Applied environmental economics |
Economic valuation of environmental damages and analysis of environmental policies

Introduction – Therorethical background

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Market, equilibrium and perfect competition

Markets provide a mechanism for allocating scarce resources to their
most highly-valued uses:
· Prices transmit *information about costs and values*
· Markets provide *incentives to improve efficiency and to redirect* resources to higher-valued uses.

Voluntary exchange is Pareto-improving, in the sense that at least one party to the transaction is made better-off, and neither is made worse off by the transaction.

A perfectly-competitive market economy leads to a Pareto optimum, provided that certain conditions are met ("First Fundamental Theorem of Welfare Economics").

If these conditions *(see next slides) do not hold then the outcome of a* market economy may not be Pareto optimal. There is "market failure".

Market, partial equilibrium and perfect competition

The market equilibrium:

- Convergent
- Stable
- Optimal, under perfect competition

Perfect competition :

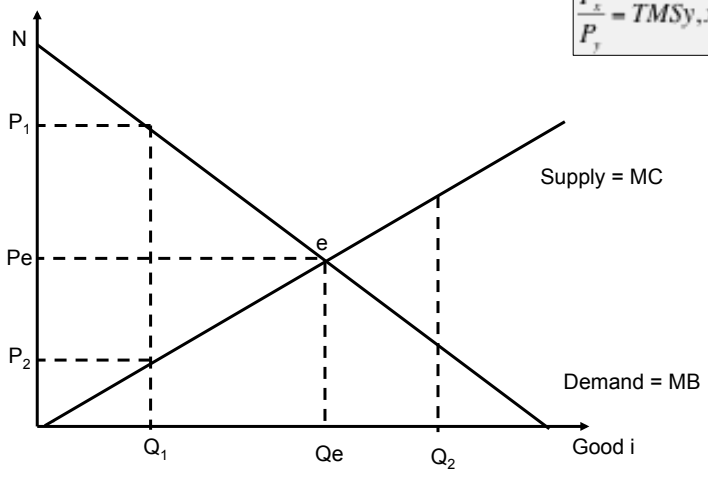
- Large number of actors
- Homogeneity
- Perfect information
- Rival and exclusive goods
- Free entrance and leave
- No external effects

Welfare economics 1st Theorem: the market equilibrium is an optimum under perfect competition
(see Pareto criteria…)

Market equilibirium under perfect competition

$$\frac{P_x}{P_y} = \frac{Bm_x}{Bm_y} = \frac{Cm_x}{Cm_y}$$

$$\frac{P_x}{P_y} = TMSy,x = TMTy,x$$



Markes, general equilibrium and perfect competition

If

(a) there is a complete set of markets with well-defined and **costlessly-enforced property rights**, such that buyers and sellers can trade freely in all current and future goods and contingencies;
(b) producers and consumers behave in **an optimising manner**, by maximising their benefits and minimising their costs;
(c) all markets are **perfectly-competitive**, and market prices are known by all individuals and firms;
(d) **transactions costs are zero**, so that the use of the price mechanism does not, in itself, consume resources;

Then
the allocation of resources will be a Pareto optimum.

Externalities : integrating the environment into the economics

In the basic general equilibrium model economic agents interact only through their effect on prices. When the actions of one agent affect the interests of another agent ***other than by affecting prices****, this is* described as an **externality**.

A **consumption externality** occurs where the utility of one agent is affected directly by the actions of another agent
· my neighbour's violin practice sessions reduce my utility
· a local factory emits dangerous pollutants which injure my health, and hence my standard of living
A **production externality** occurs where the production function of a firm is affected directly by the actions of another firm or individual
· a smoky factory increases the costs of a neighbouring laundry
· a beekeeper benefits a nearby apple orchard (pollination)

Externalities : integrating the environment into the economics

Meade definition: "An external economy (diseconomy) is an event which confers an appreciable benefit (inflicts an appreciable damage) on some person or persons who were not fully-consenting parties in reaching the decision (or decisions) which lead directly or indirectly to the event in question »

Meade's definition is broader than the conventional definition: includes "**distributional externalities**" as well as "**real income externalities**".

