

September 25, 2019

Chairman Schuring, Vice-Chair Rulli, Ranking Member O'Brien and Members of the Senate General Government and Agency Review Committee, thank you for the opportunity to provide Interested Party testimony on Senate Bill 119.

My name is Austin Smith, and I am an assistant professor of Economics at Miami University, and a research affiliate for IZA, the institute of labor economics. I published a highly cited study about the impact of Daylight Saving Time (DST) on fatal automobile accidents in the United States. I am here to testify about my work, related academic studies regarding DST, and their implications for the proposed bill.

Today I will make three points. First, DST transitions are costly, and there are clear benefits to choosing a single time regime that eliminates switches back and forth. Second, there are tradeoffs in the choice between permanent Standard Time or permanent DST, and third, the choice should be informed by existing sunrise and sunset times in the state of Ohio.

Background

Daylight Saving Time, commonly referred to as DST, has been a consistent feature in most US states since the Uniform Time Act of 1966. The procedure for DST is characterized by the phrase "spring-forward, fall-back." Each year on the spring transition date, clocks are moved forward by one hour, from 2 a.m. to 3 a.m. This alters the relationship between clock time and solar time by an hour, moving sunlight from the morning to the evening. The process is then reversed for the fall transition with clocks "falling-back" from 2 a.m. to 1 a.m.

DST was originally introduced as a wartime measure to save energy. The intuition is that transferring more ambient light to the evening could reduce energy used for artificial lighting. Recent studies demonstrate that DST does not save energy, and may even increase energy use, in part because the way we use energy has changed.¹ Additional energy use for heating and cooling offsets any gains from reduced lighting. Mounting evidence that DST fails in its primary goal has led researchers to consider other costs and benefits of DST. Informed by this research and public outcry, several states have begun to reconsider whether they will continue the practice.

Costs of DST Transitions

Existing research provides a clear consensus that the transition into DST causes several adverse outcomes. Recall that transitioning into DST involves clocks jumping from 2 a.m. to 3 a.m. The "lost" hour disrupts sleeping patterns and reduces sleep duration for an already sleep-

deprived population.ⁱⁱ Consequences of lost sleep from the spring transition include increases in fatal automobile accidents, heart attacks, and workplace accidents, and decreases in worker productivity in the days immediately following the transition.ⁱⁱⁱ Moreover, effects are not reciprocal. In general, there are not benefits associated with the transition back to Standard Time.^{iv}

The costliness of DST transitions provides a clear policy implication, locations should choose one time regime and stick with it. I applaud the bill's sponsors for seeking to eliminate transitions. Unfortunately, there is less consensus on whether permanent Standard Time or DST is preferred. Tradeoffs are involved. Senate Bill 119 proposes permanent DST, and I would like to highlight some of the likely benefits and costs associated with this proposal.

Potential Benefits of SB 119

Permanent DST pushes sunset later and potential benefits of later sunset include reductions in certain types of crime and increases in outdoor activity. Because street crimes, such as robbery, are most common during the evening hours of 5-8pm, additional ambient light during this time frame can act as a deterrent. A study using data from over 500 U.S. jurisdictions found a 7% reduction in robberies due to DST.^v For outdoor activity, because a large share of Americans work rigid schedules, having a larger block of time after work with sufficient ambient light can increase the likelihood that individuals partake in outdoor activities. Additional outdoor activity could be beneficial to the extent that it implies additional exercise. Using data from the American Time Use Survey, researchers document an increase in the probability of engaging in outdoor activities during the 3-7pm time block following the spring transition.^{vi}

Potential Costs of SB 119

Permanent DST pushes sunrise and sunset later and potential costs include reduced sleep and corresponding reductions in academic performance and worker productivity. Sleep schedules are heavily influenced by ambient light. Holding the total hours of darkness constant, less sunlight in the evening naturally moves bedtimes earlier and increases morning alertness.^{vii} Researchers have found that when sunrise is an hour earlier relative to school start times the academic performance of K-12 students improves substantially.^{viii}

A similar phenomenon has been found in adults. Earlier sunsets cause workers to begin sleeping earlier on average, and because work schedules are typically set independent of sunrise times, this translates into longer sleep duration. Researchers have found that earlier sunset times cause both longer sleep duration and higher earnings among workers, suggesting that earlier sunset times can increase worker productivity.^{ix}

