Notes for Instructors

Chapter 7: Externalities – Policy Considerations

Chapter 7 is designed as a policy-oriented companion to Chapter 6. It presents a number of policy issues relating to industrial pollution and uses as its theoretical support the following materials from Chapter 6:

- The pollution-proportional-to-output model
- The model in which air and water are productive resources, primarily as convenient disposals for industrial wastes
- The idea that the optimal amount of pollution reduction occurs when the marginal benefits and marginal costs of reducing pollution are equal.

For simplicity, all the examples in Chapter 7 assume that the pollution is an aggregate externality rather than an individualized externality.

THE COASE THEOREM

The chapter begins with Coase's idea that no government policy is required to achieve efficiency with externalities other than the assignment of property rights. The pollution-proportional-to-output model is chosen to illustrate the theorem, stripped down to have only one polluting factory and one consumer affected by the pollution, since the efficiency result is more likely to occur when small numbers of people and firms are involved.

Key points

- Figure 7.1 recalls Figures 6.4 (Supply and Demand) and 6.9 (MC, MB of pollution reduction) to illustrate the bargaining to the efficient outcome.

- Assigning the firm the property rights to clean air gives it the right to produce (pollute) as much as it wants. In this case the consumer buys some of the rights from the firm to get the firm to reduce its production (pollution).
- Assigning the property rights to the consumer means that the firm has to buy some of the rights to be able to produce (pollute) at all.
- Either diagram shows that it is in the interests of both parties under either assignment of rights to generate the efficient amount of production (pollution).
- Figure 7.2 uses the utility possibilities frontier to show the mutual gains possible from correcting for externalities and returning to the frontier.

TAXING POLLUTION - ITERATING TO A SOLUTION

The motivation here is a measurement issue, that even if the damages from pollution were known, the aggregate marginal damages would first be measured at the zero-tax competitive equilibrium, and not at the optimum.

Key points

- The pollution-proportional-to-output model is used.
- The tax is first set equal to the aggregate marginal damages at the competitive equilibrium, which overshoots the optimum and causes too little output to be produced.
- The tax is then reset to the aggregate marginal damages at the now-too-low output, which overshoots the optimum in the other direction, leading to a third tax, and so on. Figure 7.3 illustrates this.
- In the diagram, the amount of overshooting diminishes with each tax such that the tax eventually homes in on the optimal tax rate. (I do not describe the stability conditions required for this result to hold. One could note that the government has to be a bit lucky here for the iterative tax policy to work.)

  At this point the text assumes that the marginal damages are not known, so that the government sets an arbitrary pollution reduction standard, which it then tries to meet at least cost.

COMMAND AND CONTROL (CAC) APPROACH

The disadvantages of the CAC approach favored by the U.S. are highlighted using both models from Chapter 6.

Pollution-proportional-to-output model

The comparison is an equal reduction of output in two firms with different supply curves (marginal costs) versus the tax solution.

Key point

- The even-handed approach is excessively costly because it ignores the equal marginal cost principle in obtaining output from two or more sources, which the pollution tax honors. Figure 7.4 illustrates this, comparing the tax solution with a 45% output reduction at each firm.

Air (water) as resources model

CAC dictates certain pollution-reducing equipment for all firms.

Key points

- CAC is excessively costly because it ignores that firms vary in their ability to substitute capital and labor for air (water) in disposing of industrial wastes, which the pollution tax exploits.
- The CAC approach leaves the price of air (water) at zero, which leads to an incentive for the firms to cheat, and government prosecution is required to deter cheating. In contrast, firms have an incentive to report reductions in pollution under the tax to reduce their tax liabilities.

The text then turns to a comparison of three pricing solutions – taxes, subsidies, and marketable permits – divided into two parts.

THE MARGINAL EQUIVALENCE OF TAXES, SUBSIDIES AND MARKETABLE POLLUTION PERMITS

The marginal equivalence is demonstrated in the pollution-proportional-to-output model by considering the competitive firm's profit function under the three policies and noting the first-order conditions for profit maximization.

Note: Knowledge of derivatives is useful but the profit function is simple enough that an intuitive explanation can easily be substituted if students do not have even a minimal calculus background.

IMPORTANT PRACTICAL DIFFERENCES IN THE THREE POLICIES, WITH SUBSIDIES AND PERMITS COMPARED WITH TAXES

Subsidies

Since firms are subsidized in total, there is an incentive to enter the industry to obtain the subsidy, which can increase total output and, therefore, pollution. Figure 7.5 illustrates this, assuming perfect competition.

