Competitiveness Impacts of a Carbon Tax in the Steel Sector

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Issue

- What are the consequences for steel production and CO_2 emissions of carbon taxes (or tradable emission permits) at a rate of 25 USD per tonne CO_2 being introduced for this sector and for electricity generation (but not elsewhere)?
- The following policy experiments were made:
  - An OECD-wide carbon tax;
  - Unilateral carbon taxes by individual OECD countries (or groups of OECD countries);
  - Exemptions for process-related emissions;
  - Revenue recycling (4 different policies);
  - Border tax adjustments (6 different policies).

The Study

- Used a medium-term partial equilibrium model of the global steel industry
- Strengths:
  - Integrates the steel market with major input markets (ore, coal, scrap, electricity, transport);
  - Focus on alternative technologies for steel production;
  - Focus on substitution between polluting inputs and cleaner ones;
  - Consistency.
- Weaknesses (overestimates the costs of the tax):
  - Does not deal with inter-material competition;
  - Does not include all abatement possibilities;
  - Does not include endogenous technological development.

The Steel Industry

Technology	Market share	Major inputs	Average CO_2 emission per tonne steel
BOF (Basic oxygen furnace)	58	Ore, coal, scrap (10-30%)	2.5
Standard EAF (Electric arc furnace)	27 (34?)	Electricity, scrap (>90%)	0.6
EAF based on DRI (Directly reduced iron)	7	Ore, gas, electricity, scrap (20-50%)	1.2

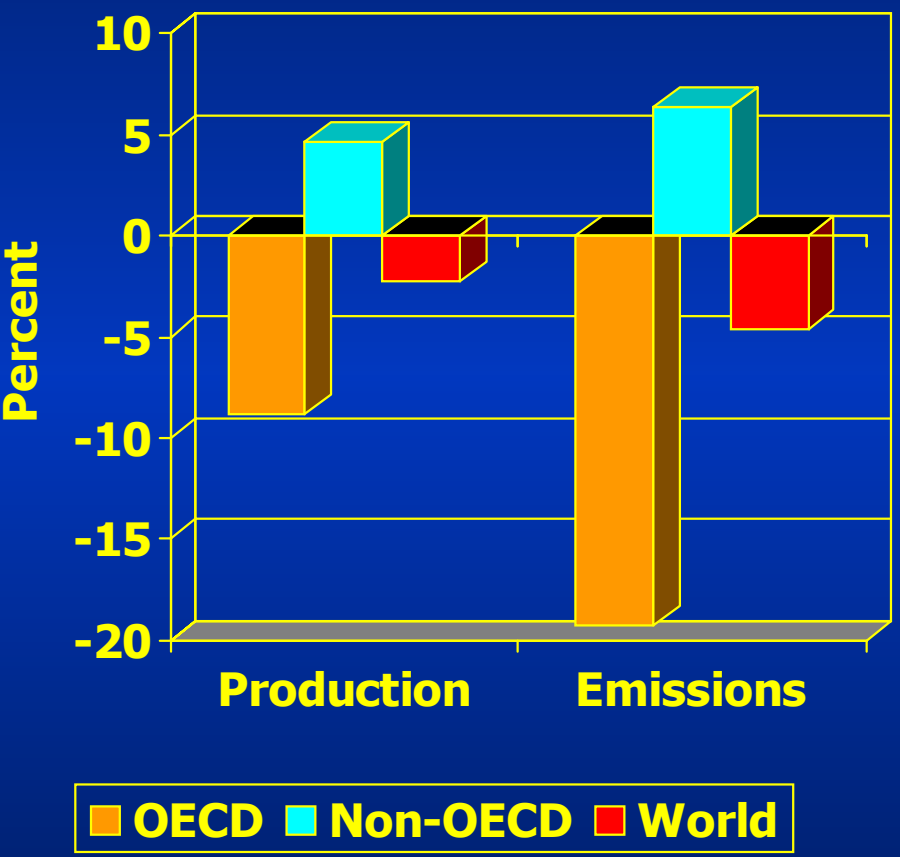
The SIM model

Was developed for the Norwegian Ship-owners Association – who should not have an à proiri bias regarding the results.

