Science, Service, Stewardship

Estimating Recreation Benefits Through Joint Estimation of Revealed and Stated Preference Discrete Choice Data*

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Measuring recreational fishing economic values

Discrete choice models

- Revealed preference (RP) approach
  - Site choice models: Haab, Hicks, Schnier, & Whitehead (2012 MRE); Kuriyama, Hilger, & Hanemann (2013 ERE), Lew and Larson (2011 Land Econ, 2013 MRE), Larson & Lew (2014 AJAE), McConnell, Strand, & Blake-Hedges (1995 MRE); Raguragavan, Hailu, & Burton (2013 AJARE)

- Stated preference (SP) approach
  - Choice experiments: Anderson, Lee, & Levin (2013 Land Econ); Anderson & Lee (2013 MRE); Carter & Liese (2012 NAJFM); Lew & Larson (2012 NAJFM, 2015 Mar Policy)

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Strengths and weaknesses of RP data

- Limited range of observed site characteristics variation (e.g., catch per day, regulations)
- May have high correlation in characteristics (e.g., between catch per day variables across species) leading to multicollinearity
- More likely to lead to unbiased estimates of the role of cost

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Strengths and weaknesses of SP data

- Use of constructed experimental designs allow for avoiding multicollinearity issues and variation in key policy variables

- Hypothetical bias
  - Choices may not reflect budget and time constraints on behavior

- Respondents may focus on attributes other than cost (i.e., attribute non-attendance [e.g., Scarpa et al. 2011])
  - Downward biased cost coefficients (in absolute value)→upward biased WTP estimates

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Combining RP and SP data

- Combining SP data with RP data grounds hypothetical choices with real choice behavior
- Long history in environmental valuation literature
  - Adamowicz et al. (1994, 1997); Whitehead et al. (2008); Whitehead, Haab, & Huang (2011)
- Handful of applications in recreational fisheries
  - Whitehead, Dumas, Landry, & Herstine (2011): combined site choice and stated behavior questions (number of trips)

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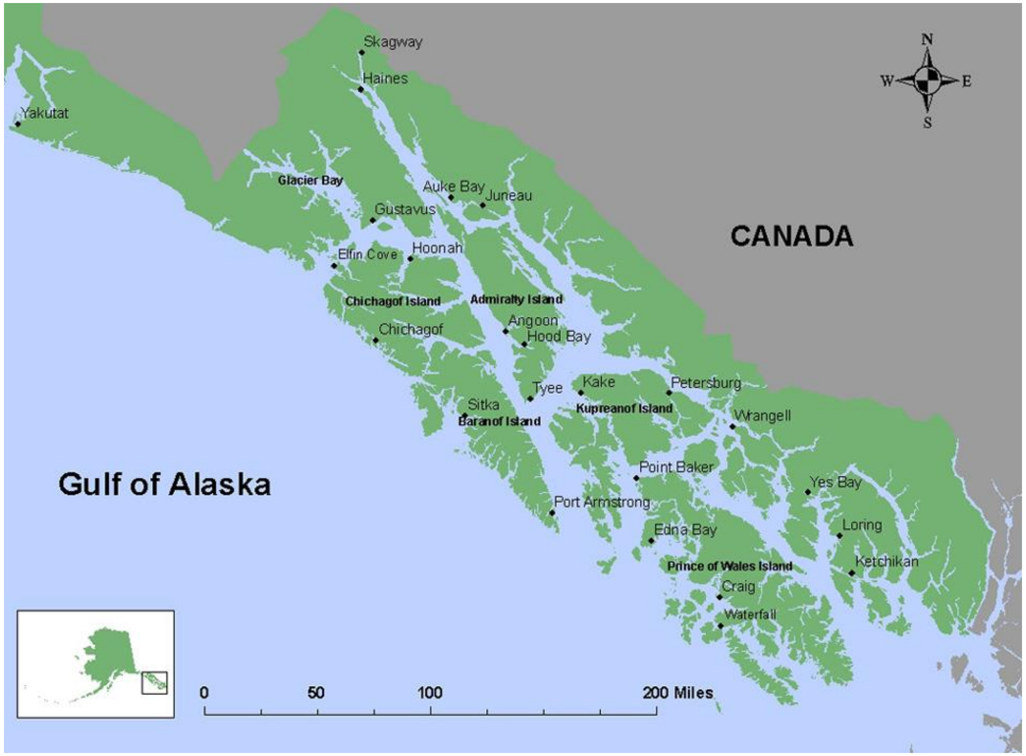
Main goals of paper

