Supporting Information for The Fossil-Fueled Roots of Climate Inaction in Authoritarian Regimes

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This project is about climate inaction in authoritarian regimes. It draws on various observational datasets and statistical procedures to examine why some non-democracies contribute more to climate change than others. In this file, I present additional information about the data and methods used in the main analysis and conduct additional tests to evaluate the validity of the findings. This file contains five Appendices:

- Appendix A: Main Results
- Appendix B: Data and Descriptive Statistics
- Appendix C: Placebo Tests
- Appendix D: Model Diagnostics and Alternative Estimators
- Appendix E: Measurement and Sampling

All quantitative analysis for this project was performed entirely in `R` (versions 4.1.1-4.2.1). Contact the author with any questions or comments.

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Appendix A: Main Results

Tables 1 – 6 summarize the results of the main analysis.

Table 1: Main Results

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.456***	0.598***	0.517***
	(0.068)	(0.147)	(0.077)	(0.134)
Executive Constraints		0.364	0.458	−4.887**
		(0.641)	(0.439)	(1.899)
Electoral Democracy		−0.461		−3.982
		(1.719)		(3.807)
GDP		0.242		0.024
		(0.217)		(0.218)
Trade		0.076		0.169
		(0.077)		(0.129)
Population Density		−0.007*		−0.009**
		(0.004)		(0.004)
Oil and Gas × Executive Constraints			−0.164*	−0.532***
			(0.096)	(0.175)
Electoral Democracy × Executive Constraints				7.753
				(6.307)
GDP × Executive Constraints				1.220***
				(0.402)
Trade × Executive Constraints				−0.371
				(0.339)
Population Density × Executive Constraints				0.003
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,511	2,174
Adjusted R^2	0.974	0.980	0.973	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 2: Main Results (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.456***	0.598***	0.518***
	(0.068)	(0.147)	(0.077)	(0.134)
Executive Constraints		0.346	0.441	−4.919**
		(0.645)	(0.439)	(1.901)
Electoral Democracy		−0.459		−4.002
		(1.720)		(3.806)
GDP		0.243		0.025
		(0.217)		(0.218)
Trade		0.075		0.169
		(0.077)		(0.129)
Population Density		−0.007*		−0.009**
		(0.004)		(0.004)
Oil and Gas × Executive Constraints			−0.164*	−0.534***
			(0.096)	(0.175)
Electoral Democracy × Executive Constraints				7.796
				(6.307)
GDP × Executive Constraints				1.224***
				(0.402)
Trade × Executive Constraints				−0.370
				(0.339)
Population Density × Executive Constraints				0.003
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,511	2,174
Adjusted R^2	0.974	0.980	0.974	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 3: Non-Legislative Oversight Results

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.456***	0.511***	0.271***
	(0.068)	(0.147)	(0.058)	(0.086)
Non-Legislative Oversight		0.099	0.145	−1.169**
		(0.165)	(0.119)	(0.500)
Electoral Democracy		−0.429		−0.146
		(1.534)		(1.283)
GDP		0.240		0.527***
		(0.219)		(0.156)
Trade		0.076		0.012
		(0.078)		(0.053)
Population Density		−0.007*		−0.008***
		(0.004)		(0.003)
Oil and Gas × Non-Legislative Oversight			−0.059*	−0.141***
			(0.030)	(0.049)
Electoral Democracy × Non-Legislative Oversight				2.050
				(1.399)
GDP × Non-Legislative Oversight				0.310**
				(0.140)
Trade × Non-Legislative Oversight				−0.118
				(0.077)
Population Density × Non-Legislative Oversight				0.001
				(0.001)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,531	2,174
Adjusted R^2	0.974	0.980	0.974	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 4: Non-Legislative Oversight Results (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.457***	0.511***	0.271***
	(0.068)	(0.147)	(0.058)	(0.086)
Non-Legislative Oversight		0.099	0.144	−1.174**
		(0.166)	(0.120)	(0.501)
Electoral Democracy		−0.443		−0.153
		(1.534)		(1.284)
GDP		0.241		0.528***
		(0.219)		(0.156)
Trade		0.076		0.011
		(0.078)		(0.052)
Population Density		−0.007*		−0.008***
		(0.004)		(0.003)
Oil and Gas × Non-Legislative Oversight			−0.059*	−0.141***
			(0.030)	(0.049)
Electoral Democracy × Non-Legislative Oversight				2.067
				(1.400)
GDP × Non-Legislative Oversight				0.311**
				(0.140)
Trade × Non-Legislative Oversight				−0.118
				(0.077)
Population Density × Non-Legislative Oversight				0.001
				(0.001)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,531	2,174
Adjusted R^2	0.974	0.980	0.974	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 5: Legislative Oversight Results

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.454***	0.492***	0.270***
	(0.068)	(0.148)	(0.054)	(0.086)
Legislative Oversight		−0.163	−0.010	−1.237***
		(0.110)	(0.098)	(0.383)
Electoral Democracy		0.484		0.834
		(1.492)		(1.264)
GDP		0.243		0.451***
		(0.218)		(0.154)
Trade		0.076		0.052
		(0.078)		(0.043)
Population Density		−0.007*		−0.008***
		(0.004)		(0.003)
Oil and Gas × Legislative Oversight			−0.059*	−0.110**
			(0.031)	(0.051)
Electoral Democracy × Legislative Oversight				2.373**
				(1.104)
GDP × Legislative Oversight				0.199
				(0.145)
Trade × Legislative Oversight				−0.082
				(0.067)
Population Density × Legislative Oversight				0.001
				(0.001)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,511	2,174
Adjusted R^2	0.974	0.980	0.974	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 6: Legislative Oversight Results (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.454***	0.493***	0.269***
	(0.068)	(0.148)	(0.054)	(0.086)
Legislative Oversight		−0.168	−0.014	−1.247***
		(0.110)	(0.098)	(0.382)
Electoral Democracy		0.485		0.833
		(1.493)		(1.260)
GDP		0.244		0.453***
		(0.218)		(0.154)
Trade		0.075		0.051
		(0.078)		(0.043)
Population Density		−0.007*		−0.008***
		(0.004)		(0.003)
Oil and Gas × Legislative Oversight			−0.059*	−0.111**
			(0.031)	(0.051)
Electoral Democracy × Legislative Oversight				2.394**
				(1.102)
GDP × Legislative Oversight				0.200
				(0.144)
Trade × Legislative Oversight				−0.081
				(0.067)
Population Density × Legislative Oversight				0.001
				(0.001)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,511	2,174
Adjusted R^2	0.974	0.980	0.974	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Appendix B: Data and Descriptive Statistics

Tables 7 and 8 provide information and descriptive statistics for the variables used in the main analysis and in each Appendix. This Appendix also outlines decisions made when compiling the dataset, updating it through the present, and preparing it for analysis.

Table 7: Variable Codes, Names, Descriptions, Measurements, and Sources

Code	Name	Description	Measurement	Source
cowcode	COW Code	Numeric country identifier from the Correlates of War (COW) project	Ordinal [0,997]	Correlates of War: https://correlatesofwar.org/
country	Country Name	Name of country	Character string	Coppedge et al. (2023)
year	Year	Year of observation	Ordinal [1960,2023]	Coppedge et al. (2023)
row_ambig	Regimes of the world – the RoW measure with categories for ambiguous cases (v2x_regime_amb)	Country-year RoW category based on ambiguous cases	Ordinal [0,9]	Coppedge et al. (2023); Lührmann, Tannenberg, and Lindberg (2018)
row_unambig	Regimes of the world – the RoW measure (v2x_regime)	Country-year RoW category	Ordinal [0,3]	Coppedge et al. (2023); Lührmann, Tannenberg, and Lindberg (2018)
ghgs_total	Total Emissions	Total per capita fossil and non-fossil emissions of CO2, CH4, N2O, and F-gases	Tons of CO2 equivalent	Crippa et al. (2023)
ghgs_fossil	Fossil Emissions	Total per capita fossil emissions of CO2, CH4, N2O, and F-gases	Tons of CO2 equivalent	Crippa et al. (2023)
ghgs_agriculture	Total Agricultural Emissions	Total per capita fossil and non-fossil emissions of CO2, CH4, N2O, and F-gases from agricultural production	Tons of CO2 equivalent	Crippa et al. (2023)
consumption_co2_t	CBA-Based CO2 Emissions	Total per capita consumption-based CO2 emissions	Tons of CO2	Ritchie et al. (2019)
oilgasrealpop_eia	Oil and Gas (EIA)	Total real per capita value of oil and gas production	2015 USD (1,000s)	US Energy Information Agency: https://www.eia.gov/international/overview World Bank (2023)
oilgasrealpop_rm	Oil and Gas (RM)	Total real per capita value of oil and gas production	2015 USD (1,000s)	Ross and Mahdavi (2015); World Bank (2023)
oilgasrealpop_hm	Oil and Gas (HM)	Total real per capita value of oil and gas production	2007 USD (1,000s)	Haber and Menaldo (2011)
netoilgasexportsrealpop_eia	Oil and Gas Exports	Net real per capita value of oil and gas exports	2015 USD (1,000s)	US Energy Information Agency: https://www.eia.gov/international/overview World Bank (2023)
netoilgasexportsrealpop_rm	Oil and Gas Exports	Net real per capita value of oil and gas exports	2015 USD (1,000s)	Ross and Mahdavi (2015); World Bank (2023)

Table 7: Variable Codes, Names, Descriptions, Measurements, and Sources *(continued)*

Code	Name	Description	Measurement	Source
noc	NOC	Indicator of an upstream nationalized oil company with >50% state ownership	Dichotomous [0,1]	Mahdavi (2020a)
polyarchy	Electoral Democracy	Electoral democracy index (v2x_polyarchy)	Interval (0,1)	Coppedge et al. (2023)
exec_cons_vdem	Executive Constraints	Legislative constraints on the executive index (v2xlg_legcon)	Interval (0,1)	Coppedge et al. (2023)
exec_cons_polity	Executive Constraints (Polity)	Executive Constraints – Decision Rules (xconst)	Ordinal [1,7]	Marshall and Gurr (2020)
jud_cons	Executive Constraints (Judiciary)	Judicial constraints on the executive index (v2x_jucon)	Interval (0,1)	Coppedge et al. (2023)
leg_oversight	Legislative Oversight	Legislature investigates in practice (v2lginvstp)	Ordinal [0,4] converted to interval	Coppedge et al. (2023)
non_leg_oversight	Non-Legislative Oversight	Executive oversight (v2lgotovst)	Ordinal [0,4] converted to interval	Coppedge et al. (2023)
exec_corr	Executive Corruption	Executive corruption index (v2x_execorr)	Interval (0,1)	Coppedge et al. (2023)
state_capacity	State Capacity	Hanson and Sigman (2021) State Capacity Index	Interval [-2.31, 1.908]	Hanson and Sigman (2021)
oppo_seat_share	Opposition	Proportion of lower-chamber seats (v2paseatshare) held by opposition (v2pagovsup) legislators	Interval [0,1]	Lindberg et al. (2022)
gdprealpop	GDP	Total real gross domestic product per capita	2015 USD (1,000s)	World Bank (2023)
traderealpop	Trade	Total real per capita value of international trade	2015 USD (1,000s)	World Bank (2023)
popdense	Population Density	Total mid-year population density	People per kilometer-squared	World Bank (2023)

First, I transform the emissions data so that they are measured in the same per capita tons of CO_2 equivalent. Crippa et al. (2023) measure emissions in gigagrams of CO_2 equivalent based on the gas-specific 100-year global warming potential (GWP) values in the IPCC's fifth assessment report (IPCC 2014). Therefore, I simply converted the data from gigagrams to per capita metric tons, with

$$\mathrm{GHG}_{\mathrm{it}}^{\mathrm{tCO2e,pc}} = \frac{\mathrm{GHG}_{\mathrm{it}}^{\mathrm{ggCO2e}} \times 1,000}{\mathrm{Pop}_{\mathrm{it}}}$$

using population data from the (World Bank 2023).

The emissions data I use in the main analysis rely on production-based accounting (PBA) procedures rather than consumption-based accounting (CBA) procedures to estimate

Table 8: Descriptive Statistics

	N	Mean	SD	Min	Median	Max
Total Emissions	2773	7.050	12.182	0.388	2.910	108.234
Fossil Emissions	2773	6.940	12.219	0.323	2.812	108.227
Total Emissions – Agriculture	2773	0.454	1.010	0.002	0.102	8.292
CO2 Emissions – Consumption	1546	5.144	8.505	0.053	1.507	63.445
Oil and Gas (Ross and Mahdavi)	2581	1.115	3.895	0.000	0.000	49.663
Oil and Gas (Haber and Menaldo)	1416	0.862	2.711	0.000	0.003	28.553
Executive Constraints (VDEM)	2762	0.359	0.250	0.024	0.315	0.931
Executive Constraints (Polity)	2325	-3.252	22.137	-88.000	3.000	7.000
Judicial Constraints	2828	0.340	0.243	0.003	0.294	0.944
Legislative Oversight	2762	-0.492	1.161	-2.749	-0.569	3.131
Non-Legislative Oversight	2783	-0.472	1.091	-2.745	-0.562	2.830
Democracy	2849	0.269	0.128	0.013	0.263	0.760
GDP	2602	5.359	10.374	0.166	1.944	73.493
Trade	2309	6.728	20.933	0.000	1.340	226.910
Population	2675	197.042	737.353	1.397	58.133	7965.878
Density	2481	0.423	2.111	-6.443	0.000	27.010
Oil and Gas Exports	2102	-0.122	0.680	-2.310	-0.118	1.908
State Capacity	2207	0.506	0.500	0.000	1.000	1.000
NOC	330	26.083	17.390	0.000	24.200	100.100
Opposition Seat Share						

emissions. I use PBA emissions estimates for three reasons. First, the United Nations Framework Convention on Climate Change uses PBA not CBA estimates to inform international climate science and policy; thus, I do so as well, assuming this reflects the official scientific consensus (Afionis et al. 2017). Second, there is little evidence that PBA and CBA methods yield significantly different emissions estimates at the country-year level (Franzen and Mader 2018). Third, PBA emissions estimates help guard against the possibility that the main results are confounded by fossil fuel consumption, rather than production (Franzen and Mader 2018). Nevertheless, in Table 9 below, I re-estimate the models used in the main analysis but where the dependent variable measures per capita CBA estimates of CO_2 found in the Global Carbon Project and compiled by Ritchie (2019). The results of this analysis support those of the main analysis.

