International Trade & the Environment: Theory and Evidence

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Some Facts

- Poor Environmental Quality in many less developed countries
- Continuing deforestation; capture fisheries are in a state of decline if not collapse.
- Carbon emissions continue to grow at rapid rates

The Case Against Free Trade

- Poor environmental outcomes in many developing countries
- Weak if any Environmental Regulations.
- Trend towards specialization in environmentally sensitive or dirty goods
- Worldwide movement towards liberalized trade

Stepping Back to Reconsider

- Regulations are weak or non-existent in developing countries
- Patterns of specialization are moving towards pollution intensive goods
- There are many serious environmental problems in the world today.

Introduce some useful Definitions

- Scale, Composition & Technique Effects

$$E = \sum_{i=1}^{n} a_i s_i Y$$

$$\sum_{i=1}^{n} s_i = 1$$

Trade's Impact

$$\hat{E} = \sum_{i=1}^{n} \pi_i [\hat{a}_i + \hat{s}_i] + \hat{Y} \qquad \pi_i = E_i / E$$

$$Technique\ Effect = \hat{a}_i < 0$$

$$Composition\ Effect = \hat{s}_i$$

$$Scale\ Effect = \hat{Y} > 0$$

3 Questions for Theory to Solve

- What determines the policy response and hence the technique effect?
- Since trade liberalization affects incomes and if income growth affects policy responses, how does this simultaneity problem work out in general equilibrium?
- What determines the pattern of trade and hence the composition effect?

What did the Theoretical work Find?

- All of the important results are determined by just two factors:

1. The direction of the composition effect.

2. The speed and strength of the technique effect.

The Direction of the Composition Effect

Pollution Haven Hypothesis

vs.

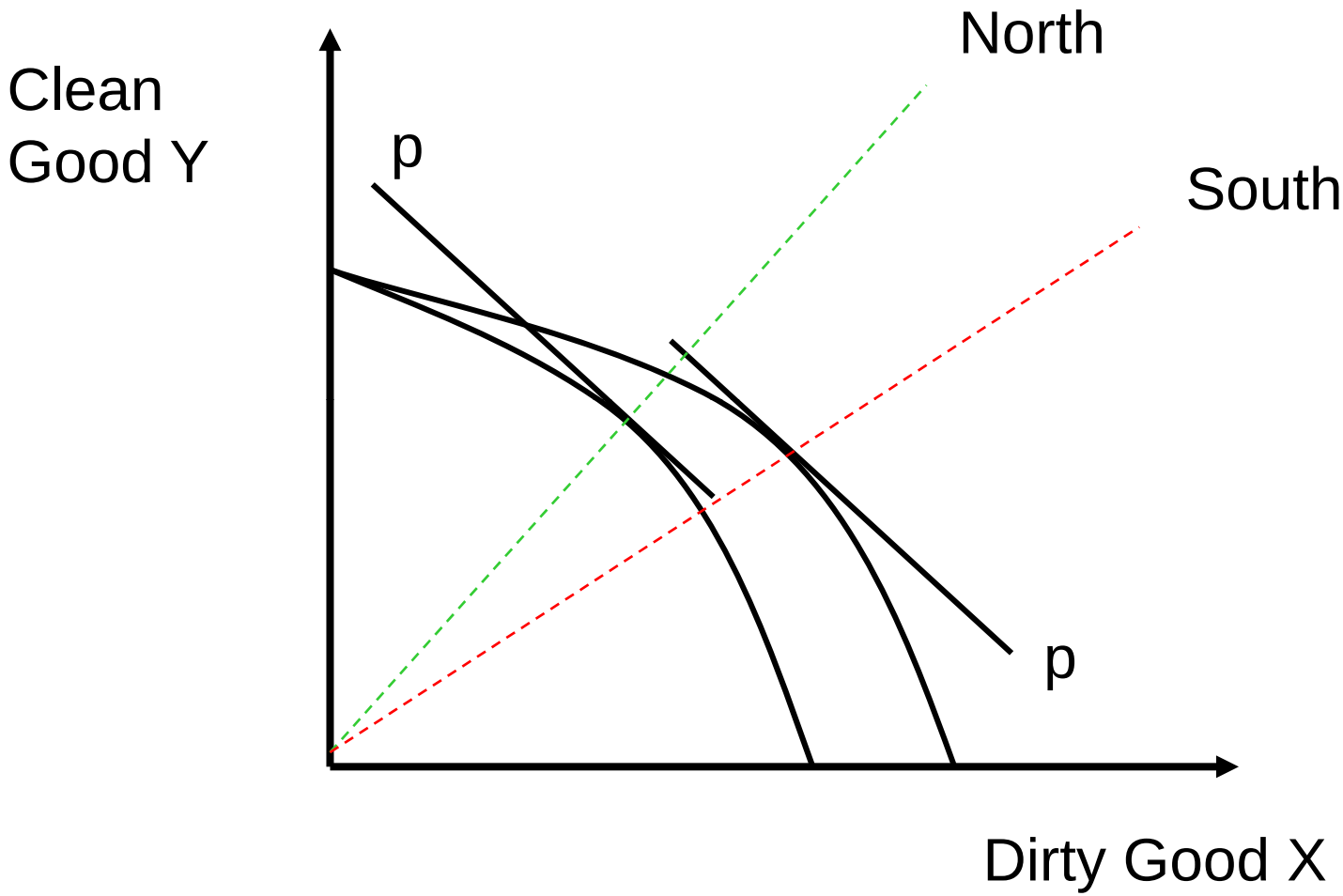
Factor Endowments Hypothesis

The Pollution Haven Hypothesis

- Differences in the costs of meeting environmental regulations are the most important motivation for trade in dirty goods.
- Income levels are key determinants of environmental standards.
- World income distribution is highly skewed.

