Investigating the effect of carbon leakage on the environmental Kuznets curve using luminosity data

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ONLINE APPENDIX

Table A1. *LIGHT – Energy/Emission correlation*[a]

	(1) logLIGHT World	(2) logLIGHT Low income	(3) logLIGHT Lower middle	(4) logLIGHT Upper middle	(5) logLIGHT High income Non-OECD	(6) logLIGHT OECD
logCO_2eq	0.796***	0.380**	0.735***	0.616***	0.687**	0.249
# Adm0	135	33	41	25	12	24
logEnergyUse	0.796***	0.390***	0.713***	0.533***	0.440	0.602***
# Adm0	151	38	48	28	13	24
logElectr	0.878***	0.746***	0.734***	0.577***	0.258	0.720***
# Adm0	136	33	41	26	12	24

Notes:

[a] Light, energy and emission data are averaged at the country level.

** $p < 0.05$, *** $p < 0.01$.

Table A2. *Effect of manufacturing on* $\boldsymbol{\eta}$

	(1) η	(2) η	(3) η	(4) η
Share of manufacturing (% of GDP)	-0.0154***	-0.0154***	-0.0152***	-0.00806***
	(-10.42)	(-10.43)	(-10.37)	(-5.51)
Satellite FE	NO	YES	YES	YES
Year FE	NO	NO	YES	YES
Country FE	NO	NO	NO	YES
Constant	13.17***	13.26***	13.38***	13.42***
	(540.38)	(305.07)	(198.97)	(186.53)
#Observations	4835	4835	4835	4835
R-squared	0.0240	0.0394	0.0601	0.9165

t statistics in parentheses. *** $p < 0.001$.

Table A3. *Fixed-effects model*

FE regressions	(1) η World	(2) η Low income	(3) η Lower middle	(4) η Upper middle	(5) η High income Non-OECD	(6) η OECD
Merch. Imports (% of GDP)	-0.343***	0.151*	-0.534***	-1.547***	0.106	0.154
	(-6.61)	(1.98)	(-6.41)	(-9.51)	(0.83)	(0.35)
Merch. Exports (% of GDP)	0.237***	-0.188**	0.596***	1.506***	0.0166	-0.151
	(5.60)	(-3.30)	(6.58)	(8.97)	(0.11)	(-0.40)
Constant	13.11***	13.34***	12.94***	12.82***	13.30***	12.93***
	(560.24)	(340.39)	(326.64)	(157.37)	(191.94)	(187.91)
#Obs.	3464	1128	972	573	270	521
#Countries	164	53	47	27	13	24
R-squared within	0.2584	0.2672	0.4176	0.3587	0.4700	0.3211
R-squared between	0.0018	0.0118	0.0579	0.0349	0.7463	0.0304

t statistics in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A4. *First-difference model*

	(1) $\Delta\eta$ World	(2) $\Delta\eta$ Low income	(3) $\Delta\eta$ Lower middle	(4) $\Delta\eta$ Upper middle	(5) $\Delta\eta$ High income Non-OECD	(6) $\Delta\eta$ OECD
ΔMerch. Imports (% of GDP)	-0.0673 (-1.19)	-0.0490 (-0.70)	-0.104 (-0.97)	-0.281 (-1.82)	-0.102 (-0.84)	0.105 (0.13)
ΔMerch. Exports (% of GDP)	-0.0515 (-1.23)	-0.136** (-3.04)	0.278* (2.37)	0.463* (2.46)	0.298* (2.33)	0.239 (0.30)
ΔSatellite Config	-0.141*** (-22.82)	-0.162*** (-15.84)	-0.154*** (-15.69)	-0.154*** (-9.59)	-0.0686*** (-6.33)	-0.117*** (-4.89)
Constant	0.0483*** (11.38)	0.0506*** (7.16)	0.0481*** (7.13)	0.0555*** (5.09)	0.0391*** (5.43)	0.0424** (2.74)
#Obs.	3297	1075	922	546	257	497
R-squared	0.1425	0.2058	0.2137	0.1519	0.1400	0.0495

t statistics in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A5. *Constituents of merchandise trade*

