Competitiveness Effects of EU ETS: Border Tax Adjustment vs. Global Emission Trading

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Motivation

- March 2007, **EU Spring Summit**: *Commitment to a European Post-Kyoto plan, envisioning a reduction of greenhouse gas emissions by 20% by 2020 in the European Union*
- July 2007, **G8 Summit**: *Despite rising awareness of climate change problems, international disagreement over a global climate policy persists*

What are the economic effects for EU economies?

How to mitigate distortions of competitiveness?

Border Tax Adjustments (BTA)

...offset detrimental effects of domestic (environmental) taxation on international competitiveness.

- Bhagwati & Srinivasan (1973)
- Meade (1974)
- Grossman (1980)

…establish welfare equivalence under ***origin*** *and* ***destination principle*** *of taxation with BTA.*

BTA & European Emission Trading System (ETS)

- Ismer & Neuhoff (2004)
- Petersen & Schleicher (2007)

Are international sector agreements likely?

Can the EU sell off emission allowances to companies Exporting goods the domestic European market?

Global Emission Trading (GET) levies a duty on **emissions**, not on **quantities** of goods.

BTA vs. GET

… corresponds to taxation of **domestic production** versus taxation of **domestic consumption**, i.e. to

Origin vs. Destination Principle.

Objections:

- Leakage: addressed by both policies
- Political Feasibility: Perhaps a problem, but…

"… Brussels is becoming the world's regulatory capital."

The Economist, Sep. 20, 2007

Theory: Model

- GE model with two countries *r*, i.e. *d* (domestic) and *f* (foreign)
- Representative household in each country disposes of initial wealth
- Armington assumption: domestic good and import are imperfect substitutes, both enter into Cobb-Douglas preferences with elasticity
- Representative firm in *r* chooses quantity q_d^r of standard good for market in *d* and q_f^r for market in *f* and energy intensity of production μ^r
- Costs of production $C(\mu, q) = c(\mu)q$ are CRS w.r.t. quantity and decreasing in energy intensity
- Energy intensity and quantities determine emissions $E^r = \mu^r(q_d^r + q_f^r)$

Abatement Policies

- All abatement policies are conducted only by domestic government
- Unilateral Abatement Policy (UAP): *tax* τ *on emissions from domestic production, such that they remain below cap* $\overline{E}$
- Border Tax Adjustment Policy (BTA): *tax emissions as in UAP, but put a tariff* $\kappa = \tau \mu^d$ *on imports and pay a tax compensation* κ
- Global Emission Trading (GET): *tax emissions of domestic firm for domestic market and imports of foreign firm to meet emission cap*

Results Theory: LF vs UAP

$$(\mu^d)^{LF} > (\mu^d)^{UAP} \qquad (\mu^f)^{LF} = (\mu^f)^{UAP}$$

$$(c^d(\mu^d))^{LF} < (c^d(\mu^d))^{UAP} \qquad (c^f(\mu^f))^{LF} = (c^f(\mu^f))^{UAP}$$

$$(p^d)^{LF} < (p^d)^{UAP} \qquad (p^f)^{LF} = (p^f)^{UAP}$$

$$(q_d^d + q_f^d)^{LF} > (q_d^d + q_f^d)^{UAP} \qquad (q_d^f + q_f^f)^{LF} = (q_d^f + q_f^f)^{UAP}$$

LF vs BAT

$$(\mu^d)^{LF} > (\mu^d)^{BTA} \qquad (\mu^f)^{LF} = (\mu^f)^{BTA}$$

$$(c^d(\mu^d))^{LF} < (c^d(\mu^d))^{BTA} \qquad (c^f(\mu^f))^{LF} = (c^f(\mu^f))^{BTA}$$

$$(p_d^d)^{LF} < (p_d^d)^{BTA} \qquad (p_d^f)^{LF} < (p_d^f)^{BTA}$$

$$(p_f^d)^{LF} < (p_f^d)^{BTA} \qquad (p_f^f)^{LF} = (p_f^f)^{BTA}$$

$$(q_d^d + q_f^d)^{LF} > (q_d^d + q_f^d)^{BTA} \qquad (q_d^d + q_f^d)^{LF} > (q_d^d + q_f^d)^{BTA}$$

