Measuring survey-based trip satisfaction of feeder modes for bus rapid transit in Rawalpindi Islamabad, Pakistan

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Abstract

The relationship between travel modes and the commuters’ trip satisfaction affected by mode characteristics is well known. These characteristics substantially impact travel mode choice used either as a mass transit feeder or direct transport. However, the perception of those feeder modes based on their service quality and the travel pattern determining trip satisfaction demands extensive exploration in developing cities. This paper analyzes feeder mode choice and trip satisfaction when accessing bus rapid transit (BRT) in Rawalpindi-Islamabad Metropolitan Area (RIMA). The study identified the factors contributing to travel mode choice as BRT feeder based on the empirical comparative evaluation of the service quality of public transportation services using survey analysis of 240 BRT commuters.

The results of the binary logistic analysis confirmed that daily BRT users with no vehicle ownership who travelled to work- and education-related destinations were more likely to use paratransit. Furthermore, the commuters showed substantial dissatisfaction when travelling with paratransit transportation due to low service quality. Similarly, trip satisfaction with low-quality feeder modes was also low when accessing BRT compared to Careem services, which showed high service quality and trip satisfaction. The findings showed that passengers reported the most dissatisfaction with paratransit regarding safety, waiting time, and travel speed, indicating service quality below acceptance level. Therefore, the provincial government must consider improving the paratransit service quality to an acceptable level when integrating this service as BRT feeders.

Keywords: Bus rapid transit, feeder mode, paratransit, Rawalpindi-Islamabad, service attributes, trip satisfaction

1. Introduction

Many developing countries face a rapid increase in their urban population, which has caused a high travel demand, especially on private automobiles, making the traffic and transportation systems highly unstable. Susilo and Kitamura (2008) argued that the ownership and usage of cars affect the structure of urban settings and travel behaviours. The primary reason for high vehicle ownership is the lack of prudent public transportation structures in developing cities. Without proper access to public transportation services, the urbanites pursue alternative means of mobilization: their private vehicles. Besides, it is common in growing cities that public transportation serves its purpose primarily to transport only low or no-income people.

Bus rapid transit (BRT) has received substantial attention from the policymakers in developing cities to mitigating transportation issues mainly because of the cost-effectiveness (ITDP, 2019) and “rail-like” characteristics (Levinson et al., 2003). These characteristics make BRT an affordable mass transit service (MTS) compared to rail transit systems. A complete BRT network consists of integrated high-capacity feeder bus services with the main BRT corridor, as seen in Bogota, Curitiba, and Ottawa (to name a few). The integrated feeder buses provide better access to BRT from residential areas, substantially increasing modal split (Levinson et al., 2003). However, some developing cities such as Beijing, Dhaka, Bangkok, Lahore, and Rawalpindi-Islamabad have established only a single corridor without any feeder network. As a result, the already existing informal incumbent transportation operators irregularly function as a feeder to transport commuters to BRT.

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Since paratransit service popularity is growing in the developing world, several existing studies have also established encouraging policies to promote its usage both as a direct service and MTS feeder (Tangphaisankun et al., 2010; Satienam et al., 2006; and Shafiq-Ur-Rehman et al., 2012). This promotion may be because paratransit can provide its services when needed, especially in a market that lacks regular bus services. It is a flexible and low-cost service widely spread in the city area for better coverage in developing regions. On the contrary, various studies discourage the usage of paratransit as an MTS feeder, stating that these services may be functional for the short term but might not be accepted as regular BRT feeders. This may be because these services are arguably unsuitable to be an integral part of any MTSs due to functional and operational gaps (Duarte and Rojas, 2012; Gilbert, 2008; Gomez, 2007; Tabassum et al., 2016). Though these services have the advantage of running in the narrow streets to provide high accessibility where high-capacity feeder buses cannot penetrate, only the people who are highly dependent on paratransit are the loyal commuters despite showing satisfaction below the acceptable level (Cervero and Golub, 2007).

Additionally, if integrating high-capacity feeder buses with MTS such as BRT is not feasible due to planning and financial constraints, using the already existing informal paratransit becomes the only available option. To formally integrate paratransit with BRT, commuters’ perception and trip satisfaction are essential to understanding the provided service level. In this way, transportation operators can improve the service quality of these paratransit services up to an acceptable level for potential integration with the BRT system. Unfortunately, literature about transportation policy and planning has not paid serious attention to the commuters’ perception satisfaction level of using paratransit services to reach BRT. Moreover, focus on the factors contributing to choosing paratransit or any other mode as a BRT feeder is also a handful.

Therefore, this paper takes the BRT in Rawalpindi-Islamabad Metropolitan Area (RIMA) as a case study to examine the passengers’ perception of choosing a particular mode as a feeder when accessing BRT. It aims to identify the factors such as commuter dynamics, satisfaction with feeder more service attributes and overall trip satisfaction that could be influential in decision making. The findings could help identify the weak aspects of the chosen feeder modes and possible improvements from a policy perspective. This paper contributes to the literature on feeder mode service satisfaction and overall trip satisfaction amongst the transit users. Hence, this research brought up the following research question:

What factors amongst commuter dynamics and satisfaction level with service attribute and trip from home influence the feeder mode choice to reach BRT?

The remaining paper is structured in the following manner: Section 2 describes the existing literature on the role of paratransit services as MTS feeders. Section 3 illustrates the description of the study area along with the empirical analysis of the questionnaire survey. Section 4 discusses the results in more detail, and lastly, section 5 ends with the conclusion, including the recommended policies.

2. Bus rapid transit, the role of paratransit and commuters’ perception

2.1 Bus Rapid Transit (BRT) Systems

Many transport authorities in developing cities have installed a bus rapid transit (BRT) system as a high-quality rubber-tire system that delivers secure, cost-effective, and fast services in metropolitan areas (ITDP, 2019). BRT system consists of dedicated lanes with signal-free busways and well-designed stations aligned at the centre of the roads. It also includes off-board fare collection to smoothen the operations. According to the BRT data, more than 160 cities have installed BRT due to its affordability and potential for stimulating urban growth (Global BRT Data, 2018). A few successful examples are Ottawa, Bogota, and Curitiba (the birthplace of BRT), where high-capacity feeder buses are well-integrated with the BRT systems for better accessibility from inner cities to the main transit stations.

