

新型コロナウイルスの流行に伴う 時間価値の変容

Change in the Value of Travel Time due to Pandemic of the COVID-19

3 東京大福田研/Univ. of Tokyo Fukuda Lab.

荒井・田端・長谷川・江橋

Arai, Tabata, Hasegawa, Ebashi

新型コロナウイルスの流行で人々の生活様式が変化した。

The new coronavirus epidemic has changed people's lifestyles.

- ・ **テレワーク**が普及した。
Telework has become popular.
- ・ **混雑への抵抗感**が増した。
Resistance to congestion has increased.



人々の**時間価値**も変化し、
求められる都市の姿が変容したのではないだろうか。

As the value of people's time has changed, the shape of the city that people want has changed.



目的 Objective

豊洲周辺の人々の時間価値の変化を2019年と2020年で比較し、今後の都市計画について検討する。

Changes in the time value of people in the Toyosu area will be compared between 2019 and 2020, and future urban planning will be discussed.

1.時間価値が低下している Time value of money is declining.

時間がかかっても徒歩や自転車を選択しているのではないだろうか。

They may choose to walk or bike even if it takes longer.

2.混雑不効用の金銭価値は増加している The monetary value of congestion disutility is increasing.

混雑を避けた時間帯に公共交通機関を利用しているのではないだろうか。

They may be using public transportation at times when they can avoid congestion.

▼使用したデータ Used data

豊洲PPデータ（2019年/2020年の10月~12月）

Toyosu-PPdata between October to December in 2019/2020

▼データクリーニング Data cleaning

OD直線距離500m 以上 OD Direct Distance >500m

▼目的の分類 Categorize objectives as follows,

業務 : 目的が「通勤・通学」、「帰社・帰校」、「業務」

Business : "Business", "Commute to work/school", "Return to work/school"