All regressions Contain Satellite Country, Year FE	(1) η World	(2) η Low income	(3) η Lower middle	(4) η Upper middle	(5) η High income Non-OECD	(6) η OECD
Agricultural IM	1.968	3.352*	-7.953**	14.58**	-11.99	22.30***
(% of GDP)	(1.53)	(2.42)	(-2.99)	(3.00)	(-1.80)	(3.34)
Food IM	-1.286***	-0.874	-0.0154	0.535	-3.842***	-5.623
(% of GDP)	(-3.66)	(-1.82)	(-0.02)	(0.45)	(-3.85)	(-1.23)
Fuel IM	-0.225	-1.298***	-1.259***	0.393	1.242***	2.100
(% of GDP)	(-1.26)	(-3.64)	(-4.99)	(0.94)	(4.94)	(1.81)
Manufactures IM	0.0509	0.273	-0.862***	0.923***	0.0788	-0.785
(% of GDP)	(0.54)	(1.53)	(-4.69)	(5.36)	(0.45)	(-1.32)
Ores and Metals IM	-1.296*	-1.705*	3.789***	-9.601***	1.933	3.460
(% of GDP)	(-2.33)	(-2.52)	(4.43)	(-4.70)	(1.50)	(1.42)
Agricultural EX	0.860*	1.050*	-0.237	-0.867	-10.48**	-10.68***
(% of GDP)	(2.12)	(2.37)	(-0.18)	(-1.38)	(-3.03)	(-3.65)
Food EX	0.0381	-0.600*	0.625***	-0.956***	6.472***	1.971
(% of GDP)	(0.29)	(-2.13)	(3.68)	(-4.96)	(6.28)	(0.74)
Fuel EX	0.293**	-1.253***	1.228***	-0.271	-0.352*	1.577*
(% of GDP)	(2.76)	(-3.98)	(7.13)	(-1.33)	(-2.37)	(2.01)
Manufactures EX	0.106	-0.991***	0.498***	-0.00414	-0.0566	0.191
(% of GDP)	(1.27)	(-4.53)	(4.24)	(-0.03)	(-0.36)	(0.54)
Ores and Metals EX	-0.111	-0.201	0.136	-0.476	-0.183	-2.019

(% of GDP)	(-0.73)	(-0.88)	(0.58)	(-1.75)	(-0.60)	(-1.21)
Constant	12.90***	13.86***	13.17***	11.73***	12.61***	13.16***
	(256.91)	(175.23)	(187.96)	(107.20)	(104.62)	(183.34)
#Observations	4181	1043	1187	796	352	803
R-squared	0.9119	0.9457	0.9037	0.8171	0.9911	0.7581

t statistics in parentheses.
$^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table A6. *Robustness check using different subgroups*

All regressions contain Satellite, Year, Country FE	(1) η LOW	(2) η MIDDLE	(3) η HIGH
Merch. Imports (% of GDP)	0.111	-0.321*	0.0524
	(1.58)	(-2.58)	(0.29)
Merch. Exports (% of GDP)	-0.144**	0.243**	0.0232
	(-3.06)	(3.17)	(0.15)
Constant	13.29***	12.88***	13.22***
	(206.02)	(242.95)	(66.52)
#Observations	2077	2795	498
R-squared	0.9344	0.8813	0.8989

t statistics in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A7. *Robustness check of traditional EKC on the condition of the absence of trade (detailed perspective)*

	(1) logALIGHT	(2) logALIGHT	(3) logALIGHT
logAGDPpC	3.626***	3.547***	-6.828
	(6.82)	(5.55)	(-1.36)
logAGDPpC²	-0.141***	-0.136***	1.040
	(-4.75)	(-3.76)	(1.84)
logAGDPpC³			-0.0438*
			(-2.09)
Constant	-25.11***	-24.79***	5.299
	(-10.67)	(-8.91)	(0.36)
#Observations	152	147	152
R-squared	0.8462	0.8378	0.8506

