1st Teaching Workshop on Environmental Economics

for the Middle East and North Africa

December 5-16, 2005 - ICTP, Trieste, Italy

Policy Instruments for Pollution control and resource management Introduction

Thomas Sterner

University of Gothenburg

SMR 1684 - 5

First Teaching Workshop for Middle East + N Africa ICTP Dec 2005

Policy Instruments for Pollution control and resource management Introduction

Thomas Sterner

Environmental Economics Unit
Göteborg, Sweden

- Research and teaching on natural resources and environmental economics.
- Dozen PhDs & 25 grad students
- Major focus on developing countries, the choice of policy instruments for transport, industrial environmental problems and welfare related issues.

EEU in the winter

EEU Activities

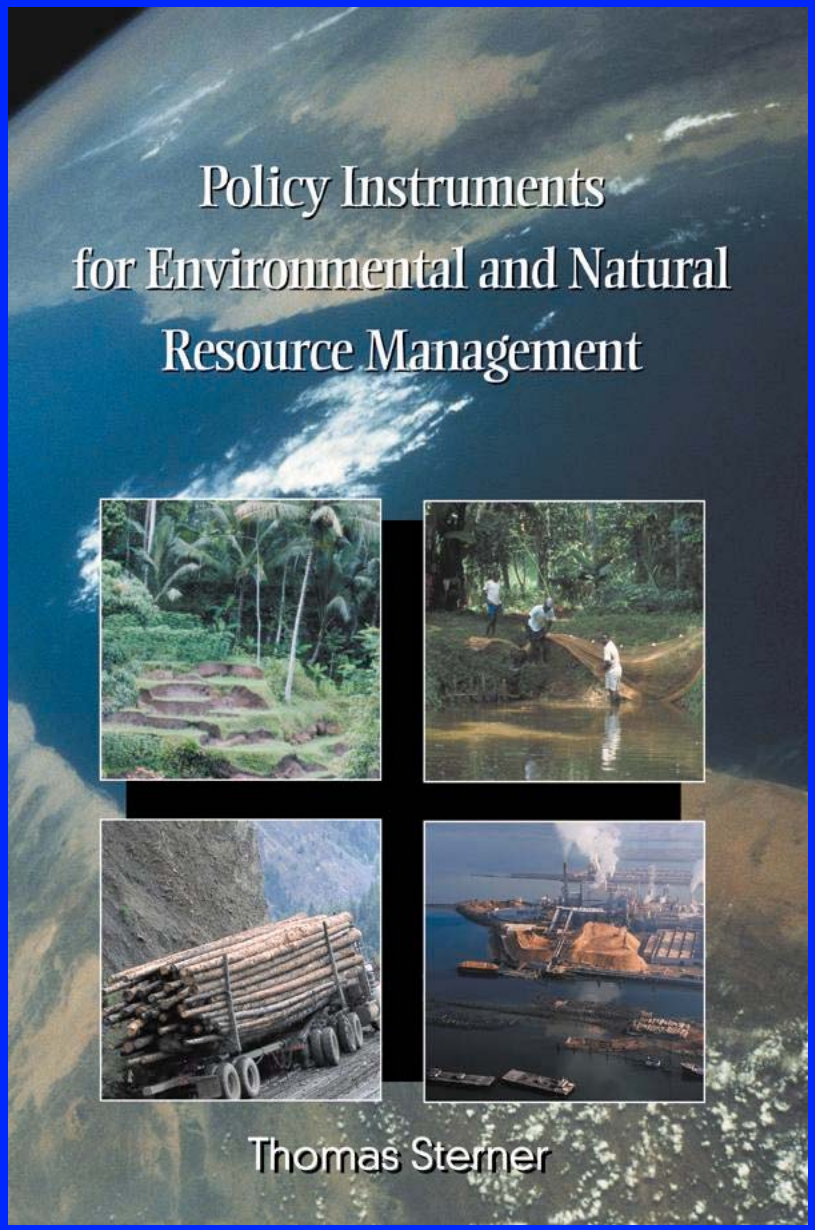
- Masters in env economics
- Ph.D. Program in ecological economics
- Specialization courses
- Capac Building in Developing Countries
- Visiting researchers - Bilateral programs
- Development projects
- Involvement in regional networks

Graduate Courses

- **Welfare Economics (Sept –Oct, 2004)**
- **Environmental Valuation (Oct 2004)**
- **Natural Resource Economics (spring 2005)**
- **Environmental Economics and Policy Making**
- **Systems Ecology**

Graduated PhD's

- Ammon Mbelle 1988
- **Ruben Tansini 1989**
- Mikael Franzén 1994
- Olof Johansson 1996
- **Jorge Rogat 1998**
- Mohammed Belhaj 1998
- Alemu Mekonnen 1998
- Gunnar Köhlin 1998
- Fredrik Carlsson 1999
- Tekie Alemu 1999
- Lena Höglund 2000
- Adolf Mkenda 2001
- Henrik Hammar 2001
- Håkan Eggert 2001
- Lena Nerhagen 2001
- Martin Linde-Rahr 2002
- **Francisco Alpizar 2002**
- Åsa Löfgren 2003
- Susanna Lundström 2003
- Edwin Muchapondwa 2003
- Hala Abou-Ali 2003
- Jessica Andersson 2004
- Mahmud Yesuf 2004
- Eseza Kateregga 2005
- Minhaj Mahmud …



Published by RFF & World Bank.

1. The need for policy
2. The menu of instruments
3. Theory of Instrument selection and design
4. Application to Transport
5. Application to industry
6. Application to natural resources

Covers both US, Europe, other OECD, developing and transitional countries

Policy Instrument Menu

PRICE-TYPE	RIGHTS	REGULATION	INFO/LEGAL
Taxes	Property rights	Technological Standard	Public participation
Subsidy (Reduct.)	Tradable permits	Performance Standard	Information disclosure
Charge, Fee/Tariff	Tradable Quotas	Ban	Voluntary Agreement
Deposit-refund	Certificate	Permit	Liability
Refunded Charge	CPR	Zoning	

Criteria

- Effectiveness
- Static Efficiency
- Dynamic Efficiency
- Fairness (Distrib. of costs/benefits)
- Political feasability
- Instrument costs
- Information needs

Conditions (Ecol. or economic)

- Heterogeneity in abatement costs
- Heterogeneity in damage
- Uncertainty/Risk
- Asymmetric information
- Monopoly or oligopoly
- Synergies or ecological thresholds
- Non-point pollution

