
Assessment of Hypothetical Bias in the Estimation of the VOT Using SP and SP-off-RP Data

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Agenda

1. Problem
2. Experiment
3. Results
4. Conclusion

Context

- Choice models
 - Understand behavior
 - Estimated using empirical observations
 - Retrieve the relative importance of attributes
- Various applications
 - Predict behavior
 - Design incentives
 - **Willingness to pay (VOT)**

RP vs SP

- Revealed Preference (RP) choice model
 - Limited range of attributes types and variance
 - Expensive
 - **True behavior**
- Stated Preference (SP) choice model
 - Any range of attributes types and variance
 - Relatively inexpensive
 - **Hypothetical bias**

Hypothetical Bias

- Transportation
 - SP Value of Time (VOT) **~50%** of RP's
 - Brownstone & Small (2005), Issacson (2007)
 - From neglecting true *scheduling* constraints?
- Marketing
 - WTP for goods overestimated **~35%**
 - Murphy et al. (2005) [review of 28 studies]
 - From neglecting true *budget* constraints?

Curbing Hypothetical Bias

- Cheap Talk: mixed results
- Monetary Incentives: positive results
- Pivoting: negative results
- SP-off-RP: **Not investigated yet**

Goals:

- Confirm hypothetical bias in SP experiments
- Assess SP-off-RP experiments ability to correct it

SP-off-RP: the best of both worlds

- Train&Wilson (2008)
- First collect RP data
 - Alternatives in SP are the same of the RP
 - SP attributes shifted to change RP choice
 - e.g. chosen RP alternative worsened in 10% and non-chosen RP alts. improved in 15%
- Endogeneity: Inconsistent estimators
 - Train&Wilson FIML method rarely applied
 - Guevara&Hess LIML (robust and *easy*)

SP-off-RP: Example

van Cranenburgh et al. (2014)

- Vacation destination choice model
 - RP: Elicit six alternatives considered on a previous vacation period + the choice
 - SP: All attributes of RP alternatives varied, except for the destinations, enhancing realism

Vacation context:	
Travel party:	Partner
Travel period:	July 2012
Destination categorie:	European

Destination	Rome, Italy
Length of stay	15 days
Accommodation type	Hotel, Hostel, apartment
Most important mode of transport to destination	Aircraft
Estimated travel costs per person (two-way)	250 euro
Estimated door-to-door total travel time (one-way)	8 hours


A map of Europe showing various countries. A red pin is placed on Italy. The map includes labels for countries like Sweden, Finland, Norway, Denmark, Poland, Germany, Austria, France, Spain, Portugal, Greece, and Turkey. It also shows the North Sea and the Bay of Biscay. The Google logo is visible at the bottom left of the map.

Fig. 1. Screen shot of vacation alternative elicitation.

Methodology

- Revealed Preferences: **VOT (RP)**
 - Self-reported alternatives, self-reported attributes and choice of **recent commute**
 - *Ex-post* recalculation of attributes from Google-Maps
- SP-off-RP: **VOT (SP-off-RP)**
 - Generate 4 profiles varying self-reported RP attribs.
- Stated Preference: **VOT (SP)**
 - Generate 4 exogenous car & transit profiles
- **Order randomized to avoid learn./tired. bias**
- **Compare VOT(SP-off-RP) &(SP) with (RP)**
- **Perform out-of-sample analysis**

SP-off-RP Design

- Seek variance yet realism on automatic display
- Same self-reported RP choice-set
- Randomly choose which attributes to vary
 - only cost
 - only time
 - only cost and waiting time
 - only cost and travel time
 - cost, time and waiting time
- RP chosen alternative worsened in $U(1.2,2)$
- RP non-chosen improved in $U(\frac{1}{2}; \frac{1}{1.2})$

SP-off-RP Design: Example

RP	Cost	Travel time	Waiting time
Car	\$3.000	25	0
Transit	\$700	40	7
Bicycle	\$0	45	0

