

Trade, Growth, and the Environment

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Environmental & Resource Economics and Policy
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Central question:

Is trade good or bad for the environment?

More specifically, is trade good or bad for the environment *for a given level of GDP?*

Outline:

1. The trade-off between GDP & environmental goals.

- Is there an Environmental Kuznets Curve?

2. Effects of trade on the environment:

- Harmful
- vs. Beneficial

3. Which effects tend to dominate in practice?

- Correlations. E.g., for SO₂ & CO₂.
- OLS estimates of effect of trade per se.
- Conclusion: Domestic vs. global externalities.

1. Trade-off between GDP & environment

Widely agreed: trade is good *for economic growth*

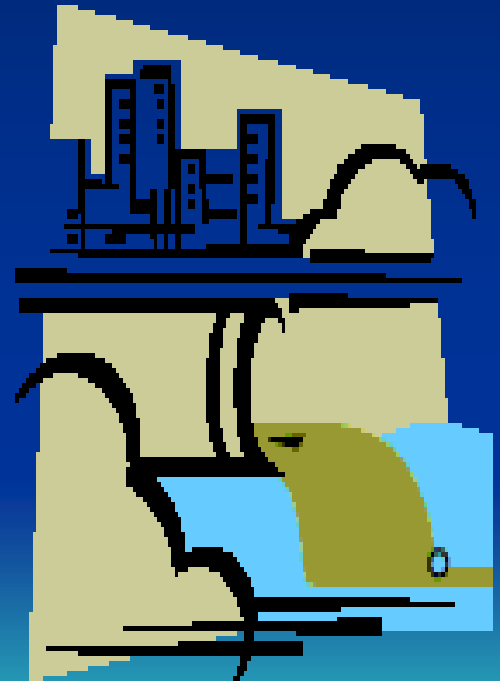
- In theory:
 - Classical comparative advantage (e.g., Ricardo)
 - & modern theories of trade based on imperfect competition (e.g., Krugman).

- Empirically:
Econometric studies.

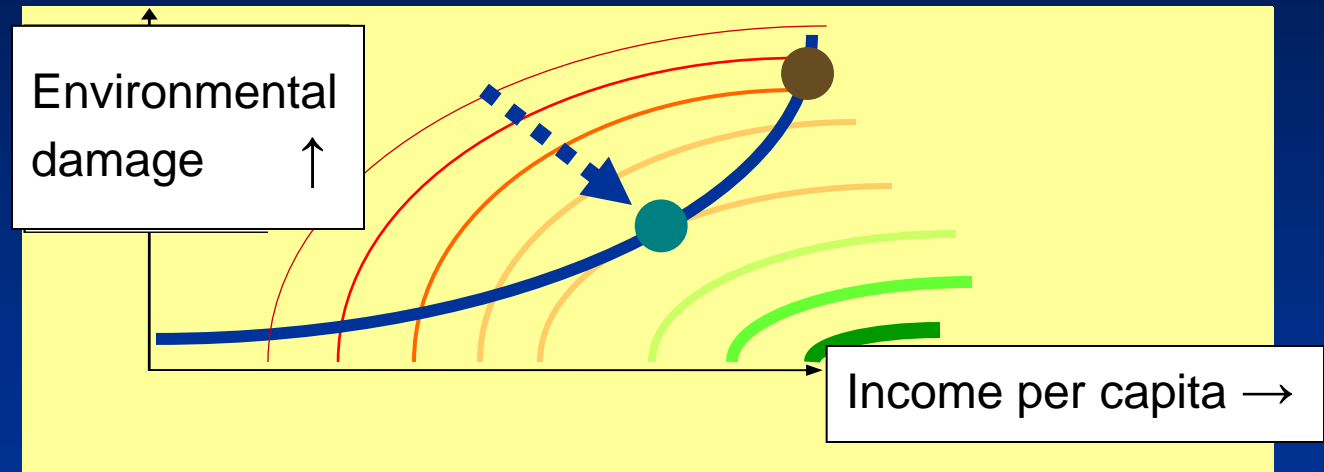
- One estimate: every .01 increase in a country's trade/GDP ratio raises income 3 ½ % (over next 20 yrs.).



But what about effects of openness
on *environmental quality*,
which is not captured
in GDP statistics?

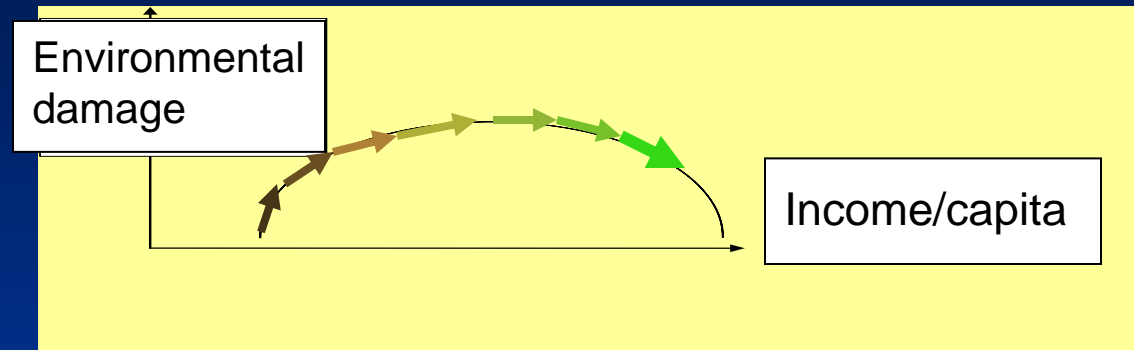


We care about *both* environmental quality *and* (market-measured) real income.



