Macroeconomic Theory

Econ 4310 Lecture 1

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Some practical information

- Reading list with net addresses
- Lecture plan
- No lectures next week
- Exercises every week (almost)
- Seminars only in last half

Introduction

- Explaining the behavior of economic aggregates over time
- Micro-based macro theory
- Starting from static general equilibrium
- Extending it with a time dimension and uncertainty
- Trade period by period
- Intertemporal choice (saving and investment decisions)
- Flows accumulating to stocks
  - Investment to capital
  - Saving to wealth
  - Deficits to debt
- Labor market rigidities

ECON4310 Some substantial issues

- Economic growth
- Real interest rates
- Government deficits and debts
- Public pension schemes
- Petroleum funds
- Business cycles
- Asset pricing
- Unemployment

Basic questions about research strategy

- ▷ Equilibrium or disequilibrium?
- ▷ Always start with individual agents optimizing?
- ▷ Rational opinions or animal spirits?
- ▷ Money - important or not?

Less emphasis in ECON4310

- ▷ Money, monetary policy, nominal rigidities (ECON4325, ECON4330)
- ▷ Open economy issues (ECON4330)

Assumed background

- Standard micro theory
- Basic national accounting
- Simple Keynesian models

Alternative mathematical techniques

- Discrete time (Williamson, Romer)
- Continuous time (Romer)

A simple, static general equilibrium model

- Source: Williamson 1.1
- Example of micro approach to macro
- Static starting point
- Need to refresh micro theory?

Model structure

- N identical households
- Two goods: consumption (c) and leisure ($0 \leq \ell \leq 1$)
- M identical firms, constant returns to scale in each
- Two factors of production: labor n and capital k
- The aggregate capital stock K is exogenously given
- Three markets: output, labor, capital
- Two relative prices: real wage (w) and real rental price of capital (r). (The consumption good is the numeraire with price 1)
- All agents are price-takers

Competitive equilibrium

1. Each household chooses c and ℓ optimally given w and r.
2. Each firm chooses n and k optimally given w and r.
3. All markets clear. The choices of consumers and producers are mutually consistent.

Households

Maximize:

$$U = u(c, \ell) \tag{1}$$

with respect to c and ℓ given budget

$$c = w(1 - \ell) + rK/N \tag{2}$$

$0 \leq \ell \leq 1$, $1 - \ell$ being labor supply.
Each household owns the same share of K.
First order condition:

$$\frac{u_2(c, \ell)}{u_1(c, \ell)} = w \tag{3}$$

(2) and (3) can be solved for c and ℓ as functions of w, r and K/N.
Regularity conditions on u to ensure that there is one and only one solution (e.g. u strictly increasing and quasi-concave u).

Firms

Production function:

$$y = zf(k, n) \tag{4}$$

z = exogenous productivity shock
Constant returns to scale:

$$f(\lambda k, \lambda n) = \lambda f(k, n)$$

Marginal cost constant and equal to average cost.

"First-order conditions for maximum profit":

$$zf_1(k, n) = r \tag{5}$$
$$zf_2(k, n) = w \tag{6}$$

Is there a (unique) profit maximum when returns to scale are constant?

Firm behavior with constant returns to scale (CRS)

First order condition for minimum cost:

$$\frac{zf_1(k,n)}{zf_2(k,n)} = \frac{r}{w} \tag{7}$$

Zero profit condition:

$$zf(k,n) - rk - wn = 0 \tag{8}$$

Necessary for equilibrium with finite and strictly positive output.

The marginal-productivity conditions, (5) and (6), are equivalent to the minimum cost and the zero profit condition, (7) and (8).

- No profits to distribute to owners / consumers
- Distribution of output on firms indeterminate (assume equal)

Proof of equivalence 1

1) (5) and (6) $\Longrightarrow$ (7) and (8)
(5) and (6) obviously imply (7). To prove that zero profits is also implied, we need the Euler's theorem

$$f(k,n) = f_1(k,n)k + f_2(k,n)n \tag{9}$$

(This is a general property of functions that are homogenous of degree one, easily proved by differentiating with respect to λ).
Insertion from (5) and (6) in Euler equation yields

$$f(k,n) = rk/z + wn/z$$

or after rearrangement

$$zf(k,n) - rk - wn = 0$$

which is the zero profit condition.

Proof of equivalence 2

2) (7) and (8) $\implies$ (5) and (6)

Combining (9) and the zero profit condition yields:

$$zf_1(k,n)k + zf_2(k,n)n = rk + wn$$

Use the condition for cost-minimization to eliminate f_2 and solve for f_1. You then end up with (5) and (6)follows accordingly.