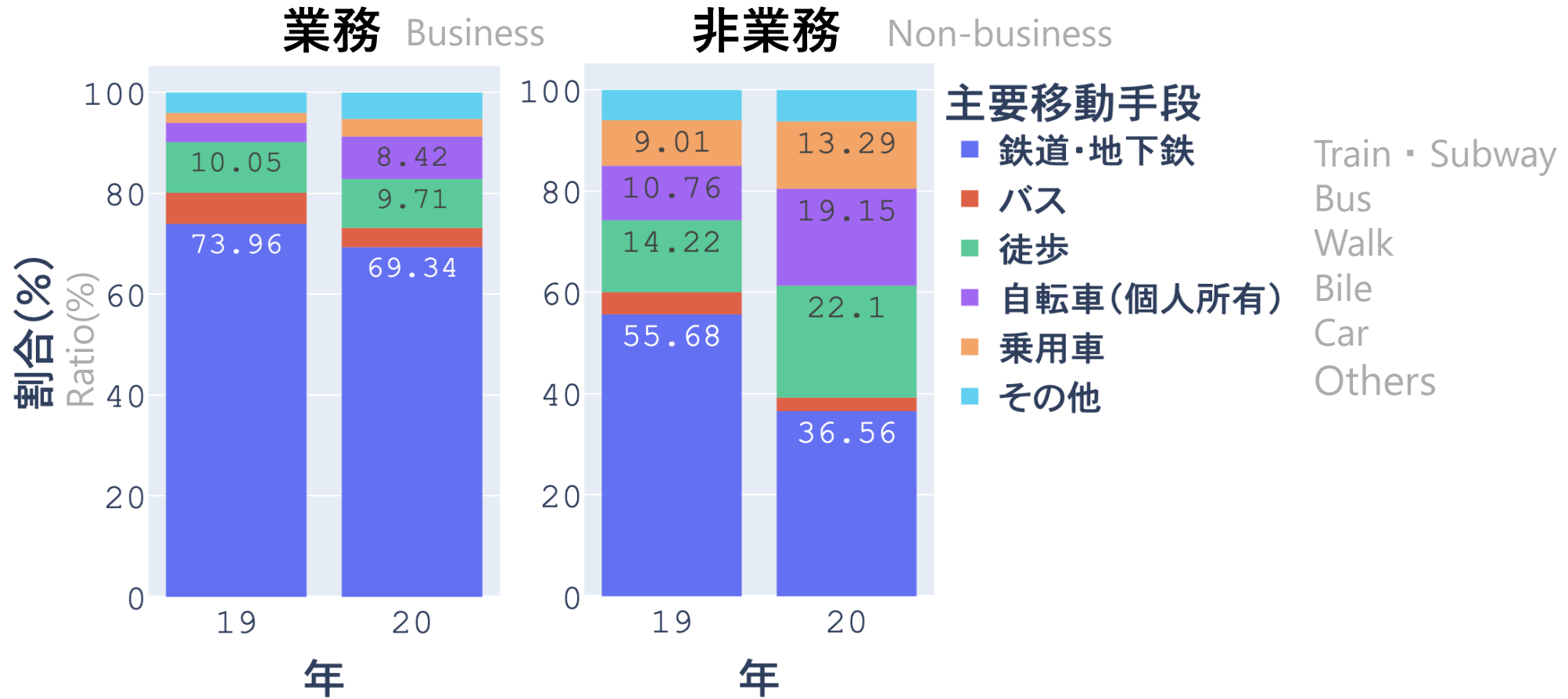
非業務 : 目的が上記以外

Non-business : Other purposes

▼ピーク時間ダミー Peak hour dummy

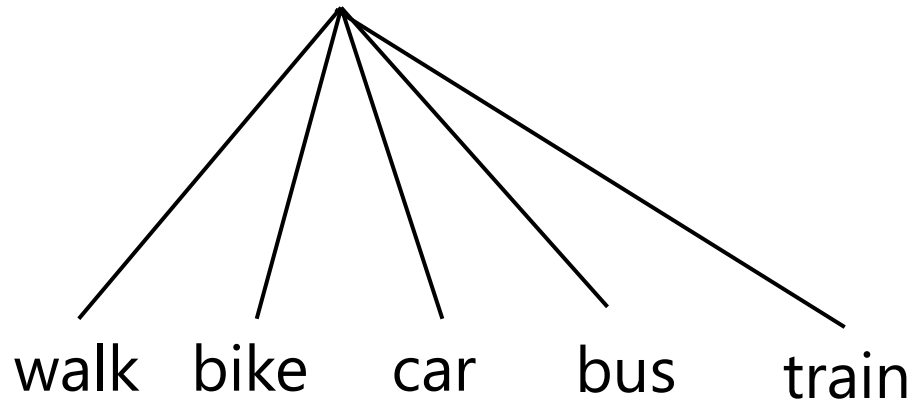
1 : 午前7~9時 or 午後5~7時 1 : 7~9 a.m. or 5~7 p.m.

0 : 上記以外の時間帯 0 : Times other than the above



- 公共交通機関（鉄道地下鉄，バス）の割合が減少している。
The ratio of public transportation (railroad, subway, bus) is decreasing.
- 私有交通機関（徒歩，自転車，乗用車）の割合が増加している。
The percentage of private transportation (walking, bicycling, and passenger cars) is increasing.

多項ロジットモデル (Multinomial Logit Model)



$$V_{walk} = +\beta_6 t_{w,n}$$

$$V_{car} = \beta_1 + \beta_7 t_{c,n}$$

$$V_{bike} = \beta_2 + \beta_8 t_{i,n}$$

$$V_{bus} = \beta_3 + \beta_9 t_{b,n} + \beta_{11} c_{b,n} + \beta_{12} d_{b,n}$$

$$V_{train} = \beta_4 + \beta_{10} t_{t,n} + \beta_{11} c_{t,n} + \beta_{13} d_{t,n}$$

多項ロジットモデルの所要時間パラメータやピーク時間ダミーをそれぞれ別のものに設定
Parameters of travel time and peak hour dummy were set for each mode.

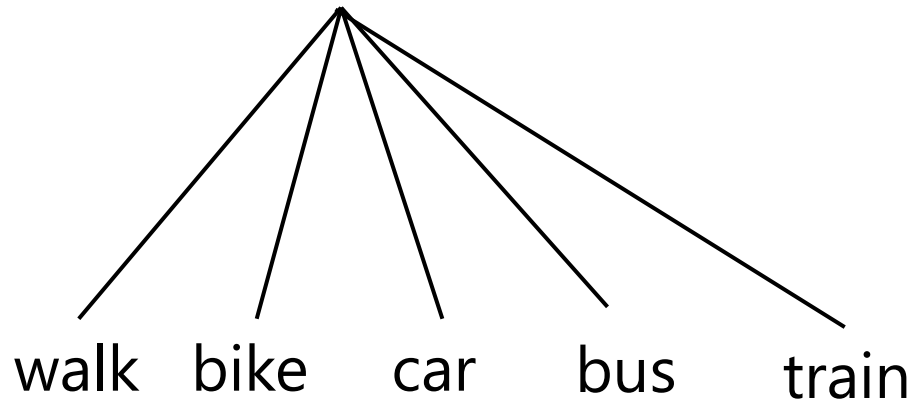
しかし、費用のパラメータが正となる
However parameter of cost was positive.



