Unilateral Climate Policies: Challenges, Designs, and Implications

Christoph Böhringer

University of Oldenburg

Climate Policy

- Hypothetical first-best global design:
  - Global cost- benefit analysis: How much?
  - Global cost-effectiveness analysis: 2°C target
    - Where?
    - When?   } Flexibility
    - What?

- Practical second-best unilateral (sub-global) design:
  - Limitation of where-flexibility (CDM, JI)
  - International spillovers: leakage

Unilateral Action And Leakage

- Emission leakage:
  - Energy channel
  - Trade channel

Source: Sinn (2007)
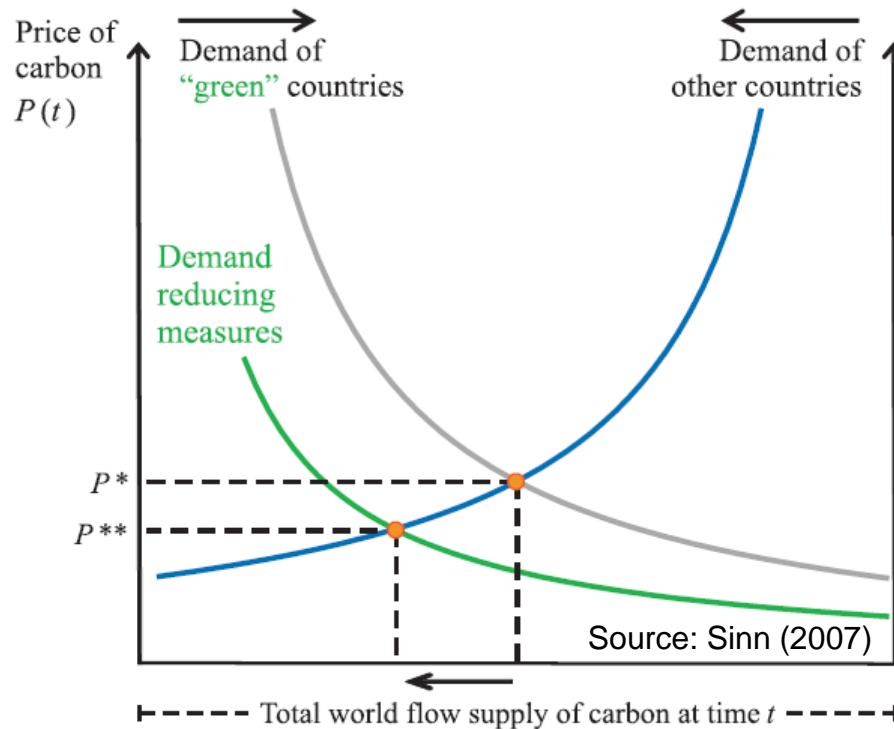
- Second-best anti-leakage measures:
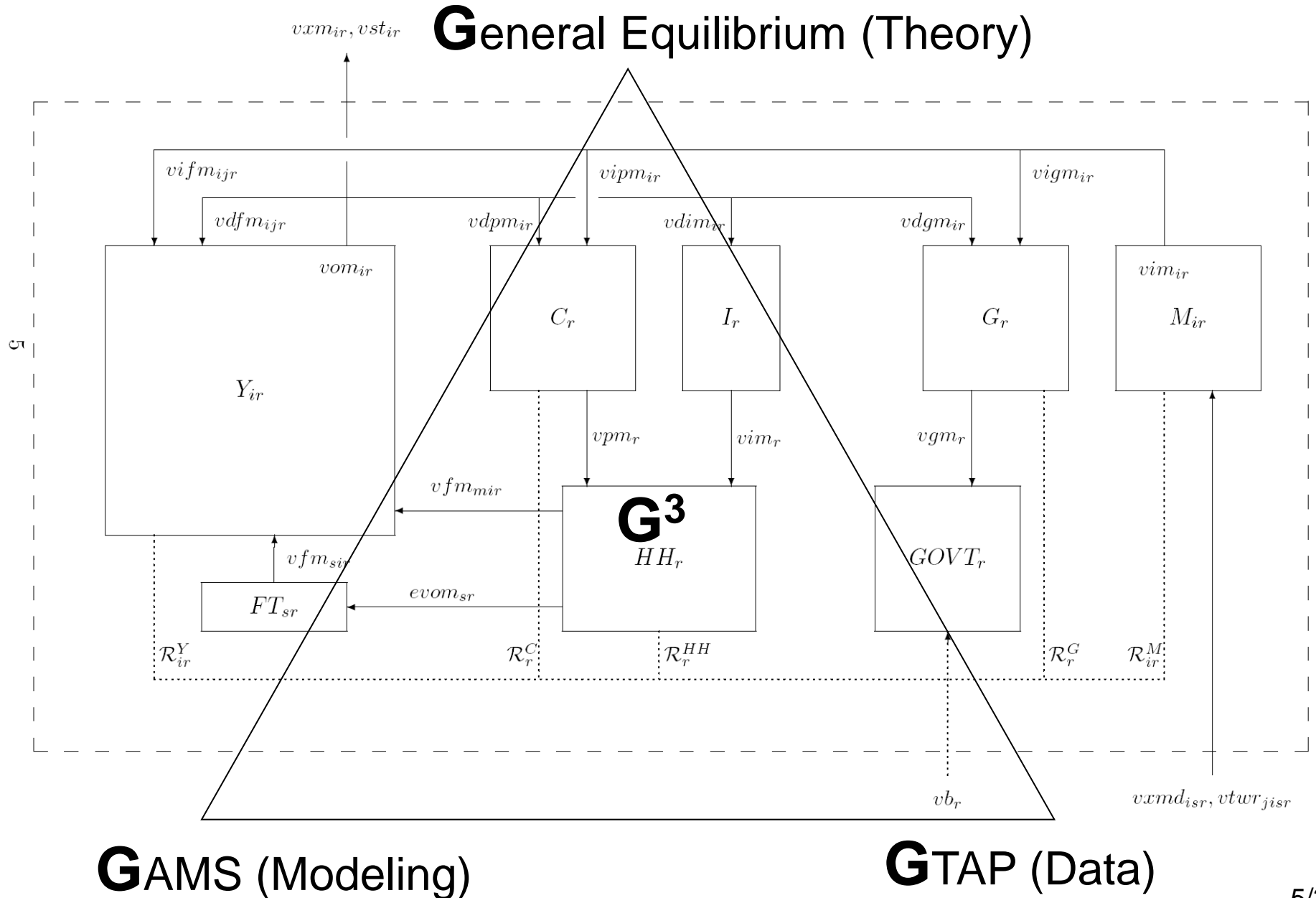 - Border carbon adjustment (import tariffs and export rebates)
  - Output-based rebates/allocation
  - Differentiated domestic CO_2 pricing (including exemptions)
  - Intensity standards

Anti-Leakage Measures: Issues At Stake

- Leakage reduction?

