Market Failures: Externalities and Public Goods

Week 15

M. Pelliccia

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Not, if we have asymmetric information we can have Market failures!

Externalities and Public Goods

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Is it true for ALL goods?

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- In equilibrium the marginal benefit from eating an additional loaf is equal to its marginal cost.

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Too little bread is produced!

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From a social point of view, too many tires will be produced by the market!

Bilateral Externalities

An **externality** is present whenever the well-being of a consumer or the production possibilities of a firm are directly affected by the actions of another agent in the economy (and this interaction is not mediated by the price mechanism).

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- People get positive utility from the smell of baking bread. This is true regardless of whether the people participate in any market.
- If the smell attracts new customers, the bakery can charge higher price which may have harmful effects on the previous customers who were buying the bread regardless of the smell.

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These are NOT the externalities we are considering!

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Activity h is something that has no direct monetary cost for person 1.

Bilateral Externalities

- From the point of view of consumer 2, h represents an external effect of consumer 1's action. In the model, we assume that

$$\frac{\partial u_2}{\partial h} \neq 0$$

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We know that consumer 1 will choose h in order to satisfy the FOC (assuming interior solution): $\phi_1'(h^*) = 0$.

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We know that consumer 1 will choose h in order to satisfy the FOC (assuming interior solution): $\phi_1'(h^*) = 0$.

Even though consumer 2's utility depends on h, it cannot affect the choice of h. Herein lies the problem.

Bilateral Externalities

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$$\max_h \phi_1(h) + \phi_2(h)$$

with FOC, $\phi_1'(h^{**}) + \phi_2'(h^{**}) = 0$, and h^{**} is the Pareto optimal amount of h.

Bilateral Externalities

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Thus the level of the externality will not generally be the socially optimal one.

Bilateral Externalities

In particular, if the externality is bad for agent 2, then $h^* > h^{**}$, while if the externality is good for 2, then $h^* < h^{**}$.

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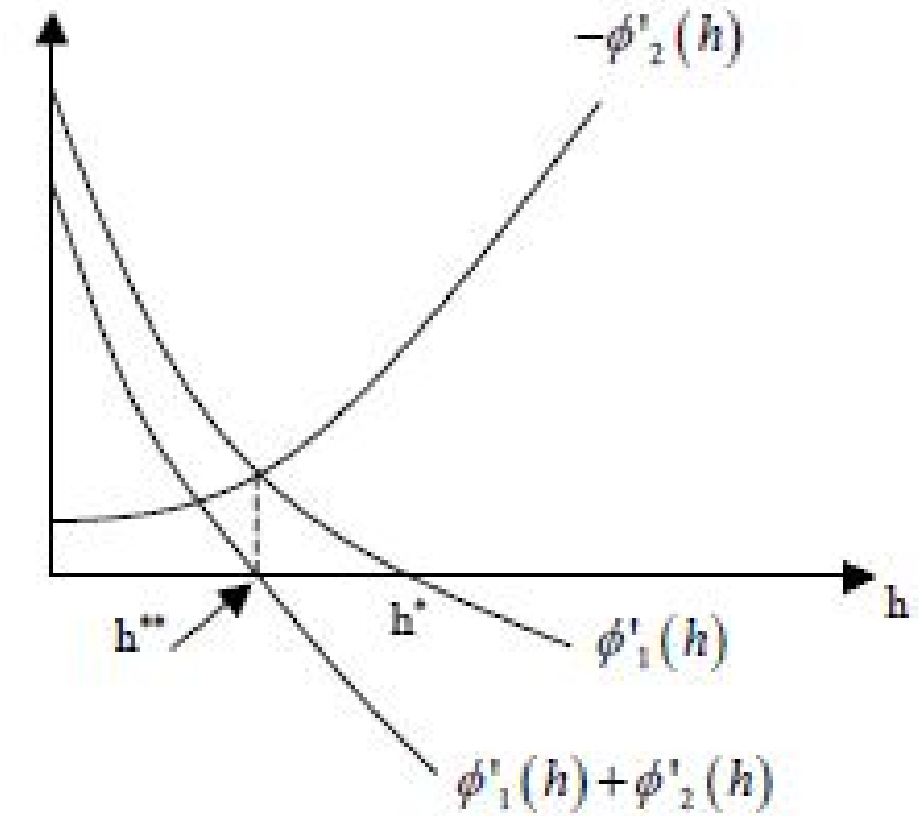

