

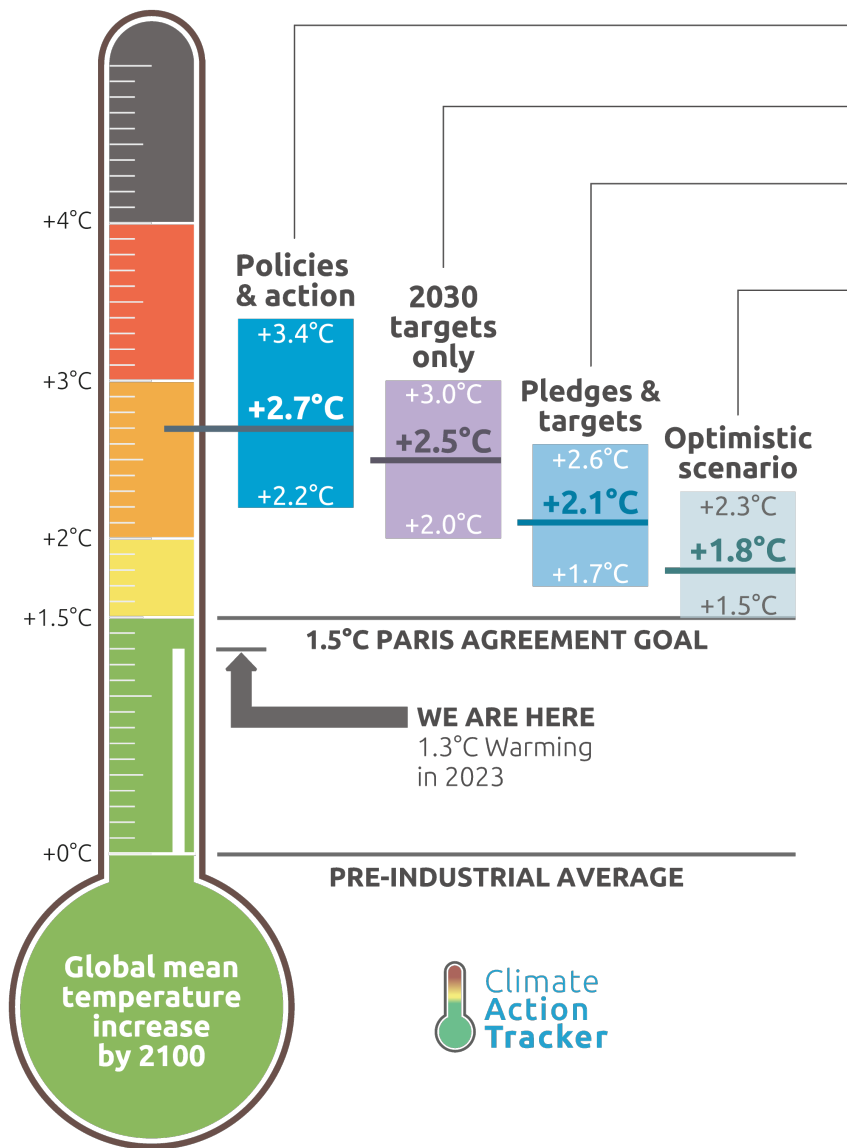
Do global carbon markets help us achieve the Paris goals?

Analysis of carbon market incentives for
national emission reductions

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Policies & action

Real world action based on current policies †

2030 targets only

Based on 2030 NDC targets* †

Pledges & targets

Based on 2030 NDC targets* and submitted and binding long-term targets

Optimistic scenario

Best case scenario and assumes full implementation of all **announced** targets including net zero targets, LTSs and NDCs*

