10TH EUROFRAME CONFERENCE ON ECONOMIC POLICY ISSUES IN THE EUROPEAN UNION

Economic effects of unilateral European climate action

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Agenda

- Why economists would take care of climate policy?
- Polluters pay principle
- Carbon leakage
- EU unilateral actions
- CGE model
- Analysis for 2020
- Conclusions

Climate action

Strategies (energy efficiency, energy conservation,…) intended to guide community efforts for reducing GHG emissions:

GHG – **(77%) carbon dioxide** CO_2 used by food industry,

(14%) methane $CH_4$for electrical generation,

(8%) laughing gas N_2O for surgery and engines,

freon (CFC) for aerosol-sprays,

chlorodifluoromethane (HCFC) for air-conditioning

ozone (O_3) for treating water,

water vapor (H_2O),

…

Anthropogenic sources – combustion of fossil fuels and waste, deforestation, agricultural activities, chemicals, **…**

Anthropogenic sources of GHG

- Energy 62%
  - Electricity & heat 25%
  - Transportation 14%
  - Industry 10%
  - Other fuel combustion 9%
  - Fugitive emissions 4%
- Land use change 18%
- Agriculture 13%
- Waste 3.5%
- Industrial processes 3.5%

Top 10 emitters of GHG

1. China 19%
2. USA 18%
3. Russia 5%
4. Brazil 5%
5. India 5%
6. Japan 3.5%
7. Germany 2.5% (vs EU 13%)
8. Canada 2%
9. UK 2%
10. Italy 1.5%

…

…

20. Ukraine 1%
21. Poland 1%
22. Thailand 1%
23. Turkey 1%

…

International agreemetns

- United Nations Framework Convention on Climate Change (1992) - 194 countries

non-binding aim to stabilize emissions of GHG at 1990 levels by 2000

- Berlin Mandate (1995)

differentiated responsibilities - the distinction between the Annex I countries and the non-Annex I countries (the last group of countries does not have any responsibilities in GHG emission reduction)

- Kyoto Protocol (1997) – 191 countries **(no US)**

binding reductions for Annex I countries in GHG reduction of 6-8% below 1990 levels between the years 2008–2012 (I commitment period)

- Conference in Durban (2011) - ? countries **(no US, Russia, Canada, Japan,…The only one from the top 10 emitters is EU)**

binding reductions for Annex I countries in GHG reduction of 20% below 1990 levels between the years 2013–2020 (II commitment period)

Purporse of the analysis

1) to provide an economic analysis of unilateral climate policy by the EU,

2) to quantify the risk of carbon leakage,

3) to investigate economic effects related to the potential anti-leakage policy measures.

We propose a three-region CGE model of the global economy with a simulation for 2020 in order to provide a decomposition of carbon emissions by region.

Carbon leakage

CL is an additional emission elsewhere caused by an emission decrease somewhere (everything else being constant)

$$CL(\Delta R) =$$

$$(f_N(GDP_N, P_N, GDP_A(R_0+\Delta R)) - f_N(GDP_N, P_N, GDP_A(R_0))) / \Delta R$$

N - the region where the carbon emissions „leak to” (though it may also undertake some climate action)

A - the region which undertakes an abatement program

R_0 - the baseline reduction target adopted in A

ΔR - an additional reduction target contemplated in A

f_N - an emission function for N

P_N - an abatement policy adopted in N

GDP_A is assumed to be a function of a reduction target adopted in A

Carbon leakage

CL< 0 ⇒ emission reduction in N corresponding to an increased carbon abatement target adopted in A

For example, this occurs if the abatement action in A induces a strong technological progress.

CL>0 ⇒ emission increase in N corresponding to an increased abatement target adopted in A

It is a result of moving production to where it is not constrained by environmental policies.

100>CL>0 ⇒the increase in emissions in N due to the additional reduction in A is lower than this additional reduction in A

Abatement action in A contribute to climate protection.

CL>100 ⇒ the additional emissions in N turn out higher than the additional reduction undertaken in A.

Abatement action in A is detrimental for climate protection

CL=0 ⇒ neither emission increase nor reduction in N corresponding to an increased abatement target adopted in A

N do not change behavior, but A decrease emission.

