

External Costs of Climate Change

Richard S.J. Tol

Hamburg, Vrije and Carnegie

Mellon Universities

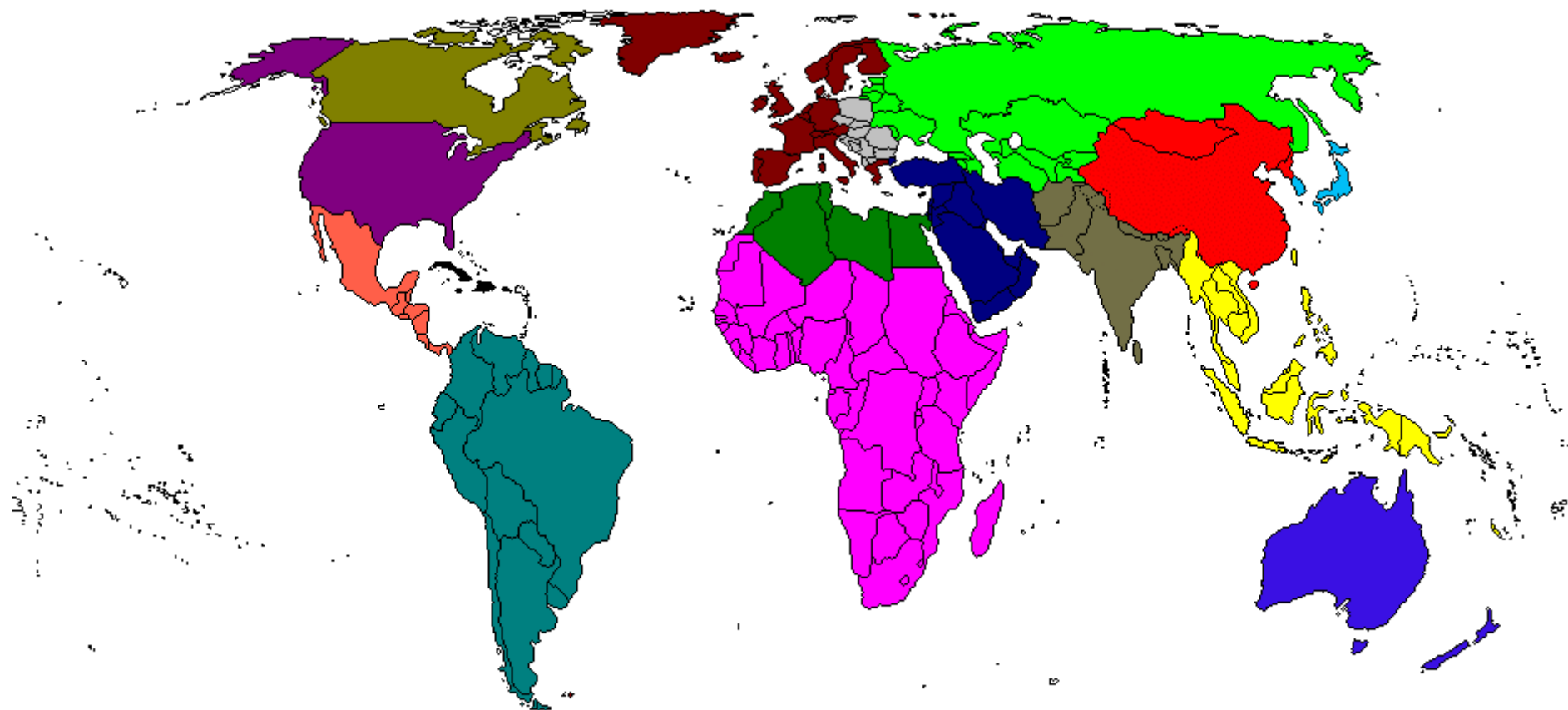


FUND2.8

- The Climate Framework for Uncertainty, Negotiation, and Distribution, version 2.8
- FUND is an integrated assessment model, coupling demographics, economy, technology, carbon cycle, climate, and climate change impacts, so as to derive insights into climate policy
- The model has been in operation since 1994, has been reviewed, compared, assessed and used to advice EC, UN, US, UK, and banks, utilities and insurers