A Typical Pollution Haven Model

- Two regions: North versus South
- Each region: many small identical countries
- Homogenous goods
- Factors in inelastic supply
- Benevolent Government
- Efficient pollution policy
- Mechanism to generate trade:
  - differences in income
  - differences in environmental regulation
  - differences in production costs
  - trade pattern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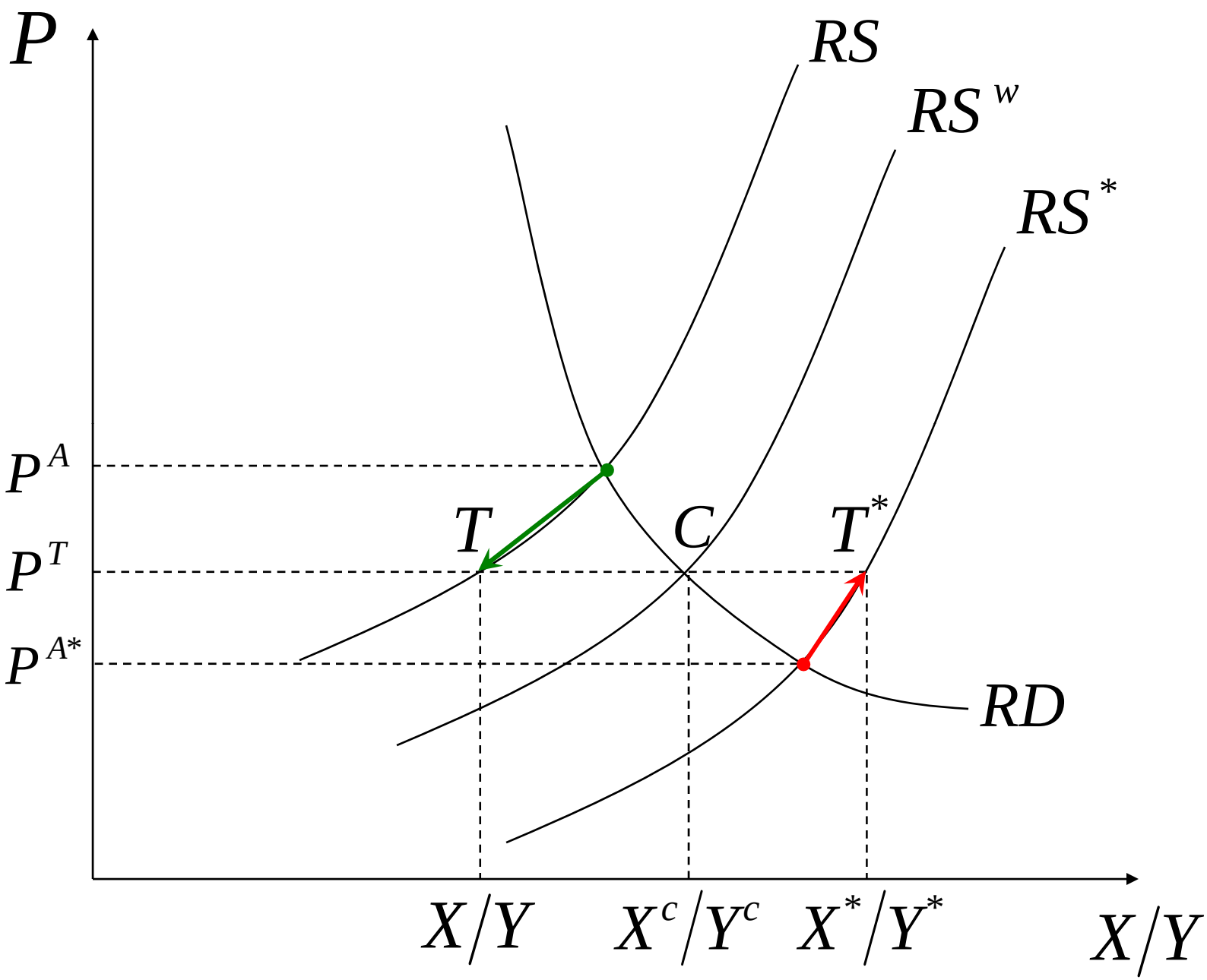
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Trade's Impact on the South

- Trade liberalization leads the South to specialize in relatively dirty industries
- Pollution in the South rises
- Real income gains may lead to tighter environmental policies.
- Real income gains from trade may more than compensate for a dirtier environment. Trade may be welfare improving.