- Attenuation of output losses for energy-intensive and trade-exposed industries?

- Global efficiency gains?

- Burden shifting?

Reality Check: Quantitative Impact Assessment

vxm_{ir}, vst_{ir}

General Equilibrium (Theory)

$vifm_{ijr}$

$vipm_{ir}$

$vigm_{ir}$

$vdfm_{ijr}$

$vdpm_{ir}$

$vdim_{ir}$

$vdgm_{ir}$

vom_{ir}

vim_{ir}

C_r

I_r

G_r

M_{ir}

Y_{ir}

vpm_r

vim_r

vgm_r

vfm_{mir}

G^3

HH_r

$GOVT_r$

vfm_{sir}

FT_{sr}

$evom_{sr}$

$\mathcal{R}^Y_{ir}$

$\mathcal{R}^C_r$

$\mathcal{R}^{HH}_r$

$\mathcal{R}^G_r$

$\mathcal{R}^M_{ir}$

vb_r

$vxmd_{isr}, vtwr_{jisr}$

GAMS (Modeling)

GTAP (Data)

Border Carbon Adjustments (BCA)

- Tariffs imposed on carbon embodied in imports

- Rebates to exports based on average carbon costs

Emissions embodied in non-OECD exports to OECD = 14.5% of all OECD emissions.

Source: Böhringer, Carbone, Rutherford (2011)
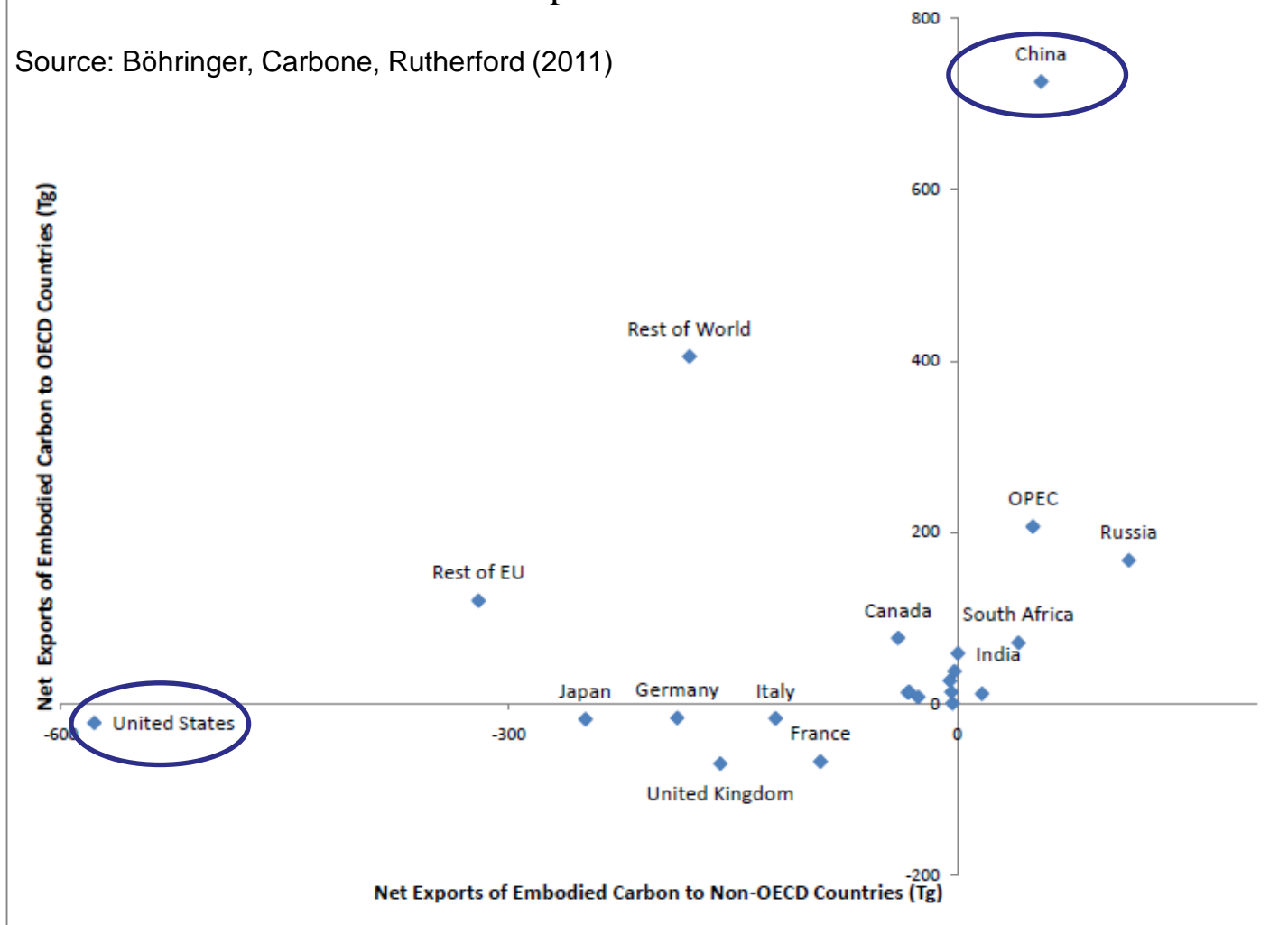
EMF 29: Scenario Design

- Unilateral abatement coalition:
    - EU + EFTA

- Reduction target:
    - 20% from business-as-usual (*bau*) coalition emissions

- Two strategies:
    - *ref*: uniform unilateral emissions pricing stand-alone
    - *bca*: *ref* complemented by border carbon adjustment for emission-intensive and trade-exposed industries (EITE)

