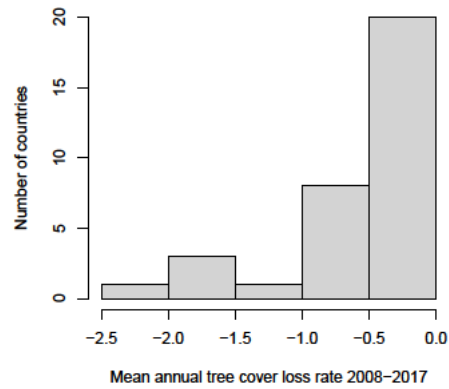


Supplementary Material

1 Variable Descriptions and Descriptive Statistics

Supplementary Table 1. Variable descriptions and descriptive statistics

Variable	Description	Descriptive Statistics				
		Min	Median	Mean	Max	NAs
Overall Governance	IIAG Overall Governance Score (0-100); mean of the four sub-category scores	19.03	48.70	50.06	81.70	-
Safety & Rule of Law	IIAG Safety and Rule of Law Sub-Category Score (0-100)	13.50	55.90	54.27	83.70	-
Participation & Human Rights	IIAG Participation and Human Rights Sub-Category Score (0-100)	19.10	51.10	50.52	78.70	-
Sustainable Economic Opportunity	IIAG Sustainable Economic Opportunity Sub-Category Score (0-100)	16.60	44.00	44.25	77.50	-
Human Development	IIAG Human Development Sub-Category Score (0-100)	23.1	49.20	51.20	89.4	-
Environmental Governance	Environmental Policy Score by Bertelsmann Stiftung provided in IIAG database (1-10, data unavailable for 7 countries)	1	4	3.926	8	70
Tree cover percentage loss	Annual rate of loss in tree cover within PAs per country (as percentage to previous year's tree cover)	-11.405	-0.297	-0.559	0	-
PA area	Sum of the area (in km ²) of all terrestrial protected areas (PAs) within each country that are included in the WDPA, excluding PAs established after 2008, UNESCO MAB Bioserves and adopted and proposed PAs.	11.7	36,672.3	72,413.4	347,590.6	-
Tree Covered Area in PAs in 2008 (%)	Proportion (%) of tree covered area in each country's protected areas in 2008	0.02%	22.85%	34.38%	94.23%	-
GDP (constant 2010 US\$)	Gross domestic product in constant 2010 US\$	180.0Mio	11.94Bio	41.21Bio	46.20Bio	2
Population Density	Number of people per square kilometer of land area	5.89	63.39	121.60	622.96	



Supplementary Figure 1. Frequency histogram of countries' mean annual tree cover loss rate in PAs from 2008-2017.

2 Correlation Matrices

Supplementary Table 2. Correlation matrix for mean values for each country across time

Correlation coefficients									
	OG	SR	PHR	SEO	HD	ENV	tree_cov er_prop _PA_20 08	log(gdp)	log(pop ulation.d ensity)
OG	1	0.94	0.87	0.9	0.91	0.81	-0.14	0.07	0.58
SR	0.94	1	0.81	0.76	0.81	0.73	-0.1	-0.01	0.49
PHR	0.87	0.81	1	0.68	0.65	0.71	-0.16	0.01	0.44
SEO	0.9	0.76	0.68	1	0.84	0.79	-0.19	0.26	0.5
HD	0.91	0.81	0.65	0.84	1	0.79	-0.05	0	0.67
ENV	0.81	0.73	0.71	0.79	0.79	1	0.24	0.13	0.5
tree_cover_prop_PA_2008	-0.14	-0.1	-0.16	-0.19	-0.05	0.24	1	-0.15	-0.04
log(gdp)	0.07	-0.01	0.01	0.26	0	0.13	-0.15	1	-0.21
log(population.density)	0.58	0.49	0.44	0.5	0.67	0.5	-0.04	-0.21	1
Number of observations									
	OG	SR	PHR	SEO	HD	ENV	tree_cov er_prop _PA_20 08	log(gdp)	log(pop ulation.d ensity)
OG	33	33	33	33	33	26	33	33	33
SR	33	33	33	33	33	26	33	33	33
PHR	33	33	33	33	33	26	33	33	33
SEO	33	33	33	33	33	26	33	33	33
HD	33	33	33	33	33	26	33	33	33
ENV	26	26	26	26	26	26	26	26	26
tree_cover_prop_PA_2008	33	33	33	33	33	26	33	33	33
log(gdp)	33	33	33	33	33	26	33	33	33

