Second Midterm Exam – Econ 2450
30 March 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.

1. Labor Markets [4 marks]

Labor supply is given by:

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

where $\overline{L}$ is the labor force, w is the wage rate, and b is an unemployment benefit. Let N be the number of firms. Output of each firm is given by

$$Y = AL^{\gamma} + BL,$$

where $A > 0$, $B > 0$, and $\gamma \in (0, 1)$ are exogenous parameters, and L is the number of workers hired by each firm. We assume that $B < b$.

(a) Set up a firm's profit maximization problem, and show how to derive aggregate demand for labor. (Hint: here labor demand is only defined for $w > B$; if $B = 0$, then everything should look like the case we discussed in class.) [2 marks]

(b) Illustrate the demand and supply curves in a diagram with w on the vertical axis and L^D and L^S on the horizontal axis. Draw the graphs so that there is less than full employment in equilibrium. Show B and b on a suitable axis, and recall that $B < b$. [2 marks]

NOTE: In Problem 1 (b) you do not need to show how you arrived at your answer, only draw everything correctly.

2. Intertemporal Models I [4 marks]

Consider a two-period model. The budget constraints of the representative agent are

$$C_1 = Y_1 - S, \tag{1}$$

$$C_2 = Y_2 + S(1 + r), \tag{2}$$

where C_1 and C_2 denote consumption in the first and second periods, Y_1 and Y_2 are incomes in the same two periods, S is saving, and r is the interest rate. The agent maximizes the utility function

$$U = (1 - \beta)\ln(C_1) + \beta \ln(C_2), \tag{3}$$

where $\beta \in (0, 1)$. Utility maximization gives optimal saving as

$$S = \beta Y_1 - (1 - \beta)\frac{Y_2}{1 + r}, \tag{4}$$

which you do not need to show here.

(a) In a diagram with C_1 on the horizontal axis and C_2 on the vertical axis, draw the (intertemporal) budget line associated with (1) and (2). Indicate the vertical intercept, the slope of the budget line, and the points on the axes representing Y_1 and Y_2. Show how you arrived at your answer, using equations (1) and (2). [2 marks]

(b) In the same type of diagram as in (a), show the indifference curve associated with a utility maximum (i.e., the curve which is tangent to the budget line at the optimal C_1 and C_2). Draw the indifference curve so that $S > 0$. You may answer (a) and (b) using the same diagram, if you wish. [1 mark]

(c) What word is represented by X in the following sentence? "A common tool used by modern macroeconomists is the so-called Dynamic X General Equilibrium (DSGE) model." [1 mark]

NOTE: In Problem 2 (b) you do not need to show how you arrived at your answer, only draw everything correctly.

3. Intertemporal Models II [4 marks]

Consider a two-period model with the same notation as in Problem 2. The budget constraints of the representative agent are the same as (1) and (2), and utility is logarithmic as in (3), so optimal saving, S, is given as in (4).

In this problem there is also production. Total output in the second period is produced by a representative firm, and equals AK^{α}, where K is the capital stock, $A > 0$ and $\alpha \in (0, 1)$. Second-period labor income is given by

$$Y_2 = (1 - \alpha)AK^{\alpha}.$$

(The firm is active only in the second period, so we treat Y_1 as exogenous and need no sub-index on K.) Profits for the firm, π, are given by

$$\pi = AK^{\alpha} - (1 + r)K.$$

(a) Use the first-order condition for the firm's profit maximization problem, and the expression for Y_2 above, to show that

$$\frac{Y_2}{1 + r} = \left(\frac{1 - \alpha}{\alpha}\right) K.$$

[1 mark]

(b) Derive an expression for equilibrium investment, K. Use the capital market equilibrium condition for a closed economy, together with equation (4) in Problem 2, and the expression for $Y_2/(1 + r)$ derived under (a) of this problem. Your answer should be an expression involving some, or all, of α, β, A, and Y_1. [2 marks]

(c) What is the equation $u'(C_t)/u'(C_{t+1}) = \beta(1 + r)$ called? (Hint: it starts with an E.) [0.5 marks]

(d) A common result in two-period models with taxes and government spending is that the agents' optimal consumption choices in the two periods do not depend on in which period they are being taxed. What is this result called? (Hint: it has two words starting with R and E.) [0.5 marks]

Answer sheet for Problem ___ Econ 2450 Midterm Exam 30 March 2015

Student Name: SID Number:

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

Sketches of solutions:

1.
(a) A firm's profit equals

$$\pi = AL^\gamma + BL - wL.$$

The first-order condition becomes

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

which can be solved for L to give the optimal number of workers hired per firm:

$$L = \left(\frac{\gamma A}{w-B}\right)^{\frac{1}{1-\gamma}}.$$

Now aggregate labor demand becomes:

$$L^D = \underbrace{N}_{\#\text{ firms}} \underbrace{\left(\frac{\gamma A}{w-B}\right)^{\frac{1}{1-\gamma}}}_{\#\text{ workers hired per firm}}.$$

(b) See attached sketch. Note that L^D goes to infinity as w approaches B from above.

