# Online Appendix

## Democracy, Autocracy, and Everything in Between: How Domestic Institutions Affect Environmental Protection

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## Section I. Main Results

**Table 1A. Free/Fair Elections, Civil Liberties/Protections, and Political Constraints: Impacts on Environmental Degradation**

| | Greenhouse Gases | | Sulfur Dioxide (SO2) | | Nitrogen Oxides (NOX) | | Energy Use | | Non-Renewable Use | | Land Non-Protection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* |
| Free/Fair Elections | .090 | **.007** | .556 | **<.001** | .161 | **<.001** | .254 | **<.001** | .114 | **<.001** | -.340 | **<.001** |
| Civil Liberties/Society | -.115 | **.002** | -.295 | **<.001** | -.085 | **.003** | -.179 | **<.001** | -.076 | **.015** | .073 | .413 |
| Political Constraints | .016 | .650 | -.074 | .086 | -.087 | **.001** | -.041 | .112 | -.011 | .583 | .086 | .141 |
| GDP per Capita | .134 | **<.001** | .173 | **<.001** | .119 | **<.001** | .312 | **<.001** | .079 | **<.001** | -.083 | **.001** |
| GDP per Capita$^2$ | -.024 | **<.001** | -.063 | **<.001** | -.030 | **<.001** | -.004 | **.013** | -.051 | **<.001** | -.020 | **.001** |
| Trade Openness | .090 | **<.001** | .066 | **.002** | .076 | **<.001** | .062 | **<.001** | .102 | **<.001** | .005 | .893 |
| Population Density | -.159 | **<.001** | 1.078 | **<.001** | -.239 | **<.001** | .346 | **<.001** | .317 | **<.001** | .187 | **.002** |
| Constant | 15.926 | **<.001** | 5.001 | **<.001** | 6.949 | **<.001** | 5.366 | **<.001** | 2.463 | **<.001** | -2.24 | **<.001** |
| $\sigma^2$ | .09 | | .11 | | .05 | | .04 | | .02 | | .16 | |
| Intra-class correlation (yr/country/region) | .00/.47/.23 | | .17/2.66/1.33 | | .02/.46/.10 | | .02/.62/.45 | | .00/.30/.28 | | .03/1.83/.13 | |
| Observations | 5213 | | 4867 | | 5351 | | 4826 | | 3752 | | 3336 | |
| Countries | 157 | | 158 | | 157 | | 142 | | 160 | | 159 | |
| Fixed $R^2$/Random $R^2$ | .111 / .903 | | .392 / .984 | | .202 / .937 | | .321 / .975 | | .273 / .972 | | .049 / .930 | |

Results of a mixed effects model. Findings significant at $p < .05$ appear in bold. All independent variables are lagged one year.

**Figure 1A. Coefficient Plots with 95% Confidence Intervals from Table 1A**

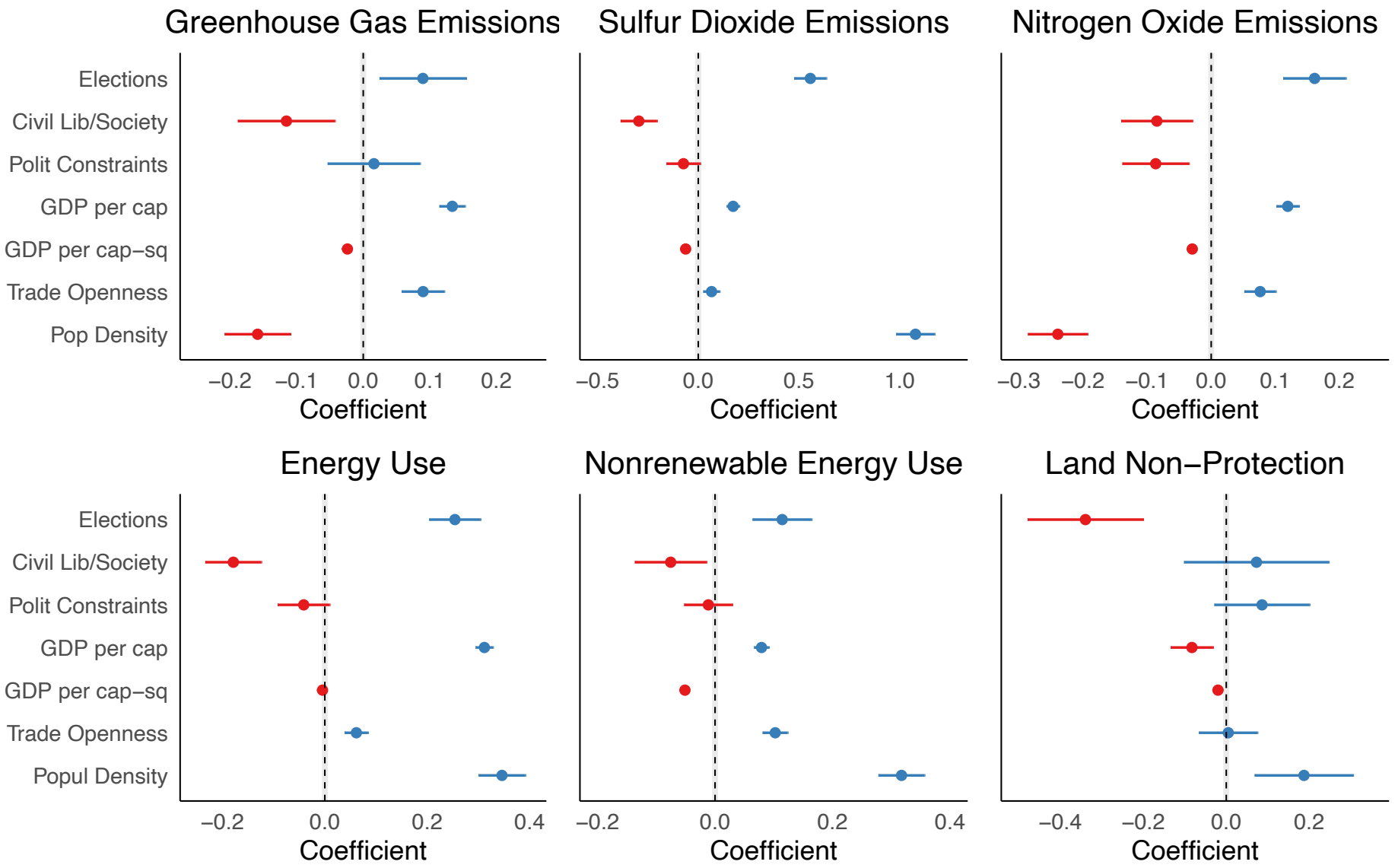


**Table 2A. Free/Fair Elections, Civil Liberties/Protections, and Political Constraints: Impacts on Environmental Degradation**

| | Greenhouse Gases | | Sulfur Dioxide ($SO_2$) | | Nitrogen Oxides ($NO_X$) | | Energy Use | | Non-Renewable Use | | Land Non-Protection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* |
| Free/Fair Elections | .014 | .723 | .385 | **<.001** | .166 | **<.001** | .253 | **<.001** | .061 | **.038** | -.481 | **<.001** |
| GDP per Capita | .137 | **<.001** | .335 | **<.001** | .132 | **<.001** | .351 | **<.001** | .097 | **<.001** | -.026 | .463 |
| GDP per Capita$^2$ | -.004 | .511 | .046 | **<.001** | .023 | **<.001** | .050 | **<.001** | -.066 | **<.001** | -.003 | .823 |
| Free/Fair Elections*GDP per Capita | -.005 | .811 | -.198 | **<.001** | -.093 | **<.001** | -.064 | **<.001** | -.040 | **.009** | -.260 | **<.001** |
| Free/Fair Elections* GDP per Capita$^2$ | -.014 | .092 | -.170 | **<.001** | -.052 | **<.001** | -.052 | **<.001** | .031 | **<.001** | .003 | .863 |
| Civil Society | -.040 | .353 | .033 | .514 | -.085 | **.011** | -.423 | **<.001** | -.100 | **.004** | .053 | .578 |
| Manufacturing/GDP | -.026 | .226 | .219 | **<.001** | .019 | .242 | -.248 | **<.001** | -.040 | .212 | -.219 | **.013** |
| Civil Society*Manufacturing/GDP | .138 | **<.001** | -.187 | **<.001** | .050 | .088 | .526 | **<.001** | .211 | **<.001** | .502 | **<.001** |
| Political Constraints | -.055 | .156 | -.025 | .561 | -.045 | .122 | -.012 | .643 | -.024 | .287 | .035 | .567 |
| Population Density | .119 | **<.001** | .080 | **<.001** | .085 | **<.001** | .095 | **<.001** | .094 | **<.001** | -.012 | .741 |
| Trade Openness | -.157 | **<.001** | .306 | **<.001** | -.317 | **<.001** | .348 | **<.001** | .314 | **<.001** | .248 | **<.001** |
| Constant | 15.737 | **<.001** | 7.748 | **<.001** | 7.111 | **<.001** | 5.314 | **<.001** | 2.553 | **<.001** | -2.238 | **<.001** |
| $\sigma^2$ | .08 | | .09 | | .05 | | .03 | | .02 | | .15 | |
| Intra-class correlation (yr/country/region) | .00/.46/.22 | | .05/1.03/.90 | | .00/.45/.13 | | .01/.60/.42 | | .00/.30/.26 | | .02/1.83/.14 | |
| Observations | 4149 | | 3876 | | 4267 | | 4047 | | 3513 | | 3114 | |
| Countries | 151 | | 152 | | 152 | | 140 | | 157 | | 156 | |
| Fixed $R^2$/Random $R^2$ | .109/.906 | | .149/.962 | | .254/.945 | | .326/.978 | | .276/.970 | | .109/.937 | |

Results of a mixed effects model. Findings significant at $p < .05$ appear in bold. All independent variables are lagged one year.

