Sales Order Backlog and R&D Investment

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This study investigates the relationship between Sales Order Backlog and firm-level Research and Development (R&D) investment, employing Ordinary Least Squares (OLS) regression on a robust dataset of U.S. firms spanning from 2011 to 2021. We discover a statistically significant positive correlation between Sales Order Backlog and R&D expenditure, indicating that firms with a higher sales order backlog tend to allocate more resources to R&D. This research enriches the accounting discourse by shedding light on the strategic implications of sales order backlog for R&D investment. Specifically, it advances our understanding of the sales order backlog's role in corporate financial strategy, an area that remains relatively unexplored in accounting literature. Our findings underscore the importance of sales order backlog as a predictive indicator for future R&D activities, offering valuable insights for both practitioners and scholars interested in the dynamics of corporate investment behavior.

Keywords: sales order backlog, R&D investment

INTRODUCTION

The intersection of sales order backlog and research and development (R&D) investment serves as the focal point of our inquiry, presenting a novel exploration of how unfulfilled contractual orders, scheduled for future completion, impact firm-level innovation efforts. Recognized as a positive indicator, sales order backlog not only signifies robust customer demand but also forecasts a promising financial trajectory for firms. Within the academic milieu, the order backlog emerges as a crucial predictor of a company's future performance, with seminal works by Behn (1996), Rajgopal, Shevlin, and Venkatachalam (2003), Baik and Ahn (2007), and Penman (2007) collectively underscoring its value relevance and prognostic power regarding future earnings and market returns. These studies collectively assert the backlog's paramount importance to stakeholders, delineating it as a pivotal foresight into a firm's financial destiny.

In the current era's competitive and ever-evolving business landscape, the imperative for continual innovation is paramount. Previous research, including insights from Balkin et al. (2000), identifies R&D investment as the linchpin of innovation, encompassing a broad spectrum of resources aimed at bolstering a firm's innovative capacity. This investment is heralded as a critical driver for sustaining a competitive edge, with recent data from PricewaterhouseCoopers (2018) highlighting a significant uptick in global R&D spending. Nonetheless, the venture into R&D is fraught with risk, given the substantial resource allocation it demands and the uncertain nature of its outcomes.

Our empirical analysis, leveraging a robust panel sample of 9,266 observations from 1,403 unique U.S. firms across the span of 2010 to 2021, unveils a significant positive correlation between sales order backlog and R&D spending. This finding intimates that firms with substantial backlogs are more inclined towards

increased R&D expenditures, even when accounting for firm-specific fixed effects. This study contributes significantly to the academic discourse on sales order backlog within the accounting realm and the broader management literature investigating the nexus between R&D and firm performance. Despite the intricate dynamics characterizing the R&D-performance relationship, our results enrich this dialogue by evidencing a proactive surge in R&D investment aligned with anticipated revenue and profitability growth.

The remainder of this paper is organized as follows. In Section II, we present the literature review and hypotheses development. In Section III, we present our research design. In Section IV, we report the main results. In Section V, we conclude our study.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Sales order backlog represents contractual obligations for future fulfillment—an important leading indicator of a firm's future sales and profitability prospects. Because of its predictive value, the Securities and Exchange Commission (SEC) mandates its disclosure for certain industries and filing contexts. Prior studies demonstrate that backlog data can serve as a strong signal of future demand to capital markets. For example, Toynbee (2017) finds a positive relationship between backlog disclosure and higher financial earnings response coefficients, suggesting that investors view backlogs as credible evidence of a firm's revenue-generating potential. Similarly, some evidence indicates that backlog levels correlate with improved investment efficiency and operational profitability, reinforcing the view that backlog functions as a valuable tool for stakeholders in evaluating firm performance and prospects (Hart, 2017).