- Explore gains from combining RP and SP data using recreational fishing **choice** data
  - Survey not developed for data combination

- Compare the Generalized Mixed Logit (GMXL) model (Fiebig et al. 2010) against other models

Data

- Saltwater fishing in Southeast Alaska by resident anglers (n=204)
  - Took private boat fishing trip(s) to one or more of 10 sites in 2006
  - Provided responses to four SP questions
- Focus on individuals with both RP and SP data to illustrate gains from combining data



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Example of SP question

D5 Now, consider the three choices in this table. Below the table, indicate which of these three choices you like best and which you like least.

	Choice A	Choice B	Choice C
Charter or Private boat	Private	Private	Do something other than Alaska saltwater fishing
Number of fishing days	4	2	
Fish targeted	King salmon	Halibut	
Daily bag (take) limit *Number of fish you can keep each day*	2	2	
Catch per day *If your catch is more than the limit, some fish are released*	1	4	
Average size of fish caught	15 lbs.	40 lbs.	
Fish targeted		Silver salmon	
Daily bag (take) limit *Number of fish you can keep each day*		4	
Catch per day *If your catch is more than the limit, some fish are released*		3	
Average size of fish caught		10 lbs.	
Fishing trip cost per person *Includes all fishing trip related costs*	$50	$125	

	Choice A	Choice B	Choice C
Which do you like best? *Check one box------>*	☐	☐	☐
Which do you like least? *Check one box------>*	☐	☐	☐

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Sample characteristics

Table 1. Sample characteristics.

Variable	Mean	Std dev	Min	Max
Male	0.67		0	1
Age	46.56	13.67	18	84
Fishing experience	22.98	13.97	0	70
Income ($1000s)	80.33	45.61	5	200
Household size	2.28	1.46	1	11
Trips	11.89	10.06	1	50

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Balancing the data

- Best to have the same number of RP and SP observations so that neither data source dominates in estimation
- Four SP observations per person and 2,245 RP observations (i.e., trips) across the sample

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Balancing the data (cont.)

- Generate four RP observations
  - Simulating a typical trip (based on max visited)

- Four SP observations
  - Excluded ambiguous responses to best-worst choices
  - Assume that respondents would choose the fishing site that they select as “most preferred”

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RP-SP models: Pooling data

- Naïve models
  - Stack the data
  - Ignore scale differences between data sources

- Scale models
  - Account for scale differences between data sources
  - Nested logit “trick” (Hensher and Bradley 1993; Hensher et al. 2005)

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RP-SP models: RUM models

- Past random utility maximization (RUM) models used in literature
- Multinomial logit (MNL)
  - $U_{ij} = \boldsymbol{\beta}' \boldsymbol{x}_{ij} + \varepsilon_{ij}$, ε_{ij} ~TEV
- Mixed logit (MXL)
  - $U_{ij} = (\boldsymbol{\beta} + \boldsymbol{\eta}_i)' \boldsymbol{x}_{ij} + \varepsilon_{ij}$, $\boldsymbol{\eta}_i \sim N(\mathbf{0}, \Omega)$
- Mixed logit with error components (MXL-ECM)
  - Scale estimated as a standard deviation parameter on SP alternatives (alternative specific constants)

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Accounting for individual-level scale heterogeneity

- Generalized mixed logit (Fiebig et al. 2010)
  - Individual-level scale variation
  - The GMNL-I specification

    $U_{ij} = (\sigma_i \boldsymbol{\beta} + \boldsymbol{\eta}_i)' \boldsymbol{x}_{ij} + \varepsilon_{ij}$

  - Scale parameter specification

    $\sigma_i = exp(-\tau^2/2 + \tau w_i)$, $w_i \sim N(0,1)$

  Accounts for individual-specific and data-level scale differences

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Separate RP and SP models

Table 4. Separately estimated RP and SP models.