† Temperatures continue to rise after 2100

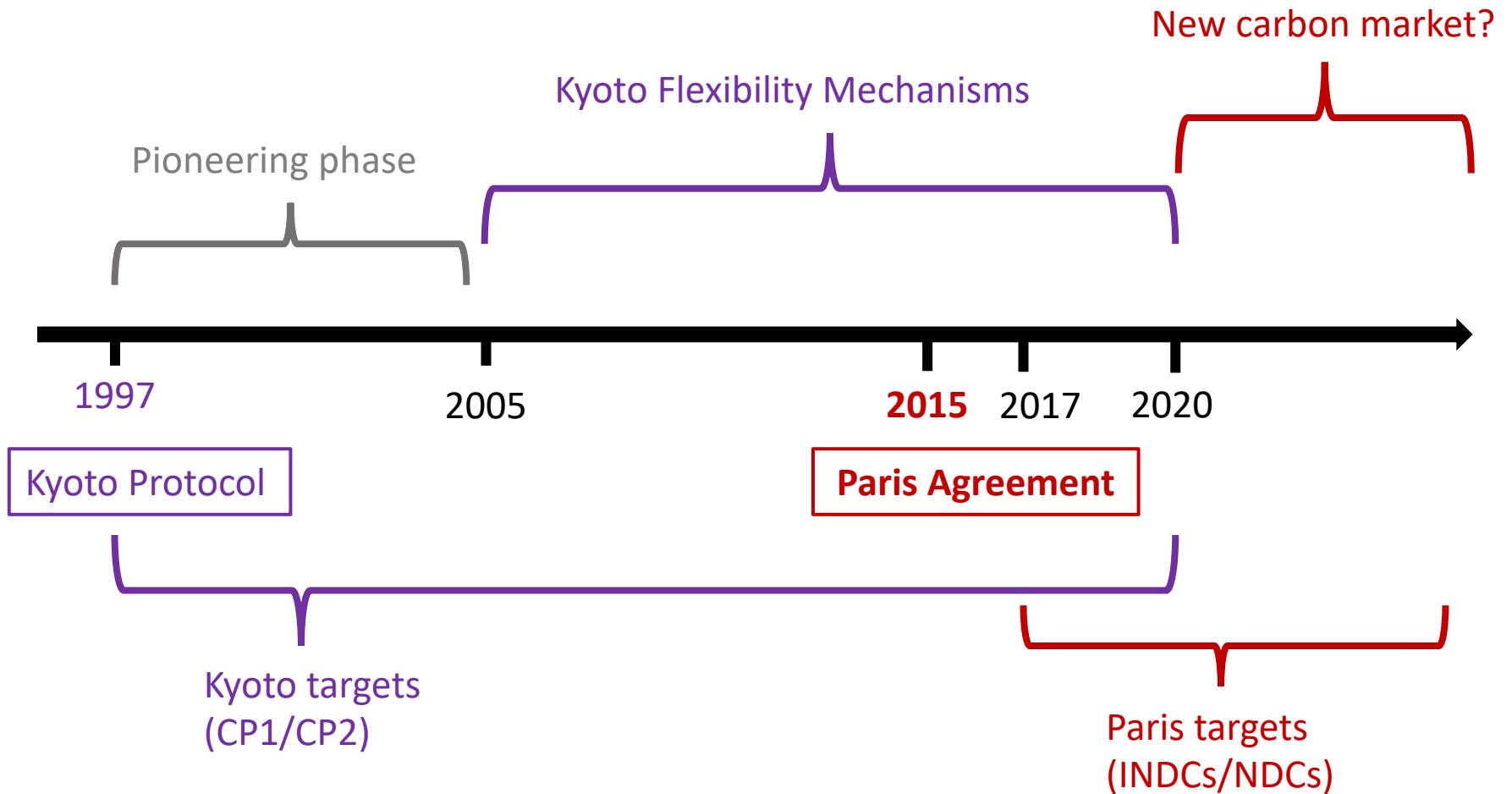
* If 2030 NDC targets are weaker than projected emissions levels under policies & action, we use levels from policy & action

CAT warming projections
Global temperature increase by 2100

December 2023 Update



Global carbon markets over time



Carbon markets in the Paris Agreement

Paris Agreement 2015, p.7:

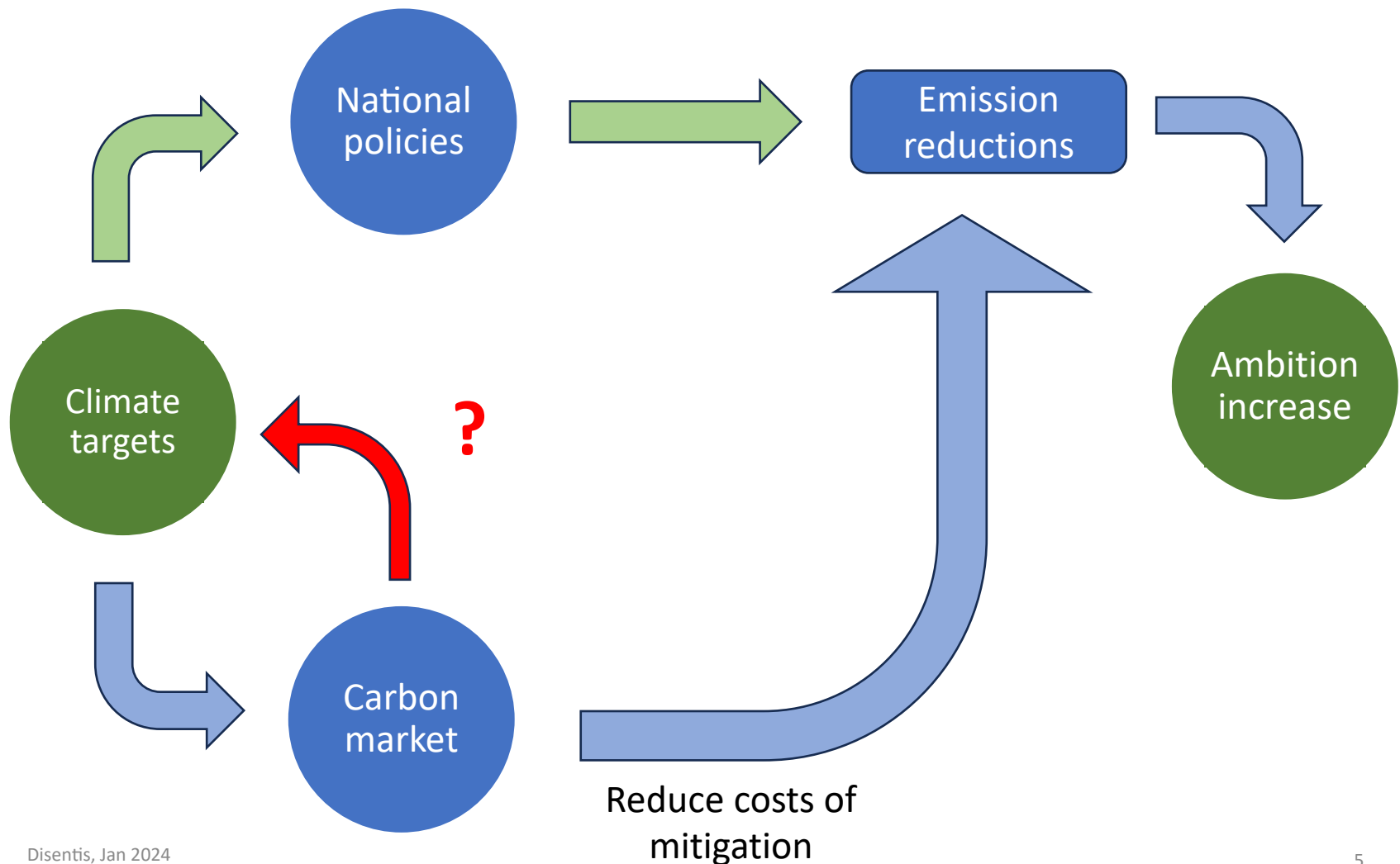
“Parties recognize that some Parties choose to pursue voluntary cooperation in the implementation of their nationally determined contributions to allow for higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity.”

