

SIMON FRASER UNIVERSITY  
Department of Economics

Econ 305  
Intermediate Macroeconomic Theory

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MIDTERM EXAM  
(Solutions)

Answer the following questions True, False, or Uncertain. Briefly explain your answers. No credit without explanation. (10 points each).

1. The Solow model predicts that a higher saving rate produces a higher growth rate.

FALSE/UNCERTAIN. *A higher saving rate produces a temporary increase in the growth rate, but not a permanent increase.*

2. Government policy should try to reduce the unemployment rate to zero.

FALSE. *Because workers are firms are heterogeneous, it takes time and effort to match workers to firms. Therefore, we would not expect the unemployment rate to be zero, even when the labor market is operating efficiently.*

3. According to the DMP (Diamond-Mortensen-Pissarides) model of search unemployment, an increase in productivity increases the equilibrium unemployment rate.

FALSE. *Higher productivity increases the profits of firms, which makes them want to expand. They post more vacancies. This increases labor market ‘tightness’, which makes jobs easier to find, and the unemployment rate decreases.*

4. The CPI inflation rate overstates increases in the cost-of-living.

TRUE. *The CPI measures increases in the prices of a fixed basket of goods. It ignores the fact that consumers can substitute away from goods whose prices rise by the most. This is sometimes called “substitution bias”.*

The following questions are short answer. Briefly explain your answer. Clarity will be rewarded.

5. (30 points). Consider a static one-period economy as discussed in Chapter 4. Output is produced using the production function:  $Y = \phi \ln(N)$ , where  $N$  denotes hours of labor, and  $\phi$  is a constant parameter. The representative household’s preferences are given by

$$U(C, \ell) = \ln(\ell) + b \cdot C$$

where  $b$  is a constant parameter. The household’s time constraint is  $h = \ell + N$ . For simplicity, suppose there is no government in this economy.

- (a) Derive the labor supply and labor demand curves.

*The household’s optimality condition is*

$$\frac{U_\ell}{U_c} = \frac{1}{b\ell} = w$$

*Solving for  $\ell$  we get  $\ell = \frac{1}{bw}$ . The household’s time constraint then gives the following expression for labor supply*

$$N^s = h - \ell = h - \frac{1}{bw}$$

Note this is an increasing function of  $w$ . The firm's optimality condition is

$$\frac{\partial Y}{\partial N} = \frac{\phi}{N} = w$$

Solving for  $N$  gives the labor demand curve

$$N^d = \frac{\phi}{w}$$

Note this is a decreasing function of  $w$ .

- (b) Compute the competitive equilibrium wage rate and employment for this economy. How do  $b$  and  $\phi$  affect the equilibrium wage and output level? Illustrate your answers with a labor supply/labor demand graph.

To compute the equilibrium wage, just set  $N^s = N^d$ . This gives

$$h - \frac{1}{bw} = \frac{\phi}{w} \quad \Rightarrow \quad w = \frac{\phi + 1/b}{h}$$

To compute equilibrium employment, just substitute the market-clearing wage into either the labor supply or labor demand curve. This gives

$$N = \frac{\phi h}{\phi + 1/b}$$

Note that wages and employment rise when  $\phi$  increases (i.e., labor demand shifts out). Note that an increase in  $b$  causes wages to fall, and employment to rise (i.e., labor supply shifts out).

6. (30 points). In 1980 China implemented the so-called "One-Child Policy", which reduced its population growth rate. Use the Solow diagram to illustrate the predicted effects of this policy. (Assume that China was initially in a steady state). According to the Solow model, what happens to the growth rate of output? What happens to the level of per capita income? Suppose that China's production function is  $Y = K^{1/3}L^{2/3}$ . Assume that initially the population growth rate was  $n = .03$ , and that the policy reduced it to  $n = 0$ . Finally, suppose that the depreciation rate is  $\delta = .01$ . Assuming that the only thing that changed was the population growth rate, calculate the predicted long-run effect on per capita incomes in China.

A reduced population growth rate reduces the slope of the breakeven investment line,  $(n + \delta)k$ . As a result, the steady state capital/labor ratio and per capita income level increase. However, the growth rate of the level of income drops from 3% to 0.

To calculate the steady-state increase in per capita income, use the following steady-state condition

$$sy = sk^\alpha = (n + \delta)k$$

where in this case,  $\alpha = 1/3$ . This implies the following steady-state condition for per capita output,

$$y^* = \left( \frac{s}{n + \delta} \right)^{1/2}$$

Let  $y_0^*$  be initial steady-state per capita income, and  $y_1^*$  be the new steady-state per capita income. We then get (since  $s$  stays the same)

$$\frac{y_1^*}{y_0^*} = \left( \frac{n_0 + .01}{n_1 + .01} \right)^{1/2} = \left( \frac{.04}{.01} \right)^{1/2} = 2$$

Hence, the Solow model predicts that per capita income will double.