Carbon leakage

The first value added of the paper – the alternative definition of CL

1. New distinction between regions N & A

Non-abating countries may also undertake some climate action

2. *Caeteris paribus* assumption crucial

It is important that variables (apart from ΔR and thus GDP_A) are kept constant

3. BAU with no climate action cannot represent a baseline

Hypothesis: unilateral climate policy by the EU is ineffective and detrimental for global climate protection

Relevant literature

A major issue in many modeling exercises of carbon leakage is that they reflect authors' assumptions regarding actions that are expected on behalf of some agents.

e.g. 20% emission reduction by Annex I countries generate the following carbon leakage:

1% by Mattoo et al. (2009) – World Bank

6% by Burniaux et al. (2009) - OECD

15% by Boehringer et al. (2010) - RFF

25% by Winchester (2011) - MIT

50% by Carbone et al. (2009)

130% by Babiker (2005)

Relevant literature (2)

The carbon leakage results depend also on which regions are defined as those that undertake an abatement program,

- unilateral commitments by US generate lower carbon leakage than by EU

e.g. 20% emission reduction by EU generate CL:

11% by Kuik and Hofkes (2010)

20% by Loeschel et al (2008), Schinko (2010)

50% by Steininger (2011)

74% by Bossello et al. (2011)

e.g. 20% emission reduction by US generate CL:

8% by Fischer and Fox (2010)

10% by Boehringer at al. (2010)

Instruments of climate action

- Carbon tax

  -ecological tax reform is possible

- Tradable emission permits

  -auctioning, grandfathering, OBA

- Fuel standards
- Quota for renewable fuels
- Climate-friendly subsidies (eg. biofuels)

  -considerable controversy

- Nuclear power

  - effective but dangerous

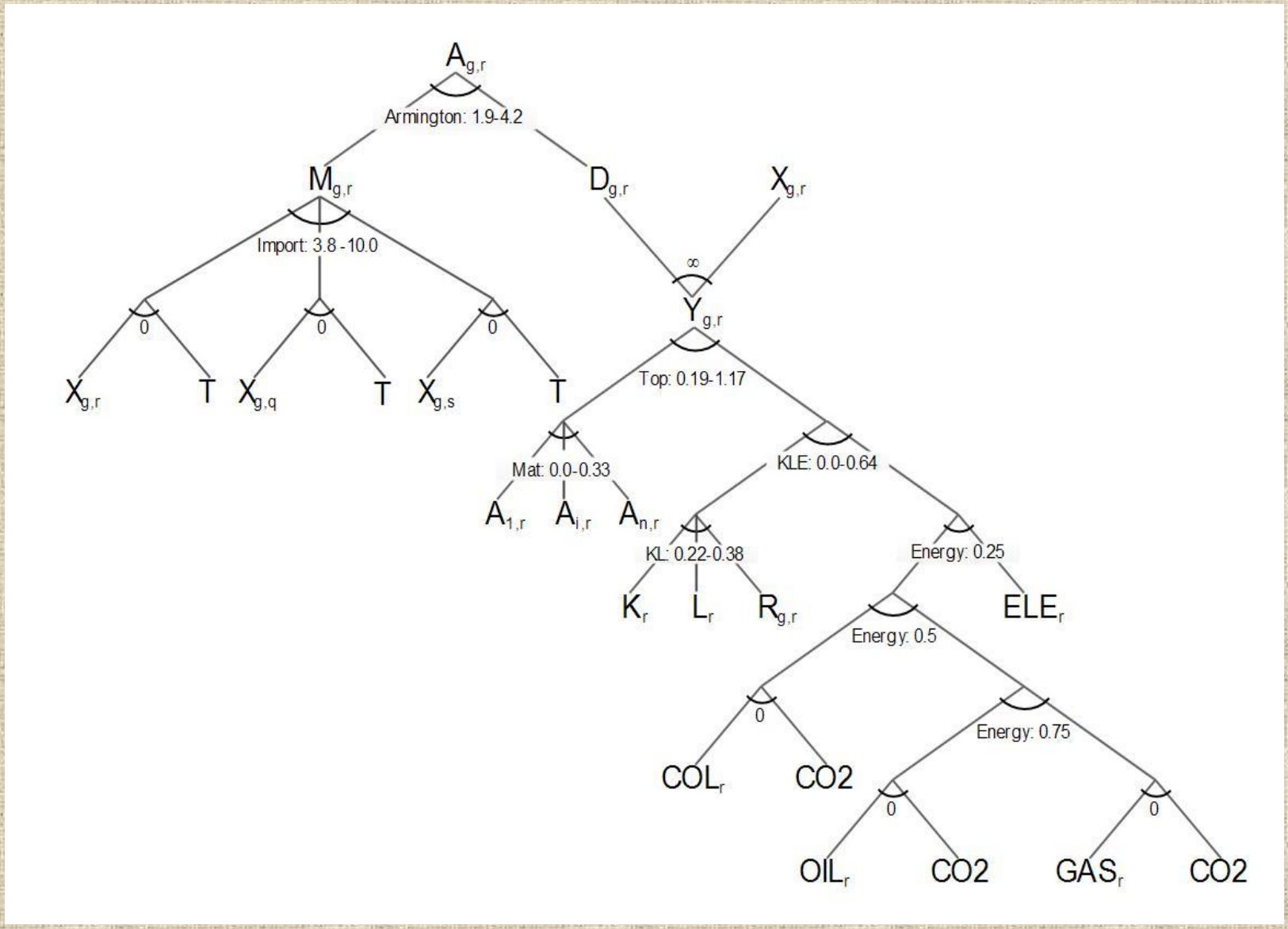
Anti-leakage instruments

- BTA
  - on imports, on exports, full adjustment
  - based on the carbon content of imports or domestic production
- Tax on international transportation
  - exclude/include passenger transportation
- CDM
  - GHG emission level before/after CDM is at the BAU level
- OBA
  - only for trade-exposed sectors that are energy-intensive

