

Economics 8823

**Project 3**

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**Ramsey Optimal Fiscal Policy**

As per Ramsey (1927) and the ensuing DSGE macro-Ramsey fiscal policy literature that began in the 1980's, the government has exogenous government spending that has to be financed using state-contingent real government debt and linear income taxes on labor income and capital income – lump-sum taxes are assumed to be unavailable.

The functional forms for period-t utility and period-t production of goods are  $u(c_t, n_t) = \ln c_t - \frac{\varphi}{1+1/\psi} n_t^{1+1/\psi}$  and  $f(k_t, n_t) = z_t k_t^\alpha n_t^{1-\alpha}$ , and the goods resource constraint for the economy is  $c_t + k_{t+1} - (1-\delta)k_t = z_t k_t^\alpha n_t^{1-\alpha}$ .

The household's period-t budget constraint is

$$c_t + \sum_j \frac{1}{R_t^j} b_{t+1}^j + k_{t+1} = (1 - \tau_t^n) w_t n_t + \left[ 1 + (1 - \tau_t^k)(r_t - \delta) \right] k_t + b_t,$$

in which  $\tau_t^n$  is the proportional labor income tax rate,  $\tau_t^k$  is the proportional capital income tax rate (inclusive of a depreciation allowance), and the vector  $b_{t+1}^j \forall j$  is holdings of state-contingent real government debt that pays off in period t+1.

The steady-state value of government purchases ( $\bar{g}$ ) is 20% of steady-state GDP, the initial (as well as long-run) government debt ( $b_0$ ) is 50% of steady-state GDP, and the steady-state level of TFP is  $\bar{z} = 1$ .

The exogenous TFP process evolves as

$$\ln z_{t+1} = \rho_z \ln z_t + \varepsilon_{t+1}^z,$$

in which  $\varepsilon_{t+1}^z$  is distributed as i.i.d.  $N(0, \sigma_z^2)$ . The persistence and standard deviation parameters are, respectively  $\rho_z = 0.95$  and  $\sigma_z = 0.007$ . The exogenous government spending process evolves as

$$\ln g_{t+1} = (1 - \rho_g) \ln \bar{g} + \rho_g \ln g_t + \varepsilon_{t+1}^g,$$

in which  $\varepsilon_{t+1}^g$  is distributed as i.i.d.  $N(0, \sigma_g^2)$ . The persistence and standard deviation parameters are, respectively  $\rho_g = 0.97$  and  $\sigma_g = 0.027$ .

The remaining parameter values to be used (some of which are left for you to determine) are listed in Table 1.

		Description
$\beta$	0.99	Quarterly subjective discount factor
$\delta$	0.02	Quarterly depreciation rate of physical $k$
$\psi$	2	Utility parameter
$\alpha$	0.36	Elasticity of Cobb-Douglas output with respect to physical $k$
$\varphi$	???	To be determined (target so that $n$ in Ramsey steady state is $n = 0.3$ )
$\bar{g}$	???	To be determined (target so that $\bar{g}$ is 20% of Ramsey steady-state GDP)
$b_0$	???	To be determined (target so that $b_0$ is 50% of Ramsey steady-state GDP)

**Table 1.** Parameter values.

For the first-order approximation, use  $x_t = [k_t, z_t, g_t]'$  as the state vector,  $y_t = [c_t, n_t, w_t, \text{wedge}_t^n, \text{inv}_t, \tau_t^n]'$  as the co-state vector, **and assume that the Ramsey-optimal capital income tax rate is  $\tau_t^k = \tau_{ss}^k \forall t$ .**

## What To Submit

- A clear, concise definition of the (dynamic stochastic) private-sector equilibrium.
- A clear, concise definition of the (dynamic stochastic) Ramsey equilibrium. (**Note:** The definition of the Ramsey equilibrium is **not** identical to the definition of the private-sector equilibrium.)
- One clearly organized, easy-to-read Table containing the parameter values  $(\varphi, \bar{g}, b_0)$ .
- One clearly organized, easy-to-read Table containing the Ramsey-optimal steady-state values of: the labor income tax rate, the capital income tax rate, the labor wedge  $wedge^n$ , the capital wedge  $wedge^k$ , the Lagrange multiplier on the PVIC, gross domestic output, consumption, investment, and labor.
- The  $g_x$  and  $h_x$  matrices that correspond to the Ramsey optimal policy functions.
- **One** plot that contains **both** the average Ramsey-optimal labor income tax rate  $\tau_t^n$  **and** the average Ramsey-optimal labor income wedge  $wedge_t^n$  across 200 simulations of the Ramsey economy (each simulation will be 200 periods in length).
- Include your code (i.e., all the relevant files that one would need to replicate your results).