CBA | cost-benefit analysis

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Decision-making criteria

Legality : accepted by the law
Pertinence : legitimacy of the objectives
Efficacy : reaching the aim
Efficiency : reaching the aim at the lowest costs
Equity : fair
Acceptability : accepted by the majority
Faisability : workable

CBA principles

Setting

comparing costs and benefits resultings from a given choice (public policy, project)

The « best » project = the largest differential between benefits and costs

= max (B – C)

Origines: USA

Galatin (1808, Secretary to the treasury) : infrastructure for water connexions; see Flood Control Act (1936) – US Army Corps of Engineers

ACB Green Book : 1950, by the Interagency River Bassin

O. Eckstein (1958): therethical basis of CBA (link with welfare economics)

Since 1970: new areas for CBA (wildlife, air quality, human health), monetary valuation techniques, non-use value appraisal

CBA = legal obligation for water related public project

Origines: Europe

GB
1960: Transports (highway, metro, aeroport) in GB
Dpt of transport (GB) : routine CBA for new road project (environmental costs are not examined)

1990: Pearce Report; CBA for public legislation

Theorethical backgroung : Pareto criteria

Pareto criteria

A change from one allocation to another that can make at least one individual better off without making any other individual worse off is called a Pareto improvement.

An allocation is defined as Pareto efficient or Pareto optimal when no further Pareto improvements can be made.

The Pareto criteria

Limited for applications

There are always loosers !

Compensation test (HICKS ET KALDOR)

An outcome is considered more efficient if a Pareto optimal outcome can be reached by arranging sufficient compensation from those that are made better off to those that are made worse off so that all would end up no worse off than before.

= B net = B – C

= ACB

Compensation test and Pareto criteria

Pareto criteria

We need to classify (order) individual situations (preferences): purely ordinal ranking

Compensation test

Utility has to be measured : cardinal ranking of individual situation.
Welfare gains and looses have to be compared across individuals.

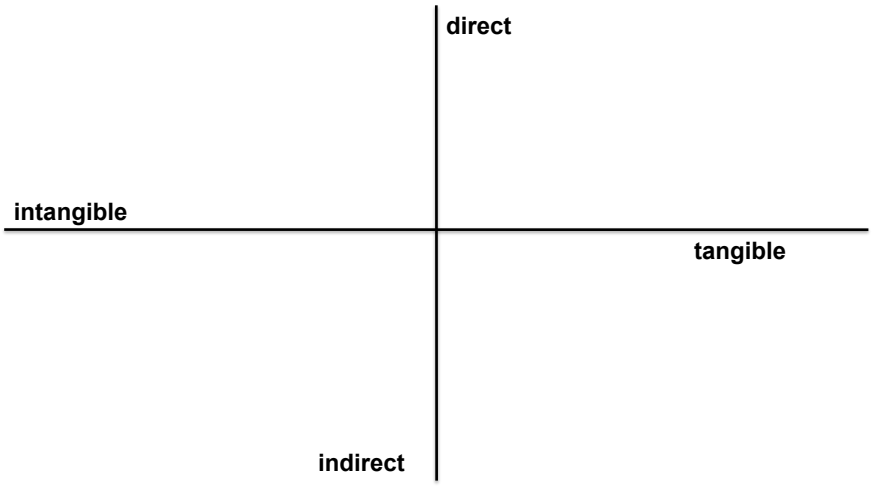
If you do not consider that utility may be measured, no social ranking of alternative situations is possible (see Arrow, impossibility theorem).

CBA : implementation

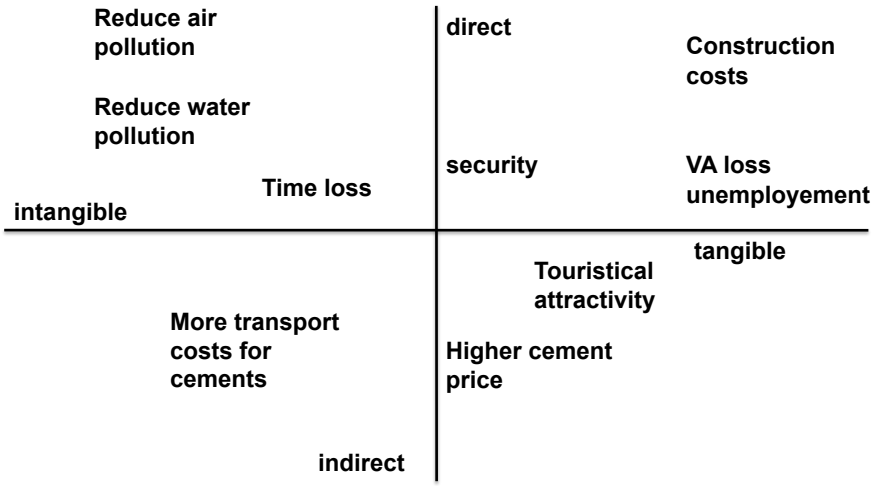
Main issue : putting together various costs and benefits whose monetary values may not be directly available.

