Effects of Supply Chain Management for Food and Grocery Companies

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Wal-Mart entered the grocery business in the late 1980s with a supply chain management strategy of continual replenishment of products based on consumer purchasing habits. This approach has allowed Wal-Mart to lower inventory levels, reduce the cost of goods sold, and lower its prices. To counter Wal-Mart's entry into the grocery business, large supermarket chains (e.g., Kroger and Safeway) and food manufacturers (e.g., Kraft and General Mills) formed an industry task force that called for an industry-wide commitment to Efficient Consumer Response (ECR) (Kurt Salmon Associates, 1993). The ultimate goal of ECR was for retailers and suppliers to work closely together to reduce costs within the supply chain and to bring better value to the grocery customer. The four main ECR strategies are efficient store assortment, efficient replenishment, efficient promotion, and efficient product introduction (King and Phumpiu, 1996).

Brown and Bukovinsky (2001) suggested that grocers are dissatisfied with ECR because it failed to deliver the promised cost savings or increased profitability. However, this finding seems counterintuitive given the level of investment in supply chain initiatives by firms in the food retailing and manufacturing sector, as well as the continuing reports of new initiatives in the trade press. In contrast, other studies have found that adopting supply chain management systems such as information technology "increase gross margin, inventory turnover, market share, return on sales" (Dehning, Richardson, and Zmud, 2007). The median increase attributable to investments in supply chain management was 1.78 % for return on assets (ROA) and 1.44% for return on sales (ROS) (Hendricks, Singhal, and Stratman, 2007).

In addition, Whipple and Dawn (2007) stressed the importance of collaboration in supply chain performance. They counter that rather than being dissatisfied with supply chain initiatives like ECR, firms involved in supply chains are seeking even greater collaboration through participation in industry initiatives such as the Voluntary Interindustry Commerce Solutions (VICS). By implementing ECR or VICS strategies, firms in the food supply chain aim to lower inventory levels, thereby decreasing cash conversion cycles. In turn, lower cash conversion cycles should allow firms to increase liquidity and raise profitability.

Given the inconsistency of Brown and Bukovinsky (2001) with other work, the first objective of this paper is to determine whether food retailers and manufacturers that adopted ECR and/or VICS improved their financial and operating performance compared to firms that did not adopt such strategies. A second objective of this work is to consider Giunipero et al. (2008) who encourage "creating a body of literature that is more heavily influenced by a deeper analysis of the supply chain on a chain wide or network basis as opposed to the more popular dyadic studies." Specifically, the goal of this work is to revisit Brown and Bukovinsky (2001) in light of Giunipero et al.'s recommendation to place great attention on (1) small sample size, (2) one-tier investigation, and (3) longitudinal study.

The next part of this paper presents considers Brown and Bukovinsky (2001) in light of recommendations for supply chain research from Giunipero et al. (2008). The variables and empirical model are then presented, followed by the empirical results. The paper ends by providing findings and conclusions.

Supply Chain Research and Data

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, return on sales, gross profit margin, 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 had 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%.

Return on Sales for non-adopters increased 130%, but decreased 47% for adopters (Brown and Bukovinsky, 2001). Adopters and non-adopters' gross profit margins were

similar and increased 3% and 2%, respectively. The gross profit margin 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 work builds on the approach of Brown and Bukovinsky (2001), yet differs in five ways as it strives to address the gaps in supply chain research identified by Guinipero et al. (2008). First, Brown and Bukovinsky (2001) is classified as a one-tier investigation in that it only considers one level of the supply chain, namely grocers (Table 1). This is a chain level analysis in that it includes grocers, mass merchandisers, food wholesalers, and manufacturers of food and consumer product goods. The scope of the analysis was

Table 1. Contrast of Brown and Bukovinksy with New Research, by Research Limitation

Supply Chain Research Limitation Criteria[1]	Brown and Bukovinsky	Current Work
Tier	Firm level – grocers	Chain Level – food and consumer product manufacturers, wholesalers, grocers and mass merchandisers
Sample Size	20 to 25 grocers	1,560 observations from 104 firms
Research Method	Multiple Regression	Multiple Regression
Years of Study	1992-98	1992-2007
Classification of ECR	Survey	Google Search

[1]Giunipero et al. (2008).

expanded to include the entire food industry to reflect that ECR is an industry wide supply-chain initiative. Mass merchandisers were added because part of the intent of ECR was to develop strategies to compete with the entry of Wal-Mart. The product categories were also expanded beyond food to consider other consumer products like health and beauty. Thus, the model in this study includes a binary variable distinguishing between the retail/wholesale sector and the food and consumer goods manufacturing sector.