LF vs GET

$$(\mu^d)^{LF} > (\mu^d)^{GETS} \qquad (\mu^f)^{LF} > (\mu^f)^{GET}$$

$$(c^d(\mu^d))^{LF} < (c^d(\mu^d))^{GET} \qquad (c^f(\mu^f))^{LF} < (c^f(\mu^f))^{GET}$$

$$(p_d^d)^{LF} < (p_d^d)^{GET} \qquad (p_d^f)^{LF} < (p_d^f)^{GET}$$

$$(p_f^d)^{LF} < (p_f^d)^{GET} \qquad (p_f^f)^{LF} < (p_f^f)^{GET}$$

$$(q_d^d + q_f^d)^{LF} > (q_d^d + q_f^d)^{GET} \qquad (q_d^d + q_f^d)^{LF} > (q_d^d + q_f^d)^{GET}$$

Results Theory

For the comparison, we have to impose additional assumptions:

- Comparison of UAP and BTA

  symmetry of cost functions

- Comparison of UAP and BTA with GET

  full symmetry between countries

  Bounded cost function: $-c'(\mu)\mu > \frac{1}{2}c(\mu)$

Results Theory: Comparison of UAP and BTA

$$(\mu^d)^{UAP} > (\mu^d)^{BTA} \qquad (\mu^f)^{UAP} = (\mu^f)^{BTA}$$

$$(c^d(\mu^d))^{UAP} < (c^d(\mu^d))^{BTA} \qquad (c^f(\mu^f))^{UAP} = (c^f(\mu^f))^{BTA}$$

$$(p_d^d)^{UAP} < (p_d^d)^{BTA} \qquad (p_f^f)^{UAP} = (p_f^f)^{BTA}$$

$$(p_f^d)^{UAP} > (p_f^d)^{BTA} \qquad (p_d^f)^{UAP} < (p_d^f)^{BTA}$$

$$(q_d^d + q_f^d)^{UAP} < (q_d^d + q_f^d)^{BTA} \qquad (q_d^f + q_f^f)^{BTA} < (q_d^f + q_f^f)^{UAP}$$

Results Theory: Comparison of energy intensities

Under assumption of full symmetry between the countries there are parameters α^* and α^{**} with $0 < \alpha^* \leq \alpha^{**} \leq 1$ such that for all $\alpha \leq \alpha^*$

$$(\mu)^{GET} \leq (\mu^d)^{BTA} < (\mu^d)^{UAP},$$

for $\alpha^* < \alpha \leq \alpha^{**}$

$$(\mu^d)^{BTA} < (\mu)^{GET} \leq (\mu^d)^{UAP},$$

and $\alpha^{**} < \alpha$

$$(\mu)^{UAP} < (\mu^d)^{GET}.$$

Results Theory: Comparison of BTA and GET 1

Under the assumption of full symmetry and bounded costs the following relations hold i.e. for $\alpha \leq \alpha^*$

$$(p_d^d)^{BTA} < (p_d^d)^{GET} \qquad (p_f^f)^{BTA} < (p_f^f)^{GET}$$

$$(p_f^d)^{BTA} < (p_f^d)^{GET} \qquad (p_d^f)^{BTA} < (p_d^f)^{GET}$$

$$(q_d^d + q_f^d)^{BTA} > (q_d^d + q_f^d)^{GET} \qquad (q_d^f + q_f^f)^{BTA} > (q_d^f + q_f^f)^{GET}.$$

Results Theory: Comparison of BTA and GET 2

In the second and third case, i.e. for $\alpha > \alpha^*$, the relations are

$$(p_d^d)^{BTA} > (p_d^d)^{GET} \qquad (p_f^f)^{BTA} > (p_f^f)^{GET}$$

$$(p_f^d)^{BTA} > (p_f^d)^{GET} \qquad (p_d^f)^{BTA} > (p_d^f)^{GET}$$

$$(q_d^d + q_f^d)^{BTA} < (q_d^d + q_f^d)^{GET} \qquad (q_d^f + q_f^f)^{BTA} < (q_d^f + q_f^f)^{GET}.$$

Relaxing assumptions in numerical framework

- No symmetry of production functions
- Heterogenous preferences across countries
- Grandfathering, NAP
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Modeling studies: Literature review

