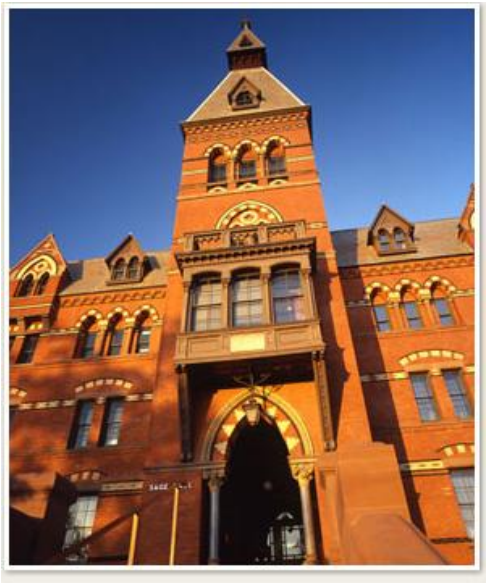
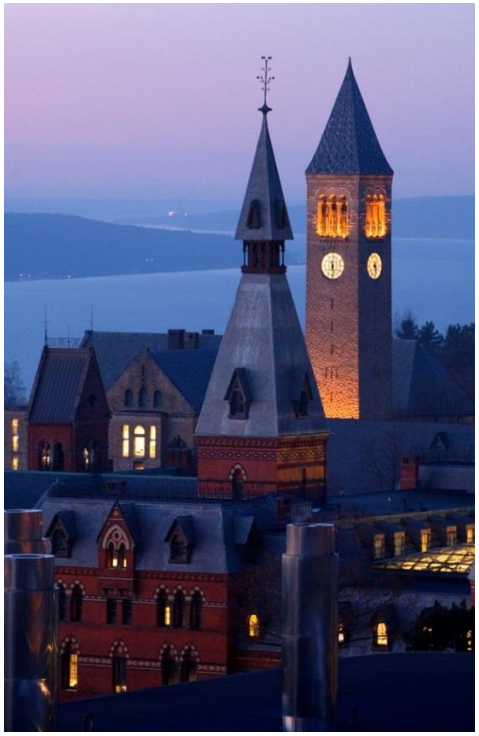
JOHNSON
Cornell University



Retail Inventory

Managing the Canary in the Coalmine



Vishal Gaur, Saravanan Kesavan, Ananth Raman

May 15-16, 2014

for presentation at

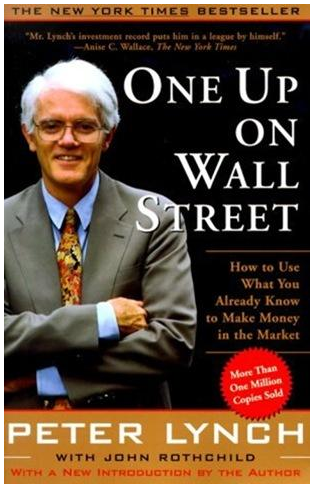
Annual Retail Conference, Koc University

Key takeaways

- Assessment of retail inventories is important for retailers, their investors, and their lenders (and suppliers)
- But is difficult because
  - **inventory turnover** is a coarse metric
  - inventory *hides* information
- A new metric, **Adjusted inventory turnover (AIT)**,
  - to benchmark inventory productivity performance by adjusting inventory turnover for its correlation with **gross margin** and **capital intensity**.
  - can be computed by retailers, investors, as well as lenders.
  - examples showing how and why AIT is useful

Anecdotal Evidence

- "When I research a stock, I always check to see if inventories are piling up… With a manufacturer or a retailer, an inventory buildup is usually a bad sign. When inventories grow faster than sales, it is a red flag." – Peter Lynch*



*** One Up On Wall Street : How To Use What You Already Know To Make Money In The Market, page 215**

Inventory, a widely used metric of inventory productivity, varies widely across firms or even over time.

Thus, performance comparisons based on inventory turnover can be erroneous.

Variation in inventory turnover within retail segments

- Within-firms variation
  - Range of inventory turnover of commonly known firms in 1985-2003:

Amazon.com	
Best Buy Co. Inc.	2.8 – 8.5
Circuit City Stores, Inc.	4.0 – 5.8
The Gap, Inc.	3.6 – 6.3
Radio Shack Corp.	1.1 – 3.1
Wal-Mart Stores, Inc.	4.9 – 7.9

- Across-firms variation
  - Range of inventory turnover of supermarket chains during the year 2000: 4.7 to 19.5.

- Inventory turnover = [Inventory @ cost]/[Cost of goods sold]
  OR [Inventory @ retail]/[Sales]

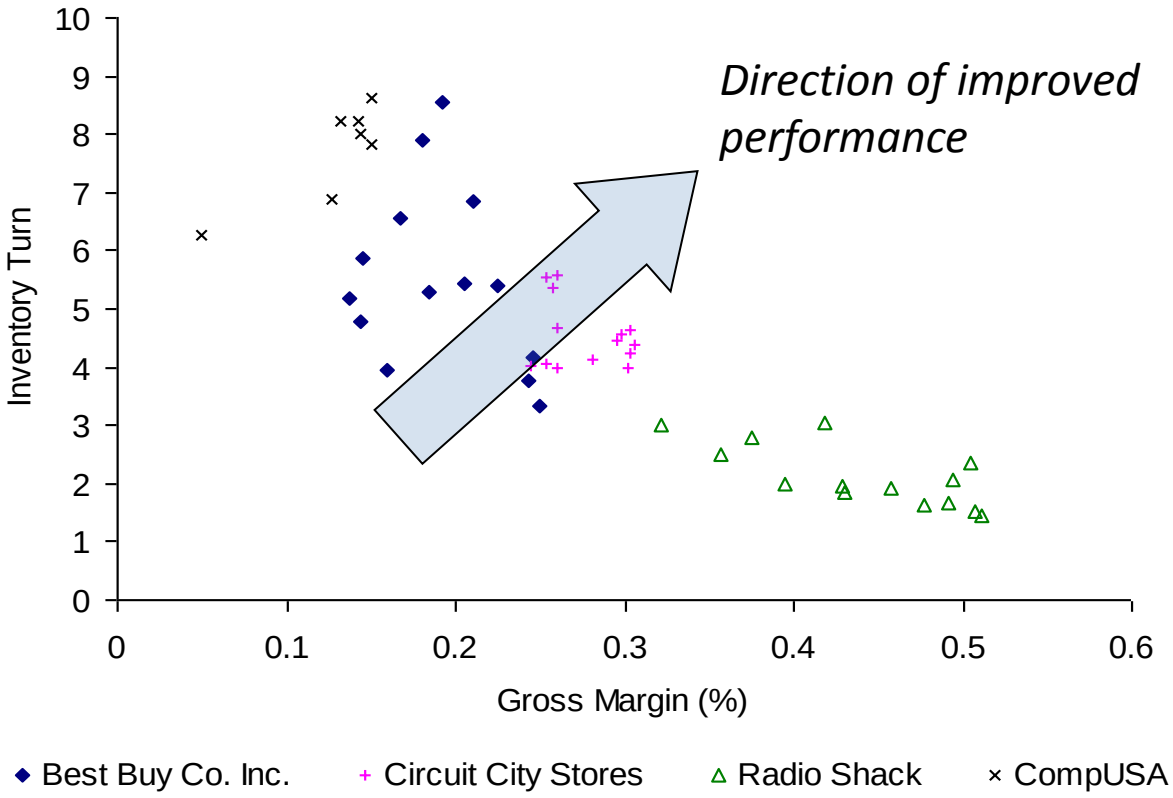
Variation in inventory turnover across retail segments

