THE MARKET VALUE OF INVENTORY

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Abstract: We examine how stock investors value one dollar of inventory holdings and how the market value of inventory is affected by various firm characteristics. Based on a large number of U.S. firms from 1971 to 2013, we find that on average, one dollar of inventory is valued at $0.507 in the stock market. We further decompose inventory change into normal and abnormal inventory changes and find that the market value of one dollar of abnormal inventory change is 43% smaller than that of normal inventory change. We also find that the market value of inventory is higher for firms with more efficient inventory management, better growth prospects, higher sales predictability, and tighter financial constraints.

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1. Introduction

This paper investigates factors associated with the market value of inventory. Corporate financial performance receives substantial attention in the academic supply chain management (SCM) literature.[1] Much less attention is given to the effectiveness of SCM and stock price behavior, and we know of no papers that attempt to attach changes in shareholder value to optimal and suboptimal changes in inventory. Therefore, we begin by investigating the market value of normal versus abnormal changes in inventory, where normal changes move the inventory balance to an optimal target level and abnormal changes refer to the gap between a company's actual inventory change and the optimal change. We test the hypothesis that, relative to the normal change, the market attaches less value to the abnormal change in inventory. We also test hypotheses regarding the sensitivity of the relation between stock returns and total changes in inventory to various firm-specific factors, including gross margin, expected growth, inventory productivity (turnover), financial constraints, and uncertainty around sales projections (demand uncertainty). Results are consistent with our expectations described later in this introduction and in more detail in the hypotheses section of this paper.

While our paper is the first to hypothesize and examine differences in the value the stock market attaches to normal versus abnormal changes in inventory and whether those market values vary with hypothesized value-relevant factors, other papers have examined the relation between effective (or ineffective) SCM and stock price behavior. For example, Chen, Frank, and Wu (CFW 2005) find "no evidence" of an association between industry-adjusted inventory

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[1] See Shi and Yu (2013) for a recent review of the literature.

turnover ratios and the value of the firm, as measured by the market-to-book ratio.[2] CFW also sort stocks into deciles based on relative turnover ratios and find that stocks of firms with marginally high inventory turnover ratios (deciles 3 and 4) significantly outperform stocks in all other deciles, and stocks with very low inventory turnover (deciles 9 and 10) significantly underperform stocks in all other deciles over the 12 months following the year of the assignment of firms to decile portfolios. Other papers assessing the relation between long-term stock returns and inventory management include Steinker and Hoberg (2013), Alan, Gao, and Gaur (2013), Hendricks and Singhal (2001), Hendricks, Singhal, and Stratman (2007), and Thomas and Zhang (2002).

Defining abnormal inventory growth as the annual percentage increase in inventory divided by the annual percentage increase in cost of goods sold, Steinker and Hoberg (2013) find a negative relation between abnormal inventory growth and both contemporaneous and one-year ahead returns. In a sample of 399 retail firms, Alan et al. (2013) find that inventory turnover predicts returns over the year following portfolio formation, with higher returns to firms with higher turnover. Hendricks and Singhal (2001) find that, relative to control samples, firms adopting Total Quality Management (TQM) programs experience significantly higher returns over the five years following adoption. Thomas and Zhang (2002) find that firms with unusually high inventory changes experience negative abnormal returns over the two years following portfolio formation. Finally, Hendricks et al. (2007) find benefits in terms of significantly positive long-run returns following firms' announcements of adopting SCM systems; whereas

[2] Book values come from the firm's financial statements which equate total assets to the sum of the book values of the firm's liabilities and stockholders' equity (i.e., net assets equal stockholders' equity). In a sample of publicly traded manufacturing firms spanning the years 1981-2000, CFW measure market-to-book as the sum of the market value of a firm's publicly traded stock and the book value of the firm's debt divided by the book value of the firm's total assets.

they find very little evidence of benefits to announcements of adoption of enterprise resource planning (ERP) or customer relationship management (CRM) systems.

Several papers in the SCM literature conduct event studies of the stock market reaction to public announcements that provide insight into the quality a firm's inventory control. For example, Hendricks and Singhal (2003) identify 519 announcements of "supply chain glitches" between 1989 and 2000 and estimate a 10.28% decline in stock prices during the two-day period ending with the day of the glitch announcement.[3] Hendricks and Singhal (2009) find a significant negative market reaction to excess inventory announcements, and Hendricks and Singhal (1997) find a significant negative market reaction to announcements of product introduction delays. On the plus side, Hendricks and Singhal (1996) find a significant positive market reaction to announcements of awards to firms for outstanding TQM programs.

Our study extends the investigation of the value the stock market attaches to effective inventory management in the following ways. First, our model disaggregates the annual change in a firm's inventory into a portion consistent with an optimal (normal) change and a portion representing the (abnormal) gap between the actual change and the optimal change. Second, we rigorously estimate the market value of the normal and abnormal changes in inventory by extending a broadly accepted theoretical model of the market value of a firm as a function of the firm's earnings and the book value of its stockholders' equity. Third, we analyze factors that we expect to explain cross-sectional differences in the value that the stock market attaches to total changes in inventory.

We draw on the accounting literature to develop our models to: (1) separate normal from abnormal changes in inventory; and (2) test for differences in the market values attached to

[3] Based on a careful review of the academic literature, SCM books, websites of supply chain solution providers (e.g., SAP, Inc. and Oracle), Hendricks and Singhall (2003) conclude that "little evidence exists that systematically links effective SCM to shareholder value creation."

normal versus abnormal changes. A series of papers combine to provide estimates of abnormal changes in inventory. Bernard and Stober (1989, Appendix A) provide a model that separates the end-of-period inventory balance into an "optimal balance, given management's expectation of future sales" and a "deviation from the optimal balance." Bernard and Stober's purpose is to assess the degree to which unexpected inventory accruals predict future sales and the degree to which the stock market reacts to these unexpected inventory accruals.[4] Dechow, Kothari, and Watts (1998) extend Bernard and Stober's model to an investigation of the advantages of current period accruals versus current period cash flows in models that predict future cash flows and that, therefore, provide better inputs to the valuation of the firm's net assets and stockholders' equity. Roychowdary (2006) extends the model to investigate whether unexpected production costs reflect earnings management to avoid reporting negative earnings (i.e., losses) for an accounting period, and Gunny (2010) uses the model to assess whether managing earnings through managing production costs, along with other real activities management, provides the market with information regarding future financial performance.

Armed with a model for separating inventory changes into normal (expected) and abnormal (unexpected) components, we then extend models of the market value of the firm's stockholders' equity as a function of the book value of stockholders' equity and earnings (Ohlson 1995, Easton and Harris 1991). We first convert the models to estimate coefficients relating price-deflated changes in market value (i.e., returns) to price-deflated changes in the book value of stockholders' equity and earnings. Then, we expand the model to estimate coefficients relating

[4] Inventory accruals represent the difference between a company's quarterly or annual cost of goods sold expense (recorded in the period when the company records related sales revenue) and the amount that the company would recognize on a strictly cash basis accounting system, where cost of goods sold would simply equal the amount paid for inventory during the period. Inventory accruals generally equal the change in inventory as reported on the company's balance sheet.

market value to components of the book value of stockholders' equity (net assets), including normal and abnormal changes in inventory.

Many studies focus on the role of agency costs of contracting between owners and managers in mismanagement of cash (e.g., Jensen 1986; Myers and Rajan 1998; Dittmar and Mahrt-Smith 2007).[5] Some studies examine agency problems leading to suboptimal SCM, but these agency problems generally concern contracting between suppliers, manufacturing firms, retailers, and customers.[6] Mismanagement can lead to insufficient inventory which leads to customer dissatisfaction and loss of sales revenue, or too much inventory which creates costs associated with obsolescence and warehousing. Agency costs also might allow managers to overstate earnings by moving certain overhead or obsolescence costs that should be expensed from the income statement to the balance sheet. These manipulations have a temporary income effect, which Thomas and Zhang (2002) argue reflects stock market overpricing. Our results indicate that the market attaches a lower market value to both abnormally large and abnormally small inventory changes suggesting that the market at least partially prices the risk associated with mismanagement leading to either insufficient or bloated inventory balances.

Using a sample of 98,941 firm-years (9,475 unique firms) between 1971 and 2013, we find that the average marginal value of inventory is \$0.507. After decomposing total inventory changes into normal and abnormal components, we show that the value placed by investors on abnormal changes remains significantly positive but its magnitude is 43% smaller than that of normal changes. Consistent with our prediction, this result suggests that investors at least

[5] Also see Bates, Kahle, and Stulz (2009) who develop a model that separates changes in cash into normal and abnormal components and argue that the abnormal component reflects agency costs of contracting between firms' owners and managers.
[6] Fayezi, O'Loughlin, and Zutshi (2012) provide a review of the literature.

partially discount abnormal inventory changes to the extent that they indicate management incompetence or opportunistic overproduction strategies to inflate earnings.

