Introduction to Law and Economics: Coase Theorem

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Welfare and Efficiency

- In economics, we usually compare policies by their comparative efficiency.
- A policy or allocation of resource, A, is more efficient than another B if everybody involved under A has at least as great a profit or utility as under B.
- A policy or allocation is called a Pareto-optimum if nobody's benefit can be improved by decreasing that of at least one of the others.
- Example: Suppose there are two consumers, A and B, and two goods, x and y. Originally, consumer 1 has 2 units of x and consumer 2 has 1 unit of y. The utility tables are as follows.

Welfare and Efficiency

$u_A(x, y)$:

		y = 0	y = 1
x	0	0	1
	1	2	4
	2	3	6

$u_B(x, y)$:

		y = 0	y = 1
x	0	0	2
	1	3	4
	2	4	5

- Originally, the utility of consumer 1 is 3, and that of consumer 2 is 2. This allocation, however, is not efficient.
- Consumer 1 can exchange 1 unit of x with 1 unit of y from consumer 2. In that case his utility increases from 3 to 4, and consumer 2's utility increases from 2 to 3.

Welfare and Efficiency

- What are the Pareto-optimum allocations?
- $\big((0,0),(2,1)\big)$, which yields utility (0, 5)
  $\big((1,0),(1,1)\big)$, which yields utility (2, 4)
  $\big((1,1),(1,0)\big)$, which yields utility (4, 3)
  $\big((2,1),(0,0)\big)$, which yields utility (6, 0)
- The following are not Pareto-optimum allocations:
  $\big((2,0),(0,1)\big)$, which yields utility (3, 2)
  $\big((0,1),(2,0)\big)$, which yields utility (1, 4)

Externalities

- When the action of one agent affects the welfare of others, we say this agent's action has an externality.
- Law and economics (or law itself) is very concerned with externalities, because the function of law is exactly to regulate how one's action (or inaction) affects the others.
- A consumption externality is caused by an agent's consumption. A production externality is caused by an agent's production.

Externalities

- Examples of consumption externality: smoking, playing fireworks, any consumption which cause pollution, charities, receiving education, getting vaccines. The first three have negative consumption externality, while the last three have positive consumption externality.
- Examples of production externality: Refining oil or essentially any production process which pollutes or discharges CO_2. This is the case of negative production externality. Building schools or universities, producing vaccines or drugs and giving to poor countries are examples for positive production externality.
- Private consumption or production with externalities often leads to inefficiency.

- Negative consumption externality example:

unit of consumption	private benefit	private cost	social cost	net private benefit	net total social benefit
0	0	0	0	0	0
1	5	2	1	3	2
2	9.5	4	2	5.5	3.5
3	12	6	3	6	3
4	14.5	8	4	6.5	2.5
5	15	10	5	5	0

- Since a consumer considers his private benefit only, he will consume 4 units of the good, which maximizes his own benefit. But the net total social benefit attains its maximum at 2 units.
- Lesson 1: Negative consumption externality usually results in level of consumption being greater than social optimum.

Externalities

- Positive consumption externality example:

unit of consumption	private benefit	private cost	social benefit	net private benefit	net total social benefit
1	5	2	2	3	5
2	9.5	4	4	5.5	9.5
3	12	6	6	6	12
4	14.5	8	8	6.5	14.5
5	15	10	10	5	15

- A consumer on his own will consume 4 units, while net total social benefit is maximized at 5 units.
- Lesson 2: Positive consumption externality usually results in level of consumption being <u>less than</u> social optimum.

Externalities: Some math

- x: Level of consumption.
- $B(x)$: Consumer's private benefit.
- $C(x)$: Consumer's private cost.
- $SC(x)$: Social cost, if negative externalities.
- $SB(x)$: Social benefit, if positive externality.
- $B' > 0, B'' < 0; C', C'', SC', SC'' > 0$.

Externalities: Some math

- Private incentive:

$$Max_x B(x) - C(x).$$

- First-order condition (FOC):

$$B'(x) = C'(x).$$

- Social incentive (negative externality):

$$Max_x B(x) - C(x) - SC(x).$$

Externalities: Some math

- FOC:

$$B'(x) = C'(x) + SC'(x).$$

- Social incentive (positive externality):

