Productive use of travel time, values of time and reliability in The Netherlands

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Contents of this presentation

- The three national VTT surveys for **passenger** transport in The Netherlands
  - Methods used
  - Main results from the 2009/2011 survey
  - Some new results on the impact of time and cost on the VTT

- **Productive** travel time and the Hensher equation for **business** trips

- **Useful** travel time for all purposes

- **Changes** in the VTT over the years
  - Results so far from The Netherlands
  - Zero VTT?
But first (something to think about):

“What is a cynic?

... A man who knows the price of everything and the value of nothing.”

Lord Darlington, Act III of Lady Windermere’s Fan (1892), Oscar Wilde
### The Dutch national VTT studies (passengers)

<table>
<thead>
<tr>
<th>Year</th>
<th>Methodology</th>
<th>Segments</th>
<th>SP experiments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>(en-route and mailback)</td>
<td>Car, Train, Local PT</td>
<td>2 attributes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Time vs. Cost</td>
</tr>
<tr>
<td>1997</td>
<td>(en-route and mailback)</td>
<td>Car, Train, Local PT</td>
<td>2 attributes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Time vs. Cost</td>
</tr>
<tr>
<td>2009 &amp; 2011</td>
<td>(internet panel)</td>
<td>Car, Train, Local PT, Air</td>
<td>2 attributes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Time vs. Cost</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 attributes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Time vs. Cost vs Reliability</td>
</tr>
</tbody>
</table>
Common characteristics of all three studies

- The **goal** is standard values by mode and purpose for CBA

- VTTs are **escalated** using an *income elasticity* of the VTT, but this may not properly capture structural changes
  - Hence the requirement to **redo** the VTT study every ten years or so

- Reliance of **WTP** of travellers using within-mode SP experiments

- **Discrete choice** models with interaction terms for observed heterogeneity
  - 2009/2011 survey used power-law functions of (base) time and cost, and panel latent class models for unobserved heterogeneity

- **Use of the Hensher equation** for business VTT

- **Expansion** of survey results to national average values using the national travel surveys
Example of an SP choice screen (experiment 1)

1988/1997:

<table>
<thead>
<tr>
<th>A</th>
<th>(1)</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reisduring</td>
<td>HETZELFDE</td>
<td>als nu</td>
</tr>
<tr>
<td>Reiskosten</td>
<td>HETZELFDE</td>
<td>als nu</td>
</tr>
<tr>
<td>Reisduring</td>
<td>20 MINUTEN LANGER</td>
<td>dan nu</td>
</tr>
<tr>
<td>Reiskosten</td>
<td>f 2,00 LANGER</td>
<td>dan nu</td>
</tr>
</tbody>
</table>

Note: no reference value, Changes only with respect to “As Now”

2009/2011:

Welke rit heeft uw voorkeur?

Rit A
Gebruikelijke reistijd: 60 min.
Kosten: € 2.80

Rit B
Gebruikelijke reistijd: 45 min.
Kosten: € 3.60

Voorkeur voor Rit A
Voorkeur voor Rit B
Example of an SP choice screen (experiment 2a)

Welke rit heeft uw voorkeur?

**Rit A**
Vertrektijd: 08:10
U heeft een even grote kans op elk van deze 5 reistijden en dus om op deze tijdstippen aan te komen:
- 25 min. -> 08:35
- 35 min. -> 08:45
- 55 min. -> 09:05
- 75 min. -> 09:25

Gebruikelijke reistijd: 35 min.
Kosten: €1.80

☐ Voorkeur voor Rit A

**Rit B**
Vertrektijd: 08:00
U heeft een even grote kans op elk van deze 5 reistijden en dus om op deze tijdstippen aan te komen:
- 35 min. -> 08:35
- 45 min. -> 08:45
- 55 min. -> 08:55
- 65 min. -> 09:05

