Exploring the Role of Online ‘Ojek’ In Public Transport Trips: Case of Jakarta Metropolitan Area Rail Users

A F Saffan¹, M Rizki²

¹Consultant, Cardno, Jakarta, Indonesia
²Alumnus, Civil Engineering, Parahyangan Catholic University, Bandung, Indonesia

Corresponding author: farissaffan@gmail.com

Abstract. The invention of information technology shapes people’s lives in the city, including the recent invention of online motorcycle taxi service. Known as ‘ojek’, it offers a reliable means of tactical commuting in dealing with traffic congestion in Greater Jakarta. Moreover, recent development in the online system improves the punctuality and reliability of ojek services. The emergence disrupts the transport landscape, resulting in commuters’ dependency to this transport mode. However, academic sources are insufficient to answer the policy debate among planners and policy maker regarding this issue. This paper probes the role of online ojek in Jakarta Metropolitan Area Rail users’ trip from their perspective, especially for the first mile and the last mile of their trip. The intensive commuter survey is currently being done at selected stations to gain information of their first mile and last mile trip diary. Discriminant analysis will be exercised to explain that to some extent online ojek is able to work to fill the gap produced due to minimum proper pedestrian facilities and a lack of public transport connection.

1. Introduction: Contextualizing Online Ojek in the Setting of Jakarta Transport

Unreliable public transport has triggered an explosion of the use of cars for daily commuting that is driven by powerful forces of inequality. Trunk public transport network does not fully cover all Greater Jakarta area (see Figure 1). Inevitably, people in Jakarta, especially the urban poor, are trapped in the consumerist use of low-cost motorcycles. A study reveals the remarkable fact that low-income people predominantly use motorcycles for daily transport [1].

The public transport share is lower than 40%, mostly used by low and medium income individuals. The new high-income people mostly tend to take their trips by car. Among the low-income, the motorcycle is the most dominant mode of transportation at 56% of all trips [1].

The circumstances of pedestrian facilities in Jakarta does not encourage people to walk for the first or last mile of their trips. People who walk in Jakarta must be ready for any risks related to traffic accidents and robbery. Good pedestrian pathways are only present in the center of the business district. Moreover, street vendors occupy many existing pathways throughout the city, leaving just a narrow space for pedestrians.

In consequence to the lack of pedestrian facilities and the lack of full public transport coverage, the market produces alternative modes of transportation such as online ojek to fill the gap. Combining IT an transport service into a smartphone application, online ojek emerged in early 2014. Technically, ojek is a motorcycle taxi service that functions as one of Jakarta’s paratransit systems. It offers many benefits to commuters. It is easy to order, and easy to ride. Meanwhile, in cities in most developing countries,
e.g., Jakarta, the government suffers from limited budget for an ideal public transport infrastructure, limited planning capacity, and insufficient maintenance and control [2]. The user just needs to order a trip using a smartphone application featuring transparent pricing and a clear destination map.

A transformation in transportation is inevitable, because people need more utility and effective instruments to make their life easier. Technology and users shape one another, and they somehow reconstruct human culture [3]. Fundamental application of smart applications, for instance, implies a change of way to life. The politics of innovation on public transportation triggers a renewal of constellation and learning on new procedures, which is not easier than the existing ways [3].

In terms of legal standing, ojek has a judicial bias that makes transportation policy development problematic. Naturally, ojek is a ‘free-rider’ because they simply pick up passengers from the street and disregard regulations [4]. On the one hand, many people still rely on this means of transportation. Also, ojek sustains the life of the urban poor [4]. By using ojek, commuters are able to cut significant transport cost instead of using a less regulated public transport, e.g., a microbus[5]. On the other hand, ojek operations are hard to monitor and are not controlled by authorities.

This paper intends to explore the relevance of ojek trips taken by commuter rail users with particular factors: income level, user attitude, quality of pedestrian facilities around the station, and quality of public transport services around the station. There are two questions that mainly construct this research: i) How does the quality of access plays a role in commuters’ choice to use online ojek? and ii) How does online ojek play a role in connecting commuter rail and their competition with public transports and private vehicles? We explore these questions in the sense of individuals’ decisionmaking behavior and connecting it to their travel and activity participation in the context of trip chain. The use of the paper is designed to enrich the academic discussion on commuter rail (KRL) trips and online ojek trip interaction discussion.

Figure 1. Jakarta public transport trunk network
2. Methodology

2.1 Data collection

Data for the analysis are obtained from questionnaire distribution. The concept of the first mile and last mile of the trip in the questionnaire is developed based on its interaction with accessibility [6]. The component of transport accessibility plays an important role in providing the needs of individuals’ activities at their point of origin and destination, which for public transport users are in the first and last mile of their trip. The questionnaire consists of three parts: first is the individuals’ social and demography characteristics. The second part of the questionnaire gathered information on the characteristic of the individuals’ first mile of the trip, from their home to the rail station, and the last part is characteristics of the last mile of the trip, from the rail station to their activity location.

This research obtained more than 1015 samples from face-to-face questionnaire interviews collected at 22 selected Jakarta Metropolitan Rail stations to capture their users. The questionnaire was prepared to gather data on rail users’ trip information. The survey was conducted consistently in the morning to get a typical trip chain as shown at Figure 2. Every interviewee was asked to imagine their routine travel chain in morning peak hour, and express it in the questionnaires. The trip chain approach in the questionnaire was inspired by the concept of structural trip chaining [7,8].

The selection of stations considers the variance of characteristics of land near the stations: urban business district, urban mixed use, or suburban settlements. Before the analysis is performed, the data will be evaluated based on the variance and completeness [9].

