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A pooled SP and RP mode in Greater Jakarta

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Exploring Willingness to Pay of Urban Air Mobility and On-Demand Transport; A Pooled SP and RP Mode in Greater Jakarta

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Abstract

Research presented in this paper analyzed two data sets from Revealed Preference (RP) and Stated Preference (SP), obtained with a new travel diary and mode choice survey. This survey, called Mobility Jakarta, combines both revealed and stated preference parts and was conducted in the Greater Jakarta region. This is the first survey that collected responses from a substantial sample of the population across the whole metropolitan area. We estimated a pooled SP and RP data sets using a mixed logit (MXL) model and a multinomial logit (MNL) model. We explored their Willingness To Pay (WTP), e.g., the Value of Travel Time Savings (VTTS), Value of Travel Time Assigned to Travel (VTAT), and the elasticity for all mode choice alternatives, including On-Demand Transport (ODT) and Urban Air Mobility (UAM).

Keywords: Stated Preference; Revealed Preference; Urban Air Mobility, On-Demand Transport, Choice Modelling; Greater Jakarta

1. Introduction

1.1. Background

Many hours are spent in traffic every day. For example, in Jakarta, commuters spend at least three hours a day in traffic. People do not benefit from this useless and unproductive use of their time. Travelers could use this time for something more important than sitting in traffic; however, this phenomenon is not only happening in Jakarta. Most metropolitan cities face this problem as well. To tackle this problem, there are a growing number of new mode choice alternatives available in many cities. Additional alternatives surely will emerge in the coming years.

One of the alternatives is On-Demand Transport (ODT). ODT connects potential passengers and potential drivers through a smartphone app. Growing ODT systems

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have become popular in many countries. The passenger volume of the conventional taxi industry has decreased since this mode of transportation became available (Lam and Liu, 2017). The lower price and the convenience of using a smartphone are the main advantages of an ODT compared to a conventional taxi service.

In addition, another potential alternative mode is Urban Air Mobility (UAM). There is a growing interest to solve urban transportation by using urban air mobility. Nevertheless, UAM might be suitable only for high-income users due to the price being much more expensive than other alternative modes. Urban Air Mobility (UAM) will eventually become a realistic alternative mode of transportation.

We explore the demand of each choice alternatives: the willingness to pay (WTP) or value travel time savings (VTTS), value travel time assigned to travel (VTAT), and elasticity of all choice alternatives including ODT and UAM. We conducted a stated choice experiment to gather the data and use discrete choice model to do the analysis. The measurement of WTP: VTTS, VTAT, and elasticity all together is rarely explored by other researchers.

- We conducted a state-of-the-art RP and SP survey and presented its methodology with a total of 5,143 respondents, which covers 52,731 observations.
- We explored willingness to pay (WTP): VTTS, VTAT, elasticity, and the preference of all choice alternatives including ODT and UAM using pooled SP and RP data sets.

The remainder of this paper is structured as follows. The second section describes the survey design and data collection. This is followed by the third section, which shows the descriptive statistics of the data in general. The fourth section describes the experimental design of an SP survey and the construction of non-chosen alternatives in an RP data set. The fifth section explores the WTP, the value of travel time savings (VTTS), and the direct elasticity of parameters of choice alternatives using a discrete choice model. Finally, the last section of this paper presents conclusions, limitations, and further recommendations.

2. Survey design and data collection

The survey was conducted in Greater Jakarta, which includes three provinces: West Java, Jakarta, and Banten, with 13 cities in total. The data collection was conducted from April to May 2019. The cities outside Jakarta are called Bodetabek (Bogor, Depok, Tangerang, Bekasi). The survey was conducted in three waves. The first wave was executed from 1^{st} to the 13^{th} of April, 2019, the second wave from the 18^{th} to the 26^{th} of April, 2019, and the third wave from the 29^{th} of April to the 9^{th} of May, 2019. Due to the presidential and parliamentary elections in Indonesia, the survey was paused from 13^{th} to 17^{th} of April, 2019. A total of 5,143 respondents were interviewed, some of which represent complete households. To the best of our knowledge, no previous study conducted in Jakarta had such a large sample size. Finally, the survey consisted of 3711 respondents in 951 households and 1432 individuals. The respondents' home location can be seen in Figure 1.

The questions are summarized in Table 2. Public Transport (PT) refers to Bus, Bus Rapid Transit (BRT), Train, and Angkot (Microbus). Angkot refers to a microbus where maximum of 12 passengers can ride (Ilahi et al., 2015; Cervero, 1991).