Note:
- Carbon tariff revenues accrue to importers
- Carbon tariffs are levied on direct emissions and indirect emissions from electricity
- Leakage adjustment of unilateral target to keep global emission reduction constant (*bau* emissions minus 20% of coalition's *bau* emissions)

EMF 29: Key Results*

* Mean values   % : 100*(*bca-ref*)/*ref*

	ref	*bca*	*%*
Leakage rate (%)	23,9	17,1	-28
CO_2 price (USD per ton of CO_2)	65,2	56,7	-13
EITE output by coalition (% from *bau*)	-3,85	-0,62	-84
EITE output by non-coalition (% from *bau*)	1,21	-0,07	-106
Global consumption (% from *bau*)	-0,31	-0,26	-16
Coalition consumption (% from *bau*)	-0,78	-0,50	-36
Non-coalition consumption (% from *bau*)	-0,09	-0,15	67

Source: Böhringer, Balistreri, Rutherford (2012)

EMF 29: Conclusions On BCA

- Leakage reduction? Yes.

- Attenuation of output losses for energy-intensive and trade-exposed (EITE) industries? Yes.

- Global efficiency gains? Modest.

- Burden shifting? Substantial.

Economic Policy And Murphy's Law

„If there's more than one possible outcome of a job or task, and one of those outcomes will result in disaster or an undesirable consequence, then somebody will do it that way."

EMF 29: Conclusions On BCA

- Leakage reduction? Yes.

- **Attenuation of output losses for energy-intensive and trade-exposed (EITE) industries? Yes.**

- Global efficiency gains? Modest.

- Burden shifting? Substantial.

Carbon Tariffs Revisited

Output changes of energy-intensive and trade-exposed industries (% from *bau)*

	USA		EU27		Japan		South Korea	
	REF	*TRF*	*REF*	*TRF*	*REF*	*TRF*	*REF*	*TRF*
EITE	-2.5	-2.4	-2.9	-2.1	-3.2	-3.0	-3.3	-3.0
crp	-2.2	-2.2	-2.3	-1.8	-3.7	-3.9	-3.4	-3.4
i_s	-2.4	-1.0	-4.3	-0.6	-4.1	-4.6	-4.3	-3.6
nfm	-5.1	-3.9	-6.4	-0.8	-5.9	-4.3	-4.1	-7.0
nmm	-2.0	-1.4	-2.3	-0.6	-5.6	-1.9	-5.6	-3.7
oil	-5.9	-5.7	-7.1	-6.7	-7.6	-7.4	-4.5	-4.3
ppp	-0.8	-0.8	-0.9	-1.0	-1.2	-1.2	-1.5	-1.3

|	Switzerland		Norway		Canada		Australia	
	REF	*TRF*	*REF*	*TRF*	*REF*	*TRF*	*REF*	*TRF*
EITE	-2.6	-18.0	-6.2	-13.7	-5.2	-6.7	-4.4	-4.9
crp	-1.5	-18.3	-7.5	-9.0	-3.0	-3.9	-0.4	0.3
i_s	-2.0	1.8	-17.9	-22.9	-5.8	-4.2	-1.7	-1.0
nfm	-0.7	-42.5	-0.8	-50.2	-12.2	-21.3	-15.5	-17.9
nmm	-4.1	-2.9	-4.0	-1.5	-7.4	-8.2	-4.4	-5.4
oil	-21.6	-22.0	-15.6	-16.8	-9.6	-9.7	-5.2	-5.1
ppp	-1.8	-1.2	0.1	0.0	-2.2	-2.8	-0.1	0.2

EITE – average of all emission-intensive and trade-exposed industries; **crp** – chemical products; **i_s** – iron and steel; **nfm** – non-ferrous metals; **nmm** – non-metallic minerals; **oil** – refined oil products; **ppp** – paper, pulp and print;

Source: Böhringer, Müller, Schneider (2015)

