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ECR and the Importance of Collaboration for Supermarkets

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Abstract: Collaboration and advanced information technology are considered essential for successful supply chain management. The effect of supply chain factors, along with store characteristics, market characteristics, and competitive position are considered upon performance measures for sales productivity and labor efficiency for food retailers.

Key words: food retail productivity, supply chain initiatives, Efficient Consumer Response, collaboration, regression analysis

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ECR and the Importance of Collaboration for Supermarkets

These are challenging times for manufacturers and retailers in the consumer packaged and goods marketplace. The retail food sector embodies a wider range of store formats, higher levels of concentration, and continued product proliferation (Kahn and McAlister 1997). Faced with a plethora of shopping choices and more attraction to eat out, today's shoppers view food retailers as interchangeable, leading to an increasingly fragmented customer base (Capps 1997). As consumer behavior has become less predictable, modern logistical solutions like Supply Chain Management (SCM) and Efficient Consumer Response (ECR) are pursued by the food industry as a means to increase sales and control costs (King et al., 2001).

To achieve higher supply chain efficiencies, the various members of the supply chain are presumed to share information and trust one another. According to SCM theory, the level of collaboration depends on the nature of relationships (e.g., the frequency of the contact, the level of trust, etc.) and the application of advanced information technologies such as collaborative forecasting (Handfield and Nichols 1999, Mentzer et al. 2001). Improving relationships among the members of the supply chain in turn leads to cost reductions and higher levels of customer service (Svensson 2002).

Disagreements can be found in the literature over the importance of SCM/ECR to financial and operating performance for the food sector. Phumpiu and King (1997) created an ECR index by measuring the adoption rate of seventeen technological, organizational and management practices. They determined that ECR adoption rates for 40 Minnesota grocery stores were related with stronger performance. Regression analyses of 20 to 25 grocers by Brown and Bukovinsky (2001) found that ECR adopters had worse financial and technical results than non–adopters. Using a similar approach, but with a larger sample of 115 firms

that also included food manufacturers, Dooley et al. (2002) found that ECR adopters' financial performance to be 3 to 4% higher than non-adopters. Finally, King, Jacobson and Seltzer (2002) created a supply chain score by measuring the adoption rate of information technologies and the importance of decision sharing among the supply chain members for a sample of 866 grocery stores. Their results found that supply chain management led to better financial performance (higher gross profit as a percent of sales) and improved operational performance (lower payroll as a percent of sales).

This research will analyze the impact of SCM adoption by grocery stores on sales and cost performance. Using the same data as King, Jacobson and Seltzer (2002), this analysis will deconstruct their supply chain management index into three components. The first component considers the importance of adopting information technologies. The second component captures the importance of collaboration among supply chain members. The final component considers whether in-store personnel are involved in decision-making or if the decisions are shifted to parties outside the store. No prior work was discovered in a literature review that simultaneously analyzed the importance of all three components.

In the sections that follow, we briefly describe our data and the variables used in the empirical model. Next we provide a descriptive analysis of the variables that capture information technology, collaboration, and decision making. In the remainder of the paper, we present the results of our empirical analysis and conclude with a discussion of the implications of our findings and directions for future research.

Data and Model Variables

This study uses data from the Retail Food Industry Center's Supermarket Panel for 2002, part of an annual, nation-wide survey of supermarkets (King, Jacobson, and Seltzer, 2002). Established in 1998, the Supermarket Panel collects information about store

characteristics, operating practices, and performance. The 2002 Supermarket Panel is a representative sample of 866 observations selected from the 32,000 supermarkets from across the United States. Statistical weights adjust for imbalances in sampling intensities and for differences in response rates by region and ownership group size.

Each year the annual report for the Supermarket Panel conducts regression analyses which typically include four general classes of explanatory variables 1) market characteristics, 2) store characteristics, 3) competitive strategy, and 4) management practices indices (see Kinsey et al. 2003, King, Jacobson, and Seltzer 2001 and 2002, and King, Wolfson and Seltzer, 2000). A factor analysis by King and Jacobson (2001) was used with data from the first year's Supermarket Panel to construct empirically based management practice indices.

The first class of variables, market characteristics, includes population density (PopDen), median household income (HHInc), and a binary variable indicating whether the store is located in a metropolitan area (SMSA) (See Table 1 for descriptive statistics). Income and population are demand shifters, and can have important effects on store performance.

Second, the food retailing marketplace is increasingly fragmented. Thus, differences in store characteristics likely lead to different sales and cost performance. A set of binary variables are used to designate different store formats. Using conventional grocery stores as a base, the other store formats are superstore (SSdummy), food/drug combination (FDdummy), warehouse store (WHdummy), superwarehouse (SWHdummy) and supercenters (SCdummy).[1] Other store characteristics include the proportion of space in backroom storage (Invsize), the number of stores in the same ownership group (Chainsize),

[1] See pp. 5-6 of King, Jacobson, and Seltzer (2002) for a description of the store formats.

and binary variables indicating whether the store is part of a self-distributing group (SelfDist), and if the store has a union workforce (Union).

