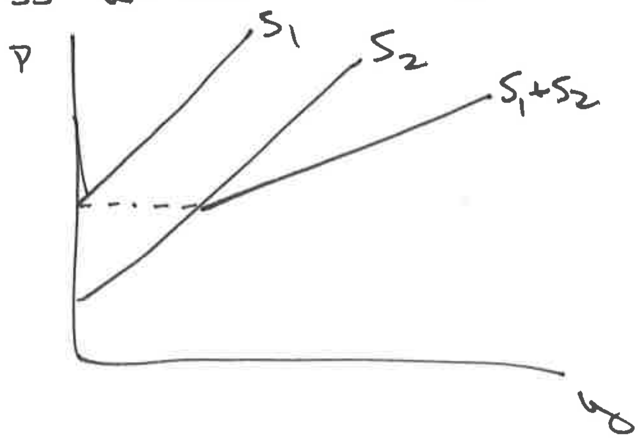
# Chapter 24 - Industry Supply

## Industry Supply - Short Run

- To find the industry supply in the short-run, simply sum the individual supply curves.
  - → If $S_i(p) = y_i$, the supply curve of firm i, then the industry supply curve is:

$$S(p) = \sum_{i=1}^{n} S_i(p)$$

→ so we are summing horizontally.




## Industry Eq'm - Short Run

→ Find where SR supply curve intersect market demand curve
  → this gives eq'm p and y

→ w/ this price we can go and find the profits and quantity produced by each firm in the market
  → Note - firms may produce even if profits negative in Short Run - just need to cover variable costs

Industry eq'm in the LR:

→ In long-run, all factors variable

→ So in LR, will never make negative profits – no factors are fixed, so would exit the industry if can't cover ~~fixed~~ costs

→ Also, in LR firms may enter industry

→ if there are no restrictions on entry, we say there is ~~[illegible]~~ free entry

→ if there are restrictions to entry, we say there are barriers to entry

→ what does free entry imply?

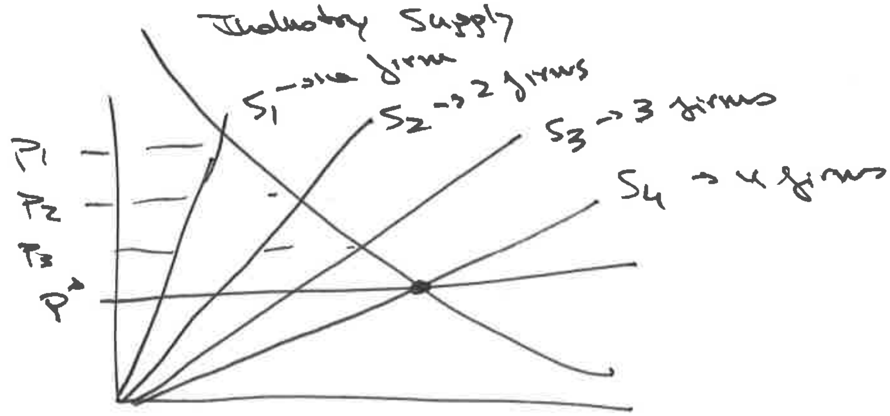
→ if positive profits, more firms enter

→ firms enter until profits zero

→ let $p^* = \frac{c(y^*)}{y^*}$ → the price that equals the min of avg cost

→ for a price $> \frac{c(y^*)}{y^*}$, profits $>0$

→ for a price $< \frac{c(y^*)}{y^*}$, profits $<0$




→ at prices $P_1, P_2, P_3$ → profits > 0

⇒ more firms enter

→ entry happens until $\pi$'s = 0 (w/ 4 firms in picture above)

## The Long Run Supply Curve

→ Think about fact that firms keep entering when profits positive

→ as they enter, price bid down

→ So w/ large # of firms (as we would have in competitive market), we can approx. the LR supply curve w/ a horizontal line at $p = \min(AC)$