Trade's Impact on the North

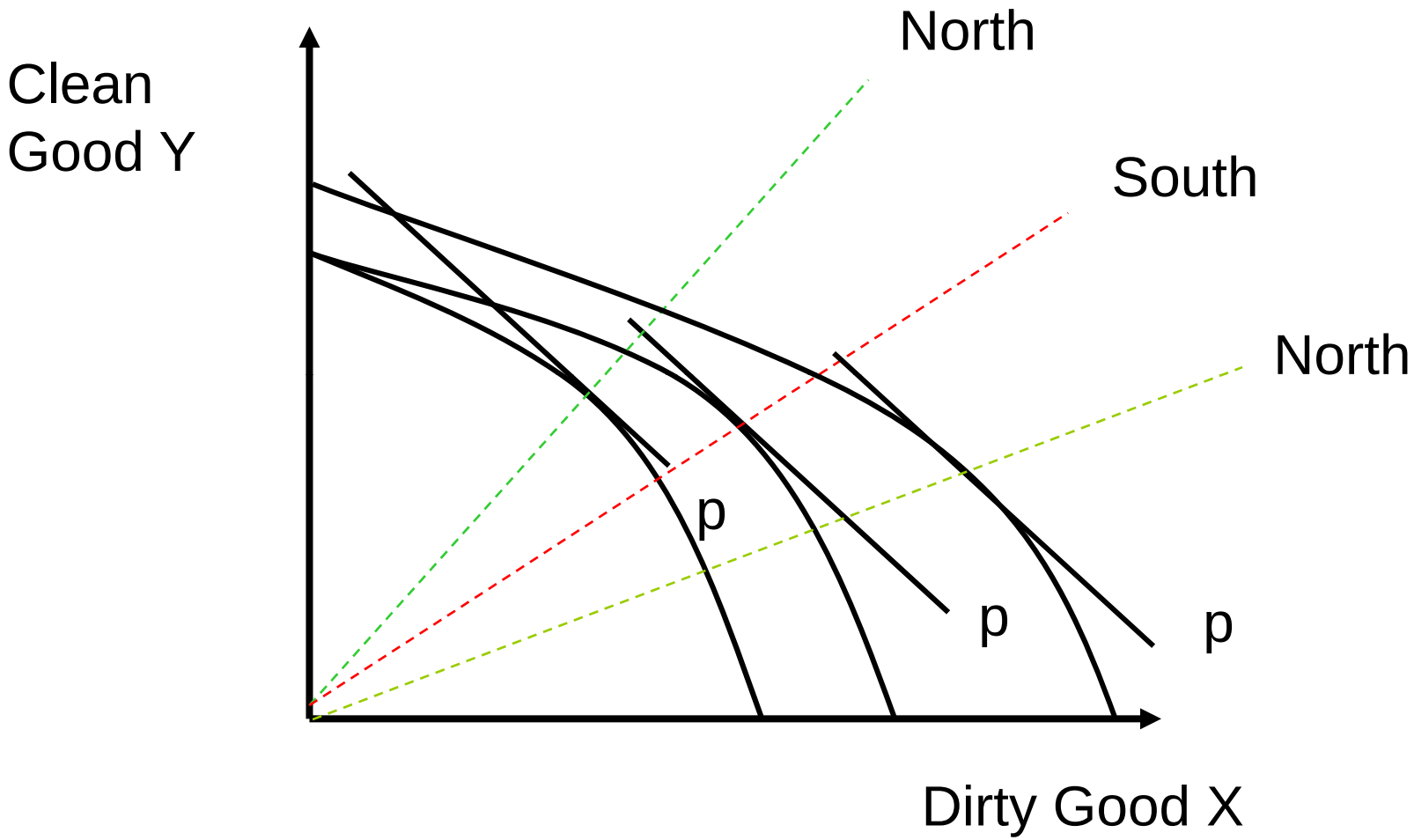
- Trade liberalization leads the North to specialize in relatively clean goods.
- Pollution in the North falls, and their real incomes rise.
- Trade is necessarily welfare improving regardless of the efficacy of policy.

Trade's Impact on the World

- Perhaps a more efficient distribution of production across countries.
- An increase in global pollution.