Property Rights are Fundamental

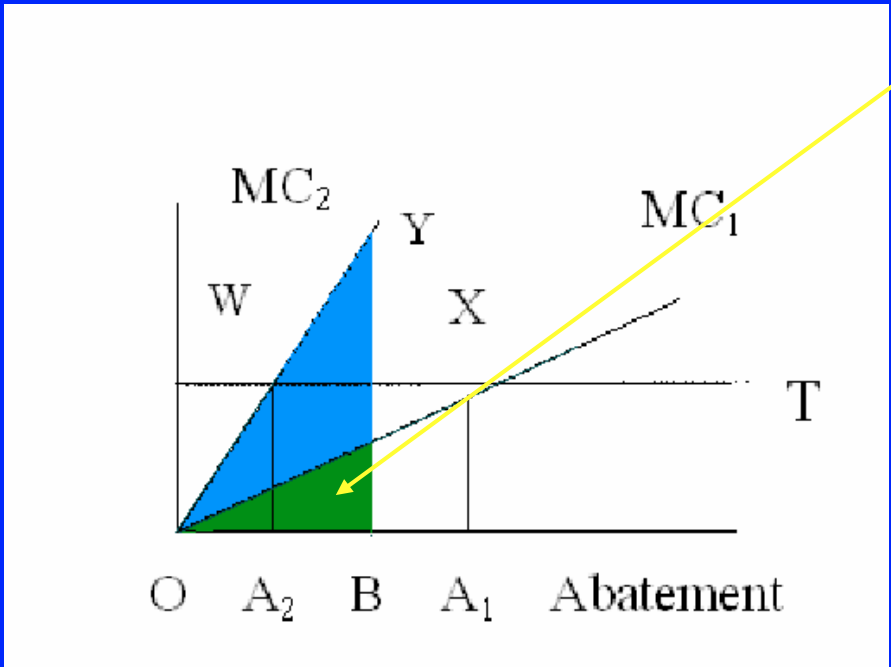
- Property is a bundle of rights: Access, productive use, exclusion, lease, sale, destruction.
- ”Real” Property from King →Feudalism
- Enclosure and Common Property

Property Rights II

- Rights to water, air, ecosystems:
- Land owner, State, First user, citizens.
- Water rights: Riparian or Prior Appropriation
- The rights of the tiller …and of squatters
- La Tierra para quien la trabaja…
- The Coasian Perspective
- Who disturbs who (Dr or conf.) Who has rights
- Market Failures: Externalities, Public goods

Say you have 2 sources of pollution with abatement MC1 = q1 and MC2 = q2. Each pollutes 20 (total 40) and you want a total abatament of 20

- Equal abatement 10 each



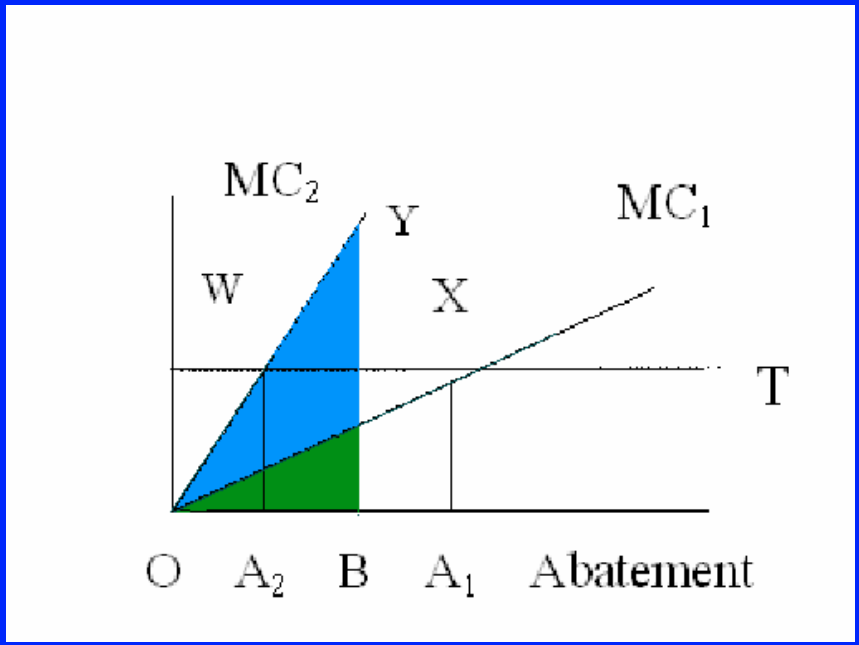
- Cost would be 10.10.½ = 50 for plant 1

And 10.40.½ = 200 for plant 2 (Blue triangle)