BRT has proved itself to be substantially cost-effective in terms of money and implementation time (Carlos, 2010). BRT brings a unique image much different than conventional buses. Few developing cities such as Jakarta, Bangkok, Istanbul, and Manila have planned and implemented
started phases of BRT infrastructure. This implementation should pay attention to regional issues, especially in a built environment that substantially contributes to the BRT's success. A BRT system can be successful if a strategy is made for a well-designed plan integrated with land usage for both transit and road networks (Satienam et al., 2006). However, many developing cities implement BRT without land use integration; it gives birth to many regional issues such as suburbanization, increases in traffic, and air pollution. Thus, it becomes nearly impossible to achieve expected results from the BRT built in this state.

2.2 Role of paratransit as BRT feeders: A compliment or a complication?

Whether paratransit can be an integral part of BRT even after the modification is still under debate when planning MTSs such as BRT. Transportation planners prioritize a comprehensive BRT network integrated with regular feeder buses without including incumbent informal paratransit to increase ridership. As evident in Bogota’s case, before the launch of the BRT system called TransMilenio, Bogota’s public transportation was filled with conventional paratransit such as micro and minibuses (Gilbert, 2008). During the first phase of launching TransMilenio, this system included paratransit operators as part of the formal transit service. The TransMilenio operators attempted to formalize the paratransit to improve their service standards. Those paratransit operators who did not live up to the drawn conditions by the significant stakeholders were then forced out of the main corridor lines (Gilbert 2008). Later on, with the expansion of the TransMilenio phases, the stakeholders and associations realized that this coordination among BRT and paratransit became the primary issue as it was not giving expected results. Therefore, TransMilenio operators forcefully removed that paratransit and replaced them with formal high-capacity feeder buses over time (Gomen, 2007). Furthermore, the integration of BRT with paratransit is a complicated task because BRT requires regular planning and monitoring (Duarte and Rojas 2012). In contrast, paratransit operates relatively in the context of no planning and regulations.

Another example of a relationship between BRT and paratransit was well-documented in Santiago that included the implementation of TransSantiago to modernize the public transportation system (Salazar, 2015). The study stated that paratransit operators were not interested in getting involved in this BRT system because they were private cooperatives. Similar to Bogota, paratransit operators were first included in the systems as a social responsibility. However, after the implementation of extended phases, those operators could not accept the formal regulations of the BRT stakeholders, resulting in their relocation to the peripheral regions of the city (Salazar, 2015). Hence, new high-capacity feeder buses were launched as an integral part of the BRT system.

These examples mentioned above suggest that transportation policymakers may consider paratransit as an integral part of MTSs only if they strictly follow the regulations assigned by the stakeholders. Among many restrictions, some may include modifying and maintaining the vehicles and abiding by the schedule and routes. If these regulations are not followed strictly, the informal paratransit services are likely to get dismissed from the formal BRT system and are forced to operate away from the main corridors. Nevertheless, the current state of paratransit in developing cities is considered below the acceptance level mainly because of low service level, making it a complicated transportation service.

2.3 Survey-based perception of paratransits’ role as feeders

The service qualities and access to public transportation are linked directly or indirectly with the quality of life. Several studies have attempted to set the parameters that reflect the commuters’ perception of BRT service attributes to determine service quality and loyalty to the transit system in developed and developing cities (Eboli and Mazulla, 2007; Van Lierop and El-Geneidy, 2016). These qualities are set to compare the perceived satisfaction with the service quality promised by the public transport operators. However, most studies established interior service parameters such as cleanliness, safety, air-conditioning, proper seating, female compartment, and many more to determine BRT service quality. However, the exterior parameters such as the access capacity of the passengers to reach BRT via various modes, waiting time at bus stops, travel time, travel speed, and passengers’ overall trip satisfaction from home to BRT demand extensive exploration.
A handful of research exists that evaluates the commuters’ perception about accessing BRT using feeder modes. One study on Dhaka BRT (Shafiq-Ur-Rehman et al., 2012) attempted to integrate BRT with rickshaw services. They concluded that the incorporation of rickshaws with BRT remains challenging due to; 1) the vehicular structure of rickshaws, 2) the intricate BRT station designs needed for integrated operation, and 3) the distrust of paratransit among commuters in general. This research lacked survey-based perception to determine the service quality of rickshaws when using them as feeders to ensure that customers will remain loyal if the integration plan worked. One research in Bangkok concluded that despite high dissatisfaction with paratransit service quality for direct trips, passengers showed a positive attitude towards paratransit as feeders for MTSs (Tangphaisankun et al., 2010). Moreover, the research suggested that improving safety, convenience, and comfort could increase commuters’ satisfaction. However, this research also lacked commuters’ overall satisfaction when using paratransit services, and the specific service attributes that affect the trip satisfaction were also not available.

Perhaps it is evident that the level of accessibility towards BRTs through travel modes and their provided services affecting trip satisfaction demand extensive attention. Such research in the global South is a handful. Therefore, it has become essential to examining the factors influencing the choice of using various transportation services as feeders for BRT in a developing city in Pakistan that can be a lesson for other transportation planners in other developing states. This improvement can, in turn, eventually increase the ridership of BRT systems by attracting non-regular transit users as well as car users. This research adds to this transportation literature by providing another perspective of commuters’ perception of paratransit as BRT feeders. It fills the gap about the specific service attributes of feeder modes affecting the overall trip satisfaction.

