Using Secondary Data in Operations Management Research: Overview and Research Opportunities

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January 2016

Why Empirical Research

• Without facts you are just another person with an opinion

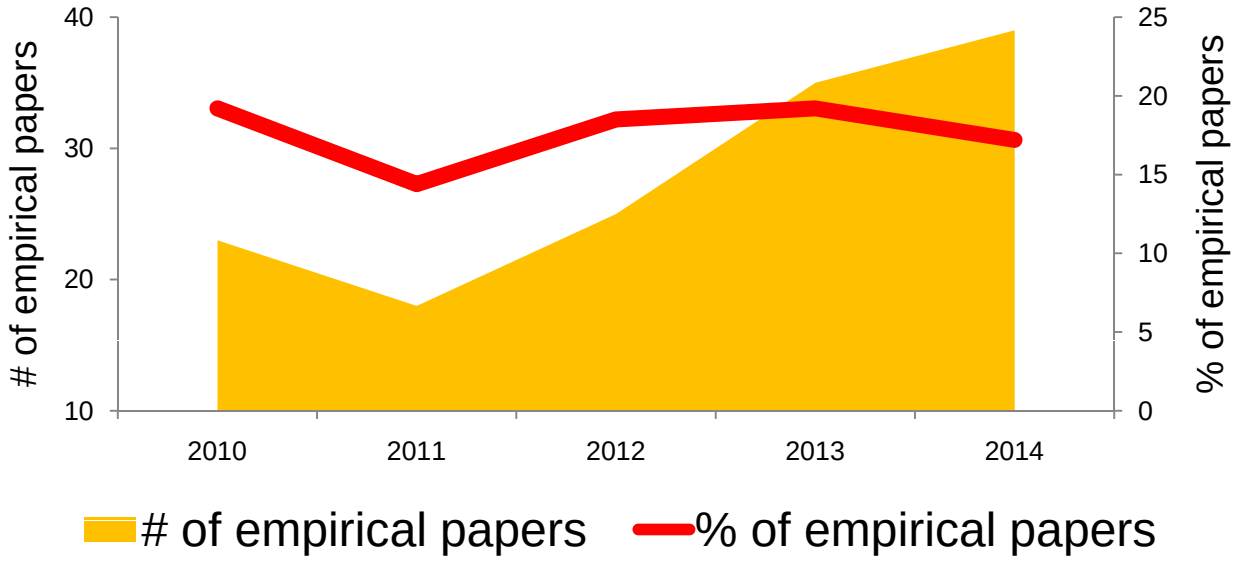
unless

you are at a level of the organization where your opinion becomes fact

• When research is limited or absent, anecdotes prevail

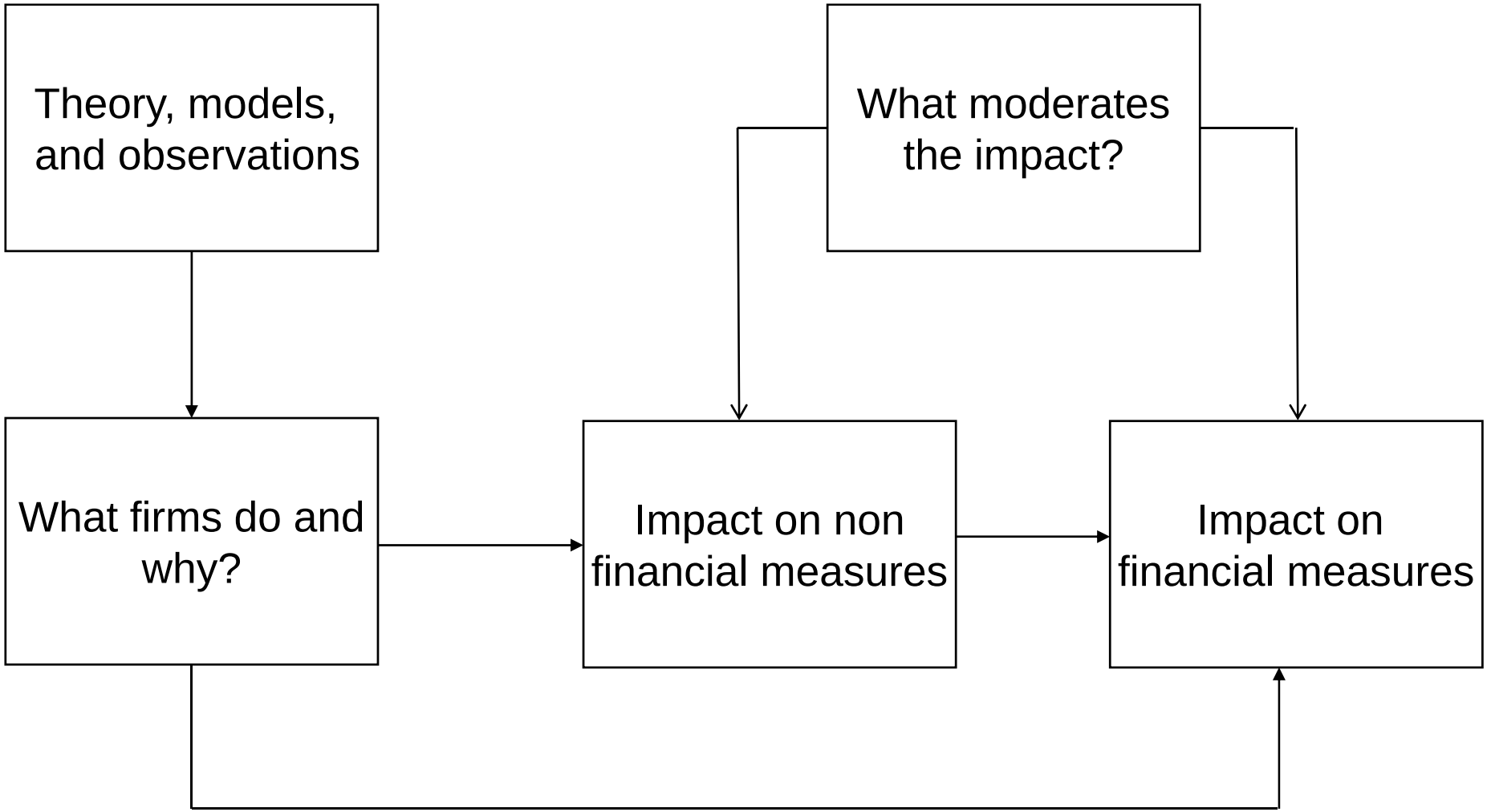
Trend of Empirical OM Research

- ✓ Examine the publications in MS, MSOM, and POM from January 2010 to June 2015
- ✓ 17.2% (157 out of 908) of the publications contain empirical analysis
- ✓ Number of OM papers has increased in the recent years, but the percentage of OM articles include empirical analysis remains largely unchanged



Presentation made by Tech Ho at the INFORMS 2015 conference in Philadelphia

Empirical research framework



Motivation

- Effect of OM practices, decisions, and strategies on performance – non financial, accounting metrics, and stock market based metrics

- How is the effect on performance moderated by different firm characteristics, operating variables, environment variables, etc.

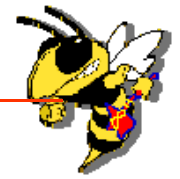
Non-financial measures

- Inventory turnover
- Bull-whip effect
- Product development performance
- Environmental performance
- Responsiveness\flexibility
- Quality performance
- Planning\forecasting accuracy
- Others

Financial measures

- Stock returns
- Stock volatility
- Accounting performance
- Earnings forecast by analysts
- Others

Moderating factors



- Size
- Geographical location
- Competition
- Industry
- Growth potential
- Technology
- Supply chain structure
- Economic and business environment
- Others

Factors to consider in empirical research

- Generalizable
- Replicable
- Objective
- Target journals (JOM, MS, MSOM, and POM)
- Impact on academics
- Impact on practice

Approaches used in empirical research

- Case studies
- Surveys
- Data from firms/industry – high frequency/big data
- Experiments or behavioral research
- Secondary data from CRSP and Compustat

Plan

- Data sources
- Event study methodology
- Creating a sample
- Measurement time period
- Estimating performance effects
- Statistical tests