log(population.density)	33	33	33	33	33	26	33	33	33
p-Values									
	OG	SR	PHR	SEO	HD	ENV	tree_cov er_prop _PA_20 08	log(gdp)	log(pop ulation.d ensity)
OG		0.0000	0.000	0.000	0.0000	0.0000	0.4426	0.6924	0.0004
SR	0.0000		0.000	0.0000	0.0000	0.0000	0.5618	0.9724	0.0037
PHR	0.0000	0.0000		0.0000	0.0000	0.0000	0.3889	0.9462	0.0100
SEO	0.0000	0.0000	0.0000		0.0000	0.0000	0.2844	0.1469	0.0029
HD	0.0000	0.0000	0.0000	0.0000		0.0000	0.7959	0.9927	0.0000
ENV	0.0000	0.0000	0.0000	0.0000	0.0000		0.2335	0.5382	0.0095
tree_cover_prop_PA_2008	0.4426	0.5618	0.3889	0.2844	0.7959	0.2335		0.4173	0.8106
log(gdp)	0.6924	0.9724	0.9462	0.1469	0.9927	0.5382	0.4173		0.2508
log(population.density)	0.0004	0.0037	0.01	0.0029	0.0000	0.0095	0.8106	0.2508	

Supplementary Table 3. Correlation matrix for panel dataset

	OG	SR	PHR	SEO	HD	ENV	log(GDP)
SR	0.425***						
PHR	0.510***	0.818***					
SEO	0.567***	0.590***	0.180**				
HD	0.470***	0.356***	0.046	0.486***			
ENV	1.200***	1.449*	0.912*	0.958*	1.505***		
log(GDP)	9.058***	13.927***	4.594**	8.361***	9.396***	0.660*	
log(population.density)	4.746	4.441	-0.827	-0.163	15.257**	4.032***	0.634**

Notes:

*p<0.1; **p<0.05; ***p<0.01
Models include country and time fixed effects

3 Preliminary Analysis of Time-lags

Supplementary Table 4. Summary of parameter estimates (clustered SE) from panel regression with a one-year time-lag of tree cover loss against governance and additional covariates, considering changes within countries over time. Models include country and time fixed effects. Models (1) - (6) include the different governance indices. *p<0.1; **p<0.05; ***p<0.01

	Dependent variable:					
	Annual tree cover loss rate in PAs (% , log transformed)					
	(1)	(2)	(3)	(4)	(5)	(6)
Overall Governance	0.062 (0.047)					0.030 (0.064)
Safety and Rule of Law		0.037 (0.023)				
Participation and Human Rights			0.00002 (0.024)			
Sustainable Economic Opportunity				0.019 (0.036)		
Human Development					0.038 (0.041)	

Environmental Governance						-0.185 (0.390)
log(GDP) (constant 2010 US)	-0.313 (0.903)	-0.262 (0.797)	0.260 (0.556)	0.099 (0.748)	-0.078 (0.804)	-0.215 (1.067)
log(Population Density)	1.591 (4.436)	1.698 (4.531)	1.440 (4.579)	1.571 (4.507)	1.082 (4.068)	5.513 (6.470)
Overall*Environmental Governance						0.003 (0.009)
Observations	325	325	325	325	325	255
R ²	0.015	0.020	0.003	0.005	0.011	0.036
Adjusted R ²	-0.140	-0.133	-0.154	-0.152	-0.145	-0.139
F Statistic	1.406 (df = 3; 280)	1.951 (df = 3; 280)	0.262 (df = 3; 280)	0.432 (df = 3; 280)	1.002 (df = 3; 280)	1.586 (df = 5; 215)

Supplementary Table 5. Summary of parameter estimates (clustered SE) from panel regression with a two-year time-lag of tree cover loss against governance and additional covariates, considering changes within countries over time. Models include country and time fixed effects. Models (1) - (6) include the different governance indices. *p<0.1; **p<0.05; ***p<0.01

	<i>Dependent variable:</i>					
	Annual tree cover loss rate in PAs (% , log transformed)					
	(1)	(2)	(3)	(4)	(5)	(6)
Overall Governance	0.055 (0.047)					-0.075 (0.053)
Safety and Rule of Law		0.034 (0.026)				
Participation and Human Rights			-0.021 (0.032)			
Sustainable Economic Opportunity				0.025 (0.038)		
Human Development					0.044 (0.039)	
Environmental Governance						-1.192*** (0.426)
log(GDP) (constant 2010 US)	-0.281 (0.927)	-0.264 (0.884)	0.325 (0.574)	0.008 (0.796)	-0.165 (0.775)	0.057 (0.772)
log(Population Density)	2.455 (5.222)	2.562 (5.325)	2.211 (5.361)	2.496 (5.267)	1.911 (4.780)	4.479 (4.357)
Overall*Environmental Governance						0.028*** (0.009)
Observations	325	325	325	325	325	255
R ²	0.015	0.022	0.008	0.009	0.016	0.107
Adjusted R ²	-0.139	-0.132	-0.147	-0.147	-0.138	-0.055
F Statistic	1.465 (df = 3; 280)	2.074 (df = 3; 280)	0.793 (df = 3; 280)	0.856 (df = 3; 280)	1.566 (df = 3; 280)	5.173*** (df = 5; 215)

