

EE312 Macroeconomic Theory
Semester 1/2014
Mid-Term Examination

Date: Wednesday 8 October 2014
Time: 11:00 – 13:00 hr.

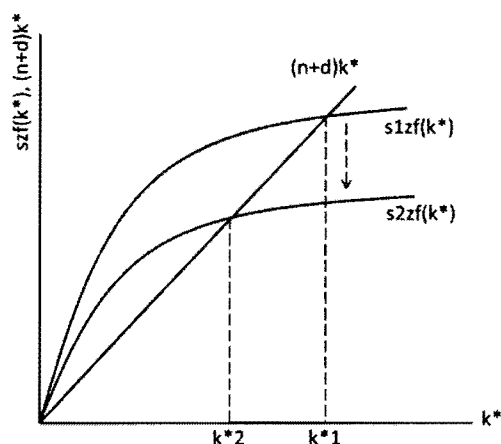
Instructions:

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. Use pens to write your answers; pencils are allowed for drawing only.
5. Explain the chain of effects among variables correctly. Describe your analysis in words and use diagrams appropriately.

Questions:

1. In the **Solow growth model**, suppose the saving rate (s) in the economy decreases. Analyze the effects of such decrease on the quantity of capital per worker and output per worker in the steady state. Give the economic reason of why capital per worker and output per worker change in that way. (10 point)

Answer:



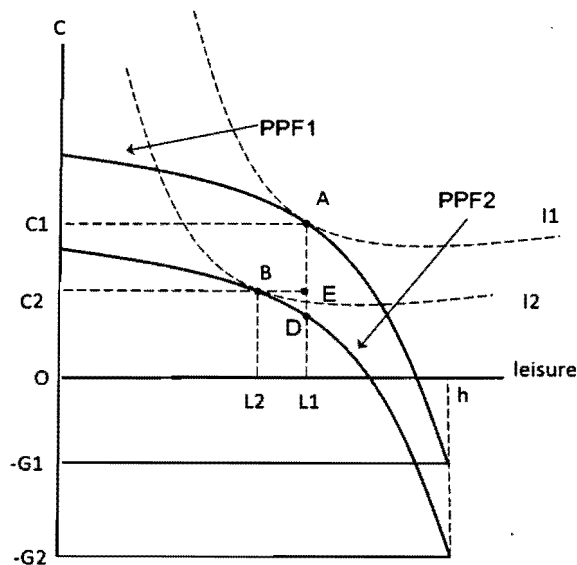
Assume the initial saving rate is s_1 so that saving per worker is $s_1zf(k^*)$. At equilibrium, saving per worker equals steady-state investment per worker. So the initial steady-state capital per worker is k^*_1 . As the saving rate decreases to s_2 , saving per worker also decreases to $s_2zf(k^*)$. The saving per worker curve rotates downwards from $s_1zf(k^*)$ to $s_2zf(k^*)$ which is equal to the steady-state investment at the lower level of steady-state capital per worker k^*_2 . Lower capital per worker results in lower output per worker at y^*_2 , given the production function using capital per worker as an

input.

At the initial steady-state capital per worker of k^*_1 , both aggregate capital (K) and aggregate output (Y) are growing at the rate of population growth (n). As the saving rate decreases, aggregate saving (sY) and aggregate investment (I) are also decreasing. In the transitional period, the decreasing aggregate investment causes aggregate capital (K) and aggregate output (Y) to grow at a lower rate than n while population (N) is still growing at the rate of n . Therefore, capital per worker ($k = K/N$) falls from k^*_1 and output per worker ($y = Y/N$) from

y^*1 . Finally, when the economy arrives at the new steady-state capital per worker (k^*2) and output per worker (y^*2), aggregate capital, aggregate output and population will be growing at the same rate of n again.

