Macroeconomic Theory and Policy

Lecture 33

Micro Founded Macro Equilibrium: Role of the Price System

Main Points of a Micro Founded Macro Model

- The price system is an outcome of the preferences, endowments and technology in the economy. Parameters defining the preferences of households and the technology of the firms and endowments are the only argument of the equilibrium prices in a competitive equilibrium.
- Basis of all economic activities is consumption. Production occurs because there is demand for products by the households.
- Firms demand for factors to produce output. They pay labour according to its marginal product. The remuneration for labour services provides income to the households, which they use to demand consumption goods.
- Once equilibrium price is determined that determines all other quantities, such as demand for goods and leisure and supply of labour by households and demand for labour and supply of commodities by firms.
- Money is macroeconomically neutral.

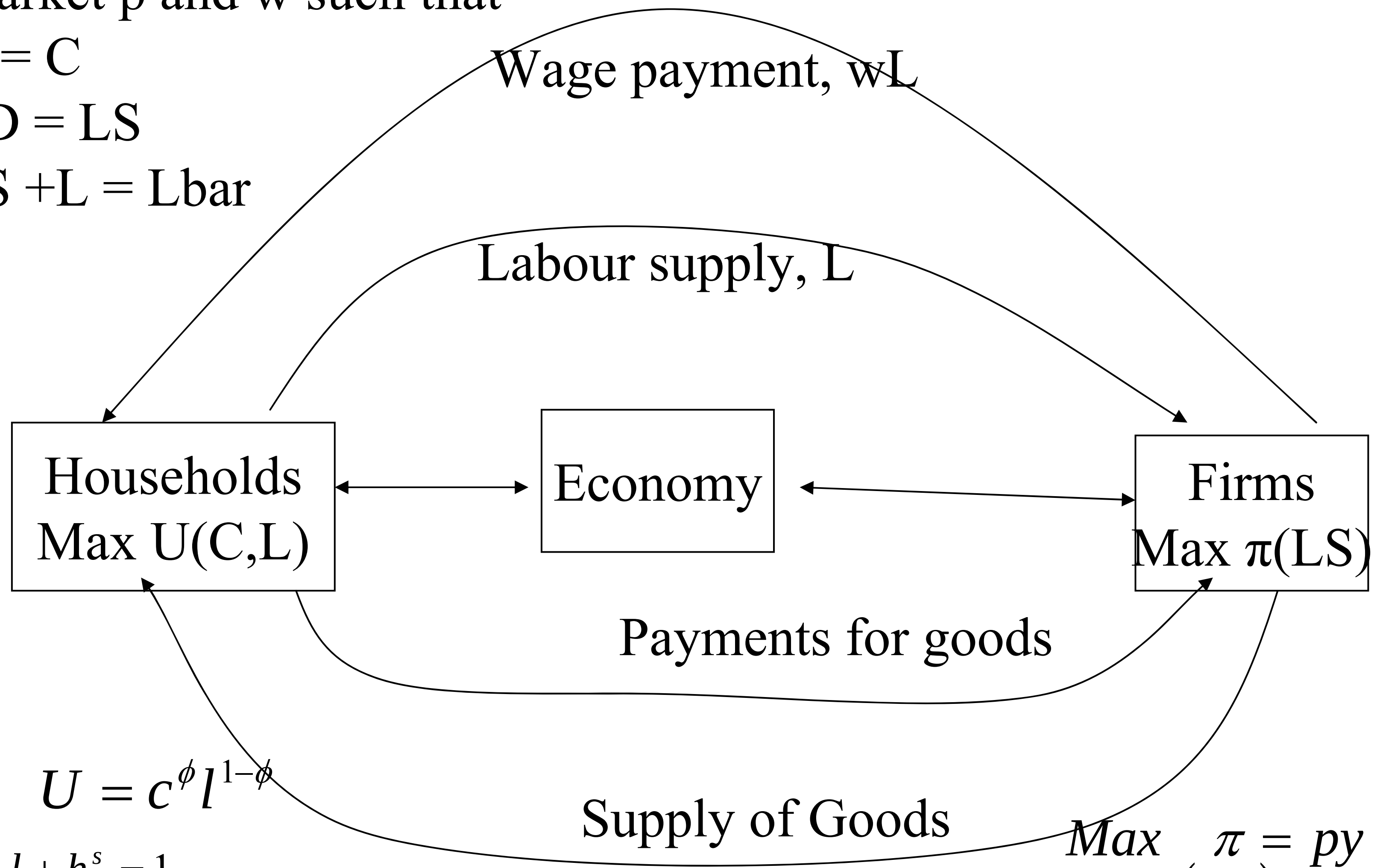
Micro-Foundation to Macro:
General Equilibrium with a representative household and firm

