

Intertemporal VTT changes in Switzerland

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Outline

1. Background
2. Changes in survey methodology
3. Original model specification
4. Data description and summary statistics
5. Proposed methodology to account for reference dependency

Motivation and background

- Four national SP surveys conducted since 2010
- Directly linked to the revealed preference (RP) survey MTMC
 - pivoted SP experiments for observed reference trip
 - representative datasets with high response rates
- Empirical basis for the National Passenger Transport Model (NPVM), MATSim and VTT studies (CBA)
- One additional VTT study in 2021 by ETH (D-CH)

⇒ **Data pooling** usually improves model robustness and identification (e.g. VTT for each trip purpose)

- However, substantial VTT differences btw. studies
- **Are differences in VTT artifacts of methodological changes** (see e.g. Börjesson *et al.* (2023) for SE and NL)?

Changes in survey methodology

- 2010 Establishes **personalized RP/SP setting**; relatively simple SP designs with small deviations; PAPI with large tables
- 2015 Survey **intentionally kept comparable** to 2010; mostly minor technical **improvements incl. trip routing**
- 2021 VTT study (by ETH; CAWI) for D-CH workers; **symmetric designs; focus on regular** work, shopping and leisure **trips**
- 2021 Modified experimental designs, improved trade-offs and routing; introduction of CAWI; **RP trip selection algorithm**
- 2025 **Simpler and cleaned-up** attribute sets; **more realistic** trade-offs; **table-based layout** with individual time/cost components; PT crowding by SBB; **more personalized** tasks

Changes in survey methodology

		öV-Route 1	öV-Route 2
Reisedauer			
Fahrtzeit:		12 min	22 min
+ Zu- und Abgangszeit:		11 min	23 min
+ gesamte Umsteigezeit:		4 min	4 min
Reisekosten			
Fahrtkosten:		2.60 CHF	3.80 CHF
+ Zuschlag zu Stosszeiten:		2.30 CHF	0.60 CHF
Umsteigevorgänge		1	1
Takt: Verbindung alle ...		30 min	20 min
Auslastung			
			

Changes in survey methodology

- VTT 2021 and ARE 2025: **Methodological break** in the calculation of car reference travel costs
 - Fuel/energy costs ($\approx$ **0.12 CHF/km**) represent only a fraction of the economically relevant variable costs ($\approx$ **0.3 CHF/km**), especially in the age of EVs
 - **Improved comparability** between car and PT
 - Variable costs are **standard in CBA** (e.g. ASTRA, 2022) and relevant in the **NPVM**
- ⇒ Using a **consistent cost concept** in **behavioral model** and **downstream applications** improves the comparability and transferability of results!

WTP original specification

- Focus on **route choice** experiments (e.g. Hess *et al.*, 2017)
- **Multiplicative error** structure (Fosgerau and Bierlaire, 2009)
- Income and cost attributes are in **2025 prices**
- "Simple" methodology (comparable to previous CH modeling efforts; see e.g. Weis *et al.*, 2021; ARE, 2024):

$$V_{i,n,t} = -\psi_n \log \left(x_{i,n,t}^{tc} + (1 + \mu^{mp}) x_{i,n,t}^{mp} + \mathbf{x}_{i,n,t} \beta \right) \quad (1)$$

$$\psi_n = \exp \left(\beta^{scale} \right) \left(\frac{dist_n}{20 \text{ km}} \right)^{\lambda^{scale}} \quad (2)$$

