ECON 300
Econometrics

Introduction to Regression
and
Causal Inference

Dennis C. Plott

University of Illinois at Chicago
Department of Economics
www.dennisplott.com
https://uic.blackboard.com

Fall 2014
## Contents

1 Economic Theory & Models .......................................................... 1  
   1.1 What Economics Is Not ....................................................... 2  
   1.2 Ceteris Paribus ................................................................. 3  
   1.3 Economic Theory & Models: Mathematical Functions ................. 3  
   1.4 Consumption Example in Practice ....................................... 4  

2 Economic (Logical) Fallacies ..................................................... 4  
   2.1 Common Economic Fallacies ............................................... 4  
       2.1.1 Schrödinger’s Cat (A Thought Experiment) .................. 5  
       2.1.2 “The Road Not Taken” ............................................ 5  
   2.2 The “Broken Window” Fallacy ............................................ 7  
   2.3 Common Causes of Fallacies ............................................. 8  

3 What Is Econometrics? .............................................................. 8  
   3.1 Critiques of Econometrics .................................................. 9  
   3.2 Why Study Econometrics? .................................................. 9  

4 The Structure of Economic Data ............................................... 9  
   4.1 Types of Data .................................................................. 9  
       4.1.1 Time Series Data .................................................... 10  
       4.1.2 Cross-Sectional Data ............................................. 10  
       4.1.3 Pooled Cross Sections ........................................... 10  
       4.1.4 Panel or Longitudinal Data .................................... 10  
   4.2 Data Sources ................................................................. 10  
   4.3 Econometrics and Regression: An Example from Keynes ............. 11  

5 Causality .................................................................................. 14  
   5.1 Selection Issues ............................................................... 15  
   5.2 Types of Causal Relationships ............................................ 17  
       5.2.1 Examples Confusing Causality and Correlation ............ 17  
   5.3 Causality and the Notion of Ceteris Paribus in Econometric Analysis .................................................. 18  
   5.4 Random Assignment .......................................................... 19  
       5.5 Random Assignment Application: Labor Market Discrimination .................................................. 21  

6 Appendices .............................................................................. 26  
   6.1 Common Latin Phrases ........................................................ 26  
   6.2 Greek Alphabet ............................................................... 26
List of Figures

1. Map of UIC – East Campus
2. Riots!
3. Schrödinger’s Cat (A Thought Experiment)
4. Traffic Fatalities and Imported Lemons
5. Internet Explorer Usage and the Murder Rate
6. XKCD Causation vs. Correlation
7. John Maynard Keynes (1883–1946)
8. Scatter Plot with Linear Fit of Income and Consumption
9. Scatter Plot and Linear Fit of Grade and Attendance
10. XKCD New Study
11. Callback Rate and Mother’s Education by First Name

List of Tables

1. Real Interest Rate and Consumption
2. Real Interest Rate, Consumption, and Income
3. Mean Callback Rates by Racial Soundingness of Names
4. Common Latin Phrases
5. Greek Alphabet
1 Economic Theory & Models

- Economic theory: a set of ideas about the economy, organized in a logical framework
- Economic model: a simplified description of some aspect of the economy or a representation of economic phenomenon that takes a mathematical and/or, conceptual, and/or graphical form
- Models embody assumptions about individual behavior, market structure and what is taken as given (including policy regime).
- Usefulness of economic theory or models depends on reasonableness of assumptions, possibility of being applied to real problems, empirically testable implications, and theoretical results consistent with real-world data.
- A primary goal of developing models is to determine what policies can produce better economic outcomes.
- Abstraction: means ignoring many details so as to focus on the most important elements of a problem

\textit{Essentially, all models are wrong, but some are useful.}

\hspace{1cm} \text{– George Box}

- Models are abstractions from reality and should be simplified to focus on only the most crucial elements to explain economic phenomena.
- Abstraction from unimportant details is necessary to understand the functioning of anything as complex as the economy.
- Models do not need to be “realistic”, but should be consistent with the facts.
- May need to switch between models according to context; no grand “true” model.

- As an example of a model, suppose you are new to UIC.
  - To navigate your way around campus you consult a map.
  - See Figure 1
  - What makes a good map?
  - You can list numerous attributes, but the most important aspect of a good map is that it helps you get from point A to point B.

- Endogenous variable: a variable that is explained by an economic model
- Exogenous variable: a variable that is taken as given and is not explained by an economic model
- A solution to a model gives the endogenous variables in terms of the exogenous variables.
- Variables that are exogenous in some models might be endogenous in other models.
  - For example, in one macroeconomic model, we might take interest rates as exogenous.
  - But some economic models are designed exactly to explain interest rates.
  - In some cases, a variable is exogenous in the building block of a more general model, but endogenous in the general model.
1.1 What Economics Is Not

- Economics wants to be physics (or chemistry or biology, etc.); the hard or physical sciences. Why is physics and the like enviable? They have, for the most part, controlled experiments.

- It is rarely possible to conduct controlled experiments in economics.

- *Non Sequitur*: Vernon Smith shared the 2002 Nobel Prize in Economics for his work in experimental economics. For more information see: Wikipedia “Vernon L. Smith”

- Why? Two main reasons:
  1. The costs for large social experiments tend to be prohibitive.
  2. A more important concern is that many of the experiments economists would like to perform, if they were even feasible, would likely be ethically questionable.
• For example, what if an economist wanted to determine how Government spending would impact an economy experiencing a level of unemployment like the peak level during the Great Depression (approximately 25%). So, let’s randomly layoff/fire 15%–20% more of the labor force. What do you think would happen?

![Figure 2: Riots!](image)

1.2 *Ceteris Paribus*

• In the models, like the ones used in this class, economists use *ceteris paribus*.

• This Latin phrase acts along the lines of a thought experiment and roughly translates to “if all other relevant things remain the same” or “holding other things constant” or “all other things being equal”.

• To isolate the relationship of interest in a laboratory experiment, a scientist holds everything constant except for the variable whose effect is being studied. Economists use the same concept to demonstrate a relationship that has more than two variables.

1.3 Economic Theory & Models: Mathematical Functions

Functional notation is used to express the idea that one variable is determined by other variables.

• Macroeconomic Example

1. Model aggregate consumption as depending on disposable income ($Y - T$) and the real interest rate ($r$):

$$C = C(Y - T, r)$$

2. In this model, income ($Y$), taxes ($T$), and the interest rate ($r$) are exogenous; while consumption ($C$) is endogenous.

3. $C = C(\cdot)$ is functional notation indicating consumption ($C$) is a function of what is inside the parentheses.

• Positive (direct) relationship: A relationship between two variables that move in the same direction.; the relationship between two variables that change in the same direction, for example, product price and quantity supplied; positive relationship.
• Negative (inverse) relationship: A relationship between variables that move in opposite directions.