The theory of economic externalities. The control of environmental pollution and similar social costs. James E. Meade, 1973

Externalities : integrating the environment into the economics

Distributional externalities vs **real income externalities**

A **distributional externality or pecuniary externality** occurs when prices change because of a change in demand and consequently an agent's income is indirectly affected by the actions of others.
=a **distributional externality (or "pecuniary externality") occurs** when a change in demands leads to a change in prices, and hence to a change in the incomes of other people.

Distributional externality reflects the process by which a market economy transfer goods and resources from people who value them less to people who value them more.

Externalities : integrating the environment into the economics

Distributional externalities vs **real income externalities**

Real income externalities arise where there is a direct effect on real incomes (utility or profits)

Distributionnal externalities do not reflect a reduction in total output, unlike **real income externalities**, which has a destructive (as opposed to distributional) effect.

An externality is present whenever there is an insufficient incentive for a potential market to be created for some good, and the nonexistence of this market leads to a non-Pareto-optimal equilibrium.

This relates to Kenneth Arrow's observation that *"the problem of externalities ... is a special case of a more general phenomenon, the failure of markets to exist".*

Externalities : integrating the environment into the economics

Externalities from pesticide use in agriculture include:

(1) **Use of pesticides by farmer A wipes out pests that might affect farmer B**.
This externality is *positive, a production externality, unidirectional (for a single use)*, *primarily a flow externalities*, *local, depletable (rival)*

(2**) Use of pesticides by farmer A increases pesticide resistance,** reducing effectiveness of pesticides available to other farmers.
This externality is *negative, a production externality, a stock effect (resistance arises through cumulative use), mutual (farmer A is affected too), many-person, wider-than-local, potentially global, non-depletable*

(3) **User of farm pesticides has possible health externalities** through pesticide residues on food, leaching of pesticides into water system, etc

Externalities : integrating the environment into the economics

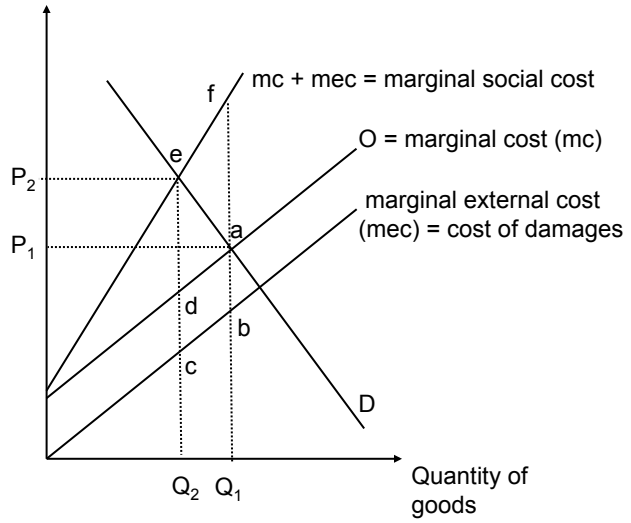
An externality exists when the following two conditions are satisfied:

- the activities of one agent lead to a loss/gain of welfare for another agent
- this loss/gain in welfare is uncompensated.

Pollution - There are then three consequences:

- the existence of “physical” pollution does not necessarily mean that an “economic” pollution exists;
- even if an “economic” pollution exists this does not automatically mean that the corresponding “physical” pollution should be eliminated;
- there is a possible gain to be made through negotiation.

Supply , demand and externalities



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Public good and environmental goods

Public goods are non-excludable and non-rival.
• Non-excludable: Once the good has been provided to one individual it is impossible to prevent others benefitting from it.
• Non-rival: An individual's consumption of the good has zero opportunity cost (ie does not reduce the amount of the good available for consumption by anyone else).

