I. Solutions to Externality and Commons Problems

A. Introduction

i. The previous two handouts demonstrate that environmental problems are special cases of what economists call "externality problems."

ii. This conclusion is based on three assumptions:

a. First, we assumed that people are more or less rational net-benefit maximisers. This allows us to model market demand and supply and to use information from supply and demand curves to estimate the marginal benefits that consumers and firms get from market transactions.

b. Second, we assume that external costs and external benefits are ignored by persons creating them in a variety of circumstances.

c. (Both the first two assumptions are positive claims about people and their behavior that can be tested in a variety of ways.)

d. Third, we assume that social net benefits (or Pareto efficiency) were the best norms for ranking social states. Given the social-net-benefit maximizing norm, we demonstrated that the existence of either (significant) spillover costs and benefits imply that some activities are over engaged in (polluting ones) and others are under engaged in (pollution reducing ones).

e. That is to say, normatively, externalities are problems if one wants to achieve Pareto efficiency or to maximize social net advantages from economic production.

iii. The same rational choice models, economic predictions, and norms can be used to shed light on the properties of alternative solutions to externality problems.

a. In some cases, incentives can be created (artificially) to encourage polluters and pollution reducers to take account of their spillover costs and benefits.

b. In some cases, mandates (emissions standards) might be adopted, in others new markets in "emissions rights" might be created.

c. In some cases, externalities and commons problems arise because laws defining "user rights" have been poorly drafted, rather than because of technological properties of the goods, services, or production methods of interest.

d. In such cases, new property rights or new forms of collective management can be created to manage common property or to monitor the performance of solutions.

iv. We now examine a variety of regulatory steps that can be undertaken to address commons and externality problems.

B. Do nothing

i. As noted in the lecture on externalities, not every externality or commons generates "Pareto relevant" problems.

a. In some cases, the existence of an externality may be compatible with Pareto efficiency and/or with maximizing the net advantage from the activities in question.

b. There may be no external costs of benefits at the "margin" (e.g. at Q*).

c. Or, the cost of creating and implementing a program may exceed the benefits obtain by addressing "small" externality problems.

d. In such cases, there may not be a method of making one person better off without making another worse off, or no method of increasing social net benefits.

ii. Thus, the absence of policies to address what superficially look like environmental problems does not necessarily imply "political failure," although it may.

a. A variety of laws already "on the books" may already adequately address the problems of interest.

b. (However, inaction may also be a sign of “political failure.”)

C. Creating Ownership Rights: Privatization of the Commons

i. Commons problems--overuse of a freely available resource--arise from unrestricted access to a productive (often natural) resource. So, most solutions to commons problems involve limiting access in some way.

ii. In such cases, the externality may simply be an improper specification of property rights.

iii. For example, commons problems involving non-circulating or readily identifiable resources such as land, can often be solved by dividing the resource up and granting persons, firms, or clubs exclusive rights to control the usage of "their" part of the resource in question.

a. Owners have incentives to exclude others from using their property whenever such use generates negative externalities.

b. Owners also, as net benefit maximizers, have incentives to maximize output (or more precisely their net benefits) from the things that they own.

c. It bears noting that ownership is actually a "bundle of rights."

d. Many early property right systems created "owner control" but not tradable property rights. These more limited forms of ownership were evidently adopted to address commons (and under investment) problems.

iv. Some commons problems **cannot** be addressed through privatization, because the nature of the good is such that an "owner" cannot easily exclude others from using "his" or "her" property.

a. For example, fish in the sea and molecules of air and water freely circulate.

b. Such things cannot easily be declared to be private property because particular units cannot be "tagged" and assigned to particular persons or groups.

c. Nonetheless, even such commons problems (b) can often be addressed by creating tradable or nontradable "**use rights**" for the communal resource in cases in which the communal resource cannot itself be privatized.

d. (Fishing licenses are an example of a nontradable use-right that helps to address the over fishing problem.)

v. Tradable use rights are arguably more efficient than un-tradable ones, because they allows gains to trade to be realized and provide other contractual means for solving a variety of commons problems. However, untradeable rights and user right systems are often sufficient to address commons problems.

vi. Some examples of privatizing wild animals are described at "privatizing wildlife."

vii. However, it is important to note that privatization is not the only method for solving commons problems (Elinor Ostrom [2009])

D. Coasian Contracts (Tradable Pollution Rights)

i. Ronald Coase won a Nobel prize [in 1991] for pointing out that private exchange can sometimes solve externality problems.