3. Study area, data collection, methodology

3.1 Rawalpindi-Islamabad Bus Rapid Transit (RI-BRT)

Islamabad is the capital city of Pakistan, whose population has grown from 100,000 to 1.30 million between 1951 and 2014. At the same time, Rawalpindi has become the third largest, with 4.5 million people. These cities are considered twin since they are highly dependent on each other’s resources. The inter-city BRT runs between these twin cities so that people living in Rawalpindi can easily commute to Islamabad for work or other purposes.

The first phase of the RI-BRT Red Line was launched in June 2015, which is a 22.4 km long single line corridor with 68 articulated buses running on the dedicated lane, located on the main Murree Road that connects two cities. The first station on this corridor starts from Saddar (city center) in the Rawalpindi region to Pak Secretariat in Islamabad (see Appendix A for the name of the stations). It runs six days a week from 06:00 to 22:00, where on Sundays, the timing is from 07:00 to 22:00. Table 1 shows other characteristics. The names of all the stations are given in Appendix A (Table 6).

The RI-BRT network plan 2022 involves four main BRT corridors integrated with feeder buses (NESPAC, 2015); however, the RI-BRT Red Line is the first single corridor with no feeder bus in RI. It provides access to only eight per cent of the people within ten minutes of walking distance (Adeel et al., 2014). That is why the already existing informal paratransit services in Rawalpindi

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Table 1 Characteristics of Rawalpindi-Islamabad BRT Red Line

| Characteristics of BRT RED Line | 2014-2015 |
|---------------------------------|-----------|
| Length of Corridor              | 22.4 km (8.6 km elevated) |
| Capacity of Corridor            | 12,465 passengers/hour/direction |
| Size of Fleet                   | 68 articulated buses |
| No. of Bus Bays/Station         | 3 |
| Speed (Average)                 | 32 km/hour |
| Cost of the Infrastructure      | US $419 Million |
| Fare price per trip             | PKR 30 (fixed) |
| Ridership without feeder services | 135,005 passengers/hour/direction/day |

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National Engineering Services Pakistan conducted extensive field research in RIMA to produce traffic model and evaluate transportation structure to recommend BRT corridors plan until 2020.
transport people to BRT and other parts of the city. These services include a privately-owned 12-seater pickup wagon, 20-seater Hiace minibus, and three-wheeler rickshaws (Adeel et al., 2014). Unlike BRT service, the fare of the paratransit services is not fixed. According to the NESPAK report, the fare cost of non-AC mini wagons is PKR 15 within four kilometres of travel distance; however, the fare increases up to PKR 33 within 30 km (NESPAK, 2015; pp 67).

Moreover, a newly emerged private transportation service called Careem, similar to Uber, also function as a feeder for RI-BRT. Careem can be ordered from home using a mobile application as both a private service for a single client or “share a ride” with other passengers as carpooling. Since it is a private service, the minimum fare starts from PKR 250 and increases depending on the distance travelled. The fare can either be paid online or by cash.

3.2 Data Collection

Given the lack of government data on the transit use, distance travelled, modes used to reach transit, and the commuters’ spatial location of origin, I had to collect the commuter data by visiting RI-BRT. First, the ridership data of the first week of January 2017 was obtained from Punjab Mass Transit Authorities (PMA) during the field trip to RI in 2018 (see Table 7 Appendix B for detailed ridership data). From this ridership data, three stations, namely Station 1 = Saddar, Station 6 = Chandni Chowk, and Station 9 = Shamsabadd, were chosen as study sites (Red circles in Figure 1). Due to time and cost constraints, stations only in Rawalpindi were selected based on the ridership data, both from and to the selected stations. Station 1 is the first station of RI-BRT Red Line located in the central city of Rawalpindi, primarily occupied by commercial areas such as retail shops, restaurants, shopping malls and education facilities in its surrounding. Station 6 has somewhat similar dynamics as Saddar. Whereas other than commercial area, the residential area can be found within 500 meters of Station 9, providing better proximity from home. The mean ridership clearly shows that Station 1 is the busiest, followed by Station 9 and Station 6 (Appendix B).

Table 2 Service attributes, their description and authors of previous studies

| Service Attributes | Service Attribute Description | Source |
|--------------------|--------------------------------|--------|
| Availability       | The availability and area coverage of the feeder services to gain access to MTs | Gahlot et al., (2013) |
| Waiting time       | Time consumed when waiting for the feeder mode at the stops and the comfort level | Mahmoud and Hine (2016) |
| Travel time        | Time consumed in feeder mode when travelling towards BRT; this includes frequent stops and vehicle exchanged | Feng (2014) |
| Travel Speed       | Speed of the feeder mode when travelling towards BRT | Eboli and Mazulla (2007) |
| Ease in Transfer   | The comfort of transferring from feeder mode to BRT station | Mahmoud and Hine (2016) |
| Safety             | Concerns about safety and security while waiting at stops or in-vehicle, and even driving skills | Dorion et al., (2009); Mahmoud and Hine (2016); |
| Overall service quality | Perceptions concerning the overall service provided by the paratransit operators | Morton et al., (2016) |
| Trip satisfaction  | Satisfaction with the trip from origin (home) to BRT station | Susilo and Cats (2014) |

Since a quantitative method was employed for this study, a questionnaire survey was conducted with the BRT commuters at the selected stations for four days; one weekend (Sunday) and three weekdays. The respondents completed the questionnaires at the BRT stations in less than five minutes on average. Since young adults (between the ages of 18 and 50) frequently travel by using city transportation services, they were the target population for this study. The surveyors stopped the potential target population based on their appearance after the passengers egressed the bus and walking towards the exit. Overall, 240 valid samples were successfully collected, with a response rate of 48.6%.

The questionnaire survey included three sections. The first one consists of socioeconomic and demographic characteristics, including age, gender, employment status, income, and vehicle ownership of the respondents. The second section included travel behaviour such as frequency and
purpose of BRT usage, travel modes choice as feeders, and origin and destination. The third part highlights the satisfaction with the service attributes borrowed from the previous studies. Table 2 describes the service attributes used in this study. The survey participants evaluated the service attributes based on the 5-point Likert-scale method, that is, 1 = Very Dissatisfied, 2 = Dissatisfied, 3 = Normal, 4 = Satisfied, and 5 = Very Satisfied. The sample implies that all the respondents were RI-BRT users. For this study, I adopted the socioeconomic and demographic characteristics from the previous research that showed a substantial effect on the choice of transit service as a travel mode (Hunecke et al., 2010).

