

11.202: Planning Economics

Section

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Rent Gradients and Land Use (von Thünen Model)

$R = q(p-c) - qtd$

$R =$ Rent per unit of land

$q =$ Output per unit of land

$p =$ Market price per unit of output

$c =$ Average production costs per unit of output

$t =$ Travel cost per unit of output and unit of distance from market (often expressed in miles)

$d =$ Distance from market

Assumptions:

- Lot size is fixed (like 1 acre lot size)
- All transactions occur at the central marketplace. No trading with other towns/regions/countries.
- The land surrounding the market is flat and of equal quality.
- The total cost of travel depends on 1) the good being transported and 2) the distance involved. Note that travel costs *per mile for the same good* are constant.
- The price of the crop can be held constant.

Assuming an infinite quantity of pumpkins is demanded at \$4

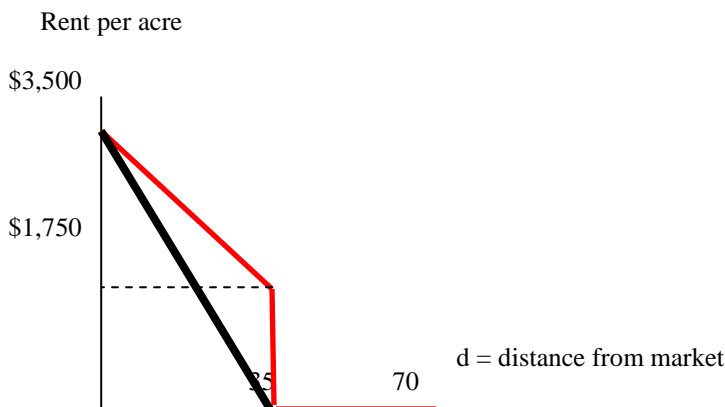
What happens when:

- travel costs rise to 35 cents per mile? (see dashed line... “city” of pumpkins shrinks to 10 miles)
- travel costs fall to 5 cents per mile? (see dotted line... “city” grows to 70 miles)

Assuming demand for land is fixed, with no more or less land demanded than 35 miles... let’s say exactly 35 miles worth of pumpkins is demanded at $P=\$4$, with no incentive to grow pumpkins beyond 35 miles, because no one would buy them.

What happens when:

- travel costs fall from 10 cents to 5 cents per mile?



See red line to left. Rent at the center ($d=0$) doesn’t change, since that group pays nothing for transportation. For those located at 35 miles, the price of transporting pumpkins falls from $(1,000 \text{ pumpkins} * 10 \text{ cents/mile} * 35 \text{ miles}) = \$3,500$ to $(1,000 \text{ pumpkins} * 5 \text{ cents/mile} * 35 \text{ miles}) = \$1,750$. Given that farmers still make $\$3,500$ after accounting for growing costs $[(\$4 - \$.50) * 1,000]$, this leaves $\$1,750$ for rent, which will go to the landlord as profit. Note that the slope of the budget constraint between 0 and 35 miles is the cost of transportation per mile ($\$50$, or $1,000 * \$0.05$)

Land Use Practice Problem

Review Questions 11.202

1. (11.202 Final Exam, 2002) Many cities from Sacramento to Boston have developed “Historic Preservation Districts” or “Old Towns” in which buildings retain the character and architectural style at the time the city was created.

a. Explain why such districts might be in the economic interest of both historic building owners and the city itself.

There are several potential correct answers here, but the clearest one may be that historic preservation improves the character of a neighborhood, thus bringing in tourists and new residents, which pushes up property values (good for existing owners) and increases tax revenue (good for the City).

b. We can assume that building owners, like any other entrepreneur, will seek to maximize profits. Explain why it does or does not follow that the building owners, operating through the private market, will be sufficient to create historic districts. Construct a prisoner’s dilemma game to illustrate your answer.