2. Suppose the government decides to increase its spending. Use the **Closed-Economy, One-Period Macroeconomic Model** to determine the effects of such spending increase on aggregate output, consumption, employment and the real wage. (10 points)



Answer: The initial competitive equilibrium is at point A where the firm's PPF1 touches the consumer's highest indifference curve I1. At A, the firm maximizes profit and the consumer maximizes utility at the real wage rate equal to the slope of the PPF and I1. The optimum 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 $h - L1$.

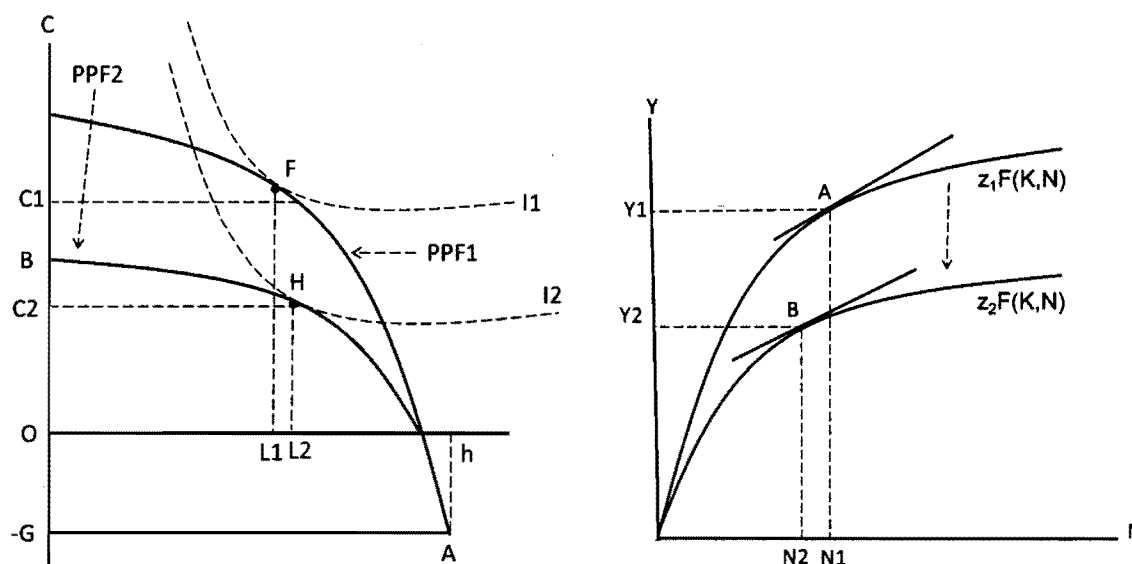
The government increases spending (G), causing taxes to increase ($G = T$). Non-

wage income ($\pi - T$) and the disposable income decrease. This is a negative income effect. The consumer reduces both consumption goods (C) and leisure (L) as they are normal goods. Less leisure is equivalent to an increase in working time ($h - L$). The consumer supplies more labor service (N^s). The real wage (w) drops to induce more labor demand (N^d) by the firm. Employment increases. More labor input in production results in larger total output (Y).

The increase in government spending and taxes causes the PPF1 to shift downward to PPF2 as $G = T$ increases from $G1$ to $G2$. The competitive equilibrium moves from point A to point B at a lower indifference curve I2. The optimum amount of consumption goods drops from $C1$ to $C2$ while leisure decreases from $L1$ to $L2$. The consumer's working time increases from $h - L1$ to $h - L2$. The real wage decreases because the slope of the PPF2 and I2 at point B is less steep than at point A. The drop in consumption (the distance $C1C2=AE$) is smaller than the increase in government spending (the distance $G1G2=AD$).

In conclusion, an increase in government spending results in larger total output, lower consumption, higher employment and a lower real wage. The increase in government spending partially crowds out consumption because higher taxes reduce disposable income. The consumer works more at a lower real wage and receives less consumption goods. Consumer welfare and utility are lower.

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



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 z_1 to z_2 causes the production function to rotate downwards from $Y1 = z_1F(K, N^d)$ to $Y2 = z_2F(K, N^d)$, 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.