ECN 106 Macroeconomics 1 $\,$

Lecture 3

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ECN 106 Macroeconomics 1 - Lecture 3

Roadmap for this lecture

- ▶ What determines the distribution of income: factor market equilibrium.
- Output determination in the long run: long run labour market equilibrium.
- ► The classical model: output and real interest rate determination in the long run.
- Blanchard Ch. 6-3, 6-4, 6-5 (available on Blackboard), Mankiw Ch. 3-1, 3-4, 3-5

Where do we stand

Up to now:

- ► We have assumed that output can respond to demand without considering whether the necessary factors of production are available → output increases in response to, however large (!), increases in demand
- We have not talked about employment/unemployment of factors of production.
- We now consider how factor supply affects output supply.
 For simplicity, just one factor: labour.
- ▶ In the process we also learn how the distribution of aggregate income is determined.

The circular flow



- Income distribution among the various factors depends on payments to those factors.
- ▶ We need to understand what determines factor prices and quantities.
- We consider only one factor: labour.

From factors to output: the production function

The quantity of goods and services produced depends on:

- 1. The quantity of factor inputs used.
- 2. The technology that transforms inputs into outputs: **the production function**.

$$Y = F(K, N).$$

In what follows we assume that the quantity of capital is fixed at \overline{K} and concentrate on how N (the number of employed workers) and Y are determined.

The production function



- Output is increasing in labour input (positive marginal product).
- ▶ Marginal product $MPL(N) = F(\overline{K}, N+1) F(\overline{K}, N)$ is decreasing in N.
- Extra labour necessary to produce one extra unit of output is 1/MPL(N); i.e. if one extra unit of labour produces 0.5 units of output, you need 2 extra workers to produce one extra unit of output.

Optimal input choice: profit maximization

- Firms set their output price/choose labour so as to maximize profits.
- ▶ Profit maximization requires marginal profit to be zero or

$$M\Pi = MR - MC = 0$$

 Since capital is a fixed factor, variable costs coincide with labour costs and

$$MC = \frac{W}{MPL(N)}.$$

- One more unit of output requires 1/MPL(N) workers at unit cost W.
- Profit maximization then implies

$$MR = \frac{W}{MPL(N)}.$$

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71/311

Optimal input choice: profit maximization II



▶ $P \ge MR$ with equality in perfect competition. That is

 $P = (1 + \bar{\mu})MR,$

where $\bar{\mu} \ge 0$ is an **exogenous** mark up.

▶ So, in general we can write

$$P = (1 + \bar{\mu})MC = (1 + \bar{\mu})\frac{W}{MPL(N)}.$$

Price setting or labour demand

We can rearrange the last equation as

$$\frac{W}{P} = \frac{MPL(N)}{1+\bar{\mu}} \tag{PS}$$

- Price setting (imperfect competition) or labour demand (perfect competition) equation.
- Implication: real wage (in units of output) W/P grows at the same rate as labour productivity MPL(N).

Time Period	Growth Rate of Labor Productivity	Growth Rate of Real Wage
1959-2007	2.1%	2.0%
1959-1973	2.8	2.8
1973-1995	1.4	1.2
1995-2007	2.5	2.4

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Wage setting

We assume that workers' wage demands are captured by the following wage setting (WS) equation

$$\frac{W}{P} = F\left(\underline{u}, \bar{z}\right) \tag{WS}$$

Intuition:

- Workers care about the real wage.
- Workers demand higher <u>real</u> wages when their position is stronger, i.e. when the unemployment rate u is lower.
- Other exogenous factors affect workers' position vis à vis firms. These exogenous factors (union strength, level of unemployment benefits, etc.) are captured by \bar{z} . These factors increase workers' <u>real</u> wage demands at any given level of u.

Wage setting II

Unemployment theories consistent with this wage setting equation:

- ▶ Bargaining: workers and firms bargain over wages. The workers' bargaining power is higher when u is lower and \overline{z} higher.
- ► Efficiency wage: firms pay more than workers' **reservation wage** (disutility of working) to motivate, attract and retain workers. Motivating, attracting and retaining workers require higher real wages when employment prospects are better.

Remember that

$$u = \frac{L - N}{\bar{L}} = 1 - \frac{N}{\bar{L}}$$

where L is the (exogenous) size of the labour force.

Long-run labour market equilibrium

We can now put the price and wage setting conditions together and solve for the labour market equilibrium

$$\frac{W}{P} = \frac{MPL(N)}{1 + \bar{\mu}}$$
(PS)
$$\frac{W}{P} = F\left(1 - \frac{N}{\bar{L}}, \bar{z}\right)$$
(WS)

- ▶ Implicit **long-run** assumptions: (1) Workers and firms have the same (perfect) information; (2) *W* and *P* are perfectly flexible.
- Two equations and three endogenous variables: the nominal wage W, the nominal price P and employment N. But ...
- W and P enter as a ratio: the real wage.

