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Assessing the effects of daylight saving time on the industrial sector: evidence from Mexico

Evaluación de los efectos del horario de verano en el sector industrial: evidencia de México

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Abstract

We use a unique time series of electricity consumption by end-customer type and the differences-in-differences (DID) methodology to assess the effect of daylight saving time (DST) on electricity consumption in the Mexican industrial sector. As expected, our results indicate that industrial customers do not significantly modify their electricity consumption in response to DST.

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Resumen

Utilizando una serie de tiempo única de consumo eléctrico por tipo de cliente final y la metodología de diferencias en diferencias (DID), en este artículo se estima el efecto del horario de verano (DST) en el consumo eléctrico del sector industrial mexicano. Como era de esperar, los resultados indican que los clientes industriales no modifican significativamente su consumo eléctrico en respuesta al DST.

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1. Introduction

Daylight saving time (DST) has been introduced in many countries throughout the years to take advantage of natural light. However, as explained by Aries & Newsham (2008), lights in industrial buildings are usually on all the time while production is taking place. Furthermore, many industrial activities have several shifts (including one at night). Therefore, DST is not expected to affect electricity consumption for this type of customer significantly.

In this paper, we empirically evaluate the effect of DST on industrial electricity consumption in Mexico. For this purpose, we use the differences-in-differences (DID) method and time series data on industrial electricity consumption, including several years around the implementation of DST in Mexico. This type of information is unique for two reasons. First, many countries have been using DST for a long time, while Mexico just started in 1996. Therefore, it is difficult to find good data covering a relatively long period before and after the implementation of DST in most countries. Second, despite being one of the main energy consumers, it remains challenging to find a consistent time series of national electricity consumption disaggregated by end-user type. According to the Ministry of Energy (SENER, by its Spanish acronym), using data from the 2024 edition of the *World Energy Balances* by the IEA, the industrial sector accounted for 27.73% of total energy consumption in 2023¹.

Our estimates indicate that DST, as expected, has no effect on electricity consumption in the industrial sector. This result is relevant for two reasons. First, it provides empirical evidence to support something that is usually assumed to be true. That is, the idea that industrial customers do not adjust their electricity consumption in response to DST. Second, the results can be interpreted as a test for other studies using a DID approach to evaluate DST. In other words, we can be more confident in the results of other studies finding that DST reduces residential electricity consumption or overall consumption using this technique. For example, this result contrasts with the one obtained by Flores & Luna (2019), who used the same methods but found that DST reduced electricity consumption among Mexican residential customers.

The article is structured as follows: Section 2 reviews some of the literature related to the impact of DST on electricity consumption. Section 3 describes the data and methodology used in this article. Section 4 presents and discusses the results, and finally, Section 5 summarizes the conclusions.

2. Literature review

A substantial body of literature examines the impact of DST on electricity consumption across different countries. For example, Havraneck *et al.* (2018) conduct a meta-analysis covering 44 studies on this topic. Among other things, they explain that most of the existing econometric studies make no distinction between residential, commercial, or industrial consumption. According to them, there are a few studies that measure the effect of DST on residential consumption, while the rest do not differentiate between the types of end-customers. In other words, there are no econometric studies—as far as we know—measuring specifically the effect of DST on the industrial consumption of electricity.

More recently, Araujo *et al.* (2025) conducted a literature review on the impact of DST on energy consumption in commercial buildings. They argue that DST was originally conceived to take advantage of natural light at residences. However, the use of air conditioning and industrial processes are currently more important determinants of electricity consumption.

¹ Secretaría de Energía (2023). “Balance de Energía 2023”. Available at: https://www.gob.mx/cms/uploads/attachment/file/977268/Balance_Nacional_de_Energ_a_2023.FINAL06.02.2025.1.pdf

3. Data and methodology

The main source of information in this study is the National Statistics Information Agency in Mexico (INEGI). Until a few years ago, this agency published a time series of monthly electricity consumption by customer type. This information included electricity consumption in the industrial sector from 1982 to 2016. As mentioned before, DST was implemented for the first time in the whole country in 1996. Since then, DST starts on the first Sunday of April and ends on the last Sunday of October. Therefore, our data covers 14 years before the use of DST and 21 years afterward. It is important to note that DST is no longer in effect in most of Mexico since 2022, except for some regions along the northern border that continue to implement it in coordination with the United States.

As explained by Havraneck *et al.* (2018), DID is one of the most frequently used techniques in the econometric literature on this topic. In their review, 9 out of 44 studies evaluate the impact of DST on electricity consumption using this method. Moreover, almost 60% of the estimates they use in this meta-analysis come from DID evaluations.

