Externalities

Massimo D’Antoni
Department of Economics and Statistics
University of Siena

Course of Public Economics
Academic Year 2013-2014
What are externalities, and what they imply
Externalities

While the standard model assumes that $h$’s utility is $x_h + v_h(y_h)$ for $h > 1$, in this case we have $x_h + v_h(y_h) + \phi_h(y_1)$: consumption of $y_1$ affects other individuals’ utilities.

- Efficiency requires

$$v'_1(y_1) + \sum_{h>1} \phi'_h(y_1) = v'_h(y_h)$$

- however, in a competitive market we have $v'_h(y_h) = p$ for all $h$
  (individuals, including 1, only take into account their private benefit from $y_h$)

- demand is lower (higher) than optimal as long as $\sum_{h>1} v'_h > 0$ ($< 0$)

Externalities can be

- **Negative** or **positive**
  - negative $\rightarrow$ overprovision of the good involving the externality
  - positive $\rightarrow$ underprovision etc.

- They can affect **consumption** or **production**
Pecuniary externalities are not real externalities
Example: the market value of my skill depends on others’ decision to acquire that skill. However, in this case the "external" effect goes through market prices and market is conducive to efficiency

The economic view of externalities (vis-a-vis other views) is that externalities are a matter of costs and benefits among the parties involved.

- The optimal level of externality is defined by the condition that an additional level of externality involves a marginal social cost larger than the marginal social benefit;
- in general, the optimal level of an harmful activity is larger than zero (there are diminishing returns to reducing externalities);
- as emphasized by Coase, the externality can be seen as bilateral (the "direction" of the externality is a function of the entitlement of "property" rights)
  - Who "causes" the externality? See the case of the sparks from a railroad on the farmer’s land: was it fault of the railroad, or was it the farmer who located his crops too near the tracks?
Examples of negative externalities

- **Harm from risky activities (accidents).** Precautions to reduce the risk of an accident reduce the benefit from (increase the cost of) the activity.

- **Pollution.** A factor of production (environment, clean air) the polluter is not required to pay for.

- **Congestion.** The use of an asset/resource reduces others’ use to some degree.

- **The tragedy of the commons.** Impossibility/difficulty to exclude anyone from use of a common resource implies overexploitation (individuals do not internalize the full cost of their use).

- **The rat race (positional competition).** What counts is not the absolute level of consumption, but consumption relative to other individuals.
  - **Positional goods** (e.g. social status, exclusive real estates, etc.)
  - Others’ consumption affects negatively one’s utility
    See recent contribution on relative income/consumption: Hopkins & Kornienko (2004); Luttmer (2005); Clark, Frijters & Shields (2008)

In all these cases too much of the activity producing the externality...
Positive externalities

- **Education** or, in general, sharing of a common language, values, culture, as it facilitates communication and cooperation

- **Health**, either "objectively" (communicable diseases) or "subjectively" (I care for other people’s health)

- **Altruism** can be represented as an externality (note however the *warm glow* interpretation of altruism)

In all these cases, it is efficient to encourage externality producing activities (incentives, subsidies, direct provision at reduced cost)

Additionally:

- **Bandwagon effect and fashion (network externalities)**
  - Individuals’ benefits from using a certain technology (or standard) increase with the number of those using the same technology
  - it can determine a positive feedback to increased market share, so that the market tends to become monopolistic and efficient innovations can be prevented
Solutions to negative externalities
The analysis of externalities as a source of divergence between private and social returns to individual actions (as emphasized mainly by A. C. Pigou) supported the case for state intervention, through taxation or regulation.

This conclusion was criticized—and put into correct perspective—by Ronald Coase (1960, "The problem of social cost", republished in 2013).

Coase points out that in many circumstances the parties entitled to the right (to do something or to prevent someone else from doing something) can negotiate over the best course of action.

This has been taken to imply that in many cases the government only needs to assign and enforce property rights: decentralized negotiation will do the rest—the scope for government intervention is narrower than it was thought.
Coase’s theorem

Coase theorem (version 1)
As long as private property rights are well defined under zero transaction cost, exchange will lead to efficient use of resources.

