

## I. An Introduction to Externalities and Market Failures

- A. The first part of the course addressed how a governments efforts to raise its revenues and its associated pattern of expenditures affect “private” or “ordinary” market equilibria.
- i. It did so without explaining why governments might want to raise revenues or spend money in specific ways.
  - ii. It also did so under the assumption that the markets taxed or subsidized were competitive markets that produced no externalities and so tended to produce outputs that maximizes social net benefits.
    - From this perspective, both subsidies and taxes tended to reduce social net benefits and so had a dead weight loss associated with them.
- B. The next two blocks of the course addresses why democratic governments “need” revenue and why its spent in particular ways.
- i. The first block (handouts 5A and 5B) explore cases in which markets do not usually maximize social net benefits.
    - Two cases of special interest for public economics are (i) externalities and (ii) public goods problems.
    - In these cases, markets usually "fail" to produce the output of a good or service that maximize social net benefits.
    - Handout 5A covers externality problems and solutions. Handout 5B covers public goods problems and solutions.
  - ii. Many solution to such failures require governments to adopt policies to solve or reduce the problems.
    - If so, there are issues about the kinds of policies can address the problems of interest, and, issues concerning the types of policies that governments will actually address.

- iii. Handout 6 develops rational choice models of public policy formation using tools similar to those used to model market outcomes.
  - (One can think of the public choice block as exploring “government failures,” cases in which government policies fail to maximize social net benefits.)

## II. Externalities

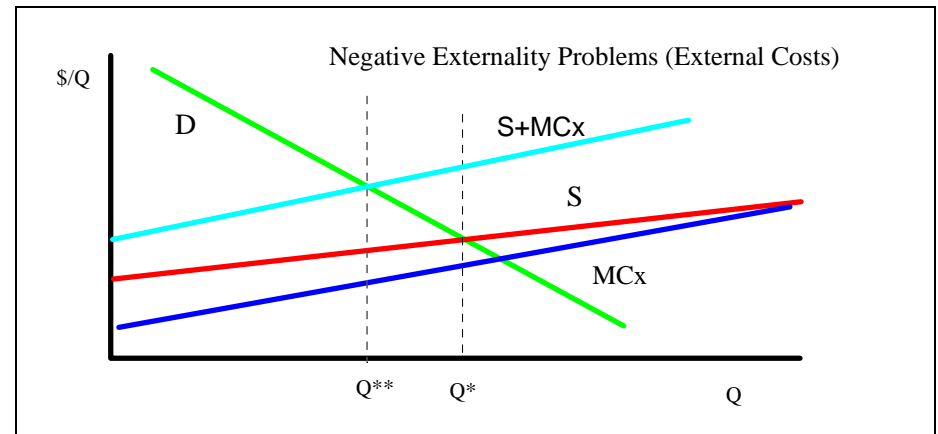
- A. DEF: An *externality* occurs whenever a decision made by an individual or group has effects on others not involved in the decision. That is to say, an externality exists whenever some activity imposes spillover costs or benefits on other persons not directly involved in the activity being analyzed.
- B. The existence of externality "problems" follows from the normative framework of welfare economics given these (positive) predictions about firms and consumers.
- 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.**
  - ii. Externality problems occur because individuals are assumed to be self interested and so tend to ignore spillover costs and benefits associated with their choices.
  - iii. As a consequence some relevant costs or benefits are not taken into account by firms and/or consumers.
- C. The **geometry of externalities** is fairly straight forwards.
- i. From the first part of the course, we know that market demand curves can be used to characterize the marginal benefits realized by consumers and the supply curve can be used to characterize the marginal cost of production for industry.