Market p and w such that

Y = C

LD = LS

LS +L = Lbar



$$Max \quad U = c^{\phi} l^{1-\phi}$$

$$l + h^{s} = 1$$

$$pc = wh^{s} + \pi$$

$$c \geq 0; l \geq 0; h^{s} \geq 0$$

$$Max \quad \pi = py - wh^{d}$$

$$y \leq \left(h^{d}\right)^{\alpha}$$

$$y \geq 0; h^{d} \geq 0$$

The optimisation problem of a representative **household**

$$Max \quad U = c^{\phi} l^{1-\phi}$$

Subject to:

i. $l + h^s = 1$ time constraint

ii. $pc = wh^s + \pi$ budget constraint

iii. $c \geq 0; l \geq 0; h^s \geq 0$ non-negativity constraint

where c is consumption,
l is leisure and h^s is labour supply,
p is the price of the commodity,
w is the wage rate
π is the profit from owning the firm.

Optimisation problem of a representative **firm**

$$Max \quad \pi = py - wh^{d}$$

subject to :

i. $y \le \left(h^{d}\right)^{\alpha}$ technology constraint

ii. $y \ge 0; h^{d} \ge 0$ non negativity constraint

where y is the output supplied by the firm and h^{d} is its demand for labour.

First Order Conditions for Household Optimisation

From time constraint define $l = 1 - h^s$ and substitute it into the utility function $U = c^{\phi}\left(1 - h^s\right)^{1-\phi}$.

Desired Lagrangian is:

$$L(c, l, \lambda) = c^{\phi}\left(1 - h^s\right)^{1-\phi} + \lambda\left[wh^s + \pi - pc\right] \qquad (2.1)$$

It has three choice variables (c, l, λ), λ is shadow price of income; necessary first order conditions for utility maximisation are:

1. $\frac{\partial L(c, l, \lambda)}{\partial c} = \phi c^{\phi-1}\left(1 - h^s\right)^{1-\phi} - \lambda p = 0$ => the first term if marginal utility from consumption.
2. $\frac{\partial L(c, l, \lambda)}{\partial h^s} = (1-\phi)c^{\phi}\left(1 - h^s\right)^{-\phi}(-1) + \lambda w = 0$

$$\frac{\partial L(c, l, \lambda)}{\partial \lambda} = wh^s + \pi - pc = 0$$

Demand for Consumption Goods

Dividing FOC (2) by FOC (1) and solving for c

$$\frac{\frac{\partial L(c,l,\lambda)}{\partial h^s}}{\frac{\partial L(c,l,\lambda)}{\partial c}} = \frac{(1-\phi)c^{\phi}\left(1-h^s\right)^{-\phi}(-1)}{\phi c^{\phi-1}\left(1-h^s\right)^{1-\phi}} = \frac{w}{p} \quad (2.2)$$

marginal rate of substitution between leisure and consumption should be equal to the real wage rate to optimise.

or, $c = \left(\frac{\phi}{1-\phi}\right)\left(1-h^s\right)\frac{w}{p}$:

Thus consumption depends on real wage rate and the work efforts.

