BASQUE CENTRE
FOR CLIMATE CHANGE
Klima Aldaketa Ikergai

Some practical examples: Case studies for policy making

The equivalency principle for discounting the value of natural assets

Aline Chiabai

San Sebastian, 11 July 2012

EUSKO JAURLARITZA GOBIERNO VASCO
INGURUMEN ETA LURRALDE ANTOLAMENTU SAILA
DEPARTAMENTO DE MEDIO AMBIENTE Y ORDENACIÓN DEL TERRITORIO

EUSKO JAURLARITZA GOBIERNO VASCO
HEZKUNTZA, UNIBERTSITATE ETA IKERKETA SAILA
DEPARTAMENTO DE EDUCACIÓN, UNIVERSIDADES E INVESTIGACIÓN

Universidad del País Vasco
Euskal Herriko Unibertsitatea

ikerbasque
Basque Foundation for Science

ihobe

Outline

- Motivations and objectives
- The equivalency principle: definition and hypothesis
- Implications for discounting
- Illustration of the principle in selected study areas
- Application to an investment project in the Basque Country
- Concluding remarks

Backgrounds and motivations

- Making decisions about optimal investments having long-term environmental impacts necessitates setting social discount rates
- The issue is still controversial and does not have wide agreement
- How do we reconcile the wellbeing of present and future generations?
- The debate on discounting is highly relevant in the context of climate change, given the expected high costs that future generations are likely to bear based on past and current economic activities

Objectives

- To identify a practical rule to determine the discount rate for projects in which one of the options is to maintain or restore undeveloped land which is either in or close to its natural state
- To illustrate the application of the rule in selected study areas for which valuation studies from the literature are available
- To exemplify the rule for a specific case in the Basque Country where a contentious project to build a sea port involves reclaiming natural land that has ecological value

The equivalency principle

- Any policy maker should value equivalently and consistently a track of land in its natural (undeveloped) state and another one which has been designated for development (e.g. residential or industrial use)

- The long term value of preserving undeveloped land is at least equivalent of the value of land with permission to build up (located in the same area)

- The principle assumes that future generations would assign the same utility (and economic value) to both lands, <u>as a minimum</u>

- Advantage of avoiding making other uncertain assumptions about the expected welfare or growth rate of consumption of future generations

Hypothesis

- Assume in *t=0* two tracks of land, *N* and U, with identical size, environmental and site-characteristic attributes (location, slope, orientation, proximity to infrastructure, etc)

- If a land market would exist:

$$P_N = P_U$$

- Assume now that in *t=1* an administrative procedure is granted on U (right to be built upon):

$$P_N < P_U$$

Industrial land

Undeveloped land

Residential land

- When $PN<PU$ decisions about the appropriateness of investment projects with environmental impacts versus protection of the natural asset will be heavily influenced by the higher value attached to U
- If long-germ environmental impacts, the choice of the discount rate will be crucial

Implications for discounting (1)

Constant benefits over time

- Conventional discounting formula for present value (finite time scale)

$$\boxed{PV_N = \sum_{t=1}^{T} \frac{(V_N)_t}{(1 + i_N^*)^t}} = P_U$$

Implications for discounting (2)

Increasing benefits over time

- Finite time scale

$$\boxed{PV_N = \sum_{t=1}^{T} \frac{V_N(1+g)^t}{(1+i_N^*)^t} \approx \sum_{t=1}^{T} \frac{V_N}{(1+i_N^*-g)^t}) = P_U}$$

Internal Rate of Return IRR (1)

- IRR is the annualized compounded rate at which the net present value of all cash flows equal to zero

- If *T=1* using conventional discounting formula (constant flows)

$$PV_N = \sum_{1}^{2} \frac{(V_N)_t}{(1+i_N^*)^1} = V_N + \frac{V_N}{(1+i_N^*)^1} = P_U$$

Internal Rate of Return IRR (2)

- For perpetuity with constant flows of benefits

$$i_N^* = \frac{V_N}{P_U} \qquad (1')$$

- With increasing flows

$$i_N^* = \frac{V_N}{P_U} + g \qquad (2')$$

Basic assumptions

- Past decision making on development versus protection of natural land was socially optimal in the "administrative unit" of reference having the responsibility for land-use planning and for granting building permits
- Implies that marginal price of preserved undeveloped land is equal to marginal price of the adjacent developed land
- Future generations are affected in the long run by the decisions taken on the land

Illustrating the principle

- Study areas:
  - In "administrative units" in the Basque Country and UK characterized by a fairly balanced allocation of developed and undeveloped land (socially optimal)
  - Availability of valuation studies providing TEV for different types of undeveloped land in a context of preservation of natural land

- Estimate i_N^* to apply in selected areas if an investment project (for ind or residential use) were realized with long-term environmental impacts, under two hypothesis:
  - Constant future flow values
  - Future flow values grow following the expected growth of real per capita income (A2 and B2 IPCC)

Values of *N* and *U*

- Value of *N* (undeveloped land)
  - TEV estimated in valuation study, converted into value per hectare per year (flow)
- Value of *U* (developed land for industrial or residential use)
  - Average price observed in the market for industrial/residential land located within the "administrative unit" where the selected study area is located, converted into value per hectare
- Original prices and TEV are converted into international dollars of year 2006 using the implied purchasing power parity (PPP) conversion rate and the average consumer prices