- Competitiveness effects in Partial vs. General Equilibrium Models
- Recent studies on competitiveness effects of the EU ETS (selection):
  - Klepper and Peterson (2004): *The EU Emissions Trading Scheme: Allowance Prices, Trade Flows, Competitiveness Effects*
  - Peterson (2006): *The EU Emissions Trading Scheme and its Competitiveness Effects upon European Business Results from the CGE Model DART*
  - Climate Policy (2006), Vol. 6(1): Special Issue on *Allocation and Competitiveness in the EU emissions Trading Scheme*
  - Anger and Alexeeva-Talebi (2007): *Developing Supra-European Emissions Trading Schemes: An Efficiency and International Trade Analysis*

Explicit sectoral competitiveness indicators

- *Revealed Comparative Advantage (RCA)*

⬄ compares the ratio of exports by a specific sector over its imports with the ratio of exports over imports across all sectors of the region

$$RCA_{ij} = \frac{X_{ij} / M_{ij}}{\sum_j X_{ij} / \sum_j M_{ij}}$$

- *Relative World Trade Shares (RWS)*

⬄ compares the ratio of country's exports in a certain sector over the world's exports in this sector with the ratio of country's overall exports over the world's exports in all sectors

$$RWS_{ij} = \frac{X_{ij} / \sum_i X_{ij}}{\sum_j X_{ij} / \sum_i \sum_j X_{ij}}$$

- *Relative Trade Balance (RTB)*

⬄ compares the trade balance (exports minus imports) for a product to the total trade (exports plus imports) of that product

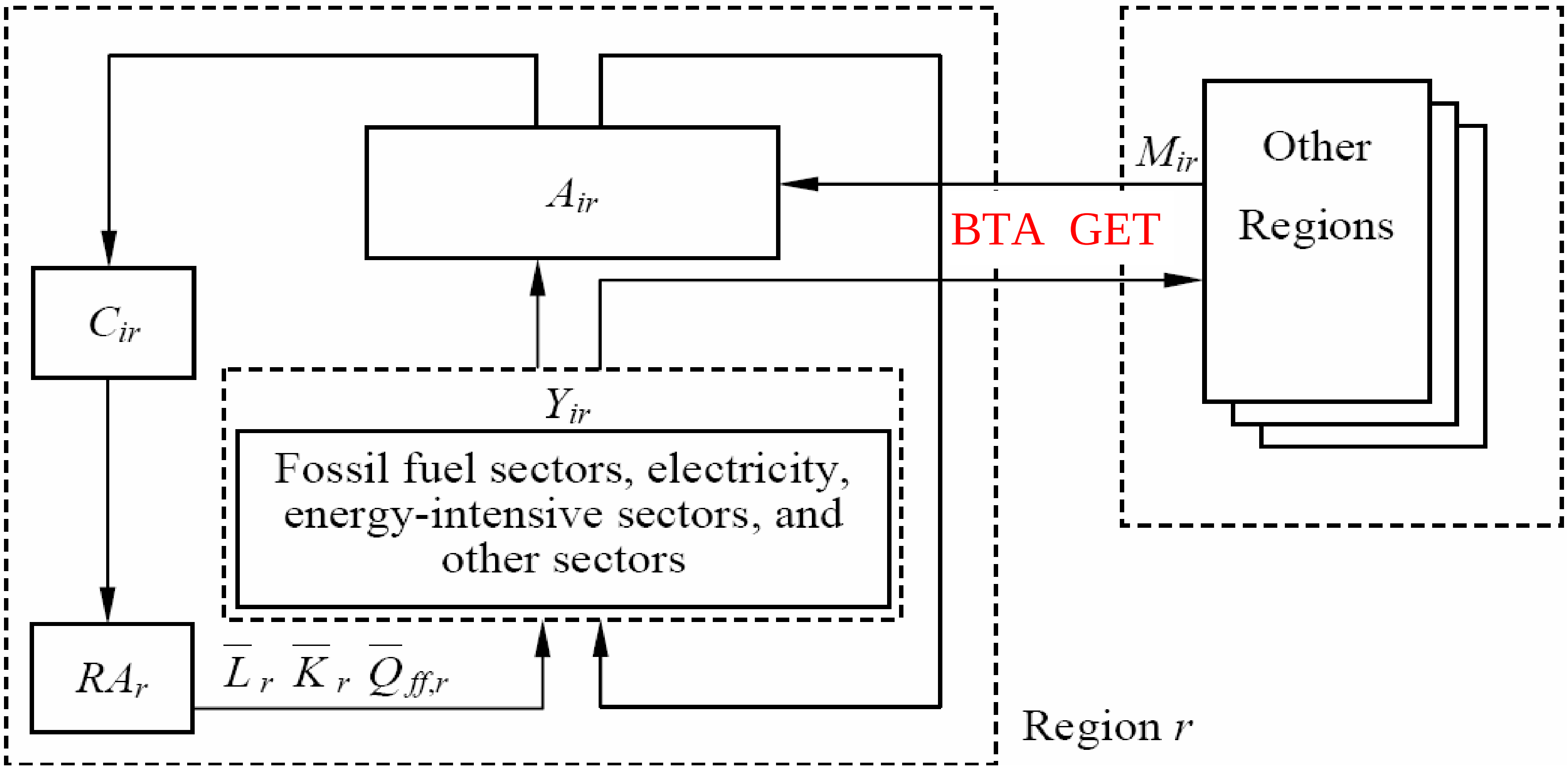
$$RTB_{ij} = \frac{X_{ij} - M_{ij}}{X_{ij} + M_{ij}}$$

