Assessing Temporal Reliability and Dynamics of Water Quality Value Estimates using Recreation Demand Models

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Temporal reliability / stability

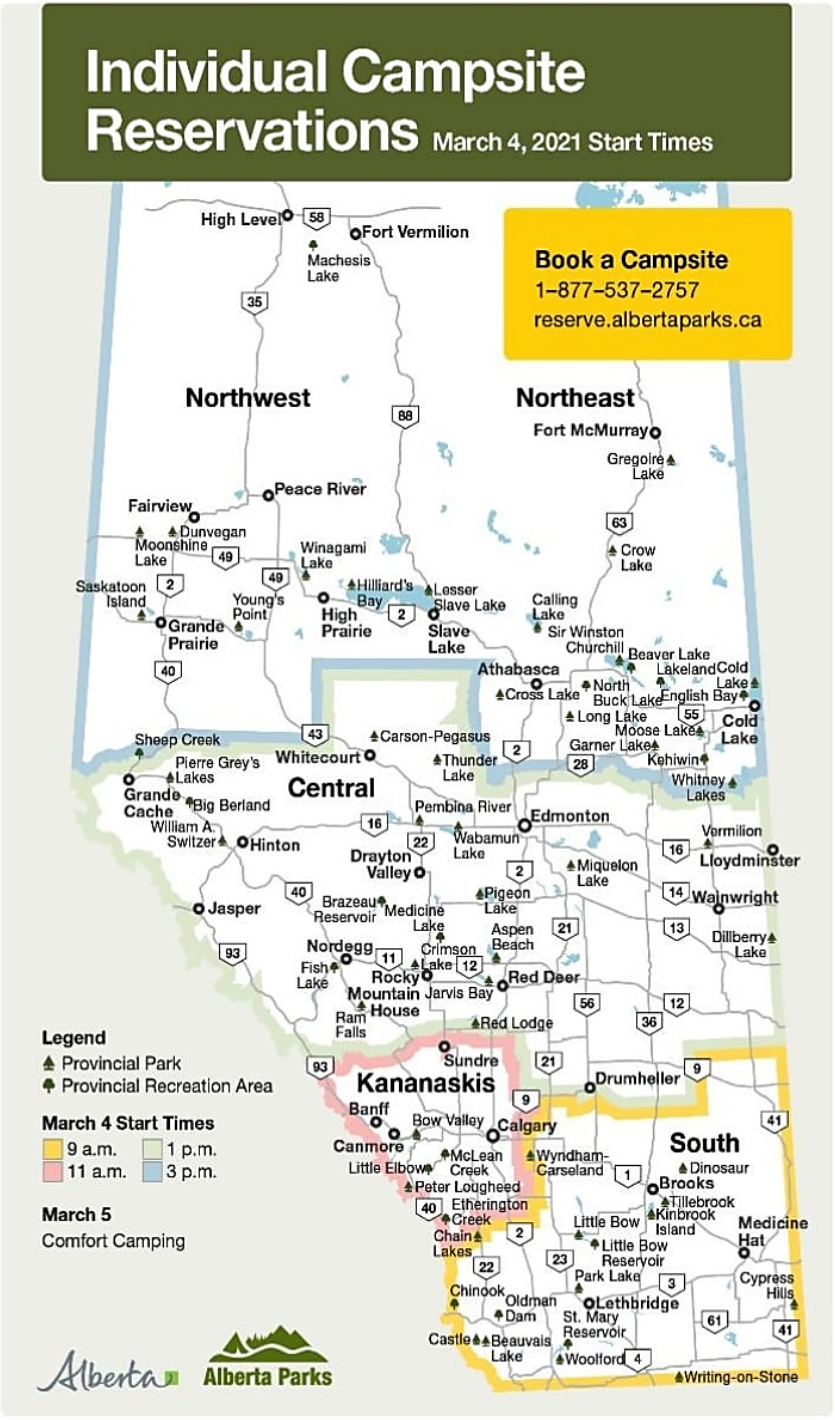
- One dimension of reliability
- Typically assessed by comparing value estimates from two or more years of data
- Many validity and reliability tests of stated preference methods
- Value estimates often come from studies undertaken at one point in time, but are used in:
  - benefit transfer exercises, which assume the estimates' transferability over time
  - policy assessments and benefit-cost analyses of long-term projects

Research questions

1. Do people respond to WQ advisories?
2. Are recreation demand value estimates of lake WQ stable over the years 2014-2021?
3. How long does it take for people to respond to the issuance of WQ advisory?