![Figure 1](image)

**Figure 1** Visual display of respondents' travel mode choice from home to access RIBRT

### 3.2.1 Respondents dynamics and travel behaviour

The nature of the sample reflects young, low-income and students in the chosen study area (Table 3). Around 94% of the total sample ranged from 18 to 35 years, with an average age of 23.04. Additionally, around 67% were male, 63.3% were students, nearly 60% had no income, and around 53% did not own any vehicle. It is safe to state that majority of the BRT users are low-income population. It is understandable because some BRT stations are within walking distance to schools, colleges, and universities.
Five travel modes were considered as the main modes to access the nearest BRT station. These travel modes are categorized as green services (walk/bicycle), kiss and ride (dropped by a family member), paratransit (HiAce minibuses/pickup wagons), rickshaws, and Careem. Table 4 summarizes the travel behaviour of the respondents when accessing BRT from home. The descriptive indicated that nearly 50% of the sample used BRT daily. Whereas among non-daily BRT users, the percentage differs for seldom, once-a-week and twice-a-week BRT users. Around 35% used BRT for education purposes compared to 31.25% of work-related travels. Paratransit services (45.82%) were dominant among the sample compared to nearly 23% Careem users, 15.83% used green services, and the remaining sample used rickshaws and kiss and ride modes (approximately 15%). The major portion of the sample could access BRT within 30 minutes (around 70%) compared to 2.08% of users who travelled for more than one hour to reach BRT station.

Moreover, Figure 1 shows the visual distribution of the respondents’ travel modes from the origin (residence) when accessing the nearest BRT station. The data was geocoded in ArcGIS 10.5. The dots represent the geographical residence location. The colours represent the travel mode: green as walk/bicycle, purple as kiss and ride, pink as rickshaw, dark blue as paratransit, and light blue as Careem. Green and yellow regions around the BRT route illustrate one-kilometre and three-kilometre buffers, respectively. It was worth noticing that some respondents used green services to travel more than three kilometres. Also, with the increase in the distance from the origin to BRT stations, the travel mode choices became limited to only paratransit and Careem. Therefore, this study limits the comprehensive analysis of paratransit with Careem to assess the service quality of paratransit.

3.3 Methodology

It is essential to examine passengers’ perception of the informal paratransit services to determine whether such services can be integrated as feeders for RI-BRT. The comparative assessment of paratransit with relatively high-quality Careem services would highlight the weak aspects of paratransit for potential improvements.

| Table 3 Respondents’ socioeconomic indicators |
|-----------------------------------------------|
| Characteristics | Frequency | Percentage |
| Age            |           |            |
| <18            | 9         | 3.75%      |
| 18-35           | 225       | 93.75%     |
| 36-53           | 5         | 2.08%      |
| >54            | 1         | 0.42%      |
| Gender         |           |            |
| Female         | 79        | 32.92%     |
| Male           | 161       | 67.08%     |
| Occupation     |           |            |
| Students       | 152       | 63.33%     |
| Government     | 11        | 4.58%      |
| Employees      | 60        | 25.00%     |
| Own Business   | 9         | 3.75%      |
| Others         | 8         | 3.33%      |
| Personal Income (PKR) | |     |
| 0              | 143       | 59.58%     |
| 1-25,000       | 38        | 15.83%     |
| 25,001-50,000  | 41        | 17.08%     |
| 50,001-75,000  | 8         | 3.33%      |
| 75,001-100,000 | 10        | 4.17%      |
| Vehicle Ownership |         |            |
| Car            | 30        | 12.50%     |
| Motorbike      | 75        | 31.25%     |
| Bicycle        | 8         | 3.33%      |
| No Vehicle     | 127       | 52.92%     |

Note: USD. 1 = PKR 139.9 in 2018.

| Table 4 Respondents’ travel behavior characteristics |
|------------------------------------------------------|
| Characteristics | Frequency | Percentage |
| Frequency       |           |            |
| Daily BRT users | 119       | 49.58%     |
| Non-Daily BRT users | 121   | 50.42%     |
| Purpose         |           |            |
| Education       | 85        | 35.42%     |
| Work            | 75        | 31.25%     |
| Others          | 80        | 33.33%     |
| Travel mode     |           |            |
| Green service   | 38        | 15.83%     |
| Kiss and ride   | 18        | 7.50%      |
| Rickshaw        | 19        | 7.92%      |
| Paratransit     | 110       | 45.82%     |
| Careem          | 55        | 22.92%     |
| Travel time (min) |         |            |
| 0-14            | 56        | 23.33%     |
| 15-29           | 111       | 46.25%     |
| 30-44           | 41        | 17.08%     |
| 45-60           | 27        | 11.25%     |
| >60             | 5         | 2.08%      |
For this purpose, the analysis is divided into two parts: First, the commuter dynamics, travel behaviour, and service attribute satisfaction levels were crossed-tabulated with feeder modes, i.e., paratransit (n = 110), Careem (n = 55) to understand the possible association. Second, binary logistic regression was employed to predict the significant association of respondents’ characteristics with paratransit services. The details are given in the following sections.