Gebruikelijke reistijd: 45 min.
Kosten: €2.80

☐ Voorkeur voor Rit B
## Main results: VTT in euro/hour (2010 prices)

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>Train</th>
<th>Bus, tram, metro</th>
<th>All surface modes</th>
<th>Air</th>
<th>Recr. Navigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commute</strong></td>
<td>9.25</td>
<td>11.50</td>
<td>7.75</td>
<td>9.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Business employee</strong></td>
<td>12.75</td>
<td>15.50</td>
<td>10.50</td>
<td>13.50</td>
<td>85.75</td>
<td></td>
</tr>
<tr>
<td><strong>Business employer</strong></td>
<td>13.50</td>
<td>4.25</td>
<td>8.50</td>
<td>10.50</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Business</strong></td>
<td>26.25</td>
<td>19.75</td>
<td>19.00</td>
<td>24.00</td>
<td>85.75</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>7.50</td>
<td>7.00</td>
<td>6.00</td>
<td>7.00</td>
<td>47.00</td>
<td>8.25</td>
</tr>
<tr>
<td><strong>All purposes</strong></td>
<td>9.00</td>
<td>9.25</td>
<td>6.75</td>
<td>8.75</td>
<td>51.75</td>
<td>8.25</td>
</tr>
</tbody>
</table>
### Main results: reliability ratios

(standard deviation relative to time)

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>Train</th>
<th>Bus, tram, metro</th>
<th>All surface modes</th>
<th>Air</th>
<th>Recr. Navigation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commute</strong></td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Business</strong></td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0</td>
</tr>
</tbody>
</table>
The impact of base time on VTT (new results)

- Trip distance is not an explanatory variable in the model
- Time and cost of the reference trip are (in a non-linear way)
- Also indirect effect from other explanatory variables
  - High income respondents make on average longer trips and have higher values-of-time
- Sample enumeration shows total effect
The impact of base cost on VOT (new results)
Productive travel time and the Hensher equation
Based on DeSerpa (1971), McFadden (1981) and Jara-Diaz (2008) we define the Value of Travel Time (VTT) for project appraisal as:

\[
VTT = \frac{\mu}{\lambda} - \frac{\partial U}{\partial T}
\]

Where does time gain go to? Employer or employee?

- Utility at origin or destination
- Utility while travelling, e.g. work during trip

\( \mu = \) Lagrangian multiplier of the time constraint
\( \lambda = \) Marginal utility of income;
\( U = \) Direct utility;
\( T = \) Travel time

How much trip time is spent working?

How productive is working during trip relative to the workplace?
## Fraction of saved time that would be spent working (business trips)

<table>
<thead>
<tr>
<th></th>
<th>1988</th>
<th>1997</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>0.67</td>
<td>0.54</td>
<td>0.56</td>
</tr>
<tr>
<td>Train</td>
<td>0.47</td>
<td>0.37</td>
<td>0.38</td>
</tr>
<tr>
<td>BTM</td>
<td>0.53</td>
<td>0.34</td>
<td>0.54</td>
</tr>
<tr>
<td>Airplane</td>
<td></td>
<td></td>
<td>0.21</td>
</tr>
<tr>
<td>Total</td>
<td>0.63</td>
<td>0.50</td>
<td>0.51</td>
</tr>
</tbody>
</table>
## Fraction of trip time spent working (business trips)

<table>
<thead>
<tr>
<th></th>
<th>1988</th>
<th>1997</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>0.02</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>Train</td>
<td>0.11</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>BTM</td>
<td>0.03</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>Airplane</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.03</td>
<td>0.06</td>
<td>0.06</td>
</tr>
</tbody>
</table>
### Productivity of work during travel
(relative to work at the workplace; business trips)