**Figure 2A. Coefficient Plots with 95% Confidence Intervals from Table 2A**

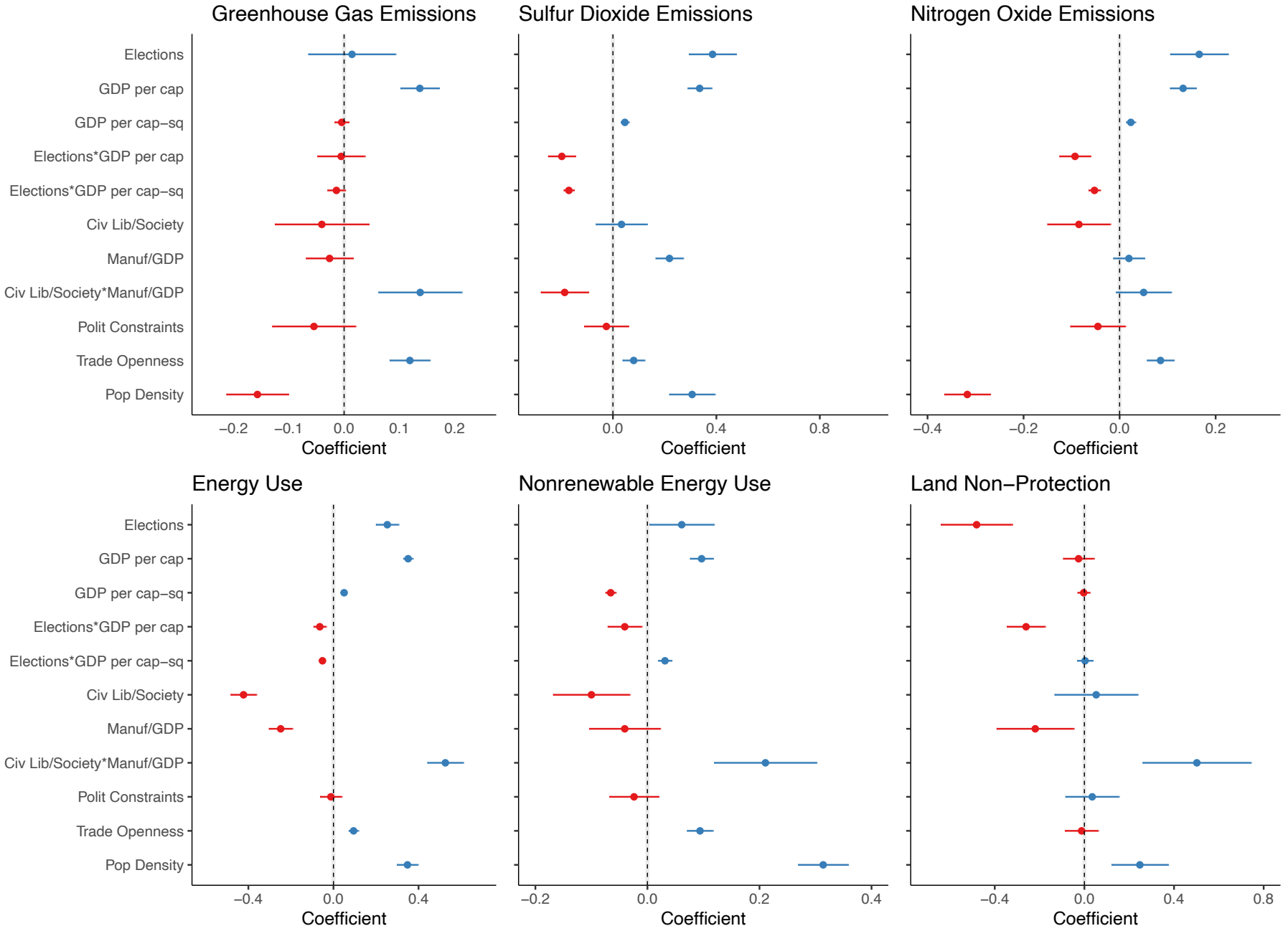
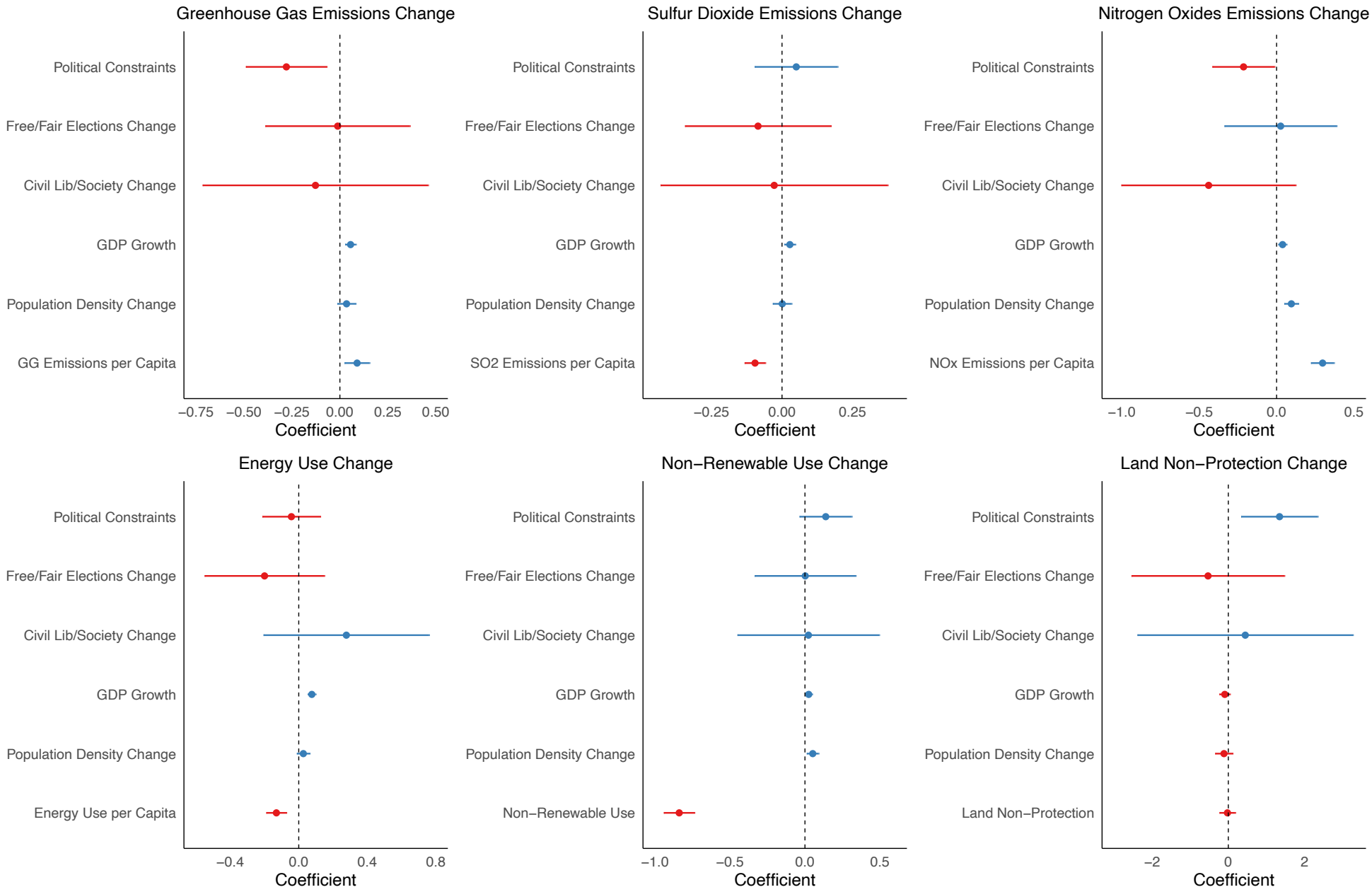


**Table 3A. Political Constraints and Environmental Change**

| | Greenhouse Gases | | Sulfur Dioxide ($SO_2$) | | Nitrogen Oxides ($NO_X$) | | Energy Use | | Non-Renewable Use | | Land Non-Protection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* |
| Political Constraints | -.279 | **.009** | .050 | .501 | -.213 | **.038** | -.043 | .619 | .139 | .119 | 1.345 | **.009** |
| Free/Fair Elections Change | -.011 | .953 | -.085 | .519 | .026 | .887 | -.200 | .263 | .002 | .990 | -.533 | .603 |
| Civil Liberties/Society Change | -.127 | .671 | -.028 | .893 | -.439 | .127 | .278 | .260 | .023 | .924 | .446 | .758 |
| GDP Growth | .056 | **<.001** | .028 | **.006** | .039 | **.005** | .076 | **<.001** | .025 | **.041** | -.093 | .194 |
| Population Density Change | .035 | .156 | .001 | .956 | .096 | **<.001** | .027 | .166 | .052 | **.010** | -.114 | .332 |
| GG Emissions per Capita | .090 | **.007** | | | | | | | | | | |
| $SO_2$ Emissions per Capita | | | -.096 | **<.001** | | | | | | | | |
| $NO_x$ Emissions per Capita | | | | | .297 | **<.001** | | | | | | |
| Energy Use per Capita | | | | | | | -.130 | **<.001** | | | | |
| Non-Renewable Use | | | | | | | | | -.839 | **<.001** | | |
| Land Non-Protection | | | | | | | | | | | -.023 | .83 |
| Constant | -4.417 | **<.001** | -1.846 | **<.001** | -4.620 | **<.001** | -3.116 | **<.001** | -.693 | **.006** | -16.114 | **<.001** |
| $\sigma^2$ | 1.19 | | .51 | | 1.10 | | .69 | | .47 | | 15.43 | |
| Intra-class correlation (yr/country/region) | .11/.20/.09 | | .01/.12/.04 | | .09/.19/.09 | | .12/.01/.06 | | .56/.00/.16 | | 4.86/3.32/1.95 | |
| Observations | 5386 | | 4917 | | 5648 | | 4903 | | 3575 | | 3344 | |
| Countries | 164 | | 164 | | 164 | | 148 | | 162 | | 163 | |
| Fixed $R^2$/Random $R^2$ | .010 / .259 | | .030 / .266 | | .050 / .283 | | .037 / .252 | | .300 / .723 | | .006 / .400 | |

Results of a mixed effects model. Findings significant at $p < .05$ appear in bold. All independent variables are lagged one year.