Key Drivers

- Composition of embodied carbon in EITE production

  – Direct combustion of (direct) fossil fuel inputs

  – Domestic embodied in domestically produced intermediate inputs

  – Imported embodied in imported intermediate inputs

- Export supply share of EITE output

Export-oriented industries producing with a large share of imported embodied emissions will suffer under carbon tariffs.
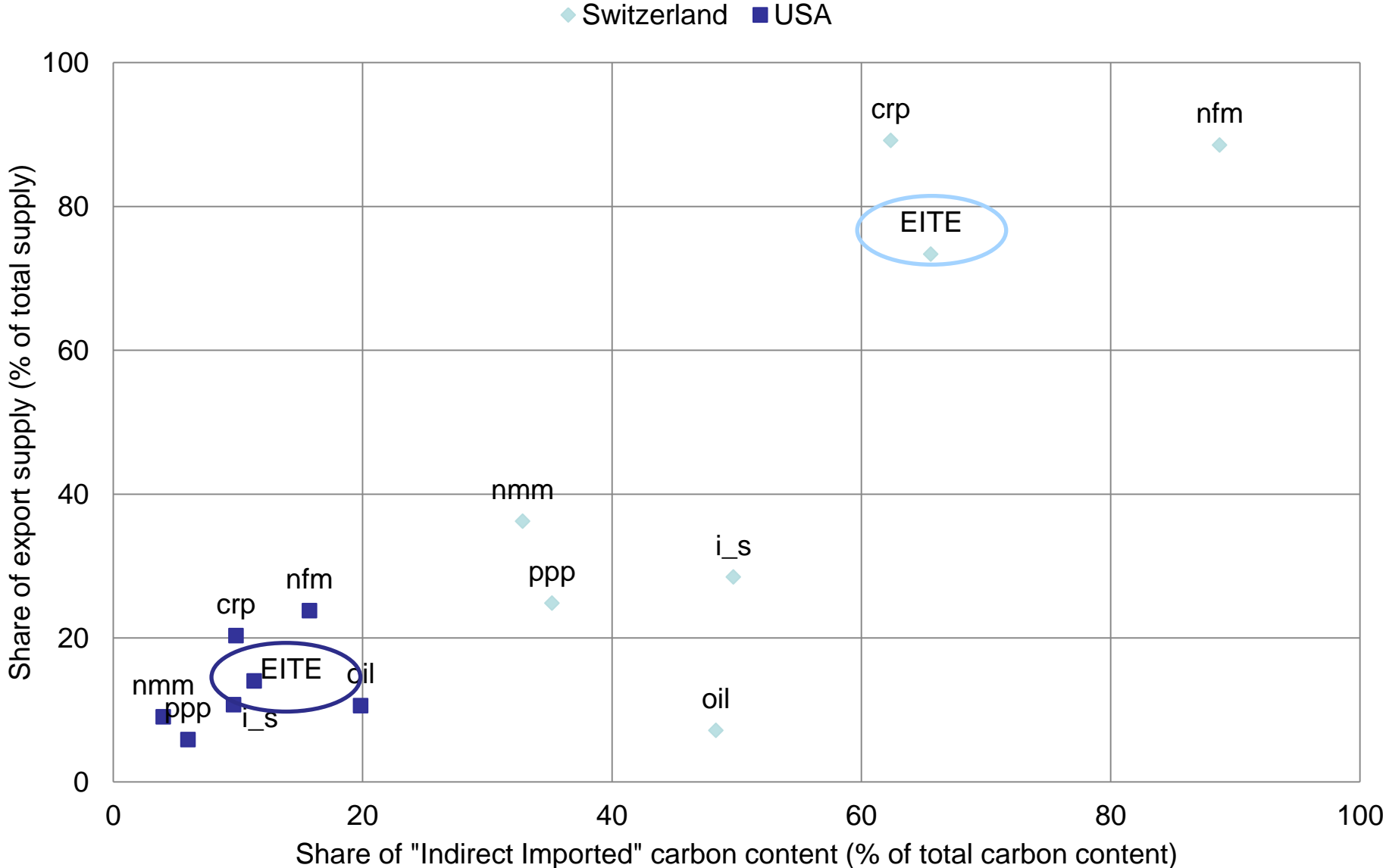
MRIO – CO$_2$ Content
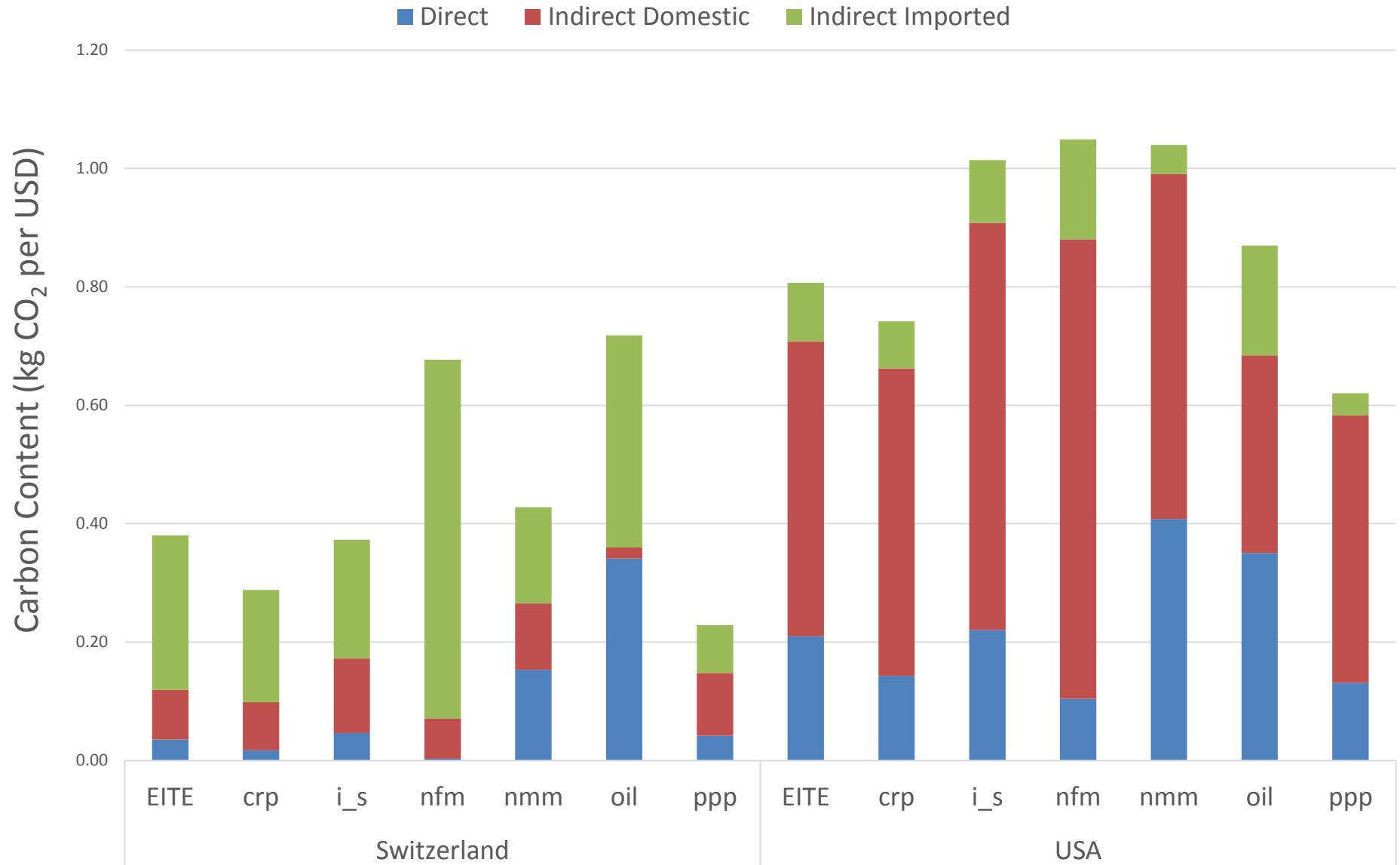
EITE – average of all emission-intensive and trade-exposed industries; **crp** – chemical products; **i_s** – iron and steel; **nfm** – non-ferrous metals; **nmm** – non-metallic minerals; **oil** – refined oil products; **ppp** – paper, pulp and print;

