The economic impact evaluation of climate change

Ancona, ACT Conference 2010

14.12.2010

Enrica De Cian FEEM

With the contribution of the LIFE financial instrument of the European Community

Outline

Economic assessments:

- Motivation and role
- Methodology
- Uncertainties and Issues
- An example: climate change impacts on tourism in Italy

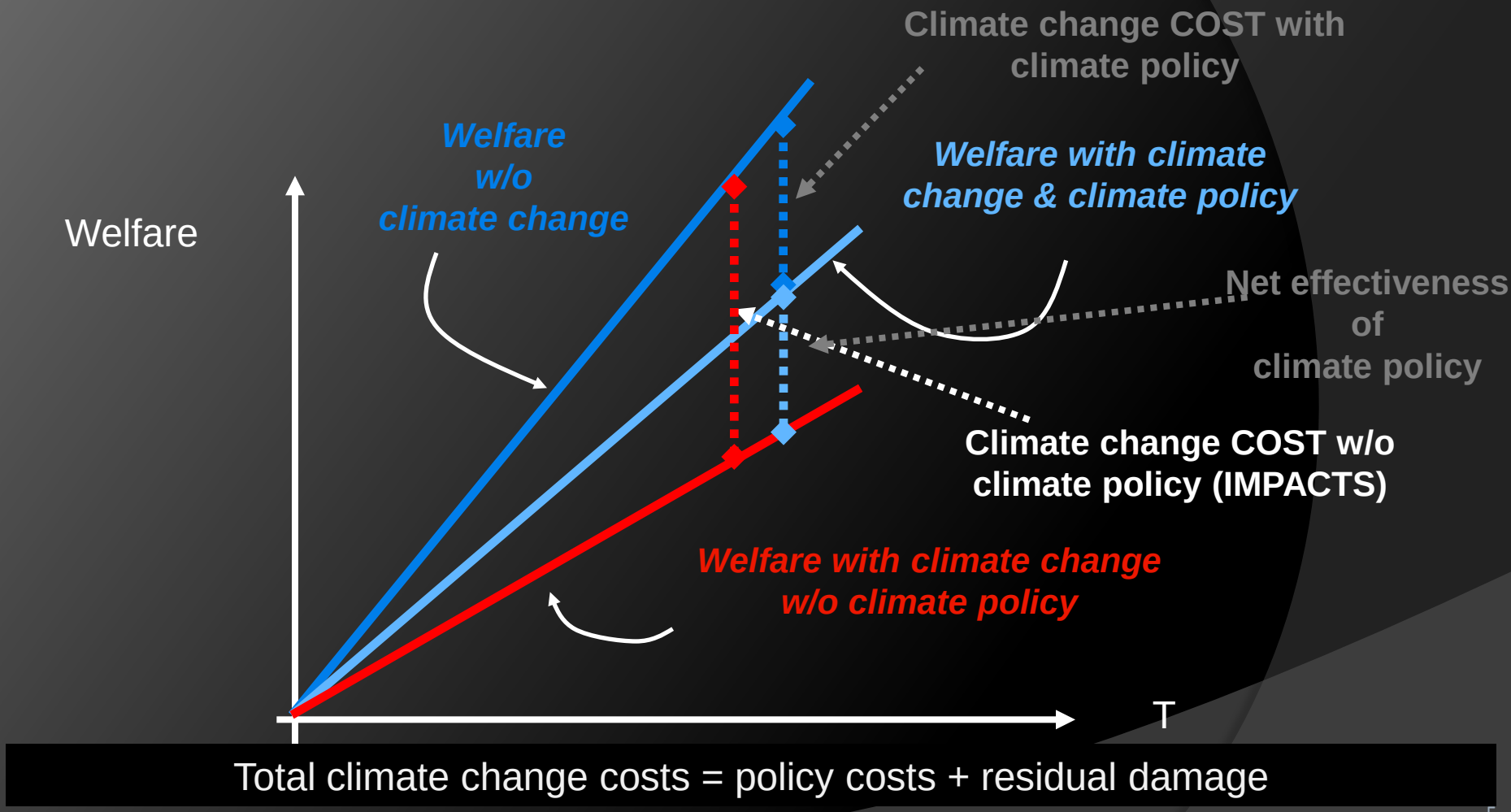
Motivation

- Is it better not to act and bear the damages of climate change or act to reduce those damages while bearing some costs?
- Climate-economy models as the laboratory for scientists dealing with climate change=>provide counterfactual experiments

Role

- A measure of the welfare impacts of a change
- Information on the costs and benefits of different policies to contrast (if undesired) or enhance (if desired) a change
- Rank policy solutions in term of effectiveness, efficiency, equity
- Assessment of the optimal reaction to uncertainty

Economic assessment of CC impacts: methodology

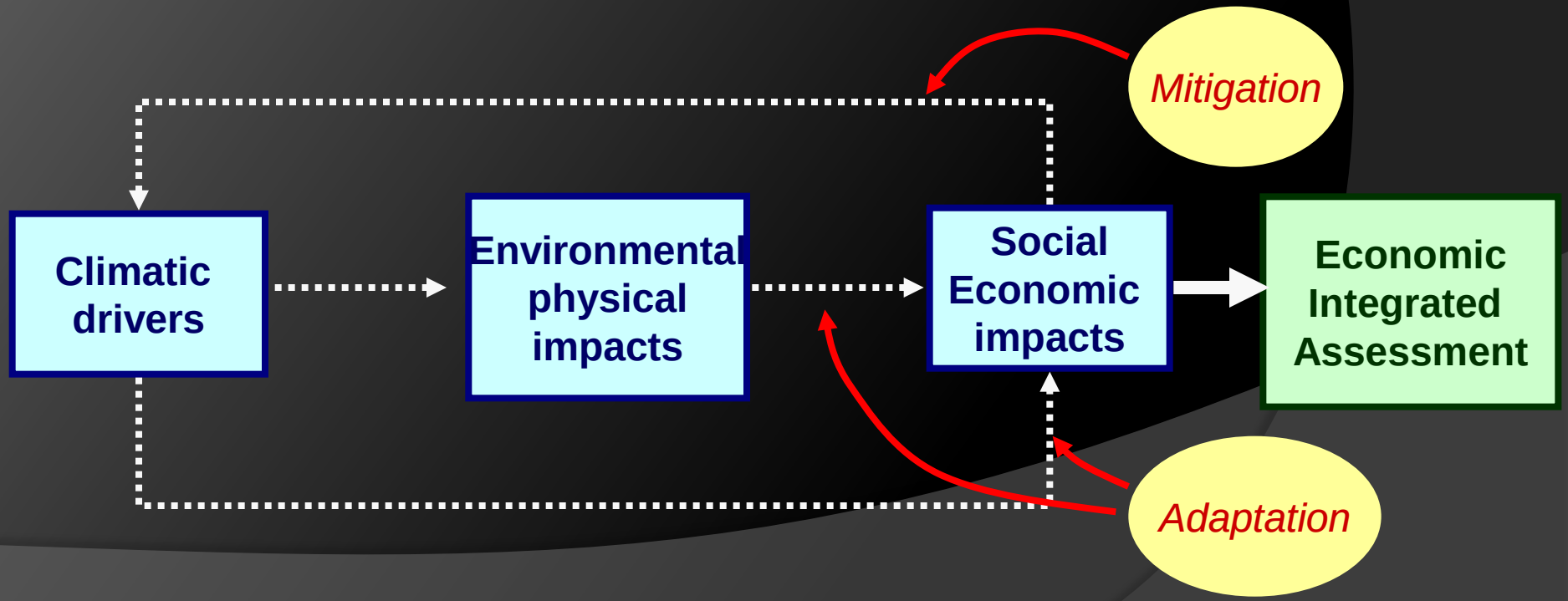


Total climate change costs = policy costs + residual damage

Sketching an economic impact assessment exercise

Climatic impacts cannot be assessed directly in economic terms
They have to be mediated through some observable behavior relevant for market dynamics or welfare