Next, we test hypotheses predicting cross-sectional variation in the market value of changes in inventory. We draw on the SCM literature for our first two hypotheses. Gross margin, inventory productivity (turnover), and increased market share are key performance measures that improved effectiveness of SCM (Dehning, Richardson, and Zmud 2007), so we expect the coefficient relating stock market returns to changes in inventory (i.e., the market value of inventory) to increase with increases in gross margin, inventory turnover, and growth prospects. The importance of demand forecasting as a critical component of inventory management is well-documented in the management science and operations management literature (e.g., Hendricks and Singhal 2014; Taylor and Xiao 2009). Therefore, we expect the market value of a firm's inventory to decrease with demand uncertainty. Many prior papers have studied the relation between financial constraints and investment in inventory. Most of these papers conclude that financially constrained firms acquire and hold less inventory (e.g., Carpenter, Fazzari, and Petersen 1998). We are aware of no papers that investigate the relation between the market value of inventory changes (or holdings) and financial constraints. We test the hypothesis that financially constrained firms lean towards the acquisition of inventory with higher market value. Our results are consistent with all of the above hypotheses. Furthermore, as expected we find stronger evidence with respect to normal versus abnormal inventory changes.

While an extensive literature, either at a macro level or a firm level, attempts to identify the optimal inventory policy and its contributing factors (e.g., Irvine 1981; Akhtar 1983; Christiano 1988; Guariglia 1999; Jones and Tuzel 2013), researchers have not paid much attention to shareholder valuation of changes in a firm's reported inventory stock. The challenges associated with separating the value of the firm's net assets (stockholders' equity) as reflected by stock market prices into various asset categories (including inventory) are, perhaps, responsible for the paucity of evidence on factors affecting the market value of inventory. Our paper contributes to the literature by offering a technique for separating the market value of changes in inventory from changes in the rest of the firm's net assets and by testing hypotheses regarding factors that affect the market value of changes in firms' inventory balances. These factors include the effect of the change on the firm's divergence from its optimal target inventory (i.e., normal versus abnormal changes in inventory), gross margin of sales relative to the cost of inventory sold, inventory productivity (turnover), demand uncertainty, growth prospects, and financial constraints.

The rest of this paper is organized as follows: Section 2 discusses related prior studies and develops testable hypothesis. Section 3 describes our research design to test the hypotheses. Section 4 describes our sample and provides descriptive statistics. We present the main empirical results and perform additional analysis in section 5, and Section 6 concludes.

2. Literature Review and Hypotheses Development

Given that a large number of studies have examined firm motives for holding inventories (such as product smoothing, target adjustment, stockout-avoidance, and agency-related managerial opportunism) as well as firm characteristics that affect inventory behavior (such as financing constraints and cost of capital), our study moves to the question of what value the market places on inventory investment and, more importantly, how that value varies cross-sectionally. Note that our research differs from Thomas and Zhang (2002) who study the ability of current inventory change to forecast future stock returns. While Thomas and Zhang (2002) argue that earnings management could be a plausible explanation for the stock return predictability[7], recent work by Belo and Lin (2012) reveals that Thomas and Zhang (2002)'s result is more consistent with a risk-based story. In this study, we focus on the contemporaneous market value of inventory investment, and in particular, how it varies with firm motives and characteristics that shape the inventory behavior. The maintained assumption underlying our analyses is that the market is sufficiently efficient to see through different motives for inventory investment and the implications of inventory investment for firm value.

2.1 Market value of normal and abnormal inventory changes

Our first hypothesis disaggregates a firm's changes in inventory into normal and abnormal components and examines whether investors value them differently. Normal changes in inventory are driven by changes in fundamental characteristics of the firm's operating environment and move the inventory balance to an optimal target level, whereas abnormal changes in inventory may result from agency costs allowing self-interested managers to act in ways that diverge from shareholder interests.

Misalignment of managers' and shareholders' incentives induces managers to make suboptimal production decisions in order to inflate short-term earnings at the expense of long-term shareholder value. Several accounting studies find that, in the presence of agency frictions, managers may purposefully deviate from optimal production level in order to manipulate reported earnings. For example, to manage earnings upward, managers can produce more goods than necessary to meet expected demand. Such overproduction leads to fixed overhead costs being spread over a larger number of units, lowering fixed costs per unit. This earnings management strategy causes COGS to be lower and operating margins to be higher.

[7] Thomas and Zhang (2002) interpret their finding as confirming the accruals anomaly first documented by Sloan (1996). After ruling out several alternative explanations, they conclude that their results are most likely to be explained by earnings management masking the implications of demand shifts.

Roychowdhury (2006) finds evidence of overproduction in firms with strong incentives to meet earnings targets. Cohen and Zarowin (2010) show a similar pattern in SEO firms. Both Cohen and Zarowin (2010) and Kothari et al. (2016) document that overproduction jeopardizes firm value in the long run.

When a firm produces more goods than necessary to meet expected demand, it must bear production and holding costs on the over-produced goods that cannot be recovered in the same period through sales. An important implication is that cash flows from operations will be lower than normal given sales levels (Roychowdhury 2006). Both anecdotal and empirical evidence suggests that overproduction results in a sacrifice in economic value to hit short-term earnings targets (Graham et al. 2005; Cohen and Zarowin 2010; Kothari et al. 2016). If the market is able to identify agency-related overproduction, we should expect that investors will discount the value of abnormal changes in inventory. Accordingly, we hypothesize that,

> **H1:** The market value of abnormal inventory changes is less than the market value of normal inventory changes.

The pricing of abnormal inventory changes is a joint test of (1) market efficiency with respect to inventory information and (2) the power of our model to measure abnormal inventory changes. While the Roychowdhury (2006) model, on which we rely to calculate abnormal inventory changes, has been used extensively to detect (real) earnings management, the model's precision in partitioning inventory changes into normal and abnormal components is an empirical issue.

2.2 Inventory control efficiency and market value of inventory holdings

Besides production, ordering, delivery, and stockout costs, a critical and most quantifiable cost associated with inventory is the holding cost. The most obvious holding costs include warehousing and logistic costs, insurance costs, inventory obsolesce, and the opportunity cost of tied up capital. Because a pile-up of unsold inventory increases holding costs and reduces return on inventory investment, investors are likely to discount the value of inventory holdings to the extent that the firm's inventory management is inefficient. Consistent with this intuition, Chen et al. (2005) find that stock performance measured by market-to-book ratio or Tobin's q over the long run is stronger for firms with reasonably high inventory turnover, indicating that efficient inventory management enhances firm value.

We infer inventory management efficiency using two measures. The first one is a standard textbook approach, inventory turnover ratio, which is commonly used to assess the performance of inventory managers and compare inventory control efficiency across firms and over time. Stock analysts track inventory turnover ratios and reward firms for their improvement of inventory turnover (Gaur et al. 2005). The second measure captures the (value-destroying) inventory behavior that is likely to deviate from some optimally chosen "target" level. Under the target adjustment motive (Lovell 1961), managers strive for reaching some "target" level of inventories in their production decisions. Excessive inventory buildup may result from deviations from the target level and is indicative of a less efficient inventory control system. In general, if a company does not do a good job in inventory management and thus build up excess inventory, it increases the likelihood of excessive markdowns, resulting in lower gross margin.[8] Thus, we also use gross margin to infer efficiency of inventory management. Based on the above discussion, we hypothesize that,

H2a: The market value of inventory changes is lower for firms with lower inventory turnover.

[8] Based on analyst report by Jim Kelleher on Corning INC (GLW) on Oct 27, 2009: The supply (inventory) and demand (at retail) balance is much more favorable than it was at this time a year earlier. The company estimates that inventories at distribution are 16% below the year-ago level; at the same time, retail demand is estimated to be 15% above year-ago levels. This supply-demand balance, in our view, will enable Corning to maintain pricing at or near current levels.

H2b: The market value of inventory changes is lower for firms with lower gross margin.

