Holdren's model by considering in-store and competitors' prices as well as in-store and competitor's advertising.

Regarding featuring and display behavior, some stores did not conduct any special promotion activity associated with displays or featuring in our sample. In this case, we excluded the display or featuring variables for that particular equation. Mathematically, our SUR model can be expressed as:

(1)

$$\ln Q_{ikt} = \alpha_{1ik} + \alpha_{2ik} \ln P_{ikt} + \alpha_{3ik} \ln P_{ijt} + \alpha_{4ik} FEATURE_{ikt} + \alpha_{5ik} DISPLAY_{ikt} + \alpha_{6ik} FVALUE_{ikt} + \alpha_{7ik} (TVADS)_{itk}^{\frac{1}{2}} + \alpha_{8ik} QTT2_t + \alpha_{9ik} QTT3_t + \alpha_{10ik} QTT4_t + \alpha_{11ik} \ln Q_{itk-1} + \alpha_{12ik} \ln COMPRICE_{ikt} + \in_{ikt},$$

where

Q_{ikt} = number of units of product k sold in store i in time period t;
P_{ikt} = price of product k in store i in time period t;
P_{ijt} = price of product j in store i in time period t;
$FEATURE_{ikt}$ = 1 if featuring occurred for product k in store i in time period t; 0 otherwise;
$DISPLAY_{ikt}$ = 1 if product k in store i was subject to an in-store display in time period t; 0 otherwise;
$FVALUE_{ikt}$ = face value of coupon for product k in store i in time period t;
$TVADS_{ikt}$ = moving average of television advertising expenditures for product k in store i in time period t; and
$COMPRICE_{ikt}$ = a weighted average of prices for product k for store i from competing stores in time period t.
The subscripts k and j refer to the products, Prego and Ragu, respectively. The subscript i refers to the different stores within each market; *QTT2*, *QTT3*, and *QTT4* are quarterly dummy variables to reflect seasonality. Prices from competing stores for any time period are weighted average prices for the commodity across all stores in the market excluding itself.

To account for the effect of TV advertisement (dollar expenditure per week), there are several different ways to proceed. Empirical findings from previous studies support the hypothesis that advertising has carry-over or lagged effects (e.g., Nerlove and Waugh; Waugh; Ward and Lambert; Ward and Dixon; Wohlgenant and Clary). However, theory provides relatively little guidance as to the structure and length of these dynamic processes. Conventionally, researchers, through the use of statistical criteria like the Akaike Information Criterion (AIC) or the Schwarz Loss Criterion (SLC), allow the data to choose the optimal number of lags to include in the specification of an advertising stock variable. The coefficients associated with the contemporaneous and lagged advertising expenditures also are commonly assumed to be a free-form lag or to follow some type of distribution, e.g., a geometric decay or a polynomial (or Almon) distributed lag. To illustrate, Piggott, Chalfant, Alston, and Griffith (1996) consider the advertising process to follow a free-form lag of four quarters. Cox (1964), as well as Brester and Schroeder (1995), use a second-order exponential lag distribution of a particular length. Baye, Jansen, and Lee (1992) employ a geometric lag.

In our analysis, we deviate from the norm through the use of an 8-week moving average for television advertising expenditures. Based on our previous research in a paper entitled "Measurement of Advertising Effort: The Issue Revisited," the mean lag of TV advertisement (dollar expenditure) was 7.74 weeks. We assume that the 8-week moving average is a reasonable length of lag to capture the trend of TV promotion activity on the sales of spaghetti sauces. The use of moving-averages simplifies the analysis, but at the same time allows us to control for advertising effects. Additionally, to consider diminishing marginal returns to advertising, we use a square root transformation for the moving-average term.

Data

Our data set corresponds to weekly sales (in dollars) and movement (number of items sold) information collected by IRI over the period June 3, 1991 to May 31, 1992 for individual stores from the Houston and the Dallas/Ft. Worth markets. Promotion variables such as featuring, display, coupon face value, and TV advertisement $ expenditure also are given for the brands of Prego and Ragu for each supermarket in Houston, TX and Dallas/Ft. Worth, TX for each of the 52 weeks in our sample. The rationale to focus on only those two markets is that, even though we have additional information on 50 other markets, we wish to concentrate our attention on markets within Texas. Of course, this analysis could be replicated using other markets areas. Descriptive statistics by store for each brand and market are available from the authors.

Concerning the issue of data confidentiality, even though we acquired the store-level data from IRI, we are not able to identify the specific name of each store within a given market. Instead, we designate the individual store as a numerical number and the different number distinguishes the source of data from one store to another store in each market area.

In case of Prego, there are 33 stores in the Houston market, and in the case of Ragu, there are 29 stores in the Houston market in our sample. In the Dallas/Ft. Worth market, the number of stores is 26 for Prego and 21 for Ragu.

