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AERONAUTICS AND SPACE TECHNOLOGIES' INVENTORY EFFICIENCY, INVENTORY PRODUCTIVITY AND INVENTORY RESPONSIVENESS VS. FINANCIAL PERFORMANCE

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ABSTRACT

In this paper the relationship between aeronautics and space technology companies' inventory management performances and companies' financial performances are studied by conducting empirical analysis. Specifically, inventory efficiency, inventory productivity and inventory responsiveness are studied in order to assess the effect of inventory management performance on company competitive outperformance. A time-series model, that takes into account of some inventory performance indicators and financial performance measures, is developed and tested using data for 230 publicly listed U.S. aeronautics and space technology companies for the 32-year period, 1985 to 2017. This study utilizes firm financial data, acquired from the Standard and Poor's COMPUSTAT database using Wharton Research Data Services (WRDS). The implications of the results on the inventory management implementation and directions for future research are provided.

Keywords*: Aeronautics, Space Technologies, Operations Management, Inventory Management.*

HAVACILIK VE UZAY TEKNOLOJİLERİNDE ENVANTER YETERLİLİĞİ, ENVANTER VERİMLİLİĞİ VE ENVANTER DUYARLILIĞININ MALÎ PERFORMANSLA İLİŞKİSİ

ÖZET

Bu makalede havacılık ve uzay teknolojileri şirketlerinin envanter yönetimi performansları ile malî performansları arasındaki ilişki ampirik analizlerle incelenmiştir. Envanter yönetimi performansının etkilerini değerlendirebilmek için spesifik olarak, envanter yeterliliği, envanter verimliliği ve envanter duyarlılığı üzerinde çalışılmıştır. Envanter performans ve malî performans ölçütlerini göz önünde bulundurarak zaman-serileri modeli geliştirilen bu çalışmada 32 yıllık bir zaman diliminde, 1985-2017 yılları arasında, Amerika Birleşik Devletleri'nde halka açık, havacılık ve uzay teknolojileri endüstrilerinde yer alan 230 şirketin verileri bir araya getirilmiş ve kullanılmıştır. Firmaların malî verileri Wharton Araştırma Veri Servisi (WRDS) kullanılarak Standard and Poor's COMPUSTAT veri tabanından elde edilmiştir. Analizler neticesinde envanter yönetimi uygulamaları ve gelecek çalışmalar için öneriler sunulmuştur.

Anahtar Kelimeler: *Havacılık, Uzay Teknolojileri, Operasyon Yönetimi, Envanter Yönetimi.*

1. INTRODUCTION

This paper studies the empirical relation between the inventory management of aeronautics and space technology firms and firm operational performance benefits. The efficacy of inventory management performance indicators in a firm may not necessarily be same as in a different firm even if both belong to same industry segment. Hence, for academics and the sector analysts, performance assessment and benchmarking of firms are no longer straightforward [1]. This leads to the idea of divergence of the characteristics of inventory strategy and firm performance across product groups.

For instance, in its 2014 international forecast report, Orbital Sciences Corporation, the Orbital's products and services are grouped into industry segments as follows: launch vehicles, satellites and space systems, and advanced programs. Each of these segments also consist of sub-units, which are summarized as below; and the company is managing their inventories separately [2].

- Launch Vehicles
  - Space Launch Vehicles
  - Interceptor Vehicles
  - Target Launch Vehicles
- Satellites and Space Systems
  - Communication Satellites
  - Science & Remote Sensing Satellites
  - Space Technical Services
- Advanced Programs
  - Human-Rated Space Systems
  - National Security Systems
  - Advanced Flight Systems

Industry competitiveness [3], managing gross margin, capital investment and sales surprise [4-7] have been considered as company-level inventory management issues in various industries. In addition, various company-level inventory styles [8] and buyer-supplier cooperation impacts [9] have been taken into account. Moreover, aggregate inventories have been studied across broad segments of industries or countries, by several operations management scholars; for example, inventory levels held by US manufacturers [10], US public firms [11-13], US retailers [14,15] , local and international companies collected from various industries [16,17]. Some recent research has focused on firm performance in various industries, especially in retail; however, the studies focusing on inventory management policies in aeronautics and space technology industries are quite few [6]. In this study, the focus is to determine which inventory performance measures are most appropriate for determining aeronautics and space technology companies' financial performance. The paper extends the previous literature [6] in a way that new dependent variables, return-on-equity and return-on-investments that measure financial performance, are taken into account in addition to return-on-assets. Moreover, it has been shown that the three hypotheses tested earlier prevail with a more recent and larger dataset. There are three main research goals:

- To demonstrate and test a performance model that integrates the various dimensions of aeronautics and space technology companies' inventory management implementation empirically. Specifically, inventory efficiency, inventory productivity and inventory responsiveness are studied.
- To assess the inventory management performance impact on firm financial performance.
- To build on existing literature supporting a more scientific understanding of company performance benchmarking and evaluation in this unique industry [18].

