

# ECON 602 - Macroeconomic Analysis II

## Comprehensive Exam

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**Note that the timing convention of these questions are different from the one adopted in Spring 2008 and later.**

Consider the following environment. There are a continuum of identical two-people households. Each household has a shopper and worker. The shopper can **either** use the money she has at-hand to purchase goods,  $c_{1t}$ , or issue nominal claims which are settled in the next securities market,  $c_{2t}$ . The worker works  $h_t$  hours for a neoclassical firm (with CRS technology) and receives real wage  $w_t$  per hour. The household's flow utility function is  $u(c_{1t}, c_{2t}, 1 - h_t)$ . The household is able to buy and sell a one-period nominal government bond,  $b_{t+1}$  purchased in  $t$  with gross return  $R_t$ . There is no capital in the model.  $A_t$  denotes a **stochastic** aggregate technology shock with law of motion  $A_{t+1} = A(A_t)$ . Government expenditures are constant over time at  $G$ . The government levies a labor income tax  $\tau_t^h$ . Use  $p_t$  to denote price of a good in period  $t$ .

The worker and shopper are together (and therefore can pool their resources) at the end of every period, after both goods and securities markets close and during the securities market. Denote  $m_t$  to be the beginning-of-period money balances of the household, before any activity takes place and  $\tilde{m}_t$  the money balances after the securities market. We will consider two versions:

VERSION 1 : Securities market opens first, followed by the goods market.

VERSION 2 : Goods market opens first, followed by the securities market.

In each question below, where relevant clearly mark VERSION 1 or 2 in your answers.

- a. (10 points) In both versions relate  $m_t$  to  $\tilde{m}_{t-1}$  and  $\tilde{m}_t$  to  $m_t$ .
- b. (20 points) (**Household's Problem**) Write down the problem of the household for each version and write down the conditions that characterize the solution. Use  $\tilde{m}_t$  in Version 1 and  $m_t$  in Version 2 as choice variables. (This will keep the notation simpler.) No multipliers should appear in (the final versions of) these conditions.
- c. (5 points) (**Firm's Problem**) Write down the problem of the firm and solve it.
- d. (15 points) (**Equilibrium**) Remembering that there is also the government, using all the information so far, carefully define the equilibrium. Your definition must be self-contained. At the expense of being redundant, **write down all the equations** that need to be in this definition.
- e. (10 points) (**Ramsey Planner's Problem**) Write down the Ramsey planner's problem with the objective function, things that he chooses, constraints and multipliers carefully specified. [You do not need to derive the implementability constraint, unless you do not remember how it should look like.]

For the rest of the question, assume  $G = 0$ , the utility function takes the form

$$u(c, 1 - h) = c_1 c_2 + B(1 - h)$$

and assume that  $A_t$  follows the iid process

$$A_t = \begin{cases} -1 & \text{with probability } p \\ 1 & \text{with probability } 1 - p \end{cases} \quad (1)$$

- f. (20 points) What is the optimal interest rate rule,  $R(A_t)$ , that comes out of the Ramsey problem?
- g. (20 points) What is the optimal labor income tax rule  $\tau^h(A_t)$ , that comes out of the Ramsey problem?