**Figure 3A. Coefficient Plots with 95% Confidence Intervals from Table 3A**



## Section II: Data Discussion and Robustness Checks

1. *Core Independent Variables*

To gauge whether/how electoral accountability affects environmental protection, I use V-Dem's Clean Elections Index. For my purposes, it is preferable to Cheibub et al.'s (2009) measure because it covers more years and employs a continuous approach to measuring the concept. Some countries fit quite obviously on one side of the spectrum or the other (e.g., in 2017, Saudi Arabia vs. Norway). But this variable is by no means bimodal. It detects similarities and differences 'in the middle' where others do not. For instance, for Cheibub et al. (2010), 2008 Namibia and Malaysia were both autocracies; for Marshall et al. (2017) these countries both had Polity2 scores of 6. In contrast, V-Dem perceives Namibia's elections as far cleaner.

To measure protection of civil liberties/society, I use V-Dem's Core Civil Society Index. It is highly correlated with the Clean Elections Index ($\rho = .786$), a point to which I return later. Nonetheless, a non-competitive electoral process does not always preclude relatively robust civil liberties and/or civil society. In Fiji, the 2006 coup was followed by almost a decade of 'postponed' elections and a massive crackdown on press freedoms (Fraenkel and Lal 2009). Yet, most other aspects of Fijian civil society carried on unfettered, particularly in anti-domestic violence efforts and support of Fijian youth. The V-Dem data capture many of these differences.

I gauge political constraints using Heniz's (2017) Political Constraints variable. This variable is also fairly highly correlated with Free/Fair Elections and Core Civil Society ($\rho = .711$ and .721, respectively), a point to which I return below. However, they do not always align or necessarily even move in the same direction. For instance, in early 2011, the Democratic Republic of the Congo (DRC) amended its electoral law to eliminate the requirement of a presidential runoff, thereby favoring the incumbent, Joseph Kabila. Elections later that year were

marred with serious and widespread fraud and violence, leading various members of the Opposition to refuse to accept the results (Carter Center 2011). Nonetheless, Kabila's government committed to significant domestic reforms a little over a year later.[1] These included security sector reform, decentralization and devolution, domestic war crimes legislation, and the establishment of a national civilian structure to manage mining activities equitably (UNSC 2013). Senegal in the late 1980s and early 1990s was, in some respects, the opposite. Reforms included a new system whereby all parliamentarians are elected directly, granting opposition parties access to state-run radio and TV, and the provision of secret ballots and opposition monitors at voting sites. Senegalese civil society was robust and vibrant. Nonetheless, the ruling Socialist Party never faced a serious challenge to its hold on power (Castro-Cornejo et al. 2013; Freedom House various years).

*2. Environmental Degradation*

I begin by checking for unit roots in the dependent variables. All tests are significant at $p < .05$, and therefore I reject the null hypothesis; the data appear to be stationary for all dependent variables. Following Bates et al. (2015), I test whether each level (year, country, region) 'belongs' in the model. In all models, these are significant at $p < .01$, strongly suggesting that the inclusion of three levels of hierarchy significantly improves model fit.

While my main interest in using mixed effects is to control for sources of heterogeneity in the data, it is also useful to explore some of the other model parameters. $\sigma^2$ is simply the (residual) variance of the fixed portion of the model (discussed earlier in the article). The intra-class correlation (ICC) is of particular interest: it indicates how much of the overall model variance is

[1] See Koko 2013 for a broader discussion of the backdrop. Most scholars and practitioners agree that the DRC's undertakings involve significant constraints on executive authority. However, debate continues over how successfully the DRC has actually implemented those commitments. See for example UNSC 2019.

explained by the model's grouping structure. In most models, the ICC is very large, specifically for country and region. This provides additional support for the idea that employing a complex hierarchical error structure is sensible. (For year, the ICC is much smaller and in some cases minute, but the tests discussed earlier in the article confirm that they do 'belong' in each model). Finally, comparison of the two sub-models' $R^2$s is insightful. The fixed part of the models provides an important contribution to overall model fit, depending on the environmental outcome (e.g., land non-protection consistently has poor model fit, whereas most other outcomes have respectable if imperfect $R^2$s). But overall, it is clear that the random portion of the model is doing much of the explanatory work, consistent with other environmental politics studies using this method (Povitkina 2018). This is neither a good nor a bad thing – it simply tells us that, for these data, much of the explanatory power is in the model's complex, hierarchical, error structure.

I conduct five main robustness checks.[2]

(a) I run each model using the Polity2 variable instead of electoral accountability, civil society protections, and political constraints. In all models but one, Polity2 is negative – though they fall short of statistically significant in some specifications. $SO_2$ is the exception: in my analyses, there appears to be no relationship between Polity 2 and per capita emissions. These differences likely reflect a combination of factors: the longer time-span of my data as compared to some studies; the more sophisticated modeling approach employed here; and the fact that Polity2, despite being highly correlated with these variables ($.816 < \rho < .863$), measures a different concept.

(b) Given the high correlation of the three main independent variables, there is good reason to be concerned that multicollinearity may be creating problems for model fit and interpretation.

[2] All results are available upon request.

These problems are well-known, so I do not review them here. As a first step, I calculate the variance inflation factor (VIF) for the models presented in Tables 1A and 2A. Figures 4A and 5A present the results. VIFs offer a useful diagnostic of the degree to which collinearity with other predictors 'inflates' the variance of that variable's coefficient. As a rule of thumb, a VIF greater than 10 is cause for concern. Figures 4A and 5A show that all VIFs are in the acceptable range, providing some confidence that multicollinearity is not a significant problem in these analyses.[3] As a further probe of whether the results are contaminated by multicollinearity problems, I estimate the model with each of the three core 'democracy' variables separately. Table 4A and Figures 6A and 7A below present the results for electoral accountability; Table 5A and Figures 8A and 9A present the results for civil liberties/society; and Table 6A and Figure 10A present the results for political constraints. The results differ little from those presented in Tables 1A and 2A (Appendix)/Figures 2 and 3 (main article). Overall, this provides additional confidence in the results. I considered additional modeling approaches such as variance decomposition and partial least squares, but a key drawback of both is that variable choice is based on the data rather than the theory. Given the acceptable VIFs and the robustness across model specification, I argue that we can have reasonable confidence in the results.

[3] I also calculated VIFs for the analyses of policy change (Table 3A), but the values were never greater than 1.5 for any variable.

