William Greene
Stern School of Business
New York University

Jordan River Conference
Indiana University
April 17, 2009
An Econometrics Buffet

• **Basic Research:** Heterogeneity (Unobservables) in Econometric Models

• **Applied Research:**
  • Who Has the Best Health Care System?
  • Obesity
  • Where Have All the Nurses Gone?

• **Consulting/Applied Research:** Credit Scoring

• **Consulting:** How Should We Pay the Musicians for their Music?
1. What You Don’t See Matters
Modeling Economic Behavior

• **Economic Outcomes**: Labor markets, insurance, health care, firm performance, growth, etc. etc. etc.

• **Can be explained by observable characteristics**: Age, education, firm size, income, market characteristics, etc.

• **Are also explained by unobservable features**: Attitudes, skills, motivation, hidden characteristics, etc.
Econometric Model Building

• How do the measured variables relate to each other?
• How is that relationship affected by the unmeasured (unobservable) variables?
• Do they matter – can they be ignored?

Usually not.
Basic Research

• Takes place in the lab

• Isn’t always obviously related to “the real world”

• Is not undertaken specifically to solve a particular real world problem.

• Often produces results that are useful in ways that might not have been anticipated

• Sometimes doesn’t produce useful results at all. It’s worth the gamble to find out. That is why we have a National Science Foundation.
Modeling the Unobservables

\[ \log L = \sum_{i=1}^{N} \log \int_{-\infty}^{\infty} \prod_{t=1}^{T_i} \Phi[\Delta_{it} (\beta + \Gamma w_i)^' x_{it}] \, dw_i \]

\[ = \lim_{R \uparrow \infty} \sum_{i=1}^{N} \log \frac{1}{R} \sum_{r=1}^{R} \prod_{t=1}^{T_i} \Phi[\Delta_{it} (\beta + \Gamma \hat{w}_{ir})^' x_{it}] \]

Questions?

Answers
2. Ignoring What You Don’t See Doesn’t Make It Go Away
August 12, 2007

EDITORIAL

World’s Best Medical Care?

Many Americans are under the delusion that we have “the best health care system in the world,” as President Bush sees it, or provide the “best medical care in the world,” as Rudolph Giuliani declared last week. That may be true at many top medical centers. But the disturbing truth is that this country lags well behind other advanced nations in delivering timely and effective care.

Michael Moore struck a nerve in his new documentary, “Sicko,” when he extolled the virtues of the government-run health care systems in France, England, Canada and even Cuba while deploiring the failures of the largely private insurance system in this country. There is no question that Mr. Moore overstated his case by making foreign systems look almost flawless. But there is a growing body of evidence that, by an array of pertinent yardsticks, the United States is a laggard not a leader in providing good medical care.

Seven years ago, the World Health Organization made the first major effort to rank the health systems of 191 nations. France and Italy took the top two spots; the United States was a dismal 37th. More recently, the highly regarded Commonwealth Fund has pioneered in
Health Care Systems

Michael Moore's SiCKO (official trailer)
Life Expectancy Is the Usual Measure of Health Care Success
World Life Expectancies

One-fifth of all countries exceed U.S. in life expectancy

Japan's life expectancy was 82 years for babies born in 2004, leading the list of developed countries, while the U.S. is just above Mexico with 77.9 years.

U.S. life expectancy has been extended by 30 years in the past century.

Life expectancy, in years

- 34.1 to 45.0
- 45.1 to 50.0
- 50.1 to 65.0
- 65.1 to 80.0
- 80.1 and more

Sources: Census Bureau; National Center for Health Statistics
WHO Was Interested in Broader Goals of a Health System
"In order to assess overall efficiency, the first step was to combine the individual attainments on all five goals of the health system into a single number, which we call the composite index. The composite index is a weighted average of the five component goals specified above. First, country attainment on all five indicators (i.e., health, health inequality, responsiveness-level, responsiveness-distribution, and fair-financing) were rescaled restricting them to the [0,1] interval. Then the following weights were used to construct the overall composite measure: 25% for health (DALE), 25% for health inequality, 12.5% for the level of responsiveness, 12.5% for the distribution of responsiveness, and 25% for fairness in financing. These weights are based on a survey carried out by WHO to elicit stated preferences of individuals in their relative valuations of the goals of the health system."

(From the World Health Organization Technical Report)
Did They Rank Countries by COMP? Yes, but that was not what produced the number 37 ranking!

