

Emission trading and uncertainty



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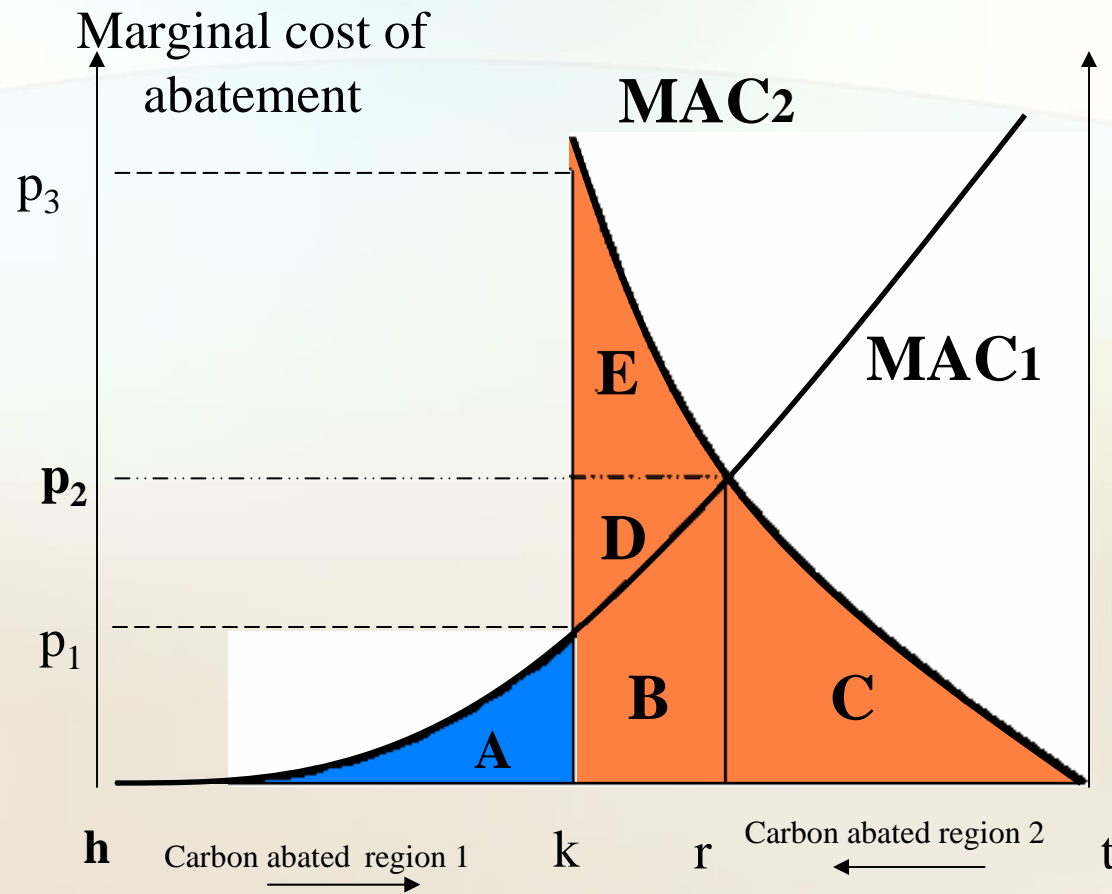
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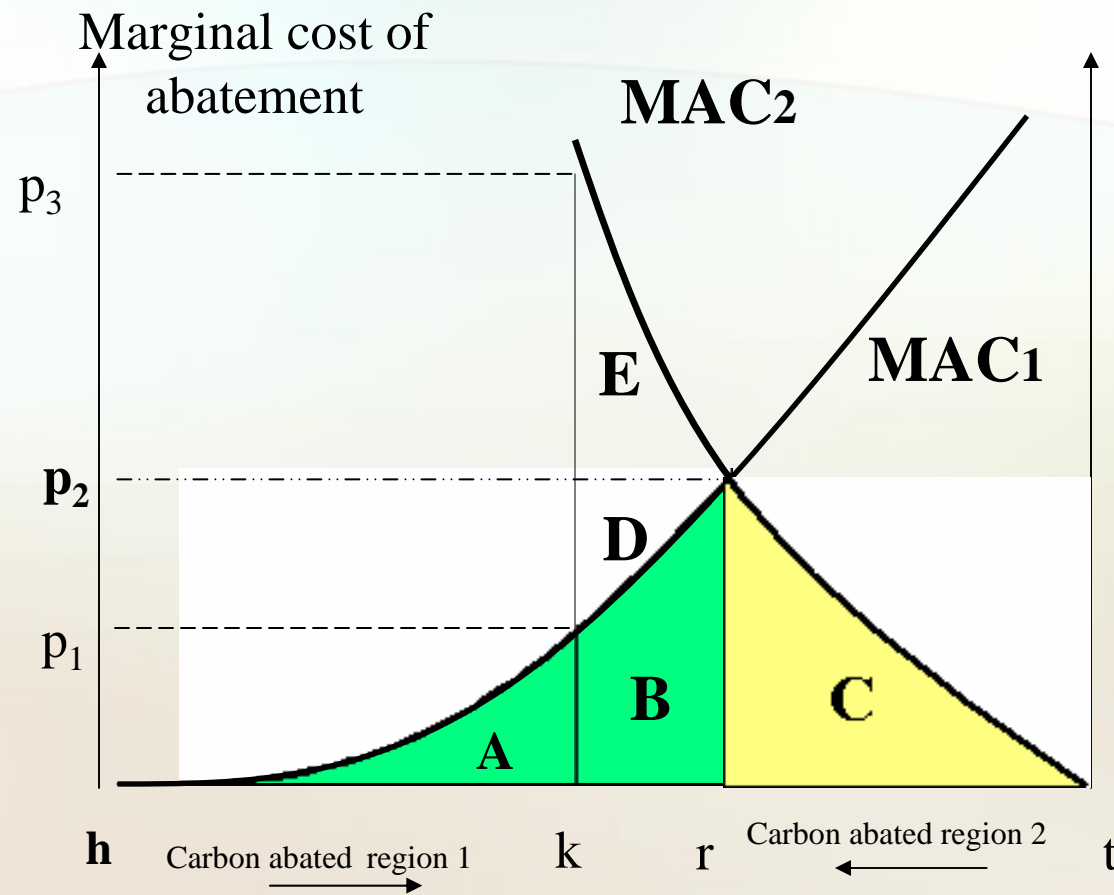
Outline

