Assessing the Effect of ECR on Financial and Operating Performance

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Abstract: A debate has emerged in the literature and trade press whether the adoption of Efficient Consumer Response (ECR), the supply chain management initiatives for the food industry, leads to improved inventory and financial performance. Using regression analysis, the financial performance for adopters of ECR is about 3 to 4% higher than for non-adopters. However, the growth in profit does not appear to come from improved performance for traditional inventory measures (such as inventory turnover, inventory-to-sales, or inventory-to-assets). The driving force behind these improved financial measures can be attributed to changes leading to a shorter cash conversion cycle. In addition, size matters; ECR is more effective due to economies of scale, information technology, and buying power.

Keywords: ECR, Efficient Consumer Response, supply chain management, regression

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Wal-Mart, the world's largest retailer, entered the food industry in 1988 and implemented an information-driven distribution system (Senauer and Kinsey, 1999). Other mass merchandisers such as Kmart and Target followed Wal-Mart's move to the food industry. Wal-Mart's objective was to develop a chain of stores selling food operating with a non-stop replenishment flow of products (Troy, 1998). Traditional grocery stores faced increased competition from mass-merchandisers who were forecast to capture 14 percent of total grocery product sales by the turn of the century (Capps, Jr. and Griffin, 1998).

In 1992, several food manufacturers, wholesalers, and grocers teamed-up to counter the entry by mass merchandisers into food sales (Adams, 1995). Large established supermarket chains, such as Kroger and Safeway, along with long-standing food manufacturers, such as General Mills and Kraft Foods, joined with several other firms and trade associations to form a task force to analyze the food supply chain. The main goals of the Efficient Consumer Response Working Group were to analyze the trade practices of the grocery supply chain, to study the practices of other retail trade channels, and to develop recommendations for making the entire food industry more competitive (Adams, 1995).

Firms in the food industry hoped to increase liquidity and raise profitability levels by adopting Efficient Consumer Response (ECR). ECR focuses on four fundamental initiatives: 1) efficient store assortment, 2) efficient replenishment, 3) efficient promotion, and 4) efficient product introduction (King and Phumpiu, 1996). With ECR, it was estimated that the food industry could eliminate $30 billion of excess costs, reduce 41 percent of existing inventory, and cut average cycle times from 106 to 61 days (Kahn and McAlister, 1997). Eighty percent of these savings were to come from product cost savings and 20% were to come from financial

savings. The financial savings were to be captured through players in the system agreeing to accept lower profit levels. Suppliers would capture 70% of these cost savings because of their higher supply-chain costs as opposed to the retailer (Adams, 1995).

The Food Marketing Institute (FMI) reported that the food industry spent $3 billion on education, training, and technology to implement ECR in 1994 and projected another $4.5 billion to be spent in 1995 (Walsh, 1995). The FMI predicted that the payback period for ECR investments would be less than three years. However, these investment costs were barriers to adopting ECR for smaller players in the food industry. In addition, the larger self-distributing chains have an advantage for developing systems and exchanges with large manufacturers that the independent grocers and their wholesalers do not share (Partch, 2000).

From the earliest stages of ECR to the most recent initiatives (known as Collaborative Planning, Forecasting and Replenishment or CPFR), some have questioned whether the adoption of supply chain management strategies has been a profitable investment (Walsh, 1995). For example, the trade press has reported that ECR has failed to achieve the potential $25 billion cost reduction in trade promotion dollars (Partch, 2000). Yet, research has found the adoption of ECR initiatives, especially information technology solutions, has improved inventory management and shortened order cycles (Stank, Crum, and Arango, 1999).

The objective of this study is to determine whether the adoption of ECR has led to improved inventory and financial performance for firms in the food industry. Comparisons are made for both sets of performance measures to distinguish food firms as either retailers/ wholesalers (hereafter referred to as grocers) or food manufacturers and to identify firms as adopters or non-adopters of ECR.

The next part of this paper presents results from previous studies on inventory and financial performance for grocers. The data, variables, and empirical model are then presented, followed by the empirical results. The paper ends by providing findings and conclusions.

Previous Research

The literature review discovered three studies that have analyzed the impact of the adoption of ECR initiatives on inventory and financial performance. Each of the studies analyzed aspects of inventory and financial performance for grocers.