Second, I transform the oil and gas, gross domestic product (GDP), and trade variables so that they are measured in the same per capita, inflation-adjusted United States dollars (USD). To do this, I collected both the nominal and real (2015 USD) aggregate values of GDP from the World Development Indicators and computed an implicit price deflator

$$\mathrm{I}_{\mathrm{it}} = \frac{\mathrm{GDP}^{\mathrm{N}}_{\mathrm{it=2015}}}{\mathrm{GDP}^{\mathrm{R}}_{\mathrm{it}}}$$

This gives a rough index I of inflation in country i during year t based on prices measured in 2015 USD. Then, I solved for real per capita GDP and oil and gas income measured in 1,000s of 2015 USD by computing

$$\mathrm{GDP}^{\mathrm{R,pc}}_{\mathrm{it}} = \frac{\mathrm{GDP}^{\mathrm{R}}_{\mathrm{it}}}{\mathrm{Pop}_{\mathrm{it}} \times 1,000}$$

and

$$\text{Oil and Gas}^{\mathrm{R,pc}}_{\mathrm{it}} = \frac{\text{Oil and Gas}^{\mathrm{N}}_{\mathrm{it}} \times \mathrm{I}_{\mathrm{it}}}{\mathrm{Pop}_{\mathrm{it}} \times 1,000}$$

where $\mathrm{Pop}_{\mathrm{it}}$ is population. To compute the real per capita volume of international trade, I followed a similar procedure but calculated these values first from the percent of nominal aggregate GDP made up of exports plus imports, such that

$$\mathrm{Trade}^{\mathrm{R,pc}}_{\mathrm{it}} = \frac{\mathrm{Trade}^{\mathrm{N,pct}}_{\mathrm{it}} \times \mathrm{GDP}^{\mathrm{N}}_{\mathrm{it}}}{\mathrm{Pop}_{\mathrm{it}} \times 10,000} \times \mathrm{I}_{\mathrm{it}}$$

I updated the Ross and Mahdavi (2015) dataset through the present by filling in missing values using data from the United States Energy Information Administration, where most of the authors' original estimates come from. I computed real per capita oil and gas income as the sum divided by 1,000 of

$$\mathrm{Oil}^{\mathrm{R,pc}}_{\mathrm{it}} = \frac{\mathrm{Oil}^{\mathrm{Mbd}}_{\mathrm{it}} \times \mathrm{Price}^{\mathrm{bbl}}_{\mathrm{t}} \times 365,000 \times \mathrm{I}_{\mathrm{it}}}{\mathrm{Pop}_{\mathrm{it}}}$$

and

Table 9: Consumption-Based Emissions Results

	Dependent variable:			
	CBA-Based CO2 Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.085*	0.028	0.082	0.061
	(0.043)	(0.050)	(0.056)	(0.049)
Executive Constraints		−0.168	−0.303	−2.177
		(0.975)	(0.433)	(3.166)
Electoral Democracy		−0.748		−3.383
		(2.712)		(6.904)
GDP		0.090		0.080
		(0.148)		(0.150)
Trade		0.119***		0.078
		(0.035)		(0.157)
Population Density		−0.004*		−0.003
		(0.002)		(0.004)
Oil and Gas × Executive Constraints			0.005	−0.231*
			(0.058)	(0.128)
Electoral Democracy × Executive Constraints				5.267
				(10.447)
GDP × Executive Constraints				0.260
				(0.301)
Trade × Executive Constraints				0.098
				(0.382)
Population Density × Executive Constraints				−0.006
				(0.006)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	1,464	1,320	1,457	1,320
Adjusted R^2	0.952	0.955	0.953	0.956

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

$$\text{Gas}_{\text{it}}^{\text{R,pc}} = \frac{\text{Gas}_{\text{it}}^{\text{bcf}} \times \text{Price}_{\text{t}}^{\text{MMBtu}} \times 1,011,333.08326587 \times \text{I}_{\text{it}}}{\text{Pop}_{\text{it}}}$$

and the real per capita net value of oil and gas exports as the sum of exports minus imports using the same price, inflation, population and conversion factors.

Based on this processing of oil and gas income data, one might argue that my results do not contain direct evidence of executive rent-seeking. To address this concern, therefore, I multiply the oil and gas variable by V-Dem's index of executive corruption (v2x_execorr) to create a new variable that I call "Oil and Gas Corruption." This variable scales countries' level of fossil fuel wealth by their level of executive corruption, providing more direct evidence of carbon-intensive rent-seeking. Consider the following examples: v2x_execorr(0) $\times$ Oil and $\text{Gas}_{\text{it}} = 0$, implying no evidence of carbon-intensive rent-seeking by executives for any value of oil and gas income because there is no evidence of executive corruption, and v2x_execorr(1)$\times$Oil and Gas_{it} = Oil and Gas_{it}, implying that carbon-intensive rent-seeking by executives is exactly the same as the level of oil and gas income income because all oil and gas income vulnerable to executive corruption. I re-estimate the models in the main analysis using this new variable and present the results in Table 10 below. The results of this analysis support those of the main analysis.

Table 10: Oil and Gas Corruption Results

	Dependent variable:			
	Total Emissions		Fossil Emissions	
	(1)	(2)	(3)	(4)
Oil and Gas Corruption	0.820**	0.939**	0.820**	0.940**
	(0.326)	(0.377)	(0.326)	(0.377)
Executive Constraints	0.683	−3.849**	0.665	−3.879**
	(0.734)	(1.873)	(0.737)	(1.875)
Electoral Democracy	−0.328	−3.562	−0.326	−3.581
	(1.713)	(3.841)	(1.715)	(3.840)
GDP	0.310	0.147	0.311	0.148
	(0.214)	(0.224)	(0.214)	(0.224)
Trade	0.047	0.086	0.046	0.085
	(0.067)	(0.151)	(0.067)	(0.151)
Population Density	−0.007*	−0.008**	−0.006*	−0.008**
	(0.003)	(0.004)	(0.003)	(0.004)
Oil and Gas Corruption × Executive Constraints		−0.930*		−0.934*
		(0.486)		(0.485)
Electoral Democracy × Executive Constraints		7.102		7.143
		(6.214)		(6.214)
GDP × Executive Constraints		1.002**		1.006**
		(0.388)		(0.387)
Trade × Executive Constraints		−0.215		−0.215
		(0.360)		(0.360)
Population Density × Executive Constraints		0.001		0.001
		(0.005)		(0.005)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,174	2,174	2,174	2,174
Adjusted R^2	0.979	0.980	0.979	0.980

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Appendix C: Placebo Tests

In this Appendix, I conduct four placebo tests to provide further evidence that climate inaction in non-democracies is best explained by the lack of institutional constraints on autocratic leaders' use of fossil fuel wealth for political gain. The idea behind placebo testing is that for theories to be supported empirically, they must describe both the presence *and* absence of statistical patterns that conform to theoretical expectations (Eggers, Tuñón, and Dafoe 2023). In general, the placebo tests I conduct in this Appendix produce null and negligible results, strengthening the credibility of the findings in the main analysis.

First, I test whether the results observed in the main analysis are also observed before 1990. Because this article provides a theory of *climate* inaction, fossil fuel wealth and executive constraints should not affect emissions in the same way during the analogous "pre-treatment" period when climate change was not on the international agenda. Second, I test whether similar results are observed when the models are used to predict emissions in the agricultural sector. If *fossil fuel wealth* undermines climate action, then oil and gas income should not predict – and executive constraints should not moderate the effects of oil and gas income on – a placebo outcome, namely agricultural emissions. Third, I test whether executive constraints from judicial institutions moderate the relationship between oil and gas income and emissions. My theory suggests that executive constraints from *oversight rules* moderate the effects of fossil fuel wealth on climate inaction, so executive constraints from a placebo institution without oversight authority – the judiciary – should not significantly influence this relationship. Finally, I analyze a placebo sample of democratic regimes. Since mine is a theory of climate inaction in *authoritarian* regimes, the results observed in the main analysis should not be observed in democratic regimes.

Table 11: Pre-1990 Placebo Results

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.628***	0.224	0.206	−0.129
	(0.088)	(0.226)	(0.169)	(0.199)
Electoral Democracy		−0.344	−0.658	0.130
		(0.641)	(0.553)	(1.380)
GDP		0.555		0.344
		(0.673)		(0.927)
Trade		0.186		0.175
		(0.333)		(0.324)
Population Density		0.049		0.146
		(0.064)		(0.112)
Executive Constraints		−0.0002		0.001
		(0.002)		(0.002)
Oil and Gas × Executive Constraints			5.481***	5.365**
			(1.970)	(2.521)
Electoral Democracy × Executive Constraints				−0.535
				(2.493)
GDP × Executive Constraints				0.024
				(0.146)
Trade × Executive Constraints				−0.287
				(0.202)
Population Density × Executive Constraints				0.001
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	1,440	1,103	1,263	1,103
Adjusted R^2	0.937	0.959	0.928	0.963

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 12: Pre-1990 Placebo Results (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.628***	0.226	0.206	−0.127
	(0.088)	(0.226)	(0.168)	(0.199)
Executive Constraints		−0.390	−0.680	0.061
		(0.638)	(0.550)	(1.368)
Electoral Democracy		0.631		0.412
		(0.675)		(0.931)
GDP		0.185		0.173
		(0.332)		(0.324)
Trade		0.048		0.147
		(0.064)		(0.112)
Population Density		−0.0002		0.001
		(0.002)		(0.002)
Oil and Gas × Executive Constraints			5.484***	5.362**
			(1.967)	(2.520)
Electoral Democracy × Executive Constraints				−0.507
				(2.485)
GDP × Executive Constraints				0.028
				(0.145)
Trade × Executive Constraints				−0.290
				(0.202)
Population Density × Executive Constraints				0.001
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	1,440	1,103	1,263	1,103
Adjusted R^2	0.938	0.959	0.928	0.963

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 13: Agricultural Emissions Placebo Results

	Dependent variable:			
	Total Emissions (Agriculture)			
	(1)	(2)	(3)	(4)
Oil and Gas	−0.013	−0.010	−0.013	−0.007
	(0.014)	(0.016)	(0.018)	(0.016)
Executive Constraints		−0.096	−0.103	−0.424
		(0.102)	(0.076)	(0.263)
Electoral Democracy		0.084		0.182
		(0.290)		(0.619)
GDP		0.035*		−0.005
		(0.019)		(0.018)
Trade		0.003		0.031***
		(0.009)		(0.011)
Population Density		−0.0003		−0.001***
		(0.0003)		(0.0002)
Oil and Gas × Executive Constraints			−0.005	−0.046
			(0.021)	(0.028)
Electoral Democracy × Executive Constraints				−0.394
				(1.075)
GDP × Executive Constraints				0.194***
				(0.070)
Trade × Executive Constraints				−0.089***
				(0.027)
Population Density × Executive Constraints				0.001***
				(0.0003)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,511	2,174
Adjusted R^2	0.919	0.937	0.927	0.941

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 14: Judicial Institutions Placebo Results

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.461***	0.569***	0.206
	(0.068)	(0.145)	(0.171)	(0.184)
Executive Constraints$^{\text{Judiciary}}$		2.280**	1.704*	0.929
		(1.043)	(0.900)	(1.772)
Electoral Democracy		−1.165		−3.054
		(1.110)		(2.361)
GDP		0.249		0.286**
		(0.208)		(0.131)
Trade		0.009		0.015
		(0.041)		(0.084)
Population Density		−0.004*		−0.003
		(0.002)		(0.002)
Oil and Gas × Executive Constraints$^{\text{Judiciary}}$			−0.036	0.547
			(0.272)	(0.456)
Electoral Democracy × Executive Constraints$^{\text{Judiciary}}$				4.546
				(5.232)
GDP Executive Constraints$^{\text{Judiciary}}$				−0.075
				(0.563)
Trade Executive Constraints$^{\text{Judiciary}}$				−0.005
				(0.166)
Population Density Executive Constraints$^{\text{Judiciary}}$				−0.001
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,186	2,548	2,186
Adjusted R^2	0.974	0.980	0.975	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 15: Judicial Institutions Placebo Results (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.461***	0.569***	0.207
	(0.068)	(0.145)	(0.171)	(0.184)
Executive Constraints$^{\text{Judiciary}}$		2.258**	1.682*	0.935
		(1.049)	(0.901)	(1.771)
Electoral Democracy		−1.164		−3.039
		(1.114)		(2.359)
GDP		0.250		0.287**
		(0.208)		(0.131)
Trade		0.008		0.014
		(0.041)		(0.084)
Population Density		−0.004*		−0.003
		(0.002)		(0.002)
Oil and Gas × Executive Constraints$^{\text{Judiciary}}$			−0.036	0.544
			(0.272)	(0.456)
Electoral Democracy × Executive Constraints$^{\text{Judiciary}}$				4.501
				(5.228)
GDP Executive Constraints$^{\text{Judiciary}}$				−0.074
				(0.563)
Trade Executive Constraints$^{\text{Judiciary}}$				−0.004
				(0.166)
Population Density Executive Constraints$^{\text{Judiciary}}$				−0.001
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,186	2,548	2,186
Adjusted R^2	0.974	0.980	0.975	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 16: Democracies Sample Placebo Results

