

A STUDY OF INVENTORY MANAGEMENT EFFICIENCY AND FIRM'S PROFITABILITY

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ABSTRACT

There are a lot of inventory management innovation case studies in business textbooks. However, there are few case studies to explain an efficiency of inventory management with financial terms. This paper examines financial performance data for US firms in the retail and manufacturing industries. The relation between inventory management efficiency and company profitability is investigated, and we find that fewer days in inventory is associated with higher firm profitability.

Key Words: Inventory Management, Financial Performance

INTRODUCTION

Inventory management has evolved into a highly studied and practiced concept in the business world. One popular form of inventory management is Just-in-Time (JIT) inventory systems. JIT originated from the Toyota production system (TPS), which reduces inventory and lead-time and increases quality at the same time. JIT is defined as, "an inventory strategy aimed at improving a business' financial performance by reducing excess inventory and its associated cost" (Sunguard, 2007). To implement a JIT inventory system, a sound, long-term relationship with suppliers is critical because suppliers have to fill the inventory as soon as it reaches a minimum level. Therefore, sharing information about the production schedule with part suppliers and delivery companies is essential. This information sharing is now available through a modern IT infrastructure of the Internet and ERP. The Internet was privatized in 1994 and the ERP concept was introduced in 1990. ERP is an enterprise information system designed to integrate production and accounting data and functions across organizations. The main goal of ERP is to share data by all functional departments and to access the data immediately to increase prompt decision making (Motiwalla and Thompson, 2009). These two (Internet and ERP) systems dramatically improve the JIT inventory system, allowing real time information tracking and sharing of both production and accounting information. In the late

1990's, the JIT and ERP concepts expanded into a concept known as Supply Chain Management. Supply Chain Management is defined as "management of network of interconnected business," to satisfy customers' requests (Harland, 1996).

The Advanced Manufacturing Research (AMR) announces every year the Top 25 Supply Chain companies. The companies are evaluated by 60% of financial metrics and 40% based on AMR and other experts' opinions. The financial metrics that are considered are return on assets, inventory turns, and revenue gross.

The inventory level depends on the production schedule and market demand. The inventory level of a firm does not indicate a high return in profits. Inventory management means more than just having a low level of inventory on hand. The major investigation in this paper is whether successfully managing a low level of inventory over a year period will result in higher profits for the firm. Therefore, we test two specific hypotheses:

Hypothesis 1: Firms chosen as AMR top 25 supply chain managers have better performance in inventory management and profitability.

Hypothesis 2: An inverse relation exists between firm profitability and inventory management efficiency.

LITERATURE REVIEW

The concept of Supply Chain Management has helped a lot of companies to compete more effectively in their business markets. Kannan and Tan (2004) point out the three popular methods used in order to ensure that the product or service is delivered to the customer in the most efficient way possible. These three methods are Just in Time (JIT), Total Quality Management (TQM), and Supply Chain Management (SCM). All three of these methods go hand in hand because they force the company to eliminate waste while increasing the quality of their products and distribution systems. During their study, Kannan and Tan demonstrate that the inventory management methods (JIT, TQM, and SCM) all correlate with one another. Kannan and Tan set out to not only reiterate the impact on firm's operational performance, they also point out that the firm's business performance can benefit from these three methods. The two researchers decided to use the following as measurements for business performance: market share, return on assets, overall product quality, overall competitive position, and overall customer service levels. As one can see, the only measurement that is used for profitability is return on assets. Kannan and Tan (2004) conclude that "by explicitly and effectively integrating JIT, TQM, and SCM practices into operations strategy, the potential exists to add value."

Profitability is a concept that a lot of executives and shareholders put emphasis on. This shows them that their company is operating at a level to where more money is coming in than leaving the company. Gill et al. (2010) discusses the relationship that occurs between the firm's working capital management and profitability. They define working capital as being involved with current assets and current liabilities while being able to finance these current assets. It is also discussed that prior studies have shown the importance of working capital management in increasing shareholders value. The main difference between inventory management and working capital management is the fact that working capital management involves managing all of the current assets while inventory management focuses its efforts on inventories alone. Gill et al. (2010) stated that they did not see any relationship between days of accounts payable and profitability or even with days in inventory and profitability. The researchers did note that past studies have given results that differ from their own.

