

**Final Exam (Open-Book)**  
**Advanced Macroeconomics**  
**Instructed by Xu & Yi    Spring Semester 2015**  
**Undergraduate Program in Economics, HUST**  
**Wednesday, July/01/2015**

**Name:** \_\_\_\_\_ **Student ID:** \_\_\_\_\_

1. ( 30+30+40=100 points) **Revised Calvo Model with synchronized-price setting.** Consider the Calvo Model. We require synchronization between the price-changing behaviors of all firms: In each period  $t$ , it must be either that all firms are free to set their prices, or that non of them is allowed to do so. Whether or not all firms have the opportunity to change their prices in period  $t$  is determined by the realization of a random variable: In that each period, God tosses a coin, with probability  $\alpha$  of getting a **head** result, and with probability  $(1 - \alpha)$  of getting a **tail** result. If God receives a head in period  $t$ , then all firms are allowed to set their prices within that period, otherwise all firms have to maintain their prices inherited from the previous period. All other settings are the same as in your textbook.
  - (a) What is the revised version of equation (7.55) in your textbook? Explain how you get your result.

(b) What is the revised version of equation (7.60) in your textbook? Is it different from (7.60)? Explain your answers.

- (c) Now assume that  $m_t$  follows a random walk, i.e., equation (7.29) in your textbook. Does a temporary shock  $\mu_t \neq 0$  still have permanent effects in this model? You do not need to give formal proofs, just explain your answer with economic intuitions based on your results above!

2. (30 extra points) Write an essay. It could be of any type, such as thoughts on an economic model, outlines for future research, explanations of a specific phenomenon, comments on a theory or speech by a professor, an economic story that uses materials introduced in this course, etc. **There is no standard requirement for the length of your essay, the number of points you will earn is fully determined by how well your essay is related to the materials introduced in this course.**

## Solution Hints

Version: July/02/2015

I did not have enough time to double-check this file while writing it. So please do me a favor by pointing out the mistakes and typos, if any, that I have made. (just send an email to yiming@hust.edu.cn)

1.(a) Now  $p_{t+1}$  becomes a Bernoulli-distributed random variable:

$$p_{t+1} = \begin{cases} \chi_{t+1}, & \text{with probability } \alpha. \\ p_t, & \text{with probability } (1 - \alpha). \end{cases} \quad (1)$$

We still have

$$E_t p_{t+1} = \alpha E_t \chi_{t+1} + (1 - \alpha) p_t. \quad (2)$$

Note that  $p_t^*$  is linear in  $p_t$  as in (7.17), and only expectation forms of future variables matter, as a result, mathematically, our settings in this question do not change equations (7.55) – (7.58) at all.

So revised (7.55) appears the same as the original version.

1.(b) We know that  $\chi_t$  is meaningful only if God receives a “head” result in period  $t$ . As a result, the left-hand-side of (7.58) becomes 0 because  $\chi_t = p_t$ . So revised version of (7.60) becomes

$$0 = [1 - \beta(1 - \alpha)] \phi y_t + \frac{\beta(1 - \alpha)}{\alpha} E_t \pi_{t+1} \quad (3)$$

Mathematically they are slightly different. Any arguments noting the differences in settings of the models earn points.

1.(c) Obviously, a temporary has permanent effects only if it still affects the outputs after all firms have had the chance to adjust their prices as response to the shock. Can this phenomenon happen in our model?

No. For simplicity, assume  $\mu_t \neq 0$ . Then for any period  $t_\tau$ , as long as God receives a head result, all firms have the chance to adjust their prices **simultaneously**. That is to say, firms can adjust prices flexibly at least within period  $t + \tau$ , and they can totally forget about the previous path of the economy because there is no necessary linkage between two subsequent periods for the economy (once there is a change to adjust all the prices) in our model. As a result, firms in period  $t + \tau$  respond to  $\mu_t$  just as if they were in a perfect economy. So  $\mu_t \neq 0$  affects only period  $t$  and the subsequent periods in which God receives a tail result. Once God receives a head result, from then on,  $\mu_t$  only has nominal effects. To conclude, temporary shocks cannot have permanent effects in our model.

Discussion: Compared to this model, the original Calvo model permits permanent effects for a temporary shock. That happens because the price rigidity is passed through the Poisson process of assigning price-setting opportunities to firms. As a result, in the original Calvo model,  $\mu_t$  always has effects (even in the extreme case that almost all firms have had the change to adjust). This is also the case for the Taylor model. In contrast, the synchronization feature in our model cut off the pathway through which the price rigidity passes on.

2. Grading rules are as follows:

- If you write something, which is just copy-and-paste from the textbook, you receive  $< 10$  points.
- If you write something that reveals your personal thoughts and is relevant to the course, you get  $> 20$  points.
- If you writing something that is both original and interesting, you earn 30 points.