Second, Brown and Bukovinsky's (2001) regression models apparently were based on one observation for 20 grocers in 1998 or 25 grocers in 1997 (Table 1). In contrast, the regression analysis in this work was based on 1,560 observations from 104 firms, with annual observations from 1992 to 2007. Third, the longer time span allows us to consider the effects of ECR from a longitudinal perspective as well, an additional concern of Giunipero et al. (2008).

Like the Brown and Bukovinsky study, this analysis includes an indicator variable that captures whether a firm adopted ECR. The fourth difference is that a second indicator variable is included for those firms that also have adopted VICS, which can be viewed as a next generation level of sophistication with respect to supply chain management.

Finally, this analysis also includes three additional dummy variables – MERGER, ACQUIRE, and SELL – which are meant to capture disruptions in operations that might lead to variations in growth rates. The firm history for each company was studied in the Mergent database, by year to disclose whether a firm had participated in a merger, acquisition, and sale/spin off. If the firm did, the respective variable took a value of 1, otherwise it equaled 0.

Both studies use multiple regression, with a similar set of dependent and independent variables. Additionally, both studies suffer from the challenge of classifying firms as adopters of ECR. Brown and Bukovinsky (2001) had the firms self identify based on responses to a survey. In this work, 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 VICS 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" with each company name. Results from each of the 104 searches were then inspected to verify whether the website indicated that a particular firm was an adopter of ECR. Using the Google search instead of a survey asking firms to self-identify their ECR

strategy avoids the potential for self-selection bias. 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, 62 firms were classified in the NONE category and 42 firms were in the ECR category, while 11 firms are members of the VICS consortium.

A list of grocers was first developed from the Hoover's website and *Business Week,* using SIC 5141 and 5144. The sample was then expanded beyond grocers by identifying suppliers and customers of the grocers in the Mergent database. This extended the companies to include wholesalers (SIC 5149), mass merchandisers (5331), food manufacturers from SIC group 20, as well as health and beauty manufacturers (SIC group 28) or household goods from SIC groups 30 and 34. The 10-K yearly financial report filed with the Securities and Exchange Commission (SEC) was obtained for each company from the database Mergent. The 10-K data included a balance sheet and an income statement for fifteen years for each company, beginning in 1992 and ending in 2007. There were 1,560 observations used for this research. Companies were divided into two sectors, grocers and food manufacturers. There were 25 grocery firms and 79 manufacturers in the data set.

Variables and Model

An Excel spreadsheet model was designed to calculate several inventory, profitability, and growth measures (Table 2). These measures were then used in the regression analyses. For the multiple regression models, data for all 104 firms for all years (1993-2007) were used to regress each dependent variable on the independent variables. Statistical Analysis Software (SAS) was used to estimate the regression equations.

Table 2. Formulas to Calculate 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
Return on Sales	ROS	Net Income/Net Sales
Return on Assets	ROA	{Net Income + [Interest Expense * (1 – Tax Rate)]} ÷ Total Assets
Return on Equity	ROE	Net Income/Total Equity
Gross Margin	GM	(Net Sales – COGS)/Net Sales * 100
Asset Growth	AG	$[\text{Total Assets}_{t} - \text{Total Assets}_{t-1}] / \text{Total Assets}_{t-1}$
Sales Growth	SG	$[\text{Net Sales}_{t} - \text{Net Sales}_{t-1}] / \text{Net Sales}_{t-1}$

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 (ROA, ROS, ROE, and GM) measure financial performance (Table 3). Each of the eight dependent variables (DV) was regressed on ten independent variables. In general form, the model is:

