The New Science of Retailing: How Analytics Are Transforming the Supply Chain and Improving Performance

by Marshall Fisher and Ananth Raman

Chapter One: Retail Valuation—How Investors Value Product Availability and Inventory Management

Overview

Retailers beware! David Berman is watching you. Berman, general partner of Berman Capital Management in New York, invests in retail stocks, often after investigating a retailer's inventory levels. [1] He's a member of an emerging group of rocket science investors who believe that operational data, such as inventory levels, foretell future increases or decreases in sales, earnings, and share price. Publicly traded retailers must understand how investors like Berman operate in order to effectively communicate with them. This chapter offers guidelines on how you can do so. Moreover, adopting the investor's perspective can help you benchmark your firm's performance along various dimensions against other retailers, and also identify how you can better forecast your firm's sales using past macroeconomic and financial data.

To understand Berman's approach, consider his experience with Saucony, a shoemaker based near Boston, which, though not primarily a retailer, illustrates Berman's investment approach well. In 2003, Berman rated it a strong buy when he noticed that, though sales were flattish, inventories had declined about 20 percent year over year. The stock looked riskier than average. It was thinly traded, and managers were reluctant to share information. But to Berman, a falling inventory level foretold a future rise in gross margin. He started buying shares at $14 in late 2003 due primarily to the leaner inventories. A year later, the stock had doubled. During this period, sales rose, as did inventories, and of course, the gross margin expanded significantly, just as Berman had predicted. Saucony's earnings per share increased from $0.85 in 2002 to $1.29 in 2004.

Then in late 2004 Berman decided to unload his shares. This decision, which came shortly after management asked him to ring the NASDAQ bell with them, was based on his inventory analysis. But this time, the numbers told a troubling tale. Inventories were growing at the same pace as sales. To make matters worse, managers were ignoring his calls. Sure enough, in March 2005, before Berman had been able to unwind his illiquid position, Saucony announced that it would miss earnings estimates. The stock dropped 20 percent.

A similar sort of analysis led him in 2003 to dump his shares of Bombay, a home accessories and furniture retailer. That November, the company announced that revenue had risen a healthy 19 percent. But as Berman combed through its financials, he noticed that inventories had increased 50 percent year over year. Then executives acknowledged early November sales weakness. That day, the stock fell 20 percent, to $10. Even that correction didn't satisfy Berman.

"Going into Q4 it was clear they would *have* to miss numbers again unless the consumer saved them, which would be a shocker," he said. About two weeks later, the company issued guidance, saying that it expected earnings to fall, and the stock slipped another 20 percent. Remarkably, just four weeks later, after the Christmas selling season, managers lowered their guidance yet again, and the stock declined another 20 percent. "It was so sweet to see the classic inventory/ earnings relationship at work so quickly," Berman recalls. In just one and a half months, the stock declined 50 percent primarily because of inventory mismanagement and weakening sales.

This chapter examines the relationship between retailers' stock market valuation and inventory management capabilities. We start by discussing inventory *from an investor's perspective* . That is, we analyze a firm's inventory levels and capabilities based on the information available to an investor, which is often just a subset of the data available within the firm. Then we zero in on the ever-popular inventory-turns metric, explaining how you should modify it to better understand your inventory levels and to arm yourself to communicate more effectively with sharp-eyed investors like Berman. Even if your company isn't publicly held, understanding Wall Street's perspective will help you hone your operations and communications. Financial metrics are the road map to any business. Operating without fully understanding them is like driving in a foreign country without a map or GPS.

[1]For a discussion of David Berman's business model and investment approach, see Ananth Raman, Vishal Gaur, and Saravanan Kesavan, "David Berman," Case 605-081 (Boston: Harvard Business School, 2005).

How Does Berman Use Inventory Information to Predict Stock Price?

We'll use a numerical example to show how a deep understanding of inventory helped Berman make the smart stock calls we've just described, and to lay out how a sophisticated investor such as David Berman might assess your firm.

Scenario 1: Impact of Same-Store Sales Growth

Consider two apparel retailers, A and B, whose projected performance is summarized in table 1-1. Both have projected gross margins of 40 percent of sales and selling, general, and administrative (SG&A) expenses of $180 million per year. Both of their sales are expected to hit $500 million in the first year. The only difference is their growth rate. Firm A is stable, neither growing nor declining, while firm B is growing at 3 percent per year. Neither firm is adding stores in the next few years.

To evaluate the two firms, a professional investor would use a discounted cash flow model (albeit a much more complicated one than the one we will describe). In such a model, a firm's value equals the present value of its future cash flows. Table 1-2 shows such a model for firm A. For simplicity's sake, we ignore taxes, depreciation, and capital expenses. We project cash flows for twenty-five years and assume that at the end of that time, the terminal value of each firm and its inventory is zero. Finally, we assume that the discount rate is 10 percent per year.

