Some of the following problems are adapted from Jones and Vollrath (2024, Ch.7,9). To practice for the exams, **please show your work.**

1. **TFUs.** Determine whether the following statements are **true**, **false**, or **uncertain**, and justify your answer in no more than one paragraph. Please be concise.

   (a) The model of technology diffusion (without trade) predicts that all countries, including those at the frontier, will have the same steady-state capital-output ratio.

   (b) In the basic Malthusian model, the level of GDP per capita must go to zero in the long run.

   (c) Along a balanced growth path of the nonrenewable resources model, the share of the resource that gets extracted at any given time (s_E) affects both the *level* and the *growth rate* of GDP per capita.

2. **Comparative statics.** For this problem, you will work with the model of technology diffusion involving D (and the extension to involve trade). For each of the following scenarios, assume that the economy begins in a steady state. For each scenario, draw three figures showing how each of the following terms evolve over time: the size of the A/D ratio, the growth rate of GDP per capita (g_y), and the log of GDP per capita ($\ln y_t$). Be sure to clearly label all axes and curves in your figures.

   (a) Human capital, h, jumps to a higher value and stays there permanently.

   (b) The world productivity growth rate, g_A, falls to a lower value and stays there permanently.

   (c) The ratio of imported varieties to domestic varieties, M/D, jumps to a higher value and stays there permanently.

3. **The Black Death.** In the aftermath of the Black Death of the fourteenth century, which killed up 30–50% of the European population, income per capita nearly doubled over more than a century before settling back to pre-plague levels by the sixteenth century. There are several ways to think about how this might have happened. Consider the basic Malthusian model ($g_L = \nu(y_t - \bar{c})$, exogenous g_A), and assume the economy begins in steady state.

   (a) Imagine the Black Death results in a one-time drop of population. Draw a graph showing the time path of income per capita, y_t, in this economy following that one-time drop. What is the long-run level of income per capita?

   (b) As an alternative, think of the Black Death as a decrease in the parameter ν, implying that the population growth rate is lower at any given level of income per capita, due to higher mortality rates. To begin thinking about this, imagine that the drop in ν is permanent. Draw a graph showing the time path of income per capita, y_t, in this economy. What is the long-run level of income per capita?

   (c) Expanding on (b), now consider that the drop in ν is temporary, only lasting for 50 or 100 years. Again, draw a graph showing how the time path of income per capita, y_t, evolves. What is the long-run level of income per capita after the temporary drop is over?

    (d) If you were trying to distinguish which of the three possible situations was correct, what kind of evidence or data would you look at? Could you determine what situation was most likely to be true?

Jones, Charles I. and Dietrich Vollrath. 2024. *Introduction to economic growth.* New York: W.W. Norton & Company, fourth ed.