• Question?

1. The functional notation $C = C(Y - T, r)$ indicates consumption depends on disposable income and the real interest rate, but how are they related? In other words, how would consumption change with an increase in the real interest rate ($\uparrow r$) or disposable income ($\uparrow (Y - T)$), ceteris paribus? [Hint: positively, negatively, or both (depending on context)?]

2. $\uparrow r \xrightarrow{c.p.} \downarrow C$

3. $\uparrow (Y - T) \xrightarrow{c.p.} \uparrow C$

### 1.4 Consumption Example in Practice

*In theory there is no difference between theory and practice. In practice there is.*

---

- **Yogi Berra**

<table>
<thead>
<tr>
<th>Real Interest Rate</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>1.9</td>
</tr>
<tr>
<td>2010</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Table 1: Real Interest Rate and Consumption

• $\uparrow r \rightarrow \uparrow C$ ??

• Did we break economics?

• No, there is omitted variable bias.

<table>
<thead>
<tr>
<th>Real Interest Rate</th>
<th>Consumption</th>
<th>Disposable Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>1.9</td>
<td>9077.3</td>
</tr>
<tr>
<td>2010</td>
<td>2.5</td>
<td>9334.0</td>
</tr>
</tbody>
</table>

Table 2: Real Interest Rate, Consumption, and Income

• Do not forget about *ceteris paribus*!

### 2 Economic (Logical) Fallacies

#### 2.1 Common Economic Fallacies

• loaded terminology: terms that contain the prejudice and value judgments of others; related terms include “appeal to emotion”, “inflammatory language”, etc.

  - It is very difficult for a person to describe economic behavior without letting their opinions about that behavior creep into their discussion. The distinction between positive and normative statements is not always clearly apparent.

  - Often, however, there is a deliberate attempt to sway opinion by using loaded terminology (e.g. “greedy owners”, “obscene profits”, “exploited workers”, “mindless bureaucrats”, “costly regulations”, “creeping socialism”).

• fallacy of composition: what is true for one individual or part of a whole is necessarily true for a group of individuals or the whole; the false notion that what is true for the individual (or part) is necessarily true for the group (or whole).

• Examples:

  - An individual stockholder’s sales of shares vs. a large number of stockholders selling large numbers of shares.

  - At a football game the person in front of you obstructs your view, so you stand up to get a better view vs. if everyone in the stadium stands up to get a better view.
• Counterfactual: expressing what has not happened but could, would, or might under differing conditions. Counterfactuals are what ifs, thought experiments, alternatives to actual history; they imagine what would have happened to an economy if, contrary to fact, some present condition were changed.

– When you want to know the causal effect of an intervention (policy change, medical treatment, whatever) on something, you need to compare two states of the world: the world in which the intervention occurred and the world in which it did not. The latter is the counterfactual world. Since most of us only get to live in one world (most of the time), observing the counterfactual is a rather tricky thing to do.

– Example: The stimulus was predicted to hold unemployment below 8.5%; it did not. Did the stimulus fail? It depends on the counterfactual of what would unemployment have been without the stimulus? The prediction was wrong, but that doesn’t tell you what would have happened without the stimulus.

2.1.1 Schrödinger’s Cat (A Thought Experiment)

• A theory of quantum mechanics called “indeterminacy” says that mathematically, a particle can be in two states at the same time. Schrödinger wanted to show that it was not true, so he came up with an illustration. This experiment is only hypothetical, and can’t really be done.

• Schrödinger said that if you put a cat in a box with a poison that might kill it, at the end of an hour the cat has a 50% chance of being alive, and a 50% chance of being dead. According to quantum mechanics (the branch of physics dealing with physical phenomena at nanoscopic (immensely small) scales), since we can’t see in the box to know if the cat is alive or dead, the cat is both alive and dead. Of course, we know that this is not possible (ignoring zombies1), nothing can be alive and dead at the same time. This is just what Schrödinger wanted to show.

• What does this have to do with economics? Well, if an economist described the thought experiment they could call it a “counterfactual cat” since it is impossible to observe both states (i.e., dead and alive) of the cat.

Figure 3: Schrödinger’s Cat (A Thought Experiment)

Non Sequitur: A very lame science joke: Schrödinger’s Cat walks into a bar . . . and doesn’t.

1Non sequitur: If you are concerned about a zombie apocalypse see “The Zombie Survival Guide”
2.1.2 “The Road Not Taken”

- This poem is a literary analogue to the science example of a counterfactual.

TWO roads diverged in a yellow wood,
And sorry I could not travel both
And be one traveler, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;
Though as for that the passing there
Had worn them really about the same,

And both that morning equally lay
In leaves no step had trodden black.
Oh, I kept the first for another day!
Yet knowing how way leads on to way,
I doubted if I should ever come back.

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I–
I took the one less traveled by,
And that has made all the difference.


- post hoc, ergo propter hoc [“after this, therefore because of this”] fallacy: The false belief that when one event precedes another, the first event must have caused the second event; when two events occur in time sequence, the first event is not necessarily the cause of the second event.

- Example: The Republicans (Democrats) pass a new tax reform law that benefits wealthy Americans. Shortly thereafter the economy takes a nose dive. The Democrats (Republicans) claim that the the tax reform caused the economic woes and they push to get rid of it.

- correlation versus causation: events may be related without a causal relationship

- Correlation: A systematic and dependable association between two sets of data (two kinds of events); does not necessarily indicate causation.

- Causation: A relationship in which the occurrence of one or more events brings about another event.

  - Causation vs. Correlation Example:
    1. The positive relationship between education and income does not tell us which causes the increase in the other. (Which is the independent variable and which is the dependent variable?)
    2. It may be that the increased income that occurs with increased education is due to some other third factor (an omitted variable) that is not under direct consideration.

  - For more examples see Causation vs. Correlation Examples

2.2 The “Broken Window” Fallacy

- In the essay “What Is Seen And What Is Not Seen”, a 19th Century economist named Frederic Bastiat wrote a story about a boy who breaks a shopkeeper’s window. In replacing it, the shopkeeper gives money to the glassman, and the town observes that the broken window provided a boost to the local economy. However, Bastiat emphasizes that this fallacy ignores the unseen fact that, had the window not been broken, the shopkeeper would have bought a new pair of shoes. Hence, there is no net gain for the economy.

  - Note: this a classic essay with an important point: if you look at only the benefits of government programs, you miss the hidden costs – where the tax money would otherwise have been spent, money unspent due to tariffs, and so forth.
However, Bastiat makes two hidden (implicit) assumptions:

1. All money that is spent would have been spent elsewhere – call this Say’s Law.

   * The problem with (1) can be demonstrated by supposing that the shopkeeper was, in fact, not going to spend his money at all – in that case there would have been a boost to the
economy. Not the best way to boost income, perhaps, but an income boost nonetheless. If the economy is not at full employment then spending more money does not require that you displace existing spending – to argue the opposite is to argue that private sector spending cannot increase employment either.