DV = f(TA, AG, SG, SECTOR, ECR, VICS, MERGER, ACQUIRE, SELL, TREND) (1)

where TA = Total Assets,
AG = Asset Growth,
SG = Sales Growth,
SECTOR = Firm is in Retail/Wholesale Sector = 1, Otherwise = 0,
ECR = Adopted Supply Chain Management Strategies = 1, Otherwise = 0,
VICS = Adopted Voluntary Interindustry Collaboration = 1, Otherwise = 0,
MERGER = Firm participated in a merger in year t =1, Otherwise = 0,
AQUIRE = Firm acquired other firm in year t =1, Otherwise = 0,
SELL = Firm sold or spun off a division in year t = 1, Otherwise = 0,
TREND = the time period 1993-2007 = 1-15.

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 since larger firms typically have greater access to capital than smaller firms. In turn, larger firms are expected to be more efficient, thus 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 size as measured by 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. SG is also difficult to anticipate because sales growth might lead to an inventory increase.

These three firm change variables (MERGER, ACQUIRE, and SELL) are expected to have positive signs for the inventory dependent variables. Changes from mergers, acquisitions, or disposals may lead to a short-term decrease in efficiency causing cash conversion cycles, inventory turnover to fall and increase inventory-to-assets and inventory-to-sales ratios.

SECTOR is expected to have negative signs for CCC and ItoS. Retail and wholesale firms should have shorter lag times on cash conversion cycles than food manufacturers, as

well as lower inventory-to-sales ratios. This occurs in large part because retail and wholesale firms receive payment for products as soon as they are sold. SECTOR is expected to be positive for INVTURN and ItoA because retail and wholesale firms turn over average inventory balances faster and have less capital tied up in assets than manufacturers.

The ECR and VICS variables are 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 1993-2007 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 profitability dependent variable regressions (ROA, ROS, ROE, and GM). TA is expected to have positive signs because larger firms have the pecuniary advantage of purchasing products at lower prices than smaller firms, and thus, are expected to operate more profitably. The expected sign for the independent variable AG is once again hard to predict. 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 dependent financial variables. As sales increase, profitability performance measures should increase.

For the profitability dependent variables, the independent variables for mergers, acquisitions, and disposals 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 return on sales, margin, gross margin, return on assets, and return on equity 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 four profitability dependent variables. Neither food retail/wholesale nor manufacturing firms have an advantage over the other in terms of improving financial performance. Thus, profitability performance measures for the retail/wholesale sector should be similar to the manufacturing sector.

The ECR and VICS variable should have positive signs for the regressions ROE, ROS, ROA, and GM, meaning supply chain initiatives should increase financial performance. The TREND variable is again used to measure trend effects for the period 1993-2007, 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 were compared for the overall industry, by sector, and for ECR adopters vs. non-adopters (Table 3). A paired t-test found statistical differences by sector for the Inventory Turnover, CCC, ItoA, and ItoS, and total asset variables. Mean values for ItoA were lower for the manufacturing sector than for retailers due to structural differences between the two industries. Manufacturing firms generally have larger amounts of capital invested in plants and equipment, whereas retail and wholesale firms mainly invest in stores and inventories. For CCC and ItoS, the mean values for the retail/wholesale sector were lower than the manufacturing sector. The structure of the retail/wholesale sector focuses more on turnover than the manufacturing sector, which focuses upon efficient production.

A paired t-test for the mean value of the financial measures ROS and gross margin found statistical differences by sector, and in both cases this measure was lower for the retail/wholesale sector than for the food manufacturing sector (Table 3). These results reflect differences in pricing and markup for firms in the manufacturing sector versus firms in the retail/wholesale sector.

