EKN-812 Lecture 7

Competitive Equilibrium; Tax Incidence

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Outline

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- we want to bring together the two sides of product markets now
- this is our first formal encounter with the idea of "equilibrium"
  - the actions of suppliers and demanders must be consistent with each other
  - why aren't wages zero (as employers would like) or infinity (as workers would like?
- this lecture: mostly based on McCloskey (1985), Ch. 6 and Ch. 15

Competitive Equilibrium

Competitive Equilibrium

- in the market for a single good, a *competitive equilibrium* is a pair (p^*, q^*) such that
  - given prices, firms choose a quantity to supply $Q^S = S(p^*)$ where $S(p)$ is industry supply
  - given prices, consumers choose a quantity to demand $Q^D = D(p^*)$ where $D(p)$ is total demand
  - the market clears: $q^* = Q^S = Q^D$.
- for problems involving many markets simultaneously ("general equilibrium"), the definition will be similar
  - if you have not already seen this in your macro classes (or in a trade class), you will!

Supply and Demand

Supply and Demand

- in equilibrium:
  - everyone pays the same price; and
  - individual demands and firm supplies have to add up to the total quantity.
- these mundane facts have some (perhaps) surprising implications!
- example of rich buying up grain (in fixed supply, for simplicity) and re-selling it to the poor at half the price
  - who does this actually benefit?
  - see fig. 6.5 in McCloskey (1985)
- example: did the Colonial Stock Act have any effect on credit markets?
  - see fig. 6.6 in McCloskey (1985)
  - for comparison: what if UP (and UP alone) was forced to stop enrolling foreign students?
  - under what conditions would the law have had an effect?
    - Hint: what if trusts had constituted a "large" fraction of domestic supply? How large?

Supply and Demand: Extensions

Supply and Demand: Extensions

- we can sometimes analyze the relationship between multiple markets in a single diagram
- example: joint demand for mutton and wool
  - suppose a synthetic wool substitute is invented, and this reduces the demand for wool
  - what does this do to the price of *mutton*?
  - see fig. 6.9 of McCloskey (1985)

Rent Gradient Problem

- imagine a monocentric city
  - locations within the city are described by their distance $r \geq 0$ from the center
  - all jobs in the CBD (at location $r = 0$), and all people earn the same wage w
  - travel time from r is $t = \tau r$ for some given $\tau > 0$
  - workers take the housing price $R(r)$ as given
- what will determine where people live and how much rent they pay in different neighborhoods?
  - consumer's problem: $\max_{c,r} u(c)$ s.t. $c + R(r) \leq w[1 - \tau r]$
  - apply the boundary condition $R(\bar{r}) = \overline{R}$
    - $\overline{R}$ is some given "farmland" rent
    - this determines the physical size of the city in equilibrium

Rent Gradient Problem

- integrate the first-order condition $R'(r) = -w\tau$ to get:

$$R(r) - R(0) = -\int_0^r w\tau ds$$

  - what does the "rent gradient" look like?
  - how would an increase in w affect housing prices in expensive vs. cheaper areas?
  - what about changes in τ?
- notice, this is a "general equilibrium" model
  - meaning, we are determining the outcomes in many different markets simultaneously
  - the goods here are not just consumption, but also housing in the different (infinitely many) locations

Tax Incidence

Tax Incidence

- to think about the effects of taxes, we have to generalize our definition of an equilibrium
- define an equilibrium with a per-unit tax of t to be a triple (p_S^*, p_D^*, q^*) such that
  - given the price suppliers recieve, firms want to supply q^*: $q^* = S(p_S^*)$
  - given the price buyers pay, consumers demand q^*: $q^* = D(p_D^*)$
  - the difference between the supply price and the demand price is t: $p_D^* = p_S^* + t$

Tax Incidence

- the market clearing condition $S(p_S) \equiv D(p_S + t)$ has to hold at all t
  - so, we can differentiate with respect to t to see how changes in the tax affect market outcomes
  - we get
    $$S'(p) \times \frac{dp_S}{dt} = D'(p_s + t) \times \left[\frac{dp_S}{dt} + 1\right]$$
    which can be rearranged to read
    $$\frac{dp_S}{dt} = \frac{D'(p_S^* + t)}{S'(p_S^*) - D'(p_S^* + t)}$$
- if we multiply and divide by p_S^*/q^* and let $t \to 0$ (i.e. considering small taxes), we get
  $$\frac{dp_S^*}{dt} = \frac{-\varepsilon_D}{\varepsilon_S + \varepsilon_D}$$
  - here $\varepsilon_D = -p^* D'(p^*)/D(p^*) > 0$ is the elasticity of demand (evaluated at the no-tax equilibrium)

Tax Incidence

- implications:
  - the *legal* incidence of a tax is IRRELEVANT for its *economic* incidence
    - prices are free to adjust, so "who writes the check" doesn't matter
  - the more inelastic side of the market bears a greater fraction of the burden
    - usually the reason for highly elastic demand is that you have good alternatives!
  - what about on the supply side?
    - highly elastic supply could mean that marginal costs are close to constant
    - if so, you can't do much to force competitive firms' prices lower
- now, how does the imposition of the tax affect equilibrium quantities?
  - can read q^* off either demand or supply curves (why?)
  - we get that (for a small tax $t \approx 0$)

$$\frac{dq^*}{dt} = S'(p^*)\frac{dp_S}{dt} = \varepsilon_S \times \left(\frac{q^*}{p^*}\right) \times \left(\frac{-\varepsilon_D}{\varepsilon_S + \varepsilon_D}\right)$$

- notice that the quantity effects are larger when either ε_S or ε_D are large
  - by definition, high elasticity (on either side of the market) means that quantities are sensitive to prices

Tax Incidence

- what about the deadweight loss of the tax?
  - $DWL \approx \frac{1}{2} \times t \times dq^*$
  - using the previous results, this is

$$DWL \approx \frac{1}{2} \times \left(\frac{q^*}{p^*}\right) \times \left(\frac{\varepsilon_S \varepsilon_D}{\varepsilon_S + \varepsilon_D}\right) \times t^2$$

- both (or either) elasticity higher results in higher efficiency costs
  - corollary: may be optimal to tax inelastic goods
- deadweight loss is proportional to t^2
  - more efficient to spread taxes across many goods
  - in an intertemporal context:
    - may want to finance large expenditures (e.g. war) with debt
    - repay over a longer period instead of burdening just one generation with high taxes
- pre-existing distortions make the marginal burden worse
  - the "Harberger triangle" becomes a trapezoid
  - a corollary of the first point above!

References

McCloskey, Donald N. 1985. *The Applied Theory of Price*. 2nd ed. New York: Macmillan.