2.3. Expected sales growth and market value of inventory holdings

Inventory holdings can rise as a response to expected sales growth. This is because inventory stockout is costly to the firm under the stockout-avoidance motive for holding inventories (Kahn 1987, 1992). Jones and Tuzel (2013) find that current period inventory growth is positively related to expected sales growth, consistent with the stockout-avoidance motive for inventory investment. Kesavan et al. (2010) assess the ability of current period inventory holdings to forecast future sales for US public retailers. They develop a sales forecast model after incorporating COGS, inventory, and gross margin, and show that their model produces more accurate sales forecasts than consensus forecasts from financial analysts. The Kesavan et al. (2010) result offers evidence confirming the stockout-avoidance motive for inventory investment.

The objective of our study is not to test the existence of the stockout-avoidance motive for inventory investment; rather, it is to examine how investors respond to inventory investment driven by the stockout-avoidance motive. To the extent that managers increase inventory holdings to minimize stockout costs, investors should interpret that as a positive signal of strong demand for products.[9] The question becomes how investors can detect the stockout-avoidance motive for inventory investment as opposed to simply inefficient inventory control. We argue that investors may infer the stockout-avoidance motive from other credible signals that are suggestive of strong future sales growth. In other words, investors are more likely to attribute inventory buildup to stockout avoidance and hence, to react favorably to it, if they anticipate strong demand in the future. Such signals can be conveyed through market-based or analyst-based sales growth forecasts. Our next hypothesis is stated as follows:

[9] Note that inventory buildup will at least involve a tradeoff between holding costs and stockout costs. Under the stockout motive for inventory investment, the stockout costs are presumably greater than the holding costs.

H3: The market value of inventory changes is higher for firms with strong expected future sales growth.

The precision of the signal of future demand affects investor confidence in interpreting inventory growth as motivated by stockout avoidance. If there is greater uncertainty in sales forecasts, investors are likely to discount the value of inventory pile-ups. One can draw a parallel with investor reaction to earnings announcements. Imhoff and Lobo (1992) examine the effect of the uncertainty in analysts' earnings forecasts on investor reaction to earnings announcements. They find that the earnings response coefficient is significantly higher for firms with lower variance in analysts' earnings forecasts prior to the earnings announcement, their proxy for ex ante earnings uncertainty. Therefore, we also hypothesize that,

H4: The market value of inventory changes is higher for firms with less sales forecast dispersion.

2.4 Financing constraints and market value of inventory holdings

Given capital market imperfections, a firm's financing constraints should also play a role in explaining its inventory investment. Researchers have adopted different measures of financial constraint variables but they all reached the same conclusion that financing constraints depress inventory growth. For example, Gertler and Gilchrist (1994) measure balance sheet constraints through coverage ratio (the ratio of cash flow to total interest payments) and document that coverage ratio is a highly significant predictor for small firm inventory behavior but not for large firms. Kashyap et al. (1994) find that bank-dependent firms (i.e., firms without access to public debt or large internal cash reserves) cut their inventories significantly more during a recession than their non-bank-dependent counterparts. Carpenter et al. (1994) find that large fluctuations in cash flow over the business cycle cause firms to make large adjustments to inventories to partially offset shocks to cash flow.[10] In a similar vein, Fazzari and Petersen (1993) show that firms use working capital (including inventory stocks) as a source of liquidity to smooth fixed investment relative to cash-flow shocks when they face financing constraints. Extending this line of research, Jones and Tuzel (2013) examine the relation between inventory investment and the cost of capital in the time series and the cross section. They find that risk premiums, rather than real interest rates, are significantly and negatively related to future inventory growth. The Jones and Tuzel results challenge the general perception that inventory investment is inversely related to interest rates (Maccini et al. 2004).

Faulkender and Wang (2006) find that market value of cash holdings is higher for financially-constrained firms. Firms facing greater financing constraints must pay higher transaction costs to access external capital. Therefore, an additional dollar of cash (internal funds) enables a constrained firm to avoid the higher costs of raising external capital which makes it relatively more valuable. Inventories are readily convertible to cash so they may also provide liquidity to a financially-constrained firm. Fazzari and Petersen (1993) highlight an often-ignored role of working capital (including inventories) as both an input and a readily reversible store of liquidity. They find that when firms face financing constraints, they tend to liquidate working capital investment to smooth fixed investment in the short run. Investors are likely to value the liquidity of inventory to a greater extent for financially-constrained firms (similar to cash holdings).

Several accounting studies also report that value-relevance shifts from earnings (income statement) to book values (balance sheet) when earnings are negative or as firms face financial distress (Barth et al. 1997; Burgstahler and Dichev 1997; Collins et al. 1997, 1999). This is

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[10] Carpenter et al. (1998) compare the explanatory power of several common proxies for financing constraints and conclude that inventory investment is most sensitive to a firm's cash flow.

because a firm's abandonment value becomes more relevant from a shareholder's perspective as the firm suffers losses or becomes financially distressed and constrained. To the extent that book value of net assets represents the lower bound on a firm's value and is closely associated with the firm's abandonment or liquidation value (Berger et al. 1996), as abandonment becomes more likely for financially constrained firms, the value relevance of balance sheet, including the book value of inventory holdings, may increase.

Based on the above discussion, we conjecture that market value of inventory holdings is higher for financially constrained firms because inventories can be liquidated to fund fixed investments, avoiding higher costs of raising external capital, and the value of inventory holdings increases as abandonment option for financially constrained firms becomes more attractive to investors.[11] Our last hypothesis is stated formally as follows,

H5: The market value of inventory changes is higher for financially constrained firms.

3. Research Design

To examine how stock investors value one dollar of inventory holdings, we start with the following model (A1) (Easton and Harris 1991):

$$RET_t = \beta_0 + \beta_1 \Delta EARN_t + \beta_2 EARN_t + \varepsilon_t \qquad (1A)$$

where $EARN_t$ is the earnings during year t while $\Delta EARN_t$ is the change in earnings from year t-1 to year t. To invoke the clean surplus relation, let BV_t be the (net) book value of equity at year t. The clean surplus accounting relation states:

$$BV_t = BV_{t\text{-}1} + EARN_t - DIV_t \qquad (1B)$$

where DIV_t is dividends paid at year t. Re-arranging (A2) yields:

[11] Berger et al. (1996) find that a dollar of book value produces, on average, \$0.72 in exit value for receivables, \$0.55 for inventory, and \$0.54 for fixed assets.

$$EARN_t = \Delta BV_t + DIV_t \tag{1C}$$

Substitute the clean surplus accounting relation (A3) into (A1) to obtain:

$$RET_t = \beta_0 + \beta_1 \Delta EARN_t + \beta_2 \Delta BV_t + \beta_3 DIV_t + \varepsilon_t \tag{1D}$$

To examine the value of inventory holdings relative to non-inventory assets, we express the book value of equity as the sum of inventory (INV_t), cash ($CASH_t$), assets other than inventory and cash ($OASSET_t$), and negative amounts of liabilities ($LIAB_t$):

$$BV_t = INV_t + CASH_t + OASSET_t - LIAB_t \tag{1E}$$

Assets other than inventory and cash ($OASSET_t$) is total assets net of inventory (INV_t) and cash ($CASH_t$). Taking first differences and substituting (1E) into (1D) yields:

$$RET_t = \beta_0 + \beta_1 \Delta INV_t + \beta_2 \Delta CASH_t + \beta_3 \Delta OASSET_t + \beta_4 \Delta LIAB_t + \beta_5 \Delta EARN_t + \beta_6 DIV_t + \text{industry fixed effect} + \text{Year fixed effect} + \varepsilon_t \tag{1F}$$

where, RET_t is the stock returns during the fiscal year t, ΔINV_t, $\Delta CASH_t$ $\Delta OASSET_t$, $\Delta LIAB_t$, $\Delta EARN_t$, and DIV_t are the change in inventory holdings, change in cash holdings, change in assets other than cash and inventory, change in liabilities, change in earnings, and dividends, respectively. The change variables on the right-hand side of the equation (1F) are measured during the fiscal year t to be consistent with the return measurement window. All variables on the right-hand side are scaled by the market value of equity at year t-1 so that we can measure the marginal market value of \$1 of inventory change. In other words, the coefficient on ΔINV indicates how stock investors value \$1 change of inventory holdings. We include year and industry fixed effects to further control for the variations in firm value not captured by accounting variables in the model (1F). We also adjust for firm clustering (Petersen 2008).

To examine the effect of cross-sectional determinants on the marginal market value of inventory holdings, we interact each cross-sectional determinant with change in inventory holdings, ΔINV. If the coefficient on the interaction term between each determinant and change in inventory holdings is significantly positive (negative), the determinant increases (decreases) the market value of inventory.

