Lecture 3: Trade and the environment

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Road map

1. Trade as a threat to the environment?
2. Trade policies for environmental regulation?
3. Trade as an adaptation mechanism?
4. Conclusion

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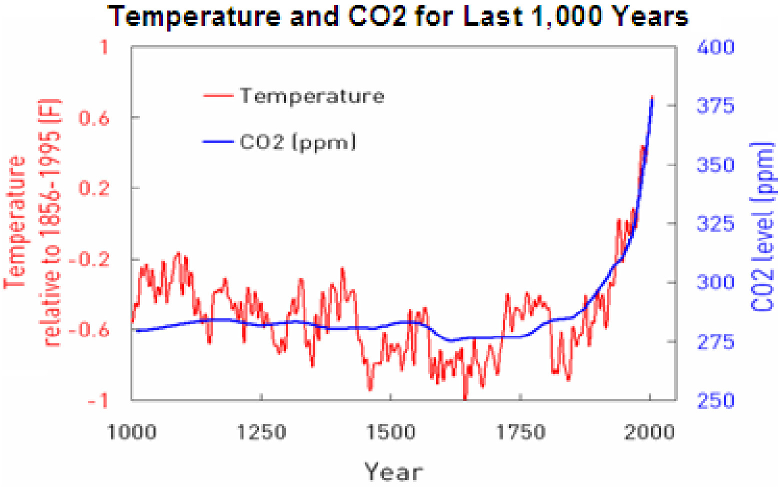
What do we mean by environmental degradation?

Environmental degradation can take many forms:

- biodiversity losses;
- land use;
- air pollution;
- water pollution;
- rising see levels;
- extreme weather events;
- non-renewable resource depletion (e.g. oil, some minerals used for batteries);
- renewable resource depletion (e.g. fish stocks, forests)
- etc.

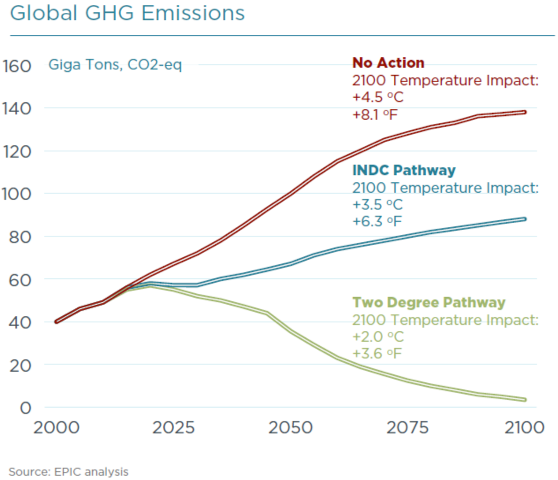
$\rightarrow$ As a global problem affecting all ecosystems, **climate change is closely linked to many of the above**.

Trends in temperature and CO_2 concentration



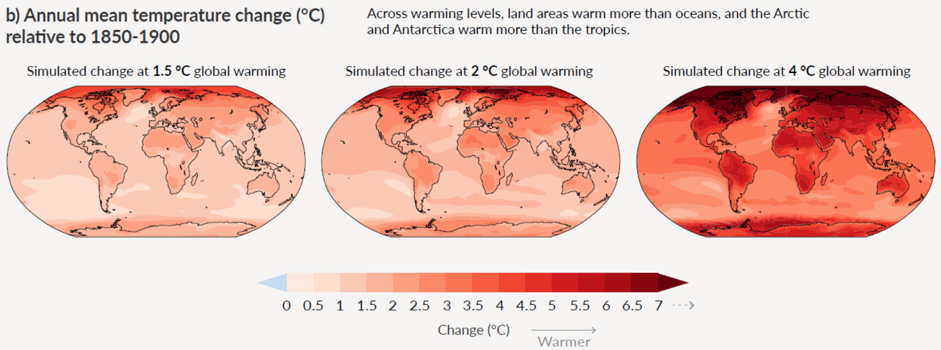
Source: Environmental Defense Fund

Climate change: what is to be expected



Different future scenarios are possible. Note: these figures mask great uncertainty, especially as emissions increase.

Average temperature increase masks spatial heterogeneity



Source: IPCC, AR6

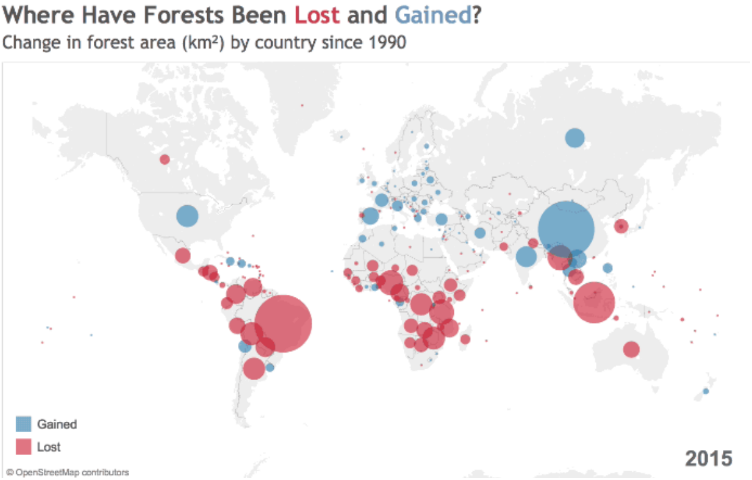
Trends in environmental degradation – What we know about climate change