Camping data

- Administrative data on campground reservations at provincial parks in the province of Alberta in Canada
- Data from online reservation system
  - Each user assigned a unique ID to track over time
  - Cancelled reservations removed from the data
- Eight years of data: 2014 to 2021
- Trips taken by campers over the "summer" season
  - 3rd week of May and 1st week of September (Victoria day and Labour day)
  - 61 campgrounds used in analysis (~80% of campgrounds) – open throughout all eight years
  - Group/luxury/horseback riding campgrounds excluded
- Each camper is linked to a postal code to calculate a travel cost
  - Non-Alberta residents excluded (likely multiple destinations; camping not the primary purpose)



Our study in the literature context

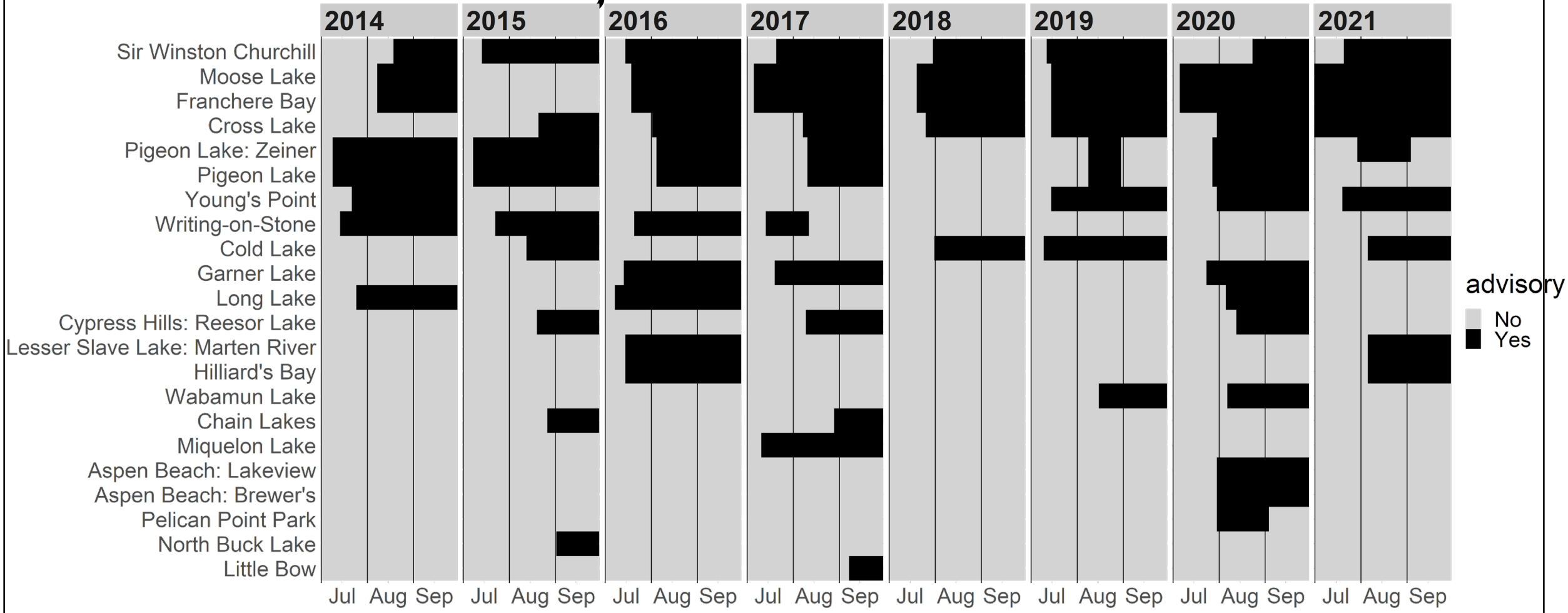
- We identify four former studies of temporal reliability in recreation demand analysis
- What is different in our study compared to the former assessments?