![Figure 2. Typical morning trip chain](image)

2.2 Selected indicators

The basic idea of this research is to try to analyze the behaviour of commuter rail users and their pedestrian and transit quality against online ojek trips. Presumably, every commuter who uses public transport has the largest possibility of effecting travel change, either by walking or using paratransit.

| Indicators                     | Description                                                                                      | References                                                                                      |
|-------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| First mile and last mile cost | Transit fares (usually users will compare the cost with the service quality). The fares significantly affect affordability. | Dell’ Olio, et al, 2010; Lai and Chen, 2011; Sumaedi et al., 2014 |
| Transit travel time           | Tight headway and minimum dwelling                                                              | Joewono and Kubota, 2007; Dell’ Olio, et al, 2010; Tyrinopoulos and Antoniou, 2008            |
| Transit reliability           | How easy to get adequate transit service; close to station with minimum walking                 | Joewono and Kubota, 2007; Parasuraman et al., 1985; Tyrinopoulos and Antoniou, 2008; Sumaedi et al., 2014 |
The perception of feeling secure from crimes and accidents while travelling on board

The perception of feeling safe while crossing junctions or mid-road links.

How easy it is to walk to the station. The variable is determined by comprehensive perspective or perceived distance and ease. The indicator could be represented by the quality of walking pathways, green shades, etc.

This research uses classification analysis to determine the first mile and last mile mode choice with the individual perception of facilities at the station. Individuals’ decisionmaking consists of a series of psychological steps which are formed by an interaction between perceptions and beliefs based on available information, and influenced by affect, attitudes, motives, and preferences that produce a choice [10]. The variables are analyses in the form of utility theory and the evaluation of the choice is done under the utility maximization concept [11–13].

The walking and transit service indicators are constructed based on intensive literature analysis. Many studies emphasize the measurement of service quality through passenger reflection to be a fundamental method, because they can be considered as the most experienced judges [14–19]. Also, some studies revealed the interaction model of service quality indicators and the effect to passengers’ behavioral intentions of using public transport or Paratransit [17,20,21]. The accessibility will be assessed by a perceived scale [22].

3. Sample socioeconomic characteristics

Table 2 shows the descriptive analysis of the 1015 samples that had been collected. From the survey results, the average travel time from home to destination is 15 minutes by any mode. The average distance of the first mile is 4.2 km and the average distance of the last mile is 3.7 km. In average, the respondents spend 13-15 minutes for their last mile and first mile. Particularly, there are some respondents who spend 90 minutes for their first mile to station. This figure is typical for Greater Jakarta where many commuters live in the suburbs and work in the city of Jakarta or industrial areas such as Bekasi. In addition, not many suburban settlements are covered by commuter stations. Commuters who live in Indonesia’s smaller cities might have 5 km as their full journey.

The average income of the sample is close to IDR 6.68 million per month, where the maximum monthly income is IDR 30 million or approximately EUR 2000. The data also shows that ownership of private vehicles is maximum 2 units. This figure reflects that the sample likely come from middle class families. The standard deviation of income is close to IDR 41 million. The average vehicle ownership is 1-2 units of private vehicle, and the maximum is 8. This vehicle ownership number does not differentiate by vehicle type, so it could be car or motorcycle.

| Variables                        | Minimum | Maximum | Mean       | Std. Deviation |
|----------------------------------|---------|---------|------------|---------------|
| Distance from home to station (km) | .10     | 30.00   | 4.2028     | 3.90          |
| TT from home to station (min)    | 1.00    | 90.00   | 15.0020    | 12.07         |
| First-mile cost (IDR)            | .00     | 50000.00| 7000.7220  | 6839.29       |
| Distance from station to workplace (km) | .10     | 32.00   | 3.7626     | 4.48          |
The data shows the average spending for the first-mile of the trip (7000 IDR or ±0.5 EUR), and the last-mile of the trip (5000 IDR or ± 0.32 EUR). There are a few samples that do not spend any money. Typically, this data occurs when they travel on foot, or picked up by their family.

The first/last-mile cost does not represent the perceived value of satisfaction. The perceived value is more significantly affecting satisfaction instead of actual fare [21]. The typical fare for using feeder buses is 4000 IDR. If the commuters are able to use Transjakarta, transfer will not be charged again. However, if the route is surfed only by minibuses (called angkot) or regular buses, transfer will be charged. Thus, the total fare can be more expensive, instead of using online ojek. Online ojek applies distance-based fares. They also quite often offer discount. Moreover, the microbus and regular bus usually dwell at particular spots to gather passengers. The delay is unpredictable. On the other hand, online ojek offers punctuality. In peak hour, online ojek will increase the fares due to high demand. Therefore, the trade off between attitude and cost will be investigated further.

4. Perception of access

The station accessibility is assessed by exploring the quality of pedestrian access and quality of transit. The pedestrian access quality towards the station is not only affected by constant distance, but also affected by crossings, route choice, pathway quality, and conflict with other street elements [19,23]. The feeder transit quality is assessed by exploring the perception of accessibility, reliability, fare affordability, and safety. The transit reliability is the most significant service parameter that applies for all user categories [24].

Figure 3 shows users’ perception of station accessibility. The parameters consist of transit safety, transit accessibility, transit reliability, transit affordability, pedestrian pathway quality, crossing environment, and pedestrian access which also means continuity of protected pathways. The pathway quality is more associated with pavement with proper betterment: flat and spacious. The doughnut diagram contains 2 circles: outer and inner. The inner circle stands for home to station trip, and the outer circle represents the trip from station to activity place.