Table 1: The survey questions

Socio-demographics	Travel diary	Choice alternatives
Age	Destination	Walk
Gender	Mode transport	Car
Income	Departing time	Motorcycle
Expenditures	Arrival time	Public transport
Address	Address	Car ODT
Number of households	Trip distance	Motorcycle ODT
Vehicle ownership	Transport cost	Car Taxi
License	Frequency activity	Motorcycle Taxi
Access to private vehicles	Type of activity	UAM
Main mode		
Education		
Occupation		
Dwelling		
Working hour		

3. Descriptive analysis

Table 3 shows the socio-demographic characteristics of the respondents. The share of male respondents in the sample was slightly higher than in the census (57.30%). About 46.90% of the sample was younger than 34 years old, which was slightly higher than in the census. 31.70% of the sample had a university degree. More than 90% of respondents were living in a single-family (landed) house and own the house. The share of the respondents, who lived in a landed house, is expected as the number of the apartment is less than 2% (Yudis, 2019). But, the number of respondents who owned the houses was oversampled based on the data from the statistics bureau, which stated the percentage to be around 47.85% (BPS, 2019)

Jakarta City tends to have high rise buildings in the center and then low-rise buildings towards the outskirts of the city. This makes the city more spread out and expensive to maintain or invest in infrastructure. 41.60% of respondents drove in the city of Jakarta, and 28.60% drove in the agglomeration. The shares of the main modes can be seen Table 3. The main mode means the most frequent modes that respondents used. The number of On-Demand Transport (ODT) or ride-sourcing users was substantial. We found that motorcycle (MC) had the highest share (54.30%), followed by car (15.30%), motorcycle ODT (10.90%), and public transport (bus, BRT, commuter rail, microbus) (9.9%).

Table 2: Socio-demographics of respondents

Variable	Sample (%)	Census (%)
Male	57.30	50.70
Female	42.70	49.30
Age categories		
Younger than 24 years old	46.90	44.09
Aged 24-29 years old	11.30	9.19
Aged 29-34 years old	6.30	9.10
Aged 34-39 years old	8.30	8.44
Aged 39-44 years old	8.80	7.39
Aged 44-49 years old	9.20	6.20
Aged 49-54 years old	5.30	5.01
Older than 54 years old	3.90	10.54
University degree	31.70	-
Owned house	92.40	47.85
Landed house	97.20	-
Has access to car	25.60	-
Has access to motorcycle	67.90	-

4. Constructing choice alternatives from Stated Preference (SP) and Revealed Preference (RP)

4.1. SP data set: Experimental Designs

The experimental designs were developed by Ngene with a D-efficient design. The total of the respondents was the same as in the RP survey, which equals to 5,143 respondents. The mode choice experiment in Greater Jakarta was categorized by travel distance to the place of their daily activities, driver or non-driver, traveling inside or outside of Jakarta. To classify this, the respondent received preliminary questions about that. The mode alternatives and variables were based on the respondent's answers to the preliminary questions. Each respondent received four choice experiments. In total, there are 20,064 observations.

The classification for the experiment is shown in Table 7. The congestion/toll charging attribute was only available for the respondent who had trip purposes to Jakarta. There are nine different modes, such as walk, PT, car, motorcycle (MC), car Taxi, MC Taxi, MC ODT, car ODT, and UAM. The walk was only available for a distance less than 1.5 km and applicable for drivers or non-drivers. The car and motorcycle were always available in each distance interval, but not available for Non-drivers. We assigned ODT and conventional taxi as a random mode. The detail of the attributes can be seen in Table 8. We make sure that the travel time and travel cost offered were within the range of VoT that was found in the paper by Belgiawan et al. (2019b). In the survey design, for car-based modes, the car was the highest, followed by conventional car taxis and car ODT. Then, for motorcycle-based modes, the motorcycle was the highest, followed by motorcycle taxis and motorcycle ODT. The VoT design for UAM was the highest compared to other modes because UAM has the fastest travel time and highest cost.