2. DATA DESCRIPTION

The firm financial data for the time-period 1985-2017 is collected for all aeronautics and space technology companies publicly listed in the Standard and Poor's COMPUSTAT, "Compustat North America Annually Updated", Annual Fundamentals database using Wharton Research Data Services (WRDS). All of the measures considered in this study are not only directly retrieved but also derived from the firm-level COMPUSTAT data. Almost 333 firms reported at least one-year financial data during this 32-year time-period, with 6759 annual observations. Then, the firms that have less than five consecutive years of data were omitted from the original dataset. This approach follows practices applied in the literature [4-7,19,20]. The final data set contains 230 firms and 3227 annual observations (Table 1).

Table 1. Number of years of reported data (1985-2017).

Number years of complete financial information	Number of firms	Number of observations
≤5	59	218
6-15	85	876
16-25	48	957
26-31	15	440
32	23	736
Final segment sample	230	3227

The U.S. Department of Commerce assigns a four-digit Standard Industry Classification (SIC) code to each firm according to its product line segment where it operates. Since there are firms in similar product groups, they may span multiple categories. Table 2 lists the SIC codes, corresponding segment names and example firms for each segment.

3. DEFINITION OF VARIABLES

The data is obtained from COMPUSTAT to calculate the dependent and independent variables that are used in this study. All data are in units of million U.S. dollars; for instance, Inv_{it} is the total inventory value in dollars for firm *i* in year *t*. S_{it} is the sales, net of markdowns in dollars for firm *i* in year *t*, etc. The model variables and their corresponding COMPUSTAT codes and definitions are constructed as stated in Table 3.

In order to conduct the empirical analysis, few adjustments are made. For example, each balance sheet item, e.g. $COGS_{it}$-cost of goods sold-, was transformed to get a mean value for that item for each firm for a period.

Table 2. Firms reporting financial performance data by industry (1985-2017).

SIC (4 digit)	Segment name	Number of firms	Number of observations	Examples of firms
3720	Aircraft and Parts	2	41	Alcoa Inc., General Donlee Canada Inc.
3721	Aircraft	19	270	BAE Systems, General Dynamics Corp., Textron Inc.
3724	Aircraft Engine, Engine Parts	10	195	HEICO Corp., United Technologies Corp.
3728	Aircraft Parts, Auxiliary Equipment	27	470	Air Industries Group Inc., Goodrich Corp., Rockwell Collins Inc.
3760	Guided Missiles, Space Vehicles and Parts	7	130	Lockheed Martin Corp., Orbital Sciences Corp., Spacedev Inc.
3812	Srch,Det,Nav,Guid, Aeronautical Systems	56	736	Aerosonic Corp., Esterline Technologies Corp., Garmin Ltd., Thales
4512	Air Transport, Scheduled	74	952	American Airlines Group Inc., Delta Airlines Inc., JetBlue Airways Corp., US Airways Group Inc.
4513	Air Courier Services	8	124	Air Transport Services Group, Cargojet Inc., Fedex Corp.
4522	Air Transport, Nonscheduled	15	182	Air Methods Corp., River Hawk Aviation Inc., PHI Inc.
4581	Airports and Terminal Services	12	127	Hudson General Corp., Spar Aerospace Ltd., TAT Technologies Ltd.
Sample total		230	3227	

Table 3. Definition of model variables.

Variables	COMPUSTAT code	Definition
Inv_{it}	INVT	Inventories-Total
S_{it}	SALE	Sales/Turnover (Net)
$COGS_{it}$	COGS	Cost of Goods Sold
AT_{it}	AT	Assets-Total
$LIFO_{it}$	LIFR	LIFO Reserve
$EBITDA_{it}$	EBITDA	Earnings Before Interest
NI_{it}	NI	Net Income
K_{it}	ICAPT	Invested Capital-Total
E_{it}	SEQ	Stockholders' Equity-Total

In other words, $COGS_{it}$ becomes the mean cost of goods sold for firm *i* calculated by averaging the ending cost of goods sold for period *t-1* ($COGS_{it-1}$) and year *t* ($COGS_{it}$) for each period. Likewise, the similar procedure is applied for total assets and total inventory for each company.