It uses:

- a -0.3 demand elasticity for steel in all regions;
- a 0.5 substitution elasticity between BOF and EAF;
- an Armington elasticity of 8;
- in most cases Leontief production functions;
- but includes a possibility to switch between scrap and pig iron in BOF, with a substitution elasticity of 1.5 or 0.5 depending on region;
- supply elasticities of 0.7 and 1.2 for BOF and EAF respectively;
- a supply elasticity of 0.5 for scrap, 2 for coal, 1 for iron ore and 0.27 for bulk shipping.

Impacts of an OECD-wide tax
(or a tradable permit system)



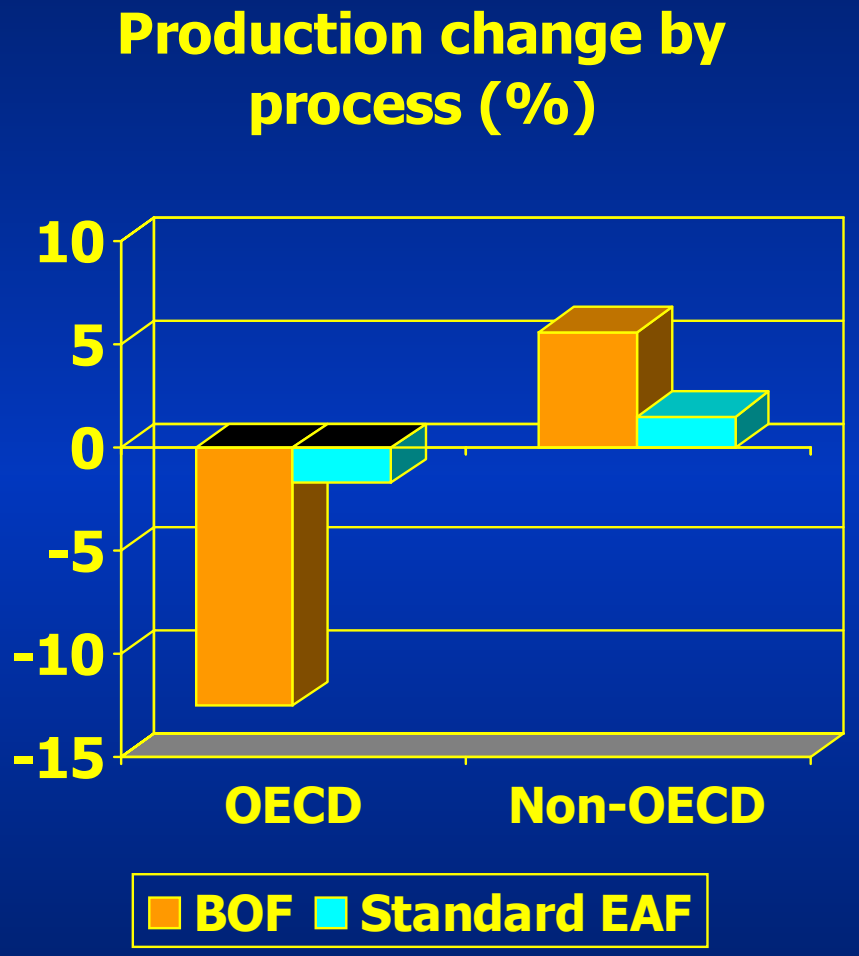
Production:

- OECD steel production declines.
- Partly offset by increased production outside OECD.

Emissions:

- Stronger impact on emissions than on production (cleaner in OECD, dirtier outside OECD).
- World emission reduction is significant (twice the decline in the global production level).

