ECO2143 Macroeconomic Theory II
2nd mid-term examination: March 3rd 2014
University of Ottawa
Professor: Louis Hotte
Time allotted: 1h 20min

Attention: *Not all questionnaires are the same. This is questionnaire* ***A****. On the answer sheet, you must indicate the letter of your questionnaire with the course's number as follows:* ***ECO2143A****. You must answer according to* ***the material seen in this course****. Read all answer choices before choosing your answer. Calculator permitted.* GOOD LUCK!

QUESTIONNAIRE A

I. MULTIPLE CHOICE QUESTIONS (3 points each)

1. Suppose that there are two countries, Abysus and Chimerica, that differ in both their rates of investment and their population growth. In Abysus, investment is 6% of GDP and population grows at 4% per year. In Chimerica, investment is 20% of GDP and population grows at 2% per year. Further assume that both countries have the same constant level of productivity (A), that capital's share of national income (α) is 1/3 and that their depreciation rates (δ) are both 5%. Using this information, what is the ratio of the two countries' steady-state levels of income per capita (y_a^{ss}/y_c^{ss})?
   (a) 0.48✓
   (b) 1.52
   (c) 0.76
   (d) 0.38
   (e) 1.47

2. Which of the following statements best describes the importance of the relationship between income and health?
   (a) Better health leads to higher income.
   (b) There is no causal relationship between health and income.
   (c) Higher income leads to better health.
   (d) Better health leads to higher income and higher income leads to better health.✓
   (e) There is no correlation between health and income.

3. Assume two countries (1 and 2) have the same values of A (a constant productivity level) and γ (investment as percentage of output). Country 1 has a depreciation rate $\delta = 0.05$ and population growth $n = 0.025$. Country 2 has a depreciation rate $\delta = 0.06$ and population growth $n = 0.03$. Noting these differences, what can be said about their relative steady state levels?
   (a) Country 1 has a lower steady state stock of capital per capita.
   (b) Country 2 has a higher steady state level of income per capita.
   (c) There is no difference in their steady state levels of income and capital per capita.
   (d) The growth rates of income per capita at both countries' steady states are equal.✓
   (e) Not enough information is given to come to any conclusions about relative steady states.

4. Regarding productivity between two countries, A and B, which statement is true?
   (a) If Country A has a higher level of accumulated factors than Country B, it will have a lower level of productivity.
   (b) If Country B has the same level of accumulated factors as Country A, both countries will have the same level of productivity.
   (c) If Country B has a higher level output per worker and more accumulated factors than Country A, it necessarily has a higher level of productivity.
   (d) If Country A and Country B have the same level of accumulated factors but Country A has a lower level of output per worker, then Country A has a higher level of productivity than Country B.
   (e) None of the above statements is correct.✓

5. Suppose that the yearly returns to education are the following: 13.4% for grades 1 to 4, 10.1% for grades 5 to 8, and 6.8% beyond 8 years. What fraction of wages is due to human capital for a worker who has nine years of education?
   (a) 25.5%
   (b) 40.5%
   (c) 50.5%
   (d) 61.5% ✓
   (e) None of the above is anywhere close to the real value.

6. Which of the following is TRUE?
   (a) According to the Malthusian model of population and economic growth, a technological improvement leads to higher standards of living in the long run.
   (b) The Malthusian model of population and economic growth is useful to explain increases in standards of living in the industrialized world over the last 200 years.
   (c) A drop in the mortality rate can lead to lower fertility through the effect of increased incentives to invest in a child's education. ✓
   (d) A drop in the mortality rate can only lead to higher population growth in the long run.
   (e) Better access to contraceptives is the leading explanation for lower population growth in today's developed world.

7. The relative productivity levels of countries can be estimated
   (a) directly by observing worker productivity levels.
   (b) indirectly by comparing relative output levels to relative factor input levels.✓
   (c) by simply comparing relative education levels.
   (d) by simply comparing the relative health of workers.
   (e) It is impossible to compare productivity levels between countries.