ii. His work suggests that in worlds with no transactions costs, externality problems only exist if some "property rights" are not tradable.

iii. The Coase theorem says that (a) as long as property rights are well defined (tradable and contracts enforced) and (b) transactions costs are negligible, then voluntary exchange can solve all externality problems.

a. Surprisingly, if 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.

b. In such cases, the original assignment of "use rights" is clearly not important.

c. (Unfortunately, as the number of persons involved increases, transactions costs tend to increase, and the original assignment of "use rights" tend to become an increasingly important determinant of the final outcome, and solving the externality problem through Coasian contracts becomes less likely.)

iv. Intuitive Example.

a. Suppose 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 .

b. The *weak form* of the Coase theorem (a and b) suggests that voluntary exchange can be used to solve the externality problem.

c. The home owners can band together and attempt to pay the firm to reduce its emissions either by reducing output or by using pollution control devices.

d. Gains to trade exist because at the margin, the firm realizes no profits from the last unit sold, but members of the home owners association are willing to pay a positive amount to get the firm to produce less smoke.

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

v. Notice that similar gains to trade would exist if the home owners initially had veto power over the firm's output.

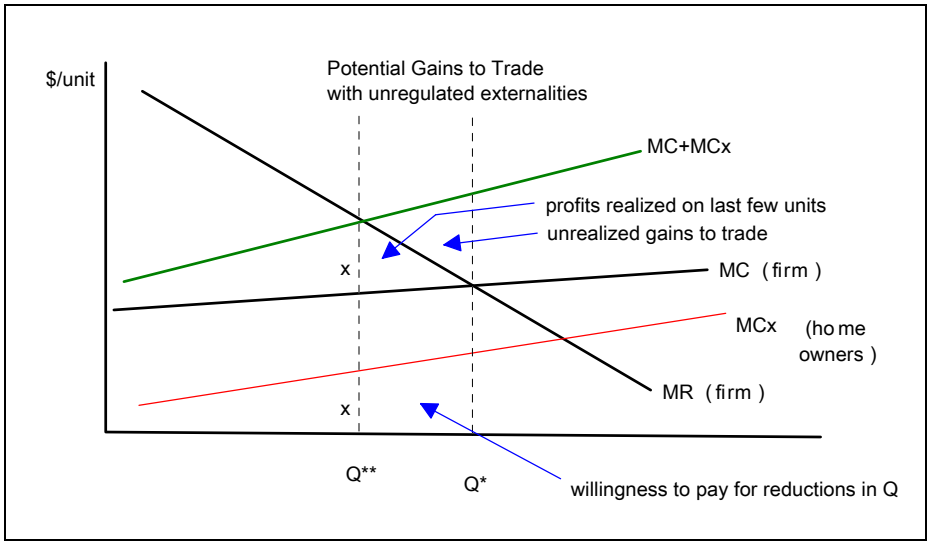
a. In this case, the initial output would be that that maximized the net benefits of homeowners, and the firm would be willing to pay the home owner association for the privilege of producing its output and smoke.

b. (See the class notes and the illustration below for more on Coases irrelevance of initial property rights result.)

vi. The following figure illustrates the essential geometry of the Coase Theorem

a. Suppose that a firm, here Acme, initially controls the output or emissions.

b. In this case, in the absence of a Coasian Contract, the outcome will be an output that maximizes profits such as Q*.



c. Acme does not have to pay to use air as a waste disposal method and will use it as long as its production costs can be reduced by doing so.

d. However, **using air to dispose of wastes is not really "free"** if it imposes costs on others that live down wind from Acme's factory.

e. 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.

f. Consumers are willing to pay more to have Acme reduce its emissions (at the margin) than Acme saves by using the air as a method of disposing of its waste products.

g. 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.

h. 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).

vii. In the reverse case, in which person's down wind can control whether Acme can use the air for waste disposal or not, the gains to trade run in the opposite direction.

a. Initially, consumers would set the allowed pollution level at zero, because they do not bear the costs of doing so.

b. In this case, however, the firm can compensate the homeowners for the damages imposed on them by its smoke.

c. Such gains from trade exist because Acme saves more from this mode of waste disposal (or gains more by selling its output) than consumers are damaged.

d. Such gains to trade exist for 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, that is until Q**.

viii. Note that, in this case, the **strong form** of the Coase theorem holds.

a. The same output level occurs regardless whether the firm or the home owners initially control the emission or output level.