$$Max_x B(x) - C(x) + SB(x).$$

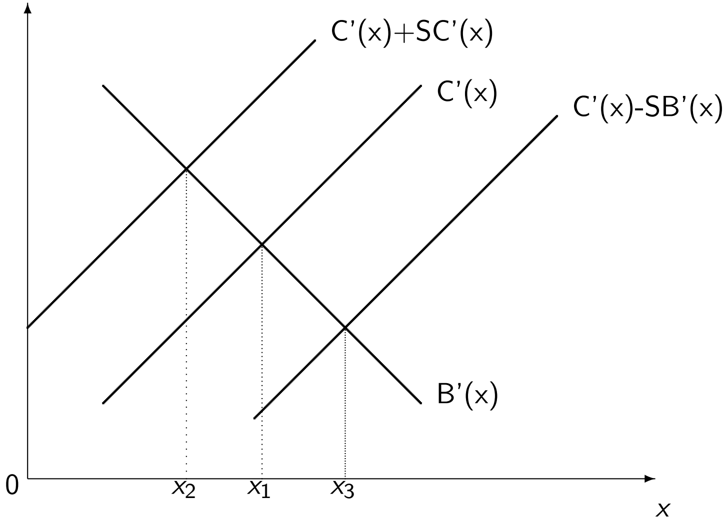
- FOC:

$$B'(x) = C'(x) - SB'(x)$$

Externalities

- The case for production externality has exactly the same reasoning. We therefore have a similar lesson:
- Lesson 3: Negative (positive) production externality results in production level greater (smaller) than social optimum.
- In summary, if people consider only their private benefits, then whatever they do which benefits (hurts) the society they do too little (much), in the society's view.

Externalities: Some math



Externalities: Pigou Taxes and Subsidies

- How to cure it: Tax or subsidy.
  The government can tax (in the case of negative externality) or subsidize (in the case of positive externality) consumption or production by exactly the same amount of externality it causes to restore social optimum.
- This is generally called Pigou taxation.
- Pigou taxes thus internalize the externalities caused by the consumption or production.
- Pigouvian taxation requires governmental intervention, and government has to know the details of cost/benefit.

Coase Theorem: Preview

- In general, do externalities necessarily call for governmental intervention?
- Ronald Coase (1960): Social optimum will realize without governmental intervention, as long as (i) information is perfect, and (ii) bargaining has no friction. That is, when there is no "transaction cost".
- More importantly, although efficiency can be reached without intervention, different assignments of legal rights will result in different distributions of welfare.

Coase Theorem: Assignments of Legal Rights

- Two possible assignments of rights, reflecting two possible legal regulations:
  (i) Victims (or beneficiaries) to externalities have the legal rights.
  (ii) Consumers or producers have the legal rights.

Coase Theorem: Assignments of Legal Rights

- In case (i), when the victims have the legal right, the consumer (or producer) can bribe the victims to "buy the right" to consume (or produce). Similarly, in the case of positive externality, the beneficiaries can directly designate the consumption level. If that level is not what consumer (or producer) most desires, he can bribe the beneficiaries to "buy out the responsibility".

Coase Theorem: Different Assignments of Legal Rights

- In case (ii), the consumer (or producer) has the legal right. In order to avoid the negative externalities, the victims can offer bribe to the consumer (or producer) to "buy it out". Similarly, in the case of positive externality, the beneficiaries can bribe the consumer to a level they most desire.

Coase Theorem: Case When the Consumer Has Legal Rights in the Negative Externalities Example

- Take the example in page 7.
- If consumer (i.e., the smoker) has the legal right, he chooses 4 units of consumption.
- The victims can "bribe" the smoker by compensating his loss, and change the level of smoking.
- The buyout that is most beneficial to the victims is for them to pay (6.5-5.5) to the consumer, which reduces the cost of the victims from 4 to 2. Net gain: (4-2)-(6.5-5.5)=1.
- The consumption level is 2, which is the social optimum.

Coase Theorem: Case When the Victims Have Legal Rights in the Negative Externalities Example

- On the other hand, when victims have legal rights, level of consumption will be chosen to be 0.
- The consumer must bribe the victims to go to the consumption level he most desires.
- The optimal is for consumer to pay 2 to the victims, in that case he gains $5.5 - 2 = 3$.
- The consumption level is 2, which is the social optimum.
- Under both property assignments, final consumption level is at the social optimum (2).

Bargaining Procedure: Smoker has the Legal Rights

- When the smoker has the right, he is will consume 4 units, as this maximize his net benefit.
- Nonsmoker can bargain with smoker to change his consumption level by offering him compensation. For example, nonsmoker can offer a compensation of $(6.5 - 0)$ for nonsmoker to reduce his consumption from 4 to 0. This reduces nonsmoker's (the social cost) from 4 to 0. However, since he must pay 6.5 as compensation, the nonsmoker's net benefit to bargains to a 0 consumption is $4 - 6.5 = -2.5$.