Supplementary Table 6. Summary of parameter estimates (clustered SE) from panel regression with a three-year time-lag of tree cover loss against governance and additional covariates, considering changes within countries over time. Models include country and time fixed effects. Models (1) - (6) include the different governance indices. *p<0.1; **p<0.05; ***p<0.01

	<i>Dependent variable:</i>					
	Annual tree cover loss rate in PAs (% , log transformed)					
	(1)	(2)	(3)	(4)	(5)	(6)
Overall Governance	0.018 (0.035)					-0.188*** (0.057)
Safety and Rule of Law		0.018 (0.023)				
Participation and Human Rights			-0.030 (0.030)			
Sustainable Economic Opportunity				-0.005 (0.030)		
Human Development					0.032 (0.031)	
Environmental Governance						-1.991*** (0.547)
log(GDP) (constant 2010 US)	-0.339 (0.802)	-0.447 (0.819)	0.010 (0.560)	-0.114 (0.654)	-0.443 (0.727)	0.412 (0.511)
log(Population Density)	3.656 (7.349)	3.706 (7.363)	3.604 (7.349)	3.616 (7.272)	3.289 (6.967)	4.325 (3.440)
Overall*Environmental Governance						0.047*** (0.012)
Observations	293	293	293	293	293	230
R ²	0.012	0.016	0.017	0.011	0.018	0.276
Adjusted R ²	-0.159	-0.154	-0.153	-0.160	-0.152	0.131
F Statistic	1.006 (df = 3; 249)	1.334 (df = 3; 249)	1.421 (df = 3; 249)	0.927 (df = 3; 249)	1.485 (df = 3; 249)	14.529*** (df = 5; 191)

Supplementary Table 7. Summary of parameter estimates (clustered SE) from panel regression with a four-year time-lag of tree cover loss against governance and additional covariates, considering changes within countries over time. Models include country and time fixed effects. Models (1) - (6) include the different governance indices. *p<0.1; **p<0.05; ***p<0.01

	<i>Dependent variable:</i>					
	Annual tree cover loss rate in PAs (% , log transformed)					
	(1)	(2)	(3)	(4)	(5)	(6)
Overall Governance	-0.003 (0.026)					-0.171*** (0.066)
Safety and Rule of Law		0.006 (0.016)				
Participation and Human Rights			-0.019 (0.025)			

Sustainable Economic Opportunity				-0.015 (0.022)		
Human Development					0.017 (0.023)	
Environmental Governance						-1.583** (0.638)
log(GDP) (constant 2010 US)	-0.304 (0.629)	-0.430 (0.605)	-0.228 (0.570)	-0.162 (0.588)	-0.464 (0.649)	0.026 (0.606)
log(Population Density)	5.376 (7.537)	5.359 (7.533)	5.378 (7.508)	5.229 (7.424)	5.125 (7.286)	5.453 (3.757)
Overall*Environmental Governance						0.040*** (0.014)
Observations	261	261	261	261	261	205
R ²	0.025	0.026	0.028	0.027	0.028	0.252
Adjusted R ²	-0.162	-0.162	-0.159	-0.160	-0.160	0.087
F Statistic	1.891 (df = 3; 218)	1.930 (df = 3; 218)	2.093 (df = 3; 218)	2.019 (df = 3; 218)	2.073 (df = 3; 218)	11.280*** (df = 5; 167)

4 R Script

```

#libraries
library(tidyverse)
library(ggplot2)
library(gridExtra)
library(plm)
library(stargazer)
library("Hmisc")

#### DATA PREPARATION
#####
# load data
df<- read_csv("data.csv")

# year and country as factor
df$year <- as_factor(df$year)
df$Country <- as_factor(df$Country)

#calculate proportion of protected areas that was tree covered in 2008
forest_prop_2008 <- df %>%
  subset(year == 2008) %>%
  mutate(forest_prop_PA_2008 = 100*cover/PA_AREA)
#South Sudan is only included from 2011 onwards - calculate separately then merge
forest_prop_ss <- df %>%
  subset(Country == 'South Sudan') %>%