**Figure 4A. Variance Inflation Factors from Table 1A**

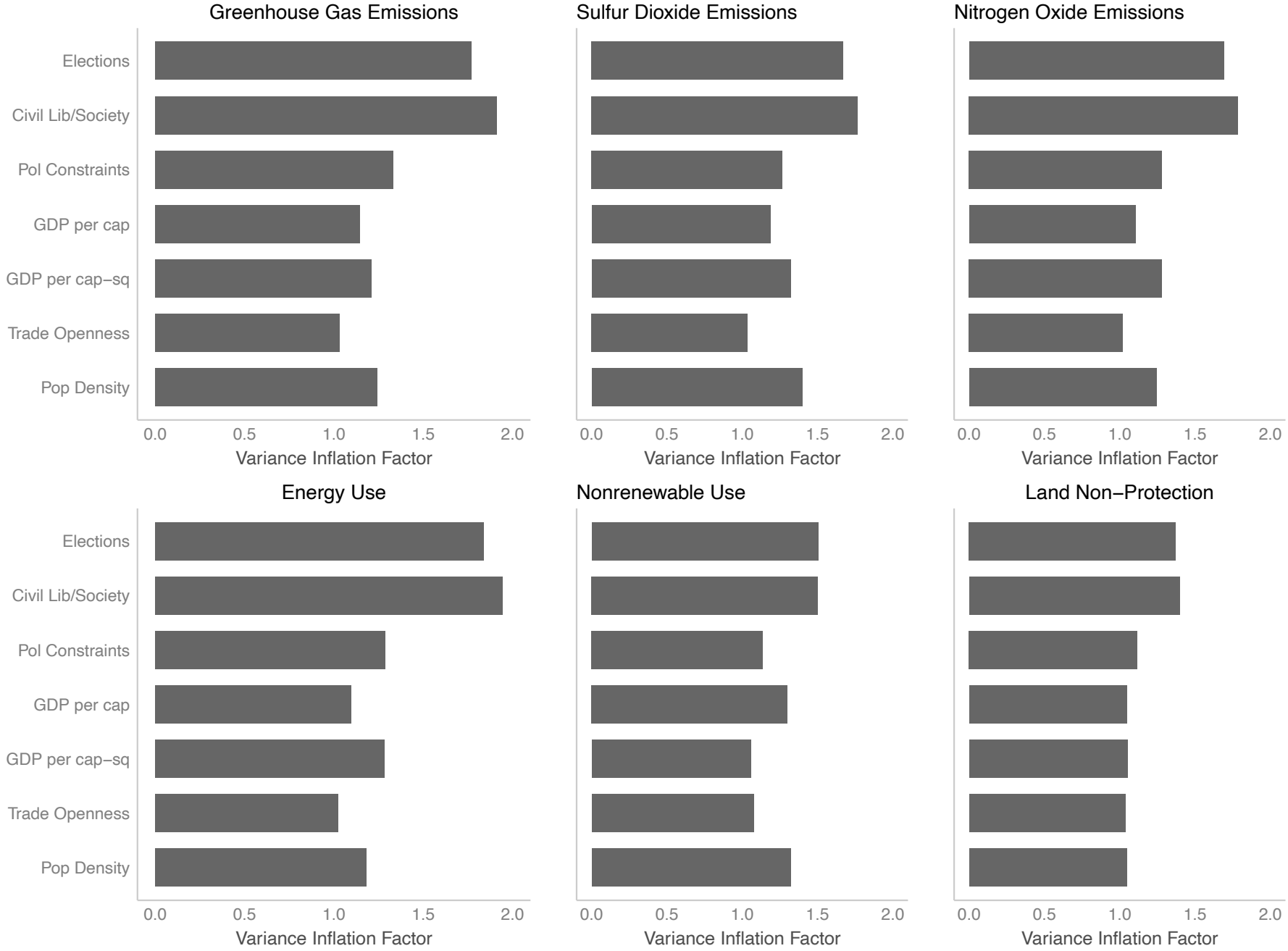


**Figure 5A. Variance Inflation Factors from Table 2A**

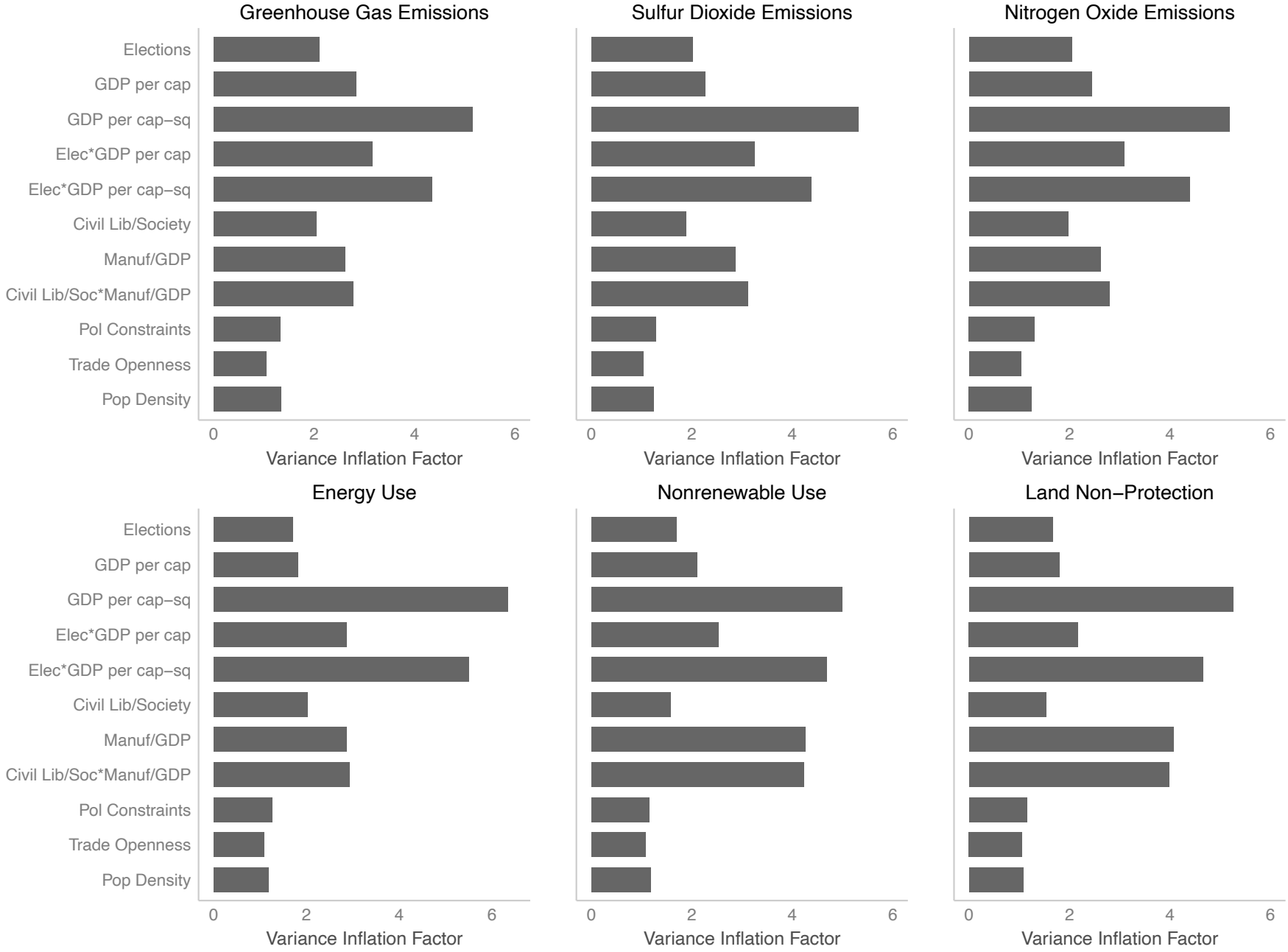


**Table 4A. Free/Fair Elections: Impact on Environmental Degradation**

| | **Greenhouse Gases** | | **Sulfur Dioxide ($SO_2$)** | | **Nitrogen Oxides ($NO_X$)** | | **Energy Use** | | **Non-Renewable Use** | | **Land Non-Protection** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* |
| Free/Fair Elections | .064 | **.020** | .471 | **<.001** | .094 | **<.001** | .169 | **<.001** | .037 | .105 | -.344 | **<.001** |
| GDP per Capita | .141 | **<.001** | .314 | **<.001** | .154 | **<.001** | .334 | **<.001** | .086 | **<.001** | -.008 | .797 |
| GDP per Capita$^2$ | -.015 | **.010** | .034 | **<.001** | -.008 | **.048** | .037 | **<.001** | -.062 | **<.001** | -.005 | .645 |
| Free/Fair Elections*GDP per Capita | .090 | **<.001** | .076 | **<.001** | .084 | **<.001** | .07 | **<.001** | .095 | **<.001** | .019 | .596 |
| Free/Fair Elections*GDP per Capita$^2$ | -.165 | **<.001** | .877 | **<.001** | -.284 | **<.001** | .291 | **<.001** | .314 | **<.001** | .151 | **.012** |
| Trade Openness | .009 | .642 | -.13 | **<.001** | -.036 | **.007** | -.005 | .736 | -.027 | **.044** | -.176 | **<.001** |
| Population Density | -.163 | **<.001** | .289 | **<.001** | -.322 | **<.001** | .056 | **.004** | .307 | **<.001** | .239 | **<.001** |
| Constant | -.015 | **.026** | -.135 | **<.001** | -.029 | **<.001** | -.057 | **<.001** | .022 | **<.001** | -.001 | .940 |
| $\sigma^2$ | .09 | | .11 | | .05 | | .04 | | .02 | | .16 | |
| Intra-class correlation (year/country/region) | .00/.48/.21 | | .14/2.10/.97 | | .01/.46/.09 | | .02/.58/.44 | | .00/.30/.29 | | .03/1.80/.11 | |
| Observations | 5325 | | 4991 | | 5472 | | 4934 | | 3853 | | 3383 | |
| Countries | 161 | | 162 | | 162 | | 147 | | 165 | | 162 | |
| Fixed $R^2$/Random $R^2$ | .121 / .901 | | .372 / .978 | | .256 / .940 | | .300 / .973 | | .272 / .972 | | .056 / .930 | |

Results of a mixed effects model. Findings significant at $p < .05$ appear in bold. All independent variables are lagged one year.