Flexibility of carbon markets lowers the costs of emissions reductions

→ Should help countries achieve their climate targets

→ Should help countries be more ambitious

How does the participation in the global carbon market influence emission trajectories?



Buyer states

- Market attractive for states with high marginal abatement costs
 - Opportunity for states to reach climate targets in an easy way
 - Participation in the international market complementary to national policies
 - The need for offsetting emissions depends on the ambition level of climate targets. Only ambitious states need certificates in the first place.
- The level of buying certificates indicator of climate ambition
- Ambitious states are more inclined to use cost savings from trading to further mitigate

H1 – The market demand effect: Higher levels of buying certificates are associated with lower levels of domestic emissions

Seller states

- Seller states have financial revenues and co-benefits (financial and knowledge transfer, capacity building, sustainable development outcomes)
 - Traditionally seller states did not have climate targets
 - Separation gradually blurred over time
 - From Paris: Selling of certificates and the compliance with mitigation responsibilities compete with each other
- Any reduction commitment limits a state's selling opportunity

H2 – The market supply effect: High levels of supplying certificates are associated with stationary or higher levels of domestic emissions

Empirical strategy

Explanatory variables: Participation in the global carbon market

- Certificates from the project-based Kyoto Flexibility Mechanism (CERs & ERUs)
- **Market demand:** Number of certificates country uses (retirements, cancellation)
- **Market supply:** Number of certificates a country issues

Control variables

- GDP
- Population
- Annex I status
- Fossil fuel rents
- Environmentally Related Tax Revenue data (related to climate change)
- Democracy (combined QoG: Liberal Democracy Index, V-Dem: Freedom House variable and Electoral Democracy Index)

Empirical strategy

Estimation model: Buyer states

$$Y_{i,t} = \beta_0 + \beta_1(\text{Market Demand})_{i,t} + \beta_3\text{Controls}_{i,t} + \theta_t + \delta_r + \omega_{r,t} + \epsilon_{i,r,t} \quad (1)$$

- **Year-fixed effects** θ_t to control for economic shocks and other omitted factors that are constant across states but vary over time.
- **Region fixed effects** δ_r that capture heterogeneities across regions and control for constant region-specific omitted variables.
- **Year times region fixed effects** $\omega_{r,t}$ to control for unobservable that vary within regions, such as economic shocks that hit only states within one region such as the collapse of the Soviet Union
- $\epsilon_{i,r,t}$ is the error term

Estimation model: Selling states

$$Y_{i,t} = \beta_0 + \beta_1(\text{Market Supply}_{i,t} \times \text{Post Paris}_{i,t}) + \beta_3 \text{Controls}_{i,t} + \theta_t + \delta_r + \omega_{r,t} + \epsilon_{i,r,t} \quad (2)$$

- Post-Paris indicator might not be helpful since certificates belong to Kyoto mechanisms
- Instead: Post-Copenhagen Pledges: Many developing states submitted pledges in 2009 and 2010 during COP in Cancun.

Possible biases

Simultaneity bias:

states decide simultaneously on their climate target—and in consequence their emissions levels—and whether they want to use markets to achieve said target

Reverse causality:

A state's rising emissions could fuel the demand for international certificates to offset its emissions and meet its climate targets

Instrument variable approach

- Market Friendly Culture: Countries in which a high degree of Market Friendly Culture prevails are more inclined to use the global market mechanism to offset their domestic emissions
- Measurement: Property rights protection and regulatory quality (capable of ruling out the incidence of market-unfriendly policies)

First stage:

$$\text{Carbon Market}_{i,t} = \alpha_0 + \alpha_1 \text{Market Friendly IVs}_{i,t} + \alpha_3 X_{i,t} + \theta_t + \delta_r + \omega_{r,t} + u_{i,t} \quad (3)$$

Second stage:

$$\text{Emissions}_{i,t} = \beta_0 + \beta_1 \widehat{\text{Carbon Market}}_{i,t} + \beta_3 X_{i,t} + \theta_t + \delta_r + \omega_{r,t} + u_{i,t} \quad (4)$$