Retail Industry Segment	Inventory Turnover	Gross Margin
Apparel And Accessory Stores	4.57	37%
Catalog, Mail-Order Houses	8.60	39%
Department Stores	3.87	34%
Drug & Proprietary Stores	5.26	28%
Food Stores	10.78	26%
Hobby, Toy, And Game Shops	2.99	35%
Home Furniture & Equip Stores	5.44	40%
Jewelry Stores	1.68	42%
Radio,TV, Cons Electr Stores	4.10	31%
Variety Stores	4.45	29%

Source: Gaur, Fisher and Raman (2005) "An econometric analysis of inventory productivity in US retail services," *Management Science*.

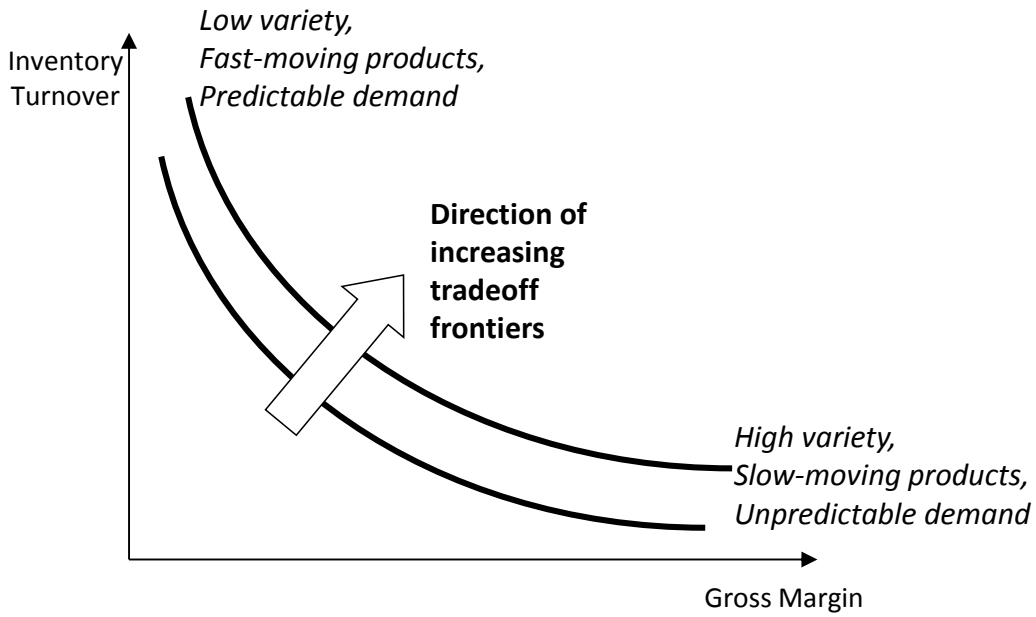
One reason why inventory turnover varies across firms and years: tradeoff with gross margin

Example: Annual Inventory Turnover versus Gross Margin for four Consumer Electronics Retailers for 1987-2000

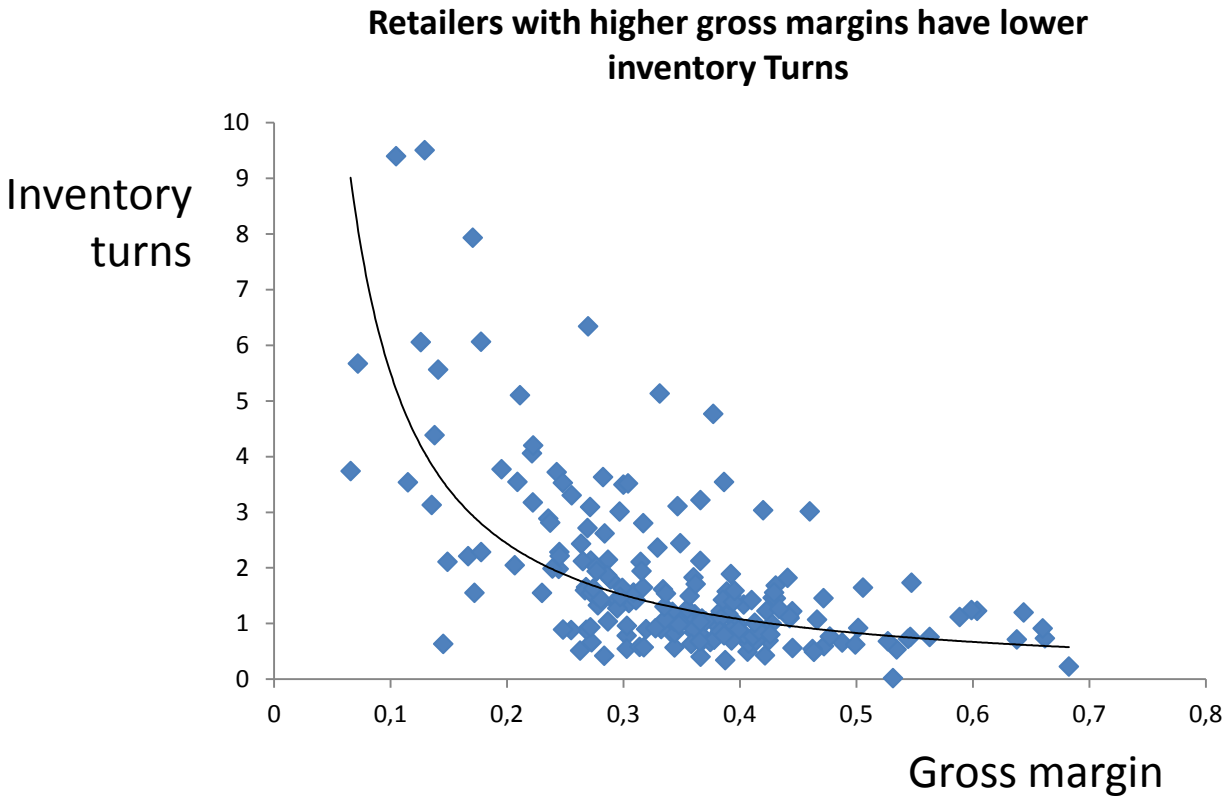


Source: Gaur, Fisher and Raman (2005) "An econometric analysis of inventory productivity in US retail services," *Management Science*.