4. Sample and Descriptive Statistics

4.1. Sample development

Our initial sample includes all Compustat firms from 1971 to 2013 with sufficient data available to estimate the inventory valuation model (1F). We discard firm-year observations with missing data for any of the variables used in our analyses. We consider various determinants of the market value of inventory such as inventory turnover, inventory holding efficiency, gross margin, sales growth, financial constraints, and sales volatility. If data are missing in constructing these determinant variables, we remove the corresponding observations from our final sample. We also exclude observations with negative market value of equity, negative dividends, and negative net assets (i.e., total assets – total liabilities). We eliminate firms in utility (SIC codes between 4900 and 4999) and financial industries (SIC codes between 6000 and 6999). All continuous variables are winsorized at the top and bottom 1 percent of their distributions in each year. Data on stock returns are available from the CRSP database, and stock analysts' sales forecasts are obtained from the I/B/E/S summary file. The final sample for our main analysis consists of 98,941 firm-year observations and 9,475 unique firms. However, the sample size varies depending on the data requirements for subsequent tests. For example, the subsample that requires data on sales forecast dispersion is significantly reduced to 19,030 firm-year observations from 1996 to 2013 due to the constrained availability of analysts' sales forecast data.

4.2. Descriptive statistics

We present descriptive statistics in Table 1. Panel A shows the number of observations by year during the sample period 1971-2013. The number of observations in our sample steadily increased from 1,417 in 1971 to 2,992 in 1997, then decreased to 1,674 in 2013. Panel B contains the summary statistics on variables used in our analyses. The mean (median) value of RET_t is 0.170 (0.069), suggesting that firms in our sample exhibited positive stock market performance. The standard deviation of RET_t is 0.642, implying a large variation in our sample in terms of stock returns. The mean (median) amount of inventory change (deflated by market value of equity) ΔINV_t is -0.004 (0.002), indicating that average firms have decreased inventory holdings, but the magnitude of inventory change is not large. When we decompose inventory change into normal and abnormal changes, the mean of normal inventory change (ΔINV_NL_t) is positive (0.005), while the mean of abnormal inventory change ΔINV_AB_t is negative (-0.009). This suggests that during the sample period average firms decreased abnormal inventory holdings, leading to an increase in inventory holding efficiency. The mean of cash change ($\Delta CASH_t$) is positive (0.007), consistent with the cash literature (e.g., Bates et al. 2009), indicating that firms in the U.S. have accumulated cash over time. Untabulated statistics reveal that the mean (median) of inventory deflated by total assets is 0.217 (0.192). Thus, for the average (median) firm in our sample, inventory accounts for approximately 22% (19%) of total assets. The mean (median) of inventory turnover ($INVTURN_t$) is 11.342 (4.249), suggesting that for our sample firms the cost of goods sold is twelve times greater than the average value of beginning and ending inventories. The average of $GRMARGIN_t$ is 0.329, indicating that when a firm recognizes one dollar of sales, the cost of goods sold is \$0.671 on average and thus gross margin is \$0.329 per one dollar of sales, on average. The average (median) of sales growth $SALEG_t$ is 8.2% (4.2%).

Panel C provides Pearson and Spearman correlation coefficients below and above the diagonal, respectively. Based on Spearman correlation results, current year stock returns (RET_t) are positively correlated with inventory change (ΔINV_t) and normal inventory change (ΔINV_NL_t) while the correlation between RET_t and abnormal inventory change (ΔINV_AB_t) is relatively low (Pearson) or insignificant (Spearman). These results suggest that normal inventory change is more value-relevant than abnormal inventory change. According to Pearson correlations, the value implication of $1 inventory change is approximately seven times larger for normal inventory change, compared to abnormal inventory change.

5. Empirical Results and Additional Analysis

5.1. Testing H1: The marginal market value of normal and abnormal inventory holdings of one dollar

We first estimate the marginal market value of $1 of inventory holdings. Results of estimating model (1F) are presented in the first column of Table 2. The coefficient on ΔINV_t is significantly positive and its magnitude is 0.507, suggesting that one dollar of book inventory is valued as $0.507 by stock investors. The market value of $1 of inventory is lower than the market value of $1 of cash holdings ($0.998). The coefficient on $\Delta OASSET_t$ is significantly positive as well and its magnitude is 0.396, and lower than inventory value. Turning to control variables, their coefficients are generally consistent with our predictions. The coefficients on earnings change and dividends (liability change) are positively (negatively) related to stock returns.

To further investigate the difference in the stock valuation of normal vs. abnormal inventory, we decompose the change in inventory into normal and abnormal portions of inventory change based on the literature (e.g., Roychowdhury 2006). The normal and abnormal portions of inventory changes from year t-1 to t are measured as the predicted and residual values from the following industry-year regression model:

$$\Delta INV_t/A_{t-1} = \alpha_0 + \alpha_1(1/A_{t-1}) + \alpha_2(\Delta S_t/A_{t-1}) + \alpha_3(\Delta S_{t-1}/A_{t-1}) + \varepsilon_t \qquad (2)$$

where ΔINV_t is the change in inventory from year t-1 to t, A_{t-1} is total assets in year t-1, and ΔS_t is the change in sales from year t-1 to t. The regression is estimated for each industry-year group. There are 2,400 separate industry-year groups over our sample period 1971-2013. Industries are classified based on the two-digit SIC code. We require each industry-year regression to have at least 15 observations. Results of estimating the model (2) are presented in Appendix II. The mean coefficients are from all industry-years and t-statistics are calculated using the standard error of the mean across industry-years. We find that both coefficients on current year and past year sales growth are significantly positive, suggesting that inventory growth increases with current year and past year sales growth. The adjusted R-squared is 39%, implying that the model used in Roychowdury (2006) explains inventory growth reasonably well.

To test how differently stock investors value the normal and abnormal inventory holdings, in model (1F) we substitute the change in inventory (ΔINV_t) by the change in normal inventory (ΔINV_NL_t) and the change in abnormal inventory (ΔINV_AB_t). Results are presented in the column (2) of Table 2. Consistent with our hypothesis, the magnitude of the coefficient on the normal inventory change is significantly greater than that of the abnormal inventory change (0.680 vs. 0.389) (p-value from F-test = < 0.001), suggesting that stock investors discount the abnormal component of inventory holdings significantly. These results are different from Chen et al. (2005) which suggest that stock investors do not understand the market value implications of current year abnormal inventory changes.

5.2. Testing H2: The effect of inventory holding inefficiency on the market value of inventory

Since holding higher levels of inventory increases inventory holding costs and inventory obsolescence risk, we hypothesize that the market value of inventory decreases in the level of inventory holding inefficiency. To test this hypothesis, we employ two proxies to capture inventory holding inefficiency.

Our first inventory holding efficiency measure is based on inventory turnover (i.e., the ratio of the cost of goods sold divided by average inventory). The higher inventory turnover indicates that inventories are sold and replaced more quickly, leading to higher inventory holding efficiency. Thus, we predict that the market value of inventory holdings is higher for firms with higher inventory turnover. To test this, we interact $INVTURN_t$ with ΔINV_t in model (1F). To reduce the noise in the estimates and ease the interpretation of economic significance of the effect of the variable on the market value of inventory, inventory turnover ratio ($INVTURN_t$) is decile-ranked (within year-industry) and scaled so that it ranges between zero and one, with observations in the bottom decile taking the value zero and those in the top decile taking the value one. The first column of Table 3 presents the results of testing H2a. We find that the coefficient on the interaction term between inventory change (ΔINV_t) and inventory turnover ratio ($INVTURN_t$) is significantly positive (coefficient = 0.181), consistent with our prediction. Its magnitude suggests that the value of inventory holdings of $1 for firms with the most efficient inventory management is higher than that for firms with the least efficient inventory management by $0.181.

H2b predicts that the market value of inventory increases with gross margin. To test the effect of gross margin on the market value of inventory, we add and interact a gross margin ($GRMARGIN_t$) with ΔINV_t. Results are presented in the second column of Table 3. Gross margin ($GRMARGIN_t$) is measured as sales minus the cost of goods sold deflated by sales. Similar to our previous measures, the gross margin is ranked to deciles within year-industry and standardized to range between zero and one. Consistent with our hypothesis, we find that the coefficient on the interaction between inventory change (ΔINV_t) and gross margin ($GRMARGIN_t$) is 0.189 and significantly positive. The magnitudes of the coefficient on the interaction term and the coefficient on inventory change (0.424) suggest that for firms with the lowest (highest) gross margin, the market value of inventory change of one dollar is valued at \$0.424 (\$0.613).