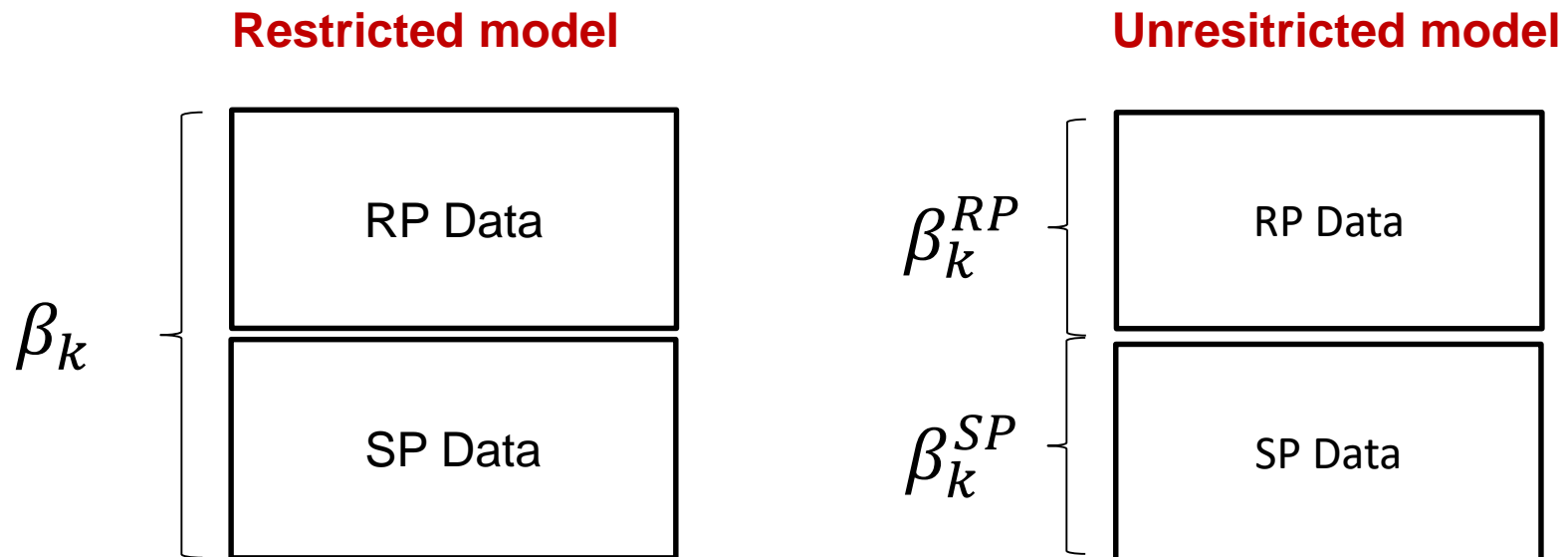
SP-off-RP	Cost	Travel time	Waiting time
Car · $U(1.2; 2)$	\$3.800	30	0
Transit · $U(\frac{1}{2}; \frac{1}{1.2})$	\$500	32	7
Bicycle · $U(\frac{1}{2}; \frac{1}{1.2})$	\$0	35	0

Analysis

- Compare VOT estimates obtained from each experiment, reporting confidence interval
- Likelihood ratio test to check whether pairs of estimates are the same for time and cost

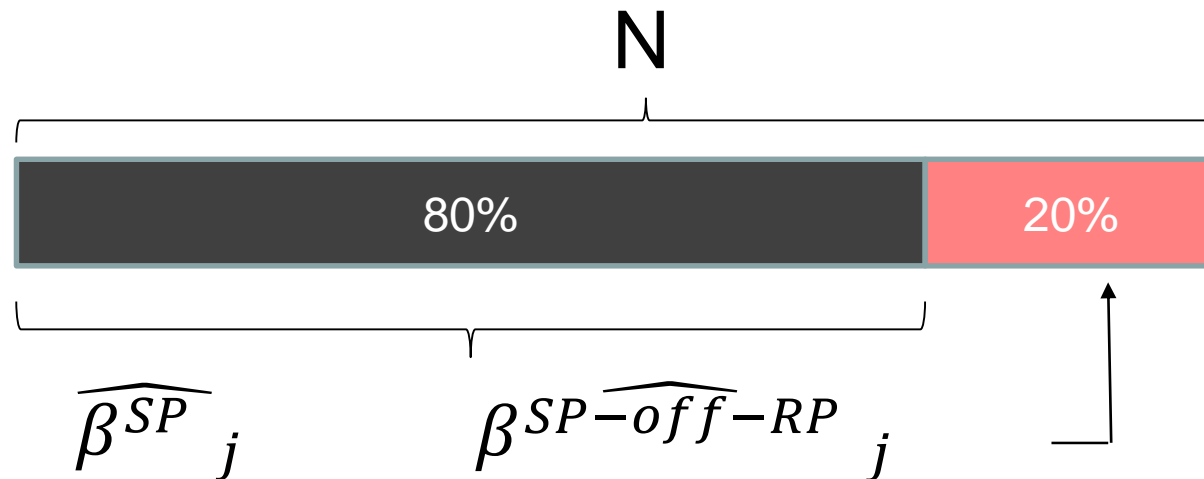
Analysis

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Analysis

- 80/20 out-of-sample analysis predicting RP choices. SP constants recalibrated (Train, 2009)



- Sample:
 - 322 individuals (322 RP, 1228 SP and SP-off-RP)
 - 80% students, 12% workers, 8% others