FUND2.8 Impacts

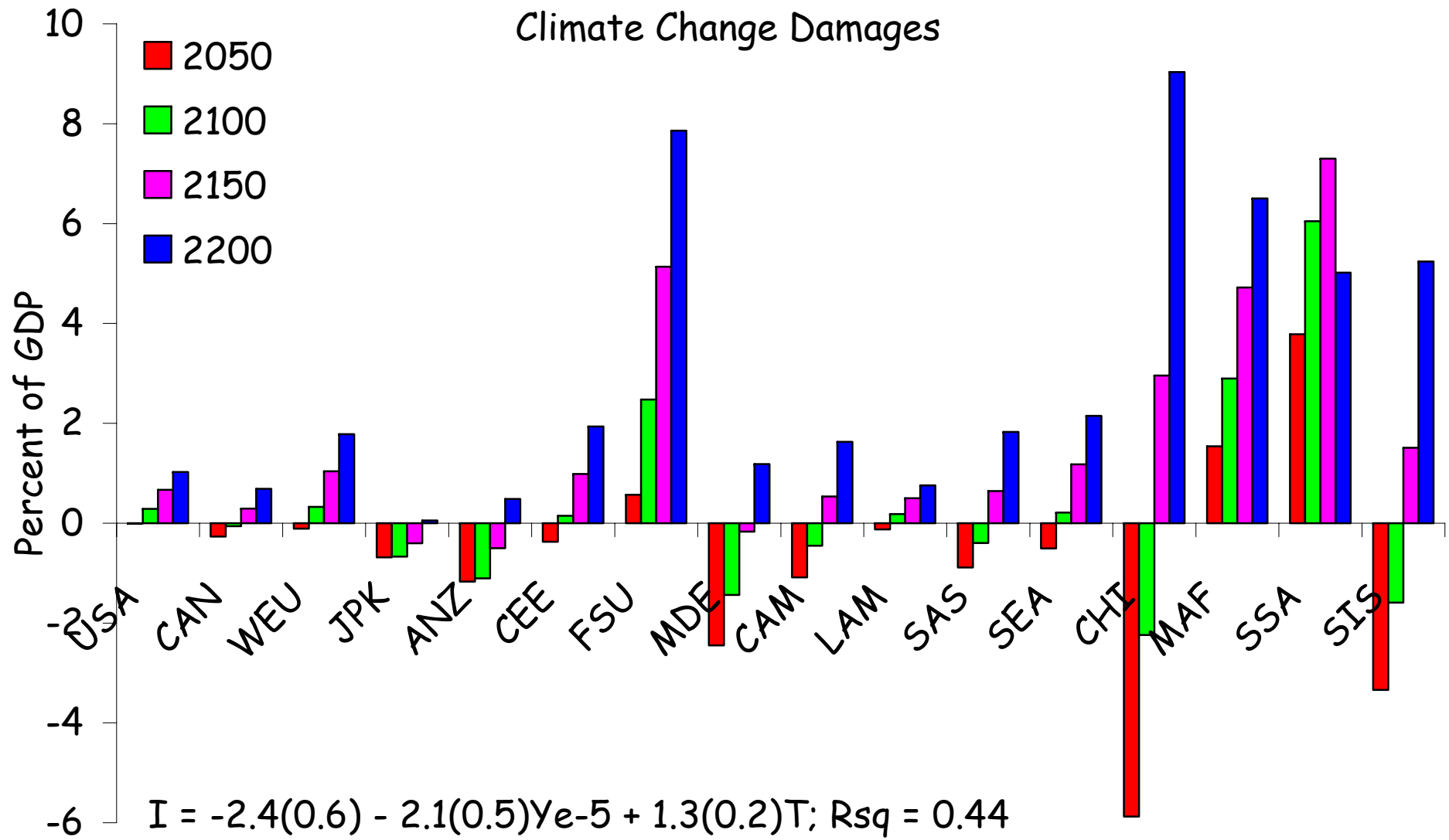
- FUND2.8 includes sea level rise, energy consumption, agriculture, forestry, water resources, cardiovascular and respiratory diseases, malaria, dengue fever, schistosomiasis, diarrhoea and ecosystems
- Other impacts are unknown
- Reduced forms of more complex models
- Valued using standard monetary valuation methods, particularly benefit transfer
- Vulnerability changes with development
- Up to 2300, 16 world regions



The 16 regions of FUNDS2.5 and higher

Note: Small Island States are a separate region.