According to Arisoy & Osturk (2014), the demand for electricity in the residential or business sector is typically assumed to depend on the price of electricity and some measure of income or economic activity. Therefore, we assume that the daily average consumption of electricity in the industrial sector (Q) during month i of year t is given by:

$$\text{Ln}Q_{it} = \alpha + \beta \cdot \text{Ln}P_{it} + \delta \cdot \text{Ln}Y_{it} + \theta \cdot \text{Ln}W_i + \gamma \cdot \text{DST}_{it} + \varepsilon_{it}. \quad (1)$$

The variables at the right-hand-side of the equation are the price of electricity (P), a measure of income or economic activity (Y), monthly weather conditions (W), a dummy indicating if DST is in effect, as well as an error term.

As explained earlier, all the data we use in this study is obtained from INEGI. We measure economic activity (Y) with the monthly indicator of industrial activity (IMAI). On the other hand, we consider three measures of electricity prices (P) for industrial customers: high and medium tension price indexes, as well as an average of them. These prices are divided by the national consumers price index to express them in real terms².

The demand equation is almost identical to the one used by Flores & Luna (2019). However, there is a subtle difference between the two demand specifications. Given that we model industrial consumption while they model residential consumption, variable Y here is a measure of economic activity instead of permanent income. Therefore, we allow economic activity to vary throughout the year, whereas Flores & Luna (2019) consider that permanent income remains fixed during the same period. As we will see in a moment, this is important because variables that remain constant throughout the year will cancel each other out when we calculate the differences between the treatment and control periods.

As in Flores & Luna (2019), we use an average of all non-DST months³ as the control period. Note that we can take an average of electricity consumption during all non-DST months and compare it with a single DST month because quantities are expressed as daily averages. This allows comparing months with 28, 30, or 31 days. Similarly, it will enable comparing a month with a set of months. The sub-index letter o indicates that the variable belongs to the control period. Hence, the difference between industrial electricity consumption during treatment and control periods is given by the following expression:

$$\begin{aligned} \text{Ln}Q_{it} - \text{Ln}Q_{ot} = & \beta \cdot (\text{Ln}P_{it} - \text{Ln}P_{ot}) + \delta \cdot (\text{Ln}Y_{it} - \text{Ln}Y_{ot}) + \theta \cdot (\text{Ln}W_i - \text{Ln}W_o) + \gamma \\ & \cdot \text{DST}_{it} + \varepsilon_{it} - \varepsilon_{ot} \end{aligned} \quad (2)$$

² The descriptive statistics are provided in the appendix.

³ These months are November, December, January, February and March.

Finally, we can rewrite this equation as follows:

$$\ln \frac{Q_{it}}{Q_{ot}} = A + \beta \cdot \ln \frac{P_{it}}{P_{ot}} + \delta \cdot \ln \frac{Y_{it}}{Y_{ot}} + \gamma \cdot DST_{it} + \eta_{it}. \quad (3)$$

Equation (3) relates differences in consumption between the treatment and control periods with differences in prices, economic activity, and DST. Note that the constant A represents differences in weather conditions between the treatment and control periods. Finally, we will add a time trend to control for potential changes in the electricity consumption patterns that may occur over time in the industrial sector or due to changing weather conditions. This variable proved to be relevant when modeling differences in residential electricity consumption between treatment and control periods in Flores & Luna (2019).

4. Results and discussion

We consider two different types of DID regression models. In the first type of model, we conduct a regression analysis for each DST month. This approach helps identify the specific effects of DST for each month. However, the disadvantage of running separate regressions is that the number of observations is relatively small. Thus, it is less likely to find significant effects. In the second type of model, we pool all the DST months in a single regression. The advantage of this approach is that we can substantially increase the number of observations in the regression. Consequently, it is more likely to find significant effects. Nevertheless, we only estimate a single DST effect for all the periods.

4.1. Separate month regressions

The results of the separate month regressions are presented in Table 1⁴. As we mentioned earlier, it is hard to obtain statistically significant effects for any variable with a small number of observations. However, it is interesting to note that all the variables, except for DST, are statistically significant in at least two of the regressions. Moreover, most of the statistically significant coefficients – except for those related to economic activity in July – have the expected signs. That is, electricity consumption increases with industrial activity and decreases with the real price of electricity.

Table 1. Industrial electricity consumption DID separate regressions

Variable	April	May	June	July	August	September	October
Constant	-0.010	-0.007	0.031***	0.005	0.027**	0.080***	0.031**
Trend	0.003***	0.003***	0.004***	0.002	0.002*	-0.001	0.001
Y	0.625*	0.778***	0.704***	-0.002**	0.043	0.094	-0.025
Price	0.022	0.074	-0.191**	-0.186*	-0.025	0.134	-0.036
DST	-0.023	-0.004	-0.020	0.021	0.029	0.024	0.026
No. Obs.	35	35	35	35	35	35	35
R ²	0.435	0.665	0.732	0.587	0.520	0.138	0.209

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' elaboration.