### 3.3.1 Descriptives of service attribute satisfaction and overall trip satisfaction

First, I calculated the commuter satisfaction percentage with seven service attributes for paratransit and Careem services, as shown in Figures 3 and 4. Then, two trip satisfaction percentages from home to BRT were calculated, i.e., 1) across daily and non-daily BRT users, and 2) across paratransit and Careem, as shown in Figures 5 and 6. These percentages can help understand the dynamics of the commuters when self-selecting the feeder mode to reach BRT.

| Service Attribute | Paratransit | Careem |
|-------------------|-------------|--------|
| Comfort           | 67.31%      | 66.0%  |
| Time              | 67.0%       | 66.0%  |
| Convenience       | 66.0%       | 64.0%  |
| Safety            | 66.0%       | 64.0%  |
| Cost              | 66.0%       | 64.0%  |
| Environment       | 66.0%       | 64.0%  |
| Overall Satisfaction | 66.0%   | 64.0%  |

| Purpose | Work | Education | Others |
|---------|------|-----------|--------|
| Daily Users | 77.4% | 55.6% | 46.4% |
| Non-Daily Users | 22.6% | 44.4% | 53.6% |

| Vehicle Ownership | Paratransit | Careem |
|-------------------|-------------|--------|
| Car               | 45.8%       | 54.2%  |
| Motorbike         | 41.8%       | 58.2%  |
| Bicycle           | 40.0%       | 60.0%  |
| No Vehicle        | 91.4%       | 8.6%   |

### 3.3.2 Logit model formation and specification

I designed a binomial logit model to comprehensively estimate the probability that the commuters would use paratransit as feeders to reach BRT in the RI context. Given a probability of paratransit being chosen as a feeder is \( p \) for every individual commuter \( i \), then the formulated logistic regression is expressed in terms of variables used in Equation 1.

\[
\ln\left(\frac{p}{1-p}\right) = b + b_1*A_i + b_2*M_i + b_3*In_i + b_3*Ar_i + b_4*T_i + b_5*Bu_i + b_6*Tu_i + b_7*Av_i + b_8*Wt_i + b_9*Tr_i + b_10*S_i + b_11*Et_i + b_12*Os_i + b_13*Tsi_i
\]

\[(1)\]
where $A = \text{age}$, $M = \text{male sample}$, $In = \text{monthly income}$, $Ar = \text{auto-owner riders}$, $Bu = \text{daily BRT users}$, $Tt = \text{travel time taken in minutes}$, $Av = \text{satisfaction level with availability}$, $Wt = \text{satisfaction level with waiting time}$, $Tsp = \text{satisfaction level with travel speed}$, $S = \text{satisfaction level with safety}$, $Et = \text{ease in transfer}$, $Os = \text{overall service satisfaction}$, and $Ts = \text{trip satisfaction from home (origin) to BRT}$.

This primary reported logit model was divided into three separate models for additional control variables (Table 5). Model 1 includes socioeconomic and travel indicators of the respondents controlling the service attribute and trip satisfaction. The frequency usage of BRT and the travel purpose and travel time can correlate with selecting the feeder mode to reach BRT.

Model 2 includes socioeconomic indicators and service attributes, and trip satisfaction while controlling the travel indicators. The quality of the service provided, and the overall trip satisfaction strongly influence the choice of a transportation service as a BRT feeder.

Lastly, Model 3 included all the predictors to compare their statistical significance with paratransit services. Since the tolerance level of “travel time” violated the condition of the valid model after attempting to produce several logistic models, this service attribute was eventually removed from the final models. Similarly, the occupation of the commuters was also removed due to the high correlation with travel purposes. Table 5 shows the summary of the models.

4. Results

4.1 Cross-tabulation of commuters’ dynamics with paratransit and Careem

Figure 2 highlights the cross-tabulation of commuter dynamics with paratransit and Careem. It illustrates that young people under the age of 35, with income less than PKR. 75,000, both workers and students, those without vehicle ownership, and daily BRT riders used paratransit as a feeder to access BRT. This analysis introduces some points worth noticing. For example, percentages of both men and women were almost equal when taking the paratransit.

Additionally, car and motorbike users preferred Careem to reach BRT. This could be because private vehicle users may prefer using Careem to enjoy their privacy, especially female BRT commuters. Since Careem is a door-to-door service that can be called using a mobile application, it is accessible from any residential location. Also, the gap in the usage of paratransit between daily and non-daily BRT users could be due to travel purposes and economic reasons. Those travelling to work or educational facilities theoretically take their trip more seriously than those using BRT for entertainment purposes.

Overall, this cross-tabulation suggests that paratransit was more prevalent among young and low-income people and those who used BRT daily. On the contrary, those who owned motor vehicles were inclined to use Careem more than paratransit. Additionally, the service satisfaction of these feeder modes also contributes substantially to choosing these modes, which is discussed in detail in the following section.

4.2 Satisfaction with Service attributes of Paratransit and Careem

The commuters’ satisfaction levels with the seven attributes of two feeder modes were assessed to determine the overall performance of the transportation services. The 5-points Likert scale was converted into a 3-point Likert scale only for the descriptive analysis, meaning that “Very dissatisfied” and “Dissatisfied” were recoded as “Not satisfied” and “Very satisfied” and “Satisfied” were recoded as “Satisfied”. At the same time, “Neutral” remains as is. Figure 3 shows the service satisfaction of daily commuters using paratransit to access the BRT stations. The respondents who used paratransit as BRT feeders showed high dissatisfaction with safety (50.8%), waiting time (46.2%), and travel time (41.5%). Whereas ease in transfer to BRT stations and availability were the least dissatisfied attributes. The reason could be because, for one, as mentioned in the NESPAK report, paratransit operates on multiple routes around RIMA and usually connect with Murree road, where the Red Line runs (NESPAK, 2015). This connection possibly aids in transferring passengers from paratransit to the BRT station within only a few minutes of walking without crossing signals in-between. Secondly, the official report also stated that both the Hiace minibuses and pickup
wagons run in a high volume around Rawalpindi (NESPAK, 2015); therefore, people can catch paratransit at any time of the day.

Figure 4 demonstrates the daily BRT users’ satisfaction with service attributes of Careem. Unlike paratransit, Careem users did not show dissatisfaction with any of the examined service attributes. However, it is worth noticing that respondents showed a “Neutral” feeling with six service attributes other than safety. The respondents indicated the highest satisfaction with safety (73.7%). The reason could be the lack of privacy and comfort that daily travelers usually desire.