According to the Intergovernmental Panel on Climate Change (IPCC)

- Total anthropogenic GHG emissions have been increasing in the past decades, and at an increasing rate: about 2.2% per year between 2000 and 2010 (despite the 2008 crisis), vs. 1.3% between 1970 and 2000.
- CO_2 emissions — in particular from fossil fuel combustion and industrial processes — are the main contributors to the growth in GHG emissions.
- "About half of cumulative anthropogenic CO2 emissions between 1750 and 2010 have occurred in the last 40 years".
- The increase in GHG emissions is mainly driven by energy supply (47%), industry (30%), transport (11%) and buildings (3%) sectors;
- The growth in emissions is driven by a scale effect: economic and population growth lead to higher emissions. Economic and climate forecasts predict that absent additional mitigation measures, by 2100, the global mean temperature will have increase by 2.5°C (very optimistic) to 7.8°C (very pessimistic);

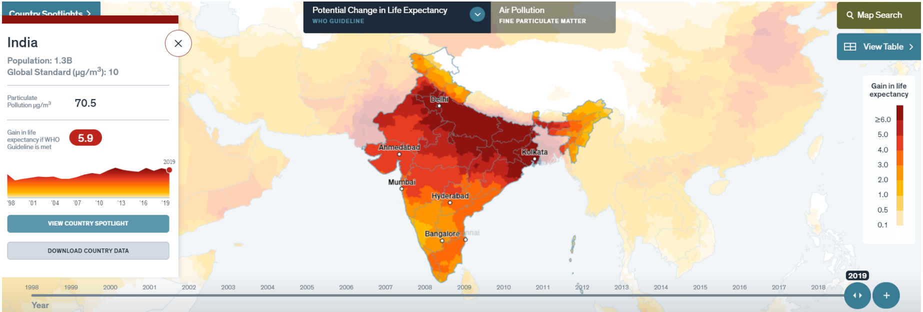
Source: IPCC report AR5, summary for policymakers.

Deforestation around the world



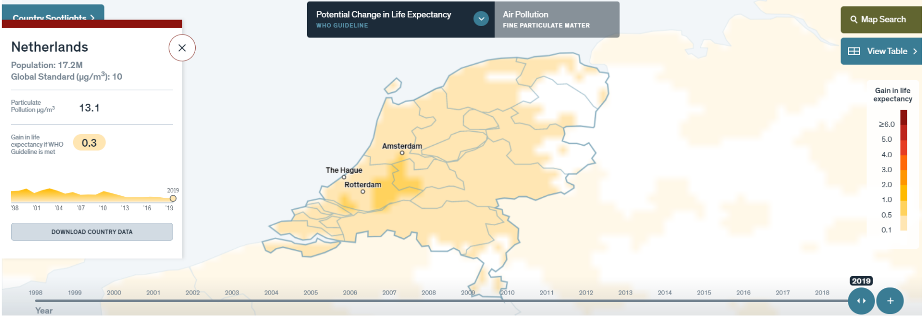
Source: World bank data. Note: new forests do not substitute for the old-growth forests that have much richer ecosystems.

The effect of air pollution on life expectancy – India



Very high and heterogeneous impacts, with an upward trend.

The effect of air pollution on life expectancy – Netherlands



Great progress since the times of the Great smog in developed economies. Still, not a minor issue.

What does trade have to do with this?

Perhaps the most obvious association between trade and pollution:

Figure: A container ship at the Port of Hamburg

Transports heavily rely on fossil fuels whose consumption generates:

- greenhouse gas emissions responsible for climate change;
- local pollution with large negative effects on health.

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- concerns for the environment had progressively grown and became a global issue (major Earth Summit in Rio in 1992, Kyoto Protocol in 1997);
- the NAFTA was created (January 1994) to promote free trade between Mexico, the U.S. and Canada;
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$\rightarrow$ Seminal paper by Grossman and Krueger (1991) attempts to clarify the debate.

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Trade and the environment: three mechanisms – Grossman and Krueger (1991)

Standard framework: one can decompose the effect of trade on the environment into three key mechanisms:

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- a **scale** effect: if trade increases aggregate output, everything else equal — i.e. if the nature of this output and the technology used to produce it remain unchanged —, pollution increases;
- a **composition** effect: if trade leads to a shift towards less (more) pollution-intensive sectors, everything else equal, pollution decreases (increases);
  - this effect is *a priori* ambiguous, and most likely heterogeneous depending on how countries specialize;
  - in aggregate, it could be positive for the environment if global production shifts towards less polluting sectors (e.g., services instead of manufacturing). However, trade also favors one of the most polluting sectors: transportation;
  - furthermore, it could also be negative if production is relocated in countries with weaker environmental regulation (carbon leakages).

