

Problem Set 5 (Ungraded)

Changes are indicated in red.

Note on ungraded: "Ungraded" means that we do not go through your problem set in detail to determine whether all your answers are correct. Instead, we provide an answer sheet, and you are responsible for checking your answers and making sure that you understand the correct answers. We do determine whether you have done the work and will give grades of "check+" or "check" or "check minus" or "zero" depending upon the work you have done.

1. Investment and the User Cost of Capital

You are hired to consult for an airline deciding whether to buy a new, fuel-efficient Boeing 787 aircraft. Assume that prices are constant ($P = 1$) and that the airline is small (price-taking or perfectly competitive).

Further assume that (i) the list price of a 787 is \$200 million, (ii) the airline can borrow at an annual real interest rate of 3% per year, and (iii) the aircraft depreciates at 5% per year.

- What is the airline's user cost of capital for a new 787 for the next year?
- If a leasing company offered the airline an opportunity to rent a new 787 for \$18 million per year, payable at the end of the year, would you recommend that the airline buy or rent? Explain.

Suppose now that the airline's annual output (in US\$ millions) depends on the number of 787 aircraft in its fleet (N) via:

$$Y = 1000 + 64 \ln(N)$$

For the remainder of the problem, assume that the airline rents all aircraft, at a rental rate that makes them just indifferent between buying and renting.

- Given the cost of capital you calculated in part (a), what is the steady-state (long run) number of 787s that the airline will rent?
- Congress is debating a bill that would grant a 20% tax credit (subsidy) for aircraft rental costs. If this bill were to pass, how many 787s would the airline rent in the long run?
- Assume now that the bill fails, but that the Fed steps in to stimulate the economy. Specifically, the Fed keeps interest rates exceptionally low for the foreseeable future, thus enabling airlines to borrow at an annual interest rate of 1.4% instead of 3%. What is the steady-state number of 787s in the airline's fleet in these circumstances?

2. Wage Rigidity and Unemployment

The economy's aggregate production function is given by:

$$Y = K^{(1/3)}L^{(2/3)}$$

Normalize the price of output to $P = 1$, so all variables are given in real terms.

- Assuming that labor markets are competitive, solve for labor demand as a function of the **wage marginal product of labor (MPL)** and the capital stock K .
- Solve for the equilibrium wage and employment if the capital stock is $K = 100$ units and labor supply is given by: $L^s = 100 \cdot w$
- Assume now that the government enacts a minimum wage of $w=1$. Find the new equilibrium level of employment. Depict the situation on a graph of labor demand and supply. Label unemployment and the labor force.
- Next, assume that the government also enacts a 10% payroll tax on employers (in addition to the minimum wage law). Find the new equilibrium level of employment, and depict the situation on a graph of labor demand and supply. Label unemployment and the labor force.
- Assume now that the minimum wage law was repealed, but the payroll tax remained. Show this new situation in a graph of labor demand and supply. Would there still be *unemployment*? Explain why or why not?

3. Zipcar and Tobin's Q

In its most recent quarterly report, the car-sharing company Zipcar reported the value of its equipment to be \$98 million, which you can consider as the replacement cost of its installed capital.¹

- Compute the Tobin's Q for Zipcar based on its current market valuation, defined for our purposes as the number of shares outstanding times the price per share. You can assume that Zipcar has no debt. You can find the stock market data at:
[<http://www.nasdaq.com/symbol/zip>].
- Zipcar has roughly 9,400 vehicles in its fleet. Compute the average replacement cost and the average market valuation per vehicle.
- Based on Q-theory, would you recommend that Zipcar invest in additional vehicles? Explain the economic intuition behind your answer. Draw a graph based on the lecture notes to illustrate your answer.
- Suppose now that there is bad news regarding Zipcar's future profitability. For example, a competitor may announce that it will enter the car sharing market. How would this announcement affect Zipcar's Q, and your investment

¹ "Zipcar Reports 2011 Second Quarter Results," Source www.zipcar.com

recommendations? Explain the mechanism in the model through which such an announcement would affect Zipcar's Q .

4. A Search and Matching Model of Unemployment

Assume the following notation:

- L is the labor force
- u is the unemployment rate
- v is the vacancy rate
- θ is labor market tightness ($= v/u$)
- $\alpha(\theta)$ is the rate at which unemployed workers find jobs (the fraction of the unemployed that will find a job in a unit of time)
- φ is the rate of job destruction (the fraction of jobs that will be destroyed in a unit of time)

a. Defend the assumption that $\alpha'(\theta) > 0$. That is, explain why this assumption makes sense.

b. Write an expression for the change in the unemployment rate (Δu) over the course of a unit of time.

Hint: There are two flows to consider: the *decrease* in unemployment due to unemployed workers finding a job, and the *increase* in unemployment due to employed workers losing/quitting their job.

c. In steady-state, the flows into and out of unemployment should exactly balance, and the change in the unemployment rate should be zero. Based on the equation you derived in (b), solve for the unemployment rate u^* consistent with this steady-state condition. Note that your equation for u^* can be a function of θ .

d. Draw the appropriate curve for the equation you derived in (c) on a graph with the unemployment rate on the x-axis, and the vacancy rate on the y-axis.

Now suppose there is some structural change in the economy. Specifically, consider the emergence of online job search at websites that pool job postings and allow job-seekers to search vacancies based on their skills (e.g., monster.com, dice.com, etc.)

e. Explain the mechanism by which such a structural change would affect the curve you drew in part (d). Show the impact on your graph as well.