The Ohio Context

Key to understanding the tradeoff between permanent Standard Time and permanent DST, is knowledge of the initial allocation of light. Sunrise and sunset times vary drastically by location, and a policy that is beneficial for one state may not make sense for Ohio. Given Ohio's western position within the Eastern Time Zone, our citizens currently experience later sunrise

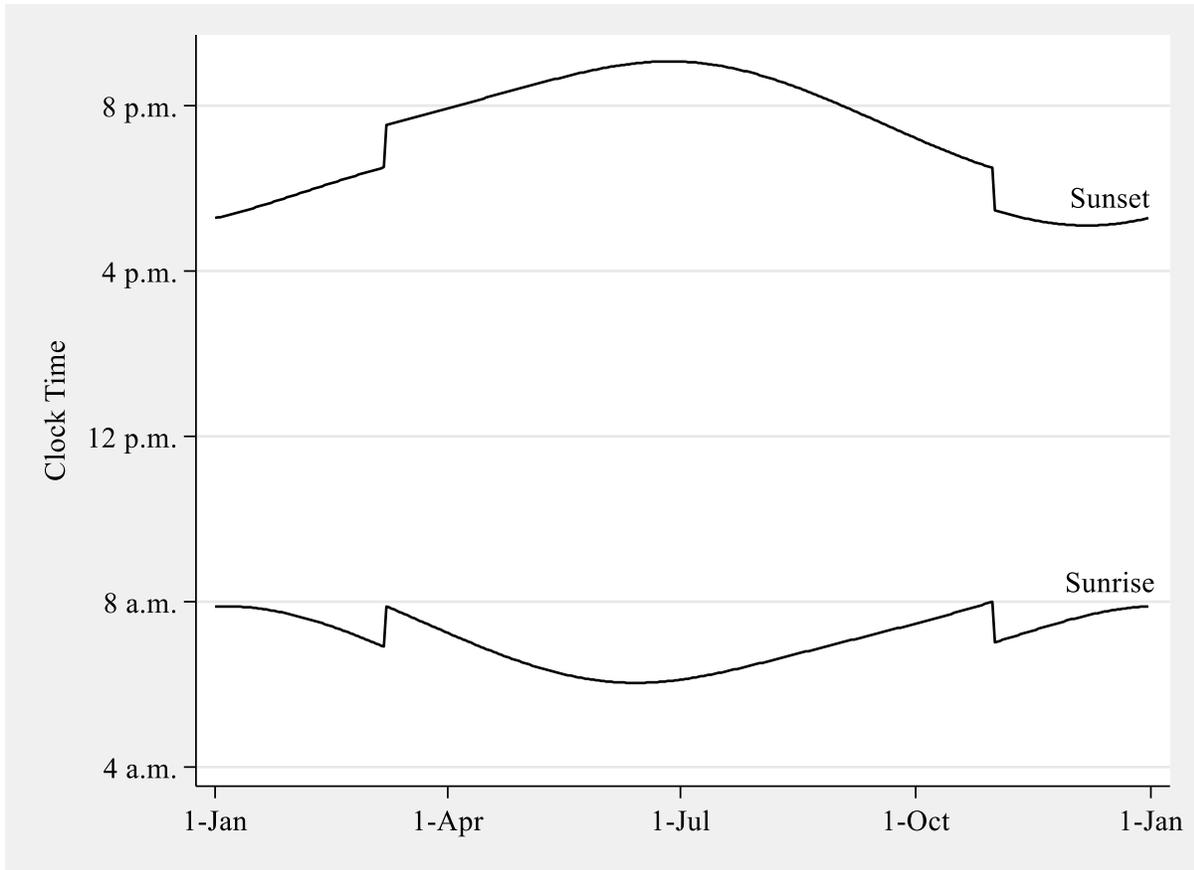
and sunset then citizens in many other states. A movement to permanent DST, as SB 119 proposes, would push sunrise and sunset back further during the darkest months of the year. Using Columbus as an example, sunrise would not occur until 8:53 a.m. on January 1st. Permanent DST would mean that for over four full months sunrise would not occur until after 8 a.m. The delayed sunrise times would force students in several school districts to travel to and arrive at school prior to sunrise for a large share of the academic year.

