Micro Data for Macro Models

Topic 0: Course Intro and Representative Agent Macroeconomics

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January 7th, 2019

Some Thoughts on the Research Process: Three Key Skills

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    - What do you want to understand about the world?
    - Why is it important to understand that?
    - Why don’t we understand it already?

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   - Presentations (job talks)
   - Papers (job market paper)

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Typical Chicago Placements

- Slightly more than half go to academic jobs
  - About one-quarter go to top 40 departments
  - Even less end up getting tenured...
- About one quarter go to government agencies (central banks, World Bank, etc.)
- Another quarter to private sector (primarily consulting)

Publishing

- The median Ph.D. fom a top 20 department never publishes in a peer-reviewed journal
- The median peer-reviewed paper has less than 15 citations

- See `https://www.jstor.org/stable/2138379`

The Good News

- The creation of research is a skill just like inverting a matrix, solving a DSGE model, computing a standard error, etc.
  - The more you practice, the better you'll become
  - Read papers of those recently tenured at top schools. **Every one of you could have written those papers.**
- Impact on the profession comes from good ideas
- But that's something Ph.D. students are not directly taught. Typical skills that are lacking:
  - Identifying interesting research questions
  - Explaining why anyone should care about their reserarch
  - Knowing that technical skills are means, not an end

“Where Do Good Ideas Come From?”

1. Reading literature (finding holes, being unsatisfied with consensus, etc.)

2. Understand the world around us (“what drives employment?,” “how does one measure uncertainty?,” “which firms respond to interest rate cuts?,” etc.)

3. Playing around with data

4. Talking with other graduate students

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- **Pick projects you’re interested in!**
  If you’re not interested, no one else will be either.

Some Tips From a (Not So) Recent Grad Student

- **Treat this like a job** (it is one)
  - Do 30-40 hours of research per week, 48 weeks per year
  - Keep regular hours
- **Organize your workflow**
  - Write down everything you do (record your progress)
  - Make your work readable and replicable by your future self
- **Talk to faculty!**
  - Come to every meeting with something written
  - Big question $\rightarrow$ your last steps $\rightarrow$ what you did since then $\rightarrow$ your next steps

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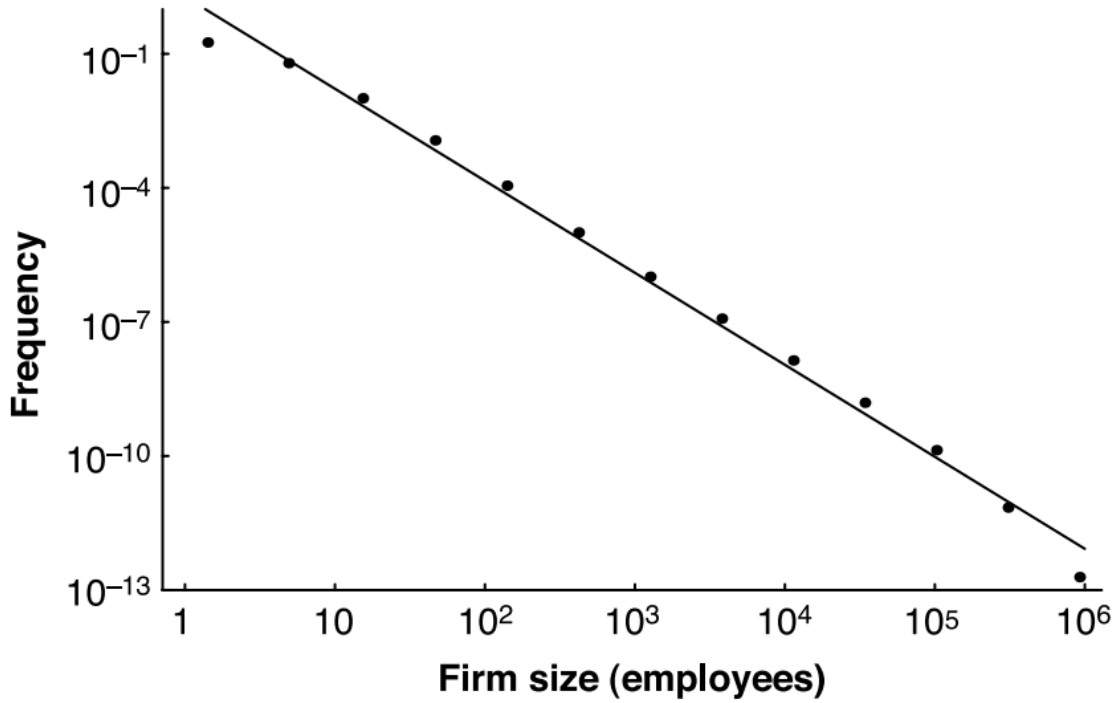
- **Talk to faculty!**
  - Come to every meeting with something written
  - Big question → your last steps → what you did since then → your next steps
- **Be happy**
  - Take one day off per week
- **Don’t be mean, aggressive, arrogant, etc.**