First, Phumpiu and King (1997) studied the impact of ECR initiatives on financial performance and inventory turnover for 40 Minnesota grocery stores. They focused on five areas: 1) store and manager characteristics, 2) inventory management and ordering processes, 3) store layout, shelf-space allocation, and product assortment, 4) product pricing and promotion decisions, and 5) key challenges facing managers. Three store productivity measures were calculated: sales per labor hour, sales per square foot of selling area, and inventory turnover. Stores were then compared by organizational form and by an "ECR readiness" index. Stores were categorized as a corporate chain, an independent chain, or a single store. The "ECR readiness" index measured the level of adoption for each store of 17 technological, organizational, and managerial practices considered necessary for the implementation of ECR. Based on the number of ECR practices implemented, stores were grouped into three "ECR readiness" classes: low, medium, or high.

For stores with a high level of ECR readiness, sales per labor hour were 59% higher than stores with a low level of ECR readiness, while sales per square foot of selling area were 125% higher (Phumpiu and King, 1997). Average inventory turnover was 131% higher for stores with a high level of ECR readiness versus stores with a low ECR readiness. By organizational form,

the sales per labor hour for corporate and independent chains were over 52% higher than sales per labor hour for single stores. Corporate chains had sales per square foot of selling area 75% higher than single store grocers did, while independent chains sales per square foot of selling area were 38% higher than single stores. Inventory turnover for independent chains and single stores were similar, both averaging around 30% below the average for corporate chains.

Phumpiu and King (1997) could not determine whether the adoption of ECR practices leads to strong performance or whether strong performance facilitates ECR practices. However, they concluded there was a strong association between the adoption of ECR practices and financial performance. Their results for organizational form suggest that size is important for achieving a high level of financial and inventory performance.

Second, Bowersox et al. (1999) compared annual data for nine retail grocery chains from 1992 through 1997. ECR was not explicitly identified in this study as a factor contributing to inventory and financial performance. The study found average inventory turns declined slightly, days in inventory increased, the cash conversion cycle dropped by 5%, net profit margin increased by 22%, asset turnover fell 10%, and return on assets increased 7%. Results suggested that the improved profits were obtained from procurement practices such as forward buying rather than through improved operating efficiency.

Finally, Brown and Bukovinsky (2001) analyzed the impact of ECR strategies on financial performance for grocery retailers. Financial data came from annual company financial reports for the period 1992-1998. Mail surveys to 29 retail grocery companies had the firms self-identify as adopters or non-adopters of ECR. For the 1992-1997 period, responses for 25 companies were used, including 13 adopters and 12 non-adopters. For the 1992-1998 period, 20 companies were used, consisting of 11 adopters and 9 non-adopters.

Multiple regression analysis was used to estimate six models, testing whether firm size, growth rates, and ECR adoption affected performance. The independent variables used in the six models were total assets at year-end, asset growth, sales growth, and ECR. ECR was a binary variable, where one represented a company that was an ECR adopter, and zero represented a non-adopter of ECR. Six dependent variables were used: cash conversion cycle, inventory turnover, profit margin, gross profit percentage, inventory as a percent of total assets, and inventory as a percent of sales.

The results from Brown & Bukovinsky (2001) were clearly not what ECR advocates anticipated. Over the period 1992-1998, cash conversion cycles increased 17% for adopters of ECR, but decreased 29% for non-adopters. Inventory turnover increased 9% for non-adopters, while adopters' inventory turnover fell 12%. Inventory-to-assets and inventory-to-sales for non-adopters decreased 44% and 14%, respectively, but for adopters, inventory-to-assets decreased 8% while inventory-to-sales increased 6%.

Profit margins for non-adopters increased 130%, but decreased 47% for adopters (Brown and Bukovinsky, 2001). Adopters and non-adopters' gross profit percentages were similar and increased 3% and 2%, respectively. The gross profit percentage was positively related to firm size, indicating that prices charged by suppliers were lower for larger customers. This price advantage may encourage mergers and make it difficult for small grocers to compete on the basis of price. ECR was adopted more often by larger firms, reflecting the difficulties that small firms face in obtaining capital, and giving greater advantages of technology use to the larger firms.