In general, the survey data reveals poor perception of pedestrian environment connecting the commuter station to other places. In the case of pedestrian pathway quality, 75% of respondents answered that the quality at their destination station is poor, and 65% answered poor for their origin station. Both crossing environment and pedestrian access are also perceived as poor by more than 60% of the respondents. These results is relevant with the current situation in the most part of Greater Jakarta.

Typically, pathways around the central business district has a proper image and quality. The pathway is more or less 3 metres wide. However, the continuity of descending pathways and crossings is still an issue. Traffic and reckless driving behavior threaten every pedestrian who cross the road. Instead of calming the traffic, the design of the city tends to use pedestrian bridges, which are troublesome for persons with disabilities, senior citizens, and pregnant women. In areas farther away from the city center, pathways are typically encroached by street vendors. All these create contribute to conflict in pedestrian traffic and create a perception of a longer trip. Thus, those conflicts may lead to a longer perceived distance for commuters.

Figure 3 also indicates that the feeder transit service to stations mostly have adequate frequency and sufficient supply, but still lack coverage area, safety, and affordability. In the case of feeder service, 84% of the interviewees stated that transit service for the last mile of the trip to have poor affordability, and 76% claimed poor affordability for the first mile. The high transit service fares occur because the transit
ticket is not integrated to the commuter train ticket. The passenger will be charged for an extra trip. Transferring to two different bus routes might cost a similar amount to or even more than the cost of online ojek. The samples also mostly perceive transit accessibility to be poor, expressed by 86% for the last mile of the trip, and 65% for the first mile of the trip. In addition, most interviewees also think that the transit is not safe. Unlike other parameters about transit, most respondents answered that feeder reliability is adequate, as expressed by 77% for home to station trip, and 73% for station to activity place trip.
Figure 3. Station transit and perceived pedestrian quality; inner diagram (home to station trip); outer diagram (station to activity place trip).
5. First mile and last mile mode of transportation share at stations

The presence of online ojek is obviously seen at many commuter rail stations in Jakarta. Typically, online ojek flocks at spots nearby the stations to meet their customer. They encroach some spaces and claim those spaces as their informal stations. Technically, online ojek can only carry one passenger each. Figure 5 shows the share of mode of transportation choice from house to first station, and last station to destination. The figures reveal that online ojek plays a significant role in commuter rail users’ trip chain, especially for the first mile and last mile of the trip. The mode choice is categorized into online ojek, private vehicle, active transport, public transport, and others, e.g., taxi.

In the case of the first mile of the trip, private vehicles are majorly used (33%), followed by online ojek (24%), walking (16%), and public transport (12%). On the other hand, most respondents are walking (31%) and using online ojek (28%) for the last mile of their trip from station to destination. There are a few samples (8%) who use their private vehicle to travel from the station to their activity place. This figure occurs since there are some commuters who park their motorcycle in their last station chain. The shares of feeder transit users for the last mile of the trip (23%) is bigger than the first mile of the trip (12%).

The mode share of public transport is less than online ojek for all of the trip chain. This figure indicates that online ojek leads the share of the first mile and last mile of the trip chain. Besides, this figure also shows obvious interaction between commuter rail trip with online ojek trip. Most rail users spend many minutes of their travel time on board. Online ojek is able to cut off their travel journey because it is able to surf narrow alleys, and find shortcuts to avoid congestion [5].

The online ojek shares between the first mile and last mile of the trip differ. The utilization of online ojek for the first mile (home to station) seems less than the last mile (station to destination). This result indicates that most rail commuters prefer using their private vehicle for the first mile (30%). More commuter rail users ‘park and ride’, instead of using online ojek. It also indicates that private vehicles, e.g., driving a personal motorcycle, is more convenient than online ojek. Motorcycle one-day parking typically costs half the online ojek fare for 5 km. On the other hand, one-day parking for a car can cost double the online ojek fare for 5 km. The perceived cost of private motorcycle is cheaper than online ojek. Other factors, e.g., convenience, likely affect the preference of most commuters to use a private vehicle. Further analysis of these results will be explained in section 6.1 and 6.2. The next part explains the discriminant analysis of the mode used for the first mile and last mile, which focuses more on understanding the factors that affect the mode choice of rail commuters. In the case of the first mile of the trip, this research is not able to explain more about private vehicles versus online ojek, since there are no significant indicators that allow a discriminant analysis to compare online ojek and private vehicles at the first-mile case.

Figure 4. Online ojek, parked around the Kebayoran Station, wait for their passengers
6. Ojek user classification analysis
Individuals’ choices could be understood through many aspects of human behavior, which attracts many researchers in the past decades. The classification analysis used in this research reveals the pattern of commuters’ mode of transportation choice. This analysis is divided into two types of trip: first mile and last mile. As explained above, the first mile of the trip consists of the trip from home to the rail station, while the last mile is from the rail station to the activity location. The interpretation of the model refers to a broad literature of classification analysis in the sense of transportation [8,25,26]. Variables in every classification analysis are chosen based on the Mahalanobis value using the stepwise method. Thus, the number of variables in first mile and last mile discriminant model can be different, which depend on the optimum Mahalanobis value. Furthermore, the ratio of cases to independent variables in every model turned out to be more than 5:1 as stated in [9]. In addition, the structural matrix interpretation considers a loading value that is higher than 0.30, which is based on [27].

