EC 471: Handout 7 -- Externalities and Taxes Solutions from Utilitarian and Paretian perspectives

I. Externalities: Definitions and Geometry

A. DEF: An **externality** occurs whenever a decision made by an individual or group has effects on others not involved in the decision.

- That is to say, an externality exists whenever some activity imposes spillover costs or benefits on other persons not directly involved in the activity being analyzed.

i. Generally, an activity that imposes *external losses* (costs) on third parties (at the margin) will be carried out at levels greater than that which maximizes the social net advantage from the activity.

a. This follows because the people who decide the level of the activity that gets carried out tend to focus only on their own costs and benefits.

b. [Note that this is a positive prediction about behavior--that spill over costs and benefits will be ignored by those controlling the activity.

ii. Generally, an activity that imposes *external benefits* on third parties at "the margin" will be carried out at levels below that which maximizes the social net advantage from the activity.

a. The production of pure public goods often tend to produce such external benefits. (why?)

b. Within environmental economics, polluters ignore spillover costs, while pollution controllers ignore spillover benefits associated with cleaning up.

B. Demonstrating the existence of externality "problems" requires a normative framework and assumptions (positive predictions) about how firms and consumers make decisions when there are spillover costs and/or benefits.

i. The problem from the point of view of welfare economics is not externalities themselves, but rather that **the wrong level (too much or too little) of the externality generating activity gets produced to maximize social net benefits**.

a. Consider, for example water pollution.

- Water pollution imposes costs on other users of a river or lake, and tends to be over produced.
- However, the optimal amount of pollution is not generally zero! The "optimal" amount of water pollution sets the marginal cost of cleaning up the pollution equal to the social marginal benefits of engaging in the polluting activity. (See the diagrams below.)

b. In nearly every case in which an *environmental problem* is claimed to exist-- the underlying "economic problem" is an externality problem.

ii. It bears noting that some activities generate external benefits for some people, but external costs for others.

- For example, some people might be allergic to the flowers planted under "b."

C. To find out (geometrically) whether an externality generating activity or output is over or under supplied, we first add the marginal benefit (or marginal cost curves) up to find the social marginal benefit (or cost) of the activity in question.

i. **An externality generating activity generates benefits or costs for a wide range of people simultaneously.**

ii. **So, the social marginal benefit and marginal cost curves for externality generating activities are "vertical" sums of the relevant individual and firm MB and MC curves**.

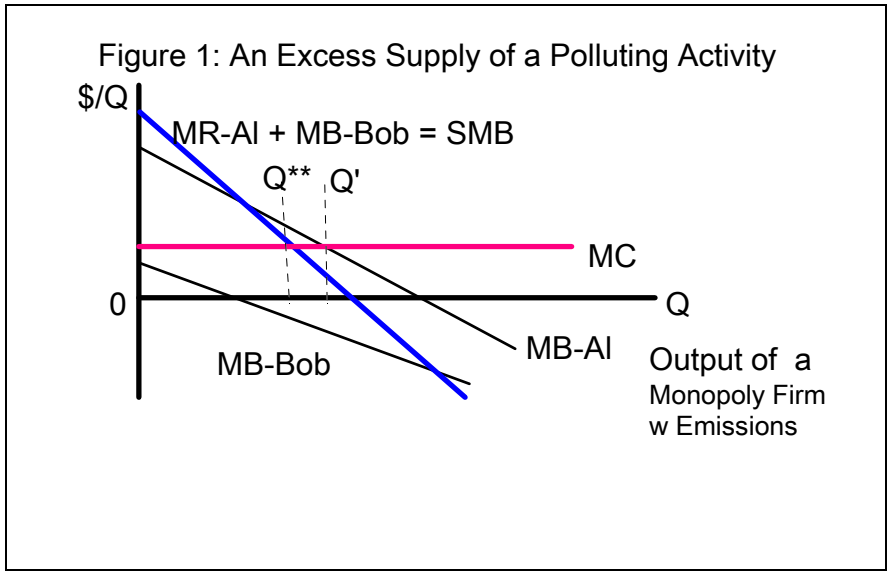
iii. The level of the activity that maximizes social net benefits is generally found where the social marginal benefit of the activity equals its social marginal cost curve.

- (Recall that net benefits are "normally" maximized where the relevant MB and MC curves intersect.)