5.3. Testing H3: The effect of growth opportunities on the market value of inventory

In this section, we test whether the market value of inventory holdings is higher for firms with higher future growth since the costs (benefits) of holding inventory are lower (higher) for such firms. We employ two proxies for growth opportunities - sales growth, and the magnitude of sales forecasts.[12] Sales growth is measured as a change in sales from year *t*-1 to *t*, scaled by sales in year *t*-1. The use of current sales growth as a proxy for growth opportunities is based on the assumption that the current year sales growth will continue in the future periods. Our second proxy for growth is the magnitude of stock analysts' earliest sales forecast available during year *t*, scaled by market value of equity at the end of the prior year. We assume that higher sales forecasts for forthcoming year more likely reflect higher demands for products and services from customers and thus, greater potential for future growth.

Results of testing the third hypothesis are presented in Table 4. To examine the effect of growth opportunities on the market value of inventory, we add and interact each of two growth opportunity measures with the change in inventory in the model (1F). When sales growth is used as a measure of growth opportunities in the first column, the coefficient on the interaction

[12] We also consider the market-to-book ratio as a measure of growth opportunities. We measure the market-to-book ratio as a ratio of market value of equity to book value of equity and find that results based on the market-to-book ratio are generally similar to those based on sales growth and sales surprise. However, we don't use it as a primary measure of growth perspective since the market-to-book ratio reflects so many different firm characteristics such as investment opportunities, information asymmetry, accounting conservatism, etc.

between $GROWTH_t$ and ΔINV_t is significantly positive and its magnitude is 0.551. This suggests that the market value of $1 inventory is $0.166 for firms with the lowest sales growth, while the value is $0.717 (= 0.166 + 0.551) for firms with the highest sales growth. When we use the magnitude of sales forecasts in the next column, the sample size is significantly reduced from 98,941 to 26,156 firm-year observations due to data availability of sales forecasts from the I/B/E/S database. The coefficient on the interaction term between inventory change and sales forecasts is significantly positive (coefficient =1.015), consistent with the results based on sales growth, implying that the difference in terms of the market value of $1 inventory is $1.015 between firms with the lowest and highest sales surprise.

5.4. Testing H4: The effect of future sales predictability on the market value of inventory

We also examine how future sales predictability affects the market value of inventory change. We hypothesize that higher future sales predictability reduces managers' optimism about future sales, and thus managers are less likely to over-stock inventory. Therefore, we predict that higher future sales predictability increases the market value of inventory holdings. We use two proxies for future sales predictability - sales volatility and sales forecast dispersion. In essence, similar to earnings volatility, we believe that future sales are more difficult to predict for firms with higher sales volatility. Also like the literature (e.g., Brown et al. 1987) which uses earnings forecast dispersion as a proxy for future earnings predictability, we employ sales forecast dispersion as a proxy for future sales predictability.

To examine the effect of future sales predictability on the market value of $1 of inventory holdings, we interact sales predictability measures with inventory change in model (1F). Sales forecast dispersion is measured similarly to earnings forecast dispersion. Specifically, we first compute the standard deviation of individual analyst's sales forecasts at the end of the current fiscal year and then divide it by the market value of equity at the end of the current fiscal year. Due to data availability on sales forecasts on the I/B/E/S database, the sample size is reduced to 19,030 observations. To proxy for future sales predictability, we multiply sales forecast dispersion by negative one, so that a higher result indicates higher sales predictability. Consistent with our other proxies, we decile-rank and scale each variable to range from 0 to 1. Results are presented in Table 5. In the first set of results, the coefficient on the interaction term between inventory change and sales predictability based on sales forecast dispersion is significantly positive (coefficient = 1.298; *p*-value = <0.001), supporting our hypothesis. This suggests that stock investors place higher value on inventory holdings for firms with higher future sales predictability.

In the next column, we present the results when we measure sales predictability based on actual sales volatility. Sales volatility is defined as the standard deviation of sales (SALE) from year t-9 to t scaled by market value of equity in year t-1 (MVE_{t-1}).Again, we multiply sales volatility by negative one, so that a higher value indicates higher sales predictability and then we decile-rank and scale the variable to range from 0 to 1. We find that the results are qualitatively similar to those based on sales forecast dispersion. The coefficient on the interaction term between inventory change and sales predictability based on sales volatility is significantly positive (coefficient = 0.486; *p*-value = <0.001). This result suggests that the market value of $1 inventory for firms with the smallest (highest) sales predictability is $0.444 (0.930). In sum, we find that the marginal market value of inventory holdings increases with sales predictability.

5.5. Testing H5: The effect of financial constraints on the market value of inventory

We also test whether the market value of inventory holdings is higher for firms with greater financial constraints. *All other things equal*, inventory holding is more beneficial for financially constrained firms since inventory can be used as collateral when borrowing or inventory relieves financial constraints by the relative ease of converting it to cash. Therefore, we predict that the market value of inventory is higher for financially constrained firms.

We use the SA index ($SAINDEX_t$) and total payout ratio as proxies for financial constraint (Hadlock and Pierce 2010; Faulkender and Wang 2006).[13] The SA index is based on firm size and firm age, and is calculated as follows: $SAINDEX_t = (-0.737*SIZE_t) + (0.043*SIZE_t^2) – (0.040*AGE_t)$, where $SIZE_t$ is log of one plus total assets (*AT*), and *AGE* indicates firm age.[14] Then $SAINDEX_t$ is decile-ranked and scaled to range between zero and one. Thus, the higher *SAINDEX* indicates more financial constraint. Following Faulkender and Wang (2006), total payout ratio is defined as the sum of total common dividends and repurchases scaled by earnings. The literature (e.g., Fazzari et al. 1998) shows that firms with higher payout ratio are less likely to be financially constrained. To be consistent with the interpretation based on the SA index, we multiply payout ratio by negative one so that the higher value indicates more financial constraint. Again we decile-rank the variable to range from zero to one.

We first interact $SAINDEX_t$ with inventory change in model (1F). Results are presented in Table 6. Consistent with our prediction, we find that the coefficient on the interaction term between inventory change (ΔINV_t) and the SA index ($SAINDEX_t$) is significantly positive (coefficient = 0.143; *p*-value = <0.001), indicating that stock investors place higher value on inventory holdings for financially constrained firms, compared to financially unconstrained firms. Specifically, the market value of $1 inventory is $0.567 ($0.424) for the most (least) financially constrained firms. Results based on total payout ratio are similar to those based on the SA index.

[13] Following Faulkender and Wang (2006), we also use the following measures of financial constraints: firm size (based on sales and total assets), long-term bond rating, and commercial paper rating. We find that our results based on these alternative measures are qualitatively similar to those reported in Table 6.
[14] Following Hadlock and Pierce (2010), $SIZE_t$ and AGE_t are winsorized at $4.5 billion and 37 years, respectively.

When total payout ratio is used as a measure of financial constraint, the coefficient on the interaction between *FINCON* and ΔINV_t is significantly positive (coefficient = 0.159).

5.6. Results including cross-sectional determinants simultaneously

So far, we have examined the effects of various determinants on the market value of inventory separately. To mitigate concerns on potential correlated omitted variables problem, in this section, we re-estimate the model (1F) by including all the determinants of inventory value simultaneously. Since data requirement for sales forecasts and sales forecast dispersion significantly reduce the sample size for this test, we exclude the magnitude of sales forecasts and sales forecast dispersion from this analysis. Results presented in Table 7 show that after including all the determinants simultaneously, the market value of inventory is higher for firms with higher inventory turnover, gross margin, sales growth, sales predictability and financial constraint.

5.7. Robustness tests

To check the robustness of our results, we also perform the follow analysis. First, our main analysis is based on both manufacturing and non-manufacturing firms. Since some prior studies use only manufacturing firms to examine managers' inventory holding decisions, we also examine whether our results are robust to the exclusion of non-manufacturing firms from our sample. We find that the results based on only manufacturing firms (66,992 firm-year observations) are qualitatively similar to what we report in previous sections. Second, we also check the possibility that our results are affected by the global financial crisis (2007-2009). The literature (e.g., Gupta, Pevzner, and Seethamraju 2014) shows that managers' inventory decision and the inventory valuation are significantly affected by macro-economic condition. Thus, we also examine whether our results are robust to the elimination of observations during the period of the global financial crisis (2007-2009). When we remove observations during the global financial crisis, our results are reduced to 93,092 firm-year observations. We find that with this reduced sample, our main inferences are the same. Third, we re-estimate our main models after removing observations with stock prices less than $1 and total assets less than $10 million. Such firms are often neglected and generally suffer from financial distress. Therefore, stock valuations for such firms are quite different from other firms. Again, we find that our results with this sample (80,591 firm year observations) hold without such firms.

