



Do Residential Water Use Restrictions Reduce Water Consumption?

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Presentation Outline

- Background
- Research Question
- Previous Literature
- Methodology
- Empirical Results
- Future Work
- Conclusion

Background

- In 2022, Spokane implemented a city ordinance on water use restrictions called the “Drought Response Measures Ordinance”.
- Information website for Spokane residents.
- Full text of the ordinance.

Watering Rules and Drought Response Measures

OUTDOOR WATERING SCHEDULE
Watering rules apply June 1st through October 1st.

Day	Watering Rule
S	EVEN addresses
MONDAY	TAKE A DAY OFF
T	ODD addresses
W	EVEN addresses
T	ODD addresses
F	EVEN addresses
S	ODD addresses

NO WATERING BETWEEN 10:00 a.m. – 6:00 p.m.

Help us use water wisely by doing your part! City of Spokane watering rules apply June 1st - October 1st every year. Exemptions are allowed for trees, newly planted landscapes, vegetable gardens and to mitigate wildfire risk.

Source: City of Spokane: <https://my.spokanecity.org/publicworks/water/water-wise-spokane/watering-rules-and-drought-response-measures/>

Research Question

- Did the City of Spokane's Drought Response Measures Ordinance reduce average water use in July and August of 2022 and 2023 compared to prior years?

Previous Literature

- Case studies:
 - Browne, Gazze, and Greenstone (2021) – Case study from Fresno, CA
 - Survis and Root (2012) – Case study from Southeast Florida
 - Barnes, Yue, and Watkins (2021) – Case study from Minneapolis-St. Paul about perceptions
 - Finley and Basu (2020) – 15 Canadian cities studied
- Price and non-price approaches:
 - Olmstead, Hanemann, and Stavins (2007) – evaluate increasing block pricing
 - Olmstead and Stavins (2008) – discuss price and nonprice approaches
 - Sedlak (2023) Water for All – chapter on ways to reduce water use in wealthy communities

Methodology

- Use 5 years of residential water data from the City of Spokane at the household level
 - Look at patterns and trends of water consumption behavior in Spokane city and county residents over five-years
 - Control for temperature, precipitation, yard size and other factors using a regression framework
- Panel data
 - Monthly data over 5 years
 - Residential users - homes and duplexes
 - Use Maintenance Number for a specific location regardless of the owner