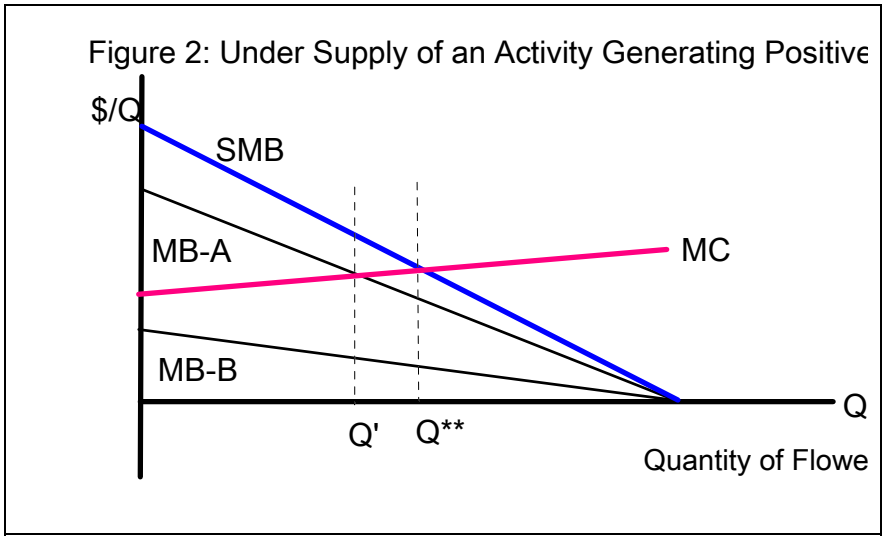
iv. For example, in Figure 1, note that at Al's preferred output level, Q', (the one that maximizes her own net benefits) there are spill over **costs** at the margin. Al's production makes Bob worse off *at the margin*.

a. Consequently, the activity being analyzed is provided at greater than optimal levels.

b. Q' is larger than Q**, the quantity where net social benefits are maximized.



D. In Figure 2, an activity with positive externalities (benefits) is depicted.



E. Note that the mere existence of an externality does not necessarily imply that there is an externality problem.

i. One may privately reach **the Pareto optimal level of an externality generating activity if there are no external benefits or costs at the margin** (e.g. at Q'), but in other cases some form of collective action will be required to "solve the externality problem."

ii. For example, marginal benefits or marginal costs may be zero at Q', as when an external marginal benefit for B is offset by an external marginal cost for A.

iii. [Depict such a case as an exercise.]

F. That external cost producing activities are over provided relative to that which maximize social net benefits, and that external benefit producing activities are under provided relative to that which maximizes social net benefits are simply useful rules of thumb.

i. It bears noting the the behavioral assumption may also be false in some circumstances.

ii. With respect to the latter, it bears noting that many **norms** for private conduct in social settings seem to have **evolved to solve** externality and free-riding problems.

- See for example, Axelrod (1981) or Congleton and Vanberg (1992).

iii. **A good deal of civil, criminal, regulatory, and environmental law appear to be attempts to solve externality problems.**

- (To the extent that these norms and laws work, externality problems will be smaller than predicted by public finance models. Indeed some externality problems can be solved by creating appropriate "property rights.")

II.Some Basic Mathematics of Externalities in Competitive Markets

A. There are several types of externalities associated with the normal operation of markets for pure private goods:

a. Pecuniary externalities: effects of changing relative prices on the value of individual holdings of wealth. (Automobiles impoverished buggy whip manufacturers.)

- Some scholars argue that pecuniary externalities are irrelevant--at least unavoidable if one uses markets for allocative choices. Are they?

b. Technological externalities: effects of one firm's (or consumer's) output decisions on the costs of other firms. (Effluent upstream increase the cost of drinking water down stream.)

c. Consumption externalities are the most studied.

- Consumption externalities occur when one person's activity(s) directly affects another person's utility level.
- Here the effect is directly included in an individual's utility function.
- (Al enjoys Bob's garden. Jane is made "ill" by Dick's red shirt, or choice of music, etc.)

d. [It also bears noting that public policy decision may impose externalities on persons similar to the ones listed. A public policy may affect relative prices, spur or retard the use of technology, or the production and use of a government service may affect the welfare of consumers of other goods.]