- The marginal abatement cost curves
- Uncertainty in trading
- Optimisation problem
- Scenarios and results
- Conclusion

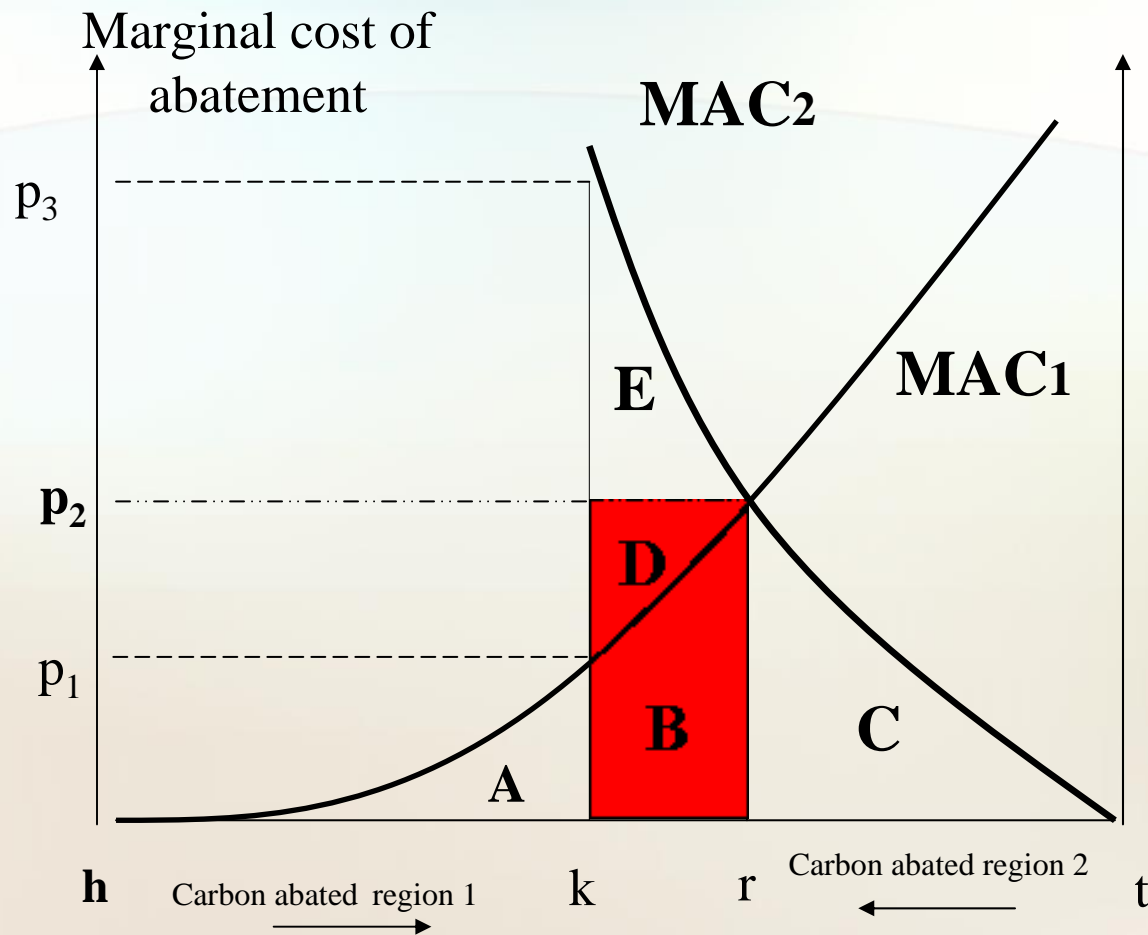
MAC's for 2 regions (example)



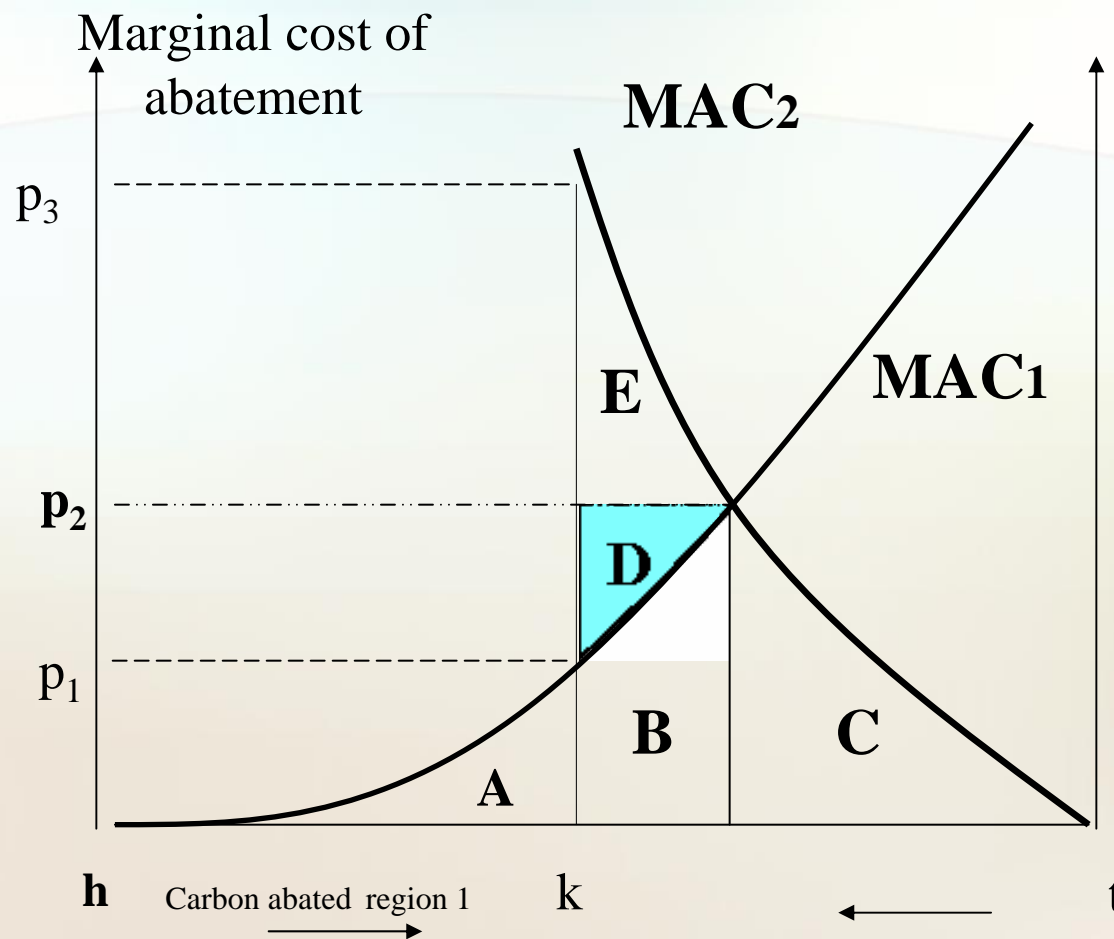
MAC's for 2 regions (example)