```

```

subset(year == 2011) %>%
mutate(forest_prop_PA_2008 = 100*cover/PA_AREA)
forest_prop_2008 <- bind_rows(forest_prop_2008, forest_prop_ss)
forest_prop_2008 <- subset(forest_prop_2008, select=c("ISO3", "forest_prop_PA_2008"))
df <- merge(df, forest_prop_2008, by = "ISO3")

#means across years
sum <- df %>%
  group_by(ISO3) %>%
  summarise(
    OG = mean(OVERALL.GOVERNANCE, na.rm = TRUE),
    SR = mean(SAFETY...RULE.OF.LAW, na.rm = TRUE),
    PHR = mean(PARTICIPATION...HUMAN.RIGHTS, na.rm = TRUE),
    SEO = mean(SUSTAINABLE.ECONOMIC.OPPORTUNITY, na.rm = TRUE),
    HD = mean(HUMAN.DEVELOPMENT, na.rm = TRUE),
    ENV = mean(EnvPolBS, na.rm = TRUE),
    loss_km2 = mean(loss.in.km2, na.rm = TRUE),
    loss_rate = mean(frate, na.rm = TRUE),
    gdp = mean(gdp, na.rm = TRUE),
    gdp.growth = mean(gdp.growth, na.rm = TRUE),
    fdi = mean(fdi, na.rm = TRUE),
    pop.density = mean(pop.density, na.rm = TRUE),
    nr.rents = mean(nr.rents, na.rm = TRUE),
    agr.land = mean(agr.land, na.rm = TRUE),
    forest_prop_PA_2008 = mean(forest_prop_PA_2008, na.rm = TRUE),
    country.area.sqkm = mean(country.area.sqkm, na.rm = TRUE)
  )
#add country name
country <- unique(subset(df, select=c("ISO3", "Country")))
sum <- merge(sum, country)

# tree cover loss distributions are highly skewed and have outliers
hist(df$frate)
boxplot(df$frate)
hist(sum$loss_rate, main = "", xlab = "Mean annual tree cover loss rate 2008-2017", ylab = "Number
of countries")
boxplot(sum$loss_rate)

# log transform frate
df$log_loss_rate <- log(-(df$frate)+0.001) # cannot log 0 and negative values, direction of
interpretation changes
hist(df$log_loss_rate)
boxplot(df$log_loss_rate)

sum$log_loss_rate <- log(-(sum$loss_rate)+0.001)
hist(sum$log_loss_rate)
boxplot(sum$log_loss_rate)
#####

```

```

#### Figure 2. Plotting average governance scores with average forest change rate
#####
####First plot Overall Governance
#transform into long data format
longOG <- sum[,c(1, 2, 9, 18)]
longOG <- longOG %>% gather(IIAG, score, -c(ISO3, loss_rate, Country))

#select countries to be labelled (because mentioned in text)
longOG$label <- ""
longOG$label <- ifelse(longOG$Country == "South Sudan", "South Sudan",
  ifelse(longOG$Country == "Mauritius", "Mauritius",
    ifelse(longOG$Country == "Malawi", "Malawi",
      ifelse(longOG$Country == "Sierra Leone", "Sierra Leone",
        ifelse(longOG$Country == "Benin", "Benin",
          ifelse(longOG$Country == "South Africa", "South Africa",
            ifelse(longOG$Country == "Seychelles",
              "Seychelles",
                ifelse(longOG$Country == "Equatorial
Guinea", "Equatorial Guinea",
                  ifelse(longOG$Country == "Central
African Republic", "Central African Republic",
                    ifelse(longOG$Country == "Sao
Tome & Principe", "Sao Tome & Principe",
                      ""))))))))))

#assign title
title <- c(`OG` = "(A) Overall Governance")
#plot
p1 <- ggplot(longOG, aes(x=score, y=loss_rate, label = label)) +
  facet_wrap(vars(IIAG), labeller = as_labeller(title)) +
  geom_point(shape = 20, size=3, colour = "lightseagreen") +
  geom_text_repel(label.size = NA, size=3, box.padding = unit(0.5, "lines"))+
  geom_point(data = longOG[longOG$label != "",], size = 3.5, colour = "lightseagreen")+
  theme(legend.position = "none",
    axis.text=element_text(size=9),
    axis.title=element_text(size=9),
    panel.background = element_rect("white"),
    panel.grid.major = element_line("lightgrey"),
    axis.ticks = element_line("lightgrey"),
    panel.grid.minor = element_blank()) +
  xlab("IIAG Score (1-100)") +
  ylab("Tree cover change in PAs (%)") +
  xlim(0,100) +
  ylim(-2.5,0.2)

####plot for SR, PHR, SEO and HD