Brown and Bukovinsky (2001) reported four limitations to their work. First, the companies could not be randomly classified as either an adopter or a non-adopter of ECR. The lack of random assignment was a weakness since it was possible that firms in one of the groups

may have had some attribute other than ECR adoption that determined or affected the outcome. Second, the firms' annual financial reports may aggregate information from several different divisions or business units. Thus, all firms were reviewed to ensure that they were primarily grocery retailers. Third, by using annual report data, the number and size of firms eligible for the study was limited since many food retailers are smaller, privately held firms. Fourth, for simplicity, binary variables were used for all adopters of ECR, even though some firms may have implemented more ECR initiatives than others.

This analysis builds upon the earlier research, in particular that of Brown & Bukovinsky (2001). While the three previous studies only considered grocers, the data set in this study includes grocers and food manufacturers. The scope of the analysis was expanded to include the entire food industry to reflect that ECR is an industry wide supply-chain initiative. In addition, one goal is to determine whether differences exist between the food manufacturing sector of the industry and the grocery sector. Thus, the model in this study includes a binary variable distinguishing between the grocery sector and the food manufacturing sector.

Data, Variables, and Model

Regression analysis was used with a data set of 115 food companies. The list of companies was developed from the Hoover's Online website (www.hoovers.com) and *Business Week*. The 10-K yearly financial report filed with the Securities and Exchange Commission (SEC) was obtained for each company from the database "Disclosure Global Access." The 10-K data included a balance sheet and an income statement for ten years for each company, beginning in 1991 and ending in 2000. There were 1,137 observations used for this research. For some firms, less than ten years of financial reports were available because of mergers and acquisitions

that have occurred. Companies were divided into two sectors, grocers and food manufacturers. There were 37 grocery firms and 78 food manufacturers in the data set.

Firms were classified into one of two supply chain categories, ECR or NONE. ECR represents firms that have adopted supply chain management strategies. NONE represents firms that have not adopted ECR practices. The classification of a firm's ECR strategy followed a two-step process. First, a review of company reports, trade press reports, and organizational lists associated with supply chain management strategies from websites (e.g., www.cpfr.org or www.vics.org) were used to identify firms as adopters of ECR or CPFR initiatives.

The second step sought to verify the findings of the first step by using the Google search engine to locate websites by combining the terms "Efficient Consumer Response" or "Collaborative, Planning, Forecasting and Replenishment" with each company name. Results from each of the 230 searches were then inspected to verify whether the website indicated that a particular firm was an adopter of ECR or CPFR. Using the Google search instead of a survey asking firms to self-identify their ECR strategy avoids the potential for self-selection bias. From a total of 4,114 websites found, 2,287 web pages indicated firms were practicing ECR. If one website was found that indicated a firm had employed some aspect of ECR, the firm was classified as an ECR adopter. In this study, 59 firms were classified in the NONE category and 56 firms were in the ECR category.

An Excel spreadsheet model was designed to calculate several inventory, financial, and growth measures (Table 1). These measures were then used in the regression analyses. For the multiple regression models, data for all 115 firms for all years (1991-2000) were used to regress each dependent variable on the independent variables. Statistical Analysis Software (SAS) was used to estimate the regression equations.

Table 1: Formulas to Measure Inventory, Financial, and Growth Performance

Variable	Abbreviation	Formula
Cash Conversion Cycle	CCC	Days Inventory + Days Receivables – Days Payable
Inventory Turnover	INVTURN	COGS/Inventories
Inventory-to-assets	ItoA	Inventories/Total Assets
Inventory-to-sales	ItoS	Inventories/Net Sales
Profit Margin	PM	Net Income/Net Sales
Gross Profit Percentage	GPP	(Net Sales – COGS)/Net Sales * 100
Return on Assets	ROA	{Net Income + [Interest Expense * (1 – Tax Rate)]} ÷ Total Assets
Return on Investment	ROI	PM * Asset Turnover
Asset Growth	AG	[Total Assets $_t$ - Total Assets $_{t-1}$] / Total Assets $_{t-1}$
Sales Growth	SG	[Net Sales $_t$ – Net Sales $_{t-1}$] / Net Sales $_{t-1}$

The multiple regression model uses eight different dependent variables with a set of eight independent variables. Four dependent variables (CCC, INVTURN, ItoA, and ItoS) measure inventory performance, and four dependent variables (PM, GPP, ROA, and ROI) measure financial performance (Table 1). Each of the eight dependent variables (DV) was regressed on eight independent variables. In general form, the model is:

DV = f(TA, AG, SG, DEVAG, DEVSG, SECTOR, ECR, TREND) (1)

where   TA = Total Assets,
        AG = Asset Growth,
        SG = Sales Growth,
        DEVAG = Deviation in Asset Growth,
        DEVSG = Deviation in Sales Growth,
        SECTOR = Firm is in Grocery Sector = 1, Otherwise = 0,
        ECR = Adopted Supply Chain Management Strategies = 1, Otherwise = 0,
        TREND = the time period 1991-2000 = 1-10.