Environmental policy is often concerned with the provision (or preventing the destruction) of public goods
• *nature reserves → non-excludable*
• *the global climate → non-rival and non-excludable*
• *biodiversity (as a natural "bank" of possible future value) → non-rival and non-excludable*

→ « Free riders » : market provision fails

Optimal level of pollution

The socially-optimal level of pollution abatement requires a balance to be drawn between

· **the costs of pollution abatement, and**

· **the benefits of abatement, in terms of reduced environmental damage**

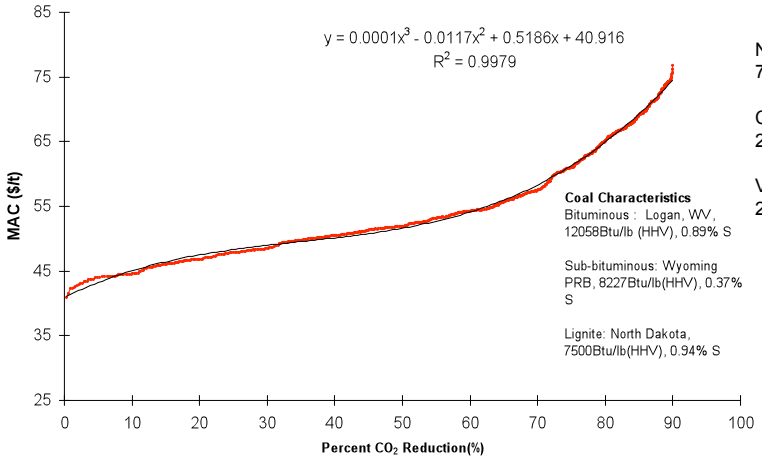
Optimal level of pollution

Marginal Remediation (or Abatement) Cost (MRC or MAC) schedule shows the cost of each successive unit of pollution abatement

Abatement costs include
· **private costs (eg of pollution filters), borne by the polluter (*net of any private benefit to the polluter of additional* abatement)**
· **publicly-funded costs (eg water treatment plants)**

Example :
- costs of installing "end-of-pipe" abatement measures to remove pollutants from discharges (eg pollution filters)
- (additional) costs of using "clean" production technologies compared with"dirty" technologies
- costs (in terms of reduced profit) of reducing emissions by operating polluting plants at lower output
- costs (in terms of foregone expected profits) of premature closure of polluting production facilities

Marginal Abatement Cost Curve



No of units: 787

Capacity: 296GWe

Vintage: 2006

Development of Supply Curves for Abatement of Greenhouse Gas Emissions from Coal-fired Utility Boilers by Samudra Vijay, William Yelverton and Joseph DeCarolis

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Optimal level of pollution

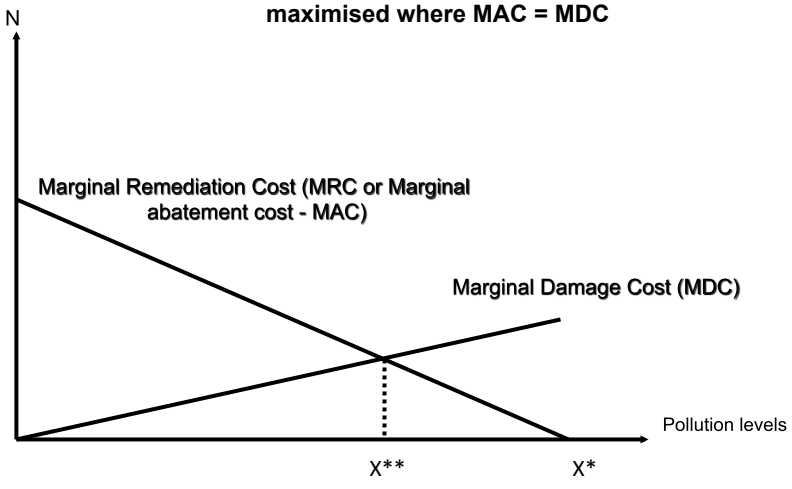
Marginal Damage Cost (MDC) shows the value of each successive unit of pollution abatement, in terms of the *external b*enefits (the decrease of external costs) of reduced pollution

