Lecture 2:
Externalities

Reading:

- Keohane and Olmstead, Chapters 4 & 5 (pp. 65-70)
- Haab & Whitehead, pages 146-8
- Baumol & Oates, Chapters 3 & 4

1. Introduction

- ➡ Externalities give rise to "market failure".
  - Circumstances where the market produces inefficient outcomes
  - In particular too much pollution
- ➡ This implies grounds for government intervention or regulating markets in such a way that efficient outcomes may be realized
- ➡ Understanding these concepts guide us in developing specific policies

2. Definitions and Examples

- Story
- Definition: *An externality exists when the consumption of one person or firm enters the utility or production function of another entity (person or firm) without that entity's permission or compensation.*
- Examples:

- disposal of toxic wastes
- air pollutants
- water pollutants
- deterioration of neighborhoods
- highway congestion
- noise
- greenhouse gases
- pesticides
- positives: garden, bees

3. Production & Consumption Externalities

- Production externality
  - ↪One firm's emissions enters another firm's production function and is unaccounted for in the market
  - ↪Example. Steel firm's action affects a laundry business
    - » Laundry's production function

$$L = f_L(x_1, ..., x_n, e)$$

inputs

emission externality from steel company

Production of 'clean clothes' is affected by air pollutants from the steel firm.