- Intangible vs tangible costs and benefits
- Indirect and direct costs and benefits
- Distribution of costs and benefits

Classification



Classification



Time and discounting

Discounting is necessary when comparing a stream of benefits and costs accruing over a number of years.

Long term benefits and costs have lower present value (a dollar received today is considered more valuable than one received in the future).

Why ?

- impatience : diminishing marginal utility of comsumption (we should become richer in the future), uncertainty

- Inflation: positive rates of inflation diminish the purchasing power of dollars over time

- Opportunity costs: forgone interest earning potential of the capital invested in the public project (dollars could be invested today, earning a positive rate of return)

Discount rate: rate at which society as a whole is willing to trade off present for future benefits/costs.

Time and discounting

Discounting formula;

$PV = FV / (1+i)^{n}$

Example 1 : 10'000'000 Usd in 10 year with a 3% discount rate:

$PV=10'000'000 / (1+.03)^{10} = 7'440'940$

Example 2 : 10'000'000 Usd in 10 year with a 10% discount rate:

$PV = 10'000'000/ (1 +.1)^{10} = 3'855'433$

Time and discounting

Investment project
Year 0 : benefit = 0, cost = 100
Year 1: benefit = 105, cost = 0
i = 5%

NB = 105 / (1+5%) – 100 = 105/1.05 -100 = 0

If i < 5%, the project is accepted
Si i > 5%, the project is refused
Internal rate of return = 5% (rate at which NB = 0)

Time and discounting

At one extreme, an infinitely high social discount rate would render all future actions meaningless. At the other extreme, using no discount rate means that benefits today are no more valuable than benefits experienced 100 years from now.

zero discount rate : ensure intergenerational equity by preventing the present generations from ignoring the long-term environmental and other consequences of present-day economic activity.

Proponents of the zero discount rate argue that discounting can almost entirely devalue the economic impact of even catastrophic environmental events occurring outside a 50-year time horizon. For example, the present value of a catastrophic event occurring 50 years from today would be valued at less than 1 percent of its future value (assuming a 10 percent discount rate).

The ethical arguments against discounting are compelling; however, the existence of inflation, time preference, and the opportunity cost of capital suggests that a positive discount rate better reflects societal preferences.

Without discount rate, we may not consider time preferences and thus we may not allocate capital between projects and through time.

Time and discounting

Choice of the discount rate : controversially discussed especially when investments in the public sector are at stake or if the durations considered are long.

1. The *private* discount rate : observed on the financial markets; for instance, a typical value would be between 5 and 7% per year in the European Union. Many companies, however, calculate with private discount rates greater than 10%. Businesses need to consider the discount rate when deciding whether to spend some of their profits on buying a new piece of equipment, or whether to give the profit back to their shareholders.

2. The *social discount rate* can be defined as the interest rate at which society is willing to lend money for public projects.
s = p + u + g
p = pure time preference rate, empirical test 1% - 2%
g = consumption growth per head
u = rate at which utility decreases when consumption increases, empirical test 2%

Time and discounting

Exemple : 6% en GB en 1991

Taux d'emprunt du secteur public : 4-6%
p = taux pur de préférences temporelle: 1.5%
g = croissance de la consommation par tête : 2.5%
u = taux auquel utilité décroit lorsque la consommation/revenu augmente: 1.5%

CBA steps

1. Grasping the project /public policy
- Which ressources are concerned?
- Which people are concerned ? Population, beneficiaries, loosers

2. Inventory of impacts / consequences
Additionnability: considering the « net » consequences (escaping the trend)
Taking care of redistributive issues if necessary

CBA steps

3. Physical assessment of impacts
The quality of data should be evaluated

4. Monetary valuation

5. Discounting and calculus of the net discounted benefits

Weighting (according to the category of beneficiaries for example)

a) low income: - 2.4 millions
b) middle income: +1.1 millions
c) high income : +2.3 millions

Weight according to marginal utility of income

CBA steps

7 . Sensitivity analysis

Main parameters :

- Discount rates
- Quantities
- Price
- Life span
- Seize of concerned population

Example : Economico- environmental analysis

Damage costs & inefficiencies costs (DIC) : economic impacts

What is the value of the loss of well-being from the surrounding population due to air pollution ?