- The objective, as always in economics: to attain the best “indifference curve” or “iso-welfare” curve possible, subject to physical constraints.
- But environmental externalities are the classic case where the free market will not deliver the optimal tradeoff point.
 - Such market failure calls for government intervention.
 - Government regulation, if optimally designed, can deliver the optimum point (e.g., taxing pollution).

Is growth *per se* good or bad for the environment in practice?



Environmental Kuznets Curve:

Grossman & Krueger (1995)

“Economic growth (whether trade-led or not) can improve the environment *above a peak level of income.*”

- EKC is confirmed for some pollution measures, e.g., SO_2 ,
- but rejected for some others, especially CO_2 .

The first EKC: The London Fog (1700-1910), i.e., coal smoke, peaked before 1900.

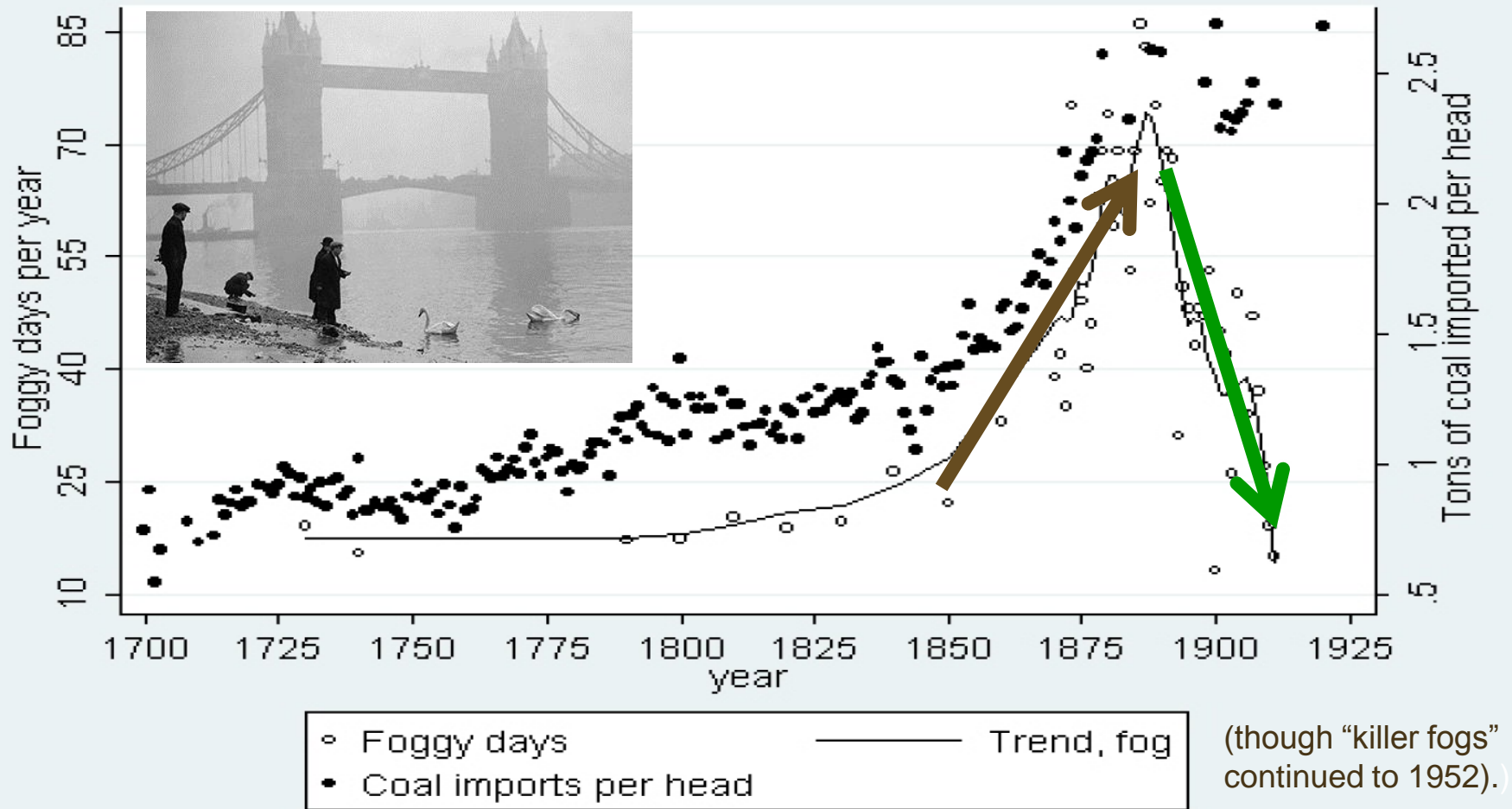
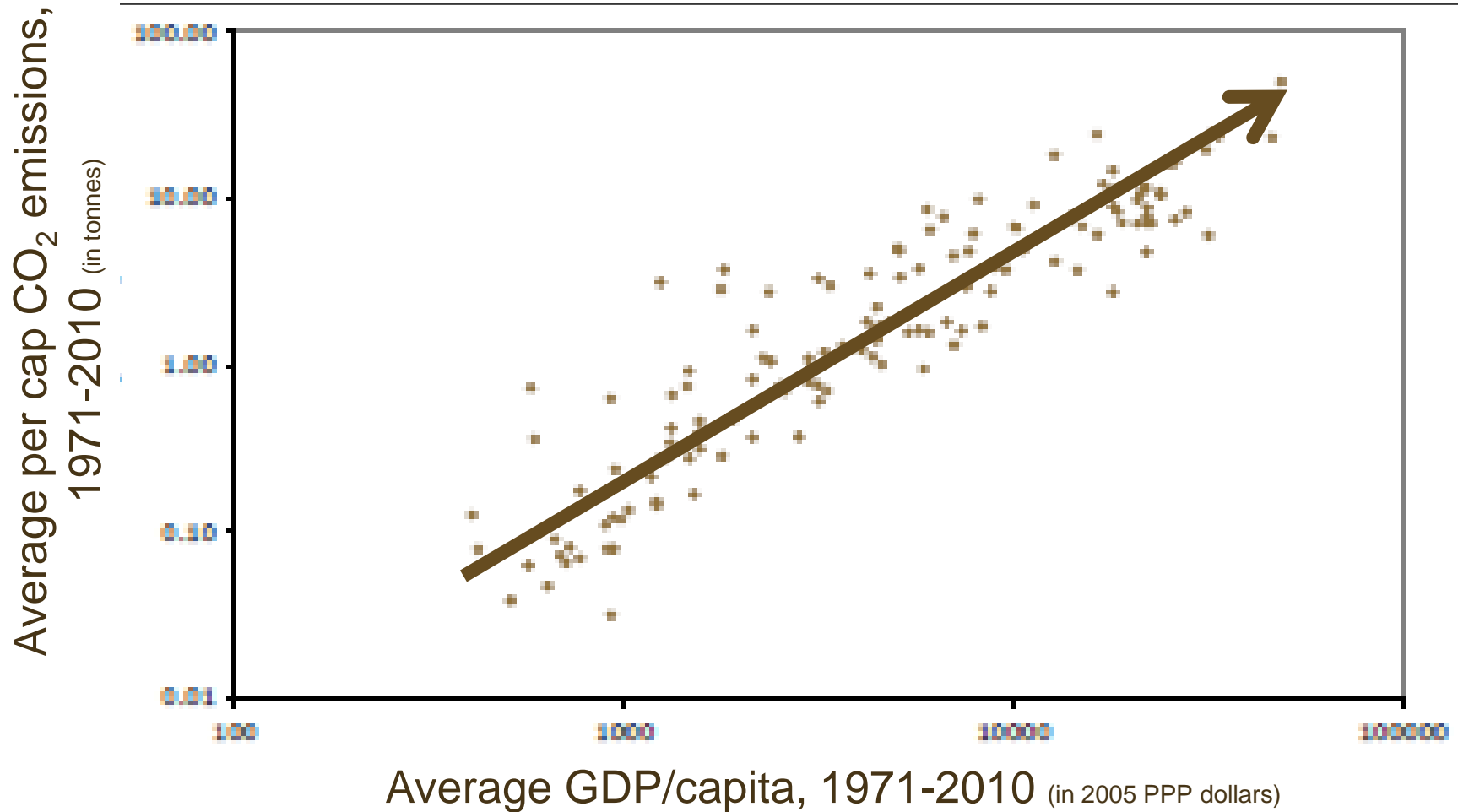