Model

- recursive-dynamic CGE for 2020 based on 2004
  - 3 regions (EU, A1, DC)
  - 13 sectors per region
  - 7 production factors (including 5 energy factors)
  - 1 representative household per region
  - government per region
  - benchmark taxes (but not for CO2)
  - benchmark unemployment
  - sectors in EU are grouped into ETS and EITE
  - CO2 is the only pollution

Production and trade structure



Scenarios for 2020

Characteristics / Scenario	BAU	REF	LOW	HIGH	BTA	CDM	CDM_NEW	OBA
Carbon reduction targets, in % relative to 2004								
EU ETS	0	21	10	34	21	21	21	21
EU non-ETS	0	10	2	16	10	10	10	10
Rest of Annex 1 (A1)	0	4	4	4	4	4	4	4
Developing Count. (DC)	0	0	0	0	0	0	0	0
Allocation of emission allowances and carbon tax								
Free emission allowances								EITE (excl. OIL)
Auctioning with lumpsum recycling		EU ETS	EU ETS	EU ETS	EU ETS	EU ETS	EU ETS	non EITE
Carbon tax with lumpsum recycling		non-ETS A1	non-ETS A1	non-ETS A1	non-ETS A1	non-ETS A1	non-ETS A1	non-ETS A1
Border carbon adjustments based on carbon content of traded goods								
Import tariffs					EU A1			
Use of international carbon offsets								
BAU emission level in DC						Before trading	After trading	
Limit as a % of reduction target in EU ETS						20%	20%	
Limit as a % of reduction target in non-EU ETS						33%	33%	

Results relative to BAU [%]

	Welfare			GDP			Unemployment rate		
	EU	A1	DC	EU	A1	DC	EU	A1	DC
LOW	-0.09	-0.32	-0.12	-0.19	-0.45	-0.05	0.1	0.2	0.0
REF	-0.47	-0.37	-0.19	-0.73	-0.48	-0.10	0.3	0.2	0.0
HIGH	-1.23	-0.42	-0.28	-1.65	-0.53	-0.16	0.6	0.2	0.0

	Carbon price [US $ per t CO2]				Electricity price		
	EU-ETS	EU-nonETS	A1	DC	EU	A1	DC
LOW	21.4	21.3	29.8	-	5.3	12.6	-0.6
REF	49.3	96.2	30.6	-	11.0	12.8	-0.8
HIGH	117.9	196.6	31.7	-	24.1	13.1	-0.9

Results relative to BAU [%]

