Tradable Emission Permits as Efficient Strategy for Achieving Environmental Goals

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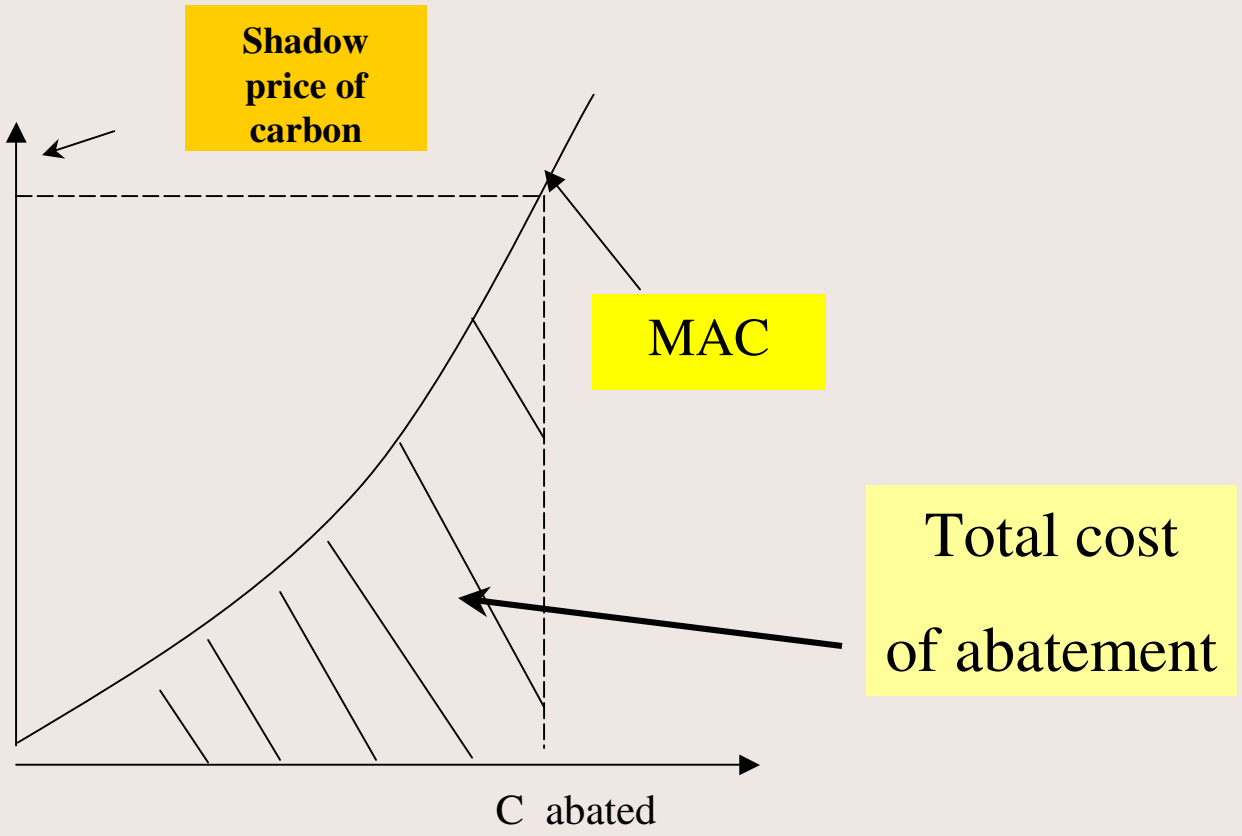
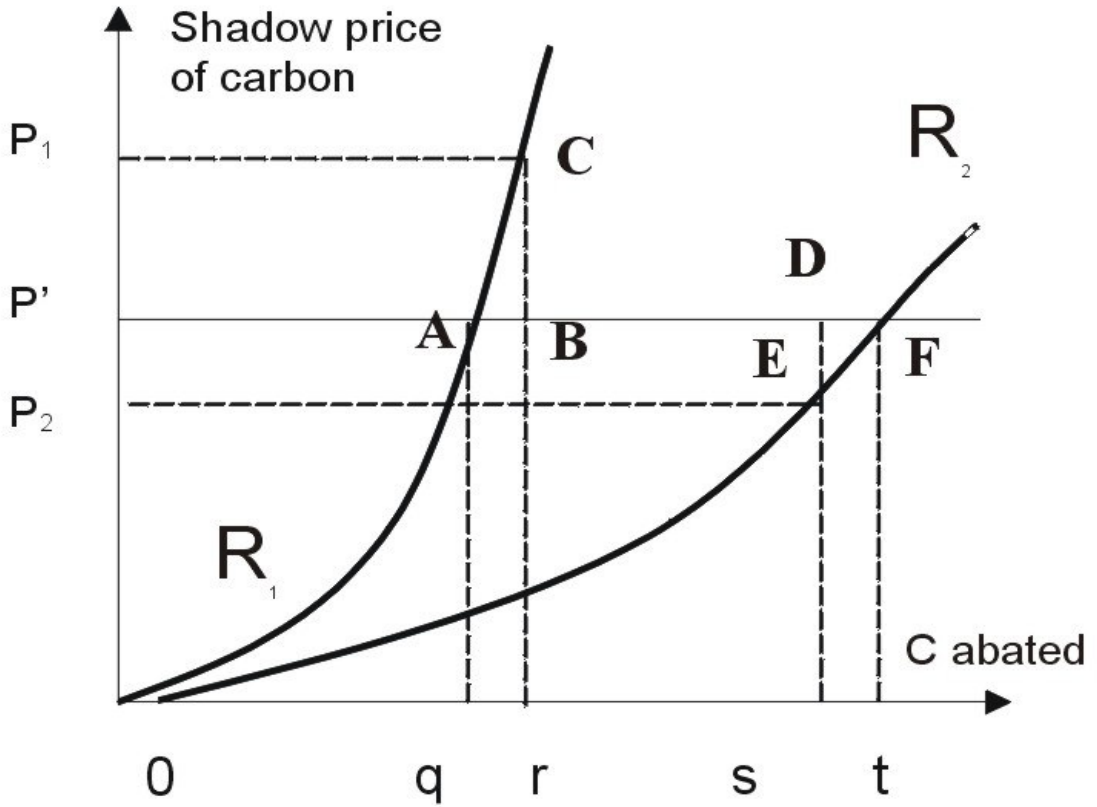
Outline