- ii. In the absence of externalities, these curves represent all relevant costs and benefits, so the demand curve can be used to represent social marginal benefits (SMB) and the supply curve can be used to represent social marginal costs (SMC).
  - iii. Social net benefits are maximized at the quantity where SMB equals SMC, which in the absence of externalities is the output produced by competitive markets.
  - iv. The existence of externalities implies that demand and supply curves no longer fully characterize social marginal benefits or social marginal costs.
  - v. In a supply and demand (market) diagram, we introduce a new curve to represent external marginal costs and/or external marginal benefits for the activity or product of interest.
  - vi. The predicted market outcome ( $Q^*$ ) is not affected by the existence of the new marginal external cost curve, because both firms and consumers are assumed to ignore the externality generated.
    - Markets still “clear” where  $Q^D(P^*) = Q^S(P^*)$
    - But the market output no longer maximizes social net benefits.
    - To show this we have to find the SMB and SMC curves.
- a. (This is actually a positive behavioral assumption or prediction, as noted above. Why?).

**D. Finding the SMC curve when there are external costs (negative externalities).**

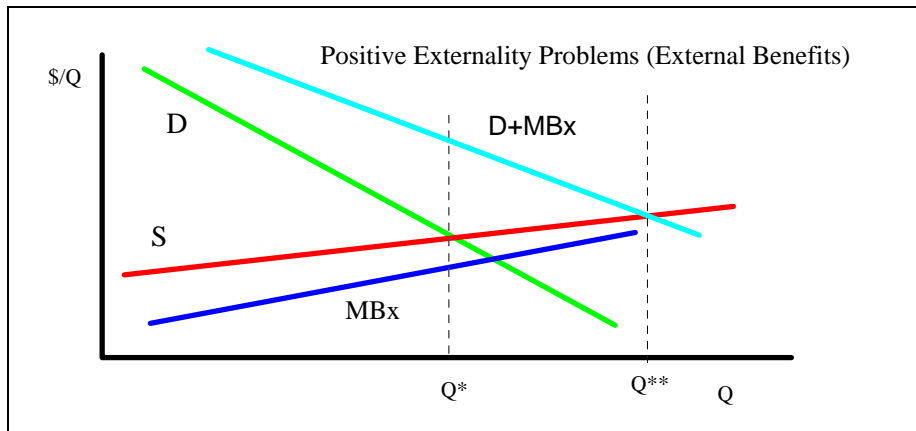
- i. Geometrically, there is a recipe or algorithm for finding the social marginal cost curve when there are external costs associated with production or consumption of a good or service.
- ii. To find the **social marginal cost curve** (SMC), when there are negative externalities (external costs)
  - a. First pick a quantity,  $q$ .
  - b. Find the marginal cost that market participants are taking account of (from the supply curve) and add the external marginal cost to it.

- Geometrically, this involves adding the **vertical distances** from the  $Q$  axis to the supply and the  $MC_x$  curves.
  - $SMC(q) = MC_{ind}(q) + MC_{ext}(q)$
- c. Repeat with another quantity (until the SMC curve is traced out).
- E. The level of the activity ( $Q^{**}$ ) that **maximizes social net benefits** is (generally) found where the social marginal benefit of the activity equals its social marginal cost curve.



- a.
    - i. If there are external marginal costs but not external marginal benefits, then the demand curve can be used as the SMB curve.
    - ii. Let  $Q^*$  denote the market equilibrium output and  $Q^{**}$  the quantity that maximizes social net benefits.
      - **If  $Q^*$  does not equal  $Q^{**}$ , there is an externality problem.**
      - (Social net benefits are not being maximized.)
- F. Finding the SMB curve when there are external benefits (positive externalities).
- i. The process of finding a social marginal benefit curve when there are positive externalities similar.

- ii. The demand curve represents the marginal benefits realized by consumers. To these marginal benefits we have to add the spillover marginal benefits realized by others (MBx).
  - iii. To find a **social marginal benefit curve** (SMB),
    - a. First pick a quantity, q.
    - b. Find the marginal benefit that market participants are taking account of (from the demand curve) and add the external (spillover) marginal benefits to it (from the MBx curve).
      - Geometrically, this involves adding the **vertical distances** from the Q axis to values on the respective curves.
      - $SMB(q) = MB_{con}(q) + MB_{ext}(q)$
    - c.
    - d. Repeat with another quantity (until the SMB curve is traced out).
- G. Illustration of the problem associated with positive externalities.