- Surprisingly, the result is not changed by a reassignment of property rights.
- This counter-intuitive result is why Ronald Coase won the Nobel prize in economics in 1991.
- (Of course, the flow of payments clearly differs! Acme prefer the first setting, and the homeowner's association prefer the second.)

ix. The *strong form of the Coase theorem* applies when transactions costs are low and there are no important income effects (no shifts in MB curves) that arise from the assignment of control over the resource or activity of interest.

a. In that case, the Pareto efficient outcome tends to be unique and trade can reach that point no matter who has the property rights initially.

b. In such cases, exactly the same outcome is reached after all gains from trade are realized--regardless of the original assignment of control!

c. However, if income effects matter, the MR, MC, and Mcx curves will shift when the rights assignment changes, which will change the outcome.

d. (This possibility is ignored in Coase's original paper.)

x. 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.

- In the case where the home owners association controlled, their decision imposed large costs on Acme!
- However, the Coasian approach assumes that transactions costs are very low.
- It is hard to imagine all the folks affected by air pollution in Los Angeles, New York, or Washington banding together to negotiate with all the persons that produce the local air pollution.

II. Negative Externalities, Torts, and Civil Law

i. Environmental economic text books often forget that a good deal of civil law emerged to address a variety of long-standing externality problems.

a. Private property rights can solve many commons problems as noted above.

b. Contracts can solve many externality problems as suggested by Coase.

c. And, torts (lawsuits) can solve many others by making persons pay for damages imposed on others through their carelessness.

- For example, if your neighbor cuts down a tree on your property, you can sue him for damages in civil court and charge him with theft in criminal court. (This limits over cutting of forests.)
- Similarly, if he or she has a bon fire that damages your property in some way, whether from smoke or flame, one can sue for damages in civil court.
- Torts (lawsuits) normally induce tort feasors to pay for accidental damages imposed on others, which "internalizes" thost costs and causes them to exercise greater care.

ii. Intentional externality problems are also addressed through criminal law.
- Many intentional externalities illegal and punishable through, fines, jail sentences and obligations to pay damages.
- For example, a person that dumps toxic or other waste on your property may be punished in criminal court and in civil court.
- These change incentives for would-be dumpers to engage in that activity.

iii. Many local rules and regulations also address externality problems.
- For example, if your neighbor has a wild party next door that prevents you from sleeping, normally you can call the police and they will insist that your neighbor quiet down.
- Trash burning ordinances curtail smoke externalities within towns.

iv. However, as in the case of Coasian solutions, as the number of persons involved increases, ordinary civil law solutions tend to become problematic.

a. It would take a large number of tort cases to try poluters for their damage generating behavior, and the individual claims tend to be too small to make such suits worthwhile. (There are significant court costs associated with such trials.)

b. In cases in which damages are imposed on more than one person, "class action" suits are also possible.

c. On the other hand, it is essentially impossible to sue large groups who are jointly responsible for damages
- Such jointly caused damages are common in Environmental policy areas,
- as for example with automobile drivers and smog, utilities scattered among many states that cause acid rain, and air conditioner and refrigerator firms and customers who jointly thin the ozone layer.
- Such problems are normally beyond the scope of "ordinary" civil law to address.

v. Nonetheless, in many cases, the prospect of fines, jail time, and liability for damages causes persons to take at least some account of "spillover" costs that they might impose on their neighbors.
- As noted in the first lecture, **explicitly environmental law is only a subset of the laws that attempt to control the production of negative environmental externalities.**

III. Collective Management of Externality and Commons Problems: Use Rights and User Fees

i. Because of transactions costs, not all externality problems can be solved with torts, Coasian contracts, privatization of communal property, or ordinary criminal law.

a. It may be impossible for the resources of interest to be readily divided up and ownership given to specific users.

b. It may be difficult to assign guilt for a crime to specific individuals.

c. *(Political Transactions costs may also be very large to privatize, regulate, or fine those generating environmental externalities--but we'll ignore this until after the exam.)*

ii. In such cases, collective management may be easier (and less costly) to undertake than civil or criminal law solutions.

a. In such cases, some other **more direct or explicit** form of "collective management of a commons" or "environmental regulation" will be necessary to address externality and commons problems.

b. For example, a community (club or group of users) may impose user fees on persons who make use of the commons.

c. The example below illustrates how a commons problem can be solved through user fees.