B. The essential mathematics of externality problems is quite straightforward:

i. Suppose that Al and Bob are neighbors, and that Al likes to barbecue steaks on a grill in his back yard. The resulting smoke affects both Al and Bob, neither of whom care for smoke.

a. Suppose that Al allocates time between cooking outside and inside, and for purposes of analysis that these are the only two uses of his time. Al's cooking time constraint is $T = I + O$.

b. The amount of smoke produced is $S = s(O)$, his output of barbecued food is $F=f(O)$ and of indoor food is $G = g(I)$.

c. Al's utility function is $U=u(F, G, S)$ with F and G being goods and S a bad.

d. Bobs decision calculus is not of particular interest so his welfare can be represented as $Ub = ub(K,S)$ where K is some other activity, held constant at this point (alternatively it could have been optimized various smoke levels).

ii. Substituting yields: $U = u(f(O), g(T-O),s(O))$

a. Differentiating with respect to O yields: $U_F F_O - U_G G_I + U_S S_O = 0$ at O*

b. Note that the last two terms represent the marginal cost of outside cooking. The first is AL's marginal benefit from barbecued food.

iii. The Pareto optimal level of barbecuing can be characterized using $W = w(U,Ub)$ where W is a social welfare function, U is Al's utility and Ub is Bob's utility.

a. Differentiating with respect to O yields

$$W_U [U_F F_O - U_G G_I + U_S S_O] + W_{Ub} Ub_S S_O = 0 \text{ at } O^{**}$$

b. Note that *only in the case where the last term is zero* does Al's private maximizing choice yield a Pareto optimal result.

- (Note that the terms in brackets characterizes Al's choice since these are Al's f. o. c. for his O*.)
- [Explain why we can use an "arbitrary" social welfare function to characterize a Pareto optimal state.]

III. Private Solutions to Externality Problems:

A. Do nothing

i. In some cases, the existence of an externality or pure public good may be compatible with Pareto efficiency or maximizing the net advantage from the activities in question.

ii. That is to say, there may not be a "Pareto relevant" externality at the margin even ignoring transactions costs.

iii. In other cases, nothing may be done because transactions costs are too great.

B. Privatization

i. In some cases, the reason for the externality is simply an improper specification of property rights.

ii. For example, commons problems involving non-circulating or readily identifiable resources such as land, can be addressed by granting a person, firm, or club exclusive rights to control the usage of the resource in question.

a. Privatization may solve such commons problem even if the "user rights" are not tradable, because *owners have no incentive to overuse their own resources.*

b. (Privatization is not, strictly speaking a private solution because it normally requires government intervention to characterize the rights and to enforce them—although once implemented such "user rights" require no more enforcement than other civil or criminal law.)

C. Coasian Contracts (Private Agreements)

i. In other settings, privatization may not be sufficient by itself to eliminate an externality problem, but it may be possible for the affected parties to contract with one another to solve the problem, given improved property rights.

ii. For example those affected by pollution may pay the polluter not to pollute.

iii. Alternatively, those wishing to engage in a negative externality producing activity (pollution) may pay those who will be affected by that pollution for the privilege.

iv. The Coase theorem (R H Coase 1960) says that if (a) property rights are well defined (or contracts enforced) and (b) transactions costs are negligible, then voluntary exchange can solve essentially all externality problems.

v. Moreover, in its strong form: if (c) there are no significant income (original endowment) effects, then the **final result tends to be the same regardless of the original assignment of property rights**

a. "a through c" is sometimes called the Coase theorem.

b. It bears noting that part "c" of the "Coase theorem" **requires the Pareto set to be composed of a single point,** which is often the case in our diagrams, where there is a unique output level that maximizes social net benefits. (Explain why will not be true in more general circumstances.)

D. An Intuitive Example.

i. Suppose that a factory, Acme, uses a production process that produces smoke along with its marketable output. The wind mostly comes out of the West so that the smoke fall mostly on homeowners who live East of the factory .

a. The **weak form of the Coase theorem** (a and b) suggests that voluntary exchange can be used to solve the externality problem. The home owners can band together and pay the firm to reduce its emissions either by reducing output or by using pollution control devices.

b. Gains to trade exist because at the margin, the firm realizes no profits from the last unit sold, but the home owners association is willing to pay a positive sum to get the firm to produce less.

c. Notice that very similar gains to trade would exist if the home owners initially had veto power over the firm's output. In this case, the firm would be willing to pay the home owner association for the privilege of producing its output and smoke.

d. Whenever transactions costs are small, contracts can be developed (trade can take place) that completely solve the externality problem in the sense that after the "Coasian contract" all gains from trade are realized, and net benefits are maximized.

ii. The **strong form of the Coase theorem** holds if transactions costs are low and there are no important income effects that arise from the assignment of control over the resource or activity of interest.

a. In such cases, Coasian contracts will always reach the same output level, insofar as there is a unique output that maximizes social net benefits--as it often is in our diagrams.

b. In this case, the **final outcome is the same no matter who controls the resources** after all gains from trade are realized!

c. (In other words, the gains to trade are exhausted at the same output level regardless of the initial assignment of control (property rights). For this and one other important insight about the nature of firms Ronald Coase won the Nobel Prize in economics.)

iii. The Coasian approach to externalities implies that essentially all externalities are reciprocal in the sense that who "creates" the externality depends on the original assignment of control.

a. In the case where the home owners association control the resource, their decision imposed large costs on Acme!

b. And vice versa. If Acme controls the output or activity level, then the home owners are made worse off.

