Economics 220C
Empirical Methods in Industrial Organization
Bronwyn H. Hall
Economics, UC Berkeley
Spring 2005
Goals for this course

1. Survey various styles of research in the field with representative papers.
   - Present the state of the art (knowledge) in the field
   - Possibly generate some new ideas that lead to thesis topics

2. Introduce some of the methodological approaches that have been used in the applied IO literature
   - some of these approaches are dictated by data limitations; not obvious from reading the theoretical literature in the field
   - Hands-on training in empirical methods using existing data via problem sets
Topics

• Introduction
• Production and cost functions
• Demand estimation; welfare
• Short-run competition
  – Single product industries (incl price discrimination)
  – Differentiated product industries
• Standards and network externalities
• Entry and industry structure
  – Intro to dynamic models
• Suggestions?
Basics

• Course meets Tues 2:15-4
  – No class March 9, March 23
• Office hours Wed 2:15-4, 653 Evans
• Web emlab.berkeley.edu/~bhhall
• Grading
  – 40% 2-3 problem sets
  – 40% empirical research paper (abstract March 1; paper due May 3)
  – 20% class participation
• Late problem sets and papers not accepted
Introduction to applied IO

• What is it used for? Why do we study it?
• Methodology overview
  – Descriptive analysis
  – Structural modeling framework – static analysis
• Example of descriptive/statistical analysis:
  – Gibrat’s Law
Goals of applied work in IO

• test theoretical models via the scientific method.
  – ideal, but difficult. Why?
• document facts about industries and firms in an informed and careful way, without using theory
  – Measure a specific quantity, such as a price elasticity
• answer a specific policy or regulatory question.
  – What are the consequences of a particular merger for innovation in an industry?
  – What is the rate of return to public R&D?
Methodologies used

• historical analysis
  – e.g., David on QWERTY

• case study
  – e.g., Farrell and Shapiro on HDTV, Henderson on photolithography

• sample survey
  – e.g., Levin, Klevorick, Nelson, & Winter; Cohen et al on IP and innovation

• econometric analysis using existing data
  – Descriptive (motivated by theory)
  – Using structural models derived from theory
Static IO analysis

• **Condition on “primitives”**
  – Goods marketed along with their production or cost functions
  – Consumer preferences over the goods or their characteristics
  – Institutional features – type of equilibrium, regulations, market

• *Assume current decisions do not affect future behavior*

• Analyze how prices, quantities, profits, and consumer surplus are determined
Static IO analysis rules out

- Durable goods
- Storable goods
- Experience goods
- Network goods
- Addictive goods
- Learning by doing
- Adjustment costs in production
- Models of collusion supported by punishment schemes

But we have to start somewhere......
The role of empirical IO

• Estimate
  – cost, production, demand functions

• Test
  – functional forms
  – type of market equilibrium or firm behavior

• Problem
  – Observed data is intersection of demand and supply (cost function)
  – Identification achieved in one of two ways
    1. Assume the other side is perfectly competitive, or given (one-sided market)
    2. Find appropriate instruments, perhaps by fully specifying both sides of the market
Stylized fact example

- Competitive industry, many small price-taking firms with identical U-shaped cost curves:
  - Firm size distribution degenerate at a single $q$
  - Entry and exit driven by changes in demand or common cost function (so either one, but not both, occur)
    - $P=MC$ in the shortrun $\Rightarrow$ equal SR profits
    - $P=AC$ in the longrun $\Rightarrow$ zero LR profits
  - No real dynamics

- Do any industries really look like this?
Firm size distribution

• Large literature beginning with Gibrat (see Sutton 1997) finds
  – Firm size distribution very skewed, either lognormal or Pareto with parameter <2 (no variance)
• Dunne, Roberts, and Samuelson (using Census data) find
  – entry and exit positive correlated across industry (sunk costs?)
Firm size distribution in levels
Compustat 2002

Fraction

Sales in millions of dollars
Firm size distribution in logs
Compustat firms 2002
Pharmaceutical industry 1996

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Gibrat’s Law

- Expected value of the increment to a firm’s size in each period is proportional to the current size of the firm.
- Let $x_t =$ size at $t$
- $\varepsilon_t =$ the proportionate rate of growth
- Then
  $$x_t = (1 + \varepsilon_t) x_{t-1} = x_0 (1 + \varepsilon_1)(1 + \varepsilon_2)\ldots(1 + \varepsilon_t)$$
  and
  $$\log x_t \approx \log x_0 + \varepsilon_1 + \varepsilon_2 + \ldots + \varepsilon_t$$
Gibrat’s law consequences

Define \( y_t = \log x_t \)

Assume \( \epsilon_t \sim i.i.d.(\mu, \sigma^2 < \infty) \) and \( \epsilon_0 = y_0 \)

Then

\[
y_t = \sum_{s=0}^{t} \epsilon_t
\]

and the CLT ensures that \( y_t \) has a normal distribution.

If \( \epsilon_t \) has no second moment but \( E \epsilon_t^\alpha \) exists for \( 1 < \alpha < 2 \), then \( x_t \) is Pareto-distributed.

Also,

\[
E[y_t - y_{t-1} \mid y_{t-1}] = E[\epsilon_t \mid y_{t-1}] = \mu
\]
Models

• Simon and coauthors
  – Equally sized opportunities arrive at random
  – Probability next opportunity taken up by active firm proportional to firm’s current size
  – Probability next opportunity taken up be a new entrant constant over time

• Lucas, Kihlstrom-Laffont, Jovanovic
  – Individuals vary in ability, and each can manage only one firm or become a worker; diminishing returns conditional on ability
  – Yields equilibrium with some workers and some managers
  – Firms vary in size and average cost, but have same marginal cost
  – Evolution over time due to learning about ability
Empirical results

• Early work on large firms, small samples, confirms Gibrat’s law
• Recent work has larger samples, more small firms, concludes that
  – Gibrat is mostly correct but
  – Smaller and/or younger firms grow slightly faster than larger and/or older firms
New data issues

• Entry and exit occur frequently
• Balanced or unbalanced panel?
• Bias from exit or entry?
  – Evans and Hall find mortality higher for smaller/younger firms
  – If slow-growing small firms exit and slow-growing large firms do not, it will appear that small firms grow faster in the surviving sample
  – Do small firms create more jobs? Not if they also exit more rapidly (Davis and Haltiwanger)
Next time

• Dealing with attrition in panels (part 1)
• Some more stylized facts about industry
• Estimating production/cost functions