SIMON FRASER UNIVERSITY
Department of Economics

Econ 305
Intermediate Macroeconomic Theory

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PROBLEM SET 1
(Solutions)

1. Briefly describe how the CPI (Consumer Price Index) and GDP deflator are constructed. Briefly explain why each provides a biased measure of changes in the "cost of living".

   The CPI and the GDP deflator are both measures of the "cost of living", i.e., how much extra money you would need to maintain your standard of living in the presence of a changing level of prices. This is a surprisingly difficult calculation to make, because in practice increases in the general level of prices (due to inflation) are also accompanied by changes in relative prices. That is, because of changing market conditions, not all prices rise by the exact same percentage amount. As a result, consumers tend to substitute away from those goods which experience the greatest price increases, and instead buy more of the goods which experience the mildest price increases.

   The CPI measures changes in the cost of living by changes in the cost of a fixed basket of commodities. Hence the CPI ignores the ability of consumers to substitute away from commodities that have large (relative) price increases. As a result, the CPI tends to overstate increases in the cost of living.

   The GDP deflator, on the other hand, measures changes in the cost of living by computing the cost of the current output of the economy at two different sets of prices – the current set of prices and some base-year set of prices. Thus, in the GDP deflator the output basket changes each period. As a result, the GDP deflator fully reflects the substitutions which consumers make in response to changing relative prices. However, it doesn't reflect the fact that consumers might not like the current basket as much as the original one. That is, it ignores the costs of substituting among goods. Hence, the GDP deflator tends to understate changes in the cost of living.

2. Suppose household preferences are described by the utility function

$$U(C,\ell) = \frac{1}{2}C + \alpha\sqrt{\ell}$$

   where C stands for consumption of market goods and ℓ stands for leisure.

   (a) Assuming the market (real) wage is w and the total amount of time available is h, derive expressions for the household's consumption and labor supply decisions as functions of w and h. (For simplicity, assume the household has no nonmarket income). Does the income effect ever dominate the substitution effect for this household? Under what conditions will the the household only consume leisure (i.e., not work at all in the market)?

   The household's optimality condition is:

$$\frac{U_\ell}{U_c} = w$$

Taking the derivatives we can write this as:

$$\frac{\alpha}{\sqrt{\ell}} = w$$

Solving for ℓ gives:

$$\ell = \left(\frac{\alpha}{w}\right)^2$$

From the time constraint, we know that labor supply, N^s, is just $N^s = h - \ell$. This gives us the labor supply curve:

$$N^s = h - \left(\frac{\alpha}{w}\right)^2$$

Notice that this is always increasing in w. Therefore, the substitution effect always dominates the income effect. Also notice that if $\alpha \geq \sqrt{h}w$ then the household would choose not to work at all.

(b) Now suppose output, Y, is produced by competitive firms with technology

$$Y = zK^{1/2}N^{1/2}$$

where K denotes the (fixed) supply of capital, N denotes the amount of labor, and z stands for total factor productivity. Given this production function, derive an expression for the demand for labor as a function of w, K, and z.

The firm's optimality condition is:

$$(1/2)zK^{1/2}N^{-1/2} = w$$

Solving for N gives us the firms labor demand curve:

$$N^d = \frac{(1/4)z^2K}{w^2}$$

Notice that this is a downward sloping function of w. Also notice that labor demand increases (i.e, shifts right) when either productivity or the capital stock increase.

(c) Using your answers to parts (a) and (b), derive an expression for the market-clearing wage rate. (For simplicity, assume the firm's profits do not accrue to the household, so that the labor supply curve is the same as in part (a)). How does the equilibrium wage change when z increases? How does the equilibrium wage change when α increases? Use a Labor Supply/Labor Demand graph to illustrate these changes.

Equating labor supply to labor demand (i.e., $N^s = N^d$) gives us the equilibrium wage rate

$$h - \left(\frac{\alpha}{w}\right)^2 = \frac{(1/4)z^2K}{w^2} \qquad \Rightarrow \qquad w = \sqrt{\frac{(1/4)z^2K + \alpha^2}{h}}$$

Notice that w increases when z increases. That's because the labor demand shifts up and to the right. Also notice that w increases when α increases. That's because the labor supply curve shifts up and to the left.