Examples

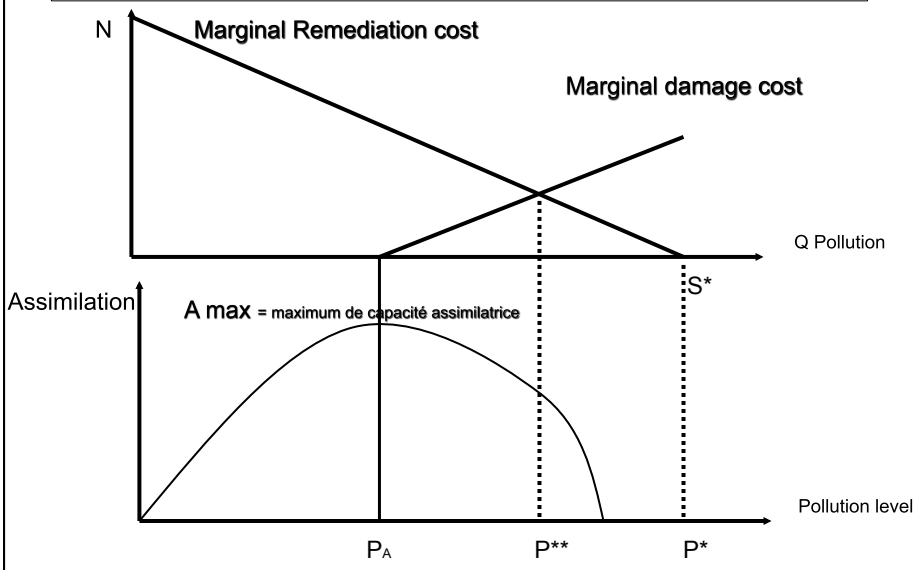
- losses in profit experienced by businesses which are adversely affected by production externalities
- losses in utility suffered by individuals (eg the value of injury to health, loss of amenity, etc)
- the cost of defensive measures taken by firms and individuals to reduce their exposure to pollution damage

Optimel level of pollution

X** = optimal pollution level
The net benefits of pollution abatement are maximised where MAC = MDC



Assimilative capacity



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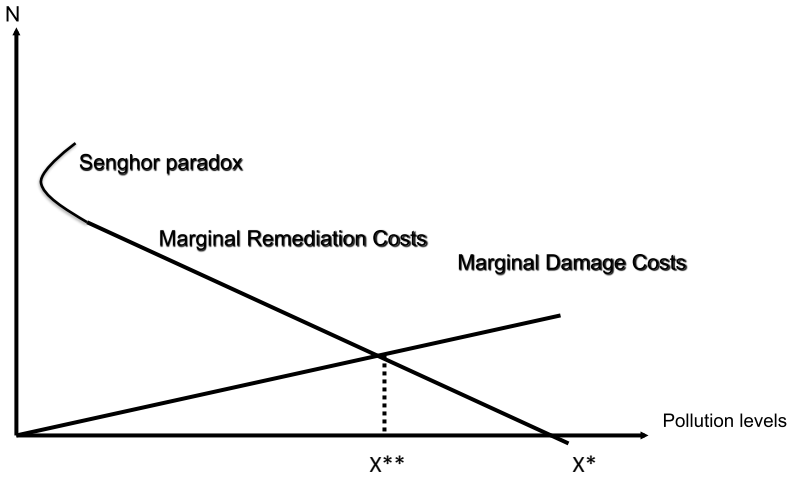
Senghor Paradox (G. Pillet)



Applications ?

Which problem are the most efficient to solve ?
For which pollution damages costs can be reduced at the least cost?

