

# Empirical Economic Modeling

## Structuralist/experimentalist/unified approaches

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## Illustration: labor choice

What is the effect of wages  $w$  on hours worked  $h$ ?

Given data  $(w_i, h_i)_{i=1}^N$ , estimate this regression:

$$\ln h_i = \beta_0 + \beta_1 \ln w_i + u_i$$

In Stata: regress lnh lnw, vce(robust)

vce(robust) calculates White-corrected standard errors

## Illustration: labor choice (cont'd)

What is the most parsimonious model that reduces to this equation?

Economics research is all about empathy

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$$\begin{aligned} \max_{c,h} \quad & u(c, h) = c - \gamma h^\alpha \\ \text{s.t.} \quad & c \leq wh \end{aligned}$$

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$$\leadsto h = (\gamma\alpha)^{\frac{1}{1-\alpha}} w^{\frac{1}{\alpha-1}} \Rightarrow \ln h = \underbrace{\frac{1}{1-\alpha} \ln(\gamma\alpha)}_{\doteq \beta_0} + \underbrace{\frac{1}{\alpha-1} \ln w}_{\doteq \beta_1}$$

$\beta_1$  is called ...

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$\beta_1$  is called ...the wage elasticity of labor supply

## Illustration: labor choice (cont'd)

Structural model with structural parameters:

$$\begin{aligned} \max_{c,h} \quad & u(c, h) = c - \gamma h^\alpha \\ \text{s.t.} \quad & c \leq wh \end{aligned}$$

Reduced form with reduced-form parameters:

$$\ln h = \beta_0 + \beta_1 \ln w$$

We just showed how to reduce the structural model:

$$\begin{aligned} \beta_0 &= \frac{1}{1-\alpha} \ln(\gamma\alpha) \\ \beta_1 &= \frac{1}{\alpha-1} \end{aligned}$$

# General concepts

Structural model:

- Full model of economic behavior
- Structural parameters capture mechanisms

Reduced form:

- Reduced-form parameters are a function of structural parameters
- The function is not necessarily invertible!
- I.e., you might not be able to recover the structural parameters from the reduced form

# Why model economic behavior?

We cannot observe behavior (at scale), only outcomes



# Why model economic behavior?

We want to understand how the world works

- What mechanisms are at play?
- How do aggregate outcomes emerge?

We want to understand what a different world would be like

- What if parameters would take a different value?
- What if we shut down certain mechanisms?

We want to understand how policies affect outcomes

⇒ We need both theory and empirics

- Only theory: cannot assess real-world relevance
- Only empirics: cannot interpret/extrapolate from results

Example 1: markets for lemons

Example 2: American Recovery and Reinvestment Act of 2009

# A very brief history of modern economic thought

1930: Econometric Society

- “for the advancement of economic theory in its relation to statistics and mathematics”

1939: Cowles Commission

- Explicit probabilistic framework + simultaneous equations model

1976: the Lucas critique

- Tomorrow's behavior will adapt to today's policy so one cannot blindly forecast

'70s-'80s: microfoundations

- Better theory: “deep” parameters

'90s-'00s: the Credibility Revolution

- Better empirics: (quasi-)experimental research designs

'10s onwards: the “Great Reunification”

- Cutting-edge papers combine theory with empirics

# How I read economics papers

Sidenote

I don't read papers and you shouldn't either

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Sidenote

I don't read papers and you shouldn't either

1. Authors, title, abstract      ⇒ relevance to my work
2. Beginning of introduction    ⇒ importance
3. “In this paper [...]”        ⇒ what the paper does
4. Skim model section          ⇒ how the paper does it
5. End of abstract              ⇒ headline result
6. End of introduction        ⇒ (policy) implications
7. Literature review          ⇒ contribution

Conditional on making it past 1., average time to “read” is 45 seconds

Instead of reading lots of papers, *learn* the few relevant ones

# My ideal structure for a successful introduction

Sidenote

1. Hook setting the scene
2. What we do research question & headline result
3. Why we do it relevance
4. How we do it methods
5. What we find results
6. What we learn policy implications
7. What the contribution is literature overview

I expect the introduction of your papers to follow this structure

## '70s-'80s: microfoundations

Example

Rust, John (1987). Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher. *Econometrica* 55(5), 999-1033.



# '70s-'80s: microfoundations

Example

Rust (1987 ECMA). An Empirical Model of Harold Zurcher



# '70s-'80s: microfoundations

Example

Rust (1987 ECMA). An Empirical Model of Harold Zurcher

**Research question:** When to replace bus engines?

## Theory

- Optimal stopping problem
- Stochastic engine failure, mileage accumulation
- If replace engine, mileage resets  $\Rightarrow$  replace engine if above threshold mileage

## Empirics

- Data on bus engine replacement record in Madison, WI (Harold Zurcher)
- Nested fixed point MLE algorithm does not require a full solution
- Implied demand for bus engine replacement

Meta paper, famous for its technical contribution

## Structuralist approach

- o. Formulate a relevant and important research question
1. Propose a structural model that can answer it
2. Obtain structural parameter values from data
3. Simulate policy counterfactuals

+

- Can do counterfactuals
- Can illustrate mechanisms
- Can pit mechanisms against each other
- Can be used as building blocks

-

- Entry cost can be large
- Empirical methods can be opaque
- Can be hard to communicate

Estimation vs. calibration

## '90s-'oos: the Credibility Revolution

Example

Angrist, Joshua D. (1990). Lifetime Earnings and the Vietnam Era Draft Lottery: Evidence from Social Security Administrative Records. *American Economic Review* 80(3), 313-336.