Study area or site	Country	Location	Habitat	Price/ha $\bar{U}$ (Int$ 2006) [a,b]	Source price of U	TEV/ha per year N (Int$ 2006)[b]	Context	Source value of N
Jaizkibel montain	Basque Country (Spain)	Gipuzkoa, bay of Pasaia	Cliffs with sandy strata, beaches and gullies, non-wooded forest area, scrubland, pasture	9,654,161	Basque Gov (2004): residential land; Public Society of housing depart, personal conversation: industrial land	93,008-186,014	Preservation against degradation for ec reasons	Hoyos et al (2007)
Beaches and rocky shore	Basque Country (Spain)	Coastal zones Bizkaia and Gipuzkoa	Sandy and shingle beaches and rocky shore	8,849,179	Basque Gov (2004): residential land; Public Society of housing depart, personal conversation: industrial land	126,850-232,300	Restoration of beaches due to Prestige oil spill damages	Galarraga et al (2004)
Birkham woodland	North Yorkshire (UK)	Knaresborough -Harrogate bypass	Forest ancient wood	1,184,453	Valuation Office Agency (2011)	11,174	Land use planning: avoiding bypass through ancient woodland	Hanley and Spash (1993)
Mar Lodge Estate	Scotland (UK)	Scottish Highlands, Aberdeenshire	Native ancient Caledonian pine forest	1,351,872	Valuation Office Agency (2011)	4,599-8,090	Preservation of habitat in the context of land-use planning	Cobbing and Slee (1994)
Waukenwae Moss and Red moss	Scotland (UK)	South Lanarkashire	Bogs, marshes, water fringed vegetation, fens, humid grassland, broad-leaved decidious wood	763,557	Valuation Office Agency (2011)	17,631	Preservation against degradation for ec reasons	Jacobs (2004)

Range of estimated discount rates by study area based on the equivalency principle (perpetual flows)

Study area or site	Country	Results		
		i^*_N (constant flows)	i^*_N (B2 IPCC)	i^*_N (A2 IPCC)
Jaizkibel montain	Basque Country (Spain)	0.96-1.93-3%	2.01-2.98-4.05%	2.45-3.41-4.48%
Beaches and rocky shore	Basque Country (Spain)	1.43-2.63%	2.48-3.68%	2.92-4.11%
Birkham woodland	North Yorkshire (UK)	0.94%	1.99%	2.43%
Mar Lodge Estate	Scotland (UK)	0.34-0.60%	1.39-1.65%	1.83-2.08%
Waukenwae Moss and Red moss	Scotland (UK)	2.31%	3.36%	3.79%

A range of discount rates is presented instead of a point estimate when different figures for TEV are available from the valuation studies

Application to an investment project in the Basque Country

- Construction of a new seaport in Pasaia (Gipuzkoa) was planned in a cliff with significant environmental attributes (Jaizkibel): project under evaluation by the Ministry of the Environment, Rural Affairs and Marine Issues within the Environmental Impact Assessment (EIA)
- Total investment: €750 million – €1.2 billion
- Jaizkibel part of Nature 2000 network with 2400 ha of natural land and 15 zones declared of high ecological interest
- Important terrestrial and marine ecosystems: landscape, seabed life, fauna and flora, endemic plants in danger of extinction
- Habitats: cliffs, small beaches and gullies, non-wood forest area with scrubland and pasture, seabed harbours.

Net market benefits

- Annual net market benefits expected to be generated by the construction of the port, in the period 2010-2054:
  - Based on input-output Leontieff model (Environmental Sustainability Report, 2010)
  - Due to incoming and outgoing maritime traffic, new transport lines, industrial and residential development in the area, … …

Market benefits per year (Int$ 2006)
641,491,148

Environmental costs

- TEV of preserving the Jaizkibel natural area in similar condition as it is today (Hoyos et al, 2007)
- Three scenarios of preservation, depending on the impact caused by the construction of the seaport, providing the social welfare loss per year

Environmental costs per year (Int$ 2006)	
lower bound	222,364,341
central estimate	444,728,682
upper bound	691,886,305

Present discounted values of market benefits and environmental costs derived from building the seaport in the period 2010-2050 (Int$ 2006; constant TEV flows)

Discount rate applied to market benefits	Present value of market benefits		
11%	6,414,128,939		
Discount rate applied to environmental costs	**Present value of environmental costs**		
	Lower bound	Central estimate	Upper bound
11%	2,223,372,152	4,446,744,303	6,918,019,027
4%	4,791,693,895	9,583,387,790	14,909,348,177
3%	na	na	17,473,086,264
1.93%	na	13,550,814,868	na
0.96%	8,172,036,231	na	na

Net present value derived from building the seaport in the period 2010-2050, based on CBA (Int$ 2006; constant TEV flows and discount rate for market benefits 11%)

Discount rate applied to environmental costs	Net present value		
	Lower bound	Central estimate	Upper bound
11%	4,190,756,787	1,967,384,635	-503,890,088
4%	1,622,435,044	-3,169,258,851	-8,495,219,238
3%	na	na	-11,058,957,325
1.93%	na	-7,136,685,930	na
0.96%	-1,757,907,292	na	na

Conditions of applicability

- CBA carried out for investment projects affecting undeveloped sites that are environmentally similar to the selected study areas in the administrative unit of reference

- Possible to apply even in “administrative units” with unbalanced allocation of land, if the price of U is taken from similar administrative units where the allocation of land looks like socially optimal

Concluding remarks

- The proposed equivalency principle simplifies the discussion about which discount rate should be used by policy makers under current uncertainty characterizing climate change impacts and long-term risks to future generations
- The current *"main intellectual battleground is whether we should be using discount rates in the range of 3% or discounting by only a token nonzero amount, such as 0.1%"* (Zeckhauser and Viscusi 2008)... but...
- The results reported in this study show that the discount rate resulting from the equivalency rule can vary based on the value of the land and the discrepancy between TEV and price of U
- Based on this rule, the estimated discount rates ought to be quite low (ranging from 0.34% to 3%) hence supporting policy decisions that are more oriented towards the protection of the environment

Muchas gracias!

Eskerrik asko!