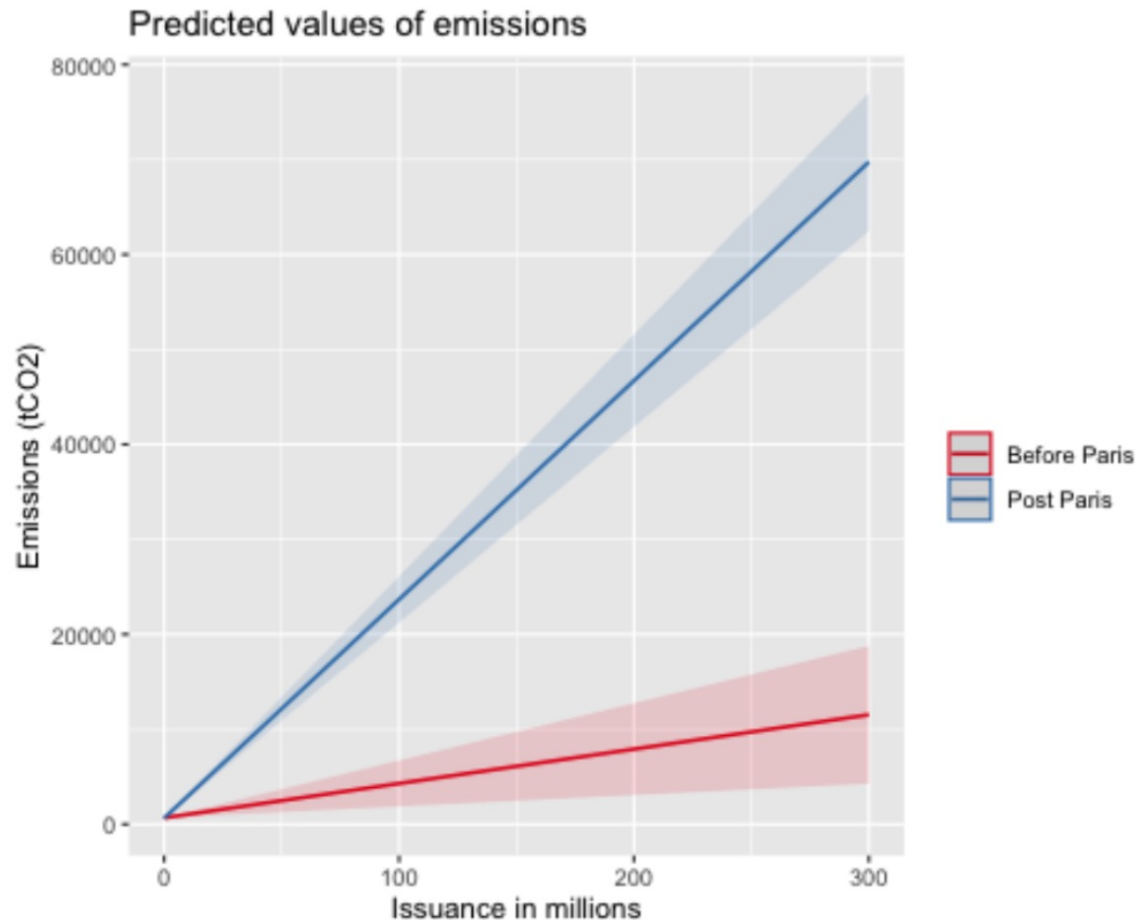
Results

Results I

Dependent Variable:	Emissions (in million tons of CO ₂)					
Model:	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
<i>Variables</i>						
Market Demand	-5.446*** (1.181)	-191.327*** (53.627)				
Market Supply			43.944*** (14.527)	179.067*** (46.382)		
Carbon Market					2.678 (2.443)	49.954 (36.956)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region FE	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>						
Observations	1,544	1,470	1,544	1,470	1,544	1,470
Squared Correlation	0.324	0.370	0.448	0.372	0.317	0.325
AIC	26,490.8	29,525.1	26,178.5	26,742.3	26,508.3	26,474.1
BIC	27,115.8	30,112.7	26,803.6	27,329.8	27,133.4	27,061.6
RMSE	1,192.6	5,157.0	1,077.9	2,001.3	1,199.4	1,826.8

Notes: This table reports coefficient estimates and standard errors from six separate regressions. The dependent variable in all regressions is the million tons of CO₂ emissions. All regression models include the controls log(GDP), log(population), log(fossil fuel rents), and Env. Tax Revenue (% of GDP). Heteroskedasticity-robust standard errors are in parentheses. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

Results II – Sellers marginal effect



Note: The figure displays the marginal effect of the regression model (6) in Table 9 in the Appendix. The model includes the control variables in the model are GDP, population, Annex I status, and year, region, and region-year fixed effects.

Conclusion

- Carbon markets have helped buyer countries in their mitigation efforts
- change in responsibility to contribute to mitigation efforts while maintaining the role of seller states creates perverse incentives.

Contributions:

1. Contributes to existing literature on the influence of carbon pricing instruments
2. Informs growing literature on policy design in ratcheting-up of climate ambition and emission reduction effort
3. Generates implications for the ongoing design of the new carbon mechanism under the Paris Agreement

Thank you!

