

Sample questions, problems, and essays

Short-answer questions (approximately 10 points/minutes each).

1. Define predetermined variables, forward-looking variables, instruments, control variables, nonpredetermined variables, exogenous variables, and endogenous variables.
2. Can exogenous variables be forward-looking?
3. What is the difference between the Klein and Blanchard-Kahn definitions of predetermined variables?
4. What is the so-called saddlepoint property?
5. What does it mean to write a linear model on state-space form?
6. Write the Lucas-type Phillips curve, $y_t = \alpha(\pi_t - E_{t-1}\pi_t) + \varepsilon_t$ on state-space form.
7. What is the generalized Schur decomposition?
8. What is the difference between “commitment (from scratch) in period t_0 ” and “commitment in a timeless perspective”?
9. Derive the solution for the matrix V to the Lyapunov equation $V = W + \delta M'VM$.
10. What is the recursive saddlepoint method for a linear-quadratic system?
11. How does the optimal policy function under commitment in a timeless perspective differ from the equilibrium policy function under discretion?
12. State the main characteristics of algorithm for finding the discretion equilibrium for a linear-quadratic problem with forward-looking variables (you don't have to provide any detailed derivations).
13. What are the expressions for the Kalman gain matrix and prediction error covariance matrix in the setup with a standard measurement equation and (backward-looking) transition equation?
14. Orphanides has recommended that policy makers should respond less to the output gap, because the output gap is uncertain. Under what different circumstances are that recommendation (a) wrong, (b) correct?
15. In the standard New Keynesian setup, what is (a) the optimal targeting rule under commitment in a timeless perspective, (b) the equilibrium targeting rule under discretion?
16. What is the difference between an explicit instrument rule and an implicit instrument rule? In a linear-quadratic model with forward-looking variables, is the optimal explicit instrument rule unique? Is the optimal implicit instrument rule unique?

17. In a linear-quadratic system with known model coefficients and additive shocks, does certainty equivalence hold for an optimal simple instrument rule?
18. What is additive and multiplicative uncertainty?
19. What is the conventional (Brainard) wisdom for how model uncertainty affects the optimal policy function? Is it always true?
20. What is the difference between robust control and optimal Bayesian control?
21. Is the policy under robust control sensitive to the assumptions about the feasible set of models?
22. What does Onatski and Williams mean when they imply that the “extremely robust” policy is not very robust to model perturbations?
23. What is a Markov jump linear-quadratic (MJLQ) system?
24. If model modes are (a) observable, (b) unobservable and there is no learning, what is the form of the optimal policy function under commitment in a timeless perspective for an MJLQ system with forward-looking variables?
25. Mention a few different kinds of model uncertainty that can be approximated with an MJLQ system.
26. Does the assumption that the ε shocks and the model modes in an MJLQ system are independently distributed imply that equation intercepts must be independent of the model modes?
27. What is the difference between “mean forecast targeting” and “distribution forecast targeting”?
28. Suppose that model modes are unobservable in an MJLQ system and the policy maker updates the probability distribution using Bayes Rule. Will the optimal policy function still be quasi-linear?
29. In the standard New Keynesian model, show why the current output gap is determined by expectations of the whole path of future interest rates matter and not just the current interest rate.
30. In a situation with private and public information, why would private agents’ actions depend more on the public signal than in the standard signal-extraction problem?
31. Morris and Shin (2002) argues that more public information may be bad. When is that true and not true in their model?
32. Mention a modification of the Morris-Shin (2002) model for which more public information is always good.

Problems and essays (20-30 points/minutes each).

1. Consider the model

$$y_t = (\pi_t - \pi_{t|t-1}) + \varepsilon_t,$$

where ε_t is a zero-mean i.i.d. shock. Suppose the central bank's loss function is

$$E_t \sum (1 - \delta)\delta^\tau L_{t+\tau}$$

where

$$L_t = \frac{1}{2}[(\pi_t - \pi^*)^2 + (y_t - y^*)^2].$$

- (a) Consider π_t to be the central bank's instrument and write the model on state-space form.
(b) Solve for the optimal policy under commitment in a timeless perspective by setting up the Lagrangian and specifying the first-order conditions.
(c) Solve for the optimal policy under commitment in a timeless perspective with the recursive saddlepoint method.
2. Let the model of an economy with a central bank be given by the equations

$$\begin{aligned}\pi_{t+1} &= s_t - i_t + \varepsilon_{t+1}, \\ s_{t+1} &= \rho s_t + \eta_t \quad (0 < \rho < 1), \\ z_t &= s_t + \theta_t,\end{aligned}$$

where π_t is inflation in period t , s_t is an unobservable variable representing the state of the economy, i_t is the central bank's instrument, z_t is an indicator of the state of the economy, and ε_t , η_t , and θ_t , are i.i.d. shocks. The shocks are $N(0, \sigma_\varepsilon^2)$, $N(0, \sigma_\eta^2)$, and $N(0, \sigma_\theta^2)$, respectively. Let the central bank have the loss function

$$E_t \sum_{\tau=0}^{\infty} (1 - \delta)\delta^\tau L_{t+\tau},$$

where $0 < \delta < 1$ and

$$L_t = \frac{1}{2}\pi_t^2.$$

Suppose that the central bank's information set in the beginning of period t , before it sets the instrument i_t , is $\{\pi_t, \varepsilon_t, z_t; i_{t-1}, \pi_{t-1}, \varepsilon_{t-1}, z_{t-1}, i_{t-1}; i_{t-2}, \pi_{t-2}, \dots\}$.

- (a) What is the optimal estimate of s_t in period t , $s_{t|t}$?
(b) What is the optimal response of the policy instrument to $s_{t|t}$ in period t ? What is the optimal response to π_t , ε_t , and z_t ?
(c) Suppose ε_t is not observable, so the information set in the beginning of period t is $\{\pi_t, z_t; i_{t-1}, \pi_{t-1}, z_{t-1}, i_{t-1}\}$. Specify the transition and measurement equations.
3. Discuss the pros and cons of a maxmin vs. a Bayesian approach to optimal control under model uncertainty.