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.402	0.157***	2.175	0.386
	(0.288)	(0.053)	(1.463)	(0.247)
Executive Constraints		0.736	1.248	−8.304**
		(1.202)	(1.465)	(3.737)
Electoral Democracy		−1.223		−12.304**
		(1.225)		(5.946)
GDP		0.012		0.149
		(0.054)		(0.244)
Trade		−0.051***		0.100
		(0.014)		(0.096)
Population Density		0.002		−0.018**
		(0.003)		(0.009)
Oil and Gas × Executive Constraints			−1.906	−0.234
			(1.520)	(0.270)
Electoral Democracy × Executive Constraints				14.226*
				(7.444)
GDP × Executive Constraints				−0.151
				(0.237)
Trade × Executive Constraints				−0.166
				(0.104)
Population Density × Executive Constraints				0.018**
				(0.008)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,766	2,490	2,766	2,490
Adjusted R^2	0.927	0.962	0.928	0.963

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 17: Democracies Sample Placebo Results (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.402	0.156***	2.174	0.383
	(0.288)	(0.053)	(1.465)	(0.246)
Executive Constraints		0.721	1.250	−8.314**
		(1.203)	(1.468)	(3.725)
Electoral Democracy		−1.191		−12.266**
		(1.219)		(5.901)
GDP		0.012		0.150
		(0.054)		(0.244)
Trade		−0.051***		0.099
		(0.014)		(0.096)
Population Density		0.003		−0.018**
		(0.003)		(0.009)
Oil and Gas × Executive Constraints			−1.906	−0.232
			(1.521)	(0.269)
Electoral Democracy × Executive Constraints				14.217*
				(7.408)
GDP × Executive Constraints				−0.151
				(0.236)
Trade × Executive Constraints				−0.165
				(0.104)
Population Density × Executive Constraints				0.018**
				(0.008)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,766	2,490	2,766	2,490
Adjusted R^2	0.928	0.962	0.928	0.964

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Appendix D: Model Diagnostics and Alternative Estimators

Though two-way fixed-effects estimators are a common technique for analyzing observational panel data, here I leverage alternative techniques for estimating causal effects with observational panel data to combat five threats to inference. First, I use lagged explanatory variable models to show that the results observed in the main analysis are not simply the product of reverse causality (Leszczensky and Wolbring 2022). Second, I use error correction and dynamic panel modeling to examine whether the main results are robust to AR(1) cointegration and confounding from lagged outcomes (Warner 2019; Boef and Keele 2008). Third, I show that the main results do not depend heavily on (non-)linear specifications of the interaction between executive constraints, oil and gas income, and other covariates (Hainmueller, Mummolo, and Xu 2019). Fourth, I compute ensemble (average) model estimates across all possible covariate configurations in any fixed-effects specification that contains oil and gas income, executive constraints, and their product. Fifth, I show that the main results do not depend heavily on multiway clustered standard errors (Cameron, Gelbach, and Miller 2011). These tests provide strong support for the results presented in the main analysis.

Two-way fixed-effects estimators do not fully address concerns about reverse causality. Indeed, some scholars suggest that non-democratic political institutions, such as executive constraints, are simply endogenous to long-run political economy outcomes, such as fossil fuel wealth (Pepinsky 2014). Below, I address this critique by lagging fossil fuel wealth, executive constraints, and their product in various configurations to show that similar results are obtained when the explanatory variables are explicitly modeled as predating each other and emissions (see Tables 18 and 19). Some scholars claim that lagged explanatory variables raise a dynamic version of the assumption of no unobserved confounding (Bellemare, Masaki, and Pepinsky 2017). This concern reflects concerns about omitted variable bias, which I address through sensitivity analysis in the main analysis (Cinelli and Hazlett 2020). Moreover, the $q = 1, \alpha = 0.05$ robustness values of the lagged explanatory variable models estimated in this Appendix (7.5% – 37.3%) are similar to those in the main analysis (13.0% – 40.6%), suggesting that there is a low probability of dynamic unobserved confounding (see Cinelli and Hazlett 2020). Thus, lagged explanatory variable models increase confidence that the observed results are not simply the product of reverse causality.

Table 18: Lagged Explanatory Variable Results

	Dependent variable:		
	Total Emissions		
	(1)	(2)	(3)
Oil and Gas$_{t-1}$	0.446***		0.446***
	(0.120)		(0.121)
Executive Constraints	−4.910**		
	(1.948)		
Oil and Gas		0.517***	
		(0.135)	
Executive Constraints$_{t-1}$		−4.089**	−4.249**
		(1.800)	(1.868)
Electoral Democracy	−4.103	−2.961	−3.195
	(3.759)	(3.569)	(3.538)
GDP	0.082	0.045	0.103
	(0.211)	(0.213)	(0.207)
Trade	0.190	0.153	0.174
	(0.125)	(0.119)	(0.115)
Population Density	−0.010***	−0.009**	−0.009***
	(0.004)	(0.003)	(0.003)
Oil and Gas$_{t-1}$ × Executive Constraints	−0.517***		
	(0.150)		
Electoral Democracy × Executive Constraints	8.184		
	(6.279)		
GDP × Executive Constraints	1.201***		
	(0.374)		
Trade × Executive Constraints	−0.426		
	(0.328)		
Population Density × Executive Constraints	0.004		
	(0.004)		
Oil and Gas × Executive Constraints$_{t-1}$		−0.520***	
		(0.166)	
Oil and Gas$_{t-1}$ × Executive Constraints$_{t-1}$			−0.499***
			(0.148)
Electoral Democracy × Executive Constraints$_{t-1}$		5.539	6.296
		(5.875)	(5.853)
GDP × Executive Constraints$_{t-1}$		1.139***	1.136***
		(0.351)	(0.344)
Trade × Executive Constraints$_{t-1}$		−0.342	−0.400
		(0.311)	(0.301)
Population Density × Executive Constraints$_{t-1}$		0.003	0.003
		(0.004)	(0.004)
Country FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Observations	2,157	2,171	2,156
Adjusted R^2	0.981	0.981	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 19: Lagged Explanatory Variable Results (continued)

	Dependent variable:		
	Fossil Emissions		
	(1)	(2)	(3)
Oil and Gas$_{t-1}$	0.446***		0.446***
	(0.120)		(0.121)
Executive Constraints	−4.943**		
	(1.951)		
Oil and Gas		0.518***	
		(0.135)	
Executive Constraints$_{t-1}$		−4.123**	−4.283**
		(1.804)	(1.872)
Electoral Democracy	−4.125	−2.976	−3.210
	(3.758)	(3.568)	(3.536)
GDP	0.083	0.046	0.103
	(0.210)	(0.213)	(0.207)
Trade	0.189	0.152	0.173
	(0.125)	(0.119)	(0.115)
Population Density	−0.010***	−0.009**	−0.009***
	(0.004)	(0.003)	(0.003)
Oil and Gas$_{t-1}$ × Executive Constraints	−0.519***		
	(0.150)		
Electoral Democracy × Executive Constraints	8.229		
	(6.280)		
GDP × Executive Constraints	1.205***		
	(0.374)		
Trade × Executive Constraints	−0.426		
	(0.328)		
Population Density × Executive Constraints	0.004		
	(0.004)		
Oil and Gas × Executive Constraints$_{t-1}$		−0.522***	
		(0.166)	
Oil and Gas$_{t-1}$ × Executive Constraints$_{t-1}$			−0.500***
			(0.148)
Electoral Democracy × Executive Constraints$_{t-1}$		5.579	6.332
		(5.876)	(5.854)
GDP × Executive Constraints$_{t-1}$		1.142***	1.139***
		(0.351)	(0.344)
Trade × Executive Constraints$_{t-1}$		−0.341	−0.399
		(0.311)	(0.300)
Population Density × Executive Constraints$_{t-1}$		0.003	0.003
		(0.004)	(0.004)
Country FEs	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes
Observations	2,157	2,171	2,156
Adjusted R^2	0.981	0.981	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Second, I diagnose selection into treatment timing and sensitivity to stochastic time trends by estimating several dynamic panel models that hold constant total and fossil emissions at each period $t-T$, as well as several error correction models that consider all variables in the analysis cointegrated on the order AR(1). Dynamic panel specifications that hold constant lagged dependent variable values allow researchers to model selection into treatment timing based on previous dependent variable values. In separate model specifications, I control for total and fossil emissions at each period $t - T$ and plot the point estimates and 95% confidence intervals for these models in Figures D1 – D4 below. The vast majority of the estimates obtained from dynamic panel modeling remain statistically significant and have the same sign as those obtained in the main analysis. In other words, the main results are generally robust to selection effects from lagged outcomes. However, the dynamic panel model results suggest that the results of the main analysis may contain bias from $t-1$ lagged outcomes. Therefore, I also estimate a more complex series of error correction models to account for AR(1) cointegration across all time series and explicitly remove this source of bias.

Although error correction modeling is increasingly common in political science (Box-Steffensmeier and Helgason 2016), scholars have only recently outlined robust techniques for analyzing conditional relationships in dynamic panel models, allowing for applications to multiplicative interactions (Warner 2019). I estimate the most general specification summarized by equation 3 in Warner (2019), which imposes no assumptions about how the conditional relationship between oil and gas income and executive constraints unfolds over time. The error correction results shown in Table 20 offer partial support for the results in the main analysis. In particular, Table 20 suggests that contemporaneous changes in oil and gas income represented by ΔOil and Gas lead to contemporaneous changes in emissions, even when accounting for AR(1) cointegration. However, none of the interactions between the oil and gas and executive constraints variables return significant results, suggesting that executive constraints may not moderate the effects of fossil fuel wealth on climate inaction over the long run. However, readers should interpret these results with caution as multiplicative interactions in error correction models are generally poorly understood in political science, let alone the combination of error correction and "fully moderated" regression models.

Figure D1: Dynamic Panel Results (Lagged Total Emissions)

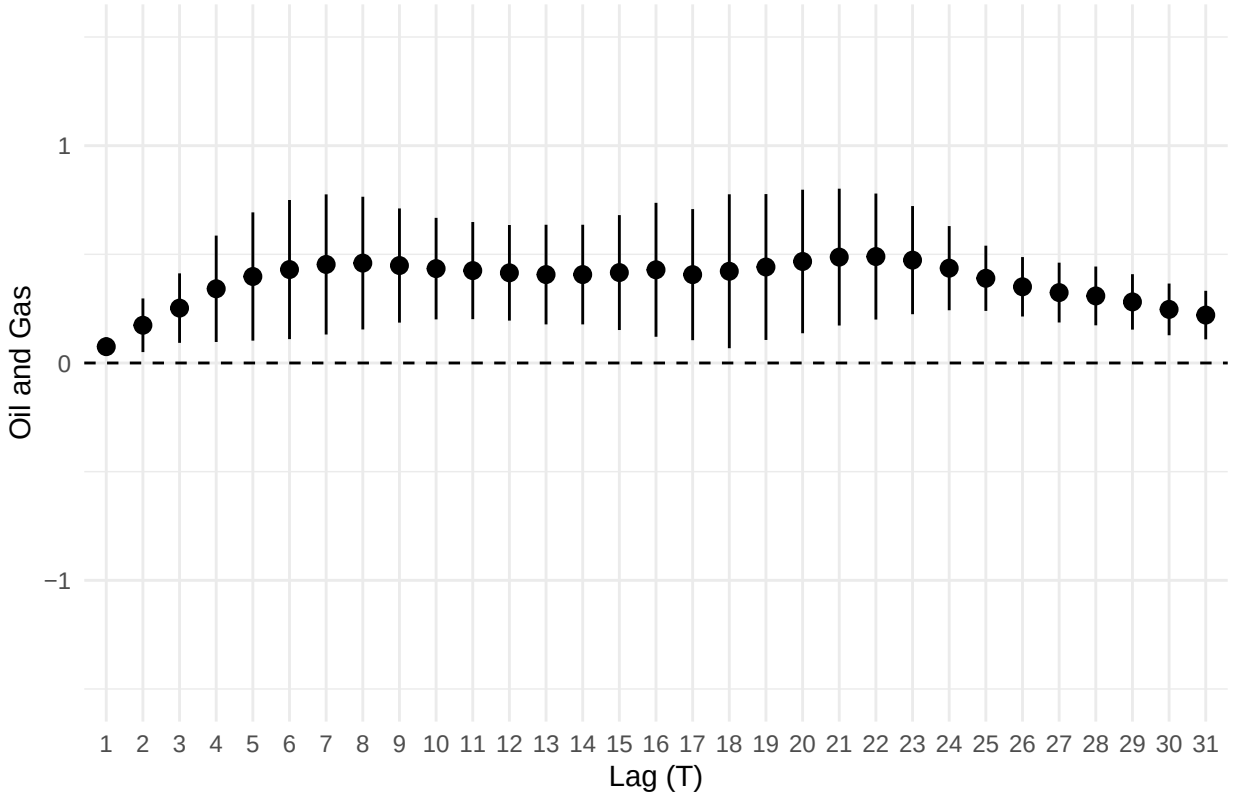


Figure D2: Dynamic Panel Results (Lagged Fossil Emissions)