Tradeoff between inventory turnover and gross margin (earns versus turns tradeoff)



Data for U.S. public retailers shows this tradeoff between inventory turns and gross margin



Adjusted inventory turnover – a superior metric for benchmarking inventory productivity

A statistical method for benchmarking inventory turnover

Description of Data and Variables

- Data:
  - Annual data for all public U.S. retailers since 1985.
  - Retailers are subdivided into ten segments based on type of business.
- Variables (s=segment, i=firm, t=year):
  - Inventory Turnover $$IT_{sit} = \frac{\text{Cost of Goods Sold}_{sit}}{\text{Average Inventory}_{sit}}$$
  - Gross Margin $$GM_{sit} = \frac{\text{Sales}_{sit} - \text{Cost of Goods Sold}_{sit}}{\text{Cost of Goods Sold}_{sit}}$$
  - Capital Intensity $$CI_{sit} = \frac{\text{Avg Gross Fixed Assets}_{sit}}{\text{Avg Inventory}_{sit} + \text{Avg Gross Fixed Assets}_{sit}}$$
  - Sales Surprise $$SS_{sit} = \frac{\text{Sales}_{sit}}{\text{Sales Forecast}_{sit}}$$

A panel data regression model to benchmark performance

Differences across firms

Differences across years

Effect of Gross Margin

Effect of Capital Intensity

Effect of Sales Surpise

$$\log IT_{sit} = F_i + c_t + b_1 \log GM_{sit} + b_2 \log CI_{sit} + b_3 \log SS_{sit} + e_{sit}$$

Error term

- We use a panel of data spanning many retailers across segments and many years
  - "*s*" denotes SIC segment that a retailer belongs to.
  - "*i*" denotes the index of each retailer.
  - "*t*" denotes year
- F_i and c_t are called FIXED EFFECTS. They are necessary to control for unobserved differences across companies.

Definition of Adjusted Inventory Turns (AIT)

- **AIT** is a metric to benchmark inventory productivity by adjusting inventory turnover for its correlation with gross margin and capital intensity.

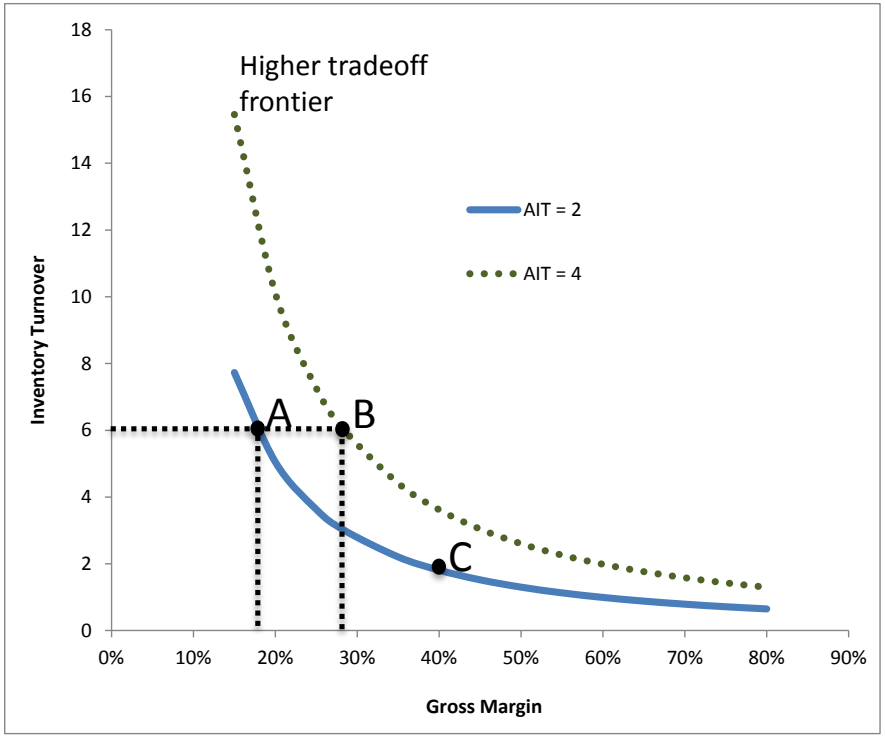
$$AIT = IT \times (GM)^{1.48} \times (CI)^{-1.05}$$

  - **IT**: Inventory turnover, **GM**: Gross margin, **CI**: Capital intensity.
  - The coefficients **1.48** and **-1.05** obtained by doing a regression on historical data.

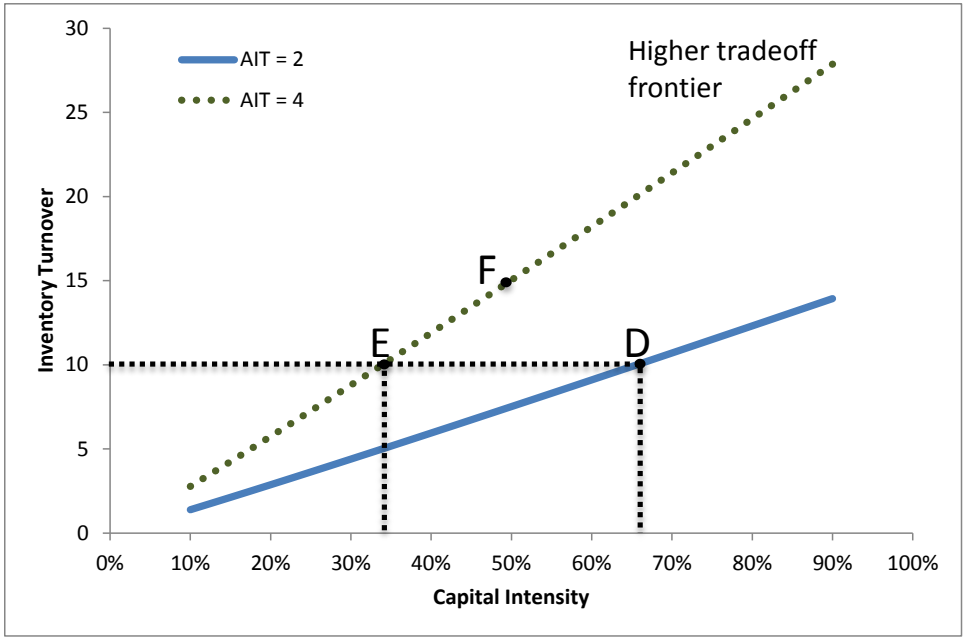
Adjusted Inventory Turns

Scenario	Inventory Turnover	Gross Margin	Capital Intensity	Adjusted Inventory Turnover
	IT	GM	CI	AIT
A	2	25%	50%	6.3
B	2	45%	50%	10.0
C	2	25%	80%	3.9
D	4	25%	50%	12.7

