HOMWORK #2

This homework assignment is due at the beginning of lecture on Monday, January 31.

1. Do problem 1 on p. 108 in Chapter 3 of the textbook. Use U.S. annual data for the time period 1965–1992. As mentioned in the notes to Table 3.1 on p. 65 of the textbook, total employment in the U.S. (measured in thousands of workers) can be found at:


   Total employment is the fourth column in this table; use total employment of persons 16 years of age and over. To obtain series for U.S. real GDP and the U.S. capital stock (both in 1985 dollars) go to the Penn World Tables at:


   There you will find series for “real GDP per capita in constant dollars using chain index” and “capital stock per worker” (both in 1985 international prices). You will also find a series for total population (in thousands). Multiply real GDP per capita by population to obtain real GDP; multiply capital stock per worker by total employment to obtain the aggregate capital stock. In addition to answering the questions in the textbook, compare your findings for productivity growth to those in Table 3.1, which uses a different set of sources for GDP and the capital stock.

2. Do problem 7 on p. 107 in Chapter 3 of the textbook.

3. Do problem 10 on p. 107 in Chapter 3 of the textbook.

4. This problem considers an individual’s labor supply decision in a specific example. The individual lives for only one time period. In this time period, he has preferences over how many consumption goods he consumes and how much leisure he enjoys. Let $c$ denote the total amount that he spends on consumption goods and let $\ell$ denote the total number of hours of leisure that he enjoys. Let $\bar{\ell}$ denote the maximum number of hours of leisure during the time period. Assume that the individual’s utility function takes the form:

   $$ U(c, \ell) = \log(c) + B \log(\ell), $$
where “log” denotes the natural logarithm and $B$ is a (positive) parameter. The individual can work at a (nominal) wage rate of $W$ per hour. The individual’s income is equal to his exogenous income $I$ plus his labor income $WN$, where $N = \ell - \bar{\ell}$ is the number of hours he works. The individual’s objective is to choose $c$ and $\ell$ so as to maximize his utility function. The individual makes this choice subject to a budget constraint, which reads:

$$PC = WN + I,$$

where $P$ is the price of a unit of the consumption good.

(a) Show that, in this problem, the income and substitution effects of a change in the real wage (i.e., $W/P$) exactly cancel each other when $I = 0$. That is, show that the optimal choice for $\ell$, and hence for $N = \bar{\ell} - \ell$, does not depend on the real wage. Graph the individual’s labor supply curve in a graph with the real wage on the $y$-axis and labor supply $(N)$ on the $x$-axis. How does an increase in $B$ affect the labor supply curve? How does an increase in the nominal wage affect the labor supply curve?

(b) Set $B = 1$, $\bar{\ell} = 80$, $I = 0$, and $W = P = 1$. Use your answer from part (a) to determine the worker’s optimal consumption-leisure bundle. What is the worker’s utility at this bundle? Find two other combinations of $c$ and $\ell$ that deliver the same utility and draw the indifference curve connecting these combinations. (Recall that an indifference curve is a locus, or set, of $(c, \ell)$ pairs that all deliver the same utility.) Show that the budget line is tangent to this indifference curve.

(c) Suppose that $W$ increases from 1 to 2 (while the remaining parameter values remain unchanged). What is the worker’s new optimal consumption-leisure bundle?

(d) Calculate the substitution effect of an increase in the real wage from 1 to 2. To do this, first set $W = 2$ (keeping $P$ set equal to 1) and set $I$ so that the budget line goes through the optimal consumption bundle that you calculated in part (b). Then calculate the worker’s optimal choice given this budget line. The substitution effect is the difference between the number of hours worked at this point and the number of hours worked when $W = 1$ (which you calculated in part (a)).

(e) Use your answers from (b), (c), and (d) to calculate the income effect of an increase in the real wage from 1 to 2.

(f) Suppose that there are $M$ individuals in the economy identical to the one you studied above. Graph the economy’s aggregate labor supply curve (put the real wage on the $y$-axis and the total number of hours worked by all workers in the economy on the $x$-axis).
5. (a) Suppose that a typical firm in the economy seeks to maximize its profits

$$PF(K, N) - WN,$$

where $F(K, N)$ is the firm’s production function. Assume that the firm’s capital stock $K$ is fixed but that the firm can freely choose $N$, the number of hours of labor that it hires. The firm does not choose either the price $P$ of its output or the wage rate $W$. Let $F(K, N) = AK^{0.3}N^{0.7}$, where $A$ is the firm’s “total factor productivity.” For $A = 1$ and $K = 1$, graph the firm’s labor demand curve in a graph with the real wage $W/P$ on the $y$-axis and labor demand $N$ on the $x$-axis.

(b) If the firm described in part (a) is the only firm in the economy and if aggregate labor supply is determined as in part (f) of the fourth problem, what are the equilibrium values of the real wage and of total hours worked? (Your answers will depend on $M$, the total number of workers in the economy.)

(c) Explain how increases in the following parameters affect the equilibrium values of the real wage and of total hours worked: $B$, $P$, $A$, $K$, and $M$.

(d) How would your answers to part (c) change (qualitatively) if the aggregate labor supply curve were upward-sloping rather than vertical? (Answer this question for all of the parameters except $B$.)