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Appendix

Buyer states - OLS

Dependent Variable:	Emissions (mio. tonnes)						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Variables</i>							
Compliance	-2.937*** (0.828)	-5.446*** (1.181)	-6.783*** (1.877)	-3.505*** (0.889)	-5.113*** (1.783)	-8.738*** (1.770)	-3.341* (1.825)
Log of GDP (in Mio. USD)	185.448*** (24.019)	390.622*** (55.259)	1,605.907*** (334.243)	195.110*** (25.617)	144.978*** (34.435)	183.942*** (38.700)	55.650 (67.585)
Log of Population (in Mio.)	27.993*** (9.623)	100.779*** (26.769)	-290.229 (277.274)	75.772*** (11.646)	185.483*** (35.388)	261.776*** (41.664)	160.349* (85.177)
Annex1Non-AnnexI	92.365 (61.195)	134.421 (122.128)	3,262.308*** (820.249)	80.534 (54.165)	87.177 (68.369)	272.456** (117.854)	-91.567 (83.278)
Log(Fossil Fuel Rents)		4.581 (6.977)	58.215 (36.135)				15.380 (10.069)
Env. Tax Revenue (% of GDP)		-165.069*** (50.399)	-261.201 (161.547)				46.775* (27.651)
Env. Policy Stringency			-1,148.619*** (202.960)				
Democracy				205.414*** (67.825)			-56.183 (186.816)
Education					72.240*** (22.129)		-11.124 (21.247)
Governance Index						59.865*** (17.961)	130.600** (65.680)
<i>Fixed-effects</i>							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>							
Observations	3,377	1,544	285	3,186	838	1,109	160
Squared Correlation	0.202	0.324	0.712	0.226	0.328	0.290	0.695
Adjusted R ²	0.174	0.269	0.603	0.197	0.238	0.249	0.534
Pseudo R ²	0.013	0.022	0.067	0.015	0.024	0.020	0.082
AIC	56,079.5	26,490.8	5,073.2	52,999.2	13,749.3	18,549.8	2,237.9
BIC	56,783.8	27,115.8	5,361.8	53,702.9	14,222.4	18,860.5	2,410.1
RMSE	944.0	1,192.6	1,345.1	955.4	784.8	980.9	185.8

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Buyer states – IV first stage

Dependent Variable: Model:	Compliance							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Variables</i>								
IV: Regulatory quality	2.715*** (0.556)		1.892*** (0.533)	1.465*** (0.508)	1.074* (0.559)	0.049 (1.222)	13.524 (11.770)	16.396 (13.655)
IV: Private Property		10.121*** (1.760)	6.824*** (1.624)	4.951*** (1.395)	4.806*** (1.403)	12.075*** (3.117)	80.090* (41.201)	43.657 (46.387)
<i>Controls</i>								
Log of GDP (in mil. USD)	1.697*** (0.331)	2.565*** (0.422)	1.804*** (0.346)	0.996*** (0.239)	1.509*** (0.381)	2.852*** (0.734)	-8.446 (5.861)	-8.728 (7.199)
Log of Population (in mil.)	0.651** (0.290)	-0.128 (0.301)	0.557* (0.296)	1.022*** (0.276)	0.565 (0.366)	0.731 (0.723)	16.623*** (6.349)	19.965** (7.741)
Annex-I				16.116*** (2.700)	15.924*** (2.658)	28.944*** (5.363)	66.835*** (21.820)	81.469*** (22.247)
Fossil fuel rents					-0.058*** (0.022)	-0.004 (0.058)	0.515 (0.676)	0.567 (0.823)
Env. Tax Revenue (% of GDP)						0.778 (0.611)		16.591*** (4.737)
Env. Policy Stringency							9.651* (5.118)	2.271 (6.566)
<i>Fixed-effects</i>								
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>								
Observations	2,867	3,032	2,867	2,867	2,798	1,780	347	293
Squared Correlation	0.277	0.279	0.278	0.297	0.298	0.321	0.410	0.460
Adjusted R ²	0.249	0.251	0.250	0.269	0.269	0.276	0.230	0.260
Pseudo R ²	0.035	0.035	0.035	0.038	0.038	0.040	0.050	0.058
AIC	25,774.0	27,362.8	25,770.1	25,695.6	25,147.8	16,778.0	3,637.7	3,110.5
BIC	26,417.8	28,048.8	26,419.8	26,351.3	25,806.7	17,392.3	3,953.4	3,404.9
RMSE	20.9	21.2	20.8	20.6	20.8	25.3	36.1	37.2
F-test (1st stage)	14.0	15.5	9.83	5.58	3.30	2.61	3.51	1.48
F-test (1st stage), p-value	0.0002	8.57×10^{-5}	5.59×10^{-5}	0.004	0.037	0.074	0.031	0.230
Wald (1st stage)	23.9	33.1	16.1	14.0	11.7	7.67	1.89	0.904
Wald (1st stage), p-value	1.09×10^{-6}	9.74×10^{-9}	1.12×10^{-7}	8.75×10^{-7}	8.43×10^{-6}	0.0005	0.153	0.407

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Buyers – IV second stage

Dependent Variable:	Emissions (mio. tonnes)						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Variables</i>							
Compliance	-32.414*** (11.396)	-61.972*** (22.005)	-46.400*** (14.806)	-163.342** (63.853)	-196.451*** (54.323)	-160.027* (92.929)	-191.327*** (53.627)
Log of GDP (in Mio. USD)	259.289*** (32.583)	317.396*** (57.059)	283.194*** (42.524)	838.457*** (213.765)	950.583*** (177.215)	1,318.913* (734.159)	1,152.456*** (240.415)
Log of Population (in Mio.)	115.363*** (16.527)	121.568*** (23.222)	119.494*** (19.815)	-10.998 (72.903)	144.259 (100.656)	928.344 (1,035.964)	88.571 (118.747)
Annex1Non-AnnexI	-425.731** (193.053)	-941.944*** (337.020)	-662.348*** (216.320)	-2,315.680** (995.568)	-5,517.655*** (1,682.627)	-9,248.564 (8,477.810)	-5,471.864*** (1,764.232)
Log(Fossil Fuel Rents)				-185.818*** (68.284)			-252.046*** (67.293)
Env. Tax Revenue (% of GDP)					133.580 (124.538)		-436.296** (190.380)
Env. Policy Stringency						1,511.799 (1,330.779)	
<i>Fixed-effects</i>							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>							
Observations	2,867	3,032	2,867	2,202	1,794	352	1,470
Squared Correlation	0.248	0.250	0.250	0.312	0.332	0.772	0.370
AIC	48,610.4	53,387.8	49,443.9	42,724.9	35,836.0	7,247.5	29,525.1
BIC	49,260.1	54,079.7	50,093.6	43,351.5	36,440.1	7,556.6	30,112.7
RMSE	1,119.5	1,551.8	1,294.6	3,761.2	4,951.7	5,701.6	5,157.0
F-test (2nd stage)	3.97	15.7	11.2	29.6	107.4	187.9	100.9
F-test (2nd stage), p-value	0.046	7.75×10^{-5}	0.0008	5.81×10^{-8}	1.97×10^{-24}	7.13×10^{-33}	5.99×10^{-23}
Wald (2nd stage)	8.09	7.93	9.82	6.54	13.1	2.97	12.7
Wald (2nd stage), p-value	0.004	0.005	0.002	0.011	0.0003	0.086	0.0004
Sargan			1.53	0.019	0.209	2.00	0.702
Cragg-Donald	8.43	8.94	5.80	1.20	2.81	4.36	2.81
Kleibergen-Paap	17.5	28.6	14.0	5.36	7.74	1.97	7.81