Table 3: Availability mode by distance and driving ability

Mode	0-1.5 km	1.5-5 km	5-15 km	15-25 km	>25 km	Driver	Non driver
Walk	True	False	False	False	False	True	True
PT	True	True	True	True	True	True	True
Car	True	True	True	True	True	True	False
MC	True	True	True	True	True	True	False
Car Taxi	Random	Random	Random	Random	Random	Random	Random
Car ODT	Random	Random	Random	Random	Random	Random	Random
MC Taxi	Random	Random	Random	Random	Random	Random	Random
MC ODT	Random	Random	Random	Random	Random	Random	Random
UAM	False	False	True	True	True	True	True

Table 4: Attributes of each mode and category

Attributes	PT	Car	MC	Car Taxi	MC Taxi	Car ODT	MC ODT	Walk	UAM	
Travel cost (Thousand IDR)										
0-1.5 km	3;6;8	6;8;10	2;4;6	12;14;16	5;10;15	7;12;15	6;10;12	-	-	
1.5-5 km	6;12;17	14;18;20	9;10;13	25;30;40	15;20;25	14;25;35	15;18;22	-	-	
5-15 km	9;18;27	22;28;32	13;20;25	58;90;110	30;35;45	55;80;100	25;35;40	-	60;100;150	
15-25 km	13;30;55	35;60;75	20;30;45	75;120;160	50;65;80	72;110;145	45;55;68	-	150;200;250	
>25 km	20;40;65	62;90;115	30;40;50	110;170;250	72;90;120	105;165;220	65;80;96	-	250;300;350	
Travel time (minute)										
0-1.5 km	5;10;16	6;12;15	4;6;8	6;10;15	6;7;8	6;8;10	4;6;8	30;50;70	-	
1.5-5 km	10;20;30	10;20;30	8;15;25	10;20;25	9;15;20	10;20;30	10;15;25	-	-	
5-15 km	15;30;45	15;30;45	15;25;35	25;40;55	15;25;32	25;40;55	15;25;32	-	8;9;10	
15-25 km	30;45;60	37;60;70	25;40;50	35;55;70	25;40;50	35;55;70	25;40;50	-	10;12;15	
>25 km	35;60;90	52;90;120	27;50;70	52;75;100	35;60;70	105;165;220	35;50;70	-	13;17;23	
Transfers (minute)	0;1	-	-	-	-	-	-	-	-	-
Waiting time (minute)	5;15;30	-	-	5;10;20	5;10;20	5;10;20	5;10;20	10;15;25		
Toll/congestion charging (Thousand IDR)	-	10;15;25	5;10;15	10;15;25	5;10;15	10;15;25	5;10;15	-	-	
Accessl time (minute)	5;10;15	-	-	-	-	-	-	-	5;10;15	

1 USD is equal to 14.400 IDR on 25th of May 2019

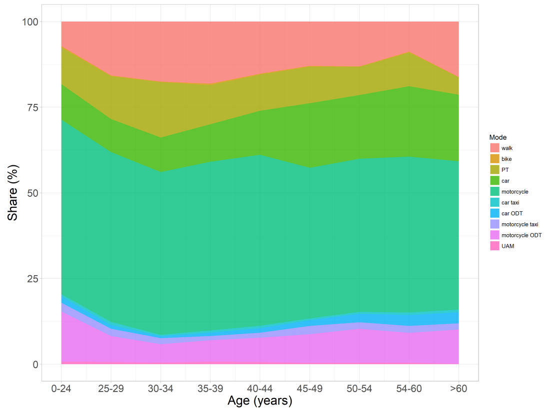
4.2. RP data set: Non-Chosen Choice Alternatives

The non-chosen alternatives of each trip of the respondent were constructed based on information from google API (Google, 2019b). We collected the coordinate of each trip origin and destination based on geocoding Google API. Then we collected the information of non-chosen alternatives; transit, driving, and walk based on Google API direction (Google, 2019a). We got information travel time of each non-chosen alternative mode available on the exact departure time reported on the survey. However, for bike and motorcycle, there was no information available for the travel time and limited only in research regarding how fast both modes were traveling in urban settings. Thus we assume that the speed of a motorcycle is 3.3 km/h faster than Car (Walton and Buchanan, 2012). For bike, it depended on the age of the respondents. The speed of an older person was 10 km/h, and the speed of a younger person was 15 km/h (City of Copenhagen, 2013; Woodcock et al., 2018). Regarding the travel cost of each mode, we assumed it based on the travel costs that exist in Greater Jakarta.