These results suggest that DST does not affect industrial electricity consumption in any of the DST months. Moreover, the signs of the coefficients are negative (indicating small energy savings) in the first three months of DST but positive in the last four months. Therefore, potential reductions in electricity consumption at the beginning of DST could be offset by increases of a similar magnitude towards the middle and end of DST. These results contrast with the findings of Flores & Luna (2019), where savings in residential electricity consumption are greater at the end of DST.

⁴ Since the variables included in the econometric model are expressed as differences relative to the control month, they are stationary by construction. This property of the series is further supported by unit root tests, which provide evidence that the series used in the regression are stationary. The results of these tests are available from the authors upon request.

4.2. Pooled regressions

In Table 2, we present the results of three versions of pooled regressions. Each regression considers a different index of the industrial price of electricity (that is, high and middle tension, as well as an average of them). All the coefficients, except for the price itself, are essentially the same in the three versions. There is a very slight but positive trend in electricity consumption during the DST months. That is, consumption during DST months has been growing slightly faster than during the rest of the year. The price coefficient has the expected negative sign but is not significantly different from zero. Industrial electricity consumption increases in proportion to industrial economic activity. DST has no significant effect on industrial electricity consumption. Finally, the monthly dummies reflect differences in electricity consumption between the DST months.

Table 2. Industrial consumption of electricity DID pooled regressions

Variable	Price H	Price M	Price (Average)
Constant	-0.012*	-0.012*	-0.013*
Trend	0.002***	0.002***	0.002***
Y	0.193*	0.196*	0.194*
Price	-0.023	-0.048	-0.035
DST	0.008	0.010	0.009
May	0.013*	0.013*	0.013*
June	0.056***	0.055***	0.055***
July	0.036***	0.035***	0.036***
August	0.049***	0.048***	0.049***
September	0.057***	0.056***	0.057***
October	0.032***	0.031***	0.031***
No. Obs.	245	245	245
R ²	0.507	0.509	0.508

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Source: Authors' elaboration.

Although the DST coefficient is very small and not significantly different from zero, it is noteworthy that, contrary to expectations, it has a positive sign. Regardless of the version of the regression that we choose, the estimates indicate that industrial electricity consumption increases by about 1% with DST. This is in contrast with the 5.6% reduction in residential consumption estimated by Flores & Luna (2019) using similar methods and data. Finally, we can use the smallest estimate (that is, 0.008) to calculate the probability that DST reduces electricity consumption in the industrial sector. This probability is only about 13%. With these results, it is difficult to argue that DST reduces electricity consumption in the Mexican industrial sector.

5. Conclusion and recommendations

Finding that DST does not affect electricity consumption from industrial customers in Mexico is interesting for several reasons. First, it provides empirical evidence supporting the idea that DST is not generating electricity savings in the industry. While the literature acknowledges that DST is not expected to yield energy savings in this sector, no specific study that we are aware of has employed DID econometric methods to demonstrate this. Second, this takes place in a country in which the opposite occurs for residential customers. Therefore, the method we use (DID) is useful for identifying whether DST affects electricity consumption or not.

It is tempting to ask whether our results support or not the implementation of DST in Mexico or elsewhere. This issue is frequently subject to debate. However, we should be cautious in interpreting the lack of effect of DST on industrial consumption as an argument against it. More precisely, our results do not imply that DST could not potentially reduce consumption in the industrial sector, especially in Mexico. According to Chen *et al.* (2014), adequately designed industrial buildings—equipped with illumination controls and daylighting

panels—have an enormous potential to benefit from natural light. Our results suggest that most industrial buildings in Mexico are not yet taking advantage of daylight.

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Appendix

The following table presents the descriptive statistics for daily industrial electricity consumption and real price indices for high- and medium-voltage users from 1982 to 2016. On average, industrial consumption was 189.99 gigawatt-hours per day (GW/day), with a minimum of 73.23 and a maximum of 321, resulting in a variability of 74.66 GW/day. The real high-voltage electricity price index exhibited an average value of 0.72, with observations ranging from 0.44 to 1.17. In comparison, the medium-voltage index showed a slightly higher mean of 0.79, within a narrower range of 0.51 to 1.09. Both indices suggest that, for most of the period, real electricity prices remained lower than most prices. Moreover, medium-voltage prices showed slightly lower volatility than high-voltage ones.

Table A1. Descriptive Statistics

	Daily industrial electricity consumption*	Real High-Voltage Electricity Price Index	Real Medium-Voltage Electricity Price Index
Mean	189.99	72	79
Maximum	321.00	117	109
Minimum	73.23	44	51
Standard deviation	74.66	17	14

*Gigawatt-hours per day

Source: Authors' elaboration.