8. Sustained economic growth in Canada over the past 200 years is best explained by
   (a) technological progress.✓
   (b) its large endowment in natural resources.
   (c) accumulation of physical capital.
   (d) education of the workforce.
   (e) global warming.

9. Which of the following assertions is clearly NOT true.
   (a) A coppersmith's apprentice's knowledge of different styles and techniques is an example of *tacit knowledge*.
   (b) It is always better for a country to try to be the *technological leader*.✓
   (c) The finding of a new medical drug that eliminates the need for older, less effective drugs, is an example of *creative destruction*.
   (d) The *size of the market* is likely to be an important factor influencing the level of R&D efforts.

10. Suppose that in a country one-quarter of all females born die in infancy, one-quarter die at age 30, and one-half live to age 60. Women bear one child at age 25, one child at age 28, one child at age 32, and one child at age 35. One-half of children are girls. The net rate of reproduction for this country is:
    (a) 0.75
    (b) 1
    (c) 1.25✓
    (d) 1.5
    (e) 2.5

NAME AND ID:

II. PROBLEM

Answer within the space provided. Your answers must be accompanied with clear explanations. Graphs and equations without explanations will not get you far.

1. Technological progress and economic growth (40 points)
Suppose that the national output of an economy is given by the following function:

$$Y = AK^{\alpha}L^{1-\alpha} = K^{\alpha}(eL)^{1-\alpha}$$

where the variables are as defined in class and $e = A^{\frac{1}{1-\alpha}}$. (The time subscripts have been removed for clarity.) The total investment and depreciation levels are given by $I = \gamma Y$ and $D = \delta K$ respectively, with $\gamma \in (0, 1)$ and $\delta \in (0, 1)$. Population (L) and total factor productivity (A) grow at constant rates n and $\hat{A}$ respectively. Let eL denote the total quantity of "effective workers" available in this economy.

a) (15) Derive an expression for the steady-state output per effective worker.

b) (10) Derive the rate at which output per worker is growing in the steady-state.

c) (15 points) Suppose that in 1950, productivity growth jumps from $\hat{e}_1$ to $\hat{e}_2$, with $\hat{e}_1 < \hat{e}_2$. Assuming that the economy was in steady-state before 1950, show and explain graphically how the output per worker will change over time after 1950. (You need draw only one graph plotting output per worker against time.)

2. (30 points) Population growth and economic growth
Consider the Solow model with population growth, as studied in class. Assume that population can grow at two different rates: n_1 and n_2, where $n_1 > n_2$. The population growth rate depends on the level of output per capita (and therefore the level of capital per capita). Specifically, population grows at (high) rate n_1 when $k < \bar{k}$ and at (low) rate n_2 when $k \geq \bar{k}$. We assume that $(n_1 + \delta)\bar{k} > \gamma f(\bar{k})$ and $(n_2 + \delta)\bar{k} < \gamma f(\bar{k})$. Using a graphical analysis, explain why this model leads to bleak predictions regarding the problem of high population growth in poor countries.

Answer: (See accompanying graphic.) In this problem, the population growth rate is *endogenous*, i.e. it depends on the income per worker. More specifically, the line $(n + \delta)k$ is given by $(n_1 + \delta)k$ when income per capita is below $f(\bar{k})$, and given by $(n_2 + \delta)k$ when income per capita is above $f(\bar{k})$. Note that with $n_2 < n_1$, we simply represent the fact that population growth decreases with income.

There are two possible steady-state equilibria: one at k_1^{SS} with a low income per capita; the other at k_2^{SS} with a high income per capita. This is another instance of a *development trap*: A country that starts off poor has a higher population growth and therefore stays poor because of the *capital dilution* effect. A country that start off rich stays rich because of its lower population growth. In order to sustainably improve the standards of living in the poor country, we would need to find a way to make its capital stock jump above the threshold $\bar{k}$ for a while, say with outside development aid or foreign investment.