Figure 12. Coal consumption per capital and foggy days in london, 1700-1925

Karen Clay & Werner Troesken, 2011, "Did Frederick Brodie Discover the World's First Environmental Kuznets Curve? Coal Smoke and the Rise and Fall of the London Fog," in *The Economics of Climate Change: Adaptations Past and Present*, Libecap & Steckel. Also <http://www.air-quality.org.uk/03.php>.

Sources: the coal data are from the 1899, 1908, and 1919 volumes of *The Coal Trade* by Saward (editor); the *Times*, July 23, 1901, p. 11; Dec. 1, 1913, p. 26; Aug. 11, 1927, p. 20; *Nature*, Nov. 5, 1891, p. 12; and for earlier years Mitchell (1988), a source which also provides data on London's population. The fog data are derived from the sources described in the text, especially Brodie and Mossman.

But no sign of an EKC in CO₂ emissions





David I. Stern, "The environmental Kuznets curve after 25 years," *Journal of Bioeconomics*, 2017.

2. Effects of trade on the environment

- There are many possible effects.
- They can be categorized
 - according to whether they:
 - (i) operate via GDP, analogously to investment, technology & other sources of economic growth,
 - or (ii) are peculiar to trade alone, and hold for a given level of GDP.
 - Within each category, there are effects both
 - beneficial for the environment,
 - and detrimental.

Is trade itself good or bad for the **environment**, in theory?

Environmental effects of trade	via growth in income:	for a given level of income :
	<i>Environmental K.Curve</i>	
Harmful effects 	larger scale of economic activity;	“Race to the bottom” in national regulation;
Beneficial effects 	shifts to cleaner techniques and composition of economic activity.	“Gains from trade”: e.g., trade in green goods...

