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Intermodal Mode Choice Modeling and Analysis of SEA&AIR

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Background

Change in trade between Japan and Russia

- Increase in Import of Russia from Japan (Automobile: 71.4%)
- Raise of the value of Ruble (purchasing power of Russia)
- Other East European countries also increases import from Japan

⇒ Logistics situation have gradually been changed
  - Excess in West-Bound (W/B)
  - Lack of SEA space

Problems in sea port of St. Petersburg (Arrival port of SEA)

- Lack of sea port space
- Decrepit in sea port
- Vessel needs icebreaker during winter
- Depth is not deep enough for large-sized container ship
- Delay occurs (congestion, custom clearance, …): 5-7days

Trans-Siberian Railway (TSR)

One of the alternative mode of SEA;

- Distance: Less than half of SEA (9,297km)
- Leadtime: Less than half of SEA (18days)
- Mass transit, Consistent haulage (150 TEU/train)
- Fare: Higher than SEA (US$8,000/40'container)

➡ Enough potential to be competitor of SEA , however, Japanese shippers tend not to use TSR. (Tsuji, 2008)

Objective

Coping with high demand on Japan-Russia trade (W/B)

1. **Enhancing use of TSR**
   - Japanese shippers tend not to use TSR, however, Korean Shippers tend to use TSR (Share in 2006, Korea : China : Japan = 63 : 33 : 4)
   - Tsuji (2008) reports that Japanese shippers have negative image towards TSR
   - Developing mode choice model in Japan-Moscow in order to reveal important factors for Japanese shippers

2. **Analyzing SEA&AIR as alternative mode of SEA**

   SEA&AIR: Intermodal mode between maritime (SEA) and air (AIR) transport

   Qualitative analysis for SEA&AIR whether it can be an alternative of SEA

   (In case future demand is expected, SEA&AIR is accepted as an alternative)
   - Shorter leadtime than SEA
   - Cheaper fare than AIR
   - No summary article and report about SEA&AIR

Practice of SEA&AIR

(a) Late 1980s - Early 1990s: Prime time of SEA&AIR

Route	Origin	Relay Point	Destination	Leadtime (Day)	Fare (JPY/kg)	Note
1	Japan (Tokyo)	US (Seattle)	Europe (Luxemburg)	14	30-50% of AIR	Operated by Cargolux

→ SEA&AIR was an alternative mode of AIR due to high AIR fare

(b) Late 1990s – present

Although # of route is increased, quantity is significantly decreased

1	Japan	US (Minami)	South America	12-18	300	• AIR is expensive • Lack of AIR space (Japan – South America)
2	East Asia (China)	Japan	US	5	n/a	Lack of AIR space (China - US)
3	Japan	US (Seattle)	Europe	12-14	260	Operated since 1980s
4	Japan	Singapore	Middle East	15-17	450	Low volume

→ SEA&AIR is used as alternative of AIR
•High AIR fare, Lack of AIR space

Leadtime and Fare of SEA&AIR

Case1: Japan → Seattle → Europe (Unit: Day)

Mode	FOB (Japan)	SEA	Relay Point (Seattle)	Arrival (Europe)	Fare
AIR	N	-	-	N+1-2	450
SEA&AIR (via SEA)	N+3	8	1-3	N+17-18	260
SEA	N+3	24	-	N+27 (fastest)	82

Case2: Japan → Singapore → Middle East (Unit: Day)

Mode	FOB (Japan)	SEA	Relay Point (Singapore)	Destination (Middle East)	Fare
AIR	N	-	-	N+2-3	600
SEA&AIR (via SIN)	N+3	7	1-3	N+15-17	450
SEA	N+3	25	-	N+28 (fastest)	60