The use of IRI data in market analysis is not unique to this study. Iskow, Kolodinsky and Russo (1994) used movement data from IRI to analyze the demand for maple syrup. They estimated price and promotion elasticities for five leading brands of maple syrup. Cotterill (1994), using IRI data, estimated demand elasticities for carbonated soft drinks, including Coke, Pepsi, and Dr. Pepper. Capps, Seo, and Nichols (1997) also used movement data from IRI to estimate own-price, cross-price, and total expenditure elasticities as well as own- and cross-product advertising elasticities via the use of the national level data on item movement of six brands of spaghetti sauces (Prego, Ragu, Classico, Hunt's, Newman's Own, and Private Label).

Estimation Issues

We estimate four different linear systems of seemingly unrelated regressions corresponding to the Prego and Ragu brands for the Houston and Dallas/Ft. Worth markets. In a SUR, we assume that the disturbances in the regression equations are correlated. The variance-covariance matrix of the disturbance terms is incorporated within the estimation procedure. The use of SUR is tantamount to generalized least squares. The estimation procedure assures the large-sample properties of consistency and asymptotic normality of the estimated coefficients so that the conventional tests of significance are applicable. Using the software package SHAZAM version 7.0, estimates of parameters and standard errors are obtained via SUR methods. In our model, because of the lagged dependent variables, we employ the Durbin-h test to examine of first order serial correlation. On the basis of the Durbin-h statistics, in most cases (for 102 out of 109 stores), there is no evidence of serial correlation.

Empirical Results

In Tables 2-5, the estimation results are summarized. We organize this result into four parts, by brand and by market. Each row of the tables represents the response of the individual store within the system of equations in the analysis of a particular brand. As mentioned earlier, because we can not identify the specific name of the stores in the two markets, we designate numerical numbers to distinguish the stores within a market. In addition, missing cells in the tables associated with display or featuring means that the specific stores did not conduct any special promotion activity for the sales of spaghetti sauces (Prego and Ragu) during the 52-week sample period. For estimation details, besides the estimated coefficients, we could provide the standard errors, t-ratios, and p-values associated with all coefficients upon request.

Prego in Houston

As exhibited in Table 2, the signs of the own-price coefficients are negative, conforming to expectations. Except for two stores (store id 13 and store id 27), the coefficients also are statistically significant. For all statistically significant coefficients, all price responses are in the elastic range from -1.1201 (store id 17) to -9.4462 (store id 19). Generally, most within store cross-price coefficients, (those associated with Ragu), are positive (24 out of 33), indicating that Prego and Ragu are substitutes. Seventeen of the cross-price elasticities are positive and significantly different from zero. These 17 range from 0.3853 (store id 9) to 4.2192 (store id 33). The coefficients associated with competing store are expected to be positive; however, out of the 12 statistically significant coefficients, 10 are negative.

Except for a few cases, most featuring and display coefficients are positive and statistically significant. The impacts of coupons are statistically significant and positive in only three stores (store ids 2, 9, 20). The effects of TV advertisement are positive and significant in only six stores

(store ids 2, 9, 18, 19, 24, 26). For about two-thirds of the stores, seasonality in sales is evident. The coefficients associated with the lagged dependent variables are significant in 20 out of the 33 stores. Thus, dynamic effects are evident. Most statistically significant coefficients are negative, which may indicate the presence of inventory effects in sales for Prego spaghetti sauces in the Houston market.

Ragu in Houston

As exhibited in Table 3, the signs of the own-price coefficients also are negative, as expected. Except for three stores (store ids, 13, 30, 31), all coefficients are statistically significant. For these statistically significant coefficients, the price elasticities range from -0.8283 (store id 14) to -16.2554 (store id 19). Regarding cross-price coefficients associated with Prego for 16 of the 29 stores, the coefficients are positive, indicating that in most cases Prego and Ragu are substitutes. Only about a one-third of the within-store, cross-price elasticities are statistically significant; however, of these, 8 are positive ranging from 0.7039 (store id 22) to 1.7656 (store id 11). As the case for Prego in the Houston market, most coefficients associated with prices from competing stores for Ragu are negative; of the 11 statistically significant elasticities, only two are positive (store id 2, 19).

Only a few stores receive statistically significant positive effects on sales from featuring (8 of 29) and displays (11 of 29). For coupon face values, coefficients for only five stores (store ids 1, 11, 22, 25, 29) are statistically significant, and only one store (store id 11) receives a positive effect from free-standing inserts. Only two stores (store ids 21, 22) receive positive statistically significant effects from television advertising. In fourteen stores, seasonality is evident. Dynamic effects are evident in twelve stores, which have statistically significant coefficients associated with lagged dependent variables; of those, nine stores show negative signs and three stores show positive signs. Similar to the case for Prego, inventory patterns of sales for Ragu spaghetti sauce in Houston market appear to dominate over habit persistent patterns.

Prego in Dallas/Ft. Worth

As exhibited in Table 4, the signs of own-price coefficients are negative, conforming to expectations. Except for five stores (store IDs 17, 18, 24, 29, 30), the coefficients also are statistically significant. For all statistically significant coefficients, the own-price elasticities range from -0.7233 (store ID 4) to -11.3542 (store ID 26). Generally, most within-store cross-price coefficients (those associated with Ragu) are positive (23 out of 29), indicating that Prego and Ragu are substitutes. However, only eight of the cross-price elasticities are positive and statistically different from zero. These eight range from 0.3815 (store id 10) to 8.6105 (store id 15). In contrast to the case for Prego in the Houston market, 9 out of the 11 statistically significant coefficients associated with competing stores are positive.

