DUSP 11.202/203 Frank Levy
Micro/Planning Economics December 15, 2009

2009 Micro/Planning Final Exam

Instructions (READ CAREFULLY):

Students who are taking both Planning Economics and Microeconomics should answer Questions 1-8. You have three hours to complete the exam.

Students who are registered only for Planning Economics should answer Questions 1-4 ONLY. You have 90 minutes to complete the exam. *Please check your name off the class list when you hand in your exam and mark your bluebook "Planning Economics Only"*

Blue Books: NO STUDENT NAMES – MIT ID only.

Questions 1-4 in a single blue book

Questions 5 and 6 (if relevant) in a second blue book

Questions 7 and 8 (if relevant) in a third blue book

Calculator ok But Otherwise Closed Book

This is a fairly long exam. To save time, think through what you want to say in each answer before writing.

1) (15 points) A company with multiple stores often thinks of "service areas", the geographic area whose residents a particular store is supposed to serve. Where data is available, a company often identifies service areas by using the cross price elasticity of demand:

$$\varepsilon_{X,Y} = (\Delta Q_X/Q_X)/(\Delta P_Y/P_Y).$$

where Q_X is the quantity of a particular good demanded at Store X, P_Y is the Price of that good at Store Y, and so on.

a) (7 points) General Motors is currently restructuring the way it produces and sells cars in the United States. Part of this restructuring involves sharply reducing the number of dealerships that sell each brand of General Motors cars. For example, a year from now, there will be significantly fewer dealerships in the United States that sell Chevrolets than there are today. Using the concept of cross-elasticity of demand, explain what General Motors is trying to accomplish and how they will want their dealerships geographically positioned.

Answer: General Motors wants less competition among same-brand dealerships to allow the dealerships to be more profitable (and perhaps have more money to give better service). They want to position the dealerships sparsely at a sufficient distance from each other so that the cross-elasticity above is very low.

b) (8 points) Last week, a story on National Public Radio explained why stores selling similar products in a city – stores specializing in chess sets, stores specializing in diamonds, etc – often locate next to each other to form shopping districts. (Recall the Hotelling model of hot dog carts on the beach). Does this clustering strategy conflict with General Motors' strategy in (a)? If so, explain the contradiction. If not, explain how the two strategies can be reconciled.

Answer: The two ideas don't really conflict. The retail clustering model refers to the clustering of sellers of similar, but not identical products typically owned by different owners. The argument goes that by forming a recognizable district, the district will attract more traffic (and more traffic to each member) than the individual stores would attract on their own. If clustering involved multiple stores of exactly the same product, the increase in business would likely be less than double the business of one store and so we are back to the problem that General Motors is trying to avoid.

2) (7 points) At any point in time, a typical firm will be considering a number of potential investment projects. Ultimately, it will borrow money to finance some of these projects but probably not all of them.

Below are the axes for the business sector's demand curve for bank loans to finance investment projects. In your bluebook, draw a complete version of this demand curve and use the concept of Internal Rate of Return to explain the graph's shape.

Bank Rate of
Interest (i)

Quantity of Project Loans
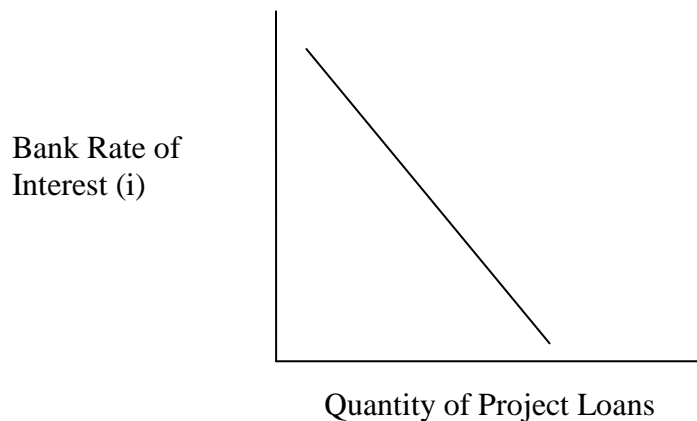
Answer: Basic investment criteria is to do the project if the project's internal rate of return (i.e. the interest rate the project pays on your money) is higher than the interest rate at which you can borrow money. Assume that firms are looking at a variety of potential project with a distribution of internal rates of return. As interest rates drop, more projects pass the IRR test and so demand for loans go up.

3) (8 points) In order to fulfill a two year contract to produce car doors, Ajax Metal Company needs to acquire a specialized stamping press. Because of the special nature of the press, Ajax has no use for the press after the contract is completed. It can acquire the press in either of two ways:

- Buy – Ajax can purchase the press today for $130,000. At the end of two years, when the contract is completed, it can sell it on the second-hand market for $90,000.