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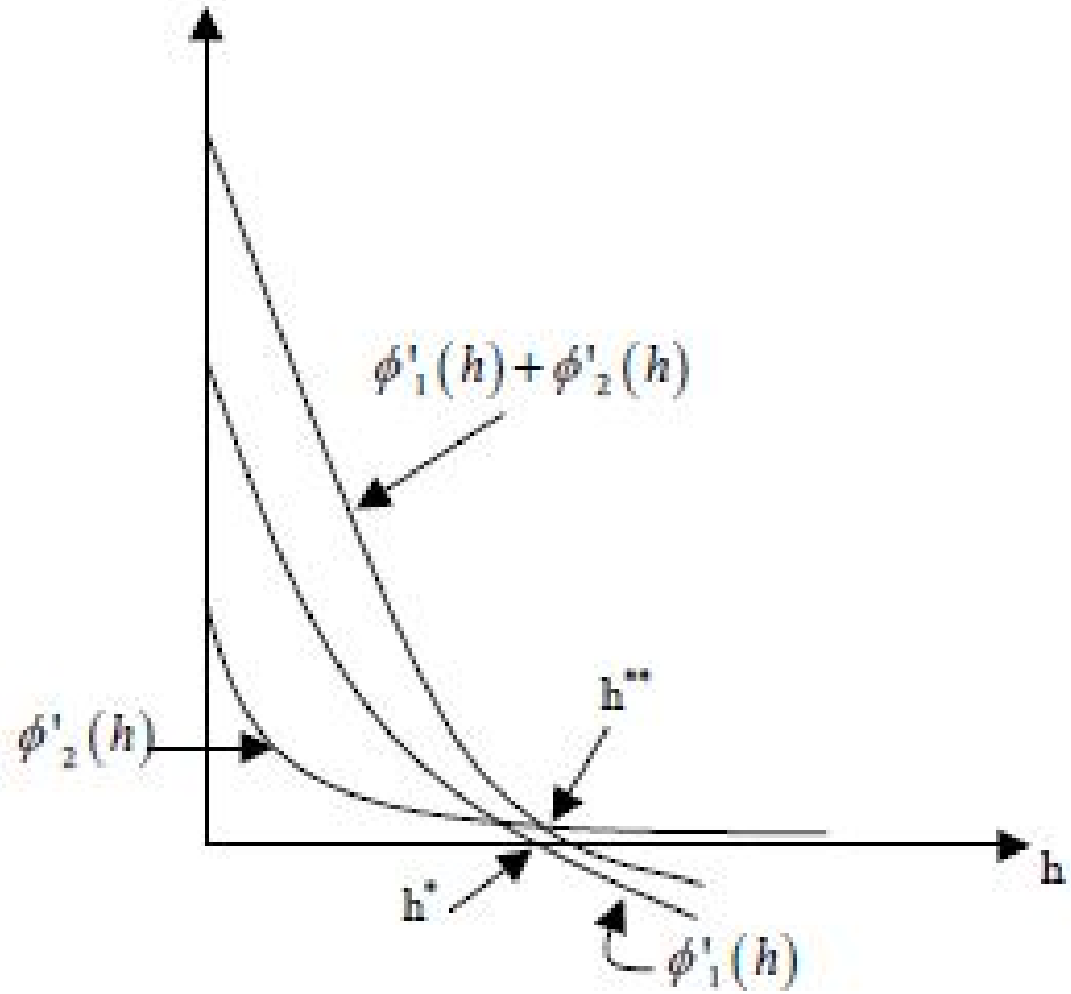

Bilateral Externalities

Note that the social optimum is not for the externality to be eliminated entirely. Rather, the social optimum is where the sum of the marginal benefit of the two consumers equals zero.

Traditional Solutions to Externality Problem

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- Quotas: impose a maximum (or minimum) amount of the externality good that can be produced.
- Taxes: impose a cost of producing the externality good on the producer. Positive taxes will tend to decrease production of the externality, while negative taxes (subsidies) will tend to increase production of the externality.

Quotas and Taxation

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Easy to say...less simple to implement!

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One way to do this, known as **Pigouvian Taxation**, is to impose a tax on the production of the externality good, h.