A paired t-test found the financial measures ROS, ROA, and ROE have statistical differences for adoption or non-adoption of ECR (Table 3). These results suggest that firms

Table 3. Mean Values by Overall Industry, Sector, and ECR Adopter/Non-Adopter

Variable	Mean Values				
	Overall Industry	Retail and Wholesale	Food Manufacturer	ECR Adopter	Non-Adopter
Return on Sales [a,b]	2.8%	1.2%	3.3%	4.8%	1.6%
Return on Assets [b]	5.8%	5.9%	5.7%	7.6%	4.7%
Return on Equity [b]	4.3%	4.2%	4.4%	6.0%	3.3%
Gross Margin % [a]	33.6%	24.6%	36.5%	32.7%	34.2%
Inventory Turnover [a,b]	8.77	13.22	7.36	8.30	9.04
Cash Conversion Cycle [a,b]	59.81	22.51	71.61	43.00	69.59
Inventory-to-assets [a,b]	18.5%	21.2%	17.6%	17.6%	19.0%
Inventory-to-sales [a,b]	12.3%	7.8%	13.7%	11.0%	13.0%
Asset Growth	11.7%	12.3%	11.6%	10.5%	12.4%
Sales Growth [b]	12.8%	14.7%	12.2%	8.6%	15.2%
Total Assets* [a,b]	4.56	7.44	3.64	10.41	1.15

*Measured in billions.

[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 ECR adopter/non-adopter.

adopting ECR initiatives have higher profitability levels than non-adopters. ECR adopters also have statistically lower levels of inventory and shorter cash conversion cycles. The ECR adopters are also ten times larger than non-adopters on average.

Tables 4 and 5 report the results for the eight inventory and financial dependent variables, respectively. 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 0.14, are low for all eight regressions, which is similar to the results of Brown & Bukovinsky (2001).

Table 4. Empirical Results for Inventory Models

	Dependent Variables			
	CCC	INVTURN	ItoA	ItoS
Independent Variables	Parameter Estimates for the Independent Variables (t-Value)			
INTERCEPT	84.909 (18.13)***	6.865 (16.06)***	0.202 (29.80)***	0.148 (20.30)***
TA	-0.866 (-4.88)***	-0.027 (-1.64)	-0.001 (-3.41)***	-0.001 (-2.02)**
AG	-0.542 (-0.10)	-1.04 (-2.05)**	-0.011 (-1.32)	0.019 (2.22)**
SG	6.812 (2.19)**	-0.378 (-1.33)	0.004 (1.00)	0.003 (0.71)
MERGE	-15.715 (-1.24)	1.138 (0.99)	-0.022 (-1.19)	-0.013 (-0.65)
ACQUIRE	1.2667 (0.30)	-0.211 (-0.54)	-0.003 (-0.48)	0.001 (0.11)
SELL	-9.135 (-1.56)	0.429 (0.80)	-0.009 (-1.03)	-0.005 (-0.52)
ECR	-15.569 (-3.54)***	-1.031 (-2.57)	-0.006 (-0.93)	-0.01 (-1.52)
VICS	34.128 (3.46)***	-2.163 (-2.40)**	0.011 (0.80)	0.032 (2.09)**
SECTOR	-44.579 (-9.76)***	6.084 (14.59)**	0.04 (6.01)***	-0.056 (-7.85)***
TREND	-0.758 (-1.65)*	0.151 (3.59)***	-0.002 (-3.34)***	-0.001 (-1.63)
Multicollinearity Test	Variance Inflation Values for Models			
TA	1.35	1.35	1.35	1.35
AG	1.15	1.15	1.15	1.15
SG	1.10	1.10	1.10	1.10
MERGE	1.03	1.03	1.03	1.03
ACQUIRE	1.09	1.09	1.09	1.09
SELL	1.04	1.04	1.04	1.04
SECTOR	1.22	1.22	1.22	1.22
ECR	1.24	1.24	1.24	1.24
VICS	1.03	1.03	1.03	1.03
TREND	1.07	1.07	1.07	1.07
R^2	0.1103	0.1396	0.0431	0.0569
F-Value	19.21	25.13	6.97	9.35

*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 5. Empirical Results for Profitability Models