3.1 Inventory Performance Measures

For competitive financial advantage, firms have to be effective in inventory leanness, inventory productivity and inventory responsiveness [21]. Based on the model variables provided in Table 3 and being parallel to the operations management literature, the following inventory performance measures are defined and computed in order to quantify the various aspects of inventory management execution: relative inventory level, gross margin return on inventory investment and inventory responsiveness. The measures and the calculations are shown in Table 4.

- The inventory efficiency or inventory leanness is measured by relative inventory level (XI), inverse of inventory turnover, which is calculated as the total average inventory over cost of goods sold.
- The inventory productivity is measured by gross margin return on inventory investment (GMROII), which calculates how much profit contribution a company gets on every dollar it spends on inventory.
- The inventory responsiveness (XC) is measured by over-responsiveness (XC^+) and under-responsiveness (XC^-), which calculates how fast inventory levels are modified by a company in reaction to variations in the sales atmosphere.

Table 4. Definition of inventory policy performance variables.

Inventory performance measures	**Calculations**
Inventory efficiency	$XI_{it} = \frac{Inv_{it}}{COGS_{it}}$
Gross margin return on inventory investment	$GMROII\ _{it} = \frac{GM_{it}}{Inv_{it}}$
Inventory responsiveness	$XC_{it} = \frac{Inv_{it} - Inv_{i(t-1)}}{Inv_{i(t-1)}} - \frac{COGS_{it} - COGS_{i(t-1)}}{COGS_{i(t-1)}}$
Inventory responsiveness (over-responsiveness)	$XC +_{it} = XC_{it} \times 1_{(IR \geq 0)}$
Inventory responsiveness (under-responsiveness)	$XC -_{it} = XC_{it} \times -1_{(IR \geq 0)}$

3.2 Firm and Segment Control Variables

There are couple of control variables that are taken into account in this study; first, the firm's total capital investment, K_{it} (Table 3). Companies possibly either buy or take part in lease agreements to invest in different technologies, or other capital investments to manage total inventories. Moreover, existing research has mentioned the importance of controlling invested capital when evaluating inventory and operational performance) [8,15]. Companies revenue growth are significantly linked to the sales growth; therefore, the second control variable is the sales growth for each company. ΔS_{it} is the sales growth of the firm *i* in period *t* from period *t−1*. Again, according to the literature, companies' gross margins of the product portfolio and non-inventory fixed asset are two important performance indicators to be controlled [4,15]. Therefore, segment-adjusted gross margin rGM_{its} (relative product gross margin vs. its segment average) and segment-adjusted non-inventory fixed assets $rSOA_{its}$ (relative sales over fixed assets vs. its segment average) are taken into consideration as third and fourth control variables, respectively. The variables and their calculations are summarized in Table 5.

3.3 Dependent Variables

In addition to the dependent variables, firm's segment adjusted return-on-assets (rROA) and return-on-sales (rROS) that are used in the literature earlier [6], adjusted return-on-equity (rROE) and return-on-investment (rROI) are taken into consideration to measure financial performance in this paper.

Table 5. Definition of control variables.

Control variables	**Calculations**
Sales growth rate (firm revenue growth)	$\Delta S_{it} = \frac{S_{it} - S_{i,t-1}}{S_{i,t-1}}$
Relative gross margin (firm vs. segment avg.)	$GM\%_{it} = \frac{S_{it} - COGS_{it}}{S_{it}}$ $rGM_{its} = GM_{it} - GM_{seg,t}$
Relative sales over fixed assets (firm vs. segment avg.)	$SOA_{it} = S_{it}/(AT_{it} - Inv_{it})$ $rSOA_{its} = SOA_{it} - SOA_{seg,t}$

ROA is defined as earnings before interest (EBITDA) generated per dollar of total asset investment. ROS is the earnings before interest generated per dollar of total sales. ROE is defined as the amount of profit or net income (NI) a company earns per investment dollar. In other words, it shows the income before extraordinary items available for common equity [22]. ROE is not only the financial measure of primary interest to most managers and strategic planners, it is a common measure of profits used in economic research. Finally, ROI measures the amount of return on an investment relative to the investment's cost. In this study, the segment mean *s* in year *t* will be the performance measure mean for the firm's operating segment where $rROA_{its}$, $rROS_{its}$, $rROE_{its}$ and $rROI_{its}$ denote the firm's financial performance versus its predefined segment competitors as indicated by each operating performance measure [23]. The variables and their calculations are summarized in Table 6. Descriptive statistics (overall and by segment) and the correlation matrix are listed in Tables 7-9.

