ECO2143 Macroeconomic Theory II
Midterm #2
Instructor: Alex Armstrong
July 17, 2013
Time Allotted: 1 hour 20 minutes

Student's Name:
Student ID:

Part 1: MULTIPLE CHOICE QUESTIONS (4 marks each)
Read all answers carefully and choose the best answer by circling the letter beside it.

1. Suppose that two countries X and Z produce per capita output according to the following production function $y_i = A_i k_i^{\alpha} h_i^{1-\alpha}$ where $i = X, Z$ and $\alpha = \frac{1}{2}$. Given the following data:

	y	k	h
X	10	25	16
Y	1	4	4

   the ratio of productivity in country X to productivity in country Z is:

   (a) 0.5
   (b) 2.9
   (c) 2.0*
   (d) 4.0

2. The following characteristics distinguish technology from factors of production

   (a) Non-rival and high level of excludability
   (b) Rival and low level of excludability
   (c) Rival and high level of excludability
   (d) Non-rival and low level of excludability*

3. If a country's per capita GDP is increasing at an average rate of 3% per year, in roughly how many years can we expect that its per capita GDP will be double what it is now?

   (a) 72
   (b) 24*
   (c) 36
   (d) 16

4. The term "featherbedding" refers to:

   (a) The collaborative relationship between Japanese automakers and their suppliers
   (b) Employers hiring more workers than is needed for the required work*
   (c) Representatives of firms lobbying government officials to enact favorable regulations
   (d) A novel production process for textiles introduced in the mid-19th century

5. According to the Solow model, an increase in the growth rate of the population will lead to:

   (a) A transitory increase in the growth rate of per capita income

   (b) A permanent decrease in per capita income*

   (c) No long-run change in per capita income

   (d) The same steady-state population level in the long run as before the increase

6. Suppose that country A has both a higher output level and a higher level of factor accumulation than country B. Which country has the higher productivity?

   (a) Country B

   (b) They both have the same level of productivity

   (c) Country A

   (d) We cannot say which has the higher productivity without further information*

7. Suppose that the return to each of the first four years of education is 13.4% and for each of the following four years is 10.1%. If everyone in a given country has five years of education and labour's share in national income is $\frac{2}{3}$, then *human capital's* share in national income is:

   (a) 45%

   (b) 66%

   (c) 30%*

   (d) 37%

8. Suppose that goods A and B are perfect complements in consumption and are produced with a fixed total labor force size which must be allocated for the production of each good. The rate of technological progress is equal to 2% in sector A and zero in sector B. In the long run, we would expect

   (a) the output of both goods to grow at a rate of 2%

   (b) the output of good A to grow at a rate of 2% while that of good B does not grow

   (c) the output of both goods to stop growing*

   (d) all the labour force to be working the sector that produces good A where there is higher technology growth

9. In the two-country technology growth model studied in class, the consequences of the follower country shifting a larger proportion of its workforce into research and development are:

   (a) a short-run decrease in output and a long-run increase in the growth rate of productivity for both countries

   (b) a short-run increase in output and a long-run decrease in the growth rate of productivity for only the leader country

   (c) a short-run decrease in output and a long-run increase in the growth rate of productivity for only the follower country

   (d) a short-run decrease in output and no long-run effect on the growth rate of productivity for either country*

10. Which of the following statements best describes the relationship between income and health?

    (a) Better health leads to higher income

    (b) Better health leads to higher income and higher income leads to better health*

    (c) Higher income leads to better health

    (d) There is no causal relationship between health and income

PART 2: PROBLEMS (60 marks)
In the booklet provided answer the following questions.

11. **Solow Model:** Output is produced using labour and physical capital. The production function in per-worker terms is:

$$y = f(k) = Ak^{1/2}$$

where A represents technology. The depreciation rate (δ) is 1%, the population growth rate (n) is 1% and the investment rate (γ) is 20%. Technology is determined as follows:

$$A = \begin{cases} 1 & \text{if } y \leq 10 \\ 2 & \text{if } y > 10 \end{cases}$$

(a) (**10 marks**) Calculate the steady-state values of y and k.
If $y \leq 10$, then in the steady-state:

$$\begin{aligned} .20 \times 1 \times \left(k^{SS}\right)^{1/2} &= (.01 + .01) \times k^{SS} \\ k^{SS} &= \left(\frac{.20}{.01 + .01}\right)^2 \\ &= 100 \end{aligned}$$

and:

$$y^{SS} = 1 \times \left(k^{SS}\right)^{1/2} = 10$$

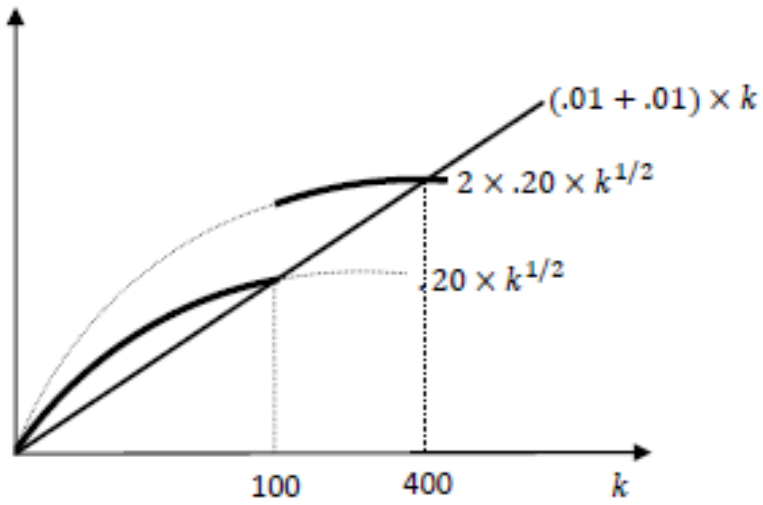
If $y > 10$, then in the steady-state:

$$\begin{aligned} .20 \times 2 \times \left(k^{SS}\right)^{1/2} &= (.01 + .01) \times k^{SS} \\ k^{SS} &= \left(\frac{2 \times .20}{.01 + .01}\right)^2 \\ &= 400 \end{aligned}$$

and:

$$y^{SS} = 2 \times \left(k^{SS}\right)^{1/2} = 40$$

(b) (**10 marks**) Draw a diagram depicting the steady-state(s) of the model.



(c) (**10 marks**) Briefly describe what this model implies about the potential for convergence between rich and poor countries when:

- there are barriers to technology transfers between countries.
  If technology cannot be transfered, those countries with initial income levels below or equal to 10 will have steady-state income levels of $y^{SS} = 10$ in the long-run while those with initial income levels above 10 will have steady-state income levels of $y^{SS} = 20$. Thus convergence will not occur between rich and poor countries even though they have the same underlying economic fundamentals.
- when technology can be costlessly transferred between countries.
  In this case, if enough technology can be transfered to poor countries so that $y > 10$, they will shift to a higher growth path and eventually arrive at the new steady-state of $y^{SS} = 20$. Since technology is non-rival, this will do no harm to the rich country that does the transfer. So convergence can occur in this case.

12. **Growth Accounting:** The following table provides data on the annual growth rates of output, physical capital, and human capital per worker for two countries Erewhon and Utopia.

	$\widehat{y}$	$\widehat{k}$	$\widehat{h}$
Erewhon	0.66	0.31	0.52
Utopia	1.82	1.83	0.51

Output per worker is produced using the Cobb-Douglas production function:

$$y = Ak^{\alpha}h^{1-\alpha}$$

where the share of capital in total output $\alpha = 1/3$.

(a) (**10 marks**) Write down (but do not derive) the equation that describes the relationship between growth rates of income per worker, productivity, physical capital per worker and human capital per worker.

$$\widehat{y} = \widehat{A} + \alpha\widehat{k} + (1-\alpha)\widehat{h}$$

(b) (**10 marks**) For each country, calculate the growth rates of productivity and determine in which country productivity accounts for the largest share of growth in income per worker.
Erewhon:

$$\begin{aligned}\widehat{A} &= \widehat{y} - \left(\alpha\widehat{k} + (1-\alpha)\widehat{h}\right) \\ &= 0.66 - \left(\frac{1}{3}\times 0.31 + \frac{2}{3}\times 0.52\right) \\ &= 0.21\end{aligned}$$

Utopia:

$$\begin{aligned}\widehat{A} &= \widehat{y} - \left(\alpha\widehat{k} + (1-\alpha)\widehat{h}\right) \\ &= 1.82 - \left(\frac{1}{3}\times 1.83 + \frac{2}{3}\times 0.51\right) \\ &= 0.87\end{aligned}$$

Erewhon:

$$\frac{\widehat{A}}{\widehat{y}} = \frac{0.21}{0.66} = 0.32$$

Utopia:

$$\frac{\widehat{A}}{\widehat{y}} = \frac{0.87}{1.82} = 0.48$$

So productivity growth accounts for the largest share of income growth in Utopia.

(c) (**10 marks**) In 2013 Erewhon's output per worker is \$42,000. Economists working for Utopia's government have calculated that, if both countries economies continue to grow at the rates given in the table, in twenty years their outputs per worker will be the same. What must Utopia's output per worker be (to the nearest dollar) in 2013 for this to be true?

$$\begin{aligned} \$42,000 \times (1.0066)^{20} &= y_{Utopia} \times (1.0182)^{20} \\ y_{Utopia} &= \$42,000 \times (\frac{1.0066}{1.0182})^{20} \\ &\approx \$33,398 \end{aligned}$$