- » Laundry takes *e* as fixed
- » Figure on next slide shows this externality

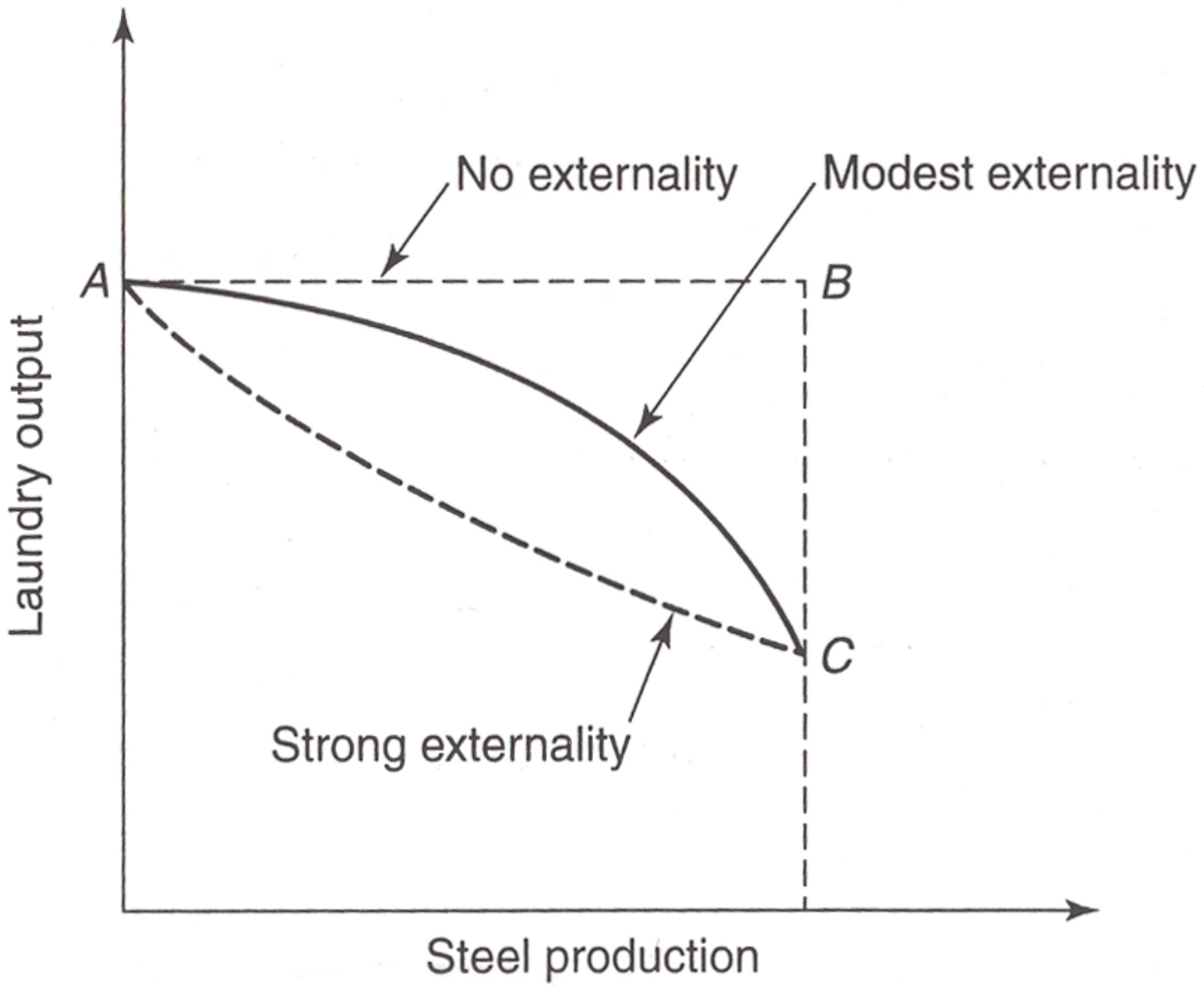


Figure 5.5 Production possibilites with an externality, steel and laundry.

- Consumption externality
  - ↪External effect enters a person's utility function
    - » Utility function w/ an external effect

$$U = U(w_1, ..., w_n, e)$$

market goods externality

- » Utility of individual affected by emissions from another
- » Individual takes *e* as fixed

4. Why concerned about externalities?

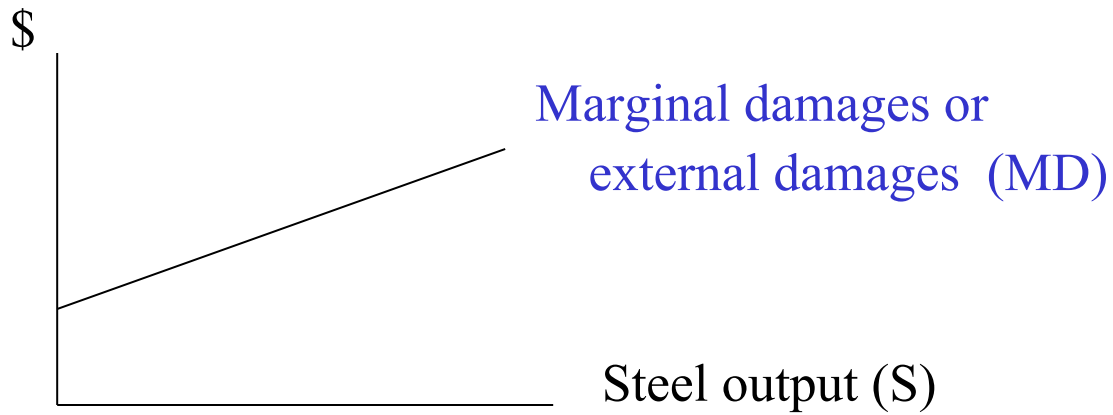
- Basic problem is the generator of the externality is deciding how much of the externality to produce but is not taking into account the effects of the externality on others.

- This leads to an inefficient level of emissions (or whatever the external effect is)

- I will show this graphically and then mathematically

5. Externalities on a Graph

- Efficiency in the presence of externalities
  - Consider a steel market with harmful emissions
  - Assume damages are a function of steel output (the only way firms can control pollution is by reducing output)
  - Damage function