Table 6. Definition of dependent variables.

Dependent variables	**Calculations**
Return-on-assets (Earnings before interest/Assets)	$ROA_{it} = \frac{EBITDA_{it}}{AT_{it}}$ $rROA_{its} = ROA_{it} - ROA_{seg,t}$
Return-on-sales (Earnings before interest/Sales)	$ROS_{it} = \frac{EBITDA_{it}}{S_{it}}$ $rROS_{its} = ROS_{it} - ROS_{seg,t}$
Return-on-equity (Net income/Equity)	$ROE_{it} = \frac{NI_{it}}{E_{it}}$ $rROE_{its} = ROE_{it} - ROE_{seg,t}$
Return-on-investment (Net income/Capital investment)	$ROI_{it} = \frac{NI_{it}}{K_{it}}$ $rROI_{its} = ROI_{it} - ROI_{seg,t}$

Table 7. Sample descriptive statistics (N=3227 observations).

Firm level	Mean	Standard Deviation	Minimum	Maximum
Inv	$529,384	$22,409	$1.3	$4,725,700
S	$452,725	$9,823	$4.4	$961,140
AT	$506,426	$10,754	$1.6	$991,980
ROA	0.06	1.72	-60.67	0.64
ROS	-0.03	0.38	-7.62	0.64
ROE	0.17	8.64	-110.60	374.63
ROI	-0.02	2.17	-110.60	15.25
XI	0.24	0.34	0.000	7.54
GMROII	-0.47	17.16	-650.39	60.97
XC	0.09	2.39	-23.12	103.48
K	$2476	$5062	$2.4	$53,071
ΔS	0.14	0.74	-0.98	32.03
%GM	0.21	0.97	-41.17	0.87
SOA	1.37	0.95	0.021	16.79

Table 8. Descriptive statistics (averages) by segment.

SIC Code	ROA	ROS	ROE	ROI	XI	GMROII	XC	K	ΔS	%GM	SOA
3720	0.13	0.16	0.22	0.03	0.22	0.01	0.04	11359.03	0.07	0.23	0.90
3721	-0.03	-0.16	0.20	0.06	0.33	-1.93	-0.02	5372.65	0.16	0.03	1.63
3724	0.12	0.12	0.08	0.06	0.29	0.02	0.00	3504.18	0.09	0.25	1.42
3728	0.08	0.01	0.33	0.06	0.43	-1.24	0.03	949.95	0.18	0.18	1.56
3760	0.11	0.09	0.96	0.13	0.13	0.15	0.11	2759.28	0.11	0.20	1.34
3812	0.01	-0.31	0.32	-0.24	0.39	0.08	0.19	1233.13	0.15	0.28	1.39
4512	0.07	0.09	-0.04	0.03	0.04	-0.67	0.09	3325.41	0.15	0.19	1.21
4513	0.18	0.12	-0.06	0.05	0.04	0.16	0.04	2892.85	0.10	0.22	2.02
4522	0.08	0.15	0.00	0.04	0.16	0.50	0.07	571.93	0.14	0.24	0.96
4581	0.06	0.07	-0.10	-0.11	0.25	0.34	0.13	397.59	0.17	0.27	1.33

Table 9. Correlation matrix of key model variables.

Correlations										
	ROA	**ROS**	**ROE**	**ROI**	**XI**	**GMROII**	**XC**	**K**	**ΔS**	**rGM**
ROS	0.80									
ROE	-0.04	-0.19								
ROI	0.44	0.63	0.25							
XI	-0.55	-0.62	0.16	-0.40						
GMROII	0.55	0.41	-0.07	-0.25	-0.40					
XC	-0.19	-0.36	0.19	-0.72	-0.04	0.50				
K	0.19	0.21	0.07	0.28	-0.10	-0.17	-0.44			
ΔS	-0.67	-0.46	-0.14	-0.31	0.38	-0.43	0.25	-0.69		
rGM	0.44	0.23	-0.14	-0.49	-0.10	0.88	0.60	-0.25	-0.26	
SOA	0.07	-0.28	-0.06	0.07	0.04	-0.32	-0.20	-0.29	0.17	-0.31

4. HYPOTHESIS DEVELOPMENT

In order to demonstrate how individual aeronautics and space technology companies manage inventory responsiveness, inventory productivity and inventory efficiency in various ways for superior financial performance, several hypotheses will be discussed. The hypotheses that are discussed in this section are inspired by the mathematical models of inventory theory.