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- a **technique** effect: if trade favors the diffusion of cleaner techniques of production, everything else equal, pollution decreases. This effect is considered to be generally positive for the environment for two reasons:
  - modern technologies are typically (although not necessarily) less polluting;
  - trade-induced economic growth in less developed countries may increase their demand for environmental regulation.

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Technological progress vs. carbon leakages – Levinson (2009)

Starting point: Between 1972 and 2002, total pollution from U.S. manufacturers has dramatically declined (e.g. by around 30% for NO_X, 66% for SO_2). Meanwhile, the output from manufacturing has significantly increased (by more than 70% in real value). Thus, **despite a scale effect**, important reduction in emissions. How come?

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Two potential explanations:

- **technique** effect: stricter environmental regulations and technical progress (potentially endogenous to it) may have lowered the pollution-intensity of manufacturing;
- **composition** effect: the set of goods produced in the U.S. may have changed to become less pollution-intensive. This could be because:
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Critical question: is U.S. manufacturing less polluting because production processes have improved or because pollution has leaked abroad?

Method: the author builds on the framework of Grossman and Krueger (1991), formalized by Copeland and Taylor (1994), to decompose total pollution from manufacturing (P) as follows:

$$P = \sum_i p_i = \sum_i v_i z_i = V \sum_i \theta_i z_i$$

which, in vector notation, gives $P = V\theta'\mathbf{z}$, with p_i the pollution from industry i, v_i the total value from industry i and z_i its pollution intensity (so that $p_i = v_i z_i$) and θ_i the share of industry i in total output V (so that $v_i = \theta_i V$).

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$$dP = \theta'\mathbf{z}dV + V\mathbf{z}d\theta + V\theta' d\mathbf{z}$$

Using data from the Environmental Protection Agency (EPA) from 1972 to 2002 for 4 pollutants, the author quantifies these three terms (scale, composition, and technique effects).

Technological progress vs. carbon leakages – Levinson (2009)

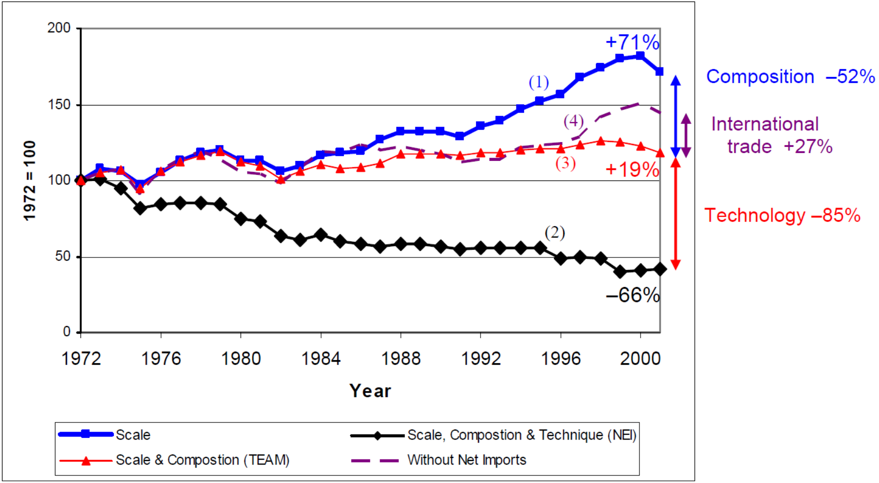

Figure: Sulfur Dioxide Emissions from U.S. Manufacturing (Levinson, 2009).

Technological progress vs. carbon leakages – Levinson (2009)

Conclusions:

- technology accounts for the major part of reduction in U.S. manufacturing emissions from 1972 to 2002;
- international trade has played a significant role in lowering domestic emissions (by moving them abroad), but the effect remains much smaller than the one of technology;
- the technique effect has played a key role up to the 80's, after which its relative importance has declined. This could be due to several reasons:
  - increasing marginal costs from pollution abatement;
  - a decline in demand for environmental improvements from regulators;
  - higher incentives to improve energy efficiency in the 70's and early 80's due to higher energy prices.

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Looking ahead: the future trend in emissions reductions is therefore hard to predict, but ambitious environmental policies with a significant effect on energy prices seems key to incentivize technological progress and lower the pollution-intensity of production.

Trade, pollution and mortality in China – Bombardini and Li (2020)

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Hypothesis: as usual, export expansion could have affected the environment in three distinct ways:

- through a **scale** effect: the growth rate in Chinese exports was 14% in the 90's and 21% in the 2000's. If much more goods are produced, we can expect an effect on pollution;
- through a **composition** effect: the expansion of exports could have been larger in more pollution-intensive sectors;
- through a **technique** effect: the regions which witnessed significant increases in their exports got richer. As a result they may have:
  - undertaken stricter regulations against pollution, improved their technology, or find ways to reduce their exposure to pollution;
  - change other aspects of their economy thereby affecting the local pollution (e.g. by increasing the size of the local vehicle fleet).