Climate Change Damages



Source: FUND 2.5

Marginal Damage Costs

- The marginal damage cost is the damage done by an additional tonne of CO₂ emitted
- It is the change in the net present value of the monetised impacts, normalised by the change in emissions
- The marginal damage cost is the Pigou tax - it says how much we should spend on climate policy, by how much we should raise energy prices
- It is a normative concept; it tells us what to do

Marginal Damage Costs -2

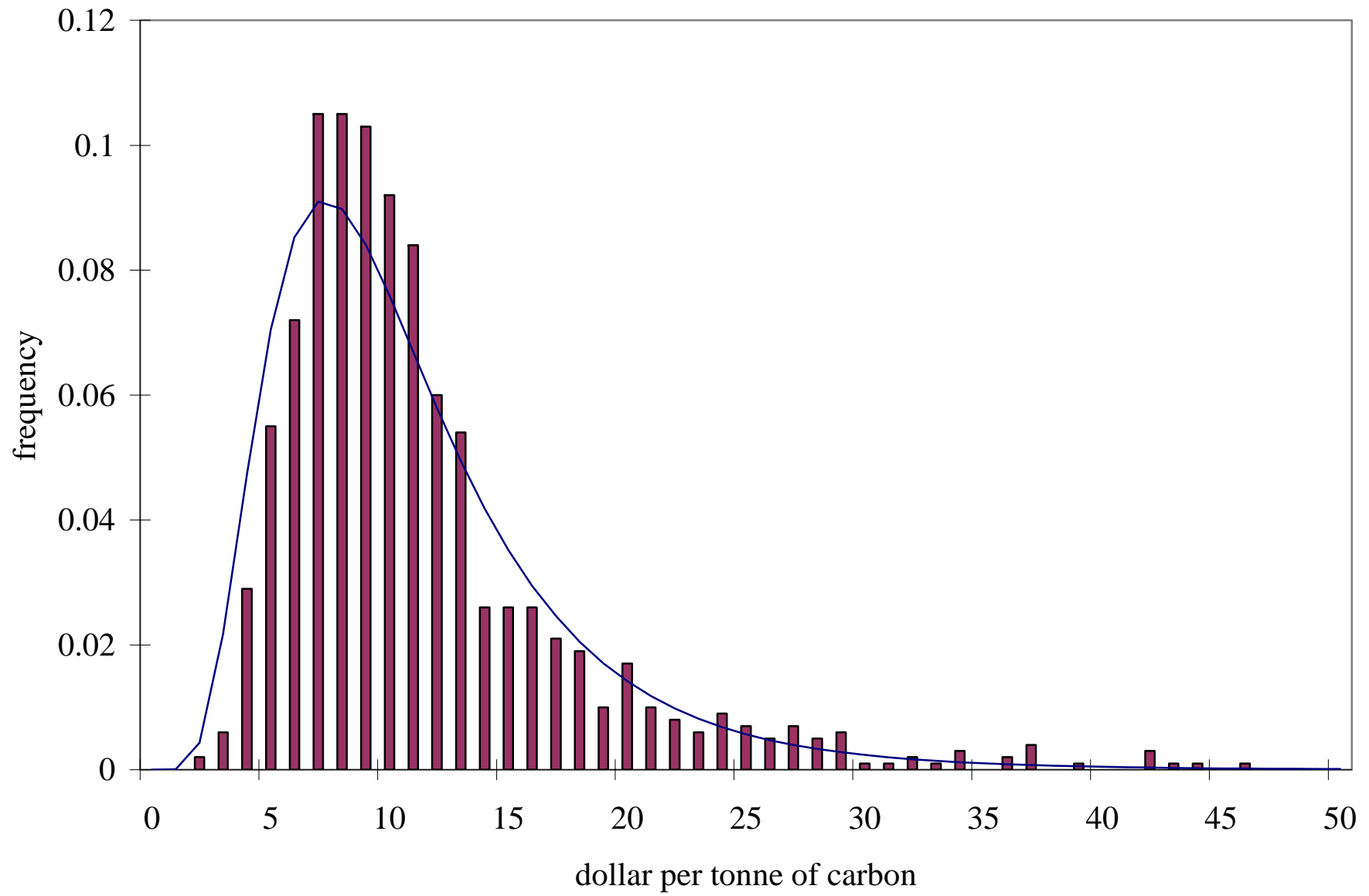
- The marginal damage cost is also a normative concept in that one cannot calculate it without making assumptions about values
- First, how much do we care about the future?
- Second, how much do we care about what happens in foreign lands?
- Third, how much do we care about risk?
- The answers to these questions are partly constrained by our behaviour in other issues, but they also depend on ethics