If we had more money to spend to help the world's poorest people, where could we spend it most effectively? Using a common framework of cost-benefit analysis a team of leading economists, including five Nobel prize winners, assess the attractiveness of a wide range of policy options for combating ten of the world's biggest problems:

Air pollution, Conflicts, Diseases, Education, Global Warming, Malnutrition and Hunger, Sanitation and Clean Water, Subsidies and Trade Barriers, Terrorism, Women and Development.

See *Global Crises, Global Solutions* (Lomborg, Ed., Copenhagen Consensus 2004, Cambridge, 638 pp.).

Applications ?

IN GLOBO Niveau planétaire		**MACRO** Echelle d'un pays		**MÉSO** Echelle d'un secteur et, par extension, niveau d'une région	
Domaine	B/C	*Domaine*	B/C	*Domaine*	B/C
Contrôle de la malaria	**1.8 à 4.3**	Algérie	**1.4 à 2.2**	Secteur du ciment, Algérie	**1.1 à 2.9**
Sida en Thaïlande	**14.4**	Egypte	**0.9 à 2.2**	Secteur du ciment, Syrie	**1.4 à 2.9**
Soins de santé de base dans pays à revenus moyens et faibles	**2.6**	Tunisie	**1.2 à 4.6**	Secteur du ciment, Tunisie	**1.0 à 2.6**
Source : Copenhagen Consensus 2004 | Global Crises, Global Solutions | Lomborg, B., Ed., Cambridge.		**Note :** par la suite, la Banque a renoncé, par manque d'audace peut-être, à calculer des ratios B/C.		Génération d'électricité, Maroc	**1.2 à 2.8**
				Grand Agadir, Maroc	**1.0 à 2.0**
				Grand Irbid, Jordanie	**1.2 à 1.5**
		Sources : PNAE-DD, MATE, Alger, 2000 | Pillet, G., Egypt and Tunisia Draft Studies, The World Bank, Washington, D.C., 2000, 2001.		**Source :** Méso-economic Studies, DDC|Ecosys®-SBA, 2002-2005.	

06.12.04 | Gonzague Pillet | Universités de Fribourg et de Genève | Ecosys® Genève

Who has to pay?

Victim-pays-principle : paying for less pollution

Polluter-pays-principle : paying for polluting

The solution depends on the allocation of property rights for environmental goods.

If no proper regulation is put in place to ban polluting activities and property rights are indeterminate, polluters will implicitly have the advantage.

As environmental goods are not market goods the ownership of their rights tends to be undefined and by default it is the polluters that tend to be favoured.

Who pays?

Coase illustrates this result by using the example of a farmer cultivating his land and another who breeds cattle that needs land to graze on. Both individuals have adjoining land which is not enclosed. There are two possible consequences depending on how property rights are allocated.

→ Case 1: the law is in favour of the farmer breeding cattle. Nothing prevents the cattle from grazing on the other farmer's land. The latter will have an incentive to bargain with the former and try and get him to reduce the damage done to his crops by reducing the herd.

→ Case 2: the law is in favour of the farmer with crops. In this case the farmer with the cattle is responsible for the damage his herd causes to the other's crops and must pay for these damages. It is in his interest to negotiate to try and reduce his costs.

Coase theorem

Assume a world in which some producers or consumers are subject to externalities generated by other producers or consumers.

