Some Doubts about the Carbon Leakage Effects of the Kyoto Protocol

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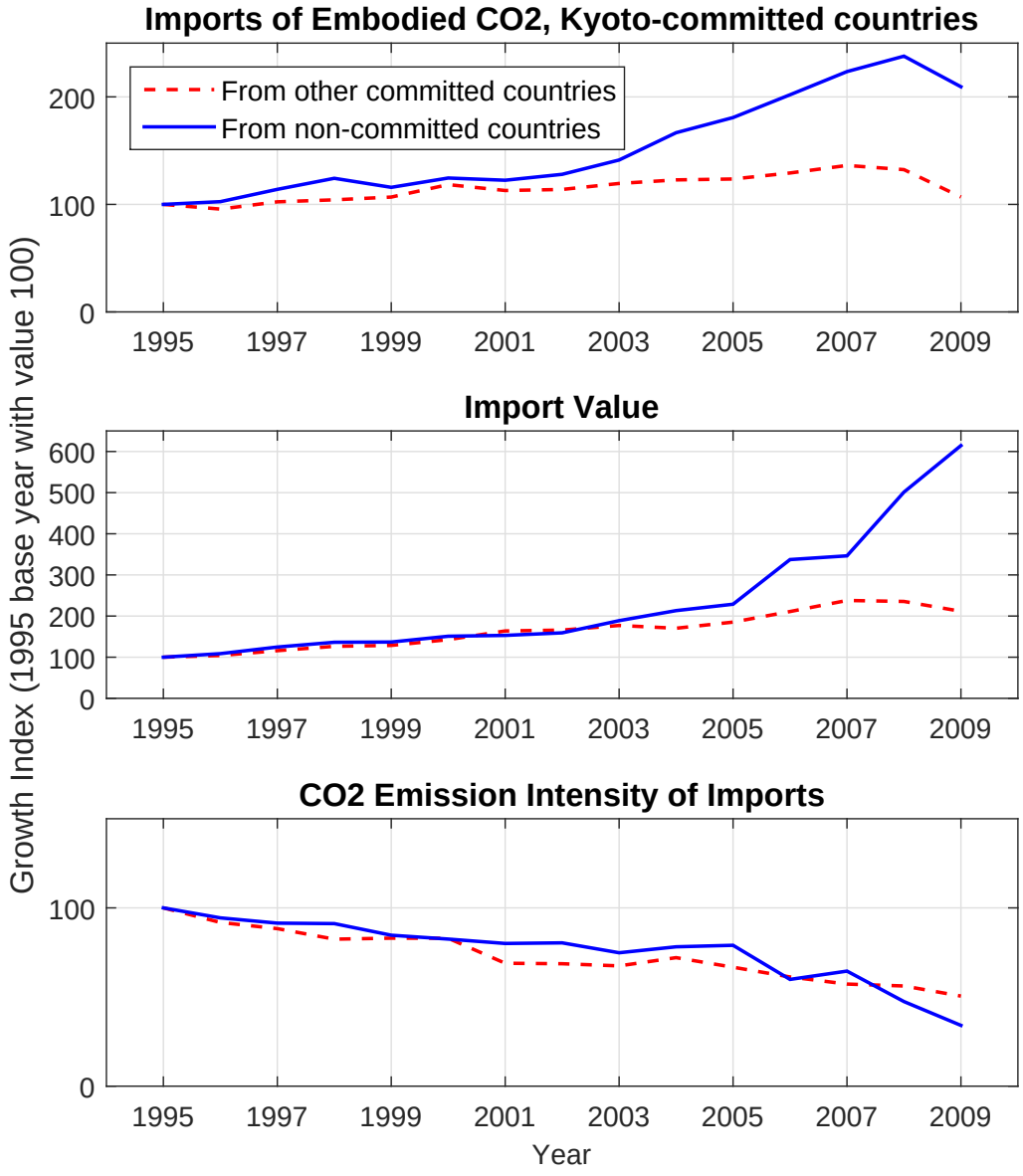
Introduction

- There are widespread fears that unilateral policy action against climate change results in **carbon leakage**
  - If domestic climate regulation causes CO_2 emissions to increase in non-regulated areas we speak of carbon leakage (CL)
  - Channel of CL: Trade
- CL can counteract the goal of climate regulation $\Rightarrow$ global emissions could even increase due to domestic regulation
- How do differences in Kyoto status affect international trade and its CO_2 content?