Only a few stores receive statistically significant positive effects on sales from featuring (7 of 26). Only four stores have any type of display for Prego in this market. Three stores (store ids 4, 9, 11) receive statistically significant and positive effects from displays. Only one store (store id 29) receives statistically significant and positive effects from free standing inserts. The effect of TV advertisement is positive and significant in only one store (store id 17). For about thirty percent of the stores, seasonality in sales is evident. The coefficients associated with the lagged dependent variables are significant in 17 out of the 26 stores. Similar to the cases for Prego and Ragu in the Houston market, most statistically significant coefficients are negative which may indicate the presence of inventory effects in sales for Prego spaghetti sauces in Dallas/Ft. Worth market.

Ragu in Dallas/Ft. Worth

As exhibited in Table 5, the signs of own-price coefficients also are negative as expected. Except for seven stores (store IDs 9, 10, 16, 19, 21, 25, 27), all coefficients are statistically significant. For these statistically significant coefficients, the price elasticities range from -0.9561 (store id 1) to -11.4151 (store ID 13). Regarding cross-price coefficients associated with Prego, for 10 of the 21 stores, the coefficients are positive indicating that, in most cases, Prego and Ragu are

Table 2. Summary of SUR Results for Prego Across all Stores in the Houston, TX Market.

STORE ID	LPUNTP	LPUNTR	FEAT	DISP	FACVL	SQSPRG	QTT2	QTT3	QTT4	LLUNTP	CPRGP	CONST	RSQ	Durbin-h
1	-2.3595*	-0.1263	0.3052*	0.4772*	-0.6378*	-0.01545*	0.0437	0.0176	0.0666	0.1210*	1.1305	4.0979*	0.5881	-2.0447**
2	-1.6210*	0.5566*	0.0519		0.4208*	0.01845*	0.0901	0.1349*	-0.1029*	-0.3674*	-1.9130*	6.8127*	0.7061	-0.4536
3	-1.7967*	1.0566*	0.2977*	0.6173*	-0.7692*	-0.03209*	0.2273*	-0.0830	0.0692	-0.0732	0.1251	5.0746*	0.7073	-1.7333
4	-3.9351*	0.2834	-0.0539	0.4381*	-0.0842	0.00240	0.0264	0.1991	-0.1362	-0.2204*	1.4881*	5.8582*	0.6669	1.3570
5	-3.0401*	1.1181*	0.4108*	-0.2508*	-0.4435*	-0.00362	0.0303	-0.2797*	0.0084	0.0832	0.0795	5.1294*	0.7692	-0.1149
6	-2.1684*	0.6498*	0.4558*		0.0705	0.00350	-0.1765*	-0.2026*	-0.2504*	-0.0024	-0.0353	5.6260*	0.7224	-0.4310
7	-1.7682*	1.0153*	0.4330*	0.1968*	0.1335	0.00622	0.0279	-0.0281	0.0366	-0.1714*	-1.1373*	6.0259*	0.7101	-0.7512
8	-2.2891*	0.5212*	0.2217*		0.0760	0.00084	-0.0324	-0.1181	-0.0416	-0.2095*	0.7002	5.7526*	0.5186	-0.0515
9	-1.4494*	0.3853*	0.1825*		0.2825*	0.01431*	-0.0036	0.0794	0.0438	-0.2573*	-1.4492*	6.8057*	0.6511	-0.6338