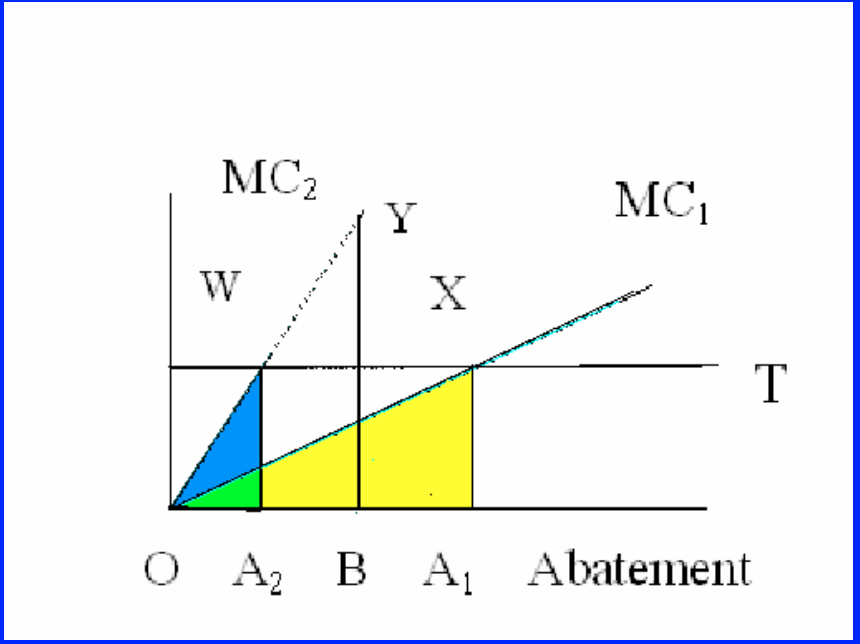
TOTAL COST 250 M $

Cost savings due to equal MC

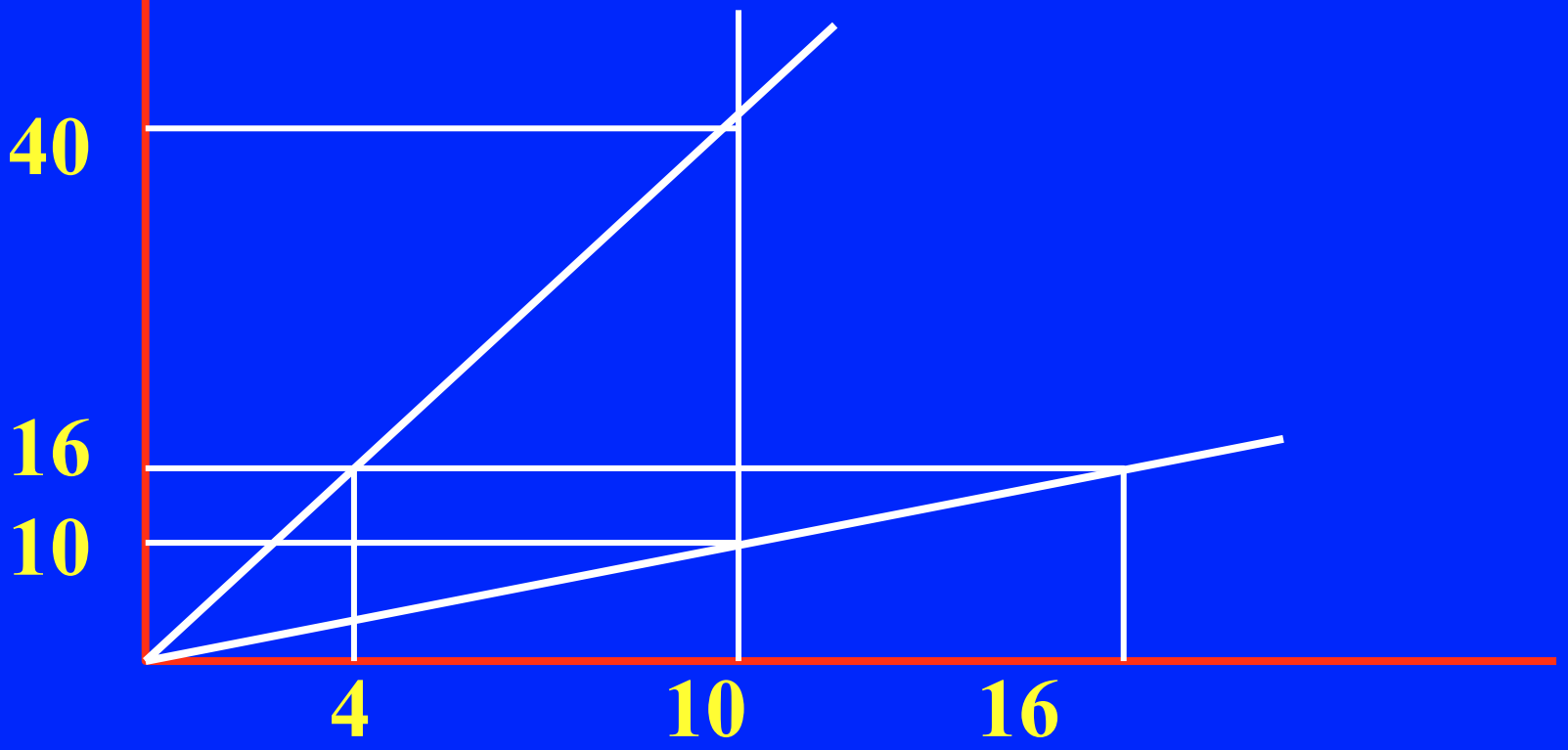
- Equal abatement



- Efficient abatement



Firm 1 abates 16 & firm 2, 4 whenever MC_{abate}<16. Either a tax/fee/subs 16 or free permit trade. If each firm gets10 Firm 1 will sell 6 & firm 2 buy 6.



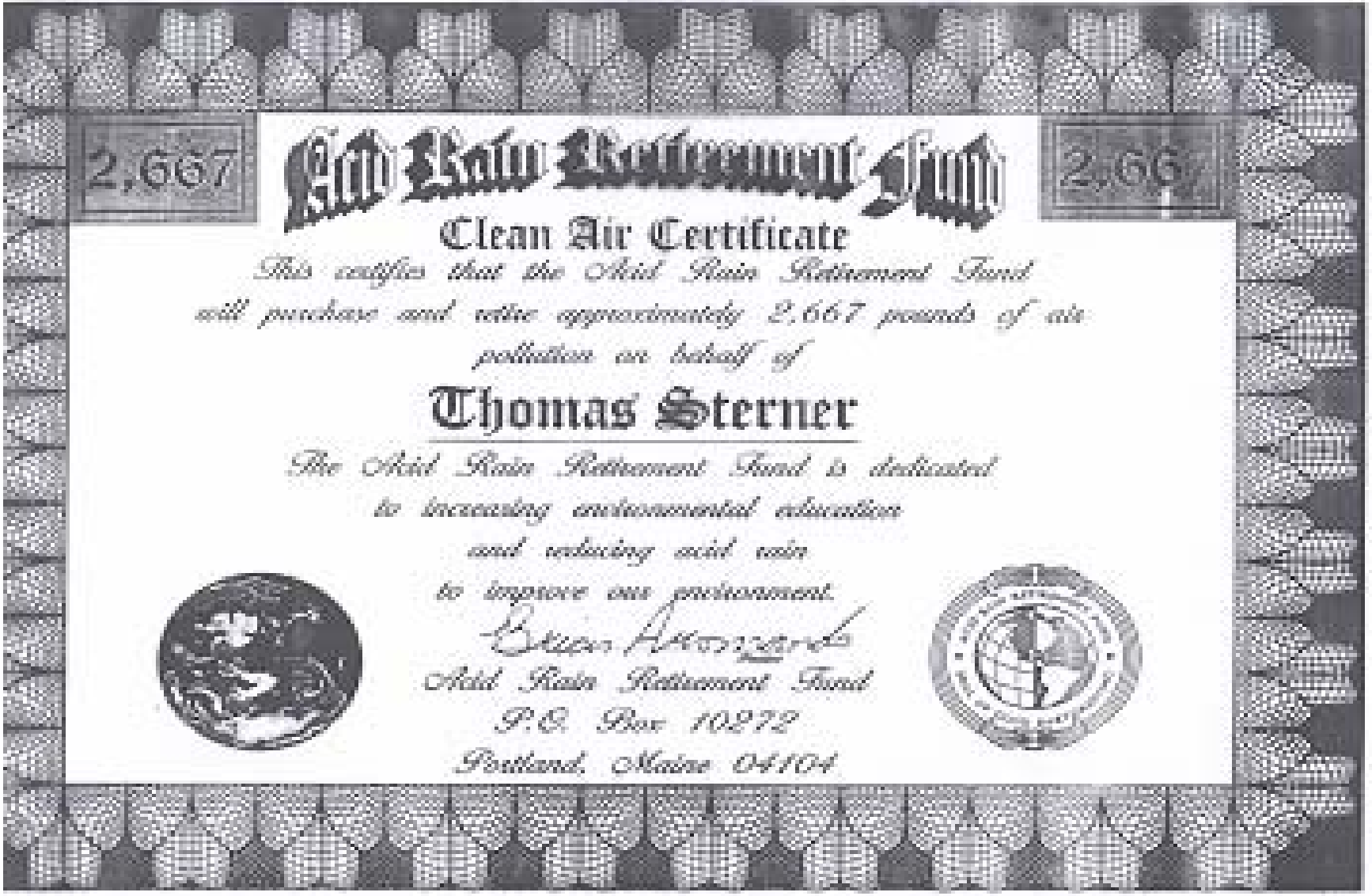
Heterogeneous MC (2)