Method: to separately identify these different channels, the authors construct two indexes of export exposure shock:

- *ExShock*: it measures how much each prefecture is initially specialized in industries that subsequently experience a positive export shock;
- *PollExShock*: it measures the interaction between *ExShock* and the pollution intensity of the industries in which each prefecture is initially specialized;

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- while the first index may capture both the scale and technique effect (prefectures with higher *ExShock* produce more, get richer, and may change accordingly), the second index captures the composition effect (how much the economy grows in pollution-intensive industries);
- Considering the second index while controlling for the first enables to isolate the composition effect from the scale and technique.

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Main findings:

- a one standard deviation increase in *PollExShock* increases SO_2 concentration by 19% of the standard deviation (statistically significant);
- a one standard deviation increase in *ExShock* decreases SO_2 concentration by 6.3% of the standard deviation (*not* statistically significant);
- a one standard deviation increase in *PollExShock* increases infant mortality by an additional 4.1 infant deaths per one thousand live births (statistically significant);
- a one standard deviation increase in *ExShock* decreases infant mortality by 1.2 infant deaths per one thousand live births (*not* statistically significant);
- the negative impact of trade shocks on infant mortality is concentrated in mortality due to cardio-respiratory conditions (the most sensitive to air pollution) while other forms of infant deaths are not affected.
- the authors calculate that the elasticity of infant mortality to SO_2 concentration is 0.81, and find that export expansion between 1990–2010 would have caused 803,088 infant deaths;

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Conclusion: at the local level, in the case of China, major negative role of the **composition** effect on pollution. **Caveat:** if polluting exports have expended there, polluting production may have decreased elsewhere. The global impact remains ambiguous.

Trade, transport and the environment – Some simple facts

Some basic facts:

- transportation is one of the most polluting sectors:
  - it represents around 24% of CO_2 emissions worldwide;
  - 45% of those emissions come from passenger vehicles, 29% from freight, 12% from aviation and 11% from shipping (source: IEA and ICCT).
- the pollution generated from transportation can be very heterogeneous depending on the mode:
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$\rightarrow$ if trade induces a shift of production towards countries in which it is less polluting, then lower emissions from production may outweigh the additional pollution from transportation. Some simple anecdotal evidence:

- Williams (2007): buying roses from Kenya transported by air to the U.K. is less polluting than buying roses from the Netherlands: growing roses in the Netherlands emits 6 times as much greenhouse gases than in Kenya;
- Saunders et al (2006): lamb consumed in the United Kingdom imported from New Zealand generates 70% less CO_2 than domestic lamb.

Trade and the greenhouse gas emissions from international freight transport – Cristea et al (2013)

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What they find:

- 33% of trade-related worldwide emissions come from international transport (the rest comes from production);
- 31% of trade flows lower emissions, i.e. producing these goods domestically would increase emissions even accounting for transportation. For the rest of the goods, trade increases emissions relative to autarky;
- trade-related emissions are expected to increase in the near future due to global output growth and an increase in trade flows between distant partners (exports from China and India being rapidly growing).

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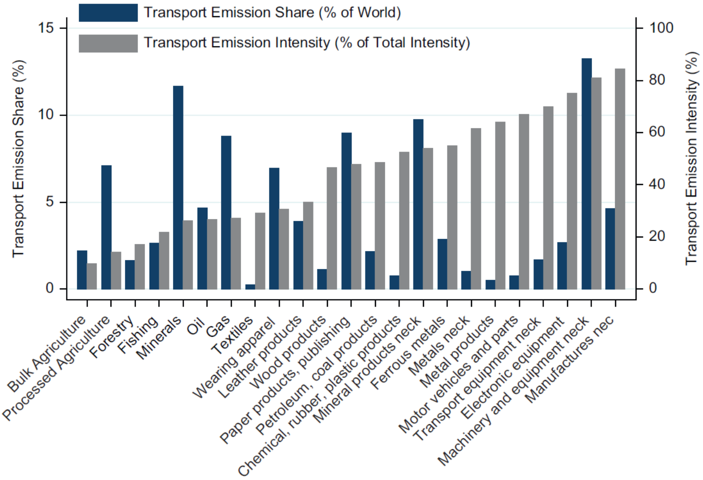

Figure: The contribution of transport to total trade-related emissions (Cristea et al, 2013)

Trade Liberalization, Exports, and Technology Upgrading – Bustos (2011)

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Bustos, 2011: trade liberalization also boosts productivity through exporters' investments in new technologies. The paper builds on a theoretical model and a set of empirical estimations.

The model:

- the set-up is similar to Melitz (2003);
- firms pay a fixed cost to enter the domestic market, and an additional fixed cost to export;
- in addition, they pay a fixed cost to adopt a newer (more productive) technology;

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Question: what does the model predict will happen in equilibrium? What will be the impact of trade liberalization on technology adoption?

