Factors affecting Americans' Reluctance to Support Renewable Energy Sources*

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April 16, 2024

Using data from CES2020, we investigated the support for the question: "Require that each state use a minimum amount of renewable fuels in the generation of electricity even if electricity prices increase a little?". We found that a person is more likely to answer with support if they are in a more urban living environment and if they have a higher education level. These findings give an insight into areas where we may need to focus resources on promoting the benefits of switching to sustainable and renewable sources of energy.

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*Code and data are available at: https://github.com/RenfrewA/us-pop-env-stance

1 Introduction

Society is becoming increasing aware of the effects that humans have on the environment. To prevent this on a large scale, it is up to the governments of countries. One of the leading causes of pollution is the burning of fossil fuels to generate electricity (UN). To prevent this, a shift towards renewable energy sources has been on the rise. Harnessing renewable energy sources such as wind, solar, and hydroelectric will be needed if we are to reduce the harmful air pollution from the retrieval and use of sources such as coal, oil, and natural gas. The challenge is that the infrastructure has been in place for a long time and thus, we need to build new infrastructure for renewable energy sources such as building dams, wind turbines, and solar panels. This will come at a financial cost which will have to ultimately come from the citizens in the form of increased taxes or increased electricity payments.

From the CES 2020 dataset, we will analyze whether household income, education level, and type of area a person is living in affects their stance on reducing pollution and climate change prevention.

The scenario that was proposed in the survey was: Require that each state use a minimum amount of renewable fuels (wind, solar, and hydroelectric) in the generation of electricity even if electricity prices increase a little. In this paper, we will call this scenario the "proposition". Our estimand is the value of support for this proposition, either support or oppose. By analyzing this data, we can identify trends with the previously stated factors. This can be used to better understand people's stance on this issue and help develop different ways to increase support.

The structure of the paper is as follows: Data, Model, Results, and Discussion.

2 Data

We chose to display the data by plotting it with a double bar graph using `ggplot` (Wickham 2016) where the left bar represents the amount of people who support the proposition and the right bar representing the amount of people who do not support the proposition.

We created three graphs, one for each of the explanatory variables.

2.1 Support for Proposition based on Household Income

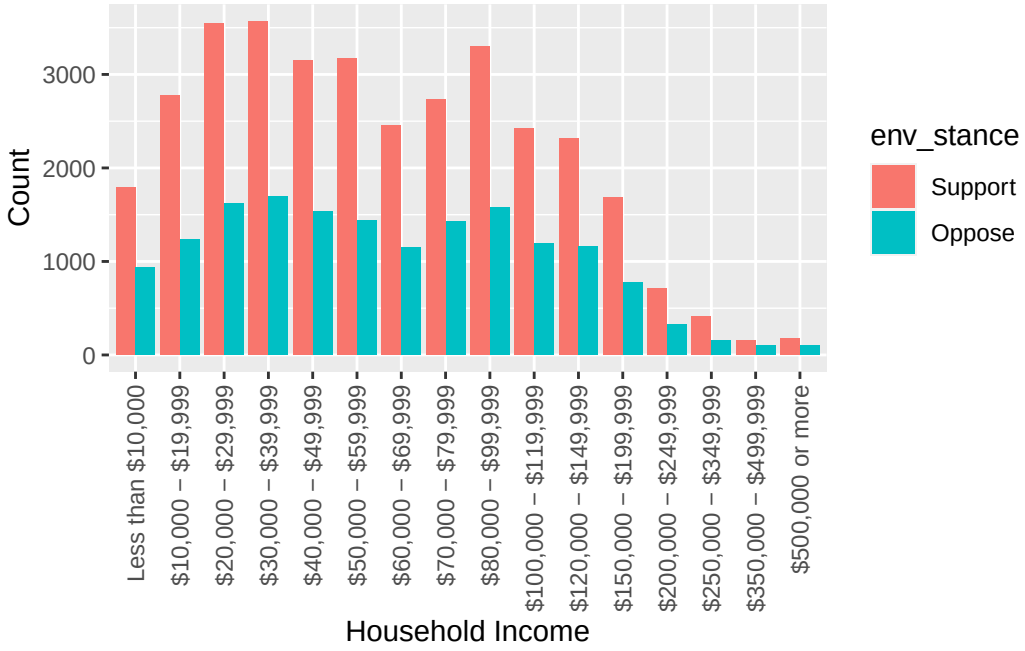

Figure 1: Support for Proposition based on Household Income

In Figure 1 we can see that there is not much variation between the income brackets in terms of their support for the proposition. The amount of people who support are about twice as much as those who oppose in the same income bracket and this appears to be the case for all income brackets.

