Graduate Macroeconomics I: Midterm

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Instructions: Write your answers on blank paper. Start each problem on a new sheet. Write your name and the problem number of EVERY page. Number every page.

Read the whole problem before you start answering. Make sure you answer all the parts of each problem. If the problem asks you to graph something, graph it and label the axes correctly.

You have 90 minutes for the exam. Make sure you at least right down some ideas about how the problem should be answered if you cannot figure out a mathematical answer.

There are a total of 100 points.

Problem 1 (25 points): In March 2011 the Tohoku earthquake hit Japan, causing tsunamis and famously leading to the reactor meltdown in Fukushima. For this problem, assume that Japan's economy can be described by a Solow model that includes technological growth at the rate g. The level of technology at any given time is E_t.

(A) Assume the earthquake only destroyed some of the physical capital stock. Draw a diagram showing the path of output per worker after the earthquake.

(B) Assume instead that the earthquake left the capital stock intact, but caused the level of E_t to be below it's normal trend line for one period around the earthquake (say that E_{2011} was low). After that, E_t jumps back to it's previous trend line. Draw a diagram showing the path of output per worker after the earthquake.

Problem 2 (25 points): People operate in an OLG economy. Their utility is non-standard. Lifetime utility is $V = c_1 + \beta \ln c_2$, so that people have linear utility in first period consumption, but log utility in second period consumption. The only other restriction is that $c_1 \geq 0$, meaning they cannot consume negative amounts. They earn a wage only in the first period, and production is $y_t = k_t^\alpha$. Population grows at $(1 + n)$, so capital accumulates according to $k_{t+1} = s_t/(1 + n)$.

(A) Given their wage, what is the optimal amount saved by an individual in their first period of life? Make sure to point out any critical points in how savings are related to wages.

(B) Explain briefly the intuition behind your answer to part (A). Why do savings look the way they do?

(C) What is the steady state value of capital per worker? Be careful to account for the same critical points that showed up in (A).

Problem 3 (25 points): Production takes place according to $Y = K^\theta Z^\phi N^{1-\theta-\phi}$. The stocks of K and Z accumulate according to $\Delta K_{t+1} = s_K Y - \delta K$ and $\Delta Z_{t+1} = s_Z Y - \delta Z$. There is no population growth or technological progress.

(A) Under what conditions will this economy have a steady state growth rate that is *not* equal to zero?

(B) Assume that those conditions hold. What is this steady state growth rate?

(C) Assume that those conditions hold, and the economy is at steady state. There is an increase in s_K. Draw a figure that plots the growth rates of K and Z against the ration K/Z. Show on the figure what happens following the increase in s_K.

(D) Given part (C), draw a figure showing the time path of output per capita following the increase in s_K.

Problem 4 (25 points): Assume that technological growth is given by $\Delta E_{t+1}/E_t = e + \frac{\theta s_R N_t}{E_t}$, where e is some exogenous growth in E_t that the economy gets even if they do no research (i.e. if $s_R = 0$). Population grows at the rate n.

(A) What is the steady state growth rate of technology, E_t, if $e < n$?

(B) If $e > n$, then what is the steady state growth rate of technology, E_t?

(C) If $e > n$, why or why not does it make sense to have $s_R > 0$?