MRIO – EITE supply
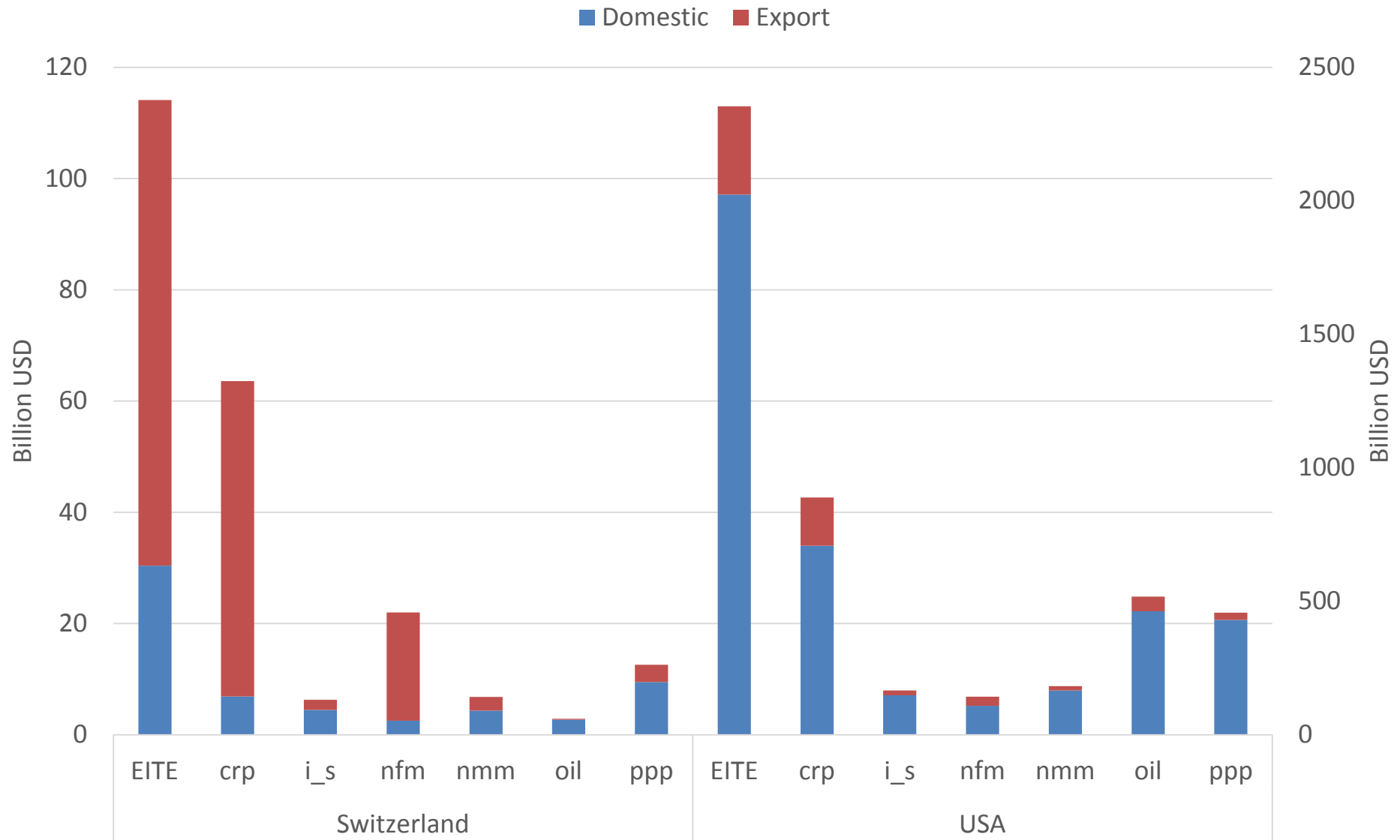
EITE – average of all emission-intensive and trade-exposed industries; **crp** – chemical products; **i_s** – iron and steel; **nfm** – non-ferrous metals; **nmm** – non-metallic minerals; **oil** – refined oil products; **ppp** – paper, pulp and print;

Source: Böhringer, Müller, Schneider (2014)

Export Supply – "Indirect Imported" Carbon Content

EITE – average of all emission-intensive and trade-exposed industries; **crp** – chemical products; **i_s** – iron and steel; **nfm** – non-ferrous metals; **nmm** – non-metallic minerals; **oil** – refined oil products; **ppp** – paper, pulp and print;

The Devil Is Not Only In The Details!

$$\$ = \sqrt[n]{\sum_{i=1}^{\infty} e^{v_i} l}$$

EMF 29: Conclusions On BCA

- Leakage reduction? Yes.

- Attenuation of output losses for energy-intensive and trade-exposed (EITE) industries? Yes.

- Global efficiency gains? Modest.

- Burden shifting? Substantial.

Embodied Carbon Tariffs

- Two potential roles as environmental policy:
  - ***Regulatory*** – directly discourage pollution abroad
  - ***Strategic*** – stimulate adoption of pollution controls abroad

- Are carbon tariffs likely to stimulate pollution control abroad?
  - Do they benefit users?
  - Do they punish targets?
  - What is a target's best response?

The Policy Game
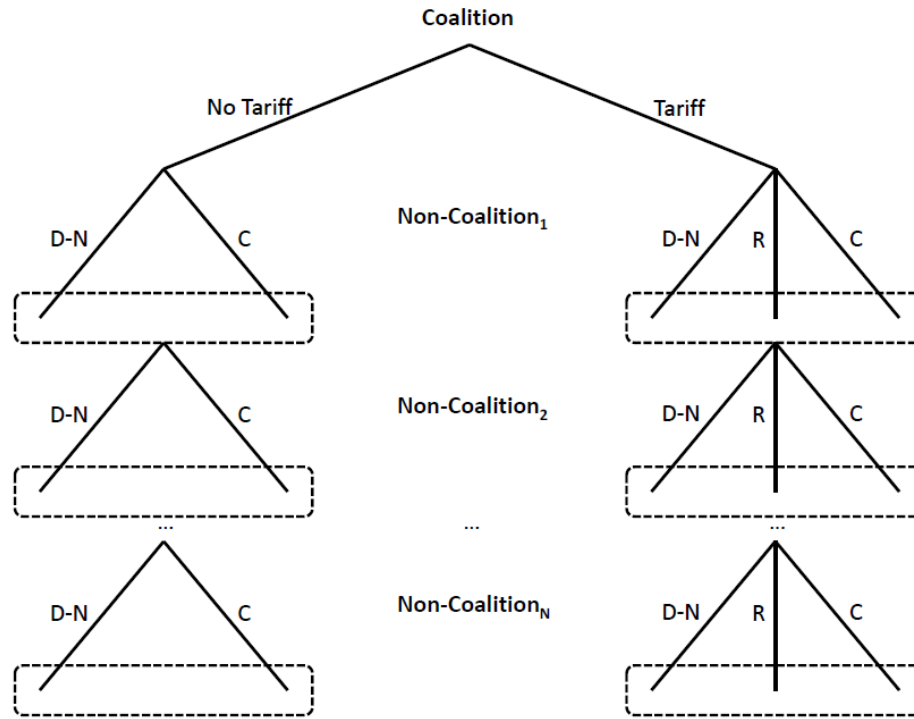
D-N = "Do Nothing", R = "Retaliate", C = "Cooperate"

