The Role of Border Measures in the Design of Unilateral Climate Policy

Insights From An EMF Model Cross-Comparison Exercise

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Background

Arguments for unilateral emission abatement:

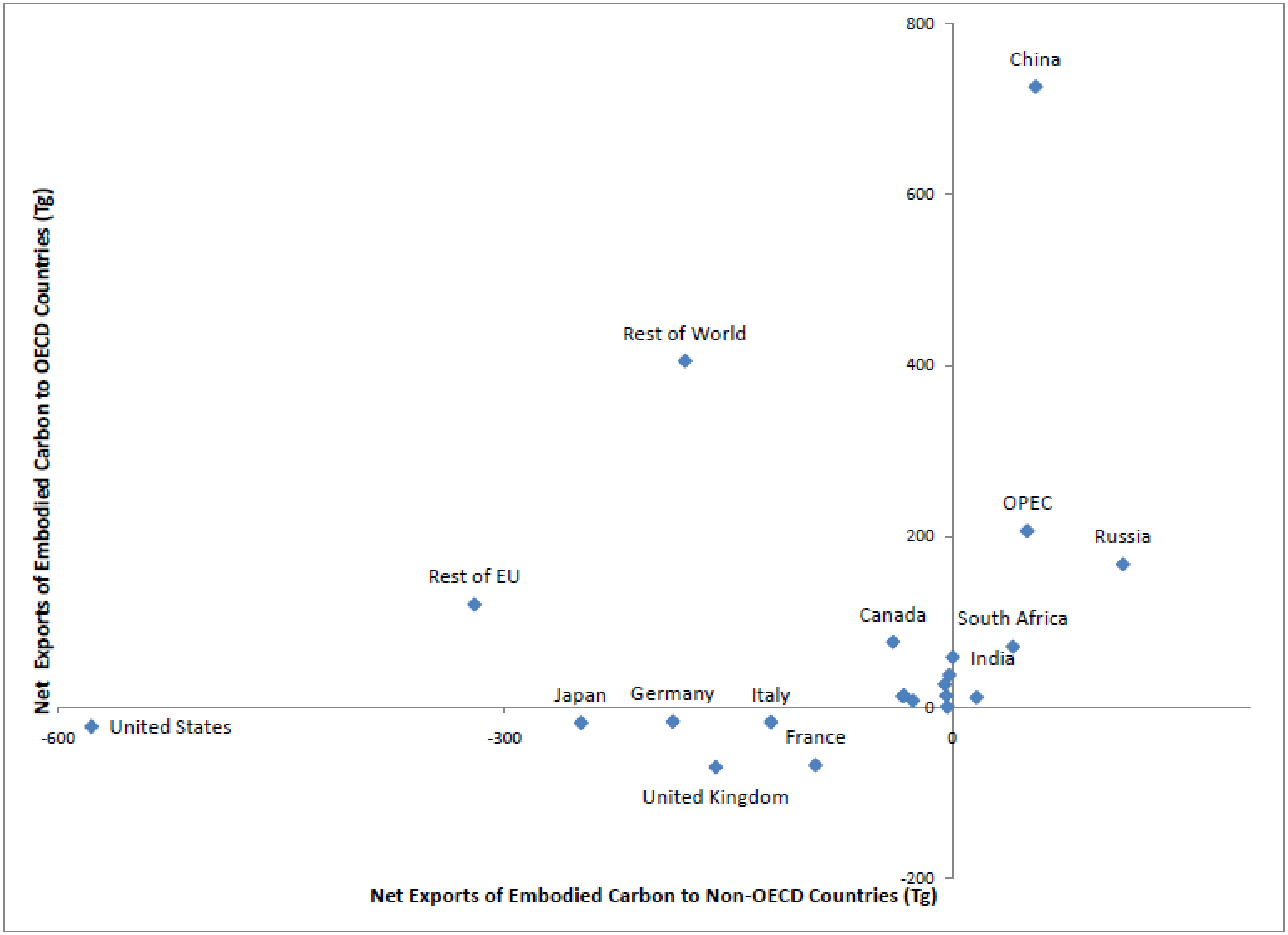
- Global climate action remains elusive.
- OECD countries should take a lead of a role.
- …

Challenges with unilateral climate policy design:

- Emission leakage
- Industry competitiveness
- …

Carbon Embodied in Trade

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



Source: Böhrnger, Carbone and Rutherford (2011)

Border Carbon Adjustments

Pros:

- 2nd best instrument for implicit regulation of pollution abroad
- Carbon-motivated tariffs and rebates help to level the playing-field
- Strategic stick in international negotiations

Cons:

- Potentially blunt instrument (no direct abatement incentives abroad)
- Scope for back-door trade policy (“beggar-thy-neighbor”)

Objectives

Economic impact assessment of complementary border measures:

- Leakage reduction
- Efficiency (global cost savings)
- Incidence (burden shifting)
- Performance of energy-intensive and trade-exposed (EITE) industries

Virtue of a systematic model cross-comparison:

- Key drivers of impacts
- Robust policy-relevant insights
- Open research/modeling issues (e.g. trade representation)

EMF Study Design – 12 Modeling Groups

Specification of core scenarios

- Policy issues
- Data availability
- Modeling (compat.)ability

Method of assessment

- Model type: computable general equilibrium (CGE)
- Data: GTAP7 (global multi-sector, multi-region data set)

Tasks

- Joint simulation of core scenarios
- Individual contributions on economic border measure research

Participants

Model (Institution)	Institution	People	Special issue topic
BCR	Univ. Oldenburg/Calgary/Madison	Böhringer, Carbone, Rutherford	Alternative anti-leakage measures: efficiency and equity
CEPE	ETH Zürich	Caron	Sectoral disaggregation
DART	IFW	Hübler, Peterson, Weitzel	Strategic use of border tariffs
CVO	Univ. Oldenburg	Springmann	Internal efficiency of abatement policy
ENV_LINKAGES	OECD	Chateau, Dellink	Offsets and international emissions trading
EC (Environment Canada)	Environment Canada	Gosh, Luo, Siddiqui	Non-CO_2 greenhouse gases
ITC_RFF	ITC, RFF	Fischer, Fox	Alternative anti-leakage measures: tax interaction effects
MINES	Univ. Colorado/Madison	Balistreri, Rutherford	International trade and firm heterogeneity
PACE	ZEW	Alexeeva-Talebi, Böhringer, Löschel, Voigt	Sectoral disaggregation
SSB	Statistics Norway	Böhringer, Bye, Faehn, Rosendahl	Alternative embodied carbon metrics
WEG_CENTER	Univ. Graz	Bednar-Friedl, Schinko, Steininger	Process-based emissions
WORLDSCAN	CPB	Boeters, Bollen	Fuel supply response