Estimates

- Even if we fix the ethical position, there is no single estimate of the marginal damage costs of climate change
- Climate change impact research is large and active; insights constantly change, and with every update of the model, estimates change by 10-20%
- Emission scenarios, climate change, and impacts are all very uncertain
- Marginal damage cost estimates provide guidance, are no prescription; always interpret and use with caution

Marginal cost estimates

		0%	1%	3%
Nordhaus 1994	BG			5
	EV			12
Fankhauser 1994	EV	20 (6-45)		
Tol 1999	BG	73	23	9
	EW	171	60	23
	EVW	244	82	35
		(143)	(51)	(22)
Downing 2000	BG	75	46	16
Tol 2000	BG	20	4	-7



Discounting

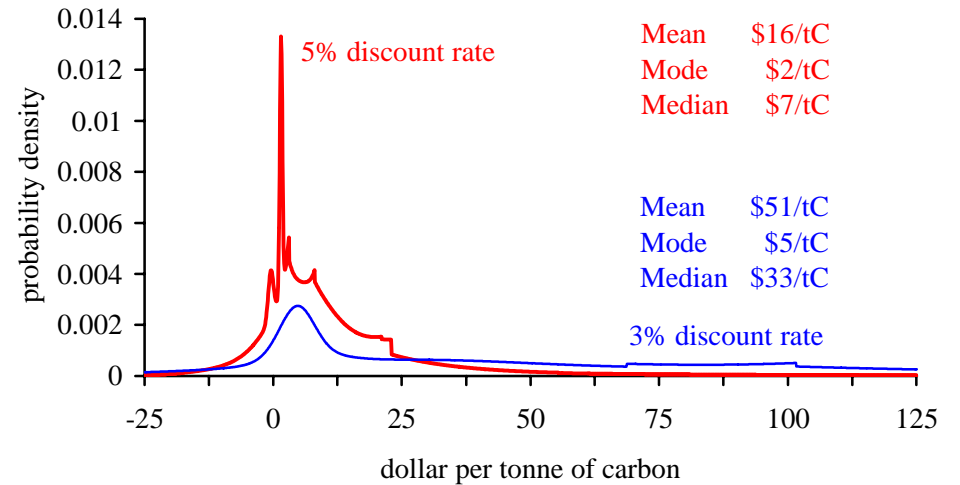
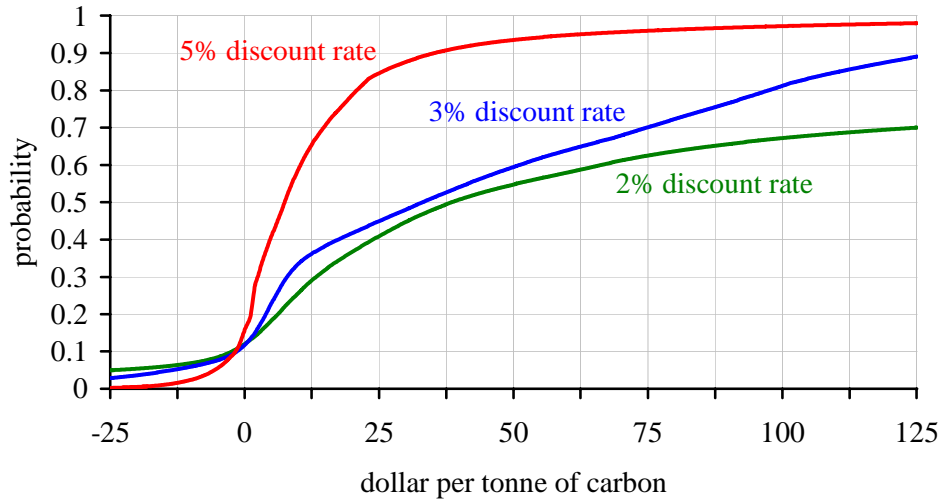
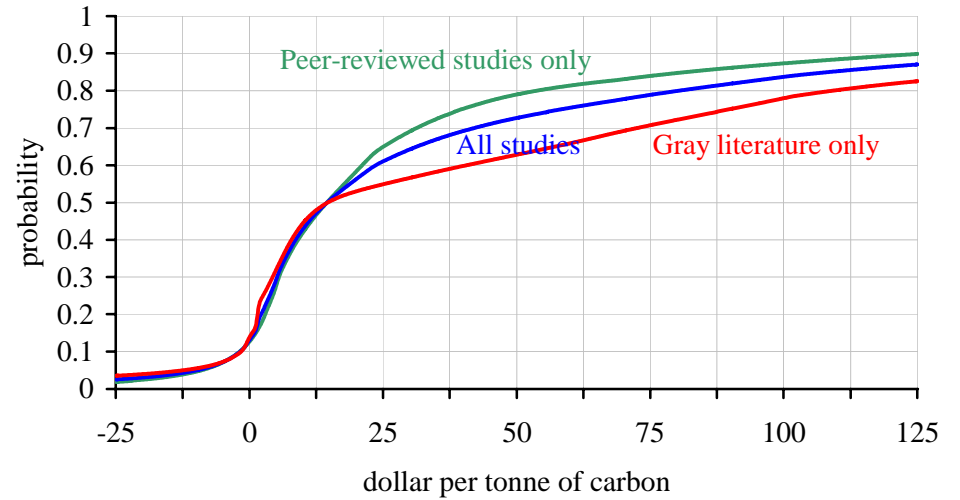
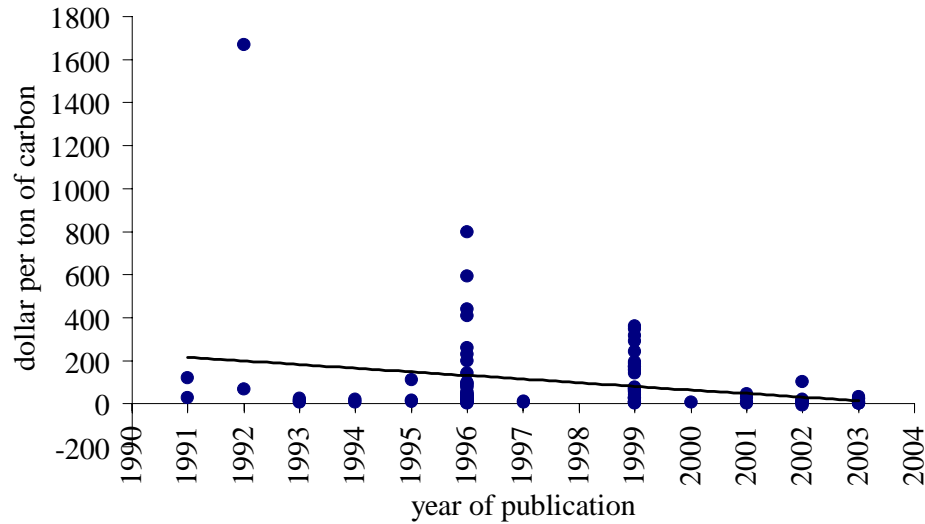
- Recently, arguments emerged that the discount rate should not be constant, but fall as the time horizon expands

Constant	\$/tC	£/tC
2%	58	32
3%	11	6
5%	-2	-1
Declining		
Greenbook	18	10
Weitzman	88	49