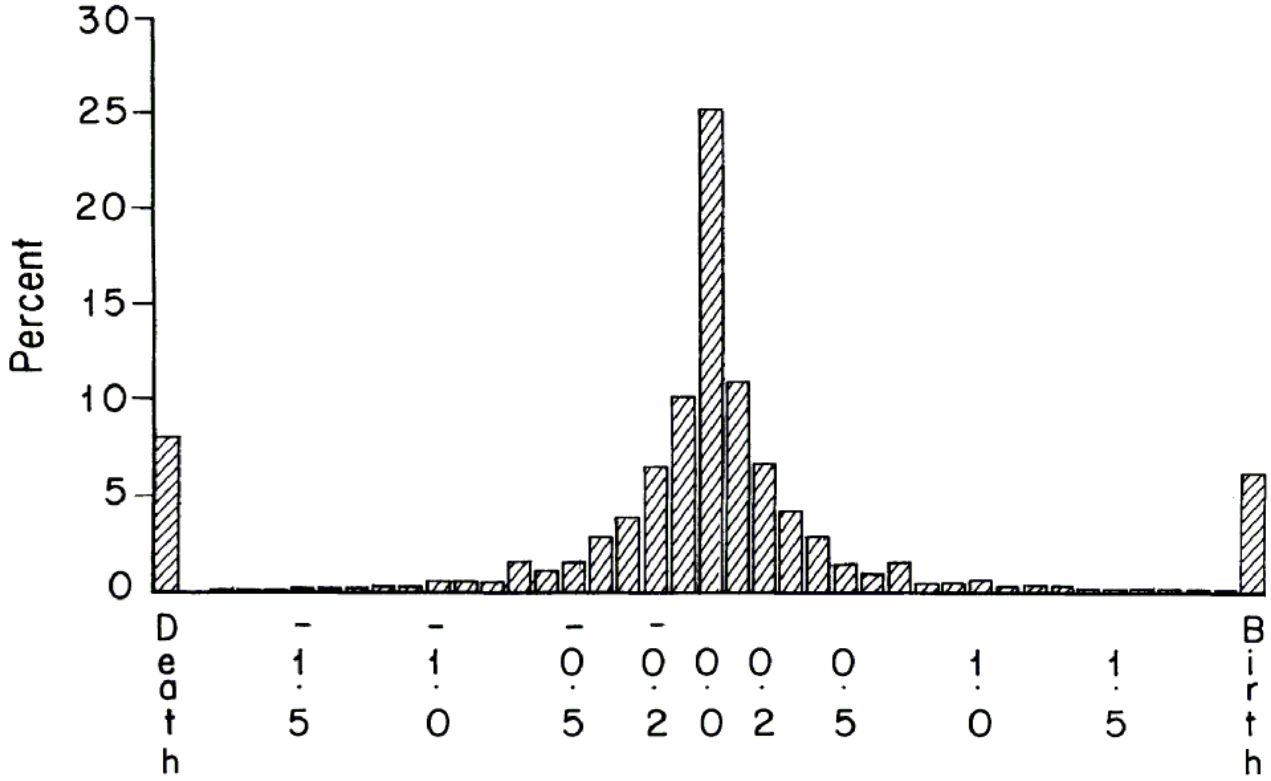
Our Half of the Course

Firm Size Distribution Has Fat Tails



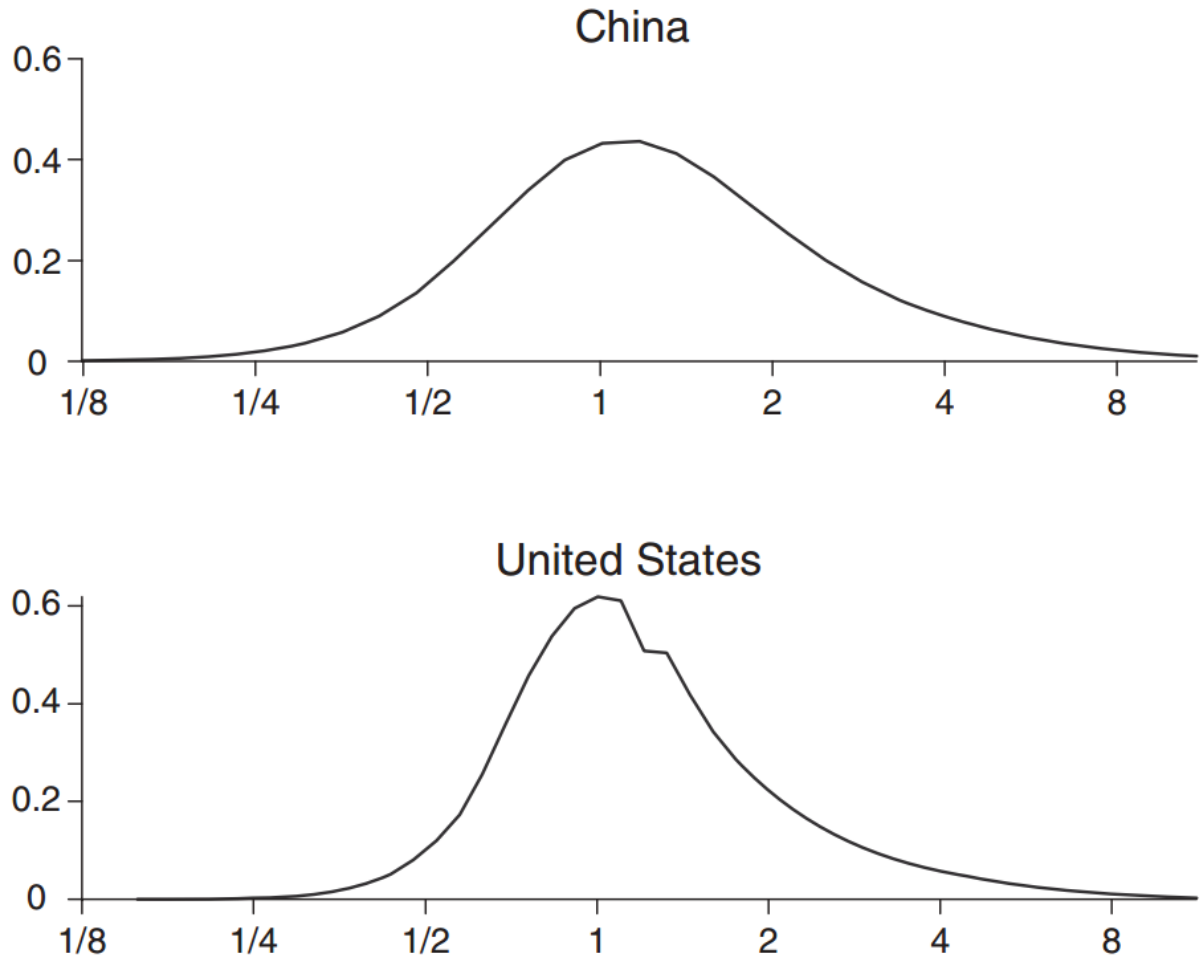