Tradeoff frontiers between Inventory Turns and Gross Margin for two values of Adjusted Inventory Turns, AIT = 2 and 4. The value of capital intensity is fixed at 25% for each frontier

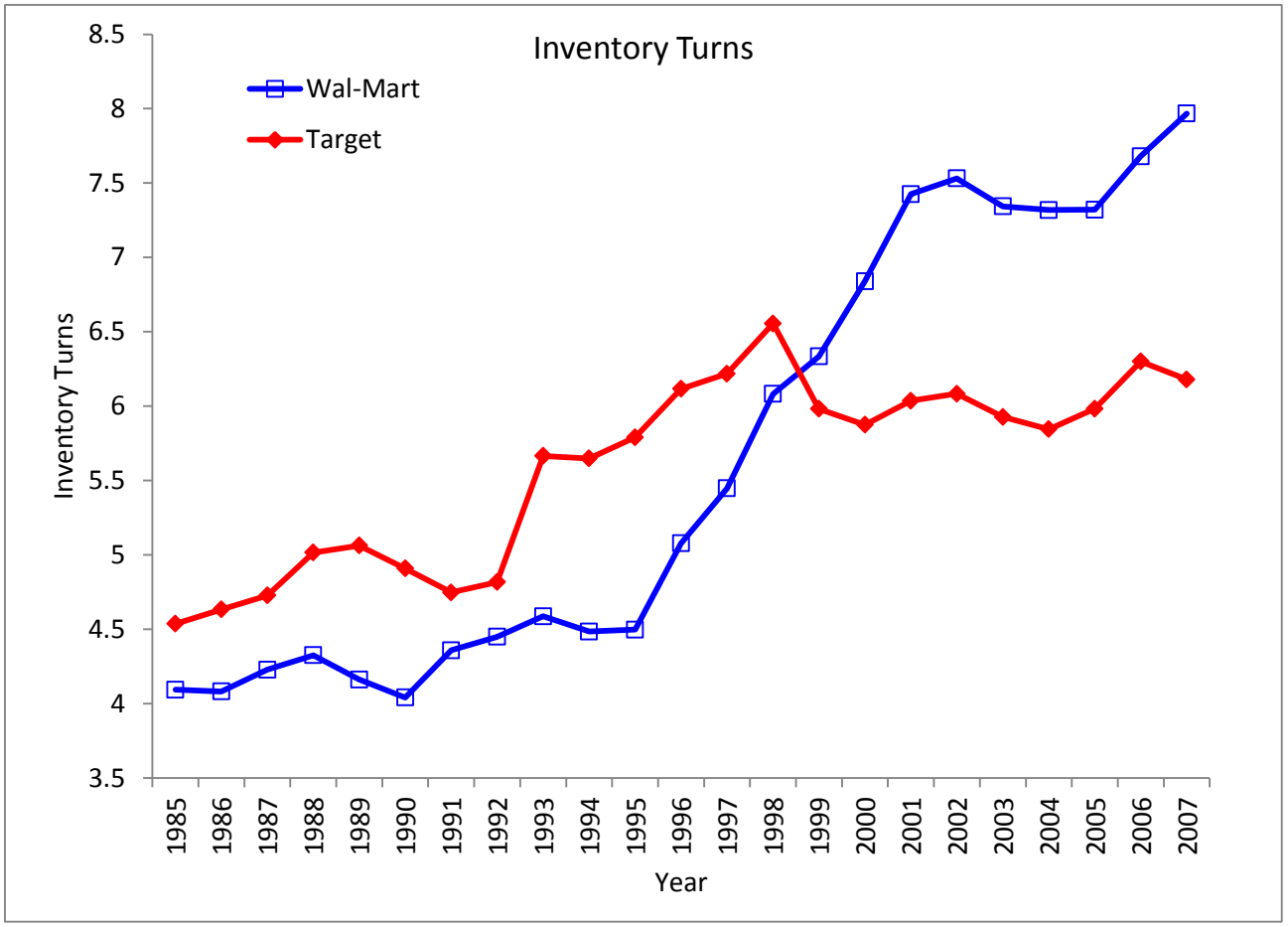


Tradeoff frontiers between Inventory Turns and Capital Intensity for two values of Adjusted Inventory Turns, AIT = 2 and 4. The value of gross margin is fixed at 25% for each frontier.

