INSTRUCTIONS

- Please place a completed label (from the label sheet provided) on the top right corner of each page containing your answers. To complete the label, write:

  (1) your assigned number
  (2) the number of the question you are answering
  (3) the position of the page in the sequence of pages used to answer the questions.

  Example:
  MACRO THEORY 1/4/08
  ASSIGNED # __________
  Qu # __1__ (Page __2__ of __4__):

- Do not answer more than one question on the same page!
  When you start a new question, start a new page.

- **DO NOT** write your name anywhere on your answer sheets!
  After the examination, the question sheets and answer sheets will be collected.

- Please **DO NOT WRITE** on the question sheets.

- Please solve any three of the four problems.
You are not allowed to use notes, books, calculators, or colleagues.

Read the problems carefully and completely before you begin your answer. The problems will not be explained—if a problem seems to be ambiguous, make clarifying assumptions and state them explicitly. Aim for well organized and legible answers that address the question and that demonstrate your command of the relevant economic theory.

If you get stuck in a problem/section, move on. Partial credit will be granted when it is clear from your work that you were approaching the problem in a generally correct way.

Please return unused portions of the yellow tablet & question sheets.

There are 5 pages in the exam – please make sure you have all of them.

Good luck!

On the top of EACH yellow sheet, write your ASSIGNED NUMBER, date and name of exam and question number. DO NOT write your name on the yellow pads. After the examination, the question sheets and yellow pads will be collected. DO NOT write on the question sheets.

You are not allowed to use notes, books, calculators, or colleagues.

Please solve any three (3) of the four (4) problems. The time assigned to each is one hour and fifteen minutes. Thus, you have an extra hour to read the questions and revise your answers.

The total time allotted is three and one half (3 and 1/2) hours.

Each problem received the same weight (100 points). The points allocated to each subsection are indicated in each problem.

If you get stuck in a problem/section, move on. Partial credit will be granted when it is clear from your work that you were approaching the problem in a generally correct way.

Read the questions carefully and completely before you begin your answer. The problems will not be explained. If you think that a problem is ambiguous or poorly worded, make the minimum necessary assumptions to make it beautiful and well posed.

Please return unused portion of the yellow tablets and question sheets.

There are four (5) pages in this exam (including this cover page). Please make sure that you have all of them.

Good Luck!
1 Problem #1: Policy Evaluation (100 Points)

Suppose that you are asked by the US Council of Economic Advisors to assess the effects of a tax rate increase in 2008 on 1) the level of GDP for the next 5 years and 2) the level of Federal budget deficit for the next 5 years. Describe a framework for doing this. Remember to use both theoretical and econometric methods as appropriate and to be as formal as possible.

2 Problem #2: Technological Change (100 Points)

Consider an economy in which workers and firms are matched using a standard Mortensen-Pissarides technology. To be precise, if \( v \) vacancies are created, and \( u \) workers are unemployed, the total number of matches is given by \( M(u, v) \).

Assume that \( M \) is homogeneous of degree one, increasing in each argument, and differentiable. Let \( \theta \) be the ratio of vacancies to unemployed workers, and denote by \( q(\theta) \) the number of matches per vacancy; thus, \( q(\theta) = M(u, v)/v \) is interpreted as the probability that a firm will meet a worker. Similarly, \( \theta q(\theta) \) is the probability that a worker who is unemployed —and only the unemployed can “contact” firms— will find an open vacancy.

If a firm and a worker are matched, the match produces \( y \) units of output. Matches are exogenously destroyed with probability \( \eta \), but can also be terminated by either party. In order to create a job, a firm must purchase \( k \) units capital. This capital must be purchased up front but can be costlessly sold or upgraded before the firm finds a worker. After the match is created, capital has no scrap value. Unemployed workers can produce \( x \) units of output at home.

1. (15 points) Briefly describe the Bellman equations for workers and firms. Compute the unemployment rate.

2. (25 points) Assume that, at time 0, it is announced that at time \( T \) any new investment will have productivity \( y' = y(1 + \gamma) \), with \( \gamma > 0 \). Thus, there will be a productivity increase. Go as far as you can computing the unemployment rate after time \( T \).

3. (30 points) Derive conditions under which, at time \( T \) the existing matches (which use the “old”, low productivity, technology) are not destroyed. Describe what happens to the average productivity in this economy from time 0 to \( \infty \). Be precise about what happens at time \( T \) and the subsequent periods.