Regarding the exploration of the findings, the independent variable is constructed by several types of data. The first part is the attitude of commuter rail users, represented by a preference for comfort, safety, time efficiency, and price affordability. Those attitudes basically show how commuter rail users consider the criteria to choose their last mile and first mile mode of transportation. The second part is the number of private vehicle ownership, converted into a dummy variable of the total unit ownership. The third part is the distance from station to activity place, and the distance from home to station. The value of the variable is converted into a dummy variable and categorized to a distance of more than 5 km, and less than 5 km. The value of 5 km is used because it approaches the 4.3 km average distance showed in Table 2. The fourth part is the cost of the last mile and first mile of the trip. This variable can be the total of ojeks fare, transit fare, or parking charge. The next part is the perception of pedestrian environment around the station, consisting of accessibility, crossing, and pedestrian pathway reliability. The last part is the feeder transit service quality perception. The transit quality is explored through analyzing safety from crimes and accidents, reliability, accessibility, and fare.

The discriminant analysis uses the mode choice as the dependent analysis. The mode options for the function consists of private vehicle, online ojek, public transport, and non-motorized transport (walking or cycling).

A further part of this paper will explain the classification analysis result. Table 3 and Table 4 show two discriminant results based on the trip chain type. This discriminant analysis uses the structural matrix approach or also known as canonical loadings to classify the categories that correlated to the first mile and last mile mode choice.
6.1. First mile classification analysis

Table 3 shows the result of the classification analysis of mode choice for the first mile of the trip. In terms of fitting to the models, the result of Box’s M test shows that the null hypothesis of the equal population covariance matrices is rejected. When using Box’s M test, the non-significant M expect the variance-co-variance matrices to be equivalent. Due to the large sample collected, a significant result is not regarded as serious [27]. This discriminant analysis uses the structural matrix approach, also known as canonical loadings, to classify the categories that correlated to the first mile/last mile mode choice. The canonical correlation of the three functions are 0.538, 0.260, and 0.155 which can be interpreted as there being 28.94%, 6.7%, and 2.4% of the variance in the dependent variables can be explained by the model. Although canonical correlation indicators show weak correlation, the parameter of Wilks’ lambda of this model indicates that the function is highly significant. Therefore, the model is acceptable to interpret [9].

The mode choice variable consists of online ojek (OO), private vehicle (PV), public transport (PT), and non-motorized transport (NMT). As explained above, the interpretation of the models depends on the function on the group centroid. It simply considers the most positive value and the most negative value of each function. Function 1 separates respondents who travelled with NMT (1.065) from respondents who travelled with OO (-0.943). We ignored the comparison with the other groups which are distinguished by another function. Function 2 separates respondents who travelled with PV (0.272) from respondents who travelled with NMT (-0.435). Furthermore, function 3 separates respondents who travelled with NMT (0.124) from respondents who travelled with PT (-0.380).

The evaluation of function 1 showed that the separation between online ojek and NMT is heavily influenced by the pedestrian infrastructure characteristics. It reveals that unreliable pedestrian facilities and crossing environment lead to the decline of the number of respondents who choose NMT, supported by negative loading values (-0.246 and -0.428). Regarding the travel cost, findings show respondents who have more than IDR 10,000 fare to stations are more likely to use online ojek than NMT, which does not have a significant cost to reach the stations (loading value 0.82).

In the sense of the second function, we found that the choice pattern between private vehicle and NMT is influenced by attitudinal characteristics of public transport such as fare and accessibility. Respondents who experience poor public transport services are more likely to choose private vehicle. The parameter ‘high transit fare’ shows an obvious loading value (0.811), indicating high transit fare leads the commuters to use a private vehicle. In addition to that finding, it is also found that respondents aged 26-40 tend to choose NMT than private vehicle. This finding is possibility related to the early respondent career stage that influences individuals’ mode choice.

Furthermore, the third function found the factors which separate NMT and public transport choice. It reveals that the attitudinal variables found separate the mode choice significantly. For example, respondents who prefer comfort, safety, and time efficiency of mode are more likely to use NMT than public transport. Furthermore, it is interesting to note that even with people who suffer negative experiences with public transport (e.g., tiring and not safe), they are still less likely to use NMT than public transport. This finding could be explained by exploring the value of group means in every choice which shows that rather than public transport, respondents are more likely choose online ojek. In terms of age, it is found that older respondents are less likely use NMT than public transport. It is also noticeable that a negative attitude to walking leads to declining NMT use by respondents.

Various findings of the first mile of the trip model emphasizes a strong association between infrastructure characteristics and individuals’ attitude to the mode choice. Lacking and poor service from the pedestrian environment has discouraged commuter rail users to use NMT instead of online ojek. A strong reason could be related to the actual experiences of commuters, where the pedestrian environment affects the actual distance, creating a perceived distance. However, although pedestrian facilities are poor, individuals still choose NMT over public transport. The interpretation of public transport pattern choice shows that feeder transit quality merits commuter rail attitude. Despite perception of good quality perception, however, commuter rail users still tend to use online ojek rather than public transport.


Table 3. Discriminant analysis of online ojek and commuter rail users (home to station)

