EE312 Macroeconomic Theory
Semester 1/2016
Mid-Term Examination

Date: Wednesday 8 October 2016
Time: 11:00 – 13:00 hr.

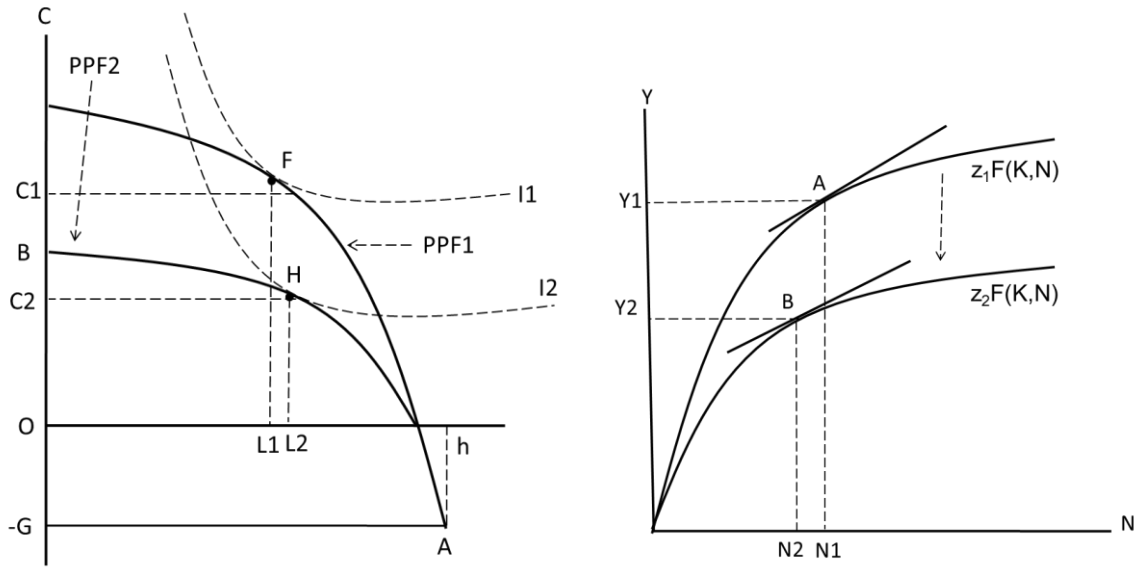
Instructions

1. There are three essay questions with a total of 30 points.
2. Write your answers in the provided booklets.
3. Books, notes, calculators and electronic devices are not allowed.
4. Explain the chain of effects among variables correctly. Describe your analysis in words and use diagrams accordingly.

Questions

1. Assume that total factor productivity decreases (or a negative productivity shock) in **the Closed-Economy, One-Period Macroeconomic Model**. Analyze the effects of the total factor productivity decrease on aggregate output, consumption, employment and the real wage. (10 points)

Answer:



The initial competitive equilibrium is at point F where the firm's Production Possibility Frontier, PPF1, touches the consumer's highest indifference curve I1. At F, the firm maximizes profit and the consumer maximizes utility at the real wage rate equal to the slope of the PPF. The optimal consumption bundle for the consumer is consumption goods equal to C1 and leisure equal to L1. So the consumer's working time (and labor supply) is h – L1.

The decrease in total factor productivity (z) from z1 to z2 causes the production function to rotate downwards from Y1 = z1F(K,N^d) to Y2 = z2F(K,N^d), given the capital input (K). The slope of the production function decreases at the initial level of labor input (N1). The marginal product of labor (MP_N) is lower, inducing the firm to reduce its demand for labor and to offer a lower real wage (MP_N = w).

The downward rotation of the production function causes the PPF1 to shift downwards to PPF2. The competitive equilibrium changes from F to H. The real wage decreases as the slope of PPF2 at H is less steep than the slope at F.

The decrease in the real wage has the substitution effect and income effect. **The substitution effect** causes the consumer to decrease consumption goods and increase leisure (because the cost of leisure has become cheaper). **The income effect** causes the consumer to reduce both consumption goods and leisure (both are normal goods). In short, consumption goods will decrease from C1 on PPF1 to C2 on PPF2, but the change in leisure (and labor supply) is unclear.

Here we assume **a stronger substitution effect**. So leisure increases from L1 to L2 and labor supply decreases from (h – L1) to (h – L2). Employment decreases from N1 to N2 and, through the production function, output decreases from Y1 to Y2. The real wage is still lower at the new competitive equilibrium as the slope of the production function at B is still less steep than at A.

In conclusion, the decrease in total factor productivity results in lower consumption, higher leisure, lower employment, lower output and income and a lower real wage (assuming the stronger substitution effect).

Note: students may assume a stronger income effect or equal substitution and income effects.

2. In **the Solow growth model**, derive the condition which maximizes consumption per worker at the steady state. What is the 'golden-rule savings rate'? What can the government do if the actual savings rate is lower than the golden-rule rate? And what are the arguments against such government policy? (10 points)

Answer:
Consumption per worker at the steady state is the difference between output per worker and saving per worker at the steady-state capital per worker (k*).

