Economic analysis and policy instruments

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ITP 2014-09-26

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1. What is economics about?

Economic value – what is that?

- Utility, satisfaction of human needs, happiness
- Food, shelter, clothes, security, social networks, clean water and air, safe chemicals and consumer products, recreation possibilities
- If people attach a value to something, or are willing to pay or sacrifice something else to get it – then it has a value

1. What is economics about?

Some basic economic principles

a) Economic decisions requires trade-offs
b) The cost of something is what you give up to get it
c) Individuals and firms reacts on incentives
d) (Free) Markets are normally a good way of organizing economic activities – but in some situations the state can improve market outcomes
e) A country's standard of living depends on how good it is at producing goods and services

1. What is economics about?

Basic principles

a) Economic decisions requires trade-offs.

- To get something you have to give up something else
- Budget restrictions

Consequences for chemical policy:

- There are goal conflicts. Our lives are more comfortable with chemical products than without (e.g. detergents, preservatives, insecticides), **BUT** human *health* and the *environment* is in many cases negatively affected by production and use of chemicals (**negative externalities**)
- To control chemical A in a better way, the control effort of chemical B has to be reduced if the budget for chemical control is restricted

Basic principles

b) The cost of something is what you give up to get it.

- Both obvious and implicit costs should be taken into account
- Opportunity cost

Consequences:

- The costs of chemical use includes (apart from production costs etc) the impacts on human *health* and the *environment*.

Basic principles

c) Individuals and firms reacts on incentives.

- Behaviour changes when costs and benefits of actions changes

Consequences:

- We can use economic policy instruments (such as emissions taxes) to influence use of chemicals

Basic principles

d) (Free) Markets are normally a good way of organizing economic activities – but in some situations the state can improve market outcomes.

- Under certain conditions (e.g. no externalities), households and firms that interact on the market allocate resources efficiently. State interventions (policies) can be used to improve the market outcome.

Consequences:

- If emissions of chemicals cause external costs that are not taken into account by the emitter. A regulation on emissions can then improve overall social welfare.

Basic principles

d) A country’s standard of living depends on how good it is at producing goods and services.
   - Standard of living is closely related to productivity – economic value produced per hour of work.

Consequences:
   - Chemical policy should – along with ’correcting’ for negative externalities – support technological progress and productivity improvements.

2. Socio-economic assessment Concepts

- Socio-economic effectiveness analysis
  - What is optimal/effective use of resources?
  - How ambitious should our goal for environmental quality be?
  - How much resources should we set aside for this?
- Cost-effectiveness analysis
  - How can the goal (from above) be achieved at lowest cost possible?
  - What is the best combination of measures or policies?
- Socio-economic impact assessment (of a proposal)
  - What impacts will there be on society?
  - Who will be affected?
  - Impacts can be e.g. social (health), economic, environmental…
- Socio-economic evaluation
  - How well is an existing measure or policy working?
  - Empirical evidence, statistics, results…

2. Socio-economic impact assessment Process

A. Problem formulation (health/environment) and target setting
B. Baseline scenario (reference alternative, business as usual)
C. Possible measures and policy options
D. Impacts: changes in environmental, health and economic effects resulting from changed policy (compared with the baseline scenario)
E. Distributional effects (for whom and when?)
F. Uncertainties in the analysis
G. Compare alternatives and conclusions

Source: European Commission

In practice – Cadmium in agricultural soils

A. Problem formulation

- Cadmium intake via food increases the incidence of a range of adverse health effects, including:
  - bone fractures,
  - breast cancer, and
  - renal failure (kidney damage)
- Cadmium levels in crops are strongly correlated to the cadmium levels in agricultural soils
- Cadmium levels in agricultural soils are strongly affected by human activities

B. Baseline scenario

- The Baseline scenario describes what we think will happen if no (new) policies are introduced

- Sometimes referred to as ‘the reference alternative’ or ‘business as usual’

- The description of the baseline scenario is often based on:
  - the current situation (e.g. used quantities or emission levels)
  - identfification of the most important factors that we think influence this situation (e.g. demand for the produced good)
  - an attempt to project how these factors will change in the future, often based on current trends (e.g. will demand increase/decrease?, or what will be the effect of expected technological development?)

In practice – Cadmium in agricultural soils

B. Baseline scenario – the current situation

Source of cadmium	Quantity added to agricultural soils in EU27	
	ton/year	gram/hectare/year
Atmospheric deposition	24	0.23
Mineral fertilizer	85	0.82
Sewage sludge	7	0.07
Manure (net) and lime	10	0.1
Total	126	1.22

- Apart from athmospheric deposition, the cadmium input is as a by-product from application of different types of soil fertilizer (and lime).
- Mineral fertilizer is the major source (67%)
- Cadmium level in soil changes slowly. Even if input is substantially reduced today it will take decades before we see substantial changes in soil (and crop) cadmium levels (and even longer before we see substantial health effects)

In practice – Cadmium in agricultural soils

task 1

B. Baseline scenario – identification of the most important and their future development

Group discussion:

What levels of cadmium input to agricultural soils can we expect in the future?