| Variables                                           | OO     | PV     | PT     | NMT    | Structural Matrix |
|-----------------------------------------------------|--------|--------|--------|--------|------------------|
| Prefer Comfort [D]                                  | .1034  | .1596  | .1263  | .2000  |                  |
| Prefer Safety [D]                                   | .0172  | .0423  | .0105  | .1053  |                  |
| Prefer Time Efficiency [D]                           | .3218  | .4202  | .2842  | .3895  |                  |
| Prefer Affordability [D]                             | .0517  | .0814  | .1368  | .0000  |                  |
| Female Commuters                                    | .4655  | .4886  | .3474  | .3895  |                  |
| < 18 Years Old [D]                                  | .0460  | .0293  | .0000  | .0105  |                  |
| 18-25 Years Old [D]                                 | .2759  | .2476  | .2105  | .2000  |                  |
| 26-40 Years Old [D]                                 | .5057  | .5081  | .5053  | .6737  |                  |
| > 40 Years Old [D]                                  | .1724  | .2150  | .2842  | .1158  |                  |
| Do Not Have Private Mode                            | .1264  | .0684  | .1263  | .1053  |                  |
| Have Private Mode                                   | .8736  | .9316  | .8737  | .8947  |                  |
| < 1 km station distance from home [D]               | .1782  | .2182  | .2105  | .3789  |                  |
| 1-5 km station distance from home [D]               | .5460  | .5831  | .5684  | .4947  |                  |
| > 5 km station distance from home [D]               | .2759  | .1987  | .2211  | .1263  |                  |
| Poor crossing environment                           | .3904  | .4316  | .2178  | .1789  |                  |
| Poor Pedestrian Facilities                          | .4340  | .4421  | .2105  | .2464  |                  |
| Unaccessible with Public Transport                  | .3678  | .4137  | .3368  | .1684  |                  |
| Public Transport Poor Services                      | .7644  | .7427  | .6947  | .7368  |                  |
| High-fare of Public Transport                       | .2644  | .3876  | .2947  | .0842  |                  |
| Public Transport is Not Safe                        | .5287  | .4300  | .4316  | .1474  |                  |
| Work/School Trip                                    | 1.2414 | 1.2020 | 1.3158 | 1.2000 |                  |
| Number of Trip to Stations                          | .9540  | .9805  | .9789  | .9895  |                  |
| < IDR 5,000 fare to Station [D] a                   | .1897  | .5863  | .6737  | .9053  |                  |
| > IDR 10,000 fare to Station [D]                     | .3563  | .1270  | .1158  | .0000  |                  |
| Unreliable Pedestrian Access                        | .6034  | .4593  | .4737  | .2000  |                  |

Fit to Parameters                                   | Mode Choice | F1     | F2     | F3     |
| Box's M [F;d1;df2;p-value]                          | .409.636 [4.760; 84; 3.48714; 517; 0.000] | Online ojek | -.943 | -.198 | .055 |
| Eigen Values [Canonical Correlation]                | 0.4088; 0.072; 0.025 [0.538; 0.260; 0.155] | Private Vehicle | .155 | .272 | .048 |
| Wilks' Lambda F1 through F3; F2 through F3; F3[p-value] | 0.646; 0.910; 0.976[0.000; 0.000; 0.006] | Public Transport | .162 | -.083 | .380 |
| NMT                                                  | .1065  | .4351  | .124   |        |                  |

D: 1 if yes, 0 otherwise; OO: Online Ojek, PV: Private Vehicle, PT: Public Transport; NMT: Non Motorized Transport
* Variable in the analysis based on Mahalanobis D2; *: Largest absolute correlation between variable and any discriminant function
6.2. Last mile classification analysis

Table 4 shows the result of discriminant analysis using the mode choice in the last mile of the trip. In terms of fitting the models, the result of Box’s M test shows that the null hypothesis of equal population covariance matrices is rejected. When using Box’s M test, the non-significant M expect the variance-co-variance matrices to be equivalent although it is not crucial since the sample is large enough.

This discriminant analysis uses the structural matrix approach, also known as canonical loadings, to classify the categories correlated to the last mile mode choice. The canonical correlation of the two functions are 0.720, 0.553, and 0.218, which can be interpreted as there being 51.84%, 30.58%, and 4.7% of the variance in the dependent variables that can be explained by the model. Although canonical correlation indicators show weak correlation, the parameter of Wilks’ lambda of this model indicates that the function is highly significant. Therefore, the model is acceptable to interpret [9].

The interpretation of the model depends on the functions in the group centroid which are strongly related to the discriminant function. Function 1 separates respondents who traveled with NMT (1.434) from respondents who traveled with OO (-1.041). Function 2 separates respondents who traveled with PV (0.535) from respondents who traveled with NMT (-1.030). Furthermore, function 3 separates respondents who traveled with NMT (0.666) from respondents who traveled with PT (-0.1216).

By evaluating the first function which discriminated between the choice of NMT and online ojek, respondents whose travel cost is less than IDR 5,000 are more likely use NMT than online ojek (loading value 0.722). In contrast, respondents with a travel cost of more than IDR 10,000 are more likely to use online ojek than NMT. Short distance last mile commuters tend to choose NMT rather than online ojek, which is shown by the loading value of 0.574 for users who travel less than 1 km from the station to their destination.

Furthermore, the second function shows the separation between online ojek and public transport choice. It reveals that in a shorter travel distance, respondents tend to choose online ojek than public transport, which is shown by a loading value of 0.544. In addition, the value of group means shows that the value of OO (0.2599) is less than the mean value of NMT (0.8069). Those figures indicate that distance affects the commuter rail decision on how to choose their last mile mode. On the other hand, respondents whose travel cost is less than IDR 5,000 travel cost are more likely to choose public transport (-0.480).

In addition to the second function, several attitude characteristics also influence the mode choice. Negative experiences with public transport, i.e., ‘public transport is tiring’ (0.367) and ‘public transport is not safe’ (0.411) indicates that respondents are more likely to choose online ojek. This finding supports the previous model in proving that the level of service will define the role of public transport in commuters’ trip. Regarding to pedestrian facilities, respondents who experienced poor quality of pedestrian bridges tend to use online ojeks than public transport.

