Math Recitation #9– November 15, 2009

Topics to be covered:

I. Externalities
        a. Production
        b. Consumption
II. Pollution mitigation to internalize externality
III. Public Goods

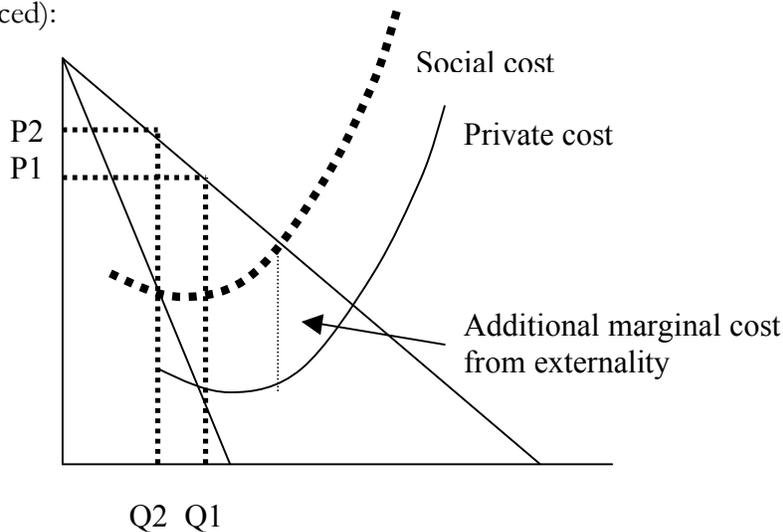## I. Externalities

Externalities occur if:

1) The price of a good isn't capturing the true benefit or cost
2) If there are gaps in the information producers and/or consumers have

Externality with production

Externality causes a higher social cost than what is being captured in the producer's costs. The producers aren't considering full social cost when making their production decisions. Therefore we have two different curves:
- Private cost
- Social cost

If it is a negative externality (i.e. polluting with emissions from a plant for every unit of power produced):

The difference between these two curves is the unaccounted for marginal cost (or marginal damage) of each unit produced (the externality).

If the externality can be monetized (a money value can be placed on it) then we can calculate the social cost curve. For example, say every unit of power produced emits 10 kg of

polluting material. If it takes $100 to clean 1kg of material, then it takes $1000 to clean the material produced from unit of production. Therefore the marginal cost associated with the externality is $1,000.

We can see that if the price and quanitity are arrived at by using the social cost curve instead of the private cost curve, we get:
1) a higher price (P2 >P1)
2) a lower quantity (Q2 < Q1)

Externality with consumption

An externality related to consumption results when the true benefit of the good isn't captured in the price. Therefore, because benefit is shown in the demand curve, we will have two demand curves:
social benefit curve
private benefit curve.
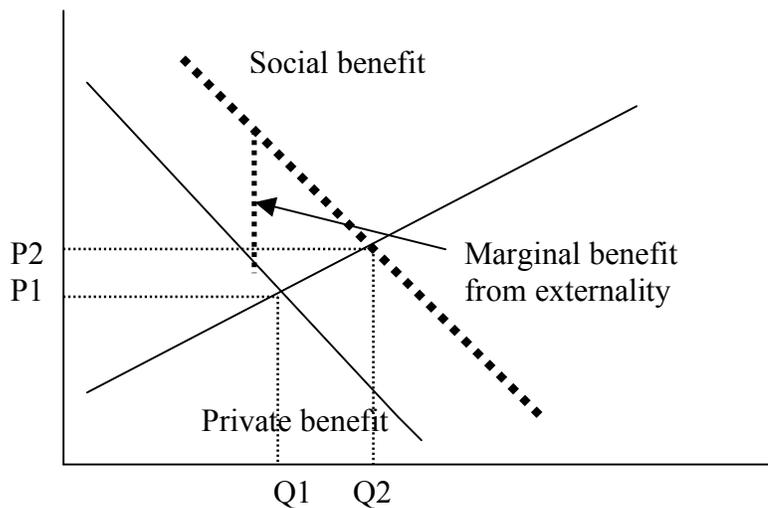
Benefit is reflected in the demand curve, therefore we have two different demand curves:
- Private beenfit
- Social benefit

Difference between thesetwo curves is the unaccounted for marginal benefit for each unit consumed.

We can see if the social benefit curve is used, the consumer will consume more

(Show four categories of things: positive with producion, negative with production, postitive with consumption, negative with consumption)

II. Pollution mitigation

Method 1:
Tax on pollution (Pigouvian tax)

To 'internalize' externality, a tax on polluting will cause the private cost curve to shift out to be equal to the social cost curve. A tax recognizes that the market out come is determined by the producer's perceived private cost curve, therefore a tax causes the producer to make decisions based on a curve that reflects the social cost.