6. Conclusion

While, corporate financial performance receives substantial attention in the academic supply chain management (SCM) literature, a paucity of literature evaluates the relation between SCM quality and stock price behavior, and we know of no papers that attempt to attach changes in shareholder value to optimal and suboptimal changes in inventory. We contribute to this literature by studying the market value of normal versus abnormal changes in inventory, where normal changes move the inventory balance to an optimal target level and abnormal changes refer to the gap between a company's actual inventory change and the optimal change. We find that the market values abnormal changes by a margin of 43% less than the value attached to normal changes in inventory.

We also test hypotheses regarding the sensitivity of the relation between stock returns and total changes in inventory to various firm-specific factors and, consistent with our hypotheses, find that the market value of inventory is higher for firms with more efficient SCM (as proxied by higher inventory turnover and higher gross margin), greater demand (as proxied by sales growth), less uncertainty (as proxied by sales predictability), and greater financial constraints, as measured by a proxy developed in prior literature.

In addition to our contribution to the SCM literature, our study has the potential to influence future research that might evaluate the market value attached to other components of the net book value of a firm's common stockholders' equity. We expect particular interest in the market value of optimal versus suboptimal changes in various balance sheet component variables.

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Appendix I: Variable Definitions

* Compustat Annual database items are provided in the parentheses.

Variable	Definition
RET_t	Annual stock return cumulated from month -11 to 0 around the fiscal-year end at year *t*.
MVE_{t-1}	Market value of equity in year *t*-1 defined as the number of common shares outstanding (CSHO) multiplied by the stock's price (PRCC_F) at the fiscal year-end *t*-1.
ΔINV_t	Change in total inventory (INVT) from year *t*-1 to *t* deflated by market value of equity in year *t*-1 (MVE_{t-1}).
ΔINV_NL_t ΔINV_AB_t	Normal and abnormal change in total inventory (INVT) from year *t*-1 to *t* deflated by market value of equity in year *t*-1 (MVE_{t-1}). They are obtained from the following industry-year regression (Roychowdhury 2006): $\Delta Inventory_t/Asset_{t-1} = \alpha_0 + \alpha_1(1/Asset_{t-1}) + \alpha_2(\Delta Sales_t/Asset_{t-1}) + \alpha_3(\Delta Sales_{t-1}/Assets_{t-1}) + \varepsilon_t$. Industry is the two-digit SIC code. Each industry-year regression requires at least 15 observations. ΔINV_NL_t and ΔINV_AB_t are the predicted values and residuals, respectively, from the regression multiplied with $Assets_{t-1}$ / MVE_{t-1}.
$\Delta CASH_t$	Change in cash and marketable securities (CHE) from year *t*-1 to *t* deflated by market value of equity in year *t*-1 (MVE_{t-1}).
$\Delta OASSET_t$	Change in assets other than cash and inventory (AT – INVT - CHE) from year *t*-1 to *t* deflated by market value of equity in year *t*-1 (MVE_{t-1}).
$\Delta LIAB_t$	Change in total liabilities (LT) from year *t*-1 to *t* deflated by market value of equity in year *t*-1 (MVE_{t-1}).
$\Delta EARN_t$	Change in income before extraordinary items (IB) from year *t*-1 to *t* deflated by market value of equity in year *t*-1 (MVE_{t-1}).
DIV_t	Dividends (DVC) in year *t* deflated by market value of equity in year *t*-1 (MVE_{t-1}).
$INVTURN_t$	Inventory turnover ratio defined as cost of goods sold (COGS) in year *t* divided by average inventory (INVT) over year *t*-1 and *t*.

$GRMARGIN_t$	Gross margin defined as sales (REVT) minus cost of goods sold (COGS) divided by sales (REVT) in year t.
$SALEG_t$	Sales growth defined as the change in sales (SALE) from year t-1 to t divided by sales in year t-1.
SF_t	The magnitude of sales forecasts defined as stock analysts' earliest sales forecast available during year t.
$SFDISP_t$	Analyst sales forecast dispersion defined as the standard deviation of individual analysts' annual sales forecasts for a given firm, scaled by market value of equity at the end of year t-1, multiplied by 100. The sales forecast dispersion is calculated based on the most recent forecasts issued in the fourth fiscal quarter.
$SALVOL_t$	Sales volatility defined as the standard deviation of sales (SALE) from year t-9 to t scaled by market value of equity in year t-1 (MVE_{t-1}).
$SAINDEX_t$	Hadlock and Pierce (2010) financial constraint measure based on firm size and firm age. The index is calculated as follows: SA-Index = (-0.737*Size) + (0.043*Size^2) – (0.040*Age), where Size is log of one plus total assets, and Age is the firm age. Size and Age are winsorized at $4.5 billion and 37 years, respectively. The higher values of the SA index correspond to greater financial constraints.
$PAYOUT_t$	Total payout ratio defined as the sum of total common dividends (DVC) and repurchases (PRSTKC) scaled by earnings (IB).

Appendix II
Cross-Sectional Estimation of Normal and Abnormal Change in Inventory

This table provides the summary statistics of the estimated parameters in the following regression: $\Delta INV_t / A_{t-1} = \beta_0 + \beta_1(1 / A_{t-1}) + \beta_2(\Delta S_t / A_{t-1}) + \beta_3(\Delta S_{t-1} / A_{t-1}) + \varepsilon_t$, where ΔINV_t is the change in inventory from year t-1 to t, A_{t-1} is total assets in year t-1, and ΔS_t is the change in sales from year t-1 to t. The regression is estimated for each industry-year group. There are 2,400 separate industry-year groups over our sample period 1971-2013. Industries are classified by the two-digit SIC code. Industry-years with fewer than 15 observations are dropped from the sample. The mean coefficients are from all industry-years and t-statistics are calculated using the standard error of the mean across industry-years. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Independent Variables	Mean	25%	Median	75%	Stdev.
Intercept	**0.001** **	-0.006	0.000	0.008	0.030
$1 / A_{t-1}$	**0.168*** **	-0.058	0.000	0.150	1.368
$\Delta S_t / A_{t-1}$	**0.111*** **	0.030	0.084	0.155	0.158
$\Delta S_{t-1} / A_{t-1}$	**0.006** **	-0.016	0.002	0.028	0.130
R^2	0.390	0.161	0.346	0.572	0.272

Table 1
Descriptive Statistics

This table provides descriptive statistics for our sample. The sample consists of 98,941 firm-years for 9,475 firms during the period from year 1971 to 2013. Panel A presents the number of firm-years by year, Panel B provides the summary statistics, and Panel C reports the correlation matrix for the variables used in our analyses. In Panel C, Pearson and Spearman correlation coefficients are provided below and above the diagonal, respectively. See the Appendix for variable definitions.

Panel A: Number of Observations by Year

Year	# Obs.	Year	# Obs.	Year	# Obs.	Year	# Obs.
1971	1,417	1982	2,271	1993	2,576	2004	2,355
1972	1,531	1983	2,317	1994	2,679	2005	2,252
1973	1,846	1984	2,398	1995	2,799	2006	2,148
1974	2,169	1985	2,329	1996	2,976	2007	2,025
1975	2,333	1986	2,364	1997	2,992	2008	1,926
1976	2,246	1987	2,445	1998	2,940	2009	1,898
1977	2,322	1988	2,364	1999	2,902	2010	1,873
1978	2,311	1989	2,416	2000	2,730	2011	1,808
1979	2,229	1990	2,539	2001	2,527	2012	1,723
1980	2,140	1991	2,552	2002	2,473	2013	1,674
1981	2,172	1992	2,531	2003	2,423		

Panel B: Summary Statistics

Variable Name	*N*	Mean	25%	Median	75%	Std
RET_t	98,941	0.170	-0.208	0.069	0.386	0.642
ΔINV_t	98,941	-0.004	-0.023	0.002	0.032	0.181
ΔINV_NL_t	98,941	0.005	-0.010	0.005	0.030	0.124
ΔINV_AB_t	98,941	-0.009	-0.033	-0.001	0.024	0.160
$\Delta CASH_t$	98,941	0.007	-0.033	0.000	0.037	0.139
$\Delta OASSET_t$	98,941	0.000	-0.073	0.012	0.095	0.381
$\Delta LIAB_t$	98,941	0.002	-0.068	0.006	0.088	0.401
$\Delta EARN_t$	98,941	0.016	-0.030	0.006	0.039	0.217
DIV_t	98,941	0.014	0.000	0.000	0.024	0.021
$INVTURN_t$	98,941	11.342	2.711	4.249	7.992	25.043
$GRMARGIN_t$	98,941	0.329	0.215	0.312	0.442	0.227
$SALEG_t$	98,941	0.082	-0.053	0.042	0.153	0.313
SF_t	26,156	5.619	0.675	2.497	7.250	29.929
$SFDISP_t$	15,450	-2.938	-2.653	-1.056	-0.447	6.135
$SALVOL_t$	98,941	-0.741	-0.756	-0.329	-0.145	1.263
$SAINDEX_t$	98,941	-3.183	-3.803	-3.188	-2.588	0.841
$PAYOUT_t$	75,089	-0.506	-0.540	-0.231	0.000	1.087