- The dilemma is that both persons have incentives to over use the commons, here 3 head each is the Nash equilibrium

Commons Problems
Solution via User Fees (for more than 2 head)

Al / Bob	1 head	2 head	3 head
1 head	2, 2	1.5, 3.5	1, 4-F
2 head	3.5, 1.5	2.5, 2.5	1.25, 3-F
3 head	4-F, 1	3-F, 1.25	1.5-F, 1.5-F

- In this case the community decides to impose a user fee of amount F on herd sizes greater than 2.
- If the herd fee is set at the "right" level, it will solve the commons problem.
- The smallest fee that solves the problem is F=0.5, although any fee larger than 0.5 will work.

d. [As an exercise, find the new Nash equilibrium that emerges if the F=0.6. Is the result Pareto optimal or not? Explain.]

e. Note that such solutions are of ten used by private clubs and condo associations to solve commons and similar problems.

iii. We now turn to solutions that are more likely to be **governmental** efforts to address specific externality and commons problems, one at a time. (This is what most environmental text books mean by environmental regulation.)

A. Pigovian Taxes 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.

a. Notice that if the externality producer is subject to a tax equal to the marginal external cost (benefit) at the Pareto efficient level, the externality producer will now choose to produce the Pareto efficient output/effluent levels.

b. Unlike many other taxes and subsidies, Pigovian taxes are explicitly designed to affect behavior.

ii. Pigovian taxes may yield substantial revenues although this is not their main purpose.

- The main purpose of a Pigovian tax is to change behavior.
- (Revenues, however, may affect the political demand for such taxes.)

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

a. (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 excise taxes" that assess the same tax on every unit of the product (or emission) produced.

b. This allows some of the standard tools from public finance to be used to illustrate the effects of Pigovian taxes.

iv. The figure below illustrates how a Pigovian tax can be used to "solve" an externality problem.

a. The case illustrated is one in which production of a desired product produces a spillover cost.

b. The spillover damages are represented with the MCx curve.

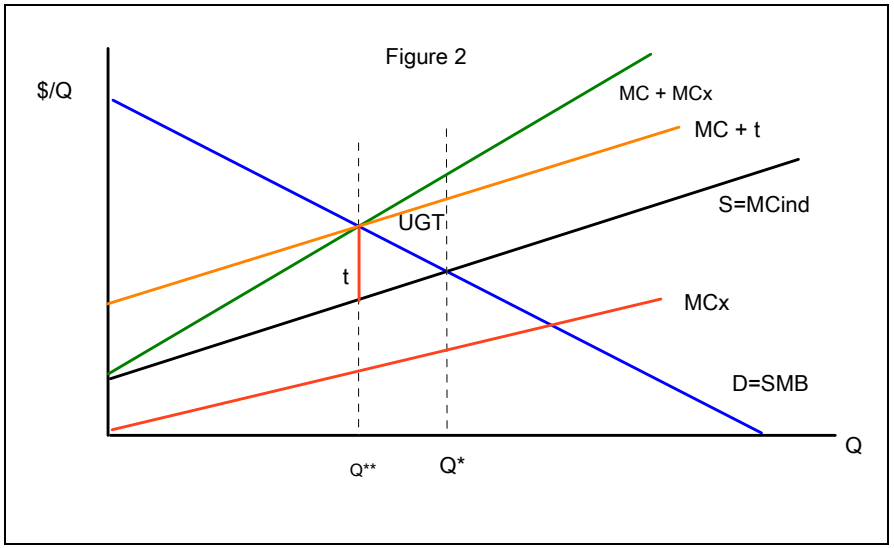
c. The Pigovian excise tax is amount "t," which equals MCx at quantity Q**.

d. (The diagram is complicated, but can be understood if one (i) finds the original equilibrium, Q*, (ii) finds the Pareto efficient quantity, Q**, and then (iii) tries to determine a tax that will change the market equilibrium from Q* to Q**.

e. Many of our "area" tools can be used to determine the benefits and costs for consumers, firms, and those affected by the externality.

f. They can also be used to illustrate the unrealized gains to trade that exist at Q*, the distribution of the burden of the Pigovian tax, and the revenues generated by the Pigovian tax

v. **Illustration of a Pigovian Tax**



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

a. The marginal external cost at Q** is the vertical distance from 0 to MCx which is the same as the distance from the MC to the MCind + MCx curve.

b. That distance is the ideal Pigovian tax, t.

c. Note that if a tax of t dollars per unit is imposed on the firm's output (or emissions) the industry (firms) now faces a marginal cost for production equal to MC + t.