2.
(a) Note from (1) that $S = Y_1 - C_1$, which can be used with (2) to give

$$\begin{aligned} C_2 &= Y_2 + S(1+r) \\ &= Y_2 + (Y_1 - C_1)(1+r) \\ &= \underbrace{Y_2 + Y_1(1+r)}_{\text{vertical intercept}} \underbrace{-(1+r)}_{\text{slope}} C_1. \end{aligned}$$

Diagrams for (a) and (b) in attached sketch.
(c) Dynamic *Stochastic* General Equilibrium model

3.
(a) The first-order condition says that

$$\frac{\partial \pi}{\partial K} = \alpha A K^{\alpha-1} - (1+r) = 0,$$

which implies

$$1 + r = \frac{\alpha A K^\alpha}{K}.$$

Using this and the expression for Y_2 gives

$$\frac{Y_2}{1+r} = \frac{(1-\alpha)AK^\alpha}{\frac{\alpha AK^\alpha}{K}} = \left(\frac{1-\alpha}{\alpha}\right)K$$

(b) Setting $S = K$, and using (4) and the expression for $\frac{Y_2}{1+r}$ above we see that

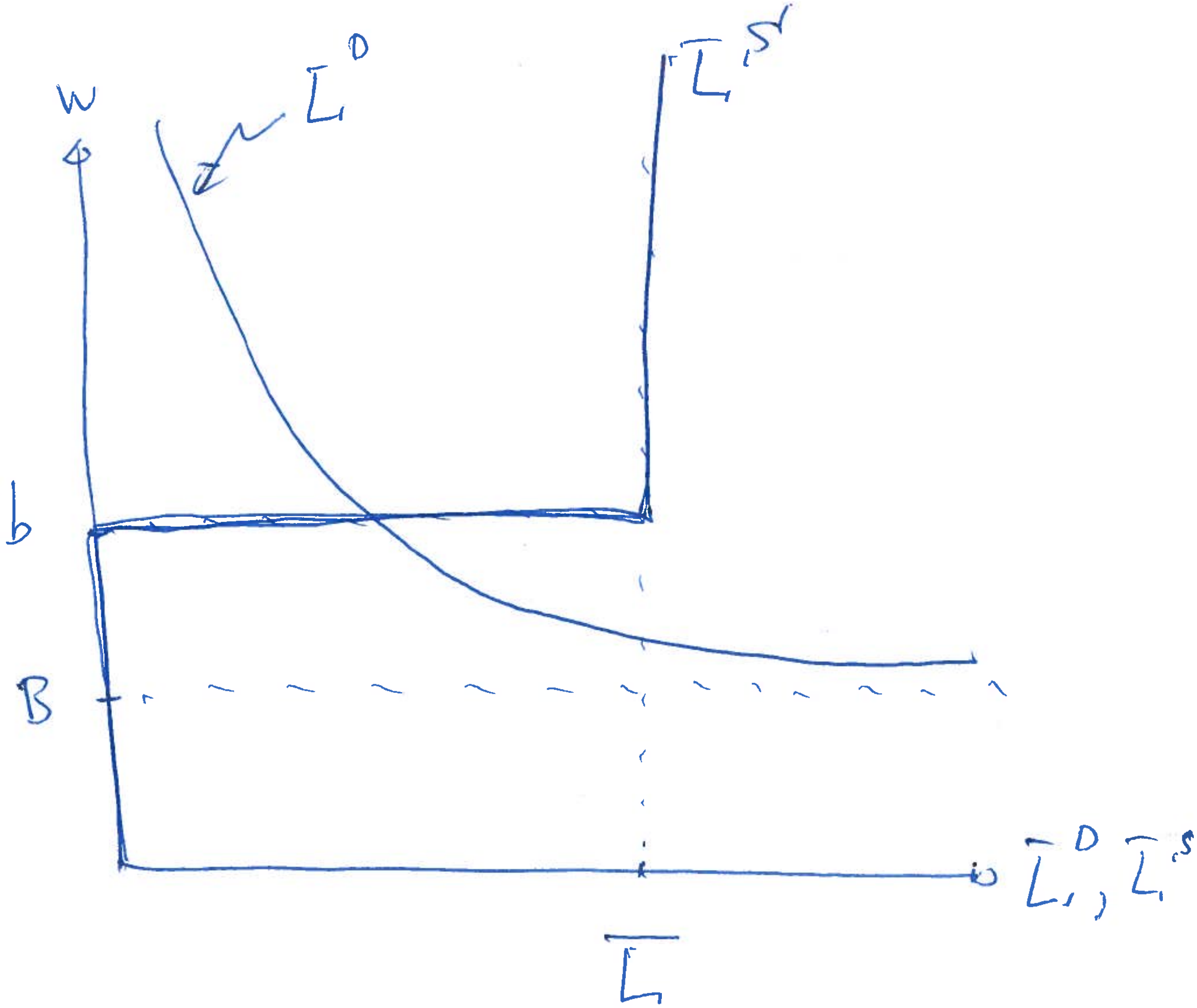
$$\begin{aligned} S &= \beta Y_1 - (1-\beta)\frac{Y_2}{1+r} \\ &= \beta Y_1 - (1-\beta)\left(\frac{1-\alpha}{\alpha}\right)K \\ &= K. \end{aligned}$$