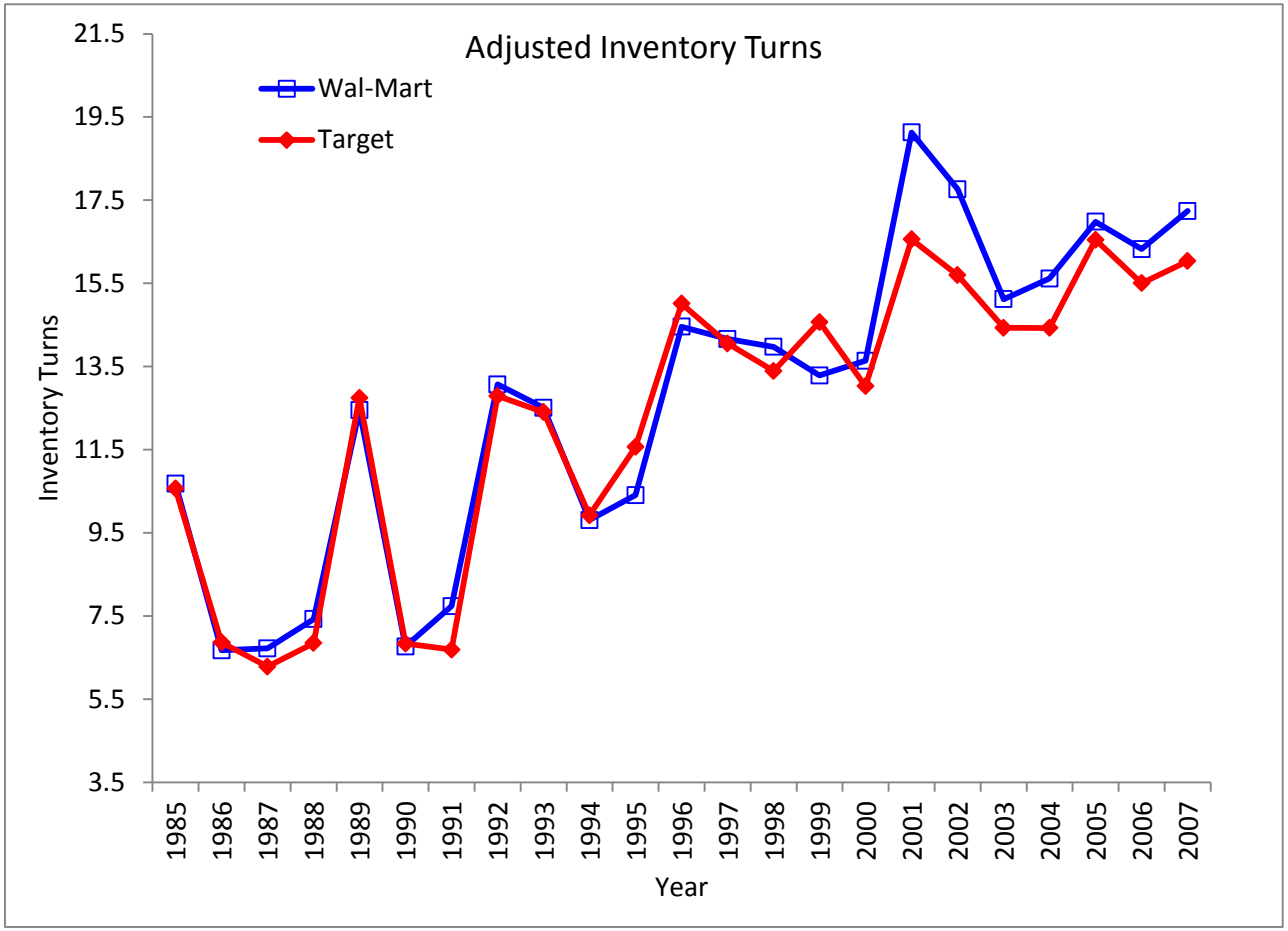


Examples of Adjusted Inventory Turns

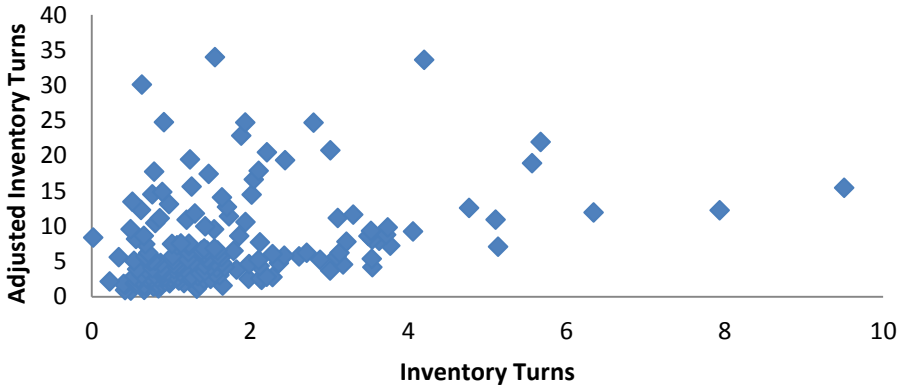
Inventory Turns for Wal-Mart and Target, 1985-2007