Coase theorem (version 2)
The allocation of resources is invariant to the assignment of private property rights under zero transaction cost and zero income effect.

Note that the zero transaction costs assumption might make this result a tautology. It is better to read it in negative: only if transaction costs are zero the allocation of property rights is irrelevant for efficiency.

- With transaction costs, the allocation of property rights affects efficiency
How should a right be protected?

Consider the right not to be damaged (in someone’s body or property). This can be protected by someone else’s action in different ways (Calabresi & Melamed, 1972)

**Property rule** if A is assigned a right, she can stop any action from B that affects her right; an agreement with A must be reached before an action is taken that threatens A’s right.

**Liability rule** if A is assigned a right, B can infringe A’s right provided that A is compensated for this (B is liable for any harm on A). It involves a third party (the judge) assessing the damage done.

Which one is better?

- when bargaining costs are low, under a property rule parties will agree on an efficient allocation of rights (but this is true also of a liability rule)
- when bargaining is too costly, a liability rule is better for negative externalities (this is clearly true when the damage is observable, and it can be shown to be the case also when the damage is uncertain but the error in its ex post assessment is not systematic)

Some kinds of right (usually referred to as *human rights*) are not alienable. Why? Is there an economic reason for this?
Note that we can have

- **Strict liability**: the injurer is liable whenever an accident takes place, regardless of the level of care exerted—we have a full internalization of the externality.

- **Negligence rule**: the injurer is liable only if the level of care is below "due diligence". This results in an efficient outcome if required care is optimally calculated (for additional care, marginal cost > marginal benefit).
  - It gives the victim incentives to take case (if she is the efficient).
  - In equilibrium (because due care is taken) the cost of the harmful activity is borne by the potential victim.
Negligence rule and optimal bilateral incentives

Assume an activity carried out by A (the potential injurer) entails the risk of an accident on B (the potential victim)

- $L$ is expected loss for B in case of accident
- $p(x, y)$ is the probability of an accident as a function of A’s care $x$ and B’s care $y$ (care is measured by its monetary cost)

The social optimal level of care is given by $(\hat{x}, \hat{y})$ which solves

$$
\min_{x, y} Lp(x, y) + x + y \quad \implies \quad \begin{cases} 
L \frac{\partial p(\hat{x}, \hat{y})}{\partial x} = -1 \\
L \frac{\partial p(\hat{x}, \hat{y})}{\partial y} = -1 
\end{cases}
$$

The negligence rule implies that A pays damages $L$ if the accident takes place and $x < \hat{x}$.

- Prove by exercise that the choice of $\hat{x}$ by A and $\hat{y}$ by B is the only Nash equilibrium of the game between A and B
The limits of liability

In some cases liability rules are not enough to induce efficiency:

▶ compensation required may exceed the injurer’s wealth (judgement proofness)
▶ difficult to identify who determined the harm/who is harmed (e.g. harm is a function of total rather than individual activity)
▶ potential injurers may not be aware of the effect of their actions on third parties
▶ victims may lack incentives to bring suit, due to legal costs or collective action problems.

When liability is insufficient to deter harmful activities

▶ additional sanctions can be imposed in case of harm (fines, punitive damages), possibly non monetary sanctions (criminal sanctions).
▶ the government can directly control/discourage potentially harmful activities (regardless of the fact an accident has taken place). This can be done through
  ▶ Regulation
  ▶ Taxation
  ▶ Licences / tradeable permits
Regulation

The government regulates activities by imposing standards of safety, requiring that some precautions are taken.

▶ Compliance to regulation is typically costly for the potential injurer or the victim, and requires costly enforcement by the government
▶ such costs should be compared to benefits (lower expected harm)

Regulation is an effective solution
▶ when actions required by regulation produce benefits always exceeding their cost
▶ and, of course, when it is not prohibitively costly to observe the activity and enforce the rules

However, regulation tends to impose uniform rules, although the optimal level of care may be different for different firms/individuals, depending on differences in cost as well as benefits from harmful activities

Regulation may not be the best solution when individuals/firms are heterogeneous and operate in different circumstances.
This was the solution suggested by Pigou (*pigouvian taxation*).

