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 $u(c_t,n_t)=\ln c_t-\frac{\varphi}{1+1/\psi}n^{1+1/\psi}$ 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 τ_t^n is the proportional labor income tax rate, τ_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 ε_{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

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

in which ε^g_{t+1} is distributed as i.i.d. $N(0,\sigma^2_g)$. 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
β	0.99	Quarterly subjective discount factor
δ	0.02	Quarterly depreciation rate of physical *k*
ψ	2	Utility parameter
α	0.36	Elasticity of Cobb-Douglas output with respect to physical *k*
φ	**???**	**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, $y_t = [c_t, n_t, w_t, wedge^n_t, inv_t, \tau^n_t]'$ as the co-state vector, **and assume that the Ramsey-optimal capital income tax rate is $\tau^k_t = \tau^k_{ss}\ \forall t$.**

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 τ_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).