INTEGRATED ASSESSMENT
full range of causes and effects

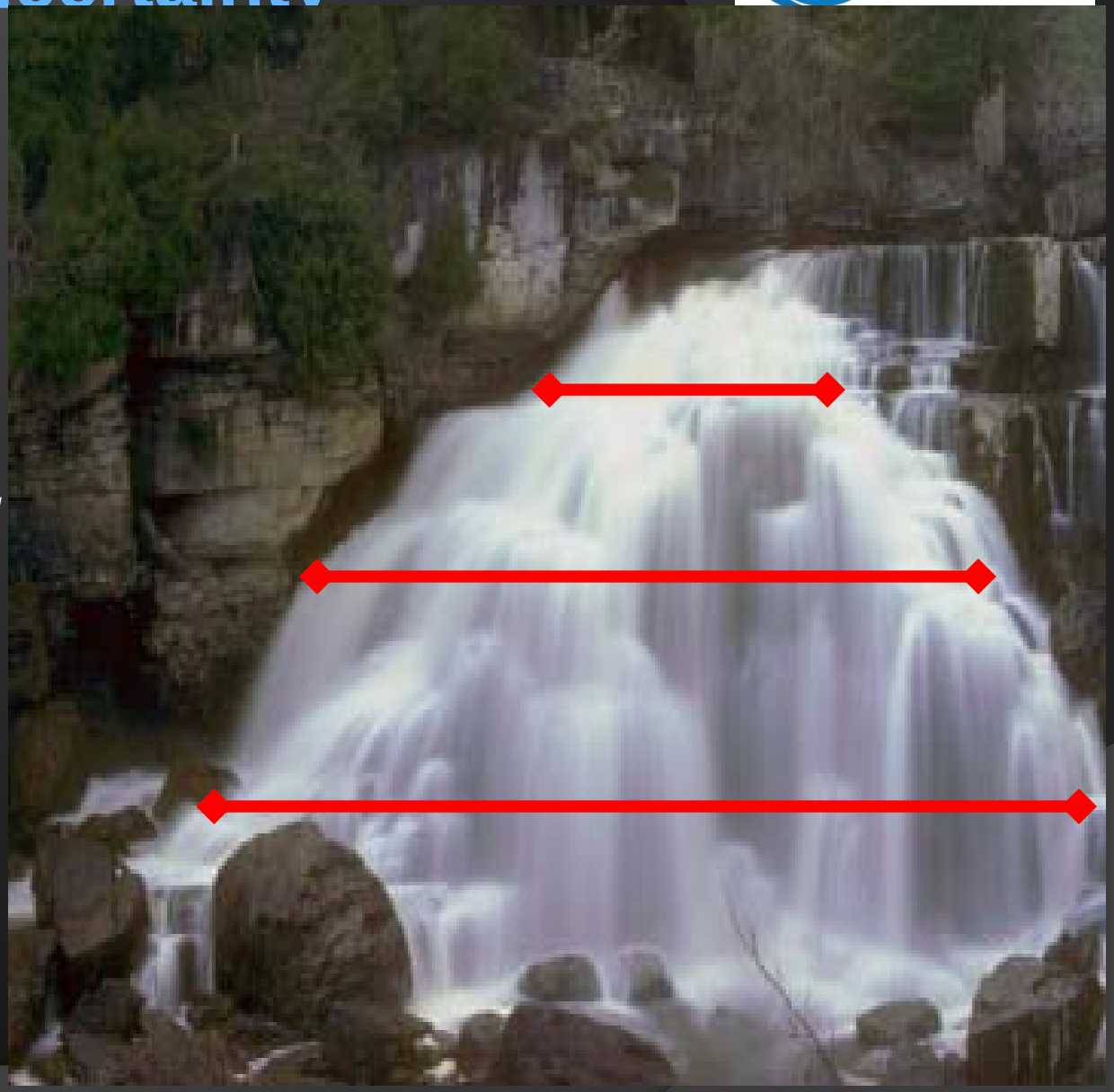


Impact economic assessment a cascade of uncertaintv

Uncertainty on climate dynamics

Uncertainty on physical assessment of cc impacts

Uncertainty on economic assessment of cc impacts



Economic assessment specific uncertainties

1. Time scale	*Evaluation of cost and benefits far in the future*	**Intrinsic uncertainty** **Baseline** **Intertemporal aggregation**
2. Welfare assessment of "NON markets" values	*Market prices, indicator of scarcity, do not exist*	**Approximations**
3. Geographical scale	*Global problem but with strong local specificities*	**Consider interdependencies** **Distributional aspects**

1. Aggregating welfare through time

Reasons to discount ⇒ Pure time preference (uncertainty)
⇒ Distributional issues (equity)

$$DF(t) = \left(\frac{1}{1+dr}\right)^t$$

dr = 0 => **DF**=1 => today = tomorrow
dr > 0 => **DF**<1 => today "more important" than future

Given the intertemporal dimension of climate change (present costs, future benefits) , the choice of policies/projects should be based on NPV considerations (at any scale)

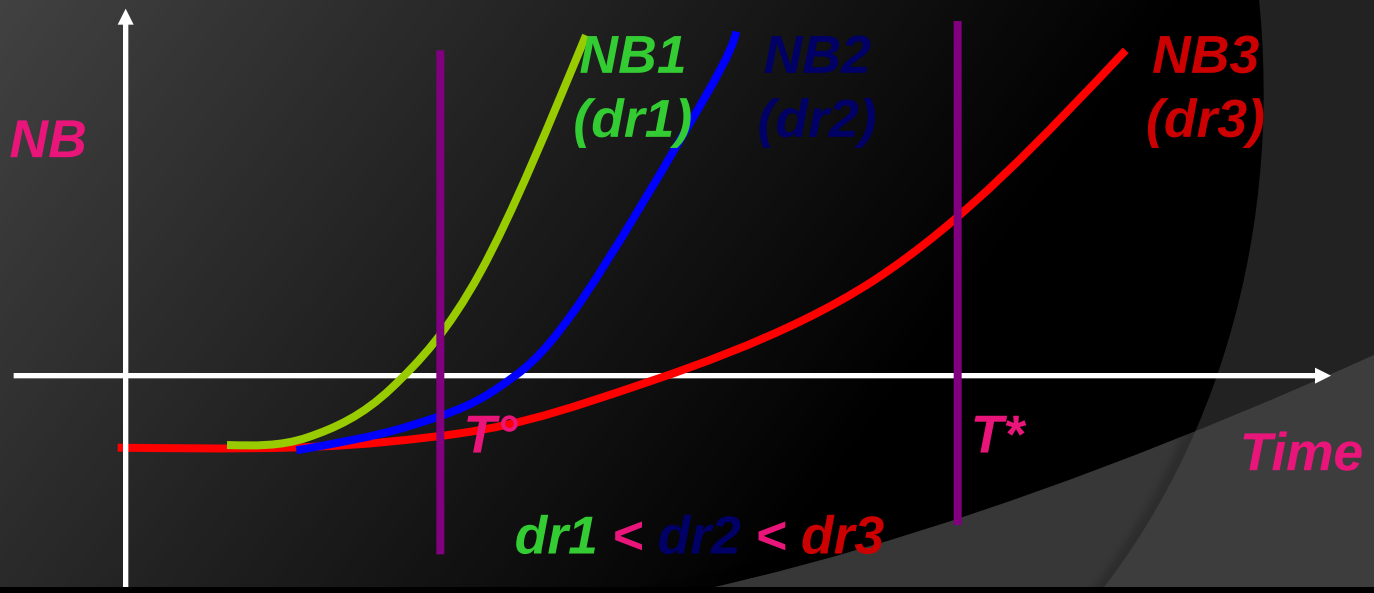
$$NPV_T = \sum_{t=0}^{T} \frac{NB_t}{(1+dr)^t}$$

