Causal effects, experiments, and identification: Quantitative Marketing and Structural Econometrics Workshop

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Let us start with what the talk is not
\[ y = \beta X + \epsilon \]

- What \( x \) in \( X \) can be used to best predict \( y \)?
- Instead does a focal \( x \) cause \( y \)?
Does an $x$ cause $y$?

This is the dominant empirical focus of published economics articles in labor, health, public finance, and innovation.
Let us start with what the talk is not
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Reduced-Form and Structural
Developing a great descriptive paper

1. Research question: Do we care if $x$ causes $y$?
2. Identification strategy: Does $x$ really cause $y$ to shift?
3. Mechanism: Why does $x$ cause $y$ to shift?
Developing a great descriptive paper

1. Research question: Do we care if $x$ causes $y$?
   - Is $y$ interesting? Is $x$ interesting and under someone’s control?
2. Identification strategy: Does $x$ really cause $y$ to shift?
3. Mechanism: Why does $x$ cause $y$ to shift?
Developing a great descriptive paper

1. Research question: Do we care if $x$ causes $y$?

2. Identification strategy: Does $x$ really cause $y$ to shift?
   - Choose a setting and data that allows you to do it

3. Mechanism: Why does $x$ cause $y$ to shift?
Developing a great descriptive paper

1. Research question: Do we care if $x$ causes $y$?

2. Identification strategy: Does $x$ really cause $y$ to shift?

3. Mechanism: Why does $x$ cause $y$ to shift?
   - Does $x$ affect $y$ for one group more than others? Does this help understand why $x$ affects $y$
Why the obsession with identification?
For any discrete event/policy \((x)\), each \(i\) has two possible outcomes

- \(y_{i1}\) if the \(i\) experiences \(x\)
- \(y_{i0}\) if the \(i\) does not experience \(x\)
For any discrete event/policy \((x)\), each \(i\) has two possible outcomes

- \(y_{i1}\) if the \(i\) experiences \(x\)
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- The difference between the two is the causal effect.
For any discrete event/policy \((x)\), each \(i\) has two possible outcomes

- \(y_{i1}\) if the \(i\) experiences \(x\)
- \(y_{i0}\) if the \(i\) does not experience \(x\)

- The identification problem:
  - Can’t both receive the treatment and not receive the treatment.
  - Only one outcome observed for each individual
As a marketing professor you may have twins
Twins illustrate the identification problem
What is Endogeneity anyhow?

- Endogeneity means that those who experience $x$ and, those who don’t, are different in unobserved ways.
- Your Goal: $\rightarrow$ make the “unobserved way” untroubling.
Random assignment solves this problem as \textit{ex ante} the ‘unobserved ways’ should not matter.
- Often called the “gold standard” of identification.
Observations on Field Experiments

- Dominant Methodology for papers submitted to QME conference
- Anja Lambrecht and I are writing a handbook chapter detailing their applicability to marketing
In experimental applications, managerial actions are actually tried out with the aim of discovering the responses to these actions. All other applications are nonexperimental or ‘observational.’

The key to modern statistical design of experiments is withholding experimental stimuli at random. To the extent that randomization and the other conditions above are met, the responses actually observed will reflect the ‘true’ effects of the stimuli plus random or chance variation. Statistical procedures then need cope only with the interpretation of chance variation. Observational methods and possible systematic error, and systematic error eludes rigorous statistical treatment.
Key Challenges for Field Experiments

- Getting the right unit for randomization (Granularity vs Spillovers)
- Ensuring the randomization leads to an interesting treatment effect
- Ensuring you have enough data to make it interesting
Class Challenge

Imagine you have the power to make any firm, industry body or government run any experiment you want. What experiment would you run?
Drawbacks of Field Experiments

- Field experiments lay bare how interesting or original you really are
- Questions which can be answered by field experiments may not be the most interesting or important questions
- Often experiments are not feasible, not appropriate, or too costly
Natural Experiments are alternatives to Field Experiments

- If the question is interesting enough but a field experiment is not possible
- Natural experiment is to identify something that approximates random assignment
Understanding the unobserved outcome

- So researchers look for exogenous variation: - A shock to the system that means that some \( i \) (the treated) are exposed to \( x \) but not \( i \) (the control)
  - The variation could happen by country, state, city, firm, establishment, street corner, individual, publication, website visit, invention.
  - The reason for the variation needs to be understood
  - The variation could occur because of an “act of God” or because of behavior by others that won’t care about the response (technology adoption, market entry, advertising, pricing, ...), etc.
For both Field and Quasi-Experimental Work You Need a Graph

- The Graph should show that before the shock both treatment and control were on similar trend
- The Graph should show that after the shock the treated group started behaving differently
Figure 2: Brand Keyword Click Substitution

(a) MSN Test

MSN and Google click traffic is shown for two events where paid search was suspended (Left) and suspended and resumed (Right).
How Practically to Construct Regression Tables

- “Diff-in-diff”
- Instruments
- Regression discontinuity
How Practically to Construct Regression Tables

http://cetucker.scripts.mit.edu/Methodology.html
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Falsification tests are about finding an example where your confounds would suggest the same result but your theory suggests otherwise.

- What are the sources of non-randomness of assignment?
- What other outcomes would be affected by these sources of bias that would not display the causal effect of interest?
- What other groups would be affected by these sources of bias that would not display the causal effect of interest?

- If the effect goes away when theory suggests it should, then this helps identify mechanism.
- Correspondingly if the effect is larger when theory suggests it should be, then this helps identify mechanism.
This last step is important

Measuring something better does mean that your paper is remembered. It is remembered for the evidence that you show in support of your theory.
Checklist: Evaluating a Field Experiment or Quasi-Experimental paper

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2. Identification strategy: Does \( x \) really cause \( y \) to shift?

3. Mechanism: Why does \( x \) cause \( y \) to shift?
Checklist: Evaluating a Field Experiment or Quasi-Experimental paper

1. Research question: Do we care if $x$ causes $y$?
2. Identification strategy: Does $x$ really cause $y$ to shift?
   - Do I understand the data structure/nature of the experiment?
   - Is there Model Free evidence?
   - Are there plenty of caveats and apologies?
3. Mechanism: Why does $x$ cause $y$ to shift?
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3. Mechanism: Why does \( x \) cause \( y \) to shift?
   - Is there evidence \( x \) causes \( y \) for the people theory would predict?
Thank you.
Please now ask me questions! And visit.
http://cetucker.scripts.mit.edu/Methodology.html