Table 1-1: Scenario 1

Financial metric	**Retailer A**	**Retailer B**
Sales	$500 million	$500 million
Gross margin	40%	40%
Net margin (current year)	4% ($20 Mn)	4% ($20 Mn)
Sales growth (1 year)	0%	3%
Comp. store sales growth (1 year)	0%	3%

Table 1-2: Sample cash flow projections

Firm A Gross margin % 40%			
FIRMA			
Year	1	2	25
Sales	500	500	500
GM	200	200	200
SG&A	180	180	180
Net margin	20	20	20
Cash flow	*20*	*20*	*20*

This discounted cash flow analysis values retailer A at $182 million. Retailer B, on the other hand, is valued at $625 million, or more than three times as much. Its higher growth rate has such a big impact on cash flow because the gross margin from the additional sales falls to the company's bottom line. In year 2, for example, firm B has sales of $515 million, a gross margin of $206 million, and cash flow of $26 million. This example underscores why analysts pay such close attention to a retailer's projected growth.

Scenario 2: The Impact of Higher but Steady Inventory Levels

Now, to understand how inventory factors into Wall Street's valuation of your firm or its competitors, let's complicate the scenario. Assume that, in addition to the data above, we discover that retailer A operates with 182.5 days of inventory, while retailer B operates with 365 days' worth.

Retailer A's inventory level does not affect its cash flow or valuation; the company is stable, so its inventory is also stable. But retailer B's higher inventory load, when combined with its growth, does hurt its cash flow compared with scenario 1. As the company grows, it has to devote part of its cash flow to funding the additional inventory needed for that growth. In the second year, for example, its inventory grows from $300 million to $309 million, and its cash flow drops by $9 million, amounting to only $17 million (as opposed to $26 million in the prior example). This time, retailer B's valuation is only $578 million.

Scenario 3: Impact of Inventory Growth Rate

Now let's add another wrinkle of just the sort that catches David Berman's attention. In this scenario, retailer B's inventory is growing at 6 percent per year. In other words, it's rising faster than the firm's sales are growing.

Plug those numbers into our discounted cash flow model, and future cash flows change substantially. In the second year, for example, inventory increases to $318 million (from $300 million in year 1), and cash flow is only $8 million (down from $26 million in scenario 1 and $17 million in scenario 2). The sharp reduction in cash flow cuts firm B's valuation to $430 million.

Scenario 4: Impact of Inventory Write-offs

If you have too much inventory, as retailer B appears to, you'll eventually have to write off some of it. So let's add into our valuation a $10 million annual write-off for obsolete inventory. Not surprisingly, our discounted cash flow model now values retailer B at $339 million.

The logic underpinning the scenarios described above also limns the views of David Berman. The relationship between inventory levels and a firm's valuation, he says, "is astoundingly powerful, but surprisingly few understand why." Berman points out that rising inventory levels are often a function of the retailer's failing to take markdowns in a disciplined way. He argues that the game of failing to mark down obsolete inventory cannot be played indefinitely. Ultimately, the "music has to stop," he says. In other words, for Berman, rising inventory levels can predict future earnings declines.

Berman likewise argues that sales growth achieved through inventory increases isn't as sustainable as growth powered by greater consumer acceptance of a brand. Consider a retailer that has historically suffered from stockouts due to insufficient inventory. When it adds inventory to its stores, sales should rise. But Wall Street analysts, who typically pay close attention to "same-store sales growth," often fail to distinguish between these two types of growth and thus overvalue retailers that inflate their sales by adding inventory. Undoubtedly, the market corrects the overvaluation when future sales growth fails to meet Wall Street's optimistic projections.

The relationship between inventory and sales can be understood from Berman's analysis of The Home Depot. In 2001 and 2002 Home Depot's new CEO, Bob Nardelli, seemed to struggle in managing the transition from a cash flow GE-type philosophy to a retailer Home Depot–type philosophy. [2] In his *DeeBee Report* dated June 10, 2003, Berman stated, "Bob Nardelli learned the power of inventory the hard way. In focusing on cash flow improvement, he dramatically lowered inventories—and yes, increased cash balances—only to see a huge decline in same store sales, and in its stock price (the stock went from around $40 to $22). And so, under immense pressure, Nardelli reversed course and focused intensely on increasing inventories. Since Q2 of last year, inventories had been building until they were up 25 percent year over year. And yes, same store sales did improve, as did the stock price." [3] Recognizing this as potentially a short fix, Berman continued: "Now the cynical would view this increase in sales with skepticism, noting that it wasn't of 'high quality' as it was due, in part, to the massive inventory build. It is, however, pleasing to note that Home Depot simply got inventories back to 'normal,' in that it now has turns similar to [its] competitors." [4] The stock, following the same-store sales and earnings increases, which in essence followed the inventories increase, rose from $22 at the start of 2003 to $36 by the end of 2003. When asked about this "fix," Berman responded, "It will be more challenging for Nardelli to increase same store sales and margins going forward because his increasing inventories and therefore same store sales is arguably a one-time benefit and is essentially what caused the 'fix.'" Berman concluded by saying, "As such the stock ought not to climb as rapidly as it did during that 2002 to 2004 inventory growth period." [5]