The Alternative Hypothesis

- Dirty Industries are also capital intensive industries.
- The North is capital abundant relative to the poor labor abundant South.
- If conventional determinants of comparative advantage swamp the cost reducing effects of lax regulation, then the direction of trade may be reversed.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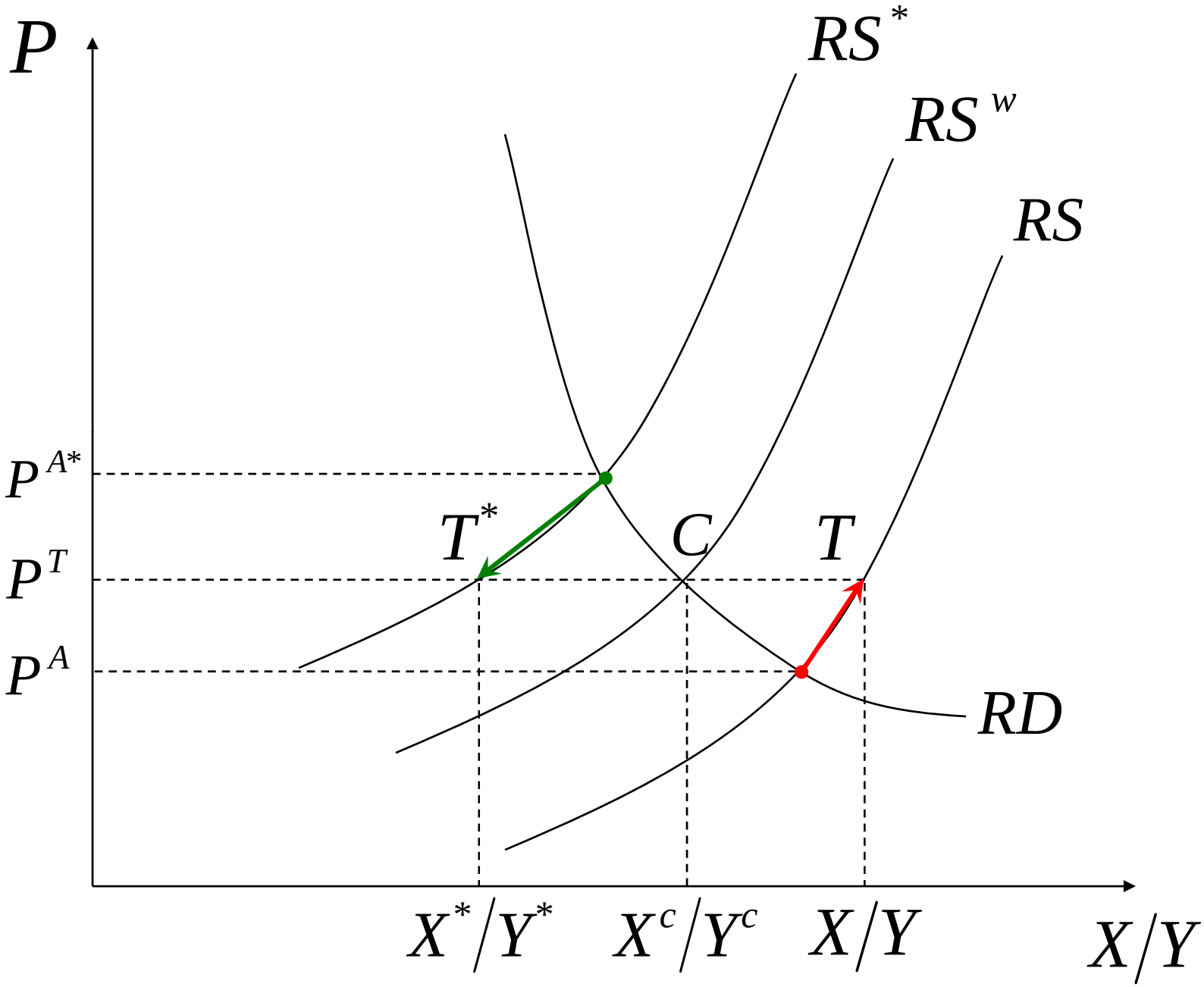
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Implications

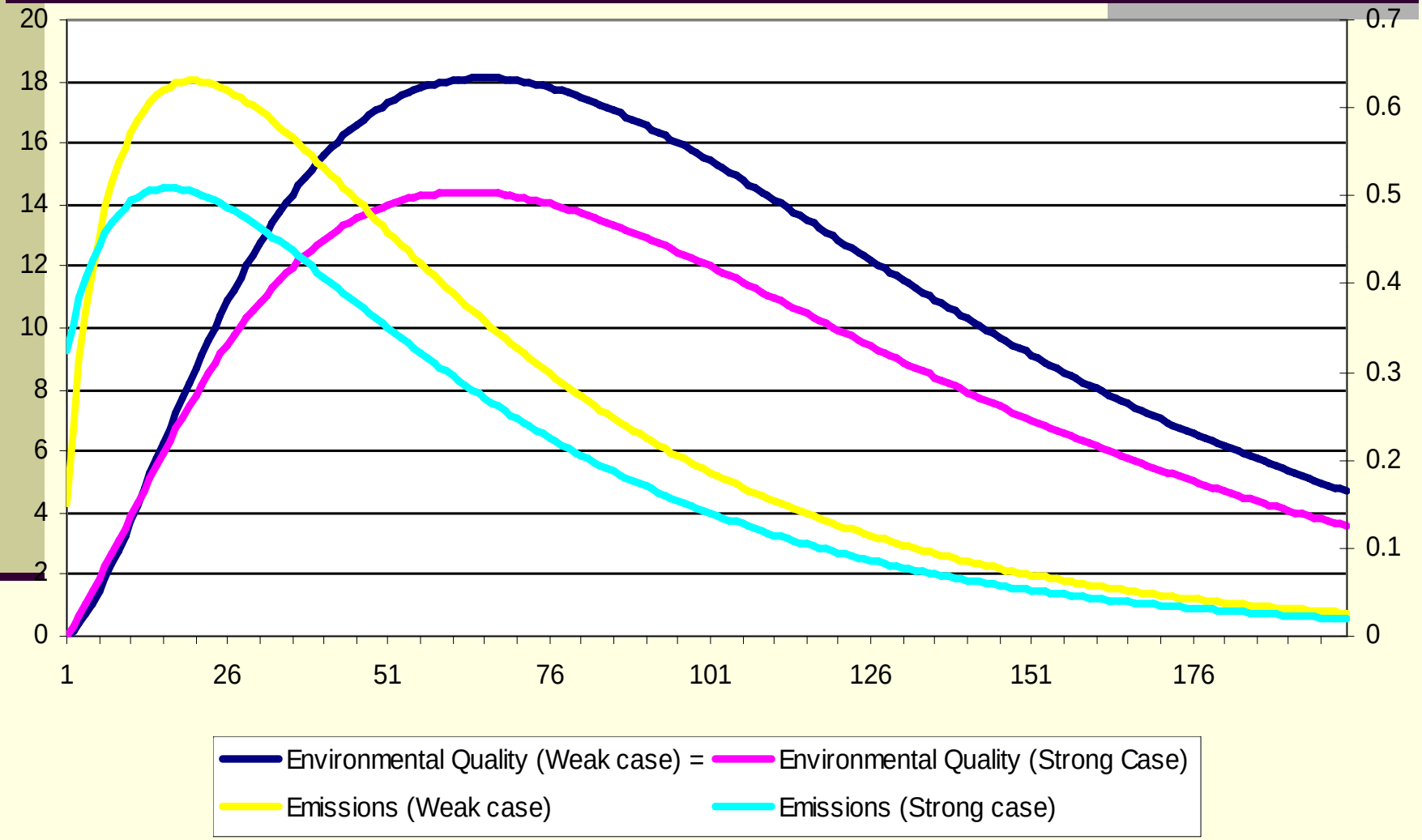
- Trade liberalization leads the South to specialize in relatively clean labor intensive goods, the North in relatively dirty capital intensive goods.
- This shift in the world distribution of production tends to concentrate relatively dirty industries in tighter regulation countries.
- Liberalized trade could lower world pollution and improve environmental quality in both the North and South.