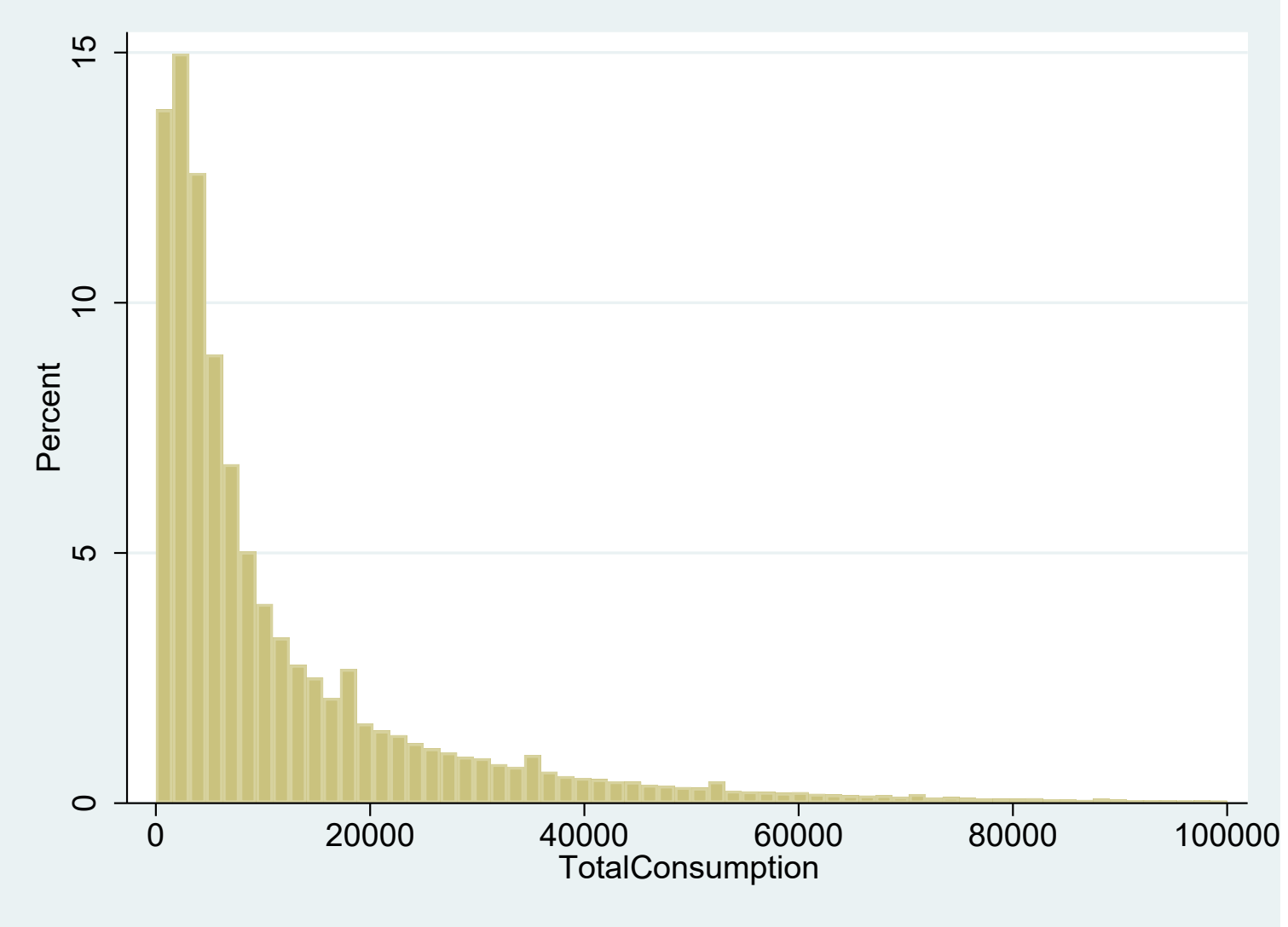
Methodology

- Model specification:
- $\text{Water Consumption}_{it} = \beta_0 + \beta_1 \text{City Ordinance} + \beta X + \mu_{it}$
 - X is a vector of control variables such as price, temperature, precipitation, size of yard, sprinklers in use, city ordinance in effect
- Use random-effects GLS estimation
 - Use random effects instead of fixed effects so that I can include parcel size (which is a time invariant variable)
 - Coefficients and significance do not change too much when using fixed effects
- Sensitivity analyses