<table>
<thead>
<tr>
<th></th>
<th>1988</th>
<th>1997</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>0.90</td>
<td>0.93</td>
<td>0.91</td>
</tr>
<tr>
<td>Train</td>
<td>0.89</td>
<td>0.90</td>
<td>0.94</td>
</tr>
<tr>
<td>BTM</td>
<td>0.93</td>
<td>0.89</td>
<td>0.83</td>
</tr>
<tr>
<td>Airplane</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
<tr>
<td>Total</td>
<td>0.89</td>
<td>0.92</td>
<td>0.91</td>
</tr>
</tbody>
</table>
Useful travel time (all trip purposes)
Some background questions on useful travel time
(2009/2011 survey; all purposes)

- Which devices did you have available during the trip?
  - mobile phone
  - computer, laptop, Blackberry, etc.
  - music player (radio/CD/Ipod/ etc.)
  - other

- Could you spend the travel time in the vehicle usefully (yes, no)?

- Which activity would the respondent have carried out in case of a shorter trip duration (by a certain amount)?
  - Would such a shorter trip duration be useful?

- Which activity would the respondent have reduced (or not carried out) in case of a longer trip duration (by a certain amount)?
  - Would such a longer trip duration be an annoyance?
The estimated model
(further analysis on the 2009/2011 VTT survey data)

- personal attributes
- computer, laptop, … available during trip

spending travel time in a useful way

value of transport time VTT

other trip attributes

useful alternative activity
Main findings on useful travel time

- If a shorter travel time is useful / a longer travel time is an annoyance, the VTT increases by approx. 20%
  - Travel time can be replaced by a more useful activity
  - Applies to all modes, all purposes

- If travel time can be spent in a useful way, the VTT decreases by approx. 20%
  - Only for train and local public transport

- The availability of computers during a trip has reduced the VTT by approx. 2%.
  - If everybody would have a computer available during the trip, the VTT will be reduced by another 1%
Change in the value of travel time over the years
VTT over the years
Earlier results on the longitudinal income elasticity of the VTT

- **Meta-analysis**
  - Measure VTT and income in multiple countries and over time
  - Observed values tend to 1
  - However, do not take all differences between studies into account (i.e. design and utility specification)

- **Longitudinal comparisons**
  - Measure VTT and income at multiple moments in time in a single country
  - Use same analysis method for both years
  - Few studies exist (Gunn, 2001; Tapley et al., 2007; Börjesson et al., 2012)
    - Over time VTT grows less than income (income elasticity of 0.5)
    - Suggested this has to do with productive use of travel time (increasing through ICT)
Comparing studies of 1997 and 2009/2011

- New material for Sweden and The Netherlands was presented at ICMC 2017 (Kouwenhoven, Börjesson, Daly and de Jong)

- For The Netherlands, this compared the studies of 1997 and 2009/2011

- For most mode-purpose combinations the real VTT goes up
  - But not by as much as income does

- For some mode-purpose combinations the real VTT even goes down

- This is related to productive use of travel time and ICT developments
Are we going to zero VTT? - I

- “It is difficult to make predictions ...
Are we going to zero VTT? - I

- “It is difficult to make predictions ...
  especially about the future”

  *Danish proverb*

- “It is far better to foresee even without certainty than not to foresee at all.”

  *Henri Poincaré, French mathematician, 1854-1912*
Are we going to zero VTT? - II

- ICT developments have made working in the train **almost as productive** as working at the workplace (factor 0.94)

- **Automated vehicles** could also make this possible in the car
  - And car would be quieter and not crowded

- But another requirement for zero VTT is that we **work all the time we travel**
  - Only 16% of travel time in the train is spent working by business travellers

- Some travel time cannot be converted to work (finding a seat in the train, time in crowded conditions)
Are we going to zero VTT? - III

- On the other hand, travel time spent for other uses than work can also yield utility
  - But on average this has a lower value than working

- So, large changes in the *how we spent* travel time are required for zero VTT

- It’s likely that VTT will **not increase** as much as income or will even **decline**

- So, time escalation factors of (close to) 1 should be **reconsidered**
Thank you for your attention!

Any questions?

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