The quotient of storage area of the store by the size of the selling area (Invsize) captures the importance of the backroom area to store extra inventory. Kurt Salmon Associates (1993) anticipates that the proportion of storage pace in a grocery store will fall for stores adopting ECR. Yet, the configuration of a store is likely to be very slow to change and so may not be very responsive to ECR. Small stores tend to have more space for inventory because they do not have a distribution center and are not supplied as often due to their small volume of sales. Large stores have larger proportions of storage space because they receive truck-load shipments.

Small grocers face challenges because of economies of size in information technology (Dooley et al. 2001). Self distributing group (SelfDist) is a binary dummy variable equal to 0 if the store is wholesaler supplied and equal to 1 if the store is part of a self distributing group. Information technology and new business practices arising from ECR can speed up product flows through both types of channels and reduce inventories at all levels of the supply chain.

A common information system is more likely when the distribution channel is self distributed instead of wholesaler supplied (Kinsey 2000). Furthermore, self distributed supermarkets are expected to have better communication with their suppliers and therefore be more efficient in replenishment, so stock-outs are reduced and sales improved. Therefore, SelfDist should be positively correlated with weekly sales per square foot, while Chainsize should be negatively correlated with payroll as a percent of sales.

Unionized workforce tended to significantly and positively impact payroll as a percent of sales. Remodeling can lead to long run improvements in store efficiency and distribution services (King and Park 2002). However, it can be very disruptive in the short

run for both store operations and the customer shopping experience. A recent remodeling (Rmaj01) is expected to affect sales negatively because customers are still getting used to the new layout, as well as add to cost. However, after one year, remodeling (Rmaj00) is expected to have a positive effect on sales because the new layout is more convenient, and better answers consumer needs and brings novelty.

To stand out in the market place, retail firms adopt one of four competitive strategies. The first is an emphasis on quality (qleader) such as product freshness, i.e., produce, meat, bakery, deli and seafood. A second effective strategy is to focus on providing higher levels of customer service (sleader). This is mainly done by smaller specialty retailers. The third strategy is to be a price leader (pleader) and offer lower prices. An emphasis on variety and selection (vleader) can be a fourth way of differentiation. In the data, a binary variable indicates if the stores manager thought the store competed in its local market on the basis of quality, service, price, or variety.

From an SCM perspective, a store's strategy is important because customers differ by local market area. Store managers that take this into account can identify local opportunities (Tordjman 1997). Furthermore, retailers have discovered dramatic variations in price and promotion sensitivity within urban markets justifying the belief that different marketing programs need to be adapted for each store to meet customer needs better (Larson 1997).

Managerial decisions for service offerings (ServOff) and supply chain at the store level and headquarters are expected to drive store performance.[2] Service offerings are often the basis for differentiation of stores in a local market area. Service Offering measures the

[2] Annual supermarket reports have also included indices for human resources, food handling, environmental practices, and quality assurance. None of these variables were statistically significant in the model, and therefore they are omitted from further consideration in this work.

adoption rate for 16 services.[3] Other analyses suggest that ServOff have a nonlinear effect on sales. Thus, the models also include ServOff squared.

Three other variables which reflect managerial strategy are included in the analysis, stockout rate (stockout), the number of checkout stands (numcheck), and analysis of customer data and marketing programs (custdata). First, out-of-stocks may lower sales by about 3 percent (Anonymous 2002). To reduce out-of-stock losses, stores are expanding the shelf space for popular items. With ECR, accurate data allow for a Just-In-Time Response from supplier to retailers, which will decrease stock-outs, lower inventories (as less space is necessary) and provide fresher products (Kurt Salmon Associates 1993).

Second, ease and convenience of shopping is an important characteristic for customers. More checkout (numcheck) stands should make the shopping experience quicker, and therefore should positively affect sales. Finally, custdata is a simple average of three variables that capture the importance of measuring customer needs and satisfaction through focus groups, customer satisfaction surveys, and mystery shopper programs.

Measures of Supply Chain

Supply Chain Score (SCS) is an indicator of a store's implementation of supply chain initiatives. In analyses conducted by the Retail Food Industry Center, SCS has two equally weighted components: information technology and decision sharing components. Supply chain initiatives are hypothesized to have profound impact on store performance. These supply chain initiatives include advanced information technologies and new business practices that foster efficiency and communication. Examples of new technologies include

[3] The services analyzed are customer self scanning, bagging service, carryout service, custom meat cutting/service meat, dry cleaning, fax ordering by customer, gasoline, home delivery, home meal replacement (HMR)/fresh prepared foods, in-store bakery, internet ordering by customer, pharmacy prescriptions, post office/mailing services, teller banking/in-store banking, video department and web site for customers.

electronic transmission of orders, invoices, and movement data. Communication presumes a sharing of decision-making among the supply chain members. Finally, the literature review stresses the importance of the in-store personnel participation in the decision making.