Data sources

- Public information
  - Announcements and articles
  - Stock price data (CRSP)
  - Accounting data (COMPUSTAT)
  - Analysts opinion
- Company information
- Trade associations and publications
- Government

Data sources: Announcements

- Business publications – use Factiva Database
- Wall Street Journal
- Dow Jones News Service
- Businesswire
- PRNewswire
- Database of Newspapers and Newswires
- Sources of information about Chinese companies

Data sources: Archival

- CRSP – Center for Research in Security Prices
  - stock prices, dividends returns
  - daily monthly, annual since 1925 (WRDS)

- Compustat (WRDS)
  - Database of Annual and Quarterly Accounting Data
  - Earnings Announcement Dates
  - Business Segment Data
  - Some Stock Data

An interesting research issue?

- What is the effect of temporary cuts in production/service rate on firm performance?

- The results may have implications on
  - Developing capabilities for short-term volume flexibility
  - Production smoothing
  - Co-ordination across supply chain partners

Issues that could be examined

- Effect of temporary cuts on economic performance

  - shareholder value (short and long-term)

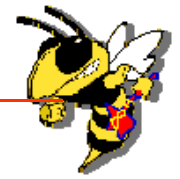
  - changes in operating income

  - share price volatility

- Stock analysts' reaction to these types of decisions

- Factors that moderate/influence the economic effect of these decisions

Creating a sample



- Announcements by firms

- Primary sources of announcements
  - Wall Street Journal
  - Dow Jones News Service
  - Business Wire
  - PR Newswire

- Key word search to identify potential announcements

- Careful reading to identify relevant announcements

- Identify the date of the announcement

Key words

• (Plant or plants or capacity or production or operation or operations or service or services or facilities or facility or output or store or stores or factory or factories or employee or employees or employment or people or positions or positions or workforce or job or jobs or payroll or staff or staffers or staffing or workers or worker or workforce)

Near 5

• (curb or curbs or curbed or curbing or furlough or furloughs or furloughed or furloughing or suspend or suspends or suspended or suspending or suspension or close or closing or closes or closed or closure or halt or halts or halted or halting or curtail or curtails or curtailed or curtailing or curtailment or shut or shuts or shutting or shutter or shuttered or shuttering or idle or idling or idles or idled or reduction or reduced or reduce or reduces or reducing or slash or slashing or slashed or slashes or cut or cuts or cutting or cutback or cutbacks or shutdown or eliminate or eliminates or eliminating or eliminated or elimination or pare or pares or paring or pared or dismiss or dismissal or dismissals or dismissed or dismisses or trim or trims or trimmed or trimming or reduce or shed or sheds or shedding or streamline or streamlining or streamlines or streamlined or layoff or layoffs or laid or laying or lays or lay)

Some examples

• Boeing to Cut 747 Output 30% in 1999 And to **Curtail Production** of Its 777 – June 10th, 1998

• Hyundai Electronics Industries Co. **stopped production for a week**, cutting its output by an amount equivalent to 10% of the world's output in June.

• U.S. **Shut** 34 Meat and Poultry Plants In Quarter Due to Sanitation or Safety

• Ford Motor Co: Plant **Cutback Next Week** Will Idle 3,500 Workers

• Echo Bay Mines Ltd. will **temporarily suspend operations** at its Lupin gold mine in the Northwest Territories

The Event Study

- Statistically examine response to an “event”
- Collect large sample of firms all experiencing the same event
- Estimate the “impact” of the event on performance

Issues in estimating performance

- Time period over which the performance should be examined

- Estimating the change in performance (economic impact) that could be attributed to the event under consideration

  – **abnormal performance**

- Testing for the statistical significance of the abnormal performance

Stock market reaction to announcements

- Stock market efficiency

  - reacts instantly to new information

  - unbiased estimate of the value implications of the announcement

- Other factors could influence stock price on announcement day – must control for these

Methodology

- Stock market's reaction to announcements is normally referred to as ***Abnormal Return***