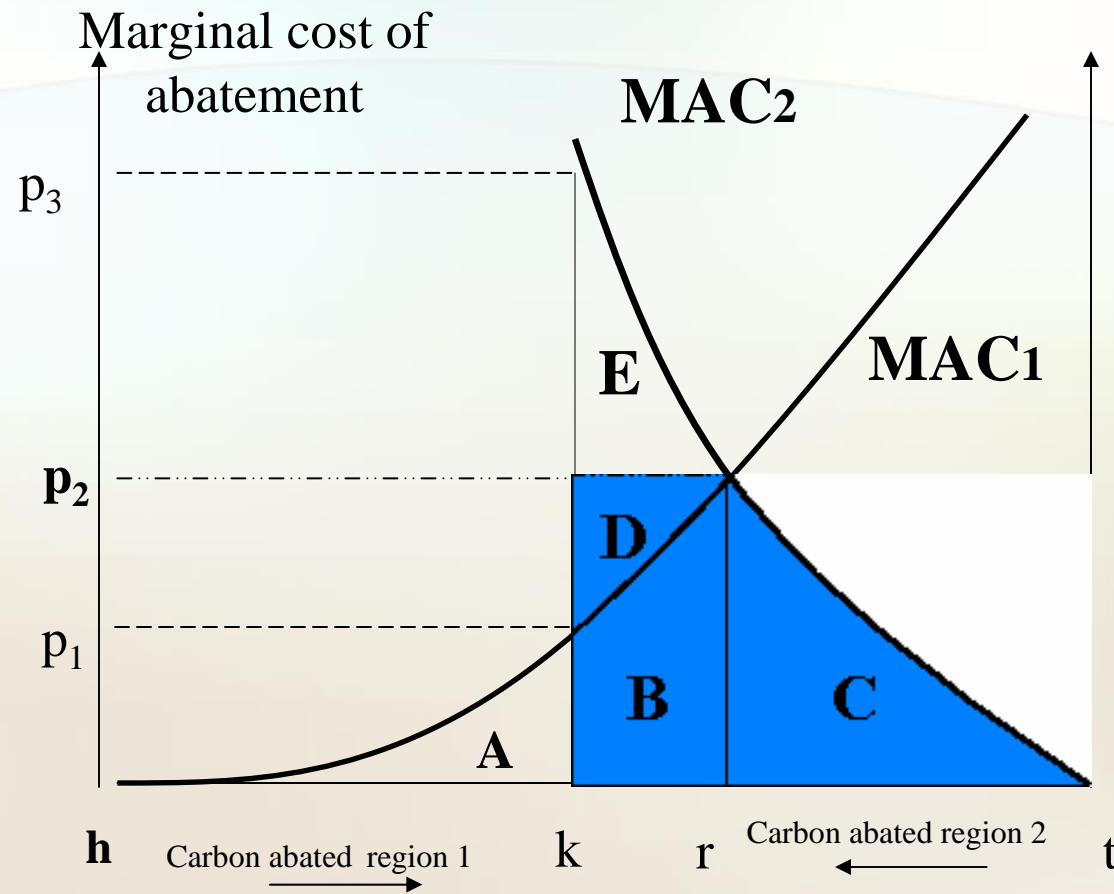
MAC's for 2 regions (example)