4. (30 points) Let \( J \) be the value, at time 0, of a firm that has a worker before the announcement. Let \( J' \) be the value after the announcement. What can you say about the relationship between \( J \) and \( J' \)? What happens to investment (measured as the number of vacancies created times \( k \)) between periods 0 and \( T \)? What happens to unemployment during the same period?
3  Problem # 3: Consumption and Growth (100 Points)

There are two parts to this problem. Answer both of them.

3.1 Consumption Smoothing

Consider a consumer whose preferences are given by:

\[ E_0 \sum_{t=0}^{\infty} \beta^t \frac{c_{t+1}^{1-\gamma}}{1-\gamma}, \]

where \( \gamma > 1, \beta \in (0,1), \) and \( E_0 \) is the expectation conditional on time 0 information. The consumer can lend and borrow at the risk-free interest rate \( r, \) with \( 1 + r = 1/\beta. \) The consumer’s budget constraint at time \( t \) is:

\[ c_t + \frac{a_{t+1}}{1+r} = y_t + a_t, \]

where \( a_t \) is the asset level that the consumer brings into period \( t. \) The consumer is subject to a “natural” borrowing limit, and her initial asset level is \( a_0 = 0. \) Her endowment process follows:

\[ y_{t+1} = y_t \exp\{p\epsilon_{t+1} + q\}, \]

where \( \epsilon_{t+1} \) is an i.i.d. standard normal random variable, \( p \neq 0, \) and \( q = 0.5\gamma p^2. \) The consumer chooses \( \{c_t, a_{t+1}\}_{t=0}^{\infty} \) to maximize her utility subject to the sequential budget constraints and the endowment process.

1. (30 points) Derive a closed-form expression for the consumer’s optimal consumption and asset accumulation plan. (Hint: If \( \log X \) is normally distributed with mean \( \mu \) and variance \( \sigma^2, \) then \( E X = \exp(\mu + 0.5\sigma^2).\))

2. (10 points) Discuss your solution above in terms of Friedman’s permanent income hypothesis.

3. (10 points) Discuss your solution above in terms of precautionary saving.

3.2 A Neoclassical Growth Model

Consider the following variation of the neoclassical growth model. There are a continuum of infinitely-lived consumers in the economy. Half the population are the typical consumers in the standard neoclassical growth model—they own capital, supply labor, and decide how much to consume and how much to save each period. The other half of the population are communists who refuse to own any capital. They work and consume all their labor income every period. That is, they live hand to mouth. We normalize the total size of the population to be 2.
The preferences of the consumers are standard: $\sum_{t=0}^{\infty} \beta^t u(c_t^i)$. The superscript $i$ denotes each group: $S$ for the standard consumers and $C$ for the communists. The period utility function, $u(\cdot)$, is twice continuously differentiable, strictly concave, increasing, and $\lim_{c \to 0} u'(c) = +\infty$.

There is a representative firm that rents capital and hires labor each period. The firm behaves competitively. The firm’s production function is: $Y_t = K_t^\alpha L_t^{1-\alpha}$. Labor is inelastically supplied by both types of consumers, and we normalize the total labor supply to 1. Each type supplies 0.5 unit of labor.

The law of motion for capital is: $C_{t+1} + K_{t+1} = Y_t + (1 - \delta)K_t$, where $C_t = c_t^S + c_t^C$.

1. (10 points) Define a competitive equilibrium of this economy.

2. (10 points) Show that, in the equilibrium, the labor income and consumption of a communist is a constant fraction $\phi$ of $Y_t$. Determine $\phi$.

3. (15 points) Show that the competitive equilibrium is not optimal for the standard consumers in the following sense: It does not maximize their objective function subject to $c_t^S + K_{t+1} = (1 - \phi)K_t^\alpha + (1 - \delta)K_t$, where $\phi$ is the fraction of output that belongs to the communists. Recall that $L_t \equiv 1$.

4. (15 points) Let the steady-state capital stock of the competitive equilibrium be $K^*$. Now, let’s have the following thought experiment. In the initial period, all the communists renounce their ideology and become standard consumers. That is, we are back in the standard neoclassical growth model. Let the steady-state capital stock of this new economy be $K^{**}$. How does $K^*$ compare to $K^{**}$?