Given conflicting results in previous studies, we are motivated to offer evidence as to whether inventory management and profitability are related to each other. This paper chooses to focus on the concept of Inventory Management because if a company is practicing JIT and SCM, then they should see a decrease in inventory levels without hurting the companies meeting customers' demands. Profit margin is chosen as our primary measurement for profitability. Profitability will be the only performance measure that we will relate to Inventory Management unlike the Kannan and Tan study. This research paper will take into account the study performed by Gill et al. and break it down and only look at how inventories influence profitability instead of working capital as a whole.

DATA

To form our sample, we use the Compustat database to obtain year-end balance sheet and income statement items from fiscal years 2005 – 2007 for firms that operate in the retail and manufacturing industries (NAICS code beginning with 31, 32, 33, 44, or 45) and that trade on the NYSE, NASDAQ, or AMEX (Exchange code of 11, 12, or 14). We end our sample period with fiscal year 2007 in an attempt to avoid our data being influenced by the financial crisis beginning in 2008. Annual balance sheet (income statement) items collected for each firm-year observation include inventory, total assets, current assets, and total liabilities (net income, sales, and gross revenue). To form a balanced panel of data, we require observations for sample firms to occur in all three years and to include all financial statement items so that our final sample includes a total of 1,499 firms. We classify each sample firm as either a top 25 supply chain manager (15 firms) or a non-top 25 supply chain manager (1,484 firms) using the 2009 Top 25 Supply Chain List from AMR. Companies making the top 25 annual list must display an excellence in total operations, which means they must have perfect orders and low total supply

chain costs. The companies are also selected on their level of innovation within the company and a scholarly opinion is factored in. We calculate three measures of profitability for each firm including profit margin (net income divided by gross revenue), return on assets (net income divided by total assets), and return on inventory (net income divided by inventory). Our measurement of inventory management efficiency is days in inventory calculated as 365 days divided by inventory turnover during the year where inventory turnover is calculated as sales divided by inventory.

ANALYSIS

Profitability and Inventory Management Efficiency

Table 1 presents t-test results for the differences in means between top 25 and non-top 25 supply chain firm groups. Differences in means between groups are calculated by fiscal year for profit margin, return on assets, return on inventory, and days in inventory. We find support for *Hypothesis 1* in that AMR top 25 supply chain managers have better inventory management performance and higher profitability. Our analysis shows that firms that are ranked as top 25 supply chain managers hold less inventory during each fiscal year than firms that are not top 25 supply chain managers. In all three sample years, days in inventory is significantly lower for top 25 sample firms than for non-top 25 sample firms. Further, sample firms that are part of AMR's Top 25 Supply Chain List are significantly more profitable than sample firms that are not part of the list. Our profitability result is true for profit margin, return on assets, and return on inventory in all three sample years with the exception of return on inventory in fiscal year 2006.

Table 1: Differences in Profitability and Inventory Management Efficiency between Top 25 and Non-top 25 Supply-chain Management Groups by Fiscal Year*

	Top 25 Group (n = 15) Mean	Non-top 25 Group (n = 1,484) Mean	Difference in Means	p-value for significance
2005				
Profit Margin (%)	12.13	-67.07	79.20**	0.012
Return on Assets (%)	12.92	-0.35	13.27***	0.000
Return on Inventory	2.50	-2.96	5.46***	0.000
Days in Inventory	26.43	64.78	-38.35***	0.000
2006				
Profit Margin (%)	12.69	-25.72	38.40***	0.000
Return on Assets (%)	13.12	0.96	12.16***	0.000
Return on Inventory	2.28	-12.34	14.62	0.189
Days in Inventory	28.03	58.96	-30.93***	0.000
2007				

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Profit Margin (%)	12.50	-21.93	34.43***	0.000
Return on Assets (%)	12.82	0.15	12.67***	0.000
Return on Inventory	2.43	-4.54	6.97***	0.001
Days in Inventory	27.13	58.20	31.07***	0.000

* Differences in means are calculated as the mean for the top 25 group less the mean for the non-top 25 group. Therefore, a positive (negative) difference indicates that the top 25 group mean is greater (less) than the non-top 25 group mean.