**Figure 6A. Coefficient Plots with 95% Confidence Intervals from Table 4A**

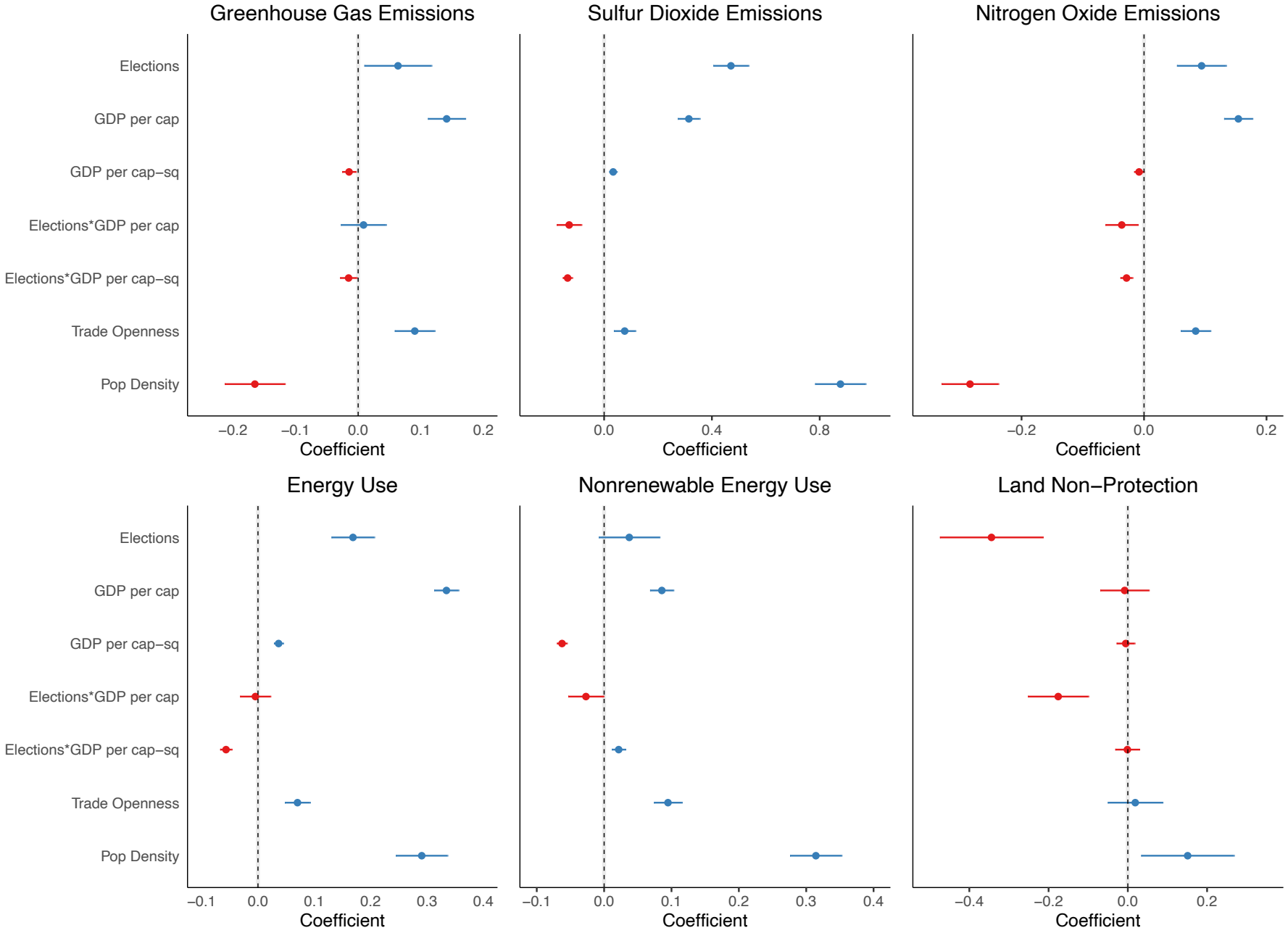
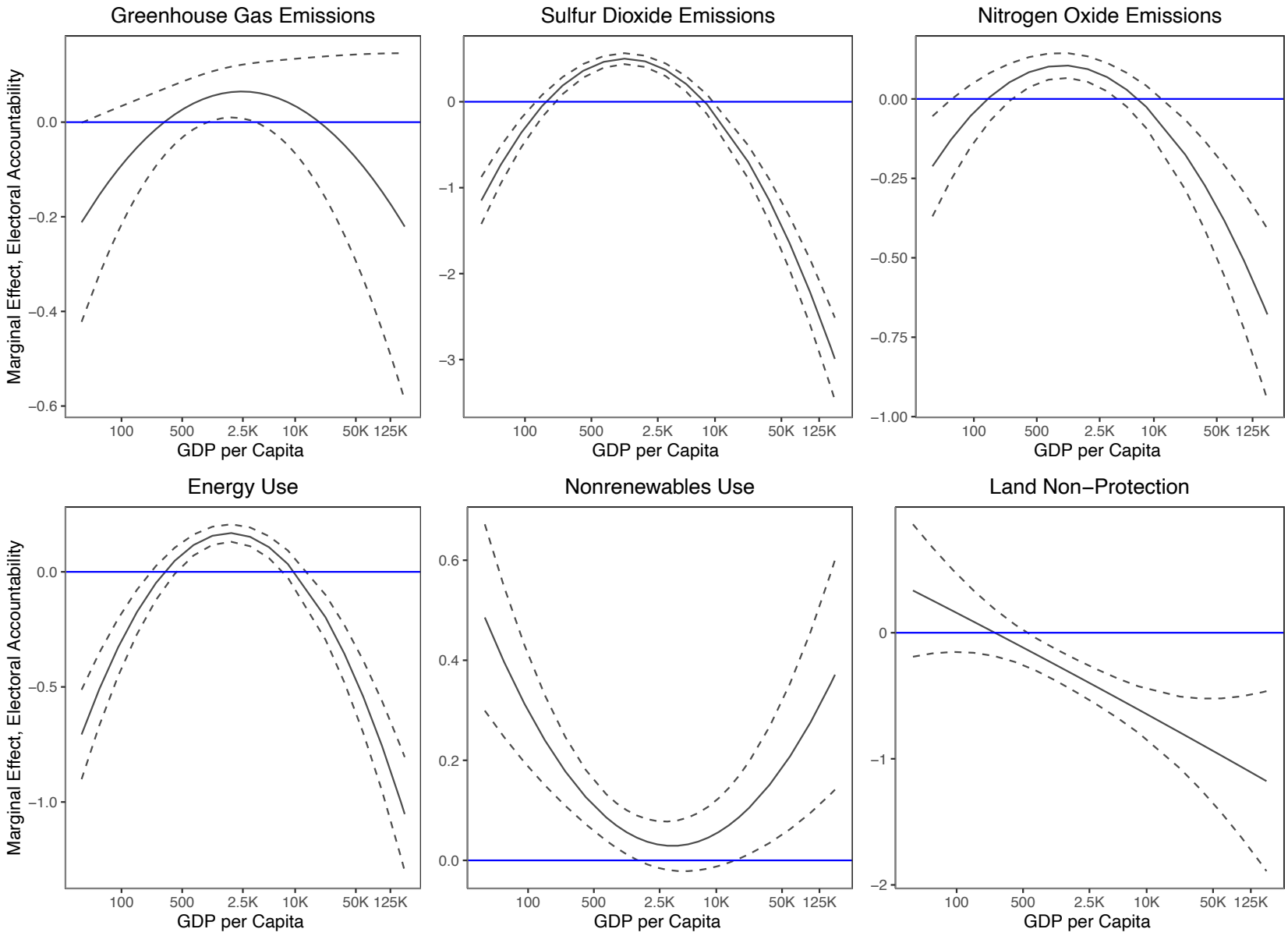


**Figure 7A. Electoral Accountability and Wealth: Impacts on Environmental Degradation**




Simulated marginal effect of a one-standard deviation change around the mean of electoral accountability. Solid lines indicate marginal effects; dashed lines indicate 95% confidence intervals. Results based on estimates from Table 4A.

**Table 5A. Civil Liberties/Society: Impact on Environmental Degradation**

| | Greenhouse Gases | | Sulfur Dioxide ($SO_2$) | | Nitrogen Oxides ($NO_X$) | | Energy Use | | Non-Renewable Use | | Land Non-Protection | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* |
| Civil Liberties/Society | -.048 | .158 | .216 | **<.001** | .01 | .715 | -.290 | **<.001** | -.018 | .542 | -.124 | .118 |
| Manufacturing/GDP | -.029 | .178 | .167 | **<.001** | .015 | .346 | -.273 | **<.001** | .006 | .857 | -.094 | .269 |
| Civil Lib/Society*Manufacturing/GDP | .158 | **<.001** | -.031 | .498 | .083 | **.003** | .590 | **<.001** | .120 | **.007** | .266 | **.022** |
| GDP per Capita | .127 | **<.001** | .184 | **<.001** | .083 | **<.001** | .339 | **<.001** | .087 | **<.001** | -.161 | **<.001** |
| GDP per Capita$^2$ | -.013 | **<.001** | -.071 | **<.001** | -.015 | **<.001** | .013 | **<.001** | -.049 | **<.001** | -.027 | **<.001** |
| Trade Openness | .107 | **<.001** | .075 | **.001** | .088 | **<.001** | .094 | **<.001** | .097 | **<.001** | -.009 | .807 |
| Population Density | -.138 | **<.001** | .403 | **<.001** | -.265 | **<.001** | .473 | **<.001** | .332 | **<.001** | .211 | **.001** |
| Constant | 15.693 | **<.001** | 7.462 | **<.001** | 6.902 | **<.001** | 4.886 | **<.001** | 2.435 | **<.001** | -2.287 | **<.001** |
| $\sigma^2$ | .08 | | .10 | | .05 | | .04 | | .02 | | .15 | |
| Intra-class correlation (yr/country/region) | .00/.48/.21 | | .08/1.09/.86 | | .01/.42/.09 | | .04/.79/.47 | | .00/.31/.29 | | .02/1.94/.00 | |
| Observations | 4192 | | 3932 | | 4314 | | 4097 | | 3567 | | 3165 | |
| Countries | 153 | | 154 | | 155 | | 143 | | 160 | | 159 | |
| Fixed $R^2$/Random $R^2$ | .098 / .904 | | .195 / .962 | | .216 / .933 | | .370 / .983 | | .276 / .971 | | .072 / .932 | |

Results of a mixed effects model. Findings significant at $p < .05$ appear in bold. All independent variables are lagged one year.