10	-1.2726*	1.7965*	-0.0174		0.4291	0.01396	-0.9032*	-0.2417	-0.1687	-0.1519*	-2.2953*	4.4922*	0.5319	0.2075
11	-1.8010*	1.7373*	0.1606		0.1423	-0.00132	-0.3382*	-0.0727	-0.2154	0.1096*	0.3422	3.0819*	0.3834	-0.4991
12	-1.6380*	0.9254*	0.3074*		0.0489	-0.00329	-0.3353*	-0.1702	-0.2247	0.1251*	-0.7967	4.3439*	0.3021	0.2433
13	-0.2648	1.1895*	-0.2169*	-0.2021	0.1143	0.00066	-0.3418*	-0.0238	-0.1771	0.0544	-3.0137*	4.7447*	0.3278	-0.3859
14	-3.0227*	0.7745*	0.1506		0.2161	0.00001	-0.4787*	-0.3804*	-0.3913*	0.0257	-0.2332	5.5944*	0.4989	-1.6983
15	-2.5112*	1.0639*	-0.1896		-0.1316	-0.00005	-0.4134*	-0.0395	-0.1806	-0.0436	-1.3042	5.5189*	0.4085	-0.2697
16	-2.8085*	0.2056	0.1988*		-0.2729	0.00917	0.0505	0.0251	-0.2375*	-0.0802	-1.1456*	6.4264*	0.7141	-0.6353
17	-1.1201*	0.2455	0.3397*	0.2225*	-0.3805	-0.00111	0.2355*	-0.0414	0.0849	-0.0759	-2.0384*	5.4799*	0.4582	0.2328
18	-1.4810*	-0.1623	0.5998*		0.4262	0.02336*	0.1422	0.4502*	-0.3195*	-0.1363*	-0.2453	3.2035*	0.6929	0.8236
19	-9.4462*	-1.5456	-1.1851*		-0.4874	0.02754*	-0.5468*	0.0066	-0.5030*	-0.0511	1.6274	8.3873*	0.4267	-0.3263
20	-0.9889*	-0.2918	0.7696*		0.5835*	0.00528	0.1677	0.4200*	0.2068	-0.1927*	0.9049	2.7781*	0.5185	1.1579
21	-0.9267*	-0.0058	0.1805*	0.3054*	-0.3249*	-0.00376	-0.0989	-0.0204	-0.0871	0.0539	-1.4674*	5.8146*	0.7547	0.7929
22	-0.9794*	-0.7009*	0.5652*	0.4566*	-0.6974*	0.00599	0.1763	0.1976	0.1076	0.3367*	0.0825	3.0135*	0.5647	-1.1020
23	-2.2959*	0.5653*	0.3219*	0.2095*	-0.2252	0.00106	0.0736	0.1288	-0.1240	0.1824*	0.7948	3.7323*	0.7110	-1.2306
24	-0.8343*	0.8156*	0.3499*	0.5519*	-0.0349	0.01567*	-0.3319*	-0.0646	-0.2410*	0.0997*	-0.5785	2.7094*	0.7991	-0.1101
25	-3.0852*	0.3727	0.1655	-0.0143	-0.1308	-0.00099	-0.0883	-0.2875	-0.3012	0.1192	0.5528	4.1327*	0.4243	0.7148
26	-1.4229*	0.6920	1.3250*		0.4726	0.02017*	0.2398	0.3518	0.0079	-0.1176*	-2.5185*	4.9444*	0.2739	1.2985
27	-0.0689	-0.7288*	0.4287		0.4850	0.00907	-0.4618*	-0.2300	-0.3083*	-0.1378*	0.4508	2.5699*	0.2096	-0.3264
28	-4.0188*	0.2834	0.4437*		0.0031	-0.00838*	-0.1999*	-0.0838	-0.1073	0.0684*	0.2386	6.1580*	0.8359	0.0091
29	-2.1161*	0.7183*	0.2373*	0.5371*	0.2997	0.00099	-0.0738	0.1988	-0.1014	0.0568	0.7686	3.6145*	0.7840	-0.6067
31	-3.0894*	-0.0765	0.3458*	-0.5148*	0.0881	0.01289	0.3755*	0.6332*	0.3119	0.1651*	1.1724	2.8158*	0.2593	-0.1171
32	-1.3572*	-0.1151	0.0449	0.1517*	-0.5900*	-0.01496*	-0.1863*	-0.3534*	-0.4366*	-0.1598*	-1.1147*	6.4774*	0.5732	-0.1354
33	-1.2644*	4.2192*	0.5381*		-0.0581	-0.00617	-0.2542*	-0.2039	-0.3111*	-0.2284*	-0.9724	2.8578*	0.5209	0.0464
34	-1.4179*	0.4434	0.6049*		-0.1803	-0.01311*	-0.3769*	-0.3941*	-0.1383	-0.0325	1.3686*	4.0064*	0.6378	-1.1995

