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Has COVID-19 changed our loyalty towards public transport? Understanding the moderating role of the pandemic in the relationship between service quality, customer satisfaction and loyalty☆

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ABSTRACT

COVID-19 has been associated with a decline in public transport ridership in many cities. However, the impact of the pandemic on passenger perceptions of public transport, particularly loyalty, has remained largely unexplored. Using a case study of Tehran’s bus system, this paper aims to assess the moderating effect of COVID-19 on passenger loyalty. A cross-sectional survey of bus users was conducted in two similar periods, before and during COVID-19. The data was analysed using structural equation modelling, with the effect of observed heterogeneity evaluated using multiple indicators multiple causes models and multi-group analysis. The results indicate that during COVID-19, perceptions of service quality have improved, particularly in relation to comfort (including crowding), safety, reliability and information. While this has led to increased customer satisfaction, loyalty to the system has decreased. An increase in the perceived attractiveness of using private cars was found to be the primary factor for reducing passenger loyalty with the perceived monetary and psychological costs of using cars being less effective in encouraging people to use the bus. Taking into account the significant utility of private vehicles in urban transportation during COVID-19, the present study identifies feasible areas for improving the performance of bus services to increase satisfaction with this form of public transport among car owners.

1. Introduction

Increasing the mode share of public transport is considered integral to supporting sustainable societies (De Gruyter et al., 2017; van Lierop et al., 2018) due to its positive impact on reducing traffic congestion, air pollution, noise, and social inequality (Davison and Knowles, 2006; de Oña et al., 2016b; Eboli and Mazzulla, 2007; Nocera, 2011). However, a key threat to achieving this goal is the...

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continued use of private vehicles for urban transport (Li et al., 2018).

Previous research has identified a range of factors associated with reductions in public transport ridership, including passenger dissatisfaction, car availability, changes in family size (Perk, 2008), and even ageing (Grimsrud and El-Geneidy, 2014). However, during the COVID-19 pandemic, despite reductions in total trip making due to teleworking and greater time spent at home (Tirachini and Cats, 2020), various studies have shown that declines in public transport ridership have been greater than those of other modes, especially private vehicles (De Vos, 2020; Gutierrez et al., 2020; Kanda and Kivimaa, 2020). Key reasons for this include restrictions imposed by authorities on using public transport (Jenelius and Cebecauer, 2020), being unable to maintain social distancing while using public transport (Musselwhite et al., 2020), lack of proper ventilation in public transport vehicles (Wang et al., 2020), perceptions of public transport as a virus transmitting agent (Gutierrez et al., 2020), and preferences towards the use of private vehicles (De Vos, 2020).

The success of public transport largely depends on the number of passengers that the system maintains and attracts (De Oña et al., 2013). A key strategy for increasing ridership is service quality improvements, typically leading to higher levels of passenger satisfaction. Ultimately, passengers satisfied with the system gradually become loyal to the system. Nevertheless, there are multiple factors that have moderating or mediating effects on the relationship between service quality, satisfaction and loyalty, such as involvement (de Oña, 2020; Irtema et al., 2018; Lai and Chen, 2011; Machado-León et al., 2016), network reform (Allen et al., 2019b), switching barriers (Jones et al., 2000; Kim et al., 2004), alternative attractiveness (de Oña et al., 2016a), commitment to environmental sustainability (Vicente et al., 2020) and passenger complaints (Zhang et al., 2019).

Recent research has highlighted the declining trend of public transport ridership during the COVID-19 pandemic (De Vos, 2020; Gutierrez et al., 2020; Kanda and Kivimaa, 2020). However, few studies have taken a deeper look at the effect of COVID-19 on travel behavior to examine why and how this decline in ridership occurred. Aghabayk et al. (2021) conducted a stated preference survey of Tehran metro users before and during COVID-19, finding that crowding has gained greater disutility during COVID-19, with the value of crowding increasing both subjectively and objectively. Furthermore, Dong et al. (2021) concluded that the presence of people on public transport is associated with a higher state of anxiety among passengers due to the reduced psychological distance with COVID-19, leading to lower perceived safety and decreased satisfaction with public transport. Despite the findings of these recent studies, the impact of COVID-19 on passenger loyalty has remained unexplored. Using a case study of Tehran’s bus system in Iran, the present paper contributes to assessing the moderating effect of the COVID-19 pandemic on passenger loyalty, providing insight into how people will use public transport in the future. In addition, due to the role of private vehicles during COVID-19, constructs such as car attractiveness and switching cost are also considered.