Recent research by Saravanan Kesavan, one of our doctoral students and currently a professor at the University of North Carolina's Kenan-Flagler Business School, supports Berman's assertion that inventory can be used to drive sales and that Wall Street understates the relationship between inventory and sales. [6] On average across all segments, a 1 percent increase in inventory is found to cause roughly a

0.224 percent increase in sales. Moreover, the impact on sales of a 1 percent increase in inventory differs substantially among different segments. Furniture retailers witness only a 0.188 percent increase in sales, while apparel and accessory retailers witness a 0.322 percent increase in sales for a 1 percent increase in inventory. Moreover, the analysis reveals that Wall Street investment analysts' forecasts fail to incorporate sufficiently the effect of inventory and price changes on sales and earnings. We find that analysts, when forecasting sales, overestimate sales for retailers whose past inventory has been inflated and prices have been lowered. On average, the analysts' bias amounts to roughly 5 percent of sales. A similar pattern applies to earnings as well. Analysts overestimate future earnings for retailers whose inventories were inflated in previous years, while they underestimate future earnings for retailers whose inventory was low in previous years.

[2]Nardelli had worked at General Electric (GE) before taking over as CEO of The Home Depot.

[3]A periodic report where Berman discusses his thoughts on retail, focusing on inventories.

[4]Raman, Gaur, and Kesavan, “David Berman.”

[5]Ibid.

[6]Saravanan Kesavan, Vishal Gaur, and Ananth Raman, “Incorporating Price and Inventory Endogeneity in Firm-Level Sales Forecasting” (working paper, Harvard Business School, Boston, 2009).

How—in Practice—Do Inventory Levels Affect a Retailer’s Valuation?

How closely are inventory levels tracked in analyst reports? If you work for a publicly traded retailer, you know that analysts often ignore inventory. Page through their reports, and you’ll seldom see the word mentioned—unless a company has landed in trouble.

A scan of roughly seventy-five analyst reports for electronics retailer Best Buy, for example, shows that the words *inventory* or *inventories* were mentioned at a rate of 0.15 times per page. In contrast, *sale* , *sales* , and *revenue* were mentioned at a rate of 1.83 times per page (or roughly twelve times as often). Inventory gets a little more attention at retailers that are prone to markdowns and discounts, particularly specialty apparel retailers and department stores with substantial apparel and footwear sales. When examining outfits like Abercrombie & Fitch, analysts will use informal techniques such as store visits to get a sense of the likelihood of future markdowns. One report on the firm, for example, mentioned “a few back tables and racks of clearance tees and tops marked down at 20–40 percent.”

But when a company stumbles, inventory springs to the front of analysts’ minds, leapfrogging from ignored to obsessed over, without ever passing carefully observed. Witness Jos. A. Bank, a men’s clothier. In 2004 and 2005, its inventory turns steadily dropped even as sales and gross margin increased; in other words, inventory was growing faster than sales. Soon, the company’s inventory level—at roughly 350 days—was roughly double that of competitors like Men’s Wearhouse. Then on June 7, 2006—after close of stock market trading—the company announced earnings that fell far short of Wall Street’s expectations of $0.46 a share. Sales had risen 18 percent, but “discounting and rising expenses clipped margins,” the company said. [7] And despite that discounting, the company’s inventory had continued to swell.

Suddenly, analysts began to scrutinize Jos. A. Bank’s inventory levels. A typical report, this one issued on September 8, 2006, read as follows: “On the positive side . . . [i]nventory increased only 12 percent year over year, well below the 20.8% sales growth. This is a significant reduction over 1Q06 inventory growth of 27%, and 38% inventory growth at the end of 4Q05.” Qualitative observations often accompanied the quantitative analysis. “The company carries a higher level of inventory than many of [its] competitors,” one analyst wrote. “Because the company has a lower level of fashion risk, in that most of the product offering is very classically styled and has a longer shelf life, we expect [it] to carry more inventory than other more fashion sensitive retailers. We also note that the company is building inventory in preparation of new store openings.”

An analysis of roughly two hundred analyst reports, from mid-2005 through December 2007, for Bank reveals that *inventory* or *inventories* were now mentioned at the rate of 0.55 times per page, while *sale* , *sales* , or *revenues* were mentioned 2.28 times per page (or roughly 4 times as often). Meanwhile, when assessing Men’s Wearhouse, analyst reports mentioned these terms far fewer times, in fact *inventory* and *inventories* were mentioned roughly 0.24 times per page.