	MNL - RP			MXL - SP		
	Coeff.	S.E.	z	Coeff.	S.E.	z
Halibut	0.708	0.600	1.18	0.865	0.144	6.01
King salmon	7.707	1.041	7.40	0.772	0.123	6.28
Silver salmon	0.577	0.486	1.19	0.017	0.054	0.32
Travel cost	-0.051	0.004	-12.58	-0.003	0.002	-1.63
No trip x income				-0.013	0.003	-4.90
Halibut std dev				1.280	0.181	7.09
King salmon std dev				0.925	0.161	5.74
Silver salmon std dev				0.286	0.100	2.87
Cases		204			204	
Periods		1			4	
Model χ^2		116			456	
AIC/n		1.669			1.658	
Pseudo-R^2		0.08			0.25	

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Model results

	Nested logit trick		MXL-ECM		MXL		GMNL-I	
Parameters	Estimate	Std Err	Estimate	Std Err	Estimate	Std Err	Estimate	Std Err
Halibut	0.732**	0.253	0.591**	0.049	1.569**	0.179	1.852**	0.243
King salmon	7.446**	0.448	0.634**	0.048	2.138**	0.257	2.532**	0.318
Silver salmon	0.782**	0.161	0.223**	0.03	0.465**	0.084	0.582**	0.092
Travel cost	-0.042**	0.001	-0.024**	0.001	-0.04**	0.001	-0.039**	0.001
No trip x income	-0.332**	0.063	-0.053**	0.007	-0.05**	0.004	-0.051**	0.004
Std dev parameters								
Halibut			0.027	0.119	1.924**	0.188	1.465**	0.235
King salmon			0.253**	0.084	2.727**	0.25	1.888**	0.3
Silver salmon			0.074	0.081	0.71**	0.117	0.556**	0.112
Scale parameters								
τ							1.092**	0.058
Rel. scale	21.028**	2.848						
Scale (ASC1)			0.626**	0.114				
Scale (ASC2)			0.121	0.245				
Scale (ASC3-no trip)			3.081**	0.468				

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Model fit statistics

Model	AIC/n	Pseudo-R^2
NL "Trick"	3.24	0.36
MXL - ECM	3.71	0.28
MXL	1.923	0.585
GMXL	1.896	0.591

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WTP per fish caught and kept by model ($)

Model	Halibut	King salmon (Chinook)	Silver salmon (Coho)
MNL – RP only	**13.97** (-8.41, 36.36)	**152.15** (116.33, 187.96)	**11.39** (-8.3, 31.08)
MXL – SP only	**308.61** (-58.74, 675.96)	**275.72** (-54.6, 606.03)	**6.03** (-30.63, 42.69)
NL "Trick"	**17.55** (6.13, 28.97)	**178.4** (161.77, 195.03)	**18.74** (10.62, 26.87)
MXL - ECM	**24.85** (20.88, 28.82)	**26.66** (22.44, 30.89)	**9.38** (6.88, 11.88)
MXL	**39.44** (31.11, 47.77)	**53.77** (41.39, 66.14)	**11.7** (7.55, 15.84)
GMXL	**47.37** (35.61, 59.12)	**64.76** (48.81, 80.7)	**14.88** (10.23, 19.52)

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Conclusions

- Significant statistical gains to joint estimation
- Differences between RP and SP WTP estimates are mitigated
- Significant implications for SP choice experiment research
  - e.g., Metcalfe et al. (2012, WRR)

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Further work

- Include additional attributes from the SP survey and time cost variables from the RP data
- Investigate the most appropriate number of RP alternatives in the data
- Include the full sample (including nonusers from the RP data, n = 398)

Questions?


thank you
danke
gracias
merci
obrigado
dziękuję
sukriya
kop khun krap
go raibh maith agat
mochchakkeram
teşekkür ederim
ngiyabonga
dank je
grazie
arigatō
dakujem
terima kasih
спасибо
мерси
хвала
рахмат
Баярлалаа
謝謝
감사합니다
ありがとう
bedankt
enkosi
faafetai lava
kiitos
dankie
dhanyavad
hvala
mersi
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welalin
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vinaka
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misaotra
matondo
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