Regression results for the inventory performance dependent variables (CCC, INVTURN, ItoA, and ItoS) are expected to generally be the same for all independent variables. TA is expected to have negative signs for CCC, ItoA, and ItoS, while INVTURN will be positive since larger firms typically have greater access to capital than smaller firms do. Thus, larger firms are expected to be more efficient, thereby leading to shorter cash conversion cycles and inventory

turnover lag times. Firms can shorten the cash conversion cycle in one of three different ways:
1) reduce the inventory conversion period, 2) reduce the receivables conversion period, and/or 3)
increase the payables deferral period (Moss and Stine, 1993). Inventory-to-Assets and
Inventory-to-Sales ratios should also be lower for larger firms because of these efficiencies.

Asset Growth (AG) and Sales Growth (SG) measure the annual change in assets and
sales. AG is expected to have positive signs if the asset growth is caused by an increase in
inventories, but is expected to be negative if the increase in asset growth is brought on by
expansion of plants and equipment. Thus, the outcome of AG is indeterminate. The expected
sign for SG is difficult to anticipate because sales growth might lead to an inventory increase.

Standard deviations for both asset growth (DEVAG) and sales growth (DEVSG) were
calculated to measure dispersion in the growth rates. The standard deviation was calculated
using a rolling two-year period. Total assets were used for the asset growth deviations, and net
sales were used for the sales growth deviations. DEVAG and DEVSG are expected to have
positive signs for the inventory dependent variables. Firms that merge may experience large
deviations in assets and sales from year to year. Mergers may lead to a short-term decrease in
efficiency causing inventory turnover to fall and increase for cash conversion cycles, inventory-
to-assets, and inventory-to-sales ratios.

SECTOR is expected to have negative signs for CCC and ItoS. Grocers should have
shorter lag times for cash conversion cycles than food manufacturers, as well as lower inventory-
to-sales ratios. This occurs in large part because grocers receive payment for products as they
are sold. SECTOR is expected to be positive for INVTURN and ItoA because grocers turnover
average inventory balances faster and have a higher ratio of inventory to assets than food
manufacturers. The median cash conversion cycle and inventory turnover for the grocery sector

are 15.3 days and 12.47 turns respectively, as compared to 40.9 days and 7.09 turns for the food manufacturer sector (Dunn & Bradstreet, 2001). Average inventory-to-assets and inventory-to-sales ratios for the grocery sector are 26% and 6%, respectively, while for the food manufacturer sector these ratios are 21% and 10%, respectively (Dunn & Bradstreet, 2001).

The ECR variable is expected to have negative signs for the regressions CCC, ItoA, and ItoS and a positive sign for INVTURN since adopting supply chain management strategies should lower inventory levels. A trend variable (TREND) was included for the time period 1991-2000 to determine whether systematic changes occurred in inventory and financial measures over the past decade. The sign for TREND is indeterminate.

Sign directions are expected to generally be the same for the independent variables in the financial dependent variable regressions (PM, GPP, ROA, and ROI). GPP is a measure of margin, while PM, ROA, and ROI measure firm profitability. TA is expected to have positive signs because larger firms have the advantage of purchasing products at lower prices than smaller firms do. The expected signs for the independent variable AG is once again difficult to anticipate. AG will have a negative sign if asset growth is caused by an increase in inventories, but will be positive if the increase in asset growth is attributable to the expansion of plants and equipment. The addition of new plants and equipment should lead to increases in efficiency, and thus, improved financial performance measures. SG is expected to have positive signs for all financial dependent variables. As sales increase, financial performance measures should increase.

For the financial dependent variables, the independent variables DEVAG and DEVSG are expected to have negative signs. Similar to the inventory dependent variables, firms that experience mergers may experience large deviations in assets and sales from year to year.

Mergers and consolidations may lead to temporary losses in efficiency causing performance measures like profit margin, gross profit percentage, return on assets, and return on investments to decrease. In the long-run, consolidations and mergers seek the advantage of economies of scale, leading to bargaining power with manufacturers, more efficient use of transportation, and the ability to utilize information technology to manage inventory throughout the food supply-chain, thereby leading to improved profitability (Kinsey and Ashman, 2000).