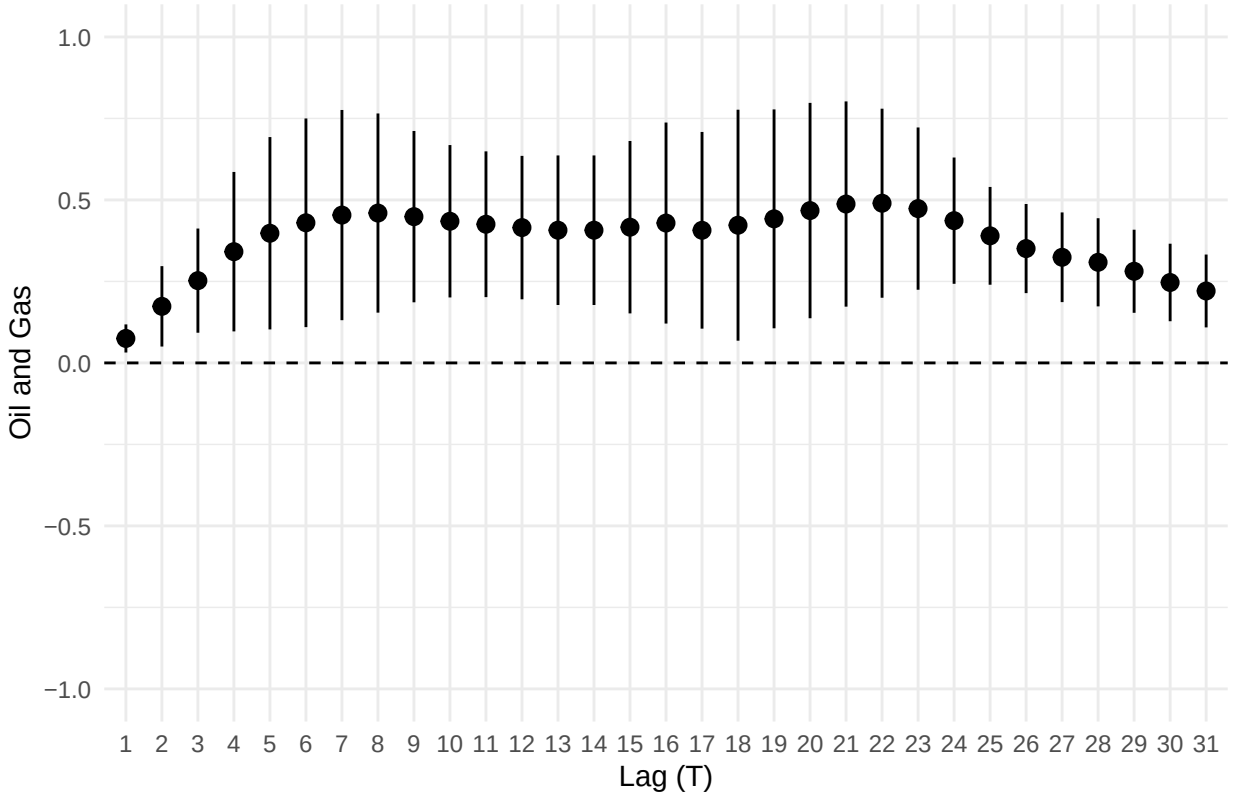


Figure D3: Dynamic Panel Results (Lagged Total Emissions)

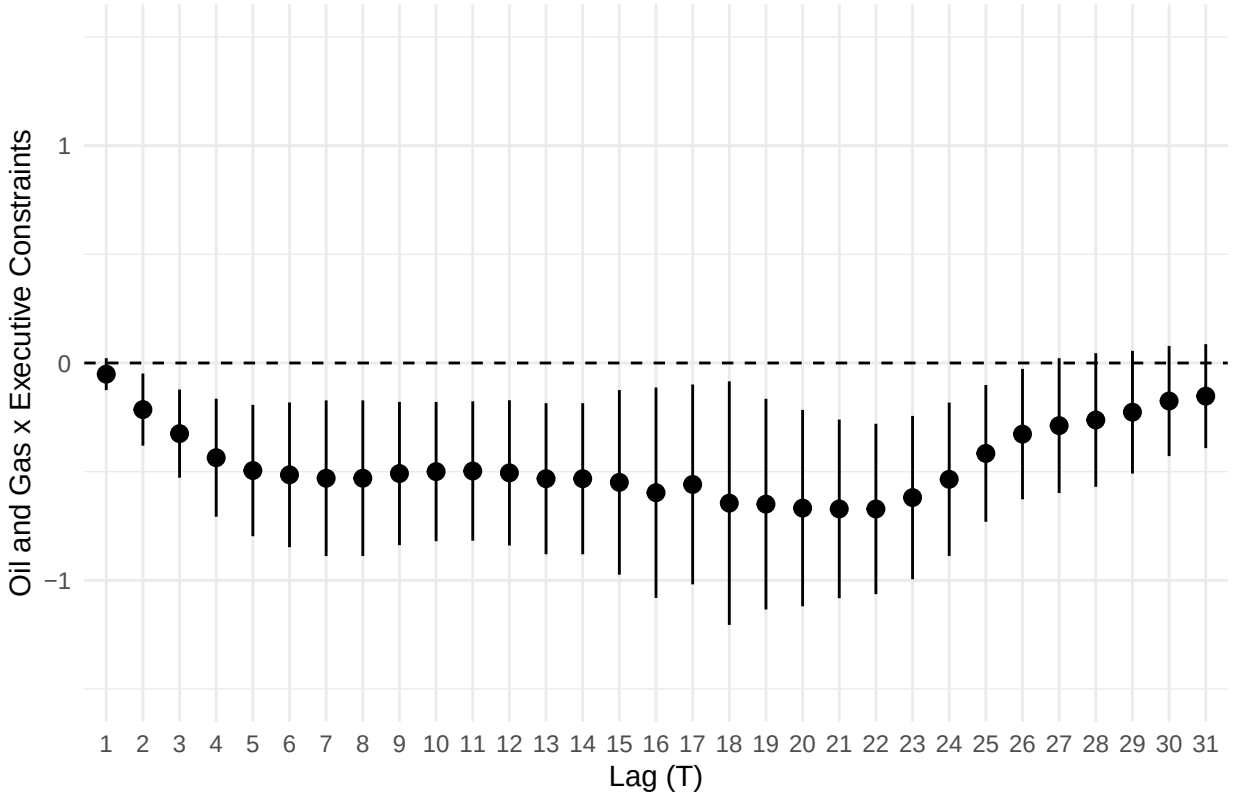


Figure D4: Dynamic Panel Results (Lagged Fossil Emissions)

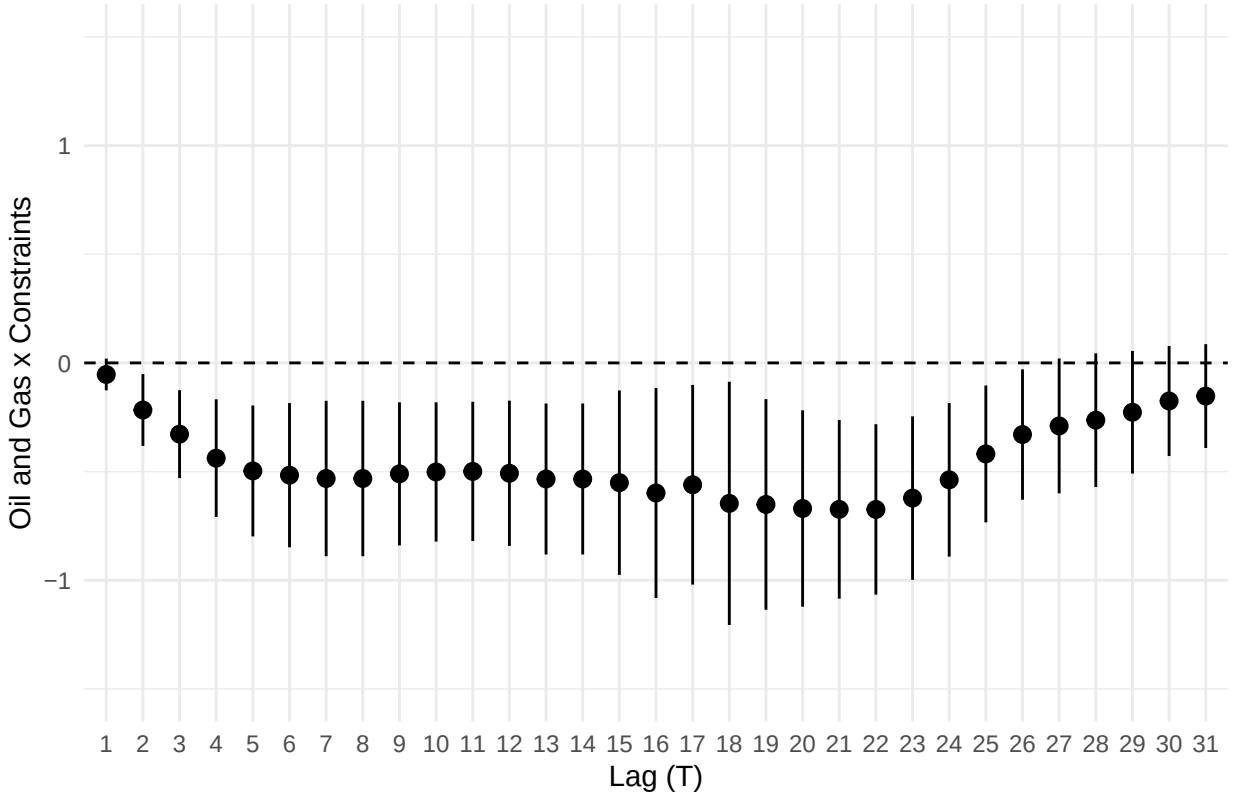


Table 20: AR(1) Error Correction Results

	Dependent variable:			
	Δ Total Emissions		Δ Fossil Emissions	
	(1)	(2)	(3)	(4)
Total Emissions$_{t-1}$	−0.126***	−0.110***		
	(0.022)	(0.024)		
Fossil Emissions$_{t-1}$			−0.126***	−0.110***
			(0.022)	(0.024)
Δ Oil and Gas	0.134***	0.121***	0.134***	0.122***
	(0.034)	(0.043)	(0.034)	(0.043)
Δ Executive Constraints	−0.009	−1.441**	−0.004	−1.423**
	(0.216)	(0.680)	(0.216)	(0.673)
Oil and Gas$_{t-1}$	−0.0004	−0.010	−0.001	−0.009
	(0.016)	(0.021)	(0.016)	(0.021)
Executive Constraints$_{t-1}$	0.236	0.048	0.235	0.026
	(0.182)	(0.466)	(0.181)	(0.464)
Δ GDP	0.604***	0.403**	0.605***	0.403**
	(0.105)	(0.183)	(0.105)	(0.183)
Δ Electoral Democracy	0.155	−0.533	0.160	−0.531
	(0.374)	(1.097)	(0.374)	(1.098)
Δ Trade	−0.016	0.127***	−0.016	0.127***
	(0.023)	(0.025)	(0.023)	(0.025)
Δ Population Density	0.001	−0.012*	0.001	−0.012*
	(0.002)	(0.006)	(0.002)	(0.006)
GDP$_{t-1}$	0.051**	−0.006	0.051**	−0.005
	(0.024)	(0.023)	(0.024)	(0.023)
Electoral Democracy$_{t-1}$	−0.280	−0.345	−0.281	−0.339
	(0.396)	(0.648)	(0.396)	(0.647)
Trade$_{t-1}$	−0.004	0.050**	−0.004	0.050**
	(0.013)	(0.025)	(0.013)	(0.025)
Population Density$_{t-1}$	−0.001	−0.001**	−0.001	−0.001**
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Total Emissions$_{t-1}$ × Δ Executive Constraints		−0.018		
		(0.199)		
Total Emissions$_{t-1}$ × Executive Constraints$_{t-1}$		−0.108**		
		(0.048)		
Fossil Emissions$_{t-1}$ × Δ Executive Constraints				−0.018
				(0.198)
Fossil Emissions$_{t-1}$ × Executive Constraints$_{t-1}$				−0.103**
				(0.048)
Δ Oil and Gas × Δ Executive Constraints		0.613		0.625
		(0.829)		(0.826)
Δ Oil and Gas × Executive Constraints$_{t-1}$		−0.011		−0.012
		(0.073)		(0.073)
Oil and Gas$_{t-1}$ × Δ Executive Constraints		0.038		0.041
		(0.889)		(0.889)
Oil and Gas$_{t-1}$ × Executive Constraints$_{t-1}$		0.003		0.002
		(0.027)		(0.027)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Fully Moderated	Yes	Yes	Yes	Yes
Observations	2,123	2,123	2,123	2,123
Adjusted R^2	0.409	0.429	0.409	0.429

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Third, I use a variety of methods to examine whether the results of the main analysis are robust to different specifications of the interaction between executive constraints and other explanatory variables. First, using what Hainmueller, Mummolo, and Xu (2019) call "linear diagnostic plots," in Figure D5, I show that both total and fossil emissions are increasing approximately linearly in oil and gas income for each tercile of executive constraints. Second, Table 21, shows that the more conventional linear regression model yields similar results as those in the main analysis. Third, I add a binning estimator (Hainmueller, Mummolo, and Xu 2019) to the fully moderated regression model and plot these results in Figures D6 and D7, which generally show a downward monotonic trend in the binning estimates. Specifically, I construct bins that estimate the effects of fossil fuel wealth on emissions at the median value of executive constraints, legislative oversight, and non-legislative oversight below the 10th percentile, above the 90th percentile, and between the 10th and 90th percentiles. However, caution is warranted in interpreting these results, since the binning estimator is not necessarily unbiased when the data-generating process is characterized by linear interactive effects (Beiser-McGrath and Beiser-McGrath 2023), as the previous two results suggest. Moreover, these estimates are substantially less efficient than the linear estimates (Hainmueller, Mummolo, and Xu 2019).