The information technology component measures a store's adoption of 12 technologies related to supply chain management. Each variable is a binary variable, taking the value of one if it is a practice in place, and zero otherwise. The information technology component index (SCS) is then calculated as the sum of the twelve dummy variables divided by 12 and multiplied by 100.

The first information technology is the presence of internet/intranet link from the store to corporate headquarters and/or key suppliers. The second is the electronic transmission of movement data to headquarters or key suppliers. The third and fourth deal with whether the store has electronic invoices from its primary warehouse or from DSD vendors. The fifth concerns the electronic transmission of orders to vendors/suppliers (e.g., Web, EDI). Datashare is an average of these five technologies which speed the flow of data and information between the store and its suppliers.

The sixth information supply chain variable is in regards to the implementation of vendor managed inventory for the orders of non-DSD items. The seventh and eighth information technologies relate to the implementation of scan-based trading for payment and for automatic inventory refill. The average of these three variables forms the variable INV, which are practices that not only speed the flow of information, but also facilitate decision sharing with trading partners.

Finally, product movement analysis (category management, space allocation (plan-o-grams), electronic shelf tags and frequent shopper programs are combined to form a third supply chain information technology subindex, ANAL. These four aspects of supply chain

management are used to support product assortment, pricing and merchandising decisions at the store level.

The decision sharing component (the second sub-index of the variable SCS) measures to what extent parties outside the store are involved in store-level decisions. In question 17, store managers were asked who (in-store personnel, wholesaler or independent ad group, chain headquarters or region, vendor or broker) has the primary responsibility for the five following areas: pricing, advertising, space allocation, display merchandising and promotional decisions. Information was reported for four products (fresh apples, dry cereal, direct store delivery snacks, and fresh fluid milk). The data were converted into a dummy variable for each product and each area. A value of 1 was given when somebody outside the store had primary responsibility, i.e., if "wholesaler or independent ad group", "chain headquarters or region," or "vendor or broker" was circled. If only "the store" was circled, a value of zero was given. The score for this sub-component is the average for these twenty dummy variables (five for each level for four products). The result is then multiplied by 100 (Finally, the two sub-components (information technology and decision sharing) are summed and divided by 2 to obtain the SCS, which is an index out of 100.

The variable DMg indicate whether store managers participate in decision-making. Like the supply chain score (SCS), these variables refer to question 17. The index for DM depends upon the responses for the 20 questions related to decision-making (Table 2).

$$DM_g = \frac{\sum_{i,j} DM_{ij}}{20} \qquad (1)$$

Where: DM_g is the decision making index for the store itself
DM_{ij} is a dummy variable for decision i and product j
i are decisions = price, advertising, space allocation, display merchandising, or promotion, and
j where a = apples, m = milk, c = cereal and d = snacks.

If the store circled in-store personnel for question seventeen i.e., the in-store personnel is involved in the decision-making for price then $DM_{i\ price}$, which is a dummy variable will have the value 1. In the situation where the personnel is not involved in the decision-making, $DM_{i\ price}$ will be zero. The decision-making situation is surveyed for four products which are fresh apples, cereals, DSD snacks and fresh fluid milk). $DM_{i\ price}$ concerned whether the in-store personnel is involved in decision regarding the price (value 1) or not. In the same way, $DM_{i\ advertising}$, $DM_{i\ space\ allocation}$, $DM_{i\ display\ merchandising}$, $DM_{i\ promotion}$ are in regards to the involvement of the in-store personnel for decision relative respectively to advertising, space allocation, display merchandising and promotion. Aggregate data, i.e., using DM_i instead of $DM_{i\ price}$, $DM_{i\ advertising}$, $DM_{i\ space\ allocation}$, $DM_{i\ display\ merchandising}$, $DM_{i\ promotion}$, have been used because the results were not significant and useful otherwise.

DMg refers to the average involvement of in-store personnel in five dimensions of decision-making for the store: pricing, advertising, space allocation, display merchandising and promotion. Larger firms are less likely to involve in-store decision-making. Conventional and food/drug combination stores are the only formats with more than half of the decisions involving in-store management. DMg concerns the decision-making strategy of the store in general. The involvement of the store management in decision-making for the overall store should have a positive impact on sales. As seen in the literature review, the strategy from the corporate level has to be adapted for each store since customers differ. Those most aware about local customers' characteristics are the in-store managers.