# '90s-'oos: the Credibility Revolution

Example

Angrist (1990 AER). Lifetime Earnings and Vietnam Era Draft Lottery



# '90s-'oos: the Credibility Revolution

Example

Angrist (1990 AER). Lifetime Earnings and Vietnam Era Draft Lottery

**Research question:** How large are the earnings losses of veterans?

## Theory

- “[M]ilitary experience is a poor substitute for lost civilian labor market experience”
- Return to experience is lower for veterans

## Empirics

- Vietnam draft lottery (Random Sequence Number 1–365)
- Compare earnings of drafted vs. non-drafted after the war

Non-technical paper, famous for quasi-experimental research design

# Experimentalist approach

- o. Formulate a relevant and important research question
1. Find a (quasi-)experiment that can answer it
2. Calculate treatment effect

+

Easy to implement  
Research design is credible  
Easier to communicate

-

Cannot do counterfactuals  
Can be hard/impossible to find (quasi-)experiments  
Tempting to be atheoretical

“Structural” vs. “reduced-form” camps

# '10s onwards: the “Great Reunification”

Example 1

Méndez, Esteban and Diana Van Patten (2022). Multinationals, Monopsony, and Local Development: Evidence from the United Fruit Company. *Econometrica* 90(6), 2685-2721.



# '10s onwards: the “Great Reunification”

Example 1

Méndez and Van Patten (2022 ECMA). Multinationals, Monopsony, and Development



# '10s onwards: the “Great Reunification”

Example 1

Méndez and Van Patten (2022 ECMA). Multinationals, Monopsony, and Development

**Research question:** How does foreign investment impact domestic economies?

## Theory

- Foreign multinationals attract domestic workers by providing amenities ...
- ...so that they can leverage monopsony power
- Long-run impact of investment in living standards

## Empirics

- Historical example: the United Fruit Company in Costa Rica, 1899–1984
- Use land concession boundaries to estimate treatment effects
- Use reduced-form techniques to rule out alternative mechanisms
- Build and estimate a parsimonious model to capture mechanisms

Insane amount of work (data, empirics—model is in Online Appendix V!)

## '10s onwards: the “Great Reunification”

Example 2

Bilal, Adrien (2023). The Geography of Unemployment. *Quarterly Journal of Economics* 138(3), 1507-1576.



# '10s onwards: the “Great Reunification”

Example 2

Bilal (2023 QJE). The Geography of Unemployment



# '10s onwards: the “Great Reunification”

Example 2

Bilal (2023 QJE). The Geography of Unemployment

**Research question:** Why is unemployment high in some places and low in others?

## Theory

- Employers choose locations based on productivity
- ⇒ spatial differences in local job losing (not finding!) rates

## Empirics

- Shows reduced-form evidence that local job losing rates vary, job finding rates do not
- Builds and estimates an extended structural model

Masterclass in writing (empirical pattern → toy model → full model → policy)

Debate: Kuhn, Manovskii and Qiu (2022a, 2022b) point out the role of vacancy flows

## Unified approach

- o. Formulate a relevant and important research question
1. Describe the underlying economic behavior
  - Propose the most parsimonious model ...
  - ...that captures all the relevant agents and most important mechanisms
2. Describe the ideal experiment that could identify the structural parameters
3. Attempt to reduce the model
  - Goal is to estimate the reduced-form parameters given data
  - If not possible, estimate/calibrate the structural model
4. Quantify policy implications
  - Reduced form  $\Rightarrow$  do back-of-the-envelope calculations and add lots of caveats
  - Structural form  $\Rightarrow$  be careful with parsimony

## Unified approach (cont'd)

Golden mean of structural and experimentalist approaches

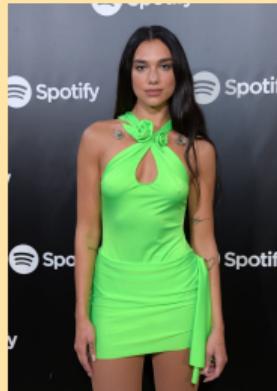
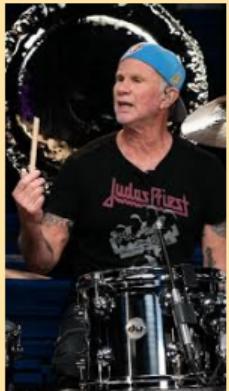
Pitfalls and solutions:

- Requires many skills ⇒ work in teams
- Takes time ⇒ plan accordingly
- Tempting to claim causality ⇒ communicate results carefully
- Tempting to oversell policy implications ⇒ communicate results carefully

I expect you to follow the unified approach in your projects

# Economics research ~ music production

Sidenote



1. Always think about the underlying economic behavior!
2. Follow the unified approach for your projects
3. Use the structure for your introduction

Next up: frontiers of various fields

- Labor, IO, macro, public
- We will not have time for all and that's okay

Matt Might: The Illustrated Guide to a Ph.D. [Link](#)