- Lease – Ajax can lease the machine for two years by making an immediate $32,000 payment and a second $32,000 payment at the end of the first year. The leasing company will take back the stamping press at the end of the second year.

Use appropriate calculations to explain which option you would choose if the interest rate were 7%. If the interest rate falls far enough below 7%, will you to change your mind? Explain your reasoning (no calculations necessary on this second part).

Answer (from Wanli):

Buying is cheaper.

If you buy, total cost would be: $51,391 = 130,000 – 90,000/1.07^2

If you lease, total cost would be: $61,907 = 32,000+32,000/1.07

No reduction in interest rate could change this: lower interest rate falls, the NPV of lease cost rises while the NPV of the purchase cost falls so you still want to buy:

4) (19 points) Composite floor tiles (like those in Building 9) are made by a number of firms in various parts of the U.S. One of these firms, Acme Tiles is located in Los Angeles. Currently, it produces an average 5,000 tiles per hour at an average cost of 50 cents per tile. Acme sells the tiles in the national market at an average price of 60 cents per tile. As a byproduct of the tiles, Acme's production process emits 1,400 particles of pollutant per cubic meter per hour.

Suppose City of Los Angeles basin has now established new air pollution controls that affect all producers.

Los Angeles authorities inform Acme that the marginal social cost of its emissions =
MSC(E) = 10E

Acme knows its marginal abatement cost of emission abatement is MCA(E) = 108 - 2E

where E is measured in hundreds of particles per cubic meter per hour and both costs are
measured in dollars/unit of E.

a) (7 points) Draw a graph that shows the Marginal Social Cost and Marginal Cost of
Abatement schedules (put dollars per E on the vertical axis and E on the horizontal axis).
By how much does Acme have to reduce its current emissions to reach the economically
efficient level of emission?
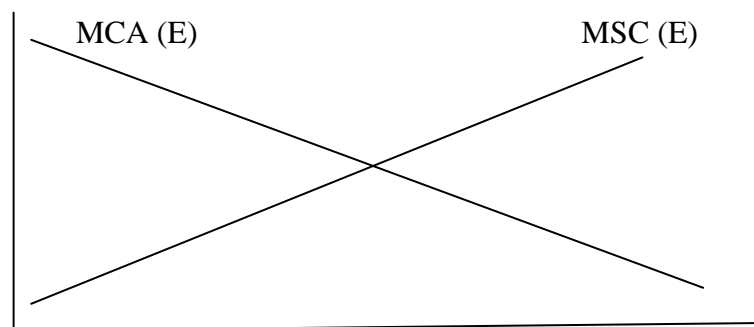
MCA (E)   MSC (E)

Economically efficient level of emissions is where MCA(E) = MSC (E)

Or 108 – 2E = 10E   or E = 9 or 900 particles per cubic meter per hour. So this means
Acme must reduce its emissions by (1,400 – 900) = 900 particles per hour.

b) (7 points) Assume the reduction in emissions will be achieved by imposing an
emissions tax on Acme. How large a tax ($/hour) is required to reduce Acme's emissions
to the economically efficient level? Is this tax enough to drive Acme's Los Angeles plant
out of business?

Answer: The tax will need to equal the MCA at 900 particles per hour = (108 – 18) =
$90/E

$90*E = $90*9 = $810 dollars. Profit that Acme makes in an hour = 5000*($.60 - $50) =
$500 so the tax does put this Acme plant out of business.

c) (5 points) Acme Tiles also has plants in other locations including downtown St. Louis,
the New Mexico desert, the outskirts of Minneapolis, etc. All these plants have identical
technologies. Can Acme achieve an economically efficient level of emissions in each

plant by removing the same amount of pollutants it has removed in Los Angeles? Briefly explain your reasoning.

Answer: While the technology and Marginal Abatement Cost may be similar across plants, the Marginal Social Cost will vary by location – i.e. it is likely to be lower in rural areas like the New Mexico Desert because there are fewer people. Hence the same emissions reduction will not be efficient at all sites.

5) (20 points) By coincidence, Louie and Stevie have both just moved to Brattleboro, Vt. with the intention of opening up pizza shops. The citizens of Brattleboro can't tell one pizza from another and their demand for pizza can be written:

$$P = \$20 - .02Q \quad (Q = \text{total quantity of pizzas sold per week by all producers})$$

Louie and Stevie both face Average Cost = Marginal Cost = $4.00/pizza.

a) (5 points) Having just met each other, Louie and Stevie strike a bargain in which each man will produce the same number of pizza's per week. Call that number X. Assuming they are interested in profit, what value of X should each man produce?

a) They jointly act like monopoly: $P = 20-0.02*2*X$ or $P = 20 – 0.04X$

$MR = 20 – 0.08X = 4$ we get $X = 200$, $P = 20-0.04*200 = \$12$, each of them make a profit of $\$1,600 = (12-4)*200$

b) (10 points) Is your solution in (a) stable? In particular, if Stevie believes Louie will keep producing X, will Stevie also produce X? If not, what number of pizzas will Stevie produce?

