Does Power Inequality have an effect on Environmental Kuznets Hypothesis?

Group 11

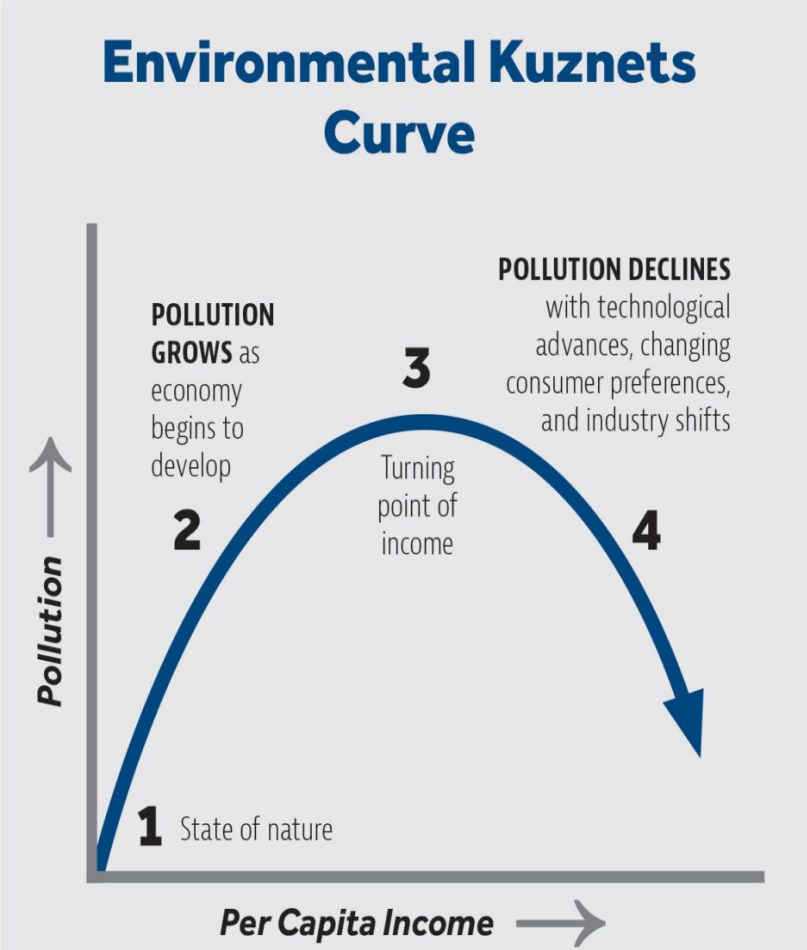
Devender(2018334)
Nischal Garg(2018350)
Mukesh Yadav(2018346)
Jatin Kumar Jadoun(2018338)

Environmental Kuznets Curve

Kuznets hypothesis was first proposed by Simon Kuznets in 1950s and 60s.

It suggests environment deterioration with initial economic development.

But beyond a certain threshold, the relationship improves and environment quality improves with rise in economic development.



Mathematical Interpretation of the Hypothesis

If E represents the degree of environmental degradation for some particular indicator of environment quality and y represents income per capita, then we would have the following relationship :-

$$E_{i,t} = \beta_0 + \beta_1 y_{i,t} + \beta_2 y^2{}_{i,t} + u_{i,t}$$

And in order to have the relationship in accordance with Kuznets hypothesis, we must have the following conditions

$$\beta_1 > 0 \ AND \ \beta_2 < 0$$

Project Motivation

Criticisms of the Kuznets hypothesis suggest that pollution is not simply a function of per capita income.

Kuznets hypothesis does not consider the effect of economic and power inequality in a social system.

It fails to give due weightage to the role of policy regulation, government interference and disproportional power structure in a society.

All these factors are likely to play a key role in the causation of the so proposed, turning point in the Kuznets Curve.

Methodology

We run regression for our indicator of environmental degradation and comment on the strength of the relationship by analysing the statistical significance.

We incorporate various factors indicating power and political inequality and compare our results to when the regression is run with only income as a factor.