The expected sign for SECTOR is indeterminate for the three profitability dependent variables. Neither grocery nor food manufacturing firms have any advantage over the other in terms of improving financial performance. Manufacturers are expected have a higher GPP than grocers because of differences in margin between the two sectors.

The ECR variable should have positive signs for the regressions PM, GPP, ROA, and ROI, meaning supply chain initiatives should increase financial performance. The TREND variable is again used to measure trend effects for the period 1991-2000, and the sign of this variable is indeterminate.

Empirical Results

Diagnostics used for testing significance are t-tests and F-tests. The t-tests were used to test whether the parameters are related to the dependent variable. F-tests were used to test the significance of the regression as a whole, testing for a linear relationship between the dependent variable and all of the explanatory variables. R^2 was used to test for goodness of fit, while variance inflation factors (VIF) were used to test for multicollinearity. For variables that are unrelated to each other, VIF will approach 1, and for variables that are closely related to other variables VIF will become large (SAS, 2000). As a rule of thumb, a VIF over 10 indicates the possibility of multicollinearity.

Mean values were computed for inventory, financial, growth, and size measures and were compared by sector, and for ECR adopters versus non-adopters (Table 2). A paired t-test found statistical differences by sector for the CCC, ItoA, and ItoS inventory variables. Mean values for ItoA were lower for the manufacturing sector than for grocers due to structural differences between the two industries. Manufacturing firms generally have larger amounts of capital invested in plants and equipment, whereas grocery firms mainly invest in stores and inventories. For CCC and ItoS, the mean values for the grocery sector were lower than the manufacturing sector. The structure of the grocery sector focuses more on turnover than the manufacturing sector, which focuses upon efficient production.

Table 2: Mean Values by Overall Industry, Sector, and ECR Adopter/Non-Adopter

	Mean Values				
Variable	Overall Industry	Grocery	Food Manufacturer	ECR Adopter	Non-Adopter
Profit Margin [b]	-0.07%	-0.65%	0.21%	3.97%	-2.70%
Gross Profit Percentage [a, b]	28.86%	22.23%	31.99%	31.68%	27.03%
Inventory Turnover	13.48	12.32	14.02	9.51	16.10
Days Inventory	61.85	41.71	71.28	62.00	61.74
Days Receivable	27.98	11.46	35.39	26.48	28.96
Days Payable	40.49	29.25	45.78	44.61	37.82
Cash Conversion Cycle [a]	50.48	22.71	62.89	43.15	55.30
Inventory-to-assets [a]	19.30%	24.02%	17.09%	19.29%	19.30%
Inventory-to-sales [a]	11.49%	8.67%	12.82%	11.02%	11.81%
Return on Assets [b]	4.97%	4.76%	5.06%	7.42%	3.21%
Return on Investment [b]	3.13%	2.19%	3.57%	5.59%	1.52%
Asset Growth	18.90%	20.36%	18.22%	10.49%	25.40%
Sales Growth	27.33%	17.55%	31.93%	9.60%	41.14%
Deviation in Asset Growth*	$248	$322	$213	$498	$55
Deviation in Sales Growth*	$374	$706	$218	$738	$91
Total Assets*	$3,528	$3,434	$3,573	$7,180	$1,158

*Measured in 000,000s.
[a] Statistical differences in mean values at the 95% level of confidence for sector.
[b] Statistical differences in mean values at the 95% level of confidence for adopter/non-adopter.

A paired t-test for the mean value of the financial measure GPP found a statistical difference by sector. GPP was almost 10 percentage points lower for the grocery sector (22.2%) than for the food manufacturing sector (32.0%) (Table 2). A paired t-test found the financial measures PM, GPP, ROA, and ROI to have statistical differences for adopters and non-adopters of ECR (Table 2). These results suggest that firms adopting ECR initiatives have higher profitability levels than non-adopters.

Tables 3 and 4 report the results for the eight inventory and financial dependent variables. F-tests for each of the eight regression models exceed the critical value 2.41 at the 1% significance level, indicating that the independent variables used in the regressions are jointly statistically significant at the 99th percentile. Results of the VIF tests suggest the absence of multicollinearity. R^2s, ranging from 0.03 to 0.16, are low for all eight regressions, which is similar to the results of Brown & Bukovinsky (2001).

