# Midterm Exam

You have until 10:50am to complete the exam, be certain to use your time wisely. Answer all questions directly on the exam. You may use printouts of the required readings. No other materials may be used during the exam. Answer questions completely but concisely. Including additional incorrect information in an otherwise correct answer may result in a loss of points. Remember to put your name on the exam. Good luck!

**Name:**

1. (15 points) Examining average wages is a common way to assess the standard of living, one that has been used throughout class and the readings. However, relying on wages to measure the standard of living has several shortcomings.

   (a) What important aspects of the standard of living do wages fail to capture?

   (b) Why might using wages as a proxy for the standard of living overestimate improvements in the standard of living over the past several centuries?

   (c) Why might using wages as a proxy for the standard of living underestimate improvements in the standard of living over the past several centuries?

2. (30 points) When we discussed the Malthusian model, one key assumption was that the marginal product of labor is diminishing. In other words, each additional worker added to an economy increases output but by less than the previous worker did.

   (a) Explain why our assumption of diminishing marginal product of labor produced a downward sloping technology curve (a negative relationship between population and income per capita).

   (b) Consider a society with a diminishing marginal product of labor that is currently in a Malthusian equilibrium in which population growth is zero and the society is at its subsistence income, $y^*$. Show this Malthusian equilibrium on a set of two graphs. One should show the birth rate and death rate curves, with income per capita on the horizontal axis and birth and death rates on the vertical axis. The other should show the technology curve, with income per capita on the horizontal axis and population on the vertical axis.

   (c) Now suppose that this society discovers a new way of producing that leads to constant marginal product of labor equal to the current subsistence income. In other words, each additional worker will contribute $y^*$ to total output. Use your graph and a written explanation to explain how this technological change will affect the equilibrium birth rate, death rate, income per capita and population.

   (d) Now suppose that there is another technological improvement that increases output per worker such that the marginal product of labor is still constant, just at a higher level of output than $y^*$. Use a new set of graphs to show how this will change the society's birth rate, death rate and income per capita in the long run. Include a written explanation of the changes.

3. (15 points) Consider the changes in labor force participation discussed by De Vries in his article on the Industrious Revolution and the changes in work hours investigated by Voth using the court records of the Old Bailey.

    (a) The break from the Malthusian world is often attributed to growth in technology. Suppose that we incorporated the changes in labor force participation and work hours during the Industrial Revolution into our growth accounting equations in the same way we include changes in capital, labor and land. Explain how would this affect our estimates of the growth rate of technology during the Industrial Revolution.

    (b) What technological changes during the Industrial Revolution contributed to increases in labor force participation rates and work hours?

    (c) What other changes (non-technological) during the Industrial Revolution contributed to increases in labor force participation rates and work hours?

4. (15 points) Consider the following quote from page 3 of the Mokyr article:

   *Technological change, like all evolutionary processes, was often wasteful, inefficient, and frequently wrong-headed...As I have argued in Mokyr (2002), the amount of wastefulness in innovation can be substantially reduced if more is known about the underlying process...If innovation requires to "try every bottle on the shelf", an improved epistemic base of technology can at least reduce the number of shelves.*

   (a) Explain why the above quote suggests that increases in the human capital stock may have been necessary to break out of the Malthusian trap.

   (b) What evidence do we have of growth in the human capital stock in the decades leading up to the Industrial Revolution?

   (c) Do you think the evidence you discussed in part (b) is really capturing the sort of human capital relevant to Mokyr's arguments? Be certain to fully explain your answer.

5. (25 points) The graph below depicts a stylized view of the demographic transition as it occurred in Western Europe, with death rates ($d$) and birth rates ($b$) starting out high and then death rates dropping followed by birth rates dropping until both reached modern, low levels. The second graph shows how this transition impacted population ($N$), with population growing throughout the transition until the final birth and death rates are achieved.

One thing that we will talk about in the coming weeks is that China began a process of industrialization similar to that of Britain but at some point had to shift workers from cities back to the agricultural sector in rural areas in order to feed the growing population. Suppose that China was undergoing a demographic transition just like Europe's until this shift of workers occurred at time $\tilde{t}$. On the graphs below, show how this shift will change the birth rate, death rate and population curves after $\tilde{t}$. Also provide a written explanation for how and why each curve would change.