Bargaining Procedure: Smoker has the Legal Rights

- Nonsmoker can bargain with smoker to any consumption level from 0 to 5. The net benefit of various level is

unit	conpensation	gain to nonsmoker	net gain of bargaining
0	$6.5 - 0 = 6.5$	$0 - (-4) = 4$	$4 - 6.5 = -2.5$
1	$6.5 - 3 = 3.5$	$-1 - (-4) = 3$	$3 - 3.5 = -0.5$
2	$6.5 - 5.5 = 1$	$-2 - (-4) = 2$	$2 - 1 = 1$
3	$6.5 - 6 = 0.5$	$-3 - (-4) = 1$	$1 - 0.5 = 0.5$
4	$6.5 - 6.5 = 0$	$-4 - (-4) = 0$	$0 - 0 = 0$
5	$6.5 - 5 = 1.5$	$-5 - (-4) = -1$	$-1 - 1.5 = -2.5$

- Nonsmoker's net gain of bargaining is positive and maximal at 2 units.

Bargaining Procedure: Smoker has the Legal Rights

- Therefore, given perfect information and frictionless bargaining, nonsmoker will settle with smoker at 2 units, paying him 1 as compensation.
- Note that 2 is the socially optimal consumption level.
- In this case, the net benefit of the nonsmoker is $-2-1=-3$. That of the smoker is 6.5.

Bargaining Procedure: Nonsmoker has the Legal Rights

- When the nonsmoker has the right, he will demand zero consumption, as this minimize the social cost.
- Smoker can bargain with the nonsmoker to increase his consumption level by paying nonsmoker compensation.
- For example, if he wants to consume 3 units, he can pay nonsmoker $3-0$. This increases the private benefit by $6-0$.

unit	conpensation	gain to smoker	net gain of bargaining
0	$0-0=0$	$0-0=0$	$0-0=0$
1	$1-0=1$	$3-0=3$	$3-1=2$
2	$2-0=2$	$5.5-0=5.5$	$5.5-2=3.5$
3	$3-0=3$	$6-0=6$	$6-3=3$
4	$4-0=4$	$6.5-0=6.5$	$6.5-4=2.5$
5	$5-0=5$	$5-6.5=-1.5$	$-1.5-5=-6.5$

Bargaining Procedure: Nonsmoker has the Legal Rights

- Again, the level of consumption that increases smoker's net benefit is 2.
- Smoker will settle with nonsmoker cut consumption level 2.
- Lesson: Regardless which side has the legal right, the bargaining outcomes are the same: 2 units. Moreover, this is the socially optimal level.
- Lesson: Although either assignment of legal right leads to efficiency, they result in different distribution of net benefits. The first is $(6.5, -3)$; the second is $(3.5, 0)$. Note that they both add up to 3.5.

Coase Theorem: Maths for Case when Consumer Has Legal Rights

- In order to persuade the consumer (smoker) to move to a new consumption level, the victims must offer a bribe (or compensation) in the value of

$$smoker's\ original\ net\ private\ benefit - smoker's\ new\ net\ private\ benefit$$

- The net gain for the victim to bargain away from the original position to a new consumption level is therefore

$$\begin{aligned}
&[original\ social\ cost - new\ social\ cost] - bribe \\
=&[original\ social\ cost - new\ social\ cost] - \\
&[smoker's\ original\ net\ private\ benefit - smoker's\ new\ net\ private\ benefit] \\
=&[original\ social\ cost - smoker's\ orignial\ net\ private\ benefit] + \\
&[smoker's\ new\ net\ private\ benefit - new\ social\ cost].
\end{aligned}$$

Coase Theorem: Maths for Case when Consumer Has Legal Rights

- The term in the first bracket is a constant. The term in the second bracket is the (new) net social benefit.
- When maximizing their net gain from bargaining, the victims are actually equivalent to maximizing the term in the second bracket, which is exactly the net social benefit.

Coase Theorem: Maths for Case when Victims Have the Legal Rights

- In order to persuade the victims to accept a new consumption level, the consumer (i.e., the smoker) must offer a bribe of

$$new\,social\,cost - original\,social\,cost$$

- The smoker's net gain from bargaining to a new consumption level is

$$\begin{aligned}
&[smoker's\ new\,net\,private\,benefit - smoker's\ original\,net\,private\,benefit] \\
&- bribe \\
=&[smoker's\ new\,net\,private\,benefit - smoker's\ original\,net\,private\,benefit] \\
&- [new\,social\,cost - \ original\,social\,cost] \\
=&[original\,social\,cost - smoker's\ original\,net\,private\,benefit] + \\
&[smoker's\,new\,net\,private\,benefit - \ new\,social\,cost].
\end{aligned}$$

Coase Theorem: Maths for Case when Victims Have the Legal Rights

- The term in the first bracket is a constant. The second term is the (new) net social welfare. Therefore, when maximizing his net gain the smoker is as if maximizing the second term which, again, is the net total social benefit.