1. Aggregating welfare through time

The "traditional" role of time *and* discounting

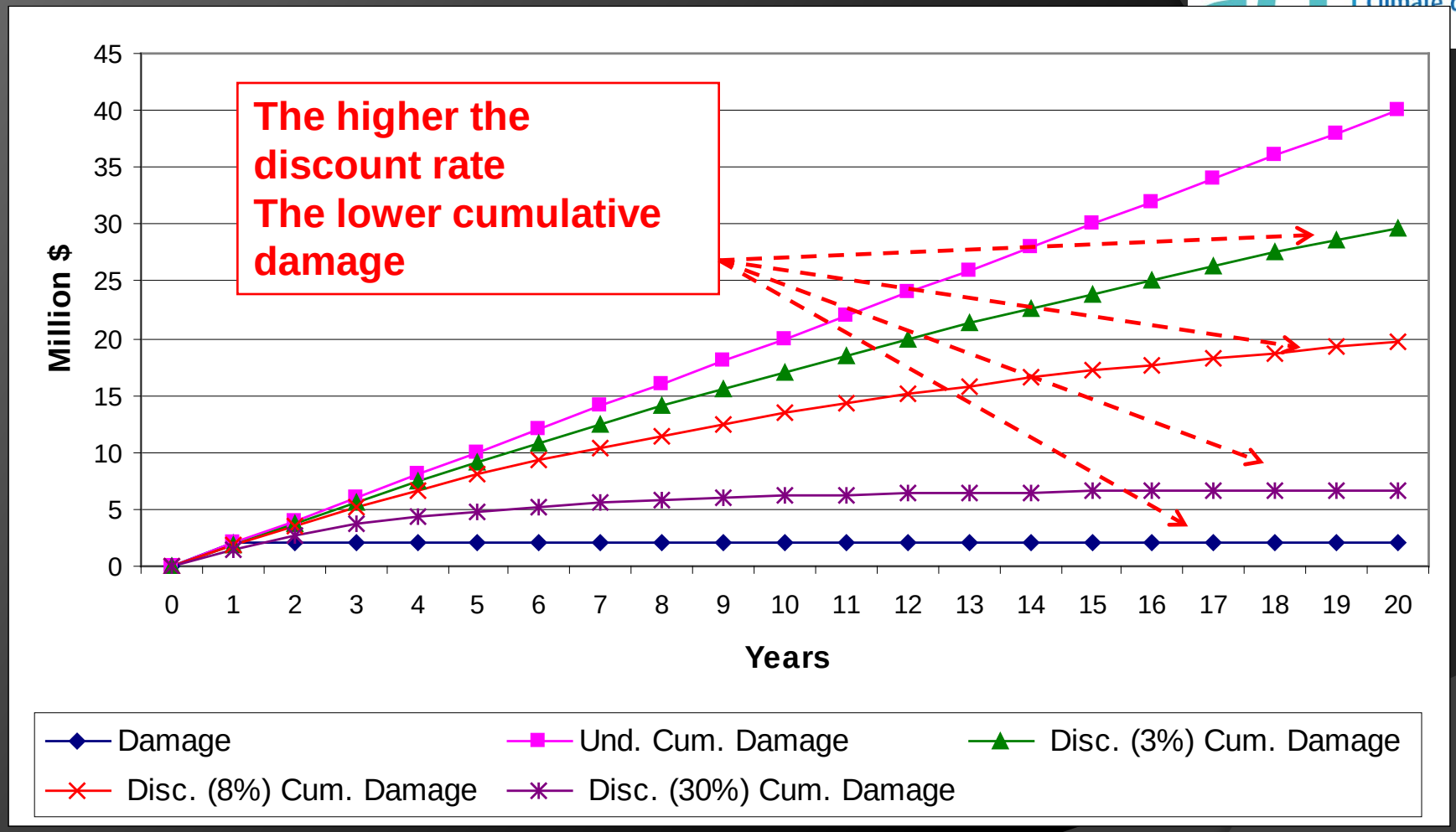
$$DF(t) = \left(\frac{1}{1+dr}\right)^{t}$$

dr = 0 => **DF**=1 => today = tomorrow
dr > 0 => **DF**<1 => today "more important" than future