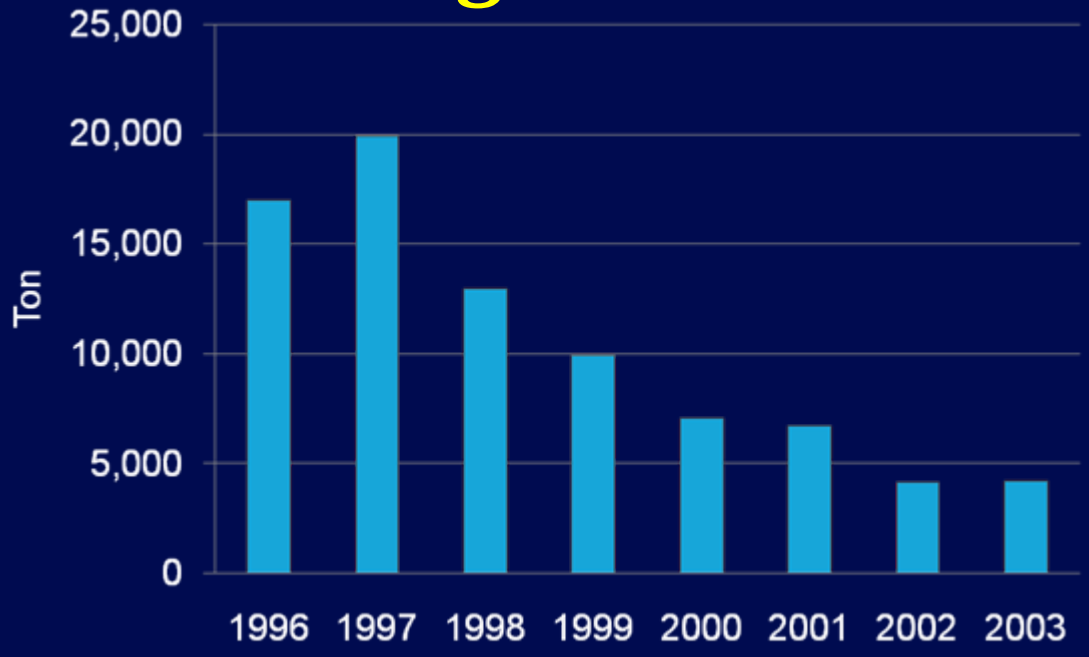
FOB: Free on Board

N: Custom clearance day is set as starting point

Change in SEA&AIR Cargo Volume

Route # 3 in current practice
(Main route of SEA&AIR)

Japan → US (Seattle) → Europe



Route # 4 in current practice
(Unstable demand)

Japan → South East Asia (Singapore)
→ Europe

Made by author based on Ocean Commerce Ltd. (2006)

Reasons of Declining SEA&AIR Demand

1. **Economies of Scale (EOS)**
   - Belly is fixed by pallet (110*110 cm in Asia)
   - Average lot size: 0.5 tons/belly
2. **Risk on Transshipment Process**
   - Risk of theft
   - Risk of getting damage
3. **Size of Container**
   - Cargo size of SEA and AIR is totally different
4. **Growth of Supply Chain Management (SCM)**
   - "On-time" performance is important
5. **Low Fare of AIR**
   - Until the late 1980s: High AIR fare
   - From the early 1990s: AIR fare is getting cheaper

SEA&AIR is not suitable for an alternative mode of SEA

Mode Choice between SEA and TSR

Objective:

Revealing important factor for Japanese shippers between Japan and

Survey Methodology and Data Collection

(a) <u>Survey Methodology:</u>

1. Stated Preference (SP) method
   - Hypothetical scenario according to the interview survey
   - Revealed Preference (RP) is almost impossible to conduct
2. Binary Logit (BL) Model
   - A model used for prediction of the probability of occurrence of an event between two events

(b) <u>Questionnaire Survey:</u>

- Target: Five potential TSR users (shippers) in Japan
- Mail-back survey
- Choice method
- Date: Between 4th and 15th April 2008
- Number of data collected: 80

Attributes and Level

- Extracted quite important attributes
- Attributes are assumed statistically independent one another

Attributes	Level	
	SEA	**SEA&RAIL (TSR)**
1. Leadtime Total travel time (port to port)	40days	15days, 25days
2. Cost Total cost (fare, custom clearance, haulage of empty container, …)	$7,000	$7,500, $8,500
3. Punctuality Related to delay	Punctual (1), Unpunctual (0)	Punctual (1), Unpunctual (0)
4. Frequency Frequency of shipping	1time/day (1), 1time/week (0)	1time/day (1), 1time/week (0)
5. Security Stolen/missing and damaging on the commodity	High (1), Low (0)	High (1), Low (0)

Questionnaire Form

Supposed that your company transport goods from Tokyo to Moscow by 40' container.