Using Structural Equation Modelling (SEM), the current study examines dependence and correlation between latent constructs, with particular attention to the effect of observed heterogeneity on the findings. In recent years, researchers have become more interested in the impact of heterogeneity on SEM, using Multiple Indicators Multiple Causes (MIMIC) models to explain heterogeneity in perceptions of latent constructs (Allen et al., 2020, 2019b, 2018; de Oña, 2020, 2022; Guirao et al., 2016), and Multi-Group Analysis (MGA) to explain differences in measurement and structural paths (Allen et al., 2019a, 2019b; de Oña, 2022). Taking into account heterogeneity is crucial to achieving robust results in research on public transport (de Oña, 2020), whose users usually possess a wide range of demographic, socio-economic, and travel pattern characteristics. As a result, both methods for capturing heterogeneity were used in this study.

The remainder of this paper is structured as follows. Section 2 defines the latent constructs used and outlines the research hypotheses. Section 3 introduces the case study and data collection method and presents a preliminary analysis of the sample. Section 4

![Fig. 1. Conceptual models: (a) Dimensions related to service quality. (b) Conceptual model with customer satisfaction as partial mediator. (c) Conceptual model with customer satisfaction as full mediator.](image-url)
describes the statistical tools used to analyse the data, including SEM-MIMIC and SEM-MGA. Section 5 presents and discusses the results of the analysis, while Section 6 provides some concluding remarks.

2. Latent constructs and research hypotheses

This section defines the latent constructs used in the conceptual models (Fig. 1), followed by a description of the research hypotheses which incorporate the moderating effect of COVID-19.

2.1. Defining latent constructs

2.1.1. Service Quality (SQ)

Parasuraman et al. (1988) introduced the SERVQUAL model, specifying five dimensions for Service Quality (SQ): tangibles, reliability, responsiveness, assurance, and empathy. However, there is still no consensus about SQ dimensionality in the public transport literature, with dimensions for SQ varying based on the survey context (Vicente et al., 2020). In this paper, by examining relevant studies and considering the context of the Tehran public transport system, six dimensions were used to represent SQ: comfort, safety, reliability, information, convenience, and economy.

2.1.2. Customer Satisfaction (CS)

The concepts of satisfaction and Service Quality (SQ) are commonly used interchangeably (Lai and Chen, 2011). This is likely because both of these concepts are derived from disconfirmatory theory (Miller, 1976), and both are attributed to the gap between perceived performance and expectations. Oliver (2014) distinguished between these two concepts, so that SQ relates more to the cognitive judgment based on the expectation of ideal services, while satisfaction relates more to the emotional judgment after experiencing a service. Public transport users are now commonly referred to as customers (de Oña, 2021); therefore, Customer Satisfaction (CS) is used as a construct in this research.

2.1.3. Customer Loyalty (CL)

In marketing studies, loyalty (Oliver, 1981), behavioral intentions (Zeithaml et al., 1996), and repurchase intentions (Anderson, 1994), despite some minor differences, all refer to how a person decides to repurchase a product or reuse a service in the future. However, the concept of loyalty is not well defined in the public transport field and researchers have not reached an agreement on measuring it (van Lierop et al., 2018). Despite the introduction of various dimensions for loyalty in the literature, de Oña (2021) considered reusage intention and willingness to recommend to others as two main characteristics of loyal public transport passengers. In this paper, Customer Loyalty (CL) is used as a construct.

2.1.4. Car Attractiveness (CA)

The concept of alternative attractiveness refers to customer perceptions of how much an alternative is available in the market (Jones et al., 2000). Additionally, this construct deals with the superiority of reputation, image, and service quality related to an alternative service provider compared to a current service provider (Kim et al., 2004). In the public transport context, alternative attractiveness can be referred to as individual preferences to use other transport modes (de Oña et al., 2016a). Due to private vehicles being the main competitor to public transport, this construct is referred to as Car Attractiveness (CA).

2.1.5. Switching Cost (SC)

Zeithaml (1988) considers the perceived cost as something a person loses or sacrifices to achieve service. Hence, Switching Cost (SC) is formed by comparing the perceived cost of the current alternative with other alternatives. SC refers to time, monetary, and effort costs related to a change in service provider, so these costs could be due to searching for a better service provider or learning how to use the new service (Jones et al., 2000). Dick and Basu (1994) also considered psychological aspects of SC, which measures how much concern the use of a new service creates for the person. In this study, SC is used as a construct.