LPUNTP is the log of price of unit for Prego.
LPUNTR is the log of price of unit for Ragu.
FEAT is the dummy variable associated with featuring in each store.
DISP is the dummy variable associated with display in each store.
FACVL is the coupon face value dropped by the manufacturer.
SQSPRG is the square root of moving average (8 weeks) of TV advertising ($ expenditure) by the manufacturer for the own brand (Prego).
QTT2 through QTT4 correspond to quarterly dummy variables.
LLUNTP is the lag of dependent variable, the lag of the log of units for Prego.
CPRGP is a weighted average of prices from competing stores for Prego.
CONST is the constant.
RSQ is the R square for each equation.
* indicates statistical significance at the 0.05 level.
** indicates serial correlation is evident at the 0.05 level of significance.

Table 3. Summary of SUR Results for Ragu Across all Stores in the Houston, TX Market.

STORE ID	LPUNTR	LPUNTP	FEAT	DISP	FACVL	SQSRAG	QTT2	QTT3	QTT4	LUNTR	CRAGR	ONST	RSQ	Durbin-H
1	-1.9284*	0.8527*	0.0950	0.2682	-1.4048*	0.00919	-0.6152*	-0.6724*	-0.5414*	0.1290	0.3099	3.7210*	0.6131	-0.2979
2	-3.3121*	-0.1503	0.1723	0.5759*	-0.0788	-0.00457	-0.2171*	0.0395	-0.1657*	-0.0731*	0.8434*	6.1762*	0.8471	0.9018
3	-2.0760*	-0.3452	0.0508	0.3476*	-0.4601	-0.00179	-0.2654*	-0.1358	-0.2107*	-0.1626*	-0.1901	6.4664*	0.7846	-0.9276
4	-1.2881*	0.3015	0.1507*	0.4771*	-0.1780	0.00151	-0.0114	-0.1666	-0.2178*	-0.0231	-0.0485	4.3510*	0.6362	-1.1373
5	2.9138*	0.8718*	0.4439*	0.0762	-0.1795	0.01511*	0.1897*	0.4901*	0.0472	0.0759*	0.2429	4.8080*	0.8231	0.7543
6	-2.9257*	0.5091	0.3196	0.1019	0.2083	0.01032*	-0.1522	0.2323	-0.0487	0.0439	0.2731	5.4472*	0.7288	-0.3752
7	-2.1193*	-0.3144	0.1990		-0.0257	-0.00680*	-0.1283	-0.0319	-0.0416	-0.0411	-0.2643	6.3136*	0.7372	0.6336
8	-2.0640*	0.3553	0.3280		0.2284	-0.00484	-0.0218	0.1284	0.1377	0.0130	-0.2100	5.0388*	0.6878	2.3084**
9	-2.4625*	0.0371	0.4007*		0.0244	-0.00211	-0.1036	-0.1442	-0.0845	-0.0346	-0.0472	6.0956*	0.8032	2.5949**
10	-0.8490*	1.1001	0.0688		0.2530	0.00568	0.1067	-0.1423	-0.1525	-0.1672*	-1.0725	4.2924*	0.1727	0.4985
11	-1.0813*	1.7656*	0.0166	-0.1593*	0.8087*	-0.00435	0.2051	0.3238	0.1274	-0.2581*	-2.0689*	5.4328*	0.3472	-0.3127
12	-0.9604*	0.4173	0.2109		-0.1361	0.00459	0.0466	0.1152	-0.1537	-0.0814	-1.1412*	5.0309*	0.4098	0.2026
13	-0.2835	1.5581*	0.2386	0.5833*	0.4365	-0.00046	-0.0795	0.2610	0.0666	-0.2737*	-2.7360*	5.4451*	0.3048	-0.0139
14	-0.8283*	0.8941*	0.3148*		0.2041	-0.00298	0.1255	0.1826	0.2386*	-0.2036*	-1.9725*	5.6214*	0.5317	-0.5489
15	-0.8908*	1.0957*	0.0857		0.1278	0.00480	0.0222	0.0868	0.0105	-0.1449*	-1.5450*	4.8439*	0.3979	-0.6491
16	-1.9558*	-0.0007	0.0091		-0.3416	0.00657	-0.3457*	-0.3632*	-0.3261*	-0.1153*	-0.6622*	5.7755*	0.7684	-0.2222
17	-2.0491*	-0.2218	0.2368*	-0.0947	0.4053	0.00251	0.1515	0.0522	-0.0747	-0.0421	-1.4710*	5.7887*	0.7232	-0.2789
19	-16.2554*	-0.0826			-0.5701	-0.01075	-0.5752*	-0.0514	-0.2981	-0.1258	2.3446*	13.6846*	0.2715	-0.4508
21	-1.2183*	-0.1959	-0.0966	0.1383*	-0.2984	0.01300*	-0.4719*	-0.3991*	-0.2544*	-0.0685	-0.5746	6.0085*	0.6036	-0.3371
22	-1.9129*	0.7039*	-0.0912	0.2574*	-1.2530*	0.01478*	-0.2928*	-0.4764*	-0.4789*	-0.1626*	0.0776	5.6031*	0.7103	0.4577
23	-1.0528*	-0.0809	0.1479*	0.2086*	0.2549	0.00297	-0.0836	-0.0555	-0.0529	0.1479*	-0.3927	4.4308*	0.6744	-2.1785**
24	-1.2459*	0.2230	0.2231*	0.2876*	-0.2572	0.00003	-0.2135*	-0.0641	-0.2340*	0.0775	-0.3694	4.3651*	0.6649	-2.0610**
25	-1.7627*	0.9108*	0.2336	0.1229	-1.0429*	-0.00811	-0.1591	-0.0128	-0.3623*	0.0198	0.1018	3.3636*	0.5635	0.1658
27	-1.8346*	-0.5098	0.3690*		0.5842	-0.01678	0.0909	0.2345	0.1248	-0.1196	0.9924	3.1680*	0.2028	-1.2986
29	-1.4711*	-0.6304*	-0.0304	0.3724*	-1.3918*	-0.00255	-0.1759	-0.0332	-0.1002	0.0634	-1.0057	6.0504*	0.5947	-0.7141
30	-0.3640	0.0316	0.1333		-0.2929	0.00018	-0.1687	0.0231	-0.1596	-0.0729	-1.9060*	4.4851*	0.3909	-0.4917
31	-0.4330	-1.0059*	0.1307	0.4012*	-0.4754	-0.00070	-0.4991*	-0.3194	-0.4348*	0.0248	0.3520	3.6405*	0.4790	0.3772
32	-1.2341*	-1.3328*	0.1972	0.1376	-0.1155	0.00254	0.0335	0.1545	-0.2389	0.0399	0.6680	4.0209*	0.3752	-0.5677
34	-2.2704*	-0.1906	0.2580	-0.1160	0.0697	-0.01586*	0.1415	0.6848*	0.1713	0.2407*	-1.0222*	4.4635*	0.4755	-0.5578

LPUNTR is the log of price of unit for Ragu.
LPUNTP is the log of price of unit for Prego.
FEAT is the dummy variable associated with featuring in each store.
DISP is the dummy variable associated with display in each store.
FACVL is the coupon face value dropped by the manufacturer.
SQSRAG is the square root of moving average (8 weeks) of TV advertising ($ expenditure) by the manufacturer for the own brand (Ragu).
QTT2 through QTT4 correspond to quarterly dummy variables.
LLUNTR is the lag of dependent variable, the lag of the log of units for Ragu.
CPRGR is a weighted average of prices from competing stores for Ragu.
CONST is the constant.
RSQ is the R square for each equation.
* indicates statistical significance at the 0.05 level.
** indicates serial correlation is evident at the 0.05 level of significance.

