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The Global Effects of Subglobal Climate Policies

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The Global Effects of Subglobal Climate Policies

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Based on paper with
Knut Einar Rosendahl (Statistics Norway)
and
Carolyn Fischer (Resources for the future)
Introduction

• Individual OECD countries (EU, US) are implementing policies to reduce greenhouse gas emissions
  – EU ETS (since 2005)
  – US cap-and-trade?

• Emerging economies lack comparable regulation – raises concerns about
  – Competitiveness of energy intensive industries
  – Carbon leakage

• As a response, controversial trade-related measures and allowance allocation designs are being proposed
Measures in Current Proposals – EU

EU ETS Phase III – from 2013-2020:

• (Almost) no allocation of allowances to power industry

• Substantial allocation of allowances to other industries
  – Sectors with significant risk of carbon leakage: 100% of "benchmark"
    ◆ Cost increase above 30%, OR Trade intensity above 30%, OR
    Cost increase AND trade intensity both above 5%
    ◆ Includes extraction of fossil fuels
  – Other sectors: 80% (2012) → 30% (2020)

• Allocation is proportional to historic production
  – Revised if capacity is changed (including new entrants)

• Similarities with Output-based rebates

• Border carbon adjustment policies not on the table before 2020
Measures in Current Proposals – US

• American Clean Energy and Security Act of 2009 (ACESA) has provisions for “Ensuring Real Reductions in Industrial Emissions”
  – Passed by the House, not yet by the Senate

• Output-based rebates (OBR) of allowances for energy-intensive, trade exposed sectors (EITE)
  – EITE: 5% energy (or CO2) intensive and 15% trade intensive, or 20% energy intensive (more restrictive than EU ETS)
    ♦ 100% of “benchmark”
  – Offsets domestic production cost increases (on average) from emissions liabilities

• Border carbon adjustment (BCA) for imports
  – Removes cost advantage for unregulated foreign competitors
  – Transition from OBR to BCA from 2020
  – Could also consider BCA for exports
Why are such measures necessary?

• EITE sectors are small share of economy (US: <6% of GDP and 10-20% of total emissions) but vocal, organized and unionized
  – US: Senators from key states

• Hard to ask sectors to take on costs when significant shares of their reductions may be offset by increases abroad

• Welfare costs per *global* emission reduction may be reduced

• Alternatives (exemptions, weak climate legislation) worse
Why are trade-related measures controversial?

• Fears of disguised protectionism

• WTO obligations
  – Nondiscrimination
  – Can regulate products, not processes
  – Some exceptions for environmental purposes
  – Least-trade restrictive alternative
  – Restrictions on subsidies

• Negotiations in WTO and UNFCCC already difficult
What’s missing from the debate?

• Focus has been on targeted EITE sectors

• Need broader understanding about how climate policies implemented unilaterally (or sub-globally) affect all countries in the global trading system.

• Largest impacts are from the targeted carbon pricing itself, which generates
  – macroeconomic effects,
  – terms-of-trade changes, and
  – shifts in global energy demand and prices
  – changing the relative prices of energy-intensive and non-energy-intensive goods.
This Paper (Böhringer, Fischer, Rosendahl)

- Effects of climate policies implemented in the EU and/or US on global distribution of economic outcomes and carbon leakage
- How these outcomes may be altered by a variety of complementary policies aimed at addressing carbon leakage.
Numerical Model

• Global multi-sector, multi-region computable general equilibrium (CGE) model based on GTAP7 database
  – Detailed accounts of regional production, regional consumption, bilateral trade flows, energy flows and CO2 emissions
  – Static model with 2004 base year

• Assumptions:
  – No change in policies in other countries
  – No cap on emissions in Annex B
Energy and EITE Sectors

• Energy Goods
  – Coal (COL), Crude oil (CRU), Natural gas (GAS), Refined oil products (OIL), and Electricity (ELE).

• EITE Goods
  – Chemicals (CRP);
  – Non-metallic minerals, including cement and glass (NMM);
  – Pulp, paper, and print (PPP);
  – Iron and steel (I_S);
  – Nonferrous metals, including copper and aluminium (NFM).

• Other Goods/services
  – Transport
  – Rest-sector
Some model features

• Bilateral trade:
  – Armington approach of product heterogeneity
    ♦ Exception: Crude oil (homogeneity)
    ♦ Armington elasticities taken from GTAP7

• Fossil fuel supply:
  – Supply elasticities equal to one

• Resources:
  – Fixed endowment of labour and capital
  – Fixed investment and government expenditures

• Welfare:
  – Hicksian equivalent variation (HEV) in income
Policy Scenarios

- US and/or EU reduce emissions by 20%
  - No international trading
- Different treatment of EITE sectors

<table>
<thead>
<tr>
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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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<tbody>
<tr>
<td>1</td>
<td>U.S. AUCTION</td>
<td>U.S. OUTPUT</td>
<td>U.S. REBATE</td>
<td>U.S. TARIFF</td>
<td>U.S. BTAX</td>
</tr>
<tr>
<td>2</td>
<td>EU AUCTION</td>
<td>EU OUTPUT</td>
<td>EU REBATE</td>
<td>EU TARIFF</td>
<td>EU BTAX</td>
</tr>
</tbody>
</table>
Results of Auctioned Allowances

• Welfare costs substantially higher in the EU than in U.S.
  – U.S. has cheaper abatement options:
    Carbon prices are $60/ton C for the U.S., and $125/ton C for the EU.
      $ (16 and $34/ton CO2)
      $ (63 and $129 when jointly implemented)
  – Different trade intensities and terms-of-trade effects.
    $ Natural gas prices are stimulated by the climate policies, whereas coal and crude oil prices are depressed.
    $ EU is net importer of all three fossil fuels, whereas U.S. was a net exporter of coal in 2004.