	Trips to …	Years studied	Number of individuals	Number of trips per year	Data source
Zandersen et al. 2007, JForestEcon; **Zandersen et al. 2007**, LE	Forests in Denmark	1977, 1997	6,500-7,000	Not reported	Survey
Yi and Herriges 2017, LE	Lakes in Iowa	2004-2005	2,150	15,050	Survey
Ji et al. 2020, JAERE	Lakes in Iowa	2002-2005, 2009	977	6,000	Survey
Our study	Campgrounds in Alberta	2014-2021	67,000-81,000	95,000-130,000	Administrative
		Pandemic year	Large dataset		No recall issues

Measure of lake water quality (WQ)

- Most existing recreation demand WQ studies use a single average annual WQ measure
- We use data on water advisories
- Water advisories for lakes by campgrounds are issued by health authority if water quality poses a threat to public health
- Advisories are typically issued during warm summer months (also when people like to go camping)
- We have within-season variation in WQ at campgrounds, which allows us to
  - capture and control for the actual water quality experienced by people
  - better identify peoples' preferences towards WQ improvement

Seasonal timing of the advisories



- 48 of the 61 campgrounds have at least one lake
- 23 campgrounds had at least one advisory

Empirical data: Summary

Year	Number of trips	Unique individuals	Campgrounds with a water advisory	Days of advisories for all campgrounds
2014	91,539	62,458	8	305
2015	99,189	67,098	9	308
2016	94,551	65,015	11	517
2017	99,234	68,200	11	411
2018	96,232	66,111	5	201
2019	95,487	65,115	9	370
2020	134,113	81,159	14	555
2021	129,103	80,325	9	478

Travel cost calculation

out of pocket driving expenses + the value of time + camping cost

- Driving costs vary across the years from $0.44 to $0.48 per kilometer
  - Based on Canadian Automobile Association
- Value of time is 2/3 of the wage rate calculated using 2016 median income levels at postal-code level
- Camping cost includes nightly fees and reservation fee
  - Per-night camping fees vary by campground and year
  - Campers are charged a fixed fee of $12 when making a reservation
- All values are converted to 2016 CAD dollars to adjust for inflation (not a large impact)

Modelling approach

- A site-choice model with alternative-specific constants for the campsites (A), an indicator for a water quality advisory (WQ) and travel costs (TC), separately for each year

$$U_{ijd} = \beta^{tc} TC_{ij} + \beta^{a} A_{j} + \beta^{q} WQ_{jd} + \varepsilon_{ijd}$$

(d – day; j – campsite, i – individual)

- Note: Preliminary results used a weekly repeated discrete choice model specification but the nested logit models suggested that the two decisions (participation and site choice) are independent
  - The number of choice sets increases by about a factor of 16 if we add "stay at home" weeks