- Estimate abnormal returns around the time of announcement

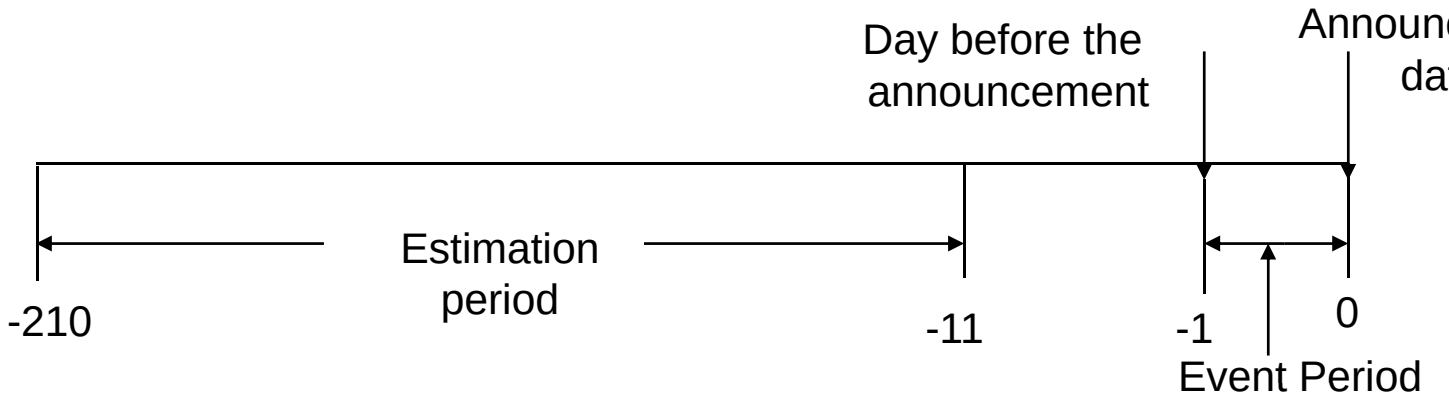
- Abnormal return = actual return including the effect of announcement - expected return (normal return) without the announcement

- Test for statistical significance

Measuring the stock market reaction

- Boeing announced short-term production cuts on June 10, 1998
- Set June 10, 1998 as day 0 in event time
- Day -1 is the previous trading day
- Day 1 is the following trading date
- Period of interest (day 0, day -1, day 1 or some combination)
- Estimate abnormal returns

Estimating abnormal returns



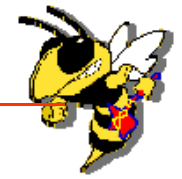
- Abnormal returns = actual returns – expected returns
- Three models for estimating expected returns (normal returns)

Market Model: $R_{it} = \alpha_i + B_i(R_{mt} - R_{ft})$

Mean adjusted model: average of R_i over days -211 to -11

Market adjusted model: average of market return over days -211 to -11

Stock market reaction – event study method



- Fourth model for estimating normal (expected) returns – four factor model

$$R_{it} = a_i + Bi_1 (R_{mt} - R_{ft}) + Bi_2 SMB_{it} + Bi_3 HML_{it} + Bi_4 UMD_{it} + e_{it}$$

$R_{mt} - R_{ft}$ = market return minus risk free rate of return (Market risk premium)

SMB_{it} = small firms minus big firms portfolio returns

HML_{it} = value stocks minus growth stocks portfolio returns

UMD_{it} = past one-year winners-minus-losers stock portfolio returns

Measures/Tests of abnormal returns

- Mean – standard t–tests (trimming and capping)

- Non-Parametric (Requires Symmetry Under Ho)
  - Median – Wilcoxon sign rank test
  - binomial sign test (% positive != 0.5)

- Event Clustered Versus Non Event Clustered
  - Industry Clustering, Date Clustering

- Variance Shift Adjusted Tests

Stock market reaction to corporate events

Operational events

Increase in capital expenditure	1.0%
Increase in R&D expenditure	1.4%
Decrease in capital expenditure	-1.8%
Plant closing	-0.7%
Automotive recalls (US)	-0.4%
Effective TQM implementation	0.7%
Supply chain disruptions	-7.2%
Excess Inventory	-6.9%
Product Introduction delays	-12.8%