The variables starting with "COLL" capture the implication of collaboration during decision-making. It is constructed using the same data as the DM variables (question 17 of the survey). However, collaboration is indicated by a dummy variable where more than one participant is circled, or involved in the decision. The index COLLg is then calculated by summing the values for the 20 collaboration dummy variables and by dividing by 20 or:

$$\boldsymbol{COLL_g} = \frac{\sum_{i,j} \boldsymbol{COLL_{ij}}}{20} \qquad (2)$$

Where: $COLL_g$ is the collaboration index for the overall store
$COLL_{ij}$ is a dummy variable for collaboration about factor i and product j
i are decisions = price, advertising, space allocation, display merchandising, or promotion, and
j where a = apples, m = milk, c = cereal and d = snacks.

$COLL_i$ captures the involvement of several persons[4] in decision-making (in-store personnel, wholesaler or independent ad group, chain headquarters or region, or vendor or broker). $_i$ is an index for the four products surveyed (fresh apples, cereals, DSD snacks and fresh fluid milk).

COLLg refers to the collaboration of the different members of the supply chain in the decision-making for the overall store. Collaboration is supposed to help the store know better about consumer needs and have a more efficient supply chain for replenishment i.e., avoid stock-outs. Therefore, COLLg should have a positive effect on sales.

Customers and suppliers must share a vision and objectives among about interdependency and principles of collaboration. The ultimate goal must be providing the best end-customer value. Goals must be realistic to avoid dissatisfaction. Serious questions arise regarding how shrinkage occurs, which party is responsible and which party should bear the loss. Discussing broader company strategies is also necessary and helps to create a better understanding of each other's business ideas and stimulates further collaboration (Hoffman and Mehra 2000).

The purpose of the collaboration is to improve the forecasting accuracy by ongoing cooperative planning, frequent and formal meetings and communication. Supply chain councils or cross-functional teams, which include representatives from all major suppliers and customers in a supply chain, meet on a regular basis to communicate objectives, goals,

[4] More than one member is circled.

measurement and changes. This communication facilitates a closer relationship and limits differences among supply chain members (Kopczak and Johnson 2003). The purpose is also to work on long-term goals and not only meet about data reviews or problems. Collaboration also focus on strategic decisions required to determine new avenues of cooperation (Frankel, Goldsby and Whipple 2002).

Building trust is a key component. Indeed, sharing information is necessary for optimizing the results of ECR and helping people to make better and quicker decisions. Private information is not easy to share. Therefore, trust among members is necessary (Svensson 2002). However, the trust issue is one of the biggest barriers to successful implementation of SCM/ECR (Brockman and Morgan 1999).

Empirical Models

The literature review clearly states that modern logistics solutions will improve sales and decrease stock-outs (Kurt Salmon Associate 1993). Three performance measures were considered, weekly sales per square foot, payroll as a percent of sales, and gross profit as a percent of sales. These measures focus on output (sales), input efficiency or labor costs, and procurement or gross profit. Sales per square foot are measured as weekly sales divided by the stores selling size in square feet. The use of a ratio allows for comparisons among stores having different selling size area. Payroll and gross profits are expressed as percent of sales.

Once the data were validated, three sets of models were estimated. The first set used a single supply chain index and does not include the managerial variables for stockouts, number of checkout stands, or tracking customer satisfaction (Table 3). The second added the three additional managerial variables, and divides the supply chain index into three sub-components (Table 4). The first measures the information technology, the second considers the importance of decision-making, and the final variable considers the importance of

collaboration. The final set of models further divided the information technology variable into three aspects, data sharing technology, data sharing practices, and supply chain analyses (Table 5).

The regression results are consistent among the three sets of models, with stronger results for the last set of models considering the information technology variable as three aspects, data sharing technology, data sharing practices, and supply chain analyses. Results were generally strongest for the sales regression, then for the payroll regression, and finally for the gross profit regression (Table 5).

For sales, all market characteristics were significant (Table 5). Sales vary by store format, being lower for most formats compared to conventional supermarkets. Being part of a self-distributing chain leads to higher sales, as does a union workforce, and remodeling in 2000. Any competitive position, except for variety leadership, is positively related to sales performance. Reducing stockouts and adding check lanes increase sales. Store level decision-making is the only supply chain variable important to sales.

For cost, a higher population density lowers costs, while higher income induces higher costs (Table 5). The later may reflect an income effect. Store formats impact costs in various manners, reflecting differences in format cost structures. Being part of a self-distributing chain is important to lowering costs. Neither a firm's competitive strategy nor its managerial practices have a statistical effect on costs. Supply chain scores are very important to costs. Data sharing technology and practices lead to higher costs, as does store level decision-making. However, collaboration leads to lower costs.