2. That the replacement for the proverbial broken window is not better in any way.
   * The problem with (2) can be illustrated by supposing that the shopkeeper’s window had been in a poor state to start with. In that case, replacing the window would have had a degree of benefit to the shopkeeper greater than in the more simple version of the story. After all, proponents of the broken window fallacy often speak approvingly of creative destruction – replacing old capital and ideas with new, better capital and ideas. A similar logic applies – again, going around breaking things that seem worn out isn’t a suggested strategy for development, but it’s not as clear cut as it first seems. (‘Broken windows’ can also become a rationalization for renovation – ‘it’s about time we redid the shop front anyway’, etc.)

2.3 Common Causes of Fallacies

- A 1987 study, published in the *Journal of the American Veterinary Medical Association*, of 132 cats that were brought into the New York Animal Medical Center after having fallen from buildings found that cats falling from five stories or less and nine stories or more had a much greater likelihood of surviving than cats who fell between five and nine stories.

- Can you explain this? Note: I do not hate cats.

- **Bad data quality (narrow definition):** data that are missing or incorrect (FYI: the word “data” is a (Latin) plural)

- In a survey of 200 children those with larger feet consistently scored more highly on a spelling test.

- Can you explain this?

- Children with larger feet are likely to be older, and older children are generally better spellers having had more exposure to words at school and at home.

- **Omitted variable (bias):** when a valid or important variable is excluded from a model

- **Reverse Causation:** a reversal of cause and effect or the existence of a feedback relationship
  - Example: Is health a cause, effect, or both of higher incomes? Higher incomes are expected on balance to lead to better health but better health may enhance productivity growth and hence lead to higher incomes.

3 What Is Econometrics?

What is econometrics? A few (historical) definitions are given below:

*The method of econometric research aims, essentially, at a conjunction of economic theory and actual measurements, using the theory and technique of statistical inference as a bridge pier.*

– Trygve Haavelmo\(^2\) (1944)

*Econometrics may be defined as the quantitative analysis of actual economic phenomena based on the concurrent development of theory and observation, related by appropriate methods of inference.*

– Samuelson, Koopmans and Stone\(^3\) (1954)

*Econometrics is concerned with the systematic study of economic phenomena using observed data.*

– Aris Spanos (1986)

\(^2\)For more information see Wikipedia “Trygve Haavelmo”

For other definitions of econometrics, see Tintner (1953).

An econometrician has to be a competent mathematician and statistician who is an economist by training. Fundamental knowledge of mathematics, statistics and economic theory are a necessary prerequisite for this field. As Ragnar Frisch (1933) explains in the first issue of *Econometrica*, it is the unification of statistics, economic theory and mathematics that constitutes econometrics. Each view point, by itself is necessary but not sufficient for a real understanding of quantitative relations in modern economic life.

More practical definitions: Econometrics is . . .

1. . . . the estimation of relationships suggested by economic theory.

2. . . . the application of mathematical statistics to the analysis of economic data.

3.1 Critiques of Econometrics

Econometrics has its critics. Interestingly, John Maynard Keynes (1940, p. 156) had the following to say about Jan Tinbergen’s (1939) pioneering work:

> No one could be more frank, more painstaking, more free of subjective bias or parti pris than Professor Tinbergen. There is no one, therefore, so far as human qualities go, whom it would be safer to trust with black magic. That there is anyone I would trust with it at the present stage or that this brand of statistical alchemy is ripe to become a branch of science, I am not yet persuaded. But Newton, Boyle and Locke all played with alchemy. So let him continue.

In 1969, Jan Tinbergen shared the first Nobel Prize in economics with Ragnar Frisch.

Other lively debates among econometricians include Ed Leamer’s (1983) article entitled “Let’s Take the Con Out of Econometrics”, and the response by McAleer, Pagan and Volker (1985); Angrist and Pischke (2010) and the response by Sims (2010). Rather than leave the reader with criticisms of econometrics especially before we embark on the journey to learn the tools of the trade, we conclude this section with the following quote from Pesaran (1990, pp. 25–26):

> There is no doubt that econometrics is subject to important limitations, which stem largely from the incompleteness of the economic theory and the non-experimental nature of economic data. But these limitations should not distract us from recognizing the fundamental role that econometrics has come to play in the development of economics as a scientific discipline. It may not be possible conclusively to reject economic theories by means of econometric methods, but it does not mean that nothing useful can be learned from attempts at testing particular formulations of a given theory against (possible) rival alternatives. Similarly, the fact that econometric modeling is inevitably subject to the problem of specification searches does not mean that the whole activity is pointless. Econometric models are important tools for forecasting and policy analysis, and it is unlikely that they will be discarded in the future. The challenge is to recognize their limitations and to work towards turning them into more reliable and effective tools. There seem to be no viable alternatives.

3.2 Why Study Econometrics?

- Rare in economics (and many other areas without labs) to have experimental data
- Need to use nonexperimental, or observational, data to make inferences
- Important to be able to apply economic theory to real world data
- An empirical analysis uses data to test a theory or to estimate a relationship
- A formal economic model can be tested
- Theory may be ambiguous as to the effect of some policy change – can use econometrics to evaluate the program
- Econometrics fills a gap between being a “student of economics” and being a “practicing economist”
  - It lets you tell your employer:
    * “I can predict the sales of your product”
    * “I can estimate the effect on your sales if your competition lowers its price by $1 per unit”
    * “I can test whether your new ad campaign is actually increasing your sales”
  - Helps you develop “intuition” about how things work and is invaluable if you go to graduate school
4 The Structure of Economic Data

4.1 Types of Data

Dataset types are distinguished by what constitutes the “unit of observation”. See chapter 1 of Wooldridge textbook for more extended discussion of data types.

4.1.1 Time Series Data

- Time series data – unit of observation is a time period (e.g., quarterly reports of U.S. GDP; annual sales figures for a single company); data for the same entity for multiple time periods. An example of time series data are the daily closing value of the Dow Jones Industrial Average.

- Time series data has a separate observation for each time period – e.g. stock prices

- Since not a random sample, different problems to consider

- Trends and seasonality will be important

4.1.2 Cross-Sectional Data

- Cross section data – unit of observation is an “entity” (person, company). The data contain information on each entity from roughly the same time (e.g., the 1990 U.S. Census of Population); data collected for different entities in a single time period. An example of cross-sectional data is the gross annual income for each of 1000 randomly chosen households in Chicago for the year 2011.