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Comparative Health Care Efficiency of 191 Countries
The US Ranked 37th in Efficiency!

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<td>36 - 44</td>
<td>Cuba</td>
<td>0.834</td>
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Countries were ranked by overall efficiency.
EDITORIAL

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What’s Wrong with the Study?

• They did not rank the quality of health care; they ranked efficiency of health care provision.

• A country could have the world’s highest quality health care and still have a low ranking, if they wasted resources providing that care.
What’s Technically Wrong with the Study?

- This was a questionable measure of health care success.
- This might not even be a measure of health care success at all.
- They ignored the heterogeneity of 191 countries
  - Misleading model for health care success
  - Even misleading as a model for efficiency
  - Heterogeneity looked like inefficiency
A Conference in New Orleans

At the meeting of the Allied Social Sciences Association in New Orleans, January 5, 2001, the WHO researchers and a roomful of economists dissected the WHO study. The WHO researchers released their data. Followup research on the WHO study/data has continued in (at least) the U.K., the U.S. and Australia.
3.
More About Health
A Bivariate Latent Class Correlated Generalized Ordered Probit Model with an Application to Modelling Observed Obesity Levels

William Greene
Stern School of Business, New York University
Mark Harris, Bruce Hollingsworth, Pushkar Maitra
Monash University
Introduction

• The International Obesity Taskforce (http://www.iotf.org) calls obesity one of the most important medical and public health problems of our time.

  • It is an associated or a risk factor in numerous health problems
  • It is extremely costly in public health expenditures and workplace productivity

• Around 300 million people worldwide are obese.
Models for BMI

Simple Regression Approach Based on Actual BMI:

\[ BMI^* = \beta'x + \varepsilon, \quad \varepsilon \sim N[0,\sigma^2] \]

No accommodation of heterogeneity
Rigid measurement by the guidelines

Interval Censored Regression Approach

\[ WT = \begin{cases} 0 & \text{if } BMI^* \leq 25 \quad \text{Normal} \\ 1 & \text{if } 25 < BMI^* \leq 30 \quad \text{Overweight} \\ 2 & \text{if } BMI^* > 30 \quad \text{Obese} \end{cases} \]

Inadequate accommodation of heterogeneity
Inflexible reliance on WHO classification

(BMI = weight in Kg / height\(^2\) in meters\(^2\))
Latent Class Modeling

• Individuals can be thought of being in one of several ‘types’ or ‘classes.’
  • Genetic reasons (Unobservable tendency toward obesity – a gene that resides in about 10% of us)
  • Lifestyle factors (Observable indicators)

• Suggests use of a latent class approach. Growing use in explaining health outcomes (Deb and Trivedi, 2002, and Bago d’Uva, 2005)

• Two class latent class model based on the genotype argument.

• Two classes allow us to easily correlate the equations driving class membership and observed weight outcomes via unobservables
Model Components

- **x**: determines observed weight levels within classes
  For observed weight levels we use lifestyle factors such as marital status and exercise levels

- **z**: correlates with the latent classes
  For latent class determination we use genetic proxies such as age, gender and ethnicity:

- **w**: determines position of boundary parameters within classes; weight-training intensity and age (BMI inappropriate for the aged?) pregnancy (small numbers and length of term unknown)
Age and Obesity

**Male**
- Normal
  - Total
  - Class 0
- Overweight
  - Total
  - Class 0
- Obese
  - Total
  - Class 0

**Female**
- Normal
  - Total
  - Class 0
- Overweight
  - Total
  - Class 5
- Obese
  - Total
  - Class 0
Income and Obesity

[Graphs showing income categories vs. obesity status for male and female]
The Relationship to Education
4.
Where Have All the Nurses Gone?
There Is a Shortage of Nurses

• Total market: About 2,000,000 nurses
• Long run trend in the U.S.
  • Rapidly rising wages
  • Recent gains due mainly to
    (1) Entry of foreign born
    (2) Reentry of older RNs
• Generally severe and worsening shortage in the U.S.
• Similar trends in other countries
Why?