• Welfare effects of unilateral policies can be quite different for different trade partners
  – Larger for some countries than for the US/EU
Welfare effects of auctioned allowances in U.S. (Scenario 1A), the EU (2A) or both (3A)
Effects of additional policies

• Not valuing the additional benefits of avoided leakage
  – Alternative assumption: Keep global emissions fixed

• Effects of other policies small but positive
  – beneficial terms of trade effects from protecting EITE sectors in these two large economies
  – Larger for EU, in which EITE larger share of emissions

• U.S. carbon price is not sensitive to the adjustment policies, while the EU carbon price rises 2% in the OUTPUT scenario and 4% with BTAX.
Welfare costs in the U.S. and the EU by policy scenario

- **U.S. (Scen. 1)**
- **EU (Scen. 2)**
- **U.S. (Scen. 3)**
- **EU (Scen. 3)**
Welfare effects for other regions

• Moderate differences for most regions and negligible for the world as a whole.

• Losses for crude oil and coal exporting regions are generally highest when the U.S. and the EU also impose import tariffs
  – Demand for fossil fuels outside these two regions are lower than in the other scenarios,

• Import tariffs also negatively affect exporters of energy-intensive goods, notably China, India and Canada.
  – Adjustments based on exporters’ emissions intensities
Welfare effects in different regions of joint caps in US and EU
Effects on Leakage

• Carbon leakage highest with unilateral EU cap
  – Up to 38%, compared to 19% for U.S.
  – EU is a more open economy than the U.S.
  – EU is a much bigger importer of fossil fuels
  – EU EITE industries less carbon-intensive

• When both regions reduce emissions, the leakage rates are closer to the U.S. policy scenarios.
  – U.S. has higher emissions than the EU
  – Joint caps eliminate EU-US leakage

• Policies limited in reducing leakage
  – Address production shifting, but not energy markets
  – Full border adjustment most effective
Global Leakage Effects

- AUCTION
- OUTPUT
- REBATE
- TARIFF
- BTAX

Scenario 1 (U.S. pol.)
Scenario 2 (EU pol.)
Scenario 3 (U.S. & EU pol.)
Distribution of Leakage

• 40% of leakage to Annex B countries
  – Large share to Russia
  – More for US unilateral policy

• Effects of adjustment policies
  – Hardly reduce leakage to other OECD countries, and also to Latin American and African countries.
  – The largest impacts on leakage are in Asian countries, former Soviet Union, and OPEC.
Leakage Rates by Region (US&EU reduction)

Annex B

Non-Annex B
Effects on EITE competitiveness (production)

• Both output-based allocation and border adjustment policies dampen the production decrease.
  – Largest impacts in the EU
  – Full border adjustment usually most effective
  – Output-based allocation has about the same effect as import tariffs alone.
  – Small effects on electricity-intensive sectors
    ✷ Not adjusting for indirect emissions
    ✷ If the import tariffs also take into account indirect emissions (i.e., from electricity production) embodied in the products, production of non-ferrous metals in the EU will actually increase
Effects on U.S. production of different U.S. climate policies

-4.0%  -3.5%  -3.0%  -2.5%  -2.0%  -1.5%  -1.0%  -0.5%  0.0%  0.5%
Effects on EU production of different EU climate policies
Competitiveness in Non-implementing Regions

• Production in EITE sectors increases across the board
• “Rest-sectors” experience production decreases in all countries except OPEC.
  – “Rest-sectors”: Excluding Energy, EITE and Transport sectors
• Adjustment policies in part shift production in the other regions back toward “Rest-sectors” from EITE.
• Aggregate production remains higher across the board with adjustment policies than with no climate policy action
  – Similar effects on EITE exports
• Welfare is determined by consumption rather than production, so while other regions reap competitiveness benefits, most remain worse off.
Percentage Change in Total Production, by Region (US&EU reduction)
Effects on Canadian EITE exports of different U.S. and EU climate policies
Effects on Chinese EITE exports of different U.S. and EU climate policies

**Graph Description:**
- **Y-axis:** Range from -12 to 6
- **X-axis:** Categories of industries: PaperPulpPrint, Chemical, Minerals, IronSteel, NonFerrousMetal
- **Legend:**
  - AUCTION
  - OUTPUT
  - REBATE
  - TARIFF
  - BTAX

**High carbon intensity**
Effects on Indian EITE exports of different U.S. and EU climate policies

Electricity use
Effects on Brazilian EITE exports of different U.S. and EU climate policies