```

```

#transform into long data
long <- sum[,c(1, 3:6, 9)]
long <- long %>% gather(IAG, score, -c(ISO3, loss_rate))
#reorder levels
long$IAG <- factor(long$IAG, levels = c("SR", "PHR", "SEO", "HD"))
#assign titles
titles <- c(
  `SR` = "(B) Safety and Rule of Law",
  `PHR` = "(C) Participation and Human Rights",
  `SEO` = "(D) Sustainable Economic Opportunity",
  `HD` = "(E) Human Development"
)

#plot
p2 <- ggplot(long, aes(score, loss_rate)) + geom_point(colour = "lightseagreen") +
  facet_wrap(vars(IAG), labeller = as_labeller(titles)) +
  theme(legend.position = "none",
    axis.text=element_text(size=9),
    axis.title=element_text(size=9),
    panel.background = element_rect("white"),
    panel.grid.major = element_line("lightgrey"),
    axis.ticks = element_line("lightgrey"),
    panel.grid.minor = element_blank()) +
  xlab("IAG Score (1-100)") +
  ylab("Tree cover change in PAs (%)")+
  xlim(0,100)

#join both plots
p <- grid.arrange(p1, p2, ncol = 1)

#save plot in pdf format
ggsave("Figure2.pdf", plot <- p, units = c("mm"), width = 180, height = 200, dpi = 300)
#####

### MODELS
#####
#Table 1. Linear models with mean values for across country analysis
sOG <- lm(log_loss_rate ~ OG + log(gdp) + log(pop.density) + forest_prop_PA_2008,
  data = sum,
  na.action = na.omit)
sSR <- lm(log_loss_rate ~ SR + log(gdp) + log(pop.density) + forest_prop_PA_2008,
  data = sum,
  na.action = na.omit)
sPHR <- lm(log_loss_rate ~ PHR + log(gdp) + log(pop.density) + forest_prop_PA_2008,
  data = sum,
  na.action = na.omit)
sSEO <- lm(log_loss_rate ~ SEO + log(gdp) + log(pop.density) + forest_prop_PA_2008,
  data = sum,

```

```

      na.action = na.omit)
sHD <- lm(log_loss_rate ~ HD + log(gdp) + log(pop.density) + forest_prop_PA_2008,
      data = sum,
      na.action = na.omit)
sENV <- lm(log_loss_rate ~ OG + ENV + OG*ENV + log(gdp) + log(pop.density) +
forest_prop_PA_2008,
      data = sum,
      na.action = na.omit)

#generate output table in html format
stargazer(sOG, sSR, sPHR, sSEO, sHD,sENV,
  digits = 3,
  header = FALSE,
  type = "html",
  title = "Table 1. Linear models with mean values for across country analysis",
  dep.var.labels = c("Mean annual forest loss rate in PAs (% , log transformed)"),
  covariate.labels = c("Overall Governance", "Safety and Rule of Law", "Participation and
Human Rights", "Sustainable Economic Opportunity", "Human Development", "Environmental
Governance", "log(GDP) (constant 2010 US$)", "log(Population Density)", "Forest Proportion in
PAs in 2008", "Overall*Environmental Governance"),
  model.numbers = FALSE,
  column.labels = c("(1)", "(2)", "(3)", "(4)", "(5)", "(6)"))

#Table 2. Panel linear models for within country analysis
OG <- plm(log_loss_rate ~ OVERALL.GOVERNANCE + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
SR <- plm(log_loss_rate ~ SAFETY...RULE.OF.LAW + + log(gdp) + log(pop.density) ,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
PHR <- plm(log_loss_rate ~ PARTICIPATION...HUMAN.RIGHTS + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
SEO <- plm(log_loss_rate ~ SUSTAINABLE.ECONOMIC.OPPORTUNITY + log(gdp) +
log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",

```

```

    effect = "twoways",
    na.action = na.omit)
HD <- plm(log_loss_rate ~ HUMAN.DEVELOPMENT + log(gdp) + log(pop.density),
    data = df,
    index = c("Country", "year"),
    model = "within",
    effect = "twoways",
    na.action = na.omit)
ENV <- plm(log_loss_rate ~ OVERALL.GOVERNANCE + EnvPolBS +
(OVERALL.GOVERNANCE*EnvPolBS) + log(gdp) + log(pop.density),
    data = df,
    index = c("Country", "year"),
    model = "within",
    effect = "twoways",
    na.action = na.omit)

# gather clustered standard errors in a list
se <- list(sqrt(diag(vcovHC(OG, type = "HC1"))),
    sqrt(diag(vcovHC(SR, type = "HC1"))),
    sqrt(diag(vcovHC(PHR, type = "HC1"))),
    sqrt(diag(vcovHC(SEO, type = "HC1"))),
    sqrt(diag(vcovHC(HD, type = "HC1"))),
    sqrt(diag(vcovHC(ENV, type = "HC1"))))

# generate output table (in html format)
stargazer(OG, SR, PHR, SEO, HD, ENV,
    se = se,
    digits = 3,
    header = FALSE,
    type = "html",
    title = "Table 2. Panel linear models for within country analysis",
    dep.var.labels = c("Annual forest loss rate in PAs (% , log transformed)"),
    covariate.labels = c("Overall Governance", "Safety and Rule of Law", "Participation and
Human Rights", "Sustainable Economic Opportunity", "Human Development", "Environmental
Governance", "log(GDP) (constant 2010 US$)", "log(Population Density)", "Overall*Environmental
Governance"),
    model.numbers = FALSE,
    column.labels = c("(1)", "(2)", "(3)", "(4)", "(5)", "(6)"))
#####

### Supplementary Material
#####

### descriptive statistics
summary(df$OVERALL.GOVERNANCE)
summary(df$SAFETY...RULE.OF.LAW)
summary(df$PARTICIPATION...HUMAN.RIGHTS)

