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Border Tax Adjustments in the Climate Policy Context: CO2 versus Broad-based GHG Emission Targeting*

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September 4-5, 2012

* Views expressed in this paper are those of the authors and do not reflect those of the Environment Canada or the Government of Canada.

Outline

- Objective of the paper
- Model framework
- CO2 and non-CO2
- Data sources and calibration
- Policy scenarios
- Simulation results
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Objective of the paper

- Objective of the paper is to explore and compare how and to what extent a GHG-based, rather than an only CO2-based unilateral climate policy, might influence the economies of emissions-abating and non-abating countries at the global level.

The model framework

- A static multi-sector, multi-region computable general equilibrium model is used.
- 12 regions: United States, China ,India, Russia, Brazil, EU 27 plus EFTA, rest of Annex 1 countries, energy exporting countries, low income countries, and middle income countries.
- 14 output production sectors:
  - 3 primary fossil fuel sectors: coal, crude oil and natural gas;
  - 5 energy intensive trade exposed (EITE) sectors: chemicals, iron and steel industry, non-ferrous metals, non-metallic minerals, refined oil products;
  - The remaining 6 sectors are agriculture, electricity and heat, pulp, paper and print, commercial and public services, transportation, and all other goods.

Modeling CO2 emissions

- CO2 emissions in the model are related to the combustion of fossil fuels (i.e., coal, oil, and natural gas) and are linked in fixed proportion to fossil fuel use in production and consumption activities.

- CO2 abatement can take place by three methods: inter-fuel substitution; energy savings from substituting energy by non-energy inputs; and/or by a scale reduction of activities.

Non-CO2 Emissions

- Non-CO2 emissions are mostly process related, while a small share of non-CO2 emissions is energy related.

- Energy related non-CO2 emissions are modeled in the same way as the CO2 emissions.

Non-CO2 Emissions - Cont'd

- The process related non-CO2 emissions are modeled and estimated in fixed proportion to associated output production.
- Abatement of process related non-CO2 emissions is achieved via end-of-pipe technologies.
- The end-of-pipe technologies are directly characterized based on marginal abatement costs (MACs) estimated by the US Environment Protection Agency (EPA 2006).
- MACs illustrate the abatement potential of process related non-CO2 greenhouse gases by source, sector and region.
- No free lunch for process related non-CO2 abatement.

Data sources and calibration

- Global Trade Analysis Project (GTAP) 7.1 database are used.
- Values of elasticity of substitution between labour, capital, energy and material in production are taken from Okagawa & Ban (2008).
- The remaining values of elasticity of substitution are taken from GTAP 7.1.

Policy design: Three hypothetical coalitions

- Three hypothetical coalitions are assumed here:
  - Europe (EU 27 + EFTA)
  - Annex1 countries
  - Annex1 plus China

Policy design: Emissions reduction target

- Each coalition undertakes a net reduction at the global level by an amount equivalent to 20% of the coalition's benchmark GHG emissions in 2004.

- The coalition achieves the required reduction under two policy options: CO2-only policies and GHG-based policies.

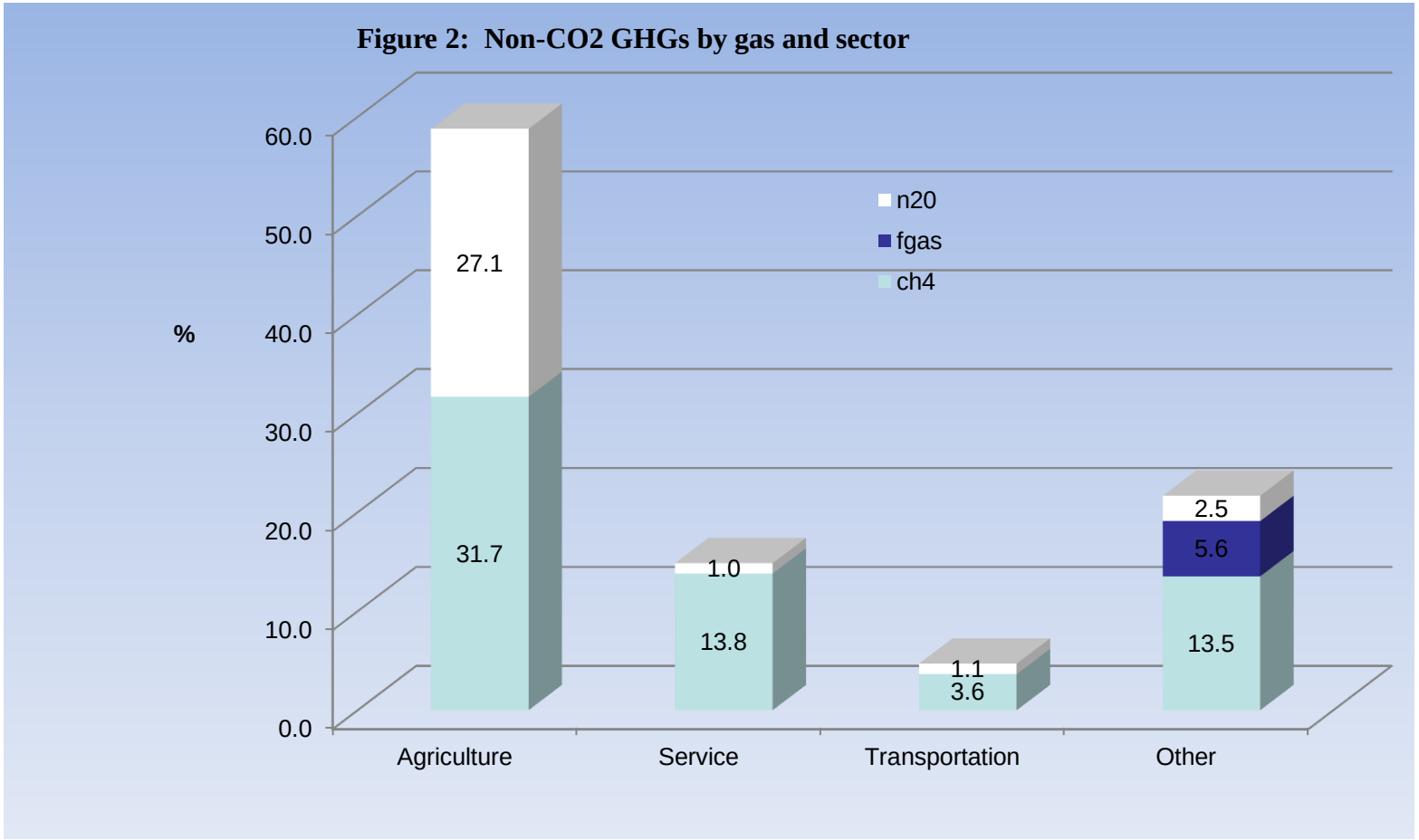
Policy design: Embodied emissions content