Policy Implementation

- EU-27: 8 percent cutback of CO_2 emissions in 2010 compared to 1990
- EU Emissions Trading Directive: Installation-based emissions trading
  - Exclusive coverage of energy-int. industries
  - Allowance allocation: Grandfathering, National Allocation Plan (NAPs)

Region	NAP I allocation factor	NAP II allocation factor
Austria	0.971	0.813
Belgium	1.053	0.943
Germany	1.044	0.876
Denmark	1.407	0.822
Spain	0.941	0.693
France	1.146	0.907
Finland	1.348	1.000
Greece	0.998	0.807
Ireland	0.858	0.750
Italy	0.942	0.849
Luxembourg	1.240	0.839
Netherlands	1.076	0.893
Portugal	1.010	0.839
Sweden	1.154	1.000
United Kingdom	0.850	0.900
Czech Republic	1.175	0.825
Estonia	1.326	0.644
Hungary	1.162	0.887
Lithuania	2.045	0.953
Latvia	1.426	0.736
Poland	1.228	0.833
Slovenia	1.048	0.777
Slovakia	1.208	0.929
Cyprus	1.077	0.881
Malta	1.269	0.997
Bulgaria	-	1.000
Romania	-	1.000
TOTAL	1.156	-

PACE: Stylized Model Structure



Parameterization of Static PACE Version

- Data base of global economy: GTAP V6

Production Sectors	Regions
ETS sectors: Refined Oil Products, Electricity Iron and steel industry Paper Products and Publishing Non-Ferrous Metals, Mineral Products *NETS sectors:* Rest of Industry (Other manufactures and services) *Other sectors:* Coal, Crude oil, Natural gas	EU-27 (single countries or reasonable aggregates) Other OECD countries (e.g. Japan, USA) China, India, Brazil Rest of East South Asia Central and South America South Africa

Policy scenarios

- Business-as-Usual (BAU)
- Unilateral Abatement Policy (UAP)
  - EU ETS: NAP II allowance allocation
- Border Tax Adjustment (BTA)
  - EU ETS + BTA
- Global Emission Trading (GET)
  - EU ETS + GET

Simulation results

Frankreich	**UAP**	**BTA**	**GET**
Welfare impacts (% EV)	-0.06	-0.05	-0.16
CO2 value ($US per ton of CO2)	88.75	88.82	162.85
CO2 value in DIR sectors ($US per ton of CO2)	9.64	9.79	37.01
Carbon emission reduction (in % from BaU)	-14.10	-14.10	-21.30
Sectoral production ORE	-1.000	-1.000	-3.700
Sectoral production PPP	-0.500	-0.500	-1.300
Sectoral production NFM	-1.200	-0.800	-1.900
Sectoral production NMM	-1.100	-0.900	-2.400
RWS indicator of ORE sector (% vs BAU)	-0.25	-0.28	-2.98
RWS indicator of PPP sector (% vs BAU)	0.05	0.07	-0.49
RWS indicator of NFM sector (% vs BAU)	-0.62	-0.17	-0.92
RWS indicator of NMM sector (% vs BAU)	-0.41	-0.24	-1.34

Outlook

- Consistency of models
- Realistic policy option
  - GET – sectoral agreements
  - WTO rules