Integrated timetables for railway passenger transport services

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Definition of integrated timetables

Level 0

• No regular timetable

Level 1

• Regular timetables: trains travel regularly

Level 2

• Symmetric regular timetables: trains meet in a railway station (network node) at a specific time (but not necessarily always at the full hour)

Level 3

• Integrated regular interval timetables: Symmetric timetables where trains meet in all network nodes at a specific time at e.g. the full hour. The symmetry of connections is valid for connections between defined network nodes

Level 4

• Metro frequency: Trains travel at a frequency which is so high (5 to 10 minute frequency) that timetables become irrelevant
Research questions and methods

- Research questions in this paper
  - Pros and Cons of IRIT
  - Requirements for a successful introduction of IRIT
- Research methods
  - Quantitative model to assess the effect on passenger’s utility
  - Case studies on CH, the NL and the UK based on desk research and interviews
Quantitative Model: Effect of IRIT on passenger utility

Description of the model

- Directed graph constructed from a given timetable
- Dijkstra’s Algorithm to get shortest traveling routes and corresponding traveling times
- Delays underlie a certain probability distribution and do not occur at starting stations of a line
- Individual chooses mode of transportation by minimizing money costs $P$, opportunity costs $K$ of elapsed time $T$ and by maximizing reliability (measured as variance):

$$\bar{\pi} = \alpha (P + KE[T]) + \beta Var(T)$$

- Equation captures value of time and reliability. Estimation of $\alpha$ and $\beta$ allows statements on change of utility and demand as well as discussion of trade-off between prices and delays.
Quantitative Model: Effect of IRIT on passenger utility

Description of the model

- Quantitative model to estimate passenger’s utility under several time table regimes
- Model can be used
  - to compare traveling times between two timetable regimes
  - to discuss the effect of delays on traveling times
  - to assess overall welfare in different time table regimes
  - to address the financial viability of ITIF under market entry
Quantitative Model: Effect of IRIT on passenger utility

Illustrative example

- Example calculated for timetable with four different lines which all meet at one station in the middle
- Simulation results:
  - IRIT allows shorter traveling times on routes with transfers
  - IRIT is more sensitive to delays
  - Effect of delays on overall traveling times:

![Graph showing Avg. Traveling Times and Share of Delayed Trains μ]

Avg. Traveling times and share of delayed trains $\mu$
Pros and Cons of IRIT

Pros

- Improvement of quality concerning services
- transfers/total travelling time
- direct connections
- Punctuality
- easy to memorise timetables
- Strengthening of rail transport in modal split
- More efficient infrastructure investment and capacity usage

Cons

- Scarce capacity
- Slower freight transport
- Barriers to entry vs. Cherry picking

Development of modal split

Traffic volume at rush hour at Zurich railway station
The success of Bahn 2000 in Switzerland

Since 1997: Every 2 years introduction of additional steps of Bahn 2000

Introduction of main part of Bahn 2000

Quelle: Bundessamt für Statistik
## Regulatory implementation of IRIT in the UK, CH and the NL

<table>
<thead>
<tr>
<th></th>
<th>CH</th>
<th>NL</th>
<th>UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority of IRIT in capacity allocation</td>
<td>✓</td>
<td>✓ (indirect)</td>
<td>-</td>
</tr>
<tr>
<td>Obligatory coordination in line with IRIT</td>
<td>✓</td>
<td>✓</td>
<td>-</td>
</tr>
<tr>
<td>Licensing regime</td>
<td>Exclusive license for national passenger rail services for SBB. Tendering of regional transport services is possible but not obligatory</td>
<td>Exclusive license for national public transport for NS Direct licensing of private transport services, tendering is possible. Open acces in cross-border rail transport.</td>
<td>Franchising by tendering licenses for regional rail networks</td>
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Requirements for a successful introduction of IRIT

- Infrastructure investment and financial resources
  - Planning according to demand
  - Infrastructure and trains are planned according to timetable (service offer)
  - Time schedule of the introduction depends on needed infrastructure and available resources
  - Priority list

- Regulatory implementation
  - Priority rule
  - Coordination obligation
  - Licensing regime
  - Compatibility with EU framework
Thank you for your attention!

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