

# Macroeconomics 1 - Problem set 3

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Due 3.10.2018. (Hand in your answers in the exercise class or send them to lauro.carnicelli (at) helsinki.fi before the class.)

1. Consider the model described in lecture notes 2 and a reform where the capital income tax is lowered from 0.3 to 0, the consumption tax increased from 0.2 to 0.3 and the labour income tax is adjusted to satisfy the intertemporal government budget constraint. Hand in a figure showing how the government debt evolves following the reform. Use the same parameter values I set in the beginning of *taxreform.m*. Try to explain the results briefly.
2. Extend *taxreform.m* so that it allows you to consider a policy where in the beginning of period 1 the government (credibly) announces that it will lower the capital income tax permanently to zero in period  $s \geq 1$ , while adjusting the labour income tax immediately at a new constant rate so as to balance the intertemporal government budget. (Assume the consumption tax rate is kept fixed and note that even if  $s > 1$ , the households should anticipate already in period 1 that the capital income tax rate will later be set to zero.) Hand in a figure showing how the capital stock, labour supply, and consumption evolve from period 1 onwards if  $s = 3$  and report the welfare effects for  $s = 1$  and  $s = 3$ . Also hand in relevant parts of the code.
3. Consider a household that lives for  $T$  periods and derives utility from consumption and housing. Its (deterministic) problem is

$$\begin{aligned} & \max_{\{c_t, a_{t+1}, h_{t+1}\}_{t=1}^T} \sum_{t=1}^T \beta^{t-1} u(c_t, h_{t+1}) \\ & s.t. \\ c_t + a_{t+1} + h_{t+1} + \kappa h_{t+1} I(h_{t+1}, h_t) &= (1+r)a_t + h_t + w \\ a_1 = 0, h_1 &= 0 \\ a_{T+1} &\geq 0, h_{T+1} \geq 0 \end{aligned}$$

where  $a$  denotes financial savings,  $h$  housing,  $\kappa$  housing transaction costs (e.g. the transaction tax one has to pay when buying a house or flat) and  $w$  wage income. The function  $I$  is defined as follows:

$$I(h_{t+1}, h_t) = \begin{cases} 0, & \text{if } h_{t+1} = h_t \\ 1, & \text{if } h_{t+1} \neq h_t \end{cases} .$$

i) Write the household problem recursively with as few state variables as possible (allowing for  $\kappa > 0$ ).

ii) Assume that  $\kappa = 0$ . Write the household problem recursively with as few state variables as possible.