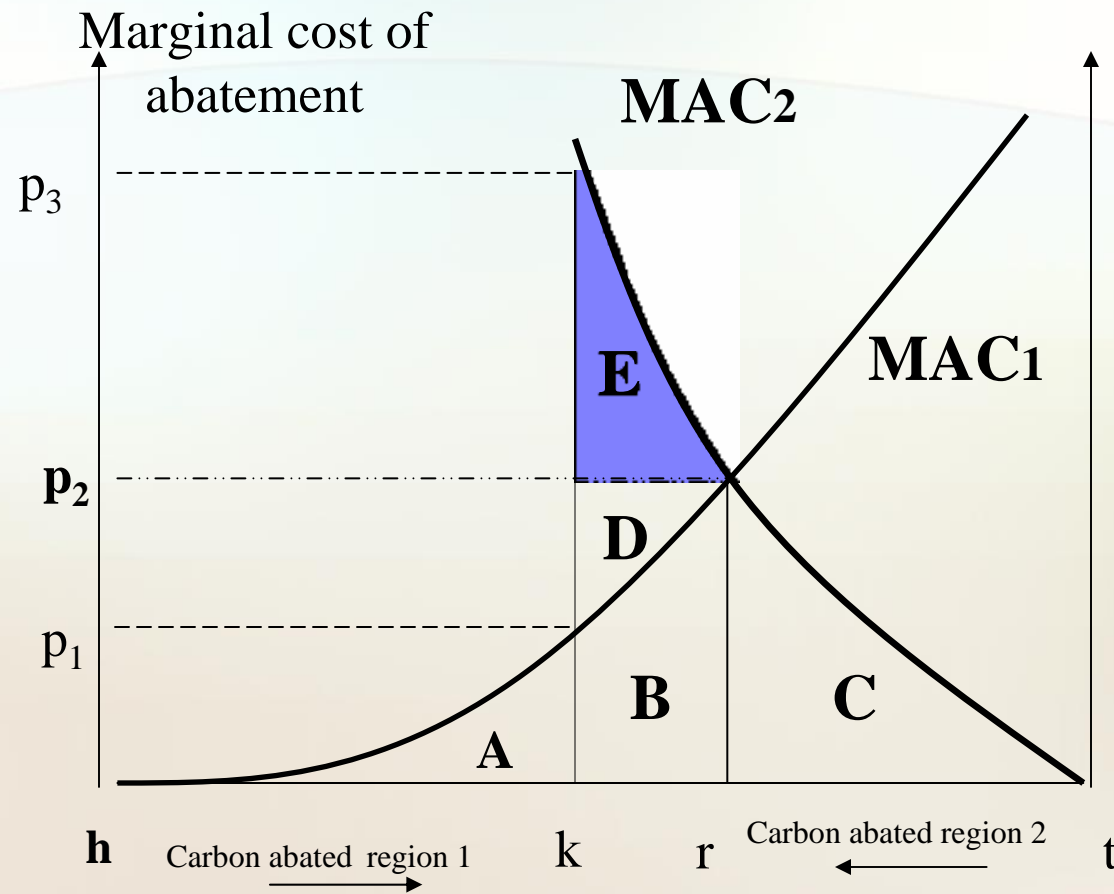
MAC's for 2 regions (example)



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MAC's for 2 regions (example)



Data

- MAC function data are from IIASA and Merge model Stanford Univ, they were applied by Godal, Klaassen in Journal of Env.Economics 51 (2006)
- Data are highly aggregated

Analysed regions (Annex B)

1. USA
2. European Union and OECD (OECDE)
3. Japan (JPN)
4. Canada, Australia and New Zealand (CANZ)
5. Former Soviet Union and Eastern Europe (EEFSU)

