Advanced Macroeconomics
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Midterm Exam II (Open-Book)
Undergraduate Economics Program, HUST
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Name: _____   **Student ID:**_____

1. $(20' + 10' + 10' + 10' = 50$ points) Consider the Romer model as in Section 3.5 of your textbook, with a revision: A government is added to the model. It imposes a permanent linear tax rate, $\xi \in (0, 1)$, on savings in each period. Specifically, given the interest rate r, individuals who save could only enjoy $r(1 - \xi)$ as their actual rate of return. What is more, the government distributes taxes back to all individuals in a lump sum manner within each period. This makes sure that the consumption demand and the output supply still clear each other in each period.

(a) It is said that Equation (3.37) in your textbook has to be rewritten because of the change above. Write out the revised version of it, and give the intuition explaining the differences. (Hint: recall how we derive the Euler equation.)

(b) Since Equations (3.37)-(3.39) in your textbook still hold in this problem, based on your answer in (a), rewrite Equation (3.43) for this model.

(c) For simplicity, let us assume $L_A > 0$ always holds, does an increase in ξ lead to more or less individuals working in the R&D sector along the Balanced Growth Path? Explain your answer both mathematically and with economic intuitions.

(d) It is said that, given two closed countries that share common fundamentals

except that one imposes a higher ξ and the other imposes a slightly smaller ξ', then the latter's output will become infinitely greater than the former's as time goes. True or False? Explain your answer.

2. ($10' \times 2 = 20$ points) Given the Production function $Y = AK^\alpha L^{1-\alpha}$, empirical economists usually use formula $\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - (1-\alpha_L)\frac{\dot{K}}{K} - \alpha_L\frac{\dot{L}}{L}$ to estimate the growth rate of the Total Factor Productivity, where α_L denotes the labor share of income. However, Hsieh (2002) argues that, it is often useful to use another method, which he calls the "dual method", to achieve the same goal. Specifically, he adopts formula $\frac{\dot{A}}{A} = (1-\alpha_L)\frac{\dot{r}}{r} + \alpha_L\frac{\dot{w}}{w}$ instead, where r stands for the real interest rate and w for real wage.

   (a) Show that the "dual" method suggested by Hsieh (2002) is theoretically equivalent to the traditional one.

   (b) Hsieh (2002) further argues that the "dual" method outperforms the traditional one under specific circumstances. Why?

3. ($10' \times 3 = 30$ points) Consider a RBC model that allows only for technology shocks as in your textbook. It is said that a positive shock, $\tilde{A}_t > 0$, leads to a higher employment rate in the current period.

   (a) Why does the firms want to hire more labor because of the positive shock?

   (b) Why does households want to work more because of the positive shock?

   (c) Based on your answers above, how does the RBC theory explain the unprecedented unemployment rate during the Great Depression in 1930s? Does this explanation make sense?

Solution Hints

1.(a) $(1-\xi)r(t) = \rho + \frac{\dot{C}(t)}{C(t)} = \rho + \frac{1-\phi}{\phi}BL_A$.

1.(b) $L_A = \frac{(1-\phi)\bar{L}}{1+(1-\phi)\frac{\xi}{1-\xi}} - \frac{\phi\rho}{B(1-\xi\phi)}$.

1.(c) $\frac{\partial L_A}{\partial \xi} < 0$. Intuition: Because the government imposes more on interests, individuals become less willing to consume in the future. In other words, their demand for future output becomes relatively lower. As a result, they would require less innovations, which benefit only their future productions but harms their currently productions.

1.(d) $\frac{\dot{Y}(t)}{Y(t)} = \frac{1-2\phi}{\phi}BL_A$ still holds. So greater ξ leads to lower growth rate along the BGP. Growth effect matters in the long run.

2.(a) Recall that there are equivalent definitions of GDP: It could be either defined directly as the value of final goods and services, or defined in an indirect way as the total income of all inputs in the closed economy. So we have $Y = AK^\alpha L(1-\alpha) = Kr + Lw$. Utilizing the second equality gives us

$$
\begin{aligned}
\dot{Y} &= K\dot{r} + r\dot{K} + L\dot{w} + w\dot{L} \\
\Rightarrow \frac{\dot{Y}}{Y} &= \frac{Kr\dot{r}}{Yr} + \frac{Kr\dot{K}}{YK} + \frac{Lw\dot{w}}{Yw} + \frac{Lw\dot{L}}{YL} \\
&= (1-\alpha_L)\frac{\dot{r}}{r} + (1-\alpha_L)\frac{\dot{K}}{K} + \alpha_L\frac{\dot{w}}{w} + \alpha_L\frac{\dot{L}}{L}.
\end{aligned} \tag{1}
$$

Rearranging the last equality above simply gives the equivalence between the

traditional method and the "dual" method.

2.(b) Sometimes, the data on K and L are just inaccurate. However, data on w and r are usually of high quality: They are observable equilibrium prices! As a result, the "dual" method often gives better estimates with bad data quality.

3.(a) The shock makes the marginal product of labor greater. In other words, the firms' demand curve for labor is pushed up.

3.(b) Consider the inter-temporal substitution of labor. Households want to supply more labor when the current wage is relatively higher, because of the current positive shock.

3.(c) Because of a huge and negative technology shock, firms hired less because of the lower productivity of labor, households worked less because they were less willing to work given the current wage. It is obviously not making sense. Since the huge group of people without jobs during the Great Depression is hardly explained by voluntary unemployment.