今回は、パラメータが共通のモデルとする

We set the same parameter for travel time and peak hour dummy.

多項ロジットモデル (Multinomial Logit Model)



$$V_{walk} = \beta_5 t_{w,n}$$

$$V_{car} = \beta_1 + \beta_5 t_{c,n}$$

$$V_{bike} = \beta_2 + \beta_5 t_{i,n}$$

$$V_{bus} = \beta_3 + \beta_5 t_{b,n} + \beta_6 c_{b,n} + \beta_7 d_{b,n}$$

$$V_{train} = \beta_4 + \beta_5 t_{t,n} + \beta_6 c_{t,n} + \beta_7 d_{t,n}$$

$c_{k,n}$: cost for travel mode k and individual n

$t_{k,n}$: travel time for travel mode k and individual n

$d_{b,n}$: dummy variable for crowdedness for mode k and individual n

時間価値 (Value of travel time)

Coefficient for travel time of each mode

各交通手段の所要時間の係数(β_5)

$$VT = \frac{\text{各交通手段の所要時間の係数}(\beta_5)}{\text{費用の係数}(\beta_6)}$$

Coefficient for cost

混雑の金銭価値 (Value of crowdedness)

Coefficient for dummy variable for peak hour

ピーク時間ダミーの係数(β_7)

$$VC = \frac{\text{ピーク時間ダミーの係数}(\beta_7)}{\text{費用の係数}(\beta_6)}$$

Coefficient for cost

2019年と2020年のデータについて分析 (2パターン)

Analysis of 2019 and 2020 data (2 patterns)

Model Estimation Table

Independent Variable	Including peak hour (dummy)				Not including peak hour (dummy)			
	2019		2020		2019		2020	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Travel time [min/100]	-187.80	-29.06***	-236.68	-35.44	-190.53	-29.45***	-230.01	-35.81***
Fare [yen/100]	-0.27	-16.32***	-0.22	-14.55	-0.29	-17.19***	-0.22	-14.54***
Peak hour [1/0]	0.82	12.19***	0.58	10.16	-	-	-	-
Constant (train)	0.94	12.76***	0.31	4.97	1.27	18.44***	0.50	8.57***
Constant (bus)	0.34	4.55***	-1.23	-17.22	0.72	10.55***	-1.09	-15.05***
Constant (car)	-1.64	-35.54***	-1.77	-42.96	-1.65	-35.78***	-1.78	-43.22***
Constant (bike)	-16.23	-0.49	-21.85	-0.11	-15.99	-0.60	-18.00	-0.64
N	10,840		14,423		10,840		14,423	
Log likelihood (Initial)	-13330		-17155		-13330		-17155	
Log likelihood (Final)	-6407		-7926		-6485		-7980	
Rho squared	0.519		0.538		0.513		0.535	
Adjusted rho squared	0.519		0.538		0.513		0.535	

*p<0.10 **p<0.05 ***p<0.01

Change in Value of Time/Crowdedness

10

ピーク時間ダミーなし
Including peak hour (dummy)

	2019	2020
時間価値 (円/min) Value of time	11.12	18.43

ピーク時間ダミーあり
Not including peak hour (dummy)

	2019	2020
時間価値 (円/min) Value of time	11.4	18.1
混雑の金銭価値 (円/ピーク時間 ダミー) Value of crowdedness	-3.00	-2.68

1. 時間価値が上昇

Value of travel time increases.

→ 仮説と異なる結果

Different from hypothesis.

2. 混雑の金銭価値が上昇

Value of crowdedness increases.

→ 仮説が検証された

Hypothesis is verified.

2019年と2020年のデータについて、目的別、休日・平日別で分析
(**2×2×2の8パターン**)

Analysis of 2019 and 2020 data by purpose, holiday and weekday (2 x 2 x 2 patterns)

