Variable Time and Cost Estimators based on Distance Segmentation

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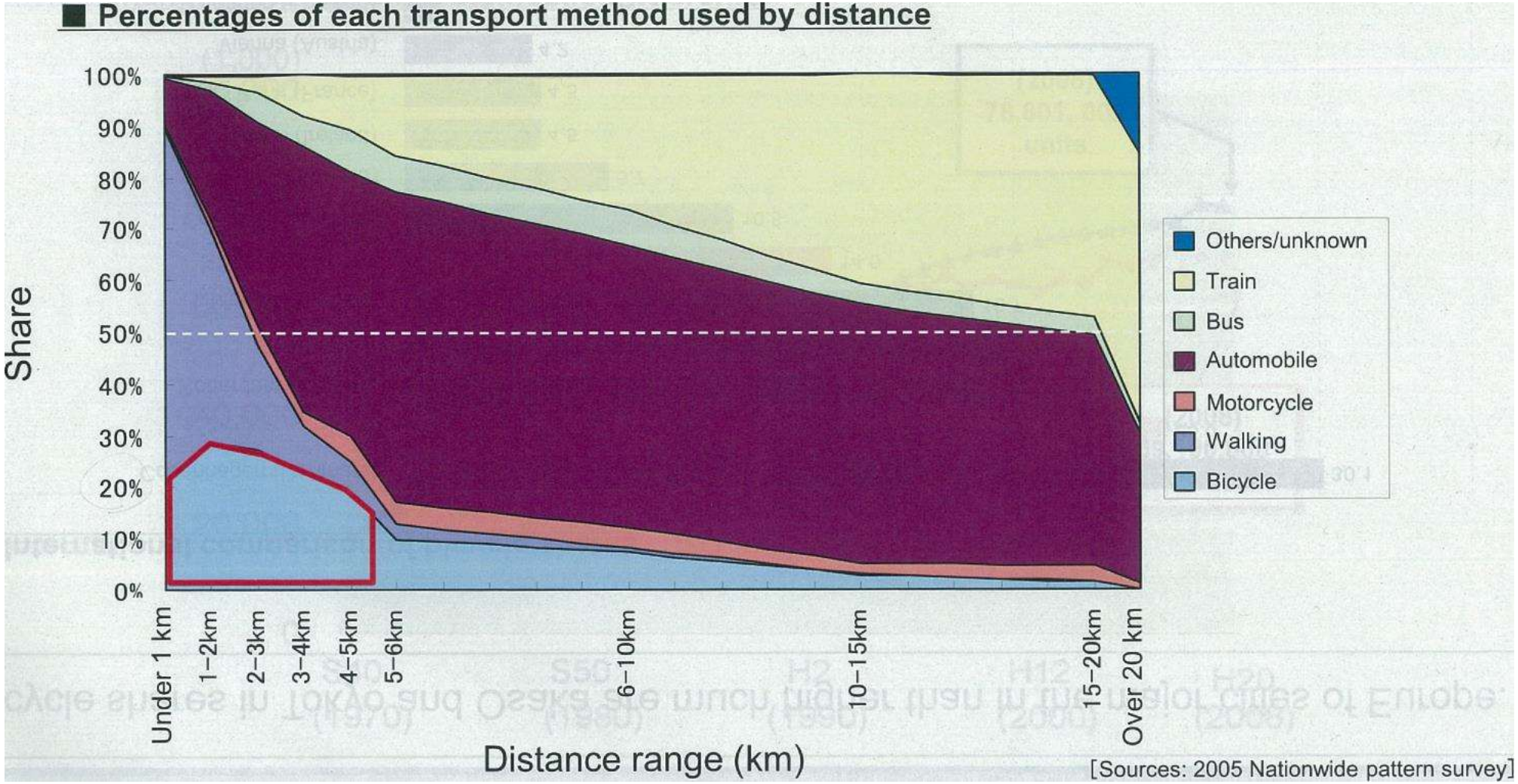
Background