2.2 Support for Proposition based on Education Level

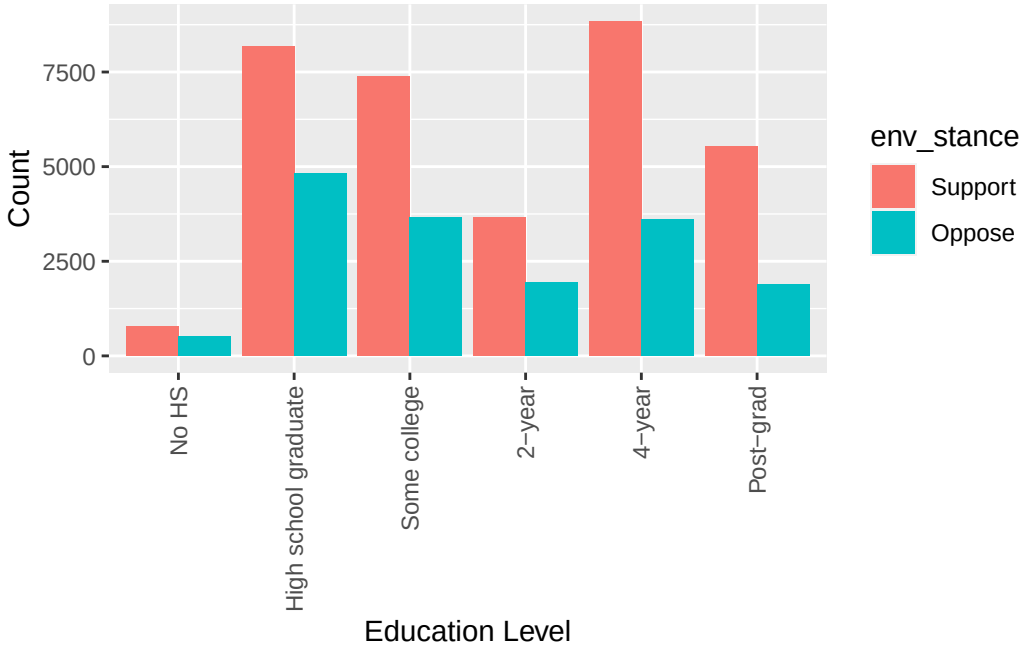

Figure 2: Support for Proposition based on Education Level

In Figure 2 we can see that as we move up in education level, the difference between the number of those who support and those who oppose the proposition grow larger. This indicates that education level may have an effect on whether an individual supports the idea that states should have a minimum amount of renewable energy sources even if it may cost more.