The Speed and Magnitude of the Technique Effect:

- In the literature on industrial pollution and trade, this question became:

- Is pollution policy flexible or rigid? Does it respond to real income gains? If so, how responsive?

The Grossman-Krueger Environmental Kuznets Curve



EKC Interpretation

- Scale dominated by Technique
- Composition effects small
- Technique effect created by income gains is very strong.

Opposing Views of the EKC

- Income gains lead to tighter environmental protection driving down emissions per unit of output and emissions (Stokey).
- Ongoing technological progress in abatement eventually overwhelms the slowing growth of mature economies (Brock & Taylor).
- Income growth leads to political transformation or crosses threshold income level leading to the start of active policy (various).

The Speed and Magnitude of the Technique Effect:

- In the literature on renewable resources and trade, this question became:

- Does the quality of property rights over a resource reflect its value? How fast can enforcement adjust to changed conditions brought about by trade?

Opposing Views

- The Hardin hypothesis: lack of property rights creates a situation of open access to resources that produces a tragedy of the commons. This situation is permanent.
- The Demsetz Hypothesis: property rights are malleable institutions and their strength is determined by economic forces.

If Hardin is right

- And if lax regulation implies a comparative advantage in resource industries, then liberalized trade will create:

1. Resource depletion, deforestation and overfishing.

2. Welfare losses from trade and large environmental costs as well.

If Demsetz is right

- And if Trade raises the value of natural resources, then trade liberalization will create:

1. Improved regulation and enforcement of property rights.

2. Gains from trade as real incomes rise and regulation improves.

Summary of the Theory

Empirical Work

- Do pollution regulations affect trade flows?
- Could regulatory cost differences swamp the impact of other determinants of comparative advantage?
- Does environmental and resource policy respond to income or price changes brought about by trade?

Do regulations affect trade flows?

- Early work found that differences in environmental policy have little or no effect on trade patterns and plant location.
- No support therefore for pollution haven hypothesis
- No need to worry about competitiveness consequences