The feared “race to the bottom”

- Environmental regulation raises the cost of doing business.
- Industry & labor worry about international competition.
- The more open is a country to trade, the more pressure will they exert on their government to reduce regulatory burden.
- E.g., Barrett (1994).

There are also fears that trade will affect the *allocation* of pollution across countries

The “pollution haven” hypothesis:

trade encourages some countries to specialize in producing dirtier goods:

- poorer countries
 - more capital-intensive countries
 - or less densely populated countries.
- E.g., Levinson & Taylor (2004).

Some examples of trade *helping* environment

- Imports of environmentally friendly products
 - US ended 1980s tariffs & quotas on fuel-efficient Japanese autos, benefiting both consumer pocketbooks & air quality.
 - Imports of cheap solar panels from China, 2010-17, lowered cost of solar power in US.
- Trade brings technological innovation, which can, for example, save energy.
- Multilateral agreements
 - Potential for trade sanctions, as in Montreal Protocol on stratospheric ozone depletion.
 - The Trans-Pacific Partnership (TPP).

The Trans-Pacific Partnership (TPP)

- Most enviro NGOs opposed TPP from the beginning.
- Did they read its enviro chapter when released in 2015?
- It had, e.g., steps to:
 - 1) protect ocean environment from ship pollution;
 - 2) limit subsidies for fishing fleets
 - which waste taxpayer money in pursuit of overfishing our oceans;
 - 3) implement bans on trade in endangered wildlife
 - insufficiently enforced under CITES,
 - 4) & crack down on illegal logging.
- For the first time in a regional agreement, these provisions were to be subject to a dispute settlement process
 - backed up by the threat of economic penalties.

Economic/environmental win-win ideas

- A global ban on subsidies to fossil fuels:
It would achieve both enviro goal of cutting carbon emissions and economists' goals of cutting deficit spending & economic distortion.
- Remove tariffs/quotas on environmental goods imports
 - The US could let in imports of Brazilian sugar/ethanol.
 - WTO negotiations: liberalize environmental goods trade.
 - 14 countries decided in 2014 to pursue it plurilaterally.



- Reform unilateral “trade remedies” which currently block imports of green goods.

- “Next Generation” cases (Wu, 2014):

- Anti-Dumping & -Subsidy actions.



- Free up trade in renewable-energy inputs.

- Almost $\frac{3}{4}$ of EU trade-remedy barriers target imports of products used for renewable energy!

- Kasteng (2013).

- AD remedies currently block trade in solar power inputs:

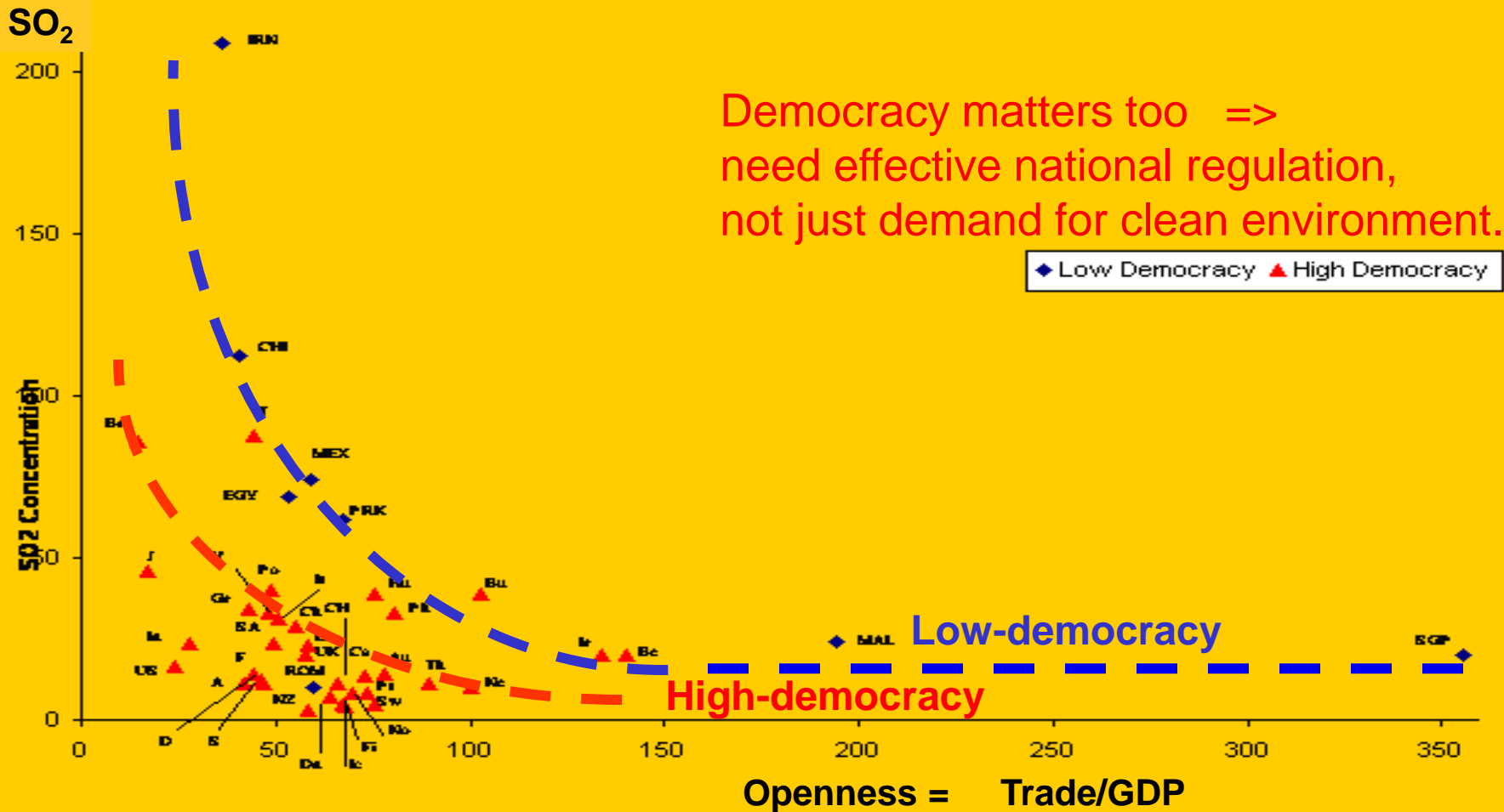
- US has AD tariffs on imports of Chinese solar panels (2012, 2014).
 - Trump added high “safeguard” tariffs against solar panels (Jan. 2018).
- China has them against imports of US polysilicon (2012);
- EU has penalties on imports of Chinese solar glass & panels (2013).
- They should be dropped, whether by negotiation or unilaterally.