Variables

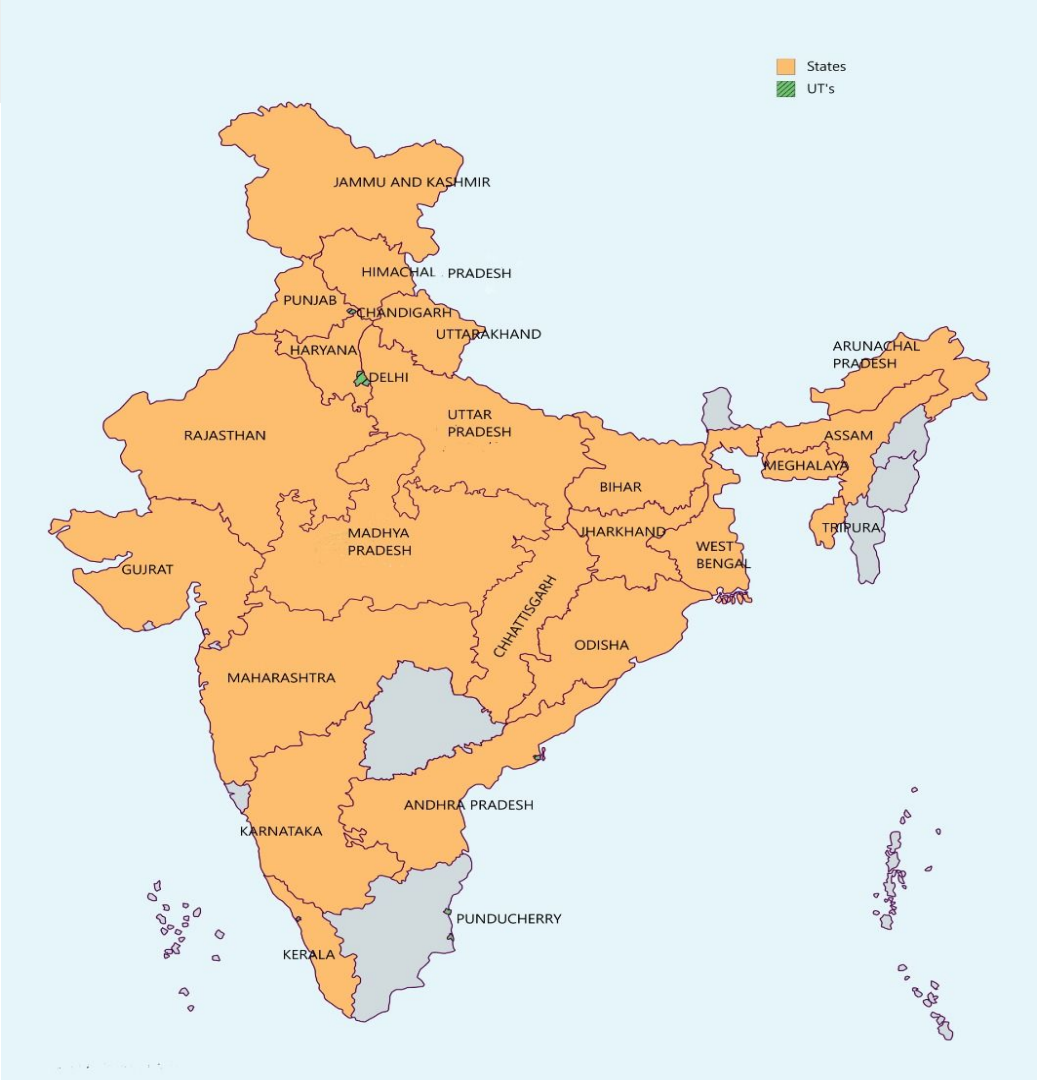
We have taken data for 25 States & UT from the year 2009-2017. All the data is state-wise unless stated otherwise. Total No. of Observations (N = 225)

VARIABLE	DESCRIPTION	ACRONYM
Depth to Groundwater (dependent variable) (N = 224)	Measured as the distance from ground to water level in meters for the month of November.	depthGW
Income Level (N = 224)	Measured as net State Domestic Product per capita. Higher powers to allow for inverted shape	sdp, sdp2, sdp3

VARIABLE	DESCRIPTION	ACRONYM
Income Inequality (GINI Index) (N = 225)	Measures Income Distribution among population	gini
Women Percent (Power Inequality) (N = 216)	Percentage of women MLAs in the respective state assembly	women
Voter Turnout (Power Inequality) (N = 225)	Percentage of eligible voters that cast their vote in the respective state assembly elections	turnout

VARIABLE	DESCRIPTION	ACRONYM
Effective Parties (Power Inequality) (N = 216)	Calculated by using the Golosov formula(2010) $N = \sum_{i=1}^{n} \frac{p_i}{p_i - p_i^2 + p_1^2}$ p_i – proportion of each party's votes p_1 – proportion of largest party's votes	effParty
Rainfall (N = 224)	Average Precipitation in India State wise. Measured annually in mm.	rain

The highlighted States & UTs have been considered for this project.



DATA SUMMARY

VARIABLE	MIN	MAX	MEAN	MEDIAN	SD
sdp	15457	328985	95298	80027	55765.36
sdp2	2.49x10^8	1.08x10^11	1.22x10^10	6.4x10^9	15397101857
sdp3	3.7x10^12	3.56x10^16	1.97x10^15	5.12x10^14	4.18x10^15
gini	0.204	0.391	0.313	0.311	0.045
rain	305.5	6063.3	1657.1	1291.9	1158.66
women	0.00	14.44	7.705	7.483	3.87
turnout	45.85	91.82	71.19	72.07	9.68
effParty	1.998	8.90	3.83	3.427	1.44

MODEL AND EQUATION

We first run regression with only the income and geographical control variable.

