Econ 210C
Spring 2015
Midterm
5/4/2014

Name (Print): ______________________________

This exam contains 12 pages (including this cover page) and 4 problems. Check to see if any pages are missing. Enter all requested information on the top of this page.

You may *not* use your books, notes, or any calculator on this exam.

You are required to show your work on each problem on this exam.

Problem	Points	Score
1	12	
2	24	
3	46	
4	18	
Total:	100	

Readings (12 points)

1. Briefly (in approx. two sentences) comment on the following statements/questions.
   (a) (4 points) Cogley and Nason (1995) argue that the canonical RBC model cannot match two empirical facts. Name **one** of these facts.

   (b) (4 points) What are the shocks that Greenwood, Hercowitz and Huffman (1988) emphasize in their paper?

   (c) (4 points) What level of returns to scale do Basu and Fernald (1997) estimate at the 2-digit industry level: strongly increasing, slightly increasing, constant, slightly decreasing or strongly decreasing?

Can Tax Shocks Drive the Business Cycle? (88 points)

2. Consider the canonical RBC model with labor taxes τ_t (notation is as in our class): A consumer maximizes

$$\max \sum_t^{\infty} \beta^t \left(\ln C_t - \frac{(L_t^s)^{1+1/\eta}}{1+1/\eta} \right)$$
$$\text{s.t. } A_t + C_t = (1+R_t)A_{t-1} + W_t L_t^s + \pi_t + T_t$$
$$lim_{t\to+\infty} \left(\prod_{s=1}^{t} (1+R_s) \right)^{-1} A_t = 0$$

taking prices as given.

A representative firm maximizes profits **given labor tax** $\tau_t \geq 0$,

$$\max \sum_t^{\infty} \left(\prod_{s=1}^{t} (1+R_s) \right)^{-1} [Y_t - (1+\tau_t) W_t L_t^d - I_t]$$
$$\text{s.t. } Y_t = K_{t-1}^{\alpha} (L_t^d)^{1-\alpha}$$
$$K_t = (1-\delta) K_{t-1} + I_t.$$

taking prices as given.

The market clearing conditions are:

$$L_t^s = L_t^d = L_t$$
$$K_t = A_t$$
$$Y_t = C_t + I_t$$
$$T_t = \tau_t W_t L_t$$

So tax revenues are rebated lump-sum to households.

Standard parameter values apply:

$$0 < \alpha < 1$$
$$0 < \beta < 1$$
$$0 < \delta < 1$$
$$\eta > 0$$
$$\bar{\tau} > 0$$

where $\bar{\tau}$ is the steady-state level of taxes.

Question continues on next page.

(a) (12 points) Set up the Lagrangian and derive the first order conditions for the household w.r.t. C_t, L_t^s, A_t. Use λ_t as the Lagrange multiplier on the budget constraint. Briefly interpret each equation (one sentence each).

(b) (12 points) Set up the Lagrangian and derive the first order conditions for the firm w.r.t I_t, L_t^d, K_t. (Substitute for Y_t first.) Use q_t as the Lagrange multiplier on capital accumulation. Briefly interpret each equation (one sentence each).

3. The log-linearized equations of the RBC model in question 2 give rise to the following dynamic equations:

$$\Delta \check{K}_t = -\frac{\bar{Y}}{\bar{K}}\left(\frac{1-\alpha}{\alpha+1/\eta}\right)\frac{\bar{\tau}}{1+\bar{\tau}}\check{\tau}_t + \left(\frac{\alpha(1-\alpha)}{\alpha+1/\eta}\frac{\bar{Y}}{\bar{K}} + \beta^{-1} - 1\right)\check{K}_{t-1} + \left(\frac{\bar{C}}{\bar{K}} + \frac{\bar{Y}}{\bar{K}}\frac{(1-\alpha)}{\alpha+1/\eta}\right)\check{\lambda}_t$$

$$\Delta \check{\lambda}_{t+1} = -\frac{\alpha\frac{\bar{Y}}{\bar{K}}}{\alpha\frac{\bar{Y}}{\bar{K}} + 1 - \delta}\left[-\left(\frac{1-\alpha}{1/\eta+\alpha}\right)\frac{\bar{\tau}}{1+\bar{\tau}}\check{\tau}_{t+1} + (1-\alpha)\left(\frac{\alpha}{1/\eta+\alpha} - 1\right)\check{K}_t + \frac{1-\alpha}{1/\eta+\alpha}\check{\lambda}_{t+1}\right]$$

(a) (10 points) Plot the dynamics of this system in a phase diagram as we did in class. I.e., plot the $\Delta K = 0$ and $\Delta\lambda = 0$ locus (K_t on x-axis, λ_t on y-axis). **Include all of the following**: axis labels, curve labels, steady-state (labeled), stable arm (labeled), and arrows showing the dynamics in each quadrant.

(b) (21 points) Suppose that labor taxes τ_t rise permanently to a higher level.

Using the phase diagram in the (λ, K) space as well as the labor market diagram, plot the response of the economy to the shock. **Label all curves, axis and points.** Summarize the impact, transition, and steady-state responses for all variables in the table below (like we did in class) **and explain the intuition behind the response.**

Make the following assumptions when shifting the $\Delta K = 0$ and $\Delta\lambda = 0$ locus:
1. The new steady-state lies **above and to the left** of the old steady-state.
2. The new stable arm (saddle path) lies **above** the old stable arm (saddle path).

Table 1: RBC model response to a permanent labor tax shock.

	Impact $t = t_0$	Transition $t \in (t_0, \infty)$	Steady State $t \to \infty$
λ			
K			
C			
L			
Y			
I			
W			
R			

(c) (5 points) Are the impact responses ($t = t_0$) you derived consistent with the co-movement of output, labor, consumption and investment over the business cycle? **Explain your answer.** What does that tell you about the plausibility of attributing the business cycle to tax shocks?

(d) (10 points) List **two** dimensions on which the standard RBC model with technology shocks did not perform well quantitatively. **Briefly,** discuss whether the RBC model with tax shocks would perform better on these dimensions. ($\approx$ 1 paragraph per dimension.)

4. Some economists attribute the 2007-2009 recession at least in part to an *anticipation* of higher labor taxes following the election of President Obama.

   (a) (10 points) Redraw your phase diagram from part 3(a). Now suppose that economic agents expect a permanently higher level of labor taxes τ_t after t_1 periods from now ($t_0 = 0$). At t_1 these expectations turn out to be correct.

   Using the phase diagram in the (λ, K) space (**no need for labor market diagrams here!**), plot the response of the economy to the shock. **Label all curves, axis and points.** Summarize the impact, transition (before and after t_1), inflection, and steady-state responses for all variables in the table below (like we did in class).

   Make the following assumptions when shifting the $\Delta K = 0$ and $\Delta\lambda = 0$ locus for $t \geq t_1$:
   1. The new steady-state lies **above and to the left** of the old steady-state.
   2. The new stable arm (saddle path) lies **above** the old stable arm (saddle path).

Table 2: RBC model response to news of higher labor taxes.

	Impact $t = t_0$	Transition I $t \in (t_0, t_1)$	Inflection $t = t_1$	Transition II $t \in (t_1, \infty)$	Steady State $t \to \infty$
λ					
K					

(b) (4 points) Draw the labor market diagram for t_0 (i.e., when news of higher taxes arrives). Explain **intuitively** why it is different to your answer in part 3(b).

(c) (4 points) Based on part 4(b) determine the output response on impact. According to this model, are *news* of higher future labor taxes a plausible source of recessions?