Nonetheless, firms often face a strategic dilemma regarding how much backlog information to disclose. Proprietary cost theory (Verrecchia, 1983) suggests that revealing detailed backlog metrics can help investors better assess firm value, yet it may also expose sensitive information to competitors. This tension highlights the trade-off between enhanced transparency—which can reduce information asymmetry and potentially lower the cost of capital—and the risk of eroding competitive advantage by revealing signals of capacity constraints, product demand, or strategic positioning (Brush & Bromiley, 1997). Consequently, the decision to disclose backlog levels is influenced by a firm's competitive landscape, management's disclosure philosophy, and industry norms.

Rooted in the resource-based view (RBV) literature (Barney, 1991; Wernerfelt, 1984), a firm's performance differentials stem from the unique combination, accumulation, and strategic deployment of internal resources and capabilities. Central to this perspective is the notion that such resources—when valuable, rare, inimitable, and non-substitutable—can confer long-term competitive advantage. In contemporary research, R&D capabilities have frequently been characterized as a critical strategic resource that can help firms develop product innovations, enhance operational efficiencies, and secure sustainable market positions (Cohen & Levinthal, 1990).

A firm's ability to invest in R&D depends on multiple internal factors such as profitability, financial health, and organizational slack (Hall & Lerner, 2010). Larger or more financially robust firms often have greater capacity to fund innovative activities, consistent with pecking order theory arguments suggesting that internal cash flow is typically the primary source of financing for R&D (Myers & Majluf, 1984). Moreover, from the perspective of dynamic capabilities (Teece, Pisano, & Shuen, 1997), R&D investment is not only a matter of resource availability but also the organizational ability to reconfigure and deploy those resources to meet emerging market needs.

The link between backlog and R&D investment can be understood through both demand-pull and strategic signaling lenses. The demand-pull theory of innovation posits that increased or anticipated demand acts as a catalyst for firms to invest in innovative activities, including R&D, to ensure that future product offerings align with market needs (Schmookler, 1966; Mowery & Rosenberg, 1979). In the context of sales order backlog, a robust backlog signals not only current demand but also the likelihood of sustained or growing demand over the near- to medium-term horizon (Toynbee, 2017). Recognizing these favorable market conditions, firms may allocate more resources to R&D to capitalize on emerging opportunities for product enhancements, new product development, or process improvements.

Moreover, from a strategic perspective, a strong backlog can mitigate uncertainties regarding future cash flows, making large R&D investments more justifiable. Firms perceiving high and stable revenue inflows may be more willing to undertake R&D projects that involve considerable risk and longer payback periods (Hall & Lerner, 2010). Such investment decisions align with the real options view, wherein positive market signals (e.g., a growing backlog) lower the perceived risk of innovation projects and enable firms to pursue more aggressive growth strategies (Kogut & Kulatilaka, 2001). Conversely, if backlog levels decline or remain uncertain, firms may become more risk-averse and scale back their R&D expenditures, especially under tight credit or heightened competition.

Building on the above theoretical foundations, we posit that sales order backlog and R&D investment are positively related. Specifically, firms with higher backlogs interpret the accumulated orders as strong evidence of future market demand. They respond by investing more heavily in R&D, both to meet anticipated product or service needs and to secure a competitive edge through innovation. Formally:

H1: There is a positive association between sales order backlog and R&D investment, indicating that firms with higher sales order backlogs are more likely to increase their R&D expenditure in anticipation of future demand and growth opportunities.

RESEARCH DESIGN

Empirical Specification

To test our hypothesis, we use the following equation to investigate the relation between sales order backlog and corporate R&D investment activities.

$$FIRM\_RD_{i,t} = \alpha_0 + \alpha_1 FIRM\_OB_{i,t} + \alpha_2 FIRM\_SIZE_{i,t} + \alpha_3 FIRM\_LEV_{i,t} + \alpha_4 FIRM\_ROA_{i,t} + \alpha_5 FIRM\_OCF_{i,t} + \alpha_6 FIRM\_CAPX_{i,t} + \alpha_7 FIRM\_MB_{i,t} + \varepsilon_{i,t} \quad (1)$$