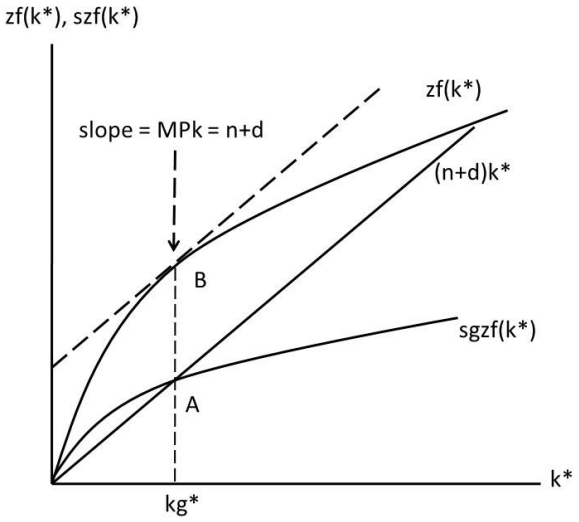
$$y^* = zf(k^*)$$
$$S / N = szf(k^*)$$
$$c^* = zf(k^*) - szf(k^*)$$
$$c^* = zf(k^*) - (n+d)k^*$$
$$c^* = (1-s)zf(k^*)$$

$$c^* = zf(k^*) - (n+d)k^*$$

$$Set\ \frac{dc^*}{dk^*} = \frac{d(zf(k^*))}{dk^*} - (n+d) = 0$$

$$\frac{d(zf(k^*))}{dk^*} = n+d$$

$$MP_k = n+d$$



Steady-state consumption per worker is maximized when the marginal product of capital per worker (MP_k = the slope of the per worker production function) equals (n + d) which is the slope of the steady-state investment per worker. The particular savings rate (sg) which maximizes steady-state consumption per worker (AB) is the golden-rule savings rate.

If the actual savings rate is lower than the golden-rule rate, the government can encourage its citizens to raise their savings rate to sg by persuasion or tax subsidy policy. But raising the savings rate requires the sacrifice of current consumption in the expectations of higher investment, more production, higher income and higher consumption in the future. The decision on current consumption and savings depends on the consumer's preference. If the consumers are already maximizing their utilities and are unwilling to sacrifice current consumption for long-run higher growth, the government measure to reduce their current consumption may make the consumer worse off.

3. In **the endogenous growth model**, assume the following variables:

Y = output
C = consumption
z = marginal product of the efficiency units of labor
H^s and $H^{s'}$ = supply of current and future human capital by the consumer, respectively
H^d = demand for human capital by the firm
b = the efficiency of human capital accumulation technology
u = time allocated to producing output.

Derive the competitive equilibrium condition. What are the growth rates of consumption, output and human capital? Explain why economic growth is unbounded in the model? And how does the model explain the lack of absolute convergence between rich and poor countries? (10 points)

Answer: The consumer's budget constraint is total labor earnings from supplying efficiency units of labor (uH^s) :

$$C = wuH^s$$

And the accumulation of human capital is expressed by:

$$H^{s\prime} = b(1-u)H^s$$

The firm's production function is given by:

$$Y = zuH^d$$

So the firm's profit function is total output (or total revenue minus labor cost):

$$\pi = Y - wuH^d$$

$$\pi = zuH^d - wuH^d$$

$$\pi = (z-w)uH^d$$

The firm maximizes profits at z = w which is also the firm's demand for efficiency units of labor (uH^d). The market clears when the demand and supply of efficiency units of labor are equal ($uH^d = uH^s$). Current output (Y) produced by the firm is equal to current consumption (C) by the consumer:

$$Y = C = zuH$$

$$H' = b(1-u)H$$

The growth rate of human capital is determined by:

$$\frac{H'}{H} - 1 = b(1-u) - 1$$

Current consumption is equal to C = zuH and future consumption is C' = zuH'. Therefore,

$$\frac{C'}{C} - 1 = \frac{zuH'}{zuH} - 1 = \frac{H'}{H} - 1 = b(1-u) - 1$$

Output is also growing at the same rate as consumption as Y = C. So both output and consumption grow at the rate of b(1-u) – 1.

Economic growth in the model is unbounded because the accumulation of human capital is not subject to diminishing returns to scale. The reason is that knowledge is '**non-rivalry**'. One's acquisition of knowledge does not reduce others' ability to acquire the same knowledge. No limit on how productive a person can be, given increasing knowledge and skills. Human capital also has **positive externalities**. One individual's high level of human

capital has positive effects on other individuals' human capital and their productivity. So there is no limit on human capital accumulation and economic growth.

There is no absolute convergence between rich and poor countries because rich countries have higher levels of human capital than poor countries. Even if rich and poor countries have the same human capital accumulation technologies (b) and the same time allocated to current production (u) so that they have the same long-run growth rates of human capital, consumption and output at b(1-u)-1, poor countries will never catch up with rich countries.

Poor countries also have lower levels of human capital. They have less contact with rich countries. So they receive little positive externalities from human capital in rich countries. Poor countries also lose their existing human capital through brain drain problems.