Table 4. Summary of SUR Results for Prego Across all Stores in the Dallas/Ft., TX Market.

STORE ID	LPUNTP	LPUNTR	FEAT	DISP	FACVL	SQSPRG	QTT2	QTT3	QTT4	LLUNTP	CPRGP	CONST	RSQ	Durbin-H
2	-2.1715*	1.8460*	0.3097		0.2933	-0.00935	0.1096	0.4239*	0.1726	-0.3583*	0.9909	2.7895*	0.3312	0.8364
3	-1.8839*	0.1855	0.7561*	0.2036	0.3575	0.00022	0.0809	0.3302*	0.0791	0.4389*	1.6974	1.5128	0.5997	-2.3677**
4	-0.7233*	0.5094	0.0352	0.4354*	-0.2469	-0.00463	-0.1368*	-0.0429	0.0656	-0.1106	0.3756	5.0652*	0.6328	0.1396
5	-4.8515*	0.5066*	-0.4813*		-0.1070	-0.00560	-0.1783*	-0.1992*	-0.0397	-0.1031	-0.7311	7.9546*	0.3897	0.3087
6	-5.9487*	0.9777*	0.0260		0.0787	-0.00371	-0.0464	-0.0091	-0.2148	-0.1319*	0.6150	7.0972*	0.3986	-0.7637
7	-1.9217*	0.6154	0.4336*		0.1212	0.01173*	-0.0726	0.3201*	-0.2787*	0.0068	0.1592	3.5400*	0.4314	-0.8436
8	-10.0954*	1.1089*	-1.5586*		-1.3729*	-0.00369	-0.0368	-0.1863	0.3324*	-0.3172*	3.1257*	9.8679*	0.5622	0.5044
9	-1.5617*	-0.3449*	1.2584*	0.5549*	0.1640	-0.00499	-0.2344	-0.0960	0.0814	0.0555	5.8500*	0.1178	0.4966	0.0570
10	-1.1479*	0.3815*	0.2625*		0.2713	0.00371	-0.2597*	0.1704	-0.1636	0.1606*	-1.9751	5.1857*	0.5519	-1.0945
11	-0.9016*	-0.0196	0.7915*	0.2723*	0.2875	-0.01019	-0.2376*	-0.0590	-0.0147	-0.1215*	4.7516*	1.7972	0.5092	0.4166
12	-1.7952*	2.1358			-0.2206	0.00290	-0.0922	0.0666	-0.0097	-0.1870*	-0.8742	3.6668*	0.1076	0.0293
14	-4.1873*	3.9521*			-0.0270	0.00708	-0.0398	0.2108	0.1727	-0.2200*	-0.1742	3.6847*	0.4268	-0.6858
15	-2.9362*	8.6105*			-0.7207*	0.00123	-0.0448	0.1253	0.0347	-0.5824*	-1.4116*	3.8376*	0.5361	-0.0259
16	-1.3787*	0.0627			-0.2932	0.00757	-0.1946*	-0.1113	0.0269	-0.2124*	2.1490*	3.4368*	0.3905	-0.0996
17	-2.5341	-0.3355			-0.1895	-0.00381	0.1659*	0.2770*	0.2480*	-0.0613	2.6396*	3.6567	0.2701	0.4024
18	-1.2966	-0.3788	0.2925*		0.2356	-0.01605*	-0.0416	0.0021	-0.0553	-0.0798	0.6477	4.9741*	0.4990	1.3773
20	-2.7423*	0.1521	-0.3522*		0.2077	-0.01248*	0.0207	-0.0602	0.2077*	-0.3247*	1.0502	6.9421*	0.3197	1.0037
21	-3.1535*	0.2467	-0.0252		0.1492	-0.00879*	0.0801	-0.1457	0.0656	0.0117	3.0960*	3.5987*	0.4398	-0.6428
23	-8.1596*	0.0181	-0.7550		-0.3535	-0.02216*	0.0612	-0.1592	0.3237	-0.2274*	5.4056*	5.3498*	0.3521	-0.5574
24	-0.8621	0.5163	-0.0726		-0.2997	-0.01237*	0.3298*	0.2477	0.4111*	-0.2466*	-2.3574	6.2535*	0.3486	1.2332
25	-7.3022*	-0.6152	0.5355		-2.1421*	0.01452	-0.2265	0.3778	0.4848*	-0.2684*	8.8541*	0.4290	0.5569	0.6031
26	-11.3542*	1.0962*	-0.1416		0.0159	0.00314	-0.4683*	-0.3034	-0.0819	-0.0384	0.2828	10.3879*	0.4809	-1.1234
27	-4.3709*	0.1216	-0.3634*		0.1996	-0.01216*	-0.0165	-0.1754*	0.2696*	-0.1974*	1.2974*	7.3309*	0.6430	0.1485
29	-0.1455	1.4759			0.7422*	-0.00388	0.0392	0.0584	0.0803	-0.2097*	-2.3367*	4.8114*	0.4339	0.4780
30	-1.2712	-0.0054	0.2953*		0.0804	-0.01744*	-0.0708	-0.6345*	0.2879*	-0.1815*	1.7877	3.7298*	0.5196	0.1329
31	-2.4591*	0.0270	-0.0321		0.0205	-0.00073	-0.0842	-0.0545	-0.0926	0.0730	-0.7457	5.9489*	0.4563	1.1666

