A two-stage travel survey approach to estimate the value of travel time (VTT): Comparison between short- and long-term choices

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Introduction

- Last update of Swiss norms for cost-benefit analyses in 2009
  - Two-stage surveys: Personalized mode and route choice (short-term) SP experiments
  - Results based on four pooled large-scale RP/SP studies
  - VTT for car/motorbike (MIV): 23.3 CHF/h
  - VTT for public transportation (PT): 14.4 CHF/h
- **Main questions:**
  - Current update: Changes in short-term VTT?
  - Adequate temporal dimension for capturing trade-off behavior?
  - How should long-term experiments be designed and respondents be introduced to the choice situations?

Short-term (mode and route) choices

- Advantages:
  - Short-term choices worldwide status-quo in (national) valuation studies
  - Relevant unit *willingness to pay to reduce travel time* directly relates to the choices made
  - Clear experimental setting (e.g. based on a RP trip and purpose)
- Disadvantages:
  - Variations in LOS attributes are relatively small (e.g. Beck *et al.*, 2017)
  - Vulnerable to situation-specific circumstances (especially RP choices)
  - Avoiding dominant options often unrealistic (e.g. route alternatives for MIV in a no-toll-environment)

Long-term (residential and workplace location) choices

- Advantages:
  - More natural trade-offs (e.g. living in the more expensive city center with shorter travel times; longer commuting trip for salary increase)
  - Typically substantial variations in attributes
- Disadvantages:
  - Relevant unit requires reweighting of LOS attributes in utility function
  - Multiple dimensions and attributes affected by choice
  - Choice task needs to be radically simplified; choice context is based on many assumptions (e.g. Hunt, 2010)

Literature review: Short- versus long-term VTT

- Higher long-term VTT: Travel time changes are more permanent (Peer *et al.*, 2015; Beck *et al.*, 2017)
- Lower long-term VTT: Other attributes more relevant than travel time (Tillema *et al.*, 2010; Kim *et al.*, 2005; Rouwendal and Meijer, 2001, Dubernet, 2019)

$\Longrightarrow$ No clear empirical evidence/theoretical framework

$\Longrightarrow$ VTT strongly context-dependent

Survey procedure and methods

- Two-stage RP/SP survey:
  - Stage I: RP reference values for trip purpose work, shopping and leisure; socioeconomic information (income, mobility behavior, etc.)
  - Stage II: Mode and route choice SP for one selected trip, residential location SP for all trip purposes and workplace location SP for work trip
  - Choice sets account for mode availability
  - 1'797 respondents; 27 choice observations (15 short-term; 12 long-term)
- 2 x 20 min. response time; 20 CHF incentive; 35.3% response rate

Mode choice SP

	Option 1: Walk	Option 2: Bike	Option 3: PT	Option 4: MIV
Travel time	56 min	14 min	20 min	11 min
Access + egress time			12 min	9 min
Congestion time				1 min
Transfers			0	
Headway			30 min	
Travel cost			1.00 CHF	1.00 CHF

Route choice MIV SP

	Route 1	Route 2	Route 3
Travel time	9 min	11 min	7 min
Travel cost	1.40 CHF	1.80 CHF	1.80 CHF
Access + egress time	9 min	3 min	9 min
Congestion time	3 min	1 min	1 min

Route choice PT SP

	Route 1	Route 2	Route 3
Travel time	11 min	11 min	7 min
Travel cost	4.50 CHF	7.50 CHF	4.50 CHF
Access + egress time	7 min	7 min	4 min
Transfers	2	0	2
Headway	3 min	10 min	7 min

Residential location choice SP

	Alt. 1	Alt. 2
Travel time work trip:		
MIV	35 min	27 min
PT	20 min	28 min
Bike	91 min	49 min
Travel time shop. trip:		
MIV	13 min	10 min
PT	14 min	11 min
Bike	22 min	15 min
Travel time leisure trip:		
MIV	29 min	22 min
PT	40 min	30 min
Bike	62 min	81 min
Housing plus travel costs/m.	2842 CHF	2657 CHF

Workplace location choice SP

	Alt. 1	Alt. 2
Monthly income minus travel costs	7380 CHF	6350 CHF
Travel time work trip:		
MIV	12 min	9 min
PT	13 min	7 min
Bike	25 min	14 min

Model specification

- Separate models for short- and long-term choices
  - Pooled RP/SP Mixed Logit models estimated in WTP-space, accounting for random intercepts, scale and VTT heterogeneity
  - Basic structure of VTT coefficients:

$$\widetilde{VTT}_{i,n,p} = VTT^{RND}_{i,n,p} \left(\frac{dist_{n,p}}{\overline{dist}} \right)^{\delta_{dist,i}} \left(\frac{inc_n}{\overline{inc}} \right)^{\delta_{inc,i}}$$

- Weighted estimation (according to the Swiss census data)
- Long-term travel times weighted according to trip frequencies in "regular" week (outward and return trip)
- Models estimated in *R* using `mixl` package (Molloy *et al.*, 2021)

Results: Average VTT

- Calculation of average VTT posterior means:
  - Short-term VTT (MNL): MIV close to previous Swiss norm; PT much higher
  - VTT $< 50\%$ of mean wage rate (49 CHF/h)
  - Long-term VTT substantially larger for MIV and PT (MIXL)
  - MNL vs. MIXL: Slightly smaller short-term VTT for MIV and PT; higher long-term VTT for PT

	Short-term		Long-term	
Indicator	MNL	MIXL	MNL	MIXL
VTT bike [CHF/h]	24.5	26.1	17.7	18.1
VTT MIV [CHF/h]	23.6	22.1	36.1	36.2
VTT PT [CHF/h]	20.8	18.7	16.9	25.1

Summary and conclusions

- Short-term VTT according to expectations. But ...
  - VTT has substantially increased for PT (**C**orona, **C**omfort, in**C**ome)
  - decreasing VTT when accounting for unobserved heterogeneity
- Long- versus short-term VTT
  - Clear differences present, most pronounced for MIV; presence of strong design/questionnaire effects
  - Long-term VTT based on stronger assumptions (e.g. task simplification, context, etc.)
  - Results crucially depend on the weighting according to trip frequencies
  - Incomplete activity pattern (only focus on three most frequent trips)

$\Longrightarrow$ Too many unknowns for a reliable implementation in CBA norms?

Questions?