Source: Axtell (2001)

Huge Amount of Churning Among Firms



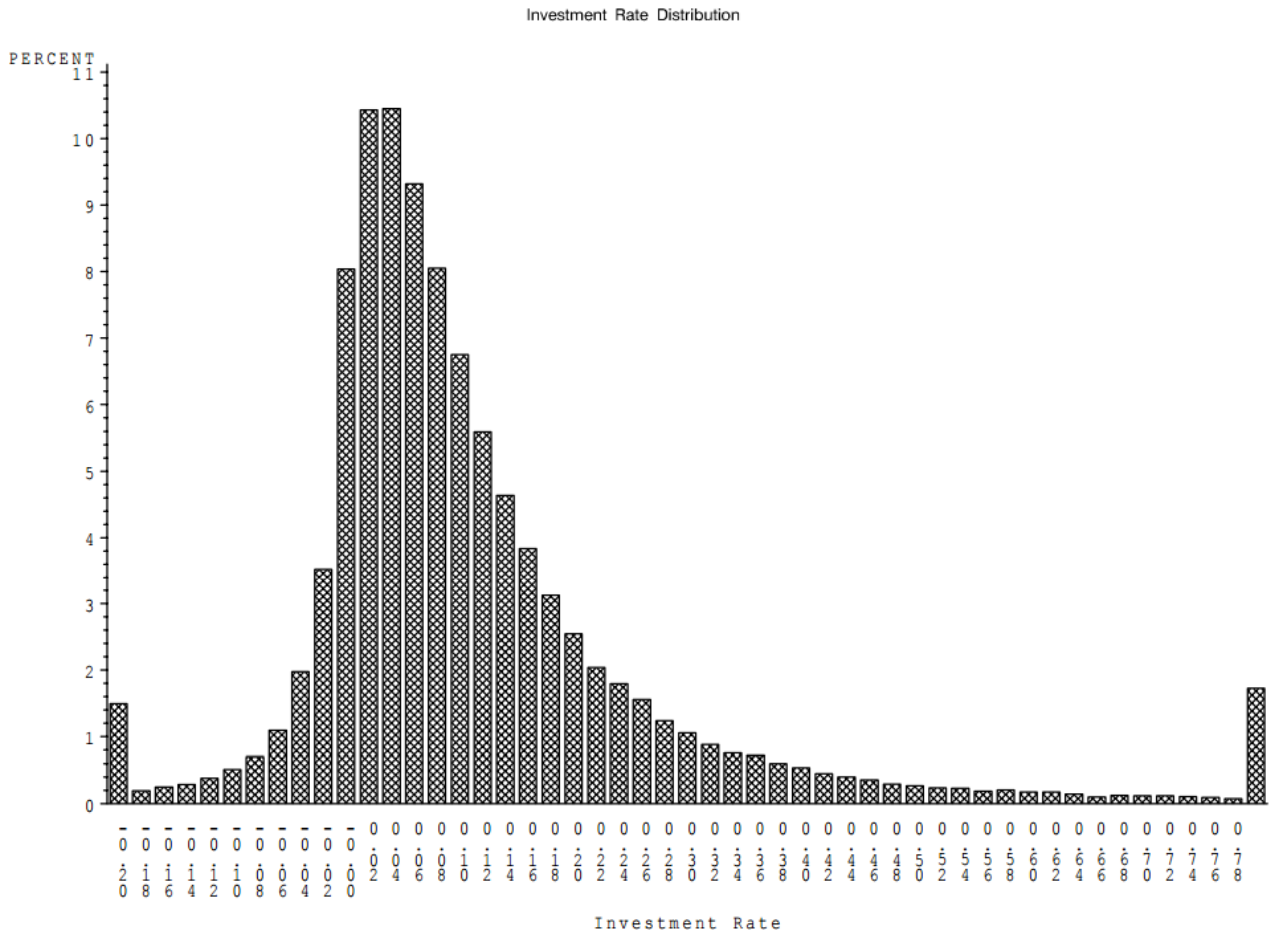
Source: Davis and Haltiwanger (1992)

