

# What Econ721 is About

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## What Econ721 is about

We add to your library of workhorse models:

1. Overlapping generations
2. Endogenous growth
3. Search and matching models

We begin to think about empirical applications:

1. Business cycles
2. Wealth inequality

## 2. Models: Why and How?

## Setting the Stage: Goals

We will develop a lot of models ... why?

- ▶ What kinds of things can we do with models?
- ▶ How should models be designed?

One example application to fix your mind: **fiscal policy**

## Fiscal Policy Questions

We want to answer questions such as:

1. Progressive income taxes:

How do they affect output / wealth inequality?

2. Is it “better” to tax consumption or income?

3. Government debt:

How does a debt-financed tax cut affect future generations?

... and many more

## Fiscal Policy Findings

The pioneering study of fiscal policy: Auerbach and Kotlikoff (1987)

Some of their findings:

**Deficits arising from income tax cuts of short duration “crowd in” saving and investment in the short run even though saving and capital formation are crowded out in the long run by such policies.**

**Consumption taxation stimulates considerably greater savings than income or wage taxation.**

**Most of the long-run welfare gains that would result from a move to consumption taxation are due to intergenerational transfers of the tax burden rather than gains in economic efficiency.**

**Officially reported government deficits can be highly misleading indicators of the “tightness” or “looseness” of fiscal policy.**

How do we get results like these?

## Methods

How could we answer the fiscal policy questions?

Run an **experiment** (randomized controlled trial)

- ▶ Great, but not feasible

**Regressions:**

- ▶ Run a regression of saving rates on tax rates and controls
- ▶ Cross-country data?
- ▶ What goes wrong?

**Case studies:**

- ▶ Compare outcomes before after a big tax reform.
- ▶ What goes wrong?

## Methods

What else could we do?

## Models

The only method we have left to answer fiscal policy questions:

- ▶ **Build a model.**
- ▶ Somehow set its parameter values so they “match” data.
- ▶ Run counterfactual experiments in the model
  - E.g.: switch from income tax to consumption tax.

The **model as a laboratory** where we can run experiments.

The big downside:

- ▶ The answer is only as good as the model.
- ▶ And it's hard to know if the model is any good.

# What is a good model?

## Simple, but not too simple

- ▶ Only model what is truly needed to answer the question.
- ▶ Especially first generation models should be simple, understandable “benchmark” models.
- ▶ Add complexity later to check what matters.

Complex models are black boxes.

Simple models are good

Keep that in mind when you think “this is a toy model”

# What is a good model?

## Standard ingredients

- ▶ Ideally, we would use a single model to study all topics.
- ▶ That model would be too complex.

But we can re-use model “blocks” (households, firms, ...)

# What is a good model?

## General equilibrium

- ▶ Ensure that all markets clear.
- ▶ Ensure that all agents satisfy their constraints.
- ▶ Keep track of the fact that “everything affects everything”.

# What is a good model?

Individuals respond to **incentives**

- ▶ Rule of thumb behavior will not do

The defining feature of economics:

- ▶ Agents solve **optimization problems**.
- ▶ Discussion below

Agents have **reasonable expectations**

- ▶ They understand how the economy works.
- ▶ In economics: rational expectations.

## Digression

Are people really this rational?

Related: What is economics?

## The Auerbach-Kotlikoff Model

The AK model is the simplest model in which dynamic fiscal policy can be studied.

Key ingredients:

- ▶ Households make consumption/saving and labor supply decisions.
- ▶ Firms hire workers and capital.
- ▶ The government imposes various kinds of taxes.
- ▶ All markets are competitive.
- ▶ There is no uncertainty.

This is a good (first) model precisely because it is simple.

We get non-trivial results, but we can really understand them.

# Households

## Households

- ▶ live for many periods (why?)
- ▶ make decisions about
  - ▶ consumption / saving
  - ▶ labor supply / leisure
  - ▶ why those decisions?
- ▶ perfect foresight (why?)
- ▶ make all of their life choices simultaneously

## Household Problem

$$\max_{\{c_t, l_t, a_t\}} \sum_{t=1}^{55} \beta^t \mathcal{U}(c_t, l_t) \quad (1)$$

subject to the budget constraint

$$a_{t+1} + (1 + \tau_t) c_t = y_t - T(y_t) + R_t a_t \quad (2)$$

where labor income is given by

$$y_t = w_t e_t (1 - l_t) \quad (3)$$

Government vary income taxes  $T(y)$  and consumption taxes  $\tau$ .

Households respond, fully understanding changes in future taxes and prices.

## Firms

Firms are trivial.

There is one competitive firm.

It rents capital and labor from households.

It pays wage  $w_t$  and gross interest  $R_t$ .

## Government

The government issues debt  $D$  and collects taxes to pay for useless government consumption  $G$ .

Budget constraint:

$$D_{t+1} + T_t = G_t + R_tD_t \quad (4)$$

Social security collects taxes and pays transfers to the old...

## Competitive Equilibrium

Key point: An equilibrium covers all time periods.

- ▶ Households need to know the future to make their decisions.