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

e. A Pigovian tax can be put on either production or consumption of the good. In either case, it will internalize the externality.

f. Note that consumers and firms share the cost of that tax, as is often true of other excise taxes as well.

vii. All that is technically required to implement a Pigovian tax is a good estimate of marginal external damages at Q**.

viii. Note that in the case in which there are positive environmental externalities (as when persons or firms use pollution reducing equipment), the externality generating activity is under provided.

a. In this case, the Pigovian approach requires subsidizing the externality generating activity.

- That is to say, an external benefit rather than an external cost should be internalized.

b. The subsidy level should be equal to the spill over marginal benefits at the Pareto efficient output (Q** in our diagrams).

c. Pigovian subsidies can be drawn in a manner similar to that in the figure above for taxes, except the now one is looking for a place where the supply curve is "s" dollars above the demand curve.

- (see class notes)

ix. Pigovian taxes tend to minimize the cost of reaching an emissions target because firms can all adjust to the tax in a manner that minimizes their total production costs, although the tax burden required to achieve the desired emissions reduction may be very large.

x. **Mathematical Appendix:** One can also model Pigovian taxes and Pigovian subsidies algebraically.

a. For example, given supply function: $Q = aP$, demand function $Q = c - bP$, and external marginal cost function $D = dQ$, one can

find (i) the market equilibrium output, the Pareto efficient output, and (iii) the tax required.

b. To find the market equilibrium, find the price that sets supply equal to demand: aP= c-bP which implies that c = aP+bP and so P* = c/(a+b). Given this price, the market clearing quantity can be found by substituting P* into either the supply or demand function.

c. Finding the Pareto efficient (social net benefit maximizing) level is found in a similar way, but requires first calculating the social marginal cost curve (or social marginal benefit curve).

d. Recall that the social marginal costs curve is found by adding the marginal external damages curve to the industry's marginal cost curve. The industry cost curve can be found from its supply curve by solving for "P," which is P=Q/a in this case.

e. Adding the marginal external damage curve yields the social marginal cost curve: P = Q/a + dQ.

f. The algebra for finding Q** is easier if we solve the demand curve for P in terms of Q (social marginal benefit curve). Given Q = c - bP, social marginal benefits are in the "P" domain: (c - Q)/b = P.

g. To find the quantity where social marginal cost equals social marginal benefit (from the demand curve), thus, requires: Q/a + dQ = (c-Q)/b.

h. A bit of algebra yields: Q** = c / [b (1/a+ 1/b + d)]

i. The Pigovian tax is the **marginal** external damage at this quanity. The marginal damage function is D = dQ, so the Pigovian tax is just dQ**, which in this case is t = dc / [b (1/a+ 1/b + d)].

xi. **The diagrams solve all of this algebra very quickly and neatly.**

a. To apply a Pigovian solution in the real world, however, requires estimates of the supply, demand, and damage functions and the algebra above.

b. The diagrams illustrate how a Pigovian solution operates in principle, but one cannot determine the exact value of an ideal Pigovian tax or subsidy without accurate estimates of S, D, and MCx.

B. Regulating Environmental Risks and Damages through Direct Regulation of Emission, Output Mandates, and "Caps"

i. Under direct regulation, the law specifies a legally permissible output level or emissions rate.
- Anyone who produces more than the allowable amount will be subject to a fine.

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

iii. Direct regulation requires one to estimate the Net Benefit maximizing level of emissions.