**Figure 8A. Coefficient Plots with 95% Confidence Intervals from Table 5A**

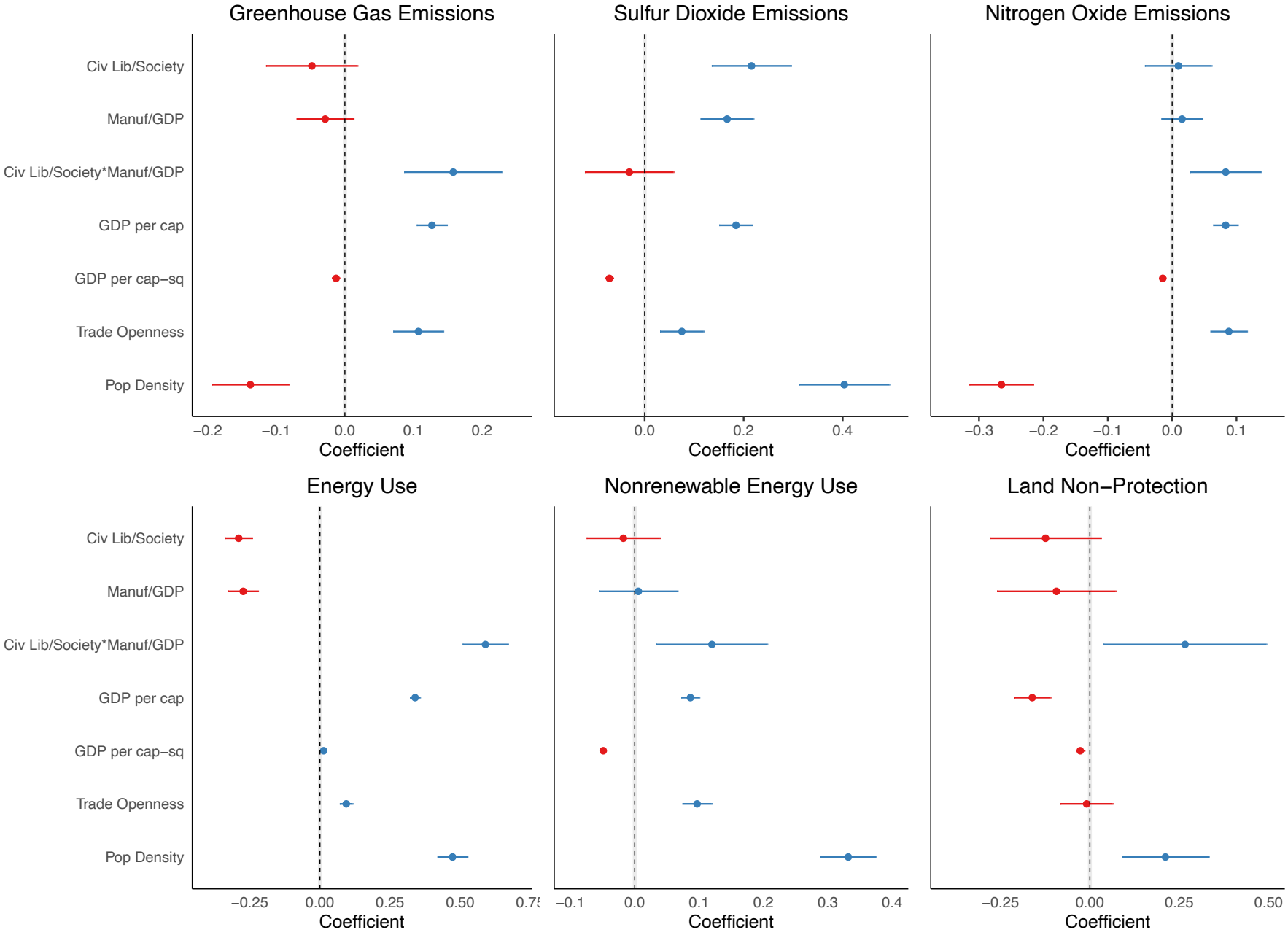
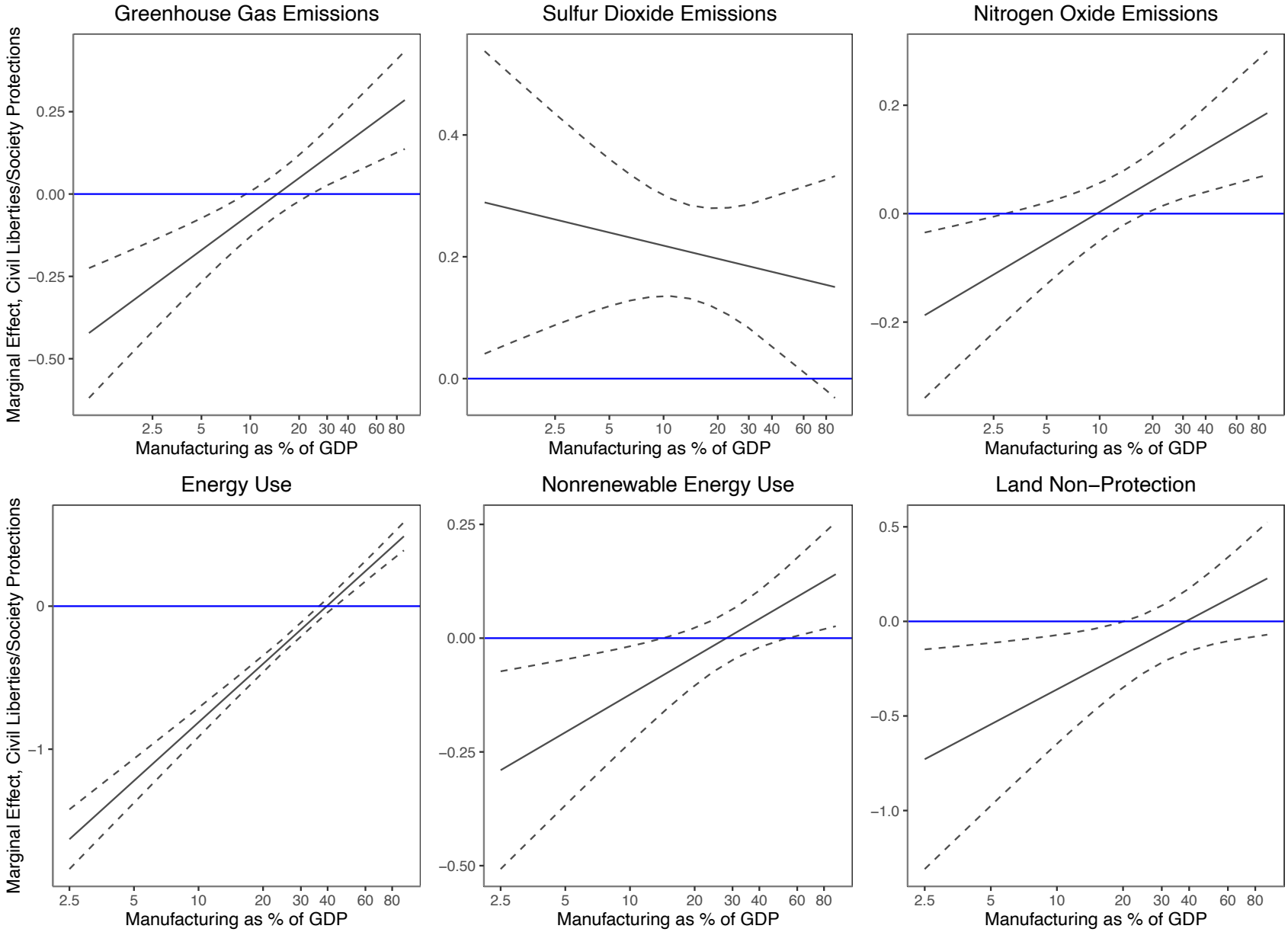