Adjusted Inventory Turns for Wal-Mart and Target, 1985-2007

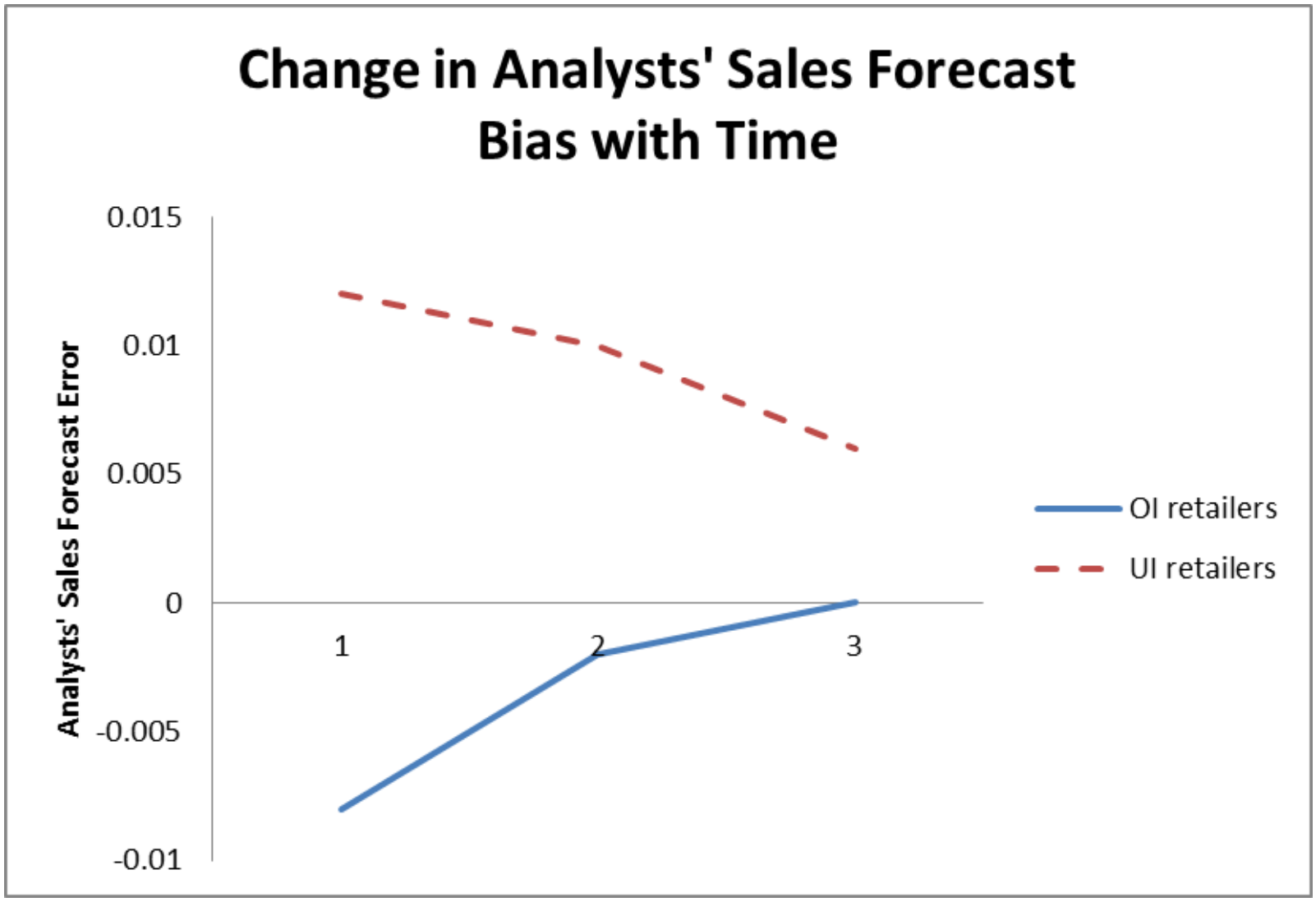


Retailers with same inventory turns could vary significantly on AIT

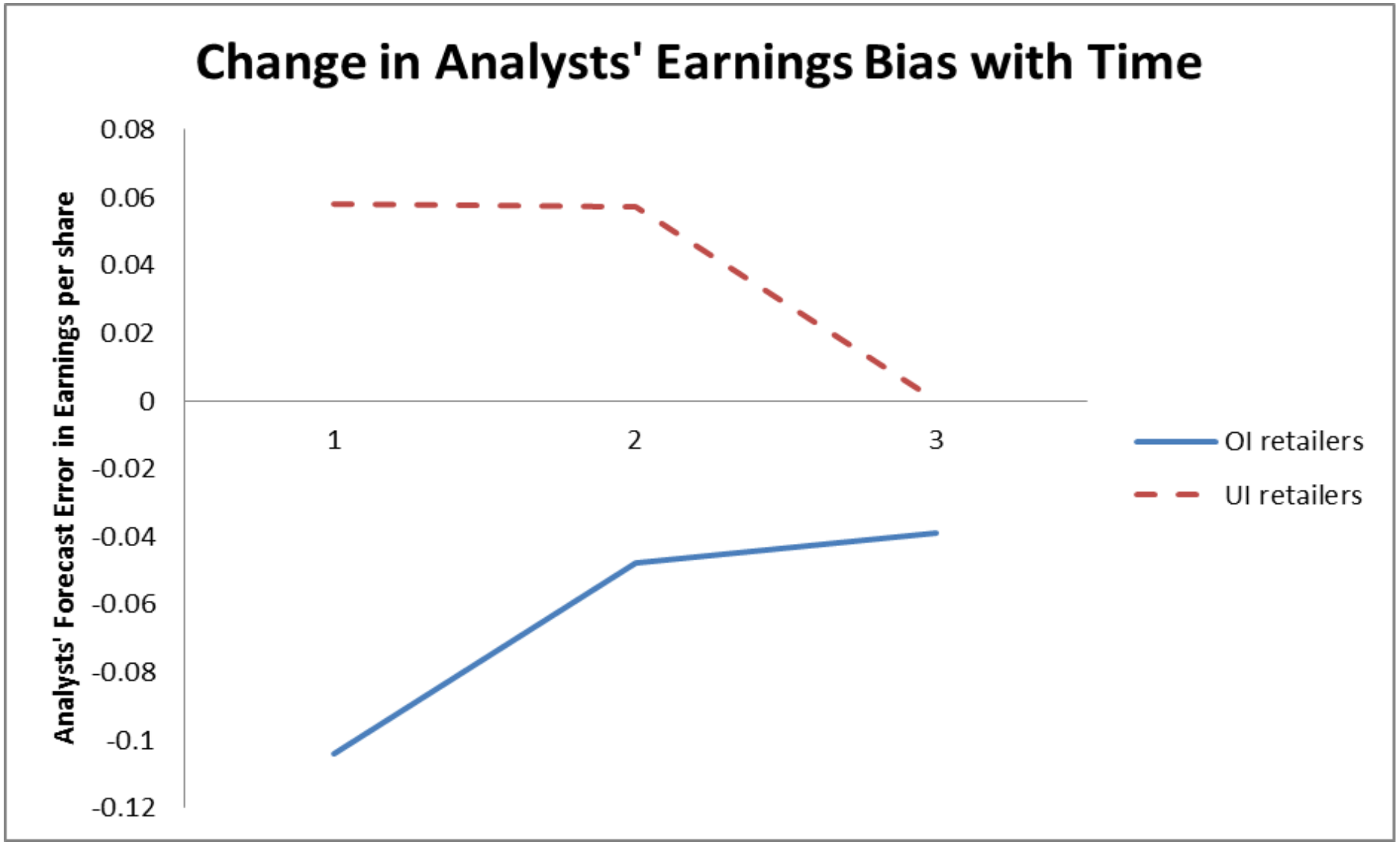


Evidence showing why Adjusted Inventory Turnover works well

i. It can help improve analysts' forecasts of retailers' future sales and earning.
ii. It predicts future stock returns of U.S. retailers.



Time periods 1, 2, and 3 refer, respectively, to 1, 4, and 7 months after the release of previous fiscal year's financial statements. OI and UI refer to over-inventoried and under-inventoried retailers.



Time periods 1, 2, and 3 refer, respectively, to 1, 4, and 7 months after the release of previous fiscal year's financial statements. OI and UI refer to over-inventoried and under-inventoried retailers.