[7] “No Mood For Shopping—Part II,” *Barron’s*, June 12, 2006.

Inventory Turns: A Commonly Used Benchmark for Evaluating a Retailer’s Inventory Level

How can we assess whether a firm has too much or too little inventory? How should we compare inventory levels across “similar” retailers? Across “dissimilar” retailers? For a single retailer over time?

As a retailer, you might carry inventory for many different reasons. Maybe you’re trying to leverage scale economies in purchasing and transportation or buffering against demand and supply uncertainty. Or perhaps you’re trying to stimulate demand through “display inventory.” Regardless of the reason, you’re aware of the challenge you face—you’re trying to balance on the razor’s edge between too little and too much. Err on one side, and you risk bankruptcy. Err on the other, and you miss out on sales and potentially lose customers to your competitors.

But despite the centrality of inventory to your or any retailer’s operations, you’d think that analysts who follow the sector would’ve developed sophisticated models that pinpoint exactly how much inventory a retailer should have. In reality, they

have a notoriously difficult time determining whether a retailer has the "right" amount of inventory. To make this judgment, they need to know not only the retailer's inventory level but also its service level (that is, the level of product availability that it aims for). [8] Higher service levels usually require more inventory. If service level could be observed externally, an analyst could get a sense for whether a retailer was using its additional inventory to offer better availability to consumers or whether it was simply covering up for inefficiency. What if, for example, a substantial portion of the inventory on a retailer's balance sheet were obsolete? This portion would not enhance the service level. What's more, service level isn't reported in public financial statements (and only rarely tracked even internally). In other words, the analyst cannot see the *mix* of inventory at the retailer and thus cannot identify whether the retailer is on or below the "inventory-service frontier."

In an attempt to sidestep these problems, analysts and even retail executives often use *inventory turns* as shorthand for the appropriate level of inventory at a retailer. [9] That's unfortunate because this metric, while useful, has shortcomings. Turns, after all, can vary substantially from one retail segment to the next. They can vary across similar firms and even over time for a single retailer. Supermarket chains like Kroger Company, for example, achieve roughly fourteen inventory turns per year, while apparel sellers like Gap (NYSE: GPS) achieve only around seven. Comparing turns for these companies makes little sense given the considerable differences in their business models.

Likewise, retailers within the same segment can show substantial differences in turns. Electronics retailer RadioShack turns its inventory less than thrice per year, while Best Buy manages more than seven turns a year. Best Buy's closest competitor, Circuit City, achieved just above five inventory turns per year (when it was a healthy retailer).

Finally, inventory turns can vary substantially for a single retailer over time. From 1985 through 2000, Gap's annual inventory turns varied between 3.6 and 6.3, Best Buy's bounced between 3.8 and 9.1, and Wal-Mart's zigzagged between 4.9 and 7.2.

What explains all of this variation in inventory turns? Is the variation in turns correlated with other variables such as gross margin or investment in noninventory assets that can be obtained from public financial data? If we could identify these variables, could we derive an alternate metric for inventory productivity that "controlled" for the variation?

[8]See Richard Lai, "Inventory Signals" (doctoral candidate research paper, Harvard Business School, 2006.

[9]Inventory turns are calculated by dividing the retailer's annual cost of sales by the average level of inventory at a firm. The calculation for an analogous term, *days of inventory* , is similar; to derive days of inventory, the firm's average inventory level is multiplied by 365 (i.e., the number of days in a year) and then divided by the cost of sales. Some practitioners, including David Berman, have argued to us that days of inventory is more intuitive and hence, more easily accessible to people. We agree but continued using inventory turns because a number of our technical results (e.g., the regression analysis reported later in the chapter) were easier to explain using inventory turns.

Explaining the Variation in Inventory Turns

Can we use the large amount of public financial data available for retail firms to quantify the relationship between inventory turns and other metrics? Would the relationship also provide an alternate metric for evaluating inventory productivity? [10]

Adjusted inventory turns —a metric that we developed with Vishal Gaur, one of our former doctoral students and currently a professor at the Johnson School at Cornell University—compensates for the problems with the traditional turns. It better measures inventory productivity by accounting for variation in other variables that affect inventory productivity. [11] To understand why, you have to walk through the logic—and a little bit of math—behind it as well as the factors that influence it.

Let's begin with gross margin. [12] Here, we'll use *markup* , defined as the gross margin divided by cost of sales, instead of the more common form where gross margin is represented as a percentage of sales. As a rule, a retailer should carry more inventory when its markup is higher. That way, it can cover unforeseen surges in demand; a higher markup implies greater costs associated with sales lost due to insufficient inventory. [13] In other words, we would expect gross margin (or markup) and inventory turns to be negatively correlated—that is, when markup rises, turns fall.