2.2. Research hypotheses

2.2.1. Relationships between Service Quality (SQ), Customer Satisfaction (CS) and Customer Loyalty (CL)

Previous studies have considered relationships between Service Quality (SQ), Customer Satisfaction (CS), and Customer Loyalty (CL). For example, Oliver (2014) considered the constructs of SQ and CS separately, with SQ entered as the antecedent of CS in a conceptual model. Zeithaml et al. (1996) considered behavioral intentions as the consequence of SQ and developed a direct relationship between SQ and behavioural intentions (i.e. customer loyalty). CS and CL have also been closely related to each other in the public transport literature, with some researchers considering CS as a component of CL (van Lierop et al., 2018). However, the predominant hypothesis is to consider CS as an antecedent for CL (Lai and Chen, 2011; Oliver, 1999). de Oña (2020) states that in almost 50% of relevant studies in the public transport field, CS exerts a full mediator effect in the relationship between SQ and CL, and in the other 50% it exerts a partial mediator effect. In the first case, SQ has only an indirect effect with CL through CS, while in the second case, SQ has both a direct and indirect (through CS) relationship with CL. Nevertheless, de Oña (2021) highlighted the superiority of the full mediating role for CS, which the proposed model without a direct relationship between SQ and CL fitted the data better. This paper examines both roles for CS (full mediating and partial mediating) and applies the corresponding conceptual model that fits the
data better. Considering the above, three research hypotheses are defined as follows:

H1: Service Quality (SQ) has a direct and positive effect on Customer Satisfaction (CS).
H2: Service Quality (SQ) has a direct and positive effect on Customer Loyalty (CL).
H3: Customer Satisfaction (CS) has a direct and positive effect on Customer Loyalty (CL).

2.2.2. Relationships between Car Attractiveness (CA), Switching Cost (SC) and Customer Loyalty (CL)

Jones et al. (2000) and Kim et al. (2004) stated that switching barriers have a direct and positive effect on Customer Loyalty (CL). Also, Lovelock (2000) considered perceived cost (under the more complex concept of perceived value) as a predictor of behavioral intentions. As Car Attractiveness (CA) and Switching Cost (SC) are known as sub-constructs of switching barriers, and SC is the comparison of perceived cost between two alternatives, this paper considers the direct relationship of CA and SC with CL. Additionally, Li et al. (2018) have shown that increasing Service Quality (SQ) in one alternative results in a lower perceived cost of that alternative, and in turn, the perception of SC increases. With this in mind, three additional research hypotheses are introduced as follows:

H4: Car Attractiveness (CA) has a direct and negative effect on Customer Loyalty (CL).
H5: Switching Cost (SC) has a direct and positive effect on Customer Loyalty (CL).
H6: Service Quality (SQ) and Switching Cost (CS) are positively correlated.

2.2.3. Effects of COVID-19 on the conceptual model

During the COVID-19 pandemic, reducing crowding and maintaining a safe physical distance in indoor environments is considered essential due to the airborne transmission of coronaviruses (Vuorinen et al., 2020). Aghabayk et al. (2021) found that Tehran metro users pay more attention to crowding as an attribute of Service Quality (SQ) during the COVID-19 pandemic. In addition, Dong et al. (2021) noted an increase in passenger anxiety due to the distance between passengers, while Wang et al. (2020) highlights the role of maintaining physical distance and ventilation in public transport fleets during the pandemic. Furthermore, cleanliness of the public transport fleet (Musselwhite et al., 2020) and providing disinfection equipment (Shen et al., 2020) are other important elements for increasing passenger confidence in public transport during the pandemic. Consequently, it can be stated that the effect of comfort on the perception of SQ has become more important during COVID-19. Therefore, the next research hypothesis is expressed as follows:

H7: COVID-19 positively moderates the effect of comfort on Service Quality (SQ).

Another key feature of the pandemic is an increase in people working from home (Tirachini and Cats, 2020), which has reduced the number of public transport trips for work purposes. Similarly, university and other education centre shutdowns have reduced the number of trips undertaken for education purposes. Trips with a work or education purpose where passengers have to reach their destination at a specific time can be seen as compulsory trips (Allen et al., 2018). Thus, during the COVID-19 pandemic, components associated with the timely execution of compulsory trips, including reliability, information, and convenience, are considered to play a less important role in explaining SQ. So, the next research hypothesis is expressed as follows:

H8: COVID-19 negatively moderates the effect of reliability, information and convenience on Service Quality (SQ).