Firms Have Very Different Productivity



Source: Hsieh and Klenow (2009)

Firms Have Very Different Investment Rates



Source: Cooper and Haltiwanger (2006)

Our Course

- **How does firm heterogeneity matter for aggregate outcomes?**
  - Implicit: relative to representative firm models
  - Focus on business cycles

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- Two main answers to this question:
  1. Micro data provides information to discipline models
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- Emphasize the interaction between
  1. Empirical work: documenting key features of firm behavior
  2. Models: draw implications for aggregate dynamics

Logistics

- Be prepared to discuss required readings in lecture

- Homework designed to introduce two skills:
  1. Empirical homework: estimate productivity in Compustat (due January 18th)
  2. Model homework: solve simple investment model in Matlab (due February 1st)

- Presentations of existing papers
  - Read my guide to presenting posted on my web site!!!

Representative Agent RBC Model

Environment

Preferences

- Representative household with preferences over consumption C_t and labor supply N_t

$$\mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t\left(\frac{C_t^{1-\gamma}-1}{1-\gamma}-\chi\frac{N_t^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}}\right)\right]$$

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Technology

- Aggregate production function $Y_t = e^{Z_t}K_t^{\alpha}N_t^{1-\alpha}$
- Output used for consumption or investment $C_t + I_t = Y_t$
- Capital accumulation follows $K_{t+1} = (1-\delta)K_t + I_t$
- Aggregate TFP follows $Z_{t+1} = \rho Z_t + \varepsilon_{t+1}$, where $\varepsilon_{t+1} \sim N(0, \sigma^2)$

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Endowments

- Household endowed with one unit of time each period: $N_t \in [0, 1]$
- Household endowed with K_0 units of capital in $t = 0$

Equilibrium

Definition: Given K_0 and z_0, a sequential markets competitive equilibrium is a list of stochastic processes for C_t, K_{t+1}, N_t, w_t, r_t, and Z_t such that

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1. Household optimization: Taking the processes for w_t and r_t as given, the household solves

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such that $C_t + (K_{t+1} - (1-\delta)K_t) = w_t N_t + r_t K_t$ for all t

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3. Market clearing + consistency: For all t, $Z_{t+1} = \rho Z_t + \varepsilon_{t+1}$

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Definition: A non-stochastic steady state sequential markets competitive equilibrium is a list C^*, K^*, N^*, w^* and r^* such that if $\sigma = 0$ and $K_0 = K^*$, then $C_t = C^*, K_{t+1} = K^*, N_t = N^*, w_t = w^*$, and $r_t = r^*$ for all t is a sequential markets competitive equilibrium.

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1. Useful in calibrating parameters of the model (steady state $\approx$ long run average)

2. Useful in solving the model using perturbation methods
    - Approximates solution using Taylor expansion around steady state
    - See my website for `Dynare` code to solve RBC model (you should know how to do this!)

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   - Choose σ to set EIS = 1
   - Choose η to set Frisch = $\frac{1}{2}$ (more on this next slide)

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3. Estimate process for TFP from measured Solow residuals

$$Z_t = \log(Y_t) - \alpha \log(K_t) - (1 - \alpha) \log(N_t)$$

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  - In symmetric equilibrium, $c_{it} = C_t$, $p_{it} = N_t$, and everyone's utility is

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- Even if micro-level $\eta \to 0$, macro-level $\eta \to \infty$!

