One of the arguments made in R. H. Coase's (1960, *Journal of Law and Economics*) paper, "The Problem of Social Cost" is that when an activity by one firm affects one other firm, the two firms can negotiate.

Suppose that initially firm 1 is using a level Z_1 of coal, which is greater than the efficient level Z_1^*. The efficient level is the level of coal use which maximizes the total profits $\pi_1 + \pi_2$ of the two firms.

Suppose as well that $Z_1 \leq Z_1^{eq}$, the level of coal usage which maximizes firm 1's profit's π_1. What would happen if firm 1 were to lower its coal usage from Z_1 (with $Z_1^* < Z_1 \leq Z_1^{eq}$) to Z_1^*? Firm 1's profits would decline, since the firm would be reducing its coal usage below the level which maximizes its own profits. Let A_1 represent the **reduction** in firm 1's profits caused by its reducing coal usage from Z_1 to Z_1^*. But firm 2's profits would increase, if coal usage by firm 1 is producing a negative externality on firm 2. Let A_2 represent the **increase** in firm 2's profits caused by the reduction in firm 1's coal usage from Z_1 to Z_1^*.

[If firm 1's labour input were fixed at L_1, then

$$A_1 = p_1(F^1(Z_1, L_1) - F^1(Z_1^*, L_1)) - w_Z(Z_1 - Z_1^*)$$

Since labour use can be varied, the actual expression is

$$A_1 = \max_L[p_1 F^1(L, Z_1) - w_L L - w_Z Z_1] - \max_L[p_1 F^1(L, Z_1^*) - w_L L - w_Z Z_1^*]$$

and

$$A_2 = \max_L[p_2 F^2(L, Z_1) - w_L L] - \max_L[p_2 F^2(L, Z_1^*) - w_L L]$$

the differences in the firms' profits when they adjust labour supplies.]

Since Z_1^* is the efficient level of coal usage, reducing coal use from Z_1 to Z_1^{eq} must increase total profits $\pi_1 + \pi_2$. That is, the fall A_1 in firm 1's profits must be less than the increase in firm 2's profits A_2.

$$A_2 > A_1 \tag{1}$$

What equation (1) implies is that it must be possible for firm 2 to bribe firm 2 to reduce its coal usage to the efficient level. If firm 2 offers firm 1 a bribe of B, with $A_2 > B > A_1$, to reduce its coal usage to Z_1, then both firms are made better off by the transaction. Firm 1 gains $B - A_1$ on net : the bribe is bigger than the reduction in its profits. Firm 2 gains $A_2 - B$: the increase in its profits is greater then the bribe it pays.

So, in the absence of government intervention, it seems unlikely that firm 1 will actually use the inefficient excessive amount of coal Z_1^{eq}, even if the firms remain under separate ownership. As long as a reduction in coal use increases the two firms' total profits, there is a deal that can

be made, which will make both firms better off. It is in each firm's interest to work out such a deal : if firm 2 did not come to firm 1 with a bribe, firm 1 would be wise to make an offer ("I'll reduce my coal usage to Z_1^* if you pay me B") to firm 2. Coal usage would equal the "equilibrium" outcome Z_1^{eq} only if the two firms were somehow unable to negotiate, or were somehow oblivious to the opportunities for a mutually beneficial deal.

Note that the actual amount of the bribe here is not completely specified. Any bribe which is somewhere between A_1 and A_2 in value will make both firms better off. Firm 1 would, naturally, want a high bribe, near the maximum possible value of A_2 ; firm 2 would want a low bribe, near the minimum possible value of A_1. What bribe might actually emerge might depend on the exact form of the negotiation taking place, and on the negotiating skills of the firms.

But the magnitude of the bribe affects only the distribution of profits between the two firms. However those profits are distributed, the outcome of negotiation will be the efficient level Z_1^* of the externality–causing activity. Why? Suppose the two firms had negotiated their way to some other output level $Z_1 > Z_1^*$. Then the fact that total profits are lower at Z_1 than at Z_1^* means that there is room for a further deal : the gain A_2 in firm 2's profits in moving from Z_1 to Z_1^* exceeds the loss A_1 to firm 1. [And if they "over–negotiated" their way to some output level $Z_1 < Z_1^*$, then the gain in firm 1's profits from moving rightward to Z_1^* would exceed the loss to firm 2.]

Was there any role for the government in the above process? The two firms negotiated on their own, motivated by their own profit maximization.