Table 1
Descriptive Statistics (Cont'd)

Panel C: Correlation Table

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1)	RET_t		**0.112**	**0.161**	0.004	**0.206**	**0.154**	**0.055**	**0.373**	**0.153**	**0.042**	**0.062**	**0.215**	**0.015**	**-0.068**	**-0.133**	**-0.094**	**0.102**
(2)	ΔINV_t	**0.074**		**0.443**	**0.627**	**-0.100**	**0.368**	**0.484**	**0.135**	**0.022**	**0.013**	**0.030**	**0.422**	**0.182**	**-0.034**	**0.048**	**-0.006**	**0.125**
(3)	ΔINV_NL_t	**0.091**	**0.524**		**-0.194**	**0.035**	**0.360**	**0.338**	**0.260**	**0.030**	**0.031**	**-0.012**	**0.646**	**0.316**	**-0.083**	**-0.043**	0.004	**0.171**
(4)	ΔINV_AB_t	**0.013**	**0.693**	**-0.187**		**-0.134**	**0.112**	**0.257**	**-0.040**	0.000	**-0.012**	**0.040**	**-0.023**	**-0.074**	**0.014**	**0.072**	**-0.010**	**0.008**
(5)	$\Delta CASH_t$	**0.219**	**-0.069**	**0.030**	**-0.101**		**-0.075**	**0.074**	**0.167**	**0.007**	**0.025**	**0.048**	**0.087**	0.002	-0.007	-0.002	**-0.042**	**0.139**
(6)	$\Delta OASSET_t$	**0.094**	**0.370**	**0.384**	**0.111**	**-0.035**		**0.683**	**0.104**	**0.024**	**0.074**	**0.073**	**0.475**	**0.151**	**0.015**	**0.138**	**-0.054**	**0.136**
(7)	$\Delta LIAB_t$	**0.020**	**0.574**	**0.423**	**0.308**	**0.104**	**0.784**		**-0.014**	**0.042**	**0.048**	**0.017**	**0.387**	**0.158**	-0.013	**0.101**	**-0.039**	**-0.009**
(8)	$\Delta EARN_t$	**0.283**	**0.035**	**0.042**	**0.011**	**0.113**	**-0.014**	**-0.139**		**-0.036**	**0.044**	**0.071**	**0.336**	**0.098**	**-0.014**	**-0.102**	**0.023**	**0.310**
(9)	DIV_t	**0.073**	**0.030**	**0.022**	**0.016**	**0.007**	**0.013**	**0.031**	**-0.037**		**0.006**	**-0.104**	**-0.069**	**0.055**	**-0.103**	0.001	**-0.384**	**-0.625**
(10)	$INVTURN_t$	0.001	**0.015**	0.004	**0.012**	**0.007**	**0.019**	**0.016**	0.002	**-0.068**		**-0.349**	**0.115**	**0.107**	**-0.172**	**-0.091**	**-0.096**	**-0.023**
(11)	$GRMARGIN_t$	**0.062**	**0.033**	**0.012**	**0.029**	**0.034**	**0.057**	**0.020**	**0.051**	**-0.068**	**-0.200**		**0.107**	**-0.106**	**0.526**	**0.446**	**0.050**	**0.033**
(12)	$SALEG_t$	**0.156**	**0.266**	**0.379**	0.003	**0.066**	**0.351**	**0.293**	**0.092**	**-0.099**	**0.058**	**0.043**		**0.369**	**0.112**	**0.133**	**0.008**	**0.258**
(13)	SF_t	**-0.062**	**0.147**	**0.268**	**-0.079**	**-0.018**	**0.130**	**0.159**	**-0.138**	-0.002	0.008	**-0.013**	**0.169**		**-0.094**	**-0.101**	**-0.209**	**-0.032**
(14)	$SFDISP_t$	**-0.070**	**0.021**	**-0.025**	**0.036**	**-0.063**	**0.020**	-0.005	**-0.086**	**-0.106**	**-0.047**	**0.219**	0.005	**0.049**		**0.641**	**0.086**	**-0.107**
(15)	$SALVOL_t$	**-0.138**	**0.170**	**0.152**	**0.063**	-0.003	**0.236**	**0.223**	**-0.179**	**0.035**	**-0.024**	**0.186**	**0.077**	**0.080**	**0.521**		**-0.092**	**-0.181**
(16)	$SAINDEX_t$	-0.004	**-0.030**	**-0.008**	**-0.026**	**-0.021**	**-0.058**	**-0.046**	**0.034**	**-0.272**	**0.012**	-0.001	**0.052**	**-0.074**	**0.030**	**-0.094**		**0.388**
(17)	$PAYOUT_t$	**0.104**	**0.051**	**0.071**	0.002	**0.106**	**0.050**	**-0.013**	**0.125**	**-0.188**	**-0.012**	-0.005	**0.130**	-0.007	**-0.038**	**-0.063**	**0.158**	

Table 2
Estimation of the Market Value of Inventory

This table provides the results of regressing the annual return (RET_t) on changes in inventory and control variables. All continuous variables are winsorized at the 1% and 99% levels using the full sample. All regressions contain industry (two-digit SIC code) and year fixed effects. Standard errors are clustered by firm level, and are provided in the parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. See the Appendix for variable definitions.

Independent Variables	Prediction	Model (1)	Model (2)
Intercept	+/-	**0.153***** **(0.033)**	**0.154***** **(0.033)**
ΔINV_t	+	**0.507***** **(0.021)**	- -
ΔINV_NL_t	+	- -	**0.680***** **(0.029)**
ΔINV_AB_t	+	- -	**0.389***** **(0.022)**
$\Delta CASH_t$	+	**0.998***** **(0.030)**	**0.969***** **(0.030)**
$\Delta OASSET_t$	+	**0.396***** **(0.017)**	**0.367***** **(0.017)**
$\Delta LIAB_t$	-	**-0.357***** **(0.019)**	**-0.339***** **(0.019)**
$\Delta EARN_t$	+	**0.644***** **(0.020)**	**0.646***** **(0.020)**
DIV_t	+	**1.909***** **(0.081)**	**1.919***** **(0.081)**
Industry Fixed-Effect		Y	Y
Year Fixed-Effect		Y	Y
Cluster by Firm		Y	Y
# Obs.		98,941	98,941
Adj. R^2		0.227	0.228

F-Test: $\Delta INV\_NL_t = \Delta INV\_AB_t$

F Value		-	114.227
p-Value		-	0.000

Table 3
The Effect of Inventory Holding Efficiency on the Market Value of Inventory

This table provides the results of regressing the annual return (RET_t) on changes in inventory and proxies for firms' inventory holding efficiency. In Models (1) and (2), $INVEFF_t$ equals inventory turnover ($INVTURN_t$) and gross margin ($GRMARGIN_t$), respectively. The proxies for growth ($INVTURN_t$ and $GRMARGIN_t$) enter the regressions as fractional rankings (between zero and one) within firms' year-industry (two-digit SIC code). All continuous variables are winsorized at the 1% and 99% levels using the full sample. All regressions contain industry (two-digit SIC code) and year fixed effects. Standard errors are clustered by firm level, and are provided in the parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. See the Appendix for variable definitions.