Retailers with high markups are termed *earns retailers* and often have low inventory turns. In 2005, for example, RadioShack Corporation had markup of roughly 84 percent (or gross margins of roughly 46 percent of sales) and 2.8 inventory turns a year. In contrast, those with low markups and high inventory turns, such as Costco Wholesale Corporation, are termed *turns retailers* . For the year ending September 3, 2006, Costco had markup of roughly 14 percent (or gross margins of 12.5 percent) and 11.5 inventory turns a year.

Capital intensity —the amount of noninventory investment that a company makes—operates in the opposite way: the more a company invests in noninventory assets, such as warehouses and information technology, the higher its turns should be. And firms often justify investments in information technology based on the technology's ability to enable faster inventory turns. To really understand the influence of capital intensity on turns, you need a precise picture of a retailer's various investments. Unfortunately, these investments are almost never broken out in a retailer's public financial statements. We'll therefore use an alternate measure of capital intensity, the fraction of a retailer's total assets that is represented by its noninventory assets, for the purposes of our calculations. [14]

A third driver of inventory turns is *sales surprise* , which is the ratio of actual sales to sales forecast in a particular year. [15] If sales are higher than had been forecast previously, sales surprise would be greater than 1. All else remaining equal, a retailer would see higher inventory turns when sales surprise is higher.

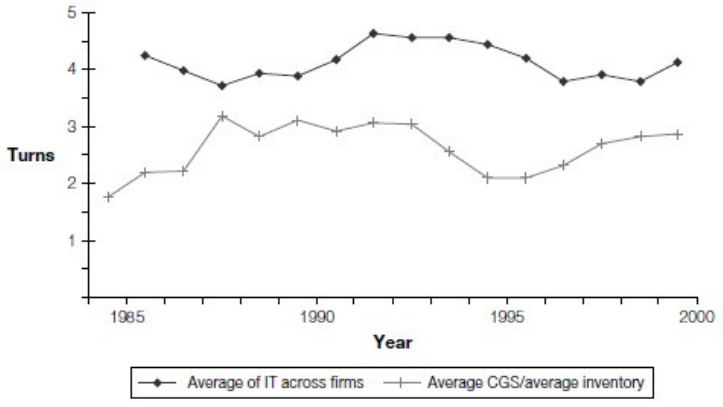
Analyzing the Data to Quantify the Relationships

Public financial data provides us with a context in which to try to quantify the relationship between these three factors and inventory turns. To do our calculations, we collected data for all public retailers in the United States for the years 1985 through 2000. (Details of the data set and the analysis can be found in Vishal Gaur, Marshall Fisher, and Ananth Raman's "An Econometric Analysis of Inventory Turnover Performance in Retail Services.")

Before we explain what we found, let's take a moment to consider why an old-fashioned analysis of the relationship between our three variables and turns could mislead.

Consider figure 1-1, which shows the time trends in average inventory turns for public retailers for the period of our analysis. For it, we've calculated average inventory turns in two ways: (1) the higher line shows the average inventory turns for all retailers, while (2) the lower one shows average cost of goods sold divided by average inventory level for all retailers. According to either one, you'd conclude that there are no time trends in inventory turns for these retailers during this period. And if you did, you'd be dead wrong.

A simple example shows why this kind of analysis misleads. [16] Consider two firms whose inventory turns vary over time, as shown in figure 1-2. Clearly, they're demonstrating downward sloping trends over time. Yet taking a simple average of the two firms' inventory turns would yield the line in figure 1-3, which shows small fluctuations up and down but no change in inventory over the 10 years (notice that the inventory turns in years 1 and 10 are roughly the same). In other words, the changing mix of firms makes it hard to gauge true inventory progress.



- Data: 311 firms in 10 retail segments for the years 1985–2000.
- Two ways to compute aggregate inventory turnover: (1) as the average of inventory turns (IT) across all firms in that year; or (2) as the average of cost of goods sold (CGS) across all firms in that year divided by the average of inventory across all firms in that year.

FIGURE 1-1: Retail inventory turn data suggests no increase in turns from 1985 to 2000