$$depthGW_{i,t} = \beta_0 + \beta_1 sdp_{i,t} + \beta_2 sdp_{i,t}^2 + \beta_3 sdp_{i,t}^3 + \beta_4 rain_{i,t} + \mu_{i,t}$$

And then we incorporate the power and income inequality factors in our model resulting in the following equation.

$$depthGW_{i,t} = \beta_0 + \beta_1 sdp_{i,t} + \beta_2 sdp_{i,t}^2 + \beta_3 sdp_{i,t}^3 + \beta_4 rain_{i,t} + \beta_5 gini_{i,t} + \beta_6 women_{i,t} + \beta_7 turnout_{i,t} + \beta_8 effParty_{i,t} + \mu_{i,t}$$

MULTICOLLINEARITY

In order to ensure that our selected factors did not exhibit a dependent relationship, we made use of the VIF coefficient. It measures how inflated the variance of each coefficient is due to multicollinearity.

VIF values of under 2.5 are acceptable but any higher than that suggest moderate to high correlation.

Regressor	SDP	Rain	GINI	Women	Turnout	Eff Parties
VIF Value	1.764	1.445	1.783	1.225	1.571	1.505

RELEVANT HYPOTHESIS

Null Hypothesis : **Ho** : There is no relationship between depth to groundwater and our inequality variables gini, women percent, voter turnout and effective parties. We will test for each variable separately.

Ho : $\beta i = 0$

Ha : $\beta i \neq 0$

where βi is the coefficients of the each inequality variable

RELEVANT HYPOTHESIS

We also expect coefficients with sdp and sdp2 to show greater statistical significance when model is run with power inequality as compared to when run only with income and geographical control factor.

RESULTS WITHOUT THE INEQUALITY VARIABLES

R-SQUARED	0.1311
ADJUSTED R-SQUARED	0.1157

	Estimate	Std.Error
β0	7.73	4.88
β1(sdp)	2.80e-4 *	1.33e-4
β2(sdp2)	- 1.47e-9	1.00e-9
β3(spd3)	2.32e-15	2.13e-15
β4(rain)	- 2.37e-3**	7.43e-4

Signif. codes: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘. ’ 0.1 ‘ ’ 1

RESULT ANALYSIS

We find that the coefficient for SDP comes as positive while the coefficient for SDP2 comes negative which indicates that the model follows Kuznets Hypothesis.

However, when we consider the statistical significance of the estimates, we can say with a certain degree of confidence(5%) that the environment worsens with increase in SDP.

Stating that the curve would surely take an inverted U-shape can’t be said with the same level of confidence owing to the statistical insignificance of coefficient of SDP2.

RESULTS AFTER INCLUDING INCOME AND POWER INEQUALITY

R-SQUARED	0.4123
ADJUSTED R-SQUARED	0.3903

	Estimate	Std.Error
β0	9.17	1.15
β1(sdp)	3.60e-04 **	1.36e-04
β2	- 1.64e-09 .	9.83e-10
β3	2.40e-15	2.05e-15
β4(rain)	- 1.19e -03	7.39e-04
β5(gini)	3.90e+01 .	2.29e+01
β6(women)	1.57 ***	2.06e-01
β7(turnout)	- 3.88e-01 ***	9.76e-02
β8(effParty)	- 1.24 *	6.20e-01

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '. ' 0.1 ' ' 1

RESULT ANALYSIS

When we run the regression and account for power and income inequality, we find significant improvements in data. The relationship between environmental degradation and SDP shows an inverted U relationship and the coefficients of both SDP(1%) and SDP2 (10%) are found to be statistically significant.

CONCLUSION

Owing to the statistical significance of the second model, which incorporates inequality, we conclude that it is critical to include inequality factors in determining the relationship between environmental degradation and SDP.

The Kuznets hypothesis does not suggest inequality measures as a factor that influences environmental degradation. However our regression analysis strongly suggests otherwise.

CONCLUSIONS

- Vote Turnout and depth to groundwater has significant relationship, as turnout percentage increases the depth to groundwater decreases.
- Women percentage in the state assemblies also has significant relationship with depth to groundwater, but this result is an exception to our hypothesis as depth to groundwater increases with increase in women percentage.
- Depth to Groundwater decreases when effective number of parties increases.

REFERENCES

Mariano Torras, James K. Boyce. (1998). Income, inequality, and pollution: a reassessment of the environmental Kuznets Curve

Laakso, M., & Taagepera,R.(1979). Effective Number of Parties: A Measure with Application to West Europe. https://doi.org/10.1177/001041407901200101

Bartle,J., Birch,S., & Skirmuntt,M.(2017). The local roots of the participation gap: Inequality and voter turnout. https://doi.org/10.1016/j.electstud.2017.05.004

Robert K. Kaufmann a,*, Brynhildur Davidsdottir a , Sophie Garnham a , Peter Pauly. The determinants of atmospheric SO2 concentrations: reconsidering the environmental Kuznets curve

Dale S. Rothman. Environmental Kuznets curves—real progress or passing the buck? A case for consumption-based approaches