- Cross-sectional data is a random sample

- Each observation is a new individual, firm, etc. with information at a point in time

- If the data is not a random sample, we have a sample-selection problem

4.1.3 Pooled Cross Sections

- Pooled cross-section data – combined cross-section data from several years. Distinguished from panel data by the fact that the “entities” need not be exactly the same in the different years. For example, a collection of telephone surveys of people’s political preferences taken each year, where different people were surveyed each year but the same questions were asked, would be a “pooled cross-section”.

- Can pool random cross sections and treat similar to a normal cross section. Will just need to account for time differences.

4.1.4 Panel or Longitudinal Data

- Panel data – the unit of observation is usually an entity by year. Roughly the same variables on the same entities are obtained in several years. For example, the National Longitudinal Survey of Youth interviewed kids aged 14–19 in 1979 and followed up with additional surveys every year or 1–2 years since then. Data for multiple entities where each entity is observed in two or more time periods. A famous example is the Panel Study of Income Dynamics (PSID) which primarily collects economic and demographic information from over 18,000 individuals living in over 5,000 families in the United States.

- Can follow the same random individual observations over time – known as panel data or longitudinal data

4.2 Data Sources

- American Economic Association (AEA)

- Bureau of Labor Statistics (BLS)

- Federal Reserve bank of Saint Louis (FRED)

- National Bureau of Economic Research (NBER)
• Current Population Survey (CPS)
• U.S. Census Bureau – Business & Industry
• U.S. Census Bureau
• Panel Study of Income Dynamics (PSID)
• Bureau of Economic Analysis
• International Monetary Fund (IMF)
• The World Bank
  – Stata World Bank
• International Food Policy Research Institute
• Euro Stat

4.3 Econometrics and Regression: An Example from Keynes

Economic theory specifies a set of relationships between variables; e.g., demand equations, production functions, consumption functions, etc. Econometrics allows us to empirically investigate economic theory using data to provide estimates of key (unknown) parameters in economic models; e.g., estimates of elasticities, marginal propensity to consume, etc.

Consider an application from Keynes (1936) using the first practical definition of econometrics given above:

The fundamental psychological law upon which we are entitled to depend with great confidence, both a priori from our knowledge of human nature and from the detailed facts of experience, is that men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income.

Figure 7: John Maynard Keynes (1883–1946)

• Keynes’ verbal theory can be converted into a mathematical model
• Specifically a deterministic mathematical model (says state of the world is exactly like this)
In this case the theory implies a straight line relationship between consumption and income given by

\[ consumption = \bar{C} + MPC \cdot income \]

\[ C = \beta_0 + \beta_1 Y \]  
(rewritten in typical regression notation)

where

- \( consumption(C) \) is aggregate (total) consumption
- \( \bar{C} \) (or \( \beta_0 \)) is autonomous consumption; consumption that will take place regardless of income level; i.e., a constant.
- \( MPC \) or \( \beta_1 \) is the marginal propensity to consumer; i.e., how much of an additional dollar are you willing to spend
- \( income(Y) \) is aggregate (total) income
- \( \beta_0 \) and \( \beta_1 \) are parameters or coefficients of the equation
- \( \beta_0 \) is the intercept of the straight line and \( \beta_1 \) is the slope.

The values of these coefficients are the things of interest and the theory outlined above tells us that the slope of this straight line,

\[ \frac{\Delta C}{\Delta Y} = MPC = \beta_1 \]

should be

\[ 0 < \beta_1 < 1 \]

But … this is only a theory. What about in practice?

- We need estimates of these coefficients to test the predictions of the theory
- Econometrics will do this for us
- Step 1: get some data on the variables of interest (consumption and income)
- In reality relationships between economic variables do not conform exactly to theory.
- Given data on consumption and income for a sample of individuals and time periods we would not expect all observations to lie on the straight line implied by the theory
- A plot of the raw data is called a scatter diagram.

Why is real life not a straight line?

- factors other than income affect consumption; e.g.,
  - individuals with the same income have different tastes and therefore different consumption patterns,
  - recessions affect incomes and hence consumption patterns in an unpredictable (non-linear) way.
- To allow for this stochastic\(^4\) (random) variation, we modify the deterministic model to include a random term, \( u \), (the error or residual or disturbance term) so that

\[ C = \beta_0 + \beta_1 Y \]

becomes

\[ C = \beta_0 + \beta_1 Y + u \]

\(^4\)Non sequitur: The word “stochastic” comes from the Greek word \( stokhos \) meaning “a bull’s eye”. The outcome of throwing darts on a dart board is a stochastic process, that is, a process fraught with misses.
This residual is used to capture all the factors which affect consumption and which are not taken into account explicitly by the model, but which are assumed to occur randomly so that there is nothing systematic that should appear in the model.

If there is anything systematic it should be in the model not in the residual.

Adding a residual means that the model has statistical properties and now becomes a probabilistic rather than an exact (deterministic) description of the world.

Rather than saying this is how the world works, equation (1) now says this is probably how the world works subject to random disturbances.

As such it needs a degree of statistical evidence to accept or overturn this view (does the majority of evidence point toward acceptance or rejection of the theory?)

This is where econometrics comes in.

How much statistical evidence is needed is a matter of debate, but the role of econometrics is to try to assemble that evidence.

By getting estimates of the parameters of an economic model (in this case estimates of the straight line coefficients $\beta_0$ and $\beta_1$) and estimates of their precision – using what we will henceforward call regression analysis – in order to try and validate or reject a theory.

However . . .

* Formal mathematical economic modeling (as above) is sometimes the start for econometric analysis, but not always
* Often the theoretical underpinnings are much less formal while still based on economic intuition

Suppose you are interested in finding out the determinants of your final grade in Econometrics.

Based on simple common (economic) sense, you might specify a causal relationship between your grade and the number of classes you attended as:

$$ grade_i = \beta_0 + \beta_1 attendance_i + u_i $$

typically use the subscript ‘$i$’ to denote individual agents (people, firms, countries, etc.)

In this case we have observations for $i = 1, 2, \ldots, 176$ students.
Ex ante, we can be expected to have some idea about the likely sign of the effect of classes on grades given here by $\beta_1$ – hopefully positive. Also the size of the effect (size of $\beta_1$) of attendance on grade – without recourse to formal mathematical theoretical modeling.

The specification of such an equation means that the implied direction of causality runs from number of classes to the final course grade and not the other way round.

$$attendance_i = \delta_0 + \delta_1 grade_i + u_i$$

would make no sense.

How can your Econometrics grade affect the number of classes you attended before the exam anyway?

$$grade_i = \beta_0 + \beta_1 attendance_i + u_i$$

Just because we observe two variables are correlated does not mean that one variable causes another.

This is a fundamental issue in econometrics.

When you do econometrics you make the fundamental assumption that changes in the levels of variables on the right hand side of an equation cause changes in the variable on the left hand side of the equation and not the other way round.