Table 3 reports the ordinary least squares estimation results for the inventory dependent variable models (CCC, INVTURN, ItoA, and ItoS). The t-tests for three variables, TA, ECR, and SECTOR, were statistically significant in the CCC model and exhibited negative signs, as expected. The results suggest that larger firms, ECR adopters, and grocers have shorter cash conversion cycles.

The two growth independent variables, AG and SG, were statistically significant for the INVTURN and ItoS models. AG was positive as expected and SG was negative (Table 3). Thus, firms experiencing asset growth are improving inventory performance, while sales growth causes firms to encounter difficulties in managing inventory.

For the dependent variable ItoA model, the independent variables TA, SG, DEVSG, and SECTOR all exhibited statistically significant results (Table 3). As expected, the sign for TA

Table 3: Empirical Results for Inventory Models

Independent Variables	Dependent Variables			
	CCC	INVTURN	ItoA	ItoS
	Parameter Estimates for the Independent Variables (t-Value)			
INTERCEPT	71.07245	15.12364	0.18180	0.13040
	(12.57)	(2.10)	(20.29)	(13.02)
TA	-8.11226E-7	-1.06892E-7	-1.30118E-9	-6.8462E-10
	(-2.15)**	(-0.22)	(-2.18)**	(-1.03)
AG	2.01997	22.77372	-0.00044708	0.00692
	(1.00)	(8.86)***	(-0.14)	(1.93)*
SG	-4.44976	-14.20179	0.01010	-0.00986
	(-1.48)	(-3.70)***	(2.11)**	(-1.84)*
DEVAG	-0.00000155	-0.00000283	-5.16203E-9	5.44768E-11
	(-0.43)	(-0.61)	(-0.90)	(0.01)
DEVSG	0.00000275	0.00000109	1.170062E-8	4.253396E-9
	(1.26)	(0.39)	(3.37)***	(1.10)
SECTOR	-41.14801	-2.13380	0.06235	-0.04354
	(-8.86)***	(-0.37)	(8.60)***	(-5.37)***
ECR	-8.34100	-5.06786	0.00437	-0.00737
	(-1.82)*	(-0.87)	(0.60)	(-0.91)
TREND	-0.18452	0.05416	-0.00184	0.00056326
	(-0.22)	(0.05)	(-1.41)	(0.39)
Multicollinearity Test	Variance Inflation Values for Models			
TA	2.34	2.34	2.34	2.34
AG	1.40	1.40	1.40	1.40
SG	1.40	1.40	1.40	1.40
DEVAG	2.26	2.26	2.26	2.26
DEVSG	2.07	2.06	2.06	2.06
SECTOR	1.06	1.05	1.05	1.05
ECR	1.19	1.19	1.19	1.19
TREND	1.03	1.03	1.03	1.03
R^2	0.0906	0.0764	0.1036	0.0347
F-Value	12.22	10.32	14.42	4.49

*Significant at the 90 percent level of confidence.
**Significant at the 95 percent level of confidence.
***Significant at the 99 percent level of confidence.

was negative, and SG, DEVSG, and SECTOR were all positive. Thus, larger firms carry lower

levels of inventory as a percent of sales. The positive signs for SG and DEVSG suggest that

sales growth and variability cause an increase in inventory-to-assets. Finally, inventory makes

up a higher proportion of assets for grocers.