- The idea of marginal abatement curve
- Trading and uncertainty
- Optimisation problem
- Scenarios
- Results
- Conclusion

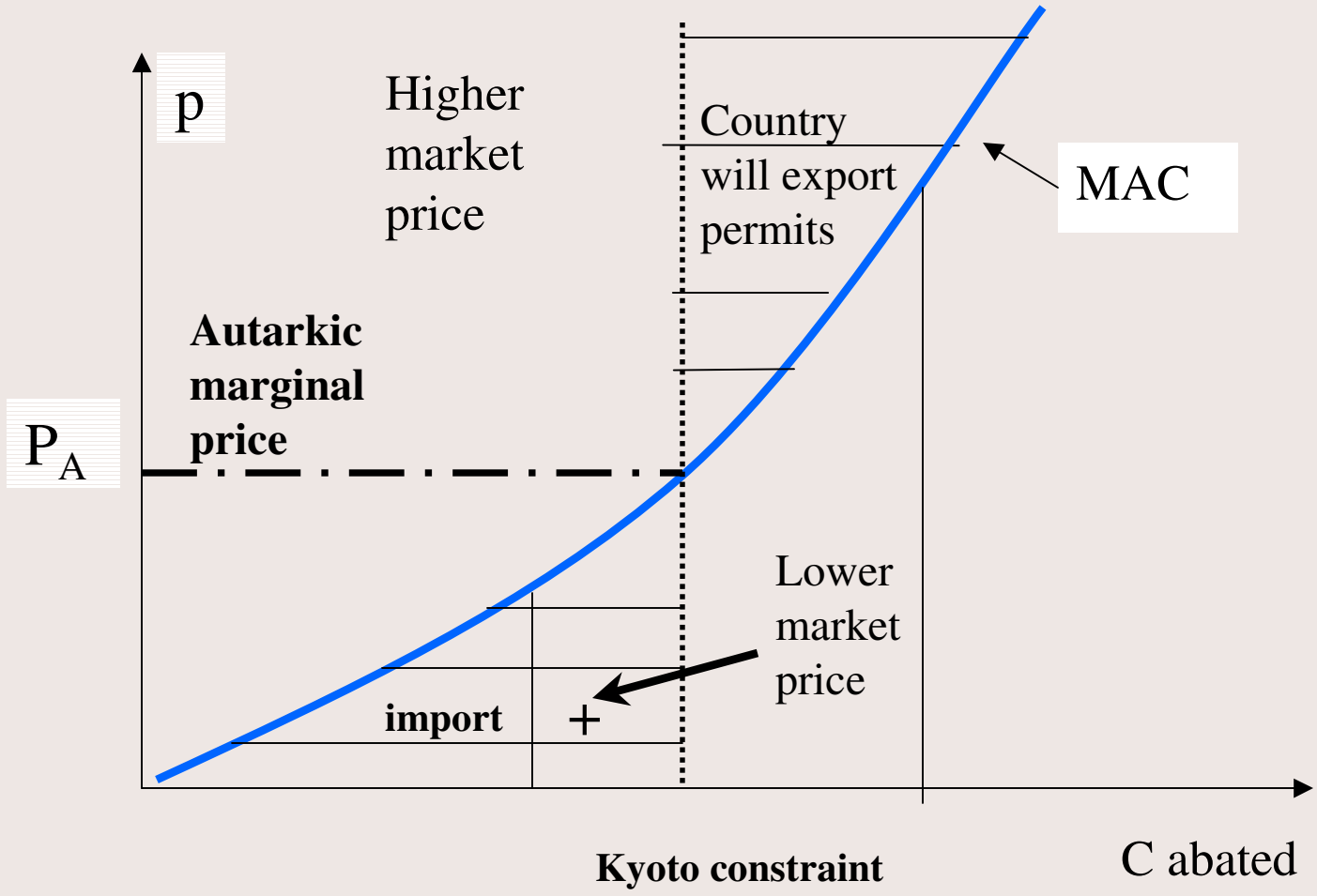
Marginal abatement cost curve



MAC for 2 regions (example)



Import/Exports of permits



Analysed countries

- USA
- Japan (JPN)
- European Community 12 (as 1992) (EEC)
- Other OECD (OOE)
- Eastern Europe (EET)
- Former Soviet Union (FSU)

How to calculate the marginal and total costs

- Equation of shadow price of carbon
- $P=aQ^2+bQ$,
- Equation of total costs
- $C=0.33aQ^3+0.5bQ^2$.
- Coeficients a, b were taken from Ellerman(1996)

Optimisation problem

$$f_i(y) = \min_{x_i} \sum_{i=1}^{6} [c_i(x_i)]$$

$$st. \quad x_i + (1+2\alpha)\, d_i n_i \le K_i + y_i$$

$$for \quad each \quad i \quad region$$

- d_i- relative uncertainty of the source i
- n_i –anticipated emissions
- x_i- emissions after trading and reduction
- Alfa-risk not satisfying Kyoto target

Relative uncertainty of the region *i*

- USA 0,15
- JPN 0,1
- EEC 0,2
- OOE 0,17
- EET 0,3
- FSU 0,3

Necessary abatement

	Emissions in 1990y. Mton	Kyota qouta -2-	Emission target Mton	Anticipated emissions in 2010 Mton	Necessary abatement Mton
			='2' x '1'		='4'-'3'
USA	1362	7%	1266,66	1838	571,34
JAPAN	298	6%	280,12	424	143,88
EEC	822	8%	756,24	1064	307,76
OOE	318	6%	300,51	472	171,49
EET	266	-4%	276,64	395	118,36
FSU	891	2%	873,18	763	

Results, a=0.5 no uncertainty

alfa 0.5	USA	JPN	EEC	OOE	EET	FSU	SUM
Marginal costs ($/ton)*	**186**	**582**	**274**	**233**	116	\	\
Reduction agreed	571	144	308	171	124	\	1318
Reduction after trade	468	49	202	129	**125**	235	1207
Permits exp(-)/imp(+)	**103**	**94**	**106**	**43**	-1	-345	0
Commitment	18%	**65%**	34%	25%			

permits price 128 $/ton

Reduction, permits exp/imp- (Mton)