2.3 Support for Proposition based on Type of Area a Person Lives In

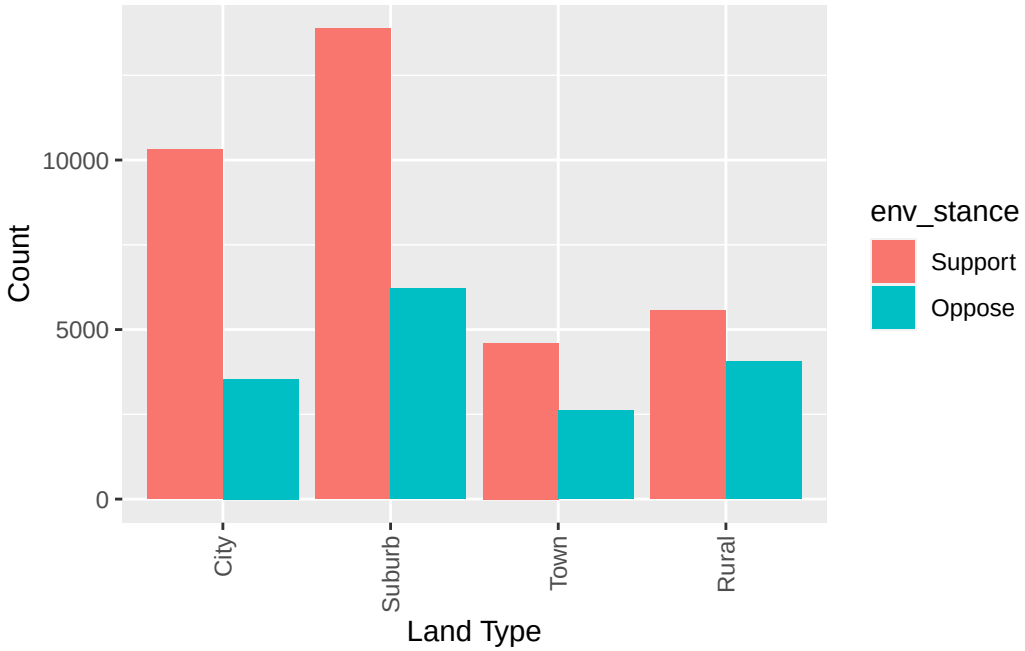

Figure 3: Support for Proposition based on Type of Area a Person Lives In

In Figure 3, we can see that as we move to more rural areas, the gap becomes larger between the number of those who support and oppose the proposition. People who live in the city tend to have more support vs people in rural areas. As we move from city to rural, it seems like the gap is getting smaller indicating less support or more opposition to the proposition.

2.4 Measurement

According to CCES Guide 2020, the data was obtained by 60 teams who each purchased a 1,000 person national sample survey, conducted by YouGov of Redwood City, CA. The two choices for the proposition in question was either `support` or `oppose`. Household income values are self reported, as this was a voluntary survey. There were 16 income brackets ranging from `less than $10,000` to `$500,000 or more` and one option for `Prefer not to say`. Education level was asked which had 6 options ranging from `No HS` to `Post-grad`. Land type had 5 options `city`, `suburb`, `town`, `rural area`, and `other`. Some of the options for these variables were excluded in the cleaned dataset as they were ambiguous.

3 Model

3.1 Model set-up

We want to model an American's stance on climate change, specifically their position on requiring that each state use a minimum amount of renewable fuels in the generation of electricity even if electricity prices increase a little. In our model, we consider a person's household income, education level, and type of area they are living in to predict their stance on this topic.

The model we are interested in is:

$$
\begin{aligned}
y_i|\pi_i &\sim \text{Bern}(\pi_i) && (1)\\
\text{logit}(\pi_i) &= \alpha + \beta \times \text{householdIncome}_i + \gamma \times \text{education}_i + \delta \times \text{livingArea}_i && (2)\\
\alpha &\sim \text{Normal}(0, 2.5) && (3)\\
\beta &\sim \text{Normal}(0, 2.5) && (4)\\
\gamma &\sim \text{Normal}(0, 2.5) && (5)\\
\delta &\sim \text{Normal}(0, 2.5) && (6)
\end{aligned}
$$

Where:

- y_i is the binary outcome variable for opposing the proposition
- π_i is the probability that respondent opposed the proposition
- $householdIncome_i$ is a predictor variable, representing the household income of the respondent i,
- $education_i$ is a predictor variable, representing the education level of the respondent
- $livingArea_i$ is a predictor variable, the residential area that the respondent i is living in (urban, rural, suburban, etc.)

Since we have a binary outcome variable and multiple predictor/explanatory variables, we chose to use a logistic regression model fitted using a Bayesian framework. We utilized the package `rstanarm` (Goodrich et al. 2022) in R (R Core Team 2023) to achieve this.

4 Results

Table 1: Explanatory models of renewable energy support based on household income, education level, and land type of residence (n = 3000)

	Oppose requiring renewable energy at a higher monetary cost
(Intercept)	−0.802
	(0.286)
household_income$10,000 - $19,999	−0.235
	(0.226)
household_income$20,000 - $29,999	−0.195
	(0.205)
household_income$30,000 - $39,999	−0.004
	(0.212)
household_income$40,000 - $49,999	−0.143
	(0.213)
household_income$50,000 - $59,999	−0.245
	(0.217)
household_income$60,000 - $69,999	0.022
	(0.227)
household_income$70,000 - $79,999	0.208
	(0.218)
household_income$80,000 - $99,999	0.135
	(0.215)
household_income$100,000 - $119,999	0.207
	(0.233)
household_income$120,000 - $149,999	0.134
	(0.234)
household_income$150,000 - $199,999	0.127
	(0.259)
household_income$200,000 - $249,999	0.317
	(0.325)
household_income$250,000 - $349,999	0.265
	(0.417)
household_income$350,000 - $499,999	0.424
	(0.514)
household_income$500,000 or more	0.465
	(0.579)
educationHigh school graduate	0.031
	(0.266)
educationSome college	−0.189
	(0.264)
education2-year	−0.140
	(0.281)
education4-year	−0.620
	(0.273)
educationPost-grad	−0.691
	(0.286)
living_areaSuburb	0.274
	(0.108)
living_areaTown	0.535
	(0.133)
living_areaRural	0.711
	(0.114)
Num.Obs.	3000
R2	0.040
Log.Lik.	−1832.708
ELPD	−1857.3
ELPD s.e.	21.2
LOOIC	3714.6
LOOIC s.e.	42.5
WAIC	3714.5
RMSE	0.46