Behind the figures: Substitution

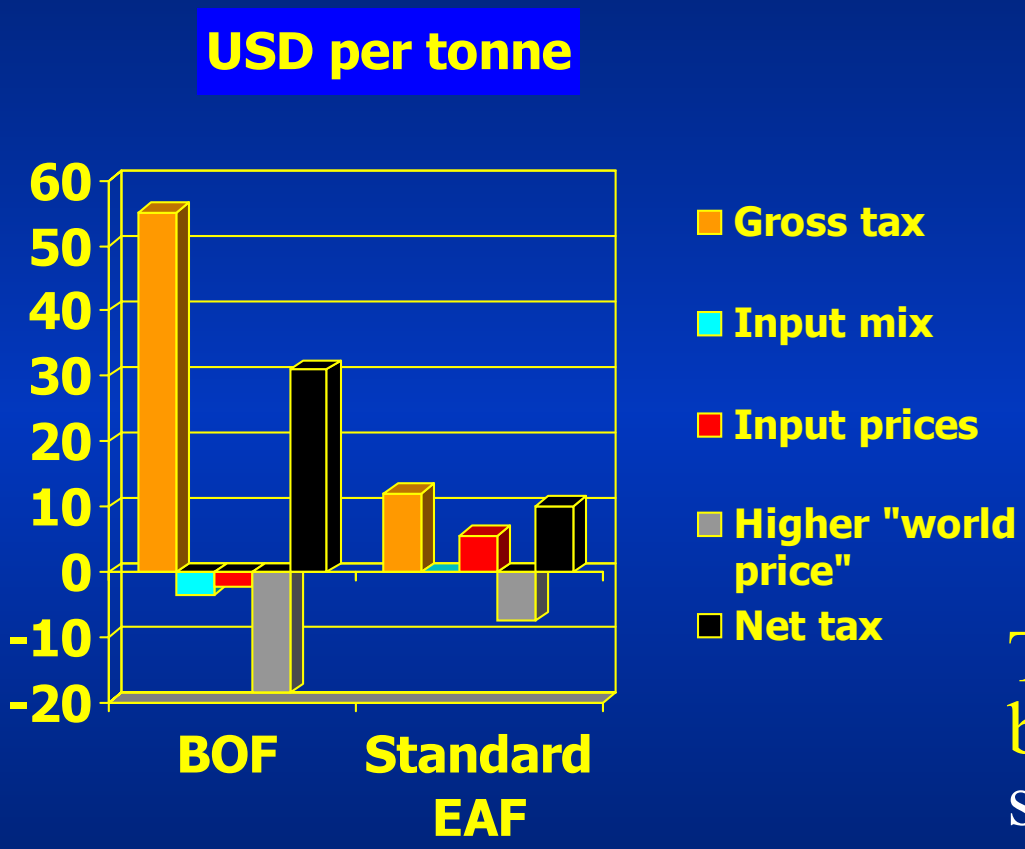


Substitution away from emission intensive inputs and processes in OECD

- From ore/coal to scrap in BOF steelmaking
- From BOF to EAF steelmaking

Higher scrap prices dampen the degree of restructuring.

Behind the figures: Tax incidence

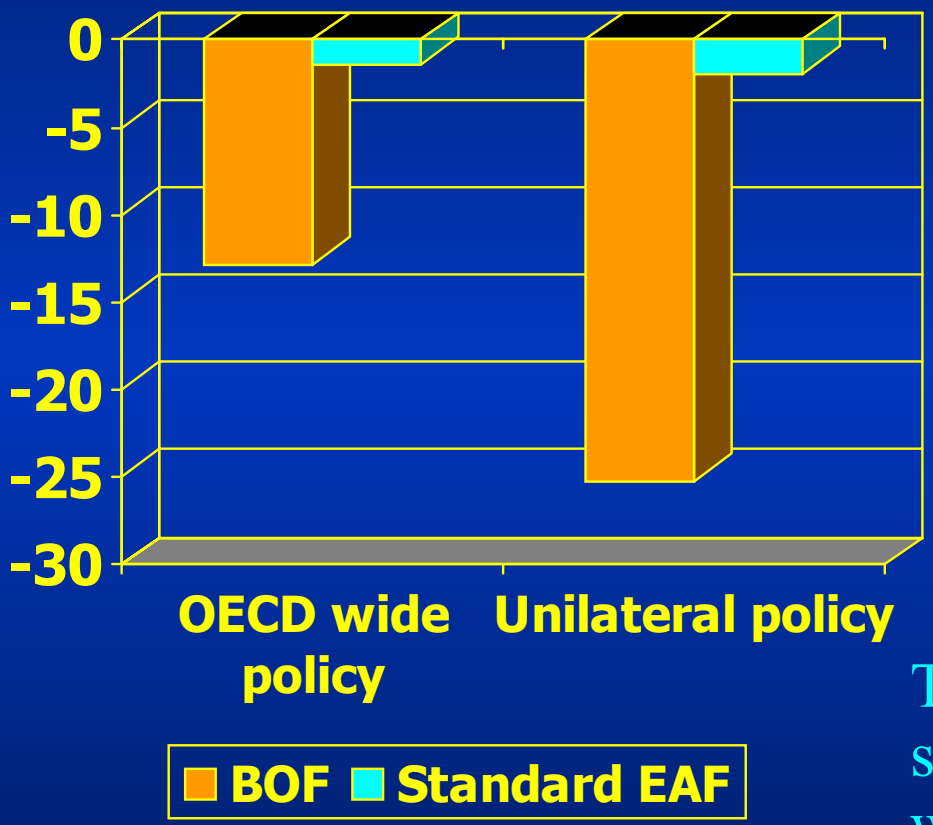


- Less input substitution in EAF steel.
- Higher input prices for EAF steel.
- A part of the net tax is borne by steel users though higher prices.
- EAF steel production is more price elastic.