Sectors and Regions

Explicit model sectors and regions

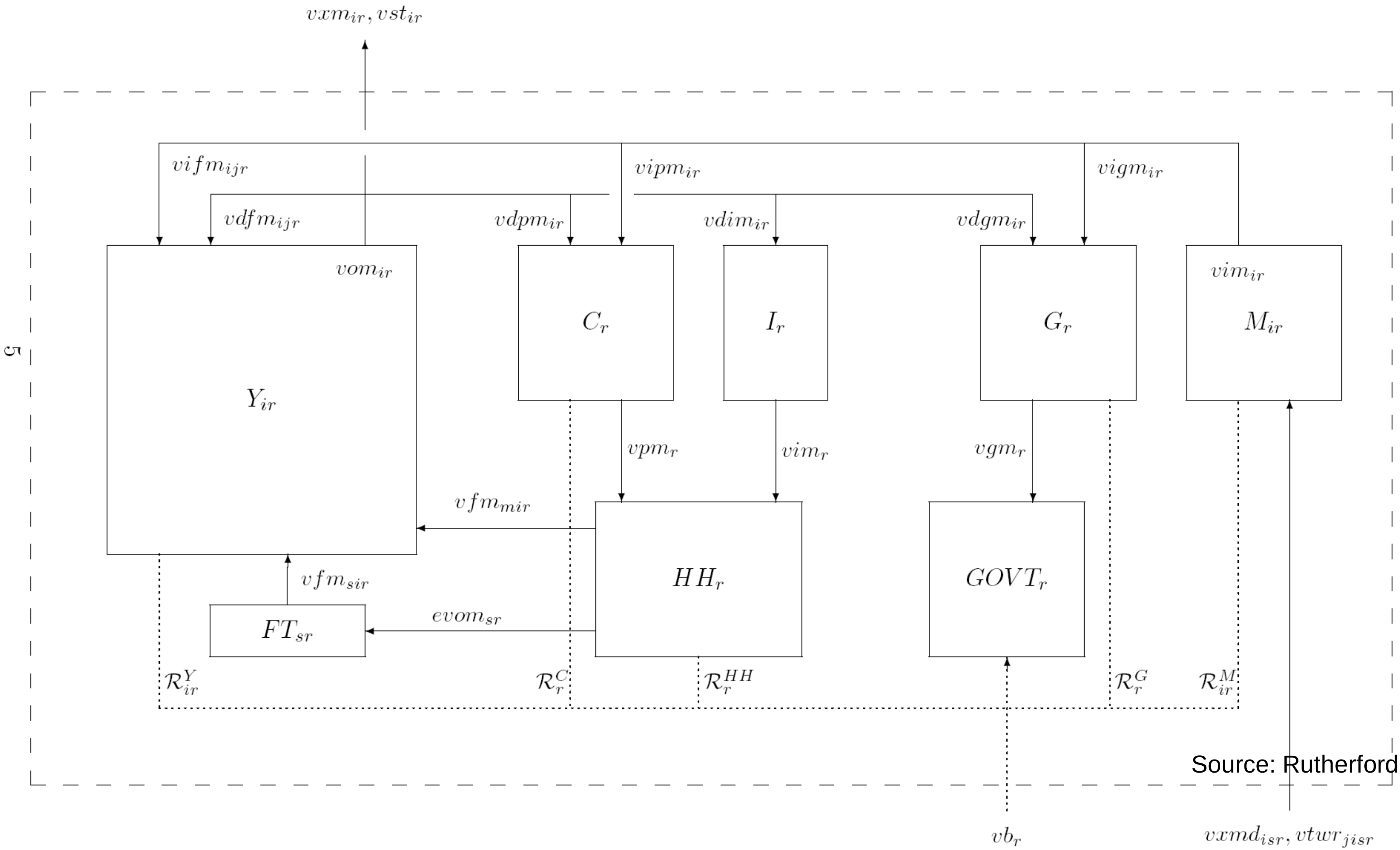
Sectors and commodities	*Countries and regions*
Energy goods	*Annex 1 (industrialized) regions*
Coal (COL)	Europe – EU-27 plus EFTA (EUR)
Crude oil (CRU)	United States of America (USA)
Natural gas (GAS)	Russia (RUS)
Refined oil products (OIL)*	Remaining Annex 1 (RA1)
Electricity (ELE)	
	Non-Annex1 regions
Non-energy goods	China (CHN)
Chemical products (CRP)*	India (IND)
Non-metallic minerals (NMM)*	Energy exporting countries excl. Mexico (EEX)
Iron and steel industry (I_S)*	Other middle income countries (MIC)
Non-ferrous metals (NFM)*	Other low income countries (LIC)
Air transport (ATP)	
Water transport (WTP)	
Other transport (OTP)	
All other goods (AOG)	

Energy-intensive and trade-exposed industry (**EITE**)

Additional reporting regions:

- *all* (composite of all regions)
- *coa* (composite of abating regions – coalition)
- *ncoa* (composite of non-abating regions – non-coalition)

Generic MS-MR CGE Model



Source: Rutherford

N.B.: All models – except for one (Mines) – adopt the Armington trade specification
(Mines builds on new new trade theory of firm heterogeneity established by Melitz)

Core Scenarios

- Policy instruments
  - *ref*: uniform unilateral emission pricing
  - *tariff* *ref* plus border tariffs for EITE goods (based on direct carbon content plus I ndirect carbon content from electricity)
  - *btax* ref plus border tariffs and rebates for EITE goods
- Size of abatement coalition
  - EUR: EU-27 and EFTA
  - A1xR: Annex 1 countries without Russia
  - A1xR_CHN: China plus Annex1 countries without Russia
- Reduction targets: 20% from *business-as-usual* (*bau*) for each coalition country
- Revenues from border tariffs
  - IMPORTER: Importing region retains revenues
  - EXPORTER: Exporting region retains revenues (alike voluntary export restraints)
- Choice of base-year for *bau:*
  - 2004 (GTAP base-year)
  - 2020 (need for forward-calibration)

- Constant global emission reduction (endogenous leakage adjustment to reach global *bau* emissions minus 20% of coalition's *bau* emissions)
- Coalition-internal efficiency through emissions trading

Presentation of (Selected) Results

- Focus on key scenario dimensions
  - base year: 2004
  - coalition: A1xR
  - policy: *ref* versus *btax*
  - revenue: IMPORTER