Overall, service satisfaction analysis of both transportation modes showed a significant difference among daily BRT commuters. Paratransit users showed dissatisfaction with all the service attributes, whereas Careem users did not show dissatisfaction with any examined service. This analysis suggests that Careem provides high-quality service to its commuters; hence, higher satisfaction levels. Whereas service level of paratransit was considered below the acceptance level, and dissatisfaction was the consequence.

4.3 Satisfaction with home to RI-BRT trip

It is essential to examine trip satisfaction when moving from one place to another on any transportation mode to determine the provided service quality of those modes for further improvement. Therefore, this research assessed the overall trip satisfaction levels of the respondents when moving from their homes to RI-BRT stations using either paratransit or Careem as feeders. Figure 5 shows the overall trip satisfaction from home to RI-BRT stations by the respondents using all the travel modes in question, that are, 1) green modes, 2) kiss and ride, 3) paratransit, 4) rickshaw and 5) Careem. The results clearly showed that dissatisfaction was much higher among daily BRT users (31.9%) than the non-daily commuters (16.53%). On the contrary, the proportion of daily commuters who felt satisfied was relatively low (23.53%) compared to the satisfaction stated by non-daily commuters (35.54%).

Furthermore, Figure 6 shows the trip satisfaction among those daily BRT users who chose either paratransit or Careem to access RI-BRT. The results of these 165 respondents indicated that, not surprisingly, Careem users’ dissatisfaction (5.26%) was far less than that of the paratransit users (46.15%) when making a trip to the nearest RI-BRT station from home. However, surprisingly, Careem users did not show excellent trip satisfaction; instead, their perception of being neutral was
high (84.21%). The proportion of satisfied paratransit users (15.38%) was higher than that of the satisfied Careem users (10.53).

The analysis of the overall trip satisfaction from home to the RI-BRT using paratransit or Careem is evident based on the service attribute satisfaction analysis in the previous section. Since Careem is a private door-to-door service that gives a similar experience as a personal automobile, people usually enjoy their individual and comfortable trips on Careem. On the contrary, paratransit users showed high trip dissatisfaction due to low satisfaction levels with paratransit service attributes.

### 4.4 Feeder modes regression analysis

The binary regression models included socioeconomic and demographic characteristics, travel behaviour, service attribute satisfaction and trip satisfaction as the independent variables in determining the usage probability of paratransit services (valued as 1); see Table 5. The numbers across the predictors are the exponentiation of the B coefficients (EXP(B)), i.e., the odds ratio, explaining the impact of the predictors on the dependent variable. The numbers in parenthesis are the Standard Errors. Overall, the logistic analyses indicate a significant statistical association of independent variables with paratransit.

#### 4.4.1 Commuter dynamics and the usage of paratransit as feeder

Among the socioeconomic indicators in the three models, age, male riders, and monthly income were not statistically associated with paratransit services. On the contrary, vehicle owners showed a significant statistical association with choosing paratransit as a feeder at a 99% confidence level in all three models when controlling the service attribute and trip satisfaction. The auto-owners show a negative association with paratransit service, meaning that those who own cars or motorbikes are less likely to choose paratransit as BRT feeders in the RI context. This could be because vehicle owners usually drive for daily travel to various destinations. In the RI context, residents living away from the BRT corridor in the gated communities have almost no access to public transportation services.

Additionally, the travel purpose did not indicate a significant statistical association with the usage of paratransit services. In comparison, daily BRT users are significantly associated with the dependent variable (Models 1 and 3). The significance level increases from 90% confidence level to 95% confidence level when adding all the variables in Model 3. The positive association also indicates that the frequent users of BRT are more likely to use paratransit services as feeders to access BRT. This may be because the paratransit services are substantially economical compared to Careem services. Therefore, low-income or no income commuters would afford to use paratransit services daily when travelling to work or education facilities. It was worth noticing that though the travel time had a significant association at 95% confidence level with paratransit services when controlling the service attribute satisfaction and trip satisfaction in Model 1, the predictor became non-significant when all the controlled variables were added in Model 3. The travel time predictor suggested that the commuters were less likely to choose paratransit services with the increase in travel time.
Also, paratransit is an economical service, which makes it suitable for almost all groups of people. In that capacity, people exercising various types of occupations among daily BRT users are also inclined to take paratransit to access the RI-BRT because daily BRT users are mainly active users of BRT. In contrast, passive users do not take their commute seriously when taking transit services.

### 4.4.2 The influence of service and trip satisfaction on feeder mode choice

For logit models, a 5-point Likert scale was used to measure the satisfaction level and determine whether commuters are inclined towards using paratransit. Out of the six service attributes, “Availability”, and “Waiting time” did not show a significant statistical association with paratransit when controlling the travel behaviour characteristics (Model 2).

The satisfaction with “Travel speed” indicates a weak association (90% confidence level) with the usage of paratransit (Model 2). The inclusion of the controlled travel behaviour indicators weakened the relationship further to the point that it became non-significant (Model 3). The more commuters travel long duration, the less likely they will choose paratransit. The “Overall service satisfaction” indicate a similar situation. Additionally, the satisfaction level with “Safety” is the weakest and negatively associated with using paratransit, meaning that the commuters indicated the highest dissatisfaction with paratransit compared to Careem. This negative association was consistent with the study conducted in Los Angeles, concluding that people concerned about their safety often are less likely to use transit services (Spears et al., 2013), in RI context; informal paratransit.

They stated that “attitude towards transit and personal safety concerns have a significant and consistent effect on the decision to use public transportation” (Spears et al., 2013).

The strongest predictor of all the service attributes amongst those commuters who are likely to use paratransit as feeder is “Ease in transfer”, even after including all the controlled variables. This association is significant at a 95% confidence level. It means that the commuters do not face any difficulty when egressing the paratransit vehicle to enter the BRT station. This could be because the paratransit routes cross paths with the BRT corridor in such a way that it is easy to access most of the BRT stations from paratransit stops.