Objects:

- ▶ Sequences of consumption, leisure, firm capital, government debt, tax rates, prices.
- ▶ For all time periods.

These satisfy:

- ▶ Given prices and tax rates, the households choose  $\{c_t, l_t\} \forall t$
- ▶ Given prices, firms are happy to hire capital and labor  $\forall t$ .
- ▶ The government budget constraint clears  $\forall t$
- ▶ Markets clear  $\forall t$  (goods, labor, bonds)

## Sample Result: Choice of Tax Base

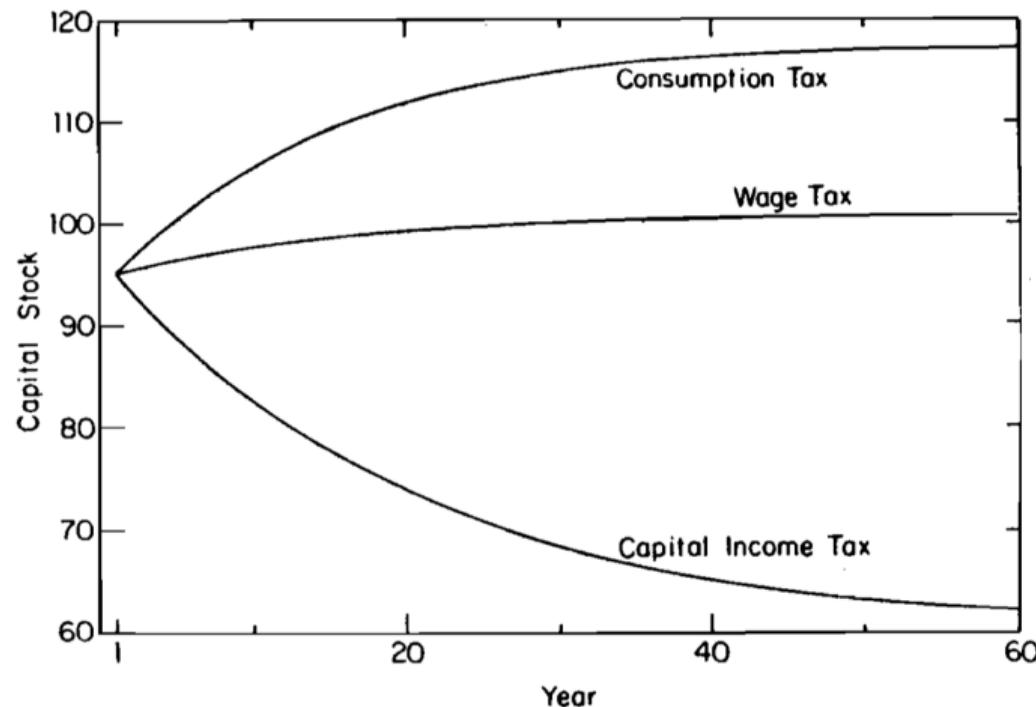


Figure 5.3. The impact on capital formation of tax reform.

We can now run counterfactual experiments in the model.

## Welfare Effects

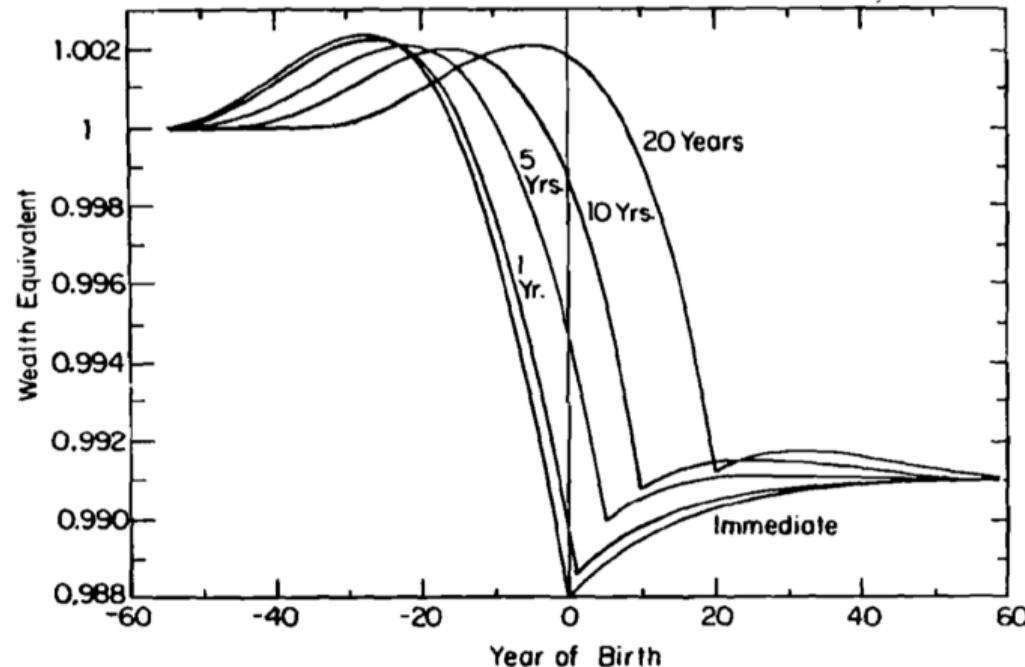


Figure 5.8. The welfare effects of preannounced switches to wage taxation.