However, the government did play a role of sorts. Why did firm 2 have to pay a bribe to firm 1, in order to get firm 1 to reduce its coal usage? Because firm 1 would not be willing to reduce Z_1 on its own, without some form of compensation. That requirement holds only if firm 1 has the **legal right** to choose whatever level of coal usage it wants. In other words, the negotiations described above would occur only if the courts had ruled that firm 1 has the right to burn all the coal it wants. In the language of Coase, firm 2 will have to bribe firm 2 if firm 1 has the **property right** to pollute if it wants.

How did firm 1 get that property right? Maybe firm 2 actually sued firm 1 first, before any negotiation. If the courts ruled against firm 2's suit, and decided that firm 1 did not have to pay any damages for the harm done to firm 2 by its use of coal, that assigned the property right to firm 1. But one of the main points of Coase's article was that the story does not end with the court decision. If the court threw out firm 2's suit, and let firm 1 do what it wants, there still is room for negotiation. Firm 2 would be willing to bribe firm 1 to reduce coal usage to Z_1^*, after firm 2 lost the lawsuit, and it would be willing to pay a high enough bribe (a bribe between A_1 and A_2 in magnitude) that firm 1 would be willing to accept it.

So, the negotiation after the failed lawsuit ensured an efficient outcome.

What would happen if firm 2 won its lawsuit? Suppose that the courts ruled that firm 1 had no right to use coal, without firm 2's permission. The "immediate" result would be a reduction in coal usage by firm 1 to $Z_1 = 0$, since coal use is not allowed (without firm 2's permission). That's an inefficiently **low** level of Z_1 : since $0 < Z_1^*$, burning a little coal increases firm 1's profits more

than it decreases firm 2's profits.

But again, this is not the end of the story. Now firm 1 has an incentive to bribe firm 2 to allow it to use coal.

Suppose that Z_1 is some low level of coal use, with $0 \leq Z_1 < Z_1^*$. What would happen if firm 1's coal use went from Z_1 to Z_1^*? Then firm 1's profits would increase (since $Z_1^* < Z_1^{eq}$, by some positive A_1'. The increase in coal use would lower firm 2's profits, by some A_2'. The change in total profits would be $A_1' - A_2'$, which must be positive, since Z_1^* leads to the highest possible level of total profits. So it must be true that the increase A_2' in firm 1's profits is greater than the decrease A_2' in firm 2's profits. That being true, there must be some bribe B' that firm 1 can offer firm 2, to be allowed to use Z_1^* of coal. If $A_1' > B' > A_2'$, then both firms would gain, if firm 1 bribed firm 2 to get the right to increase coal use from Z_1 to Z_1^* : firm 1 would gain more in profits than the cost of the bribe it paid ; firm 2 would lose less in profits than the bribe it got.

So if the courts had decided in firm 2's favour, that would not be the end of the story either. After the decision, there would be room for a deal. The deal would involve firm 1 (the loser of the court case) to bribe firm 2 to allow it to use coal, a right which it no longer can exercise without firm 2's permission. And as before, the only outcome of negotiation will be one in which firm 1 gets the right to use Z_1^* tonnes of coal. If it is allowed to use only $Z_1 < Z_1^*$ tonnes, then it could bribe firm 2 to let it use more.

So this is one of Coase's results, that — in some sense — "property rights don't matter". Here, whether the courts decided for firm 1 or for firm 2, the level of coal usage finally chosen is the same, Z_1^*.

Property rights do matter for the firms' owners. Regardless of the assignment of property rights, firm 1 uses the efficient input combination (L_1^*, Z_1^*), and earns profits of $p_1 F^1(L_1^*, Z_1^*) - w_L L_1^* - w_z Z_1^*$, and firm 2 employs its efficient quantity L_2^* of labour, earning profits of $p_2 F^2(L_2^*, Z_1^*) - w_L L_2^*$. But if firm 1 wins in court, it also collects a bribe from firm 2 (which induces firm 1 to lower its coal use to the efficient level). If firm 2 wins in court, it collects a bribe from firm 1 (to induce it to allow firm 1 to increase its coal use from 0 to the efficient level). So the firm which wins in court is better off, since it receives the payment from the other firm, rather than making the payment.

If we had people, rather than firms, involved in the externality, then the assignment of property rights would actually affect the level of the externality. With person–to–person externalities, there are many efficient allocations : assigning the property right to person 1 will give rise to an allocation more favourable to person 1. But if the people can negotiate, the outcome after negotiation will be efficient, regardless of who has the property rights.

The general result, then, is that negotiation will lead to the internalization of the externality, and an efficient outcome. In this case, the only government involvement needed is the presence of the courts, to determine who has to bribe whom. And, in this situation, it really does not matter (for the sake of the efficiency of the outcome) to whom the courts assign the property right, just as long as they do assign it.