Table 4: Empirical Results for Financial Models

Independent Variables	Dependent Variables			
	PM	GPP	ROA	ROI
	Parameter Estimates for the Independent Variables (t-Value)			
INTERCEPT	-0.03667	0.29045	0.02291	0.00659
	(-2.45)	(23.49)	(2.07)	(0.57)
TA	1.922534E-9	5.344785E-9	1.457258E-9	1.64115E-9
	(1.92)*	(6.45)***	(1.97)**	(2.10)**
AG	-0.00409	-0.00459	0.00146	0.00448
	(-0.89)	(-1.21)	(0.43)	(1.25)
SG	-0.00011784	-0.00007018	0.00867	0.00314
	(-0.09)	(-0.06)	(8.56)***	(2.94)***
DEVAG	-1.68305E-9	5.823762E-9	-5.94426E-9	-6.11345E-9
	(-0.17)	(0.73)	(-0.83)	(-0.81)
DEVSG	-5.05108E-9	-2.14047E-8	1.3388E-10	9.35956E-10
	(-0.87)	(-4.45)***	(0.03)	(0.21)
SECTOR	-0.00253	-0.08645	-0.00472	-0.01523
	(-0.21)	(-8.61)***	(-0.53)	(-1.61)
ECR	0.03994	0.02968	0.03999	0.03570
	(3.28)***	(2.95)***	(4.45)***	(3.76)***
TREND	0.00438	-0.00014094	0.00107	0.00132
	(2.00)**	(-0.08)	(0.66)	(0.77)
Multicollinearity Test	Variance Inflation Values for Models			
TA	2.34	2.34	2.34	2.34
AG	1.02	1.02	1.02	1.02
SG	1.01	1.01	1.01	1.01
DEVAG	2.25	2.25	2.25	2.25
DEVSG	2.05	2.05	2.05	2.05
SECTOR	1.05	1.05	1.05	1.05
ECR	1.20	1.20	1.20	1.20
TREND	1.03	1.03	1.03	1.03
R^2	0.0309	0.1586	0.0982	0.0430
F-Value	4.00	23.65	13.67	5.65

*Significant at the 90 percent level of confidence.
**Significant at the 95 percent level of confidence.
***Significant at the 99 percent level of confidence.

Table 4 reports the results for the financial dependent variable models (GPP, PM, ROA, and ROI). The independent variables TA, DEVSG, SECTOR, and ECR were statistically significant in the GPP model. The signs for TA and ECR were positive as expected, while DEVSG and SECTOR had the expected negative signs. Hence, it appears that larger firms and

ECR adopters are likely to improve margins. Greater variability in sales growth pressures margins, while margins are lower for grocers than food manufacturers.

Results for the three profitability models (PM, ROA, and ROI) are consistent. In each model, the signs of the independent variables TA and ECR are statistically significant and positive as expected (Table 4). Thus, it appears that firm size and the adoption of ECR is important to firm profitability.

Conclusion and Findings

Before discussing the conclusions, two limitations to this study are acknowledged. First, it is impossible to determine the actual time of implementation for supply chain management strategies by firms in the food industry. Second, this analysis does not account for differences in the implementation level for ECR and CPFR. For simplicity, a binary variable is used to distinguish firms adopting or not adopting supply chain management strategies (ECR). The availability of an ECR readiness index similar to that of Phumpiu and King (1997) likely would improve the analysis. With these limitations in mind, four conclusions for inventory measures and three conclusions for financial performance measures can be drawn from this study.

First, for inventory performance measures, as firm size increases in terms of total assets, firms convert inventory to cash quicker and carry less inventory as a percent of total assets. Second, higher growth rates in sales are accompanied by dampened inventory performance for inventory turnover, inventory-to-sales, and inventory to assets ratios, implying that with sales growth inventory become more difficult to manage. Third, inventory performance differs between the grocery and food manufacturing sectors. Grocers have lower cash conversion cycles and inventory-to-sales ratios due to continuous inventory movement, but inventory-to-asset ratios are higher. Firms in the grocery sector normally have less capital tied up in plants

and equipment than food manufacturers, thus leading to higher inventory to asset ratios. Fourth, ECR adopters have no advantages over non-adopters in traditional inventory performance measures, such as inventory turnover, inventory-to-sales, and inventory-to-assets. These results were consistent with those of Brown and Bukovinsky (2001). However, cash conversion cycles are 12 days shorter for ECR adopters than non-adopters, at 43 and 55 days, respectively (Table 2). Thus, while ECR has not apparently changed inventory performance, it has led to important changes in the management of the cash cycle.

For the financial performance measures, the results first suggest that total assets are highly relevant to profitability levels. Larger firms have the advantage of purchasing products at lower prices than smaller firms and thus operate more profitably. Second, sales growth is important for the profitability measures of return on assets (ROA) and return on investment (ROI), but not for margin. Third, enjoy superior performance for all four financial performance measures over non-adopters. ECR adopters had an average 3.97% profit margin compared to -2.70% for non-adopters (Table 2). Adopters also had higher average returns on assets and investments (7.42% and 5.59%) than non-adopters (3.21% and 1.52%).