Fourth, I conduct a specification analysis by computing ensemble (average) model estimates across all possible covariate configurations in any fixed-effects specification that contains oil and gas income, executive constraints, and their product (see Figures D8 and D9). Across 1,536 different regression models, I observe average estimates of 0.765 for the oil and gas income coefficient and -0.422 for the interaction between oil and gas income and executive constraints. The oil and gas coefficient is positive in all cases, while the coefficient for the interaction term is negative in approximately 91.9% percent of cases. The handful of models in which the interaction term is positive all have year fixed-effects but not country fixed-effects, suggesting these coefficients may not be reliable anyway. Overall, these results offer little evidence of model dependence.

Figure D5: Observed Emissions and Oil and Gas by Executive Constraints

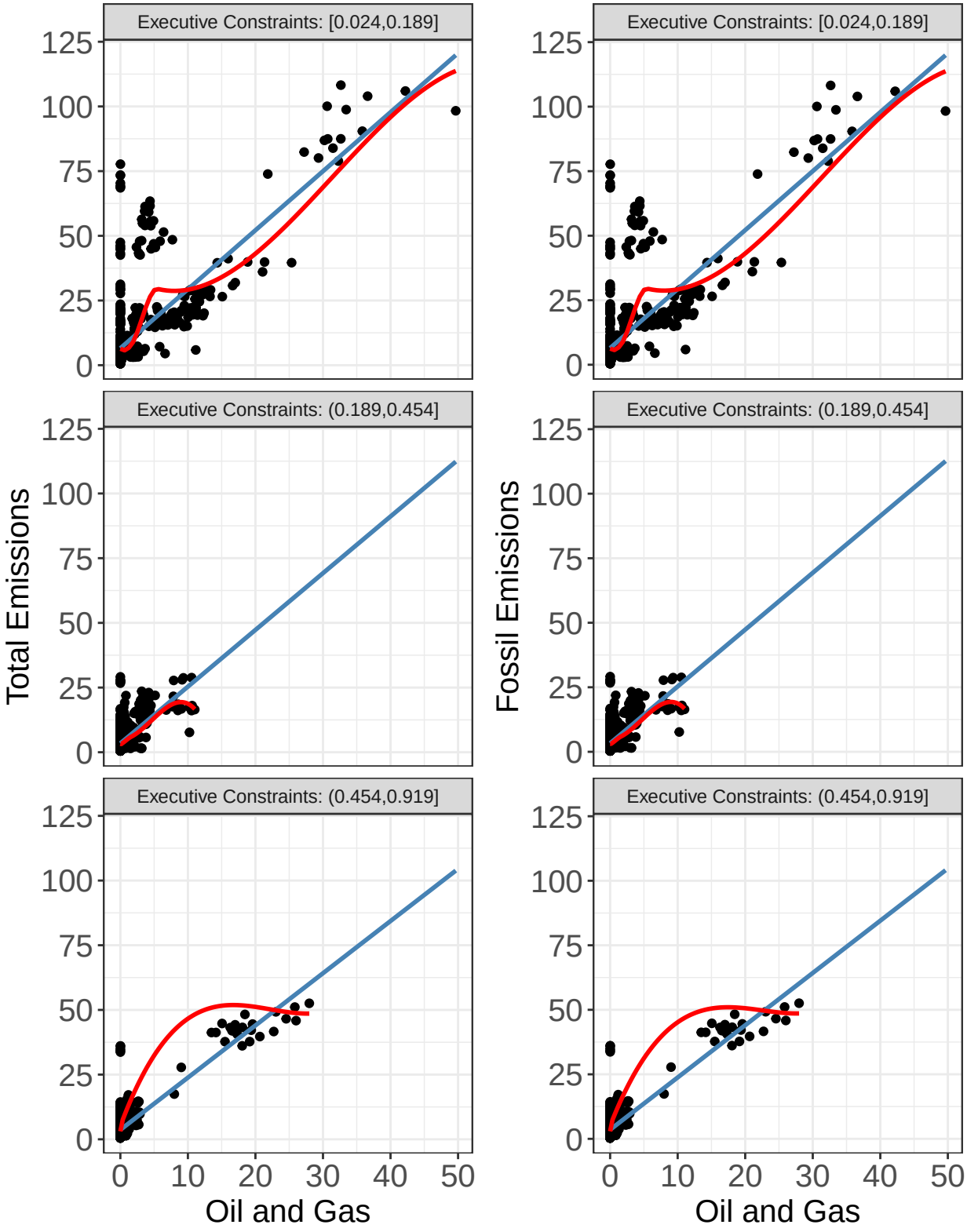


Table 21: Linear Regression Results

	Dependent variable:	
	Total Emissions	Fossil Emissions
	(1)	(2)
Oil and Gas	0.493^{***}	0.493^{***}
	(0.145)	(0.145)
Executive Constraints	0.445	0.427
	(0.654)	(0.657)
GDP	0.261	0.262
	(0.209)	(0.209)
Electoral Democracy	−0.384	−0.382
	(1.713)	(1.714)
Trade	0.073	0.073
	(0.076)	(0.076)
Population Density	-0.007^{*}	-0.007^{*}
	(0.004)	(0.004)
Oil and Gas × Executive Constraints	-0.188^{**}	-0.188^{**}
	(0.094)	(0.094)
Country FEs	Yes	Yes
Year FEs	Yes	Yes
Observations	2,174	2,174
Adjusted R^2	0.980	0.980
Note:	*p<0.1; **p<0.05; ***p<0.01	
	Country-clustered errors in parentheses	

Figure D6: Conditional Marginal Effects and 95% CIs (Binning Estimator)

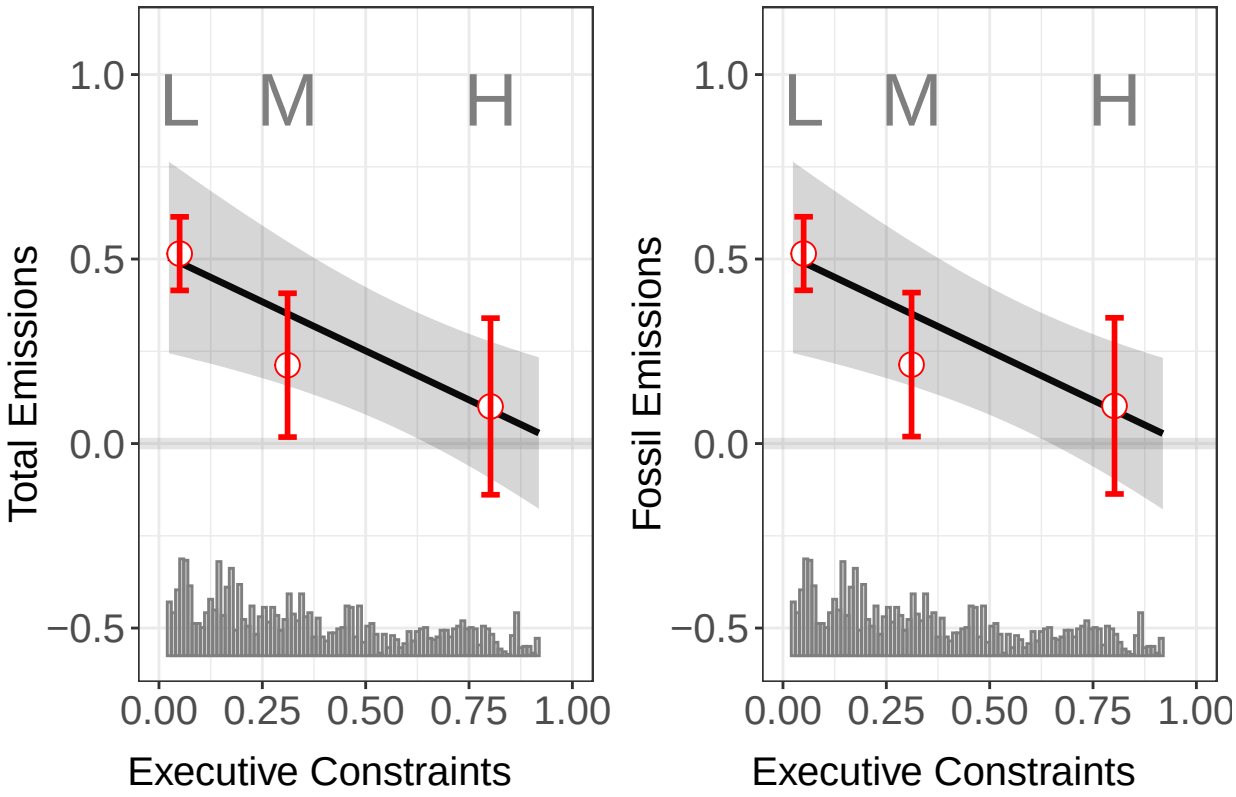


Figure D7: Conditional Marginal Effects and 95% CIs (Binning Estimator)

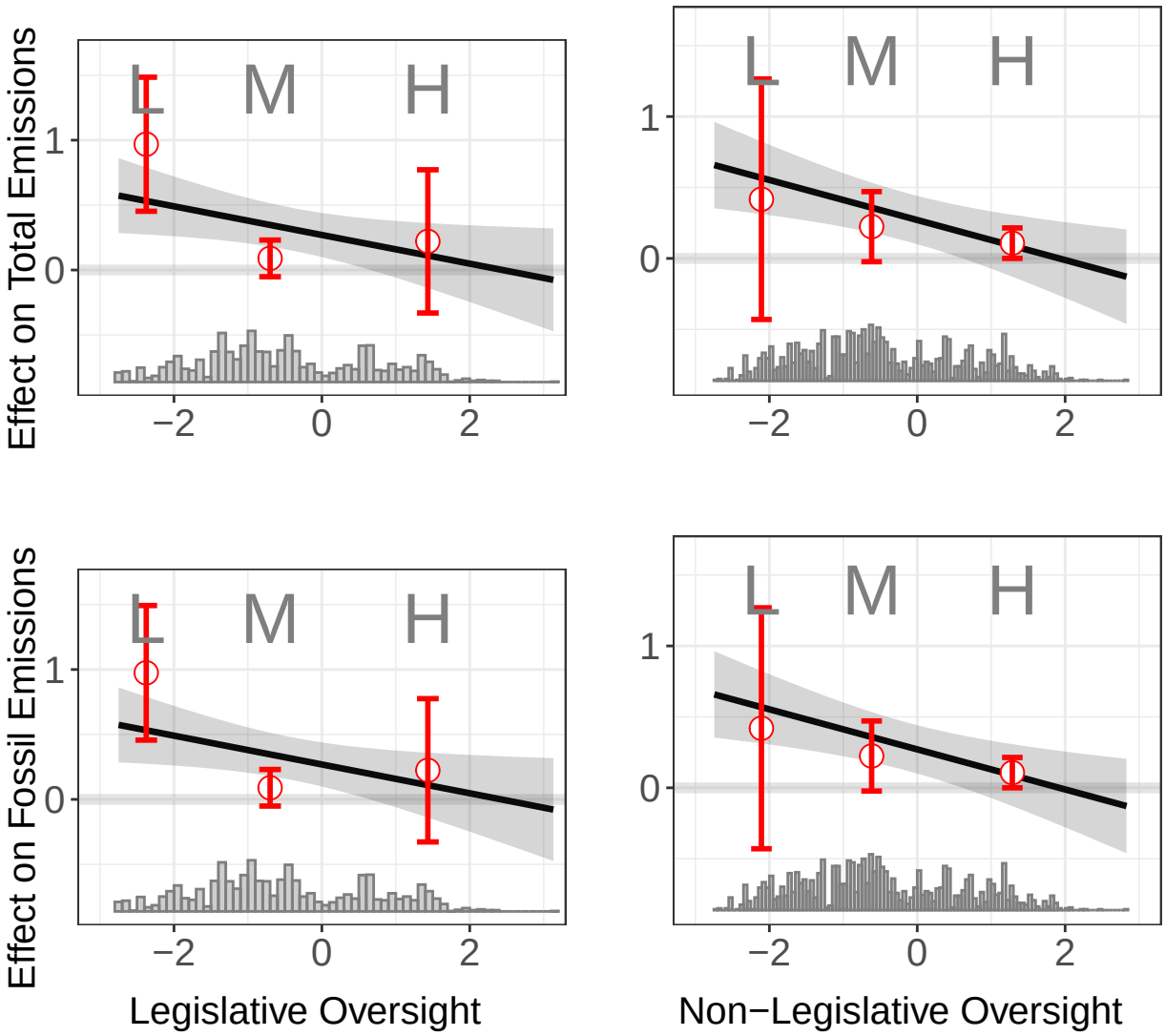


Figure D8: Specification Test (Oil and Gas)