Finally, gross profit as a percent of sales is lower as population density increases, and varies by store format (Table 5). Stores that are part of self-distributing chains are more profitable, but a recent remodeling adversely affects gross profit. Being a quality leader leads to higher margins, while a focus on service will lower gross margins. There may not be a

payoff to tracking customer satisfaction, as the variable is negatively associated with gross profit. Data sharing technology leads to higher gross margins as does collaboration.

Finding and Conclusions

Modern logistics solutions such as SCM and ECR are being developed by supermarkets to face competition from new entrants to food retailing. Improved supply chain efficiency will arise from better information technologies, closer relationships with suppliers, and a better understanding of consumer trends.

The key success factors to attain ECR efficiencies include the use of point-of-sale (POS) data (product and customer information), transferring information through EDI, and making electronic funds transfer. Furthermore, successful supermarkets are differentiated from the competition on a basis as a variety, price, service or quality leader. This differentiation strategy must be adapted at the store level rather than the corporate level because of demographic variations in local markets. This implies that the local store manager must have the opportunity to participate in the decision making process. Supply chain metrics need to be adapted, paying attention to customer satisfaction, damaged products, and forecast reliability.

The final key success factor, and the most difficult to implement, deals with relationship between supply chain members. The literature clearly suggests that close relationships will improve efficiency and knowledge of consumers. A good relationship will be possible if people are willing to change, make compromises, share investments, risk and outcome and are able to build trust. A good way of initiating relationships is to create cross-functional teams with the different members of the supply chain who will meet and communicate on regular basis.

At the individual firm level, each member of the supply chain seeks efficiency. Performance will be more often measured and related to the overall success of the supply chain. To achieve this goal, cross functional teams regrouping key members from the different departments will be created to harmonize planning and efficiency. The same changes will be asked of the partner supplier.

As suggested, SCM seeks an efficient product introduction (real new products that answer consumer needs), efficient product promotion (more focused on the loyal customer, less coupons and fewer deals with suppliers) and efficient store assortment (fewer redundant products). To achieve these goals, each product must be categorized regarding its demand. Thus, to avoid stock-outs, different approaches can be settled depending the category. Indeed, SCM is a strategy that needs to be implemented at the store level. Yet the management process will ultimately be at the department level of a store. Certain products can be reshelved by the supplier (DSD) while others can go through the warehouse, but be ordered on a regular basis through POS data. Shelf-lives, margins and many other characteristics vary by product category.

It is quite hard to compare the results of this work with previous studies by Phumpiu and King (1997), Brown and Bukovinsky (2001), and Dooley et al. (2002). All of the earlier works used one variable for ECR adoption, while in this case ECR adoption was separated into three different areas. The results suggest that a decomposing of ECR into finer detail is important. Some ECR related variables positively affect sales (decision-making at the store level, use of satisfaction survey), while others do not (collaboration, service offerings, implementation of technologies). Supply chain practices for data sharing technology and collaboration are important to payroll costs and gross profits, but not sales. Store level decision-making is key for sales and payroll costs. Yet even these could vary at a departmental basis.

For the most part, this work is more consistent with the findings of Phumpiu and King (1997) and Dooley et al. (2002). Both of these studies found that ECR adopters had higher performance and that size matters as opposed to Brown and Bukovinsky (2001) who found worse results for ECR adopters.

To summarize, this study suggests several guidelines for retail grocers seeking to boost sales. First, in general, store personnel should be part of the decision-making process, especially for products with long shelf lives. However, a solution that works in one partnering relationship may be completely different than that for another relationship (Stank et al. 2000). Second, there is no "right" way to market for a store. Price, service or quality leadership strategies (which are practiced by 29%, 65%, and 71% of the firms, respectively) can all lead to higher sales. The lower usage for a price leadership strategy can be explained because this strategy is difficult to implement. Yet, a variety leadership model is clearly ineffective. Thus, stores (37% of firms) might want to rethink their usage of a variety strategy.

Larger chains have higher sales per square foot. Furthermore, the big retailers (such as Wal Mart, CVS, Tesco, Sainsbury's, Safeway, Wal-Mart, Wegman's) have for the most part successfully implemented ECR. Therefore, the gap with smaller retailers might widen if the latter do not adopt key aspects of ECR. Thus, the question in the future will not be whether the store should implement ECR, but what aspects of ECR are necessary to survive.

Finally, SCM adoption decisions occur at the firm level for all stores in a chain. Yet its implementation may vary at the departmental level given differences in products, as well as procurement and distribution practices. Therefore, future work should also consider the effects of decision-making and collaboration at the department level.