LPUNTP is the log of price of unit for Prego.
LPUNTR is the log of price of unit for Ragu.
FEAT is the dummy variable associated with featuring in each store.
DISP is the dummy variable associated with display in each store.
FACVL is the coupon face value dropped by the manufacturer.
SQSPRG is the square root of moving average (8 weeks) of TV advertising ($ expenditure) by the manufacturer for the own brand (Prego).
QTT2 through QTT4 correspond to quarterly dummy variables.
LLUNTP is the lag of dependent variable, the lag of the log of units for Prego.
CPRGP is a weighted average of prices from competing stores for Prego.
CONST is the constant.
RSQ is the R square for each equation.
* indicates statistical significance at the 0.05 level.
** indicates serial correlation is evident at the 0.05 level of significance.

Table 5. Summary of SUR Results for Ragu Across All Stores in the Dallas/Ft., TX Market.

STORE ID	LPUNTR	LPUNTP	FEAT	DISP	FACVL	SQSRAG	QTT2	QTT3	QTT4	LLUNTR	CRAGR	CONST	RSQ	Durbin-H
1	-0.9561*	-1.7600	0.0957		0.9641*	0.00136	0.0000	-0.1155	0.0676	0.2166*	-0.7619	4.7414*	0.4100	-1.8639
2	-3.9570*	1.9706*	-0.1290		-0.2600	-0.02054*	0.2160	0.7858*	0.5965*	-0.1698*	1.3697*	2.9771*	0.4835	1.3451
3	-0.6114*	0.2350	0.5587*		1.1019*	0.00557	0.1556	-0.2216	-0.1139	0.0898	-2.7692*	4.4980*	0.7307	0.4390
4	-1.3182*	0.0182	0.0537	0.4000*	0.8478*	0.00083	-0.0052	0.0519	-0.2070*	0.0137	0.1917	4.8529*	0.7103	-0.3579
6	-1.3770*	-0.0300	0.6009*	0.0734	-0.6917	-0.00133	0.0406	0.4836*	0.2354*	-0.1134	-0.2765	4.9378*	0.6348	0.3905
7	-1.1342*	-0.2305	0.7209*	0.2032	0.8791	-0.00196	0.0859	0.2781	0.0861	-0.0340	-0.4614	4.0008*	0.3662	-0.6963
9	-0.3663	-0.0241	1.1106*	0.2663*	1.5065*	0.01261*	0.0398	-0.6181*	-0.1854	0.0611	-2.6614*	4.5467*	0.8480	0.4169
10	-0.1097	0.2373	0.6862*	0.3642	-0.6546	0.00469	-0.0206	-0.2766	-0.2033*	0.1033*	-0.6737	3.2485*	0.6867	-1.6139
11	-0.6281*	0.2058	0.7627*	0.3790*	0.0429	0.01372*	-0.0385	-0.4419*	-0.1854	0.0217	-1.1104	3.9608*	0.7531	0.0187
13	-11.4151*	7.5218*	0.8279*		-0.0011	-0.02609*	-0.4099*	0.3685	0.3711*	-0.1366	-0.4459	5.3797*	0.4452	-0.8052
16	-1.2110	0.1512	0.0043		0.0638	0.00167	-0.1109*	-0.1757	-0.0629	0.2128*	0.1850	3.2619*	0.2937	-0.6101
18	-1.7773*	0.9754	0.1410	0.4730*	-0.7514	0.00896*	0.0811	0.0489	0.2812	-0.0750	0.2889	3.5014*	0.3582	-0.7454
19	-0.7447	-0.9160	0.2087	0.2944*	0.7308	-0.00531	-0.1206	0.3075	0.0174	0.1437	-0.7937*	4.3124*	0.4291	-1.0966
20	-1.1218*	-1.2753*	0.0808	0.6679*	-0.9911*	0.00386	-0.3599*	0.2170	0.1510	-0.0820	-0.4750	6.1091*	0.6907	-0.5015
21	-0.6870	-0.7667	0.1122	-0.0536	0.1072	0.00320	-0.1463	-0.0759	0.0061	0.1310	-0.3679	4.1609*	0.3548	0.0735
22	-2.6443*	-1.8259*	-0.2378	-0.1734	0.1501	0.00743	0.1745	-0.4496	0.1791	-0.1362	-0.1838	6.2507*	0.3206	0.4312
23	-2.6376*	-0.9340	0.2382	-0.0482	0.5406	-0.00118	-0.3336*	-0.5106*	-0.2935	-0.0010	1.2111*	4.3806*	0.3789	-1.3815
24	-2.3575*	-0.7745	-0.0518	0.4248*	0.5229	0.00541	-0.0360	-0.1112	-0.0677	-0.0349	0.5397	4.9639*	0.4758	-0.1335
25	-1.1119	3.9711*	-0.2852	0.6481*	1.3667	0.01511*	-0.3915*	-0.7641*	-0.7600*	-0.2122*	0.0833	1.0699	0.4625	0.7656
27	-0.5302	-1.8297*	0.2105	0.6549*	0.4337	0.00475	-0.1184	-0.0512	-0.0798	0.2825*	-0.9220*	4.6205*	0.6777	-2.0797**
30	-2.2443*	0.0308	0.0710		0.1847	0.00516	-0.1349	-0.1712	-0.0387	0.2137*	-0.5113	4.2769*	0.3380	-1.1298