- AUCTION
- OUTPUT
- REBATE
- TARIFF
- BTAX

Low carbon intensity

Oil and el. use
Summary: Welfare

- Welfare effects of subglobal climate policies are significant not only for the countries undertaking them but also for their trade partners
  - Mostly negative, but some winners
- Policies intended to avoid leakage have little effect on welfare overall – even in the countries implementing them
  - Mainly shift global production in certain energy intensive goods.
- However, import adjustments can have significant effects for fossil fuel producing nations.
Summary: Leakage

- Significant share occurs via changes in global energy prices.
- None of the countervailing policies are able to reduce leakage rates very much – at most by 15%, in the case of full border adjustments.
- 30-50% of leakage from U.S. and EU climate policies can be attributed to other Annex B nations.
- Adjustment policies do have significant effects on the energy intensive sectors to which they are applied.
- Still, for the most part, domestic production is lower and foreign exports are higher than without any climate policy intervention.
  - Exception for cement and glass for some exporters.
Sensitivity Analysis

- Specific plans:
  - Leakage compensation (fixed global emission reduction)
    - EU welfare effects more differentiated
  - Energy supply elasticities
  - Trade elasticities
  - EITE coverage (e.g., refineries)
  - Targets
  - ??
Some conclusions

• Main effects on global welfare, emissions, and leakage arise from the primary climate policies themselves.

• Developing nations do not actually gain economically from developed country efforts to reduce GHGs.

• Nor do their sectors targeted specifically by anti-leakage policies necessarily lose, compared to a world without any climate policies.

• Ultimately, it is in all countries’ interest to mitigate climate change as comprehensively and cost-effectively as possible.
  – The larger question is whether or not unilateral anti-leakage policies can help in that transition.
EC Implementation (1)

• Economic implications of unilateral Canadian climate policies without US action
  – Ex-post justification for Kyoto compliance problems?
  – Specific protection policies for EITE (border measures and trade allowance allocation)

• Domestic/international emission reduction policies:
  – EU only (scenario: EUR)
  – EU and Canada (scenario: EUR_CAN)
  – EU and Canada and the USA (scenario: EUR_CAN_USA)

• Issues addressed:
  – Importance of US “comparable effort” for economy-wide and sectoral implications of unilateral climate policies in Canada
  – Effectiveness of border measures or output-based allocation measures for welfare, EITE output (“competitiveness”) and leakage
EC Implementation (2)

• Leakage argument:
  – Need for leakage adjustment towards constant global effectiveness
  – Leakage adjustment through proportional scaling of domestic reduction targets

  N.B.: By default there is no leakage adjustment.

• Robustness of policy conclusions:
  – Inclusion of embodied carbon for electricity (default: only direct carbon)
  – Fuel supply elasticities (default: coal=4; oil/gas=1)
  – (Armington) trade elasticities ➔ empirical estimates beyond GTAP
  – Stringency of policy target (default: 20%)
  – Coverage of EITE sectors (e.g. inclusion of refined oil products)

• [Application to 2020 forecast]
Welfare impact for Canada

The diagram shows the welfare impact for Canada under different scenarios, including Auction (AUCTION), Output (OUTPUT), Rebate (REBATE), Tariff (TARIFF), and BTAX. The y-axis represents the impact ranging from -0.300 to 0.000, while the x-axis categorizes the scenarios as EUR, EUR_CAN, and EUR_CAN_USA.
Global leakage rates

<table>
<thead>
<tr>
<th>EUR</th>
<th>EUR_CAN</th>
<th>EUR_CAN_USA</th>
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</thead>
<tbody>
<tr>
<td>BTA</td>
<td>OUTPUT</td>
<td>REBATE</td>
</tr>
<tr>
<td>0.000</td>
<td>5.000</td>
<td>10.000</td>
</tr>
<tr>
<td>15.000</td>
<td>20.000</td>
<td>25.000</td>
</tr>
<tr>
<td>30.000</td>
<td>35.000</td>
<td>40.000</td>
</tr>
</tbody>
</table>

[Bar chart showing data for EUR, EUR_CAN, EUR_CAN_USA with categories BTA, OUTPUT, REBATE, TARIFF, BTAX]
EUR: Effects on Canadian production

![Bar chart showing effects on various sectors]

- Other Man. & Ser.
- PaperPulpPrint
- Chemical
- Minerals
- IronSteel
- NonFerrousMetal
EUR_CAN: Effects on Canadian production
EUR_CAN_USA: Effects on Canadian production

**Diagram:**
- **Legend:**
  - AUCTION
  - OUTPUT
  - REBATE
  - TARIFF
  - BTAX

- **Axes:**
  - Y-axis: Values from -12 to 2

- **Data Points:**
  - Other Man. & Ser.: Output > Auction, Rebate
  - PaperPulpPrint: Output < Auction, Rebate, TARIFF
  - Chemical: Output > Auction, Rebate, TARIFF
  - Minerals: Output < Auction, Rebate, TARIFF
  - IronSteel: Output > Auction, Rebate, TARIFF
  - NonFerrousMetal: Output < Auction, Rebate, TARIFF