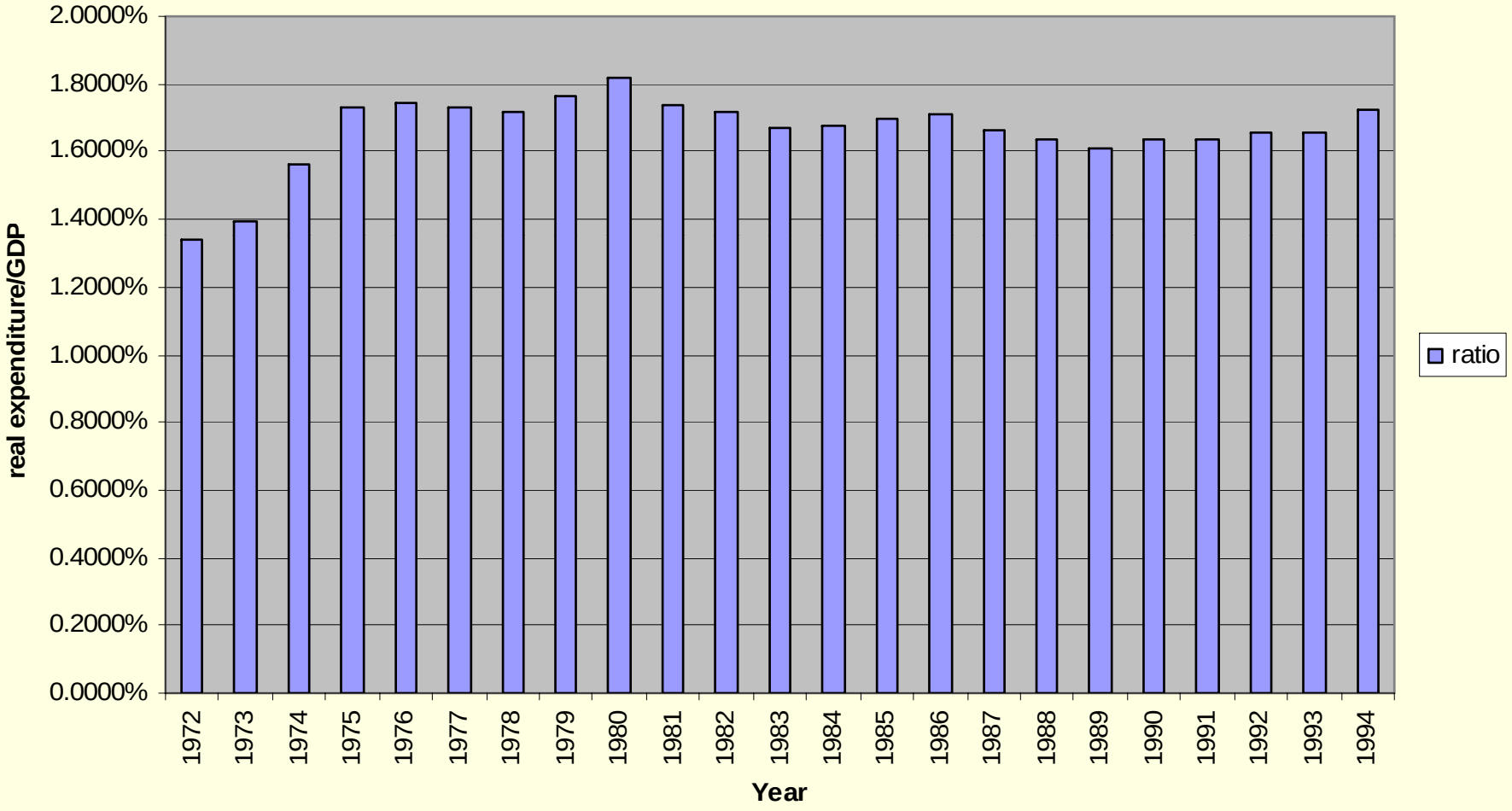
Later Empirical work

- Accounts for the endogeneity of regulation.
- Find significant effects of regulation on trade flows and plant location.
- Levinson (1999); Levinson and Taylor (2001); Ederington and Minier (2003); Becker and Henderson (2000); Kahn (1997); Greenstone (2002); List et al. (2002); Keller and Levinson (2002); List and Millimet (2004).

Could regulatory costs matter most?

- Pollution Abatement costs have been rising, but as a fraction of US Real Output they are virtually constant.

U.S. Real Pollution Abatement and Control Expenditure GDP ratio



Could regulatory costs matter most?

- Pollution abatement costs are a small fraction of output for all OECD countries.