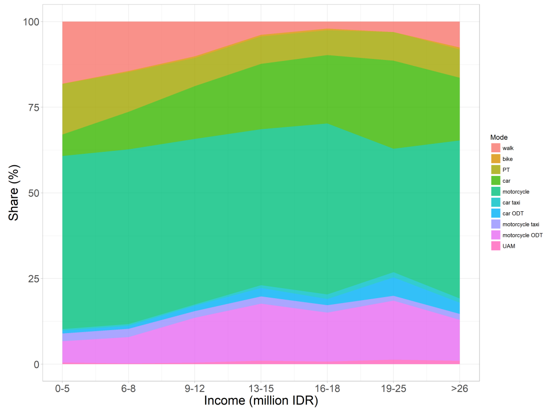
The detail of the assumptions can be seen in Table 9. There were no costs related to walking and biking. The base in the parameter travel cost means the travel cost when the respondent first begins to use the mode. Waiting time, transfer, and walking time of transit were collected based on the Google API of transit mode, there was no specific API for each different transit. The mode was not always available. For example, if the respondents did not have access to car and motorcycle, those modes would not be available for a non-chosen alternative. The waiting time for angkot, ODT and conventional taxi was 5 minutes. The walking time of angkot or microbus was 5 minutes, and the transfer available when the trip was higher than 10 km. We also assume when all kinds of public transports were merged to PT general to minimize the number of choices.

4.3. Description of the Pooled SP and RP data set

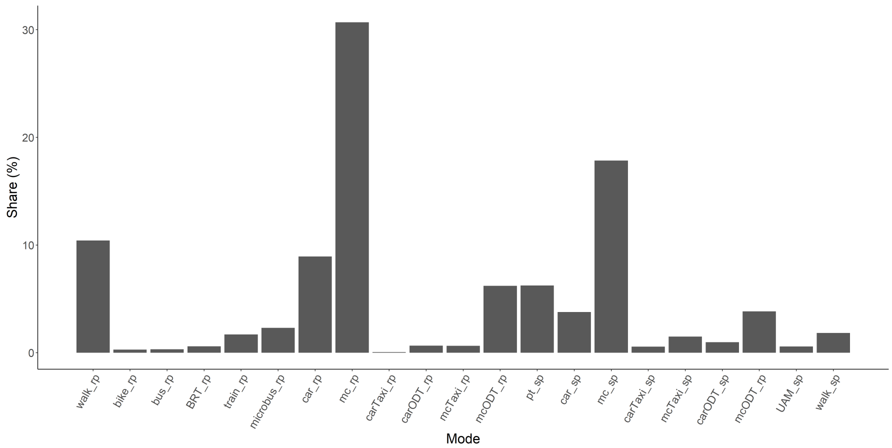
The data used in this analysis based on SP and RP data set from the same person. We estimated 52731 observations in our data set, excluding microbus. The share of motorcycle from SP and RP data set is the highest. The percentage of UAM and bike are the lowest. As can be seen in Figure 6, the share of choice alternatives is varied over the age group and income group. We created a dummy variable and availability for each mode to distinguish both data sets in our model.



(a) Share by age group



(b) Share by income group



(c) Share on SP and RP data set

Figure 1: Mode shares of data set

Table 5: Parameter assumptions for non-chosen mode alternatives

Mode	Travel time (minutes)	Travel cost (thousand IDR/km)	Waiting time (minute)	Transfer	Walking time transit (minute)	β ODT	Availability
Walk	API Walking	-	-	-	-	-	always
Bike	$\frac{APICarDistance}{SpeedBike}$	-	-	-	-	-	always
Car	CarAPI	2.95	-	-	-	-	Access Car
Motorcycle	$\frac{APICarDistance}{APICarSpeed+3km*h^{-1}}$	0.59	-	-	-	-	Access Motorcycle
Car ODT	API Car	$10(base)+3.5$	5	-	-	Yes	Always
Motorcycle ODT	$\frac{APICarDistance}{APICarSpeed+3km*h^{-1}}$	$10(4km)+2.5$	5	-	-	Yes	Always
Bus	API Transit	10 per 10 km	API Transit	API Transit	API Transit	-	Has transit
BRT	API Transit	3.5	API Transit	API Transit	API Transit	-	Has transit
Train	API Transit	5.5	API Transit	API Transit	API Transit	-	Has train
Microbus (angkot)	API Car	5 per 10 km	5	$>$ 10 km	5	-	Always
Car taxi	API Car	$6(base)+4.5$	5	-	-	-	Always
Motorcycle taxi	$\frac{APICarDistance}{APICarSpeed+3km*h^{-1}}$	$10(base)+3$	5	-	-	-	Always