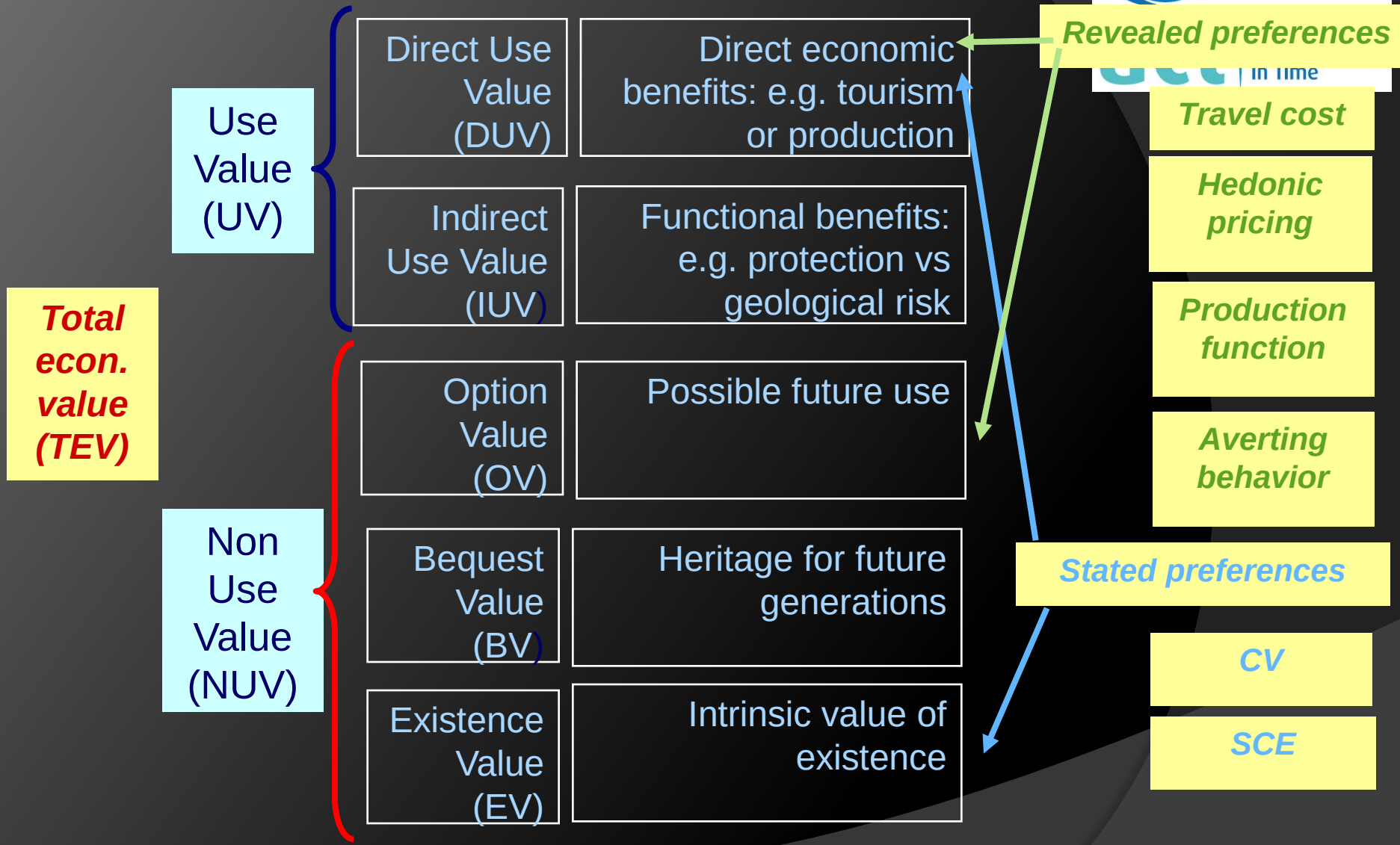


Any choice involves a subjective or ethical judgment!

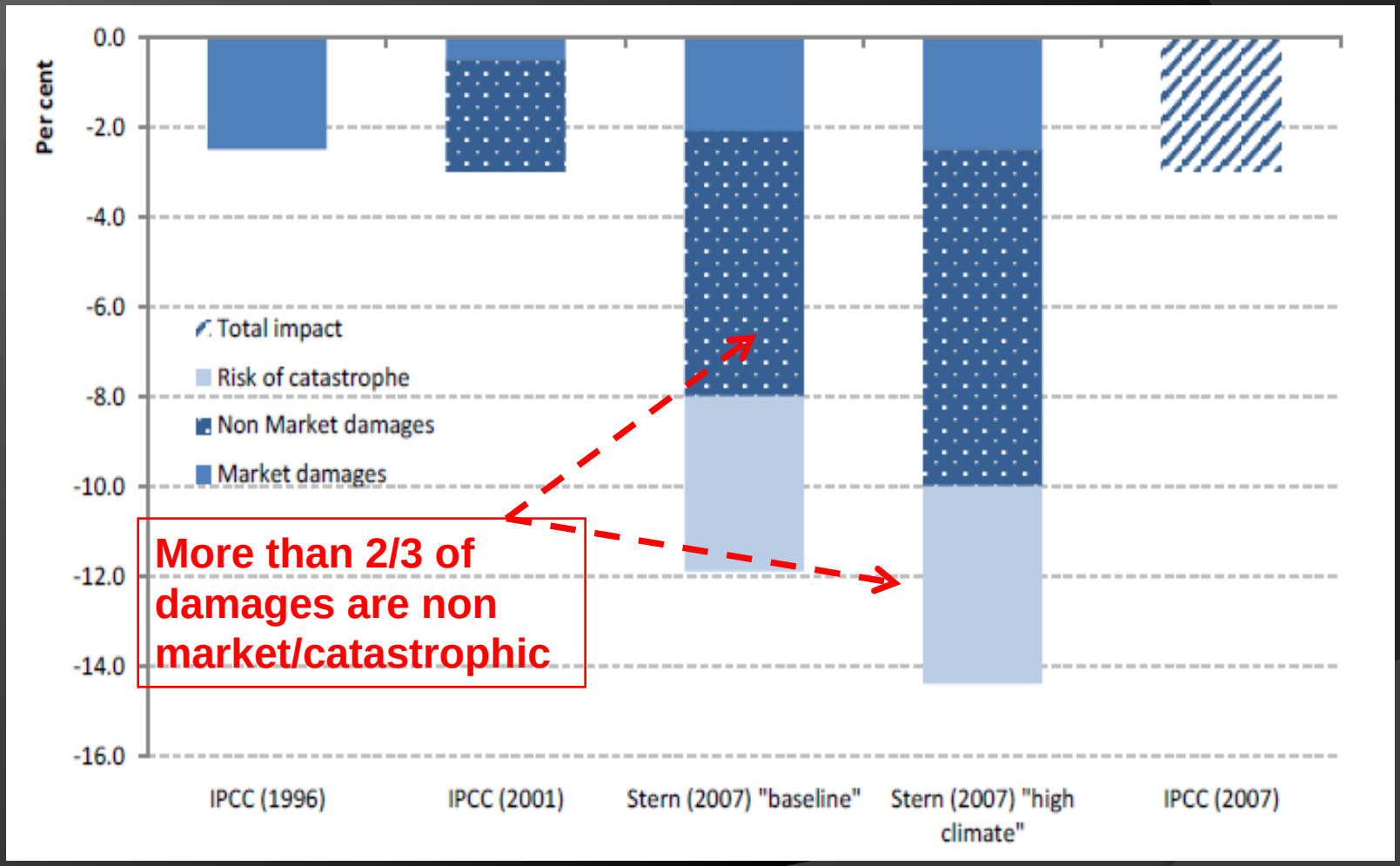
1. Aggregating welfare through time: Example



2. Welfare and non market values



2. The role of non-market impacts



Source: JAMET ET AL. 2009

2. Available approaches - models

	Confined to market (use) values	With non market (use) values
Systemic approach multi-region, multi-market	• General Equilibrium Models (market interactions)	•General equilibrium models incorporating WTP or WTA approaches (very few)
Partial or direct costing approach	• Partial equilibrium models • Travel Cost • Averting behavior • Hedonic Pricing • Production Function	•Contingent Valuation •Stated Choices Experiment

The challenge : consistently integrating general - global with partial – local or (top-down with bottom-up)