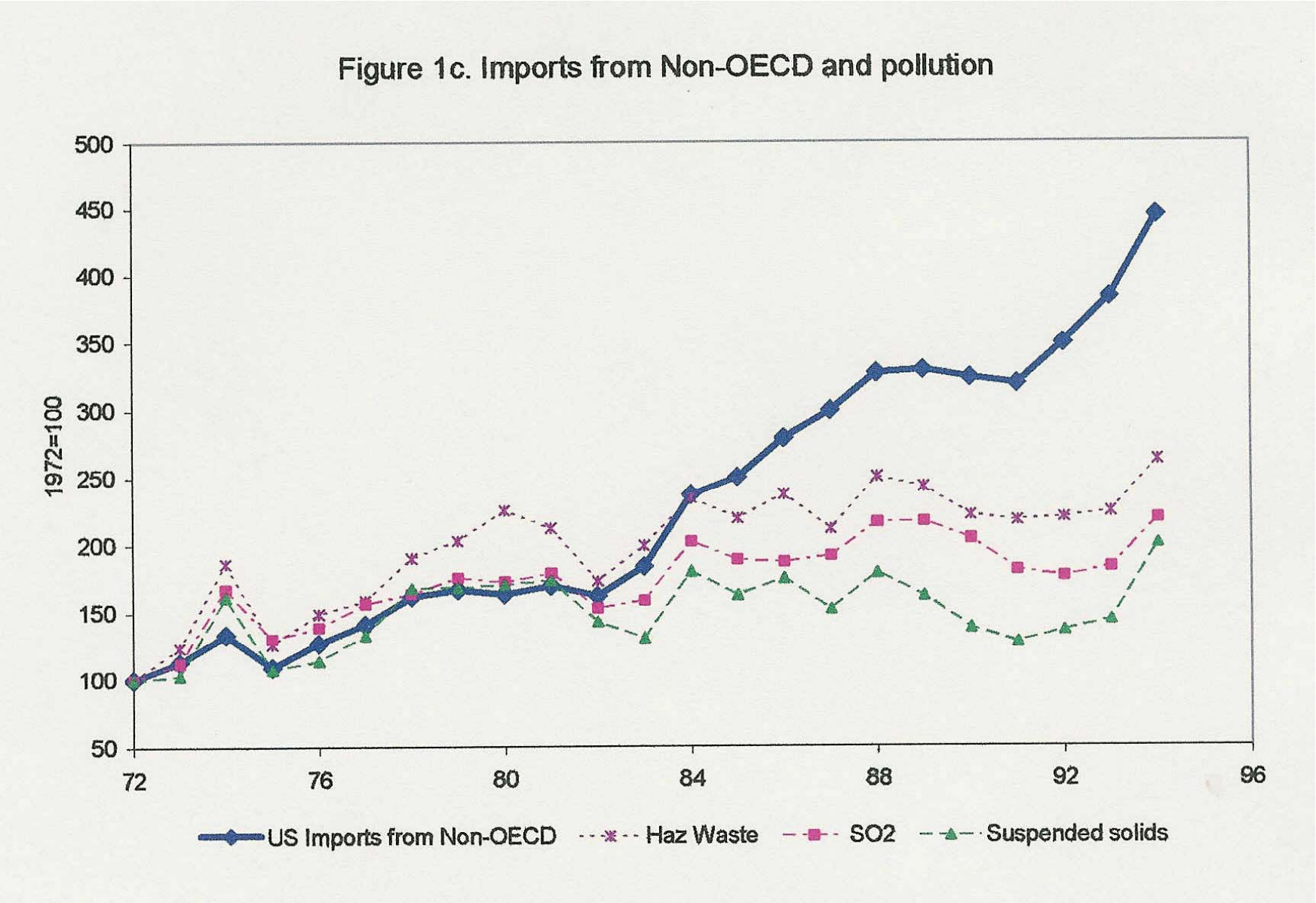
Pollution Abatement Costs/GDP

Australia	0.8	Korea	1.6
Austria	2.2	Netherlands	1.9
Belgium	1.4	Norway	1.2
Canada	1.2	Poland	1.6
Czech Republic	2.0	Portugal	0.8
Finland	1.1	Slovak Republic	1.5
France	1.4	Sweden	1.0
Germany	1.6	Switzerland	1.6
Hungary	0.6	Turkey	1.1
Ireland	0.6	United Kingdom	0.7
Italy	0.8	United States	1.5
Japan	1.3		

Could regulatory costs matter most?

- US imports are not shifting towards dirty industries; US exports remain relatively dirty.

Ederington, Levinson and Minier, 2004 BePress PH Issue



Could regulatory costs matter most?

- Empirical studies weighing regulatory costs against other determinants find conventional determinants are dominant.

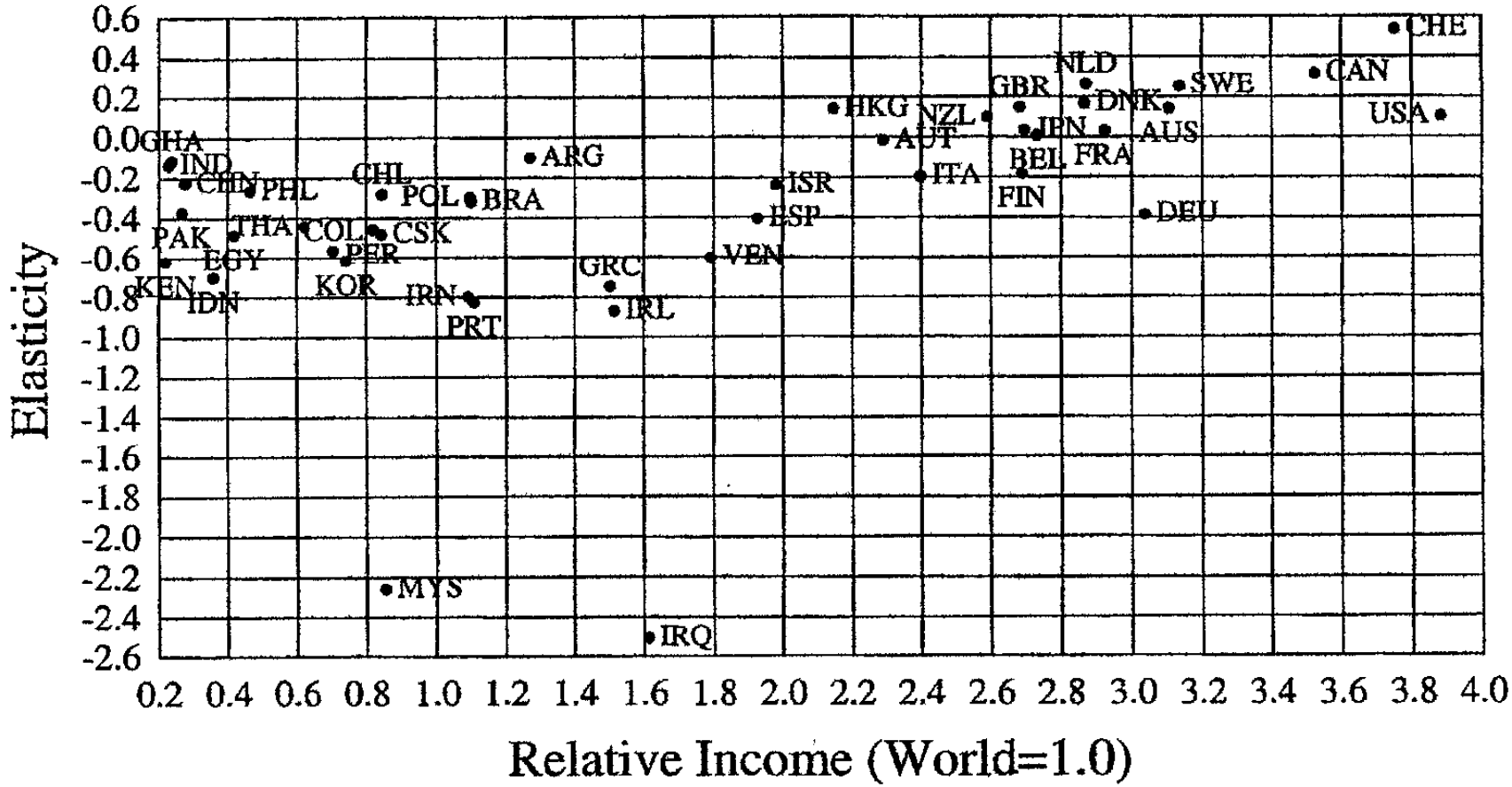
Is Free Trade good for the Environment?