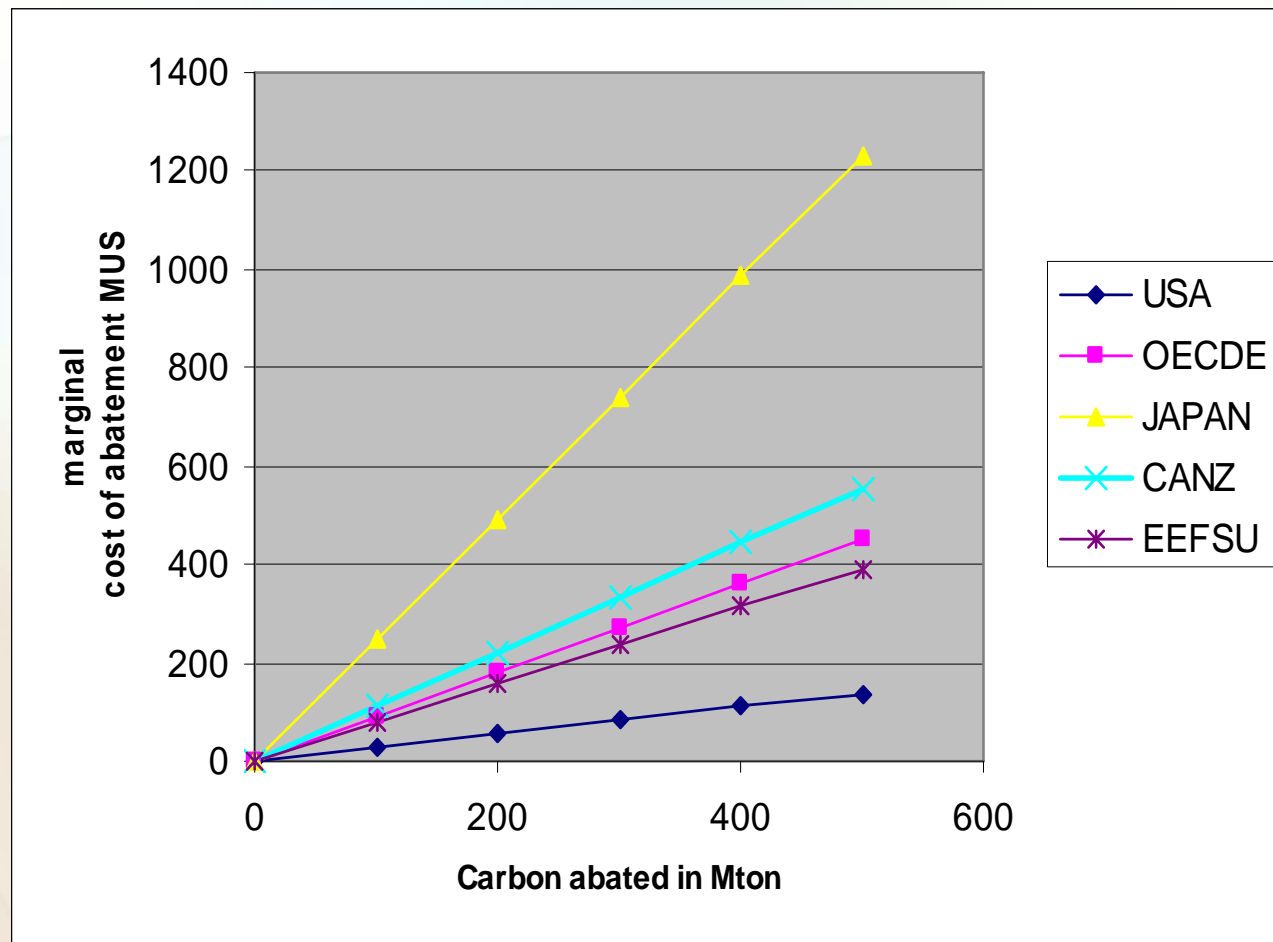
Necessary abatement

	Base year emissions (1990) Mton	Kyoto qouta	Kyoto Emission target in 2010 Mton	Anticipated emissions in 2010 Mton	Abatement agreed Mton
	-1-	-2-	-3-	-4-	-5-
	='2' x '1'			='4'-'3'	
USA	298	7%	277,14	1820,3	1 543,16
OECD	822	8%	757,062	1038	280,94
JAPAN	318	6%	298,92	350	51,08
CANZ	266	1%	264,138	312,7	48,56
EEFSU	891	2%	875,853	898,6	22,75

How to calculate the marginal and total costs

- Marginal cost of abatement
- $P=aQ$
- Total costs
- $C=0.5bQ^2$.
- Coeficients a , b were taken from IIASA data

Marginal abatement costs for regions



Optimisation problem (1)

$$\min_{x_i} \sum_{i=1}^5 [c_i(x_i)]$$

- c_i = the total costs of holding emissions in region i down *to* x_i

Optimisation problem (2)

subject to

$$x_i + (1 - 2\alpha) \Delta_{bci} \leq K_i$$

- *alfa* =not satisfying the Kyoto target risk
- Δ_{bci} = region *i* uncertainty,
- K_i = region *i* Kyoto target after trade,
- x_i =final emissions

Risk concept

- To be fully credible we should prove

$$D\hat{x} + \Delta_{bc} \leq 0 \quad D\hat{x} = x_i - K_i$$

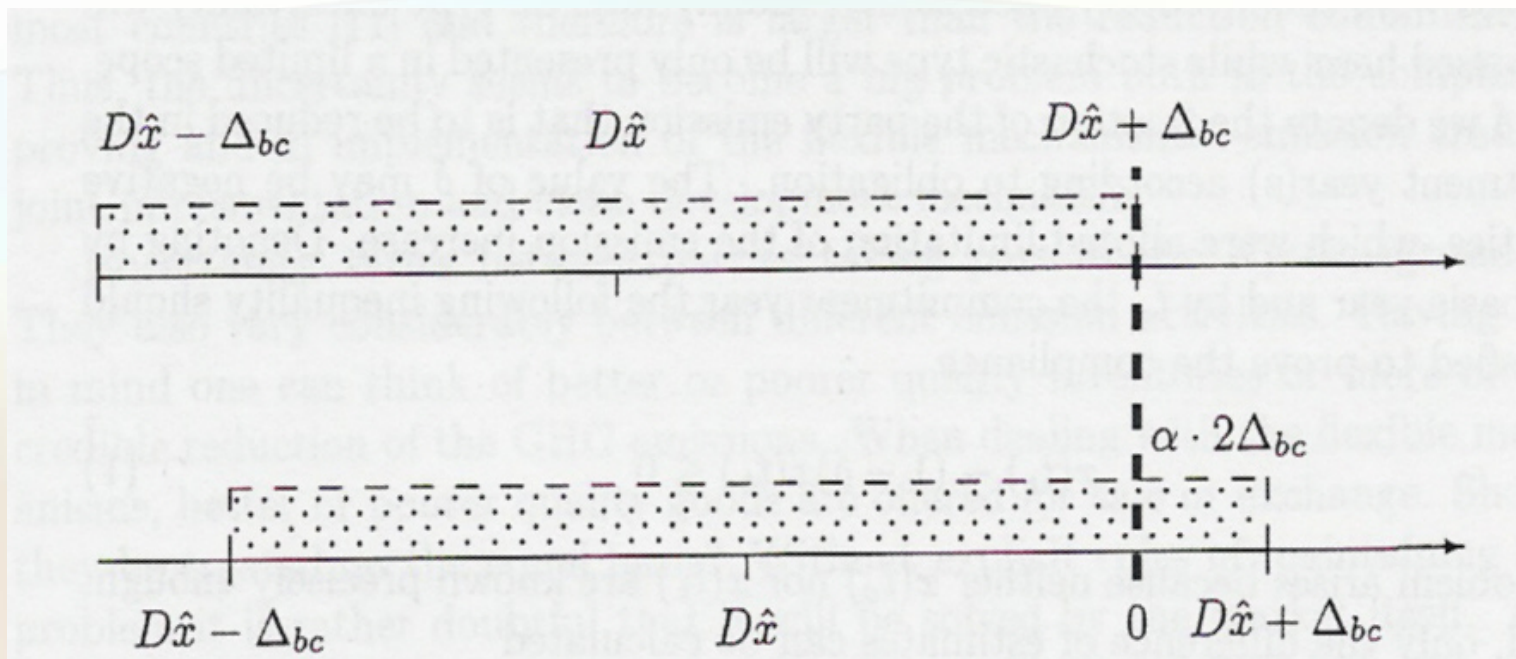
- We admit that there is possibility of not satisfying the obligations. We take a risk

$$\alpha \in \langle 0, 0.5 \rangle$$

- that obligation can be not fulfilled.

$$D\hat{x} + \Delta_{bc} < \alpha 2\Delta_{bc}$$

Full compliance and compliance with risk α



$D\hat{x}$
emission reduction

Relative uncertainty of the region *i*

- USA 0,1
- OECD 0,2
- JAPAN 0,17
- CANZ 0,3
- EEFSU 0,3

**Simulating the Carbon Permit Market with Imperfect
Observations of Emissions:
Approaching Equilibrium through Sequential Bilateral Trade**
Odd Godal