**Figure 9A. Civil Liberties/Society and Manufacturing: Impacts on Environmental Degradation**



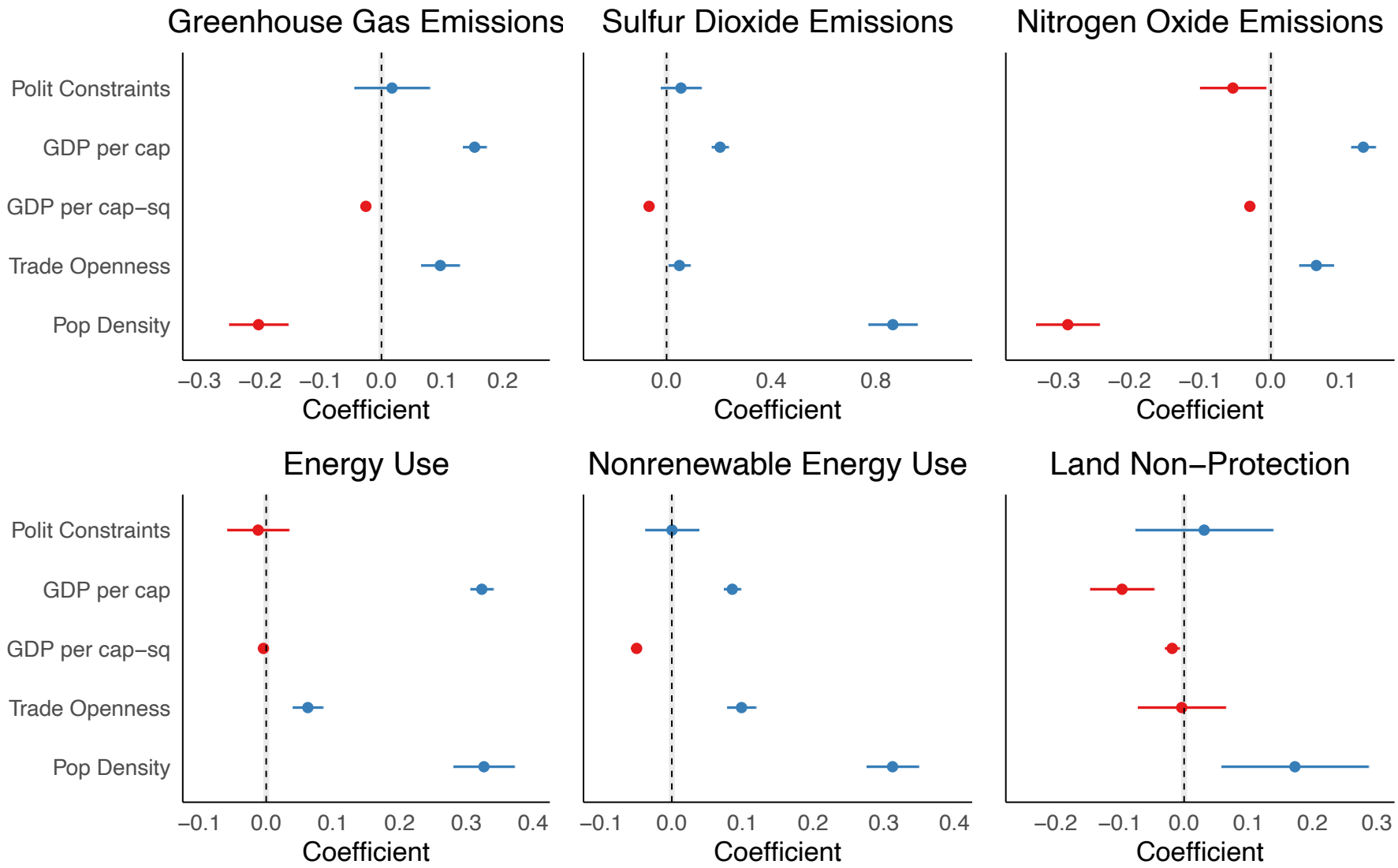

Simulated marginal effect of a one-standard deviation change around the mean of electoral accountability. Solid lines indicate marginal effects; dashed lines indicate 95% confidence intervals. Results based on estimates from Table 5A.

**Table 6A. Political Constraints: Impact on Environmental Degradation**

| | **Greenhouse Gases** | | **Sulfur Dioxide ($SO_2$)** | | **Nitrogen Oxides ($NO_X$)** | | **Energy Use** | | **Non-Renewable Use** | | **Land Non-Protection** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* | *Coeff* | *p* |
| Political Constraints | .017 | .582 | .055 | .162 | -.054 | **.024** | -.012 | .607 | .000 | .990 | .031 | .567 |
| GDP per Capita | .154 | **<.001** | .204 | **<.001** | .131 | **<.001** | .323 | **<.001** | .086 | **<.001** | -.097 | **<.001** |
| GDP per Capita$^2$ | -.026 | **<.001** | -.067 | **<.001** | -.03 | **<.001** | -.004 | **.02** | -.050 | **<.001** | -.019 | **.001** |
| Trade Openness | .097 | **<.001** | .049 | **.019** | .064 | **<.001** | .062 | **<.001** | .099 | **<.001** | -.004 | .914 |
| Population Density | -.203 | **<.001** | .864 | **<.001** | -.287 | **<.001** | .326 | **<.001** | .312 | **<.001** | .172 | **.003** |
| Constant | 15.983 | **<.001** | 5.783 | **<.001** | 7.162 | **<.001** | 5.387 | **<.001** | 2.505 | **<.001** | -2.297 | **<.001** |
| $\sigma^2$ | .09 | | .12 | | .05 | | .04 | | .02 | | .15 | |
| Intra-class correlation (year/country/region) | .00/.44/.24 | | .13/2.26/1.29 | | .01/.43/.12 | | .02/.59/.45 | | .00/.30/.26 | | .03/1.76/.13 | |
| Observations | 5584 | | 5222 | | 5759 | | 4986 | | 4079 | | 3558 | |
| Countries | 170 | | 170 | | 170 | | 155 | | 173 | | 169 | |
| Fixed $R^2$/Random $R^2$ | .151 / .902 | | .324 / .978 | | .255 / .937 | | .312 / .974 | | .281 / .972 | | .039 / .928 | |

Results of a mixed effects model. Findings significant at $p < .05$ appear in bold. All independent variables are lagged one year.

**Figure 10A. Coefficient Plots with 95% Confidence Intervals from Table 6A**



(c) I consider alternate operationalizations of two of the main independent variables of interest.[4] For an alternative gauge of electoral accountability, I use Coppedge et al.'s (2018) Electoral Democracy Index. For an alternate operationalization of the civil liberties/society mechanism, I employ Coppedge et al.'s (2018) civil liberties index. The results using these measures are similar to those presented here. Second, I add more independent variables to the models: year (and, in additional analyses, year + year$^2$ to gauge non-linear time trends), GDP growth, presidentialism, semi-presidentialism, parliamentarianism, and industry as a percentage of GDP. The results are similar to those reported in this article, and available upon request.

(d) I explore two results in further detail. First, given the perplexing U-shaped relationship between electoral accountability, wealth, and non-renewables (see Figure 2 of the article), I replace the electoral accountability variable with Polity 2 (therefore interacting it with GDP per capita and GDP per capita$^2$). Interestingly, I find a similar U-shaped relationship between Polity2 score, wealth, and non-renewables use. The main difference being that Polity2 is linked to lower non-renewables use for some values in the middle of the GDP per capita distribution. To my knowledge, no other studies have explored this moderating effect. This does not tell us *why* the unexpected U-shaped relationship exists, but it does tell us that it is not simply a matter of independent variable choice.

Second, the analyses suggest that GDP per Capita$^2$ and its interaction with Free/Fair Elections do not belong in the land non-protection model. I therefore re-run the model without those variables. The overall findings do not differ notably. The key difference is that the confidence intervals are slightly narrower at very low, and very high, levels of GDP.

[4] No viable alternative is available for Political Constraints.

*3. Statistical Analyses: Change in Environmental Outcomes*

For the analyses of policy change (Table 3A and Figure 3A), I use a mixed effects model, as in the other analyses. The main difference as compared to the results displayed in Tables 1 and 2 and their related figures is the dependent variable. As mentioned in the main article, in Table 3 and in related figures, the dependent variable is the absolute value of the percentage change, since the theory I aim to test is about change, whether positive or negative. Section III of this document provides greater detail on these variables. Most independent variables are also based on the absolute value of the percentage change. Hence, we take the absolute value of the growth rate, and so on. Political constraints is an exception, of course, for theory-testing reasons. In addition, I include a 'baseline' variable to control for the possibility that countries with higher (lower) degradation are simply more (less) prone to pendulum swings. The results suggest that these relationships vary by environmental outcome. I lag all independent variables one period; hence, GDP growth volatility between 2009 and 2010 predicts greenhouse gas emissions between 2010 and 2011, and so on.

I conduct several robustness checks as part of these analyses of environmental policy change:

(a) The dependent variable is a measure of change. This raises two potential concerns. One is whether the lag is appropriate. I chose a one-year lag as noted above, but it could well be that it takes longer for economic and other shifts to induce environmental policy change. I lag the independent variables in each model two and then three years, but the results either do not change notably or become non-significant. Second, it is well-known that yearly change data can be volatile, i.e., subject to wild swings in some years. Log-transforming the dependent variable largely mitigates this problem anyhow, but as an additional robustness check, I also average the values over two, and three, years. I use these as alternate dependent variables, and also investigate longer lags. The results either do not change or become non-significant.

(b) I use two alternate modeling approaches: a GLS model with country and year fixed effects (and, in additional specifications, a lagged dependent variable); and an Arellano-Bond linear dynamic panel-data model. In comparison to the results in Table 3 and related figures, the overall picture does not change notably. In some models, political constraints make changes in sulfur dioxide emissions significantly less likely, but this varies by model specification. There is very little evidence that political constraints widely and systematically lock in environmental policy across these six outcomes.