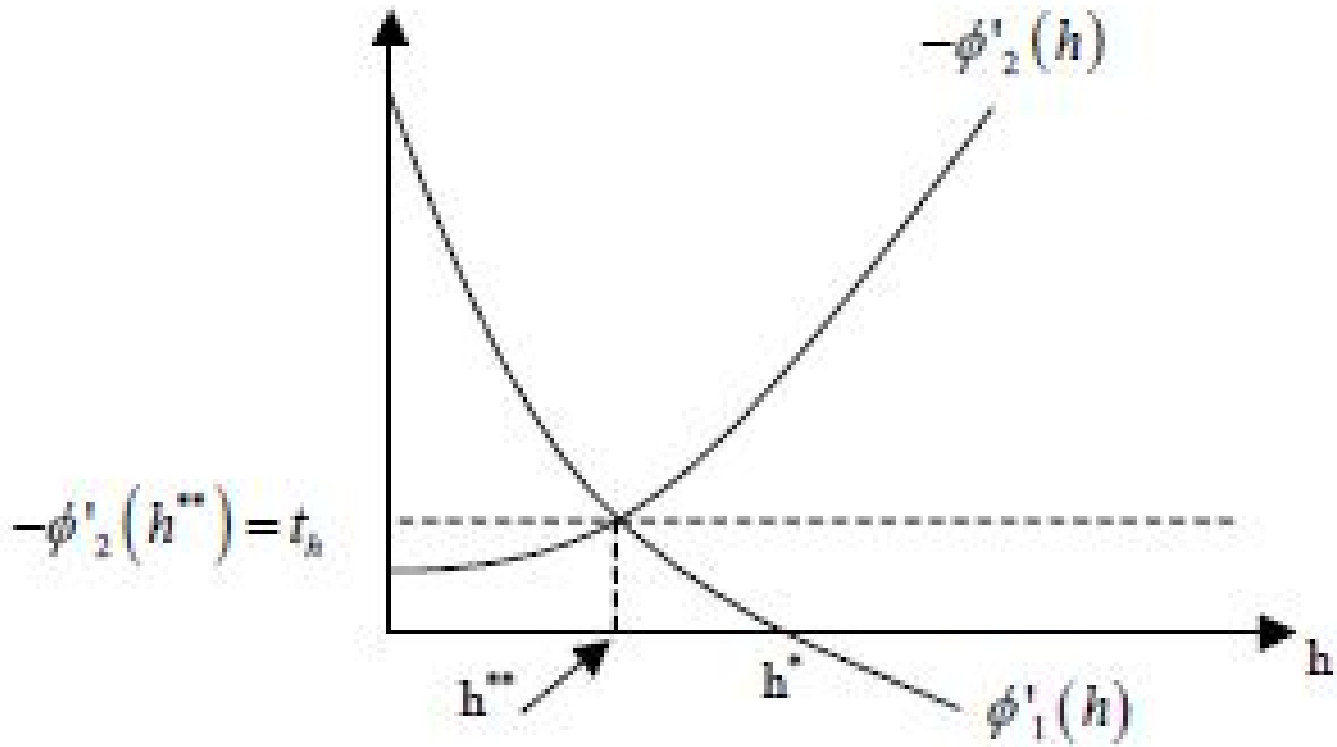
Quotas and Taxation

Suppose consumer 1 were charged a tax of t_h per unit of h produced. His optimization problem would then be

$$\max_h \phi_1(h) - t_h h$$

with FOC $\phi_1'(h^t) = t_h$. Thus, setting $t_h = -\phi_2'(h^{**})$ will lead consumer 1 to choose $h^t = h^{**}$, implementing the social optimum.

Quotas and Taxation



Quotas and Taxation

Note that the proper tax is equal to the marginal externality at the optimal level of h.

By forcing consumer 1 to pay this, he is required to internalize the externality. That is, he must pay the marginal cost imposed on consumer 2 when the externality is set at its optimal level, h^{**}. When the tax rate is set in this way, consumer 1 chooses the Pareto optimal level of the externality.

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Another equivalent approach would be for the government to pay consumer 1 to reduce production of the externality. In this case, the consumers objective function is:

$$\phi_1(h) + s_h(h^* - h)$$

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Setting $s_h = -\phi_2'(h^{**})$, the socially optimal level of h is implemented.

Quotas and Taxation

Note that it is central to tax the externality producing activity directly. If you want to reduce pollution from cars, you have to tax pollution, not cars.

Taxes on cars will not restore optimality of pollution (since it does not affect the marginal propensity to pollute) and will distort people's car purchasing decisions.

Quotas and Taxation

Note that taxes and quotas will restore optimality, but this result depends on the government knowing exactly what the correct level of the externality-producing activity is.

In addition, it will require detailed knowledge of the preferences of the consumers.

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We are going to see that as long as property rights are clearly assigned, the two parties will negotiate in such a way that the optimal level of the externality-producing activity is implemented.