Further assume

(1)everyone has perfect information,

(2) consumers and producers are price-takers,

(3) there is a costless court system for enforcing agreements,

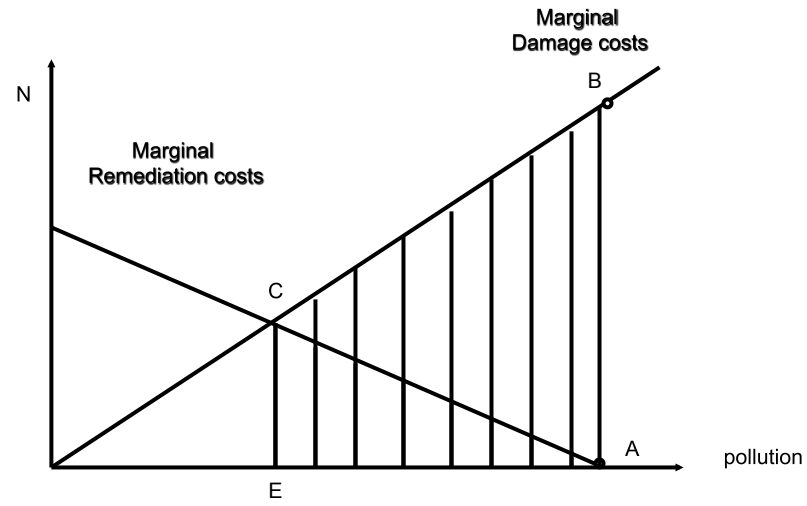
(4) producers maximise profits and consumers maximise utility,

(5) there are no income or wealth effects (*change of wealth or income that occurs when you are awarded property or property rights)* and

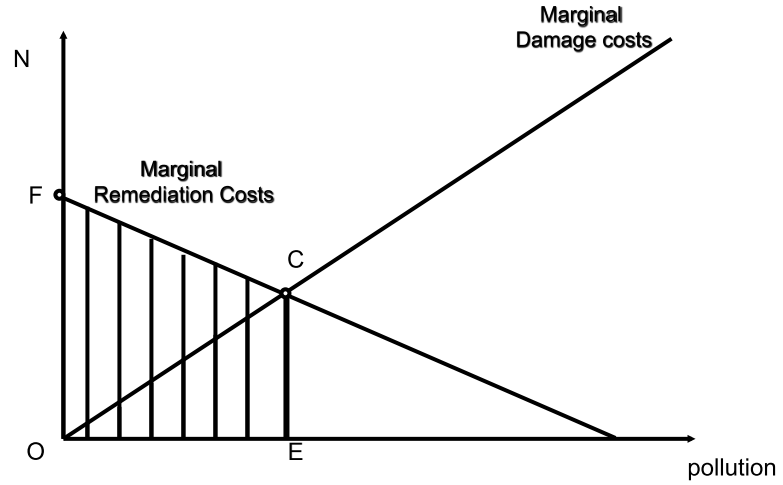
(6) there are no transaction costs (costs of negotiating and agreement)

In this case the **initial assignment of property rights does not matter for efficiency**. If any of these conditions does not hold, the initial assignment of rights does matter.

No property rights



Property rights to the victims



Negociation ? No state intervention is needed

Does the Coase theorem work?

Transaction costs may be high. If there are numerous parties (large group) involved, transaction cost may be high

+ search and information costs in finding the parties involved and informing them of exchange opportunities

+ monitoring and policing costs, to ensure that agreements are kept

+ prosecution costs for trespassers and violators.

If these costs exceed the benefits, then the agreement will not happen.

BENEFIT ARE NON-RIVAL

Negociation ? No state intervention is needed

Does the Coase theorem work?

Perfect competition and information
Without it, the incentive of firms to become even more efficient will not be as great. Also, perfect information is required if firms are to be aware of bargaining possibilities with others. This includes knowing the financial state of one's competitors and bargainers. Without such knowledge, externalities will persist, unrecognized and unresolved.

Parties with similar bargaining power : Native Americans vs U.S. Cavalry ; giant corporation with its team of legal eagles, researchers, encyclopedic information and business and political connections vs average citizen).

→ Paradox: perfect competition requires many parties but that will increase transaction costs

Negociation ? No state intervention is needed

Does the Coase theorem work?

Wealth and income effects: there are distributive consequences

Different assignment of property rights changes society's overall supply and demand since who buys the pollution-cleaning equipment depends on who is given the rights to pollue.