## Section III. Data Details

**Table 7A. Data Sources and Measurement**

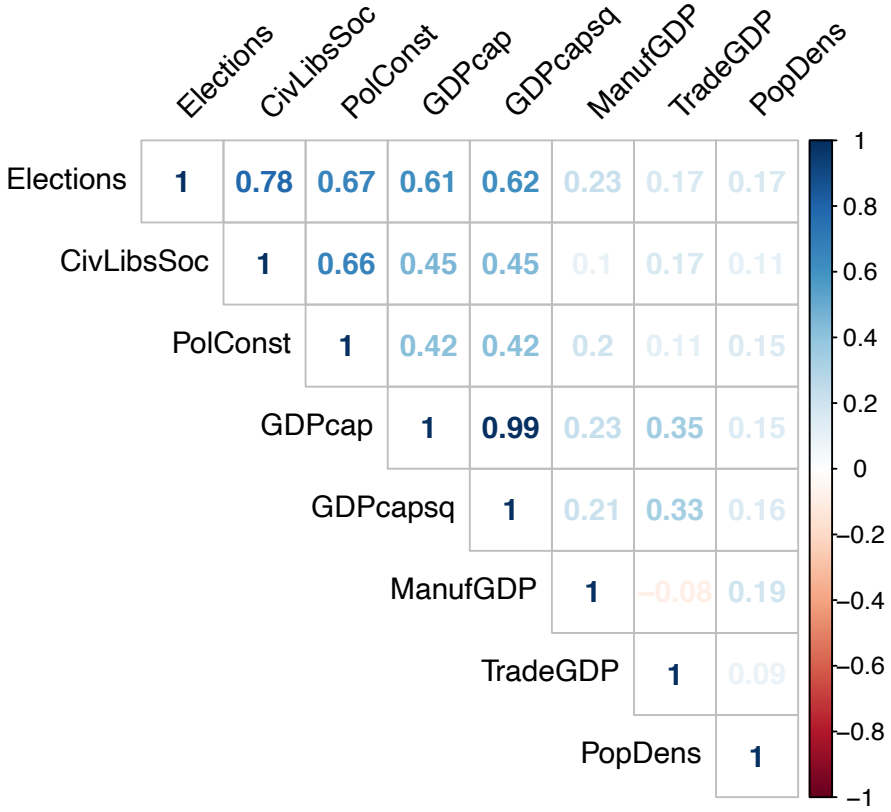
| Variable | Measurement | Transformation | Source |
|---|---|---|---|
| Civil Liberties/ Society | v2xcs_ccsi (V-Dem codebook v. 9, page 275) | -- | V-Dem (www.v-dem.net) |
| Energy Use | Kg of oil equivalent per capita | Logged due to skewness | World Bank (data.worldbank.org) |
| Energy Use Change | $\frac{\text{Energy Use}_t - \text{Energy Use}_{t-1}}{\text{Energy Use}_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | World Bank (data.worldbank.org) |
| Free/Fair Elections | v2xel_frefair (V-Dem codebook v. 9, page 44) | -- | V-Dem (www.v-dem.net) |
| GDP per Capita | GDP per capita in current LCU | Logged due to skewness; mean-centered due to inclusion in interaction terms | World Bank (data.worldbank.org) |
| GDP Growth | $\frac{\text{GDP}_t - \text{GDP}_{t-1}}{\text{GDP}_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | World Bank (data.worldbank.org) |
| Greenhouse Gas Emissions | $CO_2$, CH4, $N_2O$, in tonnes of $CO_2$ equivalent per capita | Logged due to skewness | Emissions Database for Global Atmospheric Research (edgar.jrc.ec.europa.eu); World Bank (data.worldbank.org) |
| Greenhouse Gas Emissions Change | $\frac{\text{Emissions}_t - \text{Emissions}_{t-1}}{\text{Emissions}_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | Emissions Database for Global Atmospheric Research (edgar.jrc.ec.europa.eu); World Bank (data.worldbank.org) |
| Greenhouse Gas Emissions per Capita | Greenhouse Gas Emissions/per capita GDP | Logged due to skewness | Emissions Database for Global Atmospheric Research (edgar.jrc.ec.europa.eu); World Bank (data.worldbank.org) |
| Land Non-Protection | 100 – Terrestrial protected areas (% of total territorial area) | Logged due to skewness/ being a percentage | World Database on Protected Areas (www.iucn.org) |
| Land Non-Protection Change | $\frac{\%\text{Protected}_t - \%\text{Protected}_{t-1}}{\%\text{Protected}_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | World Database on Protected Areas (www.iucn.org) |
| Manufacturing as % of GDP | Manufacturing as a percentage of current GDP | Logged due to skewness; mean-centered due to inclusion in interaction terms | World Bank (data.worldbank.org) |
| Nitrogen Oxide Emissions | $NO_X$, in tonnes of $CO_2$ equivalent per capita | Logged due to skewness | World Bank (data.worldbank.org) |
| Nitrogen Oxide Emissions Change | $\frac{\text{Emissions}_t - \text{Emissions}_{t-1}}{\text{Emissions}_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | World Bank (data.worldbank.org) |

| Variable | Measurement | Transformation | Source |
|---|---|---|---|
| Nitrogen Oxide Emissions per Capita | $NO_X$ emissions/ per capita GDP | Logged due to skewness | World Bank (data.worldbank.org) |
| Non-renewables Use | % of total final energy consumption not from renewable sources | Logged due to skewness/being a percentage | World Bank (data.worldbank.org) |
| Nonrenewables Use Change | $\frac{\%_t - \%_{t-1}}{\%_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | World Bank (data.worldbank.org) |
| Political Constraints | Polconiii | -- | Henisz 2017 (mgmt.wharton.upenn.edu/faculty/heniszpolcon/polcondataset/ |
| Population Density | Population/Land area | Logged due to skewness | World Bank (data.worldbank.org) |
| Population Density Change | $\frac{\text{Pop Density}_t - \text{Pop Density}_{t-1}}{\text{Pop Density}_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | World Bank (data.worldbank.org) |
| Region | United Nations Geoscheme | -- | https://unstats.un.org/unsd/methodology/m49/ |
| Sulfur Dioxide Emissions | $SO_2$, in tonnes per capita | Logged due to skewness | Yale Environmental Performance Index (epi.envirocenter.yale.edu); World Bank (data.worldbank.org) |
| Sulfur Dioxide Emissions Change | $\frac{\text{Emissions}_t - \text{Emissions}_{t-1}}{\text{Emissions}_{t-1}}$ | Absolute value due to inclusion in policy change model. Logged due to skewness/being a percentage. | Yale Environmental Performance Index (epi.envirocenter.yale.edu); World Bank (data.worldbank.org) |
| Sulfur Dioxide Emissions per Capita | $SO_2$ emissions/ per capita GDP | Logged due to skewness | Yale Environmental Performance Index (epi.envirocenter.yale.edu); World Bank (data.worldbank.org) |
| Trade Openness | Trade/GDP | Logged due to skewness | World Bank (data.worldbank.org) |

**Table 8A. Descriptive Statistics**

| Variable | Observations | Mean | Std Deviation | Min | Max | Years | # Countries |
|---|---|---|---|---|---|---|---|
| Civil Liberties/Society | 9,501 | .543 | .317 | .007 | .979 | 1960-2017 | 177 |
| Civil Liberties/Society Change | 9,497 | .004 | .056 | -.558 | .753 | 1960-2017 | 177 |
| Energy Use | 5,877 | 7.147 | 1.094 | 2.26 | 9.997 | 1960-2015 | 166 |
| Energy Use Change | 5,681 | -4.083 | .942 | -6.179 | -.626 | 1960-2015 | 166 |
| Free/Fair Elections | 9,480 | .445 | .344 | 0 | .985 | 1960-2017 | 177 |
| Free/Fair Elections Change | 9,475 | .004 | .082 | -.820 | .921 | 1960-2017 | 177 |
| GDP Growth | 8,412 | 1.27 | 1.154 | -13.816 | 5.01 | 1961-2017 | 188 |
| GDP per Capita | 8,759 | 7.516 | 1.708 | 3.548 | 12.129 | 1960-2017 | 187 |
| Greenhouse Gas Emissions | 7,485 | 17.159 | 2.343 | 7.813 | 23.245 | 1970-2012 | 181 |
| Greenhouse Gas Emissions Change | 7,267 | -3.167 | 1.260 | -6.743 | 2.189 | 1970-2012 | 182 |
| Greenhouse Gas Emissions per Capita | 7,482 | 15.463 | 1.133 | 11.517 | 18.907 | 1970-2012 | 181 |
| Land Non-Protection | 4,301 | 1.608 | 1.543 | -2.834 | 4.605 | 1990-2012 | 186 |
| Land Non-Protection Change | 4,113 | -15.732 | 4.968 | -28.421 | -1.881 | 1990-2012 | 169 |
| Manufacturing/GDP | 6,697 | 2.383 | .703 | -4.605 | 4.494 | 1960-2017 | 182 |
| Nitrogen Oxide Emissions | 7,874 | 7.608 | 2.69 | -4.605 | 13.283 | 1970-2012 | 184 |
| Nitrogen Oxide Emissions | 7,871 | 6.051 | 1.251 | -1.683 | 10.607 | 1970-2012 | 184 |
| Nitrogen Oxide Emissions Change | 7,684 | -3.289 | 1.250 | -6.480 | 1.789 | 1970-2012 | 184 |
| Non-Renewables Use per Capita | 4,755 | 3.973 | .807 | .511 | 4.605 | 1990-2015 | 186 |
| Non-Renewables Use Change | 4,566 | -.4.562 | 1.651 | -7.442 | 1.018 | 1990-2015 | 182 |
| Political Constraints | 9,323 | .220 | .218 | 0 | .726 | 1960-2016 | 196 |
| Population Density | 10,428 | 3.869 | 1.522 | -.459 | 9.87 | 1961-2017 | 187 |
| Population Density Change | 10,226 | -4.990 | 1.016 | -11.519 | -1.933 | 1962-2017 | 188 |
| Sulfur Dioxide Emissions | 7,519 | 10.637 | 2.605 | -1.209 | 17.216 | 1970-2010 | 181 |
| Sulfur Dioxide Emissions Change | 7,334 | -2.860 | 1.039 | -5.061 | 1.552 | 1970-2010 | 185 |
| Sulfur Dioxide Emissions per Capita | 7,015 | 9.003 | 1.654 | 1.047 | 13.558 | 1970-2010 | 181 |
| Trade Openness | 7,897 | 4.219 | .659 | -3.863 | 6.090 | 1960-2017 | 180 |

**Correlations (Independent Variables)**




**Correlations (Dependent Variables)**