Results, a=0.5, no uncertainty

alfa 0,5	USA	JPN	EEC	OOE	EET	FSU	SUM
Cost of abatement no trading ($bill.)*	**37**	**34**	**30**	13	5	0	119
Cost of abatement after trade ($bill.)*	21	3	10	5	5	10	54
Permits exp(-)/imp(+) ($bill.)	**13**	**12**	**14**	5	0	-44	0
Abatement+permits ($ bill.)	34	15	23	10	5	-34	54
Gain from trade ($bill.)	3	19	7	3	0	34	66
Gain/cost no trade (%.)	9%	56%	23%	22%	0%		55%

Results, a=0, uncertainty fully accounted for

alfa 0	USA	JPN	EEC	OOE	EET	FSU	SUM
Marginal costs ($/ton)*	315	**1044**	**729**	**514**	**455**	33	\
Reduction agreed	755	207	521	252	237	119	2090
Reduction after trading	810	105	358	212	211	395	2090
Permits exp(-)/imp(+)	-55	**103**	**163**	**40**	**26**	-277	0
%Commitment (import)		**50%**	**31%**	16%	11%		

permits price 360 $/ton

Reduction, permits exp/imp- (Mton)

Results, a=0, uncertainty fully accounted for

alfa 0	USA	JPN	EEC	OOE	EET	FSU	SUM
Cost of abatement							
no trading ($bill.)*	**82**	**85**	**132**	42	36	1	378
Cost of abatement							
after trade ($bill.)*	**101**	**16**	**46**	25	25	47	260
Permits exp(-)/imp(+) ($bill.)	**-19**	**37**	**59**	**14**	**1**	**-100**	**-8**
Abatement+permits ($ bill.)	82	53	105	39	26	-53	252
Gain from trade ($bill.)	0	32	27	3	10	54	126
Gain/Cost no trade (%)		38%	20%	7%	28%		33%

Results, a=0.33, uncertainty partly accounted for

alfa 0.33	USA	JPN	EEC	OOE	EET	FSU	SUM
Marginal costs ($/ton)*	**225**	**721**	**400**	**314**	**204**	\	\
Reduction agreed	632	165	378	198	157	\	1530
Reduction after trading	580	67	253	156	152	288	1495
Permits exp(-)/imp(+)	**52**	**98**	**125**	**42**	**5**	-322	0
% Commitment	8%	60%	33%	21%	3%		

permit price 190 $/ton

Reduction, permits exp/imp- (Mton)

Results, a=0.33, uncertainty partly accounted for

alfa 0,33	USA	JPN	EEC	OOE	EET	FSU	SUM
Cost of abatement							
no trading ($bill.)*	**50**	**48**	**54**	20	11		**183**
Cost of abatement							
after trade ($bill.)*	**39**	**6**	**18**	9	9	18	99
Permits exp(-)/imp(+) ($bill.)	**10**	**18**	**24**	8	1	-61	
Abatement+permits ($ bill.)	49	24	42	17	10	-43	99
Gain from trade ($bill.)	1	**24**	12	3	1	**43**	84
Gain/Cost reduction (%)	2%	50%	22%	15%	9%		46%

Gain from trading

Gain from Trade	USA	JPN	EEC	OOE	EET	FSU	SUM
a= 0	0	**32**	**27**	3	**10**	**54**	126
a=0.33	1	24	**12**	3	1	43	84
a=0.5	3	19	7	3	0	34	66

How far autarkic marginal costs from market price?

	USA	JPN	EEC	OOE	EET	FSU
a= 0	-45	684	369	154	95	-327
a=0.33	35	531	**210**	124	14	/
a=0.5	58	454	146	105	-12	/

Conclusion

- The effect of trading: cost reductions
- In regions whose autarkic marginal cost is further from the trading equilibrium will benefit more than those whose cost is closer to the trading equilibrium.
- The greatest benefits obtains FSU, that is the biggest exporter of permits, and Japan that imports more than 60% of its Kyoto commitment. When a=0, most regions gain from trading