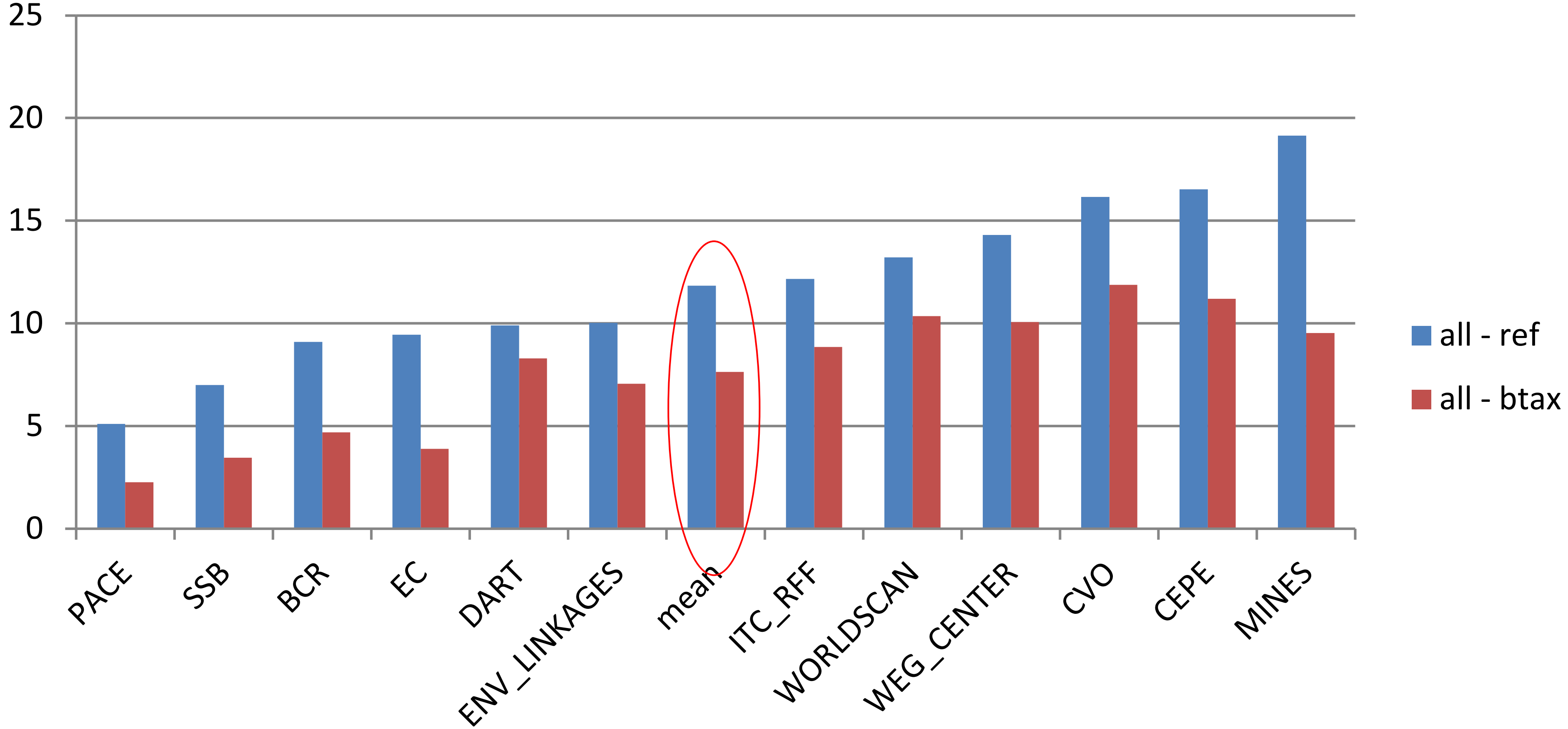
- Focus on composite regions and sectors
  - regions: all, coa (coalition), ncoa (non-coalition)
  - sectors: EITE

- Key reporting items
  - environment: leakage, emissions
  - economy: CO_2 price, welfare (GDP), output

- Sensitivity analysis
  - coalition size
  - base year

Leakage Rates (% from *bau*)

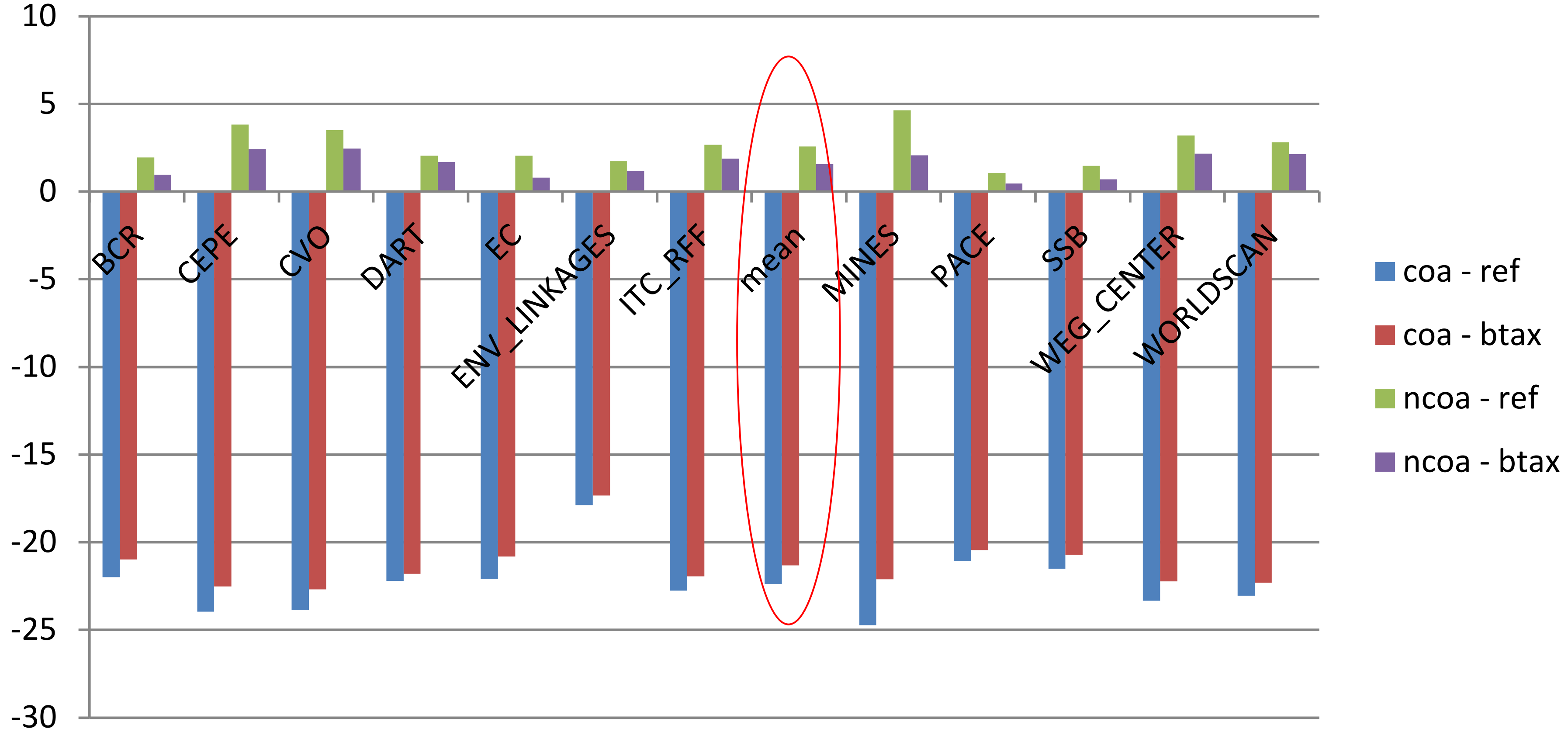
- *ref* leakage rates: ~ 5%-20% (mean: ~12%)
- BCA are quite effective in reducing leakage (mean: ~ 7.5%)
- *btax* is only slightly more effective in reducing leakage than *tariff* (mean: ~ 8%)