	Dependent Variables			
	ROA	ROE	ROS	GM
Independent Variables	Parameter Estimates for the Independent Variables (t-Value)			
INTERCEPT	0.054 (5.30)***	0.038 (3.54)***	0.008 (1.01)	0.379 (38.23)***
TA	0.0004 (1.09)	0.0005 (1.20)	0.001 (1.84)*	0.0005 (1.32)
AG	0.049 (4.01)***	0.054 (4.25)***	0.041 (4.29)***	-0.006 (-0.51)
SG	0.005 (0.68)	0.005 (0.71)	0.026 (4.87)***	0.003 (0.45)
MERGE	0.015 (0.53)	0.009 (0.31)	0.012 (0.53)	0.036 (1.33)
ACQUIRE	0.01 (1.12)	0.012 (1.21)	0.014 (1.90)*	-0.002 (-0.22)
SELL	-0.022 (-1.72)	-0.027 (-2.00)**	0.006 (0.60)	-0.035 (-2.81)**
ECR	0.028 (2.90)***	0.025 (2.51)**	0.027 (3.61)***	-0.014 (-1.46)
VICS	0.02 (0.93)	0.023 (1.02)	0.012 (0.70)	0.088 (4.21)***
SECTOR	-0.004 (-0.42)	-0.008 (-0.75)	-0.027 (-3.41)***	-0.123 (-12.67)***
TREND	-0.002 (-2.00)**	-0.002 (-1.52)	-0.00008 (-0.11)	-0.001 (-1.34)
R^2	0.0314	0.0316	0.0662	0.1105
F-Value	5.02	5.05	10.97	19.24

*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 ordinary least squares estimation results for the four inventory dependent variable models (CCC, INVTURN, ItoA, and ItoS). The t-tests for TA, ECR, and SECTOR were statistically significant in the CCC model and exhibited negative signs, while SG and VICS had positive signs (Table 4). All signs are as expected except for VICS. Firms adopting ECR are able to lower cash conversion cycles, while firms adopting closer

collaboration (VICS) have a higher cash conversion cycle. The positive sign for SG suggests that increases in sales growth rates are related to longer cash conversion cycles, suggesting sales growth can be difficult to manage.

The growth independent variable AG was statistically significant and negative in the INVTURN model, suggesting that the increase in asset growth was brought on by expansion of plants and equipment (Table 4). The sign was also negative and significant for VICS, which again was unexpected. The positive sign for SECTOR suggests higher inventory turns among retailers than manufacturers, while the positive sign for TREND suggests an underlying increase in inventory turns.

For the dependent variable ItoA model, only three independent variables had significant signs, TA, SECTOR, and TREND (Table 4). TA and TREND were negative, while SECTOR was positive, and these signs were all as expected. The independent variables TA, AG, VICS, and SECTOR were statistically significant in the ItoS model. The sign for AG was positive, and as expected, they were negative for TA and SECTOR.

Table 5 reports the results for the profitability dependent variable models (ROA, ROS, ROE, and TM). In the ROA model, the signs of the independent variables AG and ECR were both statistically significant and positive as expected, while the sign for TREND was negative (Table 5). Hence, it appears that firms who adopt ECR supply chain management strategies are likely to improve returns on assets. The positive sign for AG reinforces the sense with inventory measures that the shifts in asset growth are caused by changes in expansion of plants and equipment, rather than increases in inventories.

The independent variables AG, SELL, and ECR were statistically significant in the ROE model (Table 5). The signs for AG and ECR were positive, but SELL exhibited a negative sign. Results for the ROS model indicate TA, AG, SG, ACQUIRE, ECR, and were statistically significant variables, and their signs on these variables were positive as expected. Results for the GM model indicate the independent variables SELL, VICS, and SECTOR were significant. The negative sign for SECTOR in the ROS and GM models suggests a difference in pricing power between retailers and manufacturers. The positive sign for VICS in the GM model suggests that firms that collaborate are able to increase margins.

Conclusion and Findings

Before discussing the conclusions, it is important to acknowledge two limitations to this study. First, it is virtually 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 VICS. For simplicity, a binary variable is used to distinguish firms adopting or not adopting supply chain management strategies (ECR or VICS). With these limitations in mind, four conclusions for inventory measures and six conclusions for financial performance measures can be drawn from this study.

First, for inventory performance measures, larger firms in terms of total assets have lower cash conversion cycles and inventory-to-asset and inventory-to-sales ratios compared to smaller firms. Second, as sales growth increases, inventory ratios are statistically unchanged, but cash conversion cycles increases, implying that inventory levels become difficult to manage. Third, the retail/wholesale sector has lower cash conversion cycles and inventory-to-sales ratios due to continuous inventory movement, but inventory-to-asset ratios are higher. Firms in the

retail/wholesale sector normally have less capital tied up in plants and equipment than food manufacturers, thus leading to higher inventory to asset ratios. The cash conversion cycle is much shorter for retail/wholesale firms (22.51 days) than for food manufacturers (71.61 days).