• Low wages
• Hazardous jobs
• Workplace conditions
  • Physical
  • Sociological
• ? (other reasons)
A Large Study Using Primary Data

3,500+ newly minted U.S. nurses, 2006
To be followed for 10 years
Year 1 Model: Job Satisfaction
Year 2 Model: Job Turnover
Subsequent years...
Interesting Modeling Issues

• Modeling Attitudes: Job Satisfaction
  • How to measure it
  • What kind of econometric model

• Modeling Discrete Choices:
  • Decision to stay in or leave the job
  • Change jobs
  • Leave the profession

• Modeling many interrelated variables: Job satisfaction, turnover, workplace relationships

• (Of course) Handling unobservables

• Handling attrition from the sample. Do random samples remain?
The Objectives

• Understand current trends
• Predict the next several years
• Learn more about what actions can be taken by employers (mainly hospitals) to:
  • Increase retention
  • Reduce turnover
  • Induce new entry
  • Alleviate the shortage…
Final report to be submitted in 2016.
5. What Were They Thinking (About Credit)?
A Statistical Model for Credit Scoring

William Greene
Stern School of Business
New York University
Credit Scoring

- Credit scoring: Focused on default risk
- Formal model: Incorporate default risk evaluated by the scorer in a more complete model of the business decision whether or not to approve a loan application
Overview

Major credit card vendor (early 1990s) analyzing card application and credit history data

• Program around existing credit “scorer” to develop an “in house” procedure
• Calibrate to recent observed data
• Make sharper use of available data
  • Use information contained in available data
  • Use available appropriate econometric methods
• Better understand operation of the market after the application is processed (and accepted).
Alternative Approach to Credit Scoring

• Model default as a propensity
  • Probabilistic approach, not a population segmentation approach
  • Any individual might default – assess likelihood
  • Default probabilities become an element of the evaluation.

• Should default be the primary focus?
  • Use default as part of the evaluation
  • Analyze an application from the point of view of expected profit
  • Default probability as well as spending and costs all enter the result
Feedback in the Model

• The default probability (from the point of view of the lender) is a function of:
  • Borrower behavior: spending
  • Lender behavior: the acceptance rate

• The acceptance rate is ultimately a function of:
  • The expected default rates
  • The decision rule of the credit scorer (Fair-Isaac)
The Data

• Application
  • Consumer data
    • Income
    • Age
    • Own/Rent
    • Tenure at address
    • Type of employment
  • Scoring result

• Credit reporting
  • Major derogatories
  • Minor derogatories
  • Bank accounts
  • Open credit accounts

• Consumer behavior
  • Default
  • Expenditure for 12 months

• Market and demographic data
  • Shopping opportunities
  • Demographics
    • Employment
    • Dependents
Expected Profit vs. Default Probability

Estimated Unconditional E[Profit|C=1, S=Mean]
Expected Profit vs. Spending

Estimated Conditional $E[\text{Profit}|C=1, S]$
Feedback Effects

• $P^* = \text{acceptance rate}$
• Expected Spending rises as $P^*$ rises
• Probability of Default rises as $P^*$ rises
• Expected Profits rise as Spending rises
• Expected Profits fall as Default rises
• Expected Profit may rise or fall as $P^*$ rises
• Is there an optimal $P^*$?
Conclusions

• Accounting for spending and feedback from spending to default produced very different results from when spending did not affect the default probability.

• Accounting for the feedback, maximum aggregate profit occurred at a much higher acceptance rate than was present in the population.
Policy Recommendation

• Focus on expected profit rather than default produces a different outcome.
• Increase acceptance rate substantially to increase expected profits.
But,…

- Isn’t this what led us to the subprime loan mess?
  (No Income, No Job, No Assets? No Problem!!! - NINJA)

- **No**: In this model, the lender cares if the borrower defaults!
Postscript: 2008-2009

• P* has fallen dramatically
• American Express has “recalled” some cards
• Default has risen dramatically
• Probabilities have become extremely difficult to measure
• (Junk mail for credit card offers has fallen dramatically.)
6. New Business Model
   Same Songs
Pricing The Music

- An Application of Microeconomics
  - Price Theory
  - Welfare Economics
  - Equilibrium Theory
- Basic Principles of Public Finance
Pricing Entertainment

Music wants to be free ...
Pricing Entertainment

Music wants to be free …

at the margin!
Three Crucial Features of the Market for Digital Entertainment

Marginal Cost Equals Zero

Marginal Cost Equals Zero

Marginal Cost Equals Zero
The Users

- Verizon Wireless
- YouTube
- Yahoo! Music
- Pandora
- NBC.com
- Heroes
- Rhapsody
- iTunes
- Indianapolis City Guide
- Bed Bath & Beyond
- Indiana University Bloomington
How Can We Pay These Guys?