According to the evaluation of the third function’s structural matrix, the discrimination of private vehicle and online ojek is associated to individuals’ and infrastructures’ characteristics. It is interesting to note that although commuters have private vehicles, they still tend to choose online ojek than private vehicle. The possible reason is related to the type of trip, as the last mile of the trip of rail users depends on the first mile of the trip. For instance, private vehicle users will probably park their vehicle at the first station and rely on alternative modes at the last station. Hence, it is important to note that mode integration in the last mile has a crucial influence on the whole journey.

Several important notes found in this model fill the gaps of the previous model. Pedestrian facilities, which is a crucial infrastructure in public transport trips, similarly influence commuters in the first and last mile trip. While supported by previous findings, this model also underlined the new fact of the last mile of the trip. As individuals’ trip chain characteristics are related from one to another, individuals’ decision of mobility in the first time of the day is influenced by their evaluation of the whole journey. Thus, the analysis emphasizes that public transport journey is related to the high level of pedestrian environment and other public transport integration in every transportation hub.
| Variables                                      | OO    | PV    | PT    | NMT   | Structural Matrix | F1      | F2      | F3      |
|-----------------------------------------------|-------|-------|-------|-------|------------------|---------|---------|---------|
| Prefer Comfort [D]                            | 1.366 | .1803 | .1602 | .1386 | -0.001           | 0.952   | 0.028   |
| Prefer Safety [D]                             | 0.044 | 0.0328| 0.0000| 0.0500| -0.073           | 0.089   | 0.180   |
| Prefer Time Efficiency [D]                    | 0.3700| 0.3607| 0.2818| 0.2376| -0.014           | 0.015   | 0.079   |
| Prefer Affordability [D]                      | 1.498 | 1.639 | 1.381 | 0.891 | -0.061           | 0.006   | 0.005   |
| < 1 km station distance from activity location [D a] | 2.599 | 1.311 | 1.657 | 0.8069| 0.574            | 0.544   | 0.098   |
| > 5 km station distance from activity location [D] | 1.894 | 2.787 | 1.547 | 0.0248| -0.075           | -0.174  | 0.044   |
| < IDR 5.000 fare to Station [D]               | 2.247 | 0.4754| 0.8011| 0.9406| 0.722            | -0.480  | 0.294   |
| > IDR 10.000 fare to Station [D]              | 2.379 | 0.1148| 0.9399| 0.0149| -0.287           | 0.213   | -1.112  |
| < 18 Years Old [D] a                         | 0.0264| 0.0820| 0.0000| 0.0248| -0.036           | 0.087   | 0.558   |
| 18-25 Years Old [D]                          | 0.2687| 0.3115| 0.1878| 0.2228| 0.008            | 0.037   | 0.032   |
| 26-40 Years Old [D]                          | 0.5955| 0.4262| 0.4807| 0.5743| -0.020           | 0.165   | -0.057  |
| > 40 Years Old [D] a                         | 0.1454| 0.1803| 0.3315| 0.1782| 0.030            | -0.277  | -1.174  |
| Have Private Mode a                          | 0.9339| 0.7705| 0.8619| 0.9307| 0.039            | 0.180   | -0.515  |
| Female Commuters                             | 0.4493| 0.4754| 0.5391| 0.4802| 0.080            | 0.081   | 0.031   |
| Unreliable Pedestrian Access                 | 0.3040| 0.3770| 0.1657| 0.1485| -0.162           | 0.158   | 0.272   |
| Too long to walk a                           | 0.7137| 0.8033| 0.7845| 0.5248| -0.181           | 0.224   | 0.037   |
| Unreliable Pedestrian Bridge                 | 0.4997| 0.4918| 0.0773| 0.1386| -0.279           | 0.307   | 0.582   |
| Poor Pedestrian Facilities                   | 0.2731| 0.3934| 0.2431| 0.2574| -0.143           | 0.076   | 0.281   |
| Unaccessible with Public Transport           | 0.1938| 0.2295| 0.1105| 0.1980| 0.019            | 0.111   | 0.124   |
| Poor Public Transport Services               | 0.7181| 0.6066| 0.6243| 0.7822| 0.075            | 0.184   | -0.131  |
| High Public Transport Fare                   | 0.2819| 0.3443| 0.0884| 0.1782| -0.097           | 0.262   | 0.081   |
| Public Transport is Not Safe                 | 0.3172| 0.2459| 0.0884| 0.4208| 0.106            | 0.411   | 0.201   |

* Fit to Parameters

| Box's M [F;df1;df2;p-value] | 488.311 [5.217; 90; 100448.317;0.000] | Online ojek | 1.041 | 5.35 | 1.121
| Wilks' Lambda [Canonical Correlation] | 0.318; 0.661; 0.000; 0.000 | Public Transport | 0.034 | -1.030 | -1.119

D: 1 if yes, 0 otherwise; OO: Online Ojeks, PV: Private Vehicle, PT: Public Transport; NMT: Non Motorized Transport

a: Variable in the analysis based on Mahalanobis D^2; *: Largest absolute correlation between variable and any discriminant function.
7. Discussions and conclusions
This article reveals that online ojek somehow creates reliability for commuter rail users’ first mile and last mile tactical commuting in dealing with undermined public transport service quality and inadequate pedestrian environment.

The body of the research reveals several findings on the role of online ojek in the trip chain of commuter rail users. First, respondents experience inadequate walking environment and feeder service quality to access stations, although transit reliability receives a different assessment (see Figure 3). Second, online ojek shares occur dominantly at the first mile and last mile travel of commuter rail users’ trip chain (see Figure 5). Third, Table 3 and Table 4 explain the interaction of commuter rail attitude, background, and also station accessibility that affect the last and first mile mode choice. The discriminant analysis reveals the natural dependency of commuter rail users to online ojek services.