Heterogeneity	Saving by MBI
1	**0**
1.5	**4%**
2	**~11%**
4	**36%**
9	**64%**
99	**~96%**

- When are costs heterogeneous??
- If Abatement takes time
- If firms with different scale or different business emit same pollutant

Heterogenous Damage

- MBI less relevant: The idea of equalizing MC makes no sense with hot spots
- **Zoning** is an appropriate instrument
- Similarly the creation of natural reserves
- However note that MBIs can be made to vary geographically (and temporally)


2,667
Acid Rain Retirement Fund
2,667
Clean Air Certificate
This certifies that the Acid Rain Retirement Fund
will purchase and retire approximately 2,667 pounds of air
pollution on behalf of
Thomas Sterner
The Acid Rain Retirement Fund is dedicated
to increasing environmental education
and reducing acid rain
to improve our environment.
Acid Rain Retirement Fund
P.O. Box 10272
Portland, Maine 04104

Industrial Pollution: Permits vs Taxes

- Just like ITQs – permits have been very successful in abatement of Sulfur in the US
- Reduction by 50% in CAAA. 19-10 Gtons
- Estimated costs 600-1000 $/t.
- Actual prices per permit around 100-150!
- Marvels of the market…
- In Sweden tax works well too. T=1500 $/t

Different types of Permit

- The original add-on to regulation: Make regulations into rights and then let people trade in over-fullfilment (Emission Reduction Credits).
- Cap and Trade. Decide a maximum (CAP) for pollution and then let the market work on its own. Less transaction costs.
- Ambient permits, certificate schemes etc

Allocation of permits

- Permits can be allocated in proportion to:
- Historical pollution: Grandfathering
- (Historical/)current production: Output allocation or benchmarking.
- Equally
- By WTP ie through an auction
- NB Duration, bankability, updating…

Properties of Permits

- $L = pq_i - c_i(q_i, a_i) + P_e(\hat{e}_{i0} - e_i(q_i, a_i))$
- Kuhn-Tucker conditions are:
- $c'_a = -P_e e'_a$ MC Abatement is optimal
- $P = c'_q + P_e e'_q$ Output price is optimal
- If number of permits is related to output then second condition does not hold

Weitzman P vs Q

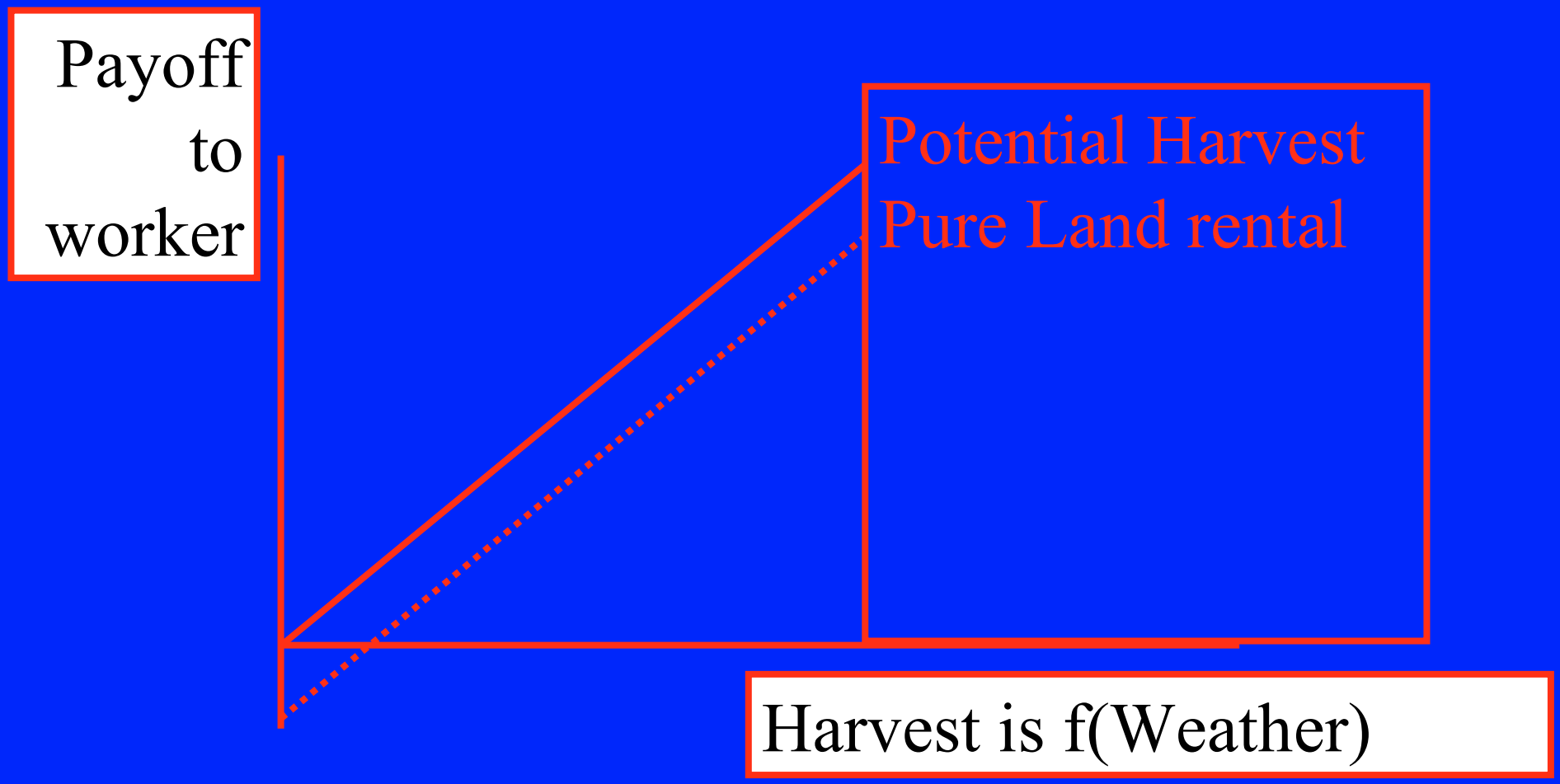
If **uncertainty** re MC abatement and

- M Damage of pollution is steep (thresholds)→**QUANTITY-type Instr**
- M costs are steeper (risk of bankrupcy) but damage is flat (eg stock pollutants) then **USE PRICE-type** instruments.

