Does Daylight Saving Save Electricity? A Meta-Analysis

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Executive summary

As of the year 2017, daylight saving time is used by 77 countries and regions with a combined population in excess of 1.5 billion, making daylight saving time (DST) one of the most widespread policies in the world. It is also one of the most controversial policies, with dozens of countries and regions having abandoned it in recent decades. While DST has many other effects, in this paper we focus on its impact on electricity consumption, which was originally the primary argument advanced in favor of the policy and for which abundant empirical evidence exists. Since the 1970s, many studies have estimated the effect of DST on electricity savings.

Previous surveys of this literature show that different researchers obtain substantially different results. No consensus exists: one can find empirical evidence in support of electricity savings resulting from DST, just as one can find evidence of increased electricity demand associated with DST. In this paper, we propose a systematic and quantitative synthesis of the literature that would allow researchers and the public to take stock of the work on this topic produced over the last four decades.

This study represents, to the best of our knowledge, the first meta-analysis that focuses on the impact of DST on electricity consumption. We collect 162 estimates from 44 studies, including research articles, government papers, and energy company reports. The literature implies that, on average, the savings from DST amount to 0.34% of total electricity consumption during the days when DST is applied. This mean estimate is consistent with the conclusions of previous narrative surveys. The simple average reported effect is, however, usually a biased estimate of the true effect in energy economics: the distribution of the estimates is often truncated due to publication bias, and the size of the effect is typically driven by study design.

When researchers or journal editors treat statistically significant estimates or estimates consistent with the conventional view more favorably, the distribution of estimates in the literature becomes biased. Random sampling errors occasionally cause estimates to have the “wrong'” sign, but suppressing these estimates on a global scale may seriously distort the mean reported effect. Nevertheless, unlike most other fields of empirical economics, the DST literature does not exhibit this bias, as we show in the paper. Negative, insignificant, and positive results are treated in a similar way by researchers, editors, and referees. We find, however, that the design of the study has important and systematic effects on the results.

We explore this influence of data, method, and even publication characteristics on the reported coefficients measuring the effect of DST on electricity consumption. Using a method that addresses model uncertainty we find that, among the 14 explanatory variables we codify, several are particularly influential: the choice of the difference-in-differences approach to estimate savings (vs. simple regression, simulation, or extrapolation), the choice of data frequency, and the

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impact factor of the journal in which the study was published, which we employ as a proxy for unobserved quality aspects. When we focus on estimates employing better data and methodology and those published in more prestigious journals, our results show no evidence of electricity savings due to DST. Importantly, we also find that the estimated electricity savings increase with higher latitudes (which translates to more savings for countries farther away from the equator).

Our results suggest that the effect of latitude can not only offset the effect of various estimation methods but can also easily outweigh the mean estimated savings and imply increased electricity consumption due to DST for countries closer to the equator. The DST policy makes little sense when the amount of daylight does not vary substantially during the year, and in this case the policy constitutes a shock that may well have unintended consequences for electricity consumption. In theory, the relationship between latitude and electricity savings from DST should be concave because DST also makes little sense near the poles where the difference between winter and summer daylight hours is too large. The human population, however, is concentrated in the subtropical and temperate climate zones, and the estimates in our sample reflect countries and regions of the corresponding latitudes. The positive relationship between latitude and electricity savings can thus be regarded as a linear approximation of the underlying relationship.

A qualification of our results is in order. Because we use meta-analysis techniques, our estimates of the effect of DST are conditional on estimates reported in previous studies. Thus, our estimate of the mean effect can be viewed as a weighted average of the literature on DST: a non-trivial weighted average, because we control for publication bias and systematic misspecifications, but a weighted average nonetheless. If all studies in the literature share a common misspecification that biases their results in one direction, we are unable to control for such a misspecification and our result gets biased as well. Therefore, the correct interpretation of our analysis is that, based on the available previous research, the best guess concerning the effect of DST on electricity consumption is close to zero. In any case, it follows from our analysis that electricity savings should not be used as a rationale of DST. To evaluate the merit of this policy, researchers will have to focus on implications to, among other things, traffic safety, crime rates, and health issues. We still await a comprehensive cost-benefit analysis of the DST related to these issues.

Keywords Daylight saving time, Energy savings, Bayesian model averaging, Meta-analysis, Publication bias.