If this is not true, then, there could be serious consequences for the estimation of such a relationship (as we will see).

5 Causality

The fundamental problem of causal inference

- Answering any causal question requires knowing the counterfactual.
- At the individual level this is impossible.
- Maybe we can solve this by using statistics?
We need a comparison group

- ... that would have had similar outcomes as the treatment group if there was no treatment.
- In general, however, those receiving treatment and those that do not usually differ due to:
  - Targeting
  - Screening
  - Self-selection.

This implies

- ... that those not exposed to a treatment are often a lousy comparison group.
- It is often impossible to disentangle treatment effects from selection bias.

Example

- A fertilizer program where fertilizers are given for free to some farmers.

We want to know the effect

- Effect = yield for the farmers who got fertilizer minus yield at the same point in time for the same farmers in absence of the program.

Problem

- We never observe the same individual with and without program at the same point in time.

We cannot simply compare before and after

- Other things may happen over time so that we cannot separate the effect of the treatment and the effect of those other things.
- Even if you know “nothing else happened” it is hard to convince others.
- The burden of proof is on you.

We cannot simply compare with those who did not get fertilizers

- Some may choose not to participate.
- Those not offered the program may differ.
- Again, the burden of proof is on you.

Solution

- Find a good proxy for what would have happened to the outcome in the absence of program
- Compare the farmer with someone who is exactly like her but who was not exposed to the intervention
- In other words, we must find a valid Counterfactual
  - only reason for different outcomes between treatment and counterfactual is the intervention

5.1 Selection Issues

Selection Bias

- Any sample that differs systematically from the population that it is intended to represent is called a biased sample
- One of the most common causes of biased samples is selection bias, which occurs when the selection of the sample systematically excludes or underrepresents certain groups
  - Selection bias often happens when we use a convenience sample consisting of data that are readily available
- Self-selection bias can occur when we examine data for a group of people who have chosen to be in that group
Survivor and Nonresponse Bias

- A retrospective study looks at past data for a contemporaneously selected sample
  - for example, an examination of the lifetime medical records of 65-year-olds
- A prospective study, in contrast, selects a sample and then tracks the members over time
- By its very design, retrospective studies suffer from survivor bias: we necessarily exclude members of the past population who are no longer around!
- Nonresponse bias: The systematic refusal of some groups to participate in an experiment or to respond to a poll

The Power of Random Selection

- In a simple random sample of size \( N \) from a given population:
  - each member of the population is equally likely to be included in the sample
  - every possible sample of size \( N \) from this population has an equal chance of being selected
- How do we actually make random selections?
- We would like a procedure that is equivalent to the following:
  - put the name of each member of the population on its own slip of paper
  - drop these slips into a box
  - mix thoroughly
  - pick members out randomly
- In practice, random sampling is usually done through some sort of numerical identification combined with a computerized random selection of numbers

Landon Wins!

Shortly before the 1936 U.S. presidential election, the *Literary Gazette* published a poll indicating that Alf M. Landon would defeat the incumbent, Franklin D. Roosevelt, by a landslide – 57% to 43%. The Gazette was right that the election was a landslide, but it was wrong about the winner: Roosevelt won by 59% to 41%!

How could the Gazette have made such a big mistake? The Gazette’s sample was chosen from telephone records and automobile registration files. But in 1936 many households did not have cars or telephones, and those that did tended to be richer – and were also more likely to be Republican. Because the telephone survey did not sample randomly from the population but instead undersampled Democrats, the estimator was biased and the Gazette made an embarrassing mistake.

Do you think surveys conducted over the Internet might have a similar problem with bias?
Wald Airplanes During WWII, statistician Abraham Wald was asked to help the British decide where to add armor to their bombers. After analyzing the records, he recommended adding more armor to the places where there was no damage! The RAF was initially confused. Can you explain?

Wald had data only on the planes that returned to Britain so the bullet holes that Wald saw were all in places where a plane could be hit and still survive. The planes that were shot down were probably hit in different places than those that returned so Wald recommended adding armor to the places where the surviving planes were lucky enough not to have been hit.


5.2 Types of Causal Relationships

5.2.1 Examples Confusing Causality and Correlation

The text in the links are actual headlines of popular press articles. Some of the headlines suggest a causal relationship between two variables, and some simply suggest a correlation between two variables. Unfortunately, the headlines of articles in the popular media often misrepresent the research on which they are based. Many
of the headlines suggest causal relationships when, upon closer reading of the article itself, one finds that the research was correlational in nature, and the headline is not justified.

- “High Levels of Immigrants ‘linked to high youth unemployment’ ”
  - “For every 1,000 migrants in the 50 local authorities in England most affected by migration, the number of youth unemployed rises by, on average, 700.”
  - The level of youth unemployment is higher in areas where the level of immigration is higher.
  - So immigration causes youth unemployment? No.
  - The level of anything (police, teachers, students, dogs etc) is higher in areas with larger populations.
  - The underlying report simply compared areas with different sized populations. Bigger populations means more unemployed and more immigrants.
  - This is not a causal relationship.

5.3 Causality and the Notion of *Ceteris Paribus* in Econometric Analysis

The Questions of Causality

- Simply establishing a relationship between variables is rarely sufficient
- Want to the effect to be considered causal
- If we’ve truly controlled for enough other variables, then the estimated *ceteris paribus* effect can often be considered to be causal
- Can be (incredibly) difficult to establish causality

Example: Returns to Education

- A model of human capital investment implies getting more education should lead to higher earnings
- In the simplest case, this implies an equation like

\[
Earnings = \beta_0 + \beta_1 \text{education} + u
\]
• The estimate of $\beta_1$, is the return to education, but can it be considered causal?
• While the error term, $u$, includes other factors affecting earnings, want to control for as much as possible
• Some things are still unobserved, which can be (is) problematic

5.4 Random Assignment

Randomization
• When individuals, or schools, or countries, are randomly assigned to treatment and comparison groups, the selection bias disappears.
• Take a sample of $N$ individuals from a population of interest.
• Divide the sample randomly into a treatment and a control group.
• Then give the treatment group a treatment so that their treatment status is $T$ and nothing to the control group so that their treatment status is $C$.
• Collect outcome data $Y$ and compare the treatment average to the control average.

What is being estimated?
• We get the overall impact of a particular treatment on an outcome.
• Note in particular that we allow other things to change as a response to the program.
• It is not the all else equal effect.

Main advantages of randomization
• A randomized evaluation provides internally valid estimates = It provides an unbiased estimate of the impact of the program in the sample under study.
• They are also easy to understand.
• Very good for testing theories.