From the budget constraint $wh^s + \pi = pc$

$$h^s \frac{w}{p} + \frac{\pi}{p} = c = \left(\frac{\phi}{1-\phi}\right)\left(1-h^s\right)\frac{w}{p} \quad (2.3)$$

Demand for Leisure

Now (2.3) can be solved for the households labour supply

$$h^s \frac{w}{p} + \frac{\pi}{p} = \left(\frac{\phi}{1-\phi}\right)\left(1-h^s\right)\frac{w}{p} => h^s\left(1+\frac{\phi}{1-\phi}\right)\frac{w}{p} = \left(\frac{\phi}{1-\phi}\right)\frac{w}{p} - \frac{\pi}{p}$$

$$h^s\left(\frac{1}{1-\phi}\right)\frac{w}{p} = \left(\frac{\phi}{1-\phi}\right)\frac{w}{p} - \frac{\pi}{p}\frac{1-\phi}{1-\phi} => h^s \frac{w}{p} = \phi\frac{w}{p} - \frac{\pi}{p}\left(1-\phi\right)$$

Labour supply, leisure and consumption all are functions of the real wage rate

$$h^s = \frac{\phi\frac{w}{p} - \frac{\pi}{p}\left(1-\phi\right)}{\frac{w}{p}} \text{; leisure } l = 1 - h^s = 1 - \frac{\phi\frac{w}{p} - \frac{\pi}{p}\left(1-\phi\right)}{\frac{w}{p}} \qquad (2.4)$$

Optimal Values of Consumption and Leisure

$$c=\left(\frac{\phi}{1-\phi}\right)\left(1-\left(\frac{1}{\alpha}\frac{\phi^{\alpha-1}}{\left[(1-\phi)\left(\frac{1}{\alpha}\right)^{\frac{\alpha}{\alpha-1}}+\phi\left(\frac{1}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]^{\alpha-1}}\right)^{\frac{1}{\alpha-1}}\right)\frac{\phi^{\alpha-1}}{\left[(1-\phi)\left(\frac{1}{\alpha}\right)^{\frac{\alpha}{\alpha-1}}+\phi\left(\frac{1}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]^{\alpha-1}}$$

$$\hat{l}=1-\hat{h}^{s}=1-\left(\frac{1}{\alpha}\frac{\phi^{\alpha-1}}{\left[(1-\phi)\left(\frac{1}{\alpha}\right)^{\frac{\alpha}{\alpha-1}}+\phi\left(\frac{1}{\alpha}\right)^{\frac{1}{\alpha-1}}\right]^{\alpha-1}}\right)^{\frac{1}{\alpha-1}}$$

Output and Labour Supply

Equilibrium output

$$\hat{y} = \left(\frac{1}{\alpha} \frac{\phi^{\alpha-1}}{\left[(1-\phi)\left(\frac{1}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} + \phi\left(\frac{1}{\alpha}\right)^{\frac{1}{\alpha-1}} \right]^{\alpha-1}} \right)^{\frac{\alpha}{\alpha-1}}$$

a. What is the equilibrium quantity of l and h^d ?

$$\hat{h}^d = \hat{h}^s = \left(\frac{1}{\alpha} \frac{\phi^{\alpha-1}}{\left[(1-\phi)\left(\frac{1}{\alpha}\right)^{\frac{\alpha}{\alpha-1}} + \phi\left(\frac{1}{\alpha}\right)^{\frac{1}{\alpha-1}} \right]^{\alpha-1}} \right)^{\frac{1}{\alpha-1}}$$

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Exercises

1. A Simple Inter temporal model

$$Max \quad U(C_1, C_2) = \ln C_1 + \beta \ln C_2 \qquad (1)$$

Subject to

$C_1 + b \le W_1$: budget constraint in period 1
$C_2 \le b(1+r) + W_2$: budget constraint in period 2 (2)

C_1, C_2 are consumption in period 1 and period 2 respectively and W_1, W_2 are endowments in period 1 and period two respectively.

1. If W_1 = 200, W_2 = 400, β =0.95 , r = 0.05 what will be consumption in period 1 and period 2, C_1 and C_2 ? What will be the life time utility of this consumer?
2. Now suppose that government imposes property taxes in both periods. If t_1=0.2 and t_2=0.4 what would be the utility of households if

a. Government consumption does not enter into the household's utility function?
b. Households care about the utility obtained from public good in the following way

$$U(G_1, G_2) = \alpha \ln G_1 + \gamma \ln G_2$$

where α =0.1and γ =0.15?

Based on above analysis would you recommend increase in taxes to provide more public goods? Why or why not?