Marketing events

Change in firm name	0.7%
Brand leveraging	0.3%
Celebrity endorsement	0.2%
New product introduction	0.7%
Affirmative action awards	1.6%

Information technology events

IT Investments	1.0%
IT problems	-1.7%

Financial events

Stock splits	3.3%
Open market share repurchase	3.5%
Proxy contest	4.2%
Increasing financial leverage	7.6%
Decreasing financial leverage	-5.4%
Seasoned equity offerings	-3.0%

Summary – short window studies

- Methodology is well established and used in numerous academic paper

- Methodology is robust for small (50 or more) sample sizes

- Results are insensitive to the method used to estimate abnormal returns

- Statistical test are well-specified and have good power

- Seminal papers on short window event study methodology

Brown, S., J. Warner. 1980. "Measuring security price performance". *Journal of Financial Economics*, 8, 205-258 – uses monthly returns

Brown, S., J. Warner. 1985. "Using daily stock returns: The case of event studies". *Journal of Financial Economics*, 14, 3-31.

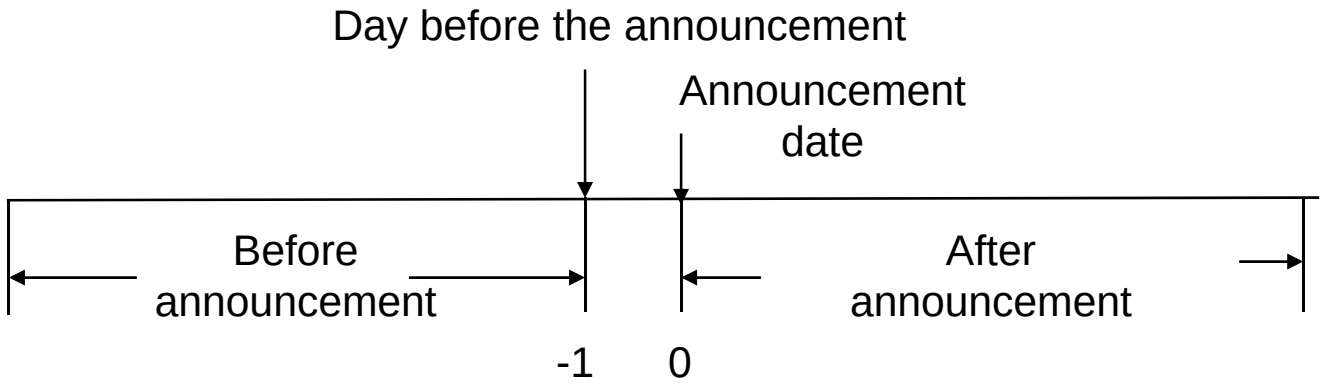
Summary – short window studies

• Eventus - Commercially available software package for computing abnormal returns

• If the abnormal return is insignificantly different from zero
  - make sure you have the right announcement date
  - the event is not a significant event
  - the event is not a surprise (partially or fully anticipated)
  - investors have mixed feeling about the event

• Cannot reject the null hypotheses of zero abnormal returns but the abnormal returns seem to be economically significant
  - May need to go to smaller window

Measuring long-term shareholder returns



- Before announcement
  - partial anticipation
  - consistent with market efficiency

- After announcement
  - inconsistent with market efficiency
  - market gets more information
  - market learns how to value specific events
  - market reacts to how the firm responds to the event

Measuring long-term shareholder returns

- Time period before and after

- No specific guidelines on how long should be the time period
  - Any where from 1 year to 10 years

- Traditional methods of computing abnormal returns do not work well

  - Random samples show statistically significant abnormal returns as the time period becomes longer

  - Traditional statistical tests assumptions are violated

  - Traditional test statistics are mis-specified

Measuring long-term shareholder returns

- Compare performance of sample firms with portfolios of similar type of firms

  - Size (created 14 portfolio)
  - Book to market value (subdivided each of the 14 into 5)
  - Prior performance (subdivided each of the 70 into 3)