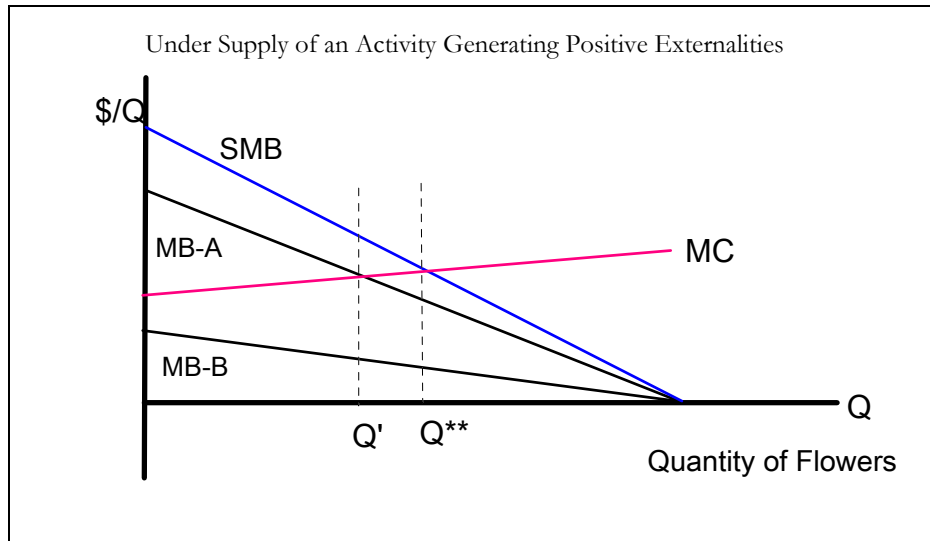


- i. The market output is found where the supply and demand cross, at  $Q^*$ .
- ii. There is an external benefit in the case illustrated, but not an external cost.

- iii. The social marginal benefit curve is found by adding the MBx and D curves (because the demand curve can be used as MB curve for consumers).
  - iv. There is no external cost, so  $SMC(Q) = MC_{ind}(Q) + 0$  which is can be represented with the supply curve.
  - v. Note that the SMC and SMB curves [S and D+MBx] cross at  $Q^{**}$ .
  - vi.
    - Since  $Q^*$  is not equal to  $Q^{**}$  there is an **externality problem**.
- H. Generally, any activity that imposes external losses (costs) on third parties at "the margin" will be carried out at levels greater than those which maximizes the social net advantage from the activity. Any activity that imposes external benefits on others will be undertaken at levels below those that maximize social net benefits.
- i. This is partly a positive prediction about behavior--that spill over costs and benefits are ignored by those controlling the activity.
    - [For example, within environmental economics, polluters ignore spillover costs, while pollution controllers ignore spillover benefits from cleaning up.]
    - Given that prediction, only cases where  $MB_x = MC_x = 0$  at  $Q^*$  will market outcomes maximize social net benefits.
    - (Draw a few such cases for practice.)
- I. Externality analysis can be undertaken at the level of individuals as well as at the level of markets.
- i. This can be done using marginal benefit and marginal cost curves for the individuals affected by an externality generating activity.
  - ii. To find the private supply, we either assume that someone initially has the right to control the activity in question. Usually this is assumed to be the "**high demander**," and that person or firm provides the quantity that maximizes his or her own net benefits.

- iii. The social marginal benefit curve is the (vertical) sum of the individual MB curves.
- iv. If the level privately chosen is not that which maximizes social net benefits, then there is an externality (or public good) problem from the perspective of the SNB maximizing norm (and also the Pareto norm as we shall see later).