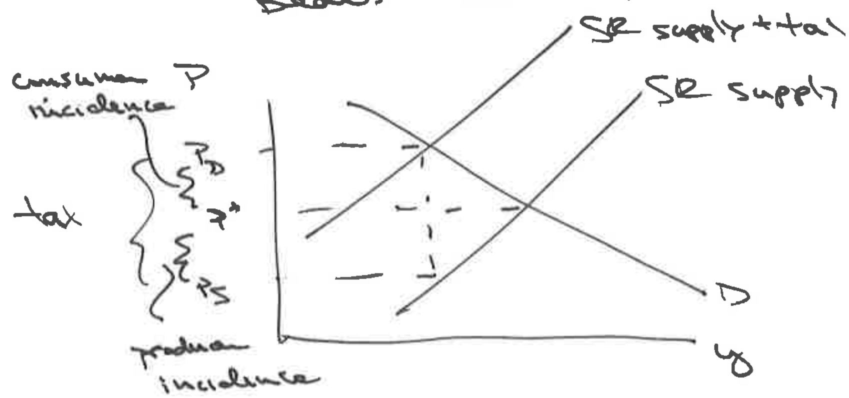
⇒ profits zero in LR

→ just like w/ CRS – profits zero when CRS, but free entry is like CRS for market – other firms replicate production process

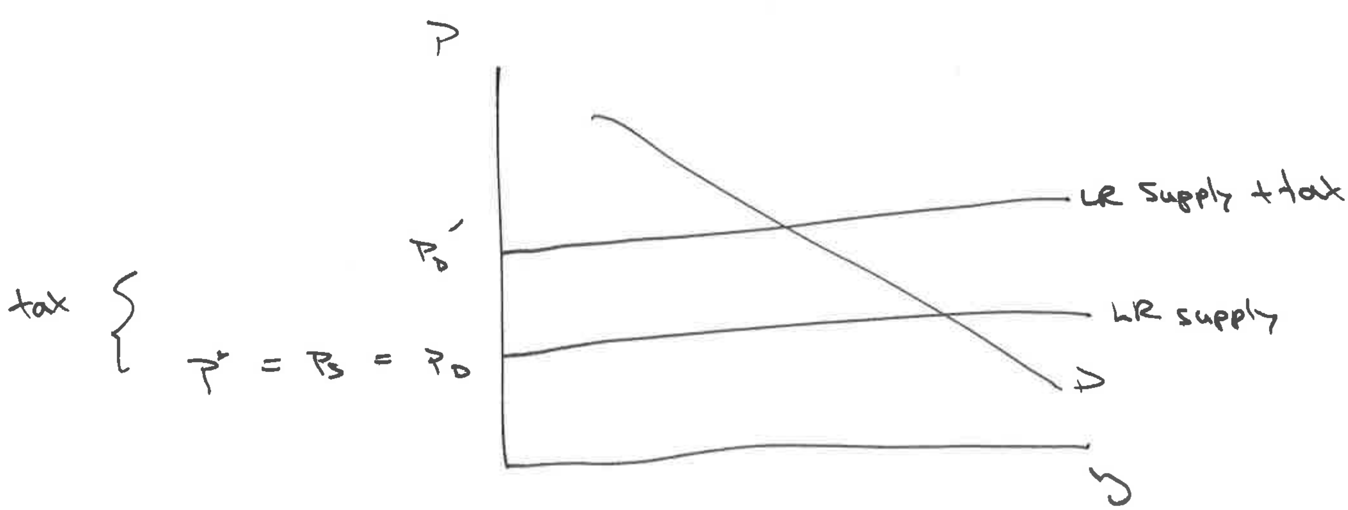
Implication of LR vs. SR - taxes

→ Who bears the economic burden of the tax?

→ we saw before, that the least elastic part of the market bears the majority of the burden




What about in LR?