3. Which tend to dominate in practice:

- The effects of trade that are detrimental to the environment (e.g., race to the bottom)?
- Or the effects of trade that are beneficial (e.g., US imports of solar panels)?
- It depends on what measure of environmental quality is at stake.

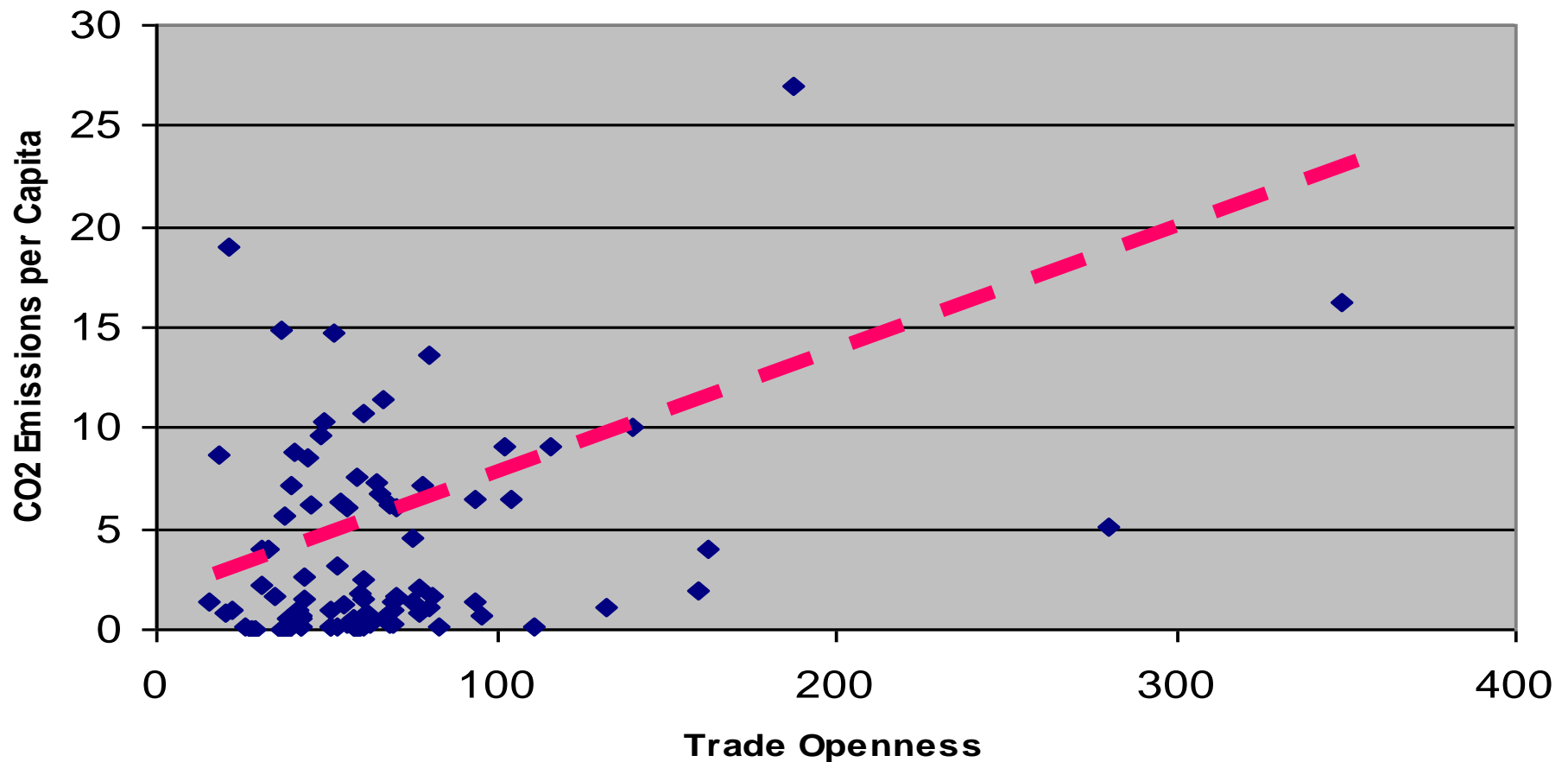
SO₂ concentrations tend to fall with openness, especially after controlling for democracy, cross-country

Openness vs SO₂ Concentration, in Low vs High Democracy Regimes, 1990



CO₂ emissions/cap tend, if anything,
to *rise* with openness.