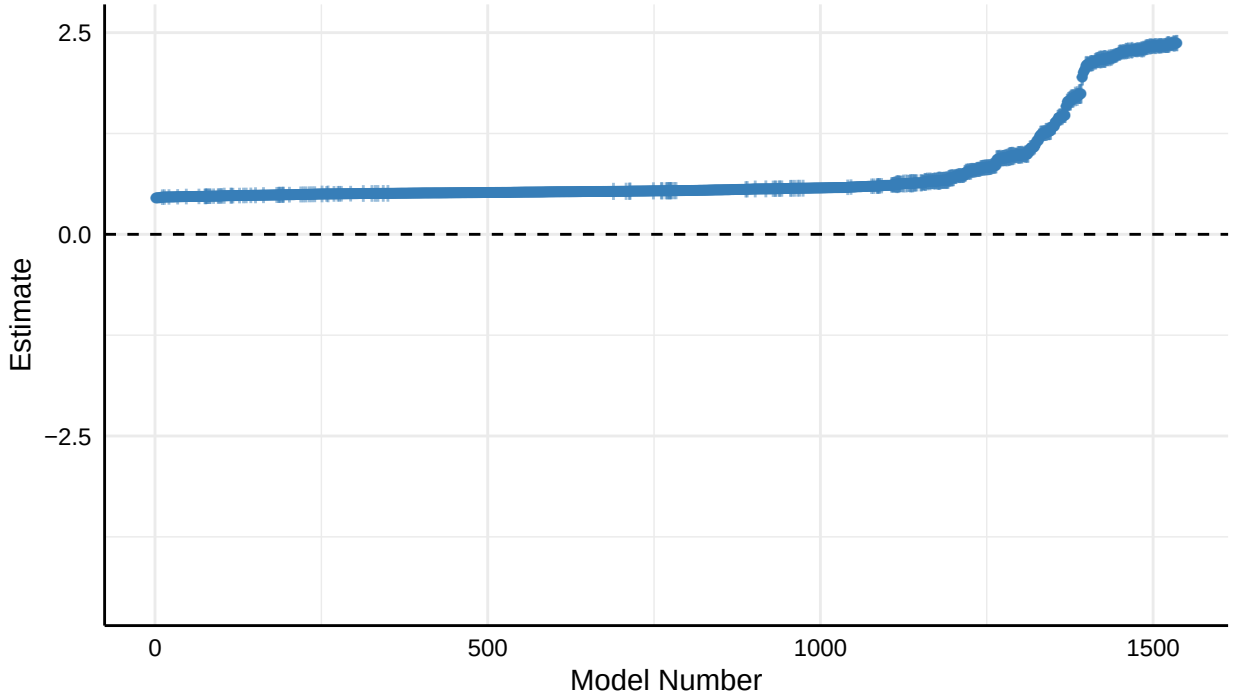
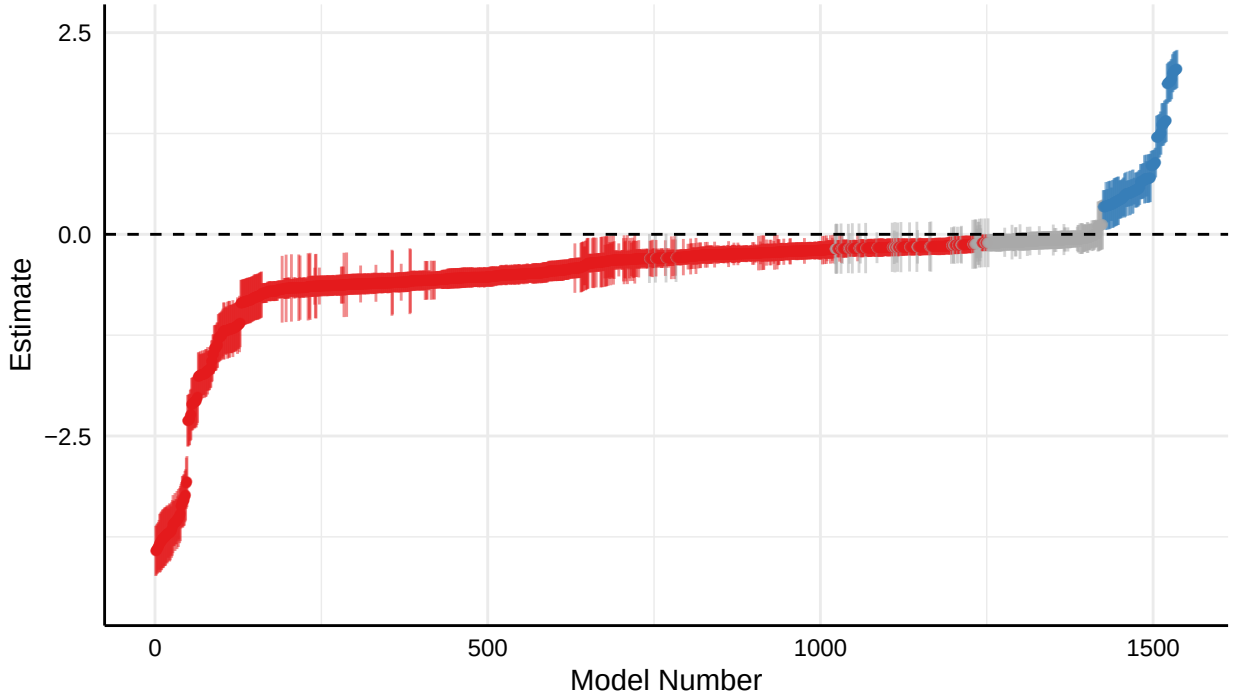


Figure D9: Specification Test (Oil and Gas x Executive Constraints)



Finally, I estimate several models with multiway (country-year) clustered standard errors to address the potential that observations are serially correlated within countries *and* years. In the literature on causal inference with observational panel data, most cluster-robust variance estimators account for "one-way" clustering at the unit (here, country) level. However, some scholars suggest that multiway clustering offers a more robust approach to inference when observations are also clustered at other levels (Cameron, Gelbach, and Miller 2011). Thus, in Tables 22 and 23 below, I estimate the same models used to report results in Appendix A but with country-year clustered standard errors. These results are broadly similar to the main results, suggesting that multiway clustering does not jeopardize the reliability of inferences in the main analysis.

Table 22: Results with Country-Year Clustered SEs

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.456***	0.598***	0.517***
	(0.072)	(0.148)	(0.081)	(0.134)
Executive Constraints		0.364	0.458	−4.887**
		(0.640)	(0.440)	(1.826)
Electoral Democracy		−0.461		−3.982
		(1.664)		(3.719)
GDP		0.242		0.024
		(0.209)		(0.208)
Trade		0.076		0.169
		(0.078)		(0.135)
Population Density		−0.007*		−0.009**
		(0.004)		(0.004)
Oil and Gas × Executive Constraints			−0.164*	−0.532***
			(0.089)	(0.163)
Electoral Democracy × Executive Constraints				7.753
				(6.168)
GDP × Executive Constraints				1.220***
				(0.393)
Trade × Executive Constraints				−0.371
				(0.338)
Population Density × Executive Constraints				0.003
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,511	2,174
Adjusted R^2	0.974	0.980	0.973	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-year-clustered errors in parentheses.

Table 23: Results with Country-Year Clustered SEs (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.456***	0.598***	0.518***
	(0.072)	(0.148)	(0.081)	(0.134)
Executive Constraints		0.346	0.441	−4.919**
		(0.644)	(0.441)	(1.831)
Electoral Democracy		−0.459		−4.002
		(1.666)		(3.719)
GDP		0.243		0.025
		(0.209)		(0.208)
Trade		0.075		0.169
		(0.078)		(0.135)
Population Density		−0.007*		−0.009**
		(0.004)		(0.004)
Oil and Gas × Executive Constraints			−0.164*	−0.534***
			(0.089)	(0.163)
Electoral Democracy × Executive Constraints				7.796
				(6.171)
GDP × Executive Constraints				1.224***
				(0.393)
Trade × Executive Constraints				−0.370
				(0.338)
Population Density × Executive Constraints				0.003
				(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	2,174	2,511	2,174
Adjusted R^2	0.974	0.980	0.974	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-year-clustered errors in parentheses.

Appendix E: Measurement and Sampling

Last, I evaluate the robustness of the main results in light of different measures of executive constraint (Marshall and Gurr 2020) and oil and gas income (Haber and Menaldo 2011), and different samples of authoritarian regimes (Coppedge et al. 2023; Maerz et al. 2023). These tests suggest that the results observed in the main analysis are moderately sensitive to measurement and sampling assumptions. I provide the results of these tests in the interest of academic transparency, although caution is warranted in interpreting these results for several reasons.

In the first test, I replace the V-Dem index of executive constraints with the index of executive constraints constructed by the Polity project and present the results of this analysis in Tables 24 and 25. This provides an indirect test of measurement error, but with certain assumptions. In particular, it assumes less measurement error in Polity's index of executive constraints than in V-Dem's – an assumption that may not be credible (Vaccaro 2021; Elff and Ziaja 2018). Moreover, the V-Dem and Polity executive constraints indices are not measured on the same scale. V-Dem's index is continuous on the range $\text{Executive Constraints}^{\text{V-Dem}} : \{0 < \text{Executive Constraints}^{\text{V-Dem}} < 1\}$ whereas Polity's index is ordinal, $\text{Executive Constraints}^{\text{Polity}} : \{1 \leq \text{Executive Constraints}^{\text{Polity}} \leq 7\}$, so the interpretation of these coefficient estimates is not directly comparable. Thus, while the results in Tables 24 and 25 differ slightly from those in the main analysis, they provide a test of measurement validity only indirectly.

Table 24: Polity Executive Constraints Measure

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.467***	0.605***	0.475***
	(0.068)	(0.146)	(0.062)	(0.149)
ExecutiveConstraints$^{\text{Polity}}$		0.001	0.0004	0.004
		(0.002)	(0.001)	(0.005)
Electoral Democracy		−0.406		−0.598
		(1.228)		(1.339)
GDP		0.225		0.233
		(0.235)		(0.228)
Trade		0.072		0.061
		(0.084)		(0.081)
Population Density		−0.007		−0.007
		(0.004)		(0.004)
Oil and Gas × ExecutiveConstraints$^{\text{Polity}}$			−0.001	−0.004
			(0.003)	(0.005)
Electoral Democracy × ExecutiveConstraints$^{\text{Polity}}$				−0.020
				(0.020)
GDP × ExecutiveConstraints$^{\text{Polity}}$				−0.002
				(0.003)
Trade × ExecutiveConstraints$^{\text{Polity}}$				0.004
				(0.004)
Population Density × ExecutiveConstraints$^{\text{Polity}}$				0.00003
				(0.00002)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	1,928	2,140	1,928
Adjusted R^2	0.974	0.981	0.975	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 25: Polity Executive Constraints Measure (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.561***	0.467***	0.606***	0.475***
	(0.068)	(0.146)	(0.062)	(0.149)
ExecutiveConstraints$^{\text{Polity}}$		0.001	0.0005	0.004
		(0.002)	(0.001)	(0.005)
Electoral Democracy		−0.421		−0.612
		(1.228)		(1.338)
GDP		0.226		0.233
		(0.235)		(0.228)
Trade		0.072		0.060
		(0.084)		(0.081)
Population Density		−0.007		−0.007
		(0.004)		(0.004)
Oil and Gas × ExecutiveConstraints$^{\text{Polity}}$			−0.001	−0.004
			(0.003)	(0.005)
Electoral Democracy × ExecutiveConstraints$^{\text{Polity}}$				−0.019
				(0.020)
GDP × ExecutiveConstraints$^{\text{Polity}}$				−0.002
				(0.003)
Trade × ExecutiveConstraints$^{\text{Polity}}$				0.004
				(0.004)
Population Density × ExecutiveConstraints$^{\text{Polity}}$				0.00003
				(0.00002)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,560	1,928	2,140	1,928
Adjusted R^2	0.974	0.981	0.975	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Second, in Tables 26 and 27 I reproduce the main analysis using an alternative measure of oil and gas income, Oil and Gas^{HM}, based on estimates provided by Haber and Menaldo (2011). Unfortunately, however, empirical discrepancies between the measures from Haber and Menaldo (2011) and Ross and Mahdavi (2015) limit the parsimony of this analysis as a measurement validity test as well. For one, the Haber and Menaldo (2011) and Ross and Mahdavi (2015) measures of oil and gas income do not cover the same time period and are not measured in the same inflation-adjusted per capita USD. Moreover, Haber and Menaldo (2011) do not provide nominal aggregate estimates of oil and gas income, so it is currently impossible to convert their data into comparable inflation-adjusted estimates that would facilitate direct comparison. While these two measures produce different results, then, it is possible that these disparities owe to measurement error in Haber and Menaldo (2011), not Ross and Mahdavi (2015).