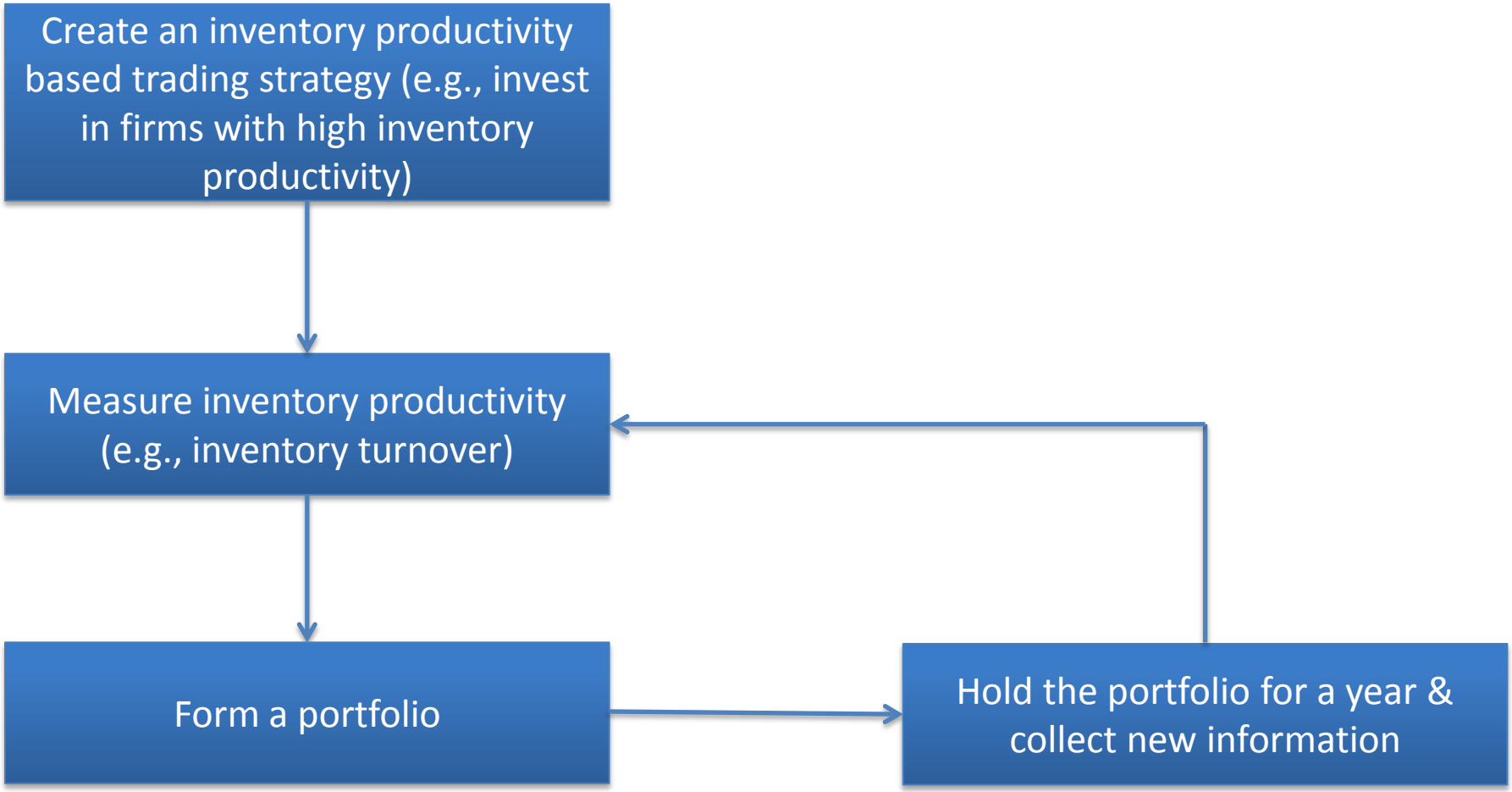
Scenarios illustrating the impact of a delay in inventory writedown on a retailer's gross margin

	Scenario A Unsold inventory is written down in the same year	Scenario B Unsold inventory is carried at cost on the balance sheet
Purchased # of units	10	10
Purchase cost ($)	$10	$10
Units Sold	6	6
Revenue	$12	$12
Unsold Units	4	4
Unsold Units (Value)	$0	$4
Cost of Sales	$10	$6
Gross Margin	$2	$6
Gross Margin (%)	17%	50%

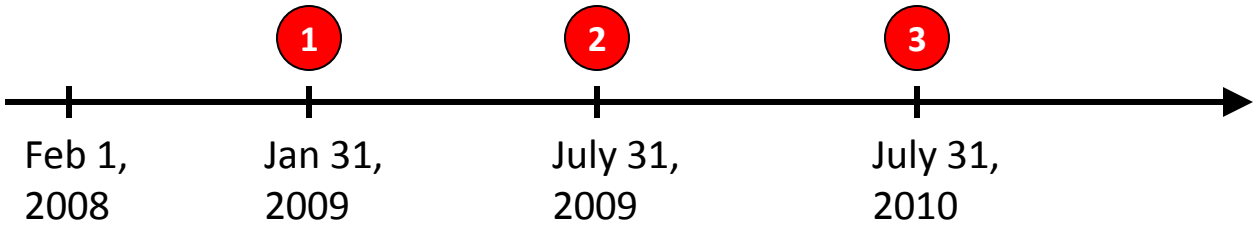
Scenarios illustrating the impact of change in inventory on cash flows

	Year 1 Actual $	Year 2 Projection $	Year 2 Actual $
Sales	100	120	100
Cost-of-goods-sold	50	60	50
Gross Margin	50	60	50
Fixed Expenses	46	46	46
Net income	4	14	4
Ending Inventory	25	30	30
Increase in Inventories	0	5	5
Total Cash Flow from Operating Activities	4	9	-1

Research Methodology



Portfolio Construction



1. Obtain annual financial statements for fiscal year ending between Feb 1, 2008 and Jan 31, 2009. For example, fiscal year 2008 may end on Jan 31, 2009.

   In each retail segment, rank firms by chosen metric and divide into 5 or 10 equal portfolios.

2. Invest $1 in each portfolio on July 31, 2009 equally divided among the firms in the portfolio.

3. Sell holdings on July 31, 2010 and form new portfolios using data available up to Jan 31, 2010.

This method is standard in finance (e.g., Fama & French 1993) with one difference. The norm is to use FYEs up to Dec 31 and form portfolios on June 30. We shift this window by one month because most retailers have their FYE on Jan 31.

Portfolio Construction - 2

- Our portfolio formation methodology is non-parametric.
- It differs from the existing literature (e.g., Chen et al. 2007).
- Eliminates the impact of skewness, which is a serious problem in parametric methods.

Data Description

- Time period: 1983-2010
  - We begin in 1983 because modern OM methods, such as JIT and EDI, were put in use mostly in the 1980s (Factory Physics, Hopp & Spearman).
- Data Source:
  - Annual financial statements: S&P's Compustat database
  - Monthly stock returns: CRSP
  - Fama & French factors: WRDS
- We group firms into five segments based on their inventory characteristics.

Description	SIC Codes	Examples of firms	No. of firms	No. of firm year observations
Department stores, discount stores	5311, 5331, 5399	WalMart, Target, Costco	92	1003
Food stores	5411	Safeway, Whole Foods	81	842
Apparel and accessory stores, shoe stores	5600-5699	Foot Locker, Finish Line	113	1313
Radio, TV, consumer electronics, computer and software	5731, 5734	Best Buy, CompUSA	45	333
Catalog, mail order, and e-retail stores	5961	Amazon.com, Buy.com	118	770
		Total	449	4261