Heteroskedasticity-robust standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Seller - OLS

Dependent Variable:	Emissions (mio. tonnes)						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Variables</i>							
Issuance	44.123*** (12.859)	43.944*** (14.527)	42.986*** (12.678)	78.289*** (23.460)	59.111*** (13.683)	50.222*** (3.858)	52.340*** (3.540)
Log of GDP (in Mio. USD)	160.803*** (21.998)	336.807*** (52.450)	169.106*** (22.962)	98.635*** (28.599)	150.496*** (34.398)	76.607*** (14.345)	66.931* (35.472)
Log of Population (in Mio.)	13.902 (9.361)	50.317** (24.599)	51.341*** (10.728)	156.484*** (29.358)	157.121*** (28.322)	51.116*** (13.215)	56.516* (31.328)
Annex1Non-AnnexI	133.502** (67.424)	176.030 (137.700)	149.241** (71.826)	95.048* (55.447)	277.820** (137.675)	103.406*** (31.413)	-11.463 (48.177)
Log(Fossil Fuel Rents)		8.429 (5.774)					10.995* (6.095)
Env. Tax Revenue (% of GDP)		-164.976*** (55.013)					22.934 (23.830)
Democracy			172.932*** (66.551)			40.241 (74.098)	-220.048* (131.904)
Education				70.702*** (17.685)		-4.449 (6.018)	0.751 (14.614)
Governance Index					19.400 (18.245)	5.615 (14.604)	47.051** (23.146)
<i>Fixed-effects</i>							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>							
Observations	3,377	1,544	3,186	838	1,109	248	160
Squared Correlation	0.347	0.448	0.362	0.393	0.516	0.864	0.887
Adjusted R ²	0.324	0.403	0.338	0.312	0.488	0.827	0.827
Pseudo R ²	0.025	0.034	0.027	0.030	0.043	0.139	0.151
AIC	55,402.9	26,178.5	52,385.9	13,664.3	18,125.2	3,174.3	2,078.9
BIC	56,107.2	26,803.6	53,089.6	14,137.4	18,435.9	3,364.1	2,251.1
RMSE	854.0	1,077.9	867.8	746.0	810.0	117.1	113.0

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Seller - OLS

Dependent Variable:	Emissions (mio. tonnes)						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Variables</i>							
Issuance	44.123*** (12.859)	43.944*** (14.527)	42.986*** (12.678)	78.289*** (23.460)	59.111*** (13.683)	50.222*** (3.858)	52.340*** (3.540)
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BIC	56,107.2	26,803.6	53,089.6	14,137.4	18,435.9	3,364.1	2,251.1
RMSE	854.0	1,077.9	867.8	746.0	810.0	117.1	113.0

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Main results

Dependent Variable:	Emissions (in million tons of CO ₂)					
Model:	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
<i>Variables</i>						
Market Demand	-5.446*** (1.181)	-191.327*** (53.627)				
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Buyers – IV first stage only year FE

Dependent Variable:	Compliance in Mio. certificates							
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Variables</i>								
Regulatory quality	5.365*** (0.616)		4.851*** (0.675)	2.622*** (0.616)	2.620*** (0.683)	2.321* (1.369)	21.368* (12.320)	18.273 (13.596)
Private Property		12.314*** (1.451)	3.714** (1.503)	-2.063 (1.267)	-2.240* (1.291)	3.418 (2.835)	80.358*** (29.036)	58.016* (34.927)
Log of GDP (in Mio. USD)	2.423*** (0.276)	4.664*** (0.388)	2.443*** (0.279)	0.946*** (0.217)	1.023*** (0.291)	1.766*** (0.577)	-7.179 (5.424)	-4.760 (5.648)
Log of Population (in Mio.)	0.200 (0.268)	-1.855*** (0.217)	0.194 (0.269)	1.197*** (0.282)	1.133*** (0.334)	1.850*** (0.654)	19.216*** (7.134)	18.879** (7.282)
annex1				16.001*** (1.251)	16.138*** (1.273)	17.514*** (1.643)	14.970*** (4.771)	31.685*** (7.974)
Fossil fuel rents					-0.009 (0.018)	0.143** (0.067)	-0.100 (0.593)	0.984 (0.701)
Env. Tax Revenue (% of GDP)						-0.078 (0.606)		11.873*** (3.679)
Env. Policy Stringency							7.572*** (2.845)	0.760 (3.912)
<i>Fixed-effects</i>								
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>								
Observations	2,867	3,032	2,867	2,867	2,798	1,780	347	293
Squared Correlation	0.160	0.153	0.160	0.199	0.201	0.227	0.313	0.358
Adjusted R ²	0.154	0.147	0.154	0.193	0.194	0.217	0.276	0.313
Pseudo R ²	0.019	0.018	0.019	0.024	0.024	0.027	0.036	0.042
AIC	26,027.8	27,664.6	26,028.1	25,895.4	25,333.8	16,832.8	3,564.6	3,041.4
BIC	26,147.1	27,790.9	26,153.3	26,026.5	25,470.4	16,964.4	3,637.7	3,115.0
RMSE	22.5	23.0	22.5	22.0	22.2	27.0	39.0	40.6
F-test (1st stage)	56.9	24.8	29.3	5.40	4.27	1.37	6.12	2.80
F-test (1st stage), p-value	6.26×10^{-14}	6.59×10^{-7}	2.53×10^{-13}	0.005	0.014	0.256	0.002	0.062
Wald (1st stage)	75.8	72.0	43.9	10.2	7.55	2.39	3.93	2.02
Wald (1st stage), p-value	5.31×10^{-18}	3.28×10^{-17}	1.7×10^{-19}	4.01×10^{-5}	0.0005	0.091	0.021	0.135