Table 26: Haber and Menaldo (2011) Oil and Gas Measure

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas^{HM}	1.230***	0.005	1.238***	0.062
	(0.254)	(0.324)	(0.332)	(0.381)
Executive Constraints		0.165	−0.687	−6.626***
		(0.929)	(0.568)	(2.458)
Electoral Democracy		−0.737		0.093
		(2.025)		(3.863)
GDP		0.759*		−0.027
		(0.394)		(0.286)
Trade		−0.057		0.049
		(0.094)		(0.233)
Population Density		−0.005		−0.020**
		(0.006)		(0.008)
Oil and Gas^{HM} × Executive Constraints			−0.004	−0.209
			(0.382)	(0.440)
Electoral Democracy × Executive Constraints				1.171
				(5.549)
GDP × Executive Constraints				1.728***
				(0.434)
Trade × Executive Constraints				−0.297
				(0.555)
Population Density × Executive Constraints				0.036**
				(0.015)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	1,405	1,114	1,346	1,114
Adjusted R^2	0.972	0.989	0.972	0.991

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 27: Haber and Menaldo (2011) Oil and Gas Measure (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas^{HM}	1.230***	0.004	1.238***	0.061
	(0.254)	(0.324)	(0.332)	(0.381)
Executive Constraints		0.120	−0.718	−6.730***
		(0.928)	(0.567)	(2.462)
Electoral Democracy		−0.706		−0.008
		(2.025)		(3.871)
GDP		0.760*		−0.029
		(0.394)		(0.286)
Trade		−0.057		0.049
		(0.094)		(0.234)
Population Density		−0.005		−0.020**
		(0.006)		(0.008)
Oil and Gas^{HM} × Executive Constraints			−0.003	−0.212
			(0.382)	(0.440)
Electoral Democracy × Executive Constraints				1.443
				(5.566)
GDP × Executive Constraints				1.735***
				(0.433)
Trade × Executive Constraints				−0.299
				(0.555)
Population Density × Executive Constraints				0.035**
				(0.015)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	1,405	1,114	1,346	1,114
Adjusted R^2	0.973	0.989	0.972	0.991

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Finally, I present results based on an alternative sample of non-democratic regimes. In the main analysis, I use the terms dictatorship, authoritarian regime, autocracy, and non-democracy interchangeably to refer to countries in which governments are not chosen through free and fair elections. There is a longstanding debate in comparative politics about how to define democracy, autocracy, and different varieties of democracy and autocracy that lies well beyond the scope of this article (see, e.g., Schumpeter 1976 [1943]; Dahl 1972; Coppedge et al. 2020; Geddes, Wright, and Frantz 2014). However, it is important to consider whether and how the results of the main analysis may be sensitive to sampling on this definition of autocracy.

In the main analysis, I sample all country-years included in the upper bound of the electoral autocracy category of Lührmann, Tannenberg, and Lindberg (2018)'s Regimes of the World (RoW) classification scheme, which is computed using the uncertainty estimates from the relevant V-Dem variables (see, also, Coppedge et al. 2023). As Table 28 shows, this sample includes a wide range of what Lührmann, Tannenberg, and Lindberg (2018) call "closed" and "electoral" autocracies across countries over time. Table 28 lists all country-years included in the sample, as well as their regime types according to Lührmann, Tannenberg, and Lindberg (2018). These country-years are those used to estimate the models in the main analysis (see Appendix A).

Table 28: Authoritarian Country-Years in the Sample

Country	**Years**	**Regimes of the World (v2x_regime_amb)**
Afghanistan	2020	Electoral Autocracy
Albania	1990-2001, 2004	Closed Autocracy (1990), Electoral Autocracy (1991-2004, 2018-21)
Algeria	1990-2021	Closed Autocracy (1990-94), Electoral Autocracy (1995-2021)
Angola	2002-21	Closed Autocracy (2000-09), Electoral Autocracy (2010-21)
Armenia	1995-2017	Electoral Autocracy
Azerbaijan	1992-2021	Electoral Autocracy
Bahrain	1992-2021	Closed Autocracy
Bangladesh	1990-91, 2002-21	Closed Autocracy (2007), Electoral Autocracy (1990-91, 2002-06, 2008-21)
Belarus	1996-2021	Electoral Autocracy
Benin	1990-91, 2019-21	Closed Autocracy (1990), Electoral Autocracy (1991, 2019-21)
Bhutan	1990-2007	Closed Autocracy
Bolivia	2019-20	Electoral Autocracy
Bosnia and Herzegovina	1994-96	Closed Autocracy (1994-95), Electoral Autocracy (1996)
Burkina Faso	1990-99, 2015	Closed Autocracy (1990), Electoral Autocracy (1991-99, 2015)
Burundi	1990-2021	Closed Autocracy (1990-92, 1996-2004), Electoral Autocracy (1993-95, 2005-21)
Cambodia	1993-2021	Electoral Autocracy
Cameroon	1990-2021	Electoral Autocracy
Cape Verde	1990	Electoral Autocracy
Central African Republic	1990-2021	Closed Autocracy (2004), Electoral Autocracy (1990-2003, 2005-21)
Chad	1990, 1993-2021	Closed Autocracy (1990, 1993-96), Electoral Autocracy (1997-2014)
China	1990-2021	Closed Autocracy
Colombia	1990	Electoral Autocracy

Table 28: Authoritarian Country-Years in the Sample *(continued)*

Country	**Years**	**Regimes of the World (v2x_regime_amb)**
Comoros	1990-2021	Closed Autocracy (2000-01), Electoral Autocracy (1990-99, 2002-21)
Croatia	1995-99	Electoral Autocracy
Cuba	1990-2021	Closed Autocracy
Democratic Republic of the Congo	1994-2021	Closed Autocracy (1994-2005), Electoral Autocracy (2006-21)
Djibouti	2013-21	Electoral Autocracy
Dominican Republic	1990-95	Electoral Autocracy
Egypt	1990-2021	Closed Autocracy (1993-98, 2013), Electoral Autocracy (1990-92, 1999-2012, 2014-21)
El Salvador	1990-98, 2021	Electoral Autocracy
Equatorial Guinea	2005-21	Electoral Autocracy
Eritrea	1993-2011	Closed Autocracy
Eswantini	1990-2021	Closed Autocracy
Ethiopia	2011-21	Electoral Autocracy
Fiji	1990-92, 2000-02, 2006-21	Closed Autocracy (1990-91, 2000-01, 2007-13), Electoral Autocracy (1992, 2002, 2006, 2014-21)
Gabon	1990-2021	Closed Autocracy (1990-92), Electoral Autocracy (1993-2021)
Georgia	1993-2011	Electoral Autocracy
Ghana	1990-95	Closed Autocracy (1990-91), Electoral Autocracy (1992-95)
Guatemala	1990-96, 2021	Electoral Autocracy
Guinea	1990-2021	Closed Autocracy (1990-93, 2009), Electoral Autocracy (1994-2008, 2010-2021)
Guinea-Bissau	1990-2014	Closed Autocracy (1990-93, 2013), Electoral Autocracy (1994-2012, 2014)
Guyana	1990-97	Electoral Autocracy
Haiti	1990-2003, 2006-14	Closed Autocracy (1992-94), Electoral Autocracy (1990-91, 1995-2003, 2004, 2006-2021)
Honduras	1990-1993, 2009-21	Electoral Autocracy
India	2017-21	Electoral Autocracy
Indonesia	1990-98	Electoral Autocracy
Iran	1990, 1993-2021	Closed Autocracy (2021), Electoral Autocracy (1990, 1993-2020)
Iraq	1990-2003, 2005-2021	Closed Autocracy (1990-94, 2000-03), Electoral Autocracy (1995-1999, 2005-121)
Ivory Coast	1990-2015, 2020-21	Electoral Autocracy
Jordan	1990-2019	Closed Autocracy
Kazakhstan	1992-2021	Electoral Autocracy
Kenya	1990-2013, 2017-2021	Electoral Autocracy
Kuwait	1992-2019	Closed Autocracy
Kyrgyzstan	1992-2018	Closed Autocracy (1992-94), Electoral Autocracy (1995-2018)
Laos	1990-2016	Closed Autocracy (1991-2016), Electoral Autocracy (1990)
Lebanon	1990-2021	Electoral Autocracy
Libya	1999-2012, 2014-19	Closed Autocracy (1999-2011, 2014-21), Electoral Autocracy (2012)
Madagascar	1990-93, 2001-07, 2009, 2010-21	Closed Autocracy (2010-12), Electoral Autocracy (1990-93, 2001-07, 2009, 2010-12, 2013-21)
Malaysia	1990-2021	Electoral Autocracy
Mali	1990-92, 2012-13, 2020-21	Closed Autocracy (1990-91, 2021), Electoral Autocracy (1992, 2012-13, 2020)

Table 28: Authoritarian Country-Years in the Sample *(continued)*

Country	**Years**	**Regimes of the World (v2x_regime_amb)**
Mauritania	1992-2021	Closed Autocracy (2006), Electoral Autocracy (1992-2005, 2007-21)
Mexico	1990-95	Electoral Autocracy
Moldova	2005-09	Electoral Autocracy
Mongolia	1990	Electoral Autocracy
Morocco	1990-2021	Closed Autocracy
Nepal	1990-2008, 2012-13	Closed Autocracy (1990, 2002-07), Electoral Autocracy (1991-2001, 2008, 2012-13)
Nicaragua	2007-21	Electoral Autocracy
Niger	1990-92, 1997-99, 2009-10	Closed Autocracy (2010), Electoral Autocracy (1990-92, 1997-99, 2009)
North Macedonia	1992-93, 2000-01, 2013-14	Closed Autocracy (1992-93), Electoral Autocracy (1994-97, 1999-01, 2013-16)
Oman	1990-2021	Closed Autocracy
Pakistan	1990-99, 2002-21	Closed Autocracy (1999), Electoral Autocracy (1990-98, 2002-21)
Panama	1990	Electoral Autocracy
Paraguay	1990-92	Electoral Autocracy
Peru	1992-2000	Closed Autocracy (1992-94), Electoral Autocracy (1995-2000)
Philippines	2004-09, 2018-21	Electoral Autocracy
Qatar	2000-21	Closed Autocracy
Republic of the Congo	1990-96, 1998-2021	Closed Autocracy (1990-91, 1998-2001), Electoral Autocracy (1992-96, 2002-21)
Russia	1993-2021	Electoral Autocracy
Rwanda	1990-92, 1994-2021	Closed Autocracy (1990-92, 1994-2002), Electoral Autocracy (2003-21)
Saudi Arabia	1990-2021	Closed Autocracy
Serbia	2014	Electoral Autocracy
Seychelles	1990-2012	Closed Autocracy (1990-91), Electoral Autocracy (1992-2012)
Sierra Leone	1990-97, 2002	Electoral Autocracy
Singapore	1990-2021	Electoral Autocracy
Slovakia	1993	Closed Autocracy
Solomon Islands	2000-03, 2006	Electoral Autocracy
Somalia	2013-21	Closed Autocracy
South Africa	1990-94	Closed Autocracy (1990-93), Electoral Autocracy (1994)
Sri Lanka	1990-94, 2000, 2005-09	Electoral Autocracy
Sudan	1990-2020	Closed Autocracy (1990-95, 2020), Electoral Autocracy (1996-2019)
Syria	1990-2021	Closed Autocracy (2013-21), Electoral Autocracy (1990-2012)
Tajikistan	1993-2021	Electoral Autocracy
Tanzania	1990-95, 2000-21	Electoral Autocracy
Thailand	1990-97, 2006-11, 2013-21	Closed Autocracy (1991, 2007, 2014-21), Electoral Autocracy (1990, 1992-97, 2006, 2008-13)
The Gambia	1990-2016, 2020	Closed Autocracy (1995), Electoral Autocracy (1990-94, 1996-2016, 2020)
Togo	1990-2013, 2016-21	Electoral Autocracy
Tunisia	1990-2011	Electoral Autocracy
Turkey	2013-21	Electoral Autocracy
Turkmenistan	1992-2021	Closed Autocracy (1991-2017), Electoral Autocracy (2018-21)
Uganda	1990-2021	Closed Autocracy (1994-95), Electoral Autocracy (1990-93, 1996-2021)
Ukraine	1998-2005, 2010-19	Electoral Autocracy
United Arab Emirates	2001-20	Closed Autocracy

Table 28: Authoritarian Country-Years in the Sample *(continued)*

Country	**Years**	**Regimes of the World (v2x_regime_amb)**
Uzbekistan	1997-2021	Closed Autocracy (2014-18, 2021), Electoral Autocracy (1997-2013, 2019-20)
Vietnam	1990-2021	Closed Autocracy
Yemen	1990-2018	Closed Autocracy (2016-18), Electoral Autocracy (1990-2015)
Zambia	1994-2001, 2013-21	Electoral Autocracy
Zimbabwe	1990-2021	Electoral Autocracy

However, the choice to sample from the RoW upper bound is not inherently objective, as debates about classifying political regimes suggest. Indeed, hybrid and competitive authoritarian regimes in which semi-democratic and semi-autocratic political institutions coexist (Diamond 2002; Levitsky and Way 2010) raise challenges to regime typologies. Thus, while empirical evidence suggests that RoW offers a more conservative typology than in most existing research (Lührmann, Tannenberg, and Lindberg 2018), some scholars may disagree with the regime classifications in Table 28. Therefore, in Tables 29 and 30, below, I present results from an alternative (and even more conservative) sample of non-democratic regimes based on the lower bound of the RoW electoral autocracy category.

These results support those of the main analysis. But it may be important to consider whether there are heterogeneous effects of fossil fuel wealth, executive constraints, and their product across subtypes of authoritarianism. To examine potential heterogeneous effects, I estimate a three-way interaction between oil and gas income, executive constraints, and electoral authoritarianism and report the results of these tests in Figures E1 below. This figure suggests that executive constraints moderate the effects of oil and gas income on emissions to a greater degree in electoral autocracies than in closed autocracies.

Last, some scholars suggest that the RoW classification scheme does not accurately distinguish between democracies and autocracies in light of discrete "episodes of regime transformation" (Maerz et al. 2023). Therefore, I re-estimate the same models as those in the main analysis but with Maerz et al. (2023)'s definition of autocracy. The results in Table 31 below support those of the main analysis.