** and *** indicate that the significant difference is at the 5% or 1% level, respectively.

Regression Analysis

Current results show that firms who are better managers of their supply chain tend to be more profitable and to hold less inventory. To test the relation between profitability and inventory management efficiency, we estimate the following cross-sectional, time series regression model:

$$PM_{i,t} = \beta_1 DI_{i,t} + \beta_2 D/E_{i,t} + \beta_3 FA_{i,t} + u_{i,t} \quad (1)$$

In model (1), $PM_{i,t}$ is the calculated profit margin used to measure the profitability of firm i in year t . The explanatory variable used to test the relation between inventory management efficiency and firm profitability is $DI_{i,t}$, which is the days in inventory of firm i in year t . Based on Eriotis, Frangouli, and Ventoura-Neokosmides (2002), we include control variables $D/E_{i,t}$ and $FA_{i,t}$ which are firm i 's debt-to-equity ratio and fixed assets, respectively, in year t . We estimate model (1) such that we account for firm fixed effects and yearly fixed effects. Therefore, the structure of $u_{i,t}$ is as follows:

$$u_{i,t} = \gamma_i + \alpha_t + \varepsilon_{i,t} \quad (2)$$

where γ and α are estimated fixed parameters. Because we estimate model (1) without an intercept term, α for year three of the sample is restricted to zero in Model (2).

Table 2 presents our regression results. Our tests show that a significantly negative relation exists between a firm's days in inventory and the firm's profit margin. A smaller value for the days in inventory ratio indicates the firm is more efficient at managing inventory. Therefore, the negative relation between firm profitability and days in inventory supports *Hypothesis 2* as we find that firms with better inventory management efficiency show higher profitability.

The R^2 from our regression estimation is 0.89, indicating that our model has a strong fit. The F-statistic of 5.94 for our model is significant at the 1% level, so we conclude that controlling for fixed effects is necessary and that we should not use a pooled regression model.

Table 2: Regression Results*

$DI_{i,t}$	-0.063*** (0.000)
$D/E_{i,t}$	-0.000 (0.888)
$FA_{i,t}$	0.000 (0.978)
R^2	0.89
F-stat (Two-way Fixed Effects)	5.94*** (0.000)

* Results are presented for our cross-sectional, time series regression model with estimates allowing for fixed effects across both cross-sections (firms) and time series (fiscal year). The dependent variable for the model is the calculated profit margin for firm i in year t . $DI_{i,t}$ is the firm-year days in inventory, $D/E_{i,t}$ is firm-year debt-to-equity ratio, and $FA_{i,t}$ is firm-year fixed assets. We report p-values for statistical significance in parentheses below the corresponding coefficient estimate and report the model's F-statistic for the test of fixed effects versus the null hypothesis of probability with the corresponding p-value in parentheses below the F-stat.

*** indicates significance at the 1% level.

CONCLUSION

Inventory management has been common practice in business for a long time. Supply Chain Management is a relatively new concept, but inventory management is at the heart of the concept. Each year, AMR announces the Top 25 Supply Chain companies based on opinion as well as financial ratios measuring inventory management efficiency and profitability. By examining the financial data of 1,499 firms over three fiscal years, we find that members of the AMR Top 25 list are more profitable and better managers of inventory. These initial results lead us to examine the relation between profitability and inventory management efficiency, and we find that better inventory management efficiency is positively related to firm profitability.

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