- Nests Pollution Haven and Alternative Factor endowments hypothesis
- Direction of trade is determined by interaction of conventional determinants of comparative advantage and policy differences.
- Use SO2 data on pollution concentrations in 108 cities (43 countries) around the world over the 1976-1996 period.

Composition effect of Trade

- Effects of trade on pollution are statistically significant, but rather small.
- Composition effect positive for some countries, negative for others (as theory would predict)
- Factor endowment effects are stronger than pollution haven motives

Trade's impact on Composition



Evidence on the Technique effect: Industrial Pollution

- Hilton and Levinson (1996): Lead content of Gasoline.
- Dasgupta, et al (1997). Informal Regulation in less developed countries
- Antweiler et al. (2001). Strong technique effects for SO2 pollution.

Conclusions: Trade and Industrial Pollution

- Pollution Haven Hypothesis is logically tight, but may be empirically irrelevant.
- Pollution regulations matter to trade flows, but not enough to make LDC's pollution havens for the developed world.
- Evidence in fact points in the opposite direction: Free trade is good for the environment.

What about Resource Industries?

- Key issue is the existence and timing of a policy response, but there is very little empirical evidence.
- Series of UNEP Studies of trade liberalization in individual countries.
- Numerous case studies from history linking trade opportunities to resource depletion: the beaver fur trade, whaling, pacific fur seal, the buffalo.

Conclusions: Trade and Resource Use

- Market forces have extinguished marketable species in a very short period of time.
- Resource losses are often irreversible.
- Waiting for economic development to foster better resource management is a risky proposition.

How can CGE help?

A Complement to Theory

- How large do pollution abatement costs have to be in order to materially affect the pattern of trade in goods?
- How is this answer affected by the number of pollution sectors, the substitution patterns across factors, and the type of pollution policy?

Example 1

- Suppose we had the simple two good, two region world presented earlier.
- Suppose the share of capital in the dirty good industry was .9; and zero in the clean good
- Suppose pollution abatement costs are 10% of the value of output in the dirty industry.

- Suppose the North had a capital to labor ratio 10 times higher than that of the South.
- Suppose the elasticity of marginal damage with respect to income is equal to one.
- If the North was twenty times richer, or even a hundred times richer would it still have a comparative advantage in dirty goods?
- Answer: Yes See Copeland and Taylor (2003), Chapter 6

An Aid to Empirical Work

- Some of the strongest evidence for a technique effect is the empirical literature on the EKC.

- Problem is that there is now almost an equally large literature disputing its very existence, and by extension the inference that policy tightens significantly with income gains.

- EKC theories have implications for observations other than incomes per capita and pollution emissions.
- CGE work on the competing models could help us sort out the evidence, by forcing theories to be consistent with other data.

Example 2. The EKC

- Suppose growth occurs via neutral technological progress and capital accumulation. Stokey (1998)
- Production is CRS using capital, labor and pollution as inputs.
- Elasticity of marginal damage exceeds one; the environment is a “normal good”
- What happens to the share of pollution abatement costs in GDP as pollution falls and growth proceeds?
- Answer: it grows to approach one in the limit. (See Brock and Taylor, Handbook of Economic Growth Chapter).

What can the Trade and Environment literature contribute to CGE?

- Common thread is that environmental policy responds to income gains and other impacts of trade.
- Problems with empirical work come from assuming policy was exogenous
- EKC literature demonstrates that in the long run environmental policy moves with income gains.
- Many Theoretical results hang on the existence and strength of the policy response.

What to do?

- Business as usual paths should account for endogenous changes in environmental policy.
- These can be calibrated from existing evidence on pollution abatement costs, pollution levels, and income levels.
- This would allow for a level of policy interaction not currently present in the literature.

How to do it?

- A series of “toy” CGE models written in GAMS with endogenous policy is already available at:
- www.econ.ucalgary.ca/taylor.htm Look for GAMS files for book; Documentation for GAMS files.
- Includes files for a pollution haven model, EKC model, trade liberalization exercise etc.

Conclusion

- Existing empirical evidence linking international trade and environmental outcomes is thin. Data problems limit our understanding and the testing of competing hypotheses.
- Key element of this literature is treating environmental policy as flexible and responsive.
- CGE models should play a much bigger role in helping us sort out various hypotheses by providing a quantitative assessment of competing models.

Additional Reading

- Werner Antweiler; Brian R. Copeland; M. Scott Taylor, “Is Free Trade Good for the Environment”, *The American Economic Review*, Vol. 91, No. 4, Sep. 2001, pp. 877-908.
- Brian Copeland; M. Scott Taylor, “Trade, Growth and the Environment”, Journal of Economic Literature, Vol. 42, No. 1, March 2004, pp. 7-71.
- Arik Levinson; M. Scott Taylor, “Unmasking the Pollution Haven Hypothesis”, forthcoming in the International Economic Review.
- Brian Copeland; M. Scott Taylor, “Trade, Tragedy and the Commons”, NBER Working paper No. 10836.
- M. Scott Taylor, “Buffalo Hunt: International Trade and the Virtual Extinction of the North American Bison, NBER working paper No. 12969