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Outcome:

- the cost of the technology being fixed, but the benefits being proportional to firms' sales, only largest firms adopt it;
- there are three types of firms on the market: those which export and use the new technology, those which export and use the old one, and those which only sell domestically and use the old one;
- as in Melitz (2003), a reduction in bilateral trade tariffs implies a reallocation of production towards the largest, most productive firms: a larger share of the production is done by the first type of firms: the most productive which use the new technology.

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Taking the model to the data: the author exploits the large drop in trade tariffs between Brasil and Argentina between 1991 and 1995, after the creation of the MERCOSUR. As predicted by her model, she finds that:

- sectors that experienced a larger drop in tariffs experienced a larger increase in their exports;
- firms increase their spending on technology faster in industries where tariffs fall more;
- the effect on technology adoption is mostly driven by firms of medium size (i.e. the second group in the model).

Firm size and pollution intensity – Barrows and Ollivier (2018)

Question: from the previous study (and consistent with other papers), trade liberalization shifts production towards bigger firms that are more productive and use newer technologies. But does it mean these firms are less pollution-intensive (i.e. pollute less per unit produced)?

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Barrows and Ollivier, 2018: they use Indian firms' data to estimate the relationship between firm size and emission intensity. Their specification is as follows:

$$e_{fy} = \sum_{j=1}^{9} \delta_j D_{jfy} + \alpha_s + \alpha_y + \epsilon_{fy}$$

where e_{fy} denotes the log CO_2 intensity of firm f in year y, D_{jfy} a dummy variable equal to 1 if firm f in year y belongs to the j^{th} decile in the size distribution, and α_s and α_y sector and year fixed effects.

The sum over deciles j going from 1 to 9, the authors express the CO_2 intensity (δ_j) of firms relative to the biggest firms (i.e. the 10^{th} decile).

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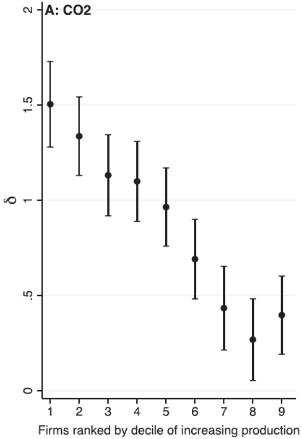

Figure: Estimated firm CO_2 intensity as a function of firm size (Barrows and Ollivier, 2018).

Conclusion: all δ_j are positive, and decreasing with firms size: the larger the firm, the lower its pollution intensity. The authors find that firms in the first decile are on average about 4.5 times more polluting than in the top decile.

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Cooperation in international environmental agreements

Two distinct approaches to international environmental agreements:

- Top-Down: for a long time, policy-makers hoped that climate policies would emerge as global policies that would harmonize the efforts between countries. This was the approach of the Kyoto Protocol (1997). The idea is to find a legally binding agreement to pressure governments to take a certain level of action. Problem: low-participation;

Cooperation in international environmental agreements

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- Top-Down: for a long time, policy-makers hoped that climate policies would emerge as global policies that would harmonize the efforts between countries. This was the approach of the Kyoto Protocol (1997). The idea is to find a legally binding agreement to pressure governments to take a certain level of action. Problem: low-participation;
- Bottom-Up: to induce larger participation, the international community has shifted to individual pledges called nationally determined contributions (NDCs). This was the approach of the Paris agreement. The idea is to let countries free to announce their own contribution to induce a larger participation. Problem: low level of ambition.

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→ From Kyoto to Paris, the international community has shifted from the search for a global agreement with harmonized efforts to heterogeneous contributions reflecting countries' individuals willingness to pay, in order to ensure a larger participation (Harstad, 2019: "the emission targets under Kyoto were binding for only 37 countries, while nearly every country in the world contributes to the Paris Agreement").

Heterogeneity and race to the bottom

Now, some regions of the world want to further accelerate the process. With the European Green Deal, Europe has set the objective to become climate Neutral by 2050.

Figure: Ursula Von der Leyen presenting the European Green Deal

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Problem: impact on competitiveness of domestic firms. How to avoid both economic losses and carbon leakages? By lowering their environmental standards, countries may attract foreign industries → clear risk of a **race to the bottom** in environmental regulation.

Climate clubs – Nordhaus (2015)

Problem: countries need to consent to joining international agreements, participation is always voluntary. Problem: there are strong incentives for free-riding in international climate agreements: countries want to receive the benefits of the public good (combating climate change) without contributing to its costs.