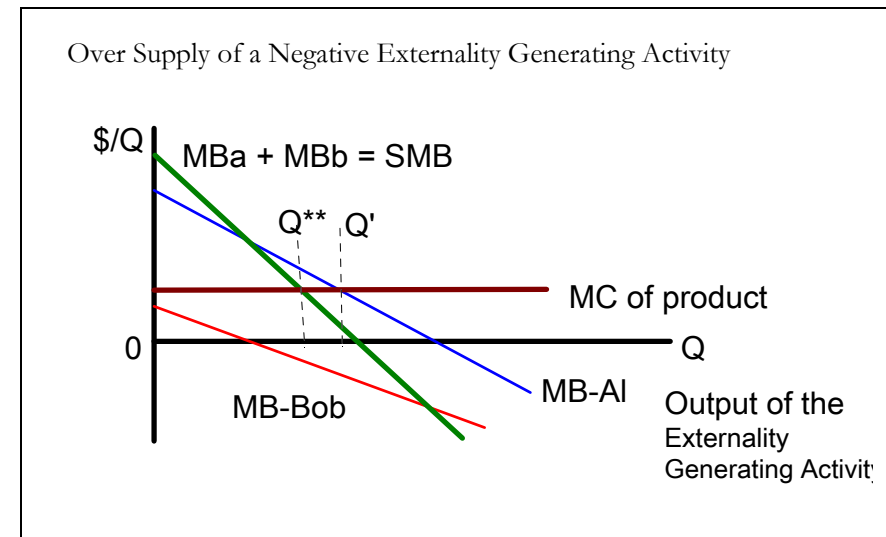
J. Such a case is illustrated below.



- i. Note that in the figure above, Al's preferred output level,  $Q'$ , (the one that maximizes her own net benefits) and there are spill over **benefits** at the margin at  $Q'$ .
  - Al's purchase and use of this good makes Bob better off-
  - However, there is still an externality problem.
- ii. To find the SMB curve add Bob's MB curve to Al's MB curve (vertically), as described in the "recipe" above.
- iii. *In this case, the social net benefit maximizing level of the activity is higher than that provided.*
  - [This is the typical case for activities that generate positive externalities and for the private supply of pure public goods.]

K. Negative externality problems can also be analyzed at the individual level.

- i. Assume that Al's activity generates spillover costs, rather than benefits, at the margins.
  - For example, Bob may be Al's neighbor and negatively affected by smoke from her barbecue or loud music.
- ii. In the diagram, the spillover cost is represented as a negative marginal benefit.
  - This is just another way of illustrating the effect of an external cost.
- iii. *Again the Social Marginal Benefit curve is a vertical sum of all the individuals affected by the externality generating activity.*
- iv. And again, the private "high demander provides" equilibrium is different from the result that would maximize social net benefits.
  - There is again an externality problem--at least from the perspective of the maximize social net benefit norm.
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- v. This type of result is the usual case for a pollution or commons problem.
  - In cases in which a firm disposes of its waste products using the "freely available air or water systems," there are often spill over costs at the margin that are neglected by the firm.

L. However, **the mere existence of an externality does not necessarily imply that there is an externality problem.**

- i. There are cases in which externalities exist (infra-marginally) but there are **no external benefits or costs at the margin** (e.g. at  $Q'$ ).
- ii. If the marginal external benefits and marginal external costs are both zero at  $Q'$  then it turns out that  $Q' = Q^{**}$ , and there is no problem.
- iii. This may also occur in cases in which spillover marginal costs exactly equal spillover marginal costs at  $Q'$ .
- iv. Of course, such geometry is pretty demanding, so most economists regard them as uncommon (at best).

M. To repeat our conclusions from the market-based analysis, in most cases external cost producing activities are **over provided** relative to that which maximize social net benefits, and external benefit producing activities are **under provided** relative to that which maximizes social net benefits.

### III. Solutions to Externality Problems

- i. Economics explains together with the social net benefit maximizing norm explain why there are externality problems.
- ii. The same tools imply that a variety of solutions to externality problems exist.
- iii. Some can be undertaken privately, others require government action.

A. **Private Solutions to Externality and Public Goods Problems**

- i. Do nothing.

- a. In some cases, the existence of an externality may be compatible with Pareto efficiency or maximizing the social net benefits from the activities in question.
  - That is to say, there may not be a "Pareto relevant" externality at the margin even ignoring transactions costs.