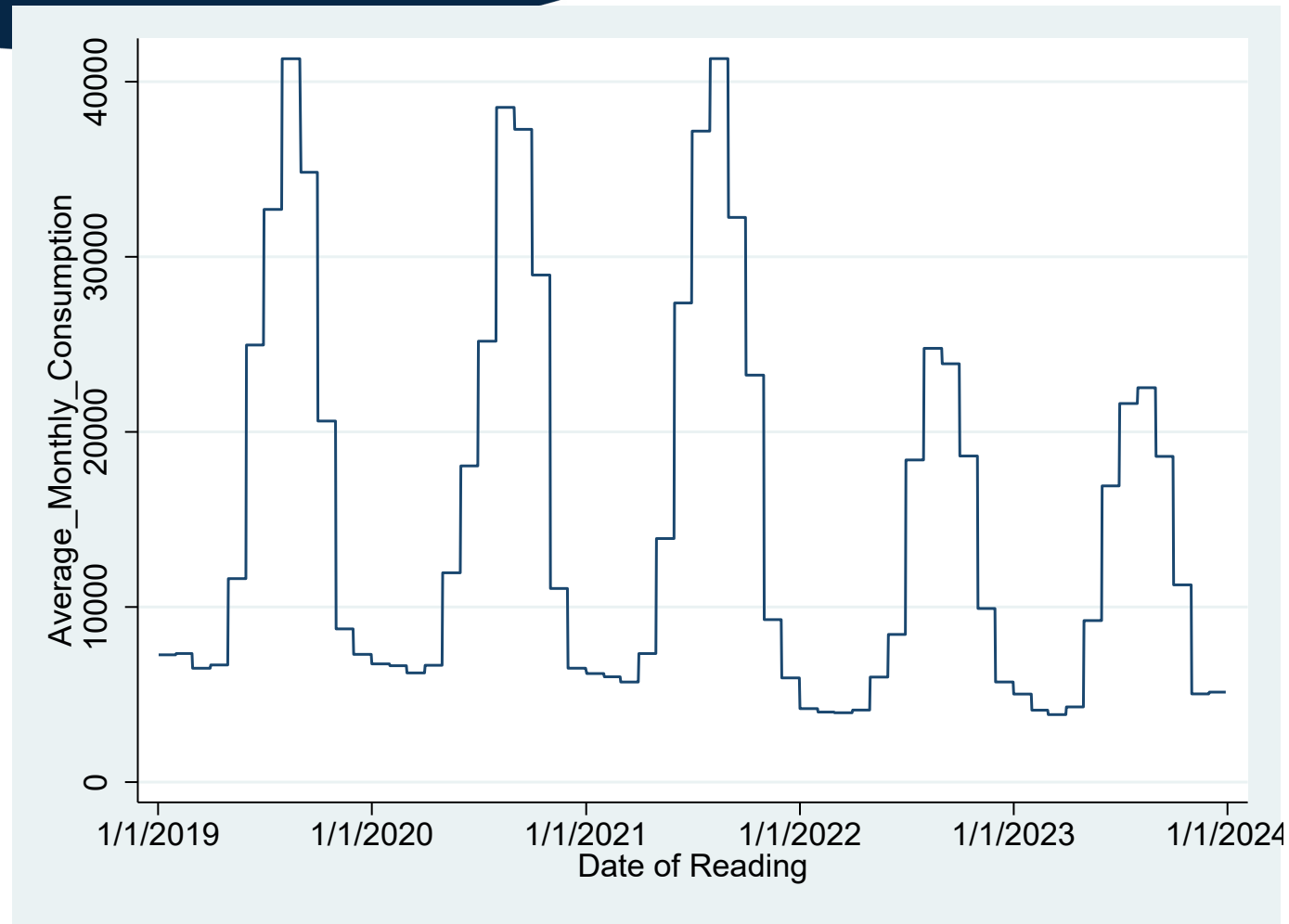
Data and Preliminary Empirical Results



Water Consumption



Average Water Consumption, in gallons, per household



Summary Statistics

VARIABLES	N	mean	sd	min	max
Consumption Gallons	2,961,364	13,952.4	22,972.38	0	4,155,543
Parcel Acreage	2,907,184	.195	.234	.01	28.55
Precipitation	2,961,364	1.22	926	0	3.59
CDD (Cooling degree days – temperature)	2,961,364	63.715	107.59	0	394
Water Service Charge (Inside City)	2,961,364	17.875	.7141	16.73	18.76
Number of MaintNum	62,697				

Water Consumption

Year	Average Water Consumption in July (per residential unit in sample)
2019	31,695
2020	24,805
2021	35,994
2022	18,146
2023	21,029

Dependent Variable: Water Consumption in Gallons	Panel Data Model
Water Service Charge (Inside City)	-4,599*** (25.42)
Parcel Acreage	11,153*** (3,240)
Sprinklers (April thru Sept)	3,963*** (31.94)
Precipitation	-919.3*** (12.31)
CDD (Cooling degree days – temperature)	60.41*** (0.247)
City Ordinance in Effect (June – Aug 2022 & 2023)	-3,609*** (42.12)
Constant	90,277*** (771.7)
Observations	2,907,184
Number of MaintNum	62,697
Random Effects	Yes

Future Work

- Price Variable: Consider how to incorporate price in a better way
 - Add tiered prices
 - Add lagged prices (after people receive a bill, do they reduce water use?)
- Right-skewed distribution for water consumption
 - Need to find the best model for data with a long tail
- Review outliers
- Analyze the impact on the highest users
- Compare with county users in the data and with duplexes

Conclusion

- I find that average water use declined in 2022 and 2023 in July and August compared to previous years and that corresponds with the city ordinance
- Yes, the ordinance appears to be helping to reduce water consumption, on average

Questions

- Thank you!
- Questions and comments are welcome.
- Feel free to contact me at johnsone@gonzaga.edu