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Potential solution: in the past, successful international agreements in trade, finance, military, often took the form of "club" mechanisms, i.e. "voluntary groups deriving mutual benefits from sharing the costs of producing an activity that has public-good characteristics" (Nordhaus, 2015). A club is successful when it meets the following conditions:

- there exists a public good that can be shared;
- the agreement is beneficial for each member;
- non-members can be excluded or penalized at low cost for members;
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Question: how to apply this "club" strategy to the global climate? $\rightarrow$ **Use trade policy as an incentive for joining!**

Climate clubs – Nordhaus (2015)

Nordhaus' climate club:

- it is an agreement by participating countries to undertake a certain amount of efforts to reduce greenhouse gas emissions (e.g., an implicit carbon price of \$50/tCO_2);
- participating countries are free to choose their preferred mechanism (e.g. carbon taxation, cap-and-trade program, etc.) to satisfy this goal;
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Outcome: Nordhaus performs a simulation exercise from his simplified model, dividing the world in 15 regions. $\rightarrow$ Suggests that a high participation could be induced by a relatively low tariff, as long as the international target carbon price is not too high.

Participation in climate clubs – Simulations for 15 regions

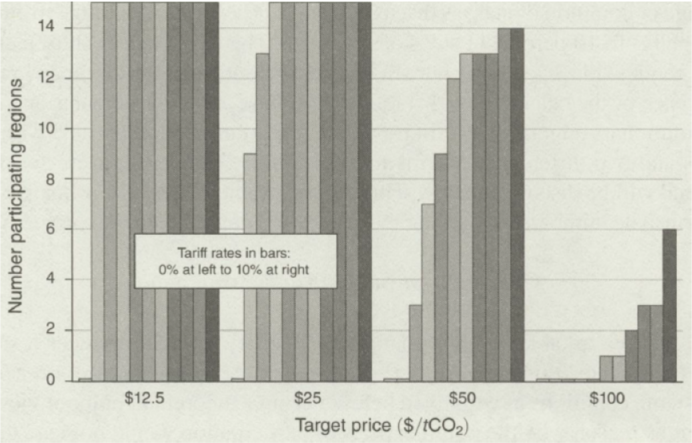

FIGURE 3. NUMBER OF PARTICIPATING REGIONS BY INTERNATIONAL TARGET CARBON PRICE AND TARIFF RATE

Are carbon border adjustment mechanisms feasible?

Question: since there is heterogeneity in the willingness to pay for the climate, differentiated trade tariffs are needed to harmonize the costs from contributing to the global public good, and avoid a race to the bottom. But are these trade penalties actually feasible?

Border adjustment tax (BAT): it is a mechanism to tax goods based on where they are consumed instead of where they are produced. If a country taxes carbon and implements a BAT, it imposes a tax on goods imported from non-carbon-taxing countries, and exempts the tax for exported goods produced domestically.

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Problem with WTO rules: requires equal treatment of similar products and no discrimination between domestic and foreign producers. Imposing different import taxes to similar products based on their origin is therefore prohibited.

Can we do anything about it?

The interpretation of WTO rules is tricky and big debates are coming ahead. The challenge is that to make BAT accepted, the WTO would have to consider that two similar products made of inputs with different levels of carbon footprints are different goods. Is that possible?

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- many people have argued that is it (e.g. Jennifer Hillman, former WTO appellate officer: "*I believe the answer is yes (...) The key is to structure any accompanying border measure as a straightforward extension of the domestic climate policy to imports. If so designed, there should be few questions about the measure's consistency with the WTO rules.*")
- in the past, the WTO has already upheld the principle that environmental concerns outweigh trade interests when the U.S. decided to prohibit the importation of shrimps caught in "turtle unfriendly" nets;
- in 2012, EU attempt to include to the EU-ETS carbon emissions from all flights leaving from or landing within the European Economic Area failed against strong international opposition. The policy had to be restricted to intra-EU flights.

For more on the topic, see also Cosbey et al (2019).

The European BAT

Although many national and regional carbon markets exist around the world, no jurisdiction has yet implemented a carbon BAT. In June 2021, forseeing future increases in the ETS price, such a mechanism was proposed by the European Commission:

- initially, should only apply to a limited number of carbon-intensive products;
- foreign suppliers would pay a fee, and be allowed to claim a rebate for any carbon price paid in the country of production;

What are its prospects?

- On paper, respects the principle of non-discrimination between suppliers;
- however, what about countries that implemented climate policies without pricing instruments? Can they claim a rebate?
- If poor countries would face the same environmental tariff, is it still compatible with the principle of differentiated responsibility for tackling climate change? Does it conflict with the Paris agreement?

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A trade policy to reduce greenhouse gas emissions: the emission trading schemes (ETS)

Pollution, externalities, and missing markets: pollution is a form of externality, i.e. a situation in which individuals produce by their actions external effects that affect the well-being of other individuals, without any counterpart. If there was a market for pollution, where polluters would have to pay for the social cost of their action, then the externality would be internalized: no more discrepancy between private and social costs.

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Emission trading systems: they are cap-and-trade mechanisms for pollution rights. Pollution rights are initially given to certain agents. Polluting agents (usually firms) may use these permits to pollute. Then:

- if their pollution exceeds their pollution rights, they need to buy new permits;
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→ when taking their decision to pollute, they make an arbitrage between the marginal benefit and cost of their pollution, including the cost (benefit) of buying (selling) an additional permit. Compared to an "autarky" situation where firms could not trade, emission trading equalizes marginal abatement costs and increases efficiency. **Note:** who is initially given the permit has no effect on the scheme's efficiency, but it does affect its distributive effects!