- b. In other cases, nothing may be done, because transactions or administrative costs are too great.
  - In such cases, it may cost more to solve the problem than is gained in social net benefits.

ii. Privatization

- a. In some cases, the reason for the externality is simply an improper specification of property rights.
- b. 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.
- c. (Privatization may solve such commons problem even if the "user rights" are not tradable, because *owners have no incentive to overuse their own resources.*)

iii. Private Agreements That Solve Externality Problems:**Coasian Contracts**

- a. In many settings, privatization may not be sufficient to eliminate externalities, but it may make it possible for the affected parties to contract with one another to solve the problem.
  - For example those affected by pollution may pay the polluter not to pollute.
  - 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.
  - Ronald Coase won the 1991 Nobel prize in economics, essentially for this one idea.

iv. **The Coase theorem 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.**

**More over 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 through c" are sometimes called the **Coase theorem**.
- (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.)

v. An Intuitive Example.

- 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 .
- 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.
- 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.
- 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.
- 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.

vi. 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.

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

vii. 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.

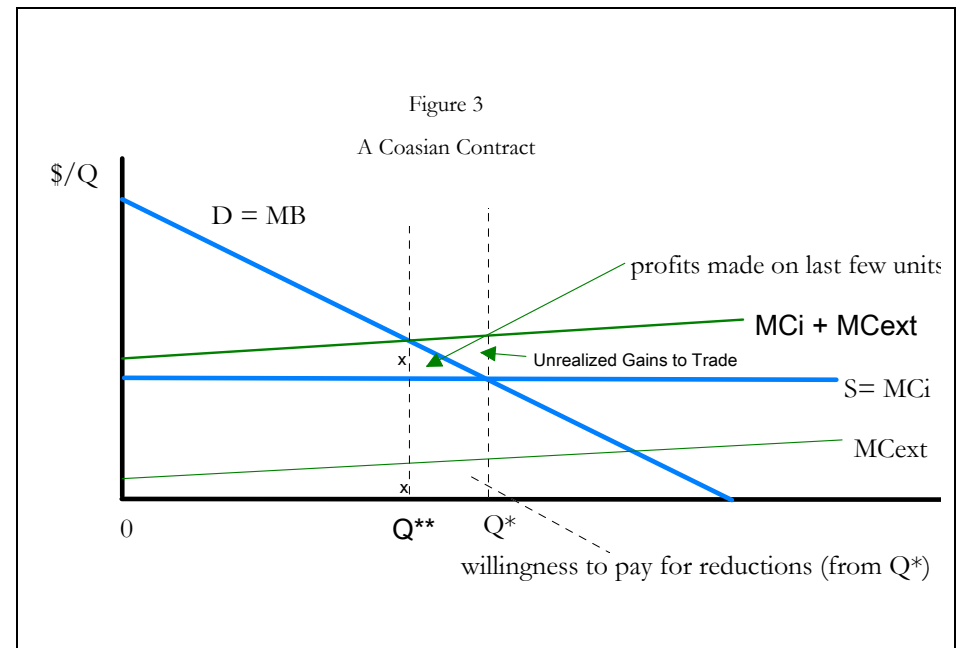
- In the case where the home owners association control the resource, their decision imposed large costs on Acme!
- And vice versa. If Acme controls the output or activity level, then the home owners are made worse off.
- However, the process of exchange always makes both parties better off, given their original circumstances.
- The original property rights assignment affects the direction of payments, although not the final output level in a Coasian world.

viii. An Illustration of the geometry of the Coase Theorem

- 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  $Q^*$ .
- 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.
- 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  $x$ ).

- d. 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.)
- e. 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.
- f. 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  $Q^{**}$ .
- g. 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.)
  - Of course, the flow of payments clearly differs!
  - Acme prefer the first setting, and the homeowner's association prefer the second.



