The efficient level of pollution, and the Coase Theorem

These notes explain how economists think about the "efficient" level of pollution, and why – under certain circumstances – the actual level of pollution does not depend on who has "property rights" to the environment (the Coase Theorem).

In order to determine how much pollution society should tolerate, we need a way to compare the costs and benefits of pollution. The social cost of pollution consists of all environmental damages (e.g. those related to health costs and reduced enjoyment from a resource) The social benefit of pollution consists of reduced production costs (and the resulting cheaper goods). Again, we measure these costs and benefits in units of dollars. We can't compare apples and oranges; a comparison requires that we use the same units of measurement for the things that are compared. The optimal level of pollution is determined where the marginal costs of emissions and the marginal benefits are equal.

Figure 1 graphs the marginal damages of pollution (emissions), the curve MD. This curve has positive slope. The first unit of pollution does not cause much damage, but successive units cause more damage. In practice, the marginal damage of emissions is very hard to measure. (The fact that we might not be able to agree on the measurement of the MD does not mean that the model is useless. The model can still help in understanding the principles that underlay the optimal choice of emissions, and the role of property rights.)

The curve MB is the firm's marginal benefit of polluting an extra unit. In order to reduce emissions, the firm has to incur abatement costs. By increasing pollution, the firm reduces its abatement costs. This reduction in costs is a benefit for the firm. In the absence of any regulation, the firm emits pollution at the level for which its abatement costs are minimized. At this point, the firm would not be able to reduce its costs by polluting an extra unit, so marginal abatement costs are 0; i.e. the marginal benefit of polluting is 0. This point is labelled $e^{BAU}$ (Business as Usual).[1]

[1] More generally, the marginal benefit might include all the factors that the firm takes into account (internalizes) in choosing emissions. For example, if higher emissions lead to higher health insurance premiums (and the firm pays those premiums) then the firm's marginal benefit of emissions includes those costs (as a negative entry). The firm's marginal benefit curve excludes those environmental costs that the firm does not internalize.

The socially optimal level of pollution occurs where marginal damages of pollution equal marginal benefits of pollution, at $e^*$. The socially optimal level is typically less than the BAU (unregulated) level, but greater than 0.

Figure 2 graphs the same information, in a slightly different form. It shows the supply (equal to the firm's marginal cost) and the demand (equal society's marginal benefit) of *abatement*, defined as the difference between the BAU level of emissions and the actual level of emissions. The optimal level of abatement is $A^* = e^{BAU} - e^*$. We obtain the supply curve in Figure 2 by using the MB curve in Figure 1. We use Figure 1 to see how much each additional unit of abatement increases the firm's abatement costs.. We obtain the demand for abatement in Figure 2 using the MD curve in Figure 1. We use Figure 1 to find the social marginal damage associated with each additional unit of abatement.

The Coase Theorems says that under "ideal circumstances", when polluters and pollutees bargain, the equilibrium level of pollution is independent of the allocation of property rights. The "ideal circumstances" include perfect information about costs and benefits and the absence of transactions costs.

Suppose, for example, that the "pollutee" has all the property rights to the environment. In the absence of any negotiation between the polluter and the pollutee, the former is not allowed to pollute – to do so would infringe upon the pollutee's property rights. The firm would save $\$A$ by being allowed to pollute one unit, and this would cost the pollutee only $\$B$ in damages. There are benefits from trade, since one party's willingness to pay is greater than the other party's cost of giving up the first unit. Suppose that the bargaining resulted in $e_1$ units of pollution. There are still opportunities to bargain, since the firm would be willing to pay $\$C$ to be allowed to pollute one more unit, and this would increase damages to the pollutee by $\$D$ All further opportunities for bargaining are exhausted when the two parties have agreed to have pollution at $e^*$ – which also happens to be the socially optimal level.

Suppose at the other extreme that the polluter has all of the property rights to the environment. In the absence of negotiation, the firm would pollute at its BAU level, $e^{BAU}$. At this point, the pollutee would be willing to pay $\$F$ to reduce pollution by one unit, and this reduction would cost the firm (almost) nothing. Again, there are opportunities to bargain up until the point where $e = e^*$.

