Problem Set # 1
14.02 Fall 2009
Due 9/25

September 18, 2009

1 True/False/Uncertain [40 points]

Please state whether each of the following claims are true, false or uncertain, and provide a brief justification for your answer.

1. "An increase in the price of a good that is imported into the US - holding all other prices and quantities fixed - will tend to increase the GDP deflator in the US" [8 points]

   ANSWER. False. The GDP deflator uses information from nominal and real GDP, which means it only takes into account good produced in the US. The imported good was produced abroad.

2. "In an economy with only two goods, the choice of the base year (b) will not affect the growth rate of real GDP with base year b, as long as the relative price between the goods (that is, the ratio of the price of one good to the price of the other) is constant over time" [8 points]

   ANSWER. True. Proof

$$\begin{aligned} y_t^b &= p_{1b}q_{1t} + p_{2b}q_{2t} \\ g_{t+1}^b &\equiv y_{t+1}^b/y_t^b - 1 = \frac{p_{1b}q_{1t+1} + p_{2b}q_{2t+1}}{p_{1b}q_{1t} + p_{2b}q_{2t}} - 1 \\ &= \frac{q_{1t+1} + (p_{2b}/p_{1b})\, q_{2t+1}}{q_{1t} + (p_{2b}/p_{1b})\, q_{2t}} - 1 \end{aligned}$$

   But if relative prices are constant, that means $p_{2b}/p_{1b} = p_2/p_1$ which is independent of b. Hence, g_{t+1}^b is also independent of b.

3. "An increase in the stock of capital of an economy tends to increase the real wage" [8 points]

   ANSWER. True. A higher stock of K increases the marginal product of labor, which increases labor demand, which tends to increase the real wage.

4. "The shorter the duration of a given increase in the real wage, the stronger the income effect is" [8 points]

   ANSWER. False. It is exactly the other way around. See page 82 of textbook.

5. "Skill-biased technical change, through its effect on labor supply, can generate an increase in wage inequality" [8 points]

   ANSWER. False. Skill biased technical change affects the demand for skilled and unskilled workers. Not the labor supplies. See page 91 of the textbook.

2 Macro Data [40 points]

Suppose that there are only 2 goods in the economy (denoted by *A and B).* We have yearly data on prices (p) and quantities produced (q) for each good for the period 2001-2004

t	p_A	q_A	p_B	q_B
2000	1	1	2	2
2001	2	2	4	2
2002	2	3	3	1

1. Compute the nominal GDP for each year [8 points]

   ANSWER.

   $Y_{2000} = 1 * 1 + 2 * 2 = 5$

   $Y_{2001} = 2 * 2 + 4 * 2 = 12$

   $Y_{2002} = 2 * 3 + 3 * 1 = 9$

2. Compute, for each year in the sample, the real GDP with base-year 2000. Do the same using 2001 and 2002 as base years [8 points]

   ANSWER.

   $y_{00}^{00} = 1 * 1 + 2 * 2 = 5, y_{01}^{00} = 1 * 2 + 2 * 2 = 6, y_{02}^{00} = 1 * 3 + 2 * 1 = 5$

   $y_{00}^{01} = 2 * 1 + 4 * 2 = 10, y_{01}^{01} = 2 * 2 + 4 * 2 = 12, y_{02}^{01} = 2 * 3 + 4 * 1 = 10$

   $y_{00}^{02} = 2 * 1 + 3 * 2 = 8, y_{01}^{02} = 2 * 2 + 3 * 2 = 10, y_{02}^{02} = 2 * 3 + 3 * 1 = 9$

3. Compute the GDP deflator for each year in the sample, using 2001 as base year. Compute the corresponding inflation rate for each year. Would you get a different value for inflation if instead you used 2000 as a base year? [8 points]

   ANSWER.

   $P_{00}^{01} = 0.5,\ P_{01}^{01} = 1, P_{02}^{01} = 9/10 = 0.9$

   Define inflation as the growth rate in prices, that is $\pi_{t+1} = (P_{t+1} - P_t)/P_t$

   $\pi_{2001} = \frac{1-0.5}{0.5} = 100\%$; $\pi_{2002} = \frac{0.9-1}{1} = -10\%$

4. Suppose that the basket of goods used by the Government to compute the CPI consists of 1 unit of good A and 4 units of good B. Using 2001 as the base-year, compute the CPI and also the CPI based inflation rate for each year. How do the numbers for CPI based inflation compare with the numbers for GDP deflator based inflation obtained above? Do you get more or less deflation between 2001 and 2002? Explain briefly. [8 points]

   ANSWER.

   $CPI_{00} = \frac{1*1+2*4}{2*1+4*4} = 0.5$, $CPI_{01} = 1$; $CPI_{02} = \frac{2*1+3*4}{2*1+4*4} = 0.78$;

   $\pi_{01}^{CPI} = 100\%$;$\pi_{02}^{CPI} = \frac{0.78-1}{1} = -22\%$

   Note that we get the same number for inflation between 2000 and 2001, but we get a bigger level of deflation between 2001 and 2002. This is because the Government's basket has a lot of good B, which is the one whose price is falling.

5. Compute the growth rates of the chain-weighted real GDP for 2000-2001 and 2001-2002. For the growth rate between 2000 and 2001, does it make a difference to use the chain index as opposed to the growth rate of real GDP with base year, say, 2000? Why? [8 points]

   ANSWER. For the growth rate between 2000 and 2001, we have

$$\begin{aligned} g_{01}^{c} &= \frac{1}{2} * g_{01}^{00} + \frac{1}{2} * g_{01}^{01} = \frac{1}{2} * \frac{6-5}{5} + \frac{1}{2} * \frac{12-10}{10} = 20\% \\ g_{02}^{c} &= \frac{1}{2} * g_{02}^{01} + \frac{1}{2} * g_{02}^{02} = \frac{1}{2} * \frac{10-12}{12} + \frac{1}{2} * \frac{9-10}{10} = -13.3\,3\% \end{aligned}$$

   Note that for the growth rate between 2000 and 2001, $g_{01}^{00} = g_{01}^{01}$. That is, the base year is irrelevant. Thus, the chain index doesnt make a difference. The reason is that relative prices did not change between 2000 and 2001.

3 Production functions [20 points]

Suppose there are two factors of production: capital (K) and labor (N). Let A be a technological parameter (take it as given)

Answer the following:

1. Does any of the following production functions exhibit constant returns to scale? Justify your answer with a one-line proof [10 points]

   (a) $Y = AK^{0.4}N^{0.6}$

   (b) $Y = AK^{\alpha}N^{\beta}$, with $\alpha + \beta > 1$

   (c) $Y = \min(K, N)$

   ANSWER. Only (a) and (c) have constant returns. Proof: Let $\lambda \geq 1$

   a. $\lambda Y = A(\lambda K)^{0.4}(\lambda N)^{0.6}$

b. $A(\lambda K)^{\alpha}(\lambda N)^{\beta} = A\lambda^{\alpha+\beta}K^{\alpha}N^{\beta} > A\lambda K^{\alpha}N^{\beta}$ (if we increase each input by a factor of λ, output increases by a a factor bigger than λ). This function has increasing returns to scale.

c. $\min(\lambda K, \lambda N) = \lambda \min(K, N)$

2. Suppose that the production function is given by $Y = C + K^{\alpha}N^{1-\alpha}$, where C is a positive constant. Does an increase in C affect the marginal product of any factor? Will it affect labor productivity? [10 points]

   ANSWER. No, an increase in C will not affect the MPK nor the MPN. Yes, it will affect labor productivity:

$$Y/N = C + K^{\alpha}N^{1-\alpha}$$

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