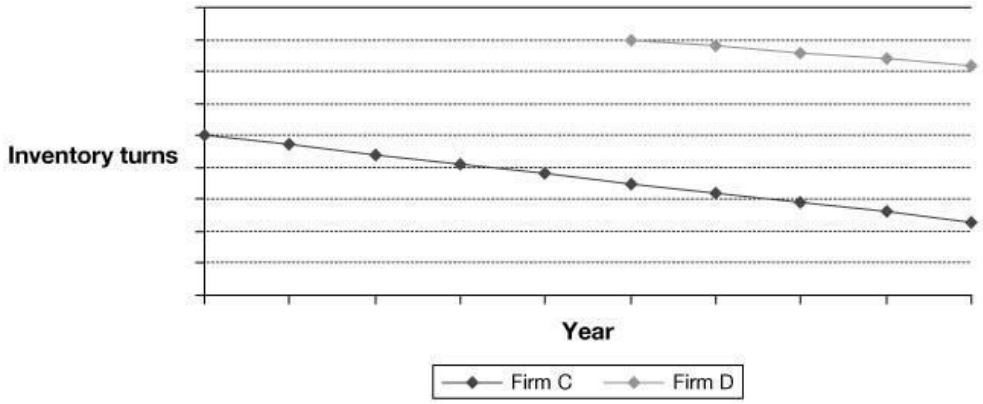


FIGURE 1-2: Firm C's and firm D's inventory levels are decreasing over time

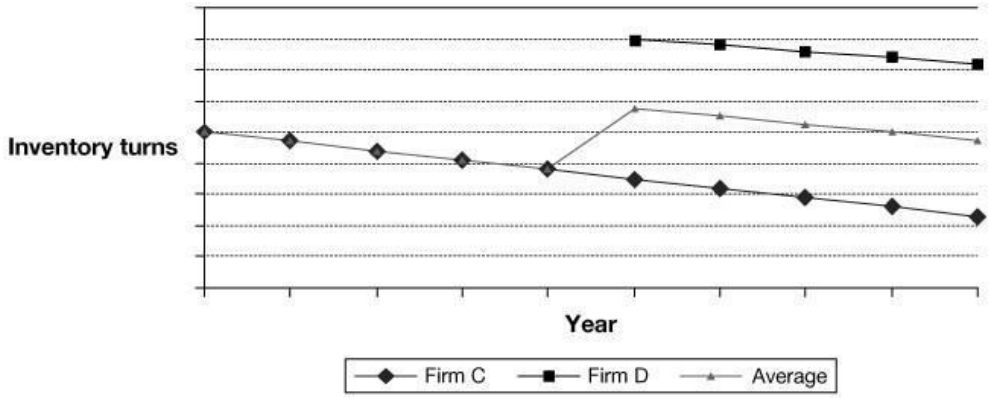


FIGURE 1-3: But average inventory for the two firms shows no decrease over time

To address this problem, our analysis does not draw conclusions based on the performance difference across firms. Stated a tad technically, we allow for a firm "fixed effect" and draw conclusions on the relationships between inventory turns and other variables, such as gross margins based on intrafirm variation in inventory turns. In other words, we fit separate lines for firms C and D but require the two firms to have the same slope.

Findings from the Data

Get ready, because this is where the math gets a little tougher. We'll use what's called a *pooled model* (that ignores the differences among various retailing segments) to compensate for the problems outlined above. If the computation looks a little scary, the conclusions aren't. So bear with us.

According to the pooled model:

$$\log IT_{it} = F_i + c_t - 0.2431 \log MU_{it} + 0.2502 \log CI_{it} + 0.143 \log SS_{it} + e_{it}$$

where,

IT_{it}	= inventory turnover for firm *i* in year *t*
MU_{it}	= markup for firm *i* in year *t*
SS_{it}	= sales surprise for firm *i* in year *t*
e_{it}	= residual in the equation for firm *i* in year *t*
log	= of a quantity denotes the logarithm to the base 10 for the appropriate quantity
F_i	= fixed effect for firm *i*
c_t	= fixed effect for year *t*

In words, the logarithm of inventory turns for a firm is a function of the markup (MU), capital intensity (CI), and sales surprise (SS) in a particular year. In this equation, a 10 percent increase in markup would translate into a 2.3 percent reduction in inventory turns, a 10 percent increase in capital intensity translates into a 2.4 percent increase in inventory turns, and a 10 percent increase in sales surprise translates to a 1.4 percent increase in inventory turns. This equation explains 67 percent of the variation in inventory turns *within* a firm, and *98 percent of the entire variation* in the data set.

Managerial Implications from the Analysis: Time Trends and Benchmarks

During the period of 1985 through 2000, inventory turns and markup declined quite clearly, while capital intensity increased. But a more interesting trend—at least in our minds—is the pattern observed in c_t, which is a year fixed effect. It shows changes in inventory turns after controlling for variation in markup, capital intensity, sales surprise, and firm differences (as measured by the firm fixed effect F_i). Thus c_t can be viewed as a metric of "average" inventory productivity for a given year. Figure 1-4 shows the trend over time. Notice that c_t has declined almost steadily, suggesting that inventory productivity has declined over time. This decline does not necessarily imply that retailers' ability to manage inventory has fallen. Other factors—such as a more competitive retail environment or changes in consumer taste—can affect inventory productivity as well. We aren't sure what caused the steady decline in inventory productivity during this period.