In this idealized world, society does not need a regulator to determine the

optimal level of pollution. By bargaining, individuals will achieve the socially optimal level, regardless of the allocation of property rights. Obviously, the idealized circumstances needed for the theorem do not describe the real world.

The OECD countries have agreed on the Polluter Pays Principle – which implies that the polluter does not have property rights to pollute.

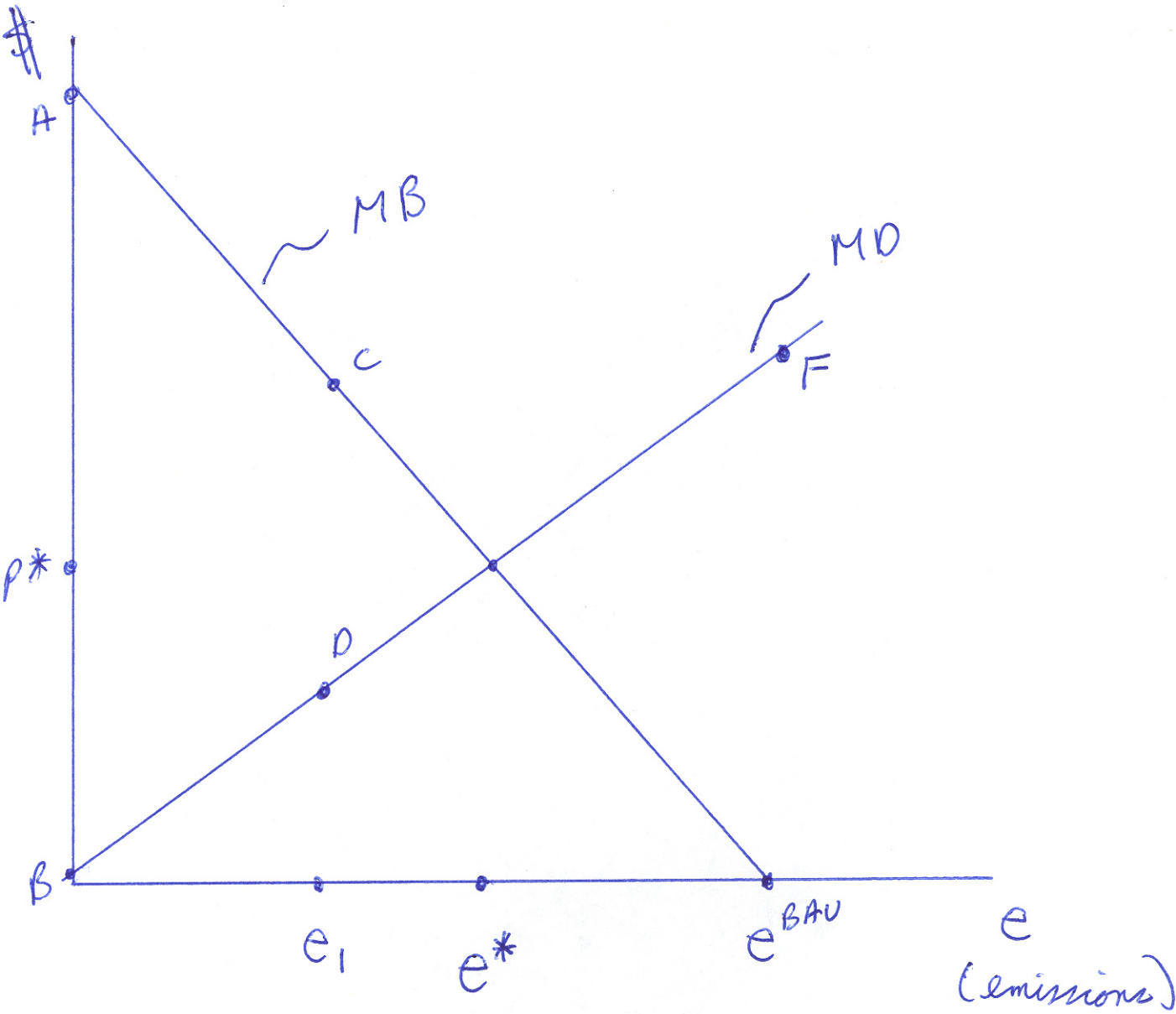
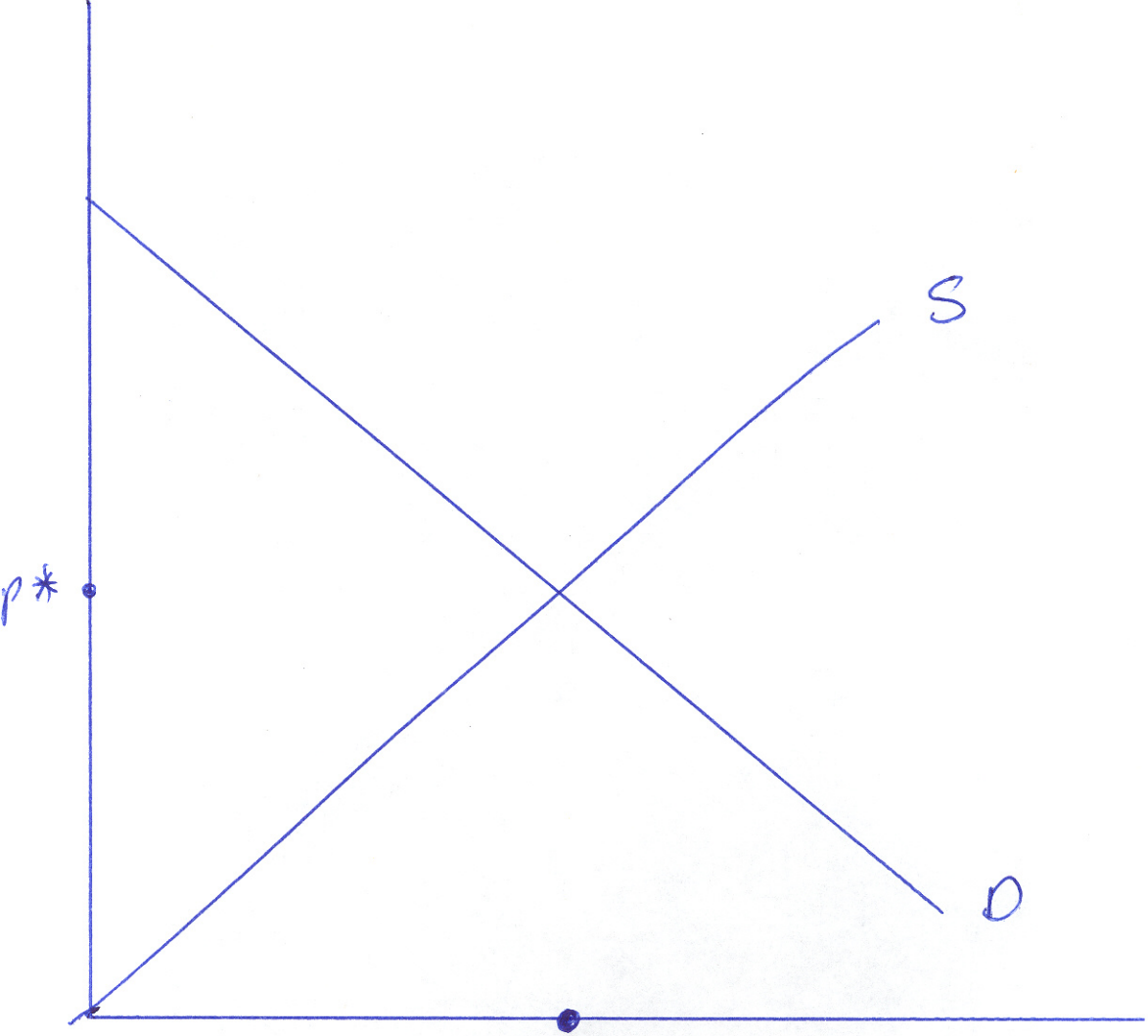



Fig 1 Marginal benefits (MB) and marginal damages (MD)




$A^* = e^{BAU} - e^*$

A = ABATEMENT

$= e^{BAU} - e$

Fig 2