Alternative measures of inventory efficiency have been used in several studies earlier [4, 11, 13, 14, 24]. The relationship between inventory efficiency and company performance is stated as positive in various industry segments [8,18]. Operations management literature proposed that relative inventory, which is proposed to specify inventory efficiency or inventory leanness, is an indicative of operational performance. Moreover, the lower relative inventory level, the better operational performance is [6,25]. Therefore, the following hypothesis stated as:

H1: A company's lower relative inventory (XI) level is linked to greater financial performance.

According to operations management literature, strategies encouraging higher gross margin returns on inventory lead to superior operational performance [4][15]. Keeping excessive inventory may be advantageous for companies when the products are popular. Nonetheless, there is a little research on expressing this relationship in terms of company's financial performance. On the other hand, existent research suggests that the higher gross margin return on inventory investment a company has the more efficient with the inventory it buys; and hence, it has a superior performance over competitors. Therefore, the following hypothesis stated as:

H2: A company's higher gross margin return on inventory investment (GMROII) level is linked to greater financial performance.

Existent operations management research implies that the more accurate a company's inventory level in response to dynamic sales environment the better the company's financial performance [25]. As provided in Table 4, the inventory responsiveness measure is dependent on inventory and cost of goods sold. Over-responsiveness (XC^+) implies that the company's inventory levels are increasing at a faster rate than sales; on the other than, under-responsiveness (XC^-) is implying that the company's inventory levels are decreasing at a faster rate than sales [25, 26]. The optimum value to inventory responsiveness is zero; in other words, changes in sales are matched with the inventory held. Therefore, the following hypothesis stated as:

H3: A company's relative over-responsiveness (XC+) or under-responsiveness (XC^-) is linked to worse inventory management responsiveness and is negatively correlated with firm outperformance.

5. MODEL DEVELOPMENT

There are different views on linking inventory efficiency, the gross margin productivity, inventory responsiveness and firm's performance [13, 18]. However, operations management literature proposes that any advancement in inventory management positively affects firm's financial performance. By implementing the proposed model to aeronautics and space technology industries, a better scientific evaluation of performance is achieved. The proposed modelling framework, which specifies the theoretical linkages in the study, is illustrated in Figure 1.

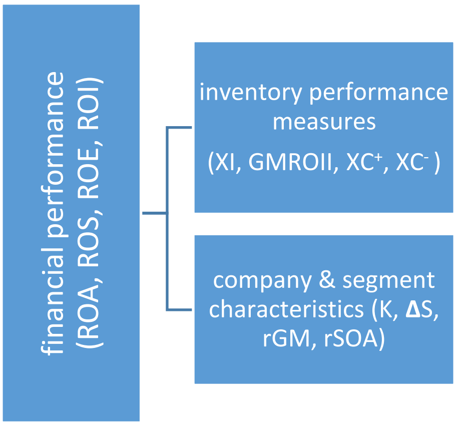

Figure 1. Inventory management to financial performance.

In this study, linear regression models are developed, where dependent variables $rROA_{its}$, $rROS_{its}$, $rROE_{its}$ and $rROI_{its}$ are the firm's segment-adjusted ROA, ROS, ROE and ROI performances as in Equations (1-4). b^1 is the coefficient for each of the firm-specific indicator variables for inventory management performance; in other words, XI, GMROII, XC; b^2 and b^3 denote the coefficients for total individual firm capital investment (K_{it}) and change in firm sales from the prior year (ΔS_{it}), respectively; lastly b^4 and b^5 are the coefficients for the segment-adjusted firm-level control variables, gross margin (rGM_{it}) and segment-adjusted non-inventory fixed assets ($rSOA_{it}$) respectively; and ε_{it} is random model error.