```

```

summary(df$SUSTAINABLE.ECONOMIC.OPPORTUNITY)
summary(df$HUMAN.DEVELOPMENT)
summary(df$EnvPolBS)
summary(df$frate)
summary(df$PA_AREA)
summary(df$forest_prop_PA_2008)
summary(df$gdp)
summary(df$pop.density)

#histogram of mean tree cover change rate
pdf("sm_fig1.pdf")
hist(sum$loss_rate, main = "", xlab = "Mean annual tree cover change rate in PAs 2008-2017", ylab
= "Number of countries", cex.lab=1.5, cex.axis=1.5)
dev.off()

#### correlation matrices

#correlations for summary dataset
cor <- sum[, c("OG", "SR", "PHR", "SEO", "HD", "ENV", "gdp", "pop.density",
"forest_prop_PA_2008")]
cor$log.gdp <- log(cor$gdp)
cor$log.pop.den <- log(cor$pop.density)
cor <- cor[,-c(7:8)]

res2 <- rcorr(as.matrix(cor))
res2

#correlations for panel dataset
summary(plm(OVERALL.GOVERNANCE ~ SAFETY...RULE.OF.LAW,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(OVERALL.GOVERNANCE ~ PARTICIPATION...HUMAN.RIGHTS,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(OVERALL.GOVERNANCE ~ SUSTAINABLE.ECONOMIC.OPPORTUNITY,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(OVERALL.GOVERNANCE ~ HUMAN.DEVELOPMENT,

```

```

data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))
summary(plm(OVERALL.GOVERNANCE ~ EnvPolBS,
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))
summary(plm(OVERALL.GOVERNANCE ~ log(gdp),
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))
summary(plm(OVERALL.GOVERNANCE ~ log(pop.density),
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))

summary(plm(SAFETY...RULE.OF.LAW ~ PARTICIPATION...HUMAN.RIGHTS,
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))
summary(plm(SAFETY...RULE.OF.LAW ~ SUSTAINABLE.ECONOMIC.OPPORTUNITY,
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))
summary(plm(SAFETY...RULE.OF.LAW ~ HUMAN.DEVELOPMENT,
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))
summary(plm(SAFETY...RULE.OF.LAW ~ EnvPolBS,
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit))

```

```

summary(plm(SAFETY...RULE.OF.LAW ~ log(gdp),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(SAFETY...RULE.OF.LAW ~ log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))

summary(plm(PARTICIPATION...HUMAN.RIGHTS ~
SUSTAINABLE.ECONOMIC.OPPORTUNITY,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(PARTICIPATION...HUMAN.RIGHTS ~ HUMAN.DEVELOPMENT,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(PARTICIPATION...HUMAN.RIGHTS ~ EnvPolBS,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(PARTICIPATION...HUMAN.RIGHTS ~ log(gdp),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(PARTICIPATION...HUMAN.RIGHTS ~ log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))

summary(plm(SUSTAINABLE.ECONOMIC.OPPORTUNITY ~ HUMAN.DEVELOPMENT,
  data = df,

```

```

      index = c("Country", "year"),
      model = "within",
      effect = "twoways",
      na.action = na.omit))
summary(plm(SUSTAINABLE.ECONOMIC.OPPORTUNITY ~ EnvPolBS,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(SUSTAINABLE.ECONOMIC.OPPORTUNITY ~ log(gdp),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(SUSTAINABLE.ECONOMIC.OPPORTUNITY ~ log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))

summary(plm(HUMAN.DEVELOPMENT ~ EnvPolBS,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(HUMAN.DEVELOPMENT ~ log(gdp),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))
summary(plm(HUMAN.DEVELOPMENT ~ log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))

summary(plm(EnvPolBS ~ log(gdp),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))