- What are the most important factors?
- How can we project their future influence on cadmium input to soils?
- What kind of information can we base our analysis on?

Base the discussion on the four main sources of input

- Athmospheric deposition (mainly from metall industry & fossil fuels)
- Mineral (phosphate) fertilizer
- Sewage sludge
- Manure and lime

In practice – Cadmium in agricultural soils

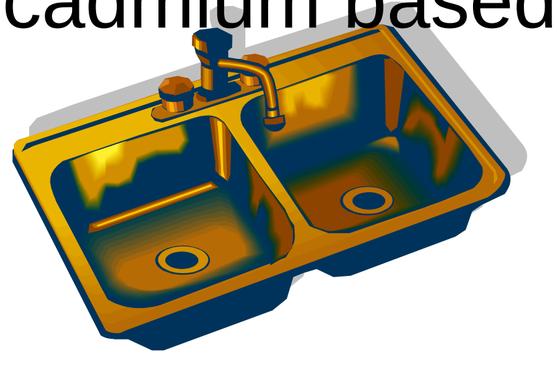
C. Possible measures and policy options

Technical measures (examples)

- Reduce industrial emissions of cadmium to air

- Use mineral fertilizer with lower cadmium content
  - Use phosphate minerals with low cadmium content
  - Decadmiate phosphate minerals

- Reduce emissions of cadmium to waste water
  - For example: reduce the emissions from cadmium to waste water from use of cadmium based artists' paints



In practice – Cadmium in agricultural soils

C. Possible measures and policy options

Administrative policy options (examples)

- Quantitative quotas on emissions or use
- Limit values
- Technology requirements
- Ban the use of certain products

Economic policy instruments (examples)

- Taxes and fees
- Subsidies

Other policy instruments (examples)

- Information and education
- Voluntary agreements

In practice – Cadmium in agricultural soils

task 2

C. Possible measures and policy options

Group discussion:

1. Which administrative policy instruments do you think would be effective to reduce cadmium input to agricultural soils? (quotas, limit values, technological requirements, bans?)

2. How could any economic policy instruments be applied? (taxes, fees, subsidies?)

3. Could we use any other instruments? (e.g. information, voluntary agreements)

2. Socio-economic impact assessment Process

- ✓ Problem formulation (health/environment) and target setting
- ✓ Baseline scenario (reference alternative, business as usual)
- ✓ Possible measures and policy options
- **D. Impacts: changes in environmental, health and economic effects resulting from changed policy (compared with the baseline scenario)**
- E. Distributional effects (for whom and when?)
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Source: European Commission

Impacts - in general

What types of values are changed (and how)?

Costs or benefits for targeted companies:

- Direct changes in production -
- Adaptation (prod., technology, prices) +
- Administrative costs (business) -
- (Tax payments) -
- (Subsidy revenue) +
- International competition -

Impacts - in general

Costs or benefits for companies in general:

- Economic potentials for competitors +
- Long run, early adaptation, new technol. +

Costs or benefits for government:

- Administrative costs (gov.) -
- (Tax revenue) +
- (Subsidy payments) -

Impacts - in general

Costs or benefits for consumers:

- No access to a product -
- Higher prices -
- Safer products (health) +

Costs or benefits for citizens (non-market):

- Cleaner environment / less environmental damage +
- Improved health +

3. Socio-economic impact assessment

In practice – Cadmium in agricultural soils

- D. Impacts: changes in environmental, health and economic effects resulting from changed policy (compared with the baseline scenario)

A ban on the sale and use of cadmium based artists' paints (recent proposal by Keml)*

- Would reduce cadmium input to agricultural soil by approximately 150 kg/year in the EU
- In the long run (~100 years) this will reduce the cadmium intake via food (all else equal) by 0.008% of current total intake via food
- Based on epidemiological studies we can estimate the effect on number of bone fractures and breast cancer cases in the EU – the number of prevented cases is assumed to grow linearly over 150 years

Table 46 Risk reduction capacity in terms of number of prevented fractures and breast cancers per year

Years from implementation	Female fractures	Male fractures	Breast cancers
	Health effect per year		
50	16	4	5
100	31	9	11
150	47	13	16
	Accumulated effects after implementation		
50	400	114	136
100	1583	453	539
150	3549	1015	1208

Note that the estimated values are EU-specific.

Not directly transferable to regions with other conditions

*http://www.echa.europa.eu/web/guest/restrictions-under-consideration/-/substance/5701/search/+/term

In practice – Cadmium in agricultural soils

- There are methods to apply monetary values to health effects

- In simplified terms, every fracture or breast cancer case generates 3 types of costs
  - Direct costs – hospitalisation, medication etc
  - Indirect costs – production losses due to sick leave, early retirement, premature death etc
  - Intangible costs – losses of life years and in quality of life. Measured in terms of quality/disability adjusted life years (QALYs or DALYs).