Independent Variables	Prediction	Inventory Turnover Model (1)	Gross Margin Model (2)
Intercept	+/-	**0.124*****	**0.116*****
		(0.035)	**(0.032)**
ΔINV_t	+	**0.430*****	**0.424*****
		(0.028)	**(0.029)**
$\Delta CASH_t$	+	**0.994*****	**0.990*****
		(0.030)	**(0.030)**
$\Delta OASSET_t$	+	**0.392*****	**0.387*****
		(0.017)	**(0.017)**
$\Delta LIAB_t$	-	**-0.356*****	**-0.350*****
		(0.019)	**(0.019)**
$\Delta EARN_t$	+	**0.642*****	**0.644*****
		(0.020)	**(0.020)**
DIV_t	+	**1.890*****	**1.941*****
		(0.081)	**(0.081)**
$INVEFF_t$	+/-	**0.057*****	**0.068*****
		(0.005)	**(0.005)**
$INVEFF_t * \Delta INV_t$	+	**0.181*****	**0.189*****
		(0.049)	**(0.051)**
Industry Fixed-Effect		Y	Y
Year Fixed-Effect		Y	Y
Cluster by Firm		Y	Y
# Obs.		98,941	98,941
Adj. R^2		0.227	0.228

Table 4
The Effect of Growth on the Market Value of Inventory

This table provides the results of regressing the annual return (RET_t) on changes in inventory and proxies for firms' growth. In Models (1) and (2), $GROWTH_t$ equals sales growth from year t-1 to t ($SALEG_t$) and the magnitude of sales forecasts (SF_t), respectively. The proxies for growth ($SALEG_t$ and SF_t) enter the regressions as fractional rankings (between zero and one) within firms' year-industry (two-digit SIC code). All continuous variables are winsorized at the 1% and 99% levels using the full sample. All regressions contain industry (two-digit SIC code) and year fixed effects. Standard errors are clustered by firm level, and are provided in the parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. See the Appendix for variable definitions.

Independent Variables	Prediction	Sales Growth Model (1)	Sales Forecast Magnitude Model (2)
Intercept	+/-	-0.014	0.149
		(0.033)	(0.095)
ΔINV_t	+	**0.166*** **	**0.502*** **
		(0.025)	**(0.146)**
$\Delta CASH_t$	+	**0.930*** **	**1.803*** **
		(0.030)	**(0.087)**
$\Delta OASSET_t$	+	**0.313*** **	**0.621*** **
		(0.017)	**(0.047)**
$\Delta LIAB_t$	-	**-0.340*** **	**-0.710*** **
		(0.018)	**(0.060)**
$\Delta EARN_t$	+	**0.604*** **	**0.756*** **
		(0.019)	**(0.047)**
DIV_t	+	**2.405*** **	**2.154*** **
		(0.081)	**(0.230)**
$GROWTH_t$	+/-	**0.287*** **	0.008
		(0.007)	(0.012)
$GROWTH_t * \Delta INV_t$	+	**0.551*** **	**1.015*** **
		(0.044)	**(0.266)**
Industry Fixed-Effect		Y	Y
Year Fixed-Effect		Y	Y
Cluster by Firm		Y	Y
# Obs.		98,941	26,156
Adj. R^2		0.246	0.253

Table 5
The Effect of Sales Predictability on the Market Value of Inventory

This table provides the results of regressing the annual return (RET_t) on changes in inventory and proxies for firms' sales forecast dispersion. In Model (1), $DISP_t$ equals analysts' sales forecast dispersion ($SFDISP_t$). In Model (2), $DISP_t$ equals sales volatility ($SALVOL_t$). The proxies for sales forecast dispersion ($SFDISP_t$ and $SALVOL_t$) enter the regressions as fractional rankings (between zero and one) within firms' year-industry (two-digit SIC code). All continuous variables are winsorized at the 1% and 99% levels using the full sample. All regressions contain industry (two-digit SIC code) and year fixed effects. Standard errors are clustered by firm level, and are provided in the parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. See the Appendix for variable definitions.

Independent Variables	Prediction	Sales Forecast Dispersion Model (1)	Sales Volatility Model (2)
Intercept	+/-	**0.159***	**0.277*****
		(0.085)	**(0.036)**
ΔINV_t	+	**0.549*****	**0.444*****
		(0.161)	**(0.026)**
$\Delta CASH_t$	+	**1.956*****	**1.015*****
		(0.096)	**(0.030)**
$\Delta OASSET_t$	+	**0.591*****	**0.439*****
		(0.051)	**(0.017)**
$\Delta LIAB_t$	-	**-0.751*****	**-0.382*****
		(0.068)	**(0.019)**
$\Delta EARN_t$	+	**0.749*****	**0.593*****
		(0.054)	**(0.020)**
DIV_t	+	**1.870*****	**2.384*****
		(0.241)	**(0.087)**
$PRED_t$	+/-	**-0.122*****	**-0.261*****
		(0.012)	**(0.006)**
$PRED_t * \Delta INV_t$	+	**1.298*****	**0.486*****
		(0.288)	**(0.054)**
Industry Fixed-Effect		Y	Y
Year Fixed-Effect		Y	Y
Cluster by Firm		Y	Y
# Obs.		19,030	98,941
Adj. R^2		0.285	0.243

Table 6
The Effect of Financial Constraints on the Market Value of Inventory

This table provides the results of regressing the annual return (RET_t) on changes in inventory and proxies for firms' financial constraints. In Model (1), $FINCON_t$ equals the size and age index developed in Hadlock and Pierce (2010) ($SAINDEX_t$). In Model (2), $FINCON_t$ equals the total payout (dividends plus repurchases) deflated by earnings ($PAYOUT_t$). The proxies for financial constraints ($SAINDEX_t$ and $PAYOUT_t$) enter the regressions as a fractional ranking (between zero and one) within firms' year-industry (two-digit SIC code). All continuous variables are winsorized at the 1% and 99% levels using the full sample. All regressions contain industry (two-digit SIC code) and year fixed effects. Standard errors are clustered by firm level, and are provided in the parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. See the Appendix for variable definitions.

Independent Variables	Prediction	SA Index Model (1)	Total Payout Model (2)
Intercept	+/-	**0.122*** **	0.042
		(0.033)	(0.046)
ΔINV_t	+	**0.424*****	**0.648*****
		(0.033)	**(0.043)**
$\Delta CASH_t$	+	**1.001*****	**1.150*****
		(0.030)	**(0.037)**
$\Delta OASSET_t$	+	**0.399*****	**0.616*****
		(0.017)	**(0.027)**
$\Delta LIAB_t$	-	**-0.359*****	**-0.521*****
		(0.019)	**(0.029)**
$\Delta EARN_t$	+	**0.642*****	**1.026*****
		(0.020)	**(0.031)**
DIV_t	+	**2.170*****	**3.453*****
		(0.087)	**(0.116)**
$FINCON_t$	+/-	**0.047*****	**0.136*****
		(0.005)	**(0.008)**
$FINCON_t * \Delta INV_t$	+	**0.143*****	**0.159*****
		(0.048)	**(0.055)**
Industry Fixed-Effect		Y	Y
Year Fixed-Effect		Y	Y
Cluster by Firm		Y	Y
# Obs.		98,941	75,089
Adj. R^2		0.227	0.279

Table 7
Simultaneously Controlling for the Determinants of the Market Value of Inventory

This table provides the results of regressing the annual return (RET_t) on changes in inventory and the determinants examined in the previous analyses. All continuous determinant variables enter the regressions as fractional rankings (between zero and one) within firms' year-industry (two-digit SIC code). All continuous variables are winsorized at the 1% and 99% levels using the full sample. All regressions contain industry (two-digit SIC code) and year fixed effects. Standard errors are clustered by firm level, and are provided in the parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. See the Appendix for variable definitions.

Independent Variables	Prediction	Coefficients
Intercept	+/-	-0.004
		(0.036)
ΔINV_t	+	0.045
		(0.047)
$\Delta CASH_t$	+	**0.915*** **
		(0.029)
$\Delta OASSET_t$	+	**0.333*** **
		(0.017)
$\Delta LIAB_t$	-	**-0.341*** **
		(0.018)
$\Delta EARN_t$	+	**0.535*** **
		(0.019)
DIV_t	+	**3.143*** **
		(0.094)
$INVTURN_t$	+/-	**0.055*** **
		(0.006)
$GRMARGIN_t$	+/-	**0.194*** **
		(0.007)
$SALEG_t$	+/-	**0.292*** **
		(0.007)
$SALVOL_t$	+/-	**-0.336*** **
		(0.007)
$SAINDEX_t$	+/-	**0.033*** **
		(0.005)
$INVTURN_t * \Delta INV_t$	+	**0.100** **
		(0.050)
$GRMARGIN * \Delta INV_t$	+	**0.128** **
		(0.051)
$SALEG_t * \Delta INV_t$	+	**0.284*** **
		(0.044)
$SALVOL_t * \Delta INV_t$	+	**0.265*** **
		(0.052)
$SAINDEX_t * \Delta INV_t$	+	**0.167*** **
		(0.044)
Industry Fixed-Effect		Y
Year Fixed-Effect		Y
Cluster by Firm		Y
# Obs.		98,941
Adj. R^2		0.270