```

```

summary(plm(EnvPolBS ~ log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))

summary(plm(log(gdp) ~ log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit))

### lag effects (flag1 is the frate value in each following year, flag2 after two years etc.)
df$log_flag1 <- log(-(df$flag1)+0.001)
df$log_flag2 <- log(-(df$flag2)+0.001)
df$log_flag3 <- log(-(df$flag3)+0.001)
df$log_flag4 <- log(-(df$flag4)+0.001)

#flag1
OG <- plm(log_flag1 ~ OVERALL.GOVERNANCE + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
SR <- plm(log_flag1 ~ SAFETY...RULE.OF.LAW + + log(gdp) + log(pop.density) ,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
PHR <- plm(log_flag1 ~ PARTICIPATION...HUMAN.RIGHTS + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
SEO <- plm(log_flag1 ~ SUSTAINABLE.ECONOMIC.OPPORTUNITY + log(gdp) +
log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
HD <- plm(log_flag1 ~ HUMAN.DEVELOPMENT + log(gdp) + log(pop.density),

```

```

data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit)
ENV <- plm(log_flag1 ~ OVERALL.GOVERNANCE + EnvPolBS +
(OVERALL.GOVERNANCE*EnvPolBS) + log(gdp) + log(pop.density),
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit)

# gather clustered standard errors in a list
se <- list(sqrt(diag(vcovHC(OG, type = "HC1"))),
sqrt(diag(vcovHC(SR, type = "HC1"))),
sqrt(diag(vcovHC(PHR, type = "HC1"))),
sqrt(diag(vcovHC(SEO, type = "HC1"))),
sqrt(diag(vcovHC(HD, type = "HC1"))),
sqrt(diag(vcovHC(ENV, type = "HC1"))))

# generate output table (in html format)
stargazer(OG, SR, PHR, SEO, HD, ENV,
se = se,
digits = 3,
header = FALSE,
type = "html",
title = "Supplementary Material Table 4. Panel linear models for within country analysis with
one-year time-lag",
dep.var.labels = c("Annual forest loss rate in PAs (% , log transformed)"),
covariate.labels = c("Overall Governance", "Safety and Rule of Law", "Participation and
Human Rights", "Sustainable Economic Opportunity", "Human Development", "Environmental
Governance", "log(GDP) (constant 2010 US$)", "log(Population Density)", "Overall*Environmental
Governance"),
model.numbers = FALSE,
column.labels = c("(1)", "(2)", "(3)", "(4)", "(5)", "(6)"))

#flag2
OG <- plm(log_flag2 ~ OVERALL.GOVERNANCE + log(gdp) + log(pop.density),
data = df,
index = c("Country", "year"),
model = "within",
effect = "twoways",
na.action = na.omit)
SR <- plm(log_flag2 ~ SAFETY...RULE.OF.LAW + + log(gdp) + log(pop.density) ,
data = df,
index = c("Country", "year"),
model = "within",

```

```

    effect = "twoways",
    na.action = na.omit)
PHR <- plm(log_flag2 ~ PARTICIPATION...HUMAN.RIGHTS + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
SEO <- plm(log_flag2 ~ SUSTAINABLE.ECONOMIC.OPPORTUNITY + log(gdp) +
log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
HD <- plm(log_flag2 ~ HUMAN.DEVELOPMENT + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
ENV <- plm(log_flag2 ~ OVERALL.GOVERNANCE + EnvPolBS +
(OVERALL.GOVERNANCE*EnvPolBS) + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

# gather clustered standard errors in a list
se <- list(sqrt(diag(vcovHC(OG, type = "HC1"))),
  sqrt(diag(vcovHC(SR, type = "HC1"))),
  sqrt(diag(vcovHC(PHR, type = "HC1"))),
  sqrt(diag(vcovHC(SEO, type = "HC1"))),
  sqrt(diag(vcovHC(HD, type = "HC1"))),
  sqrt(diag(vcovHC(ENV, type = "HC1"))))

# generate output table (in html format)
stargazer(OG, SR, PHR, SEO, HD, ENV,
  se = se,
  digits = 3,
  header = FALSE,
  type = "html",
  title = "Supplementary Material Table 5. Panel linear models for within country analysis with
two-year time-lag",
  dep.var.labels = c("Annual forest loss rate in PAs (% , log transformed)"),

```

```

covariate.labels = c("Overall Governance", "Safety and Rule of Law", "Participation and
Human Rights", "Sustainable Economic Opportunity", "Human Development", "Environmental
Governance", "log(GDP) (constant 2010 US$)", "log(Population Density)", "Overall*Environmental
Governance"),
model.numbers = FALSE,
column.labels = c("(1)", "(2)", "(3)", "(4)", "(5)", "(6)")

```

```

#flag3

```

```

OG <- plm(log_flag3 ~ OVERALL.GOVERNANCE + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