Table 1. Descriptive Statistics for Model Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
PopDen	1.1296	2.1606	0.0002	20.8578
Hhinc	47.7199	14.1962	20.7978	125.0625
MSADummy	0.6124	0.4877	0.0000	1.0000
Invsize	0.3366	0.6879	-0.8313	11.8571
Chainsize	2.1853	6.1213	0.0100	50.0000
SelfDist	0.3876	0.4877	0.0000	1.0000
Union	0.2500	0.4334	0.0000	1.0000
RMaj00	0.0562	0.2305	0.0000	1.0000
RMaj01	0.1047	0.3064	0.0000	1.0000
pleader	0.2829	0.4509	0.0000	1.0000
qleader	0.6473	0.4783	0.0000	1.0000
sleader	0.6395	0.4806	0.0000	1.0000
vleader	0.2965	0.4572	0.0000	1.0000
ServOff	38.7074	14.1678	0.0000	93.0000
stockout	-2.5832	0.4485	-4.0000	-1.0000
datashare	0.6093	0.2871	0.0000	1.0000
INV	0.1718	0.2531	0.0000	1.0000
Anal	0.5213	0.2474	0.0000	1.0000
DMg	52.4743	35.4249	0.0000	100.0000
collg	11.6570	23.3985	0.0000	100.0000
numcheck	7.6950	4.3836	1.0000	43.0000
Custdata	0.4089	0.3665	0.0000	1.0000
SCS	51.5640	23.6917	0.0000	100.0000
SCS2	0.4628	0.1975	0.0000	1.0000
einvdsd	0.4574	0.4987	0.0000	1.0000
einvWH	0.4516	0.4981	0.0000	1.0000
EDI	0.5581	0.4971	0.0000	1.0000
EDI2	0.8450	0.3623	0.0000	1.0000
elink	0.7345	0.4420	0.0000	1.0000
VMI	0.1938	0.3957	0.0000	1.0000
scanpay	0.2229	0.4166	0.0000	1.0000
scanfill	0.0988	0.2987	0.0000	1.0000
etags	0.2209	0.4153	0.0000	1.0000
CatMang	0.8372	0.3695	0.0000	1.0000
planogram	0.7422	0.4378	0.0000	1.0000
loyaltycard	0.2849	0.4518	0.0000	1.0000

Table 2. Supply Chain Practices for Stores, by Firm Size, 2002

	Number of Stores in Firm				
	1	2-10	11-50	51-750	750+
Overall Supply Chain Score	28	40	66	69	80
Information Technology Component	33	39	55	62	69
Data Sharing Technologies					
Internet Links	54	59	78	81	90
Electronic transmission of movement data	33	41	85	82	90
Electronic invoices from warehouse	25	37	55	65	89
Electronic invoices from DSD vendor	18	24	58	77	88
Electronic transmission of orders	78	85	78	83	77
Data Sharing Practices					
Vendor Managed Inventory	18	21	18	40	38
Scanned based trading	12	18	26	32	34
Automatic Inventory Refill	2	3	4	27	33
Supply Chain Analyses					
Category Management	76	76	86	94	94
Electronic Shelf Tag	20	37	27	23	33
Plan-o-gram	49	50	83	88	96
Frequent Shopper Card	13	15	41	50	66
Decision Sharing Component Overall	24	42	79	77	92
Apple pricing	19	48	93	85	96
Apple Advertising	46	73	93	92	99
Apple Space Allocation	3	12	63	59	85
Apple Display Merchandising	2	8	29	39	75
Apple Promotions	34	59	91	85	96
Dry Cereal pricing	37	59	96	85	95
Dry Cereal Advertising	52	75	95	92	99
Dry Cereal Space Allocation	8	23	74	74	92
Dry Cereal Display Merchandising	3	5	29	44	73
Dry Cereal Promotions	39	63	80	85	94
DSD Snack pricing	28	51	91	86	97
DSD Snack Advertising	45	63	95	94	99
DSD Snack Space Allocation	15	29	82	75	93
DSD Snack Display Merchandising	25	29	54	52	80
DSD Snack Promotions	44	55	86	83	99
Milk pricing	10	45	86	85	94
Milk Advertising	33	57	93	91	99
Milk Space Allocation	4	15	70	74	93
Milk Display Merchandising	8	12	48	59	79
Milk Promotions	34	49	88	84	95

Adopted from: King, Jacobson, and Seltzer. "The 2002 Supermarket Panel Annual Report." The Food Industry Center, University of Minnesota, 2002.