One alternative to the proposal of permanent DST that eliminates costly transitions into and out of DST and takes into account Ohio's relatively late sunrise and sunset times is a policy of permanent Standard Time. The existing research suggests that the earlier sunrise and sunset times associated with permanent Standard Time would increase sleep duration and benefit both students and workers.

As an appendix to my testimony I have attached two figures of sunrise and sunset times under alternative policies. The first figure presents sunrise and sunset times under Ohio's current practice of transitioning between Standard Time and DST. The second figure illustrates SB 119's proposal of permanent DST contrasted with an alternative of permanent Standard Time. Thank you for the opportunity to provide testimony, I would be happy to answer any questions at this time.

Appendix – Sunrise and sunset times under alternative Daylight Saving Time policies

Figure 1. Sunrise and Sunset Times – Status Quo



Note: Sunrise and sunset times are for Columbus, Ohio in 2020. Status quo implies the state continues to practice DST from early March to early November and Standard Time during the remainder of the year. Source of sunset and sunrise times: timeanddate.com.

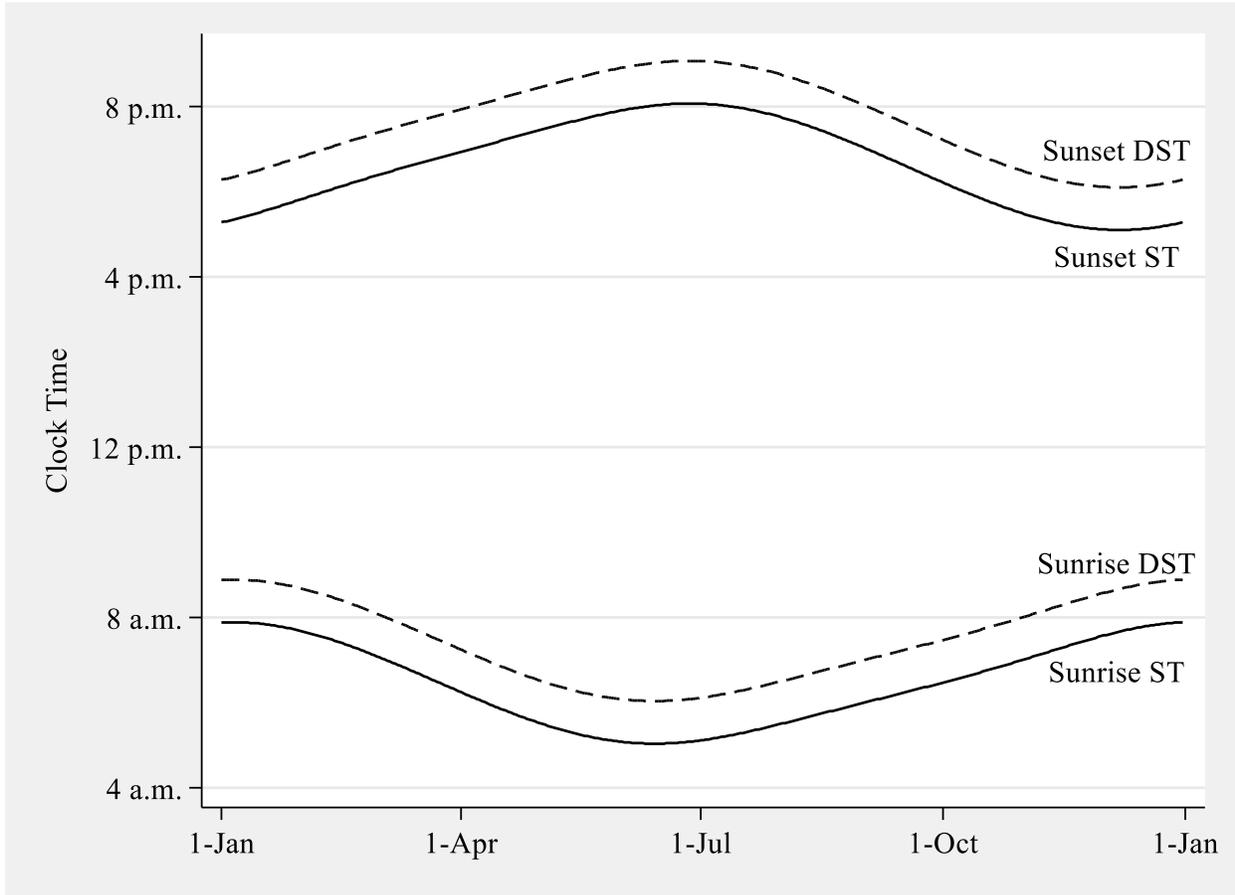
Summary for Status Quo

Latest sunrise time: 8:00 a.m

Earliest sunset time: 5:06 p.m.

Days with sunrise 8 a.m. or later: 1.

Figure 2. Sunrise and Sunset Times – Permanent DST versus Permanent Standard Time



Note: Sunrise and sunset times are for Columbus, Ohio in 2020. Permanent DST implies the state operates under Daylight Saving Time for the entire year. Permanent Standard Time (ST) implies the state exempts itself from DST and practices Standard Time for the entire year.

Source of sunset and sunrise times: timeanddate.com.

Summary for permanent DST

Latest sunrise time: 8:53 a.m.

Earliest sunset time: 6:06 p.m.

Days with sunrise 8 a.m. or later: 125.

Summary for permanent Standard Time

Latest sunrise time: 7:53 a.m.

Earliest sunset time: 5:06 p.m.

Days with sunrise 8 a.m. or later: 0.

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- ⁱ Kellogg, R. and Wolff, H., 2008. Daylight time and energy: Evidence from an Australian experiment. *Journal of Environmental Economics and Management*, 56(3), pp.207-220.