Aggregate impacts from GE models

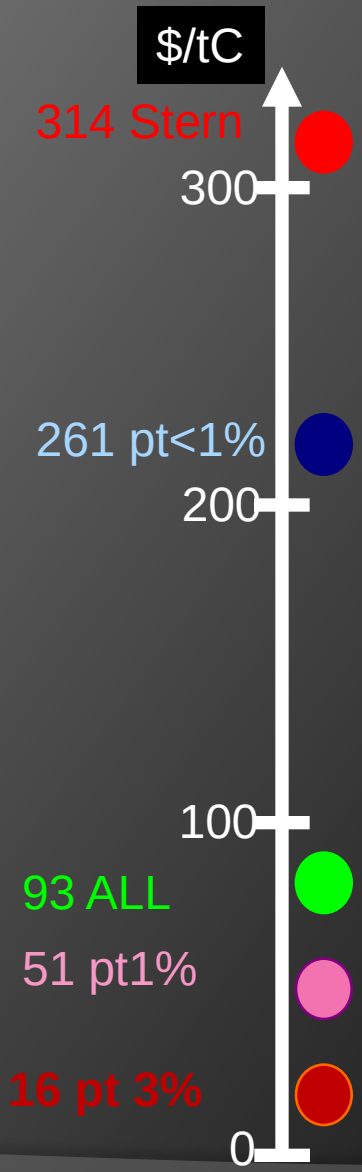
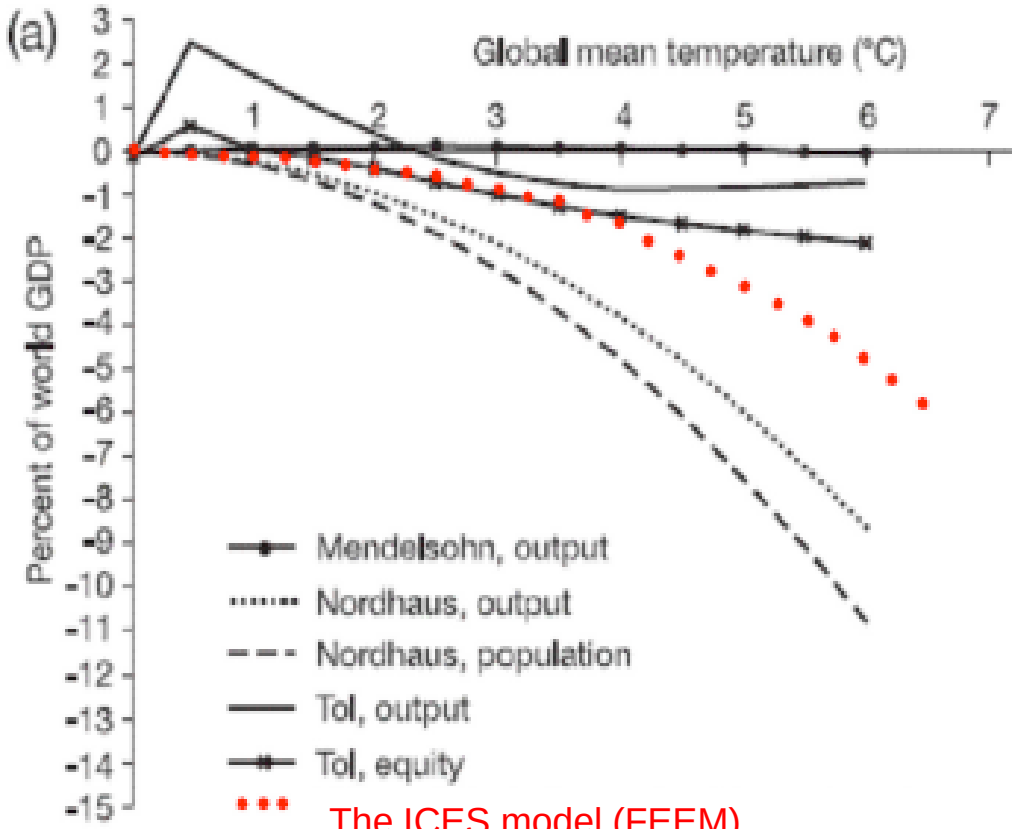


Figure 2. Climate change damages as a function of global mean temperature increase (above preindustrial levels)



Source: Our adaptation from IPCC AR4 (2007)

Survey of 103 estimates (Tol, 2005)

3. Regional impacts from GE models

Study	Warming	Impact	Worst-off region		Best-off region	
	(°C)	(%GDP)	(%GDP)	(Name)	(%GDP)	(Name)
(Nordhaus, William D. 1994)	3.0	-1.3				
(Nordhaus 1994)	3.0	-4.8 (-30.0 to 0.0)				
(Fankhauser, Samuel 1995)	2.5	-1.4	-4.7	China	-0.7	Eastern Europe and the former Soviet Union
(Tol 1995)	2.5	-1.9	-8.7	Africa	-0.3	Eastern Europe and the former Soviet Union
(Nordhaus and Yang 1996)[a]	2.5	-1.7	-2.1	Developing countries	0.9	Former Soviet Union
(Plamberk and Hope 1996)[a]	2.5	-2.5 (-0.5 to −11.4)	-8.6 (-0.6 to -39.5)	Asia (w/o China)	0.0 (-0.2 to 1.5)	Eastern Europe and the former Soviet Union
(Mendelsohn et al. 2000a)[a,b,c]	2.5	0.0[b] 0.1[b]	-3.6[b] -0.5[b]	Africa	4.0[b] 1.7[b]	Eastern Europe and the former Soviet Union
(Nordhaus, William D. and Boyer, Joseph G. 2000)	2.5	-1.5	-3.9	Africa	0.7	Russia
(Tol 2002a)	1.0	2.3 (1.0)	-4.1 (2.2)	Africa	3.7 (2.2)	Western Europe
(Maddison 2003)[a,d,e]	2.5	-0.1	-14.6	South America	2.5	Western Europe
(Rehdanz and Maddison 2005)[a,c]	1.0	-0.4	-23.5	Sub-Saharan Africa	12.9	South Asia
(Hope 2006)[a,f]	2.5	0.9 (-0.2 to 2.7)	-2.6 (-0.4 to 10.0)	Asia (w/o China)	0.3 (-2.5 to 0.5)	Eastern Europe and the former Soviet Union
(Nordhaus 2006)	2.5	-0.9 (0.1)				