Impulse Response Analysis

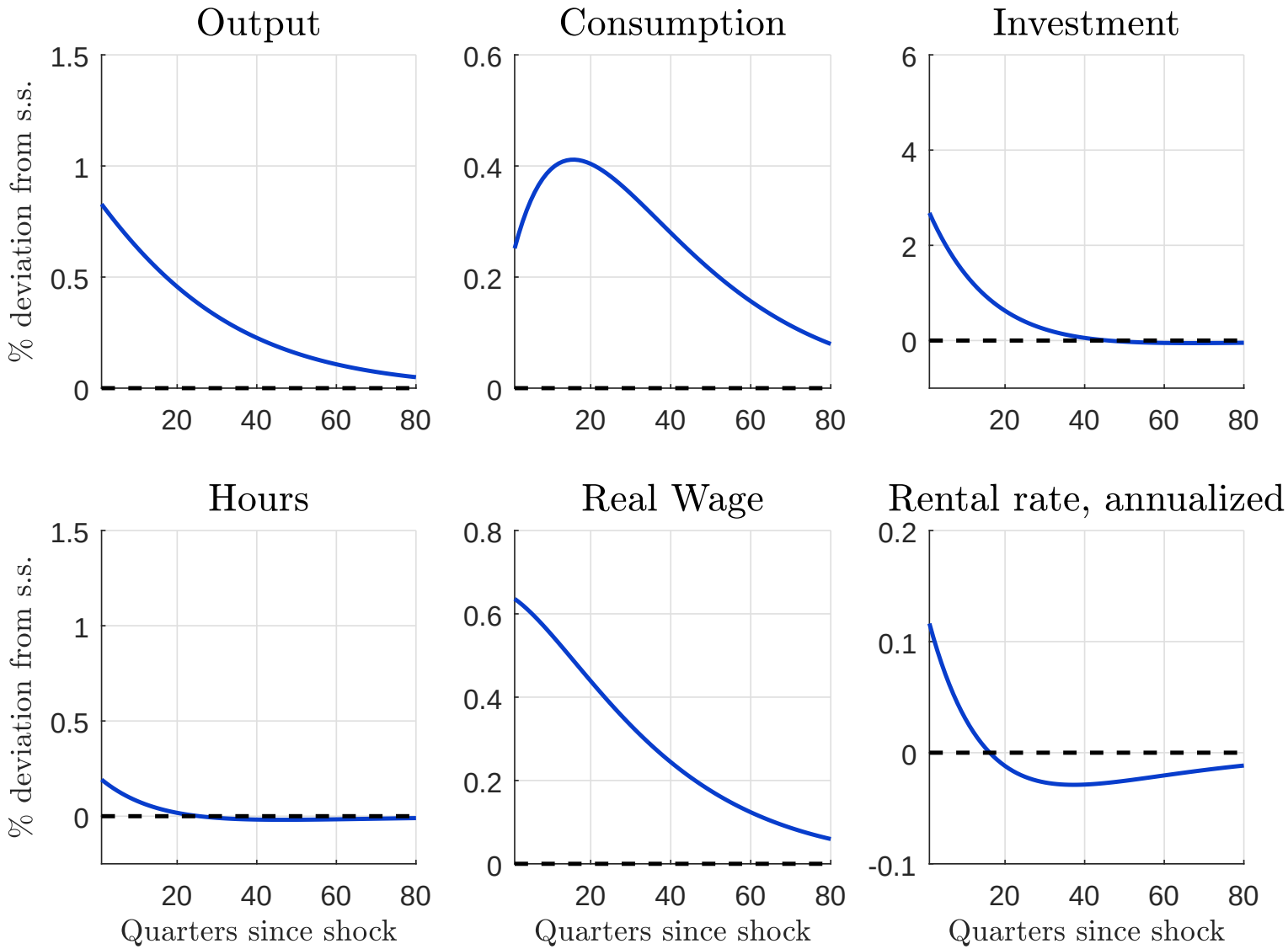
- An **impulse response function** traces out how a one-time shock affects dynamics of the economy

$$\mathbb{E}[Y_{t+s}|\varepsilon_t = \sigma, K_t, z_t] - \mathbb{E}[Y_{t+s}|\varepsilon_t = 0, K_t, z_t]$$