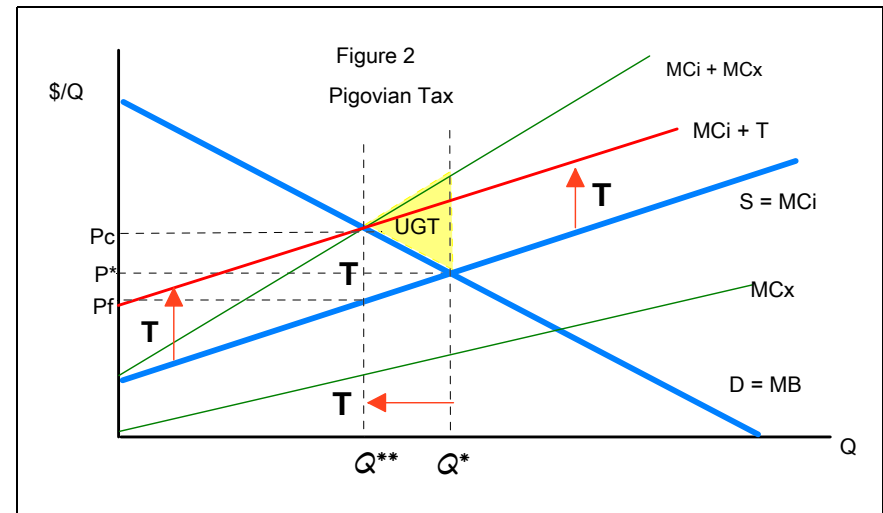
- B. Not all externality problems can be solved with Coasian contracts or with a change in the assignment of property rights.
  - a. *Transactions costs may be very large, because many people are involved.*
  - b. The resources of interest might not be easily divided up and assigned to specific users.
  - c. It may be less expensive to use a preexisting institution (government) to solve the problem.

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

- A. Of greater interest than the Coase theorem for the purposes of this class are governmental solutions, especially those that use taxes or subsidies to alter incentives to produce externalities.
- B. There are several other possible collective management solutions to externality problems.
  - i. Elinor Ostrom won the Nobel prize in 2009 for her analysis of the great variety of such solutions (and related commons problems).
  - ii. We examine just a few of the classic economic solutions in this class--namely the ones most studied by economists.
- C. **Pigovian Taxes:** Excise taxes as a means of "internalizing" negative 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. Such a tax (or subsidy) is said to **internalize** the externality, because it makes the externality producer bear the full cost of his actions (at  $Q^{**}$ ).
  - ii. 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 impose the same tax on every unit of the product (or emission) produced.
  - iii. Pigovian taxes may yield substantial revenues although this is not their main purpose.
    - a. *Unlike a neutral tax, the main purpose of a Pigovian tax is to change behavior.*
    - b. Unlike an ordinary excise tax, a Pigovian excise tax generates no excess burden (as developed below and in class.)

#### iv. Illustration of the Pigovian Tax

- a. From our analysis of externalities, we know that market equilibria may not maximize social net benefits or necessarily realize all potential gains to trade.
- b. These unrealized social net benefits (or **gains to trade**) are the triangle labelled UGT at  $Q^*$  in the diagram.
- c. A Coasian bargain might be able to realize those social net benefits if transactions costs are low enough, but they can also be realized by adopting a tax that internalizes the externality.
- d. Such a tax induces market participants to take account of the external marginal costs.



- e. The external cost at  $Q^{**}$  is the vertical distance from  $MC$  to the  $MC + MC_x$  curve.
- f. This distance is the level of an ideal **Pigovian tax**. If it is placed on production or sales of this product, it will internalize the externality.
- g. This ideal tax is labeled "T" in the diagram above.



- h. 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  $MC + T$ .
- i. 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.
- v. Pigovian taxes can be a low cost method of solving an externality problem, because firms and consumers can all independently adjust to the tax.
  - a. However, the tax burden required to achieve the desired level of the externality generating activity can be very large, which can make both consumers and firms in the taxed industry worse off.
  - b. This tends to make Pigovian taxes politically unpopular (explain why).
  - c. (This cost can be reduced by using the revenues for desired public services or by rebating the revenues as lump sum subsidies to people in the market being taxed.)
- vi. 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.
- D. **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.
  - (Internalizing the externality in this case requires producers to take account of unnoticed benefits falling on others outside the decision of interest.)
  - A Pigovian subsidy is set equal to  $M_b x$  at  $Q^{**}$  and will cause the market to produce  $Q^{**}$  units of the good after it is imposed.
  - A Pigovian subsidy increases social net benefits (beyond the cost of the subsidy) and so has no DWL.

- (As a practice exercise draw such a case.)