**Table 5 Feeder modes logistic analysis**

| Predictors | Model 1 | Model 2 | Model 3 |
|------------|---------|---------|---------|
| Sociodemographic indicators |         |         |         |
| Age | -.997 | 1.008 | 1.02 |
| Male | -.927 | 2.207 | 1.75 |
| Monthly Income | 1.00 | 1.00 | 1.00 |
| Auto-Owner Riders | -0.60** | -0.63*** | -0.03*** |
| Travel behavior |         |         |         |
| Purpose (refer. work) |         |         |         |
| College/University | 1.03 | -0.579 |         |
| Other purposes | -0.353 | -0.44 |         |
| Frequency (refer. |         |         |         |
| Non-daily BRT users) |         |         |         |
| Daily BRT users | 2.627* | 6.37** |         |
| Travel time | -0.967** | -0.977 |         |
| Feeder mode satisfaction |         |         |         |
| Availability | -.704 | .995 |         |
| Waiting time | -0.951 | -0.839 |         |
| Travel speed | -0.391* | -0.362 |         |
| Safety | -.077*** | -0.059*** |         |
| Ease in transfer | 8.477** | 7.401** |         |
| Overall service satisfaction | -0.349** | -0.510 |         |
| Trip satisfaction |         |         |         |
| Home to BRT | -.294** | -0.309** |         |
| Constant | 32.036** | 110.35** | 274.21** |
| Nagelkerke R² | .456 | .699 | .778 |

***p<0.001, **p<0.05, *p<0.1.
Lastly, the logit analysis showed a negative association of “Trip satisfaction” with paratransit at a 95% confidence level when travelling from home to the nearest BRT stations. This finding is consistent with various studies, suggesting that lower trip satisfaction levels are strongly associated with bus commutes (De Vos et al., 2016; St-Louis et al., 2014). Additionally, long travel times and in-vehicle congestions also had a significant and negative relation with trip satisfaction when using public transportsations. However, people show high satisfaction levels with long distances when using bicycles or cars (Ye et al., 2017).

5. Conclusion
The paper attempts to explore the accessibility-related issues and their influence on the choice of feeder mode to reach BRT in the Pakistani urban city context. The quantitative method was employed to examine the commuters’ perception of the service quality of the feeder modes in question by conducting a questionnaire survey at BRT stations. The findings revealed that, amongst the commuter dynamics, vehicle ownership had the most robust influence on paratransit being the less likely choice as a feeder. It means that private vehicle users consider the service quality of paratransit as below acceptance level. On the contrary, those who travel daily, regardless of their income level, were more likely to choose paratransit to reach BRT. The location of the BRT corridor significantly contributes to this behaviour. Since most of the stations in Rawalpindi and Islamabad regions are surrounded by mixed land-use comprising jobs and education facilities, urbanites tend to use BRT who commute daily and save money by taking paratransit when living in a remote area.

The service attribute satisfaction predictors showed consistent output indicating that people are less likely to use paratransit who have significant safety and overall service quality concerns. Consistency in the safety concerns was also evident in the studies of Bangkok (Tangphaisankun et al., 2010) and Belfast (Mahmoud and Hine, 2016). However, besides higher dissatisfaction, people are still loyal to paratransit in the RI context due to the large volume of such services on roads, which helps the people quickly catch them during most of the hours in a day.

The overall survey analysis showed that the quality of accessibility provided by RI-BRT feeders is deprived due to the current state of paratransit, making it too complicated to be considered for integration with RI-BRT. To enhance the quality of accessibility for RI-BRT, modifications in the paratransit network and service quality are essential. From the policy perspective, to enable the RI-BRT commuters to use paratransit, it is necessary to strictly monitor the vehicle maintenance, passengers’ safety, timetable of arrival and departure from designated stops, and the completion of the routes on time. Installing the surveillance cameras on-board and monitoring seating arrangements of both men and women would potentially help reduce criminal activities. Additionally, the government must provide financial aid to local transportation operators running paratransit that could help the operators maintain and modify the vehicle to be considered suitable for the BRT feeder integration plan. More precisely, the provision of separate lanes for the RI-BRT feeder would substantially increase travel speed, which will reduce travel time and traffic congestion.

This study has its limitations. First, the collected sample is very small as there were time and costs constraints for a single researcher. Therefore, aspired researchers wanting to explore RI-BRT more should obtain more sample size to generalize it better after excluding any obvious bias. Also, the service attribute of paratransit can be evaluated based on more meaningful variables in future research further to develop policies for improvement in other cities or countries. Though not discussed in detail in this paper, examining the commuters’ willingness to walk to transit from longer distances and willingness to pay when travelling a certain distance would also shed some light on the overall performance of small-scale public transportation as feeders for MTS. Lastly, the impact of BRT feeder buses on land development and property values is only known in Bogota and Korea. Therefore, it can be suggested to explore this area in other developing cities to understand the potential of BRTs with and without feeder networks.
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## Appendix: A

### Table 6 R1-BRT Red Line station names

| Serial. # | Station names  | Serial. # | Station names          |
|-----------|----------------|-----------|------------------------|
| **Rawalpindi** |                | **Islamabad** |                        |
| 1         | Saddar         | 12        | Potohar Road           |
| 2         | Marrir Chowk   | 13        | Khayaban-e-Road        |
| 3         | Liaquat Bagh   | 14        | Fayz Ahmed Fayz        |
| 4         | Committee Chowk| 15        | Kashmir Highway        |
| 5         | Waris Khan Road| 16        | Chaman Highway         |
| **6**     | Chandni Chowk  | 17        | Ibn-e-Sina             |
| 7         | Rehmanabad     | 18        | Katchery               |
| 8         | 6th Road       | 19        | PIMS / Centaurus       |
| **9**     | Shamsabad      | 20        | Stock Exchange         |
| 10        | Faizabad       | 21        | 7th Avenue             |
| 11        | IJP Road       | 22        | Shaheed-e-Milat        |
|           |                | 23        | Parade Ground          |
|           |                | 24        | Pakistan Secretariat   |