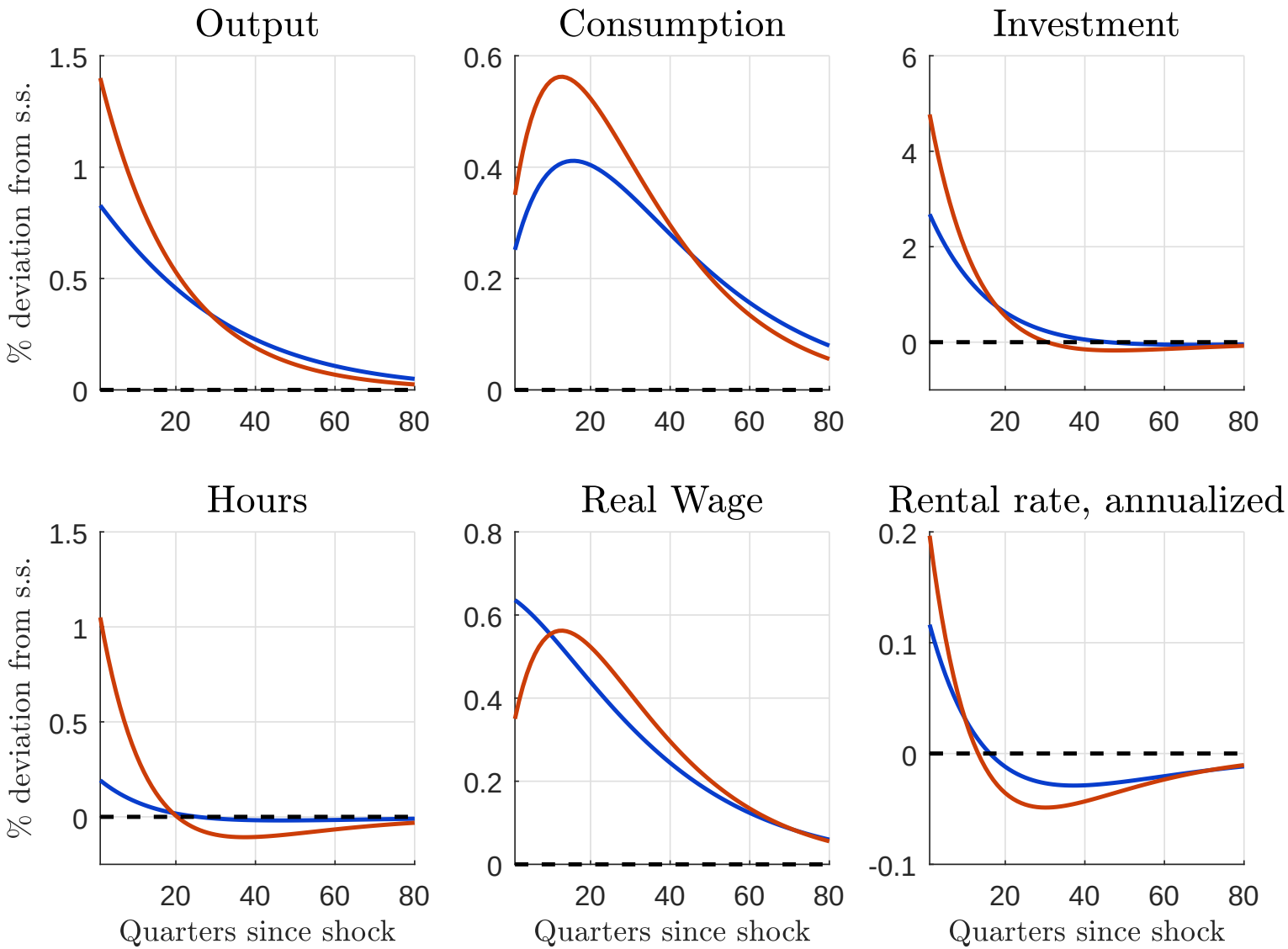
  - In principle, depends on K_t, z_t, and size of the shock
  - But in linear models, does not

- Clear and simple way to understand economic mechanisms in model

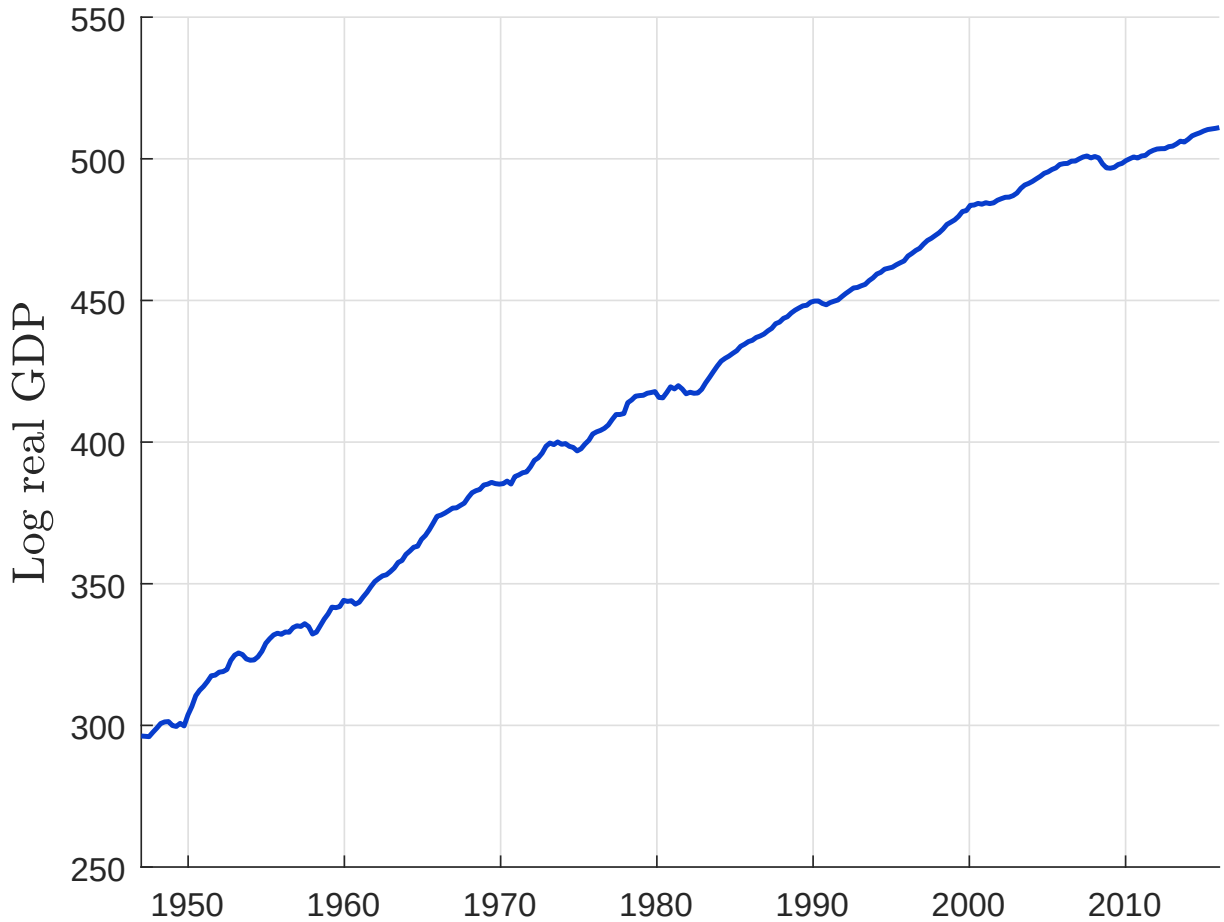
Impulse Response to TFP Shock, $\eta = \frac{1}{2}$



