Chapter Summaries

Chapter 6: Externalities – Theoretical Issues

Chapter 6 presents the theory of externalities when the externalities arise from ongoing private sector activity. The chapter begins with some of the terminology associated with market-generated externalities.

1. *Pecuniary externalities* are third party effects that operate entirely through the prices that consumers and producers face, such as the increased demand for cars by some people that drives up the price of cars for all people. Technological externalities are third party effects that directly alter or enter consumers' utility functions and/or producers' production functions. Pecuniary externalities are standard market effects and are not a policy problem. Technological externalities are the policy-relevant externalities that typically require government intervention because they are not likely to be accounted for in the marketplace.
2. *Beneficial externalities* are called external economies; harmful externalities are called external diseconomies.
3. Externalities are labeled *consumer or producer externalities* depending on the source of the externality. Highway congestion is an example of a consumer externality and industrial pollution is an example of a producer externality.
4. *Aggregate externalities* are externalities for which the affected parties care only about the aggregate amount of the externality they experience from all sources combined; the identity of each individual source is irrelevant. Highway congestion is an example. Individualized externalities are externalities for which the identity of each source matters to the affected parties. Industrial air pollution is sometimes an individualized externality (e.g. emissions of SO_2 from electric utilities) and sometimes an aggregate externality (e.g. emissions of greenhouse gases, which mix completely into the atmosphere and cause global warming no matter where they are emitted).

The analysis of externalities begins with an aggregate externality, using industrial air pollution by paper companies as an example. The amount of pollution emitted is assumed to be proportional to the output of paper produced, so that output represents the pollution in the analysis.

5. Left to its own devices, the competitive market reaches its equilibrium quantity and price at the intersection of the market demand and supply curves for paper. At each output, the market demand curve represents the marginal value of paper to consumers and the market supply curve represents the private marginal cost of the paper companies of producing paper.
6. Given the pollution externality, the efficient equilibrium or social optimum is at the intersection of the market demand curve and the social market supply curve, where the social market supply curve represents at each output the full social marginal cost of producing paper. The full social marginal cost is the sum of the firms' private marginal cost and the aggregate marginal damages to all consumers affected by the pollution.
7. The aggregate marginal damages are, graphically, the vertical sum, at each output, of the marginal damages suffered by each consumer because of the pollution.
8. The efficient equilibrium can be achieved by a per-unit tax on the producers of paper equal to the aggregate marginal damages at the efficient or optimal level of output, at the intersection of the market demand curve and the social market supply curve. This tax is called the *Pigovian tax*, after economist A. C. Pigou, who first described it.

The chapter then turns to an analysis of the *individualized externality*, again using industrial pollution as an example.

9. The aggregate marginal damages caused by each individual firm must be added vertically to the firm's private supply (marginal cost) curve to construct its social supply (marginal cost) curve.
10. Every firm's social marginal cost curve is then added horizontally to obtain the appropriate social supply curve. The efficient equilibrium or social optimum is at the intersection of the market demand curve and the social supply curve.
11. There is no tax at the market level. Instead, each firm pays a Pigovian tax equal to the aggregate marginal damages the firm causes at the intersection of the market price and its individual social supply (marginal cost) curve. The taxes differ by firm, in general; there is no tax on a firm whose production causes no damage to anyone.

The chapter next considers the often more realistic assumption that pollution is not proportional to output. Instead, water and air are useful factors of production for firms, particularly as convenient disposals for industrial waste products, and can be varied along

with a firm's other factors of production in producing the firm's output. The section assumes that the firm's output is produced with capital (K), labor (L) and air (A).

12. The firm tries to equate the ratios of the marginal product (MP) to price (P) of all its factors of production to be on its total cost curve, and produce whatever output it chooses to produce at the lowest possible cost in order to maximize its profit.
13. Since air (or water) is a common use resource, the price of air to the firm is zero. Hence, MP_A/P_A is large without limit, and the profit maximizing strategy is to use air however it can until it drives the MP_A to zero.
14. A tax on the use of air of t_A increases the price of air to the firm from zero to t_A, so that now the ratio $MP_A/(P_A+t_A) = 0$ with $MP_A = 0$. The profit maximizing strategy for the firm is to substitute capital and labor for air to dispose of wastes (or whatever the air is used for) until the ratios MP/P are equal across capital, labor, and air. The tax appeals to the same profit motive to reduce pollution that led to the pollution in the first place. It achieves a given reduction of pollution at the lowest possible cost.
15. The tax on the use of air also helps by raising the firms' marginal costs, which decreases the supply of the polluting firms' output and increasing their prices. The price increases induce consumers to substitute nonpolluting products for the polluting products, even though there is no tax on the firms' output.
16. Since the market price of air (or water) is zero, the tax has to equal the entire price of air at the intersection of the social demand curve for air and the market supply curve for air. The private demand curve reflects at each output the value of the private marginal product of air to the firms. The social demand curve subtracts vertically from the private demand curve at each output the marginal external damages to all individuals affected by the air pollution. The market supply curve reflects at each output the marginal disutility to the individuals of supplying air to the firms.

The chapter concludes with a discussion of the optimal amount of pollution reduction.

17. *The optimal amount of pollution reduction* occurs at the intersection of the marginal benefit and marginal cost of reducing pollution.
18. In terms of the supply and demand curves for air depicted in Figure 6.9, the marginal benefit of reducing pollution is equal to the vertical distance between the private and social demand curves for air at each output, and the marginal cost of reducing pollution is equal to the vertical distance between the private market demand and supply curves at each output. Therefore, the optimal amount of pollution reduction in Figure 6.10 corresponds to the optimal output of air in Figure 6.9.
19. The optimal amount of pollution reduction is much less than 100% (zero pollution) for most pollutants.