	Portfolio 1 Retailers with lowest AIT	Portfolio 2	Portfolio 3	Portfolio 4	Portfolio 5 Retailers with the highest AIT
Annual average excess return	2.28%	2.88%	10.32%	12.84%	14.88%
Names and stock tickers of apparel and accessories firms in each portfolio in 2010	Syms Corp (SYMSQ) Foot Locker Inc (FL) Casual Male Retail Grp Inc (CMRG) Mens Wearhouse Inc (MW) Finish Line Inc -Cl A (FINL) Shoe Carnival Inc (SCVL) Stage Stores Inc (SSI) Coldwater Creek Inc (CWTR) DSW Inc-Old (DSW.2)	Ascena Retail Group Inc (ASNA) Genesco Inc (GCO) Ross Stores Inc (ROST) DSW Inc (DSW) Stein Mart Inc (SMRT) Delias Inc (DLIA) Bakers Footwear Group Inc (3BKRS) Zumiez Inc (ZUMZ) Citi Trends Inc (CTRN)	Cato Corp -Cl A (CATO) Limited Brands Inc (LTD) TJX Companies Inc (TJX) Destination Maternity Corp (DEST) American Eagle Outfitters Inc (AEO) Collective Brands Inc (PSS) Childrens Place Retail Strs (PLCE) Fredericks Of Hollywood Grp (FOH)	Charming Shoppes Inc (CHRS) Gap Inc (GPS) Nordstrom Inc (JWN) Urban Outfitters Inc (URBN) Talbots Inc (TLB) Hot Topic Inc (HOTT) J Crew Group Inc (JCG) New York & Co Inc (NWY) Lululemon Athletica Inc (LULU)	Cache Inc (CACH) Ann Inc (ANN) Wet Seal Inc (WTSLA) Christopher & Banks Corp (CBK) Buckle Inc (BKE) Pacific Sunwear Calif Inc (PSUN) Chicos Fas Inc (CHS) Abercrombie & Fitch -Cl A (ANF) Aeropostale Inc (ARO)

Performance-attribution regressions

- Asset pricing theory: high non-diversifiable risk ➔ high expected return
- Four-factor model (Carhart 1997) to explain differences in returns

$$R_{pt} = \alpha_p + \beta_{1p} RMRF_t + \beta_{2p} SMB_t + \beta_{3p} HML_t + \beta_{4p} Momentum_t + \varepsilon_{pt}$$

where

R_{pt} = excess return on portfolio p in month t,

$RMRF_t$ = value-weighted market return minus the riskfree rate

SMB_t, HML_t, $Momentum_t$ = month t returns on zero-investment factor-mimicking portfolios to capture size, book-to-market and momentum effects (Fama and French 1993; Jegadeesh and Titman 1993, Carhart 1997)

- α_p = estimated intercept, interpreted as the abnormal return in excess of that achieved by passive investments in the factors.
  - Our hypothesis implies that α_p should increase in the portfolio rank.

Monthly Excess Returns

	Variables used to form portfolios					
Portfolio Rank	IT	ΔIT	AIT	ΔAIT	GMROI	ΔGMROI
1 (Low)	0.41%	0.29%	0.27%	0.40%	0.41%	0.24%
2	0.50%	0.56%	0.72%	0.79%	0.58%	0.77%
3	0.86%	0.96%	0.79%	0.83%	0.80%	0.49%
4	0.99%	1.05%	0.80%	0.78%	0.80%	0.84%
5 (High)	1.22%	0.94%	1.22%	1.10%	1.19%	1.33%

- Table reports average monthly excess returns (in excess of the risk free rate) for quintile portfolios each formed on IT, ΔIT, AIT, ΔAIT , GMROI, and ΔGMROI.
- All the analysis presented here is based on equal weighted returns, i.e., each firm in a portfolio is given equal weight.
- Excess returns increase in the portfolio rank
  - IT#1 return = 0.41% (~5% excess return per year)
  - IT#5 return = 1.22% (~15% excess return per year)

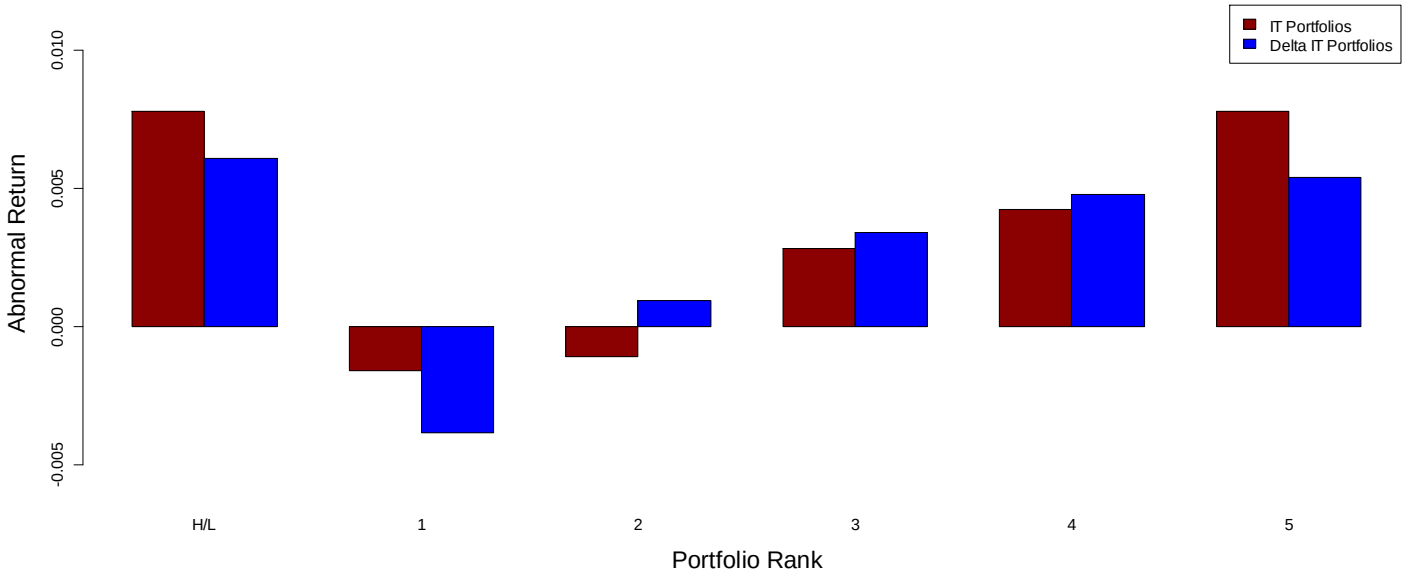
excess return = Return in excess of the risk free rate = $r - r_f$

Abnormal Returns: α values

Abnormal returns on High-Low spread portfolios:

IT = 0.78%

ΔIT = 0.61%



The trend in abnormal returns from Low to High portfolios supports our hypothesis: High inventory productivity ➔ high (abnormal) future stock returns.

The long-short spread portfolio is long on top 40% firms and short on bottom 40% firms on inventory turnover.

Summary

- Assessment of retail inventories is important for retailers, their investors, and their lenders (and suppliers)
- But is difficult because
  - **Inventory turnover** is a coarse metric
  - Inventory hides information
- **Adjusted inventory turnover (AIT)** – a better metric because it adjusts inventory turnover for its correlation with **gross margin** and **capital intensity**.
- AIT can be computed by retailers, investors, as well as lenders.
- Examples show that
  - AIT leads to different inferences than IT
  - AIT is predictive of future sales, earnings, and stock returns.
  - Accrual anomalies and well known common factors *cannot* explain this result. Inventory productivity has its own explanatory power.