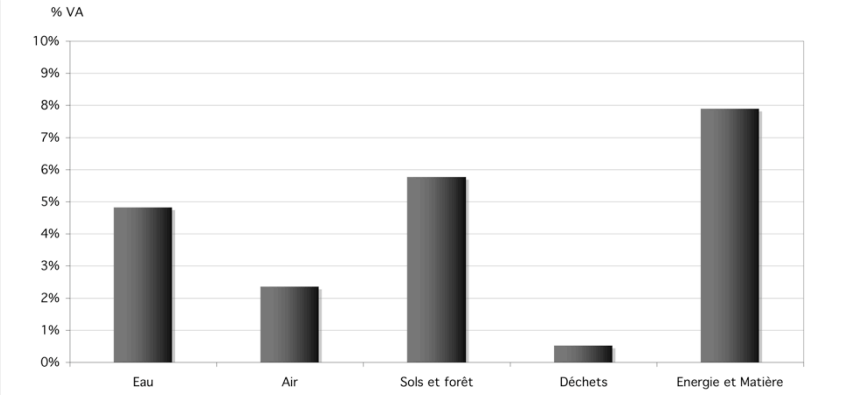
Remediation Costs (RC) : protection measures

How much does it cost to decrease air pollution so that the damages vanish?

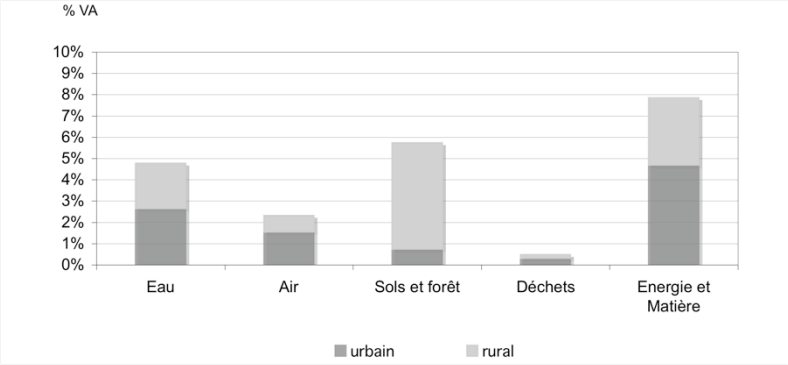
DIC/RC Ratios : decision-making tools

Investing 1 euro in remediation, how much damages are avoided

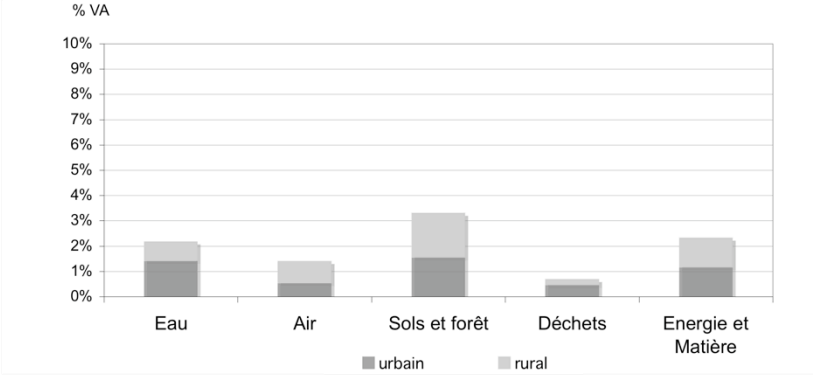
CDI Mali



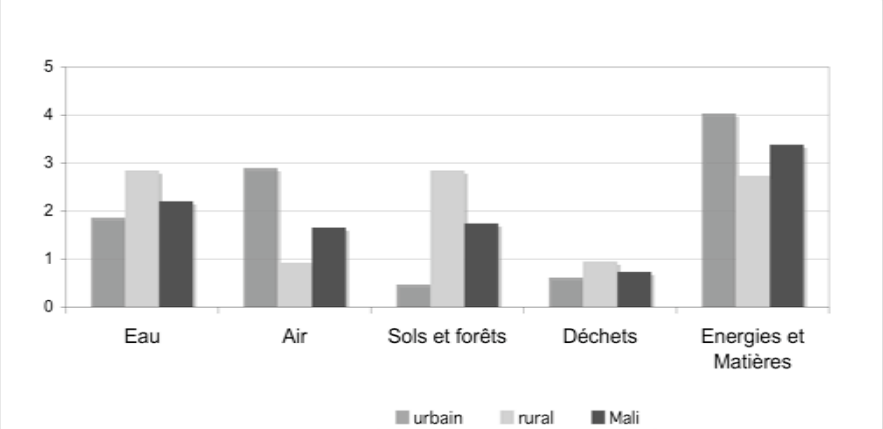
CDI Mali - urban and rural



CR Mali



Ratios



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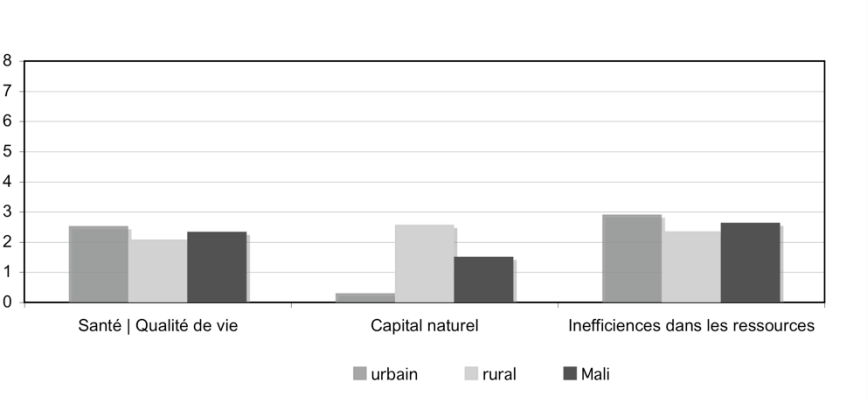


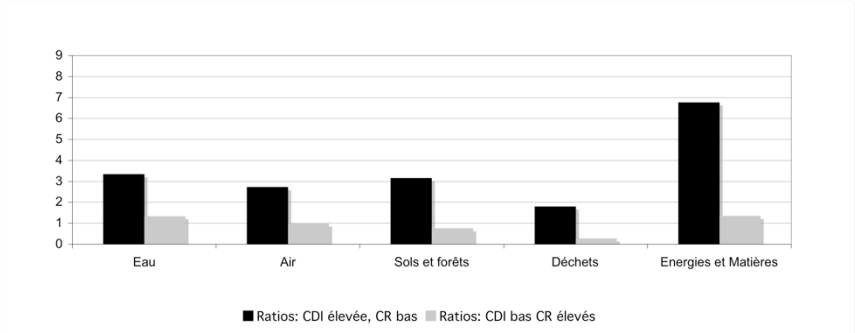
Sensitivity analysis

CDI	Estimation	Haut	Bas	Ecart entre estimation
Eau	4.82%	5.47%	3.67%	18.68%
Air	2.36%	2.92%	1.74%	25.03%
Sols et forêts	5.77%	7.87%	3.17%	40.72%