→ consumer bears entire burden

→ b/c LR supply perfectly elastic

→ in LR firms exit until those remain make zero π after tax

→ when exit, price ↑

→ zero π at some point $P_S = \frac{c(y)}{y}$

price = min avg cost

## Profits

→ Zero profits mean all factors of production are paid their market rate of return
  → the market price ~~from~~ for these factors includes the opportunity cost

→ positive profits encourage entry
  → more entry bids up factor prices and bids down output prices
  → this happens until profits are zero (i.e. until there is no excess return)
    → Thus, profits provide exactly the right signals to market participants
      → if profit > 0, then people value outputs greater than inputs, so encouraging more resources here is a good thing - net economic value is created

## Profits w/ fixed factors of production

→ we argued that LR $\pi$'s = 0 w/ free entry
→ so what happens to $\pi$'s if there is a fixed factor of production?
  → no more free entry - factor fixed amount so not everyone can have (e.g. # of taxi cab licenses, miles of ocean front property, etc.)

- so are π's zero or not?
- yes, if count them the right way — the "right way" includes accounting for the payments to those fixed factors

→ ~~we call these payments economic rents~~

→ e.g. the amount ~~economic rents~~ earned by a taxi medallion are related to the price the medallion can be sold for

→ so counting these payments ~~the economic rents~~ earned by the fixed factor mean π's are zero even w/ fixed factors

→ There is still the threat of entry
- someone could buy the medallion from you
  - competition for the fixed factors bid up their price
    → this price represents an opp. cost in the ~~production function~~ profits of the firms holding the fixed factor
      → accounting for these costs drives π's to zero

## Economic Rent

→ economic rents are the payments to factors of production in excess of what is necessary for those fixed factors to be supplied

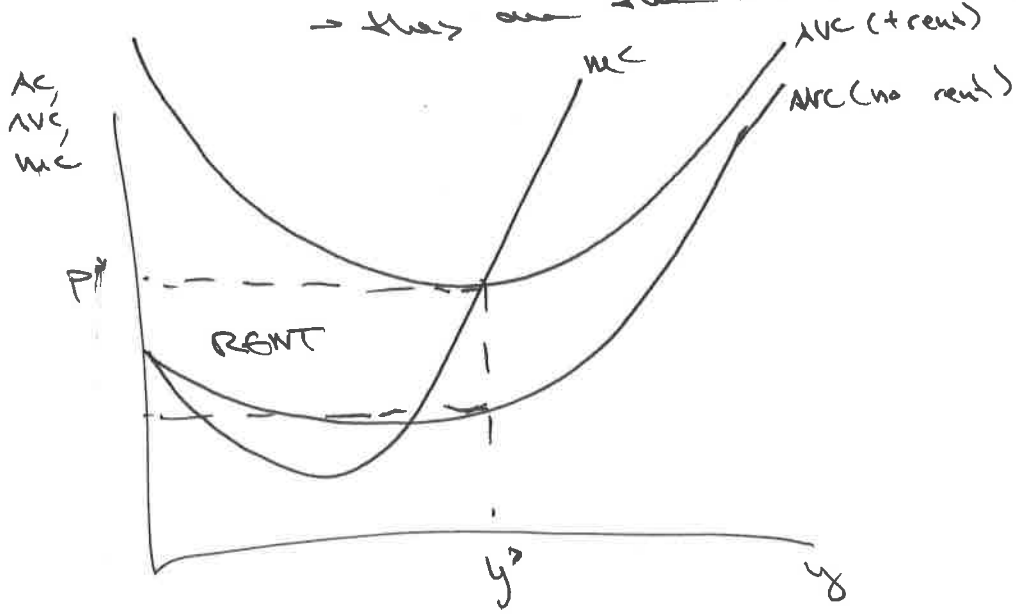
→ rents can thus be defined by the amount factors would need to be paid, in excess of their market cost, to drive profits to zero:

$$py^* - c_v(y^*) - \text{rent} = 0$$

$$\Rightarrow \text{rent} = py^* - c_v(y^*)$$

recall, this exactly same defn of producer surplus

→ they are the same concept




→ can also use just MC curve (as we did to find PS)

A problem w/ rents

→ "rent seeking" → when expend resources to try to acquire fixed factors of production
  → efforts expended and nothing new created - factors are in fixed supply

→ political problem - often happens when factors are in fixed supply due to legal restrictions
  → thus lobbying efforts to maintain rents
  → wasted effort can be quite large b/c each ~~firm~~ firm may ~~sp~~ expend amount up to size of rent could recieve/lose

An application of LR market Eq'm and economic rents → A carbon tax vs cap and trade

→ General agreement that something should be done to reduce carbon emissions.

