The ENSO Cycle and the Effect on State Abatement Policies

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Introduction

The El Niño Southern Oscillation (ENSO) cycle has major impacts on commodity pricing around the world and changes the weather in different ways across the US. El Niño typically causes milder winters in the northwest, above average precipitation in the south east, and lower annual rainfall in Ohio and the pacific northwest. La Niña results in cold, wet conditions in the pacific northwest, dry, warm conditions in the southern regions and more tornados for states already prone to having them. The ENSO cycle results in a number of costs and benefits to the United States both monetarily and in terms of human life lost or saved. These changes in weather can also affect the spread of pollution. While several authors have studied how this cycle impacts US production and loss of life (see Changnon 1999, Brunner 2002, Handler 1983, and Dabelle and Stevens 1995), none have looked at how states change pollution abatement efforts.

We construct an empirical model of green energy decisions and look at how the changing weather patterns caused by the ENSO cycle may affect them.

Objective

Identify the effect that changes in weather due to the ENSO cycle have on state level decisions about green energy use.

Data

We use panel data from all 50 states in the United States of America from 1990 to 2015. Our dependent variable is constructed from energy use collected from the U.S. Energy Information Administration. The weather variables are constructed using the Oceanic Niño Index (ONI) that is maintained by National Oceanic and Atmospheric Administration (NOAA). The voting results come from the American Presidency Project (APP) hosted by the University of California, Santa Barbara.

Empirical Model

$$Abatement_{ti} = \beta_0 + \beta_1 Politics_{ti} + \beta_2 Regional\ Weather_{ti} + \beta_3 Time_t + \beta_4 Region_i$$

$Abatement_{ti}$ is the amount of electricity produced using green energy sources in state *i* in year *t* as a fraction of total energy production. $Politics_{ti}$ is the percentage of voters that voted for the democratic candidate in the last presidential election for state *i* in year *t*. $Time_t$ is a counter for year *t*. $Region_i$ is a dummy variable for which region of the United States state *i* is located in, we will use the Pacific Northwest as our base case. $Regional\ Weather_{ti}$ is our measure of ENSO intensity for time *t* multiplied by the regional dummy for state *i.*

Results

The main result of this paper is our estimation of the impact that regional weather has in our model. Regression results show that the Midwest and Southeast regions reduce green energy production by about 1% in the year preceding a La Niña event and the Midwest also reduces green energy production by about 1% in the year following a La Niña event. We did not observe much response within the years of an ENSO cycle and El Niño events did not show any impact either. The most significant drivers of green energy use in all of the models was a general upward trend over time and that states with more democratic votes during presidential elections tend to produce more green energy.

We also are interested in the differences in energy production between regions. We find that, compared to the Pacific Northwest, the Southwest produces roughly 17% less energy using green sources, the Southeast produces 9% less, the Midwest produces 20% less, and the Northeast produces 18% more. These findings are consistent in both models.

Regression Results

	Preemptive Model	Lagged Model
Time Trend	.00705*** (.003315)	.00714*** (.0003322)
Democratic Vote Percentage	.20845*** (.0546456)	.200305*** (.0542959)
PNW El Niño	.01054 (.0067902)	.00852 (.0067905)
W El Niño	-.00661 (.0106618)	-.0043 (.0106046)
SW El Niño	-.00392 (.0061835)	-.00767 (.0061362)
MW El Niño	-.00250 (.0042181)	-.00137 (.0041706)
SE El Niño	-.00607 (.0050273)	-.01116 (.0049953)
AK El Niño	.00434 (.0154256)	-.00723 (.0153537)
HI El Niño	.00457 (.0154256)	.00005 (.0149694)
PNW La Niña	-.00154 (.0064681)	-.00842 (.0064253)
W La Niña	.00616 (.010654)	.00932 (.010485)
SW La Niña	-.00259 (.0058843)	-.00126 (.0058578)
MW La Niña	-.00994** (.0039996)	-.0101** (.0039908)
SE La Niña	-.01083** .0047474	-.00107 (.0047384)
AK La Niña	.00015 .0148545	-.01526 (.0148726)
HI La Niña	-.00474 .0143446	-.01467 (.0143215)

Regional Effects

	Preemptive Model	Lagged Model
West	.19233 (.14386)	.188682 (.1494546)
Southwest	-.17342* (.0912621)	-.17274* (.09456563)
Midwest	-.20276*** (.0546001)	-.20238*** (.0555082)
Northeast	.18238** (.0912391)	.1828* (.0946372)
Mid-Atlantic	-.08953 (.086217)	-.08931 (.0894036)
Southeast	-.090293*** (.0308019)	-.0957*** (.0310385)
Alaska	.09852 (.0770554)	.10672 (.0771491)
Hawaii	.00541 (.0783743)	.01392 (.078582)

Discussion

We only really see responses to La Niña events. For the Midwest there would be more tornadoes than typically observed. This may cause difficult conditions for the use of some green energy, or it may damage necessary equipment such as solar panels or wind turbines. This could explain the lower green energy use in the year following the event as they need to fix the equipment. The more puzzling response is the preemptive reduction we see from both the Midwest and Southeast. The Southeast experiences warmer weather during La Niña than during a normal year with lower precipitation.

Selected References

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