Emission content of imports



This study

- As Aichele and Felbermayr (2015), estimate a gravity-style model including a variable capturing the between-country difference of Kyoto status
- Use of WIOD project data
- Argue that the baseline estimates are not very informative about absolute leakage
- Absolute estimated leakage is low
  - (i) Absolute implied leakage is significantly lower in detailed breakdown by sector and country
  - (ii) Baseline results are driven by Eastern European countries - simultaneous accession to the EU biases estimates upwards

Methodology

Estimation Equation

$$ln\left(Y_{i,j,s,t}\right) = \alpha_0 + \alpha_1 \Delta K_{i,j,t} + \boldsymbol{\alpha_2 P_{i,j,t}} + \boldsymbol{V_{i,j,t}} + \nu_{i,j,s} + \epsilon_{i,j,s,t}$$

$$where\ Y_{i,j,s,t} \in \left\{M^c_{i,j,s,t}, M_{i,j,s,t}, \gamma_{j,s,t}\right\}$$

$$\Delta K_{i,j,t} = K_{i,t} - K_{j,t}$$

$$K_{i,t} = \begin{cases} 1 & \text{if } i \text{ has ratified commitments in } t \text{ or before} \\ 0 & \text{otherwise} \end{cases}$$

Outcome variables are related in following way

$$M^c_{i,j,s,t} \equiv M_{i,j,s,t}\gamma_{j,s,t}$$

Data

- Main resource: **WIOD** project (`http://www.wiod.org/`)
  - 40 countries, 85% of World GDP, 29/37 Annex-B parties to the Kyoto Protocol
  - 34 sectors, 2 primary 15 secondary 17 tertiary
  - 15 years, 1995-2009
  - World Input-Output Tables
  - Sectoral trade flows
  - Sectoral price indices
  - Environmental Accounts (Sectoral CO2 emissions, energy use)
- Multi-regional input-output analysis to obtain emission content of sectoral final demand ($\supset$ exports)

Baseline

	$M^c_{i,j,s,t}$	$M_{i,j,s,t}$	$\gamma_{j,s,t}$	$M^c_{i,j,s,t}$	$M_{i,j,s,t}$	$\gamma_{j,s,t}$
$\Delta K_{i,j,t}$	0.098***	0.088***	0.011**	0.101***	0.089***	0.012***
	(0.020)	(0.019)	(0.005)	(0.019)	(0.019)	(0.005)
$RTA_{i,j,t}$	-0.037	-0.039	0.002	-0.037	-0.039	0.002
	(0.042)	(0.041)	(0.011)	(0.040)	(0.040)	(0.010)
$WTO_{i,j,t}$	0.095	0.087	0.009	0.082	0.077	0.006
	(0.117)	(0.116)	(0.040)	(0.111)	(0.114)	(0.033)
$EU_{i,j,t}$	-0.035	-0.038	0.003	-0.047	-0.047	-0.000
	(0.044)	(0.043)	(0.013)	(0.047)	(0.047)	(0.009)
$\Delta GDPpc_{i,j,t}$				0.674***	0.247***	0.427***
				(0.053)	(0.055)	(0.014)
$\Delta GDPgr_{i,j,t}$				0.058	0.091	-0.037
				(0.106)	(0.108)	(0.026)
$Size_{i,j,t}$				1.679***	2.170***	-0.492***
				(0.245)	(0.251)	(0.081)
$Simil_{i,j,t}$				0.915***	1.148***	-0.234***
				(0.205)	(0.211)	(0.057)
$RFE_{i,j,t}$				-0.005	-0.009	0.004
				(0.100)	(0.101)	(0.022)
Adj. R2	0.917	0.922	0.846	0.918	0.922	0.848
Obs.	746267	747021	746267	746267	747021	746267