The rules of trading

- If marginal abatement cost of commitment is higher than market price, the region reduces less and buys permits
- Otherwise it reduces more and sells surplus

Scenarios with uncertainty belt

$$x_i + (1 - 2\alpha) \Delta_{bc} \leq K_i$$

1) $\alpha = 0 \Rightarrow 1 - 2\alpha_i = 1$

2) $\alpha = 0.1 \Rightarrow 1 - 2\alpha_i = 0.8$

3) $\alpha = 0.3 \Rightarrow 1 - 2\alpha_i = 0.34$

4) $\alpha = 0.5 \Rightarrow 1 - 2\alpha_i = 0$

Benefits from trading

	total benefits	MUS\$		
Country/alfa	0,00	0,10	0,30	0,50
EEFSU	50 131	72 286	128 694	201 230
Other	32 890	31 798	35 407	46 623
Total	83 021	104 084	164 066	247 853

Total reduction

	Reduction	Mton		
Country/alfa	0,00	0,10	0,30	0,50
USA	679	595	427	259
OECD	206	181	130	79
JAPAN	76	66	48	29
CANZ	169	148	106	64
EEFSU	238	209	150	91
Total	1 369	1 200	861	522

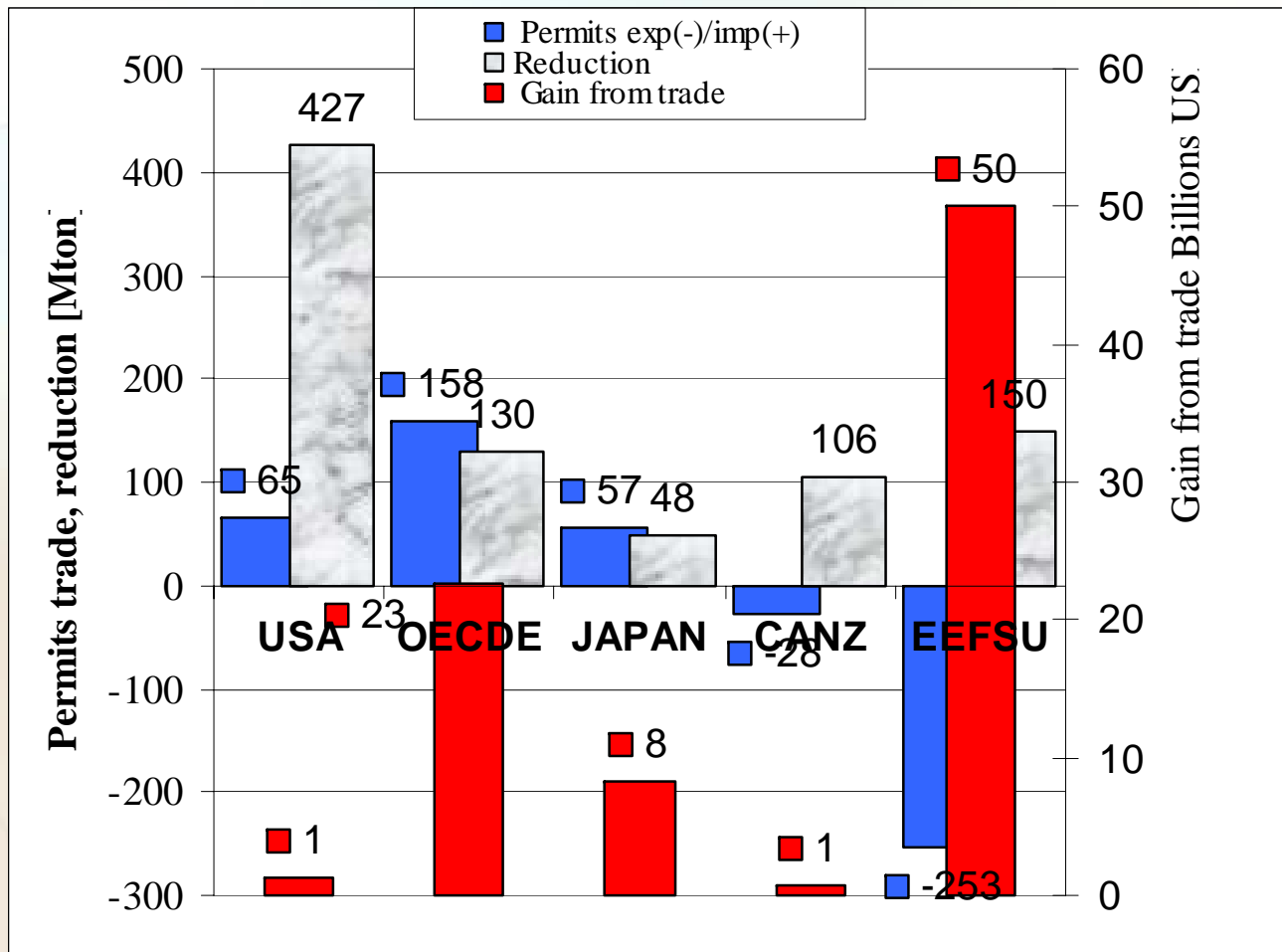
Number of permits traded

	Number of permits traded			
Country/alfa	0,00	0,10	0,30	0,50
USA	65	114	212	310
OECD	158	147	123	99
JAPAN	57	58	61	63
CANZ	-28	-16	9	33
EEFSU	-253	-303	-405	-506