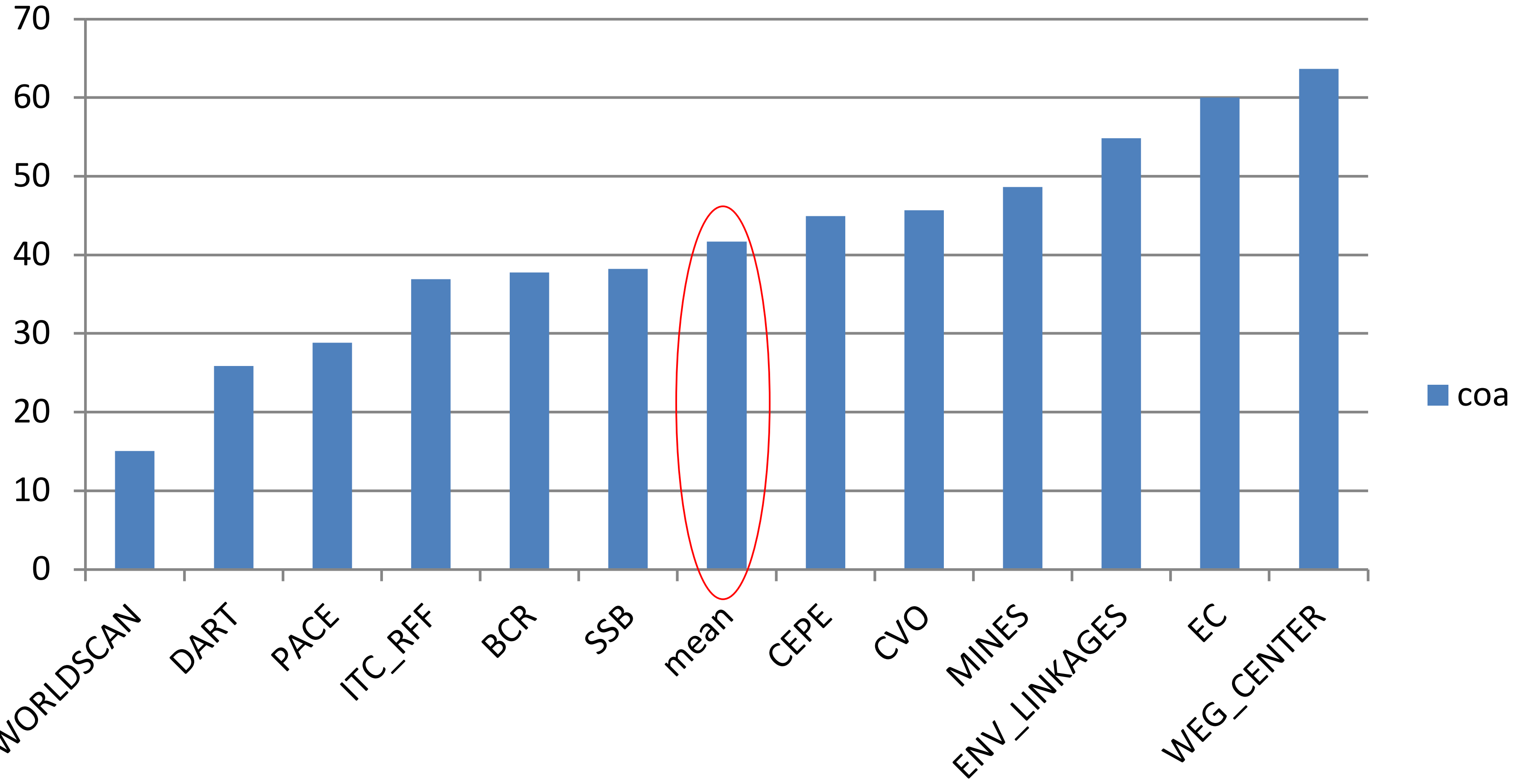
CO_2 Emissions (% from *bau*)

- Under all abatement scenarios the coalition adjusts its unilateral target to reach the exogenous global emission target (the 20% A1xR target translate into ~ 9.5% global target)

- BCA (*btax* or *tariff*) reduce leakage and thus the emission reduction requirement vis-à-vis *ref*

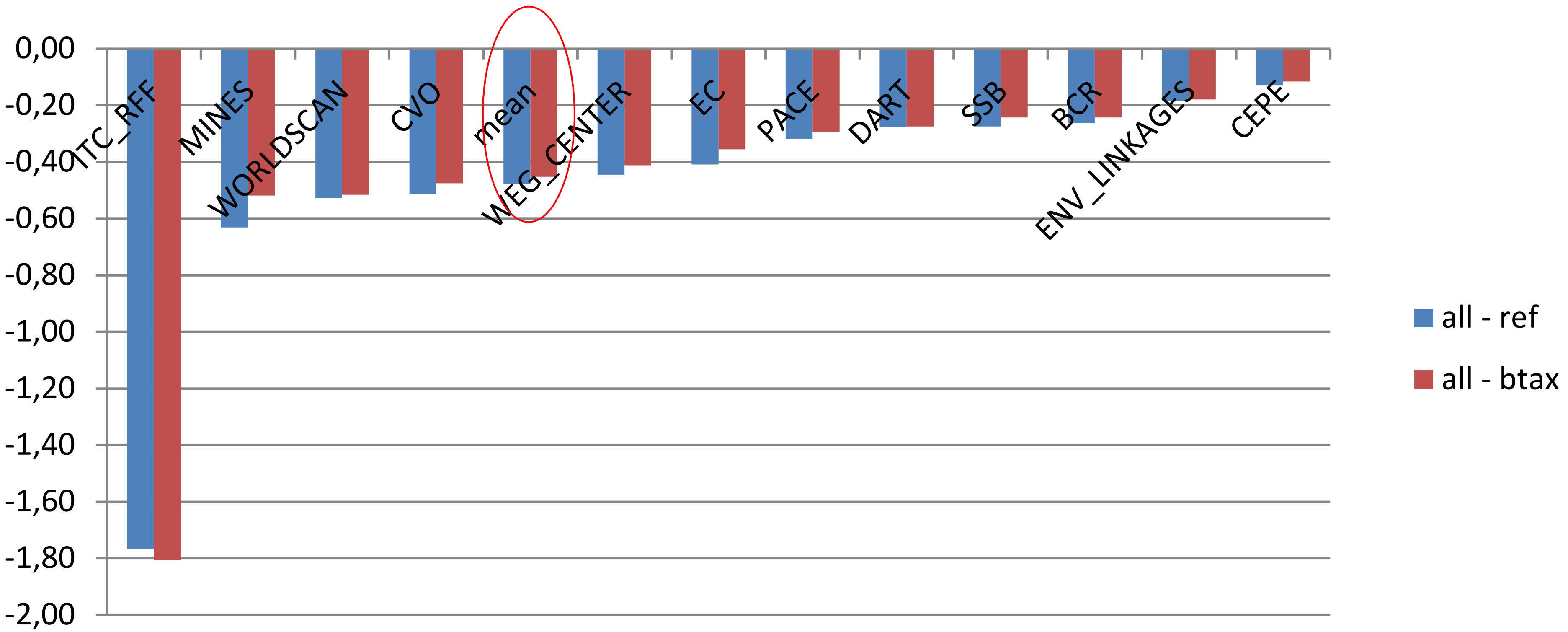


CO_2 Price ($US/t CO_2)