The difference in the net tax between BOF and EAF is surprisingly small.

Unilateral policy: Japan

Production change Japan (%)



Dramatic reduction in BOF steel production

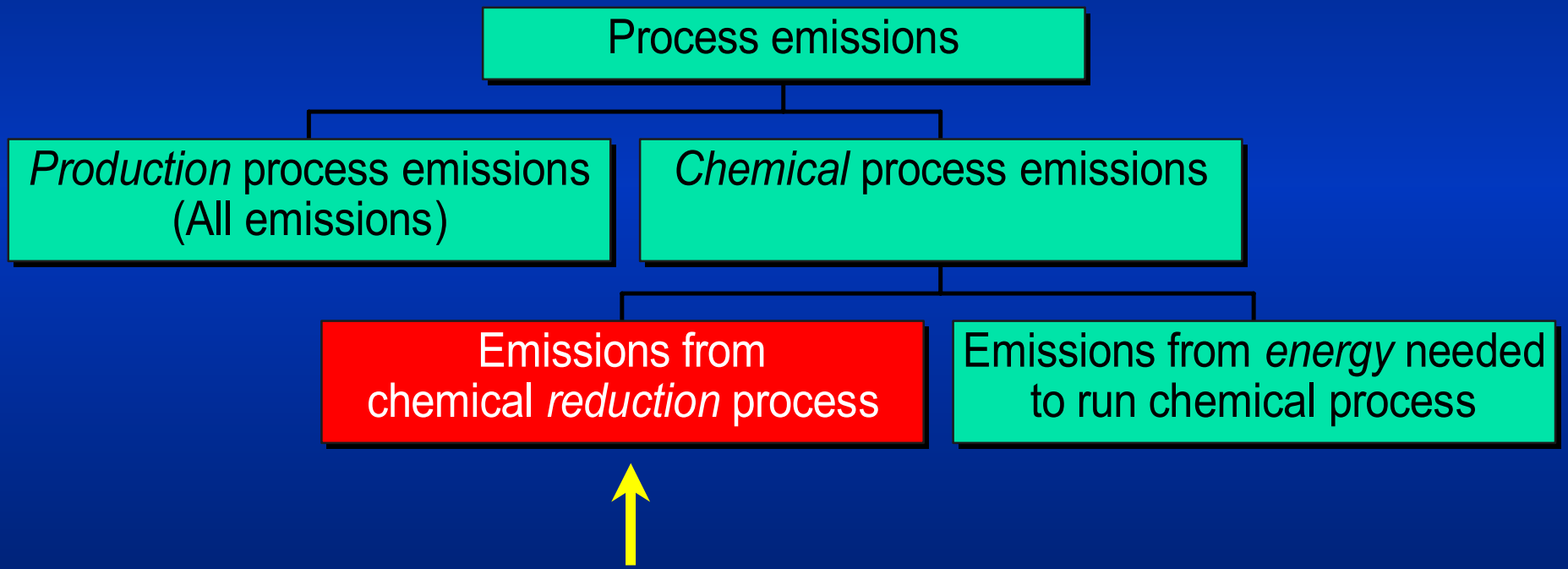
No big difference for EAF producers

- Smaller effect on input prices is harmful for BOF producers but beneficial for EAF producers