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Consumer 2 can sell consumer 1 the right to undertake h_2 units of activity h in exchange for some transfer, T_2. The two consumers will bargain both over the size of the transfer T_2 and over the number of units of the externality good produced, h_2.

Coase's Theorem

Need to specify the bargaining mechanism:

- Consumer 2 offers consumer 1 a take-it-or-leave-it contract specifying a payment T_2 and an activity level h_2.
- If consumer 1 accepts the offer, that outcome is implemented. If consumer 1 does not accept the offer, consumer 1 cannot produce any of the externality good, i.e., $h = 0$.

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Given this constraint, 2 will choose (h_2, T_2) in order to maximise $\phi_2(h) + T$.

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What happens if we change what happens in the event that no agreement is reached?

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Thus the agent 2 problem becomes

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It is only changed the transfer, $T_1 = \phi_1(h^{**}) - \phi_1(h^*)$.

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Consumer 2 is in a better bargaining position when the non-bargaining outcome is that consumer 1 is forced to produce 0 units of the externality good.

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The Coase Theorem provides an argument in favour of having clear laws and well-developed courts.

Externalities and Missing Markets

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Suppose that there was a market for h: agent 2 had the right to prevent all activity h, but could sell the right to undertake 1 unit of h for a price of p_h.

Player 2 will maximise $\phi_2(h) + p_h h$, which has a FOC given by $\phi_2'(h) = -p_h$ which implicitly defines a supply function $h_2(p_h)$.

Externalities and Missing Markets

In deciding how many rights to purchase, consumer 1 maximises $\phi_1(h) - p_h h$, which has a FOC given by $\phi_1'(h) = p_h$ which implicitly defines a demand function $h_1(p_h)$.

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Again...$h^{**} = h^m$. Thus, IF we can create the missing market, that market will implement the Pareto optimal level of the externality.

Externalities and Missing Markets

This result depends on the assumption of price taking. In most real markets with externalities, this is not an unreasonable assumption, since (as in the case of air pollution), there are many producers and consumers.

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This is the basic approach that is used in the case of tradeable pollution permits. The government creates a market for the right to pollute, and, once the missing market has been created, the market will work in such a way that it implements the socially optimal level of the externality good.

Monopoly and Externalities

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We are going to analyse the impact of a different market structure: Monopoly.

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The monopoly then could produce more than, the same as, less than the social optimum.

Monopoly and Externalities

Two offsetting effects:

- Monopoly produces less than competitive market because it sets the price above the marginal cost.
- Monopoly may produce more than the social optimal level because it does not internalize the negative externalities into the marginal cost function.