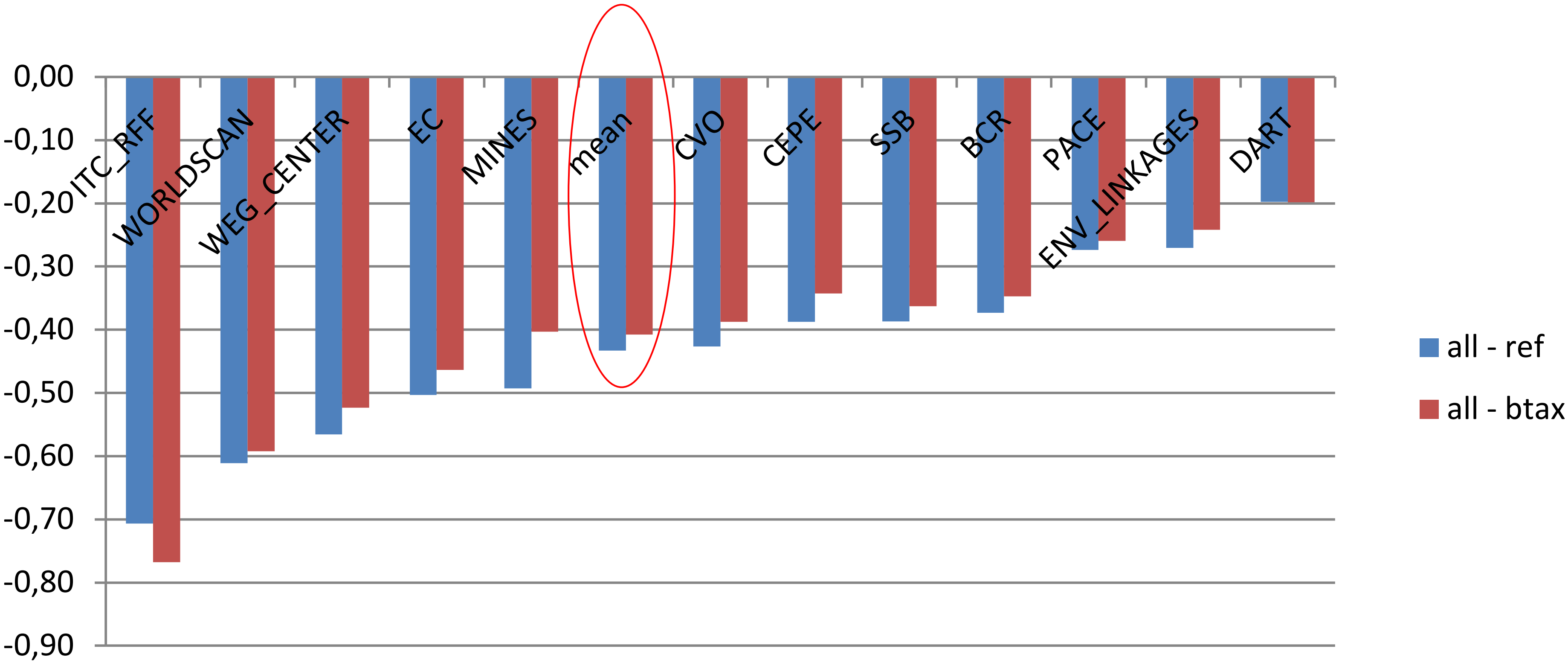
- Broad range of marginal abatement cost across models (~ 15-60 $/t CO_2 in *ref*)
- BCA with (slightly) lower emission prices as they reduce effective reduction requirement

GDP Changes (% from *bau*)



- BCA with slightly lower GDP losses (except for ITC_RFF model)
- GDP cost savings from BCA are very small (mean GDP loss goes down from 0.48% for *ref* to 0.45% for *btax*)

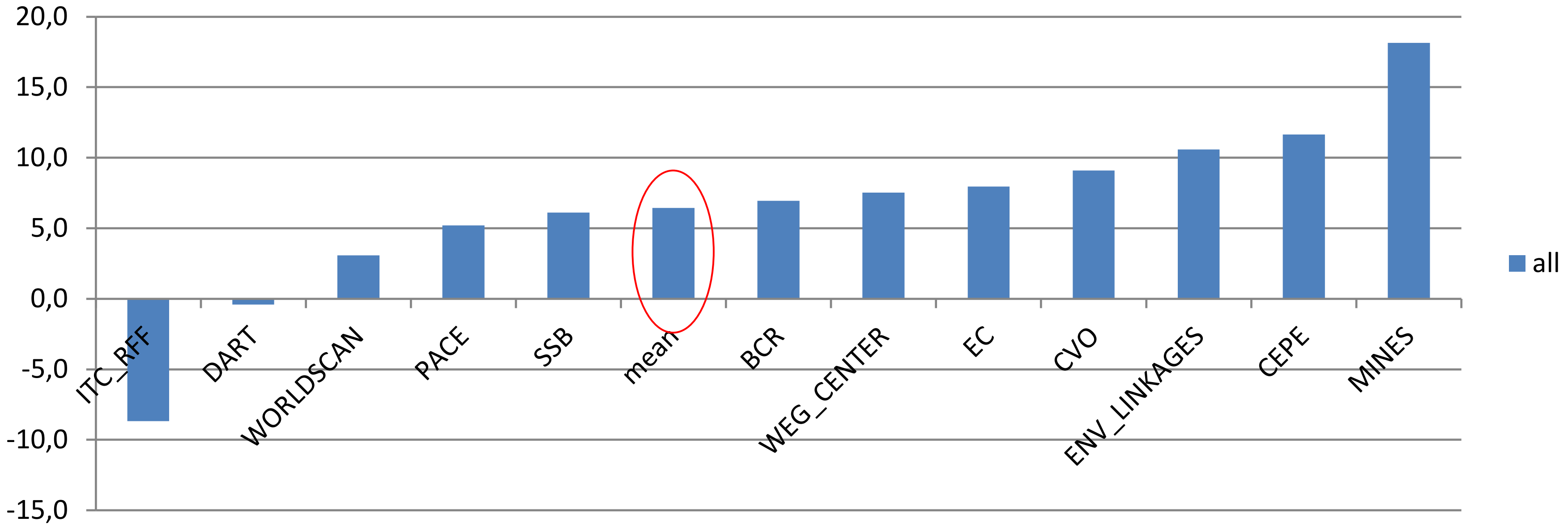
Consumption Changes (% from *bau*)



- Consumption change corresponds to gross welfare change, i.e. utilitarian-based efficiency loss, for all models (except for ITC_RFF)
- Efficiency gains from BCA are very small (mean loss goes down from 0.43% for *ref* to 0.41% for *btax*)

