Econ 1560 Second Midterm Exam

Instructions: Please answer all questions in the blue books. You may not use notes, books, or calculators. Please show your work. There are a total of 10 questions (some with sub-parts), for 100 points. Questions vary in their level of difficulty and get much harder toward the end of the exam. Partial credit will be given for partially correct answers. Good luck!

1) [5 points] Median household income in the United States in 2009 was equal to $x\%$ of mean household income in that year. What is the value of $X$? You will get full credit if your answer is within 20 percentage points of the correct answer (based on Chapter 13 in the book), and zero credit otherwise.

2) [9 points] A country described by the Solow model (closed economy version, with no human capital, population growth, or technological progress) is in the steady state. Suddenly, the rate of depreciation rises. The saving rate and production function do not change.

A) [3 points] Draw a graph with time on the horizontal axis showing the path of consumption.

B) [3 points] Draw a graph with time on the horizontal axis showing the path of the $K/Y$ ratio.

C) [3 points] Draw a graph with time on the horizontal axis showing the path of total depreciation.

In all of your answers, you should include any additional figures or verbiage required to explain how you got your result.

3) [8 points] In a certain country, equal numbers of boys and girls are born. Half of all children die in infancy, and everyone else lives to exactly 100. The TFR is 3.0. These facts have all been true for a long time.

Would you expect the number of 50 year olds to be greater than, less than, or equal to the number of 40 year olds? Explain briefly how you got your answer.
4) [10 points] The price of oil has just fallen significantly, and the price of gasoline (produced from oil) is falling as well. Let's assume that throughout 2015 the price of gasoline stays very low. Under which of the following two scenarios will gasoline consumption be higher:

A) It is widely believed that the price reduction is temporary, and that in a few years prices will go back up to their old levels.

B) It is widely believed that the price reduction is permanent.

Explain your answer in two or three sentences, making reference to the mechanism(s) discussed in the class/book.

5) [8 points] In a certain country, half of the population has an income of zero, and the other half has income of exactly $100 each. What is the Gini coefficient in this country?

6) [10 points] A renewable natural resource is being harvested at its maximum sustainable yield, which is 500 tons per year. In the year 2015, there is a bureaucratic mess up, and by accident, only 400 tons are harvested. Having realized the error, your boss proposes two courses of action:

(A) Harvest 600 tons in 2016, then in subsequent years go back to harvesting 500 tons per year.

(B) Harvest 500 tons per year in 2016 as well as all subsequent years.

Comment on these two plans, in terms of their feasibility and optimality. If neither plan is optimal, then discuss what the optimal plan might look like.
7) [12 points] Consider the following data on two fictional planets, Zerg and Protoss:

<table>
<thead>
<tr>
<th></th>
<th>Zerg</th>
<th>Protoss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output per worker, y</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Capital per worker, k</td>
<td>64</td>
<td>25</td>
</tr>
<tr>
<td>Human capital per worker, h</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Assume that the production function is \( y = A k^\alpha h^{1-\alpha} \), where the value of \( \alpha \) is one half. In both countries, technology has been growing at 1% per year for a long time, while the level of efficiency has been constant.

A) [6 points] Calculate the level of productivity, \( A \), in each country.

B) [6 points] Suppose that Zerg is technologically 70 years behind Protoss. What are the relative levels of efficiency in the two countries?

8) [12 points] Consider the following version of the two country model of technology transfer from Chapter 9.

The first four equations are standard:

Per worker production functions:

\begin{align*}
(1) & \quad y_1 = A_l (1 - \gamma_{A,l}) \\
(2) & \quad y_2 = A_f (1 - \gamma_{A,f})
\end{align*}

Technological progress in the leader country:

\[ \dot{A}_l = \frac{\gamma_{A,l}}{\mu_l} L_l \]

Technological progress in the follower country:

\[ \dot{A}_f = \frac{\gamma_{A,f}}{\mu_f} L_f \]

The only difference from the standard model is in the equation determining the cost of copying. It is:

\[ \mu_c = \frac{\mu_l}{2} \]
Suppose that
\[ L_1 = L_2 = 1 \]
\[ \gamma_{A,1} = .1 \]
\[ \gamma_{A,2} = .25 \]
\[ \mu_t = 10 \]

In the year 2000 (when our problem starts): \[ \frac{A_1}{A_2} = 2 \]

Draw a picture with time on the horizontal axis and the growth rates of output in the two countries on the vertical axis. You should be able to give the actual numbers for growth in both countries over time. Also, label on the horizontal axis the year in which any interesting changes occur.

9) [10 points] In a certain country, population growth is determined by the following equations:
\[ \Delta L = -0.01 + 0.01 \times y \quad \text{if} \quad y < 2 \]
\[ \Delta L = 0.03 - 0.01 \times y \quad \text{if} \quad y \geq 2 \]

Where \( \Delta L \) is the growth rate of population and \( y \) is income per capita.

Output is produced with labor and land. The production function is
\[ Y = L^{\frac{1}{2}}(AX)^{\frac{1}{2}} \]

Where \( L \) is the size of the population, \( Y \) is total output, \( X \) is the quantity of land, and \( A \) is a measure of technology. The quantity of land is fixed at \( X=9 \).

Suppose that the technology parameter \( A \) is equal to one and doesn’t change over time. What are the steady states of the model? (Hint: there are two of them.) Which are stable? What is the size of the population and the level of income per capita in each of the steady states?
10) [16 points] In a country, there are equal numbers of skilled and unskilled workers. The economy is closed to trade, and there is no capital. There are three goods produced in the country: sandwiches, haircuts, and books.

Each good can be produced with either skilled or unskilled labor. The chart below shows the number of hours of unskilled or skilled labor required to manufacture one unit of each good. For example, to manufacture one haircut requires either two hours of unskilled labor or one hour of skilled labor. (In the class lecture, I called these numbers “unit labor costs.”)

<table>
<thead>
<tr>
<th>Good</th>
<th>Hours of unskilled labor required to produce one unit</th>
<th>Hours of skilled labor required to produce one unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandwiches</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Haircuts</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Books</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

Each worker has a balanced budget in every period. That is, his/her earnings are the same as his/her expenditures. The preferences of workers are such that every worker, whether skilled or unskilled, spends one-third of his/her budget on each of the three goods.

A) [3 points] Explain intuitively what pattern of specialization you expect to see in this economy, and why.

B) [3 points] What is the ratio of skilled wages to unskilled wages? Explain why this will be so.

For the rest of the questions in this problem, it will be convenient to pick a “unit of account” with which to think about wages and prices. We will pick sandwiches as the unit of account. So, imagine that all wages are paid and prices are expressed in terms of sandwiches.

C) [2 points] What is the unskilled wage, in terms of sandwiches per hour?

D) [2 points] What is the price of haircuts in terms of sandwiches (i.e. sandwiches per haircut)?

E) [2 points] What is the skilled wage in terms of sandwiches per hour?

F) [2 points] What is the price of books in terms of sandwiches (i.e. sandwiches per book)? [Careful! This is tricky.]

G) [2 points] Suppose that each worker (skilled and unskilled) works six hours per day. Solve for the daily consumption, for both skilled and unskilled workers, of each of the three goods. Your answer should be in the form of a table like this:

<table>
<thead>
<tr>
<th>Good</th>
<th>Daily Consumption of Unskilled</th>
<th>Daily Consumption of Skilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandwiches</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haircuts</td>
<td></td>
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