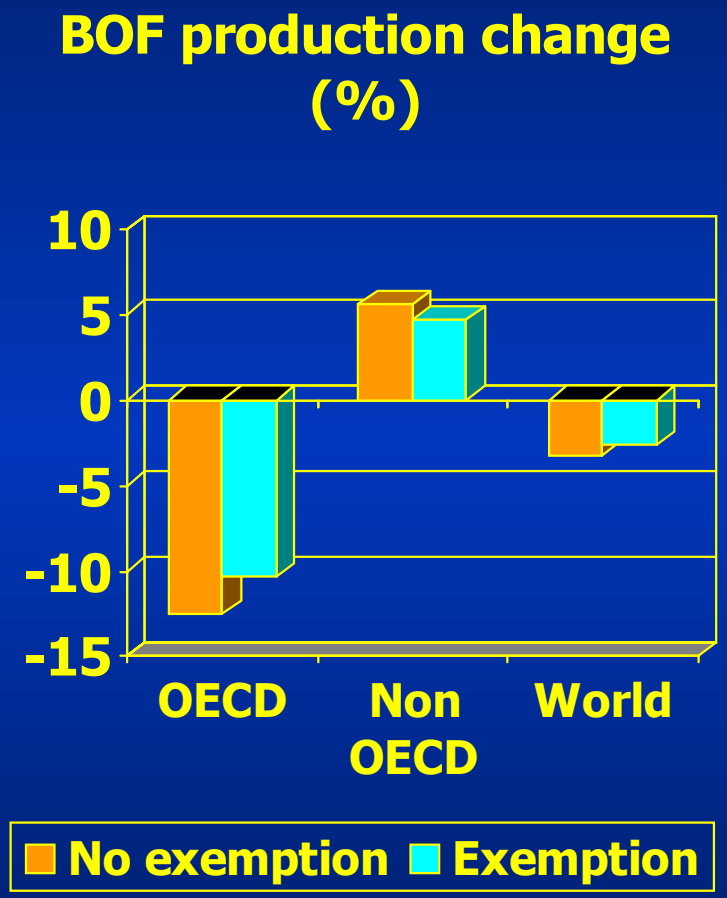
The estimated impacts for EU13 are smaller: BOF -16.5% vs. -6.5% with an OECD-wide tax.

Exemption for process emissions

Our definition of process emissions:



Exemption for process emissions



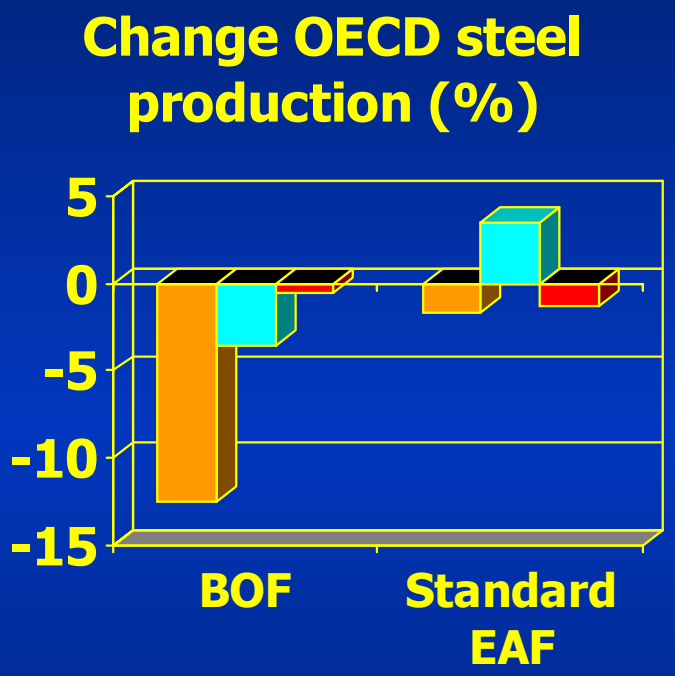
- The exemption represents about 15% of gross tax.
- BOF producers: The exemption has a small, positive impact on OECD production.
- Standard EAF producers: Are slightly negatively affected due to higher scrap price.
- The effect would be much greater by exempting also the energy emissions related to process.

Revenue recycling (or distribution of free emission permits)

How could the revenue recycling be done in practise?

- Defining the aggregate transfer
  - 100% refund, or less? (All permits for free, or only a few?)
- Allocation rule across groups of firms
  - Uniform allocation across steel producers?
  - Differentiated allocation across steel technologies?
- Defining the share to be received by individual firms
  - Grandfathering (based on historic emissions)?
  - Based on current output (or use of inputs)?