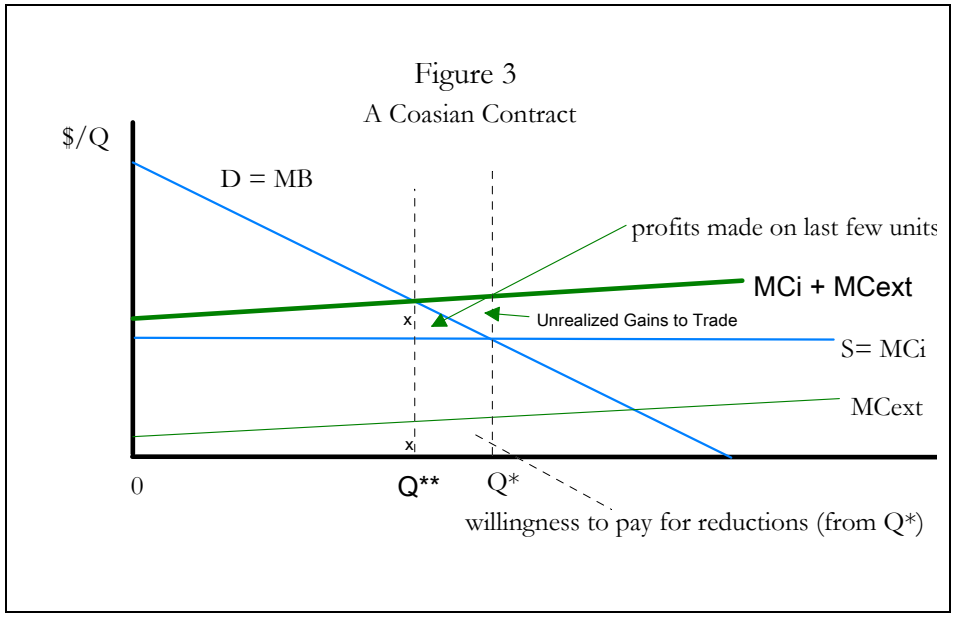
c. However, the process of exchange always makes both parties better off, given their original circumstances.

d. The original property rights assignment affects the direction of payments, although not the final output level in a Coasian world.

iv. An Illustration of the geometry of the Coase Theorem

a. Suppose that the firm, Acme, initially controls the output or emissions. In this case, in the absence of a Coasian Contract, the outcome will be an output that maximizes profits such as Q*.

b. Note that unrealized gains to trade exist at Q*. The home owners are willing to pay more for reductions in output than the firm earns as profits.



c. The last unit that the homeowners can afford to compensate the firm for "not to producing" is Q** where the marginal compensation required by the firm (the marginal profit labeled x) equals the willingness of the home owner association to pay for it (the marginal external cost labeled x).

v. **Note that the result is not changed by a reassignment of property rights**. Had the homeowner association initially had veto power over the firm's activity, they will set output at 0 in the absence of a Coasian contract. ("0" minimizes cost imposed on them by the firm.)

a. Clearly, gains to trade also exist in this case. The distance from the MR curve to the firm's MC curve is much larger than the size of the marginal external cost borne by home owners at 0.

b. The firm can, thus, compensate the homeowners for the costs imposed on them by its smoke on all units of output up to the point where Acme's willingness to pay for the privilege of producing more output exactly equals the amount required to compensate home owners at Q**.

c. In the case depicted, the strong form of the Coase theorem holds. The same output level occurs regardless whether the firm or the home owners initially control the emission or output level. (This counter intuitive result is why Ronald Coase won the Nobel prize in economics in 1991.)

d. (Of course, the flow of payments clearly differs! Acme prefer the first setting, and the homeowner's association prefer the second.)

IV. Collective Management of Externality Problems: Pigovian Taxes and Subsidies

A. Not all externality problems can be solved with changes in the assignment of property rights or Coasian contracts.

a. *Transactions costs may be very large,*

b. or the resources of interest might not be easily divided up and assigned to specific users.

c. In such cases, some form of *collective management* will be necessary to address externality problems.

B. There are **many possible collective management solutions** to externality problems.

- Elinor Ostrom (1991) is famous for her efforts to explore and catalog all the institutional solutions devised in the real world.