→ There are several ways to do this:
  1) limit each producers emissions to $\frac{T}{n}$ (where T is target emissions + n the # of firms)
  2) Impose a tax so that eq'm emissions hit target T
  3) Give out permits that allow emissions w/ total amount of permits allowing emissions of T → and let firms trade permits.

→ why is (1) a bad idea?

→ b/c the cost of reducing emissions by some firms may be very high and by others it may be very low

→ so why would you want them to reduce by same amount?

→ But can't gov't then just make some reduce by more + others by less?

→ ok, but now gov't needs to know a lot more information – some of which really isn't even knowable

e.g. Solve

$$\min_{x_1, x_2} \; c_1(x_1) + c_2(x_2)$$

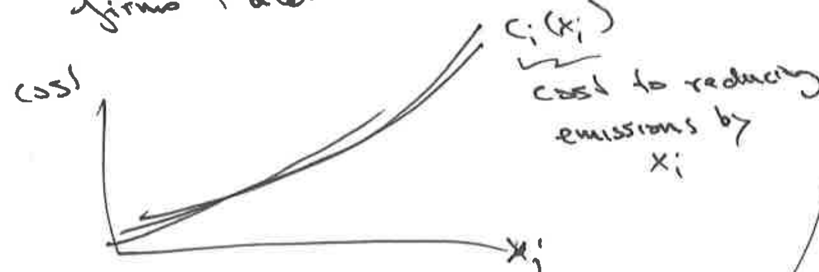
s.t. $x_1 + x_2 = T$

→ sol'n: $\frac{\partial c_1(x_1)}{\partial x_1} = \frac{\partial c_2(x_2)}{\partial x_2}$ → equal MCs

→ so lets focus on (2) + (3)

(2) ~~carbon tax~~

→ let $x_1, x_2$ be carbon emissions by firms 1 and 2




firm's p

(2) Carbon tax

Firm 1 problem

$$\min_{x_1} \; c_1(x_1) + t(\bar{x}_1 - x_1)$$

current emit ($\bar{x}_1$); reduction ($x_1$); tax rate per unit emit ($t$)

FOC: $\frac{\partial c_1(x_1)}{\partial x_1} - t = 0$

$$\Rightarrow t = \frac{\partial c_1(x_1)}{\partial x_1}$$

Firm 2 problem:

$$\min_{x_2} \; c_2(x_2) + t(\bar{x}_2 - x_2)$$

FOC

$$\frac{\partial c_2(x_2)}{\partial x_2} = t$$

$$\Rightarrow \frac{\partial c_1(x_1)}{\partial x_1} = t = \frac{\partial c_2(x_2)}{\partial x_2}$$

$$MC_1 = t = MC_2$$

now gov't just needs to adjust tax $t$ to right amt. and decentralized sol'n sets MC's equal to tax

→ get optimal outcome w/o gov't needing to know so much

(3) cap and trade

→ now suppose gov't sells permits to emit ~~(or giving them away)~~

~~→ permits allowed to be bought and sold~~

→ permits sold at price p:

→ firm 1 problem:

$$\min_{x_1} \; c(x_1) + p(\bar{x}_1 - x_1)$$

FOC: $\Rightarrow MC_1(x_1) = p$

→ same for firm 2

$\Rightarrow \; MC_1(x_1) = p = MC_2(x_2)$

now gov't can just adjust price p (e.g. by auction of permits) until total permits demanded = T

→ get optimal outcome w/o needing to know firm cost functions

→ very much like tax

→ could also give permits away + allow trade
→ trade creates price for permits and again get $MC_1(x_1) = p = MC_2(x_2)$