

EC202C1 – Intermediate Macroeconomic Analysis
Spring 2012, Boston University

Instructor: Jeremy Smith

Second Mid-term Exam (Practice #2)

Friday, April 6, 2012

This is a 50-minute exam. There is a total of 50 points allocated across two questions. Use the number of points allocated to each part as a suggestion for how long to spend on that part. I recommend that you attempt all parts before using more time than is suggested for any one part. If you complete some parts in less than the suggested time, use your extra time to revisit parts you may have had trouble with the first time through and to check your work.

Please read the questions carefully and write your answers in the space provided. You can use the backs of the sheets for scrap paper, but to get full credit you must show all relevant work in the space provided.

Please follow my instructions at all times.

Concentrate and think carefully, but try to relax too!

Student Number:

(Please do not include your name.)

1. [18 points total, 2 parts] Consider the full Solow growth model with exogenous technological progress and employment growth. The economy is described by the production function $Y = \sqrt{K}\sqrt{AN}$. Technology, A , grows at the fixed percentage rate g_A per period, and employment, N , grows at the fixed percentage rate g_N per period. The capital stock, K , depreciates at the fixed rate δ per period, and the economy saves a fixed proportion, s , of output, Y , per period. Assume throughout that taxes and government expenditure are zero. You can assume that the symbolic representation of the necessary investment function is given by $(\delta + g_A + g_N)K$ and that the symbolic representation of the intensive form of the production function is $\sqrt{\frac{K}{AN}}$ without any derivation.

a) [10 points] Draw a graph showing the output per effective worker, investment per effective worker, and necessary investment per effective worker functions. Label each of these three curves with their corresponding symbolic representations. Identify the steady state levels of capital per effective worker and output per effective worker (but you do not need to derive their expressions).

b) [8 points] State the rate at which each of the following variables grows in the steady state.

Consumption _____

Consumption per worker _____

Consumption per effective worker _____

Output per worker _____

Required investment _____

The depreciation rate _____

Saving per effective worker _____

Output per unit of capital _____

2. [32 points total, 4 parts] Consider the simple Solow model with no technological progress and no employment growth. The economy is described by the production function $Y = \sqrt{K}\sqrt{N}$. Technology is fixed at a level of one, and the number of workers, N , is constant. The capital stock, K , depreciates at the fixed rate of 10% per period, and the economy saves a fixed proportion, s , of output, Y , per period. Assume throughout that taxes and government expenditure are zero.

a) [10 points] Derive the expression for the steady state capital-labor ratio. Show all of your work.

b) [8 points]

- i. Find an expression for the steady state level of consumption per worker. Show your work.
- ii. Show that a saving rate of 35% is *not* the “golden rule” saving rate.

c) [8 points] Consider five levels of the capital-labor ratio, ordered from smallest to largest: $\left(\frac{K}{N}\right)_h < \left(\frac{K}{N}\right)_i < \frac{K^*}{N} < \left(\frac{K}{N}\right)_j < \left(\frac{K}{N}\right)_k$. As usual, $\frac{K^*}{N}$ refers to the steady state level of the capital-labor ratio. The saving rate is fixed at a single value, s , throughout. Answer the following two multiple-choice questions by clearly indicating, for each, the response that is most accurate.

I. If, in some period t , the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_h$, the change in the capital-labor ratio between periods t and $t+1$ would be

- i. positive and larger in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_i$.
- ii. positive and smaller in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_i$.
- iii. negative and larger in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_i$.
- iv. negative and smaller in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_i$.
- v. zero.

II. If, in some period t , the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_j$, the change in the capital-labor ratio between periods t and $t+1$ would be

- i. positive and larger in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_k$.
- ii. positive and smaller in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_k$.
- iii. negative and larger in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_k$.
- iv. negative and smaller in magnitude than if the capital-labor ratio were at the level $\left(\frac{K}{N}\right)_k$.
- v. zero.

d) [6 points] Find a general expression for the percentage growth rate of the capital-labor ratio between any two periods t and $t+1$ from any arbitrary starting point. (This expression should depend on the saving rate and on the level of the capital-labor ratio at time t .) Then note that the capital-labor ratio at time t can be expressed as some proportion v of the steady state level of the capital-labor ratio. Use this information to simplify the expression for the percentage growth rate of the capital-labor ratio. (The expression should now depend on v only.) Does this expression correspond with your answers in the previous part? Explain.