- **Cooperate (C):** Non-coalition regions restrict domestic emissions by an amount equal (as a percentage of BaU emissions) to the reductions undertaken by the coalition. Non-coalition abatement takes place via a regional carbon tax (or regional tradable permit system) that is uniform across all of a given region's sectors.

- **Retaliate (R):** Non-coalition region raises a uniform import tariff on EITE goods from all coalition countries such that the added revenue generated by this tariff equals the revenue generated by the carbon tariffs imposed on them collectively. It continues to operate with unrestricted emissions.

- **Do Nothing (D-N):** non-coalition region operates with unrestricted emissions.

Source: Böhringer, Carbone, Rutherford (2015)

Numerical Framework And Key Results

- Numerical framework:
  - Regions:
    - Coalition: USA, Europe, Other Annex 1 without Russia
    - Non-Coalition: China, India, Russia, OPEC, Other Middle Income, Other Low Income
  - Enumerate all policy regimes ($2^6 + 3^6 = 793$) and use CGE model based on GTAP data to generate payoffs of the policy game.
  - Solve for Nash equilibria

- Results:
  - Coalition countries benefit from using tariffs – mainly through shift in terms of trade.
  - China and Russia respond by adopting carbon regulations – to avoid tariffs and to improve world economy –| while other non-coalition regions retaliate.
  - Cooperation from China and Russia reduces global efficiency cost of 10% reduction in world emissions by roughly half.

"There is only one way to be perfect but many ways to be imperfect"
(P. Krugman)
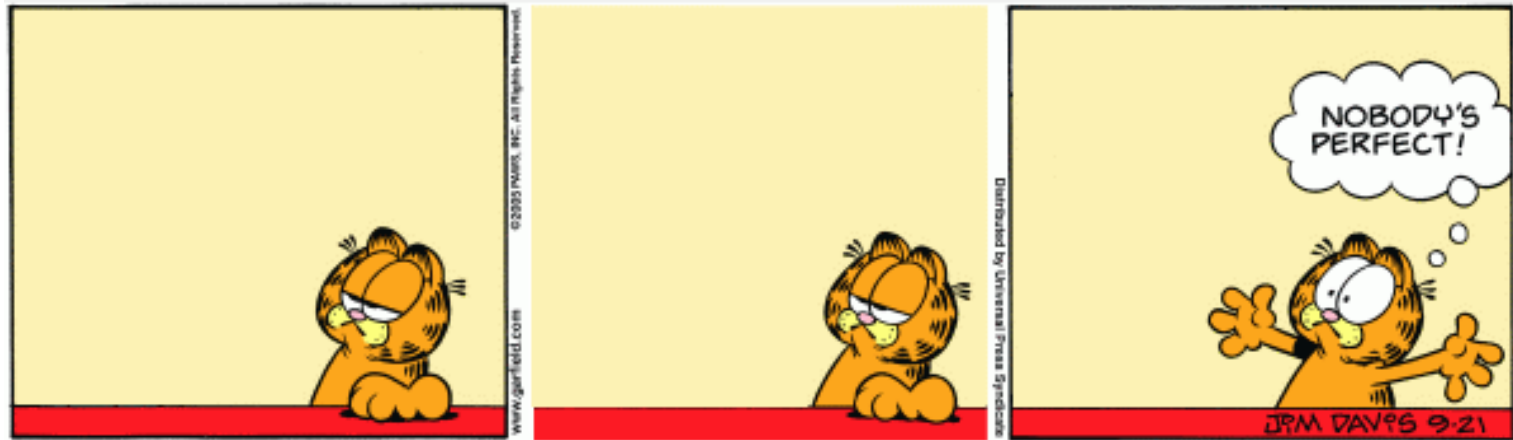
Other Choices – "Better Regulation"?

- Caveats against border adjustments:
  - Fears of disguised protectionism (substitute for strategic tariffs)
  - WTO obligations
  - Negotiations in WTO and UNFCCC already difficult

- Alternative instruments:
  - Output-based allocation of emission allowances
  - Industry exemptions (tax differentiation)
  - Intensity standards

- 2nd best benefits from instrument-specific distortions:
  - Border adjustments: trade distortions
  - Output-based allocation: production distortions (implicit output subsidy)
  - Industry exemptions: non-uniform emission pricing (implicit input subsidy)

CGE Analysis (1)

- Reference scenario (*ref*):
  - EU unilateral emission reduction (x% from *bau*)
  - Uniform emission pricing in the EU

- Leakage reduction and global cost savings: **(in % from reference scenario)**

Target (% from *ref*)		10	20	30
Leakage reduction	Border tax adjustment (bta)	33,6	37,2	39,8
	Output-based allocation (oba)	10,4	10,9	11,5
	Exemptions (exe)	9,2	8,5	7,4
Global cost savings	Border tax adjustment (bta)	11,1	13,4	17,0
	Output-based allocation (oba)	8,9	8,3	8,8
	Exemptions (exe)	6,4	2,0	-1,6

Source: Böhringer, Carbone, Rutherford (2012)

CGE Analysis (2)