$$rROA_{its} = b^1 Independent\ variables_{it} + b^2 K_{it} + b^3 \Delta S_{it} + b^4 rGM_{it} + b^5 rSOA_{it} + \varepsilon_{it} \quad (1)$$

$$rROS_{its} = b^1 Independent\ variables_{it} + b^2 K_{it} + b^3 \Delta S_{it} + b^4 rGM_{it} + b^5 rSOA_{it} + \varepsilon_{it} \quad (2)$$

$$rROE_{its} = b^1 Independent\ variables_{it} + b^2 K_{it} + b^3 \Delta S_{it} + b^4 rGM_{it} + b^5 rSOA_{it} + \varepsilon_{it} \quad (3)$$

$$rROI_{its} = b^1 Independent\ variables_{it} + b^2 K_{it} + b^3 \Delta S_{it} + b^4 rGM_{it} + b^5 rSOA_{it} + \varepsilon_{it} \quad (4)$$

Hypotheses (H1–H3) would be confirmed if each of predicted coefficients are significant for b^1 in each model series for each of the models examined in the study. Each model is estimated by substituting $rROA_{its}$, $rROS_{its}$, $rROE_{its}$ and $rROI_{its}$, respectively as the dependent variable. This process is repeated for each segment and examined for each time-period.

6. RESULTS

Ordinary least squares (OLS) method is used to estimate the parameters in Models stated in Model Development section. The pooled estimates for the coefficients of control variables, inventory performance measures and R^2 for the models are stated. According to Table 10-13: H1 (Model 1), H2 (Model 2) and H3 (Model 3) are strongly supported, as each inventory performance indicator, XI, GMROII, XC^+/XC^- is a statistically significant predictor of company's financial performance. It is observed that R^2(adj) values in ROE and ROI performances are higher compared to ROA and ROS. Specifically, it is highest in ROE based models and lowest in ROA. Moreover, increases in R^2(adj) values compared to R^2 are noticed. The reason for comparing these sub models in terms of their R^2(adj) values is that it is generally considered to be an accurate goodness-of-fit measure.

There are three main findings: First, the inventory leanness or inventory efficiency measure, relative inventory (XI) level, is negatively correlated with financial performance, and it is significant ($p<0.05$). Second, the inventory productivity measure, gross margin return on inventory investment (GMROII) level, is positively correlated with financial performance ($p<0.05$). Third, the inventory responsiveness measure, relative over-responsiveness (XC^+) or under-responsiveness (XC^-), is negatively correlated with financial performance, and it is significant ($p<0.05$). These results are consistent when using either rROA, rROS, rROE or rROI as a dependent variable.

The results show that relative inventory level, gross margin return on inventory investment, inventory responsiveness have significant effects on firm financial performance, and one can check for differences in these measures when comparing the performance of a firm with its competitors. To do this, the residuals from the models could be used. Firms with positive residuals are considered to over perform; whereas, firms with negative residuals are considered to underperform compared to their competitors in the same segment.

7. CONCLUSIONS

In this paper, an empirical model to study the relationship between inventory management and financial performance is used. Specifically, the effects of inventory efficiency, inventory productivity and industry responsiveness on financial measures in the U.S. aeronautics and space technology companies are empirically observed. The first two financial measures, return-on-assets and return-on-sales, are suggested earlier literature, and are presented to have significant effects. In order to measure financial performance, two additional proxies, return-on-equity (ROE) and return-on-investment (ROI) are utilized. Empirical models are tested on financial data for 230 publicly listed U.S. aeronautics and space technology industries for the time-period 1985-2017 obtained from Standard & Poor's COMPUSTAT database using WRDS. This paper makes a crucial contribution to inventory management literature by measuring the impact of inventory management performance indicators on financial performance advantages in such unique industries over a 32-year period.

The analysis show that the companies that operate a leaner and more efficient inventory system considerably outperform competitors (H1 supported, $p<0.05$). Similarly, companies with higher gross margin returns on inventory investment have superior financial performance (H2 supported, $p<0.05$). Moreover, companies that over-response or under-response to their inventory relative to sales changes have poor financial performance (H3 supported, $p<0.05$). The results also indicate that inventory efficiency, inventory productivity, and inventory responsiveness all significantly affect companies' financial performance in different ways, and may perhaps better gauges of outperformance in some segments than others. Hence, future studies should recall that inventory management strategies are not 'one size fits all' for the aeronautics and space technology industries as a whole, and had better take into account using each measure for assessing and benchmarking company performance within an industry segment.