Empirical test of the Coase theorem

See Timothy Hylan, Maureen Lage and Michael Treglia, "The Coase Theorem, Free Agency, and Major League Baseball: A Panel Study of Pitcher Mobility from 1961 to 1992," *Southern Economic Journal, vol. 62, no. 4, April 1996, p. 1030*

Negociation ? No state intervention is needed

The Coase Theorem and Player Movement in Major League Baseball (David G; Journal of Sports Economics, Vol. 7, No. 2, 201-221, 2006)

The Coase theorem suggests that under certain conditions, the distribution of player talent should be similar before and after free agency. Previous attempts to test the theory's applicability to major league baseball were either examinations of win-loss distributions or comparisons of player movements before and after free agency.

American League teams had changes in their win-loss records that do not fully correspond to the theory's predictions, raising questions of **what transaction costs might have impeded transferring players**.

Teams in smaller towns tended to lose talent to teams in larger cities; the flow of talent was roughly similar between periods.

Environmental transitions: the case of Algeria

Country's environmental transition : shift from a regime of property rights held exclusively by polluters to one typified by rights allocated to victims.

Algeria has had to redistribute property rights relating to environmental uses over the last few years due to its economic transition. Indeed, in order to secure sustainable development, environmental standards have had to be re-evaluated as part of the country's national action plan for the environment.

This shift is illustrative of the willingness, on the part of the local population, the State and the international community, to move towards optimal pollution abatement strategies.

Environmental transitions: the case of Algeria

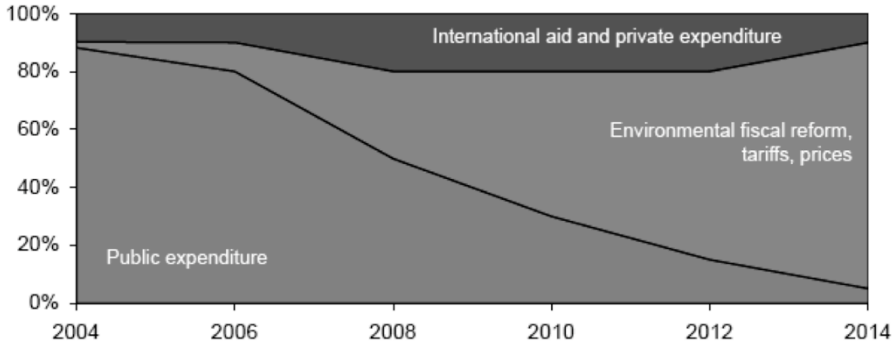
The shift involves costs which will inevitably have an impact on the State budget.

Environmental expenditure in Algeria was approximately 0.6% of GDP in 1999 whereas environmental damage and inefficiency costs amounted to 6% of GDP in 2000 with associated remediation costs of 3.8% of GDP.

A financing strategy was developed :

- The public sector must reinforce and more efficiently manage its environmental expenses.
- This does not necessarily imply an increase in Algerian public expenditure. Better use of regulatory instruments and ecological taxation will actually result in a closer link between expenditure and the origin of environmental damages (polluters-victims) and hence lighten the budgetary load.
- During this environmental transition, international aide and private expenditure are necessary.

Environmental transitions: the case of Algeria



A simple example

For S, maximizing profit implies:

$$Ps = \frac{\Delta Cs(S^*, X^*)}{\Delta S}$$

$$0 = Px = \frac{\Delta Cs(S^*, X^*)}{\Delta X}$$

A simple example

If S and F are a unique firm, maximizing profit requires

$$Ps = \frac{\Delta Cs(S^o, X^o)}{\Delta S}$$

$$Pf = \frac{\Delta Cf(S^o, X^o)}{\Delta F}$$

$$0 = Px = \frac{\Delta Cs(S^o, X^o)}{\Delta X} + \frac{\Delta Cf(S^o, X^o)}{\Delta X}$$

A simple example