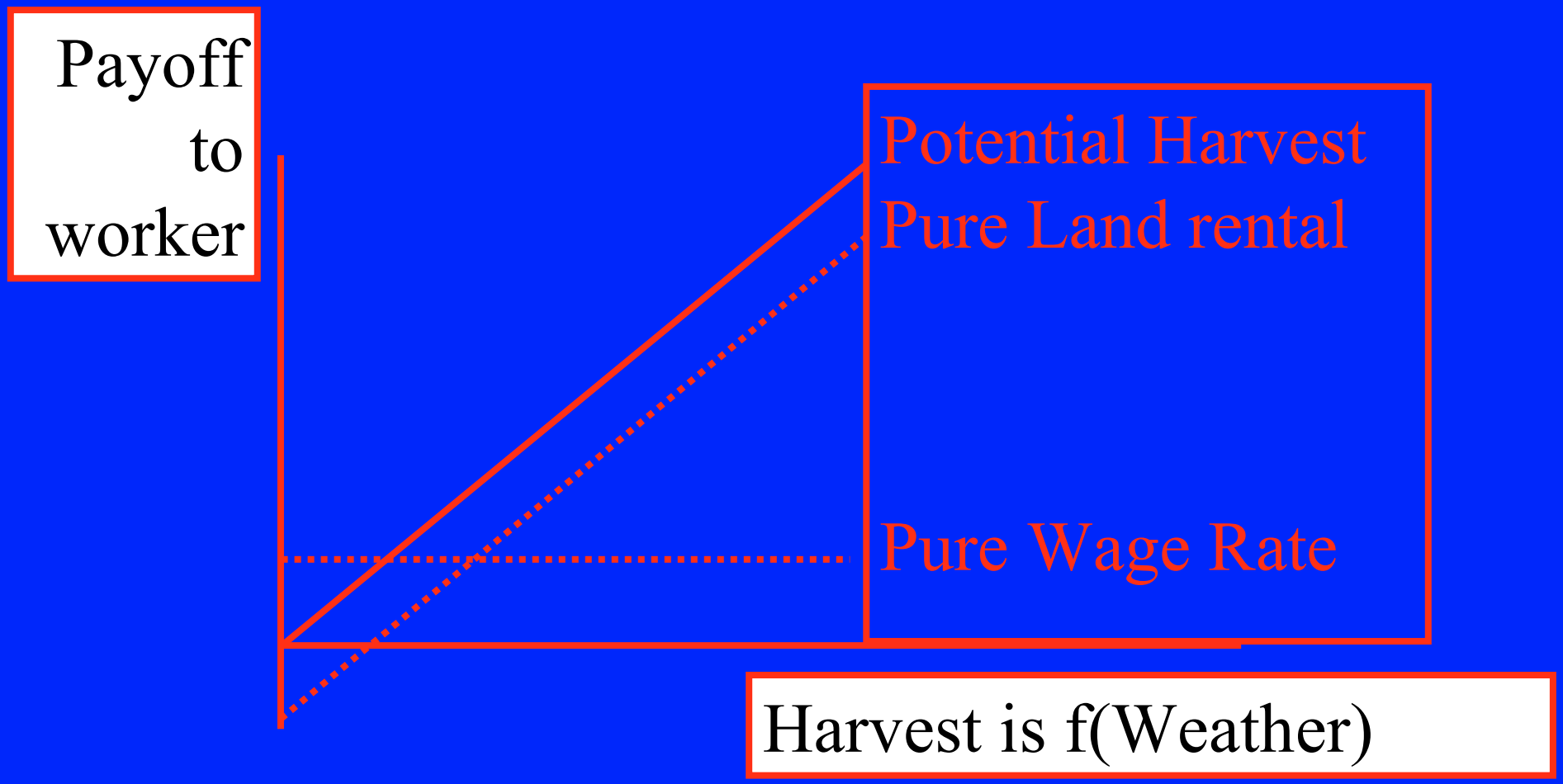
Superiority of the market

- Hinges on fact that ….
- all prices – salaries etc are equated to the marginal scarcities, marginal costs, damages, efforts etc etc
- IS THIS ALWAYS TRUE ?

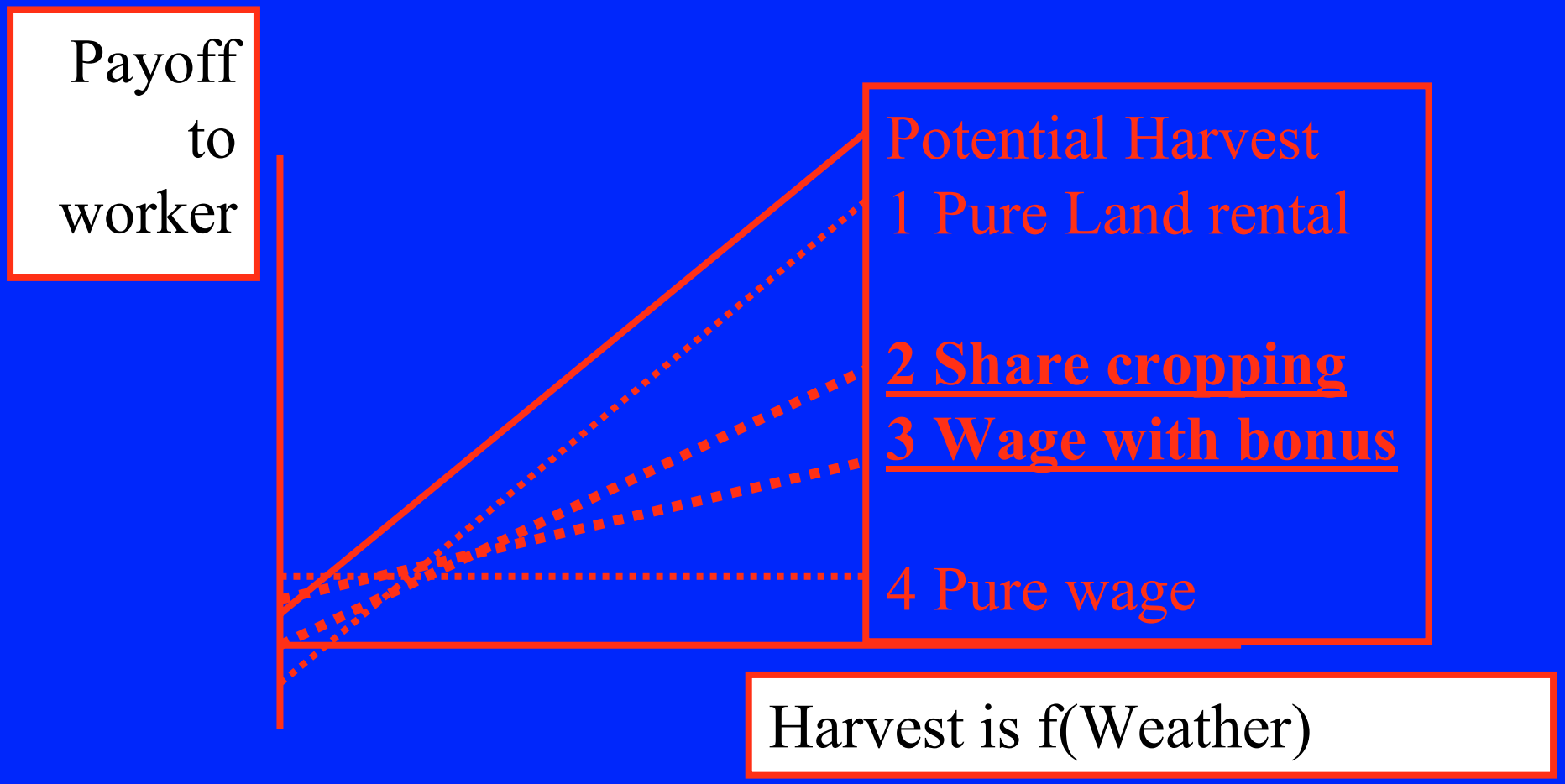
with risk, uncertainty….