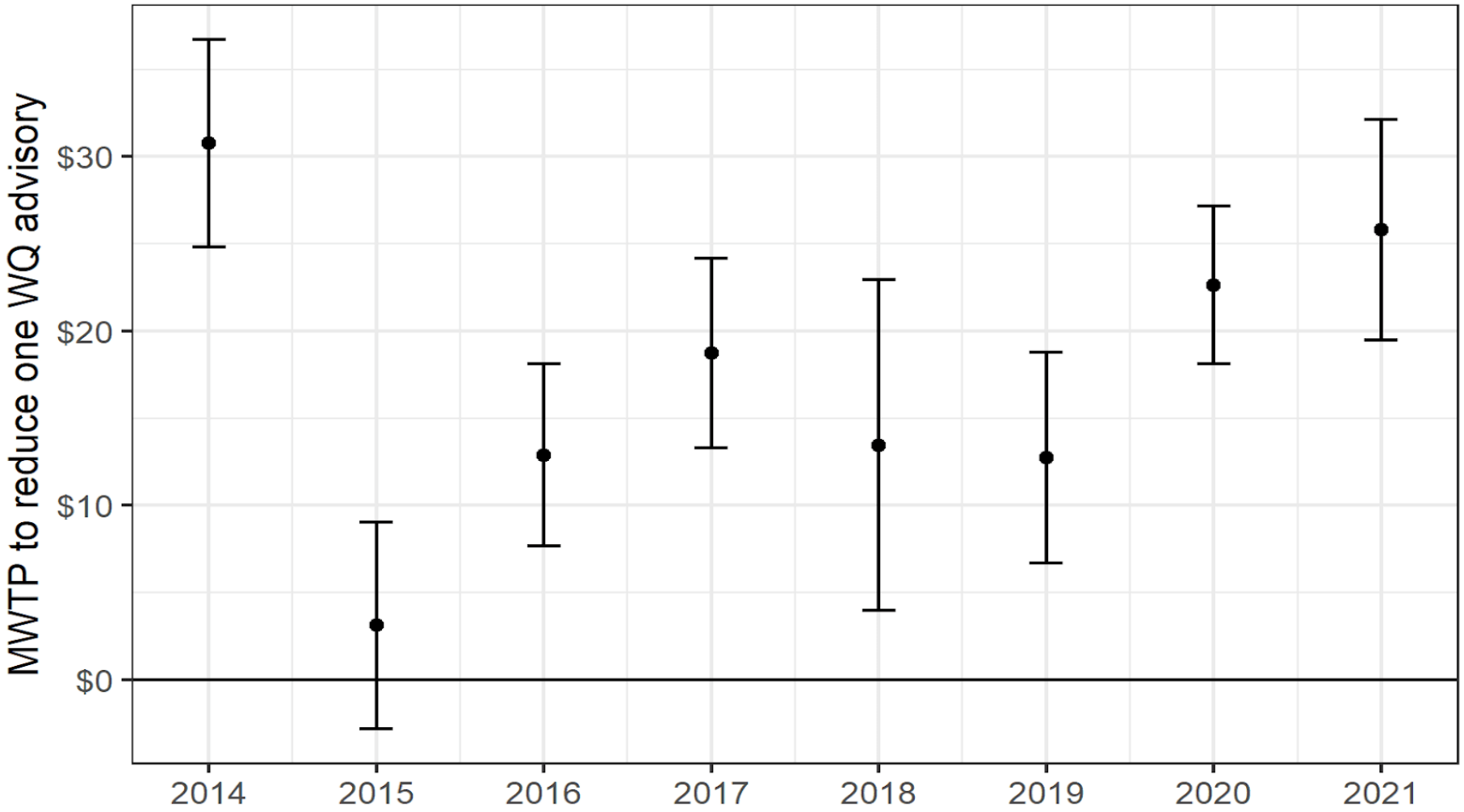
Empirical concerns and decisions

Concern	Decision
Number of campsites in the database **increases** from 63 to 74. These campsites were open (with a few exceptions) but not part of the online reservation system earlier.	Restrict the choiceset to the 61 campsites in reservation system for all years
Most **individuals** making reservations **change year over year**. If we want to keep the same sample (individuals) each year, we need to make assumptions on those who did not take any trips. If someone took a trip in one year, do we assume they took zero trips in the other years?	Use all individuals without filling in "zero" trips
Many campsites are full on most weekends and this limit may explain some stability in visitation even though the **latent demand** is higher.	Leave as is – we do not have data on how full a campsite is