LPUNTR is the log of price of unit for Ragu.
LPUNTP is the log of price of unit for Prego.
FEAT is the dummy variable associated with featuring in each store.
DISP is the dummy variable associated with display in each store.
FACVL is the coupon face value dropped by the manufacturer.
SQSRAG is the square root of moving average (8 weeks) of TV advertising ($ expenditure) by the manufacturer for the own brand (Ragu).
QTT2 through QTT4 correspond to quarterly dummy variables.
LLUNTR is the lag of dependent variable, the lag of the log of units for Ragu.
CPRGR is a weighted average of prices from competing stores for Ragu.
CONST is the constant.
RSQ is the R square for each equation.
* indicates statistical significance at the 0.05 level.
** indicates serial correlation is evident at the 0.05 level of significance.

substitutes. However, only 6 stores (store IDs 2, 13, 20, 22, 25, 27) of the within- store, cross-price elasticities are statistically significant, and of these, only three stores (store IDs 2, 13, 25) are positive ranging from 1.9706 (store ID 2) to 7.5218 (store ID 13). Concerning coefficients associated with prices from competing stores for Ragu, only six elasticities are statistically significant, and only 2 of these 6 are positive.

Only a fraction of the stores receive statistically significant and positive effects on sales from featuring (7 of 21) and displays (9 of 21). For coupon face values, coefficients for only five stores (store IDs 1, 3, 4, 9, 20) are statistically significant, and four stores (store IDs 1, 3, 4, 9) receive positive effects from free-standing inserts. The effects of TV advertisements are positive and significant in only four stores (store IDs 9, 11, 18, 25). For about half of the stores, seasonality in sales is evident. The coefficients associated with the lagged dependent variables are significant in 7 out of the 21 stores. In contrast to the Prego in Dallas/Ft. Worth market, coefficients associated with only two stores (store IDs 2, 25) are negative and statistically significant, while coefficients associated with five stores (store IDs, 1, 10, 16, 27, 30) are positive and statistically significant.

In sum, effects of factors on sales are not statistically the same across stores within a market. Thus, to make proper pricing and promotion strategies at the store-level, one needs to use store-level estimates and not those obtained at more aggregate levels. Indeed, the wide range of elasticities is surprising. This result could be due to the fact that some stores are more geographically isolated and/or different socioeconomic composition of the associated neighborhoods. In addition, the differences across stores in a market may be attributed to weekly variations in customers. Customer count information was not available.

Concluding Comments

Our store level analysis suggests that impacts of factors affecting item movement are not uniform across all stores. Thus, appropriate pricing and possibly promotion strategies are to be made using store-level information. To quote Funk et. al. "substantial differences exist between chains in terms of the magnitude of price and advertising effects. While these are probably due to differences in store location, store types, etc., sufficient data are not available to determine the exact reasons for these differences (p.537)." Also for individual stores in the two markets, most own-price elasticities for both Prego and Ragu are elastic. This results implies there is some incentive for the stores to lower prices at least in the short-run to increase total revenue, assuming everything else remains constant.

Further, at the store-level for the Houston and Dallas/Ft. Worth markets, there is incentive to use featuring and display. Use of coupons and television advertising are not very effective in stimulating sales of Prego and Ragu spaghetti sauce brands in these two markets. Seasonality is evident in sales across the respective markets. Dynamic effects, due predominantly to inventory patterns, also are evident. Within-store cross-price effects and competing store prices also play a role in affecting sales of Prego and Ragu.

Though much empirical work and theoretical work exist with respect to economic and market analyses in recent years, reliable estimates of demand parameters for specific commodities in particular stores in given market are few in number. Scanner data may result in the most detailed and definitive source of retail industry statistics available to researchers. The limits on economic and market research can be expanded through the use of scanner data. Both supermarket movement and household panel data collected by IRI and A.C. Neilson are keys for economic and market research in the private sector. As these data become more accessible to researchers, they undoubtedly will be useful in empirical analyses of pricing and promotion strategies, especially those developed at the store-level.

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