- That work earned her the Nobel Prise in Economics for 2009--a rare feat for a political scientist.
- We will, however, focus on solutions proposed by economists.

C. **Pigovian Taxes**, public finance as a method of "**internalizing**" externalities.

i. A **Pigovian tax** attempts to change incentives at the margin by imposing a tax (or subsidy) on the activity that generates the externality.

ii. Notice that if the externality producer bears all the costs associated with his or her activities, they will choose the Pareto efficient level of the activity.

- In such cases, there is effectively no externality, no neglected spillover costs borne (only) by others..

iii. A tax (or subsidy) is said to *internalize* the externality, if it makes the externality producer bear the full cost of his actions (at Q**).

- In principle, Pigovian tax schedules can have a variety of shapes, but for the purposes of this class we will assume that they are all "flat taxes" that assess the same tax on every unit of the product (or emission) produced.
- Pigovian taxes may yield substantial revenues although this is not their main purpose. *Their main purpose is to change behavior.*

D. In Figure 2 below, a typical externality problem is illustrated and then solved using a Pigovian tax.

i. Note that without a Pigovian tax, there are unrealized gains to trade (see triangle UGT) at Q*, between the firm and those affected by the externality.

- (This property is, of course, what made the Coase theorem operate.)

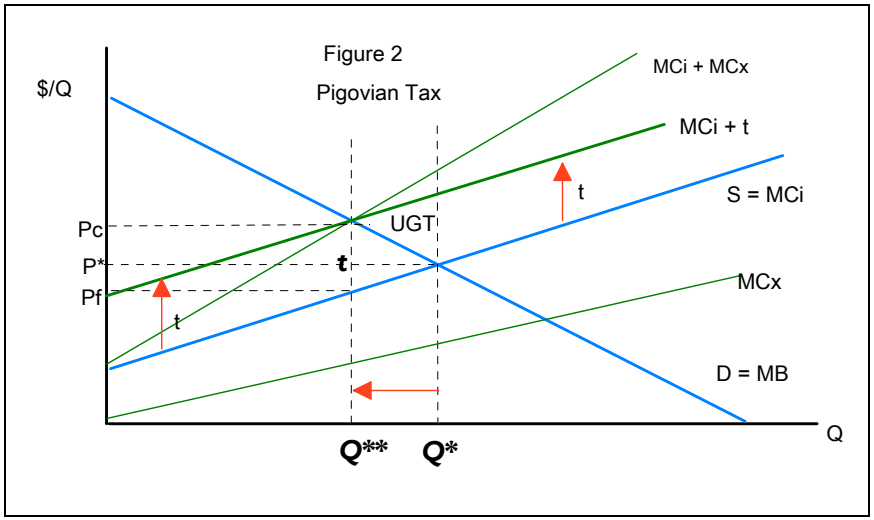
a. The external cost at Q** is the vertical distance from MC to the MC + MCx curve

b. This distance also represents the Pigovian tax that should be put on production to internalize the externality.

- The Pigovian tax is labeled "t."

c. If a tax of t dollars per unit is imposed on the firm's output (or emissions) the firm will now face a marginal cost for production equal to MC + t.

d. Given this new MC curve (which includes the tax that "internalizes" the externality) the firm will produce an output of Q**, the Pareto Efficient level.



ii. Note that Pigovian taxes allow all firms to independently adjust to the tax, which tends to imply that the burden of a Pigovian tax system is less than that associated with direct regulation.

- This is part of the reason that economists tend to "like" Pigovian taxes.
- They are also relatively easy to adjust if mistakes have been made about G**, and, as we will see next week, they have a relatively low excess. burden associated with them.
- Nonetheless, the tax burden required to achieve the desired level of the externality generating activity can be very large, which tends to make both consumers and firms in the taxed industry worse off.
- This tends to make Pigovian taxes politically unpopular.

iii. Imposing a Pigovian tax requires that the marginal external damages be estimated.

a. This may be possible at Q* , the output actually produced in the unregulated setting.

b. However this will be more difficult to do at Q** because Q** is not observed and has to be estimated using estimates of SMC and SMB.

E. **Pigovian Subsidies** are essentially similar to that of the Pigovian tax, except in this case the externality generating activity is under produced, and the subsidy attempts to encourage additional production.

i. Internalizing the externality in this case requires producers to take account of unnoticed benefits falling on others outside the decision of interest.

ii. [Draw a diagram that illustrates a positive externality and show how a subsidy can be used to induce Pareto optimal levels of the activity of interest.]