No. If Stevie believes L will keep producing X, the demand curve he faces becomes:

$P = 20-0.02*(200+Qs)$ or $P = 16-0.02Qs$; $MRs = 16-0.04Qs = 4$ so $Qs = 300$

$P = 20-0.02*500 = \$10$, Louie makes a profit of $\$1,200 = (10-4)*200$ and Stevie makes a profit of $\$1,800 = (10-4)*300$

c) (5 points) If Stevie does change his output, what is the largest amount per week that Louie would pay for Stevie to get out of town? Explain whether or not Stevie would take Louie's offer.

If Stevie get out of town, Louie will produce all the 400 pizza as calculated in question a) as a monopoly, and make a profit of $3,200, which is $2,000 more than that in question b). So he is willing to offer any price less than $2,000 to get Stevie out. Stevie is willing to accept any offer more than $1,800, so it is possible that he is willing to take the offer, i.e. an offer of $1,900.

6) (15 points) Sally and Jim are shipwrecked on a small island. When their ship broke up in a storm, they were each only able to save two goods: Apples and Hamburgers. In particular:

Sally has 12 Apples and 15 Hamburgers while Jim has 8 Apples and 10 Hamburgers.

Sally's utility function over the two goods is: U_S (A, H) = 6LN(A) + 8LN(H)

Jim's utility function over the two goods is: U_J (A, H) = 4LN(A) and 6LN(H)

Where LN( ) is the natural log function.

a) (5 points) Calculate the Marginal Rates of Substitution for both Sally and Jim.

Answer: If we think of Apples on the vertical axis, then the marginal rate of substitution for Sally can be written:

dA/dH = (6/A)/(8/H) = 6H/8A = 6*15/8*12 = 90/96 = .94

For Jim: dA/dH = 4H/6A = 4*10/6*8 = 40/48 = .83

b) (10 points) Using the concept of Marginal Rate of Substitution, explain why there are or are not potential trades between Sally and Jim that would make both people better off.

Answer: It would have been a better example if the two MRS were further apart but the basic idea still holds: Sally would give up .94 apples for a hamburger while Jim would accept .83 apples for a hamburger so there should be a trade between those two numbers – say .90 apples for 1 hamburger that makes them both better off.

7) (6 points) We have argued that while marginal cost pricing promotes economic efficiency but it is hard to apply to software where there are large, initial development costs but the marginal cost of producing another copy of the software is basically zero. The development costs help explain why, for example, Microsoft charges a significant price for *Office 2007*.

Google, on the other hand does charge marginal cost (i.e. zero) for most of its software including the use of its search engine, its desktop search program, etc. Explain briefly whether a high price for Microsoft Office and a zero price for most Google software both can be consistent with profit maximization.

Answer: Google uses its search software as a platform for advertising. The more people that use the software, the more they can make from advertising revenue and so it pays Google (in a profit maximization sense) to distribute the software freely. The only revenue Microsoft gets from a copy of Office is the sales price - no stream of follow-on revenue from advertising – so it has to make its money through the sales price.

8) (10 points) In the basic Keynesian model, the relationship between aggregate consumption spending, C_t , and aggregate income, Y_t is written:

$$C_t = a + bY_t \quad \text{where a and b are both positive constants and b}$$
$$\text{is the marginal propensity to consume}$$

In reality, this is a simplified function. Just as the demand for apples depends on more variables than just the price of apples (e.g. income, population, etc), current consumption spending depends on more variables than just current income.

In this recession as Y_t has fallen, the ratio of savings to Y_t has risen. Is this what the simple consumption function predicts? If not, what other variables might enter into the consumption function that could explain the increase in the proportion of income saved?

Answer: There are two obvious candidates. One is wealth or assets – the combination of the stock market plunge and the collapse of housing prices meant that people's net worth (e.g. for retirement) had fallen sharply. Higher current savings can be an attempt to build up some of those assets. The other is expectations about near term employment – if you feel that the recession endangers your job and income, you may want to build up increased savings as a kind of insurance plan.

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Table of Derivatives

If $y = a + bx$, then $dy/dx = b$ where a, b are constants

If $y = bx^c$, then $dy/dx = cbx^{c-1}$ where b and c are constants.

If $y = bLN(x)$, $dy/dx = b/x$, where b is a constant and LN ( ) the natural log function.

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