It’s unlikely that building owners will create historic districts on their own—that’s why we see government organized historic districts. Preservation is costly, and individual business owners probably don’t see much gain from their efforts unless a critical mass of neighbors engages in preservation. There’s also an incentive to free-ride. If not mandated to preserve your building, why not take advantage of the fact that others are doing the preservation and not contribute yourself?

For the prisoner’s dilemma, you could choose different numerical values, but the key is that the dominant strategy for you (and for others) should be to not preserve, and this results in both groups not preserving, which is inferior to having both groups preserve:

	Other Business Owner	
You	Preserve	Don’t Preserve
Preserve	(3,3)	(1,4)
Don’t Preserve	(4,1)	(2,2)

Where your outcomes are the first in each set of payoffs

c. Various jurisdictions have adopted tax incentives (for example, a 10 year reduction in a building’s property taxes) to encourage the formation of historic districts. Describe the benefits and problems in creating and administering a tax incentive of this kind.

So preservation generates positive externalities. The owners who engage in it do not get the full benefit from undertaking it (there are spillovers to others). So because of this, people will engage in less than the socially-optimal level of preservation. Subsidizing preservation through tax incentives means more preservation will occur, so that’s a benefit.

There are numerous potential problems. The most obvious is, how do we figure out what amount of subsidy to offer in order to get people to undertake the socially-optimal amount of preservation? This should be equal to the external benefit of preservation (difference between social benefit from preservation and the private benefit the individual receives). This is hard to measure!

2. (11.202 Final Exam, 2002) Consider the following statement:

“When a company calculates the net present value of a project, it discounts future revenues and costs by a bank’s rate of interest because that interest rate reflects the rate the company must pay for any borrowed money. In other words, for a project to be profitable, funds invested in the project need to grow faster than the company’s interest obligation to the bank. But in many cases, a company funds a project from its own funds and does not need to borrow any money. In those cases, since the company is supplying its own funding, the bank’s rate of interest is of no relevance as a discounting factor.”

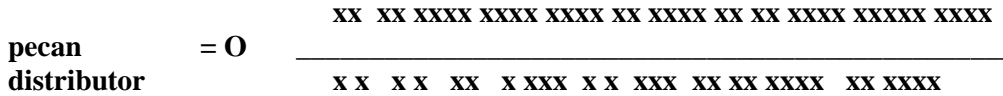
Explain which parts of the statement (if any) you agree with and which parts (if any) you disagree with.

Agree: “In other words, for a project to be profitable, funds invested in the project need to grow faster than the company’s interest obligation to the bank.” Clearly we want to earn a higher rate of return than what the bank’s charging us in interest, otherwise we would lose money!

Maybe disagree: “When a company calculates the net present value of a project, it discounts future revenues and costs by a bank’s rate of interest because that interest rate reflects the rate the company must pay for any borrowed money.” As we learned from Todd McGrath, the discount rate should reflect the opportunity cost of not being able to put that money in a similar project of comparable risk. If the opportunity cost involves not doing a project of high returns, perhaps it makes sense to use a higher discount rate, rather than the bank’s interest rate.

Definitely disagree: “But in many cases, a company funds a project from its own funds and does not need to borrow any money. In those cases, since the company is supplying its own funding, the bank’s rate of interest is of no relevance as a discounting factor.” This is incorrect. The company could also invest this money in another project. That is an opportunity cost, and the returns from the company’s project should be discounted using the rate of return it could expect from a similar project of comparable risk.