- 210 portfolios of firms

- Abnormal returns = sample firm's return – its portfolio return

- Simulated 1000 benchmark portfolios

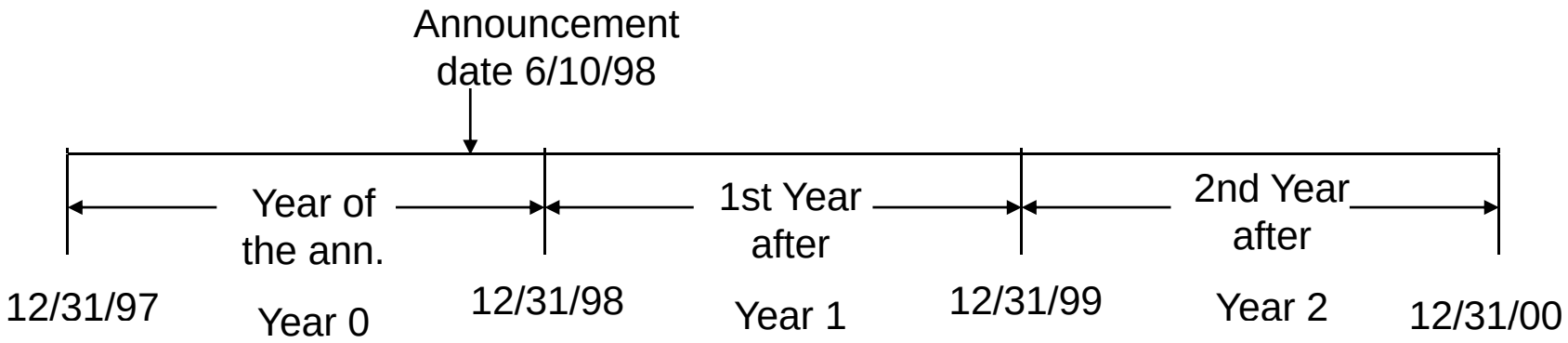
- Use the simulated distribution to test statistical significance

Recent long-term stock price studies in OM

- Quality award winners
- Supply chain disruptions
- Key papers for methodology
- Barber, B. M., J. D. Lyon. 1997. Detecting Long-Run Abnormal Stock Returns: The Empirical Power and Specification of Test-Statistics. *Journal of Financial Economics*. 43, 41-372.
- Kothari, S. P., J. B. Warner. 1997. Measuring Long-Horizon Security Price Performance. *Journal of Financial Economics*. 43, 301-339.

Measurement time period for profitability changes

- Boeing announcement date is June 10,1998
- Set the year ending after June 10, 1998 as year 0



Estimating changes in profitability measures

- Operating Income
  Sales – manufacturing costs – SGA costs
- Return on sales
  Operating income normalized by sales
- Return on assets
  Operating income normalized by total assets
- Sales over assets
  Net Revenues normalized by total assets
- Sales growth
- Total costs – cost of good sold + SGA

Methodology for estimating the profitability impacts

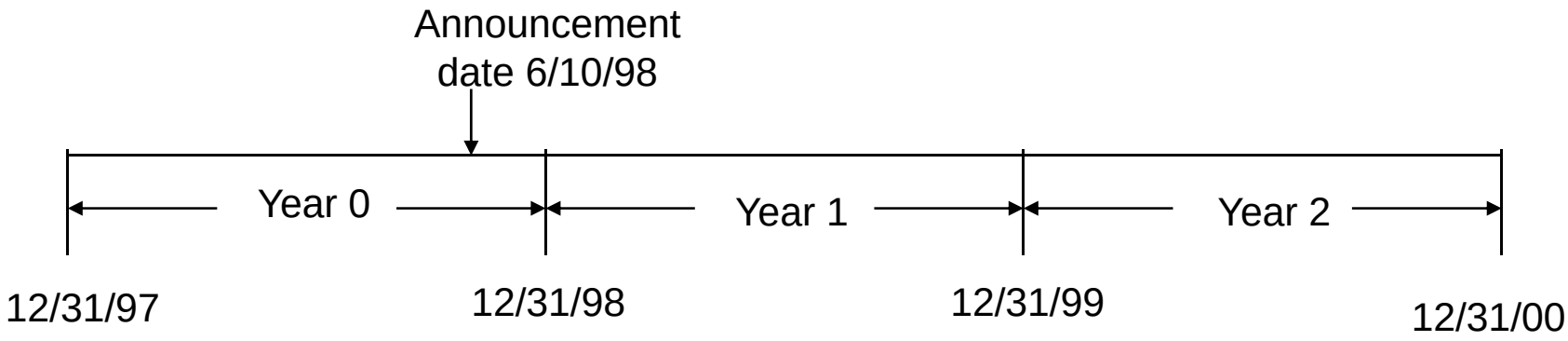
- Barber and Lyon (1996) "Detecting abnormal operating performance: The empirical power and specification of test statistics", *Journal of Financial Economics*, 41, 359-399.