5. Modeling framework

We employed the mixed logit (MXL) using 200 Halton draws and multinomial logit (MNL) model for the choice modeling analysis, which is widely used for policy analysis. The model that we presented here was based on pooled Stated Preference (SP) and Revealed Preference (RP) data sets. Train (2003); Cherchi and Ortúzar (2011); Schmid et al. (2019) claimed that the pooled SP and RP data sets gave better estimation and robustness, which could improve the quality of only SP or RP data set. The utility of a person n choosing alternative i in choice situation t is given as follows, which MXL Model (e.q 1) and MNL Model (e.q 2):

$$U_{i,n,t} = ASC_i + \beta_i X_{i,n,t} + \varepsilon_{i,n,t} \tag{1}$$

$$U_{i,n,t} = ASC_i + \beta_i X_{i,n,t} + \eta_{i,n} + \varepsilon_{i,n,t} \tag{2}$$

There are 14 alternatives. Motorcycle-based and car-based taxis were converted to taxi and motorcycle-based and car-based ODT are converted to ODT. The utility formulation for choice alternatives $i \in \{walk, bike, ..., UAM_{\mathrm{SP}}\}$ and for individual $n \in \{1, 2, .., N\}$ in choice scenario $t \in \{1, 2, ..., T_{\mathrm{n}}\}$ can be seen in Appendices. Travel cost have continuous interaction with income and distance according and travel time of UAM with travel distance, which correspond to elasticity λ_{Income} and $\lambda_{Distance}$ (Ilahi et al., 2019; Vrtic et al., 2010; Mackie et al., 2003).

6. Results

6.1. Model Estimations of Pooled SP and RP

The result is presented in Table 10, in which motorcycle is the base category. There are two different models. The first model (MXL) is mixed logit model and the second model (MNL) is multinomial Logit model. The models have eight choice alternatives: walk, bike, car, motorcycle, taxi, ODT, PT, and UAM, which public transport (PT) modes are combined of Bus, BRT, Train, and PT in SP data set.

The parameters that we included in our model, such as travel time for a specific alternative, and travel cost were generic for all choice alternatives. Socio-demographic attributes, such as household income, age, gender, and education, are specific only for some alternatives. The model includes both travel distance and living in the agglomeration area. For the case of MXL and MNL, we found that other choice alternatives are negatively significant, which means that the motorcycle is more preferred than other alternative choices.

We found that male, non-university degree, and older people were more likely not to choose ODT but non-university degree is not significant in MXL. For UAM, males and respondents living outside Jakarta (in agglomeration) were not statistically significant; however, the young and university degree holding respondents tended to choose UAM. Furthermore, variable travel costs, and access time of UAM were negatively significant, which was the same as expected. The negative means that the higher those variables were, the less likely the respondents were to choose that mode.

In both models, we found that people preferred to use ODT than taxi. The λ of income and distance are negative significance for both models, which is similar as shown in Vrtic et al. (2010). In terms of model fit, looking at BIC and rho-square, Model MXL is better than MNL. However, both models gave better model fits compared to previous study in Greater Jakarta, which Belgiawan et al. (2019b); Ilahi et al. (2019) found that the model fit was between 0.17 to 0.4.