Table 3. Results for Performance Driver Regressions, with Single Supply Chain Index

Variable	Weekly Sales per Square Foot		Payroll as a % of Sales		Gross Profit as a % of Sales	
	Estimate	t-statistic	Estimate	t-statistic	Estimate	t-statistic
MARKET CHARACTERISTICS						
Population Density	0.4974	6.28**	0.0689	0.89	-0.1633	-0.81
Household Income	0.0774	6.78**	0.0199	1.82*	-0.0013	-0.05
Located in SMSA	-0.7169	-1.71*	-0.0123	-0.03	1.8349	1.74*
STORE CHARACTERISTICS						
Proportion of storage space	0.0846	0.53	-0.1706	-1.15	0.1798	0.47
Superstore Format	-2.4359	-3.32**	-0.8917	-1.25	2.9231	1.53
Food/Drug Combination Format	0.2332	0.51	0.9911	2.23**	-1.9973	-1.73*
Warehouse Format	1.6685	1.65*	-1.6326	-1.72*	-5.2473	-2.16**
Superwarehouse Format	4.4435	3.3**	0.7312	0.58	-5.7218	-1.78*
Supercenter Format	-2.5369	-1.69*	-1.3271	-0.94	-6.1664	-1.71*
Number of stores in chain	-0.0106	-0.46	0.0425	1.92*	-0.0168	-0.27
Member of self-distributing group	0.6362	1.40	-0.9869	-2.27**	-1.2684	-1.11
Union Workforce	0.5197	1.32	0.6954	1.83*	-1.5338	-1.55
Remodel in 2000	0.0846	0.53	-0.1706	-1.15	0.1798	0.47
Remodel in 2001	-2.4359	-3.32**	-0.8917	-1.25	2.9231	1.53
COMPETITIVE POSITION						
Price Leader	1.0012	2.76**	-0.5937	-1.67*	-0.8585	-0.91
Quality Leader	1.2874	3.26**	0.7373	1.95*	3.6580	3.74**
Service Leader	1.0517	2.89**	-0.2643	-0.76	-1.6678	-1.81*
Variety Leader	0.0230	0.06	-0.1471	-0.41	1.0585	1.13
MANAGERIAL PRACTICES						
Service Offerings	-0.0163	-1.62	-0.0341	-3.52**	0.0423	1.69*
Service Offerings Squared	-0.1798	-3.72**	-0.0563	-1.23	-0.1121	-0.95
SUPPLY CHAIN SCORE	0.0017	3.3**	0.0006	1.30	0.0017	1.33
CONSTANT	7.2048	6.08**	12.3759	11.02**	22.1289	7.65**
NUMBER OF OBSERVATIONS	489		468		445	
ADJUSTED R^2	0.2964		0.0948		0.0735	

** and * denote significantly different from zero at 5% and 10% levels of confidence, respectively.

Table 4. Results for Performance Driver Regressions, with Supply Chain Index, Decision-making, and Collaboration

Variable	Weekly Sales per Square Foot		Payroll as a % of Sales		Gross Profit as a % of Sales	
	Estimate	t-statistic	Estimate	t-statistic	Estimate	t-statistic
MARKET CHARACTERISTICS						
Population Density	0.5986	6.49**	-0.2328	-2.58**	-0.5224	-2.08**
Household Income	0.0631	5.55**	0.0219	2.06**	0.0125	0.41
Located in SMSA	-1.0485	-2.55**	0.4645	1.19	1.6662	1.51
STORE CHARACTERISTICS						
Proportion of storage space	0.0482	0.32	-0.1934	-1.42	0.1232	0.33
Superstore Format	-3.8497	-4.8**	-1.1590	-1.49	4.9625	2.32**
Food/Drug Combination Format	-0.6590	-1.37	1.2162	2.64*	-2.1935	-1.71*
Warehouse Format	-0.2548	-0.25	-1.8949	-2.02**	-5.1572	-2**
Superwarehouse Format	1.5648	0.72	0.3494	0.18	1.3241	0.24
Supercenter Format	-8.5394	-4.67**	-0.9020	-0.52	-0.6035	-0.13
Number of stores in chain	0.0219	0.97	0.0301	1.44	-0.0507	-0.8
Member of self-distributing group	1.1368	2.29**	-1.4072	-3.01**	2.1240	1.61
Union Workforce	0.8093	2.08**	0.5951	1.62	-0.1738	-0.17
Remodel in 2000	1.5436	2.32**	0.2854	0.47	-0.3564	-0.21
Remodel in 2001	-0.3409	-0.59	0.9363	1.73*	-3.9396	-2.47**
COMPETITIVE POSITION						
Price Leader	0.8311	2.26**	-0.4732	-1.35	-0.7550	-0.75
Quality Leader	0.9666	2.37**	0.4971	1.29	3.2385	3.06**
Service Leader	0.7242	1.97**	-0.0913	-0.26	-1.7746	-1.81*
Variety Leader	-0.2535	-0.69	-0.0640	-0.18	0.9647	0.98
MANAGERIAL PRACTICES						
Service Offerings	-0.2415	-4.91**	-0.0621	-1.37	-0.1109	-0.88
Service Offerings Squared	0.0024	4.4**	0.0006	1.21	0.0018	1.33
Stockouts	0.8935	2.41**	-0.4230	-1.12	1.3892	1.33
Number of checkout stands	0.3581	6.17**	-0.0614	-1.1	-0.1292	-0.84
Track Customer Satisfaction	0.4824	0.90	-0.5949	-1.19	-2.3970	-1.71*
SUPPLY CHAIN SCORE	-2.4495	-2.17**	2.8400	2.69**	4.3791	1.45
Supply Chain Score	0.0270	3.91**	0.0177	2.64	0.0067	0.36
Store Level Decision-making	-0.0030	-0.35	-0.0204	-2.5**	0.0548	2.37**
Collaboration	-2.4495	-2.17**	2.8400	2.69**	4.3791	1.45
CONSTANT	8.3109	4.74**	8.5161	5.19**	25.3337	5.53**
NUMBER OF OBSERVATIONS	449		430		408	
ADJUSTED R^2	0.3922		0.1399		0.0843	