Results: Site-choice models for each year

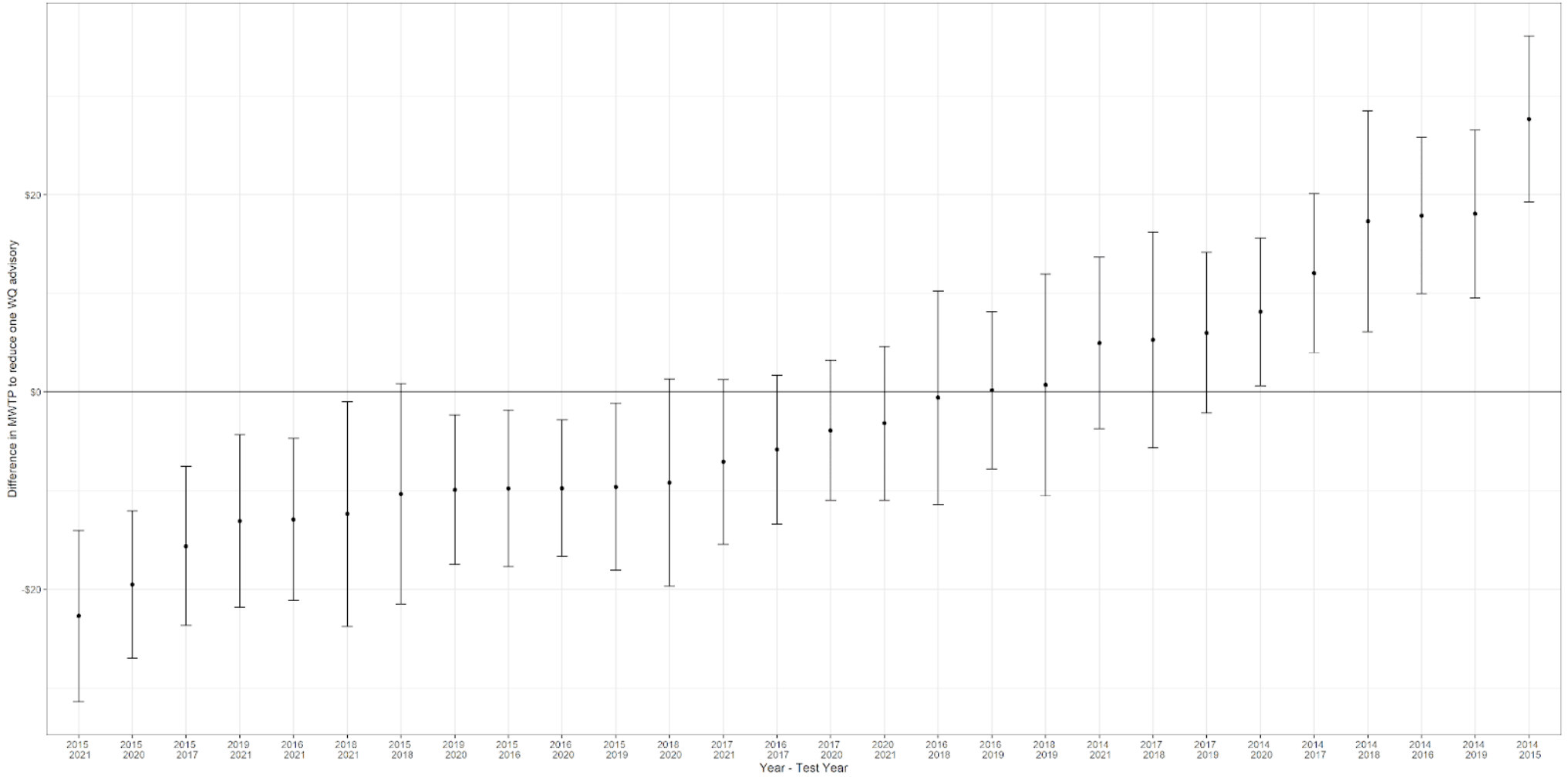
	2014	2015	2016	2017	2018	2019	2020	2021
Water advisory	-0.211	**-0.022**	-0.089	-0.129	-0.090	-0.082	-0.144	-0.168
	(0.021)	**(0.022)**	(0.018)	(0.019)	(0.032)	(0.020)	(0.015)	(0.021)
Travel cost ($00s)	-0.685	-0.716	-0.691	-0.688	-0.671	-0.646	-0.636	-0.650
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Campground ASCs	Y	Y	Y	Y	Y	Y	Y	Y
Log-L (final)	-282914	-308221	-298121	-313263	-304178	-303388	-447083	-429497
No. of individuals	62458	67098	65015	68200	66111	65115	81159	80325
No. of observations	91539	99189	94551	99234	96232	95487	134113	129103

The MWTP for reducing a water quality advisory range from $4 to $31 per trip



The Dots represent average estimates and the capped vertical lines represent 95% intervals.

Reliability tests indicate that these value estimates are statistically different in 57% of cases