Heteroskedasticity-robust standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Seller – marginal effects

Dependent Variable:	Emissions (mio. tonnes)							
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>Variables</i>								
Constant	-1,626.122*** (258.393)	-767.491*** (108.963)	24,575.585* (12,878.599)	-943.527*** (121.125)	23,232.249* (11,929.125)	3,903.489 (7,684.401)	-1,185.479*** (190.662)	7,272.645 (9,482.521)
Issuance	42.285*** (13.323)	49.408*** (4.339)	50.036*** (4.162)	49.028*** (4.130)	49.153*** (4.371)	36.192*** (12.353)	36.125*** (12.331)	36.199*** (12.347)
Log of GDP (in Mio. USD)	160.306*** (22.188)	74.118*** (13.022)	73.185*** (13.116)	80.120*** (13.054)	79.018*** (13.144)	127.980*** (16.948)	127.260*** (17.067)	128.118*** (16.985)
Log of Population (in Mio.)	15.394 (9.441)	50.043*** (12.529)	49.788*** (12.305)	48.457*** (11.969)	46.877*** (11.966)	17.678** (8.488)	18.264** (8.720)	17.606** (8.577)
Annex1Non-AnnexI	133.322** (66.652)			100.547*** (27.349)	102.443*** (27.821)	25.258 (52.087)	24.579 (52.114)	25.601 (52.068)
postParisPostParis	12.952 (30.136)	-5.110 (17.002)	36.918 (29.043)	2.308 (19.016)	39.132 (28.725)	-37.600 (46.290)	-75.003*** (23.079)	-37.241 (46.402)
RegionAPAC	201.907*** (32.523)	-42.289 (36.974)	-7,374.262 (14,476.061)	-39.095 (34.830)	-6,941.495 (13,693.152)	6,264.838 (13,295.780)	149.127*** (26.699)	148.074*** (26.615)
RegionEastern_Europe	-31.312 (22.752)	-21.894 (41.162)	-14,757.277 (11,816.960)	31.203 (38.565)	-9,895.784 (11,041.258)	-4,702.322 (8,535.274)	-36.916 (22.573)	-37.721* (22.511)
RegionGRULAC	-38.950* (23.476)	-76.697** (29.996)	-12,835.896 (16,142.721)	-92.081*** (28.655)	-11,541.815 (15,609.446)	12,514.212* (6,563.175)	-50.422** (23.198)	-51.658** (23.035)
RegionWEOG	18.124 (47.122)	-0.297 (45.186)	-48,399.566*** (11,569.276)	84.818* (44.708)	-50,479.103*** (10,732.238)	193.001 (19,336.996)	31.515 (46.060)	29.433 (45.705)
Democracy		-30.125 (60.717)	-14.004 (63.586)	39.545 (64.116)	51.716 (67.877)			
Education		-3.653 (5.786)	-3.625 (5.750)	-4.110 (5.568)	-4.531 (5.627)			
Governance Index		5.141 (14.632)	2.042 (14.964)	3.939 (14.015)	1.082 (14.531)			
Issuance × postParisPostParis		10.647 (13.863)	10.894 (13.911)		8.789 (14.178)	194.189*** (27.344)	193.906*** (27.486)	193.675*** (27.574)
Year			-12.593* (6.399)		-12.010** (5.926)	-2.539 (3.823)		-4.214 (4.714)
Year × RegionAPAC			3.644 (7.193)		3.431 (6.805)	-3.039 (6.605)		
Year × RegionEastern_Europe			7.324 (5.870)		4.936 (5.484)	2.318 (4.242)		
Year × RegionGRULAC			6.341 (8.023)		5.690 (7.759)	-6.244* (3.265)		
Year × RegionWEOG			24.070*** (5.751)		25.149*** (5.337)	-0.081 (9.608)		
<i>Fit statistics</i>								
Observations	3,377	248	248	248	248	3,377	3,377	3,377
Squared Correlation	0.340	0.845	0.850	0.849	0.855	0.450	0.450	0.450
Adjusted R ²	0.338	0.837	0.839	0.841	0.843	0.447	0.448	0.448
Pseudo R ²	0.025	0.130	0.132	0.132	0.134	0.036	0.036	0.036
AIC	55,226.8	3,124.4	3,126.6	3,118.4	3,120.4	54,625.1	54,616.8	54,618.1
BIC	55,288.1	3,170.1	3,189.8	3,164.1	3,187.1	54,723.1	54,684.2	54,691.6
RMSE	858.3	124.9	123.0	123.4	121.0	783.8	784.0	783.9