Coase Theorem: Efficiency Property

- Summary: If the victims (or beneficiaries) and the consumer can bargain without friction, then efficiency always attains.
  In the negative externalities example, regardless of property right assignment, the consumer always consumes 2 units of the good.
- Similar reasoning for positive externality and for the case of production externalities.

Coase Theorem: Efficiency Property

- Coase Theorem I: When transaction cost is zero, even if production or consumption exhibits externality, bargaining process always results in social efficiency regardless of property right assignment.

Another Example from Cooter and Ulen

- A cattle rancher resides beside a farmer, who grows corn.
- There is no fence on the boundary between the ranch and the farm.
- Cattles can wander into farm and cause a damage $100 on corn .
- Two specific rules can be adopted:
  - Farmer must bear the damage himself, an "open area" rule.
  - Rancher is responsible for the damage caused by cattle.
- Traditional legal thinking will be to adopt 2nd rule, as rancher's cattle harms the farmer's corn, but the farmer does not harm the cattle. (Causality).
- Coase's thinking is in terms of efficiency.

Another Example from Cooter and Ulen

- Suppose the damage can be avoided by either building a fence around the ranch, which costs \$75, or around the farm, which costs \$50.
- Building a fence is efficient, as both cost less than \$100. But who should build it?
- On efficiency ground, the farmer should build the fence as it incurs lower cost. (Note that this contradicts the causality thinking).
- Under first rule, the farmer will build it. Under second, the rancher.
- However, under 2nd rule, rancher can bargain with the farmer.

Another Example from Cooter and Ulen

- Rancher can offer a sum between $50 and $75 for the farmer to build it, and the farmer will agree.
- Under both rules, the more efficient way to avoid damage will be adopted, viz., farmer building the fence.
- Conclusion: Regardless of legal rule, the more efficient result will be reached by mutual bargaining. This is Coase Theorem.

Coase Theorem: Distribution Concern

- Property assignment, however, affects income distribution.
- In the negative externalities example above, the consumer's benefit is 6.5 (and the victims -3) when the consumer (i.e., smoker) has property right to consume. If the victims have the property right, the benefit of victims is 0, and that of the consumer is 3.5.
- Although the consumption level is at the efficiency level, 2, the benefit of the consumer and the victims are different under the two property rights assignments.
- In the rancher-farmer example, whoever does not have the property right will pay for the farmer's cost of building the fence.

Coase Theorem: Distribution Concern

- Coase Theorem II: Though property right assignment does not prevent the final consumption or production from being efficient, it affects the income distribution of society.

Coase Theorem: Conclusion

- Efficiency is a positive issue, while income distribution is a normative issue.
- Government policy only meddles with the normative issue without helping the positive issue.

Qualifications to Coase Theorem

- Underlying assumption for Coase Theorem is that there is no transaction cost in bargaining. This transaction cost is taken to encompass all impediments to bargaining.
- Bargaining, however, is never costless.
- What happens to Coase Theorem if bargaining is costly?

Qualifications to Coase Theorem

- Example 1: Consider the farmer+rancher example. If the total bargaining cost is $35, and the legal rule is open area rule, then efficiency attains. If rancher is responsible for damage, then he will be forced to build it despite the possibility of bargaining. (Why?)
- Lesson 1: If bargaining is costly, then legal rule matters, in the sense that some rules are efficient, some not.

Tragedy of the Commons

- When people are using a common resource whose property rights are not assigned, the resource tends to be overly expleted.
- Example: Suppose there is a common pasture where villagers graze their cows. The barrels of milk that a cow produces decreases with the number of cows on the pasture, and for simplicity it follows the pattern below:

# cows	barrels of milk per cow: 12-2n
1	10
2	8
3	6
4	4
5	2
6	0

Tragedy of the Commons

- Suppose the cost to buy a cow is $2. If the pasture is owned by one villager, then his profit as a function of number of cows he owns (or allow other villagers to graze and charge them) is

# cows	profit
1	8
2	12
3	12
4	8
5	0
6	-12

Tragedy of the Commons

- Profit-maximizing number of cow is either 2 or 3.
- If the pasture is a common ground with no property rights assigned, then anybody can buy a cow at cost $2 and graze it on the pasture. In that case the number of cow will be such that $12 - 2n = 2$, that is, when the value of milk equals cost to buy a cow. This is the case when $n = 5$.
- The latter case is not efficient since it does not maximize the net value of grazing.
- Other examples: fishing, foresting, etc.