THE IMPACT OF POWER OUTAGE ON SUBJECTIVE WELL-BEING：EVIDENCE FROM RURAL CHINA

Yao Tang, City University of Hong Kong & Renmin University of China, yaotang8-c@my.cityu.edu.hk
Lin Zhang, City University of Hong Kong, l.zhang@cityu.edu.hk
Huanguang Qiu, Liaoning University & Renmin University of China, hgqiu@ruc.edu.cn

Overview

Climate change and extreme weather pose new challenges to infrastructure stability, particularly in terms of electricity security. Rural areas are more prone to power outages due to older or less robust electrical infrastructure, greater exposure to natural shocks, and fewer resources available for repairs and maintenance. Governments and public service providers need to enact policies that support climate adaptation in the power sector. However, the impact of power outages on subjective well-being (SWB), especially in rural areas, has not been thoroughly explored. Our study addresses this research gap. We conducted a survey of 1,567 households across eight provinces in China in 2021, collecting information on power outages and household demographics. To address potential endogeneity concerns, we utilize lightning density as our instrumental variable. Our two-stage least squares estimates of the fixed-effects model reveal that a power outage reduces the SWB of respondents by 0.3 points, equating to a 3.7% decrease in SWB. We identify potential channels through access to indoor cooling equipment and medical equipment. Finally, we employ the Life Satisfaction Approach to estimate the willingness to pay to power outage mitigation in rural China.

Methods

The baseline specification is as follows:

$$SWB_{i,j} = \alpha_0 + \alpha_1 Outage_{i,j} + \alpha_2 \ln(Income_{i,j}) + \beta X_{i,j} + \varepsilon_{i,j}$$

where $SWB_{i,j}$ is the dependent variable which indicates SWB scores of the respondent i in village j. In our survey, respondents' SWB is evaluated based on their answers to the question: "How happy do you think you are?" Options are integers from 0 to 10, with higher values indicating greater happiness. The core explanatory variable $Outage_{i,j}$ denotes the number of electricity outages experienced by households in 2020. The control variables include *Log (Income)* and a vector of other variables $X_{i,j}$, comprising *Age*, *Gender*, *Marriage*, *Education*, *Family size*, and *Self-rated health*. In addition, μ_j denotes village-level fixed effects, capturing unobserved characteristics of the village j. $\varepsilon_{i,j}$ is the random error term.

To address potential endogeneity concerns caused by omitted variable bias and measurement error, we employ lightning density as our instrumental variable. The exclusion condition is satisfied because lightning activities are natural phenomena that do not influence SWB. The relevance condition is met because lightning is an significant cause of power outages. We conduct subsample analyses among respondents living in regions with higher or lower cooling days for mechanism anaysis. In addition, we perform subsample analyses among respondents with varying health levels.

At last, the willingness to pay to avoid power outages is measured by the compensating surplus based on the Life Satisfaction Approach.

$$V(Income_0;\ Outage_0) = V(Income_0 - CS;\ Outage_1)$$

$$WTP = CS = Income_0[1 - \exp(\hat{\alpha}_1 \hat{\alpha}_2^{-1} \Delta Outage)]$$

where V(·) is the indirect utility function, $Income_0$ is the annual household per capita income, and ΔOutage is the change in power outages (i.e., $Outage_0$- $Outage_1$).

Results

We find that a power outage reduces the SWB of respondent by 0.3 points, equating to a 3.7% decrease in SWB. Our results of mechanisms analysis reveal that the negative effects of power outages on SWB are significant among respondents living in regions with higher cooling days and those who are unhealthy. Heterogeneity analysis shows that the negative effects are significant among respondents with higher electricity consumption and those aged 60 years and above. Our alternative measures of subjective wellbeing and power outages further ensure the validity of our causal conclusions. Our results show that the willingness to pay for a one-time change in power outages per hour is approximately between 222.90 RMB and 253.64 RMB.

Conclusions

A power outage significantly reduces the subjective well-being of respondent by 0.3 points, equating to a 3.7% decrease in SWB. This negative effect can be attributed to limited access to cooling and medical equipment. The willingness to pay for a one-time change in power outages per hour is approximately between 222.90 RMB and 253.64 RMB.