Shipper Demand on the Columbia/Snake River System

Analysis of stated-preference questions based on revealed-preference choices

by
Kenneth Train
Wesley W. Wilson

Revealed-preference data: Shippers' chosen modes and routes

- Reflect actual choices in real-world setting
- Little variation in rates, times, and reliability

Standard Stated-Preference Experiments

- Offer shipper a choice among several hypothetical options
- Cost, time, reliability of each option is given
- Shipper states which option they would choose.

Which option would you choose?

Option A

- Rate: $6 / ton
- Time: 4 days
- Chance of arriving on time: 80%

Option B

- Rate: $5 / ton
- Time: 5 days
- Chance of arriving on time: 75%

Potential disadvantages of standard SP experiments

- Choices do not reflect shipper's situation
- Can seem unreal or silly to shippers
- Not all attributes of options are specified
- Shippers' choices can be arbitrary

SP-off-RP

- What mode and route did you use for your last shipment?
- Would you have still chosen this mode and route if
  - the cost were 25% higher?
  - the transit time were 10% longer?
  - the chance of reaching the destination on time was 30% less?
- If not, which mode and route would you have used instead?

Econometrics

- Examine shipper's choice for last shipment and answers to sp-off-rp questions
- Same unobserved factors affect both
- Possible randomness in sp-off-rp answers

RP choice

Utility: $U_j = bx_j + e_j$

Probability of chosen alternative:

$$P_i = \Pr(U_i > U_j \forall j \neq i) = \frac{e^{bx_i}}{\sum e^{bx_j}}$$

SP-off-RP choices

Utility: $W_j = b\tilde{x}_j + e_j + \mu_j$

Standard deviation of $\mu_j \propto 1/a$

Probability of choosing alt. *k* in sp-off-rp:

$$P_{k|i} = \int \frac{e^{ab\tilde{x}_k + ae_k}}{\sum e^{ab\tilde{x}_j + ae_j}} f(e \mid U_i > U_j \forall j \neq i) de$$

Sample

- Conducted by Jessup and Casavant
- Pre-tested survey instrument
- Sampled 181 warehouses
- Sample is 46% of 391 eligible warehouses
- 85% are grain shippers

Alternatives

- Truck to Pasco, barge to Portland
- Truck to other port, barge to Portland
- Rail to Portland
- Truck to rail terminal, rail to Portland
- Barge to Portland
- Other

Shipper was asked, for last shipment:

- which alternatives were available
- rates, time and reliability of each alternative
- which alternative they used.

Average rates per ton-mile

Truck to Pasco, barge to Portland	5.0
Truck to other port, barge to Portland	4.2
Rail to Portland	3.7
Truck to rail terminal, rail to Portland	4.2
Barge to Portland	2.6
Other	13.1

Average time in days

Truck to Pasco, barge to Portland	11.2
Truck to other port, barge to Portland	4.1
Rail to Portland	10.4
Truck to rail terminal, rail to Portland	11.3
Barge to Portland	1.1
Other	4.4

Average reliability

Truck to Pasco, barge to Portland	77.3
Truck to other port, barge to Portland	90.5
Rail to Portland	63.2
Truck to rail terminal, rail to Portland	73.0
Barge to Portland	88.1
Other	90.1

Model on RP Data alone

- Rate -0.125 1.98
- Time -0.034 1.07
- Reliability 0.032 2.84

1 day = 27 cents per ton

1% reliability = 26 cents per ton

Model on RP and SP Data

- Rate -0.209 5.62
- Time -0.148 6.36
- Reliability 0.028 6.13
- Scale 5.59 3.44

1 day = 71 cents per ton

1% reliability = 14 cents per ton

Random coefficients

- Price coefficient: fixed
- Time coefficient: censored normal Min(0,b)
- Reliability coeff: censored normal Max(0,b)

Random Coefficients Model on RP and SP Data

- Variance of sp errors essentially zero. Scale set at 10 for estimation.
- 1 day =
  - Average: $1.34 per ton
  - Standard deviation: 89 cents per ton
- 1% reliability =
  - Average: 16 cents per ton
  - Standard deviation: 7.2 cents per ton
- Share of shippers who do not care about:
  - Time: 9%
  - Reliability: 2%

Estimated elasticities wrt rates

Truck to Pasco, barge to Portland	-1.92
Truck to other port, barge to Portland	-0.56
Rail to Portland	-1.03
Truck to rail terminal, rail to Portland	-1.42
Barge to Portland	-0.40
Other	-1.10

Estimated elasticities wrt time

Truck to Pasco, barge to Portland	-0.93
Truck to other port, barge to Portland	-0.24
Rail to Portland	-0.69
Truck to rail terminal, rail to Portland	-0.66
Barge to Portland	-0.23
Other	-0.97

Estimated elasticities wrt reliability

Truck to Pasco, barge to Portland	1.58
Truck to other port, barge to Portland	0.52
Rail to Portland	0.85
Truck to rail terminal, rail to Portland	1.17
Barge to Portland	0.78
Other	1.57

Conclusions

- Sp-off-rp questions are useful for determining shippers' demand
- Shippers value time and reliability in addition to rates
- The value of time and reliability varies over shippers
- Only a few shippers are not willing to pay to reduce time and increase reliability