- BTAs are based on the embodied carbon content of the products calculated by using a multi-regional input-output (MRIO) approach (Böhringer et al 2012, Peters et al. 2011).

Policy design: Sectoral coverage for BTAs

- Two alternative sectoral coverage for BTAs are considered
  - Only 5 energy intensive trade exposed (EITE) sectors are assumed to be subject to BTAs;
  - EITE sectors plus Agriculture.

Non-CO2 GHGs by gas and sector



Source: GTAP 7.1 database

Policy scenarios and the target year

1. CO2 reference case: CO2 taxes are imposed on CO2 emissions. Permit trading is allowed within the coalition.

2. CO2-EITE-Btax: CO2 reference case plus border tax measures imposed on EITE sectors.

3. CO2-EITE-Agri-Btax: CO2 reference case plus border tax measures imposed on EITE and agriculture.

4. GHG reference case: GHG taxes are imposed on all GHG emissions. Permit trading is allowed within the coalition.

5. GHG-EITE-Btax: GHG reference case plus border tax measures imposed on EITE sectors.

6. GHG-EITE-Agri-Btax: GHG reference case plus border tax measures imposed on EITE and agriculture.

- Policy simulations are for 2004.

Simulation results: Welfare

(% change compared to benchmark consumption)

	CO2-based policies			GHG-based policies		
	CO2-REF	CO2-EITE-Btax	CO2-EITE-Agri-Btax	GHG-REF	GHG-EITE-Btax	GHG-EITE-Agri Btax
Europe targets emissions reduction						
World	-0.603	-0.445	-0.438	-0.221	-0.184	-0.180
Europe	-1.579	-0.889	-0.875	-0.553	-0.309	-0.315
Non-coalition	-0.146	-0.237	-0.233	-0.065	-0.126	-0.117
Annex 1 targets emissions reduction						
World	-0.726	-0.658	-0.656	-0.385	-0.364	-0.361
Annex 1	-0.698	-0.466	-0.465	-0.357	-0.231	-0.235
Non-coalition	-0.841	-1.431	-1.424	-0.495	-0.899	-0.868
Annex 1 and China target emissions reduction						
World	-0.545	-0.533	-0.533	-0.289	-0.291	-0.293
Annex 1 + China	-0.522	-0.384	-0.384	-0.278	-0.212	-0.216
Non-coalition	-0.657	-1.268	-1.267	-0.344	-0.680	-0.677

Emissions prices and emissions leakage

	CO2-based policies			GHG-based policies		
	CO2-REF	CO2-EITE-Btax	CO2-EITE-Agri-Btax	GHG-REF	GHG-EITE-Btax	GHG-EITE-Agri-Btax
CO2 Price($/tonne CO2 eqv)						
Europe	151.26	105.34	101.75	52.35	41.15	34.61
Annex 1	81.28	70.48	69.82	37.82	33.92	31.77
Annex 1 + China	51.26	48.01	47.82	20.31	19.48	18.76
Emission Leakage as % of Coalition's reduction						
Europe	26.25	9.49	9.44	12.29	1.14	-7.75
Annex 1	10.25	1.15	1.25	5.77	-0.32	-4.11
Annex 1 + China	5.34	0.64	0.69	2.49	-0.02	-1.95