Solving for K gives

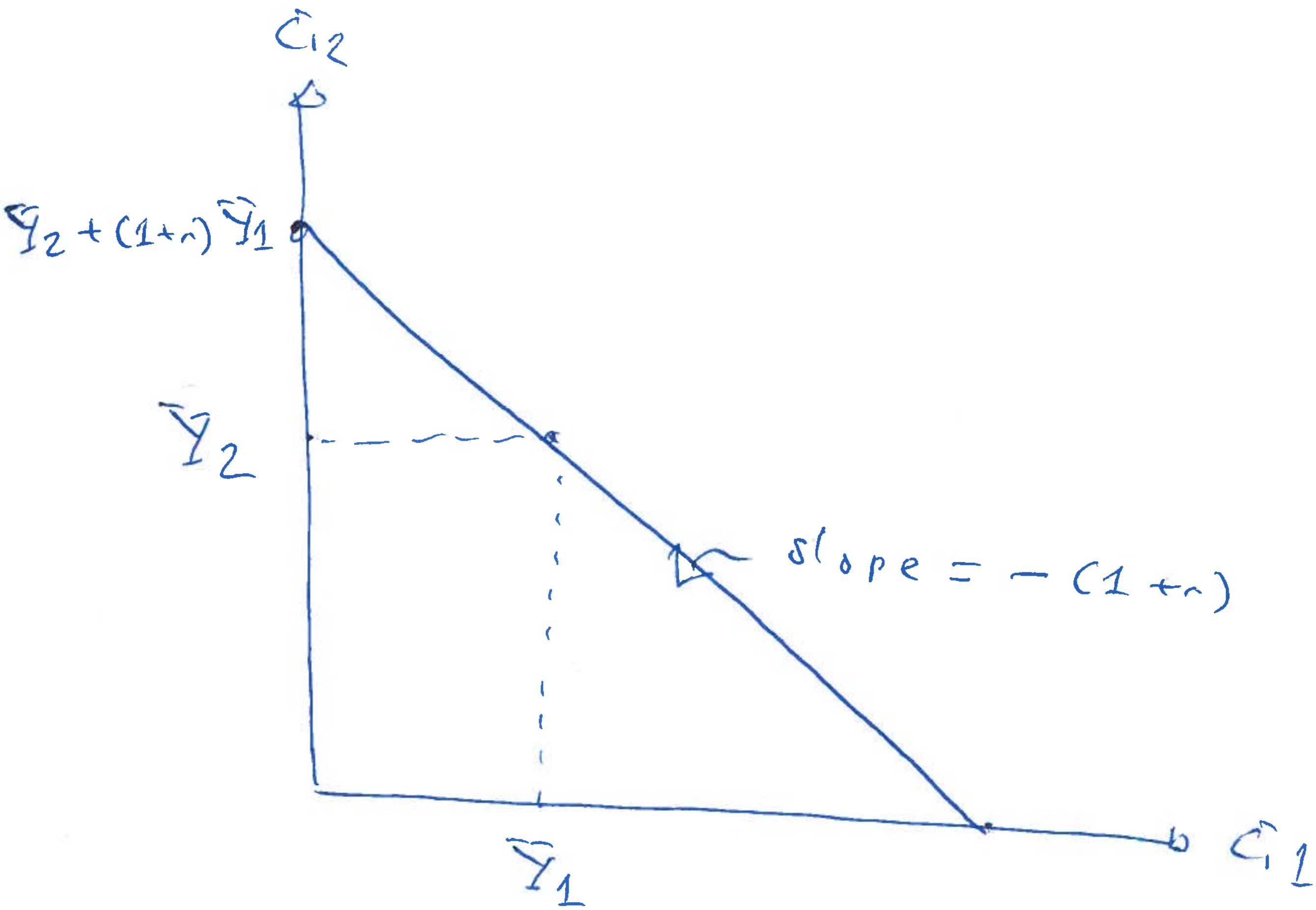
$$K = \frac{\alpha\beta Y_1}{\alpha + (1-\beta)(1-\alpha)} = \frac{\alpha\beta Y_1}{1-\beta(1-\alpha)}.$$

(c) Euler equation
(d) Ricardian Equivalence

1 (b)



2 (a)



(2) (b)