Fourth, only the CCC model exhibited significant results for adopters of supply chain management strategies, implying that ECR adopters do not have a distinct advantage in inventory management over non-adopters, although they have managed to lower cash cycles (Table 3). The mean value for CCC for ECR adopters (43.00 days) was lower than for non-adopters (69.59 days), while inventory turnover was higher for non-adopters (9.04) than adopters (8.30). Inventory-to-assets and inventory-to-sales measures were similar for both adopters and non-adopters. In general, the results for inventory measures were in accordance with the findings of Brown & Bukovinsky (2001).

For the financial performance measures, the results first suggest that total assets are only relevant to return on sales in terms of size. Larger firms have the advantage of purchasing products at lower prices than smaller firms and thus operate more profitably. However, increases in profitability accompany asset growth. Second, sales growth is important for the financial measures of return on sale (ROS).

Third, the sign for MERGER, ACQUIRE, and SELL have a limited relationship to either inventory or financial performance. This is not to say that that mergers and consolidations taking place in the food industry have no impact on profitability measures. Mergers and acquisitions may lead to economies of scale and increased profitability over time. It might be that the firms in the sample are more stable than others given that only firms with data for all 15 years were used in the analysis. Fourth, firms in the retail/wholesale sector exhibited

negative signs for the GM and ROS models, implying that retail and wholesale firms' margins are less than food manufacturers.

Fifth, ECR adopters exhibited positive results for the three profitability financial measures, as anticipated by its proponents. These results imply that ECR adopters enjoy superior financial performance over non-adopters, and they differ from the findings of Brown & Bukovinsky. ECR adopters had an average 4.81% for ROS compared to 1.61% for non-adopters. Adopters also had higher average ROA and ROE (7.64% and 6.04%) than non-adopters (4.46% and 3.31%). Thus, profitability is about double for ECR adopters.

The results of this study are important because they suggest, contrary to the results of Brown & Bukovinsky (2001) that the adoption of ECR has led to growth in profit. However, the growth in profit does not appear to come from improved performance for traditional inventory measures. The driving force behind these improved financial measures can be attributed to the CCC. By shortening CCCs, firms in the food industry can improve profits. The longer the CCC is, the greater the need for costly external financing (Moss and Stine, 1993).

It is somewhat surprising that the VICS component of the model largely turned out to be insignificant. It may be that the ECR variable may be capturing much of the benefit provided by utilizing a VICS supply chain strategy, given the large overlap among these firms. However, VICS is positive and significant while the ECR variable is negative but insignificant in the GM model. This indicates that as margins are squeezed when using an ECR strategy, the additional usage of a VICS approach may help to bring margins back up through enhanced collaboration among supply chain partners.

The difference in the financial performance results in this study from those found by Brown and Bukovinsky (2001) may arise from two sources. First, some improvement might be attributed to having a larger sample size, by including food manufacturers as well as grocers, along with lengthening the time period involved to 1992-to 2007. Giunipero et al. (2008) suggest that the advantages from supply chain strategies were more prevalent in more recent years. Second, the inclusion of the variables MERGES, ACQUIRE, and SELL were an attempt to capture deviations in variability in growth for assets and sales in the model. These variables might allow disruptions from consolidations in the industry to explain the difference in findings, but were typically statistically insignificant. Future research should consider other ways to measure these effects.

The results of this analysis strongly 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 use of information technologies, such as Electronic Data Interchange (EDI), changes the traditional processes for purchase orders, invoices, shipping notices, and funds transfer. Thus, the need for clerical, mailing, and other costs associated with paper-based information can be eliminated, while time delays and errors can be reduced. Size matters; ECR is more effective due to economies of scale and information technology. However, this may lead to more consolidations because all firms do not have the capital to invest in these initiatives. In short, to remain competitive ECR strategies should strongly be considered by firms that are lagging in implementation.

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