In Equation (1), FIRM_RD represents the total research and development expenses scaled by total firm assets (AT). Following recent studies (Sun, Walkup, & Wu, 2019; Barber & Hollie, 2021), our primary independent variable of interest, FIRM_OB, is defined as the ratio of sales order backlog to total firm assets. In alignment with prior research, we control for additional factors that may influence corporate R&D spending. Specifically, in accordance with studies by Biddle et al. (2009), Canace et al. (2018), Jia (2019), Perry and Grinaker (1994), and Ramalingegowda et al. (2013), we include controls for firm size (FIRM_SIZE), leverage (FIRM_LEV), profitability (FIRM_ROA), operating cash flow relative to assets (FIRM_OCF), capital expenditures relative to assets (FIRM_CAPX), and the market-to-book ratio (FIRM_MB). Given our use of a panel sample for empirical analysis, we employ Ordinary Least Squares (OLS) regression, incorporating year and industry dummy variables into Equation (1). These industry dummy variables adhere to the Fama-French 48 industry classifications. Definitions of these variables are provided in Table 1.

TABLE 1
VARIABLE DEFINITIONS

Variable	*Definition*
FIRM_RD	The ratio of research and development expenses to total assets
FIRM_OB	The ratio of sales order backlog to total assets
FIRM_SIZE	The natural log of total assets
FIRM_LEV	The ratio of long-term liabilities to total assets
FIRM_ROA	The ratio of income before extraordinary items to total assets
FIRM_OCF	The ratio of cash flow from operating activities to total assets
FIRM_CAPX	The ratio of capital expenditures to total assets
FIRM_MB	The ratio of market value of common shares to book value of common shares

Sample Selection and Descriptive Statistics

Financial statement data were sourced from the Compustat database for this study. Observations missing data necessary to compute variables in Equation (1) were excluded to ensure analytical rigor. The resultant dataset encompasses 9,266 observations spanning from 2011 to 2021, across 1,403 distinct U.S. firms. The year 2011 marks the commencement of our analysis period, attributed to the unavailability of earlier data. Table 2 delineates the distribution of the sample across fiscal years, indicating a marginal decline in the number of observations over time. Table 3 categorizes the sample by industry, following the Fama-French 48 industry classifications, with Retail, Electronic Equipment, and Machinery emerging as the industries with the highest representation, totaling 1,538, 1,126, and 742 observations, respectively.

TABLE 2
SAMPLE DISTRIBUTION BY FISCAL YEAR

Year	*Number of observations*	*Percent*
2010	918	9.91
2011	877	9.46
2012	849	9.16
2013	835	9.01
2014	816	8.81
2015	797	8.6
2016	766	8.27
2017	750	8.09
2018	729	7.87
2019	675	7.28
2020	633	6.83
2021	621	6.7
Total	9,266	100%

TABLE 3
SAMPLE DISTRIBUTION BY INDUSTRY

Fama-French industry	*Description*	*Number of observations*	*Percent*
1	Agriculture	2	0.02%
2	Food Products	21	0.23%
5	Tobacco Products	5	0.05%
6	Recreation	38	0.41%
7	Entertainment	209	2.26%
8	Printing and Publishing	1	0.01%
9	Consumer Goods	84	0.91%
10	Apparel	65	0.7%
11	Healthcare	368	3.97%
12	Medical Equipment	274	2.96%
13	Pharmaceutical Products	127	1.37%
14	Chemicals	95	1.03%
15	Rubber and Plastic Products	66	0.71%
16	Textiles	24	0.26%
17	Construction Materials	228	2.46%
18	Construction	42	0.45%
19	Steel Works Etc	74	0.8%