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Seller – IV first stage

Dependent Variable: Model:	Issuance						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Variables</i>							
Regulatory quality	-0.175 (0.434)	-1.318 (0.896)	-0.040 (0.303)	0.291 (0.214)	-1.145*** (0.405)	-1.326** (0.613)	-1.841 (1.214)
Private Property	-1.570 (1.640)	-13.542** (5.460)	-0.975 (2.062)	-2.271 (3.443)	-6.537* (3.878)	-6.206* (3.649)	-7.143 (9.575)
Log of GDP (in Mio. USD)	0.643*** (0.221)	1.800*** (0.577)	0.617*** (0.214)	0.587** (0.280)	0.990** (0.428)	0.647* (0.330)	0.664 (0.864)
Log of Population (in Mio.)	0.591*** (0.160)	0.217 (0.304)	0.600*** (0.165)	0.249 (0.226)	1.528*** (0.449)	0.629 (0.500)	0.845 (1.040)
Annex1Non-AnnexI	-0.466 (1.264)	2.085 (1.720)	-0.653 (1.473)	0.136 (0.290)	1.223 (1.932)	1.834** (0.737)	-1.249 (1.099)
Log(Fossil Fuel Rents)		-0.040 (0.054)					0.054 (0.142)
Env. Tax Revenue (% of GDP)		0.378 (0.652)					0.500 (0.458)
Democracy			-1.169 (1.702)			4.393** (1.700)	5.097 (3.881)
Education				-0.134 (0.092)		-0.074 (0.118)	-0.238 (0.281)
Governance Index					1.524*** (0.498)	1.066 (0.699)	1.829 (1.251)
<i>Fixed-effects</i>							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>							
Observations	2,867	1,470	2,867	818	983	248	160
Squared Correlation	0.094	0.162	0.095	0.173	0.142	0.401	0.516
Adjusted R ²	0.059	0.094	0.058	0.057	0.091	0.233	0.253
AIC	21,509.2	11,760.1	21,510.5	4,622.0	7,408.9	1,314.4	897.7
BIC	22,164.9	12,352.9	22,172.2	5,097.4	7,687.7	1,507.6	1,072.9
RMSE	9.91	12.2	9.91	3.61	9.89	2.74	2.80
F-test (1st stage)	1.20	14.9	0.221	1.45	5.58	5.81	2.35
F-test (1st stage), p-value	0.301	3.79×10^{-7}	0.802	0.235	0.004	0.004	0.100
Wald (1st stage)	1.84	5.23	0.946	0.929	4.88	2.34	1.48
Wald (1st stage), p-value	0.159	0.005	0.388	0.396	0.008	0.099	0.231

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Seller- IV second stage

Dependent Variable:	Emissions (mio. tonnes)						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Variables</i>							
Issuance	228.093** (98.602)	179.067*** (46.382)	515.910 (838.416)	201.974 (140.196)	152.728*** (53.837)	69.505*** (15.914)	86.959*** (32.428)
Log of GDP (in Mio. USD)	82.900* (49.957)	244.553*** (81.445)	-96.793 (425.733)	45.153 (93.038)	87.333*** (27.255)	71.551*** (17.628)	74.932* (43.128)
Log of Population (in Mio.)	-55.768 (73.536)	-111.123 (111.524)	-220.838 (569.967)	155.593*** (39.847)	-23.295 (89.791)	31.125* (15.999)	-4.985 (62.717)
AnnexI/Non-AnnexI	188.706 (282.981)	-207.737 (247.788)	442.867 (1,271.953)	-24.810 (60.351)	155.457 (234.819)	71.636* (42.069)	15.549 (57.146)
Log(Fossil Fuel Rents)		-5.567 (9.163)					6.792 (7.974)
Env. Tax Revenue (% of GDP)		-190.922* (108.850)					4.086 (30.360)
Democracy			732.800 (1,870.431)			-2.483 (82.922)	-328.843 (199.330)
Education				77.986*** (26.907)		-3.303 (7.080)	8.811 (15.938)
Governance Index					-45.642* (25.189)	-6.322 (19.610)	-7.746 (56.062)
<i>Fixed-effects</i>							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Fit statistics</i>							
Observations	2,867	1,470	2,867	818	983	248	160
Squared Correlation	0.251	0.372	0.251	0.336	0.313	0.686	0.713
AIC	52,059.7	26,742.3	56,939.3	13,599.9	16,862.0	3,222.9	2,170.2
BIC	52,709.4	27,329.8	57,595.0	14,070.6	17,135.9	3,412.6	2,342.4
RMSE	2,043.0	2,001.3	4,783.0	872.8	1,213.1	129.2	150.4
F-test (2nd stage)	13.5	105.0	12.8	2.48	28.7	13.4	8.66
F-test (2nd stage), p-value	0.0002	8.93×10^{-24}	0.0004	0.116	1.05×10^{-7}	0.0003	0.004
Wald (2nd stage)	5.35	14.9	0.379	2.08	8.05	19.1	7.19
Wald (2nd stage), p-value	0.021	0.0001	0.538	0.150	0.005	2.04×10^{-5}	0.009
Sargan	0.093	3.27	0.005	2.51	0.115	5.62	0.289
Cragg-Donald	1.25	16.1	0.230	1.65	5.90	7.35	3.56
Kleibergen-Paap	1.84	5.23	0.946	0.929	4.88	2.34	1.48

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*