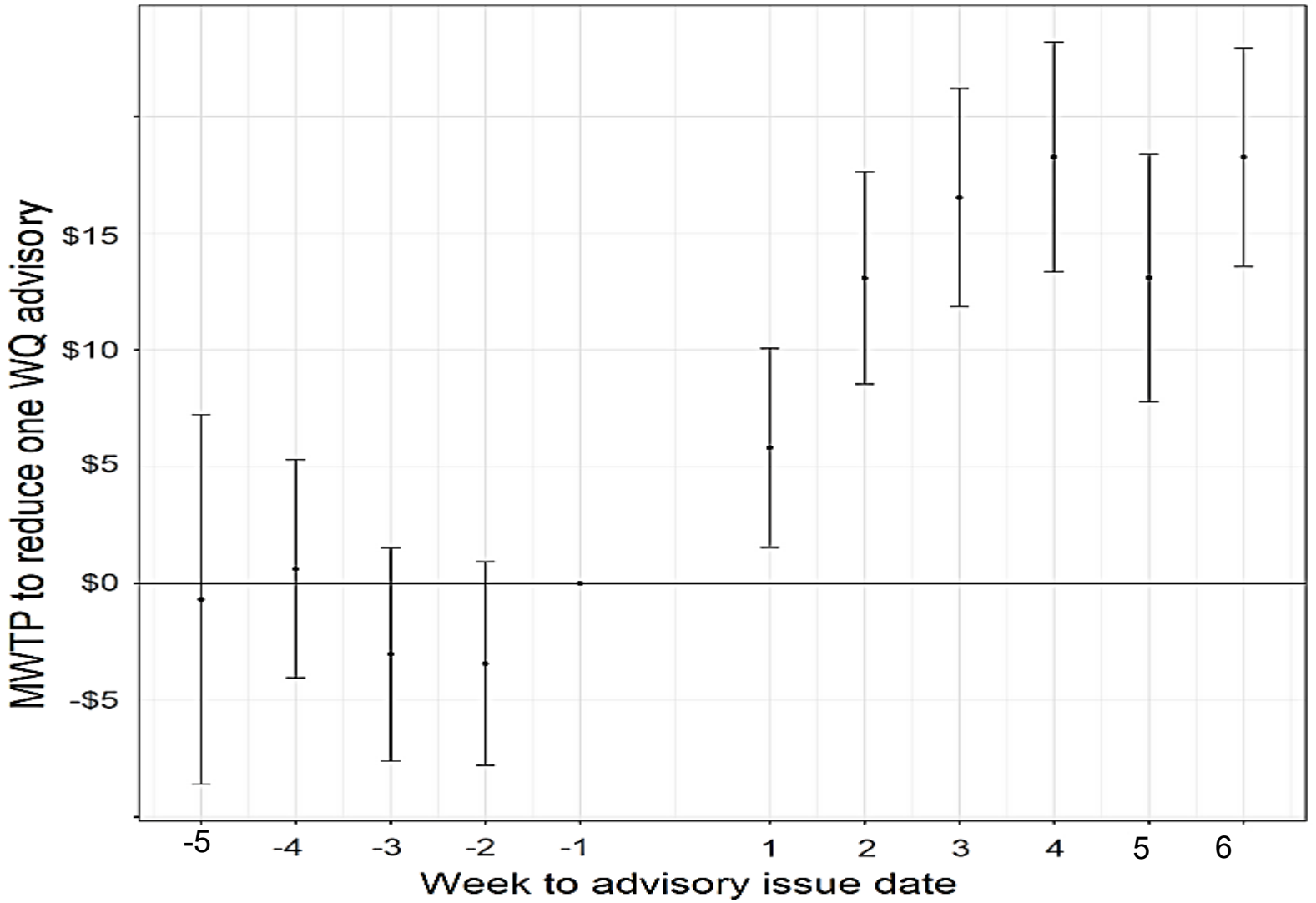


The figure shows pairwise MWTP differences each year to each of the other 'Test Years'. The Dots represent average estimates and the capped vertical lines represent 95% intervals.

Examining the dynamics of people's response to WQ changes

- Although the water advisory indicator varies over the season, it is "sticky" once an advisory is issued – it typically lasts till the end of the season
- It may raise concerns about what exactly the WQ advisory variable captures
- To address the issue, we estimate a multi-year model with all the data and include ten WQ advisory variables to capture the week(s) until/since an advisory is issued
- The single model allows us to capture both within- and across-season variation in WQ at campgrounds

MWTP for advisories is consistent after its issued



Summary

- Yes, people do respond to WQ advisories (even for camping trips)
- The eight years of data helps us assess the reliability over short time intervals (consecutive years) as well as over longer time intervals
  - The value estimates are not temporally stable over the full range of years studied
- The 2020 data allows for understanding the reliability as potentially influenced by atypical surrounding conditions such as the Covid-19 pandemic
  - Although the value estimates for 2019 and 2020 are significantly different from each other, they do not differ from some other estimates within the considered time period (2017, 2018, 2021)
- People respond quickly to WQ advisories and MWTP values are quite stable for weeks after its issued.

THANK YOU!

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