V.The Mathematics of Pigovian Taxation

A. In cases where an externality is generated by an activity, it will often be the case that the activity level will be set at levels that are not Pareto efficient.

B. The easiest way to demonstrate this mathematically is with a two person (group) illustration.

i. Suppose that Al and Bob are neighbors. Both own barbecues, and that neither enjoys the smell of smoke and such associated with the other use of their barbecue. Let us refer to Al as Mr. 1 and Bob as Mr. 2.

ii. Let $Ui = u_i(Ci, Bi, Bj)$ for each person i (here: i = 1, 2) with Ci being food cooked indoors and Bi being food cooked outdoors by i, and Bj being food cooked outdoors by the neighbor ($i \neq j$).

a. To make the model tractable, assume that Mr. I allocates his "kitchen time" Ti between cooking and barbecuing so that Ti = Ci + Bi for all i.

b. Mr I's barbecuing time can be determined by maximizing U subject to the time constraint. Substituting, the constraint into the objective function to eliminate Ci yields:

$$Ui = u_i(Ti - Bi, Bi, Bj).$$

c. Differentiating with Bi yields: $Ui_{Ci}(-1) + Ui_{Bi} = 0$.

- Each person will use the barbecue up to the point where the marginal cost in terms of reduced satisfaction from indoor cooking equals the marginal utility of further outdoor cooking.

iii. The implicit function theorem implies that $B_1^* = b_1(B_2, T_1)$.

- This can be interpreted as Mr I's best reply function.

a. In a Nash game between the two neighbors, equilibrium will occur when: $B_1^{**} = b_1(B_2^{**}, T_1)$ and $B_2^{**} = b_2(B_1^{**}, T_2)$

iv. The matter of whether this is Pareto Efficient or not is intuitively obvious. The question is whether or not Al or Bob could be made better off by coordinating their behavior or not.

a. One way to determine this is to show that a general social welfare function is maximized at by the relevant choices: e. g. whether the first order conditions are the same or not.

- [See above.]

b. Another method of characterizing the Pareto frontier without using a social welfare function can be taken from Baumol. This requires determining whether one person can be made better off at the Nash equilibrium without making the other worse off.

- For example: maximize $L = u_1(T_1-B_1^*, B_1^*, B_2^*) - \lambda(U_2 - u_2(T_2-B_2^*, B_2^*, B_2))$ by varying B_1 and B_2

- Differentiating with respect to B1 and B2, and appealing to the envelop theorem (to eliminate effects of B1* on B2* and vice versa) yields:

- $$U1_{C1}(-1) + U1_{B1} - \lambda\, U2_{B1} = 0$$
  and $$U1_{B2} - \lambda\, (U2_{C2}(1) + U2_{B2}) = 0$$

- Note that these first order conditions are different than those met for either person insofar as they imply that the externality will be internalized at the margin for both parties.

- [Draw a diagram of the Nash Equilibrium that demonstrates that too much of the externality generating activity had been produced.]

c. Note that a tax set equal to the spillover costs, generates the same output as the Pareto efficient one.

- (Once the externality is "internalized" both persons have "best reply functions" that induce the same behavior as required by the Pareto first order conditions.)

VI. Collective Management of Externality Problems: Creating Property Rights

A. The Pigovian approach essentially takes existing civil law for granted and simply attempts to change incentives at the margin in an appropriate way.

B. Another approach, and one that is more widely used--if not more widely praised by economists--is direct regulation.

i. Under direct regulation, a new law specifies a legally permissible output or service level, or specifies a new legally acceptable level of the externality.

ii. Anyone who produces more than the allowable amount will be subject to a fine.

- Such rules often eliminate a preexisting civil liberty or property right.

iii. Other laws create new duties, as with mandates of one kind or another.

- Environmental regulations often require fairly specific technologies and/or filing of reports with the EPA.

C. Direct regulation is the most widely used form of environmental control.

i. One problem with direct regulation relative is that it tends to be a relatively expensive method of controlling emissions.

- Some firms will over invest in emissions controls and others will under invest in emissions controls relative to the least cost method of achieving a given emissions level.

ii. Specifying SNB maximizing regulations require one to estimate the Net Benefit maximizing level of emissions.

iii. Enforcing a regulation requires some method of policing the new rules.

a. A cap or mandate is unlikely to change polluter decision unless it also changes their marginal costs or benefits from pollution.

b. That is to say, mandates have to be enforced in some way to have an effect.

c. This is often done with fines.

d. It is interesting to note that the fine associated with a direct regulations has some properties that are similar to those of a Pigovian tax.