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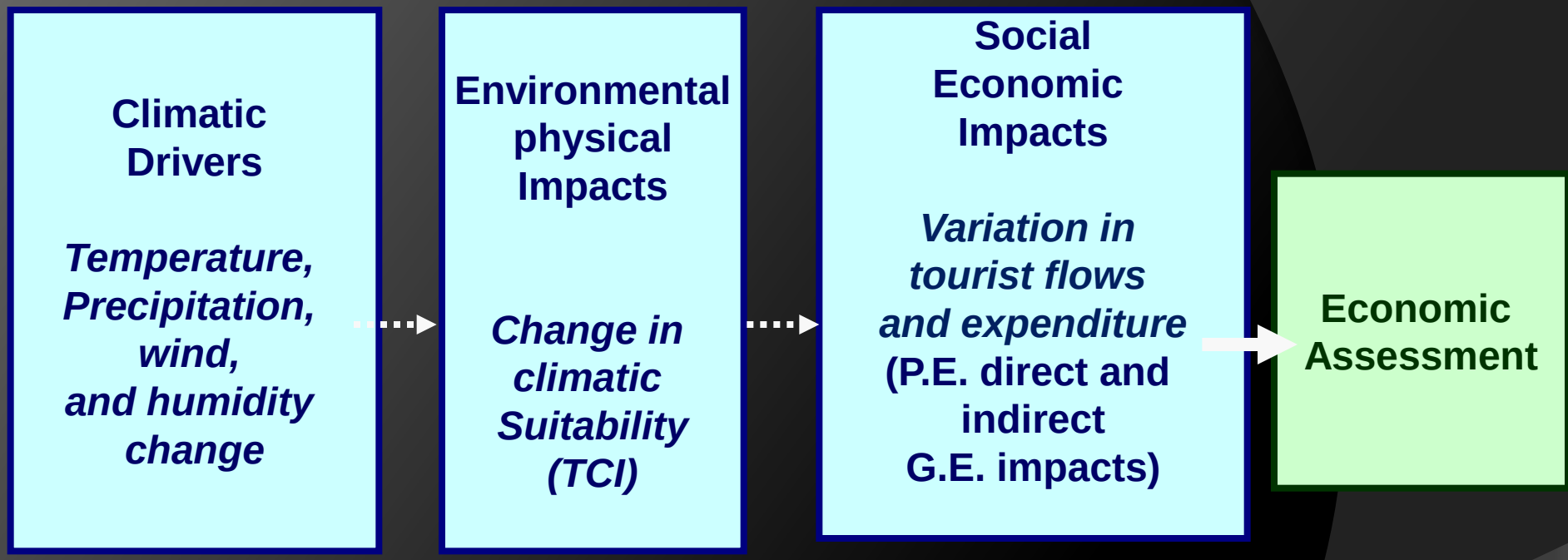
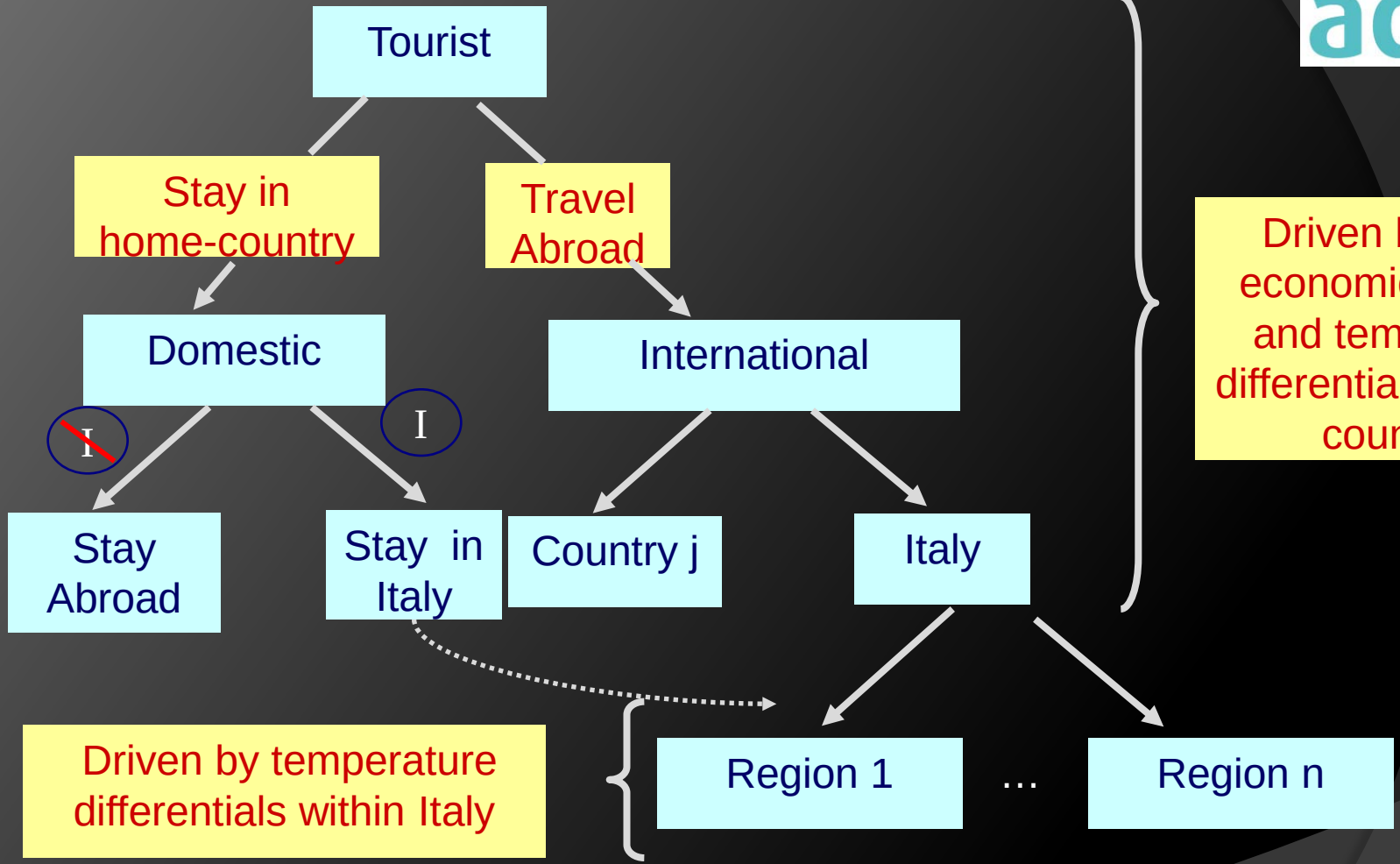
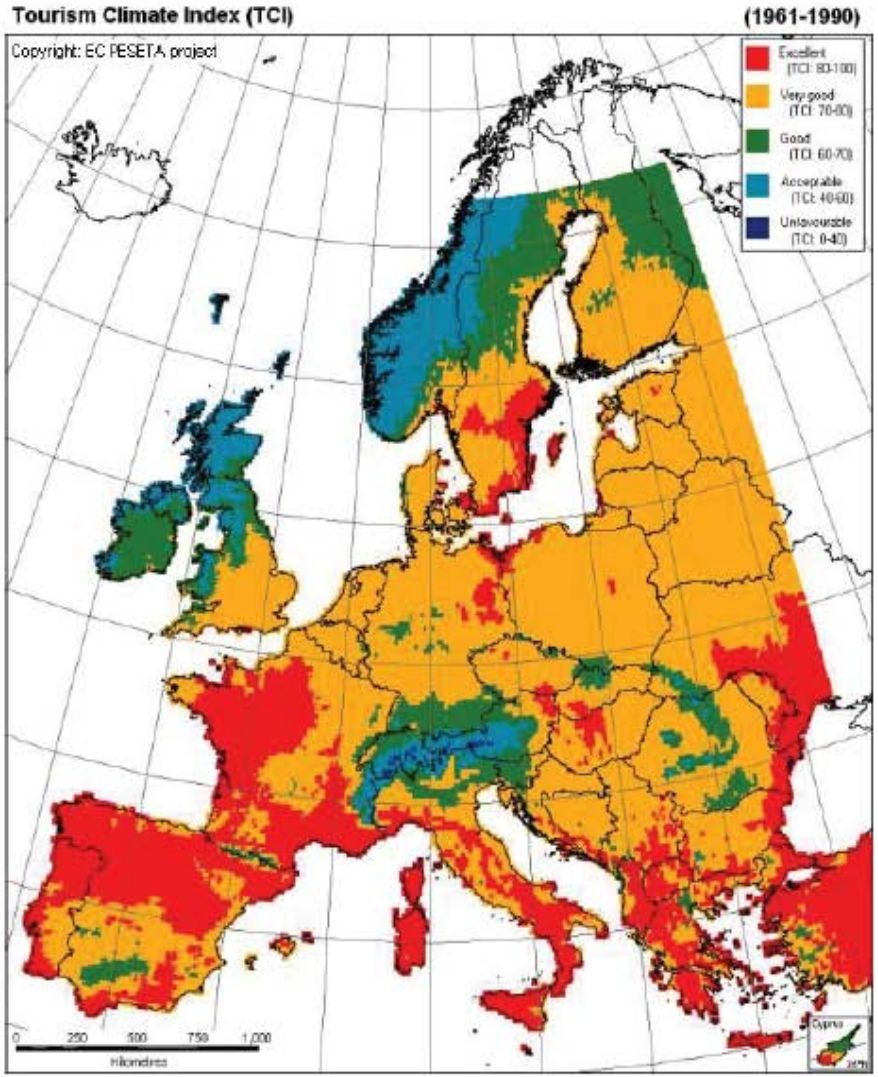
Example: economic assessment of CC impacts on tourism

