

Outline - Summary of Externality's Class

1) Introduction to externalities:

- Definition of Externality: An externality arises when a person engages in an activity that influences the welfare of someone else while neither paying nor receiving any compensation for that effect
- Types of externalities and some real-life examples:
 - positive (with welfare increasing effects and with external benefit)
 - negative (with welfare decreasing effects and with external costs)

2) How to model externalities:

New terminology:

- Private marginal benefit (PMB on D curve), Private marginal cost (SMC on S curve), EB: external benefit per unit, EC: external cost per unit.
- With positive externality we have EB, with negative we have EC and
 - $SMC = PMC + EC$, $SMB = PMB + EB$

How to graph social marginal curves: in class we saw 3 examples:

- No externality social and private curves were supply and demand
- Positive externality with $EB = 4$ we plotted SMB by adding 4 to each point in the demand curve, SMB looks like a D curve displaced by 4 units (above the D curve)
- Negative externality with $EC = 4$ we plotted SMC by adding 4 to each point in the supply curve, SMC looks like a S curve displaced by 4 units (above the S curve)

How to get free market allocation and efficient allocation

- Definition: efficient allocation is such that $SMC = SMB$ (quantity efficient $Q(\text{eff})$ is where SMC crosses SMB curve). Note before without externalities this happen in the free market allocation.
- Recall: free market allocation is such that $S=D$ (in the context of this class think $PMB=PMC$). Quantity of free market $Q(\text{fm})$ is where S crosses D curve.
- Recall first welfare theorem: the market by itself (FM) achieves efficiency ($Q(\text{eff})$)

In our examples:

- In case 1: $Q(\text{eff})=Q(\text{fm})=5$ first welfare theorem holds
- 2 positive externality: $Q(\text{eff}) = 7$ $Q(\text{fm})=5$. In the FM (when $q=5$) $SMC < SMB$ so FWT does not hold, $Q(\text{fm})$ is not efficient there is under production, why? Because $PMB < SMB$ so consumers don't internalize all the benefit from consuming

- 3. Negative externality: $Q(\text{eff}) = 3$ $Q(\text{fm})=5$. In the FM ($q=5$) $SMC > SMB$ so fm does not hold, $Q(\text{fm})$ is not efficient there is over production, why? Because $PMC < SMC$ so producers don't consider all the cost they are imposing. We can think of $SMC > SMB$ as the society as a whole is making "negative profit"

3) Welfare analysis with negative externality:

From previous discussion we know with externalities free market is not efficient. Next we did some welfare analysis to see this loss in efficiency

To do welfare analysis we need again more terminology now with externality:

- $TS = CS + PS + GS - \text{total external cost}$
- Total external cost = $EC * \text{quantity}$

Remark of DWL:

- before (without externalities) we said $DWL = TS(\text{free market}) - TS(\text{of some policy})$
- with no externality, because free market is efficient (as in case 1 above) this is exactly the same as saying $DWL = TS(\text{eff}) - TS(\text{of some policy})$ (eff means: efficient allocation)
- **now that we have externalities $DWL = TS(\text{eff}) - TS(\text{of other allocation})$ and the $TS(\text{eff})$ will not be the same as the $TS(\text{free market})$**

Analysis of welfare and negative externality

- We draw CS, PS, and total external cost with externality in FM allocation, $TS = 5$
- Next draw CS, PS and total ext cost if we were at the efficient allocation (where $q=3$, $p=7$) and $TS = 9$.
- So what the society is losing from producing at the free market instead of at the efficient allocation is $9 - 5 = 4$. **If you wish you can call this a DWL of being in the FM. (this was the triangle we got at the right of the fm equilibrium)**

Since FM is not pareto efficient, we would like to somehow be able to achieve the efficient allocation, can the government do anything to achieve efficiency? YES it can use tax, command and control, quota (among others).

4) Pigouvian tax

- As an instrument to achieve social efficient quantity
- Back to our example to get $Q(\text{EFF})=3$ we need $\text{tax}=4$
- Next we did welfare analysis first show how does welfare looked like without externality and a tax (in this case we had the usual dwl triangle at the left side of fm allocation)

- Next we said but here we have negative externality so this analysis is incomplete, we need to include the external cost (yellow rows of the welfare analysis table – slides) once we include the external cost, the tax is no longer causing a deadweight loss moreover is correcting the externality and achieving the efficient quantity so $TS = CS + PS + GS - \text{total external cost} = 9$ (the efficient one, the maximum TS we can have, if you want test different allocations to double check this)
- So if we compare the allocation with tax vs the allocation of the FM we can again see that in the FM $TS=5$ so again we can say dwl of free market is 4.
- But there is no DWL of using a tax because TS of efficient allocation is 9 the same as TS of this tax. Bottom line with pigouvian taxes (those that are the exact same size of the externality) there is no dwl and we can correct the problem of efficiency!!!

Other possible policies the government can implement to get the efficient quantity? Supply management control policies:

5) Command and control:

- A policy where the government sets a strict limit to the production of a good with externality. In reality in this policy the government sets a strict limit in the production of the externality itself not necessarily on the good, for example fuel efficiency standards on cars actually limit the amount of CO_2 of using a car.
- This is not a market based solution (the government is not using directly the market to get an outcome but imposing a particular allocation). This system is very similar to quotas without resale market, and we will have the same problem:
- Principle 2 of production might not hold: example: command and control policy: let each producer to produce at most 0.6 units each. Outcome will be $Q=3$ but S_1, S_2, S_3, S_4, S_5 will be producing – $Q=3$ is the efficient quantity however this is not pareto efficient since S_4 and S_5 are producing even though S_1-S_3 are not at full capacity.

6) Cap and Trade

- We define the system and explained it worked just as quota with exchange market
- We solved an example: again negative externality of 4 in econland, quota of 0.6 to S_1-S_5 . Then we used what we learned last week from quotas to get price of widgets = 7, quantity = 3 and price of quota = 4 (from the marginal producer)
- Map this back to cap and trade and we have welfare analysis $PS=16.5$ (12 from quota revenue, 4.5 from producers costs) $CS = 4.5$ and with externality this looks same as with tax but remember now the green box is of producers. So we achieve efficient quantity and after resales of allowances S_1-S_3 are producing so principle 2 holds.