Preliminary Examination

Econ 702-Macroeconomics
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Instructions: There is one question, divided in several subquestions. The number in brackets represents the number of points awarded for answering correctly the each subquestion. Total available points are 115. If the description of the environment seems incomplete to you, explain why, make the assumptions that you deem necessary to proceed and continue. Good Luck!

1. Reducing Working Hours to Reduce Unemployment. European politicians often propose to cap the number of hours of work during a week in order to lower the unemployment rate. We want to assess the merit of this proposal using a version of the Mortensen and Pissarides model with an extensive and intensive margin of work.

Unemployed workers home-produce $b \geq 0$ units of output per period. Firms create vacancies at the cost of $k > 0$ units of output. Unemployed workers and vacant firms meet bilaterally according to a CRTS matching function $M(u, v)$. The probability that an unemployed worker meets a vacancy is $p(\theta) = M(1, \theta)$, where $\theta = v/u$ and $p(\theta)$ is a strictly increasing, strictly concave function with $p(0) = 0$ and $p(\infty) = 1$. The probability that a vacancy meets an unemployed worker is $q(\theta) = p(\theta)/\theta$, where $q(\theta)$ is a strictly decreasing function with $q(0) = 1$ and $q(\infty) = 0$. Once matched, all firms and workers have access to the same production technology. Specifically, if the worker puts in h hours of work during the period, the firm and the worker produce $f(h)$ units of output and the worker suffers a disutility of $c(h)$, where $f(0) = 0$, $f'(.) > 0$, $f''(.) < 0$ and $c(0) = 0$, $c'(0) = 0$, $c'(h) > 0$ for all $h > 0$ and $c''(h) > 0$. The match breaks down for exogenous reasons with probability $\delta \in (0, 1)$ per period.

The terms of trade between the firm and the worker are set by Axiomatic Nash Bargaining. In particular, the firm and the worker bargain in every period over hours of work h and salary w. The worker's bargaining power is denoted by η and the firm's bargaining power is denoted by $1 - \eta$, with $\eta \in (0, 1)$.

Workers maximize the present value of wages net of the disutility of work, discounted at the factor $\beta \in (0, 1)$. Firms maximize the present value of profits net of vacancy costs, discounted at the factor β.

a. (5) Write down the Bellman Equation for V_0, the lifetime utility of an unemployed worker.[Assume throughout that the outcome of the bargain is such that a firm-worker match is created with probability 1].

b. (5) Write down the Bellman Equation for $V_1(h, w)$, the lifetime utility of a worker who, in the current period, has agreed to work h hours for a salary of w.

c. (5) Write down the Bellman Equation for $J(h, w)$, the lifetime profit of a firm that, in the current period, employs a worker for h hours at the salary w.

d. (5) Define the surplus $S(h, w)$ of a firm-worker match as $V_1(h, w) + J(h, w) - V_0$ and derive an expression for it based on (a), (b) and (c). Does S depend on h and w?

e. (10) Write down the axiomatic Nash bargaining problem. Then derive the first-order conditions for the solution (h^*, w^*) of the problem.

f. (10) Combine the first-order conditions of the Nash bargaining problem, and characterize h^* in terms of fundamentals. What property does h^* have?

g. (5) What does the first-order condition for w^* imply about the distribution of the surplus between the firm and the worker?

h. (10) Using your answers in (d) and (g), derive the two equilibrium conditions that pin down the surplus $S^* = S(h^*, w^*)$ and the tightness of the labor market θ^*.

i. (5) Plot the two equilibrium conditions in the $\{\theta, S\}$ space. Show that there exists a unique solution to the two equilibrium conditions.

j. (5) Write down expressions for the stationary unemployment rate u^* and for the stationary vacancy rate v^*, both in terms of the equilibrium market tightness θ^*. Illustrate the solution by plotting the expressions in the $\{u, v\}$ space.

Now, suppose that the Government introduces a cap $\overline{h}$ on working hours, with $0 < \overline{h} < h^*$. We want to understand the effect of this policy on the equilibrium of the labor market.

k. (10) Write down the Nash bargaining problem. The derive the first-order conditions for the solution $\{\hat{h}, \hat{w}\}$.

l. (5) Combine the first order conditions, and characterize $\hat{h}$ in terms of fundamentals.

m. (10) Write down equilibrium conditions for the surplus $\hat{S} = S(\hat{h}, \hat{w})$ and for the tightness of the labor market $\hat{\theta}$. Using the same type of graph as in part (i), show that the equilibrium is unique. Use the graph to show how $\hat{S}$ compares with S^* and $\hat{\theta}$ compares with θ^*. Explain your findings.

n. (5) Graph in the $\{\hat{u}, \hat{v}\}$ space the equilibrium conditions for stationary unemployment and vacancy rates. Use the graph to show how $\hat{u}$.compares with u^* and $\hat{v}$ compares with v^*. Explain your findings.

o. (10) Derive an expression for the equilibrium salary w as a function of h. What is the effect of the cap on working hours on w? Explain your findings.

p. (10) What economic mechanisms that are missing from our model may help reverse your findings?