2019 Estimation Table

Independent Variable	Business (weekday)		Business (holiday)		Non-business (weekday)		Non-business (holiday)	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Travel time [min/100]	-213.4	-17.61***	-496.6	-2.28**	-180.5	-13.22***	-189.7	-25.61***
Fare [yen/100]	-0.323	-11.45***	-0.347	-1.25	-2.292	-8.166***	-0.289	-14.65***
Peak hour [1/0]	0.893	7.845***	-0.311	-0.260	0.291	1.777*	0.748	9.743***
Constant (train)	0.956	6.942***	1.268	0.812	0.922	6.595***	1.023	11.67***
Constant (bus)	0.528	4.033***	0.861	0.629	0.070	0.409	0.465	5.347***
Constant (car)	-2.120	-21.81***	-2.410	-2.004**	-0.957	-11.28***	-1.913	-34.07***
Constant (bike)	-14.300	-0.468	-14.80	-0.037	-14.18	-0.667	-19.90	-0.068
N	3,913		179		4,859		1,889	
Log likelihood (Initial)	-4906		-60.93		-2486		-10844	
Log likelihood (Final)	-2076		-18.88		-1454		-4825	
Rho squared	0.577		0.690		0.415		0.555	
Adjusted rho squared	0.575		0.575		0.412		0.554	

*p<0.10 **p<0.05 ***p<0.01

2020 Estimation Table

Independent Variable	Business (weekday)		Business (holiday)		Non-business (weekday)		Non-business (holiday)	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Travel time [min/100]	-167.5	-15.71***	-48.20	1.01	-274.10	-20.14***	-321.7	-19.16***
Fare [yen/100]	-0.094	-3.354***	0.081	-0.418	-0.360	-12.12***	-0.418	-11.95***
Peak hour [1/0]	0.915	9.063***	0.819	0.39	-0.077	-0.589	-0.257	-1.73*
Constant (train)	0.368	3.103***	0.479	8.268***	0.382	3.306***	0.402	3.075***
Constant (bus)	-1.464	-10.43***	-3.998	-5.602***	-1.002	-6.719***	-0.835	-5.157***
Constant (car)	-1.450	-15.54***	-0.094	-9.723***	-1.753	-23.64***	-1.932	-23.39***
Constant (bike)	-17.90	-0.092	-131.9	-10.58***	-17.81	-0.413	-23.08	-0.039
N	4,362		300		6,586		3,175	
Log likelihood (Initial)	-5253		-358		-4083		-3441	
Log likelihood (Final)	-2258		-189		-2123		-1741	
Rho squared	0.570		0.472		0.480		0.494	
Adjusted rho squared	0.569		0.452		0.478		0.492	

*p<0.10 **p<0.05 ***p<0.01

Change in Value of Time/Crowdedness

14

業務(business)

	平日(weekday)		休日(holiday)	
	2019	2020	2019	2020
時間価値 (円/min) Value of time	11.08	29.67	23.85	-9.88
混雑の金銭価値(円/ピーク時間ダミー) Value of crowdedness	-2.76	-9.73	0.89	10.07

非業務(non-business)

	平日(weekday)		休日(holiday)	
	2019	2020	2019	2020
時間価値(円/min) Value of time	10.93	12.68	10.32	12.82
混雑の金銭価値(円/ピーク時間ダミー) Value of crowdedness	-2.59	0.21	-1.00	0.615

非業務は時間価値・混雑価値ともに上昇

Both time value and congestion value increased for non-work

時間価値がコロナ禍では**上昇** Increase value of time during the pandemic

コロナ後にテレワークなどが導入 Introduce teleworking during the pandemic

→移動を嫌がる人が増加 Increase the people who hesitate to make a trip

→コロナ収束後も時間価値はコロナ前よりも上昇している可能性大

It is likely that value of travel time after the pandemic is longer than that during the pandemic.



人々の移動が少なくなる土地利用

Land use that decreases the distance that people move

- 居住地の移動 Moving the place of residence
- オフィスの移動 Moving the place of office
 - サテライトオフィス Satellite office

混雑を回避する政策

Policy that decreases the crowdedness of public policy implication

- ダイナミックプライシング Dynamic pricing
- 鉄道 train
 - バス bus

- 自転車のデータ少ない

The number of bike data is few.

- 自転車/乗用車の代替手段生成可否がほぼ全て可能になっていた

Almost all "Whether alternatives can be generated Bike and Car " were generated .

- 自転車や車を利用できないのに利用しないという選択をしたことに

For choosing not to use bicycles or cars when they are not available.

- 自転車や車の定数項が過小評価されている可能性あり

The constant term for bicycles and cars may be underestimated.

- **Nested logit model**で私有・公共交通の選択と更なる手段選択の二段階モデルのほうが適切か？

Would a two-stage model of private/public transport choice and further means selection be more appropriate in a Nested logit model?

- 混雑を表すものとして、ピーク時間帯を用いた。

The peak hour was used as a measure of congestion.

- 時間帯別の混雑度のデータなどを用いる。

Data on the level of congestion by time of day and other data are used.