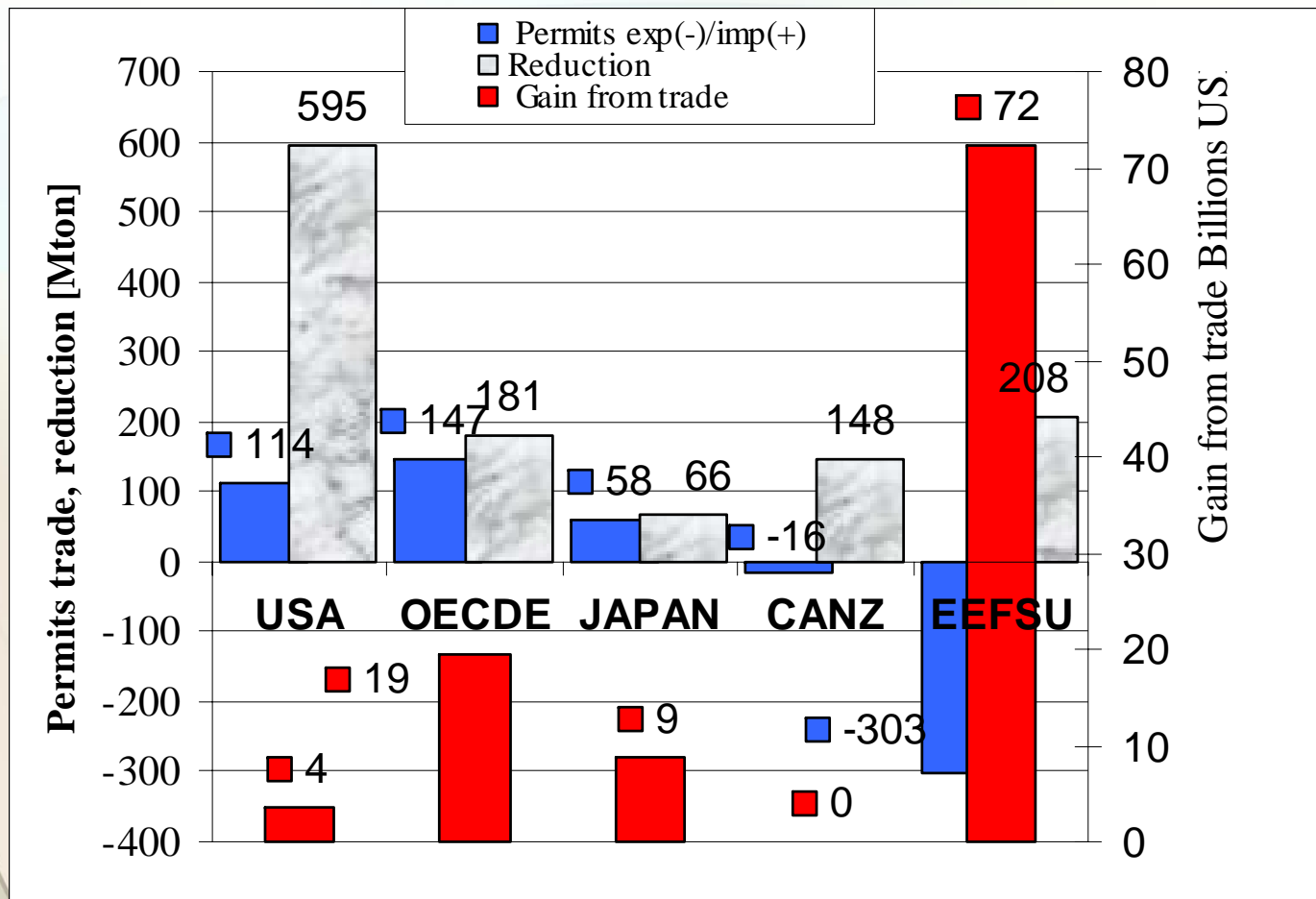
Market price of permits

	market price of permits			
Country	0,00	0,10	0,30	0,50
USA	212	198	170	142
OECD	212	198	170	142
JAPAN	212	198	170	142
CANZ	212	198	170	142

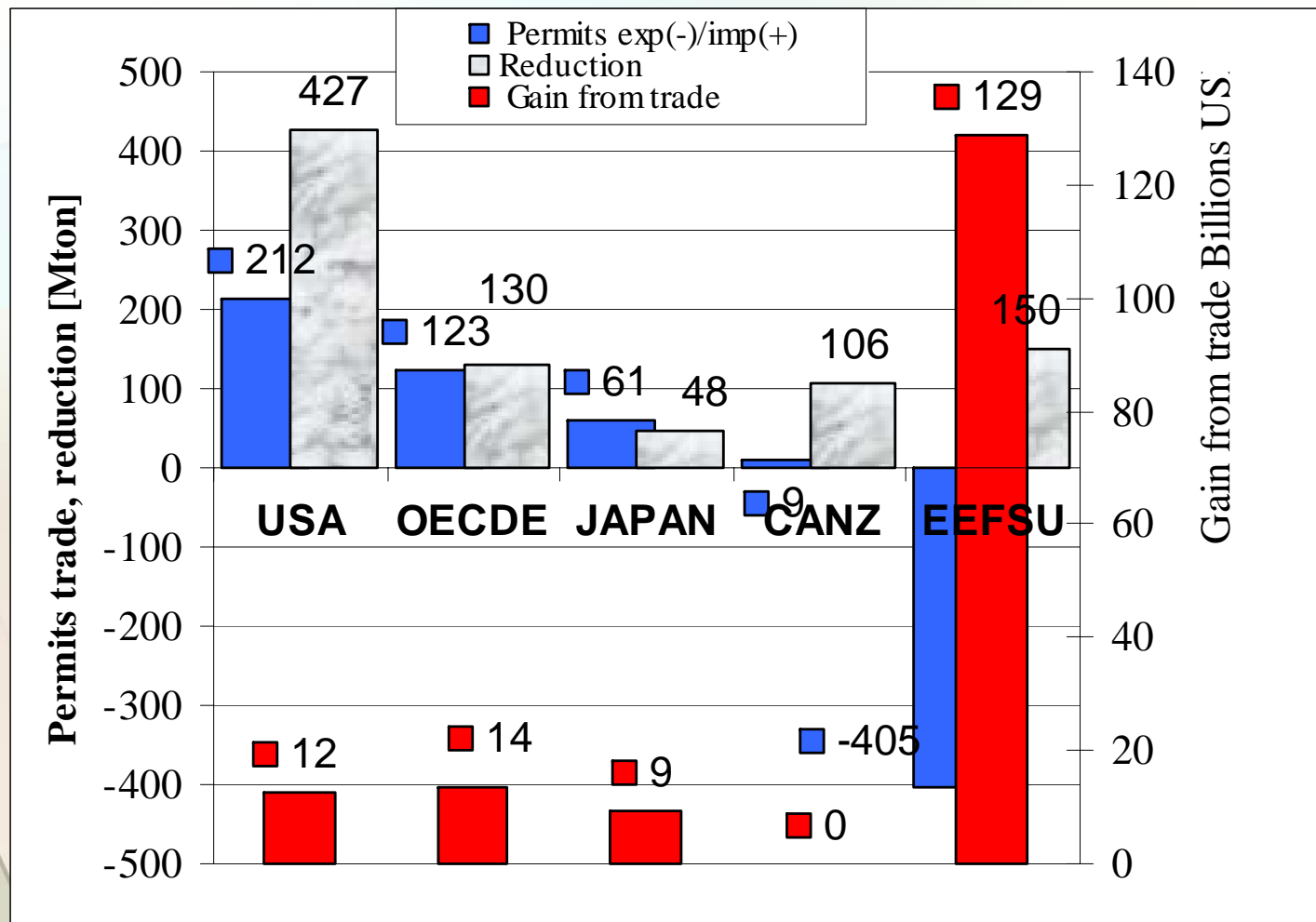
I scenario alfa 0, permits traded, benefits and reduction



