Midterm Exam – Econ 2450
9 February 2015
Department of Economics
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Instructions: Unless otherwise explicitly stated, you must show how you arrived at your answer to get full mark. However, where the answer is just one, or a few, words no further motivation is needed. Answers must be given on the answer sheets provided. Ask for extra answer sheets if needed. Do not fold the answer sheets or write on the back.

Problem 1 [4 marks]

Consider a model of the labor market under perfect competition. There are $\overline{L}$ workers. If they work, they earn a (real) wage, w; if they do not work they earn some benefit from the government, b. Total labor supply, L^S, is given by:

$$L^S = \begin{cases} \overline{L} & \text{if } w \geq b, \\ 0 & \text{if } w < b. \end{cases}$$

The demand for labor is given by

$$L^D = N\left(\frac{\gamma A}{w}\right)^{\frac{1}{1-\gamma}},$$

where (just as in class) N is the number of firms, and AL^γ is the output of a firm that hires L workers, where $A > 0$ and $\gamma \in (0,1)$.

(a) Illustrate the labor supply and demand functions in a diagram with w on the vertical axis and L^S and L^D on the horizontal axis. Draw everything so that there is some unemployment (i.e., less than full employment) in equilibrium. Indicate b and $\overline{L}$ on the appropriate axes. [2 marks]

(b) What do the letters D and S in DSGE model stand for? [1 mark]

(c) Who wrote the book The General Theory of Employment, Interest and Money? The last name suffices. (Hint: it starts with a K.) [0.5 marks]

(d) The IS-LM model was first presented by John Hicks in an article published in 1937. What was the name of the journal where it was published? (Hint: it starts with an E.) [0.5 marks]

NOTE: In Problem 1 you do not need to motivate anything, just draw everything correctly, or write the word or name correctly.

Problem 2. [4 marks]

Consider a labor market model, where there are M agents, who can choose between becoming workers or firms (entrepreneurs). Let the number of agents who become firms be N, and the number of agents who become workers be $\overline{L}$.

A firm that hires L workers produces AL^γ, where $A > 0$ and $0 < \gamma < 1$. For simplicity, we here set the unemployment benefit to zero, which means there is always full employment in equilibrium. With full employment, the total number of workers hired by all N firms must sum up to $\overline{L}$, implying that each firm hires $R = \overline{L}/N$ workers in equilibrium, where R is the worker-to-firm ratio.

(a) Use the profit maximization problem of a firm (i.e., the first-order condition for a profit maximum) to show that the equilibrium wage rate equals $w = \gamma A\,(1/R)^{1-\gamma}$. [1 mark]

(b) Find the firm's profit (π) in equilibrium in terms of R, A, and γ. [1 mark]

(c) Find the equilibrium level of R, that makes agents indifferent between becoming firms and workers. Your answer should be in terms of (some or all of) A, γ, and M. [1 mark]

(d) Find an expression for total output of the economy in equilibrium, i.e., the number of firms (N) times output per firm. Your answer should be in terms of (some or all of) A, γ, and M. (Hint: $\overline{L}$ and N sum up to what?) [1 mark]

Problem 3 [**4 marks**]

Consider a model where workers care about consumption and leisure. The utility of a worker who supplies an amount of labor l (where $0 \le l \le 1$) is given by

$$U = \lambda \ln(C) + (1-\lambda)\ln(1-l),$$

where C is consumption and λ is a parameter in the utility function ($0 < \lambda < 1$). A worker who does not work at all ($l = 0$) receives an unemployment benefit of $b > 0$, but does not receive any benefit is (s)he works ($l > 0$). The wage rate is w. The worker's budget constraint is thus

$$C = \begin{cases} b & \text{if } l = 0, \\ wl & \text{if } l \in (0,1]. \end{cases}$$

(a) Find an expression for the utility a worker gets if not working at all. Denote this utility $U^{\text{no work}}$. Your answer should be in terms of some, or all, of these variables: λ, b, and w. [1 mark]

(b) Find an expression for the maximum utility a worker gets if working, i.e., if (s)he sets $l \in (0,1]$. Denote this utility U^{work}. Your answer should be in terms of some, or all, of these variables: λ, b, and w. Remember that you must show each step. [2 marks]

(c) Some models (not this one) explain unemployment by assuming that worker productivity depends on the wage rate. What are those models called? [1 mark]

NOTE: In Problem 3(c) you do not need to motivate anything, just write the word correctly.

Solutions:

1. (b) Dynamic Stochastic (General Equilibrium Models); (c) (John Maynard) Keynes; (d) Econometrica

2. (a) The firm's profit is $\pi = AL^\gamma - wL$, so the first-order condition implies that:

$$\frac{\partial \pi}{\partial L} = \gamma A L^{\gamma-1} - w = 0.$$

Setting $L = R$ (which must hold in equilibrium) gives

$$w = \gamma A \left(1/R\right)^{1-\gamma}.$$

(b) Using $\pi = AL^\gamma - wL$ again, setting $L = R$, the answer under (a), gives

$$\pi = AR^\gamma - \gamma A \left(\frac{1}{R}\right)^{1-\gamma} R = (1-\gamma)AR^\gamma.$$

(c) Setting $\pi = w$ gives $R = \overline{L}/N = \gamma/(1-\gamma)$.

(d) Since the total number of agents is M, and each agent is either a firm or a worker, we know that $M = N + \overline{L}$. Using the answer under (c) we now get

$$M = N + \overline{L} = N\left(1 + \frac{\overline{L}}{N}\right) = N\left(1+R\right) = N\left(1 + \frac{\gamma}{1-\gamma}\right) = \frac{N}{1-\gamma},$$

which gives the equilibrium number of firms as $N = (1-\gamma)M$. Since each firm in equilibrium produces $AL^\gamma = AR^\gamma = A\left(\frac{\gamma}{1-\gamma}\right)^\gamma$, total output equals

$$NAL^\gamma = (1-\gamma)MA\left(\frac{\gamma}{1-\gamma}\right)^\gamma = (1-\gamma)^{1-\gamma}\gamma^\gamma MA.$$

3. (a) Setting $l = 0$ gives

$$U^{\text{no work}} = \lambda \ln(b) + (1-\lambda)\ln(1) = \lambda \ln(b) = \ln(b^\lambda).$$

(b) The first-order condition with $C = wl$ shows that, if working, the worker sets $l = \lambda$; see the problems posted. Then setting $l = \lambda$ in the utility function then gives

$$\begin{aligned} U^{\text{work}} &= \lambda \ln(w\lambda) + (1-\lambda)\ln(1-\lambda) \\ &= \lambda\ln(w) + \lambda\ln(\lambda) + (1-\lambda)\ln(1-\lambda) \\ &= \ln\left\{w^\lambda \lambda^\lambda (1-\lambda)^{1-\lambda}\right\}. \end{aligned}$$

(c) Efficiency wage model

Answer sheet for Problem ___ Econ 2450 Midterm Exam 9 February 2015

Student Name: SID Number:

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Write your answers below. Do not fold the answer sheets or write on the back.