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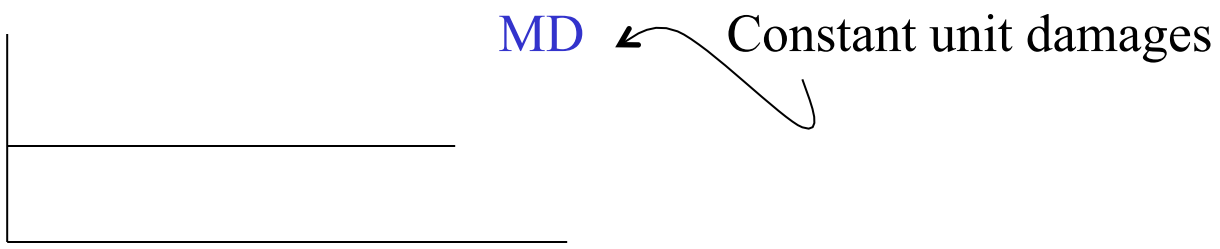
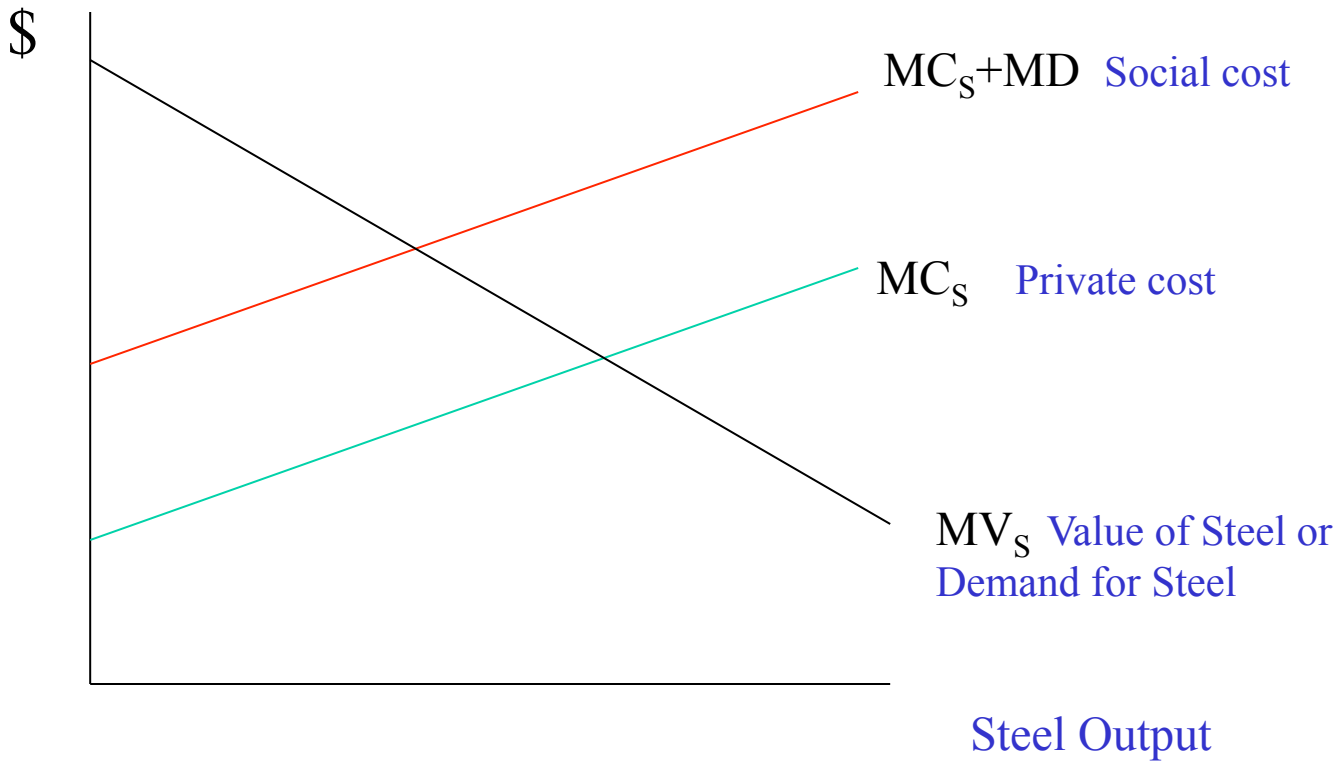