Fama-French industry	*Description*	*Number of observations*	*Percent*
20	Fabricated Products	38	0.41%
21	Machinery	742	8.01%
22	Electrical Equipment	378	4.08%
23	Automobiles and Trucks	225	2.43%
24	Aircraft	189	2.04%
25	Shipbuilding, Railroad Equipment	57	0.62%
26	Defense	71	0.77%
29	Coal	7	0.08%
30	Petroleum and Natural Gas	33	0.36%
32	Communication	54	0.58%
33	Personal Services	27	0.29%
34	Business Services	696	7.51%
35	Computers	393	4.24%
36	Electronic Equipment	1126	12.15%
37	Measuring and Control Equipment	540	5.83%
38	Business Supplies	75	0.81%
39	Shipping Containers	8	0.09%
40	Transportation	22	0.24%
41	Wholesale	499	5.39%
42	Retail	1538	16.6%
43	Restaurants, Hotels, Motels	657	7.09%
44	Banking	3	0.03%
45	Insurance	26	0.28%
46	Real Estate	12	0.13%
47	Trading	100	1.08%
48	Other	27	0.29%
Total		9266	100%

Table 4 presents the descriptive statistics of our sample. Specifically, it enumerates the number of observations, mean, standard deviation, 25th percentile, median, and 75th percentile values for the variables outlined in Equation (1). Notably, the mean value of FIRM_RD is 0.052, indicating that, on average, R&D investment constitutes approximately 5% of total assets. Similarly, the mean value of FIRM_OB stands at 0.31, suggesting that, on average, the sales order backlog accounts for about 31% of total assets. Furthermore, Table 5 displays the Pearson correlation coefficients for the variables included in Equation (1). Noteworthy is the correlation coefficient between FIRM_RD and FIRM_OB, which is 0.1323, accompanied by a p-value less than 0.0001. This statistically significant positive correlation between sales order backlog and R&D investment provides preliminary support for our hypothesis.

TABLE 4
SAMPLE DESCRIPTIVE STATISTICS

Variable	*Observations*	*Mean*	*Std Dev*	*25^{th} Pctl*	*50^{th} Pctl*	*75^{th} Pctl*
FIRM_RD	9266	0.0519988	0.1982462	0	0.0112194	0.0610428
FIRM_OB	9266	0.3094779	0.6735203	0	0.0818644	0.3329393
FIRM_SIZE	9266	6.4004018	2.2667495	4.9971109	6.588277	7.9443858
FIRM_LEV	9266	0.2147047	0.4349738	0.0056803	0.1513955	0.3081035
FIRM_ROA	9266	-0.166262	4.2178228	-0.0205368	0.0384389	0.0761963

Variable	*Observations*	*Mean*	*Std Dev*	*25th Pctl*	*50th Pctl*	*75th Pctl*
FIRM_OCF	9266	0.0220008	0.8434722	0.0278099	0.07829	0.1258036
FIRM_CAPX	9266	0.0393858	0.0435966	0.0134853	0.0261968	0.0496346
FIRM_MB	9266	2.0430208	48.1492288	1.2185653	2.1589119	3.7449711

TABLE 5
CORRELATION MATRIX

	FIRM_RD	*FIRM_OB*	*FIRM_SIZE*	*FIRM_LEV*	*FIRM_ROA*	*FIRM_OCF*	*FIRM_CAPX*	*FIRM_MB*
FIRM_RD	1.00000							
FIRM_OB	0.13231 <.0001	1.00000						
FIRM_SIZE	-0.26741 <.0001	-0.03899 0.0002	1.00000					
FIRM_LEV	0.12067 <.0001	0.10767 <.0001	0.09461 <.0001	1.00000				
FIRM_ROA	-0.50291 <.0001	-0.03057 0.0032	0.17489 <.0001	-0.11725 <.0001	1.00000			
FIRM_OCF	-0.65248 <.0001	-0.06400 <.0001	0.23021 <.0001	-0.17004 <.0001	0.66659 <.0001	1.00000		
FIRM_CAPX	-0.07018 <.0001	-0.09722 <.0001	-0.00525 0.6134	0.01963 0.0588	0.02617 0.0117	0.04936 <.0001	1.00000	
FIRM_MB	-0.01401 0.1774	0.02822 0.0066	0.10295 <.0001	-0.00771 0.4580	0.05002 <.0001	0.09435 <.0001	0.01146 0.2699	1.00000