It is obvious that most the commuter rail users are dependent to online ojek service. It is able to support rail users who face the serious problem of transit service area gap in Greater Jakarta. The usage of online ojek exceeds other public transport shares, e.g., TransJakarta and microbus at majority commuter rail stations for first mile and last mile of the trip. Meanwhile, the share of walking is still surviving for the last mile of the trip where the trip occurs in urban CBD. In this situation, online ojek shows a paradox for Jakarta’s transport setting. The online ojek role is competing with private vehicles in the first mile of the trip that typically start in sub-urban areas. In addition, this paper also reveals that online ojek threatens feeder transit sustainability. It seems that online ojek could lead to a natural displacement of the role of public transport feeder that connects home to station and vice versa. Some transit feeder routes connecting to stations are still less regulated with undermined service performance.

The role of online ojek tends to be more superior than walking and feeder transit. The discriminant analysis shows that poor pedestrian and feeder transit experience leads to online ojek needs. The walking distance is not only the single variable that is significant to the mode choice classification between OO and NMT (see Table 4). There are also commuters’ attitude and the economic aspect that affects mode choice to station. It is also noticeable despite the nature of NMT being chosen for short and medium walking distance, when the pedestrian accessibly (e.g., pedestrian bridge, etc.) is poor, online ojeks prevail over NMT.

The preference to safety is not really significant to mode choice. Even so, motorcyles are not the safest vehicle in traffic, especially for long distance travel. Even so, some studies reveal that motorized two wheelers, as well as ojek, are the most vulnerable mode of transportation in traffic [16,28]. Quick travel time is trade off for the safety issues faced by commuters.

Inadequate crossing environment around the station is statistically significant in discouraging commuters to walk. This result is relevant with a study in Bangkok that found not only acceptable walking distance from stations to home or workplace, the walking environment also influences the commuters to decide whether to use ojek, or walking [23]. Even so, findings also show that some commuters prefer walking up to a certain distance. People can walk longer while there are certain features on the street, e.g., shaded trees, clear pathways, and any interesting features [29].

The condition of pedestrian pathways in Greater Jakarta CBD close to the station varies. Some of them are deterioriating, and reduced because of street vendor encroachment, some of them are in proper condition. Nevertheless, crossing streets in Jakarta CBD is difficult. There is heavy and reckless traffic.

Continuous transit service quality is required to attract commuters to use public transport for the entirety of their trip chain. Transit passenger loyalty significantly relies on satisfaction encouraged by good safety image, adequate frequency, good stop amenities, and integrated connectivity to all mainplaces [21]. Accessibility problem at the first mile and last mile of the trip discourages them to walk and continue riding transit. In fact, Greater Jakarta still faces a ‘double standard’ in transit quality. One of them is Transjakarta which is subsidized, and follows a minimum service quality. The other one is a less regulated system that operates based on driver willingness.

Beyond these findings and relevance for planning, the competition among transport modes occur dependent on the urban settings. Each mode of transportation is struggling in their operation and gaining revenue. There are different settings of the market rules that are based on the ability of the government to control and finance all the services. More less-regulated local microbus owners and drivers are
struggling to gain passengers to run the microbus daily operation, or at least meet their breakeven point.
On the other hand, other public transport systems, e.g., Transjakarta, which is subsidized by the
Government of Jakarta, also severely struggle to achieve their cost recovery. In contrast, online ojek
companies are run by professionals who are purely profit-oriented. They provide some features in the
app for driver rating and deal with complaints from their customer, to evaluate the driver performance.

The government needs to ensure a win-win solution between the transit and the online ojek
companies. Even the state is usually weaker, enabling regulations to control the use of online ojek, since
the demand and needs of the people keep growing. The government could add more subsidy for feeder
transit that connects to commuter rail stations. Nevertheless, it needs to pledge carefully, since subsidies
also may have a stronger effect on reducing business viability and technical efficiency rather than
generating more income [30].

In the case of land use planning, Greater Jakarta needs to reshape its city structure. Typically, the
urban CBD are close to the main street and public transport line, but suburb settlements are mostly
behind in the main transport network [31]. Most of the population are moving to the outskirts to find
more affordable housing and more convenient environment. In fact, urbanization in Greater Jakarta is
polarized, and built by different developers which do not really shape efficient structures [32]. Land use
development and public transport development are not perfectly connected. Proper infrastructure for the
public transport network shall foster rapid development to bundle those incremental development. Bus
Rapid Transit can be the cheaper alternatives to reshape the land use planning, as well as Curitiba
experience [33].

Urban planners might see an opportunity in this new transport market setting. The role of microbus,
which has been controlled by informal regulations, is getting weaker. An integrated public transport
reform can replace the informal regulation microbus market with a more reliable service feeder service.
Legitimizing online ojek in the traffic law may become a strategy to control its operation by applying
formal registrations and taxes. Thailand is the first country in the world that acknowledged motorcyle
taxis in their regulation, and they effectively succeeded to intervene with the fare which affect the
demand reduction[34]. Therefore, further research on regulating online ojek and its effects may be
necessary to improve Jakarta’s transport.