with risk, uncertainty and agency problems due to ass info/ monitoring



Ass Info + Risk → Wage ≠ MP



Moral Hazard/Adverse Selectíon

- The very poor are very risk averse
- They would need savings or insurance
- Banks not available due to transaction costs and lack of collateral (→tenure issues)
- Insurance not available: Moral Hazard + Adverse Selection
- → Inequitable contracts and
- →Unsustainable use of resources

Taxing cows

- Overgrazing is a major problem. There is a stock externality:
- More cows → lower survival Farmers put more cattle on common grazing to be sure some survive.
- Should we tax cows?

Taxing cows

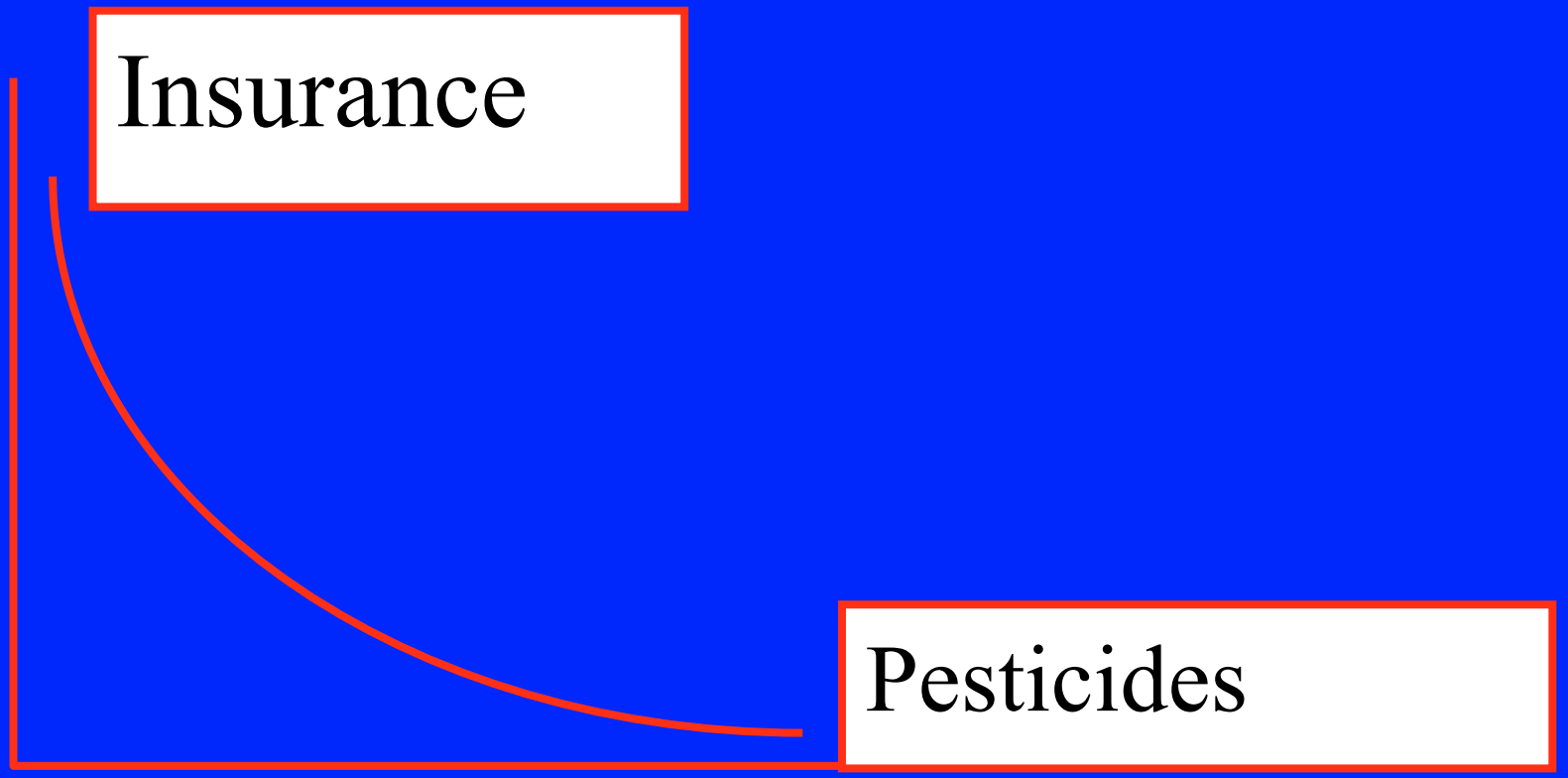
- NO! Lack of markets for saving (banks) is real cause. It leads to other saving forms such as cattle Don’t tax cows. Provide banks!

- Such as Grameen

Risk and environmental management

- Similarly Lack of insurance makes poor farmers very risk averse.
- Risk of pests (locust) unacceptable even if average damage small.
- Don’t provide pesticide spray. Provide insurance!

The important role of financial institutions



Some other rules of Instrument selection and design 1

- If abatement possibilities limited then a higher product price caused by a tax will lower consumption to socially optimal level. This **OUTPUT** effect is desirable. Except for small open economies where the products will just be imported
- Monopolies: taxes perverse because prices already too high and output too low.