Impulse Response to TFP Shock, $\eta \to \infty$



Cyclical Fluctuations with Hodrick-Prescott Filter



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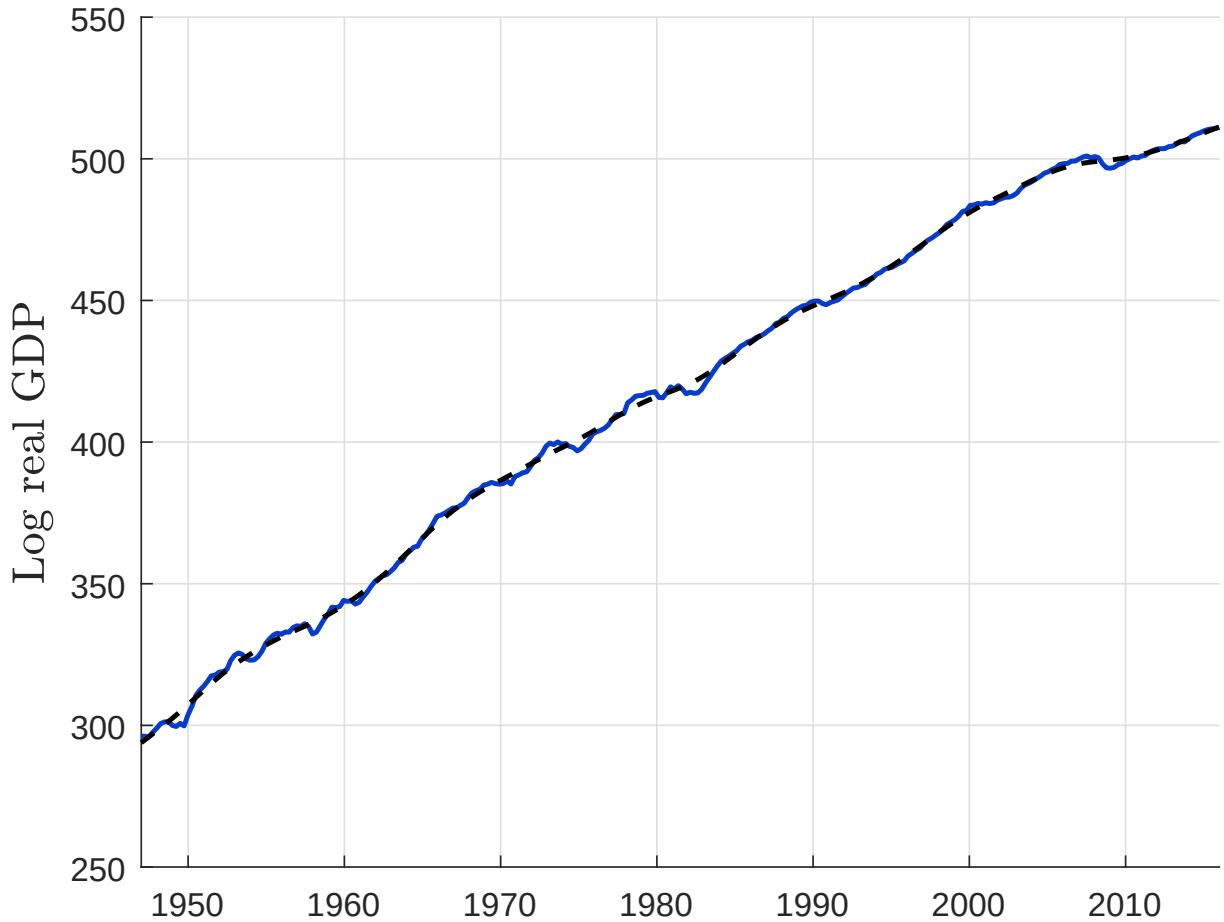