- Please assume that two transport modes such as (A) and (B) which modes are either TSR (Trans-Siberian Railway) or SEA (Maritime Transport) are available in the near future.
- In case of two transport modes such as (A) and (B) are available under the hypothetical situation like 1 to 16 in question (2), Please choose transport mode that you may be going to use.

(1) Please choose goods that your company will transport between Japan and Russia from following options. Note: Please answer on the premise that what you choose here will be transport in question (2).

1. Parts for automobile 2. Automobile (built)
3. Other parts (For what products? _____)
4. Other built products (What products? _____)

(2) Please choose transport mode that you may be going to use when you transport goods selected in question (1) between Japan and Moscow under the hypothetical situation indicated below.

Example

Mark option↓	1 Leadtime	2 Cost*1	3 Punctuality	4 Frequency	5 Security*2
A	40days	$7,000	Punctual	1time/day	Low
B	20days	$8,000	Unpunctual*3	1time/week	High

*1 **Cost:** Total cost per 40' container
*2 **Securuty:** Missing/Stolen the commodity, etc
*3 **Unpunctual:** Occurrence of delay

9. Choose one transport mode (A or B) that you may be going to use.

Mark option↓	1 Leadtime	2 Cost	3 Punctuality	4 Frequency	5 Security
A	40days	$7,000	Unpunctual	1time/week	High
B	25days	$7,500	Unpunctual	1time/week	Low

10. Choose one transport mode (A or B) that you may be going to use.

Mark option↓	1	2	3	4	5
A	40days	$7,000	Punctual	1time/week	High
B	25days	$7,500	Punctual	1time/day	Low

11. Choose one transport mode (A or B) that you may be going to use.

Mark option↓	1	2	3	4	5
A	40days	$7,000	Punctual	1time/day	High
B	25days	$8,500	Punctual	1time/day	High

12. Choose one transport mode (A or B) that you may be going to use.

Mark option↓	1	2	3	4	5
A	40days	$7,000	Punctual	1time/day	Low
B	15days	$8,500	Punctual	1time/week	High

13. Choose one transport mode (A or B) that you may be going to use.

Mark option↓	1	2	3	4	5
A	40days	$7,000	Punctual	1time/week	Low
B	15days	$7,500	Punctual	1time/week	Low

14. Choose one transport mode (A or B) that you may be going to use.

Mark option↓	1	2	3	4	5
A	40days	$7,000	Unpunctual	1time/week	Low
B	15days	$7,500	Punctual	1time/day	High

Calibration Result

Calibrated by NLOGIT 4.0

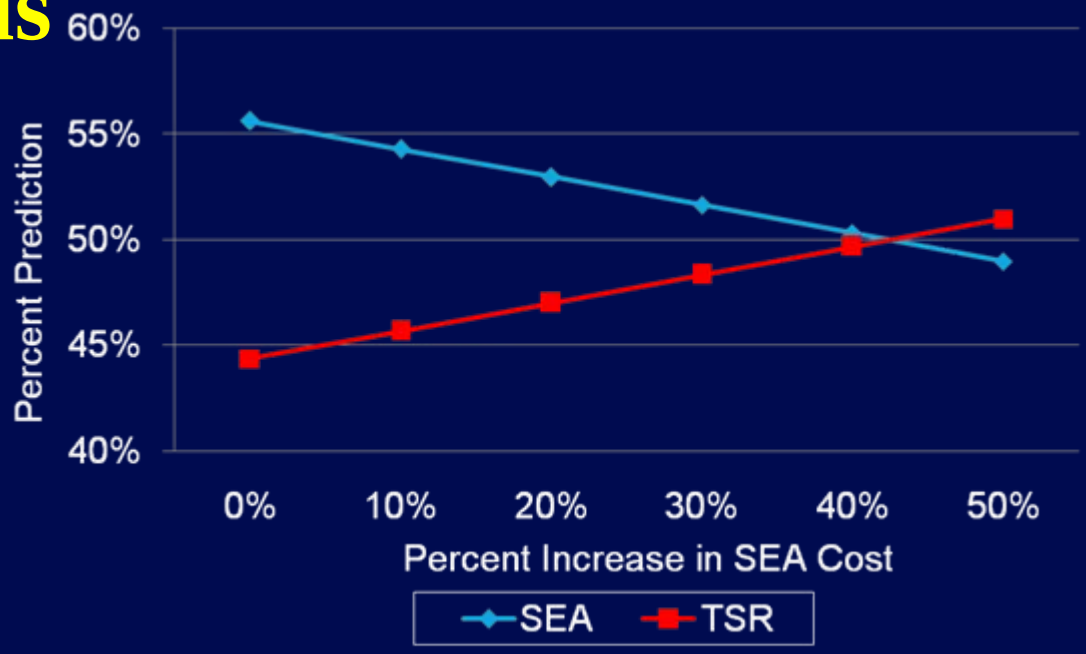
Explanatory Variables	Estimated Coefficients	Standard Error	t-value
Model Constants SEA TSR (base)	 1.423382 0	 1.120105 -	 1.271 -
Leadtime (day)	-0.048939	0.047842	-1.023
Cost (US $)	-0.7608e-04	0.000127	-0.599
Punctuality	0.679197	0.352819	1.925
Frequency	0.553472	0.353790	1.564
Security	1.352651	0.354754	3.813
Estimated Statistics	**Values**		
L(β)	-93.2585		
L(0)	-105.3584		
Likelihood Ratio Test	24.1998		
Rho-bar-squared	0.11485		