Some other rules of Instrument selection and design 2

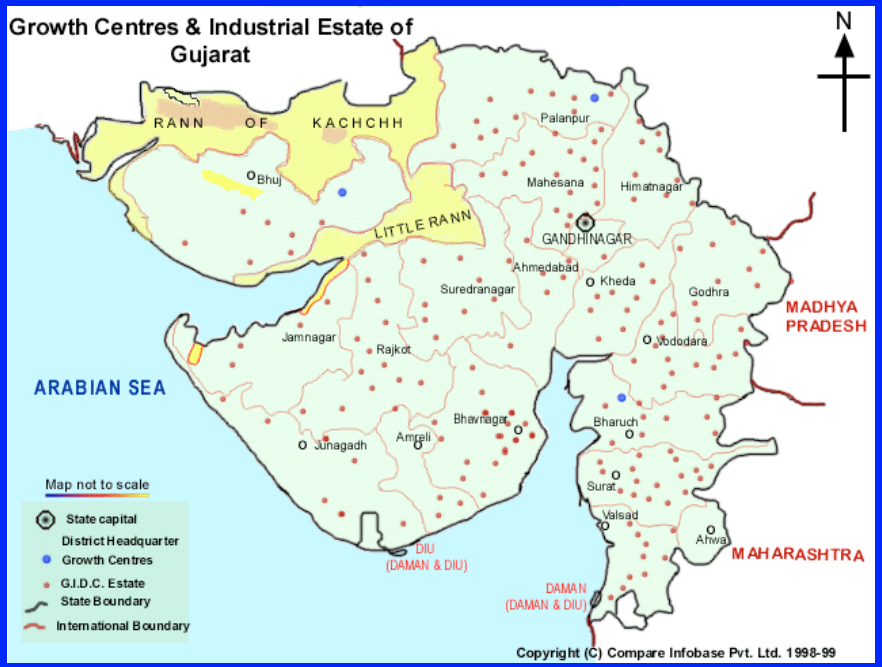
- For some pollutants (related to energy/transport) tax revenues are substantial. In this case the revenue-recycling effect of tax implies other taxes can be lowered which decreases the cost of the instrument. This effect is lost if regulation or (free) permits are used.

Some other rules of Instrument selection and design 3

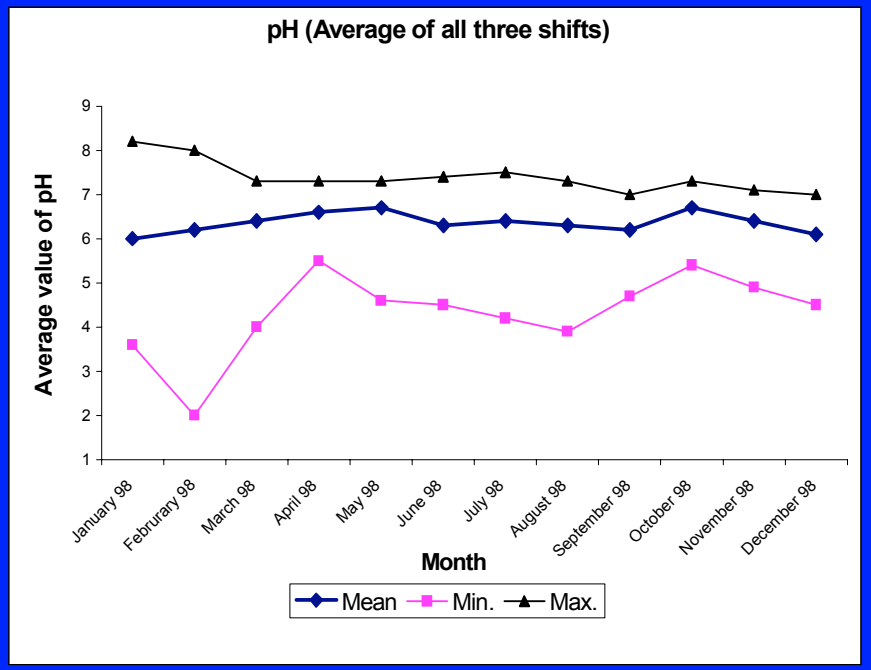
- Subsidies work ***roughly*** like taxes
- But have perverse output effect → encourage entry (delay exit from) industry
- Reduction of Perverse subsidies important
- Deposit Refund schemes superior to taxes when monitoring of pollution is expensive
- Fines or liability also important complement

Ankleshwar Indust Estate Gujarat

- One of largest in India
- 400 plants in 1605 Ha
- 5% India's chem. output
- 250 M litres effluent/day
- Common Effluent Treatm.
- Common Waste Mgt.
- Two-tier Management
- Peer monitoring
- Graduated Sanctions



Peer monitoring & graduated fines

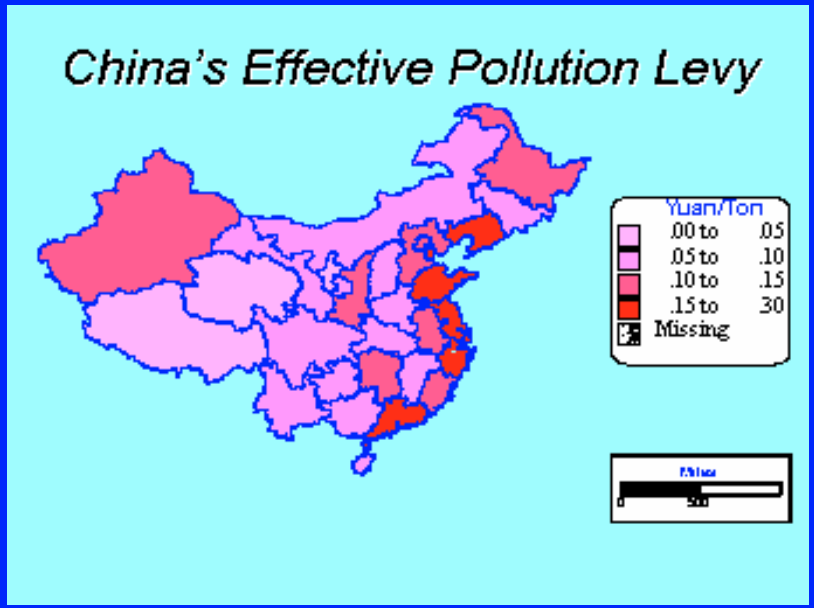


- Rain -
- Penalty -
- First Shift +

- Holliday 0
- Time (neg)

Chinese industries pay fees

- 1979 Environm. Law
- Hundreds of thousands of factories eligible for fee.
- 70-80% of fees → finance abatement
- Enforcement varies regionally