```

```

SR <- plm(log_flag3 ~ SAFETY...RULE.OF.LAW + + log(gdp) + log(pop.density) ,
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

```

```

PHR <- plm(log_flag3 ~ PARTICIPATION...HUMAN.RIGHTS + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

```

```

SEO <- plm(log_flag3 ~ SUSTAINABLE.ECONOMIC.OPPORTUNITY + log(gdp) +
log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

```

```

HD <- plm(log_flag3 ~ HUMAN.DEVELOPMENT + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

```

```

ENV <- plm(log_flag3 ~ OVERALL.GOVERNANCE + EnvPolBS +
(OVERALL.GOVERNANCE*EnvPolBS) + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

```

```

# gather clustered standard errors in a list

```

```

se <- list(sqrt(diag(vcovHC(OG, type = "HC1"))),
           sqrt(diag(vcovHC(SR, type = "HC1"))),
           sqrt(diag(vcovHC(PHR, type = "HC1"))),
           sqrt(diag(vcovHC(SEO, type = "HC1"))),
           sqrt(diag(vcovHC(HD, type = "HC1"))),
           sqrt(diag(vcovHC(ENV, type = "HC1"))))

# generate output table (in html format)
stargazer(OG, SR, PHR, SEO, HD, ENV,
          se = se,
          digits = 3,
          header = FALSE,
          type = "html",
          title = "Supplementary Material Table 6. Panel linear models for within country analysis with
three-year time-lag",
          dep.var.labels = c("Annual forest loss rate in PAs (% , log transformed)"),
          covariate.labels = c("Overall Governance", "Safety and Rule of Law", "Participation and
Human Rights", "Sustainable Economic Opportunity", "Human Development", "Environmental
Governance", "log(GDP) (constant 2010 US$)", "log(Population Density)", "Overall*Environmental
Governance"),
          model.numbers = FALSE,
          column.labels = c("(1)", "(2)", "(3)", "(4)", "(5)", "(6)"))

#flag4
OG <- plm(log_flag4 ~ OVERALL.GOVERNANCE + log(gdp) + log(pop.density),
          data = df,
          index = c("Country", "year"),
          model = "within",
          effect = "twoways",
          na.action = na.omit)
SR <- plm(log_flag4 ~ SAFETY...RULE.OF.LAW + + log(gdp) + log(pop.density) ,
          data = df,
          index = c("Country", "year"),
          model = "within",
          effect = "twoways",
          na.action = na.omit)
PHR <- plm(log_flag4 ~ PARTICIPATION...HUMAN.RIGHTS + log(gdp) + log(pop.density),
          data = df,
          index = c("Country", "year"),
          model = "within",
          effect = "twoways",
          na.action = na.omit)
SEO <- plm(log_flag4 ~ SUSTAINABLE.ECONOMIC.OPPORTUNITY + log(gdp) +
log(pop.density),
          data = df,
          index = c("Country", "year"),
          model = "within",

```

```

      effect = "twoways",
      na.action = na.omit)
HD <- plm(log_flag4 ~ HUMAN.DEVELOPMENT + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)
ENV <- plm(log_flag4 ~ OVERALL.GOVERNANCE + EnvPolBS +
(OVERALL.GOVERNANCE*EnvPolBS) + log(gdp) + log(pop.density),
  data = df,
  index = c("Country", "year"),
  model = "within",
  effect = "twoways",
  na.action = na.omit)

# gather clustered standard errors in a list
se <- list(sqrt(diag(vcovHC(OG, type = "HC1"))),
  sqrt(diag(vcovHC(SR, type = "HC1"))),
  sqrt(diag(vcovHC(PHR, type = "HC1"))),
  sqrt(diag(vcovHC(SEO, type = "HC1"))),
  sqrt(diag(vcovHC(HD, type = "HC1"))),
  sqrt(diag(vcovHC(ENV, type = "HC1"))))

# generate output table (in html format)
stargazer(OG, SR, PHR, SEO, HD, ENV,
  se = se,
  digits = 3,
  header = FALSE,
  type = "html",
  title = "Supplementary Material Table 7. Panel linear models for within country analysis with
four-year time-lag",
  dep.var.labels = c("Annual forest loss rate in PAs (% , log transformed)"),
  covariate.labels = c("Overall Governance", "Safety and Rule of Law", "Participation and
Human Rights", "Sustainable Economic Opportunity", "Human Development", "Environmental
Governance", "log(GDP) (constant 2010 US$)", "log(Population Density)", "Overall*Environmental
Governance"),
  model.numbers = FALSE,
  column.labels = c("(1)", "(2)", "(3)", "(4)", "(5)", "(6)"))
#####

```