The optimal tax will be the exact amount of the 'marginal damage' that is caused by each unit of production. The marginal damage is the distance between the private and social cost curves.
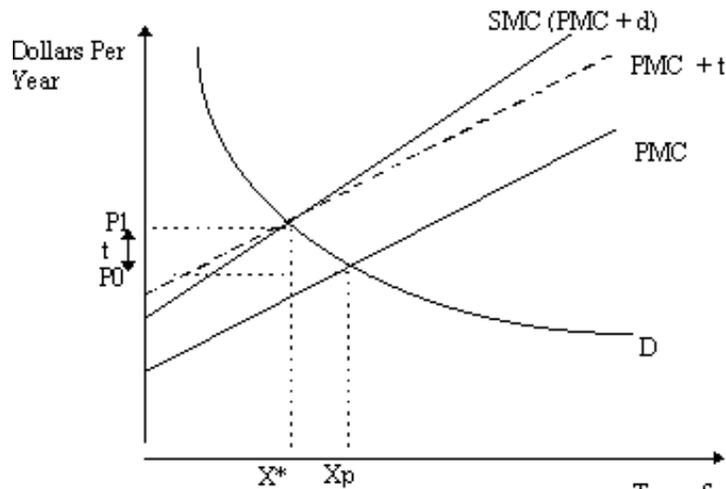

Problems with tax:
Marginal damage should be accurately calculated, the tax should reflect the real monetary value of the damage which can be difficult or expensive to determine

Method 2:
Regulation

Government can directly regulate the amounts of pollution a firm is allowed to produce. This may have the least transaction costs and seem fairly simple, however this may not have the most efficient outcome. If firms have different costs to mitigate pollution, it is not the most efficient solution to make each firm reduce their pollution by the same amount.
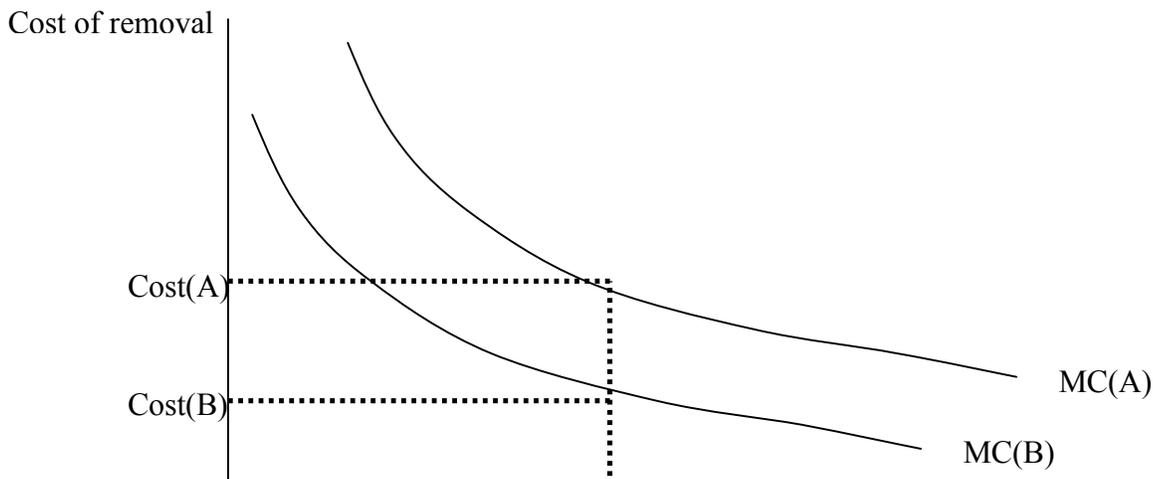
Firm A has higher costs associated with pollution removal than Firm B. If the required quantity reduction of pollution is 8 units and there are two firms, regulation would dictate that each firm has to remove 4 units. We can see that there is a lower cost way to remove 8 units of pollution. It would be difficult if not impossible for the government to know the individual marginal cost of removal curves for each firm and require that firm's remove different amounts of pollution based on these curves.

Method 3:
Cap and trade (trading permits)

This method solves the problem of regulation. It allows a market outcome that is both efficient and results in the desired level of pollution removal. A cap on total pollution by a firm is set and permits are made available for purchase which allow the firm to emit a unit of pollution.

A firm will purchase permits to pollute up until the point that the cost of the permit is equal to the cost of removing that unit of pollution.