Déchets	0.52%	0.96%	0.25%	68.72%
Energies et Matières	7.89%	11.84%	3.95%	50.00%
TOTAUX CDI	21.35%	29.05%	12.77%	

CR	Estimation	Haut	Bas	Ecart entre estimation
Eau	2.18%	2.73%	1.64%	25.0%
Air	1.42%	1.77%	1.06%	25.0%
Sols et forêts	3.32%	4.15%	2.49%	25.0%
Déchets	0.70%	0.88%	0.53%	25.0%
Energies et Matières	2.33%	2.92%	1.75%	25.0%
TOTAUX CR	9.96%	12.45%	7.47%	

	Ratios: CDI élevée, CR bas	***Ratios: CDI bas CR élevés***
Eau	3.3	1.3
Air	2.7	1.0
Sols et forêts	3.2	0.8
Déchets	1.8	0.3
Energies et Matières	6.8	1.4

Sensitivity analysis - Ratios



Sensitivity analysis & comparisons

	*CD**	*CD par hab (USD)*	*PIB/hab.*
Mali	**6.50%**	**33**	**506**
Algérie	3.60%	173	4795
Egypte	4.80%	151	3146
Tunisie	2.10%	109	5169
Maroc	3.70%	118	3188
Syrie	3.50%	95	2702
Jordanie	2.80%	73	2615