CO2 Emissions vs. Trade Openness (ave data 1991 and 1992)



But these rough correlations tell us little.

- To isolate the effect of trade on a country's environment, we need to control for other determinants, such as
 - income
 - democracy
 - population density.
- Econometric analysis
 - Antweiler, Copeland & Taylor (2001); Copeland & Taylor (2004, 05, 13)
 - Frankel & Rose (2004); Frankel (2009).

Environmental quality equation

Source: Frankel & Rose, *R.E.Stat.*, 2004

Environmental quality $_i =$

$$\varphi_0 + \varphi_1 \left(\frac{GDP}{pop} \right)_{90,i} + \varphi_2 \left(\frac{GDP}{pop} \right)_{90,i}^2 + \mu \left(\frac{X+M}{GDP} \right)_{90,i} \\ + \pi (\text{Democracy})_{90,i} + \lambda \left(\frac{\text{Land Area}}{pop} \right)_{90,i} + e_i$$

IV for GDP/cap: investment, education...

IV for openness: geographically-based prediction of trade

Is trade itself good or bad for the environment, statistically?

Source: Frankel & Rose (2004)

Environmental effects of trade	via growth in income:	for a given level of income:
for SO₂ concentrations	EKC: after an income of about \$5,700/cap.1990, further growth tends to reduce pollution (via national regulation)	The favorable effects of trade seem to dominate.
for CO₂ emissions / capita	No sign that total emissions turn down. (CO ₂ is a global externality: little regulation is possible at the national level.)	Trade may also increase emissions even for a given level of income.

Do harmful or beneficial effects of trade dominate for environmental goals? Bottom lines:

- For SO_2
 - at low incomes, harmful effects work against beneficial effects;
 - at high levels of income, trade helps through both channels.
- For CO_2
 - Even at high levels of income, trade continues to hurt. \Leftarrow Absent an effective multilateral treaty, the popular will cannot be enacted.

Summary of conclusions

- Empirical studies of cross-country data find no harmful effects of trade on *some* environmental measures such as SO₂ air pollution, for given income.
- So globalization & the environment need not conflict.
- Trade & growth give countries means to clean the air,
 - provided they have effective institutions of governance.
 - For local pollution, the appropriate governance is at the national level.

Summary of conclusions, continued

- But trade & growth can exacerbate *other* measures of environmental degradation: CO₂ emissions.
- The difference can be explained by the observation that CO₂ is a *global* externality.
 - It cannot be addressed at the national level due to the free rider problem.
 - We need institutions of governance at the *multilateral* level.

The solution

- Greater international cooperation on environmental and trade issues,
- to get the best of both.
- One very specific example: the UNFCCC or (better) the WTO should agree on guidelines for penalties on carbon-intensive imports that countries are allowed to impose on each other.





Writings underlying this lecture

available at www.hks.harvard.edu/fs/jfrankel/GEI.htm

- "Congress should approve TPP," *Boston Globe*, Nov. 11, 2015.
- "Protectionist clouds darken sunny forecast for solar power," *VoxEU*, 2013.
- "Global Environment and Trade Policy," *Post-Kyoto International Climate Policy*, eds. Joe Aldy & Rob Stavins; Cambridge Univ. Press, 2009.
- "Environmental Effects of International Trade," *A Report for the Swedish Globalisation Council*, 2009. HKS RWP 09-006.
- "The Leakage/Competitiveness Issue In Climate Change Policy Proposals," in *Climate Change, Trade and Investment: Is a Collision Inevitable?* (Brookings Institution Press), 2009, Lael Brainard, ed. WCFIA WP 4792.
- "Is Trade Good or Bad for the Environment? Sorting out the Causality," with Andrew Rose, *Review of Economics & Statistics* 87, no.1, 2005. NBER WP 9201



Appendices

- Appendix 1: Anti-globalizers & the WTO
- Appendix 2: Could trade measures be used in a climate change agreement?
- Appendix 3: Frankel & Rose paper

Appendix 1: Anti-globalizers and the WTO

- The anti-globalization movement
- Are WTO panel cases anti-environment?