- Estimated values based on literature reviews:

€ per case, 2012	Fractures	Breast cancers	Change over time
Direct costs	12 000	20 000	Constant
Indirect costs	~0	24 000	Grow with GDP/capita
Intangible costs	17 000	84 000	Grow with GDP/capita

In practice – Cadmium in agricultural soils

Years from implementation	Accumulated benefits (avoided health costs) from reduced input on cadmium to agricultural soils	
	From the ban on cadmium in artists' paints (150 kg/year)	Per kg/year
50	€18 million	€119 000
100	€55 million	€365 000
150	€113 million	€754 000

- The health based socio-economic benefits of a ban on cadmium in artists' paints in the EU is estimated to €18 million after 50 years, and €113 million after 150 years

- These benefits can be weighed against the socio-economic costs that the ban would generate

- Assuming that the effects are linear in cadmium input, we can also estimate the benefits per kg/year of reduced cadmium input to agricultural soils: €119 000 after 50 years etc.

In practice – Cadmium in agricultural soils

What other impacts would a ban on cadmium in artists' paints have?

- Administrative costs (mainly for government agencies)

- Some paints – which are already in the supply chain, or in use – might have to be discarded when the ban is introduced

- Costs for the paint users/consumers?
  - Alternative paints are of similar costs, or even cheaper to use
  - The characteristics of the alternative paints are not identical, some (most?) painters consider them less useful ➔ loss in user value

- It might be difficult to maintain historically/culturally valuable pieces of art ➔ exemption for these uses is an option

- Environmental benefits

In practice – Cadmium in agricultural soils

- Artists' paints are a minor source of cadmium in agricultural soils, other sources are more important

- The major source is mineral phosphate fertilizers

Group discussion:

task 3

- What would the impacts be of a limit value on cadmium concentration in mineral phosphate fertilizers?

- Try to identify:
  - Who will be affected? What types of + or - may there be?
  - Who do you think will bear the largest + or - ?

In practice – Cadmium in agricultural soils

D. Impacts: changes in environmental, health and economic effects resulting from changed policy (compared with the baseline scenario)

task 4

If we introduce a strict limit value of cadmium content in mineral fertilizers…

Are there wider impacts on society or distributional effects?

- Impact on farm productivity and food prices
- Are all poor/rich people affected similarly?

2. Socio-economic impact assessment Process

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Source: European Commission

4. Economic policy instruments

- Tradable emission permits
- Taxes, charges and fees
- Deposit-refund system
- Subsidies

Other (semi-economic) policy instruments

- Define ownership – voluntary solutions

- Government buys land
- Government buys goods and services

- Certification
- Demand information
- Supply information
- Research

Criteria for choice of policy instruments

- Effectiveness (*Certainty of reaching policy goal*)
- Cost efficiency *(Lowest possible cost per risk reduction)*
- Dynamic effectiveness
  - for example incentives for development of substitutes
- Flexibility
  - for example in which technical measures to use or when to implement them
- Low administrative costs & Low control costs
- Distributional effects
  - how are poor/rich people affected?
  - regional distribution of costs and benefits
- Political acceptance

Criteria for choice of policy instruments

- Taxes/Charges/Fees are often preferable to Administrative policy instruments (bans/quotas/limit values) in terms of
  - Cost efficiency
  - Dynamic effectiveness
  - Flexibility

- While the Administrative instruments often are preferable in terms of
  - Effectiveness (certainty of reaching quantitative policy goal)

Example: Tax on cadmium in P-fertilizer

- Gross cost of tax
  = Present P-use in kg * Cd/P-concentration * tax/kg Cd

- Both buyers and suppliers adapt to the introduction of a tax
  - Suppliers can choose to
    - Use mineral P-sources with lower Cd/P-concentration
    - Use decadmiation technology to reduce Cd/P-conc.
  - Buyers (Farmers) can choose to
    - Buy P-fertilizer with low Cd/P-concentration to avoid the tax
    - Reduce the overall use of P-fertilizers
    - The extent of these adaptations depend on the tax level

- Some expected effects of the tax
  - Reduced use of P-fertilizer with high Cd/P-concentration
  - Increased demand for P-fertilizer (and mineral resources) with low Cd/P-concentration
  - Increased possibility that decadmiation technologies will be implemented
  - Reduced overall use of P-fertilizers ➔ Reductions in farm yield
  - Reduced input of cadmium to agricultural soils
    ➔ Reduced cadmium levels in crops
    ➔ Reduced number of fractions and breast cancers (and other adverse health effects) due to cadmium exposure

Current suggestions from Keml

- Taxes on articles that normally contain dangerous chemicals
- No tax need to be paid if seller can declare that the article does not include the chemical
- Chemicals in articles are less well regulated than those in chemical products

Types of articles (Examples)
- electronical articles sold to consumers
- clothes and shoes
- building material
- light bulbs

Chemicals to be taxed (Examples)
- perfluorated substances,
- bromated flame retardants,
- phtalates,
- mercury

Summary

- Many uses of chemicals and chemical products contain a goal conflict – benefits of products against human health and/or environmental costs

- Socio-economic assessments can guide us to appropriate policy responses to these goal conflicts

- Regulation can be supplemented by economic policy instruments