Mode and Carrier Choice in the Quebec City - Windsor Corridor

A Random Parameters Approach

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Outline

1. Purpose and Context
2. The Stated Preference Survey
   - Survey Development
   - Survey Description
3. Modeling, Results and Conclusions
Acknowledgements

- Transport Canada
- Railway Association of Canada
- Transports Québec
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Freight Transportation in Canada

- Overall freight traffic in Canada is increasing rapidly
- Truck traffic is growing much faster than rail
- Road freight mode split particularly high in the Quebec City - Windsor Corridor
- Road freight traffic is much more GHG intensive than rail
- Can traffic be shifted to rail?
- Quantifiable models of mode choice are needed
The Quebec City - Windsor Corridor
Contestability

- The degree to which traffic can realistically be shifted from one mode to another
- i.e. TRAFFIC is contestable
- Since truck is the benchmark, contestability means...
- ...degree to which traffic can be taken from trucks
‘Standard’ Corridor Service Offerings

- In the Corridor, main intercity destinations have standard, ‘lumpy’ delivery times
  - e.g. Montreal - Toronto overnight
- Moreover, the general pattern of a shipment is:
  1. Pick-up in PM
  2. Delivery in AM
  3. Often the delivery time is ‘by-appointment’
- Competing with trucks means meeting these standards
Realistic Intermodal Options

- Several intermodal options exist (TOFC, COFC, Railcar, etc.)
- Given the exacting characteristics of standard service offerings...
- ...the only current competitive intermodal option is premium-TOFC
Premium-Intermodal

- Late 1990s Canadian Class 1 railways introduce new generation TOFC:
  - scheduled services
  - faster loading times
  - improved ride
- AKA: Smooth-ride Piggyback

Used as the model for premium-intermodal transportation
Previous Freight SP Studies

- There have been several
- They differ in two important ways:
  - survey respondents are:
    - sometimes end-shippers,
    - sometimes end- and own-account shippers
  - sometimes within-, sometimes between-mode surveys
The Concept of End-Shipper

- The important shipping players are:
  - the shipper
  - the carrier
  - the receiver
- They are not mutually exclusive
  - e.g. own-account shippers
- ‘End-shippers’ hire others to carry their shipments
In understanding use of intermodal:

- Two potentially interesting agents:
  - the shipper
  - the carrier
- Carriers put trailers on trains...
- ...but carriers are constrained by shipper preferences...
- thus a shipper carrier-choice model.
Sampling Frame

Corridor shipping managers of ‘end-shippers’:
- manufacturers...
- wholesalers and retailers...
- ...with more than 50 employees
- Freight Arrangers (3PLs, etc.)
- Around 7,000 in total

Source: D&B MDDB
Secondary Research & Pre-interviews

- Literature review → relevant attributes
- Interviews of potential respondents
  - right attributes?
  - enough information?
  - realistic attribute ranges?
- Knowledgeable interviewees invited to focus group
Sample Survey Question

It is the beginning of your work day. You are responsible for sending a pallet of mason jars from Toronto to Montreal that is supposed to arrive tomorrow before noon.

Given the characteristics of the carriers, please select which carrier you would choose for this shipment:

<table>
<thead>
<tr>
<th>Company</th>
<th>Company A</th>
<th>Company C</th>
<th>Company B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$150</td>
<td>$165</td>
<td>$135</td>
</tr>
<tr>
<td>On-Time Reliability</td>
<td>98%</td>
<td>85%</td>
<td>92%</td>
</tr>
<tr>
<td>Damage Risk</td>
<td>0.75%</td>
<td>1.5%</td>
<td>3%</td>
</tr>
<tr>
<td>Security Risk</td>
<td>1%</td>
<td>0.5%</td>
<td>1.5%</td>
</tr>
<tr>
<td>How the shipment will be carried</td>
<td>Truck only</td>
<td>Truck only</td>
<td>By rail on a portion of the trip</td>
</tr>
</tbody>
</table>

Follow these links for more information on carrier attributes, "per-unit-cost shipments," or other shipment attributes.
The Intermodal Variable

- Previous studies incorporated mode as an explicit alternative
- Included here as carrier attribute
- Indicates shipment is partly by rail
- Tests whether carriers have opinion about rail
- Unclear what sign to expect:
  - general negative image of rail
  - some saw environmental PR benefit
Survey Implementation

- Telephone marketing firm contracted to:
  - contact and pre-interview potential respondents
  - send respondents survey access information follow-up with non-respondents
- Raffle was offered as incentive
- Roughly 11,000 calls to entire sample
- 392 completed surveys
Standard Conditional Logit

- The MNL is the most common method used to model discrete choice

\[ P_{ni} = \frac{e^{\beta'x_{ni}}}{\sum_{j=1}^{J} e^{\beta'x_{nj}}} \]

Assumes:
- preferences constant across individuals
- errors not correlated across observations
Mixed-logit with Panel Data

- The mixed-logit obviates these limitations
- In the case of panel data:

\[
L_{ni}(\beta) = \prod_{t=1}^{T} \left[ \frac{e^{\beta_n' x_{nit}}}{\sum_{j=1}^{J} e^{\beta_n' x_{njt}}} \right]
\]

- Using simulation methods to integrate over the betas...

\[
P_{ni} = \int L_{ni} f(\beta) d\beta
\]
Model Results - Carrier Attributes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mixed Logit</th>
<th>MNL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost(ln)</td>
<td>-4.72</td>
<td>-3.83</td>
</tr>
<tr>
<td>On-time Reliability</td>
<td>0.120</td>
<td>0.10</td>
</tr>
<tr>
<td>Damage Risk</td>
<td>-0.44</td>
<td>-0.37</td>
</tr>
<tr>
<td>Security Risk</td>
<td>-0.17</td>
<td>-0.14</td>
</tr>
<tr>
<td>Intermodal</td>
<td>-1.15</td>
<td>-0.83</td>
</tr>
<tr>
<td>Std. Dev. Intermodal</td>
<td>1.34</td>
<td></td>
</tr>
<tr>
<td>Final LLF</td>
<td>-4339</td>
<td>-4660</td>
</tr>
</tbody>
</table>

All coefficients significant at 5%

Estimated with BIOGEME
Model Results - Shipper Characteristics

- 3PLs less sensitive to damage risk
- 3PLs are less sensitive to cost for high-value goods
- Larger companies more sensitive to on-time reliability
## Model Results - Shipment Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Reliability</th>
<th>Damage</th>
<th>Train</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-value</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By-appointment</td>
<td>-</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perishable</td>
<td></td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fragile</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Long</td>
<td>+</td>
<td>-</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

All coefficients significant at 5%
Conclusions

In understanding freight mode choice:
- end-shippers need to be considered apart from other shippers
- shipment distance affects choice characteristics
- innovative method to evaluate mode preferences
- benefits from random parameter approach

With respect to shipment mode:
- strong bias against intermodal carriers on average
  - a challenge for increasing rail mode share
- but 20% not negatively affected by rail