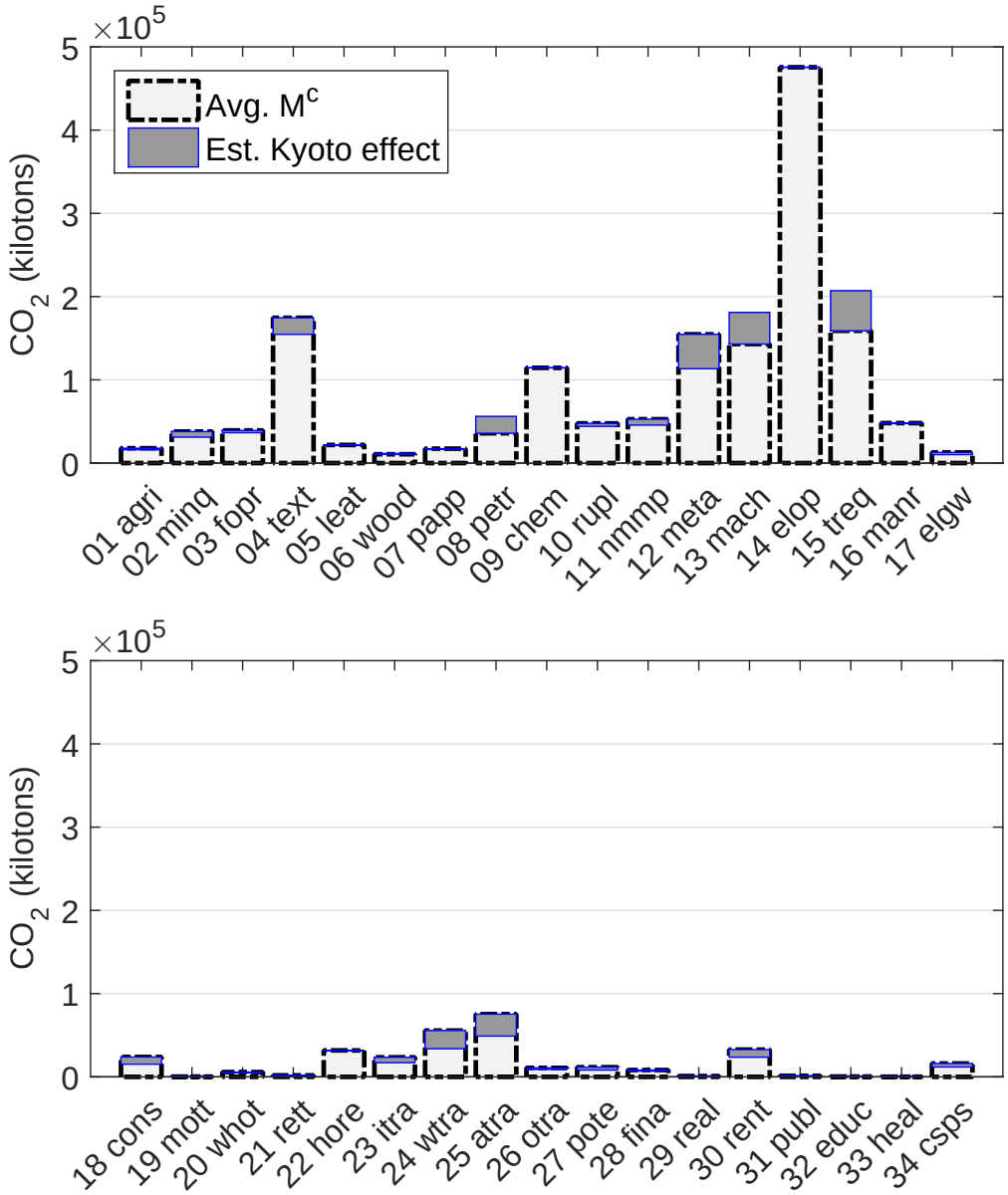
Standard errors in parentheses. Significance: * p<0.10, ** p<0.05, *** p<0.01. Includes: FE for country-year and importer-exporter-sector. Standard errors are clustered by importer-exporter (1560 clusters).