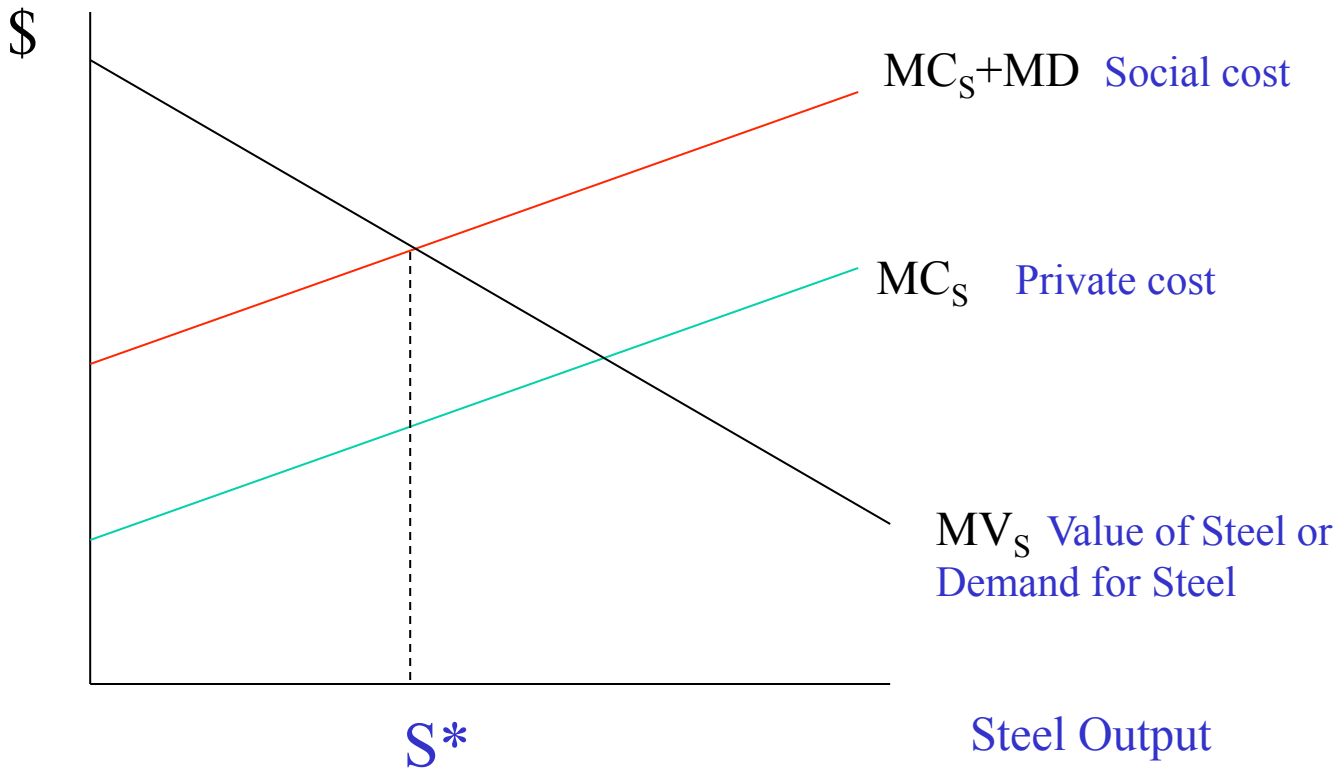


MC_S = Marginal Private Cost = capital, labor, and raw materials used to produce steel