- Create benchmark portfolios to adjust for the effect of economy and industry

- Factors to match on
  - Prior performance (mean-reversion, unique factors)
  - Standard Industry Classification (SIC) Codes
  - Size

- Estimate changes in performance

Measurement time period for profitability changes

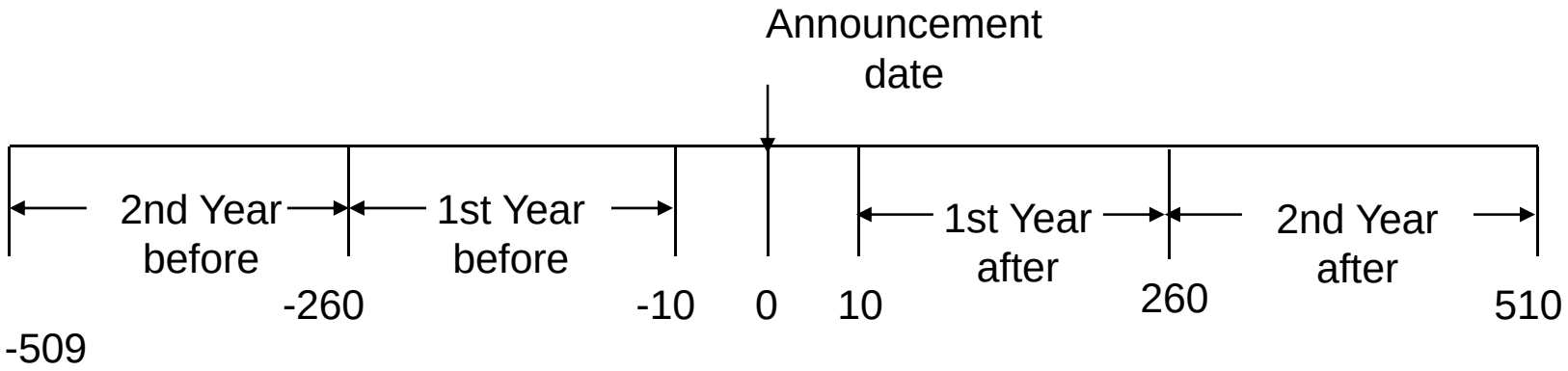


- Boeing ROA is 10% at the end of 1997
- Boeing ROA is 12% at end of 2000
- Median ROA of matched portfolio at end of 1997 is 9.9%
- Median ROA of matched portfolio at end of 2000 is 14.9%
- Expected performance of Boeing at end of 2000 is 15%
- Abnormal performance = 12% - 15% = -3%

Recent profitability impact studies in OM

- Quality award winners
- Supply chain disruptions
- ISO 9000 certification
- Investments in ERP. SCM, and CRM systems
- Delays in new product introduction