Sectoral Ranking

$M^{c}_{i,j,s,t}$		$M_{i,j,s,t}$		$\gamma_{j,s,t}$	
08-petr	-0.567	24-wtra	0.321	08-petr	-0.533
24-wtra	0.392	25-atra	0.307	13-mach	-0.464
33-heal	0.365	18-cons	0.262	15-treq	-0.452
18-cons	0.362	23-itra	0.248	04-text	0.191
25-atra	0.350	34-csps	0.221	10-rupl	0.175
32-educ	0.338	33-heal	0.213	32-educ	0.174
15-treq	-0.303	17-elgw	0.208	33-heal	0.152
27-pote	0.297	31-publ	0.203	27-pote	0.150
30-rent	0.279	19-mott	0.199	09-chem	-0.143
23-itra	0.275	13-mach	0.198	22-hore	0.130
12-meta	0.267	30-rent	0.179	06-wood	-0.122
13-mach	-0.266	32-educ	0.164	28-fina	0.121
34-csps	0.263	12-meta	0.153	12-meta	0.114
31-publ	0.254	15-treq	0.149	29-real	0.110
19-mott	0.245	27-pote	0.147	30-rent	0.101
17-elgw	0.208	02-minq	0.117	11-nmmp	0.100

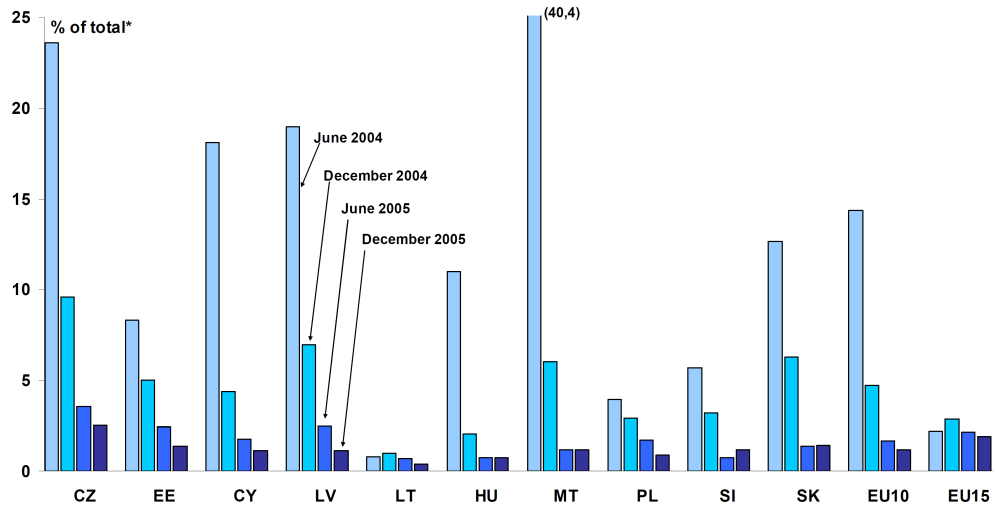
Ranking of the 16 highest (absolute value) coefficients on differential Kyoto commitment in sectoral regressions of the three outcome variables. All of the listed coefficients are significant at the 1% significance level.