MD = Marginal Damages = environment "used" to produce steel

Same as marginal external cost

Inputs not traded in the market



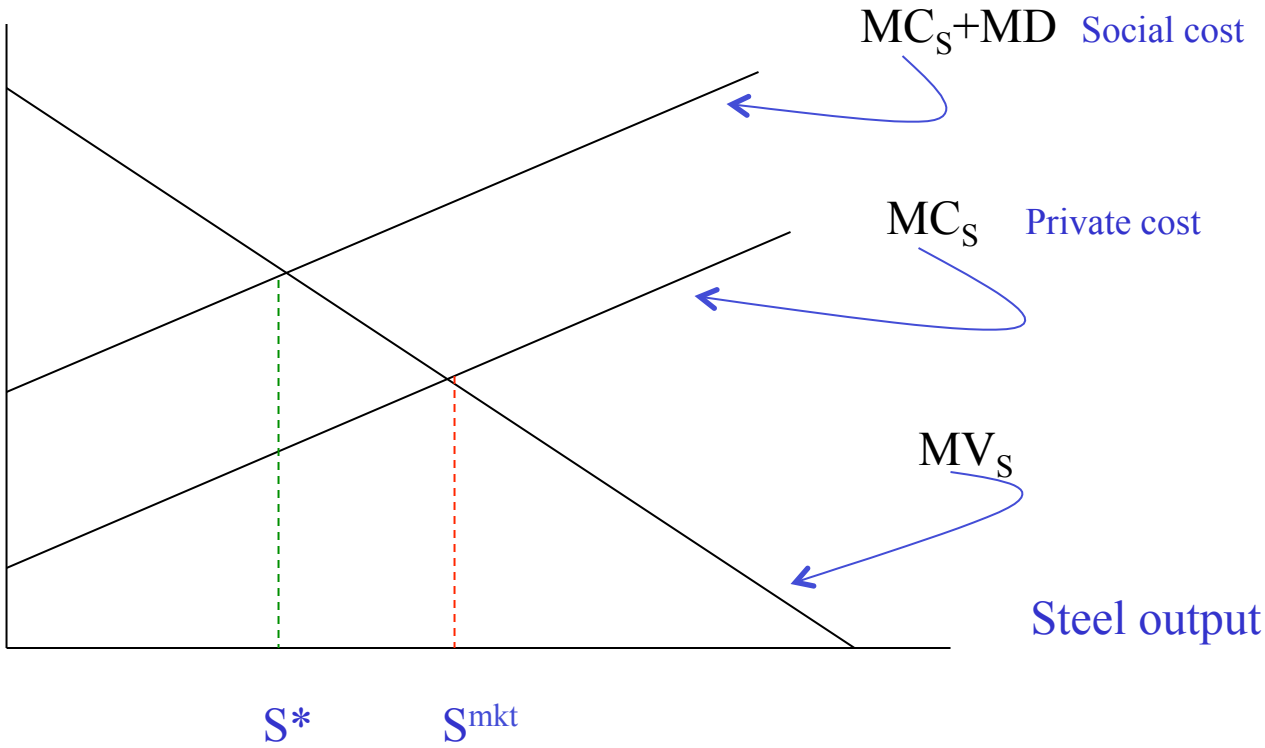
↪Efficient level of steel output is at S* where