*Source: NESPAK, 2015.*

Note: Bold station names indicate study sites.
Appendix: B

Table 7 Ridership data 2017 of BRT stations in Rawalpindi

| Characteristics | Saddar Boarding | Saddar Alighting | Total | Marrir Chowk Boarding | Marrir Chowk Alighting | Total | Liaquat Bagh Boarding | Liaquat Bagh Alighting | Total | Committee Chowk Boarding | Committee Chowk Alighting | Total |
|-----------------|-----------------|------------------|-------|-----------------------|-----------------------|-------|-----------------------|-----------------------|-------|-----------------------|------------------------|-------|
| 1-Jan           | 14545           | 15864           | 30409 | 9061                  | 4531                  | 1450   | 8681                  | 6676                  | 7049   | 13725                  |                        |       |
| 2-Jan           | 18760           | 19745           | 38505 | 13696                 | 4933                  | 19128  | 9666                  | 7312                  | 7731   | 15043                  |                        |       |
| 3-Jan           | 18627           | 19493           | 38120 | 13660                 | 4882                  | 1854   | 9854                  | 7585                  | 7813   | 15398                  |                        |       |
| 4-Jan           | 17372           | 18251           | 35623 | 11928                 | 4739                  | 16716  | 9032                  | 7042                  | 7309   | 14351                  |                        |       |
| 5-Jan           | 18810           | 20372           | 39182 | 13696                 | 5367                  | 19063  | 10382                 | 7836                  | 8296   | 16132                  |                        |       |
| 6-Jan           | 16170           | 16855           | 33025 | 11928                 | 3952                  | 15880  | 7903                  | 6227                  | 6346   | 12573                  |                        |       |
| 7-Jan           | 16463           | 17712           | 34175 | 10710                 | 4551                  | 15266  | 9458                  | 7912                  | 8075   | 15987                  |                        |       |
| Total           | 120747          | 128292          | 249039| 85581                 | 33111                 | 31665  | 64976                 | 50590                 | 52619  | 103209                 |                        |       |

Descriptives

| Characteristics | Waris Khan Road Boarding | Waris Khan Road Alighting | Total | Chandni Chowk Boarding | Chandni Chowk Alighting | Total | Rehmanabad Boarding | Rehmanabad Alighting | Total | 6th Road Boarding | 6th Road Alighting | Total |
|-----------------|--------------------------|---------------------------|-------|------------------------|------------------------|-------|---------------------|---------------------|-------|---------------------|---------------------|-------|
| 1-Jan           | 2870                     | 2581                      | 5451  | 3406                   | 3667                   | 7073  | 4561                | 4302                | 8863  | 4351                | 4734                | 9085  |
| 2-Jan           | 3385                     | 3297                      | 6682  | 5230                   | 5497                   | 10727 | 6781                | 6743                | 13524 | 6798                | 7313                | 14111 |
| 3-Jan           | 3577                     | 3328                      | 6906  | 5237                   | 5377                   | 10614 | 6891                | 6631                | 13522 | 6898                | 7238                | 14136 |
| 4-Jan           | 3403                     | 3122                      | 6525  | 4955                   | 5159                   | 10114 | 6405                | 6209                | 12614 | 6491                | 6705                | 13196 |
| 5-Jan           | 3635                     | 3336                      | 6971  | 5365                   | 5504                   | 10869 | 7248                | 6882                | 14130 | 7079                | 7304                | 14383 |
| 6-Jan           | 3056                     | 2711                      | 5767  | 4519                   | 4569                   | 9088  | 5490                | 5399                | 10889 | 6171                | 6053                | 12224 |
| 7-Jan           | 3451                     | 3111                      | 6562  | 4550                   | 4854                   | 9404  | 5975                | 5740                | 11715 | 6068                | 5903                | 11971 |
| Total           | 23377                    | 21486                     | 44863 | 33262                  | 34627                  | 67889 | 43351               | 41906               | 85257 | 43856               | 45250               | 89106 |

Descriptives

| Characteristics | Source |
|-----------------|--------|
| Mean            | PMA, 2018; compiled by the author. |
Table 8 Ridership data 2017 of BRT stations in Rawalpindi (continued)

| Characteristics | Shamsabad | Faizabad | IJP Road |
|-----------------|-----------|----------|----------|
|                 | Boarding  | Alighting| Total    | Boarding  | Alighting| Total    | Boarding  | Alighting| Total    |
| 1-Jan           | 5029      | 5175     | 10204    | 14222     | 13148    | 27370    | 2274      | 2048     | 4322     |
| 2-Jan           | 6976      | 7257     | 14233    | 15050     | 13590    | 28640    | 3124      | 3046     | 6170     |
| 3-Jan           | 7468      | 7502     | 14970    | 13566     | 13725    | 27291    | 3119      | 3157     | 6276     |
| 4-Jan           | 7064      | 6978     | 14042    | 12213     | 12723    | 24936    | 2809      | 3080     | 5889     |
| 5-Jan           | 7482      | 7499     | 14981    | 13247     | 14324    | 27571    | 2984      | 3165     | 6149     |
| 6-Jan           | 6477      | 6085     | 12562    | 11969     | 14389    | 26358    | 2762      | 3089     | 5851     |
| 7-Jan           | 5475      | 5275     | 10750    | 12418     | 14003    | 26421    | 2473      | 2490     | 4963     |
| Total           | 45971     | 45771    | 91742    | 92685     | 95902    | 188587   | 19545     | 20075    | 39620    |

Descriptives

|                | Mean   | Minimum | Maximum | Standard Deviation |
|----------------|--------|---------|---------|--------------------|
| Shamsabad      | 6567   | 5029    | 7482    | 968.6179           |
| Faizabad       | 6539   | 5175    | 7502    | 1018.293           |
| IJP Road       | 13106  | 10204   | 14981   | 1975.037           |

Source: PMA, 2018; compiled by the author.