Table 29: Alternative Sample of Autocracies

	Dependent variable:			
	Total Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.572***	0.479***	0.595***	0.545***
	(0.069)	(0.149)	(0.079)	(0.135)
Executive Constraints		−1.334	−0.353	−5.210
		(1.683)	(1.146)	(3.863)
Electoral Democracy		1.083		−5.155
		(9.485)		(17.009)
GDP		0.116		0.047
		(0.213)		(0.229)
Trade		0.017		−0.060
		(0.085)		(0.153)
Population Density		−0.017***		−0.014***
		(0.003)		(0.003)
Oil and Gas × Executive Constraints			−0.096	−0.648***
			(0.095)	(0.212)
Electoral Democracy × Executive Constraints				3.761
				(30.490)
GDP × Executive Constraints				0.900
				(0.668)
Trade × Executive Constraints				0.420
				(0.789)
Population Density × Executive Constraints				−0.024
				(0.017)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	910	745	868	745
Adjusted R^2	0.977	0.984	0.977	0.985

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Table 30: Alternative Sample of Autocracies (continued)

	Dependent variable:			
	Fossil Emissions			
	(1)	(2)	(3)	(4)
Oil and Gas	0.573***	0.480***	0.595***	0.545***
	(0.069)	(0.149)	(0.079)	(0.135)
Executive Constraints		−1.369	−0.388	−5.315
		(1.685)	(1.146)	(3.848)
Electoral Democracy		1.041		−5.282
		(9.477)		(16.983)
GDP		0.116		0.047
		(0.213)		(0.229)
Trade		0.017		−0.060
		(0.085)		(0.153)
Population Density		−0.017***		−0.014***
		(0.003)		(0.003)
Oil and Gas × Executive Constraints			−0.095	−0.650***
			(0.095)	(0.212)
Electoral Democracy × Executive Constraints				4.012
				(30.440)
GDP × Executive Constraints				0.904
				(0.667)
Trade × Executive Constraints				0.420
				(0.789)
Population Density × Executive Constraints				−0.024
				(0.017)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	910	745	868	745
Adjusted R^2	0.977	0.984	0.977	0.985

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

Figure E1: CMEs and 95% CIs in Closed vs. Electoral Autocracies

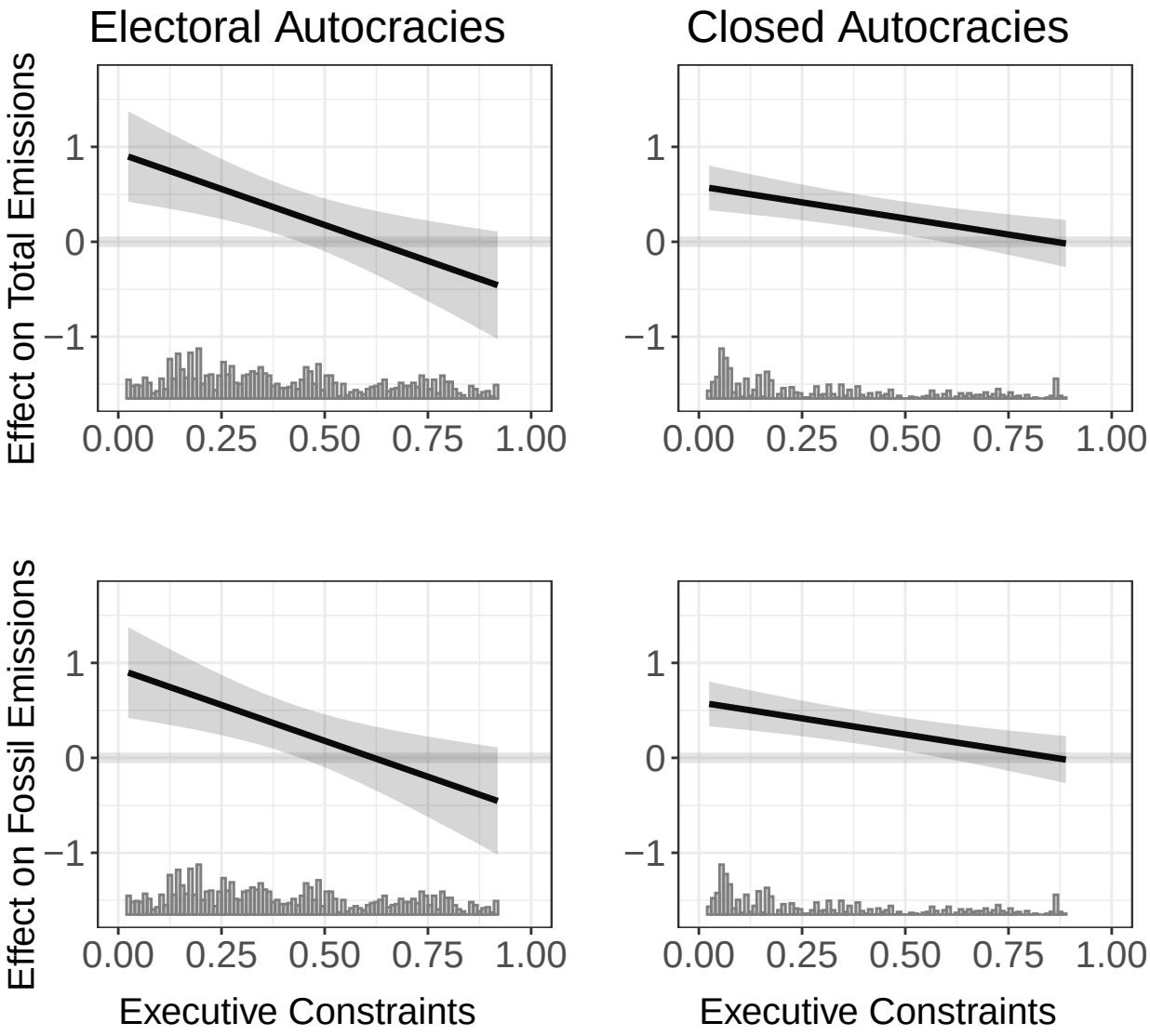


Table 31: Main Results based on Maerz et al. (2023) Autocracies

	Dependent variable:			
	Total Emissions		Fossil Emissions	
	(1)	(2)	(3)	(4)
Oil and Gas	0.455***	0.516***	0.455***	0.517***
	(0.147)	(0.134)	(0.147)	(0.134)
Executive Constraints	0.369	−4.729**	0.350	−4.759**
	(0.617)	(1.814)	(0.621)	(1.816)
Electoral Democracy	−0.332	−3.774	−0.330	−3.790
	(1.595)	(3.715)	(1.596)	(3.715)
GDP	0.242	0.025	0.243	0.025
	(0.217)	(0.218)	(0.218)	(0.218)
Trade	0.076	0.169	0.076	0.168
	(0.077)	(0.128)	(0.077)	(0.128)
Population Density	−0.007*	−0.009**	−0.007*	−0.009**
	(0.004)	(0.004)	(0.004)	(0.004)
Oil and Gas × Executive Constraints		−0.535***		−0.537***
		(0.176)		(0.176)
Electoral Democracy × Executive Constraints		7.191		7.223
		(6.047)		(6.048)
GDP × Executive Constraints		1.226***		1.229***
		(0.402)		(0.402)
Trade × Executive Constraints		−0.368		−0.368
		(0.337)		(0.337)
Population Density × Executive Constraints		0.003		0.003
		(0.004)		(0.004)
Country FEs	Yes	Yes	Yes	Yes
Year FEs	Yes	Yes	Yes	Yes
Observations	2,194	2,194	2,194	2,194
Adjusted R^2	0.980	0.981	0.980	0.981

Note: *p<0.1; **p<0.05; ***p<0.01
Country-clustered errors in parentheses.

References

Afionis, Stavros, Marco Sakai, Kate Scott, John Barrett, and Andy Gouldson. 2017. "Consumption-Based Carbon Accounting: Does It Have a Future?" *WIREs Climate Change* 8: e438. https://doi.org/10.1002/wcc.438.

Beiser-McGrath, Janina, and Liam F. Beiser-McGrath. 2023. "The Consequences of Model Misspecification for the Estimation of Nonlinear Interaction Effects." *Political Analysis* 31: 278–87.

Bellemare, Marc F., Takaaki Masaki, and Thomas B. Pepinsky. 2017. "Lagged Explanatory Variables and the Estimation of Causal Effect." *The Journal of Politics* 79: 949–63. https://doi.org/10.1086/690946.

Boef, Suzanna De, and Luke Keele. 2008. "Taking Time Seriously." *American Journal of Political Science* 52: 184–200. https://doi.org/10.1111/j.1540-5907.2007.00307.x.

Box-Steffensmeier, Janet, and Agnar Freyr Helgason. 2016. "Introduction to Symposium on Time Series Error Correction Methods in Political Science." *Political Analysis* 24: 1–2.

Cameron, A. Colin, Jonah B. Gelbach, and Douglas L. Miller. 2011. "Robust Inference with Multiway Clustering." *Journal of Business & Economic Statistics* 29: 238–49.

Cinelli, Carlos, and Chad Hazlett. 2020. "Making Sense of Sensitivity: Extending Omitted Variable Bias." *Journal of the Royal Statistical Society. Series B: Statistical Methodology* 82 (February): 39–67. https://doi.org/10.1111/rssb.12348.

Coppedge, Michael, John Gerring, Adam Glynn, Carl Henrik Knutsen, Staffan I. Lindberg, Daniel Pemstein, Brigitte Seim, et al. 2020. *Varieties of Democracy: Measuring Two Centuries of Political Change*. Cambridge University Press.

Coppedge, Michael, John Gerring, Carl Henrik Knutsen, Staffan I. Lindberg, Jan Teorell, David Altman, Michael Bernhard, et al. 2023. "V-Dem Codebook V13." Varieties of Democracy (V-Dem) Project.

Crippa, Monica, Diego Guizzardi, Federico Pagani, Marcello Schiavina, Michele Melchiorri, Enrico Pisoni, Francesco Graziosi, et al. 2023. "Insights on the Spatial Distribution of Global, National and Sub-National GHG Emissions in EDGARv8.0." *Earth System Science Data*. https://doi.org/10.5194/essd-2023-514.

Dahl, Robert A. 1972. *Polyarchy: Participation and Opposition*. Yale University Press.

Diamond, Larry. 2002. "Elections Without Democracy: Thinking about Hybrid Regimes." *Journal of Democracy* 13: 21–35.

Eggers, Andrew C., Guadalupe Tuñón, and Allan Dafoe. 2023. "Placebo Tests for Causal Inference." *American Journal of Political Science*.

Elff, Martin, and Sebastian Ziaja. 2018. "Method Factors in Democracy Indicators." *Politics and Governance* 6: 92–105.

Franzen, Axel, and Sebastian Mader. 2018. "Consumption-Based Versus Production-Based Accounting of Co2 Emissions: Is There Evidence for Carbon Leakage?" *Environmental Science & Policy* 84: 34–40. https://doi.org/10.1016/j.envsci.2018.02.009.

Geddes, Barbara, Joseph Wright, and Erica Frantz. 2014. "Autocratic Breakdown and Regime Transitions: A New Data Set." *Perspectives on Politics* 12: 313–31.

Haber, Stephen, and Victor Menaldo. 2011. "Do Natural Resources Fuel Authoritarianism? A Reappraisal of the Resource Curse." *American Political Science Review* 105: 1–26. https://doi.org/10.1017/S0003055410000584.

Hainmueller, Jens, Jonathan Mummolo, and Yiqing Xu. 2019. "How Much Should We Trust Estimates from Multiplicative Interaction Models? Simple Tools to Improve Empirical Practice." *Political Analysis* 27 (April): 163–92. https://doi.org/10.1017/pan.2018.46.

IPCC. 2014. "Climate Change 2014: Synthesis Report. Contribution of Working Groups i, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change." Vol. 218. IPCC. https://doi.org/10.1016/S0022-0248(00)00575-3.

Leszczensky, Lars, and Tobias Wolbring. 2022. "How to Deal with Reverse Causality Using Panel Data? Recommendations for Researchers Based on a Simulation Study." *Sociological Methods & Research* 51: 837–65. https://doi.org/10.1177/0049124119882473.

Levitsky, Steven, and Lucan A. Way. 2010. *Competitive Authoritarianism Hybrid Regimes After the Cold War*. Cambridge University Press.

Lührmann, Anna, Marcus Tannenberg, and Staffan I. Lindberg. 2018. "Regimes of the World (RoW): Opening New Avenues for the Comparative Study of Political Regimes." *Politics and Governance* 6: 60–77. https://doi.org/10.17645/pag.v6i1.1214.

Maerz, Seraphine F., Amanda B. Edgell, Matthew C. Wilson, Sebastian Hellmeier, and Staffan I. Lindberg. 2023. "Episodes of Regime Transformation." *Journal of Peace Research*.

Marshall, M., and T. R. Gurr. 2020. "Polity5: Political Regime Characteristics and Transitions, 1800-2018." *Center for Systemic Peace*. Center for Systemic Peace. http://www.systemicpeace.org/inscr/p5manualv2018.pdf.

Pepinsky, Thomas. 2014. "The Institutional Turn in Comparative Authoritarianism." *British Journal of Political Science* 44: 631–53. https://doi.org/10.1017/S0007123413000021.

Ritchie, Hannah. 2019. "How Do Co2 Emissions Compare When We Adjust for Trade?" Our World in Data.

Ross, Michael, and Paasha Mahdavi. 2015. "Oil and Gas Data, 1932-2014." *Harvard Dataverse*. https://doi.org/10.7910/DVN/ZTPW0Y.

Schumpeter, Joseph A. 1976 [1943]. *Capitalism, Socialism and Democracy*. Routledge.

Vaccaro, Andrea. 2021. "Comparing Measures of Democracy: Statistical Properties, Convergence, and Interchangeability." *European Political Science* 20 (December): 666–84. https://doi.org/10.1057/s41304-021-00328-8.

Warner, Zach. 2019. "Conditional Relationships in Dynamic Models."

World Bank. 2023. "World Development Indicators." World Bank Group.