$$MV_S=MC_S+MD$$

$$MV_S = MC_S + MD_L$$

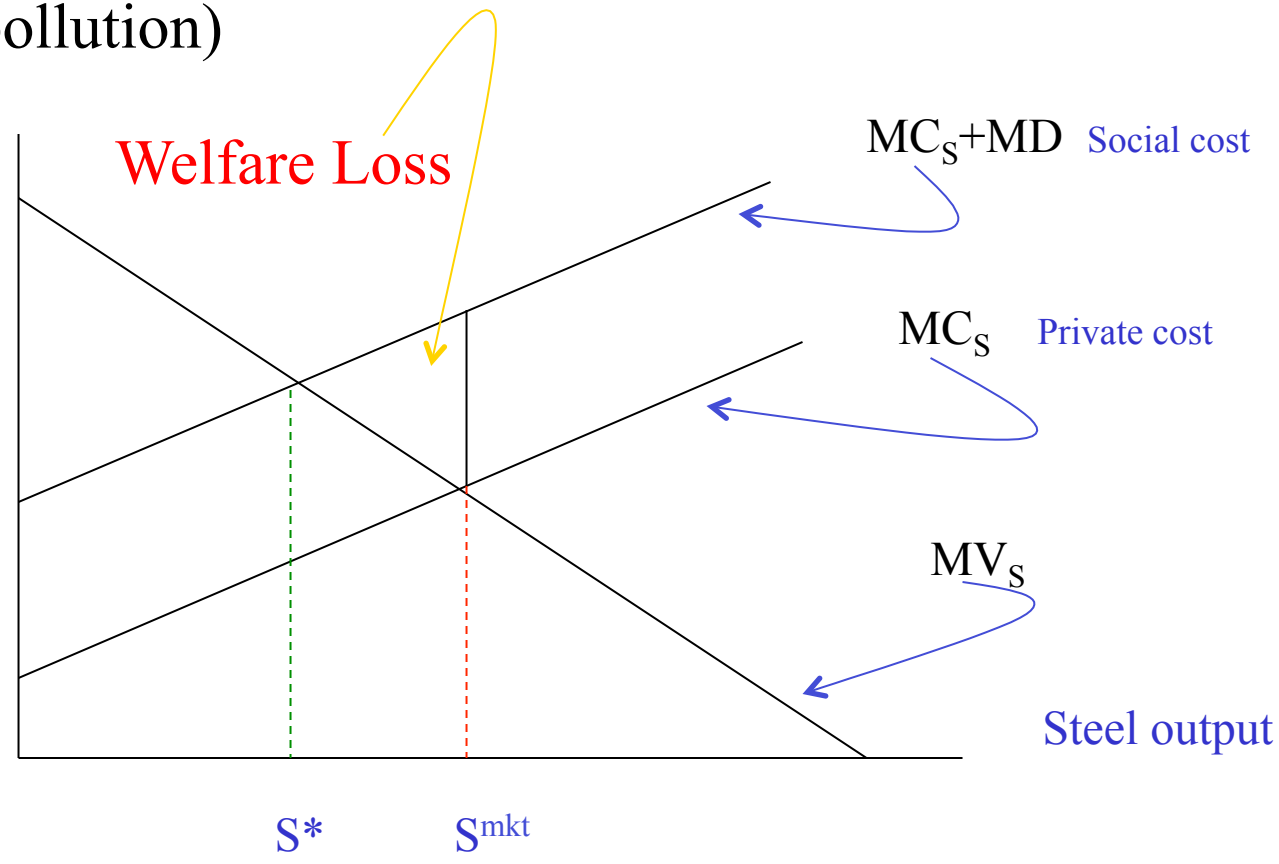
- Produce steel until the marginal value of steel equals the marginal social cost of the production, including the external effect

- Market Failure
  - ↪Steel firms' behavior:



  - ↪Firm considers only private cost and operates at S^{mkt}. Treat environment as a *free good.* Set $MV_S = MC_S$
  - ↪ Too much output, Too much pollution, and Price of steel is too low

- Welfare Loss Due to Too much output (and hence pollution)