Marketable Permits

- **Advantages**: It is easy to hit the pollution target, with the number of permits equal to the targeted amount of pollution; there is no need to iterate as with taxes; permit prices rise automatically with inflation, whereas taxes have to be continually readjusted.
- **Disadvantages**: The system can act as a barrier to entry if large firms buy more permits than they need to prevent potential entrants from buying them.
- **Uncertainty**: Permits are better for controlling output, taxes for controlling costs. Therefore permits are better if the MB of reducing pollution are steep and the MC fairly flat near the optimum, to avoid the possibility of having too little pollution reduction with a tax, with high remaining marginal damages. Taxes are better in the reverse case to avoid having too much pollution reduction that is excessively costly. Figure 7.6 illustrates the two MB and MC cases.

The text then discusses defensive strategies such as waste treatment and subsidizing the victims of pollution.

DEFENSIVE STRATEGIES

Key points

- Waste treatment of pollutants can be attractive because of economies of scale.
- The optimal strategy is usually a mixture of a pricing policy to reduce pollution at its source plus waste treatment of some of the remaining pollutants. The goal is to equalize the marginal costs of both options in reducing pollution.
- A pure defensive strategy such as waste treatment is nonoptimal (unless the economies of scale are unrealistically large) because it cannot satisfy the pareto-optimal condition relating to the production of the polluting good.
- A policy of subsidizing the victims is also nonoptimal (unless the subsidy is delivered as a lump-sum), because it violates the pareto-optimal condition that the MRS between two goods that do not generate externalities should be equal for all

consumers; the subsidy of certain defensive goods drives a wedge between the MRSs of the victims and non-victims of the pollution for these goods. Also, the policy does nothing to reduce pollution at its source.

ROAD CONGESTION

The final example relates to the problem that the direct beneficiaries of a pricing policy to reduce pollution (or some other harmful externality) may resist the policy. Road congestion is the example (one could substitute smog caused by automobiles as the externality to retain the chapter's focus on pollution). Figure 7.7 illustrates this, using consumer surplus as the measure of consumer benefit and assuming constant cost production of travel capacity to remove the supply side from consideration.

Key points

- The drivers resist a congestion toll if the toll revenues exceed the gain in consumer surplus to them of reducing congestion from the competitive (zero-toll) amount of road use to the optimal amount of road use, and if they do not believe they receive any government benefits from the services financed by the revenues.
- Figure 7.8 shows how the congestion toll can move society to the utility possibilities frontier in a manner that reduces the utility of the drivers.

USING THE EXAMPLE BANK TO SUPPORT CHAPTER 7

Examples from the ***Public Sector Economics*** **Example Bank** may be used to support teaching of the material covered in this chapter. All examples are freely available for lecturers and students to download from www.palgrave.com/economics/tresch/example/. A brief overview of a number of relevant examples from the bank is given below.

Example 7.1
Avoiding the Tragedy of the Commons in Fishing with Individual Transferable Quotas

An illustration of the wisdom of the Coasian solution of assigning property rights to efficiently account for externalities, using the assignment of property rights to fishers of Pacific halibut off the coast of British Columbia. The policy is compared with an earlier CAC approach that failed. This example can also be used in a discussion of marketable permits.

Example 7.2

Reducing Greenhouse Gases: The European Union's Emissions Trading System

An account of the EU's response to the recommendation of the Kyoto Protocol that the developed nations institute a system of marketable permits to control the emissions of greenhouse gases. To date, only the EU has followed the Protocol's recommendation.

Example 7.3

The Superfund

The U.S. Superfund was established by Congress to identify and clean up all sites throughout the nation that have been contaminated by industrial wastes to the point that they constitute a serious health hazard. The example illustrates how costly it can be not to reduce industrial pollution at its source, which was essentially the U.S. policy until the 1970s. The Environmental Protection agency has identified nearly 2,000 hazardous sites that need to be cleaned up with more to come, has already spent $billions on the clean-up, and will undoubtedly have to spend $billions more to clean up all current and future sites.

Example 7.4

Pricing Traffic Congestion in Singapore and London

Singapore was the first country to use a pricing strategy to reduce traffic congestion in its city center and London is the most recent major example. They are both success stories, and excellent illustrations of why economists recommend pricing strategies to combat external diseconomies.