Threats to Internal Validity  (more on this later in the course)

1. Failure to randomize (or imperfect randomization)
   • for example, openings in job treatment program are filled on first-come, first-serve basis; latecomers are controls
   • results in bias

2. Failure to follow treatment protocol (or “partial compliance”)
   • some controls get the treatment
   • some of those who should be treated aren’t

3. Attrition (some subjects drop out)
   • This is a reincarnation of sample selection bias.

4. Experimental effects
   • experimenter bias (conscious or subconscious): treatment is associated with “extra effort” or “extra care”.
   • subject behavior might be affected by being in an experiment; e.g., Hawthorne Effect
Critiques of randomized experiments

- **External validity**
  - Is the effect generalizable to other samples?

- **Environmental dependence:**
  - Would providing free school lunch have the same effect in Norway and in Kenya?
  - Obviously not, but the trickier question is where to draw the line: Is Argentina more like Norway or Kenya?

- **Implementer effects:**
  - The results may not generalize to other Non-Governmental Organization’s (NGO) for example.
  - More problematic, not every NGO wants to be evaluated: Probably a selection of more competent NGOs and better programs!

**But these issues apply to all empirical work**

- Argentina is not more like Norway because we build a model.
- Countries with better institutions often have better data.

**More critiques**

- **General equilibrium effects:** What happens if we scale up a successful program?
- **Randomization bias:** The fact that the program is evaluated using randomization affects behavior.
- **Hawthorne effect:** Being monitored changes behavior.

**Hawthorne Effect** During the 1920s and 1930s, the General Electric Company conducted a series of studies of worker productivity at its Hawthorne plant. In one set of experiments the researchers varied lightbulb wattage to see how lighting affected the productivity of women assembling electrical parts. In other experiments they increased or decreased rest periods, changed the workroom layout, and shortened workdays. Influential early reports on these studies concluded that productivity continued to rise whether the lights were dimmer or brighter, whether workdays were longer or shorter, whether conditions improved or worsened. Researchers concluded that the productivity improvements were not the consequence of changes in the workplace, but instead came about because their special role in the experiment made the workers feel noticed and valued, so they worked harder and harder. Over the years, the idea that being in an experiment influences subject behavior has come to be known as the Hawthorne Effect.

**Ethics**

- Is randomization unfair?
- Why are so many experiments from developing countries?
  - Generous interpretation: The questions merit it and there is not a lot of data to work with.
  - More cynical interpretation: It is cheap and feasible (e.g. no ethical review board).

**Why not more randomized impact evaluations?**

- Ignorance may have political advantages.
- Technical capacity may be limited.
- Benefits are not clearly appropriated to those who bear the costs: Evaluations as a public good.
- And randomization is simply not always feasible.
If randomization is not possible

- Other methods can be used to handle selection bias but they all require more assumptions.
- These identifying assumptions are not testable and the validity of any particular study depends on how convincing these assumptions appear.
- Identification strategy = research design to identify a causal effect.

5.5 Random Assignment Application: Labor Market Discrimination


5.5.1 Introduction

Motivation

- “Every measure of economic success reveals significant racial inequality in the U.S. labor market. Compared to Whites, African-Americans are twice as likely to be unemployed and earn nearly 25 percent less when they are employed (Council of Economic Advisers, 1998)”.
- When faced with observably similar African American and White applicants, do employers favor the White one?
- Some say yes because of employer prejudice or employer perception that race is a sign of an individual’s productivity.
- Others argue that differential treatment by race is not present nowadays (some also argue that affirmative action programs have produced an environment of reverse discrimination).

Difficult to empirically test these views

- White and African American workers that appear similar to researchers may look very different to employers.
- Any racial difference in labor market outcomes could be attributed to differences that are observable to employers but unobservable to researchers.
- To circumvent this difficulty, the authors conduct a field experiment.

Main Features

- Resumes are sent in response to help-wanted ads in Chicago and Boston newspapers and callback for interview for each sent resume is measured.
- The name of the fictitious job applicant is manipulated: White sounding names are randomly assigned to half the resumes, African American sounding names to the other half.
- Quality of the resume is also manipulated to see how credentials affect the racial gap in callback rates.
- Typically four resumes are sent in response to each ad: two higher quality and two lower quality ones (an African American sounding name is randomly assigned to one of the higher and one of the lower quality resumes)

Experimental Design

- Create a Bank of Resumes: resumes posted on two job search websites from people seeking employment in four occupational categories in Boston and Chicago and posted more than six months prior to the start of the experiment
- Resumes within each detailed occupational category are classified into two groups: high and low quality.
- To minimize similarity to actual job seekers, resumes from Boston job seekers are to be sent out in Chicago and the other way around.
Identities of Fictitious Applicants

- The authors use name frequency data calculated from birth certificates of all babies born in Massachusetts between 1974 and 1979 to choose uniquely African American and uniquely White names.
- Applicants in each race/sex-city/resume quality cell are allocated the same phone number.
- Fictitious addresses based on real streets in Boston and Chicago are used. Within cities, addresses are randomly assigned across all resumes.

Responding to Ads

- The experiment was carried out between July 2001 and January 2002 in Boston and between July 2001 and May 2002 in Chicago.
- All employment ads except those where applicants were asked to call or appear in person.
- For each ad, the authors use the bank of resumes to sample four resumes (two high-quality and two low-quality) that fit the job description and requirements as closely as possible.
- One of the high and one of the low quality resumes selected are then drawn at random to receive African American names, the other high and low resumes receive White names.
- Male and female names are assigned for sales jobs, nearly exclusively female names for administrative and clerical jobs to increase callback rates.
- The final resumes are formatted, with fonts, layout and cover letter style chosen at random. The resumes are then faxed (or in a few cases mailed) to the employer.
- All in all, more than 1300 employment ads and almost 5000 resumes.

Callback Rates by Racial Soundingness of Names

<table>
<thead>
<tr>
<th></th>
<th>Percent Callback for White Names</th>
<th>Percent Callback for African-American Names</th>
<th>Ratio</th>
<th>Percent Difference (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample:</td>
<td>9.65</td>
<td>6.45</td>
<td>1.50</td>
<td>3.20</td>
</tr>
<tr>
<td>All sent resumes</td>
<td>[2,435]</td>
<td>[2,435]</td>
<td></td>
<td>[0.0000]</td>
</tr>
</tbody>
</table>

Table 3: Mean Callback Rates by Racial Soundingness of Names†

† Table 1 Bertrand and Mullainathan, AER(2004)

- The return to a White name is 3.2 percentage points (compared to having an African American name).
- Applicants with White names need to send about 10 resumes to get one callback. Applicants with African American names, 15.

Comparing the Effect of the Name with Other Resume Characteristics

- At the average number of years of experience in the sample, an extra year of experience increases the likelihood of a callback by a 0.4 percentage point. Based on this estimate, the return to a White name is equivalent to about 8 additional years of experience.
- Whites with higher quality resumes receive nearly 30 percent more callbacks than Whites with lower quality resumes.
- In contrast, having a higher quality resume has a smaller effect for African Americans.