Contrary to the findings of Brown & Bukovinsky (2001), the adoption of ECR has led to higher profit levels. However, the growth in profit does not appear to come from improved performance for traditional inventory measures (such as inventory turnover, inventory-to-sales, or inventory-to-assets). The driving force behind these improved financial measures can be attributed to changes leading to a shorter cash conversion cycle. Shortening cash cycles involves changes in business processes and lessens the need for external financing, which leads to improved profitability. Additionally, the results support Walsh's findings that ECR favors larger sized firms.

The difference in the financial performance findings in this study and those by Brown and Bukovinsky (2001) may arise for two sources. First, some of the differences might be attributed to having a larger sample size, and by including food manufacturers as well as grocers. Second, the inclusion of the variables DEVAG and DEVSG capture deviations in growth for assets and sales in the model. These variables allow disruptions from consolidations in the industry to explain the difference in findings.

The results of this analysis support the proposition that the adoption of an ECR strategy pays off. Thus, the time spent in developing close relationships with buyers or suppliers and the investments in information technology for firms in the food industry has led to shorter cash conversion cycles, thereby improving financial performance. The adoption of information technologies changes traditional processes for purchase orders, invoices, shipping notices, and funds transfer. Size matters; ECR is more effective, due in part to economies of scale, information technology, and perhaps greater buying power. However, this may lead to more consolidations because not all firms have the capital to invest in these initiatives. The challenge to these firms will be determining how to implement ECR practices, because they do lead to stronger financial performance.

List of References

Adams, D. "Efficient Consumer Response: Retailers' New Competitive Weapon." In *Marketing Encyclopedia: Issues and Trends Shaping the Future,* pp. 277-283, edited by J. Heilbrunn. Lincolnwood, IL: NTC Business Books, 1995.

Bowersox, D.J., D.J. Closs, T.P. Stank, and D.C. Shepard. "Supply Chain Management: Differentiating Through Effective Logistics." Washington, D.C.: Food Marketing Institute, 1999.

Brown, T.A. and D.M. Bukovinsky. "ECR and Grocery Retailing: An Exploratory Financial Statement Analysis." *Journal of Business Logistics*. 22(2):77-90, 2001.

Capps, Jr., O. and J.M. Griffin. "Effect of a Mass Merchandiser on Traditional Food Retailers." *Journal of Food Distribution Research*. 29(1):1-7, 1998.

Dunn & Bradstreet. "Industry Norms & Key Business Ratios." Desk-Top Edition, 2000-2001.

Kahn, B.E. and L. McAlister. *Grocery Revolution, The New Focus on the Consumer*. Reading, MA: Addison-Wesley Educational Publishers, Inc., 1997.

King, R.P. and P.F. Phumpiu. "Reengineering the Food Supply Chain: The ECR Initiative in the Grocery Industry." *American Journal of Agricultural Economics*. 78(65):1181-1186, 1996.

Kinsey, J. and S. Ashman. "Information Technology in the Retail Food Industry." *Technology in Society*. 22(1):83-96, 2000.

Moss, J.D. and B. Stine. "Cash Conversion Cycle and Firm Size: A Study of Retail Firms." *Managerial Finance*. 19(8):25-34, 1993.

Partch, K. "Is the Supermarket Era at an End?" *Supermarket Business Magazine*. 55(7):138. Retrieved May 13, 2002 from Business Source Premier, Purdue University Management and Economics Library.

Phumpiu, P.F. and R.P. King. "Adoption of ECR Practices in Minnesota Grocery Stores." Working Paper 97-01. The Retail Food Industry Center, University of Minnesota, St. Paul, MN, 1997.

SAS System for Windows. Cary, NC: SAS Institute Inc., 2000.

Senauer, B. and J. Kinsey. "The Efficient Consumer Response Initiative: Implications for Vertical Relationships Throughout the U.S. Food System." In *Vertical Relationships and Coordination in the Food System*, pp. 443-452, edited by G. Galizzi and L. Venturini, New York: Physica-Verlag Co., 1999.

Stank, T., M. Crum, and M. Arango. "Benefits of Interfirm Coordination in Food Industry Supply Chains." *Journal of Business Logistics*. 20(2):21-41, 1999.

Troy, M. "Wal-Mart to Open 500th Supercenter." *Discount Store News*. 37(14):1-2, 1998. Retrieved May 13, 2002 from Business Source Premier, Purdue University Management and Economics Library.

Walsh, J. "Shortening the Supply Chain." *Minneapolis Star Tribune*. p. 1D, July 24, 1995.