Columbian firms pay charges

- 1993 creation of MINAMBIENTE + local EPAs
- Pollution Charges
- Example: CORNARE
- Rio Negro Watershed (near Medellin)

- <u>Allocation of Funds</u>

1. Waste treatm pl 50%
2. Clean Tech Inv 30%
3. Research 10%
4. Administration 5%
5. Education 5%

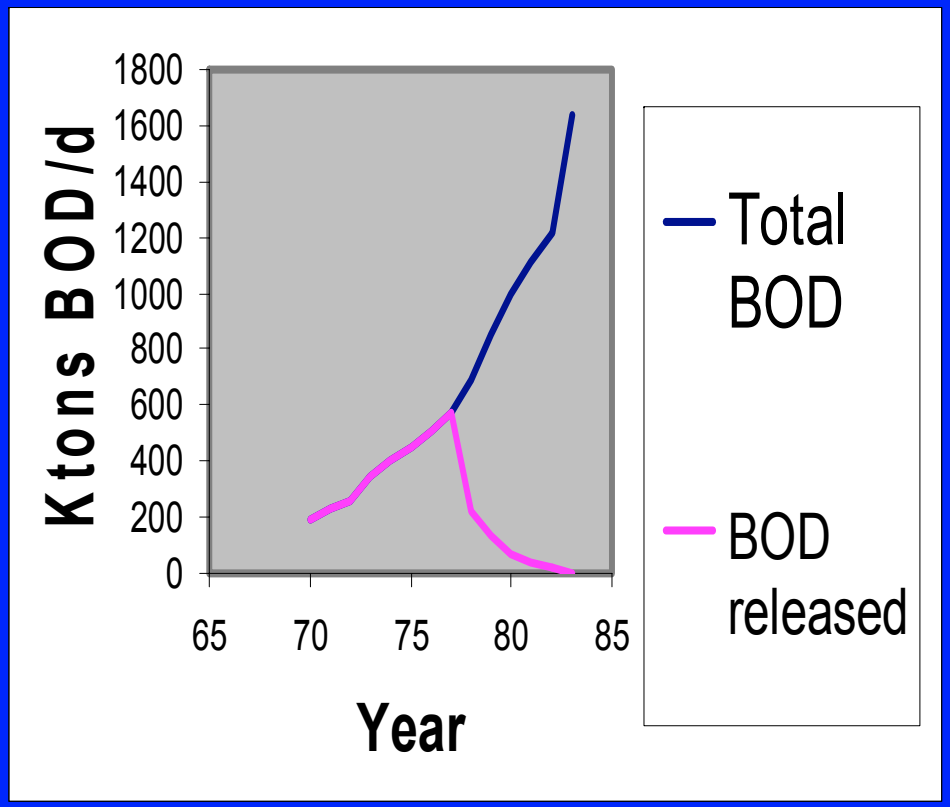
28% reduced BOD first year

PROPER Labelling in Indonesia

	June 1995	Dec 1996	Change
Gold	0	0	0
Green	5	5	0
Blue	61	94	33
Red	115	87	-28
Black	6	1	-5

Source: BAPEDAL

Taxes and Regulation of Palm Oil industries in Malaysia



<1977 25000 ppm BOD

1978 5000

1979 2000

1980 1000

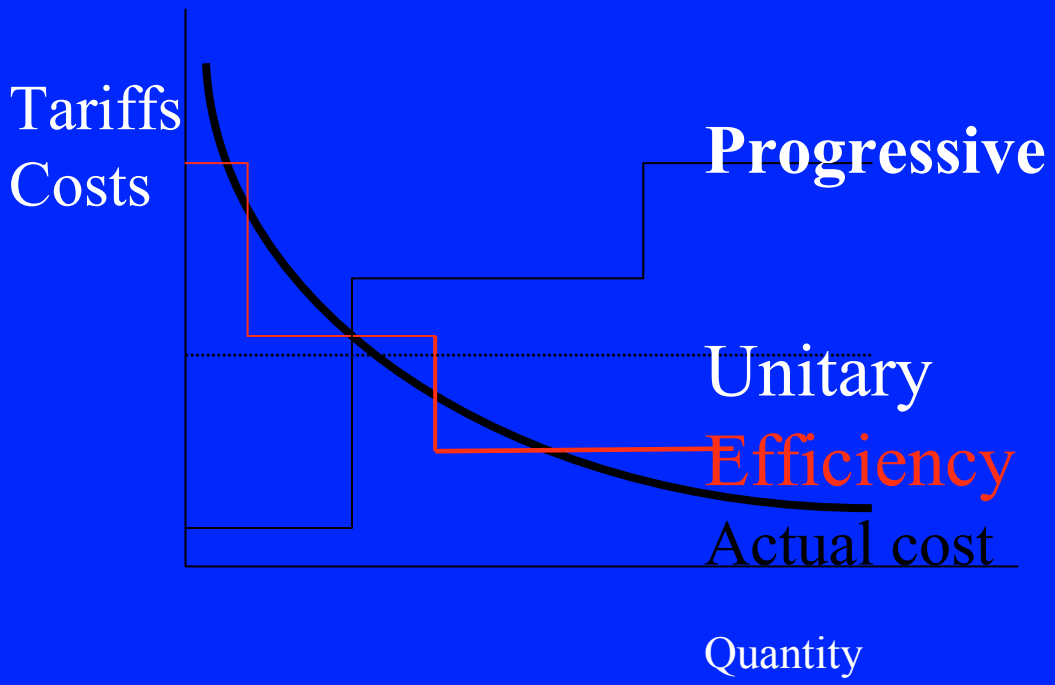
1981 500

1982 250, 1984: 100 etc

$T = T_0 + T_1 \hat{e} + T_2(e-\hat{e})$

$T_1 = 10\ T_2$

Tariff structure is a policy instrument



- Some tariffs in Mexico 1993 $/kWh
- Small Resid 0.06
- Big Resid 0.47
- Irrigation 0.10
- Big Indust 0.22
- The poor who are supposed to benefit get nothing

Water management in S Afr

Kader Asmal, ex-minister of water & forestry in S Africa and chairman of World Commission on Dams, awarded 2000 Stockholm Water Prize for water management in S A.

- 1994 >16 million S Africans lacked water.
- Water Policies include:
- Removal of invasive, species, rob 7% of water.
- Control planting of trees. License required for "stream flow reduction activity."
- Consider how "easy" is LDC carbon sequestration
- >7 million people served

Some Conclusions

- For the poor: Risks, Ecosystem resources and thus Distribution of costs important
- Institutions needed. Capacity building
- Lack of capacity may favor some instruments but does not exclude taxes
- Environmental funds & building partnerships
- Global funds (eg GEF) may be beneficial.

END