

STATE UNIVERSITY OF NEW YORK AT ALBANY
Department of Economics

Ph. D. Preliminary Examination: Macroeconomics
Spring, 2006

Instructions: Read the questions carefully and make sure to show your work. You have three hours to complete this examination. Good luck!

Section 1. (Suggested Time: 45 Minutes) *For 3 of the following 6 statements, state whether the statement is **true**, **false**, or **uncertain**, and give a complete and convincing explanation of your answer. **Note:** Such explanations typically appeal to specific macroeconomic models.*

1. The “equity premium puzzle” vanishes if one assumes that asset-holders are extremely risk-averse.
2. Explain why Ricardian Equivalence should not, in general, hold true in economies in which individuals have finite lives.
3. Economic analysts have long argued that comovement is an important feature of the business cycle, as output and employment rise and fall together across different industries. Furthermore, consistently some industries are cyclical, but others are not. Unfortunately neither general equilibrium theory nor Keynesian macroeconomic theory explains comovement.
4. Suppose that an econometric study shows that, after controlling for government spending, periods of high deficits are associated with rapid economic growth. This result should be taken as evidence against the Ricardian Equivalence Proposition.
5. Explain how money might be neutral (with respect to output) but not super-neutral.
6. General equilibrium models of business cycles always imply that recessions are efficient responses to bad events.

Section 2. (Suggested Time: 2 Hours, 15 minutes) Answer any 3 of the following 4 questions.

7. (From McCallum, 1989, and King, Plosser and Rebelo, 1988.) Consider the following version of a stochastic growth model. There are a fixed number of price-taking producers that solve

$$\begin{aligned} \max_{K_t \geq 0, L_t \geq 0} \Pi_t &= Y_t - R_t K_t - W_t L_t, \\ Y_t &= K_t^\alpha (Z_t L_t)^{1-\alpha}, \quad 0 < \alpha < 1, \end{aligned} \tag{PRF}$$

where: Π_t is profit; L_t is labor; K_t is capital; R_t is the rental rate for capital; and W_t is the real wage. Productivity, Z_t , is exogenous and follows a random walk in logs:

$$z_t \equiv \ln(Z_t) = z_{t-1} + \varepsilon_t, \tag{TS}$$

where $\{\varepsilon_t\}$ is a zero-mean i.i.d. process. There is no population growth, and the population is normalized to 1, so that upper case letters denote intensive as well as aggregate quantities.

The representative household solves the following problem:

$$\begin{aligned} \max_{\{C_t, K_{t+1}, L_t\}_{t=0}^{\infty}} E_0 \left(\sum_{t=0}^{\infty} \beta^t [\ln(C_t) - \chi L_t] \right), \\ 0 < \beta < 1, \quad \chi > 0, \\ \text{s.t. } C_t + K_{t+1} &= R_t K_t + W_t L_t + \Pi_t, \end{aligned} \tag{CA}$$

where C_t is consumption. The consumer takes prices and profits as given. Note that capital depreciates at a rate of 100 percent. Households also face the usual initial, non-negativity and No-Ponzi-Game conditions.

- (a) Write down the social planner's problem for this economy as a dynamic programming problem. Find the equilibrium conditions for this economy, namely: the labor allocation condition; the Euler equation; and the capital accumulation equation.
- (b) We can find an analytical solution to this model. In particular, we will conjecture that labor hours are constant: $L_t = L, \forall t$, and that aggregate expenditures on consumption and investment are constant shares of output, so that

$$C_t = \Pi_1 Y_t, \tag{CRULE}$$

$$K_{t+1} = (1 - \Pi_1) Y_t. \tag{KRULE}$$

Imposing these conjectures on your answers to part (a), show that

$$\begin{aligned} \Pi_1 &= 1 - \beta\alpha, \\ L &= \frac{(1 - \alpha)}{(1 - \beta\alpha)\chi}. \end{aligned}$$

- (c) When technology follows a random walk, shocks to technology have permanent effects, and the standard practice is to express variables as fractions of the current technology level Z_t . In particular, define

$$\hat{y}_t \equiv \ln \left(\frac{Y_t}{Z_t} \right), \quad \hat{k}_t \equiv \ln \left(\frac{K_t}{Z_t} \right), \quad \hat{c}_t \equiv \ln \left(\frac{C_t}{Z_t} \right),$$

Using your answers to parts (a) and (b), log-linearize the production function and the capital accumulation equation, and show that

$$\begin{aligned} \hat{k}_{t+1} &= (1 - \alpha) \Omega + \alpha \hat{k}_t - \varepsilon_{t+1} \\ \Rightarrow \hat{k}_{t+1} - \Omega &= \alpha (\hat{k}_t - \Omega) - \varepsilon_{t+1}, \end{aligned} \tag{CA'}$$

$$\hat{y}_t = \Lambda + \alpha (\hat{k}_t - \Omega), \tag{PRF'}$$

where Λ and Ω are constants. (**Hint:** Don't waste time deriving detailed expressions for Λ and Ω . Just collect terms.)

- (d) Let's consider the economy's response to a technology shock. Suppose that $\hat{k}_0 = \Omega$, $z_0 = \varepsilon_0 = 0$, $\varepsilon_1 = 1$, and $\varepsilon_2 = \varepsilon_3 = \dots = 0$.