t statistics in parentheses.
* $p < 0.05$, *** $p < 0.001$

Figure A1. *Satellite imagery range*

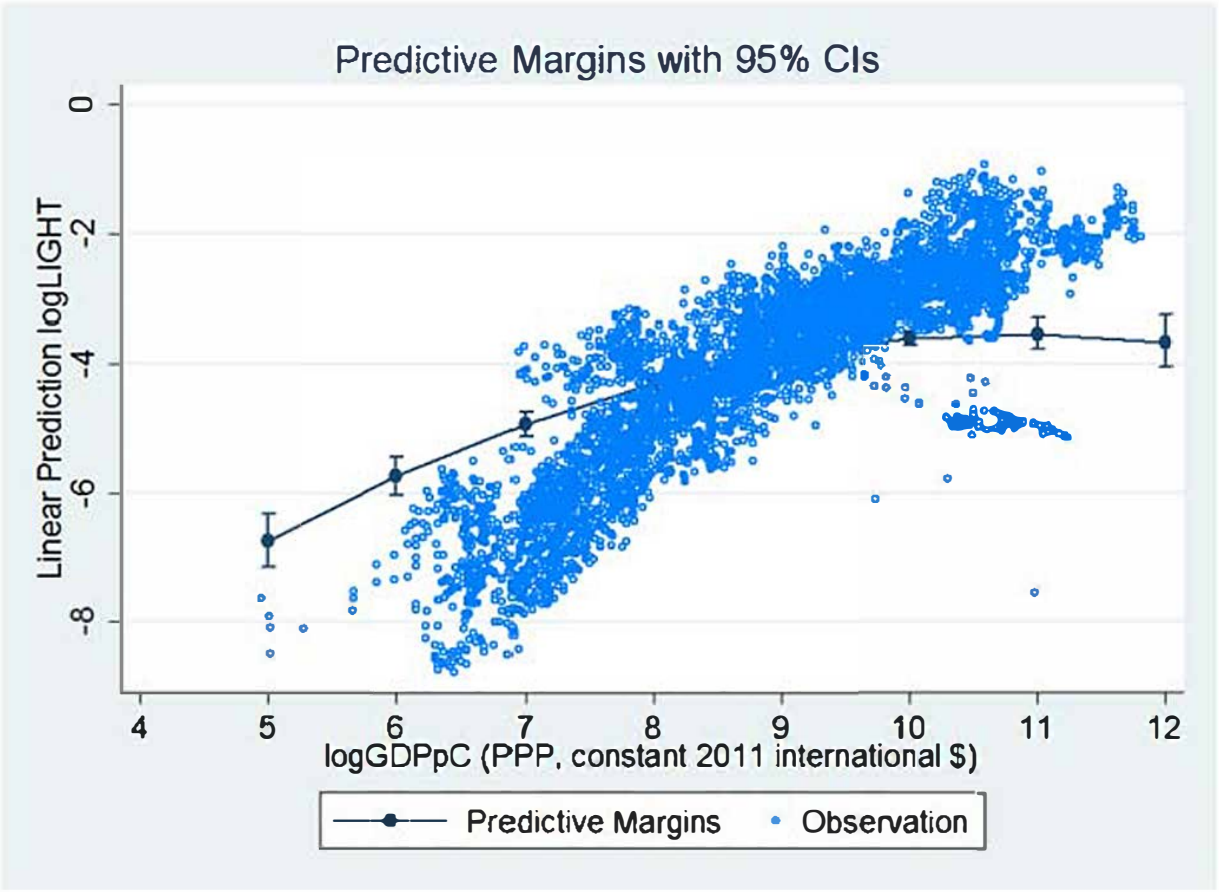

Figure A2. *Environmental Kuznets curve in raw data vs. predictive margins*

	(1) logALIGHT
logAGDPpC	1.792**
	(2.90)
logAGDPpC²	-0.0454
	(-1.30)
Constant	-16.22***
	(-5.99)
#Observations	119
R-squared	0.8152

t statistics in parentheses

* p < 0.05, ** p < 0.01, *** p < 0.001

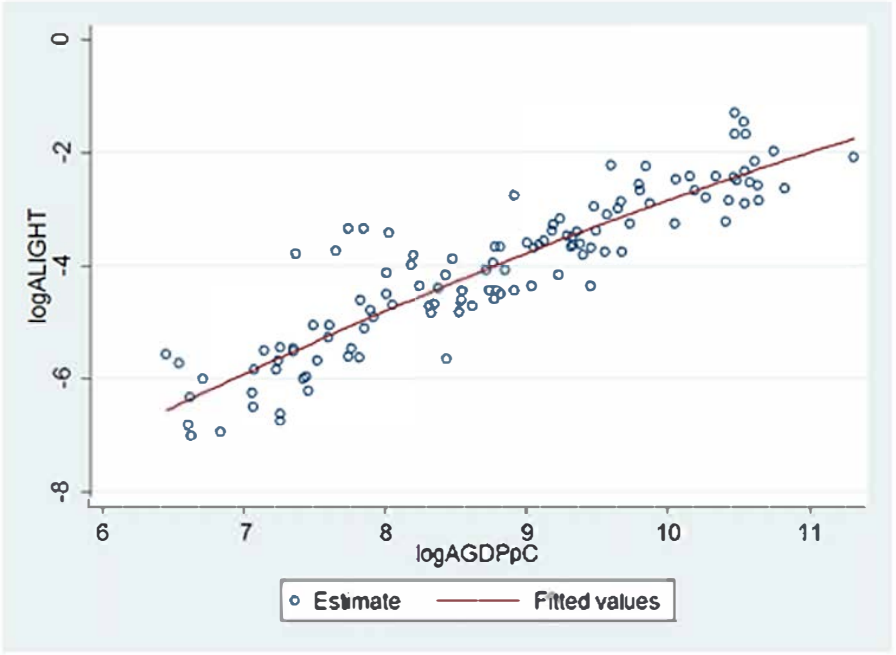

Figure A3. *Light-income relationship conditional on the absence of trade and fuel-exporting countries*