↳The range of output over which $MC_S + MD > MV_S$

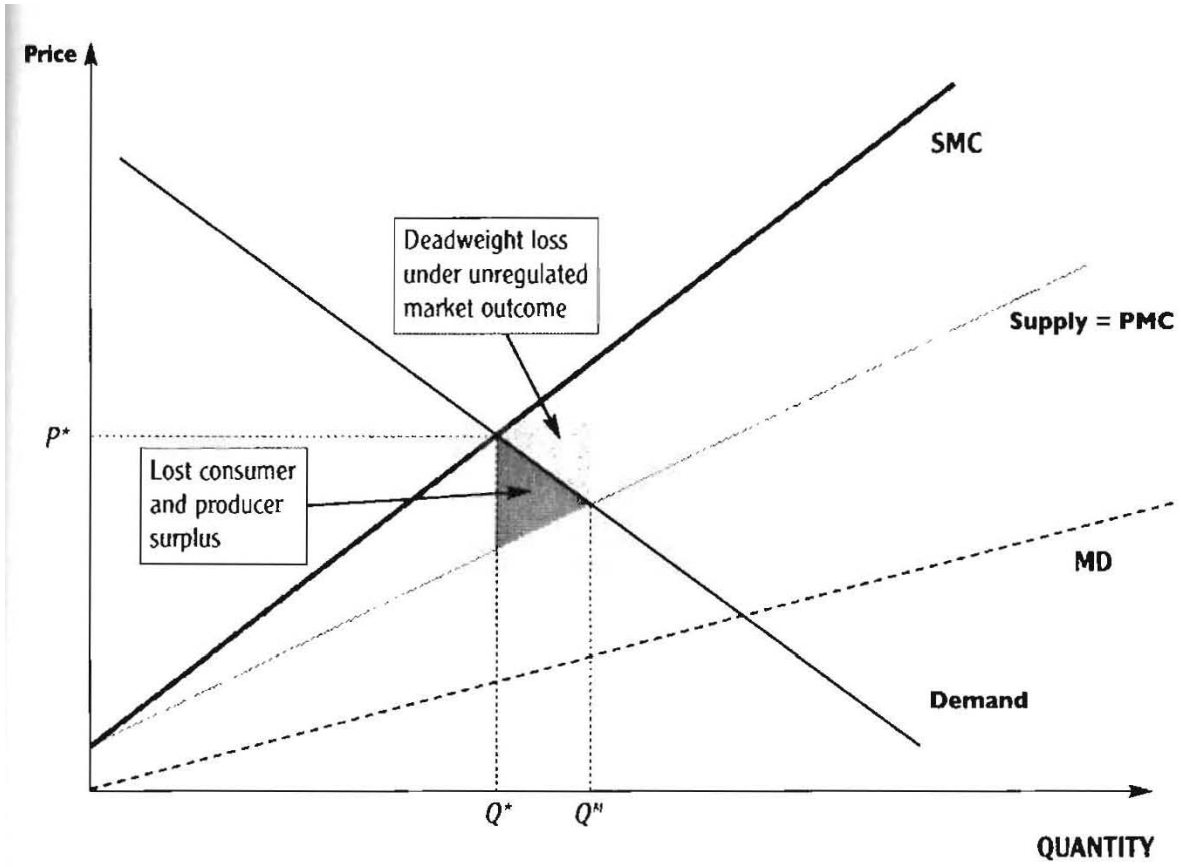


Figure 5.1 A market with a negative externality.

6. Externalities Mathematically

- What is the efficient level of output in the presence of an externality? To "internalize" the externality consider a steel firm and laundry. Profits for the merged firm is

$$\Pi_M(S,L) = \{p_S S + p_L L\} - \{C_S(S) + C_L(L,S)\}$$

"Merged"

Revenue

Cost

Notice the externality in here

S = steel output
L = laundry output
p = prices of steel and laundry services
C(.) = cost functions

- Efficiency: Choose S and L to maximize profits. External effect is internalized here, accounted for in the merged firm's decisions. The foc for max:

Steel ➪ (S)

$$\frac{\partial \Pi_M}{\partial S} = p_S - \frac{dC_S(S)}{dS} - \frac{\partial C_L(L,S)}{\partial S} = 0$$

Conditions for an efficient level of S

$$= MV_S - MC_S(S) - MD_L(L,S) = 0$$

Marginal value of steel

Marginal private cost of steel

Marginal damage or marginal external cost

Laundry ⇨ (L)

$$\frac{\partial \Pi_M}{\partial L} = p_L - \frac{\partial C_L(L,S)}{\partial L} = 0$$

Conditions for an efficient level of L

$$= MV_L - MC_L = 0$$

↪Compare to graph

- Market: Firms operate independently. Steel firm ignores the negative effects of its smoke. Profits from the steel firm and laundry (separately) are

$$\Pi_S = p_S S - C_S(S)$$

$$\Pi_L = p_L L - C_L(L, S)$$

Steel ➪ (S)

↪Choose steel output to max profit ignoring external effect

$$\frac{\partial \Pi_S}{\partial S} = p_S - \frac{dC_S(S)}{dS} = 0$$

$$= MV_S - MC_S = 0$$

↳Choose laundry output to max profits taking level of S as fixed

Laundry ⇨ (L)

$$\frac{\partial \Pi_L}{\partial L} = p_L - \frac{\partial C_L(L, S^{mkt})}{\partial L} = 0$$

$$= MV_L - MC_L = 0$$

↳Compare w/ graph. Note that steel firm increases output till MV equals private MC in the market. Too much output and too much pollution.

- Notes
  - Pecuniary externality
  - Pareto relevant externality

- Bottom Line
  - Market fails in the presence of externalities
  - Firms/individuals treat environmental inputs as "free"
  - Grounds for intervention into market