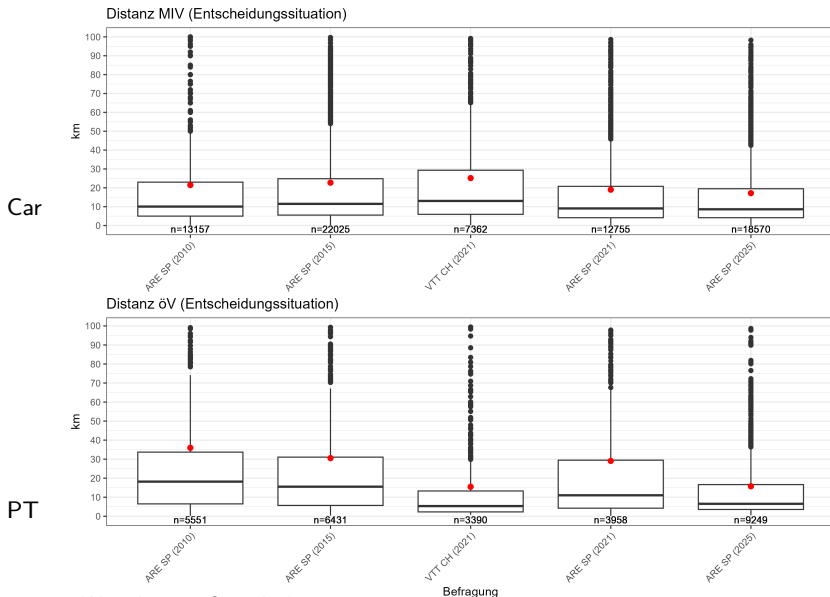
$$\beta_n^k = \beta^k \left(\frac{dist_n}{20 \text{ km}} \right)^{\lambda^k} \left(\frac{inc_n}{7 \text{ kCHF}} \right)^{\lambda^{inc}} \quad (3)$$

Respondent characteristics since 2010

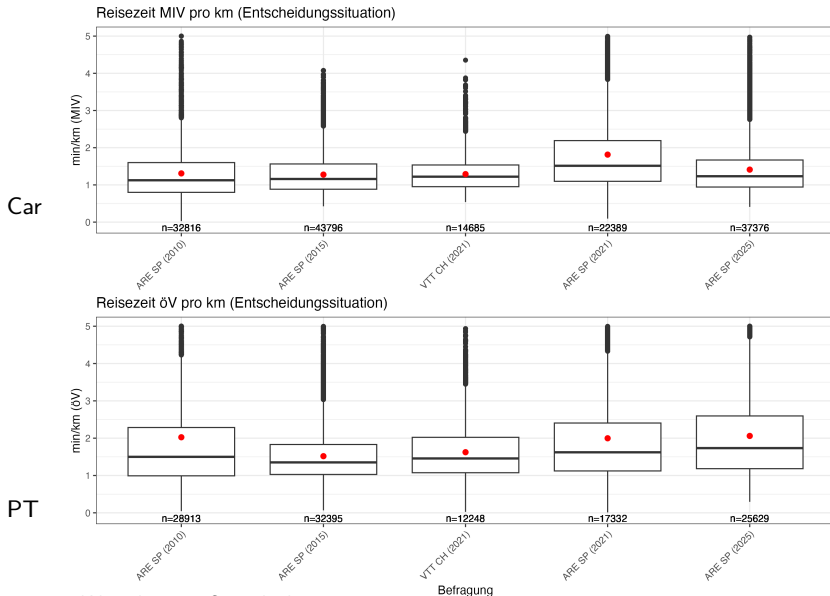
Characteristic	ARE SP (2010)	ARE SP (2015)	VTT CH (2021)	ARE SP (2021)	ARE SP (2025)
# respondents (RC car)	2'225	2'947	1'227	2'151	3'099
# respondents (RC PT)	796	855	565	667	1'544
Age (years)	50.5	47.7	40.5	50.8	?
HH income (CHF/month)	8'354	9'559	10'847	10'046	?
HH size	2.4	2.7	2.7	2.6	?
GA travelcard (%)	12.4	11.0	15.6	10.6	?
Regional travelcard (%)	14.5	14.9	11.4	10.0	?
Car always available (%)	69.0	69.2	68.5	69.0	?
Work trips (%)	25.7	27.4	34.1	32.0	24.8
Education trips (%)	2.8	2.9	0.0	3.4	1.9
Shopping trips (%)	24.6	22.0	33.8	29.8	32.6
Business trips (%)	5.1	4.4	0.0	6.4	1.9
Leisure trips (%)	41.7	43.3	32.0	28.3	38.8

- Datasets mostly homogeneous (except VTT 2021 study)
- HH-income noticeably smaller in 2010