This empirical study here makes available a preliminary idea for those sorts of analysis in airline and space vehicle segments by trying to integrate theoretically grounded and segment-specific performance variables in the modelling methodology. Industry analysts or aviation scholars can propose a better understanding of the benefits of relative performance utilizing the suggested structure and modelling framework as a guide. This study contributes to the growing empirical literature that explores the link between inventory performance measures and financial performance across various companies and over time. In particular, the literature [6], that studies the effect of various inventory performance measures on retail firm outperformance, is extended. It has been shown that the three hypotheses tested in the literature prevail with a more recent and larger dataset, and even after two new variables that measures financial performance are accounted for.

This study can be extended in a number of ways. One might explore to see whether more appropriate measures could be developed not only for inventory efficiency, inventory productivity, inventory responsiveness but also for financial performance. In this study, airline and space vehicle industries' inventory and financial performances are explored. Alternatively, one can also investigate other industry segments such as manufacturing, health and or other businesses. Moreover, additional factors such as product variety or competition can be taken into account. Finally, using a log-linear specification results in a better fit to the data with lower prediction errors, and the distributions of the log-transformed variables closer to normal. Since some of the independent variables used in this study takes negative values, the logarithmic transformation of the variables, which provides the skewness in data and reduce heteroscedasticity, could not be done. Therefore, one can develop alternative measures that could be log-transformable and used in the regression model as a future study.

Table 10. Firm-specific variables relationship with relative ROA performance.

	Model 1		**Model 2**		**Model 3**	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	0.109	0.41	0.169	0.57	0.109	0.42
XI	-0.138*	7.75				
GMROII			0.085*	13.01		
XC^+					-0.039*	2.87
XC^-					-0.046*	2.02
K	0.001	0.11	0.004	0.33	-0.004	0.41
ΔS	-0.865	0.92	-0.012	3.15	0.022	1.1
rGM	0.269	0.75	0.134	11.4	0.442	1.04
rSOA	0.047	0.74	0.041	6.13	0.034	0.55
R^2	20.18 %		23.41%		19.74%	
R^2 (adj)	22.15%		25.38%		21.41%	

*Significant <0.05

Table 11. Firm-specific variables relationship with relative ROS performance.

	Model 1		**Model 2**		**Model 3**	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	0.056	0.59	0.663	0.26	0.048	0.6
XI	-0.055*	7.19				
GMROII			0.027*	0.43		
XC^+					-0.028*	3.44
XC^-					-0.016*	1.15
K	0.016	2.17	0.009	2.78	0.014	2.55
ΔS	-0.029	1.42	-0.018	3.43	-0.001	2.57
rGM	0.278	18.01	0.206	11.5	0.275	16.56
rSOA	-0.002	1.54	-0.002	1.41	-0.002	0.84
R^2	21.45%		23.42%		19.88%	
R^2 (adj)	26.99%		27.12%		23.20%	

*Significant <0.05

Table 12. Firm-specific variables relationship with relative ROE performance.

	Model 1		**Model 2**		**Model 3**	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	0.209	0.52	0.209	0.74	0.149	0.33
XI	-0.83*	7.6				
GMROII			0.081*	14.2		
XC^+					-0.036*	2.69
XC^-					-0.047*	1.92
K	0.007	0.22	0.003	0.42	-0.005	0.52
ΔS	-0.776	0.83	-0.023	3.19	0.017	2.32
rGM	0.271	0.64	0.164	12.7	0.134	2.15
rSOA	0.038	0.79	0.039	5.66	0.042	0.43
R^2	34.22 %		33.12%		29.35%	
R^2 (adj)	39.65%		37.45%		32.13%	

*Significant <0.05

Table 13. Firm-specific variables relationship with relative ROI performance.

	Model 1		**Model 2**		**Model 3**	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	0.072	0.85	0.703	0.97	0.086	0.96
XI	-0.048*	8.17				
GMROII			0.031*	0.38		
XC^+					-0.025*	3.78
XC^-					-0.012*	1.52
K	0.002	3.15	0.003	2.22	0.002	1.67
ΔS	-0.027	1.53	-0.034	3.55	-0.023	1.73
rGM	0.275	16.3	0.405	14.5	0.286	14.49
rSOA	-0.003	1.78	-0.002	1.78	-0.001	0.96
R^2	38.88%		34.63%		29.93%	
R^2 (adj)	39.29%		38.32%		34.22%	

*Significant <0.05

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VITAE

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