Impacts on the EU's sectoral output

(% change compared to benchmark output)

	CO2			GHG		
	REF	MRIO-Btax	MRIO-Btax-AGR	REF	MRIO-Btax	MRIO-Btax-AGR
Agriculture	-1.36	-2.32	-0.11	-4.94	-4.81	0.76
All other goods	-0.04	-1.46	-1.56	-0.06	-0.86	-1.06
Coal transformation	-41.42	-36.28	-35.89	-32.14	-28.38	-26.05
Chemical industry	-4.64	2.41	2.27	-2.34	1.38	0.96
Crude oil	-2.65	-3.46	-3.48	-0.82	-1.64	-1.68
EITE	-7.73	0.94	0.84	-3.58	0.88	0.53
Electricity	-15.53	-10.48	-10.23	-6.97	-4.91	-4.34
Natural gas	-28.79	-23.09	-22.54	-14.77	-12.65	-10.94
Iron and steel	-10.83	1.24	1.08	-4.55	1.09	0.59
Non-ferrous metals	-16.64	9.52	9.08	-8.82	5.74	4.36
Non-metallic minerals	-5.55	-1.35	-1.40	-2.23	-0.39	-0.56
Refined oil	-13.84	-5.98	-5.80	-5.92	-2.01	-1.71
Paper-pulp-print	-1.85	-1.67	-1.69	-0.66	-0.73	-0.79
Commercial services	-0.32	-0.26	-0.28	-0.09	-0.09	-0.15
Transport	-8.25	-6.57	-6.46	-3.21	-2.92	-2.72

Welfare impacts of BTAs on EITE

(% change compared to benchmark consumption)

	Europe		Annex1		Annex 1 + China	
	CO2	GHG	CO2	GHG	CO2	GHG
Brazil	-0.209	-0.091	-0.479	-0.276	-0.303	-0.144
China	-0.377	-0.199	-0.999	-0.669	2.769	-0.350
Other energy exporting	-1.473	-0.848	-3.612	-2.174	-3.098	-1.590
EU 27 + EFTA	-0.889	-0.309	-0.524	-0.242	-0.483	-0.187
India	-0.176	-0.093	0.061	-0.011	0.041	-0.012
Japan	0.026	0.027	-0.811	-0.292	-0.596	-0.176
Low income countries	-0.566	-0.307	-0.664	-0.422	-0.720	-0.379
Middle income countries	-0.260	-0.122	-0.552	-0.368	-0.424	-0.267
Rest of annex 1	-0.197	-0.099	0.874	-0.439	0.139	-0.439
Russia	-3.704	-2.290	-6.500	-4.056	-5.433	-2.836
United States	-0.048	-0.018	-0.505	-0.168	-0.604	-0.200

Welfare impacts of BTAs on EITE and Agriculture (% change compared to benchmark consumption)

	Europe		Annex1		Annex 1 + China	
	CO2	GHG	CO2	GHG	CO2	GHG
Brazil	-0.234	-0.230	-0.509	-0.463	-0.330	-0.311
China	-0.368	-0.167	-0.995	-0.610	2.768	-0.360
Other energy exporting	-1.463	-0.783	-3.599	-2.082	-3.098	-1.556
EU 27 + EFTA	-0.875	-0.315	-0.529	-0.272	-0.487	-0.206
India	-0.176	-0.077	0.060	0.006	0.041	0.003
Japan	0.029	0.029	-0.799	-0.265	-0.591	-0.165
Low income countries	-0.607	-0.487	-0.702	-0.660	-0.753	-0.567
Middle income countries	-0.249	-0.095	-0.533	-0.305	-0.409	-0.223
Rest of annex 1	-0.199	-0.098	0.863	-0.453	0.136	-0.440
Russia	-3.670	-2.071	-6.491	-3.908	-5.445	-2.785
United States	-0.046	-0.011	-0.499	-0.156	-0.601	-0.193

Concluding remarks

- Efficiency costs of GHG-based policies are much lower than those based on CO2-only.
- BTAs under both CO2-based and GHG-based policies reduce emissions leakage, reduce competiveness effects and bring significant gains to the coalition.
- The gains to the coalition under BTAs are, however, at the cost of non-coalition regions.

Concluding remarks - Cont'd

- Compared to CO2-based policy, agriculture is impacted more when GHG-based policy is introduced.
- Brazil would suffer much more when agriculture is subject to BTAs and all GHGs are targeted.
- While oil exporting nations are impacted significantly, Russia is the one impacted the most.

Acknowledgement

- Professor Thomas F. Rutherford, Professor Christoph Böhringer contributed many thoughts to this paper we would like to give our thanks to them.
- Senior policy analyst Julie Vanderschot made excellent comments and suggestions, we really appreciate it.
- We also like to thank two anonymous referees who provided many very detailed constructive comments.
- The ideas expressed here are those of the authors who remain solely responsible for errors and omissions.