Measuring risk changes

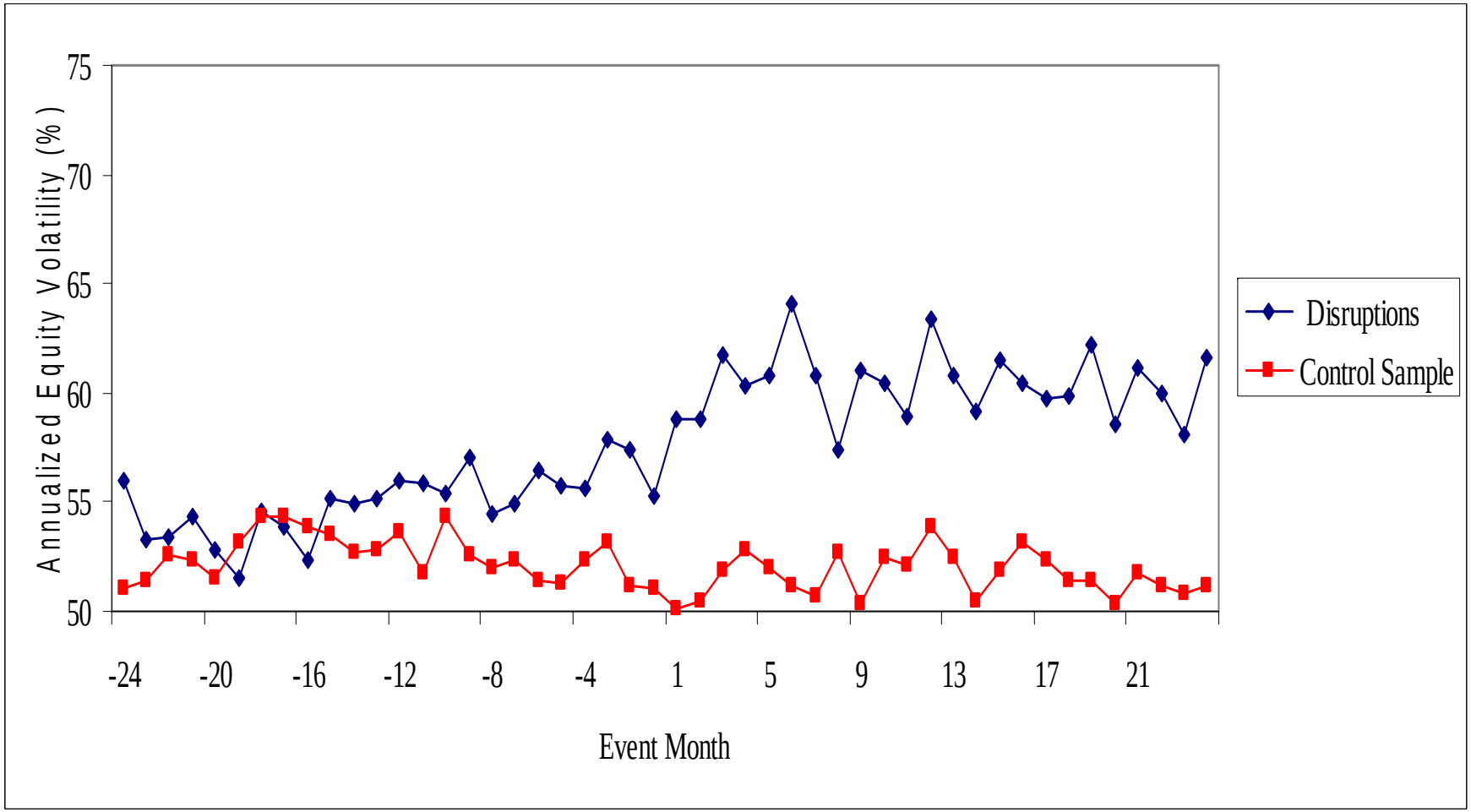


- Estimate share price volatility – before and after

- Estimate Beta $R_i = \alpha_i + B_i (R_m – R_f)$

- Very few empirical studies have examined risk changes due to OM decisions

Volatility changes



Other recent examples of use of secondary data

- Documenting inventory behavior and whether inventory turnover affects shareholder value and profitability
- Drivers of inventory turnover in retail industries
- Product variety and its implication for inventory
- Testing for the bullwhip effect
- Inventory inaccuracy in the retailing industry
- Valuation of flexibility

Summary

- Need more research that links different aspects of operations to objective performance measures
- Operations manager care about impact on share price and operating income
- Methodologies are rigorous, well developed, and widely accepted
- Data is widely available
- Requires a change in mindset
- Believe in the stock market

Summary

- Survey based research may require some objective validation of performance

- Combination of survey based data and secondary data sources could be a very powerful approach