References
[1] JICA 2012 Project for the Study on JABODETABEK Public Transportation Policy
Implementation Strategy (Jakarta: Directorate General of Land Transportation Ministry of
Transportation The Republic of Indonesia)
[2] Cervero R and Golub A 2007 Informal transport: A global perspective Transp Policy 14 6 p 445–
57.
[3] Nahuis R 2007 The politics of innovation in public transport: issues, settings and displacements
(Utrecht: Koninklijk Nederlands Aardrijkskundig Genootschap, Copernicus Institute for
Sustainable Development and Innovation)
[4] Harjoko T Y, Dikun S and Adianto J 2012 Spatial contestation and involution: a case of the public
transport, with particular reference to the Kampung Melayu, Jakarta Dev. Cty. Stud. 2 p 94–
107
[5] Syabri I, Pradono B and Soegijianto T 2013 Embracing Paratransit in Bandung metropolitan area,
West Java, Indonesia Case Study Prep. Glob. Rep. Hum. Settl.
[6] Geurs K T and van Wee B 2004 Accessibility evaluation of land-use and transport strategies:
review and research directions J. Transp. Geogr. 12 p 127–40
[7] Strathman, J and Dueker K J 1995 Understanding Trip Chaining, Special Reports on Trip and
Vehicle Attributes: Based NPTS Data 1990 (Portland: U.S. Department of Transportation,)
[8] Joewono T B and Rizki M 2015 Classification Analysis of Students’ Trip Chain in Bandung,
Indonesia and Its Interpretation J. East. Asia Soc. Transp. Stud. 11 p 392–410
[9] Hair J F, Black W C, Babin B J, Anderson R E and Tatham R L 2006 Multivariate Data Analysis
(Prentice Hall, New York: Pearson)
[10] Ben-Akiva M E and Lerman S R 1985 Discrete Choice Analysis: Theory and Application to
Travel Demand (Cambridge: Massachauttss: MIT Press)
[11] Koppelman F and Bhat C 2006 A Self Instructung Course Mode Choice Modelling Multinominal and Nested Logis Models
[12] Hensher D A, Rose J M and Greene W H 2005 Applied choice analysis: a primer (Cambridge ; New York: Cambridge University Press)
[13] Greene W H 2012 Econometric analysis (Boston: Prentice Hall)
[14] Dell’Olio L, Ibeas A and Cecin P 2011 The quality of service desired by public transport users Transp. Policy 18 p 217–27
[15] Eboli L and Mazzulla G 2011 A methodology for evaluating transit service quality based on subjective and objective measures from the passenger’s point of view Transp. Policy 18 p 172–81
[16] Joewono T B and Kubota H 2006 Safety and security improvement in public transportation based on public perception in developing countries IATSS Res. 30 p 86–100
[17] Mouwen A and Rietveld P 2013 Does competitive tendering improve customer satisfaction with public transport? A case study for the Netherlands Transp. Res. Part Policy Pract. 51 p 29–45
[18] Tyrinopoulos Y and Antoniou C 2008 Public transit user satisfaction: Variability and policy implications Transp. Policy 15 p 260–72
[19] Wibowo S S and Olszewski P 2005 Modeling walking accessibility to public transport terminals: Case study of Singapore mass rapid transit J. East. Asia Soc. Transp. Stud. 6 p 147–156
[20] Sumaedi S, Bakti I G M Y, Astrini N J, Rakhamwati T, Widianti T and Yarmen M 2014 Public Transport Passengers’ Behavioural Intentions (Singapore: Springer Singapore)
[21] Lai W-T and Chen C-F 2011 Behavioral intentions of public transit passengers—The roles of service quality, perceived value, satisfaction and involvement Transp. Policy 18 p 318–25
[22] Lättman K, Olsson L E and Friman M 2016 Development and test of the Perceived Accessibility Scale (PAC) in public transport J. Transp. Geogr. 54 p 257–63
[23] Pongprasert P and Kubota H 2017 Switching from motorcycle taxi to walking: A case study of transit station access in Bangkok, Thailand IATSS Res. 41 p 182–90
[24] Dell’Olio L, Ibeas A and Cecin P 2010 Modelling user perception of bus transit quality Transp. Policy 17 p 388–97
[25] Ortúzar J de D and Willumsen L G 2011 Modelling Transport (Chichester, West Sussex, United Kingdom: John Wiley & Sons)
[26] Pas E J 1985 State of the Art and Research Opptunities in Travel Demand Transp. Res. Part Gen. 19A No 5/6 p 460–4
[27] Burns R B and Burns R A 2008 Business Research Methods and Statistics Using SPSS 2008 (London: Sage Publication)
[28] Dandonor R, Kumar G A and Dandonor L 2006 Risky behavior of drivers of motorized two wheeled vehicles in India J. Safety Res. 37 p 149–58
[29] Jiang Y, Christopher Zegers P and Mehdiratta S 2012 Walk the line: station context, corridor type and bus rapid transit walk access in Jinan, China J. Transp. Geogr. 20 p 1–14
[30] Zhang J, Niu J, Buyantuev A and Wu J 2014 A multilevel analysis of effects of land use policy on land-cover change and local land use decisions J. Arid Environ. 108 p 19–28
[31] Mochtar M Z and Hino Y 2006 Principal Issues to Improve the Urban Transport Problems in Jakarta Mem Fac Eng Osaka City Univ 47 p 31–38
[32] Firman T 2009 The continuity and change in mega-urbanization in Indonesia: A survey of Jakarta–Bandung Region (JBR) development Habitat Int. 33 p 327–39
[33] Cervero R and Dai D 2014 BRT TOD: Leveraging transit oriented development with bus rapid transit investments Transp. Policy 36 p 127–38
[34] Oshima R, Fukuda A, Fukuda T and Satienam T 2007 Study on regulation of motorcycle taxi service in Bangkok J. East. Asia Soc. Transp. Stud. 7 1828–1843
Acknowledgement
Authors would like to convey our gratitude to BPTJ (Greater Jakarta Land Transport Authority) for supporting this research. Also, we extend out appreciation to Anugrah Ilahi, Muiz Thohir from BPTJ, and Dr. Muhammad Prayudianto for giving us insights to enhance our research design.