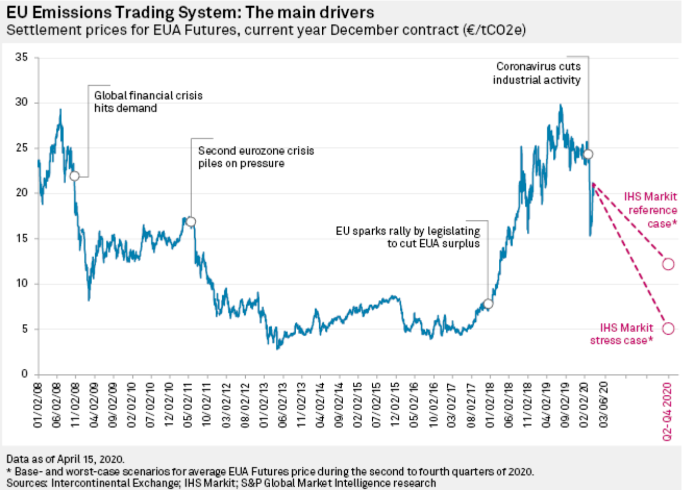
The EU-ETS: how it works

Emission trading schemes have been implemented with success in several places (e.g. China, Canada, New Zealand, Japan, certain U.S. States, etc.).

As of today, the European one ("EU-ETS") launched in 2005 is the largest:

- the EU-ETS applies to about 11,000 installations (power plants and industrial plants) and airline companies, covering around 40% of the EU's greenhouse gas emissions;
- it sets a cap on the total amount of CO_2, N_2O, and PFCs (perfluocarbons) that can be emitted by these installations;
- this cap declines over time (by 1.74% per year between 2013 and 2020, 2.2% from 2021) in order to achieve Europe's emissions targets;
- companies either receive or buy emission allowances within this cap, and can also buy international credits from elswhere in the world;
- at the end of each year, companies must surrender allowances that cover their emissions. Their excess can be kept for the next year or sold to other companies.

Historical EU-ETS prices



→ for a long period, permit prices were too low to generate significant incentives to reduce emissions. Too many permits were allocated relative to firms' capacity to reduce their emissions (especially in a post 2008-crisis context).

EU-ETS: prospects for the future

In 2021, the ETS has entered in its fourth phase, with a more rapid decrease of the emission cap. To address the problem of low but highly volatile prices, the European Comission had aldready taken additional measures:

- the auctioning of additional permits has been postponed (although not cancelled);
- a Market Stability Reserve (MSR) has been implemented to adjust the number permits in circulation, just like a central bank targets inflation through money supply.

Future plans regarding the extension of the EU-ETS (stringency, number of sectors covered) will be part of the European Green Deal.

The recent trend of the ETS price

Source: https://tradingeconomics.com/commodity/carbon

Carbon market linking

Another potential prospect for the evolution of the ETS is its merger with other carbon markets.

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Another potential prospect for the evolution of the ETS is its merger with other carbon markets.

On the one hand, this could:

- build up climate cooperation across countries;
- limit competitiveness issues between them;
- harmonize mitigation efforts;
- increase the market's liquidity;
- pool the risks associated with demand uncertainty (see Doda et al, 2019);
- etc.

On the other hand, it could:

- reduce countries' control over their environmental objective;
- dampen more ambitious initiatives;
- result in an unequal distribution of gains;
- etc.

$\rightarrow$ Typical trade considerations!

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Mitigation and adaptation

In environmental policies, we typically distinguish two types of responses to environmental issues, and more specifically to climate change:

- **mitigation** addresses the cause of the problem. Mitigation policies include all the attempts to tackle the source of climate change by reducing greenhouse gas emissions;
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Question: so far we have focused our attention on the potential for mitigation through the direct (positive or negative) effect of trade on emissions, as well as the potential role of trade policies. **But can trade also play a role on adaptation?**

Climate change and agricultural output: a heterogeneous impact

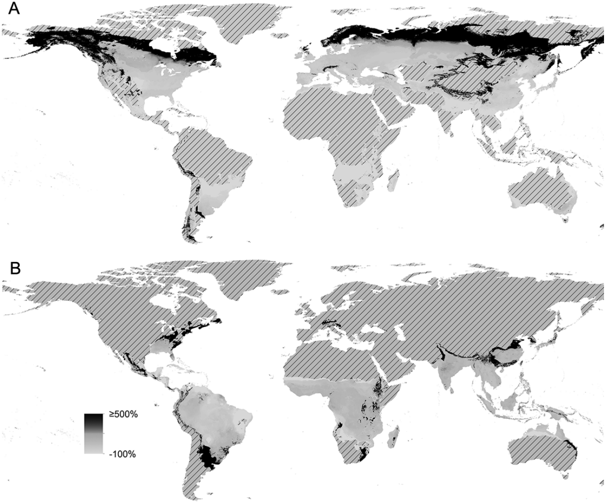

Figure: Predicted yield changes in wheat (A) and rice (B) due to climate change from Costinot et al (2016). Diagonal stripes indicate regions for which predicted yields are zero both before and after climate change.