- Incidence and efficiency

Burden sharing ratio (cost of EU/cost of non-EU)			
Target (% from *ref*)	**10**	**20**	**30**
Reference (ref)	2,4	3,3	4,3
Border tax adjustment (bta)	1,1	1,6	2,1
Output-based allocation (oba)	2,2	3,1	4,0
Exemptions (exe)	2,3	3,2	4,1
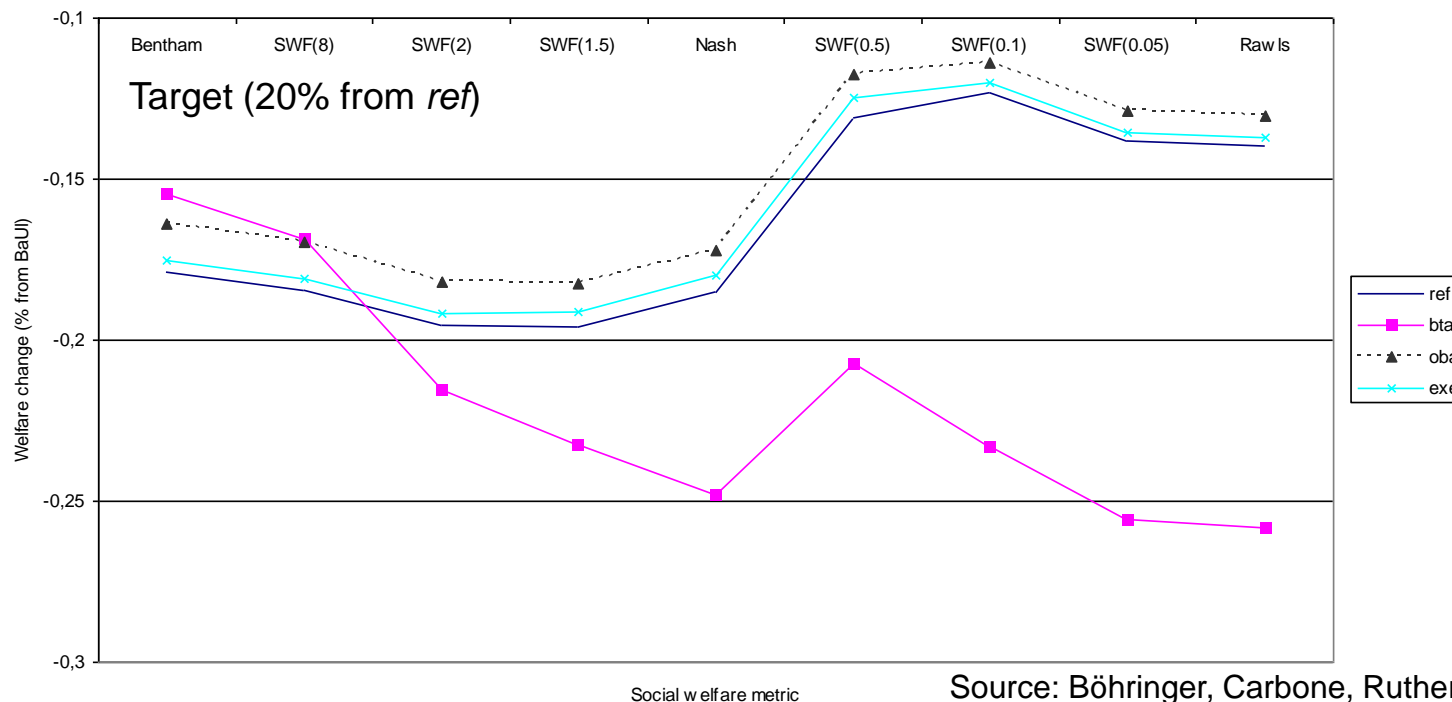
# *The Inconvenient Truth:* There Is No "Magic Bullet"!

- Border tax adjustments reduce leakage and provide global cost savings but exacerbate regional inequality.

- Exemptions deliver rather modest little leakage reduction and run the risk of increasing climate policy cost.

- Output-based allocation is also no "magic bullet" but looks like a decent and practical approach.

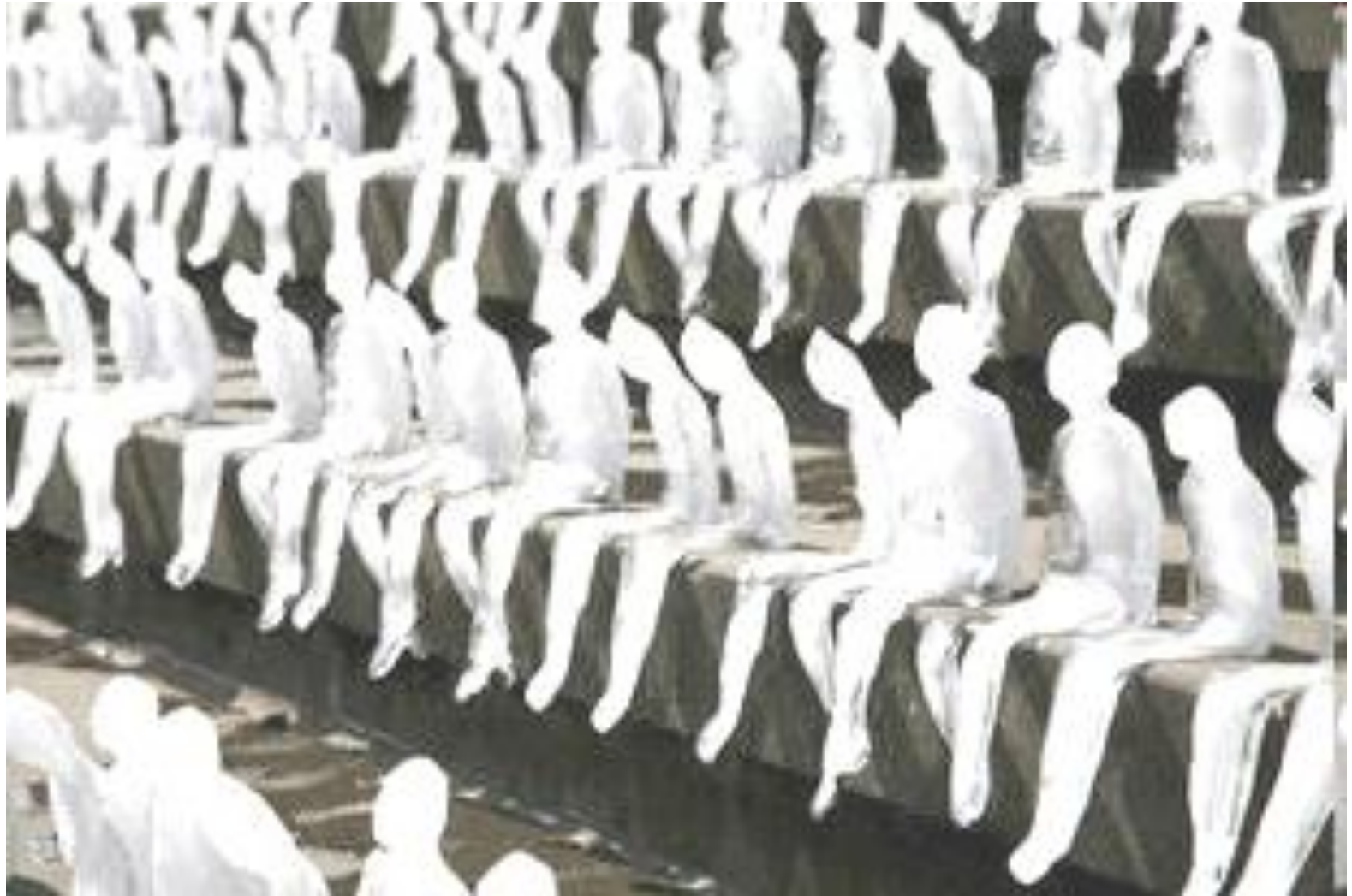# Where Is The Beef?