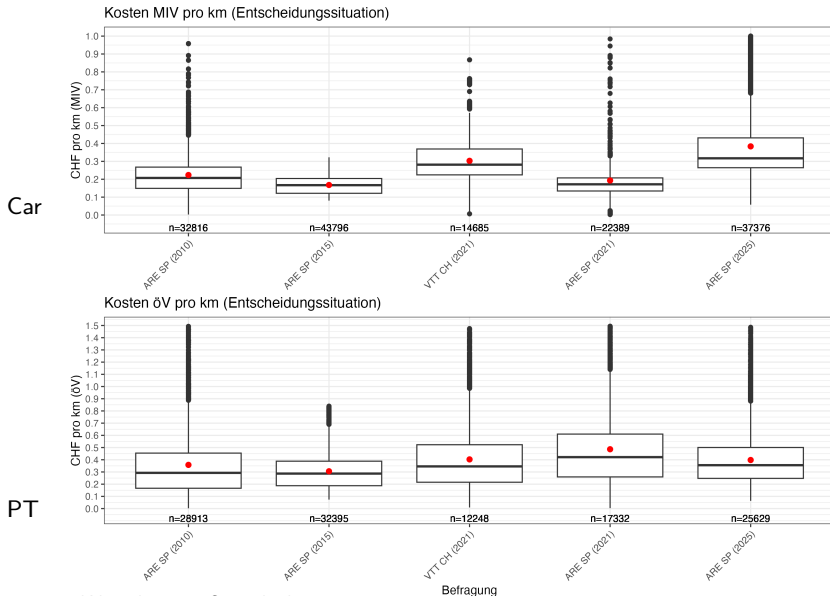
RP trip distance [km] since 2010



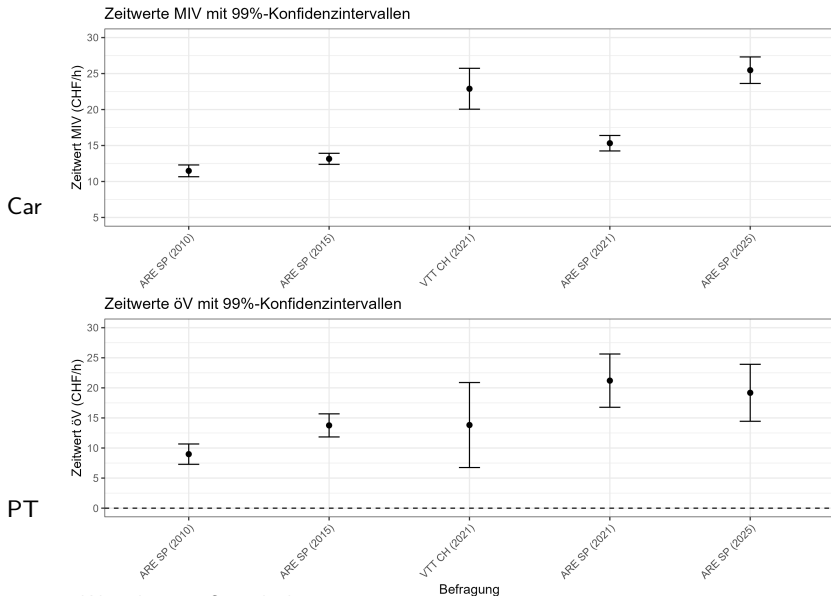
Inverse speeds [min/km] since 2010



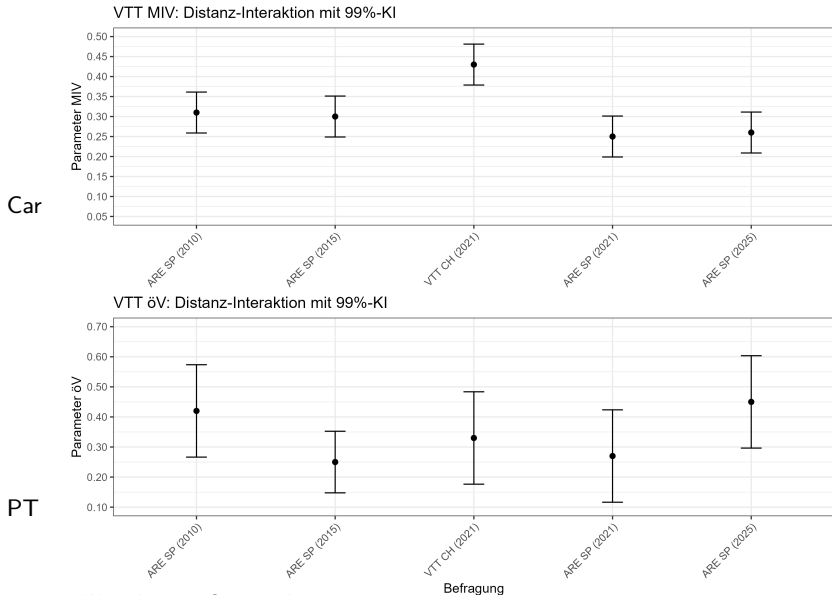
Cost per km [CHF/km] since 2010



VTT [CHF/h] with WTP specification



VTT distance elasticity with WTP spec.



Reasons for intertemporal VTT changes

Car VTT differences too large/incoherent to be explained by ...

- Survey methods, SP design and/or questionnaire layout
- Trip characteristics (distance, purpose, etc.)
- Sociodemographics (income, education, age)
- Response behavior and/or survey commitment
- Time-use during travel ($VTT = VoL - VTAT$)
- COVID-19

Is there a level effect of travel costs?

Are VTT affected by the cost levels?

Consider a simple linear utility specification:

$$V_{i,n,t} = \beta_{tt}x_{i,n,t}^{tt} + \beta_{tc}x_{i,n,t}^{tc}$$

The VTT is given by the MRS btw. travel time and cost:

$$VTT = \frac{\partial V / \partial x^{tt}}{\partial V / \partial x^{tc}} = \frac{\beta_{tt}}{\beta_{tc}}$$

For a given behavioral response and time sensitivity, higher costs imply that the same variation can be explained with a smaller β_{tc} :

$$x^{tc} \uparrow \Rightarrow |\beta_{tc}| \downarrow \Rightarrow VTT = \frac{\beta_{tt}}{\beta_{tc}} \uparrow$$

Ultimate question: What is the "actual" behavioral response?

Introducing reference dependence