The anti-globalization movement: the first big protests in Seattle, 1999

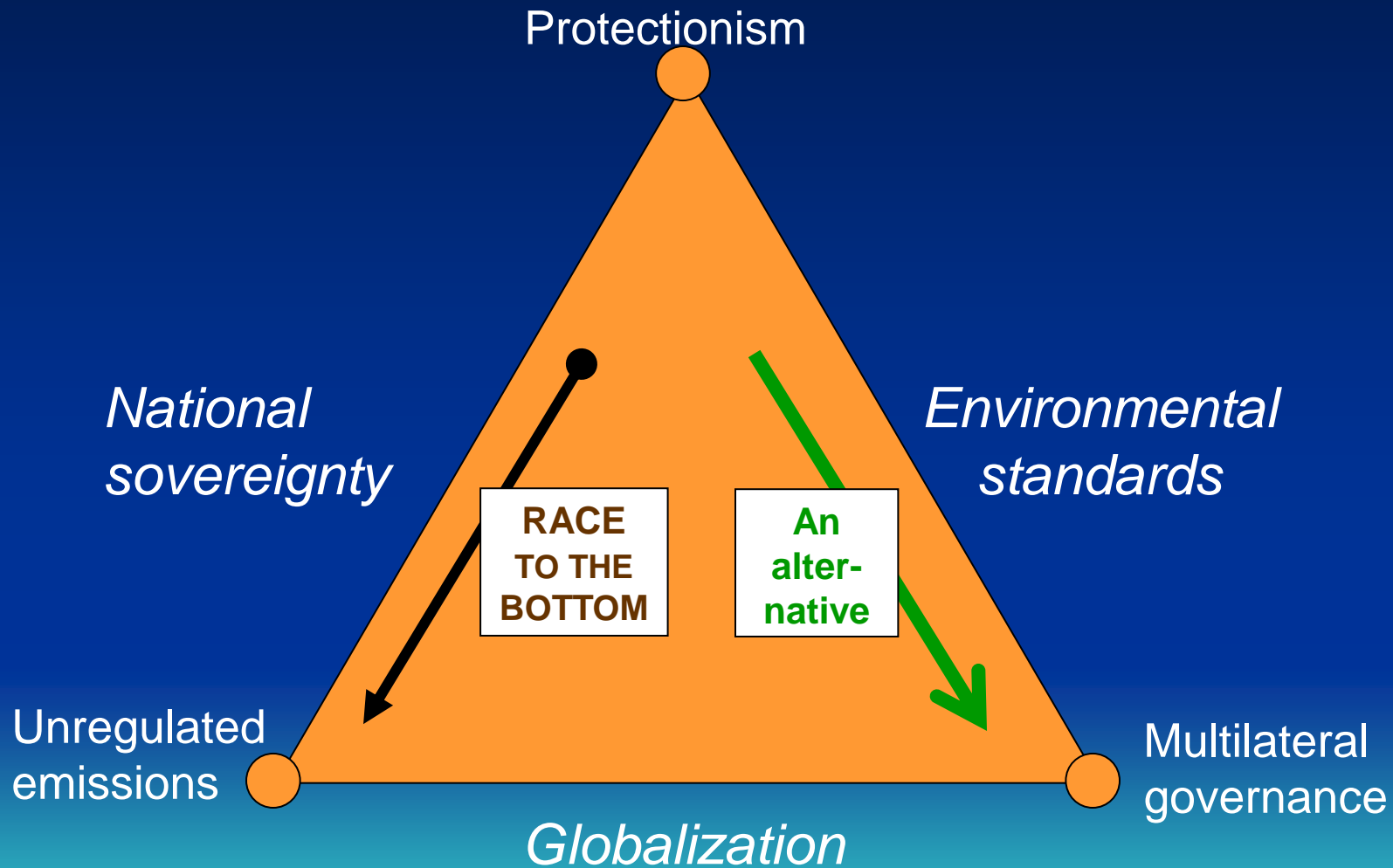


The anti-globalization movement, continued

- Some of the anti-globalization protestors at the 1999 Seattle WTO Ministerial meeting wore turtle costumes.
- Why?
- They felt that a WTO panel had, in the name of free trade, blocked the ability of the US to protect Indian ocean sea turtles from shrimpers.



The impossible trinity of global environmental regulation



What do the anti-globalizers mean when they say the WTO is an intrusive undemocratic bureaucracy?

- Its governance? = the member-country governments.
 - Technically one-country one-vote.
 - True, US & EU have disproportionate weight.
But making it more democratic means giving more weight to India.
Result: Policy gives *lower* priority to the environment.
- The Articles of Agreement?
Hard to object to (next slide).
- The WTO staff?
A few thousand powerless technocrats working in a building on Lake Geneva.
- WTO panel rulings that interpret the rules? That must be it.



WTO language supports the environment:

- Article XX allows exceptions for health & conservation.
- Preamble to 1995 Marrakesh Agreement establishing WTO seeks “to protect and preserve the environment;”
- 2001 Doha Communiqué starting new round of negotiations: “the aims of ... open and non-discriminatory trading system, and acting for the protection of the environment ... must be mutually supportive.”



Typical WTO panel cases

- Tariffs or other measures that discriminate against producers in some trading partners,
 - either in favor of other trading partners
(potential violation of MFN principle of Article I) or
 - in favor of “like products” from domestic producers
(potential violation of national treatment provision of Article III).

Typical WTO panel cases, continued

- If a targeted country files a WTO complaint alleging such a violation, the question is whether the measure is permissible under Article XX
 - which allows for exceptions to the non-discrimination principles for environmental reasons (XXb),
 - provided that the measures in question are not “a means of arbitrary or unjustifiable discrimination” nor a “disguised restriction on international trade.”

Appendix 2:

Could trade measures be used
in a climate change agreement?

Question (1):

GHG emissions are generated by so-called
Processes and Production Methods (PPMs).

Does that rule out trade measures against them?

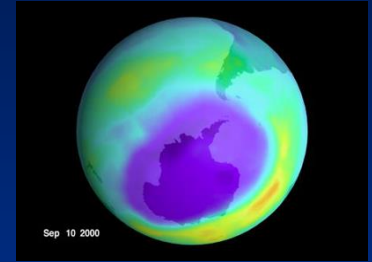
No; 3 precedents.

