

Exam 1. Econ420. Spring 2010

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Instructions:

- Answer all questions.
- *Explain* your answers – do not just state them.
- *Show* your derivations – do not just state the final result.
- Do not refer to any notes or books. You may use a calculator.
- The total time is 75 minutes.
- The total number of points is 100.

1 Measurement

- [8 points] Explain why it is difficult to measure changes in *real* GDP over long periods of time. Assume that you have good data on prices and quantities. Give an example of a good that would cause trouble.
- [12 points] How do the following events affect GDP and its components? Provide brief explanations. I am looking for direct effects on GDP, not for indirect ones (a company's spending on advertising stimulates consumption demand and such).
 - A company spends \$1m on advertising.
 - A company produces 100 tires which usually sell for \$100 each. But the tires remain unsold.
 - A person buys a painting abroad and carries it into the U.S. What happens in the expenditure approach to GDP?

2 Production Model

The production model postulates the aggregate production function $Y_t = \bar{A}K_t^\alpha L_t^{1-\alpha}$. Assume $\alpha = 1/3$, unless stated otherwise. Countries differ in their values of the productivity parameter \bar{A} .

- [6 points] If $\alpha = 1/3$, how much does output per worker (Y/L) rise when K/L increases 5-fold?
- [8 points] How does your answer change when $\alpha = 2/3$? Explain the intuition underlying the difference.
- [8 points] In cross-country data, per capita GDP and capital per worker are closely related. Should one conclude that differences in capital are an important cause of differences in GDP? Explain your answer.
- [15 points] The following table shows data for 2 countries.
 - According to the production model, how large an output gap $\frac{Y/L_A}{Y/L_B}$ does the 20-fold capital gap $\left(\frac{K/L_A}{K/L_B}\right)$ cause?
 - Calculate the productivity parameters \bar{A} for both countries.

Country	A	B
Y/L	100	10
K/L	400	20

3 Solow Model

Consider the following modified Solow model:

$$\begin{aligned} Y_t &= \bar{A}K_t^\alpha L_t^{1-\alpha} \\ K_{t+1} - K_t &= sY_t - dK_t - X \\ Y_t &= C_t + I_t \\ L_t &= \bar{L} \\ I_t &= sY_t \end{aligned}$$

with $\alpha, s, d, \bar{L}, \bar{A}, X$ given. The new part is X . I am assuming that a constant amount of capital, X , depreciates in each period regardless of how much capital the economy owns.

1. [6 points] Draw the Solow diagram for this model. That is, plot sY_t and $dK_t + X$ against K_t .
2. [6 points] Define a steady state. In your graph, how many steady states are there (including $K = 0$)?
3. [18 points] Discuss the dynamics of K_t . For any given K_0 , what happens to K_t over time? Which of the steady states are stable (i.e.: if the economy starts with K_0 near the steady state, does it converge towards it)? Explain your answer.

4 Short Questions

1. [5 points] The production function is $Y_t = \bar{A}K_t^{1/3}L_t^{2/3}$. The growth rates of the inputs are $g(K) = 3\%$ and $g(L) = 1\%$. \bar{A} does not grow. Find the growth rate of Y .
2. [8 points] Given: GDP in 1990 is \$1,000. GDP in 2000 is \$1,344. Write down a general expression that can be used to calculate the average growth rate of a variable over several years. Calculate the average growth rate of GDP per year.

5 Answers

5.1 Measurement

1. The problem: relative prices change over time. The price index then depends on which base year is used. Especially a problem for long time periods. Example: Try to calculate 2000 GDP in 1900 prices.
2. Changes in GDP:
 - (a) Advertising: no effect. It is an intermediate input. May show up in the price of the final goods later on, but that is a different issue.
 - (b) Unsold items are inventory investment.
 - (c) Nothing happens. This is obvious from the production or income approaches. Expenditure approach: C and imports go up by the same amount.

5.2 Production Model

1. $y = Ak^\alpha$. $5^{1/3} = 1.7$. This is the increase in y .
2. Now $5^{2/3} = 2.9$. The difference: MPK diminishes less quickly with the higher α .
3. No. Correlation has nothing to do with causation. k could be high because y is high or both could be high because of other common causes. This is why we need models.
4. The model attributes factor $(k_A/k_B)^\alpha$ to capital. $20^{1/3} = 2.7$. To calculate productivity we solve the production function for $\bar{A} = \frac{y}{k^\alpha}$. For A: $100/400^{1/3} = 13.6$. For B: $10/20^{1/3} = 3.7$.

5.3 Solow Model

1. This is the standard diagram, except that the depreciation line is shifted up by X .
2. A steady state is an equilibrium where all per capita variables are constant over time. There are 3 steady states.
3. The higher one has all the properties of the usual Solow model – it is stable. The middle one is unstable. $k = 0$ is stable.

5.4 Short Questions

1. $g(Y) = 1/3 \times 3\% + 2/3 \times 1\% = 1.67\%$.
2. Average growth rate: $(GDP_{2000}/GDP_{1990})^{1/10} - 1 = 3\%$.

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