- Expected marginal fines change the incentives of the externality producer to engage in the externality generating activity

D. Creating New Tradable Property Rights: Cap and Trade Systems (Tradable Emissions Permit Systems)

i. One way to avoid the worst effects of direct regulations and the high tax burden of Pigovian taxation is the creation of tradable emissions permits.

a. To do this, one first determines the Pareto efficient level of emissions, which "S" in the diagram below.

b. This establishes the number of permits that are or should be created.

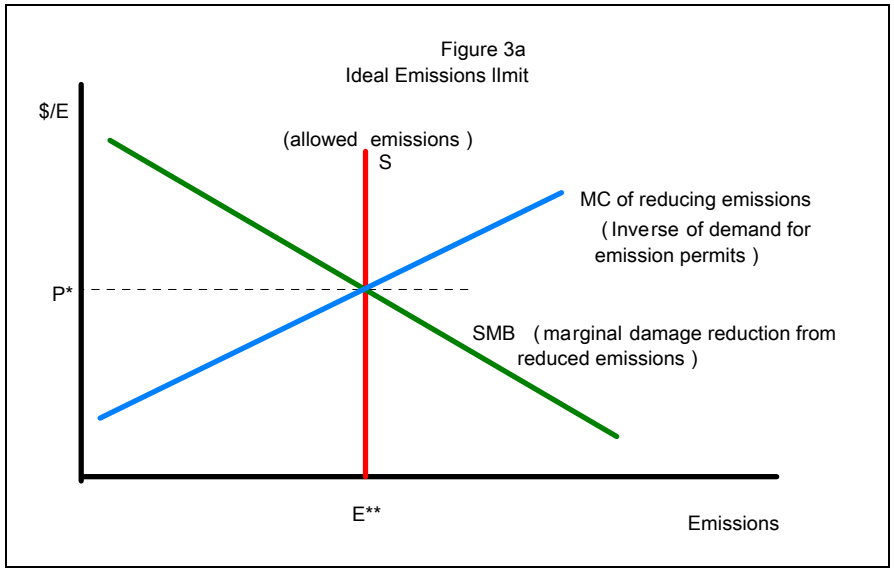
c. Then the regulator (EPA) distributes the permits.

d. Normally, permits are given to current externality generating firms, roughly in proportion to their current emissions.

- This method of distributing the permits is called "**grand fathering**," and is the most common allocation method.

e. Alternatively, the permits **could all be auctioned** off by the government--which generates revenues in a manner that makes such programs very similar to Pigovian taxes.

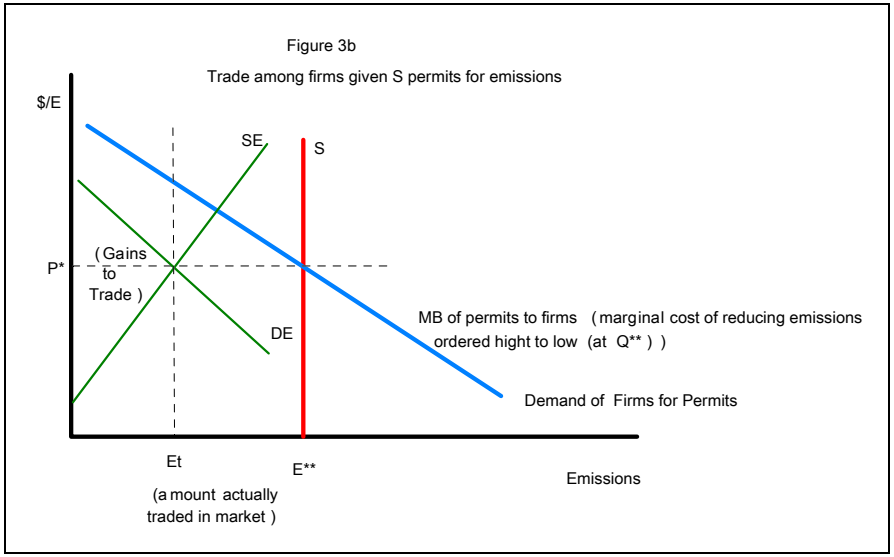
- (The Coase theorem implies that the actual distribution is not critical for success—explain why—although how the permits are initially distributed will have effects on the welfare of firms and consumers.)