- The optimal level of taxation forces the individual to internalize the *marginal* external cost of his/her activity.

Formally:

- Let $b_h(w_h)$ the benefit of firm $h$ from activity of level $w_h$, $H(w)$ is expected social harm, where $w = \sum_h w_h$.
- The optimal levels of activity are given by

$$\max_{w_1, \ldots, w_H} \sum_{h} b_h(w_h) - H(w)$$

or $\hat{w}_1, \ldots, \hat{w}_H$ such that $b'_h(w_h) = H'(w)$ for each $h$.

- Note that with different benefits $b_h$ there is no uniform level $\bar{w}$ which can induce efficiency (verify by exercise).

- The optimal solution can be implemented by requiring firms to pay a tax $t$ proportional to $w_h$, with $t = H'(w)$.

- With such tax, each firm maximizes $b_h(w_h) - tw_h$ and selects $\hat{w}_h$. 

Massimo D’Antoni  
Course of Public Economics, Academic Year 2013-2014  
Dept. of Economics and Statistics, University of Siena
Individuals are assigned permits/licences, which they are allowed to trade (cap and trade)

- the total quantity $\bar{w}$ is determined ex ante by the government, which assigns each firm $\bar{w}_h$ so that $\sum_h \bar{w}_h = \bar{w}$
- the final allocation of rights is decided by the market, rights are allocated to those who value them most
- firms trade their permits until $b'_h(w_h)$ is the same for all; if trades take place in a competitive market, the market clearing price of licences turn out to be $p = b'_h(w_h)$
- the final allocation solves

$$\max_{w_1, \ldots, w_H} \sum_h b_h(w_h) \quad \text{s.t.} \quad \sum_h w_h = \bar{w}$$

- this corresponds to the efficient solution as long as the total quantity $\bar{w}$ is such that $b'_w(w_h) = H'(\bar{w})$
This is an instance of the classical *prices vs quantity* problem. When information is complete, the two solutions are equivalent. When marginal benefits are uncertain, which is better depends on the elasticity of the function representing marginal social harm.

Quantity (licences) is better

Taxation is better
Licences vs taxation

More sophisticated solutions can improve the outcome:

▶ taxation can be *nonlinear*—i.e. increasing in the aggregate level $w$

If this is possible, taxation dominates quantity regulation even when $H(w)$ is uncertain:

▶ Nonlinear taxation is not easy to implement. However, in practice, taxes can be adjusted so that we converge to the equilibrium

▶ a similar iterative process can be envisaged for licences: we increase the quantity if the price is above the marginal social cost of the activity, and vice versa
Positive externalities, merit goods and the role of the state
Solutions to positive externalities

In many case the mirror solutions for negative externalities

- Assign property rights (from common property to private property)
- Mandates and regulation (vaccines, compulsory education and pension)
- Subsidize or tax breaks (merit activities, philanthropy, education, healthcare)
- Direct provision free of charge (or at subsidized price)
  - Note however that externalities justify subsidiation of production of healthcare and education, but they do not easily explain direct public provision

Note that it is not sufficient that an activity is socially valuable to justify intervention, there must be a market failure (underprovision by the market)
Externalities or internalities?

Same activities/consumption are encouraged or discouraged even if they are not (strictly speaking) externalities, as they do not affect third parties’ utility. Examples:

▶ smoking, alcohol
▶ to some extent: education, cultural consumption

Justification

▶ Paternalism: the individual is not the best judge of his/her well being, the government knows better
▶ Lack of self control by the individual: he/she knows what is good/bad but is not able to behave accordingly
  ▶ myopia
  ▶ time-inconsistent (hyperbolic) preferences

Recent studies of behavioural economics confirm that the individual is not always "rational" and may lack self control