• How to Get Royalties to Authors, Composers and Publishers
• ASCAP
The Gatekeepers

INDIANA UNIVERSITY
BLOOMINGTON
Pricing Models

• Commodity Pricing Model – The Listener Pays
  • Marginal pricing (iTunes) – Bad economics
  • Per play - True marginal pricing (Internet radio) – Very bad economics
  • (Intermediate) Subscription Model – OK economics

• Advertising Model – Someone Else Pays
  • Free internet radio stations (AOL, Yahoo!)
  • The price discrimination problem – listeners never see the price differences. It is imposed on the advertisers
Commodity Pricing – Positive Marginal Price
Excessive Pricing: Pay Per Song

Internet radio dealt severe blow as Copyright Board rejects appeal
By Eric Bangeman | Published: April 16, 2007 - 05:05PM CT

A panel of judges at the Copyright Royalty Board has denied a request from the NPR and a number of other webcasters to reconsider a March ruling that would force Internet radio services to pay crippling royalties. The panel’s ruling reaffirmed the original CRB decision in every respect, with the exception of how the royalties will be calculated. Instead of charging a royalty for each time a song is heard by a listener online, Internet broadcasters will be able pay royalties based on average listening hours through the end of 2008.

The ruling is a huge blow to online broadcasters, and the new royalty structure could knock a large number of them off the ‘Net entirely. Under the previous setup, radio stations would have to pay an annual fee plus 12 percent of their profits to the music industry’s royalty collection organization, SoundExchange. It was a good setup for the webcasters, most of whom are either nonprofits or very small organizations.
Subscription Model
Blanket License ➞ zero marginal charge

START YOUR 14-DAY FREE TRIAL!
INSTALL THE YAHOO! MUSIC JUKEBOX. START ROCKIN’.
■ Play and save over 2 million full-length songs
■ Unlimited access from any PC without paying per track
■ Over 150 LAUNCHcast Plus radio stations
■ Thousands of playlists to discover new music

Save $36/year with Annual Plan!
$5.99/mo
ANNUAL SUBSCRIPTION
(Deducted in one payment of $71.88 at end of trial period)

Continue

Monthly only subscription - $8.99/mo

Credit card is required. You have 14 music-filled days to cancel. A valid subscription is required to save songs.

Not ready to start a subscription? You can go a la carte and purchase individual tracks for just 99¢ each with the FREE Yahoo! Music Jukebox.
Price Discrimination

No matter what you like or how you like to listen to it, Rhapsody has a plan for you. You can even start with a plan that lets you play great music for free.

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Unlimited Plays means just that! Play any of our 4 million-plus tracks as many times as you like, on demand, from anywhere.
A Tax Model for Royalties
Tax the Ad Revenue on the Player
Gaming the System
Move the Ads off the Player 😊
The Ultimate Royalty Dodge
Tons of Music, No Royalties
A Titanic Battle is Drawn

• ASCAP the music monopolist?
  - Please pay us for the music you use
  - Please use lots and lots of music – our artists need the exposure

• Big Websites, music monopsonists?
  - We want to use lots of music
  - We think it wants to be free (we want it to be free)
Dueling Market Powers?
U.S. vs. ASCAP, 2008

• How to tax the internet users of music
• An optimal tax based on public finance principles:
  • Zero marginal charge
  • Flat percentage of total advertising revenue. (More or less)
• ASCAP won.
The Next Frontier?

Viacom on Tuesday slapped YouTube and parent company Google with a lawsuit, accusing the wildly popular video-sharing site of "massive intentional copyright infringement" and seeking more than $1 billion in damages.

How would you do it? …
Where Have We Been?

• **What you don’t see matters.**
  - Basic research on how unobservables impact models
• **Ignoring what you don’t see doesn’t make it go away.**
  - A wildly misleading and nonunderstood health care study
• **Modeling unobservables using econometric methods**
  - A study of obesity that builds a model for a hidden genotype
  - A study of the market for nurses that builds a model for individual preferences and motivations
• **Using basic principles of microeconomics and public finance in an important public policy case**
  - A precedent setting Federal case that decided the method of taxing websites to generate royalties for musicians
Thank you!