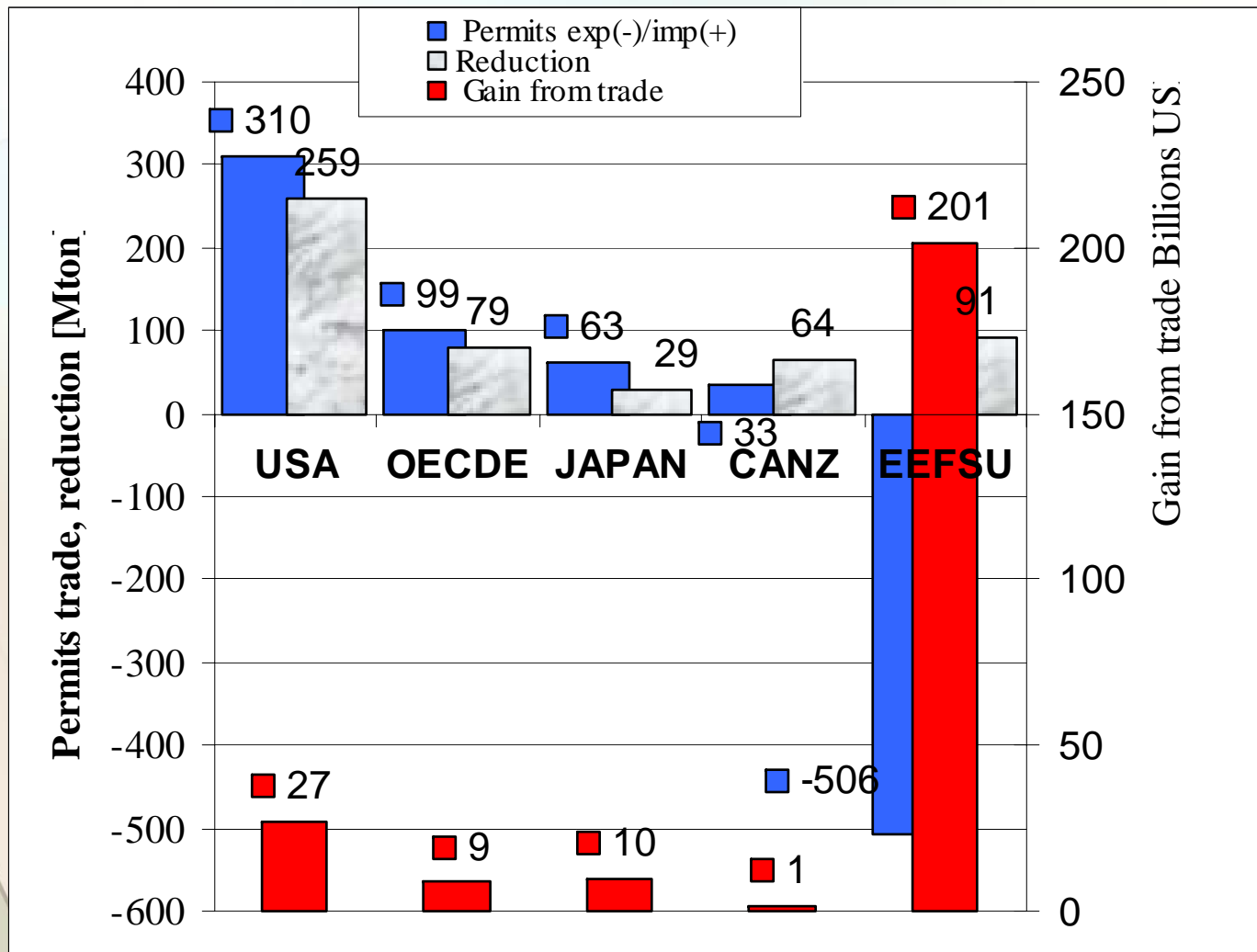
II scenario alfa 0.1, permits traded, benefits and reduction



III scenario alfa 0.30, permits traded, benefits and reduction



IV scenario alfa 0.5, permits traded, benefits and reduction



Final remarks

- Trading effect: cost reductions. Countries reduce more in scenario with full uncertainty.
- The greatest benefits obtains EEFSU, exporter of permits
- Regions whose marginal cost associated with their commitment is further from the trading equilibrium will benefit more than those whose cost is closer