We can compute how utility of each generation is affected.

## How to think about these results?

Models are simple; reality is not.

- ▶ Many policy effects are omitted.
- ▶ Models are misspecified (“wrong”)

**Quantitative results (the actual numbers) don't mean much.**

What we gain:

- ▶ Insights into the **main forces** at work.  
E.g.: progressive taxes reduce hours worked.
- ▶ An idea of **magnitudes**  
Which forces are likely large or small.
- ▶ Insights into what is **robust / fragile**  
By comparing results from several models.

## Key Points

1. A main goal of macro: policy analysis
2. We use **quantitative models**  
because we don't have any other tools
3. Good models start **simple**
4. Quantitative results are indications of orders of magnitude.

### 3. Competitive Equilibrium

## Model Primitives

An economy is described by

- ▶ the list of **agents**,
- ▶ their **demographics**,
- ▶ their **preferences**,
- ▶ their **endowments**,
- ▶ the **technologies** they have access to
- ▶ the **markets** in which they can trade.

Every model description should start with these elements.

You are not allowed to analyze anything until you have described these model elements.

# Competitive Equilibrium

Once we put all the pieces together and let agents interact in markets, we get a Competitive Equilibrium.

A key skill we will learn:

How to translate the description of an economy into a set of equations that characterize the **competitive equilibrium**.

## Definition

A competitive equilibrium is an **allocation** (a list of quantities) and a **price system** (a list of prices) such that

- the quantities **solve all agents' problems**, given the prices;
- all **markets clear**.

# How to Set Up a Competitive Equilibrium

## Steps:

1. Describe the economy
2. Solve each agent's problem
3. State the market clearing conditions
4. Define an equilibrium

All of this is really mechanical.

The hard part is to say something about what the equilibrium looks like.

(Ask your computer.)

## Step 1: Describe the Economy

1. List the agents (households, firms).
2. For each agent define:
  - ▶ **Demographics:**  
AK: Each period,  $N$  households are born; live for 55 periods
  - ▶ **Preferences:**  
AK:  $\sum_{t=1}^{55} \beta^t \mathcal{U}(c_t, l_t)$
  - ▶ **Endowments:**  
AK: each household has one unit of time each period.
  - ▶ **Technologies:**  
AK: output is produced using  $F(K, L)$ .
3. Define the **markets** in which agents interact.
  - ▶ AK: households work for firms; households purchase goods from firms.

## Step 2: Solve Each Agent's Problem

Write down the maximization problem each agent solves.

Derive a set of equations that determine the agent's choice variables.

- ▶ E.g.: A consumption function, saving function.
- ▶ We call these **policy functions** or **decision rules**.

### Example

A household chooses  $c$  and  $s$  to maximize utility, subject to a budget constraint.

Policy rules:  $c = f(y, p)$  and  $s = g(y, p)$

## Step 3: Market Clearing

For each market, calculate supply and demand by each agent.

- ▶ Aggregate supply =  $\sum$  individual supplies.
- ▶ Aggregate demand =  $\sum$  individual demands.

Market clearing is simply:

- ▶ Aggregate supply = aggregate demand.

### Tip

The market clearing condition for apples contains only quantities of apples.

- ▶ If there are prices or bananas, it's wrong.

## Step 4: Define the Equilibrium

From steps 2-3:

Collect all endogenous objects

- ▶ e.g., consumption, output, wage rate, ...

Collect all equations

- ▶ first order conditions or policy functions
- ▶ market clearing conditions

You should have  $N$  equations that could (in principle) be solved for  $N$  endogenous objects

- ▶ prices
- ▶ quantities (the allocation)

## Notes

Competitive equilibrium covers all periods

- ▶ not a period-by-period concept

Expectations are consistent with equilibrium

- ▶ agents solve for equilibrium to forecast prices

## Recap of key points

1. A macro model consists of exactly these parts:
  - ▶ Demographics
  - ▶ Preferences
  - ▶ Endowments
  - ▶ Technologies
  - ▶ Markets
2. A competitive equilibrium is an allocation (think quantities) and a price system such that
  - ▶ all agents solve their optimization problems, given prices;
  - ▶ markets clear.
3. Market clearing conditions only contain quantities of one good (no prices!).
4. Prices are in units of account that can be chosen arbitrarily at each trading date.
5. Walras' law allows you to drop one market clearing condition **or** one budget constraint.

## Reading

There is a remarkable shortage of discussions on how to properly set up a model in textbooks.

But see

- ▶ Krusell (2014), ch. 2 describes the ingredients of modern macro models.
- ▶ Ch. 5 talks about Arrow-Debreu versus sequential trading.

Hopefully up to date links to unpublished texts are in the syllabus. Let me know if you can't find something.

## References

- Auerbach, A. J. and L. J. Kotlikoff (1987): *Dynamic fiscal policy*, Cambridge University Press.
- Krusell, P. (2014): “Real Macroeconomic Theory,” Unpublished.