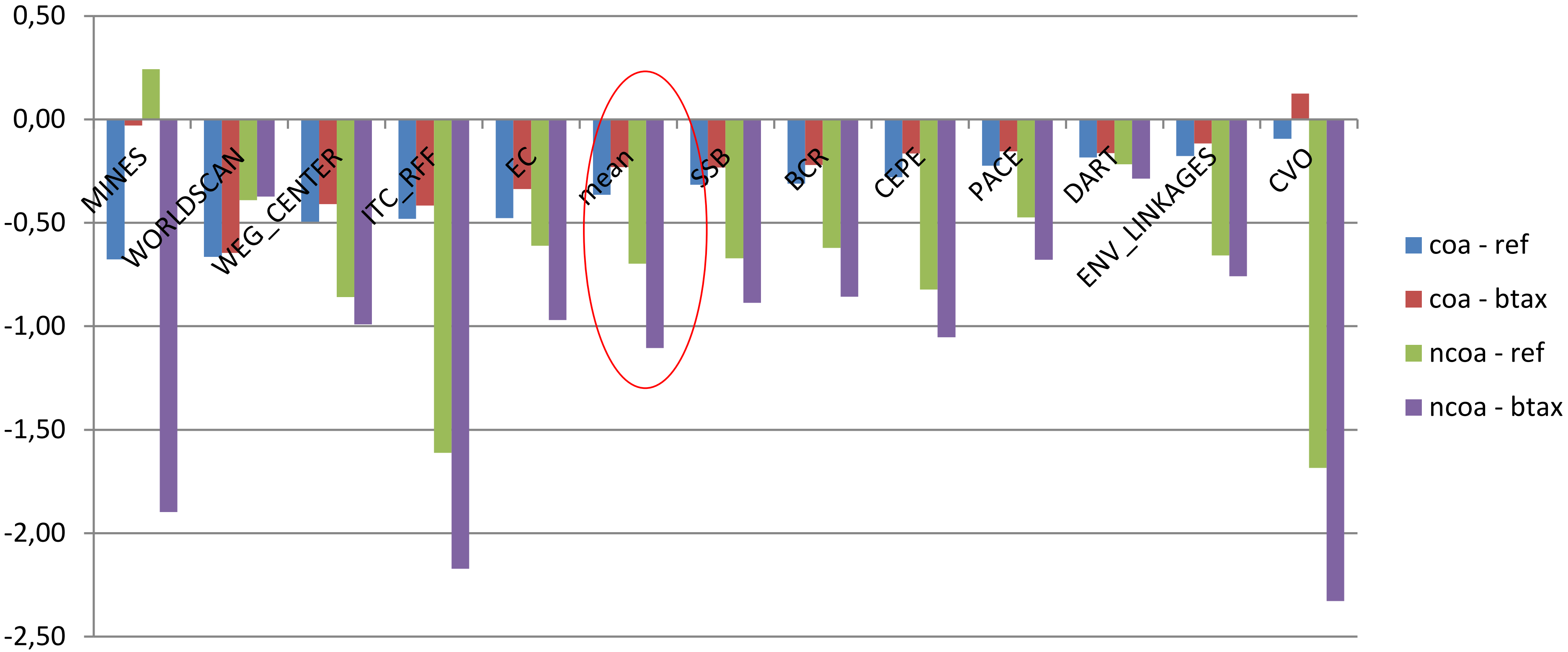
Global Consumption Cost Savings (% from *ref*)

- Limited scope for global cost savings (mean: ~6.4%)



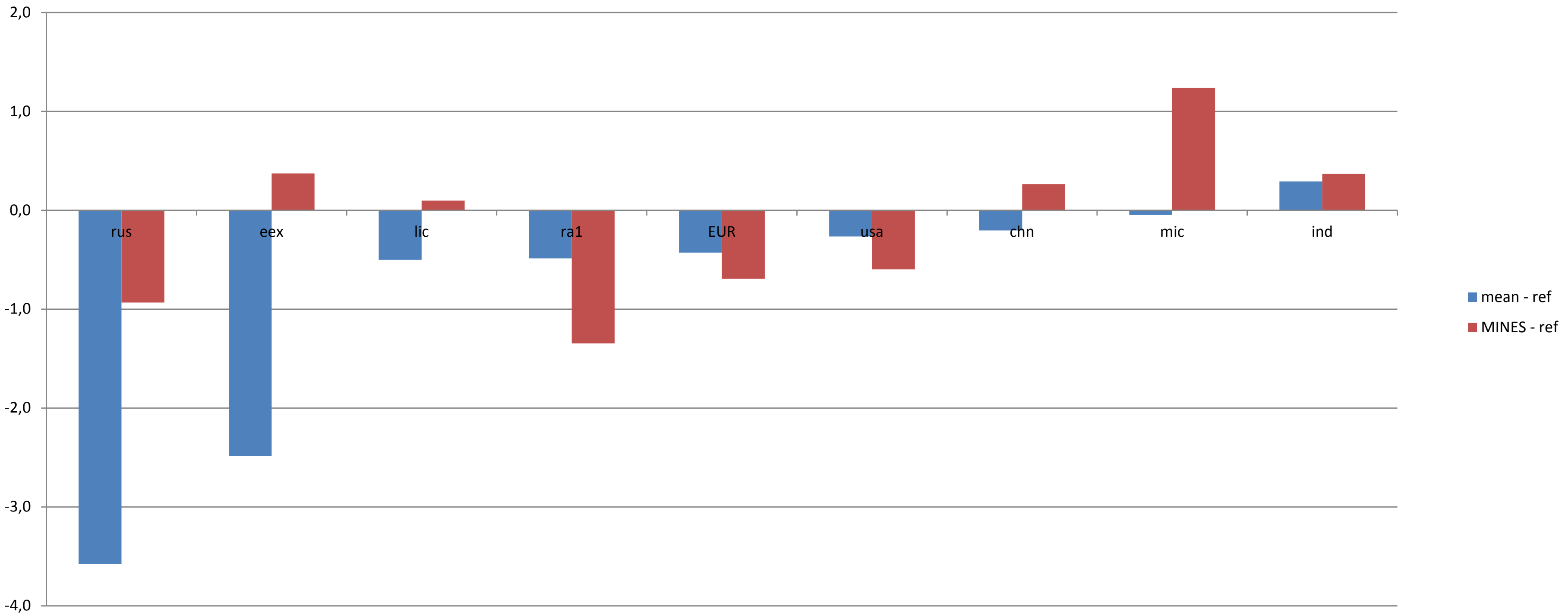
Burden Shifting - Coalition (*coa*) and Non-Coalition (*ncoa*)

- Substantial burden shifting from coalition (coa) to non-coalition (ncoa) through BCA
  - MINES is the only model where non-coalition benefits under *ref*
  - CVO model makes coalition better off for *btax* than in *bau*
  - *btax* may not be superior for coalition compared to *tariff* stand-alone