Extreme scenarios

Case	\$/tC	£/tC
Base	18	10
THC	17	9
Younger Dryas	20	11
2689 MT CH4	23	13
8667 MT CH4	30	17
4.5	101	56
7.7	269	149
9.3	359	199

A Meta-Analysis of the Marginal Damage Costs

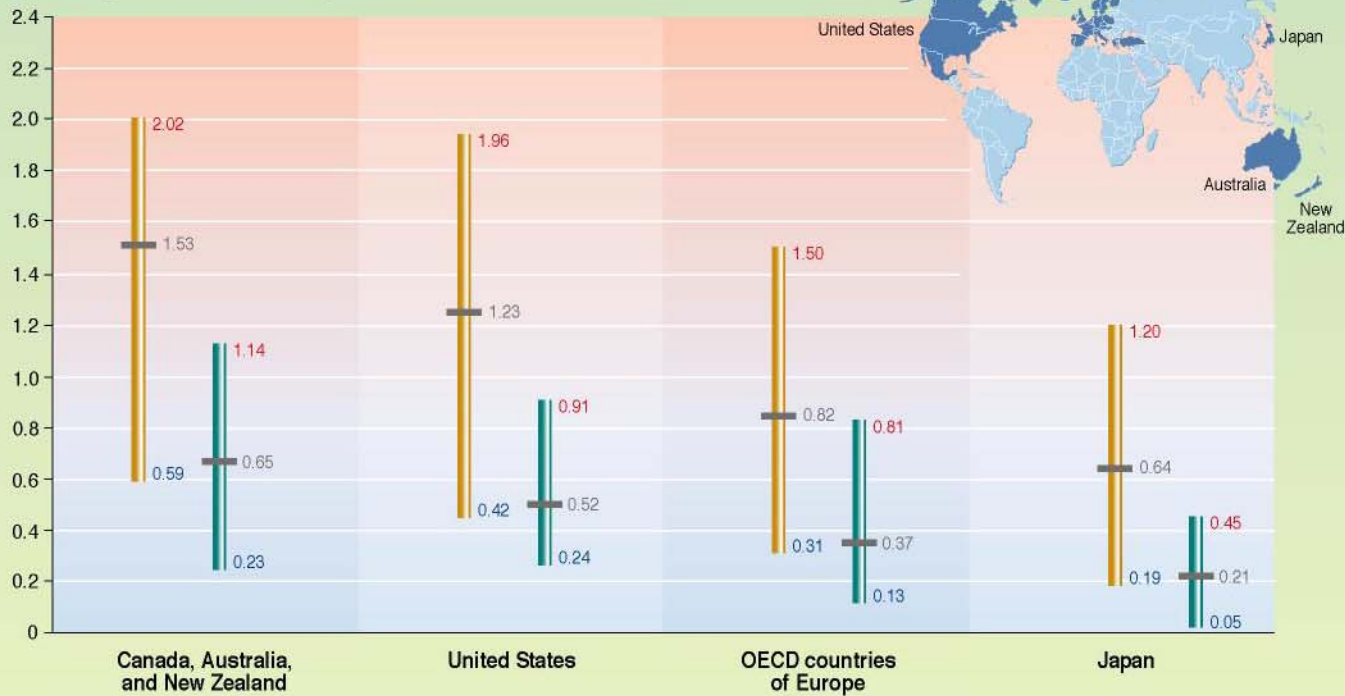


Conclusion

- External costs of carbon dioxide can be estimated, but
- ... They are incomplete, with unknown bias
- ... They are highly uncertain, primarily because impacts occur in a distant future
- ... They are strongly dependent on ethical assumptions on discounting and aggregation
- Nonetheless, the estimates provide some guidance for policy
- Alternatively, one may look at avoidance costs

Projections of GDP losses in Annex II countries in the year 2010 from global models