Sensitivity Analysis

Case 1

Increase in SEA cost

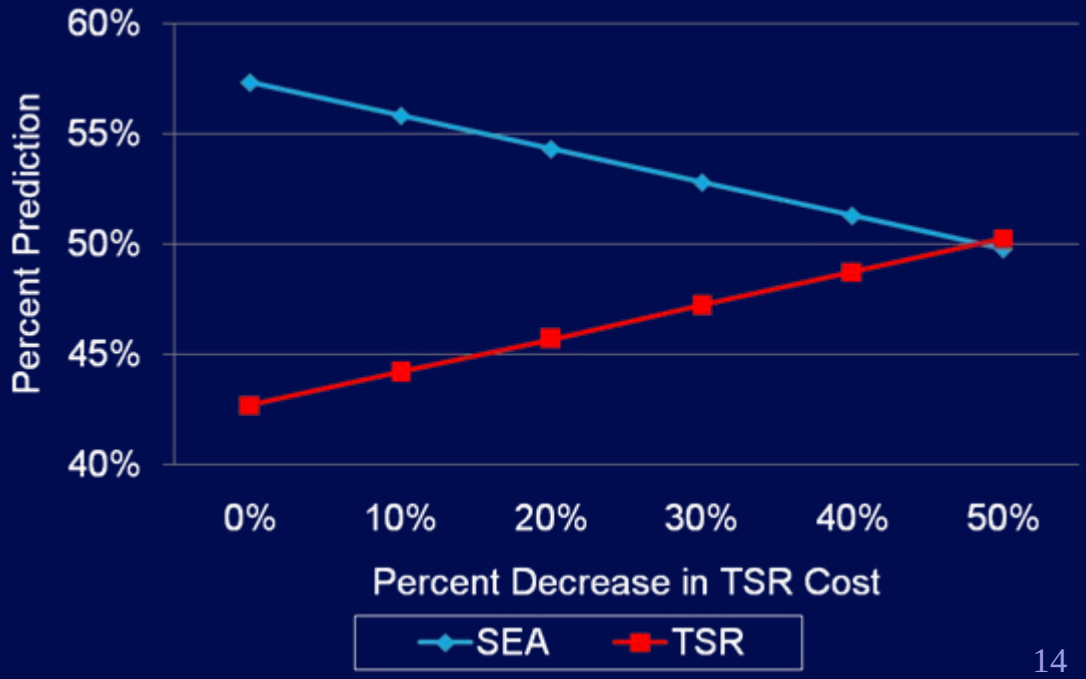
In case 50% increase in SEA cost, share is changed off



Case 2

Decrease in TSR cost

In case 50% decrease in TSR cost, share is changed off



Summary and Conclusion

SEA&AIR:

- SEA&AIR is used as alternative of AIR
- Demand on SEA&AIR can not be expected in the future

Mode Choice Modeling:

- Since security is the most important attributes of TSR for Japanese shippers, security factors should be improved. According to the interview survey, shippers are very sensitive to damage on commodities.
- Setting the level of attributes may affect the results.