- Kotchen, M.J. and Grant, L.E., 2011. Does daylight saving time save energy? Evidence from a natural experiment in Indiana. *Review of Economics and Statistics*, 93(4), pp.1172-1185.
- ⁱⁱ Barnes, C.M. and Wagner, D.T., 2009. Changing to daylight saving time cuts into sleep and increases workplace injuries. *Journal of applied psychology*, 94(5), p.1305.
- ⁱⁱⁱ Evidence for fatal automobile accidents: Smith, A.C., 2016. Spring forward at your own risk: Daylight saving time and fatal vehicle crashes. *American Economic Journal: Applied Economics*, 8(2), pp.65-91.
- Evidence for heart attacks: Janszky, I. and Ljung, R., 2008. Shifts to and from daylight saving time and incidence of myocardial infarction. *New England Journal of Medicine*, 359(18), pp.1966-1968.
- Evidence for workplace accidents: Barnes, C.M. and Wagner, D.T., 2009. Changing to daylight saving time cuts into sleep and increases workplace injuries. *Journal of applied psychology*, 94(5), p.1305.
- Evidence for workplace productivity: Wagner, D.T., Barnes, C.M., Lim, V.K. and Ferris, D.L., 2012. Lost sleep and cyberloafing: Evidence from the laboratory and a daylight saving time quasi-experiment. *Journal of Applied Psychology*, 97(5), p.1068.
- ^{iv} No significant benefit of the fall transition is found for fatal automobile accidents, heart attacks, or workplace accidents. One probable reason for no effect of fall transitions is that Americans do not tend to use the “extra” hour provided by the fall transition for sleep.
- ^v Doleac, J.L. and Sanders, N.J., 2015. Under the cover of darkness: How ambient light influences criminal activity. *Review of Economics and Statistics*, 97(5), pp.1093-1103.
- ^{vi} Wolff, H. and Makino, M., 2013. Does daylight saving time burn fat? Time allocation with continuous activities. *Unpublished working paper*.
- ^{vii} Crowley, S.J., Acebo, C. and Carskadon, M.A., 2007. Sleep, circadian rhythms, and delayed phase in adolescence. *Sleep medicine*, 8(6), pp.602-612.
- ^{viii} Heissel, J.A. and Norris, S., 2018. Rise and shine the effect of school start times on academic performance from childhood through puberty. *Journal of Human Resources*, 53(4), pp.957-992.
- ^{ix} Gibson, M. and Shrader, J., 2018. Time use and labor productivity: The returns to sleep. *Review of Economics and Statistics*, 100(5), pp.783-798.