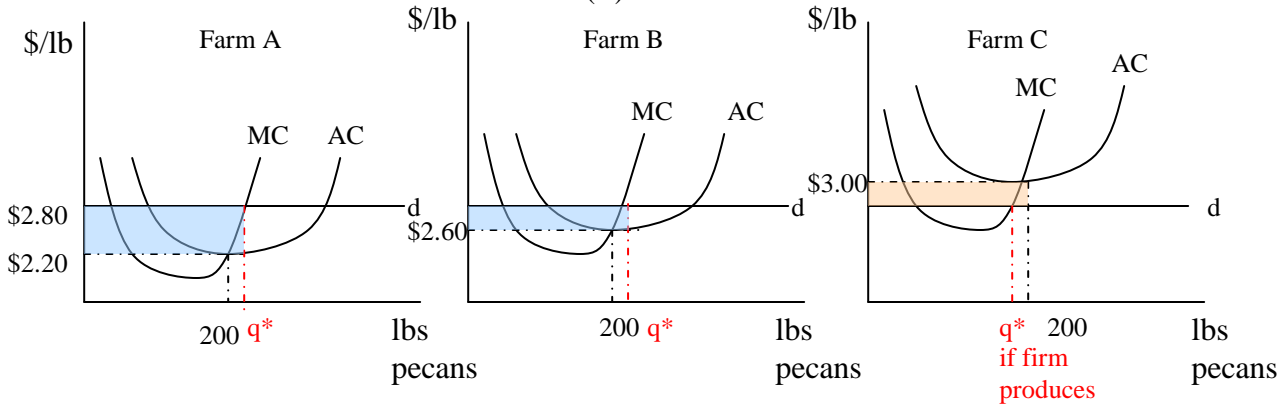
4. (11.202, ?) Pecans are produced in a number of locations across the country including Happy Valley, Georgia. In Happy Valley, pecans are produced by a set of small farms in perfect competition. Each farm has the same set of cost curves with average cost reaching a minimum of \$2.00 per pound at a quantity of 200 pounds of pecans. The farms are located along a small road (see sketch). If a farmer wants to sell pecans, she must drive them to the pecan distributor at the west end of the road. The cost of a trip is \$.10 cents per pound per mile. The distributor then sells the pecans to other parts of the country.



x = an individual farm

a) Today, the pecan distributor is buying farmers' output at today's national price of \$2.80 per pound. Assuming each farmer owns her own land, use standard diagrams to separately sketch the equilibrium position of each of these three farms, identifying profit if any:

- A farm that is 2 miles east of the market (A)
- A farm that is 6 miles east of the market. (B)
- A farm that is 10 miles east of the market. (C)



b) Suppose some of these farmers are approaching retirement age and would like to rent their land for others to farm. Explain the relationship between your answers in (a) and the amounts for which the three farms could be rented.

So when we take transportation costs into account, the min AC for the first farm (A) is at \$2.20/lb (\$2 general costs and 10 cents * 2 miles for transportation costs). For Farm B min AC = \$2.60/lb, and for Farm C min AC = \$3/lb. Firms produce the quantity where MC = p (which is the same as to say where MC = MR or where MC = d). For A and B, this quantity > 200. For C, it faces a loss if it produces. In the short run, it may produce < q* and face a loss, but in the long-run, if the price stays at \$2.80, it should exit. Profits shown in blue, loss in pink.

Farm A makes somewhere less than 60 cents profit per lb (less than 60 cents, since AC at q* is slightly higher than \$2.20/lb). Farm B makes somewhere less than 20 cents per lb. Farm C makes a loss. Because of this, rent should be highest for Farm A's lot, lower for Farm B's, and zero for Farm C's (assuming the only use for the land is growing pecans). In fact, even at a rent of \$0, if Farm C still faces \$3/lb in transportation and other non-rent costs, no pecans would be grown there.

c) Suppose that starting next week, the U.S. relaxes import restrictions so that anyone is free to import unlimited quantities of pecans at the world price of \$2.50 per pound. Explain how, if at all, these imports would change the potential rents you discussed in (b)?

Shift the demand curve for each firm down to \$2.50. This means now Farm B would also make a loss, since MC intersects the new demand curve at AC > \$2.50. This means no one would rent that lot (6 miles from the market). Farm A could still produce, but less profitably than when the market price was \$2.80/lb. Therefore, the value of the land falls, and it will be rented for less.