Table 6: A Pooled SP and RP result

Variable	MXL		MNL	
Baseline: Motorcycle	Parameter	t-test	Parameter	t-test
ASC Walk	-10.86	-13.88^{***}	-2.57	-23.27^{***}
ASC Bike	-30.52	-22.29^{***}	-4.24	-13.65^{***}
ASC PT	-18.14	-22.47^{***}	-3.75	-30.5^{***}
ASC Car	-12.01	-13.15^{***}	-1.09	-9.05^{***}
ASC Taxi	-19.94	-9.50^{***}	-3.82	-21.21^{***}
ASC ODT	-7.33	-4.94^{***}	-1.23	-7.64^{***}
ASC UAM	-14.91	-5.34^{***}	-3.23	-5.7^{***}
β Travel cost [Thousand IDR]	-6.15	-13.27^{***}	-2.08	-15.76^{***}
λ Income, cost	-0.16	-5.51^{***}	-0.06	-2.83^{***}
λ Distance, cost	-0.80	-26.75^{***}	-0.75	-19.13^{***}
λ Distance, time$_{UAM}$	-10.10	-5.91^{***}	-12.3	-9.46^{***}
σ Scale parameter MC$_{SP}$	0.20	27.47^{***}	0.67	31.31^{***}
σ Walk	-8.45	-21.79^{***}	-	-
σ Bike	14.63	38.63^{***}	-	-
σ PT	-15.90	-20.81^{***}	-	-
σ Car	16.19	21.02^{***}	-	-
σ Taxi	-9.83	-16.02^{***}	-	-
σ ODT	-12.92	-23.73^{***}	-	-
σ UAM	7.33	7.02^{***}	-	-
β Travel time Walk [minutes]	-1.69	-9.90^{***}	-0.52	-9.11^{***}
β Travel time Bike [minutes]	-29.12	-5.11^{***}	-9.05	-4.79^{***}
β Travel time PT [minutes]	-5.92	-7.29^{***}	-1.49	-7.17^{***}
β Travel time Car [minutes]	-4.31	-6.20^{***}	-1.24	-6.33^{***}
β Travel time Motorcycle [minutes]	-9.77	-9.05^{***}	-3.32	-12.68^{***}
β Travel time Taxi [minutes]	-9.43	-3.62^{***}	-4.79	-9.23^{***}
β Travel time ODT [minutes]	-15.88	-11.80^{**}	-6.26	-16.82^{***}
β Travel time UAM [minutes]	-10.85	-2.14^{**}	-2.65	-3.12^{***}
β Access time UAM	-14.98	-1.65^{*}	-4.54	-2.02^{**}
β Male ODT	-3.16	-4.34^{***}	-0.42	-4.95^{***}
β Male UAM	-0.40	-0.36	1.08	4.17^{***}
β Age Walking	3.54	1.64	-0.52	-9.11^{***}
β Age Motorcycle	-4.10	-1.74^{*}	-0.83	-3.45^{***}
β Age ODT	-6.79	-3.54^{***}	-1.32	-3.75^{***}
β Age UAM	-18.12	-3.72^{***}	-3.76	-3.35^{***}
β University degree ODT	0.55	1.31	0.27	2.97^{***}
β University degree UAM	4.61	3.99^{***}	1.08	4.17^{***}
β Agglomeration UAM	1.04	0.90	0.15	0.58
Observations	52731		52731	
Final-LL	-34824		-59103	
Rho-square	0.66		0.42	
AIC	69721		118267	
BIC	70050		118533	

$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$

6.2. Value of Travel time Savings (VTTS)

We measured the value of travel time savings (VTTS) of a person in the United States Dollar (USD), which means a person's willingness to pay in return for a reduction time. As our scenario was conducted using Indonesia Rupiah (IDR), we divide the value using 14,000 to get per USD. The VTTS was calculated using a formula as follows:

$$\mathrm{VTTS_{i,n}} = \frac{\delta \mathrm{V_{i,n}}/\delta \mathrm{T_{i,n}}}{\delta \mathrm{V_{i,n}}/\delta \mathrm{C_{i,n}}} = \frac{60,000}{14,000} * \frac{\beta \mathrm{T}}{\beta \mathrm{C}} \tag{3}$$

Where $V_{i,n}$ represented systematic utility for an alternative i for person n, $T_{i,n}$ represented travel time for the person n choosing an alternative i, and $C_{i,n}$ represents the cost for the person n choosing an alternative i. The parameters of time and cost are represented by βT and βC respectively.

In Table 7, we showed the results of the value of travel time savings (VTTS) at sample mean. It presented the willingness to reduce travel time by one unit. We did not give the VTTS of walking or biking, as travel costs were not available for those alternatives. In MXL model, the VTTS of ODT is the highest, followed by UAM, Motorcycle, and Taxi, and MNL model gave a slightly different result that ODT is the highest, followed by a taxi, motorcycle, UAM, public transport, and car.

As has been discussed in several studies in Schmid et al. (2019); Jara-Díaz et al. (2008) that VTTS is sum om value of leisure (VOL) and value of time assigned to travel (VTAT). VOL is calculated based on the proportion of hourly income, and each country has a different standard. We assumed the VOL of Indonesians is like Chileans around 66% of wages (Jara-Díaz et al., 2008). We found that VOL of 5.74 USD. As can be seen in Table 11, VTAT is positive for public transport, bus, BRT, car (Model 1), and public transport, car, and UAM (Model 2). The higher the VTAT is, the lower the VTTS will be, while the lowest VTAT means the highest VTTS.