ii. Firms can then buy and sell the permits given to them as a method of increasing their profits.
   a. Firms for which it is relatively costly to reduce emissions will attempt to buy more permits.
   b. Firms for which it is relatively easy to reduce emissions will attempt to sell them if the price paid for their permits is greater than their marginal cost of reducing emissions (by the amount allowed by a single permit).
   c. Supply and demand operate as usual, and prices will rise to clear the market.
   d. The **market price of a permit tends to equal the marginal cost of reducing emissions**.
   e. Note the "gains to trade" area in figure 3b.

iii. If the emissions levels have been set at Pareto efficient levels, the price of the permits will also equal the marginal benefit of the reducing emissions.
   a. In this case, an emissions market has effects that are very similar to those of a Pigovian tax, although there may be "distributional" differences because of trades possible under the permit system.
   b. Note that the prices of consumer goods that previously had benefited from lower production costs associated with using emissions to dispose of waste products will tend to rise.
      - Examples of emissions markets include tradable SO_2 permits and Carbon permits.
      - (Note that ordinary hunting and fishing permits are not tradable, and so are more like mandate (cap) systems than cap and trade systems.)

iv. Illustration: **A Market for Tradable Permits**
   a. Given a fixed supply of permits the market (the regulatory emissions target, S or E*) the price of permits will adjust to set supply equal to demand.



   b. The permits that firms actually purchase or sell in the permits market depends on their original "endowment" ("allocation" of permits) and their marginal cost of reducing emissions (marginal cost savings of using emissions as a disposal method).
   c. Under a "grand fathered" program, the permits are distributed to firms, without paying attention to their costs of cleaning up.
   d. As a consequence, some firms have an **"excess supply"** of permits, if at the market price, the can profit by selling permits

and reducing their own emissions through the purchase of emissions control devices or changes in production methods.

e. The SE curve characterizes the willingness of "low cost" firms to sell their "excess" permits.

f. Other "high cost" firms have an "**excess demand**" for permits, because they will wish to purchase more permits than they received under "grandfathering" whenever the market price it is cheaper for them than reducing their emissions.

g. The DE curve characterizes the willingness of such firms to purchase additional permits.

h. In equilibrium tradable permits induce relative large emissions reductions from firms who have production processes that are relatively inexpensive to "clean up," and relatively smaller emissions reductions from firms who have production processes that are relatively costly to "clean up."

i. The net sellers of permits are those that can clean up cheaply, the net purchasers are those who cannot.

j. In this manner, tradable permits can **greatly reduce the cost of reaching emissions targets** over ordinary emissions standards, while essentially guaranteeing a particular aggregate emission of the effluent of interest.

k. The **area labeled gains to trade represents the cost savings** from tradable permits over nontradable permits.

E. There is an interesting relationship between Pigovian taxes, effluent charges, and equilibrium permit costs under an ideal cap and trade systems.

i. If the emissions levels are set at the efficient level, then **the marginal cost of cleaning up (MCcu) must equal the marginal external benefit of cleaning up (MBcu)** at E**.

a. Note that P* in the permit market equals the **marginal cost of cleaning up** (under both auction and grandfathered cap and trade systems).

b. Since the MCcu = MBcu at Q*, this means that P*=M

c. A Pigovian tax on emissions will equal the **marginal external benefit** of cleaning up at the efficient emissions level (here E**).

ii. So, it turns out that the **Pigovian tax is the same as the price of permits** under an ideal cap and trade system! (P* = MCcu = MBcu = t at E*.)

a. There are, however, differences between an auction based program where the government sells off all the permits and a "grand-fathered" system in which the permits are given away.

b. An auction functions similar to a Pigovian tax in that it generates exactly the same revenue from firms (who will pass on part or all of the cost of the permits to consumers).

c. Grandfathering affects costs at the margin, but does not affect "inframarginal" costs, so firms tend to be better off (have higher profits) under a grandfathered system than under an auction system.

iii. There are other regulatory systems that have effects that are similar to a "cap and trade" system.

a. For example, "bubble emissions standards" have very similar effects at the level of firms, because they permit reductions to be made at least cost within the firm's "bubble" (total emissions), rather than mandating particular reductions for each emissions source.

b. Bubble emission standards for communities are a bit like a permit system, insofar as they allow firms to buy firms that are inexpensive to clean up and to count reductions in the emissions of such firms against the quota for the area.

c. However, the lack of a tradable permit makes it necessary to purchase firms or engage in novel contracts (analogous to Coasian contracts) when tends to have higher associated transactions costs than tradable permit systems.

F. It bears noting that the distribution of costs and benefits generated by these various regulatory schemes differ quite a bit.

- Consequently, there will be incentives for firms, consumers, and those affected by externalities to lobby in favor or against various specific forms of taxes and/or regulations.