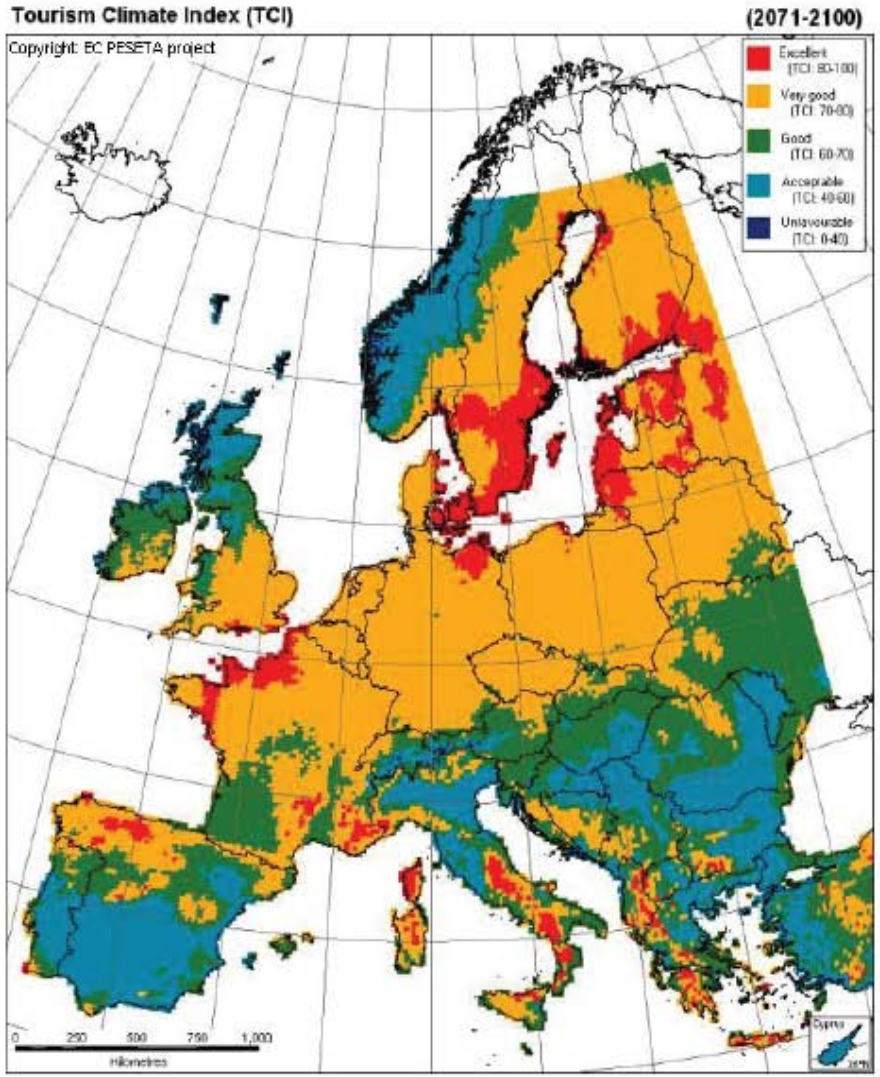


A simplified model of tourist's choices



Changing climate and attractiveness (TCI) an example





Source: PESETA project. http://peseta.jrc.es/docs/Tourism.html. P. Martens/B. Amelung/A. Moreno.

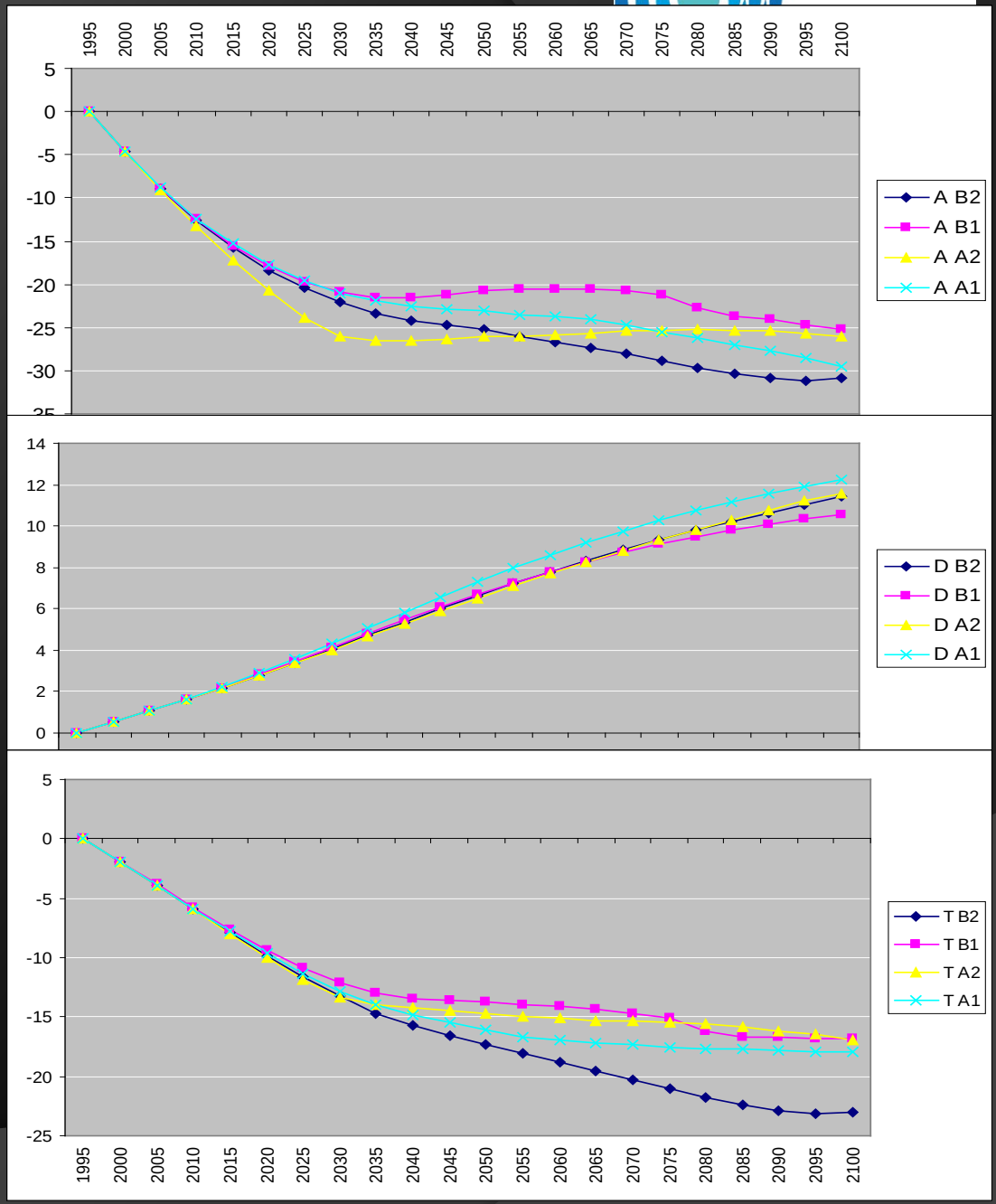
A picture for Italy: foreign and domestic tourism

International Arrivals
~ -25% -30% 2100

(% changes wrt no climate change)