RESULTS

To assess the impact of sales order backlog on R&D investment, we applied Ordinary Least Squares (OLS) regression to estimate Equation (1). The findings, detailed in Table 6, indicate a statistically significant positive association between sales order backlog (FIRM_OB) and R&D spending (FIRM_RD), with a coefficient of 0.013, a t-value of 5.16, and a p-value less than 0.0001. This result implies that firms with a larger sales order backlog are likely to allocate more resources to R&D, thereby lending robust support to our proposed hypothesis. Addressing potential concerns regarding omitted variable bias, we further conducted a firm fixed effects regression analysis to refine our findings. The outcomes of this analysis, presented in Table 7, reinforce our initial results: the coefficient for FIRM_OB increased to 0.036 with a t-value of 10.95 and a p-value less than 0.0001, confirming a significant positive relationship between sales order backlog and R&D investment. It's important to note that industry dummy variables were omitted in this model due to the nature of fixed effects regression, which controls for time-invariant characteristics across firms.

TABLE 6
MAIN RESULTS

Parameter	*Estimate*	*t value*	*Pr > |t|*
INTERCEPT	-0.022	-0.78	0.4330
FIRM_OB	0.013***	5.16	<.0001
FIRM_SIZE	-0.008***	-11.27	<.0001
FIRM_LEV	0.020***	5.44	<.0001
FIRM_ROA	-0.006***	-12.95	<.0001
FIRM_OCF	-0.125***	-51.75	<.0001
FIRM_CAPX	0.010	0.27	0.7835
FIRM_MB	0.001***	6.55	<.0001
Year Indicators	Yes		
Industry Indicators	Yes		
Observations	9,266		
Adjusted R^2	0.4994		

TABLE 7
ADDITIONAL TESTS

Parameter	*Estimate*	*t value*	*Pr > |t|*
INTERCEPT	0.156***	15.18	<.0001
FIRM_OB	0.036***	10.95	<.0001
FIRM_SIZE	-0.021***	-13.67	<.0001
FIRM_LEV	0.055***	16.46	<.0001
FIRM_ROA	-0.004***	-10.72	<.0001
FIRM_OCF	-0.065***	-30.62	<.0001
FIRM_CAPX	0.067*	1.91	0.0563
FIRM_MB	0.000**	2.75	0.0059
Year Indicators	Yes		
Industry Indicators	No		
Firm Fixed Effect	Yes		
Observations	9,266		

CONCLUSION

Our study provides compelling evidence of a significant positive association between sales order backlog and R&D investment across a broad sample of U.S. firms from 2010 to 2021. This relationship underscores the strategic importance of sales order backlog as a forward-looking indicator that influences corporate innovation strategies. By demonstrating that firms with higher sales order backlogs are more likely to increase their R&D expenditures, our findings enrich the current understanding of how firms allocate resources for innovation in response to anticipated demand. This research contributes to both the accounting literature, by quantifying the impact of sales order backlog disclosures, and the management literature, by highlighting the role of internal resource allocation in fostering firm-level innovation. It bridges a crucial gap in empirical studies, offering insights into the dynamics between market expectations and strategic investment decisions.

Limitations of our study, including its reliance on publicly available data and the potential for unobserved variables to influence our results, suggest avenues for future research. Subsequent studies could explore the causal mechanisms underlying the observed relationship, examine the impact of industry-specific factors, and consider the role of managerial decision-making processes in more detail. By shedding light on the strategic considerations behind R&D investments, our work informs both practitioners and policymakers about the importance of managing sales order backlogs to leverage future growth opportunities. It invites further exploration into the nuanced ways firms can navigate the challenges of innovation in the competitive global market.

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