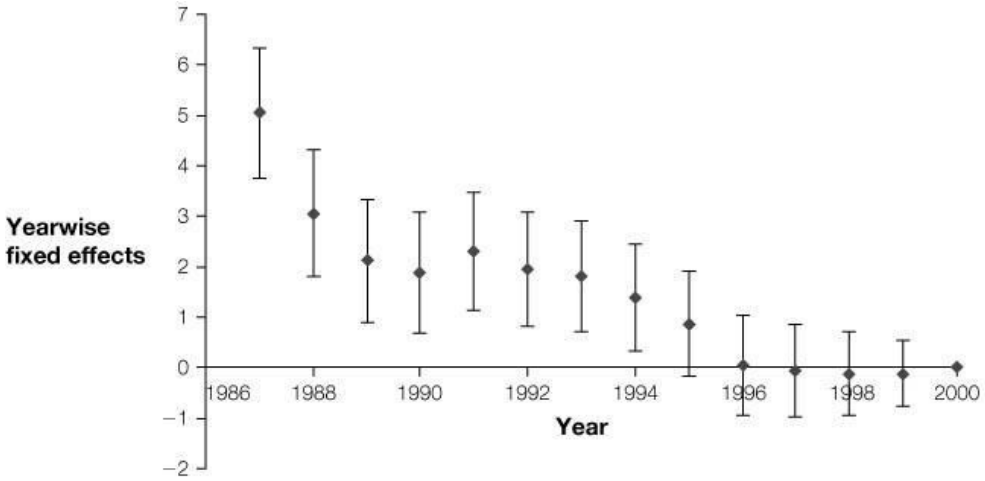


FIGURE 1-4: Time trend in inventory productivity estimated from yearwise fixed effects

Regardless, controlling for variation in markup, capital intensity, and sales surprise yields our benchmark for inventory productivity— adjusted inventory turns. Inventory turns and adjusted inventory turns can offer divergent insights. Consider the example of Ruddick Corporation. Ruddick owns and operates Harris Teeter, a chain of supermarkets in seven southeastern states, and also manufactures and distributes thread and technical textiles. Note in figure 1-5 that Ruddick's inventory turns showed a very small decrease from 1985 through 2000 even as capital intensity rose. But notice, too, that markup was rising concurrently; consequently, adjusted inventory turns were rising during this period. While we have not studied Ruddick in great detail, our understanding is that Ruddick developed a strong private label program during this period. This program required Ruddick to carry a little more inventory but afforded the company greater markups.

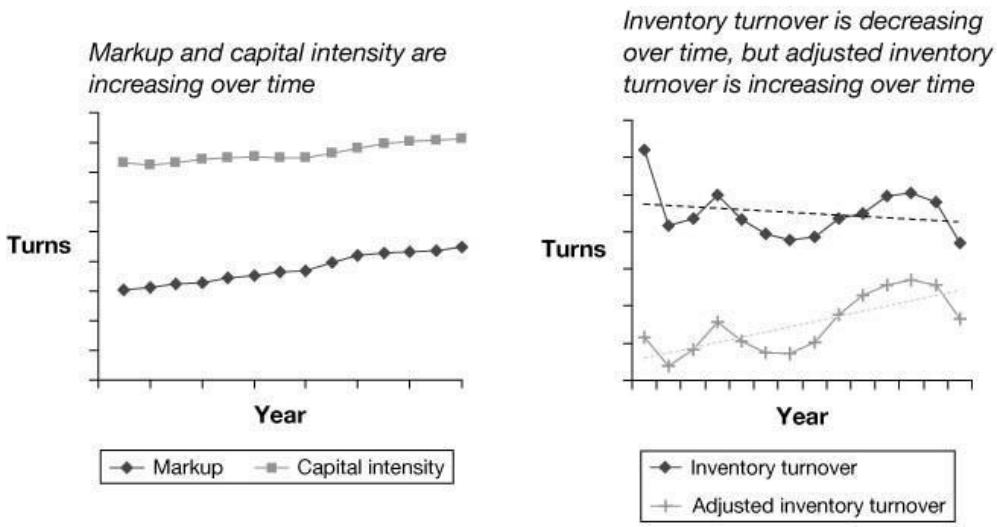


FIGURE 1-5: Comparison across years within a firm: Ruddick Corporation

[10]A detailed discussion of the results in this section can be found in Vishal Gaur, Marshall Fisher, and Ananth Raman, "An Econometric Analysis of Inventory Turnover Performance in Retail Services," *Management Science* 51, no. 2 (2005): 181–194.

[11]Using the pooled model, adjusted inventory turns can be calculated from the following equation: log (adjusted inventory turns) $_{it}$ = log(IT) it + 0.2431 log MU $_{it}$ – 0.2502 log CI it – 0.143 log SS it .

[12]Gross margin is calculated as the difference between the sale price and the cost of goods sold, divided by the sale price. It is usually expressed as a percentage.

[13]A formal argument for this logic can be found in the *newsboy model* or the *newsvendor model* , which is usually described in most texts on inventory management; e.g., Steven Nahmias, *Production and Operations Analysis* , 5th ed. (Boston: McGraw-Hill Irwin, 2005).