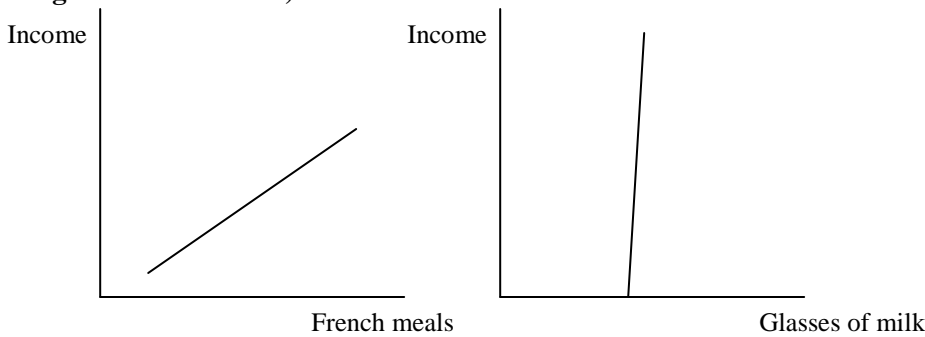
Review Questions for 11.203

8. (2009 Test-Out Exam) Consider an individual's utility function defined over two goods:

$$U = U(\text{Meals in a Fancy French Restaurant, Glasses of Whole Milk})$$

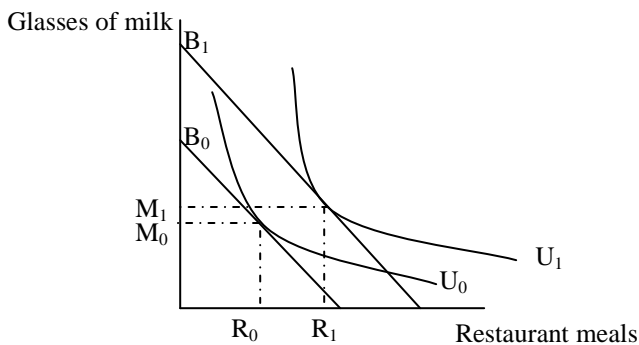
where both the restaurant meals and the glasses of milk are measured in units per month.

- a) Think about demand curves expressed in income rather than price. Draw two graphs. In the first graph, put the individual's income on the vertical axis and the quantity of meals in a Fancy French Restaurant on the horizontal axis. In the second graph, put the individual's income on the vertical axis and the number of Glasses of Whole Milk on the horizontal axis. (in both graphs, assume that the price of both goods are constant).



In the case of milk, you'd buy the same amount or maybe only a little more if your income increases.

- b) Draw a set of indifference curves and budget constraints that would give you the two "income demand curves" you have just drawn. Again, assume that prices of the two goods remain constant.



As your budget increases from B_0 to B_1 , restaurant meal consumption increases a lot (R_0 to R_1), whereas milk consumption increases very little.

- c) Consider a two-good utility function with the following property: the marginal rate of substitution between the two goods depends only on the ratio of the two goods. As long as the ratio of the two goods does not change, the marginal rate of substitution (i.e. the ratio of the marginal utilities) does not change. Explain why the utility function you have drawn in (b) is or is not compatible with this property.

The utility function drawn in (b) is incompatible with this property. We can see why in the diagram: we know that in the diagram, all the budget constraints are parallel, so that means that all the points of tangency should have the same marginal rate of substitution. But the tangencies represent very different ratios of meals to glasses of milk: glasses of milk are nearly constant at each of the tangency points, but meals rise a lot with income. Conversely, the budget constraints are parallel, let's say with slope M . So all indifference curves must have slope M at their points of tangency. But if having the same slope M requires the same ratio of meals to milk, this means that tangencies at higher incomes will mean both more meals and a comparable amount more milk—not the near constant amount of milk we have postulated.

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