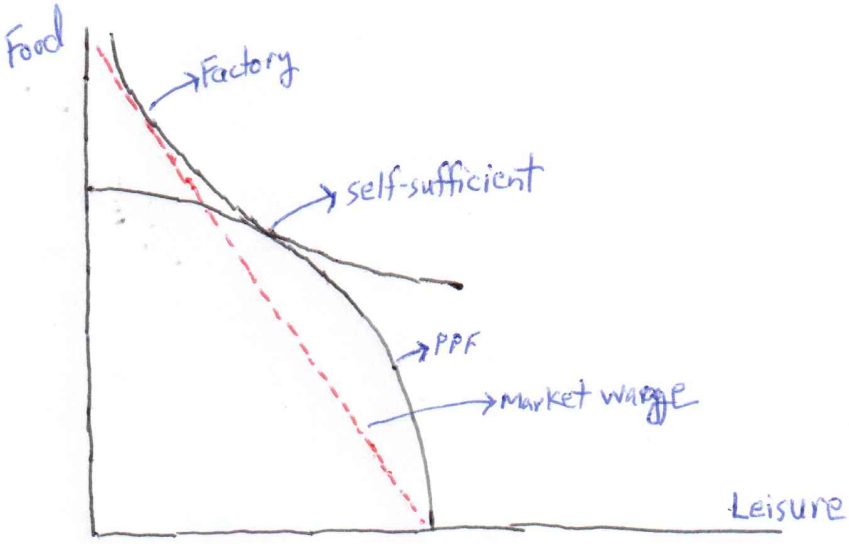
3. Consider a subsistence farmer who can produce food, Y, according to the production function, $Y = zN^{1/2}$, where N denotes the amount of hours of work he does. Suppose this farmer also values leisure in addition to food, and has h total hours of time available per period.

(a) Draw the farmer's production possibilities frontier, and use it illustrate his optimal choice of food and leisure. (For simplicity, ignore the fact that there might be some minimum amount of food required to live!).

To derive the PPF, simply substitute the time constraint, $N = h - \ell$, into the production function. This produces a concave, negatively sloped relationship between Food and Leisure. It is concave because production is subject to diminishing returns. (See the graph in part (b)).

(b) Now suppose a factory opens up nearby, giving him the opportunity to work for a fixed wage rate, which he can then use to buy his food in the town market. Draw a picture illustrating the minimum wage required to induce him to leave farming and work in the factory. Assuming a farmer decides to take a job in a factory, does he work more or less than before?

The following graph describes the situation,



Evidently, people who leave farming to work in factories will work more than before.

(c) Do you think this picture has any relevance for developing countries like China?

It has often been observed that during the early phases of industrialization workers work long hours. True, subsistence farmers work long hours too, but moving to a factory allows workers to work for a fixed wage, which allows them to escape the work-discouraging effects of diminishing returns. This might partly explain why workers in China put in so many hours.

4. Suppose Jane gets paid \$10 per hour for the first 8 hours of work, and \$15 for each hour of overtime (i.e., in excess of 8 hours). Assume Jane can decide her own hours, and decides to work 10 hours. Now suppose her employer changes the compensation policy, and decides to pay a fixed wage of \$11 per hour. Will Jane work more or less than before? Use the concepts of income and substitution effects to explain your answer. Use a graph to illustrate your answer.

The key thing to notice here is that after the policy change Jane's total income would remain the same if she kept her hours constant. Therefore, the only effect here is the substitution effect. Since at the margin the wage rate is now lower (i.e., \$11 vs. \$15), Jane will decide to reduce her hours as long as her indifference curve is convex (i.e., as long as she displays a diminishing marginal rate of substitution between leisure and consumption). Graphically, the new budget constraint runs through her original budget constraint at her original optimum point, but is now flatter.