Domestic Tourist Trips
~ +11% 2100

Total Tourism Demand
~ -16% -23% 2100



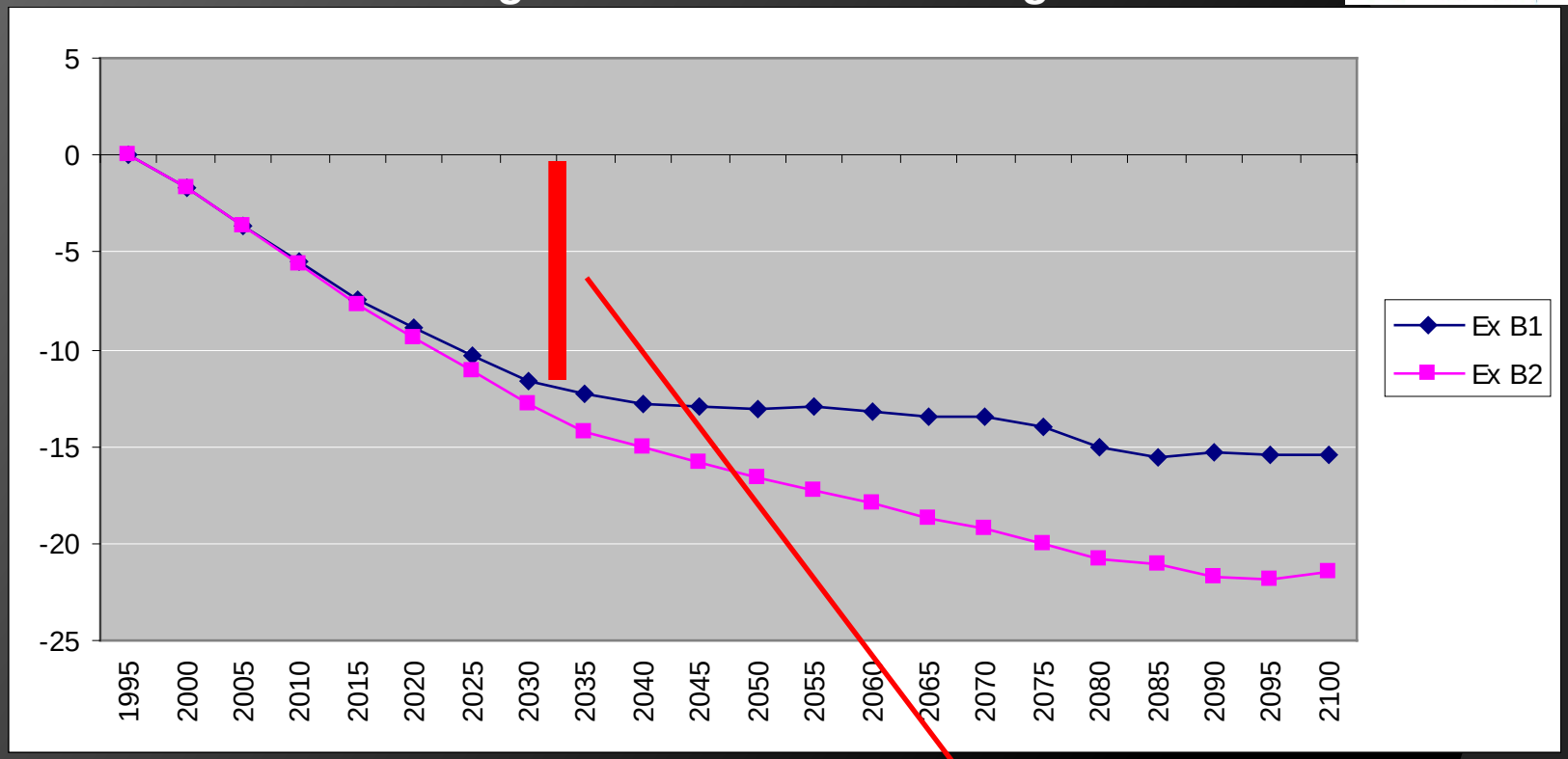
Source: Bigano, Bosello (2007)

Downscaling T. flows at the regional level

	2030			2060			2090		
%	Italians	Foreign	Total	Italians	Foreign	Total	Italian	Foreign	Total
Piemonte	5,9	-21,5	-12,4	12,1	-21,8	-14,1	17,6	-23,5	-14,7
Valle d'Aosta	9,5	-18,9	-4,0	20,4	-16,4	-1,8	31,2	-15,1	2,4
Lombardia	5,2	-22,1	-13,8	10,5	-23,3	-16,3	14,9	-25,7	-17,8
Trentino-Alto Adige	7,2	-20,5	-14,1	15,0	-19,7	-14,4	22,3	-20,2	-14,2
Veneto	4,9	-22,6	-17,2	9,7	-24,4	-20,0	13,6	-27,3	-22,5
Friuli-V.Giulia	3,6	-23,3	-15,5	6,8	-25,8	-19,4	8,9	-29,5	-22,5
Liguria	2,4	-24,2	-11,0	4,1	-27,7	-16,0	4,4	-32,4	-19,5
Toscana	4,0	-23,2	-16,1	7,6	-25,6	-19,9	10,2	-29,2	-22,9
Umbria	2,8	-23,9	-15,5	4,9	-27,1	-20,2	5,8	-31,4	-23,9
Marche	3,2	-23,5	-6,7	6,0	-26,3	-10,2	7,5	-30,3	-12,1
Lazio	4,2	-22,7	-16,6	8,1	-24,6	-19,7	11,1	-27,7	-22,3
Abruzzo	5,5	-22,1	-3,0	11,1	-23,2	-3,5	16,0	-25,5	-2,5
Molise	7,4	-20,5	1,1	15,5	-19,9	3,8	23,1	-20,4	8,0
Campania	2,2	-24,7	-14,7	3,5	-28,9	-20,5	3,5	-34,2	-25,0
Puglia	1,5	-24,9	-4,9	1,9	-29,2	-9,1	0,8	-34,7	-12,3
Basilicata	3,3	-24,1	-1,3	6,1	-27,6	-2,6	7,8	-32,3	-3,1
Calabria	2,3	-24,3	-3,9	3,8	-28,0	-7,1	4,1	-32,9	-9,2
Sicilia	0,5	-25,7	-15,9	-0,4	-31,1	-23,0	-2,8	-37,6	-29,0
Sardegna	2,6	-24,1	-6,9	4,4	-27,5	-10,9	5,0	-32,0	-13,5

Source: Bigano, Bosello (2007)

A picture for Italy: tourism expenditure



Source: Bigano, Bosello (2007)

Using 2006 tourism expenditure roughly 9855 million € = 0.6% of GDP (1476734 millions €)

Policy optimization models

Socio-economic systems can adapt, but market action might not be sufficient => residual dam., distributional issues => need policy

NORMATIVE MODELS → What is the path of a given control variable to reach a given target minimising cost or maximising welfare?

Tool useful for policy analysis

⇒ What is the optimal adaptation policy?

⇒ What is the optimal response to uncertanty?

Concluding remarks

Economic models can provide an integrated view of the overall chain effects => from climatic drivers to socio-economic impacts, but still deep uncertainties on

- Non market impacts
- Long-term impacts (non-linearity, irreversibility)
- Regional diversities

Improve integration between global and local studies

Address the impact of uncertainty (hedging or Montecarlo)

Thank you

enrica.decian@feem.it

***visit WITCH's web page at http://www.witchmodel.org/ ***

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