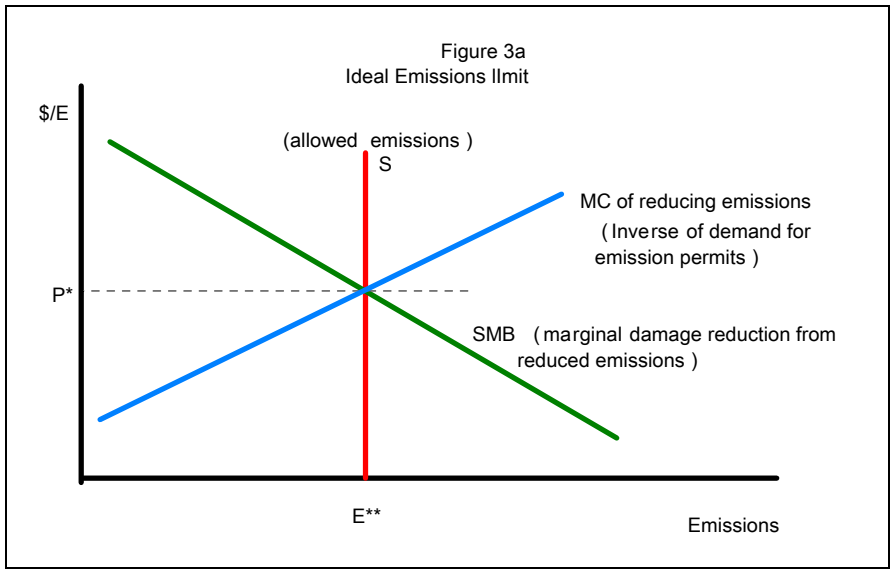
iv. Note that a cap or mandate is unlikely to change polluter decision unless it also changes their marginal costs or benefits from pollution.
- That is to say, mandates have to be enforced in some way to have an effect.
- This is often done with fines.
- It is interesting to note that the fine associated with a direct regulations has some properties that are similar to those of a Pigovian tax.
- (See the handout on probability of paying a fine.)
- Expected marginal fines change the incentives of the externality producer to engage in the externality generating activity

C. Cap and Trade Systems (Tradable Emissions Permits)

i. One way to avoid the worst effects of direct regulations and the high tax burdens 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.
   - This establishes the number of permits that are or should be created.

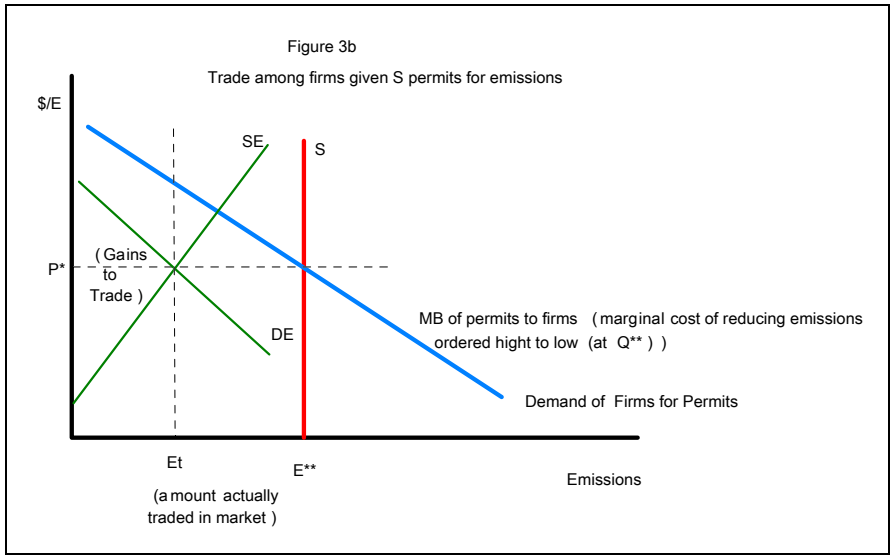
b. Then the regulator (EPA) distributes the permits.
   - Normally, permits are given to current externality generating firms, roughly in proportion to their current emissions.
   - This method of distributing the permits is called "**grand fathering**," and is the most common allocation method.
   - 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**.
      - 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.



v. The permits that firms actually purchase or sell in the permits market depend on their original "endowment" ("allocation" of permits) and their marginal cost of reducing emissions (marginal cost savings of using emissions as a disposal method).

a. Under a "grand fathered" program, the permits are distributed to firms, without paying attention to their costs of cleaning up.

b. 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.

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

c. 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.

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

vi. 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."

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

b. 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.

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

vii. Under an auction based system, the resale market tends to be smaller because each firm will tend to purchase only the quantity that make sense given their marginal clean up costs..

D. 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**.

- Note that P* in the permit market equals the **marginal cost of cleaning up** (under both auction and grandfathered cap and trade systems).
- Since the MCcu = MBcu at Q*, this means that P*=M
- 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*.)

iii. 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.

a. 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).

b. 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.

iv. 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.

- 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.
- 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.

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

i. 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.

ii. We take up the politics of environmental regulation after the midterm, which can only be understood, when one sees how different regulatory systems, taxes, etc. affect consumer and firm interests.