Long-run labour market equilibrium II



- ► The long run equilibrium level of employment N* ensures that the <u>real</u> wage that workers demand coincides with the one that firms are willing to pay.
- ▶ N^* and $(W/P)^*$ are fully determined on the labour market.
- ▶ They are unaffected by macroeconomic policy. They depend only on the exogenous structural variables \bar{z} , $\bar{\mu}$ and \bar{L} .
- ▶ N^* is often called the *natural* level of employment to stress that it is unaffected by (macro) policy intervention.

Long-run labour market equilibrium III



- Higher \overline{z} and lower \overline{L} shifts up the WS curve increasing the equilibrium real wage and decreasing eq. employment.
- Lower $\bar{\mu}$ shifts up the PS curve increasing the equilibrium real wage and employment.
- N* and (W/P)* are independent of nominal variables (W and P). Intuition: both workers and firms care only about real quantitities. If prices increase the only effect is higher nominal wages, but unchanged real wages and employment.

Long-run equilibrium output

- Output is a function of the level of employment N through the production function $Y = F(\bar{K}, N)$.
- ▶ Since, in the long run, equilibrium on the labour market fully determines the equilibrium employment level N^* it also determines the long-run equilibrium output level

$$\bar{Y} = F(\bar{K}, N^*).$$

- Given that output is increasing in employment and that N^* is decreasing in $\bar{\mu}, \bar{z}$ and increasing in \bar{L} , the long-run equilibrium level of output is also:
 - decreasing in $\bar{\mu}, \bar{z}$ and increasing in \bar{L} ;
 - independent from all over variables.

From partial to general equilibrium

- Partial equilibrium analysis studies equilibrium in one market abstracting from what happens on all other markets.
- ▶ Up to now we have just been conducting partial equilibrium analysis. We have studied goods market equilibrium without taking into account equilibrium on the labour market and viceversa.
- Since the two markets are interrelated, it is appropriate to study them jointly → general equilibrium.

The classical model: output and real interest rate in LR equilibrium

• In the long run the labour market is in equilibrium if and only if output equals \bar{Y} . So the following locus

$$Y = \bar{Y} \tag{LRLE}$$

characterizes labour mkt equilibrium in the long run.

▶ We have seen that the IS curve

$$Y = \underbrace{\bar{C} + c(Y - \bar{T})}_{C} + \underbrace{a - br}_{I} + \bar{G}$$
(IS)

is the locus of output/real interest rate combinations for which the goods market is in equilibrium.

▶ For both markets to be in equilibrium, we must be on both curves; i.e. both equations have to be satisfied.

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The classical model: LR eq. output and interest rate



- ► In the long run, equilibrium output and employment are fully determined on the labour market.
- ► In the long run, output cannot respond to demand → It is demand that has to adjust to production to ensure that the goods market clears.
- ▶ The interest rate is the variable that ensures that demand is in line with the equilibrium level of production.

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The classical model: algebraic solution

$$\begin{cases} Y = \bar{Y} \\ Y = \bar{C} + c(Y - \bar{T}) + a - br + \bar{G} \end{cases}$$

Replacing in the IS using the first equation yields

$$\bar{Y} = \underbrace{\bar{C} + c(\bar{Y} - \bar{T})}_{C} + \underbrace{a - br}_{I} + \bar{G}$$

- ▶ Labour market equilibrium fully pins down output and consumption. Investment is the only component of demand that can adjust to bring it in line with production. The interest rate ensures that investment falls in line.
- ▶ In the long run the level of output is determined on the labour market alone and the interest rate on the goods and labour market jointly (general equilibrium).

The classical model: the market for loanable funds Alternatively, one can rewrite the last equation bringing consumption and government expenditure onto the left hand side to obtain

$$\underbrace{\bar{Y} - \bar{T} - \bar{C} - c(\bar{Y} - \bar{T})}_{S^P} + \underbrace{\bar{T} - \bar{G}}_{S^G} = \underbrace{a - br}_{I}$$

- Left hand: national saving; private saving S^P + government saving S^G .
- ► In long run equilibrium the real interest rate ensures that investment equals national saving; i.e. that the market for loanable funds is in equilibrium.
- ► Goods market equilibrium ⇔ equilibrium on the market for loanable funds. → real interest rate determined by eq. on the labour and loanable funds market jointly.

The classical model: fiscal policy

Consider an expansionary fiscal policy: $\bar{G} \uparrow$ or $\bar{T} \downarrow$.



$$\bar{Y} = \underbrace{\bar{C} + c(\bar{Y} - \bar{T})}_{C} + \underbrace{a - br}_{I} + \bar{G}$$

- In the long run fiscal policy cannot affect output. It can only affect the composition of demand.
- ▶ Investment has to fall one-to-one with the exogenous increase in demand (crowding out). $\rightarrow r \uparrow$.

Fiscal policy and the interest rate: evidence

In the long run, expansionary fiscal policy increases the interest rate and crowds out private investment.



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The classical model: labour market shocks Consider instead a positive shock to \bar{Y} ; i.e. $\bar{\mu}, \bar{z} \downarrow$ or $\bar{L} \uparrow$.



- Only labour market shocks can affect the long run equilibrium level of output.
- Aggregate output increases, but consumption, hence expenditure, increases by a smaller amount (c < 1). I ↑ r ↓ - to reestablish equilibrium on the goods market.