If MC of removal > permit price → Firm buys permit
If MC of removal < permit price → Firm pays to remove pollution (doesn't buy permit)
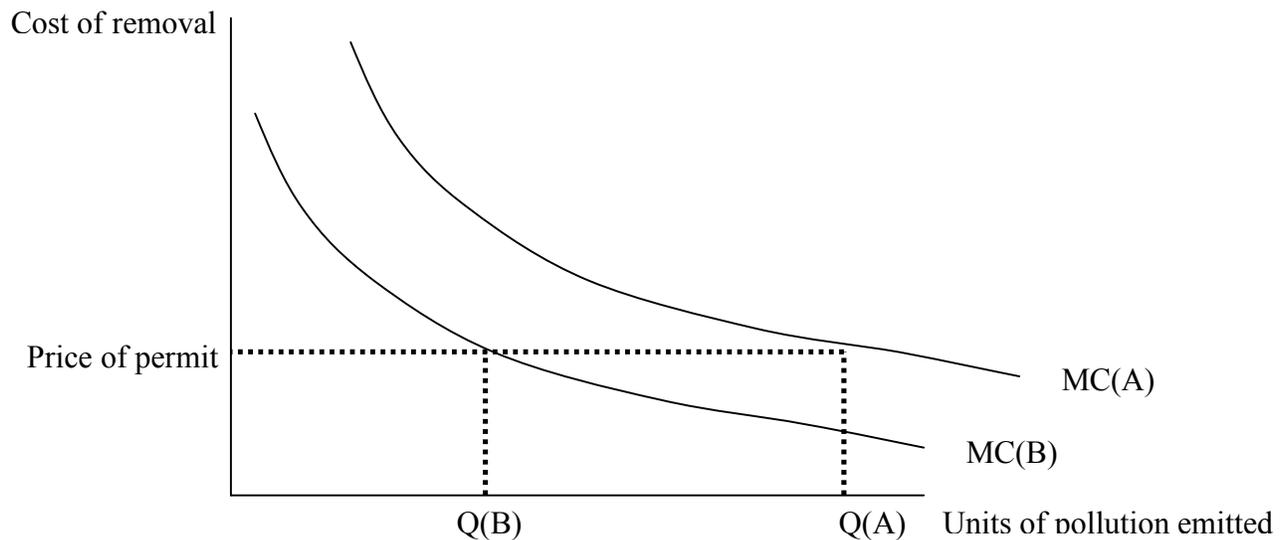
Firm with lower cost of abatement will end up removing more units of pollution and emitting less.

II. Public Goods

Private goods are:
1) Excludable
2) Rival

The 'market' demand for public goods is arrived at by adding individual demand curves vertically (adding prices not quantities).

PRIVATE GOOD:

PUBLIC GOOD:

$

$

Dt

D1 D2 Dt

D2

P=MC

MC

P2* D1

P1*

Q1* Q2* Q*=Q1*+Q2*

Quantity

Q2 Q*

Quantity
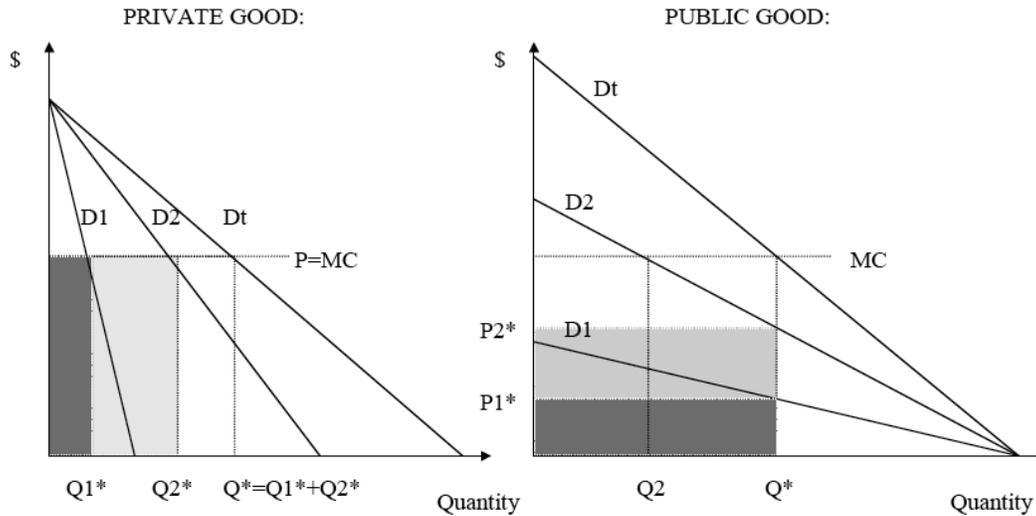
This is because in the market for a private good (that is excludable and rival) there is a market price that everyone faces, but at that price people value different amounts of the good.

In the market for a public good, individuals can't consume different amounts of the good because it is non-exludable and non-rival. Everyone is forced to consume the same amount of the good and therefore the price they value that amount at is different (hence adding prices rather than quantities).

Demand curve 1:
P=10-4Q
P=2-Q
P=12-2Q

Add prices to get market demand:
10-4Q + (2-Q) + (12-2Q) = 24 – 7Q

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