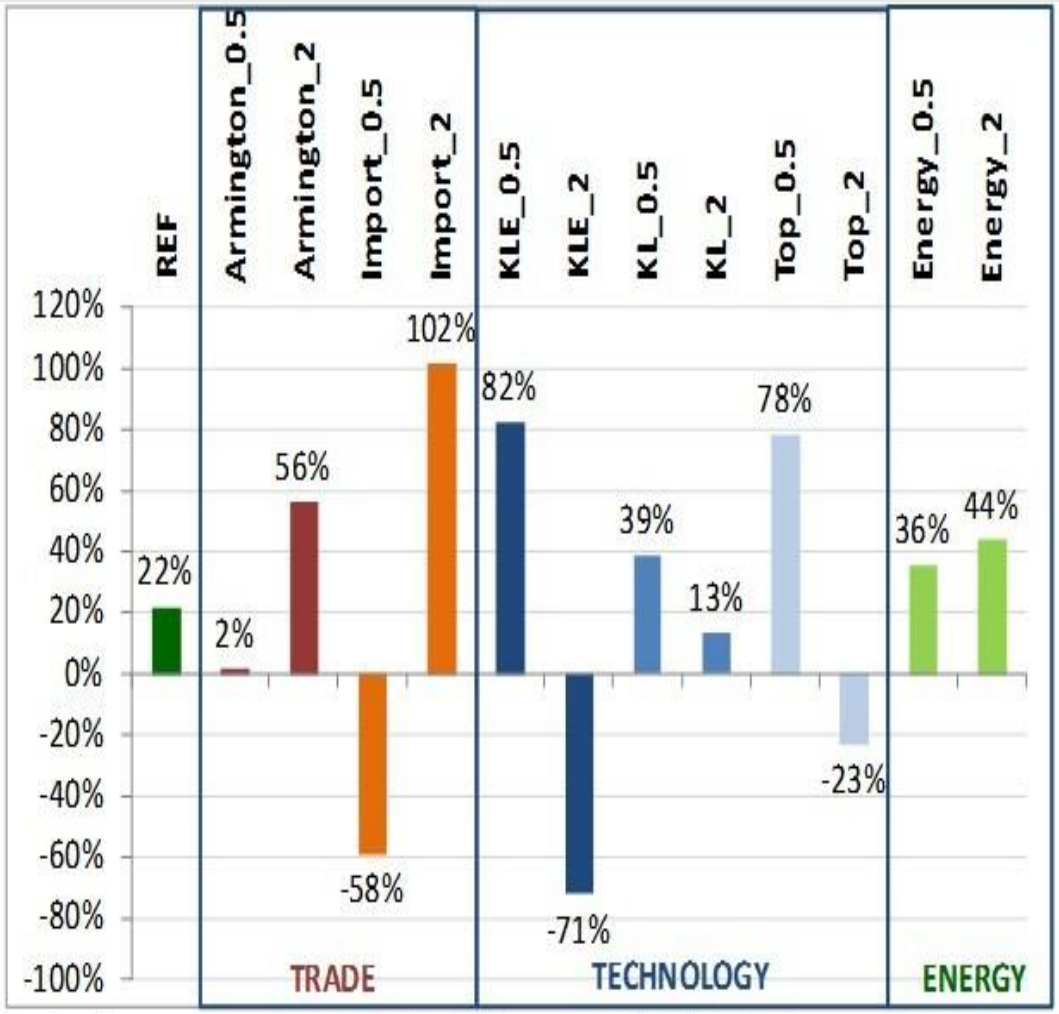
	Welfare			GDP			Unemployment rate		
	EU	A1	DC	EU	A1	DC	EU	A1	DC
REF	-0.47	-0.37	-0.19	-0.73	-0.48	-0.10	0.3	0.2	0.0
CDM	-0.32	-0.29	-0.09	-0.48	-0.35	-0.08	0.2	0.1	0.1
CDMnew	-0.32	-0.28	-0.04	-0.49	-0.35	-0.03	0.2	0.1	0.0
OBA	-0.40	-0.36	-0.19	-0.66	-0.48	-0.09	0.3	0.2	0.0
BTA	-0.31	-0.35	-0.45	-0.67	-0.47	-0.22	0.3	0.2	0.0

	Carbon price [US $ per t CO2]				Electricity price		
	EU-ETS	EU-nonETS	A1	DC	EU	A1	DC
REF	49.3	96.2	30.6	-	11.0	12.8	-0.8
CDM	36.3	58.0	20.3	2.3	8.5	8.7	1.3
CDMnew	35.9	57.6	20.1	0.8	8.4	8.7	0.0
OBA	49.9	89.2	30.5	-	11.2	12.7	-0.8
BTA	53.1	104.4	30.7	-	11.7	12.8	-1.0

Results

	BAU	LOW	REF	HIGH	CDM	CDMnew	OBA	BTA
Global emission								
% of BAU	100%	95%	94%	93%	93%	95%	94%	94%
% of LOW	105%	100%	99%	98%	98%	100%	99%	99%
Carbon leakage rate								
Leakage rate relative to LOW (A=EU, N=A1+DC) our definition			22%	28%	-200%	40%	19%	-16%
Leakage rate relative to LOW (A=EU+A1, N=DC)			22%	28%	503%	181%	19%	-16%
Leakage rate relative to BAU (A=EU+A1, N=DC) common definition		14%	16%	18%	-28%	0%	15%	10%
Leakage rate relative to BAU (A=EU, N=A1+DC)		-368%	-177%	-107%	-306%	-218%	-181%	-195%

Sensitivity analyses for CL



Note: The names of technology parameters refer to different production factors or their composites and come from K- capital, L – labor, E – energy. Parameter "Top" refers to the top nest in the production function and a substitution between a KLE composite and materials.

Conclusions

- Unilateral EU climate policy may lead to significant crbon leakage
- EU will be responsible for only about 11% of global GHG emissions in 2020 $\Rightarrow$ Its unilateral actions are doomed to fail in solving the global problem
- The welfare effects can be mitigated by anti-leakage measures, but this is rather a zero-sum game if the corresponding effects in DC region are considered.
- The EC allocated the Kyoto targets (scenario LOW) between ETS and non-ETS cost-effectively. However, targets distribution proposed in the II commitment period (scenario REF) is far from being efficient, since the marginal abatement cost is significantly higher in non-ETS.