Revenue recycling (or distribution of free emission permits)



100% refund, based on actual output
- Uniform across steel producers
- Differentiated between steel technologies

- BOF production:

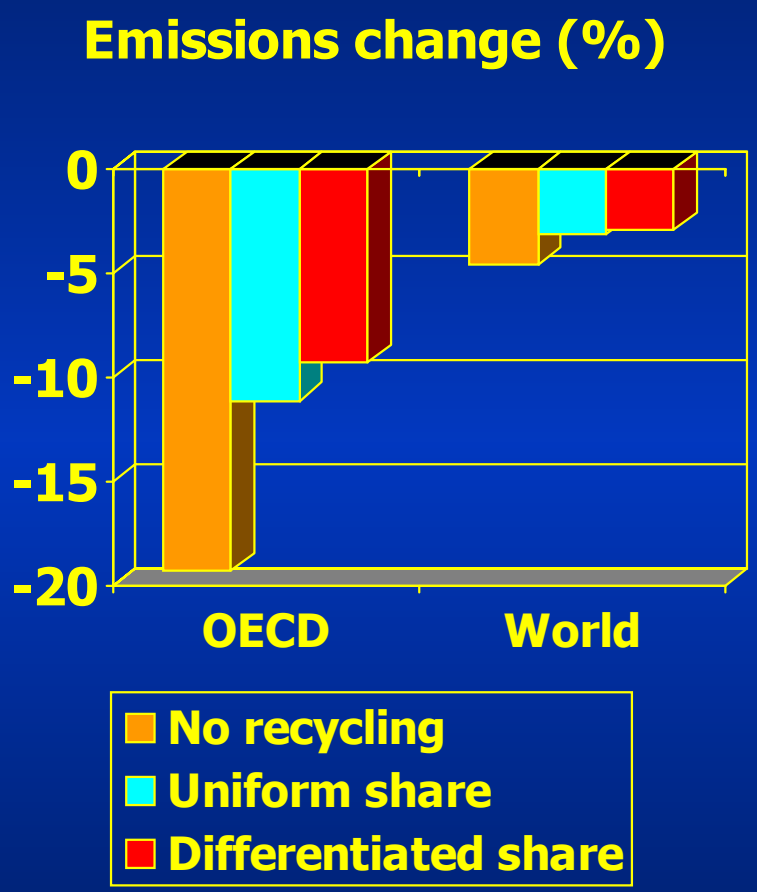
  Recycling has a big, positive impact in both cases.

- EAF production:

  No impact when the refund is differentiated between technologies (the output subsidy is outweighed by higher scrap prices).

  With uniform allocation, there is a strong restructuring towards cleaner technologies.

Revenue recycling: Emission effects

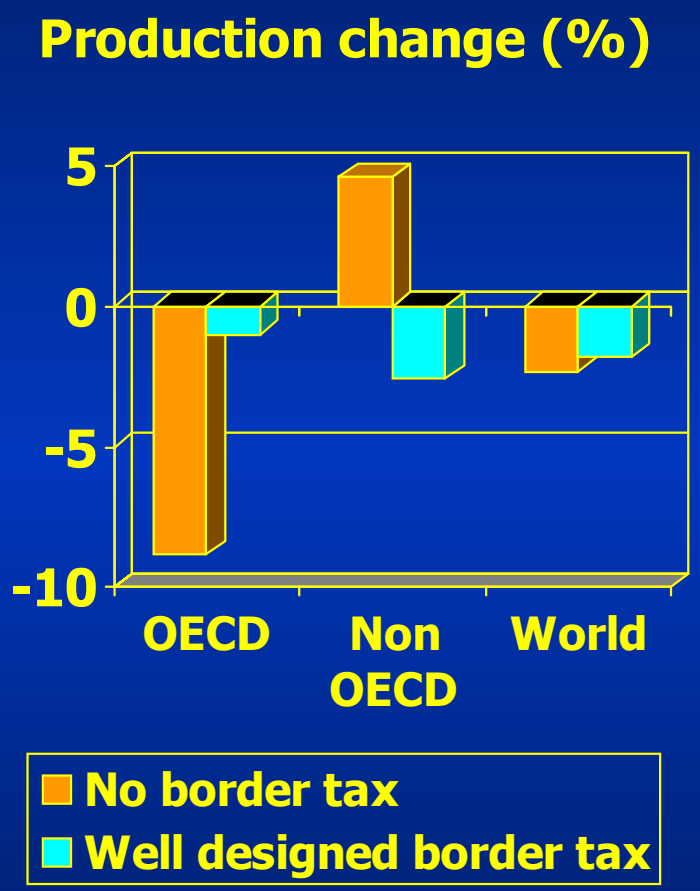


- Revenue recycling reduces abatement significantly.
- Uniform allocation of recycled amounts is better for the environment than differentiated schemes.