- Using your answer to part (c), trace out the effects of this shock by filling in the following table.

t	ε_t	z_t	$\hat{k}_t - \Omega$	$\alpha (\hat{k}_t - \Omega) + z_t$
0	0.00	0.00	0.00	0.00
1	1.00	1.00		
2	0.00	1.00		
3	0.00	1.00		

- Note that the log of **total** output is given by $\ln(Y_t) = \hat{y}_t + z_t = \Lambda + \alpha (\hat{k}_t - \Omega) + z_t$. Given your answer to part (1), how does $\ln(Y_t)$ evolve over time? Briefly explain.

8. One-sided search with long-term unemployment.

Time: Discrete; infinite horizon.

Demography: A continuum, mass 1, of infinite-lived workers. Workers can either be employed, short-term unemployed or long-term unemployed.

Preferences: Workers are risk-neutral:

$$U(\{c_t\}_{t=s}^{\infty}) = \sum_{t=s}^{\infty} \beta^{t+1-s} c_t,$$

where $\{c_t\}_{t=s}^{\infty}$ is the sequence of consumption quantities at each time period t . $\beta < 1$ is the discount factor. (**Hint:** You might want to use $r = (1 - \beta)/\beta$, the discount rate, instead.)

Endowments:

- Employed workers all receive the single wage, w , i.e. the wage distribution is degenerate. Each period, with probability λ , they are laid-off.
 - Short-term unemployed workers (those who just lost their jobs) receive b units of the consumption good per period. Also, each period with probability α_0 they get a job offer, with probability γ they become long-term unemployed and with probability $1 - \alpha_0 - \gamma$ they remain in short-term unemployment.
 - Long-term unemployed workers receive b units of the consumption good per period. Each period with probability $\alpha_1 < \alpha_0$ they get a job offer.
 - To clarify: the wage distribution from which workers draw offers is degenerate. The only difference between short-term and long-term unemployment is that in long-term unemployment job offers arrive more slowly and in short-term unemployment there is the possibility of switching to long-term unemployment.
- (a) Derive an expression for the difference between the reservation wages in short-term and long-term unemployment in terms of the model's parameters.
 - (b) How does the expression derived in part (a) depend on γ and α_1 ? Interpret your answer.
 - (c) Draw a diagram showing the rate at which individuals transition between states.
 - (d) Derive formulae for the steady-state populations in each state.
 - (e) How does the proportion of the population who are employed change with γ ? Interpret your answer.

9. Consider the following variant of the Lucas tree model. The preferences of the representative consumer are

$$E_0 \left(\sum_{t=0}^{\infty} \beta^t \left(f c_t - \frac{g}{2} c_t^2 \right) \right), \quad 0 < \beta < 1, \quad f, g > 0,$$

where c_t denotes consumption. You can assume that $0 < c_t < f/g$.

Output is produced by an infinite-lived tree: each period, the tree produces d_t units of non-storable output, with d_t following a time-invariant Markov process with the distribution function $F(d_{t+1} | d_t)$. The economy starts off with each household owning one tree apiece. Let $p_t = p_t(d_t)$ be the price at time t of all future dividends from the tree, and let $R_t^{-1} = R_t^{-1}(d_t)$ be the price of a risk-free discount bond that pays one unit of consumption at time $t + 1$.

- (a) Let s_t denote the number of trees that the consumer owns at the beginning of time t , and let b_t denote the corresponding number of discount bonds. Letting x_t denote the consumer's financial resources, write down Bellman's functional equation for the consumer's problem, and derive the Euler equations associated with stocks.
- (b) Using a recursive approach, define an equilibrium in this economy.
- (c) Derive the equilibrium pricing function for stocks, $p_t = p(d_t)$. (This function should not include any expected future prices.)
- (d) Define the return on stocks, R_t^S , by

$$R_t^S = \frac{p_{t+1} + d_{t+1}}{p_t},$$

and define the equity premium, e_t , by $e_t = E_t(R_t^S) - R_t$. Write e_t as function of current and future dividends. Argue why e_t is likely to be positive, and briefly interpret.

- (e) In his 1978 paper, Robert Hall argued that if consumers had linear-quadratic preferences, consumption should follow a martingale process. Is your answer to part (b) consistent with this result? Why or why not?

10. Consider the following model:

Time: Discrete, infinite horizon.

Demography: N newborns in every period. Everyone lives for 2 periods except for the first generation of old people (no population growth).

Preferences: for the generations born in and after period 0:

$$U_t(c_{1,t}, c_{2,t+1}) = u(c_{1,t}) + \beta u(c_{2,t+1}),$$

where $c_{i,t}$ is consumption in period t and stage i of life, $u(\cdot)$ is increasing strictly concave and twice differentiable. For the initial old generation $\tilde{U}(c_{2,0}) = u(c_{2,0})$.

Endowments:

- $\{e_t, e_t\}$, of the single perishable consumption good, where $e_t = \gamma^t e$, $\gamma > 0$, $t \geq 0$. That is, everyone gets the same endowment in youth and old age, but each subsequent generation gets a different endowment than the last generation. Endowments grow/shrink at the gross rate γ .
- H per original old person of “cash”.

Consider the following **institutional** arrangements:

- (a) Inside money only (i.e., cash has no value). Define, characterize and solve for the competitive equilibrium.
- (b) Outside money, cash is used (ignore inside money). Define and characterize a stationary competitive monetary equilibrium.
- (c) Restricting attention to $u(\cdot) = \log(\cdot)$, what restriction on β is required for existence of an equilibrium in which $c_{1,t}$ and $c_{2,t+1}$ both grow at the (gross) rate γ ? Explain why such a requirement is necessary. Given β satisfies this requirement, what is the price of goods in terms of cash in period t ?