Market clearing

Labor market:

$$N(1-\ell) = Mn \tag{10}$$

Capital market:

$$K = Mk \tag{11}$$

Goods market:

$$Nc = My \tag{12}$$

Competitive equilibrium

1. Each household chooses c and ℓ optimally given w, r and K/N. Eq: (2) (3)
2. Each firm chooses n and k optimally given w and r. Eq: (4) (5) (6)
3. All markets clear.The choices of consumers and producers are mutually consistent. (10) (11) (12)

8 equations, 7 unknowns: w, r, n, k, c, ℓ, y

Walras' law: When n-1 markets are in equilibrium, the n'th market will also be in equilibrium.

Representative consumers and producers: Let $M = N = 1$

Properties of equilibrium

$$\frac{u_2(c,\ell)}{u_1(c,\ell)} = zf_2(k, 1-\ell) = w \tag{13}$$

$$c = zf(k, 1-\ell) \tag{14}$$

$$r = zf_1(k, 1-\ell),\ \ w = zf_2(k, 1-\ell) \tag{15}$$

Output per capita determined by:

- Capital stock
- Productivity
- Preference for leisure

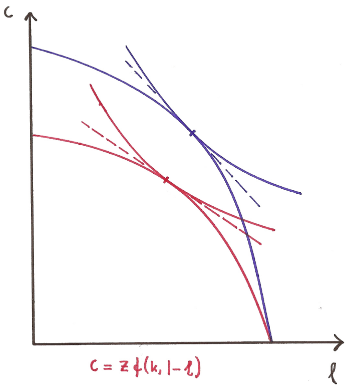
k given at the macro level

What if..?

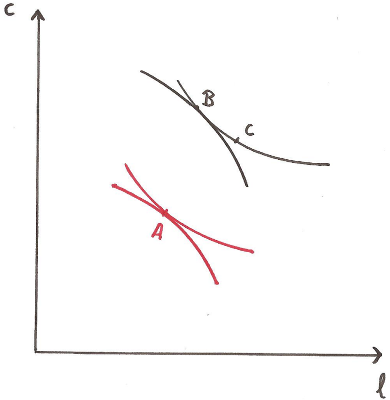
- Productivity increases?
- Preferences for leisure increases?
- More capital is available?
- A government starts taxing and spending?

The effect of increased productivity

Income effect favors leisure, substitution effect work



Income and substitution effects

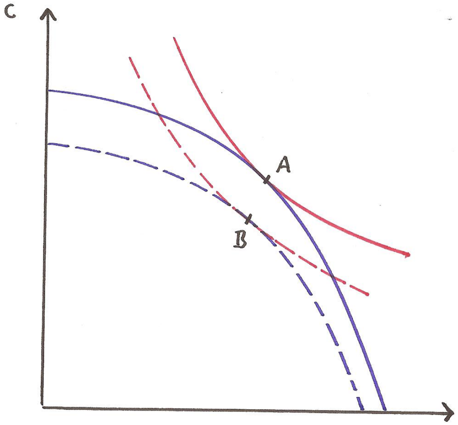


A → C Income effect

C → B Substitution

A and C: Indifference curve has same slope

Including government consumption, lump sum tax



Some properties of competitive equilibria

Existence, uniqueness

- Competitive equilibrium exists provided preferences and production possibilities satisfy some regularity conditions and markets are complete
- With sufficient regularity conditions we also get unique solutions for prices and individual utilities, but not necessarily a unique distribution of production among firms (c.f. constant returns case).

Welfare theorems

1. A competitive equilibrium is Pareto optimal
2. All Pareto optimal allocation can be achieved by appropriate redistributions of the initial endowments.

Caveats: No external effects, no collective goods, no increasing returns, complete markets, no asymmetric, information, no distorting taxes, etc

Social optimum

- Requires a welfare function that makes interpersonal comparisons
- Pareto optimum necessary, but not sufficient for social optimum.
- With a single consumer Social optimum, Pareto optimum and competitive equilibrium coincide

Social planner's problem

$$\max\ U = u(c, \ell) \tag{16}$$

$$\text{given}\ c = zf(k, 1 - \ell) \tag{17}$$

First-order condition

$$\frac{u_2(c, \ell)}{u_1(c, \ell)} = zf_2(k, 1 - \ell) \tag{18}$$

Solution to planning problem is also market solution.