The Message For Paris: Here Is The Beef!

- OECD – 20% emission reduction vis-à-vis *BaU*:
    - *REF:* unilateral emission pricing
    - *BTA:* REF plus border tariffs on EITE industries
    - *GLB*: **Global emissions trading (non-OECD with *BaU* endowment)**
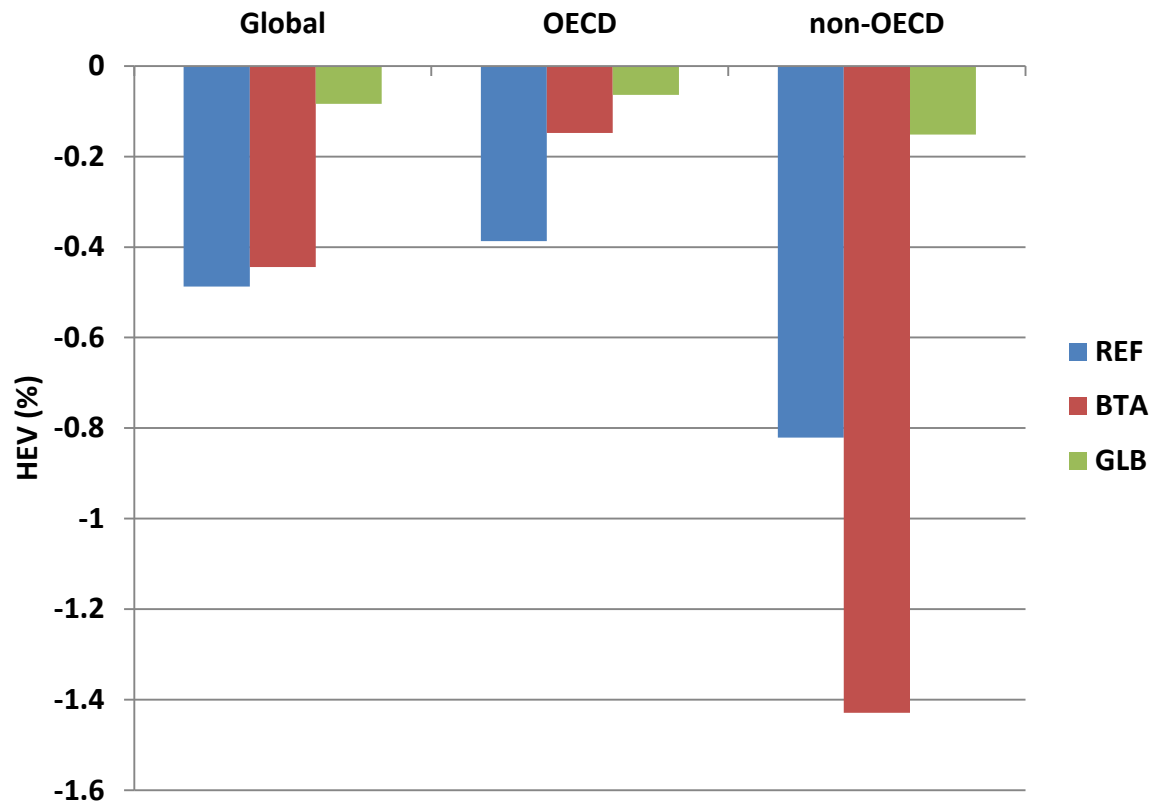
Thank You For Your Attention!

References

Sinn, H.-W. (2008). Public policies against global warming: A supply side approach. *International Tax and Public Finance* 15. 360–94.

Böhringer, C., Carbone,, and T.F. Rutherford (2011). Embodied Carbon Tariffs. *Working Paper No. 17376*, National Bureau of Economic Research.

Böhringer, C., Balistreri, E.J,. and T.F. Rutherford (2012). The Role of Border Carbon Adjustment in Unilateral Climate Policy: Overview of an Energy Modeling Forum Study (EMF29). *Energy Economics* 34. S97-S110.

Böhringer, C., Carbone, J.C., and T.F. Rutherford (2012). Unilateral Climate Policy Design: Efficiency and Equity Implications of Alternative Instruments to Reduce Carbon Leakage. *Energy Economics* 34. S208-S217.

Böhringer, C., Müller, A., and J. Schneider (2015). Carbon Tariffs Revisited. *Discussion Paper 2014-64.* Harvard Project on Climate Agreements. *Journal of the Association of Environmental and Resource Economists*. Forthcoming.

Böhringer. C., Carbone, J.C., and T.F. Rutherford (2015), The Strategic Value of Carbon Tariffs. *American Economic Journal (Policy)*. Forthcoming.