Sectoral Results in Absolute Terms

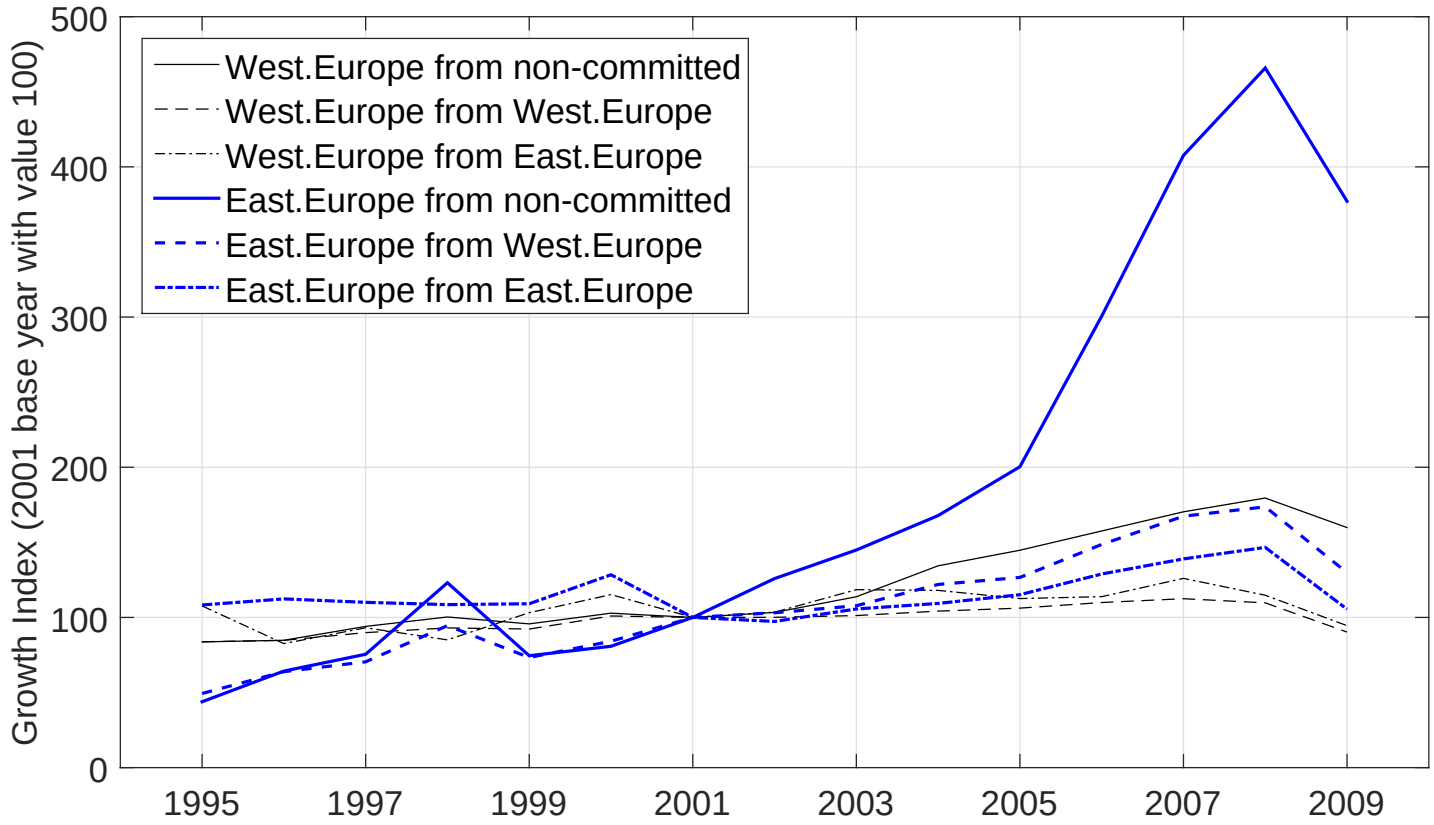


Eastern European Ratifiers

- 10 out of 11 Eastern European countries in WIOD joined the EU between 2004-2007
- Exhibit highly significant impact on estimated leakage
- In the pre-EU accession period, applicant countries have to adopt the "Acquis communautaire"
  - Environmental chapter incurred significant costs
- Environmental reforms motivated by the Acquis and the perceived gains from becoming a EU member



Eastern European Ratifiers



The group 'Eastern Europe' includes the ten countries from this region with non-binding emission constraints. The group 'Western Europe' contains all other Kyoto committed countries (i.e. also Australia, Japan, Canada).

Baseline w/o Eastern European Ratifiers

	$lnM^c_{i,j,s,t}$	$lnM_{i,j,s,t}$	$ln\gamma_{j,s,t}$
$\Delta K_{i,j,t}$	0.043*	0.084***	-0.039***
	(0.022)	(0.022)	(0.006)
$RTA_{i,j,t}$	0.051	0.056	-0.005
	(0.160)	(0.159)	(0.027)
$WTO_{i,j,t}$	-0.270	-0.253	-0.016
	(0.212)	(0.205)	(0.085)
$EU_{i,j,t}$	-0.014	-0.040	0.025
	(0.242)	(0.239)	(0.034)
Adj. R2	0.925	0.929	0.836
Obs.	410912	411483	410912

Regressions exclude 10 countries from Eastern Europe. Dependent variables in natural logarithms (e.g. ln $M^c_{i,j,s,t}$). Standard errors in parentheses. Significance: * p<0.10, ** p<0.05, *** p<0.01. Regressions include fixed effects for country-year and importer-exporter-sector. Standard errors are clustered by importer-exporter (1560 clusters).

Conclusion

- This study's results hint towards low leakage effects from the Kyoto Protocol
  - Strong increases in sectors with low absolute impact
  - Arguably, Eastern European countries increased CO2 imports mainly due to EU accession