Climate change and comparative advantage – Costinot et al (2016)

A simple illustrative example:

- consider an agrarian economy made of two islands: North and South;
- each island is divided in two fields: East and West. These fields can be used to produce two crops with the same level of yields: wheat and rice;
- consumers have the same preferences in both islands: they spend half of their income in rice, half in wheat;

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- thus, there exists a competitive equilibrium where in both islands (say) western fields produce wheat and eastern fields produce rice.
- because of climate change, productivity is negatively affected in both islands, but in a heterogeneous way:
  - In South, rice yields are unchanged, but wheat yields decrease by 50% in the eastern field and by 100% in the western field;
  - In North, wheat yields are unchanged, but rice yields decrease by 50% in the western field and by 100% in the eastern field.
- What happens?

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- What happens?
  - if countries cannot trade nor substitute crops across fields: South cannot consume wheat anymore, North cannot consume rice. They cannot substitute between crops and their consumption are halved;
  - if countries can trade and substitute crops across fields: North specialize in wheat and South in rice, and (assuming no transportation costs) consumption is not affected by climate change. Climate change is still happening, but these islands have adapted.

Climate change and comparative advantage – Costinot et al (2016)

Starting point: from the previous illustrative example, in theory, trade can be a key mechanism to alleviate the negative impacts of climate change. But beyond this simplistic model, can we measure these potential benefits from trade?

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Method:

- they use a rich micro-level data set on agricultural productivity called GAEZ;
- this dataset predicts for each type of crop the yield that would be obtainable in 1.7 million fields over the world;
- to observe the evolution of comparative advantage due to climate change, these simulations are performed under two alternative scenarios:
  - contemporary crop growing conditions;
  - crop growing conditions under climate change according to IPCC's predictions;
- in addition, they build a trade model that is calibrated to reproduce the pattern of specialization across fields in the world; they also estimate a set of parameters (e.g. the elasticity of substitution between different crops) from trade, output, and price data.

Climate change and comparative advantage – Costinot et al (2016)

Results:

- in a scenario where countries can trade (although at some cost that is empirically estimated) and farmers substitute their crops, the negative impact of climate change on crop yields amounts to about one-sixth of total crop value, that is 0.26% of global GDP;
- this effect is highly heterogeneous ranging from small positive impacts (e.g. Canada, Russia) to dramatically negative consequences (e.g. Malawi, with welfare losses of about 50% of GDP);
- in a counterfactual scenario where countries can still trade, but farmers cannot substitute their crops, the global output loss would be three times as large, at 0.78% of global GDP;
- in another counterfactual scenario where countries cannot trade anymore, but farmers can substitute their crops, the global output loss would be similar to the free trade case, at 0.27% of global GDP.

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Conclusion: local adjustments in production seem by far more important than international trade for climate change adaptation.

Caveat: other mechanisms that are ignored here deserve attention. For instance, Conte (2020) studies the effect of climate change on migration in Africa and shows that among the locations severely hit by climate–change, those better connected to markets exhibit lower rates of population outflows.

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Environmental disasters and comparative advantage – Barrows et al (ongoing)

Environmental problems are not always the slowly evolving changes seen above. Environmental disasters such as extreme weather events may impose sudden and large impacts on local economies:

- these events may temporarily change the patterns of comparative advantage between different regions depending on the specific sectors affected;
- thus, trade could **in theory** be a powerful **risk-sharing mechanism**: if the production of some products go down in the affected region, trading with the non-affected regions could be a way to alleviate the negative impact of the shock.

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Despite the importance of this issue, **there is to date few empirical studies** on the matter. One exception is the on-going research by Barrows et al (ongoing):

- they study the impact of typhoons in the Philippines;
- they find that typhoons lead to higher agricultural prices in the provinces affected, and to some extent in the neighboring provinces;
- their (preliminary) results confirm that the welfare impacts of disasters are partly mediated by trading networks.

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Conclusion

The impact of trade on the environment is not as obvious as it may seem:

- on the one hand:
  - trade between countries favors output growth, which increases the environmental impact of production through a scale effect;
  - it may dampen the effectiveness of unilateral environmental policies through emission leakages;
  - it increases the relative importance of some highly polluting sectors such as transports.
- on the other hand:
  - it favors the diffusion of cleaner technologies;
  - it may relocate production towards the most efficient firms (both within and across countries) that are on average less pollution-intensive;
  - by improving standards of living in developing countries, it may increase the demand for environmental regulation.
- in addition:
  - given the importance of trade agreements for most countries, trade policies may offer the opportunity to induce cooperation to face global threats such as climate change;
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→ **Our future will largely depend on our ability to cooperate**. Trade policies offer an *opportunity* to do so, by setting the right incentives to align consumers and producers behaviors to our common goals.