Table 7: Value of time of mode of transport pool SP and RP (USD/hour)

Model	Mode	Fuel/Ticket cost	Access cost	VTAT
Model 1	Public transport	4.13	-	1.61
	Car	3.01	-	2.73
	Motorcycle	6.81	-	-1.07
	Taxi	6.58	-	-0.8
	ODT	11.07	-	-5.33
	UAM	7.57	10.44	-1.83
Model 2	Public transport	3.07	-	2.67
	Car	2.55	-	3.19
	Motorcycle	6.85	-	-1.11
	Taxi	9.88	-	-4.14
	ODT	12.92	-	-7.18
	UAM	5.47	9.35	0.27

6.3. Point elasticities of travel time, travel cost, Access time

In this part, we measured the direct point elasticities for all modes. The method that we used were the same as those presented in Atasoy et al. (2013); Belgiawan et al. (2019a), as shown in Eq.3:

$$E^{w_i}_{iqX_{kiq}} = \sum_{q=1}^{Q_s} E_{iqX_{kiq}} \frac{w_q P_{iq}}{\sum_{q=1}^{Q_s} w_q P_{iq}} \tag{4}$$

where w_q represents the sample weight for individual q from sample Q_s from population Q and $E_{iq}X_{kiq}$ is the disaggregate elasticity on the demand of individual q for variations in attribute X_{kiq}. We weighted each observation in our data sets according to the representation of its age and gender category in the Greater Jakarta population.

The results are shown in Table 12. The sign of all the time and cost elasticities measurements were as expected, which means that a percentage increase in all travel time and travel cost would, on average, reduce the probability of choosing an alternative. We saw that travel time all mode in MXL model are elastic, which meant that a 10% increase in travel time on average have a substantial impact on the reduction of those choice alternatives.

In general MXL model gave higher subtantial reduction than MNL model. The potential reduction of ODT was higher than taxi, which the substantial reduction for the taxi of 68.6 % and ODT of 131.9%. In MNL model, there were substantial reductions for PT of 21.7%, taxi of 29.9%, and ODT of 44.3%.

However, for travel costs in MXL model, there was a substantial reduction for a 10% increase on average travel cost for the taxi (84.3%), ODT (94.4%), and UAM (88.3%). In MNL model, the potential reduction is 11.7% for car, 25.5% for taxi, 27% for ODT, and 29.6%. In addition, access time of UAM has a substantial reduction of 13.8% in MXL model.

Table 8: Point elasticities of variables

Model	Mode	Travel time	Travel cost	Access time	
	Walk	-1.61	-	-	
	Bike	-4.51	-	-	
	Public transport	-8.11	-2.61	-	
	Car	-2.11	-4.01	-	
	Motorcycle	-1.90	-1.52	-	
MXL	Taxi	-6.86	-8.43	-	
	ODT	-13.19	-9.44	-	
	UAM	-1.15	-8.83	-1.38	
	Walk	-0.48	-	-	-
	Bike	-0.99	-	-	
	Car	-0.52	-1.17	-	
MNL	MC	-0.68	-0.48	-	
	PT	-2.17	-0.96	-	
	Taxi	-2.99	-2.55	-	
	ODT	-4.43	-2.70	-	
	UAM	-0.28	-2.96	-0.42	

7. Conclusions

The Willingness To Pay (WTP) of each mode were investigated, i.e the Value of Travel Time Savings (VTTS), Value of Travel Time Assigned to Travel (VTAT), and elasticity, using pooled SP and RP data sets. The attributes of time and cost were significant in both models, as expected sign. We found that the VTTS of ODT was the highest. The low VTTS of the car in our result was related to high-income respondents, in which the users of the car have high income, and they do not consider how expensive ride by car.

High income people tend to have lower VTTS. Taxi and ODT were elastic to travel time in Model 1, and PT, Taxi, and ODT were elastic for model 2. In term of the elasticity travel cost, Taxi and ODT (Model 1), and PT, taxi, and ODT (Model 2) were elastic. Furthermore, Taxi, ODT, and UAM (Model 1) and car, taxi, ODT, and UAM (Model2) are elastic. The VTAT of public transport and car in MXL model, and public transport, car, and UAM in MNLmodel were positive, which can reduce their VTTS.

The limitation of this paper is that we generalized the users of UAM. The respondent could be more specific to high income or business people, and further see their preferences regarding trip purposes, trip time, and attitude regarding flying in urban settings.

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