[14]Gaur, Fisher, and Raman, "An Econometric Analysis of Inventory Turnover," calculate capital intensity as the ratio of the *gross fixed assets* (i.e., the noninventory assets) to the total assets at a retailer (which comprises inventory and gross fixed assets).

[15]We conducted our analysis with multiple forecasts based on past sales data.

[16]We were introduced to this example by Vishal Gaur.

Plotting the Future: A Resurgence in the Importance of Inventory Turns

If our computations seem obscure, understand that these are exactly the sorts of analyses that sophisticated investors like David Berman are using. They're dissecting your inventory turns—or those of your publicly traded competitors—even if you're not.

The increasing importance of inventory to retail valuation can be gauged from the conversation one of us had with a Wal-Mart executive recently. He noted that inventory "is now woven into the performance metric at every level of the organization." When pressed to explain the reasons for this, he said, "Our shareholders care more about inventory now than they did in the past." If a supply chain innovator like Wal-Mart is concerned, imagine the scrutiny that less efficient operators might face from shareholders.

On top of this, professional investors like Berman hire people to visit individual stores and collect data on pricing, markdowns, and freshness of inventory. A leading investment house sends a bunch of its staffers to visit about fifty stores every month to assess inventory and discount levels for a comparable basket of products at each store.

Finally, academics are developing tools like adjusted inventory turns that will help investors extract information from public financial data. Two streams of work seem especially promising to us.

In one study, Gaur validated adjusted inventory turns (AIT) by comparing the performance of a portfolio of stocks compiled using AIT with one compiled using plain-old inventory turns (IT). [17] Gaur ranked retailers by AIT and IT and then created the portfolios by investing in the top-ranked retailers and selling short the bottom-ranked ones. He updated the ranks and portfolios each year and evaluated the portfolios' performance after a number of years. The AIT-based portfolio easily beat the market, while the IT-based portfolio did not.

A caveat applies to these results: Gaur did not validate AIT-based portfolios as an investment strategy to achieve above-market returns. As is typical in research, he assumed that accurate financial data was available immediately after the end of each year in commercial databases like Compustat. That assumption is generally not valid in the real world. Before investment managers can roll out strategies based on AIT (or IT), they'll have to develop ways to quickly collect the necessary information from earnings announcements and corporate filings. As the situation stands today, it can be weeks and even months before the data appears in a user-friendly form in databases such as Compustat. Creating such processes can be challenging and expensive; the studies so far have not factored in those costs.

A second stream of academic work links retail sales to the return on aggregate indexes, such as the S&P 500 index, and identifies segments where the wealth effect is most pronounced. [18] We use the term *wealth effect* to describe the phenomenon in economics that has studied the effect of income and wealth on consumption. Not surprisingly, perhaps, scholars have found that consumption increases or decreases with wealth—the recent paper identifies segments that are more substantially affected by this phenomenon. For example, sales of "discretionary items" (such as TVs) seem more susceptible to the wealth effect than nondiscretionary items like food. Moreover, within each segment, sales of high-margin retailers are more susceptible to the wealth effect. The study identifies implications for forecasting and finds that forecast quality can be improved by combining sales forecasts from experts with information from broader market indexes.

[17] Vishal Gaur, presentation at the Consortium for Operational Excellence in Retailing, Philadelphia, PA, Wharton School, University of Pennsylvania, June 2006.

[18] Vishal Gaur, Nikolay Osadchiy, and Sridhar Seshadri, "Sales Forecasting with Financial Indicators and Experts' Input," Johnson School Research Paper Series No. 06-09, October 23, 2008.

Implications Going Forward for Retail Managers

Investors—led by a new breed of fund managers—are paying very careful attention to retailers' inventory levels. And as in many other fields of business, greater data availability and superior technology have enabled investors to glean deeper insights about firms' management capabilities.

Should you, as a retail manager, change your practices in the face of investors' closer scrutiny? Absolutely. To fail to do so would be foolish. We suggest three steps.

1. Watch your inventory numbers carefully, and if you're publicly traded, be aware that eagle-eyed investors are watching them just as closely. That doesn't mean that you should never let your inventory level increase or allow your inventory turns to slow. In fact, as we'll argue throughout this book, retailers often have compelling reasons to carry more inventory. But when that happens, you must offer a compelling explanation to your investors. Ideally, that explanation should come before the increase in inventory does.

2. Many retail executives with whom we have spoken acknowledge that their firms sometimes use inventory and gross margins to manage sales and profit levels. As one of our friends said with knowing smirk, "My firm never does this, but my friends at other companies say they do." Understand that the opportunity to play these sorts of games with inventory is eroding as investors become savvier.

3. Most important, invest substantially in your ability to plan and control your inventory level. For years, retail executives have complained to us that investors do not care about inventory. Those days are gone. Led by investors like Berman, Wall Street is paying ever-closer attention to inventory management. Isn't it time retailers did so, too?