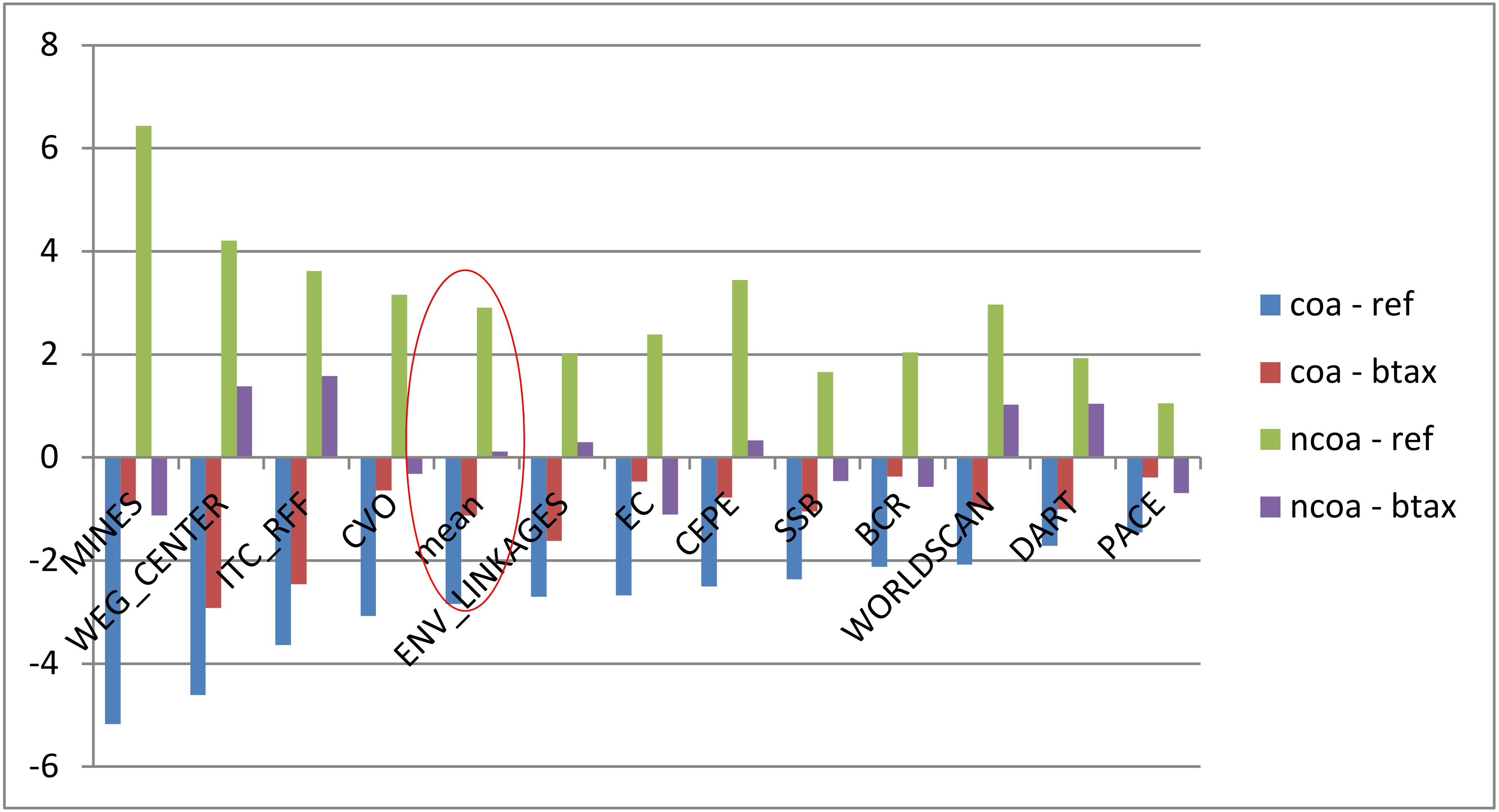
Regional Cost Incidence (% Consumption from *bau*)

- Carbon constraints hit fuel exporters worst (Russia/RUS, OPEC/EEX) – outlier: MINES
- Fuel importers benefit and might be even better off than under *bau* when outside the abatement coalition (here: India/ind)



Output of *EITE* industries (% from *bau*)

- Output losses for EITE industries in coalition countries are markedly reduced through BCA ($mean_{ref}$ ~3% vs. $mean_{btax}$ ~1%)
- EITE in non-coalition countries gain under *ref* which might turn into output losses under *btax*
- *btax* is more effective than *tariff* in protecting the coalition's EITE industries



Sensitivity Analysis: Coalition Size

- As coalition size increases leakage becomes less of a problem (mean drops from ~24% for EUR and ~12% for A1xR to ~7% for A1xR_CHN)
- Relative cost savings through BCA decline (~28% ➔ ~6% ➔ ~2%) with coalition size (N.B.: absolute adjustment cost are for a larger coalition)

Table: Implications of changes in coalition size (mean values)

Coalition size	EUR	A1XR	A1XR_CHN
ref Leakage (%)	23,9	11,8	6,7
Global cost savings (% from *ref*)	27,5	6,4	2,0

Sensitivity Analysis: Base Year (coalition: A1xR_CHN, policy: *ref*)

- Global emission reduction requirement increases considerably as we shift from 2004 to 2020
- Increase in emission reduction goes along with much higher CO_2 prices and more pronounced leakage
- Likewise global economic adjustment cost increase substantially but this does not apply to relative cost savings.

Table: Implications of base year shift (mean values)

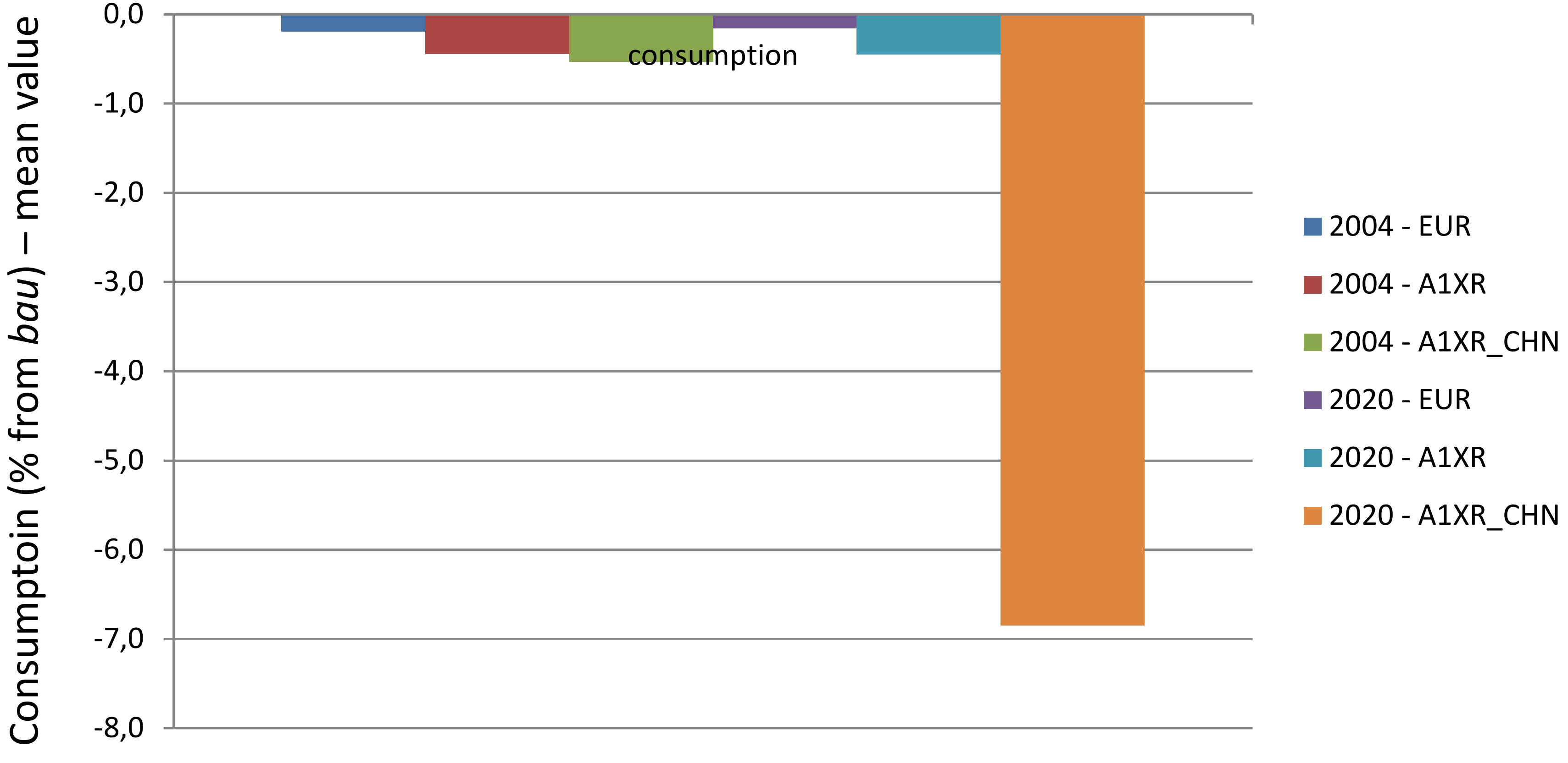
Base year	2004	2020
Global CO_2 reduction (% from *bau*)	-13,1	-23,1
ref CO_2price ($US per ton of CO_2)	26,2	104,9
ref Leakage (%)	6,7	10,3
ref Global consumption (% from *bau*)	-0,3	-1,3
Global cost savings (% from *ref*)	6,4	6,6