** and * denote significantly different from zero at 5% and 10% levels of confidence, respectively.

Table 5. Results for Performance Driver Regressions, with Supply Chain Technology, Supply Chain Practices, Supply Chain Analyses, Decision-making, and Collaboration

Variable	Weekly Sales per Square Foot		Payroll as a % of Sales		Gross Profit as a % of Sales	
	Estimate	t-statistic	Estimate	t-statistic	Estimate	t-statistic
MARKET CHARACTERISTICS						
Population Density	0.5885	6.37**	-0.2254	-2.51**	-0.5143	-2.06**
Household Income	0.0639	5.61**	0.0216	2.04**	0.0111	0.37
Located in SMSA	-1.0855	-2.61**	0.4001	1.02	1.6880	1.53
STORE CHARACTERISTICS						
Proportion of storage space	0.0317	0.21	-0.2007	-1.47	0.1974	0.53
Superstore Format	-3.9322	-4.86**	-1.1893	-1.53	5.0526	2.37**
Food/Drug Combination Format	-0.7144	-1.48	1.1459	2.48**	-2.5602	-2**
Warehouse Format	-0.3540	-0.34	-2.0687	-2.19**	-6.1979	-2.39**
Superwarehouse Format	1.5611	0.72	0.4365	0.22	1.7585	0.33
Supercenter Format	-8.8768	-4.82**	-1.3215	-0.76	-1.4951	-0.32
Number of stores in chain	0.0166	0.72	0.0253	1.20	-0.0683	-1.07
Member of self-distributing group	1.1795	2.35**	-1.3388	-2.85**	2.1870	1.66*
Union Workforce	0.7970	2.04**	0.5841	1.59	-0.4094	-0.4
Remodel in 2000	1.4964	2.24**	0.2432	0.40	-0.5660	-0.34
Remodel in 2001	-0.4017	-0.69	0.8513	1.57	-3.8374	-2.41**
COMPETITIVE POSITION						
Price Leader	0.8066	2.18**	-0.5264	-1.5	-0.8745	-0.87
Quality Leader	0.9702	2.37**	0.4961	1.29	3.0050	2.83**
Service Leader	0.7185	1.94*	-0.1023	-0.3	-1.7373	-1.78*
Variety Leader	-0.2525	-0.68	-0.0842	-0.24	0.8036	0.82
MANAGERIAL PRACTICES						
Service Offerings	-0.2362	-4.78**	-0.0585	-1.3	-0.1214	-0.97
Service Offerings Squared	0.0023	4.18**	0.0005	1.08	0.0020	1.45
Stockouts	0.8212	2.18**	-0.5432	-1.43	1.0387	0.99
Number of checkout stands	0.3604	6.14**	-0.0650	-1.16	-0.1474	-0.96
Track Customer Satisfaction	0.4461	0.83	-0.4666	-0.94	-2.5913	-1.85*
SUPPLY CHAIN SCORE						
Data Sharing Technology	-1.1900	-1.58	1.2538	1.77*	5.6718	2.67**
Data Sharing Practices	0.2700	0.42	1.7075	2.84**	1.6035	0.96
Supply Chain Analyses	-0.8419	-1.1	-0.1885	-0.26	-3.2024	-1.59
Store Level Decision-making	0.0265	3.78**	0.0150	2.22**	-0.0011	-0.06
Collaboration	-0.0034	-0.39	-0.0198	-2.43**	0.0559	2.43**
CONSTANT	8.1268	4.6**	8.7437	5.3**	25.5414	5.58**
NUMBER OF OBSERVATIONS	449		430		408	
ADJUSTED R^2	0.3890		0.1444		0.0961	

** and * denote significantly different from zero at 5% and 10% levels of confidence, respectively.

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