Question (2):

What specific trade control
design is appropriate?



Precedent (1): Montreal Protocol on stratospheric ozone depletion



- Trade controls had two motivations:
 - (i) to encourage countries to join, and
 - (ii) if major countries had remained outside, would have minimized leakage, the migration of production of banned substances to nonparticipating countries.
 - In the event, (i) worked, so (ii) not needed.

Precedent (2): The true meaning of the 1998 WTO panel shrimp-turtle decision

- New ruling: environmental measures can target, not only exported products (Article XX), but also partners' Processes & Production Methods (PPMs),
- subject, as always, to non-discrimination (Articles I & III).
- US was able to proceed to protect turtles, without discrimination against Asian fishermen.
- Environmentalists failed to notice or consolidate the PPM precedent.



Precedent (3): In case there is any doubt that Article XX, which uses the phrase “health and conservation,” applies to climate change, ...

- a 3rd precedent is relevant:
- In 2007, a WTO Appellate Body decision regarding Brazil restrictions on imports of retreaded tires confirmed the applicability of Article XX(b):
- Rulings “accord considerable flexibility to WTO Member governments when they take trade-restrictive measures to protect life or health...[and] apply equally to ... measures taken to combat global warming.”



Although border measures to address leakage need not violate trade principles or the WTO,

- the big danger in practice is: If each country imposes border measures however suits national politics,
 - they will be poorly targeted, discriminatory, and often disguisedly protectionist;
 - they will run afoul of the WTO, and will deserve to.
- A multilateral regime could guide such measures.
- Some subjective judgments as to principles that should guide design of border measures....

What form should border measures take?

1. Best choice: multilateral penalties. (Not likely.)
2. Next-best: national sanctions adopted under multilateral guidelines
 1. Penalties can only be applied by participants-in-good standing
 2. Judgments to be made by technical experts, not politicians
 3. Penalties only in 6 or 8 of the most relevant sectors (aluminum, steel,...).
3. Third-best choice: No border measures.
4. Each country chooses carbon tariffs as it sees fit.
5. Worst choice: national measures are subsidies (e.g., free permits) to adversely affected firms.

Appendix 3: Frankel & Rose (2005)

- Equations estimated:
 - Growth equation
(using gravity variable as IV for trade openness)
 - Environmental quality equation
(using factor endowments as IV for growth)

Construction of IV for openness

First-stage regression of gravity equation

- $\log(\text{Trade}_{ij}/\text{GDP}_i) =$
- .94 $\log(\text{distance}_{ij})$ + .82 $\log(\text{pop}_j)$ + .53 Language_{ij}
(.05) (.02) (.11)
+ .64 Border_{ij} - .27 $\log(A_i A_j)$ - .47 # Landlocked_{ij} + u_{ij}
(.21) (.01) (.08)

- Equation estimated for 1990.
- Number of Obs. = 4052.
- R2 = .28 (Robust standard errors in parentheses.)

Computation of Instrumental Variable

- Take exponent of fitted values of bilateral trade and sum across bilateral trading partners: $\sum_j \exp[\text{Fitted } \log(\text{Trade}_{ij}/\text{GDP}_i)]$.
- Correlation (trade ratio, generated IV) = .72

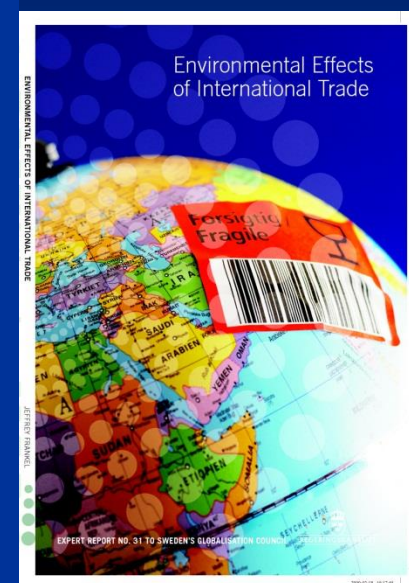
Measures of environmental damage

- SO₂: sulphur dioxide, mean (in micrograms per cubic meter), 1995
- NO₂: nitrogen dioxide, mean (in micrograms per cubic meter), 1995
- PM: Suspended Particulate Matter, mean total (in micrograms per cubic meter), 1995
- Water: Rural Access to Clean Water
- Def: annual deforestation, average percentage change, 1990-95
- Energy: Energy depletion, in percent of GDP (“genuine savings”)[1]
- CO₂/capita: Carbon dioxide emissions, industrial, in metric tons/cap

[1] Energy depletion is a measure computed for the World Bank’s *World Development Indicators*. It is equal to the product of unit resource rents and the physical quantities of fossil fuel energy extracted (including coal, crude oil, and natural gas). Table 3.15, http://www.worldbank.org/data/wdi2001/pdfs/tab3_15.pdf.

I updated the Frankel-Rose econometric analysis

- in a 2009 paper for the Swedish Globalisation Council
 - putting together data for 1990-2004,
 - for 158 countries.
- EKC (inverted U) shows up for PM10 and water pollution.
- Trade still appears to worsen CO₂.
- Again, the obvious explanation: lack of a comprehensive global climate agreement.



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