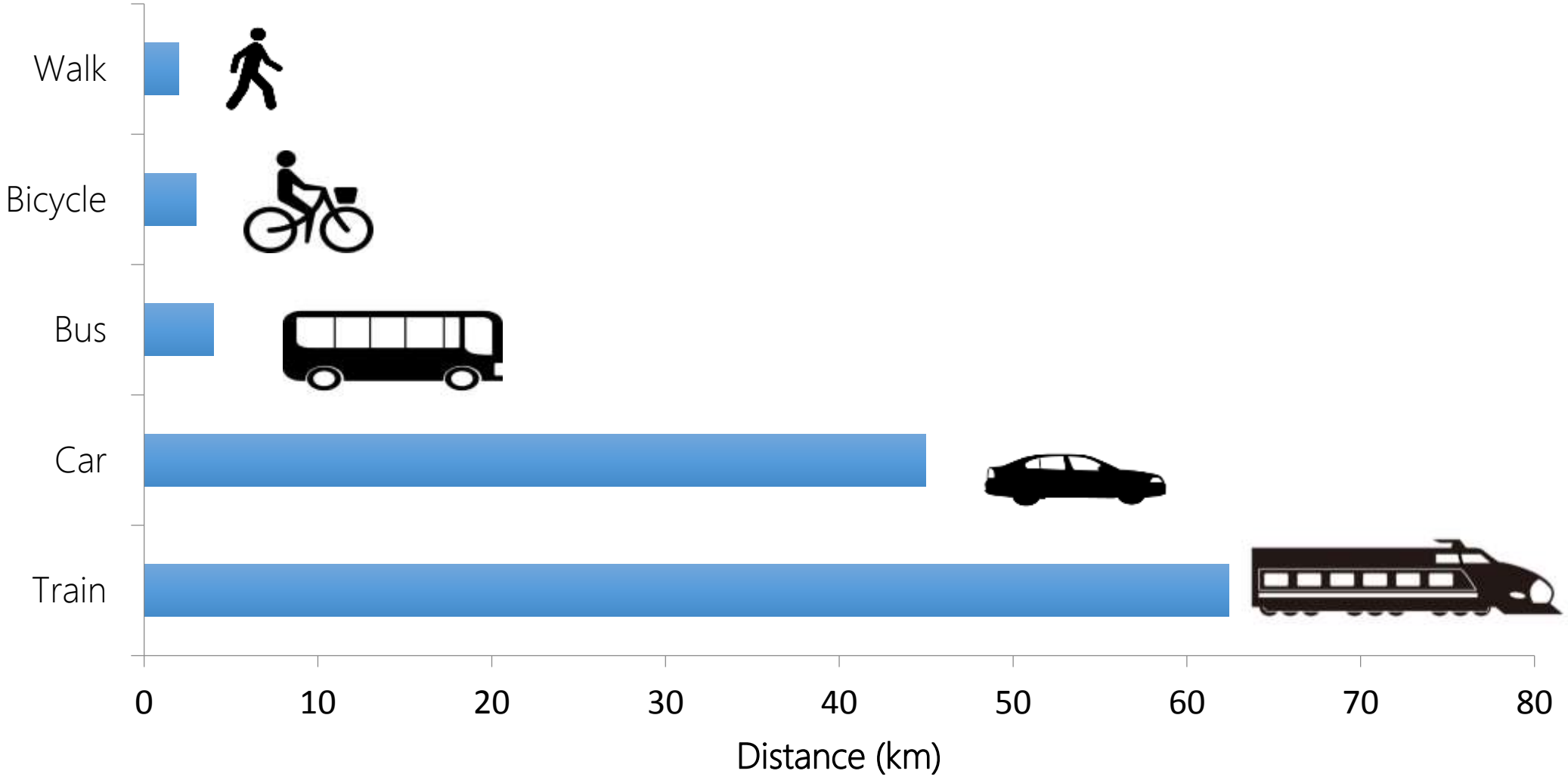

Percentages of each transport method used by distance
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Share
Others/unknown
Train
Bus
Automobile
Motorcycle
Walking
Bicycle
Under 1 km
1–2km
2–3km
3–4km
4–5km
5–6km
6–10km
10–15km
15–20km
Over 20 km
Distance range (km)
[Sources: 2005 Nationwide pattern survey]

Purpose and Hypothesis

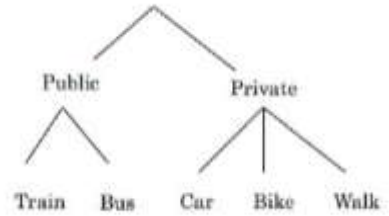
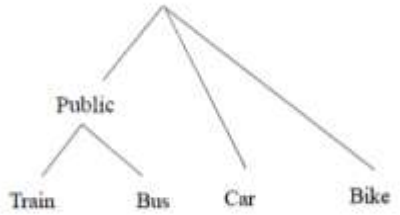
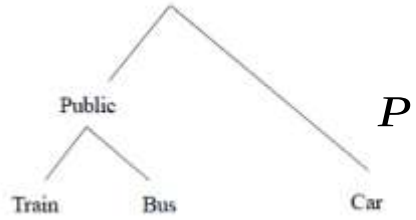
- Hypothesis: People's evaluation of time and cost varies according to travel distance -> use distance between origin and destination as segmentation factor. $\beta = F(Distance)$

- Purpose: Applying the most effective range of different mode and marginal cost by distance derived from model for urban planning, public transportation design and business activities