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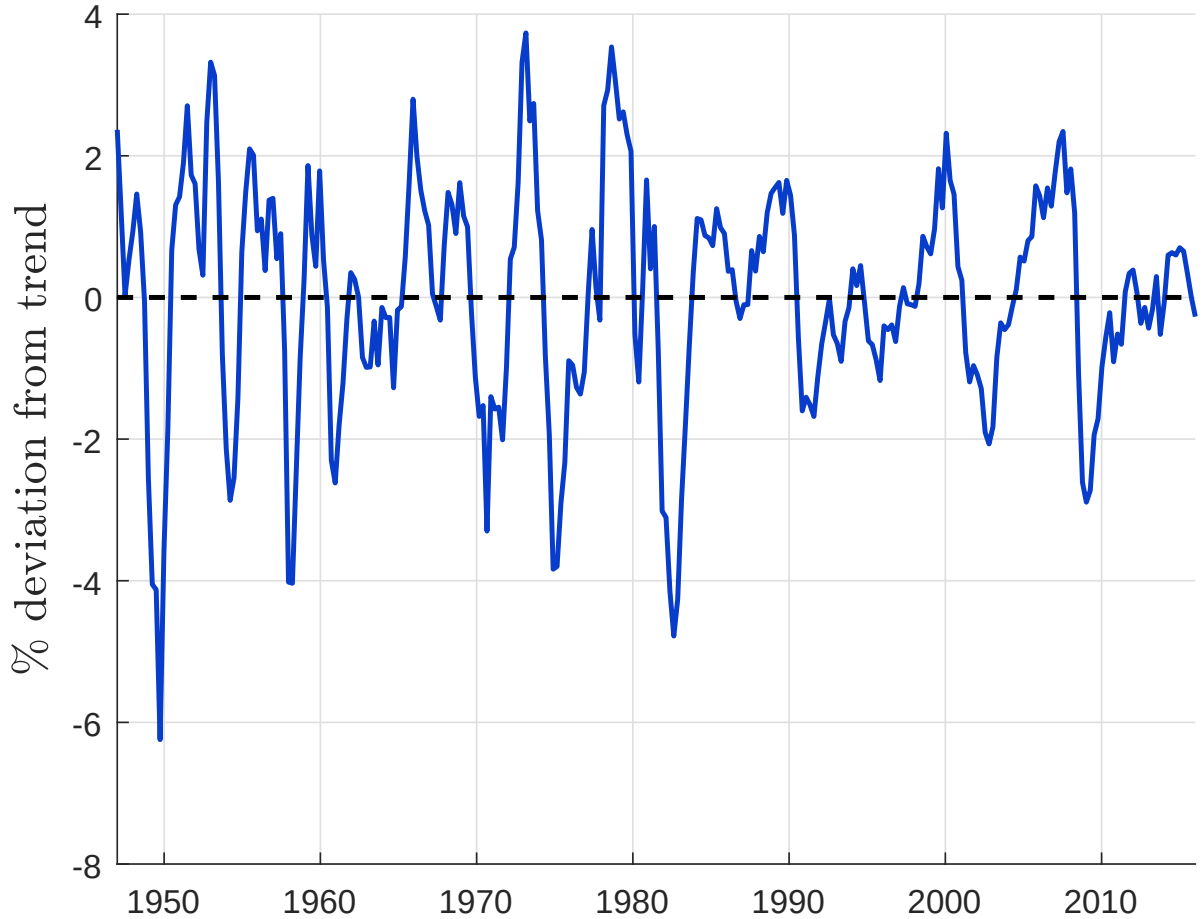

Business Cycle Statistics in the Data

	Volatilities (rel. to $\sigma(y_t)$)				
	$\sigma(y_t)$	$\sigma(c_t)$	$\sigma(i_t)$	$\sigma(n_t)$	$\sigma(r_t)$
Data	(1.62%)	0.53	2.87	1.17	(2.18%)

	Correlations w/ output			
	$\rho(c_t, y_t)$	$\rho(i_t, y_t)$	$\rho(n_t, y_t)$	$\rho(r_t, y_t)$
Data	0.79	0.77	0.87	-0.17

Business Cycle Statistics, $\eta = \frac{1}{2}$

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Model	(1.08%)	0.35	3.24	0.24	(0.15%)

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Business Cycle Statistics, $\eta \to \infty$

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Model	(1.08%)	0.35	3.24	0.24	(0.15%)
Model	(1.82%)	0.30	3.41	0.75	(0.26%)

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Takeaways From Topic 0

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  - Methodology: model specification, equilibrium, calibration, impulse response analysis, business cycle statistics
  - Economic forces: consumption smoothing, labor supply

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- Micro data cannot be used to calibrate representative agent
  - Representative agent may look very different from micro agents
- Need to build models with explicit micro heterogeneity and aggregation
  - To use micro data, need micro agents
  - Micro data is the ONLY data we have on individual decision making