Other Aspects

- Living in a wealthier (or more educated or Whiter) neighborhood increases callback rates.
- But, interestingly, African Americans are not helped more than Whites by living in a “better” neighborhood.
- Racial gaps in callback are statistically indistinguishable across all the occupation and industry categories covered in the experiment.
- Federal contractors, do not treat the African American resumes more preferentially. Neither do “Equal Opportunity Employers”.

University of Illinois at Chicago
Weaknesses

- Outcome measure is crude: who gets the job?
- Resumes do not directly report race:
  - Some employers may simply not notice the names or not recognize their racial content.
- Results are not representative of the average African American, who may not have such a racially distinct name.
- Finally, newspaper ads represent only one channel for job search.

Interpretation

- Does a higher callback rate for White applicants imply that employers are discriminating against African Americans?
- Does the design only isolate the effect of race or is the name manipulation conveying some other factors than race?

Callback Rates

- In a racially neutral review process, employers would rank order resumes based on their quality and call back all applicants that are above a certain threshold.
- Because names are randomized, the White and African-American resumes should rank similarly on average. A race-blind selection rule would generate equal treatment of Whites an African-Americans.
- So results must imply that employers use race as a factor when reviewing resumes, which matches the legal definition of discrimination.
- But even rules where employers are not trying to interview as few African American applicants as possible may generate observed differential treatment in the experiment.
- One such hiring rule would be employers trying to produce an interview pool that matches the population base rate.
- This rule could produce the observed differential treatment if the average firm receives a higher proportion of African-American resumes than the population base rate because African-Americans disproportionately apply to the jobs and industries in the experiment’s sample.
- Some of the findings may be consistent with such a rule. For example, the fact that “Equal Opportunity Employers” or federal contractors do not appear to discriminate any less may reflect the fact that such employers receive more applications from African-Americans
- However, other key findings run counter to this rule:
  - no systematic difference in the racial gap in callback across occupational or industry categories, despite the large variation in the fraction of African-Americans looking for work in those categories
  - this rule also runs counter to our findings on returns to skill: if firms are struggling to find White applicants but overwhelmed with African American ones, then they should be less sensitive to the quality of White applicants and much more sensitive to the quality of Black applicants (when they have so many to pick from).

Social Background

- One might be concerned that employers are inferring social background from the personal name. When employers read a name like “Tyrone” or “Latoya”, they may assume that the person comes from a disadvantaged background.
- Results are hard to reconcile with this interpretation: While employers value “better” addresses, African Americans are not helped more than Whites by living in whiter or more educated neighborhoods.
- Using data on mother’s education in birth certificate data for babies born in Massachusetts between 1970 and 1986, the authors find:
Consistent with a social background interpretation, the chosen African American names fall below the African American average level of mother’s education.

For African American male names, however, the gap between mother’s education for the experimental names and the population average is negligible.

For White names, both the male and female names are above the population average.

But, there is substantial between-name heterogeneity in social background.

This allows for a direct test of the social background hypothesis within our sample:

Are names associated with a worse social background discriminated against more?

The authors find no correlation between callback rates and mother’s education.

---

**TABLE 8—CALLBACK RATE AND MOTHER’S EDUCATION BY FIRST NAME**

<table>
<thead>
<tr>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emily</td>
<td>7.9</td>
<td>96.6</td>
<td>Aisha</td>
<td>2.2</td>
<td>77.2</td>
</tr>
<tr>
<td>Anne</td>
<td>8.3</td>
<td>93.1</td>
<td>Keisha</td>
<td>3.8</td>
<td>68.8</td>
</tr>
<tr>
<td>Jill</td>
<td>8.4</td>
<td>92.3</td>
<td>Tamika</td>
<td>5.5</td>
<td>61.5</td>
</tr>
<tr>
<td>Allison</td>
<td>9.5</td>
<td>95.7</td>
<td>Lakisha</td>
<td>5.5</td>
<td>55.6</td>
</tr>
<tr>
<td>Laurie</td>
<td>9.7</td>
<td>93.4</td>
<td>Tausha</td>
<td>5.8</td>
<td>64.0</td>
</tr>
<tr>
<td>Sarah</td>
<td>9.8</td>
<td>97.9</td>
<td>Latoya</td>
<td>8.4</td>
<td>55.5</td>
</tr>
<tr>
<td>Meredith</td>
<td>10.2</td>
<td>81.8</td>
<td>Kenya</td>
<td>8.7</td>
<td>70.2</td>
</tr>
<tr>
<td>Carrie</td>
<td>13.1</td>
<td>80.7</td>
<td>Latanya</td>
<td>9.1</td>
<td>31.3</td>
</tr>
<tr>
<td>Kristen</td>
<td>13.1</td>
<td>93.4</td>
<td>Ebony</td>
<td>9.6</td>
<td>65.6</td>
</tr>
</tbody>
</table>

Table: Average: White female = 91.7, Overall = 83.9, Correlation = -0.318 \((p = 0.404)\)

<table>
<thead>
<tr>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aisha</td>
<td>2.2</td>
<td>77.2</td>
<td>Keisha</td>
<td>3.8</td>
<td>68.8</td>
</tr>
<tr>
<td>Tamika</td>
<td>5.5</td>
<td>61.5</td>
<td>Lakisha</td>
<td>5.5</td>
<td>55.6</td>
</tr>
<tr>
<td>Tausha</td>
<td>5.8</td>
<td>64.0</td>
<td>Latoya</td>
<td>8.4</td>
<td>55.5</td>
</tr>
<tr>
<td>Kenya</td>
<td>8.7</td>
<td>70.2</td>
<td>Latanya</td>
<td>9.1</td>
<td>31.3</td>
</tr>
<tr>
<td>Ebony</td>
<td>9.6</td>
<td>65.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table: Average: African-American female = 61.0, Overall = 70.2, Correlation = -0.383 \((p = 0.309)\)