Travel Mode Boundaries



Segmented Nested Logit Model

Distance	Chart	Equation
Short (0~2.5km)		$\tilde{V}_{in} = \frac{1}{\mu_{in}} \ln \sum_{i \in C_{in}} \exp(\mu_{in} V_i)$
Short-Medium (2.5km~3km)		$P(m) = \frac{\exp(\mu_m \tilde{V}_l)}{\sum_l \exp(\mu_m \tilde{V})}$ $P(i \mid m) = \frac{\exp(\mu_m V_i)}{\sum_j \exp(\mu_m V_j)}$
Medium (3km~5km)		$P(i,m) = P(i \mid m) \cdot P(m) = \frac{\exp(\mu_m V_i)}{\sum_j \exp(\mu_m V_j)} \cdot \frac{\exp(\mu_m \tilde{V}_l)}{\sum_l \exp(\mu_m \tilde{V}_l)}$
Long (5km~)		$P(m) = \frac{\exp(\mu V_m)}{\sum_m \exp(\mu V_m)}$

Estimation Results

	train	bus	car	bike	walk	time	access	fare	leisure	scale	N	L0	LL	rho2	adj-rho2
0~500m	-2.06*	-0.99	-2.24**	-2.85**	base	9.22	-3.85	3.58	5.26	4.99*	119	-209.28	-71.14	0.66	0.62
t-value	-2.00	-1.45	-6.46	-5.38	/	1.74	-1.22	1.16	0.00	2.05					
500m~800m	3.03	1.18	-0.64*	-0.26	base	7.52	-18.93	-4.32	2.65	3.98	125	-221.94	-132.41	0.40	0.36
t-value	1.64	0.64	-2.01	-0.61	/	1.29	-1.43	-1.02	0.01	1.46					
800m~1.1km	2.10	1.22	-0.47	0.98*	base	4.86	-9.43	-3.72	3.16	2.29	138	-244.54	-147.43	0.40	0.36
t-value	1.38	0.67	-1.01	2.05	/	1.02	-1.04	-0.65	0.11	1.56					
1.1km~1.7km	2.07	-6.31	1.10**	1.06**	base	-3.09	-8.38	-1.95	0.00	1.59	132	-228.99	-145.02	0.37	0.33
t-value	1.62	0.15	2.48	2.51	/	-0.95	-0.61	0.93	0.00	0.85					
1.7km~2.2km	1.50	0.41	1.27	1.39	base	-4.95	-2.75	1.61	1.95	4.12	82	-141.31	-87.02	0.38	0.32
t-value	1.36	0.38	1.68	1.88	/	-1.51	-1.13	0.80	0.01	1.27					
2.2km~3km	8.30	6.53	1.21	base		-5.71	-22.82*	-8.69	5.52	1.20	78	-112.72	-40.76	0.64	0.57
t-value	1.54	1.56	1.18	/		-0.86	-2.10	-0.92	0.16	1.41					
3km~5km	5.26	2.86	base			-3.02	-23.92	-2.78	7.72	1.06	111	-84.56	-39.31	0.54	0.45
t-value	1.67	1.85	/			-0.69	-1.42	-0.61	0.18	1.49					

Estimation Results

	train	car	time	access	fare	N	L0	LL	rho2	adj-rho2
5km~10km	4.82**	base	-3.95	-13.40**	-6.04	115	-79.02	-42.56	0.46	0.41
t-value	3.76	/	-0.74	-4.29	-1.50					
10km~12km	-2.18	base	-34.71**	5.40	9.25	124	-85.95	-23.58	0.73	0.68
t-value	-1.04	/	-3.52	0.93	1.55					
12km~18km	2.26**	base	-13.57**	-4.32**	-5.60	87	-60.30	-38.24	0.37	0.30
t-value	2.53	/	-2.71	-3.04	-1.82					
18km~22km	5.01**	base	-18.75**	-9.84**	-10.37*	105	-71.39	-27.24	0.62	0.56
t-value	3.22	/	-3.24	-3.94	-2.20					
22km~26km	19.01**	base	-3.17	-30.28**	-27.29**	107	-67.24	-9.04	0.87	0.81
t-value	3.42	/	-0.37	-3.83	-3.03					
26km~30km	11.51	base	-21.39	-34.97**	-15.31	107	-74.17	-8.51	0.89	0.83
t-value	1.80	/	-1.43	-2.94	-1.46					
30km~	1.55	base	-8.96**	-10.19**	0.68	74	-51.29	-26.98	0.47	0.40
t-value	1.69	/	-2.29	-4.46	1.05					

Preliminary Conclusion

- Peoples' preference and sensitivity of time and probably other factors might change drastically based on the trip distance.
- In certain travel distance range, there are dominating modes even if they are inferior.
- Purpose is not significantly related to mode choice in short range trips.

Weakness and Potential Improvements

- Data cleaning
- Range Setting
- Model Improvement
- Calibration by open form model

Policy Application

- Parking Lot Planning
- Mode Share Estimation
- Pedestrian and Cycling Facilities Improvement
- Price Strategy