- **Decisions** are made **relative to a reference point** rather than in absolute terms (Tversky and Kahneman, 1991)
- Travel time and cost increases are typically valued differently from equivalent decreases (De Borger and Fosgerau, 2008; Hess *et al.*, 2008; Börjesson and Eliasson, 2014)
- RP trip is assumed to define individual reference point
- **Hypothesis:** Respondents anchor to the attribute range shown in the SP experiment (rather than to the reference trip)
- This is **most relevant for car travel costs**:
 - **asymmetric** cost levels (particularly in ARE 2025)
 - only **vague idea** of actual car **reference costs**

Proposed methodology

- De Borger-Fosgerau-approach not feasible (≥ 3 attributes)
- Use average cost of individual n and SP choice situation t , $\bar{c}_{n,t}$, as reference point:

$$V_{i,n,t} = -\psi_n \log \left(\frac{x_{i,n,t}^{tc} \vartheta_{i,n,t}^{tc} + (1 + \mu^{mp}) x_{i,n,t}^{mp}}{\bar{c}_{n,t}^{\tau}} + x_{i,n,t}^{tt} \beta_n^{tt} \vartheta_{i,n,t}^{tt} + .. \right)$$

- Accounting for sign and size effects relative to $\bar{c}_{n,t}$ (ϑ^{tc} and ϑ^{tt})
- Core idea: **Disentangling estimation** and final **VTT calculation**, for $\bar{c}_{n,t}$ using the variable trip costs in the MTMC:

$$VTT_n = \frac{\partial V / \partial x^{tt}}{\partial V / \partial x^{tc}} \approx \hat{\beta}_n^{tt} \hat{\bar{c}}_{n,t}^{\tau}.$$

Questions?