N.B.: Larger differences across models indicate differences in baseline assumptions and baseline calibration techniques (even more pronounced with sectoral impacts).

Sensitivity Analysis: Base Year and Coalition Size

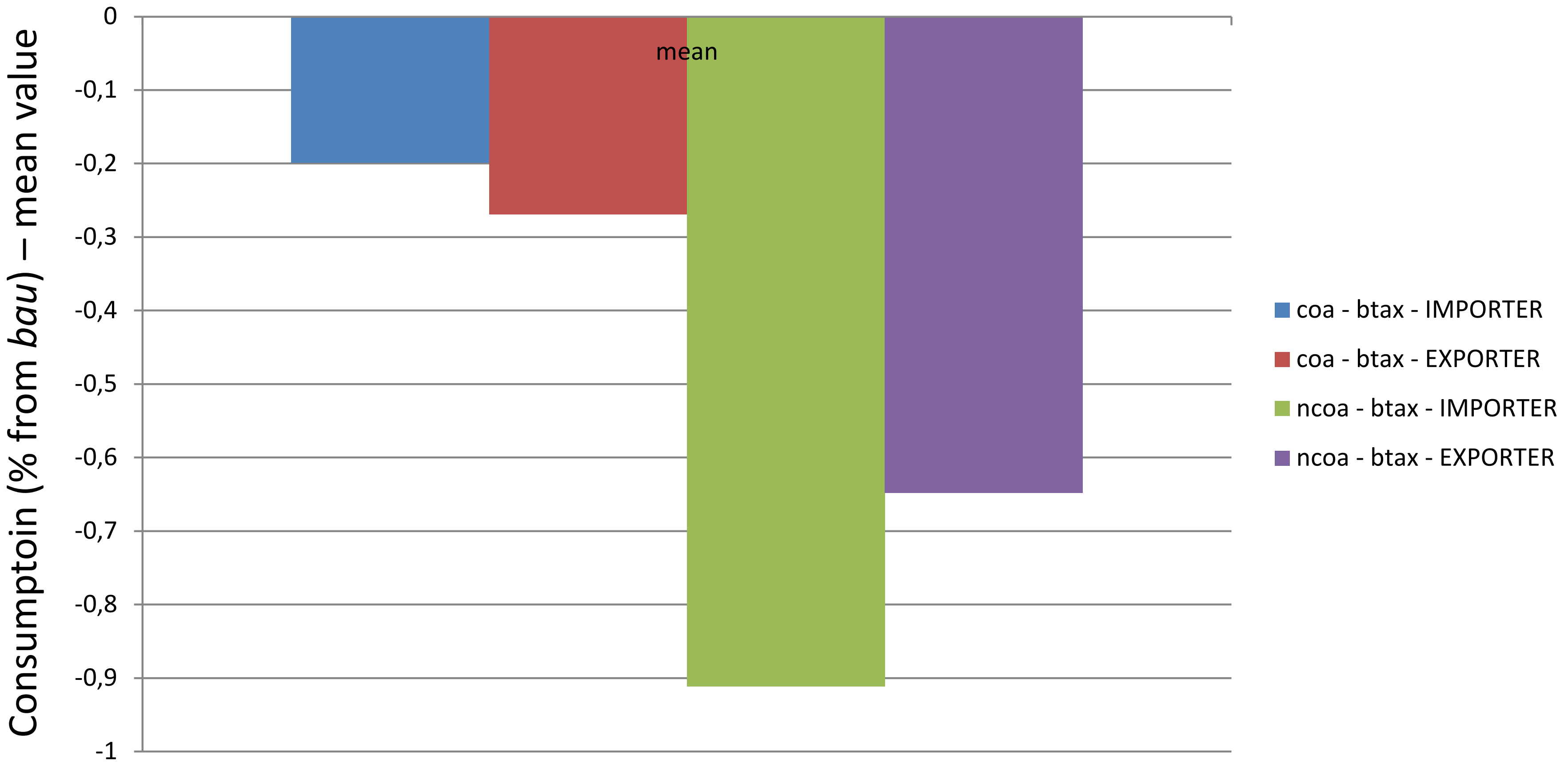
- For China base-year shift and (non-)coalition status has dramatic implications
- With 2004 *bau* emission levels coalition inclusion is not very costly for China
- With 2020 *bau* emission levels coalition inclusion is very costly for China

Figure: Cost incidence for China (mean values)



Sensitivity Analysis: Revenues

- Direct money transfers via re-routing of tariff revenues to non-coalition countries can only offset a smaller fraction of their adverse terms-of-trade effects.



N.B.: Models ITC_RFF and CEPE not included in this sensitivity analysis.

Sensitivity Analysis: Fossil Fuel Price Response

- To analyze the role of the fossil fuel market adjustments we perform additional scenarios where we keep fossil fuel prices fixed at the *bau* level (through supply rationing)
- The effects of constant fuel prices for leakage are drastic but the economy-wide implications on adjustment cost, cost savings (from BCA) and burden sharing compared to the flexible fuel price variants are rather moderate

Table: Implications of constant fuel prices (mean values)

Policy	ref	ref_ffp	btax	btax_ffp
Leakage (in %)	10,31	2,17	6,50	-3,25
CO_2 price (in $ per ton of CO_2)	38,06	30,77	35,92	28,10
Consumption – all (% from *bau*)	-0,37	-0,37	-0,34	-0,35
Consumption – coa (% from *bau*)	-0,33	-0,34	-0,20	-0,25
Consumption – ncoa (% from *bau*)	-0,54	-0,47	-0,91	-0,76
Cost savings (% from *ref*)			6,75	5,32

N.B.: Models ITC_RFF and CEPE not included in this sensitivity analysis.

Conclusions

- Border carbon adjustments can reduce emission leakage.

- The global efficiency gains from border carbon adjustments are modest.

- The cost shifting effects of border carbon adjustments are substantial – in particular when applied from OECD to non-OECD countries

- Given the limited scope for efficiency gains and the burden shifting potential, border carbon adjustments need to be handled with care.

Thank You For Your Attention!