---

<table>
<thead>
<tr>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Todd</td>
<td>5.9</td>
<td>87.7</td>
<td>Rasheed</td>
<td>3.0</td>
<td>77.3</td>
</tr>
<tr>
<td>Neal</td>
<td>6.6</td>
<td>85.7</td>
<td>Tremayne</td>
<td>4.3</td>
<td>—</td>
</tr>
<tr>
<td>Geoffrey</td>
<td>6.8</td>
<td>96.0</td>
<td>Kareem</td>
<td>4.7</td>
<td>67.4</td>
</tr>
<tr>
<td>Brett</td>
<td>6.8</td>
<td>93.9</td>
<td>Darnell</td>
<td>4.8</td>
<td>66.1</td>
</tr>
<tr>
<td>Brendan</td>
<td>7.7</td>
<td>96.7</td>
<td>Tyrone</td>
<td>5.3</td>
<td>64.0</td>
</tr>
<tr>
<td>Greg</td>
<td>7.8</td>
<td>88.3</td>
<td>Hakam</td>
<td>5.5</td>
<td>73.7</td>
</tr>
<tr>
<td>Matthew</td>
<td>9.0</td>
<td>93.1</td>
<td>Jamal</td>
<td>6.6</td>
<td>73.9</td>
</tr>
<tr>
<td>Jay</td>
<td>13.4</td>
<td>85.4</td>
<td>Leroy</td>
<td>9.4</td>
<td>53.3</td>
</tr>
<tr>
<td>Brad</td>
<td>15.9</td>
<td>90.5</td>
<td>Jermone</td>
<td>9.6</td>
<td>57.5</td>
</tr>
</tbody>
</table>

Table: Average: White male = 91.7, Overall = 83.5, Correlation = -0.0251 \((p = 0.949)\)

<table>
<thead>
<tr>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
<th>Name</th>
<th>Percent callback</th>
<th>Mother education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rasheed</td>
<td>3.0</td>
<td>77.3</td>
<td>Tremayne</td>
<td>4.3</td>
<td>—</td>
</tr>
<tr>
<td>Kareem</td>
<td>4.7</td>
<td>67.4</td>
<td>Darnell</td>
<td>4.8</td>
<td>66.1</td>
</tr>
<tr>
<td>Tyrone</td>
<td>5.3</td>
<td>64.0</td>
<td>Hakam</td>
<td>5.5</td>
<td>73.7</td>
</tr>
<tr>
<td>Jamal</td>
<td>6.6</td>
<td>73.9</td>
<td>Leroy</td>
<td>9.4</td>
<td>53.3</td>
</tr>
<tr>
<td>Jermone</td>
<td>9.6</td>
<td>57.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table: Average: African-American male = 66.7, Overall = 68.9, Correlation = -0.595 \((p = 0.120)\)

---

**Figure 11: Callback Rate and Mother’s Education by First Name**

**Familiarity**

- One could also argue that the African American names used in the experiment simply appear odd to human resource managers and that any odd name is discriminated against.

- However, the authors find no correlation between name-specific callback rates and name frequency within each gender-race group.
Reverse Discrimination

• Perhaps what appears as a bias against African Americans is actually the result of reverse discrimination.

• If qualified African Americans are thought to be in high demand, then employers might feel that an equally talented African American would never accept an offer from them.

• But this interpretation would suggest that among the better jobs, there should be a smaller racial gap.
6 Appendices

6.1 Common Latin Phrases

<table>
<thead>
<tr>
<th>Phrase</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a priori</td>
<td>Pre-supposed; your “priors beliefs”.</td>
</tr>
<tr>
<td>ad hoc</td>
<td>“for this”; formed or used for specific or immediate problems or needs</td>
</tr>
<tr>
<td>ad infinitum</td>
<td>To infinity; and so on.</td>
</tr>
<tr>
<td>ad valorem</td>
<td>Per value; a 10% tax is an ad valorem tax, whereas a duty per gallon of gasoline is not.</td>
</tr>
<tr>
<td>ceteris paribus</td>
<td>All else equal; all else held constant</td>
</tr>
<tr>
<td>de facto</td>
<td>For all practical purposes, but not officially.</td>
</tr>
<tr>
<td>de jure</td>
<td>By law.</td>
</tr>
<tr>
<td>ex ante</td>
<td>Before the event; in anticipation.</td>
</tr>
<tr>
<td>ex post</td>
<td>After the event; in retrospect.</td>
</tr>
<tr>
<td>per se</td>
<td>Literally; by itself.</td>
</tr>
<tr>
<td>prima facie</td>
<td>In the first instance; at first glance.</td>
</tr>
<tr>
<td>Q.E.D.</td>
<td>As has been asked to be shown; done.</td>
</tr>
<tr>
<td>ultra vires</td>
<td>Beyond their power, e.g. the court ruled that Congress were acting ultra vires.</td>
</tr>
</tbody>
</table>

Table 4: Common Latin Phrases

6.2 Greek Alphabet

<table>
<thead>
<tr>
<th>Lower-case</th>
<th>Upper-case</th>
<th>Pronunciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>α</td>
<td>A</td>
<td>Alpha</td>
</tr>
<tr>
<td>β</td>
<td>B</td>
<td>Beta</td>
</tr>
<tr>
<td>γ</td>
<td>Γ</td>
<td>Gamma</td>
</tr>
<tr>
<td>δ</td>
<td>Δ</td>
<td>Delta</td>
</tr>
<tr>
<td>ε</td>
<td>E</td>
<td>Epsilon</td>
</tr>
<tr>
<td>ζ</td>
<td>Z</td>
<td>Zeta</td>
</tr>
<tr>
<td>η</td>
<td>H</td>
<td>Eta</td>
</tr>
<tr>
<td>θ</td>
<td>Θ</td>
<td>Theta</td>
</tr>
<tr>
<td>ι</td>
<td>I</td>
<td>Iota</td>
</tr>
<tr>
<td>κ</td>
<td>K</td>
<td>Kappa</td>
</tr>
<tr>
<td>λ</td>
<td>Λ</td>
<td>Lambda</td>
</tr>
<tr>
<td>μ</td>
<td>M</td>
<td>Mu</td>
</tr>
<tr>
<td>ν</td>
<td>N</td>
<td>Nu</td>
</tr>
<tr>
<td>ξ</td>
<td>Ξ</td>
<td>Xi</td>
</tr>
<tr>
<td>ο</td>
<td>O</td>
<td>Omicron</td>
</tr>
<tr>
<td>π</td>
<td>Π</td>
<td>Pi</td>
</tr>
<tr>
<td>ρ</td>
<td>P</td>
<td>Rho</td>
</tr>
<tr>
<td>σ</td>
<td>Σ</td>
<td>Sigma</td>
</tr>
<tr>
<td>τ</td>
<td>T</td>
<td>Tau</td>
</tr>
<tr>
<td>υ</td>
<td>Υ</td>
<td>Upsilon</td>
</tr>
<tr>
<td>ϕ</td>
<td>Φ</td>
<td>Phi</td>
</tr>
<tr>
<td>χ</td>
<td>X</td>
<td>Chi (rhymes with ‘guy’)</td>
</tr>
<tr>
<td>ψ</td>
<td>Ψ</td>
<td>Psi (like ‘Si’)</td>
</tr>
<tr>
<td>ω</td>
<td>Ω</td>
<td>Omega</td>
</tr>
</tbody>
</table>

Table 5: Greek Alphabet
References