We performed logistic regression analysis on 3000 observations of the total 50788 observations in the cleaned dataset. We are interested in whether or not a person's household income, education, or area where they are living in will impact their stance towards switching to renewable energy sources at an increased price. The coefficients represent opposing the proposition of requiring a minimum amount of renewable energy sources at a higher cost. This means that the smaller the coefficient, the more support there is for the proposition and the higher the number, the less support or the more opposition to the proposition.

We can see that in Table 1 that as we move up the income brackets, the coefficients for household income do not decrease. This indicates that a person is not more likely to support the proposition if their income is higher.

However, when we take a look at the education variable, we get that as a person has more education, they are more likely to support the proposition. This is in line with our prediction before creating the model. We can also see that as we move from city to rural areas, the support for the proposition decreases since the coefficients are larger the more rural the area is.

We can see in Table 2 that when the estimate is small, it indicates and individual supports the proposition. When the estimate is larger, it indicates a higher chance that the individual opposes the proposition. We can see that for the value 0.4192808, which is high, we get that the person's actually did oppose the proposition. Comparatively, for row 1 with estimate 0.2653025, the individual supported the proposition which follows from the estimate value. This means our model is accurate in predicting what a person will choose based on the three explanatory variables.

Table 2: Probability that an individual opposes that each state requires a minimum amount of renewable fuels for energy generation even if it increases costs

rowid	estimate	conf.low	conf.high	env_stance	household_income	education	living_area
1	0.2653025	0.1940472	0.3489762	Support	$150,000 - $199,999	4-year	Suburb
2	0.2802627	0.2203808	0.3471261	Support	$100,000 - $119,999	4-year	Suburb
3	0.4192808	0.2904514	0.5638360	Oppose	$10,000 - $19,999	No HS	Rural
4	0.2567978	0.1128822	0.4731254	Support	$350,000 - $499,999	Post-grad	City
5	0.3772841	0.3098993	0.4472753	Support	$30,000 - $39,999	High school graduate	Suburb
6	0.3859065	0.2240998	0.5693295	Support	$250,000 - $349,999	Some college	Suburb

5 Discussion

5.1 Higher Household Income does not increase a person's willingness to contribute to renewable energy sources

When looking at Table 1, we can see that as a person's household income increases, they are not more likely to be willing to support renewable energy sources at a slightly higher cost.

This could be because people who earn a lot of money tend to be smarter about their money and try not to lose it to unnecessary things which they may think renewable energy is. Another reason is simply because the sample size is too small. We can see from Figure 1 that the amount of people above the $150,000-$199,999 bracket drops off signicantly. We use a sample of 3000 from the cleaned dataset so the amount of observations that the model had to work with was limited for higher income brackets and some observations may have skewed the results.

5.2 People who have completed more years of education tend to have higher support

For the explanatory variable `education` which is the level of education the person has completed, Table 1 shows that there is an increase in support for the proposition if a person has a higher education level.

This could be because when a person is more educated, they tend to have better critical thinking skills as those are required in any field of study. Even if a person is not educated in topics related to climate change or renewable energy sources, they have the critical thinking skills to understand the effects that these changes will have in the future and what will happen if we do not take action.

5.3 People living in more rural areas tend to have decreased support

Table 1 shows that rural areas tend to have deceased support for the proposition. (Agriculture 2023) shows that there is an educational gap between urban and rural America. As stated before, our model shows that support for the proposition increases as education level increases. This could be an effect of education as the difference between urban and rural can be seen in this aspect.

5.4 Weaknesses and next steps

There is a possible weakness in the question. It states "[...] even if electricity prices increase a little" but this is can mean something different to everyone. The wording leaves it up to the reader for interpretation on how much the price will increase. Thus, a person's decision may

be different depending on if this question had a more concrete wording with a price range or percent.

Also, the model only sampled 3000 out of 50788 total observations from the cleaned dataset. This is due to performance and time restrictions. If we were able to efficiently create a model with more observations, it would be more accurate.

References

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