Econ 808

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Books :

1.) "Recursive Macroeconomic Theory" by Ljungqvist & Sargent
2.) "Advanced Macroeconomics" by Romer
3.) "Recursive Methods in Economic Dynamics" by Lucas & Stokey

Grades :

Problem Sets	30%
Midterm	30%
Final	40%

Topics for Today

1.) Course Overview

2.) The Lucas Critique
- Reduced Form vs. Structural Parameters
- Policy Rules vs. Policy Actions
- Positive vs. Normative Approaches to Macro

3.) Intro to Dynamic optimization.

Course Overview

Topics Covered

1.) Recursive Methods

2.) Search + Matching Models (Unemployment)

3.) Arrow - Debreu General Equilibrium

4.) Growth Theory

5.) Asset Pricing

6.) Dynamic Optimal Taxation

Omitted Topics

1.) Business Cycles

2.) Monetary Theory

3.) Most Open-Economy Issues

4.) Sticky Prices / New Keynesian Models

5.) Incomplete Markets / Heterogeneous Agents

Lucas Critique Example

Suppose firms want to maximize,

$$\max_{k_t} E_t \sum_{j=0}^{\infty} \beta^j \left\{ f_1 k_{t+j} - f_2 k_{t+j}^2 - \tau_{t+j} k_{t+j} - d(k_{t+j} - k_{t+j-1})^2 \right.$$

where

f_i : production function parameters

τ_t : tax rate on capital

d : adjustment cost parameter

β : discount rate

Optimal Policy

$$k_t = \lambda k_{t-1} - \alpha \sum_{j=0}^{\infty} \delta^j E_t \tau_{t+j}$$

Demand for capital depends negatively on current and expected future taxes.

where $\lambda(f_1, f_2, d, \beta)$ $\alpha(f_1, f_2, d, \beta)$ $\delta(f_1, f_2, d, \beta)$

Government Policy

Let Z_t = $n \times 1$ vector with first element τ_t ($\tau_t = e1' Z_t$). Remaining elements are exogenous variables that influence (and hence forecast) τ_t

Suppose

$$Z_t = A Z_{t-1} + \varepsilon_t$$

$$\Rightarrow E_t \tau_{t+j} = e1' A^j Z_t$$

} Rational Expectations Hypothesis

Substituting into firms policy function

$$k_t = \lambda k_{t-1} - \alpha e1' (I - \delta A)^{-1} Z_t$$

Implications

1.) Cross Equation Restrictions.
Investment Parameters depend on Govt. policy parameters.

2.) Importance of identifying structural parameters. Allows us to predict consequences of policy.

3.) Need to think of policy as a rule, not a sequence of isolated actions.

A Critique of the Lucas Critique

- Lucas treats the Private Sector & Govt. Asymmetrically.
- The private sector optimizes, and the govt. doesn't (or at least it didn't in the past).
- This reverses the logic of the Keynesian approach.
- In Keynesian macro, the govt. optimizes against a private sector that follows mechanical, suboptimal rules.
- Sims (1982) asks, "What if **both** optimize?"

⟹ Dynamic Game
Positive vs. Normative
Sargent (1984)
Sargent (2008)

Dynamic Optimization

Consider the following general problem,

$$\max_{u} \int_0^T f(x,u,t)\,dt$$

subject to

$$\dot{x} = g(x,u,t)$$

$$x(0) \text{ given}$$

$$u \in \mathcal{U}$$

x = state variable (e.g., wealth or capital stock)

u = control variable (e.g., consumption or investment)

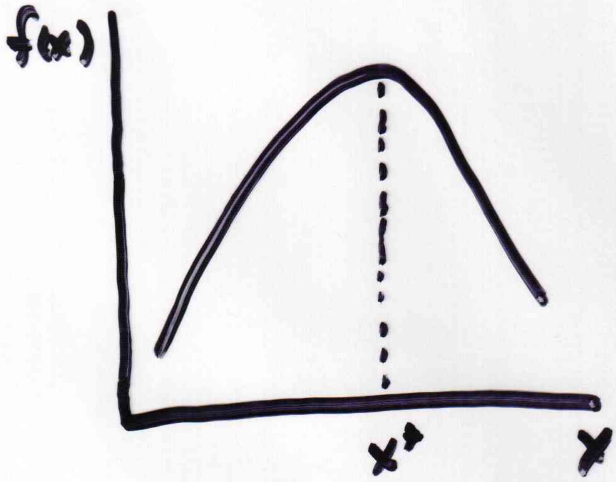
$f(\cdot)$ = return function (utility or profits)

$g(\cdot)$ = state transition eq. (budget constraints / technology)

$\mathcal{U}$ = admissable control set (e.g., continuous, differentiable, etc)

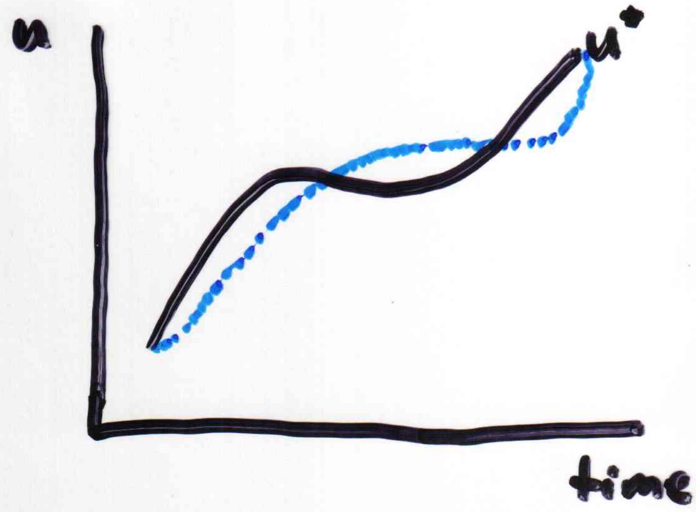
Note: The objective is an integral. Its value depends on an entire path.

Calculus



Solution is a point.
(one-dimensional).

Functional Analysis



solution is a function
(infinite number of unknowns)

Functional: A mapping from an infinite dimensional vector space to the real line.

3 General Approaches

1.) Calculus of Variations $\Longrightarrow$ Euler Eq.

(sub constraints into objective function)

2.) Optimal Control $\Longrightarrow$ Hamiltonian

(Lagrange Multipliers)

3.) Dynamic Programming $\Longrightarrow$ Bellman Eq.

(Use backward induction to split the problem into 2 parts).

In deterministic settings, it doesn't really matter which approach we use. For most stochastic problems, however, there are big advantages to Dynamic Programming.