Macroeconomics Field Exam

August 2004

Answer all questions in the exam. Suggested times correspond to the question's weight in the exam grade.

Make your answers as precise as possible, using graphs, equations, coefficient estimates with confidence intervals, etc. whenever appropriate. For example, in discussing empirical papers, explain precisely what variables are used, how coefficients are estimated, what point estimates are obtained, and give a sense of the relevant confidence interval. Include reasonably specific citations to papers when relevant: e.g. Solow (1956).

General Questions

1. *Interest Rate and Real Estate (30 minutes):*

   (This is a general knowledge question-don't make it too hard.)

   The real estate column in the local paper advised serious home buyers to move quickly to close deals before mortgage rates increase. They explained that the Federal Reserve will increase the interest rates in coming months. And, in fact, the Federal Reserve increased the Target Federal Funds rate by 1/4% to 1.5% on August 10, 2004 and indicated that more increases are likely.

   Evaluate the real estate column's advice to buyers. Be sure to consider fixed rate and variable rate mortgages.

2. *Economic Fluctuations in IS/LM and DSGE Models (30 minutes):*

   Suppose that computer scientists at Berkeley announce a revolutionary discovery in semiconductor technology that is expected to increase the speed of computers by a factor of 1000. This technology will require three years before it can be implemented in new chips for the marketplace, so it is a change that will affect productivity three years from now, but not today.

   (a) What is the effect of this shock on the economy today? Answer this question by using both a traditional Keynesian framework (like IS/LM) and the DSGE framework.

   (b) Why do the two models give different answers? What do you think the right answer is? How might the model that gives the wrong answer be augmented so that it yields the right answer?

Field Questions

3. *Tobin's q, and Real options*

Setup:

- Tastes: Agents are risk neutral with a common time discount factor of $\beta < 1$.
- Technology: the technology describes a project has a random payoff that continues forever.

State	probability	Flow payoff
Good	π	H
Bad	$1-\pi$	L

That is, the payoff for t+1 is random, but once a realization occurs the $\text{payoff}_{t+1} = \text{payoff}_{t+2}, \ldots\ldots$

- Markets: markets are perfect and complete. Agents have the same information.
- Special Assumptions for this question:
  - A publicly traded startup company, Tobin Inc, exists and will produce using the technology. Tobin Inc has a current equity value equal to the discounted expected payoffs,

$$T_0 = \frac{\beta}{1-\beta}(\pi H + (1-\pi)L).$$

  - Cost: In a competitive market any agent (group) can install (buy) the project (technology) *this* period for I_0.

Questions

(a) *Tobin's q (20 minutes):* Briefly (one paragraph) explain Tobin's q. Be sure to give the equilibrium condition and an intuitive explanation of why it is an equilibrium condition. Does it matter if the firm has outstanding debt?

(b) *(5 minutes)* Suppose that Big Inc wants to expand by investing in the technology described above. What should it do? Apply Tobin's q and explain.

(c) *(5 minutes)* Recall markets are perfect and all agents have the same information—what is the equilibrium price of this project?

(d) *Real Options (20 minutes):* Dixit and Pindyck propose a Real Options theory of investment. They claim that Tobin's q, or any expected net present value rule, is incorrect because it omits that value of the option to wait. Briefly (one paragraph) explain Real Options theory.

(e) *(20 minutes)* If the project described in the setup above has an option value, then find the option value and explain. If it doesn't have an option value, then change the setup so that it has an option value and show the option value and explain.

4. *Equilibrium in a Growth Model (30 minutes):*

   Define the competitive equilibrium for a neoclassical growth model in which households own and accumulate capital. That is, one of the constraints on the household optimization problem explicitly includes a $\dot{k}_t$ term.

5. *Optimal Health Spending (30 minutes)*

   Consider a representative agent who cares about both quality of life (consumption) and quantity of life (life expectancy). The agent has some income y that can be used for consumption c or health spending h. Spending on health increases life expectancy.

   The economic environment is

$$\text{Preferences: } \sum_{t=0}^{\infty} \beta^t p(h)^t u(c) \tag{1}$$

$$\text{Resource Constraint: } c + h = y \tag{2}$$

   where y is an exogenous and constant endowment of income each period and $p(h)$ is the health production function: in particular, $p(h)$ is the probability that someone alive today with health spending h lives until the next period. (Alternatively, $1 - p(h)$ is the probability that the person dies before the next period, conditional on being alive at the beginning of the period). Therefore, our preference equation above describes the expected utility of a person born into this world who has a constant health spending h and constant consumption c.

   (We could make the model more complicated by letting h, c, and y depend on time, but let's keep it simple so that each of these is constant over time).

   Assume that $p(h)$ is an increasing function of h (more spending increases the probability that you live until the next period), and $u(c)$ is a standard neoclassical utility function.

This is a problem that is easy to solve when you set it up in the correct way. There are no tricks and you have plenty of time to solve it so just relax and think clearly.

(a) Let $V(y)$ denote the value function for the representative agent. Write down the Bellman equation formulation describing the optimal allocation of resources in this economy.

(b) Derive the first-order condition that characterizes the optimal allocation and interpret it. (NOTE: It is okay to write this in terms of the value function V, but you get a bonus point if you can figure out how to eliminate V from the solution. Hint: Look back at the Bellman equation and notice that this is a stationary environment.)