Percentage of GDP loss in the year 2010



Range of outcomes for two scenarios

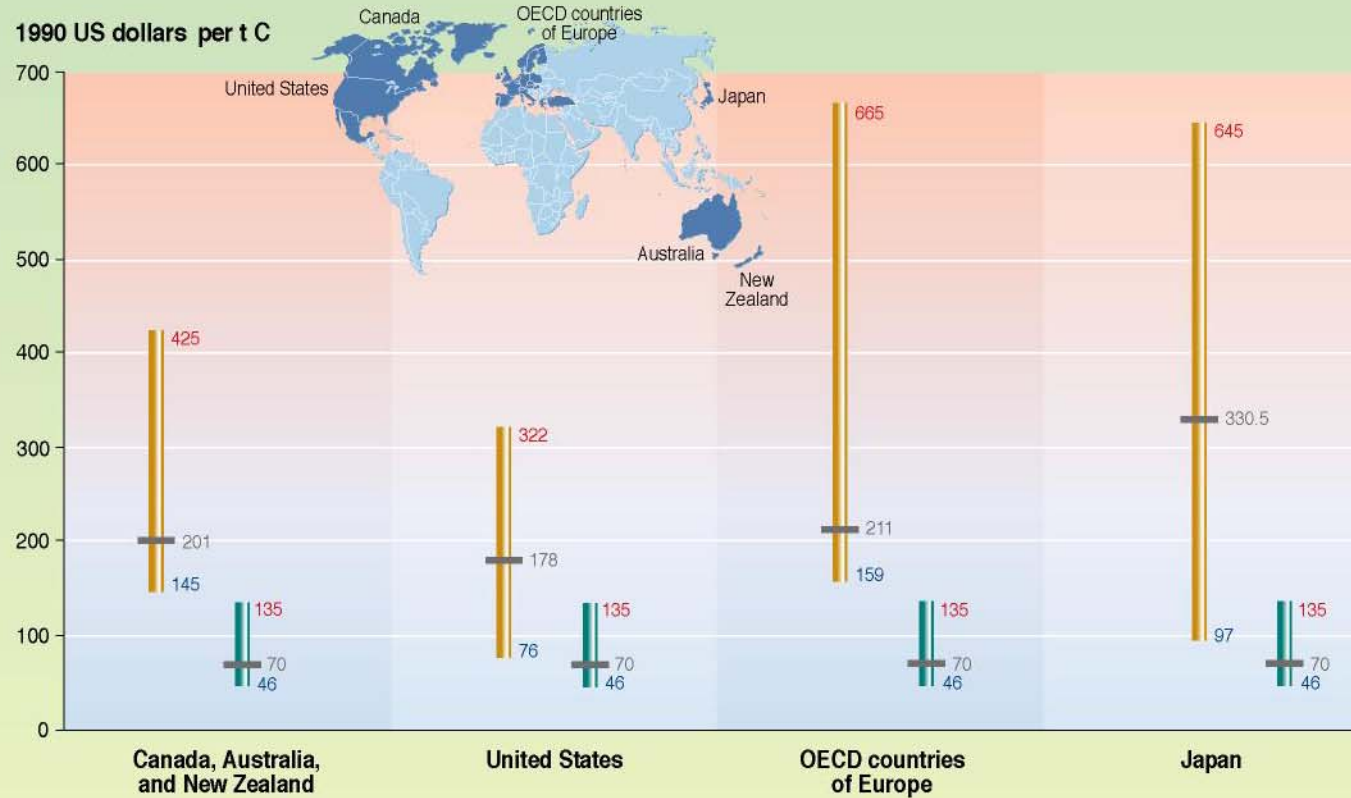
- ▮ Absence in international trade in carbon emissions rights: each region must take the prescribed reduction
- ▮ Full annex B trading of carbon emissions rights permitted

The three numbers on each bar represent the highest, mean, and lowest projections from the set of models.

SYR - FIGURE



Projections of marginal cost in Annex II countries in the year 2010 from global models



Range of outcomes for two scenarios

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SYR - FIGURE

The costs of a 25% emission reduction from baseline, decomposed

	Japan	EU	USA	Canada
C-price	323	205	231	127
Loss (%)	15	2.2	0.5	1.1
Loss (bln \$)	48	160	43	7
<i>Direct</i>	11	23	43	3
<i>Distortion</i>	28	109	0	3
<i>Oil markets</i>	0	-1	-3	0
<i>Other goods</i>	0	-2	-1	0
<i>Capital</i>	1	0	-1	0
<i>Other</i>	10	20	5	1

Paltsev et al., 2004