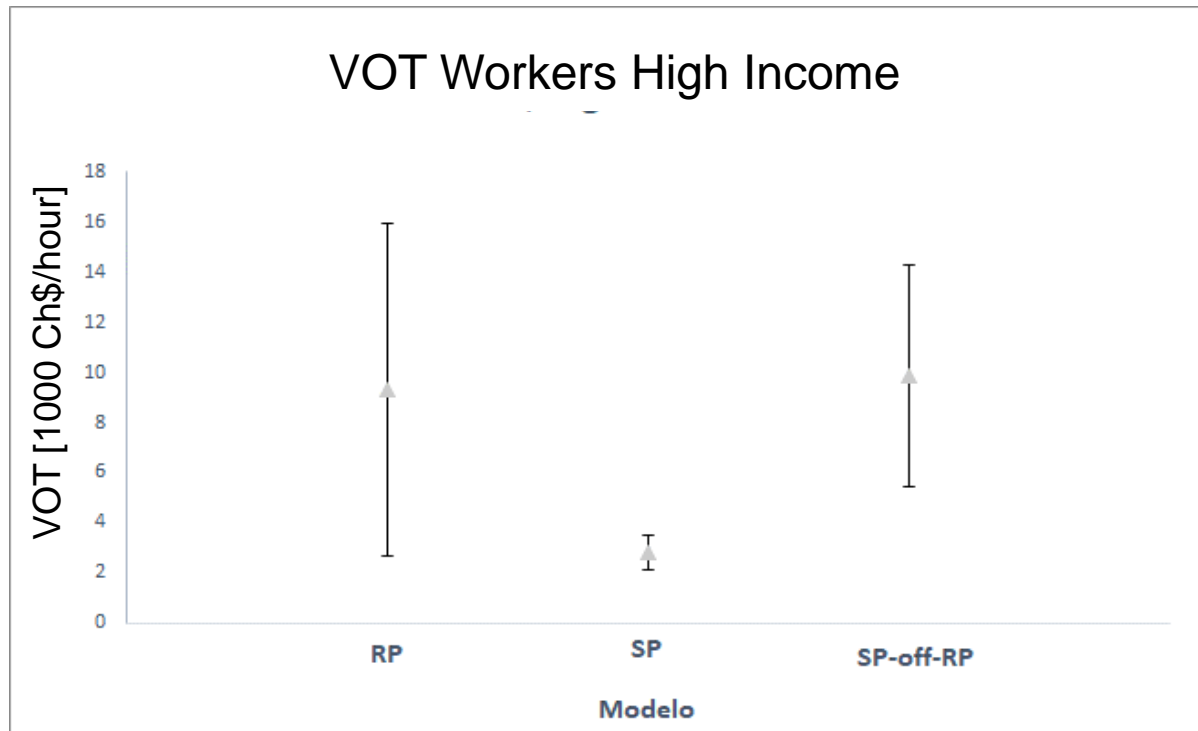
Value of Time

	RP	SP	SP-off-RP
Worker- High Income	9.440** (3.410)	2.820*** (360)	9.870*** (2.270)
Worker – Low Income	4.220* (1.690)	2.350*** (290)	4.330*** (890)
Student – High Income	5.190** (1.690)	2.580*** (290)	7.050*** (1.620)
Student – Low Income	2.320** (890)	2.150*** (230)	3.030*** (590)

*In Chilean pesos per hour (680pesos/US Dollar) ***p<0,001, **p<0,01, *p<0,05*

- Overall:
 - VOT(SP) 53% of RP, in line with literature
 - VOT(SP-off-RP) ~ RP

Value of Time (Cont.)



- RP larger variance due to smaller sample size
- SP-off-RP shows smaller empirical bias than SP

Likelihood Ratio Tests

$$\Delta L = -2 (L_R - L_U) \sim \chi^2_g$$

Null hypothesis: No hypothetical bias. Models share coefficients, besides scale and ASCs ($\Delta L = 0$)

	RP v/s SP	RP v/s SP-off-RP
ΔL	17.6	5.12
p-value	0.00731	0.530
Null Hypothetical Bias?	✗	✓

80-20 Out-of-Sample Analysis

	Average Hit-rate	Average Likelihood	Average AIC
SP	68%	56%	149
SP-off -RP	73%	59%	124

1000 repetitions

Significant differences (pvalue<0.001)

Conclusions

- Stated Preferences (SP)
 - VOT 53% of RP
 - Strong evidence suggesting abandoning SP-alone approach
- SP-off-RP
 - Results closer to RP (equality cannot be discarded)
 - Almost as inexpensive and flexible as SP without the bias
 - **More evidence is needed**
- Future Work: Why SP-off-RP seem to work?
 - Attribute levels, trade-off or both? (Hensher, 2004)
 - Compare activity at the brain level (Camerer&Mobbs, 2017)
 - Contrast with other methods (e.g. ACA, pivoting, etc.)

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