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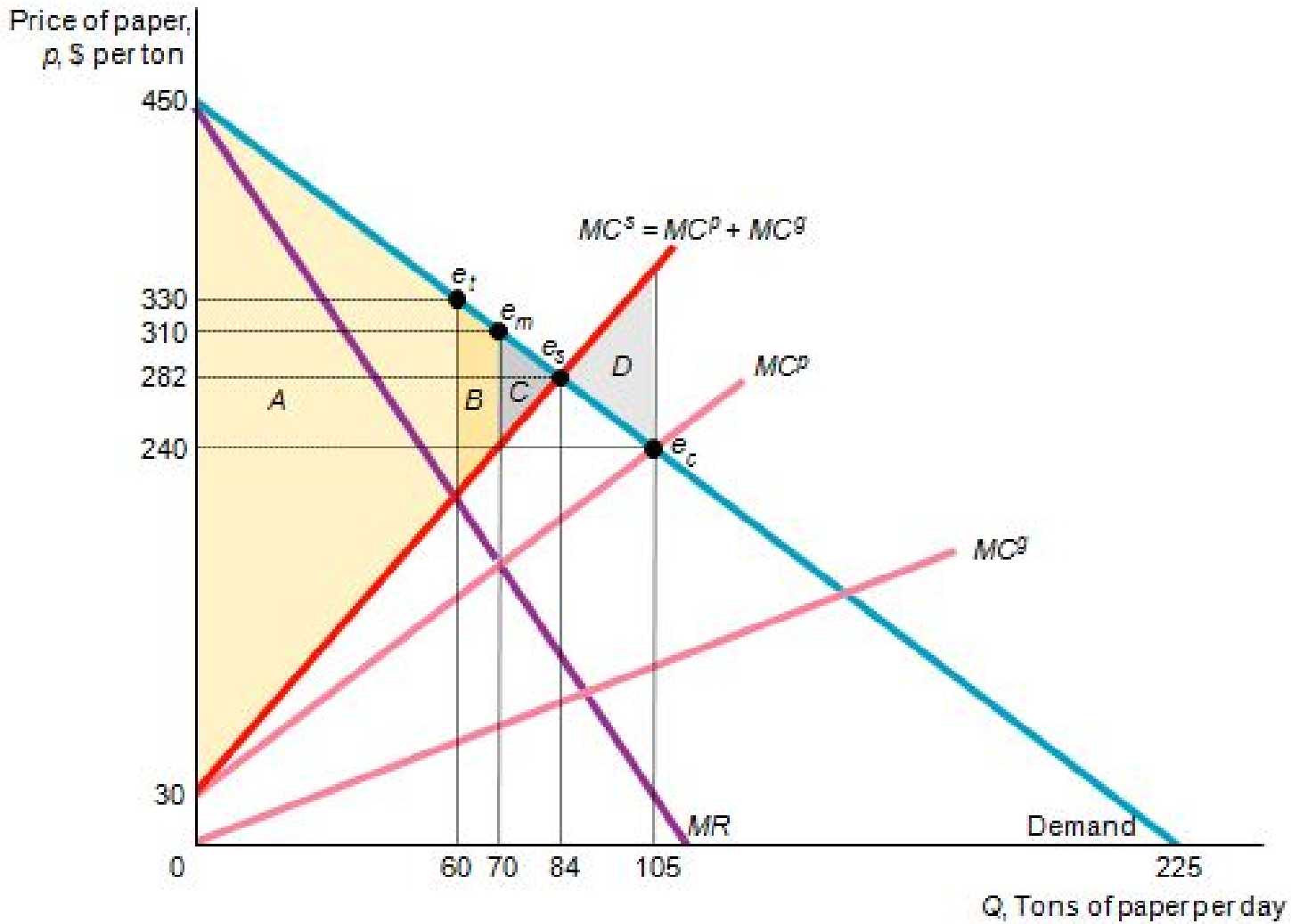
- Monopoly may produce more than the social optimal level because it does not internalize the negative externalities into the marginal cost function.

The final trade-off depends on the elasticity of demand (negatively affecting the price) and on the extent of the marginal damage the externality causes (difference between social marginal cost and private marginal cost).

Monopoly and Externalities



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With a (negative) externality, welfare under monopoly may be greater than under competitive markets.

Monopoly and Externalities

If both the monopoly and competitive market structures produce more than the social optimum, than the monopoly implies greater welfare. If monopoly produces less than the social optimal level, then we need to compare the two deadweight loss areas (the one created by the monopoly and the one created by the competitive market).

Example

Suppose that in the market for paper, demand is $p = 100 - Q$. The private marginal cost is $MC_P = 10 + Q$. Pollution generated during the production process creates external marginal harm equal to $MC_e = Q$. Is social welfare greater under monopoly or under competition?

Market for Pollution

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We can create a market "selling" rights to pollute that could be exchanged in a market (also known as *cap-and-trade* system).

Market for Pollution

Government gives firms permits each of which gives the right to create a certain amount of pollution.

Each firm can use the permits or sell them to other firms.

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If the government tells both the plants to reduce the output by 1 ton, the total cost is $TC = 500$.

Instead, the first plant can reduce the output of 2 tons and sell the right to the second plant. The total cost will be $TC = 400$. More efficient solution!

Market for Pollution

This could be an effective solution in cases where the government does NOT know the efficiency levels of the firms.

Creating a market, it needs only to decide the optimal level of pollution.

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If a firm did not use all its allowance, it may sell to another firm (by auctions).

Exercise

Suppose two agents are deciding how much to drink at dinner knowing that they are going to drive their cars afterwards. Agent i chooses the quantity of wine x_i and gets utility $u_i(x_i)$ from this choice. Assume that $u_i'(x_i) > 0$. However, the more he drinks, the more likely it is that they are involved in a mutual accident. Let $p(x_i, x_j)$ be the probability of an accident, assumed increasing in each argument, and let $c_i > 0$ be the cost imposed on agent i in the case of accident.

Exercise

(a) Show that each agent has an incentive to drive too fast from the social point of view.

Exercise

(b) If agent i is fined an amount t_i in the case of accident, how large should t_i be to internalise the externality?

Exercise

(c) If the optimal fines are being used, what are the total costs, including the fines, paid by the agents? How does this compare to the total cost of the accident?

Exercise

(d) Suppose now the agent i gets utility $u_i(x_i)$ only if there is no accident. What is the appropriate fine in this case?