Border tax adjustment

- Taxes/subsidies on trade flows between OECD and Non-OECD countries
- Instruments: Import tax, export subsidy, or both?
- Calibration of the tax/subsidy rates
  - Based on emission levels in OECD or Non-OECD?
  - Differentiated across countries and technologies?
- Answers from economic theory:
  - Both import tax and export subsidy
  - Based on emissions in Non-OECD
  - Differentiated across countries and technologies

Border tax adjustment: Production effects



Policy:

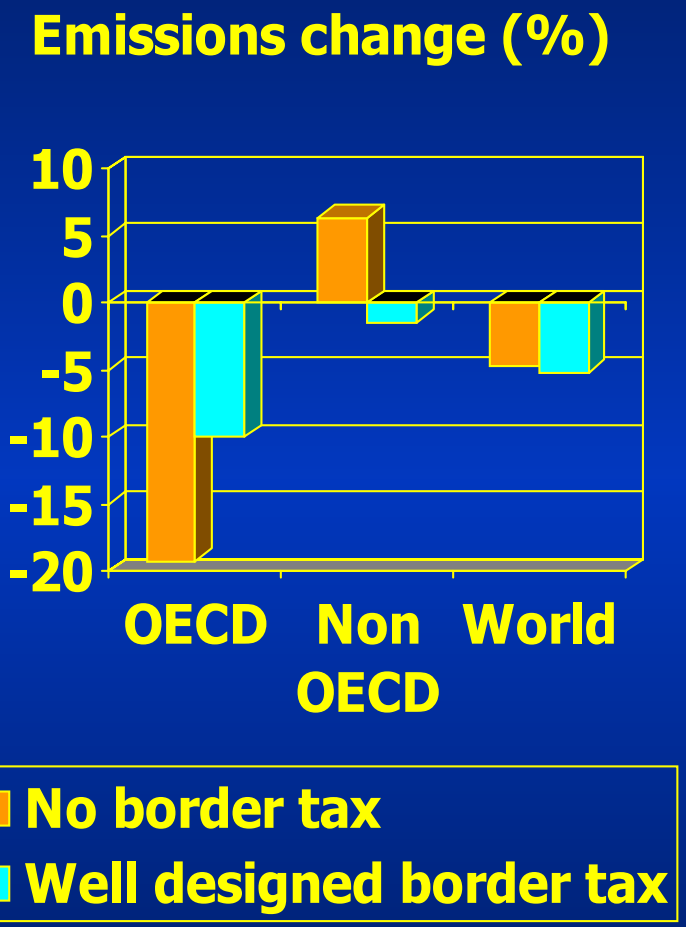
Import taxes plus export subsidies based on Non-OECD emission levels:

Results:

- Much smaller reduction in OECD production level
- Non-OECD production also declines!
- Small impact on global steel production

If taxes and subsidies were based on OECD emission levels, the impacts of BTA would be somewhat smaller.

Border tax adjustment: Emission effects



- Global emissions decline more than without border taxes! (despite a higher OECD production)
  - Significant abatement in OECD (substitution towards cleaner inputs and technologies).
  - Leakage is eliminated.
- Border taxes are better for the environment than revenue recycling (i.e. output subsidies)!

Long run impacts (outside the scope of the model)

- Net effect on OECD steel production is ambiguous
  - Technological development may reduce the cost burden of environmental regulations
  - Higher capacity in Non-OECD countries put downward pressure on steel prices
- Stronger restructuring towards EAF steel and other clean technologies in the OECD

Conclusions

- Interactions with input markets are important .
- OECD-wide taxes or quotas will reduce BOF steel production significantly in many OECD countries. Much smaller impact on EAF steel producers.
- Unilateral policies *may* be dramatic for BOF steel producers, but not for EAF steel producers.
- Revenue recycling (or allocation of free emission permits per unit of output) may reduce the fall in output. But abatement is also reduced.
- Uniform allocation of revenues across technologies implies stronger restructuring towards EAF steel.
- Border taxes may reduce the fall in output significantly while maintaining the same level of abatement.

More information

The full steel case study, and a lot of other material on environmentally related taxes, can be found at

www.oecd.org/env/taxes.

Data on the use of such taxes can be found at www.oecd.org/env/tax-database.