With greater sensitivity towards using public transport during COVID-19 (Gutiérrez et al., 2020), it is expected that public transport attributes are scrutinised more than before, thereby having a stronger impact on passenger satisfaction levels. At the same time, private vehicles have become a stronger competitor to public transport due to their ability to offer greater protection against the virus from other road users (De Vos, 2020). As a result, constructs related to private vehicles (i.e. switching cost and car attractiveness) may have a stronger negative effect on the loyalty of passengers towards public transport. Based on this, four final research hypotheses are proposed as follows:

H9: COVID-19 positively moderates the effect of Service Quality (SQ) on Customer Satisfaction (CS).
H10: COVID-19 negatively moderates the effect of Customer Satisfaction (CS) on Customer Loyalty (CL).
H11: COVID-19 negatively moderates the effect of Car Attractiveness (CA) on Customer Loyalty (CL).
H12: COVID-19 negatively moderates the effect of Switching Cost (SC) on Customer Loyalty (CL).

3. Case study, sample and survey design

Users of the Tehran bus system were the target population for this study. According to the latest report issued by Tehran Traffic and Transportation Organization in 2018 (TTTO, 2018), 18.9 million daily trips are made in Tehran on average, in which public transport (including metro, bus, and taxi) accounts for 53% of all trips. From 2015 to 2018, the number of total trips in Tehran increased by an average of 300,000 trips per year, yet the share of trips made by public transport declined by 5.2%, with most of this attributable to the bus system (4%). In addition, the number of private vehicles in Tehran reached 4.2 million in 2018, which increased car ownership levels in Tehran to their highest level of 0.3 cars per capita.

Data collection was carried out face-to-face in late October and early November 2019 on-board buses and at bus stations, in which 790 valid questionnaires were collected. With the arrival of COVID-19 in Iran in February 2020, and the application of new conditions
on individuals and social life, especially those related to mobility, the same questionnaire was used to collect new data under COVID-19 conditions. The new data was collected in November 2020, at the same time of year as the previous data, in order to minimise the effect of seasonal influences on the responses. Nevertheless, some restrictions were experienced during this period. For example, certain user groups (e.g. older pedestrians and car owners) limited their use of the service, which reduced the chance of meeting them to complete a questionnaire. Furthermore, most passengers avoided interacting with surveyors and filling out the questionnaire due to fear of high COVID-19 contamination and strict prohibition of contact with others. Therefore, it was decided that all data would be collected online during this period. At the beginning of the online questionnaire, respondents were asked whether they are a user of the Tehran bus system, and if so, the questionnaire would be provided to them. A total of 820 valid questionnaires were collected during COVID-19. Ultimately, a total of 1,610 valid questionnaires were collected from the two surveys and used for analysis.

The questionnaire consisted of two parts. The first part collected a range of socio-demographic and travel patterns characteristics from respondents. Table 1 details these characteristics for each survey and the pooled data (both surveys). A comparison of respondent characteristics from each survey shows that the two samples are relatively similar, but a few of the characteristics are affected by COVID-19. According to Table 1, the comparison of demographics between the two samples before and during COVID-19 shows that participants over 40 years (from 9.8% to 23.6%), retirees (from 1.9% to 5.7%), housewives (from 1.9% to 8.8%), and car owners (from 24.6% to 39.8%) increased. This is expected given that these types of people would have been less likely to encounter the survey face-to-face, thereby increasing their chance of responding through the online format. Both surveys also reveal significant differences in characteristics of passengers’ travel patterns, specifically in trip purpose and bus use frequency. Table 1 shows that the percentage of respondents with an education-related trip purpose decreased from 46.8% (before COVID-19) to 14.0% (during COVID-19), which is intuitive given the closure of education centres and switch to online learning. Similarly, the percentage of respondents using bus services 5+ days/week decreased from 33.3% (before COVID-19) to 9.6% (during COVID-19), while those with a seldom bus use frequency increased from 18.5% (before COVID-19) to 58.7% (during COVID-19); again this is expected due to the closure of education centres and increases in working from home.

The second part of the questionnaire measured the extent to which respondents agreed with a range of statements related to the latent constructs used in the research hypotheses. To collect the agreement scores, a five-point Likert scale was used where 1 = strongly disagree and 5 = strongly agree. Research undertaken by Allen et al. (2018), Deb and Ali Ahmed (2018), Li et al. (2018), Allen et al. (2019b) and Zhang et al. (2019) was used to guide the final selection of attributes related to Service Quality (SQ) while taking into account the local context of the Tehran bus system. Statements relating to 23 different SQ attributes were included covering six dimensions: comfort, safety, reliability, information, convenience, and economy. The statements relating to Customer Satisfaction (CS), Customer Loyalty (CL), Car Attractiveness (CA), and Switching Cost (SC) constructs were adopted from Li et al. (2018). Table 2 provides a description of each indicator variable, along with descriptive statistics from each survey and the pooled data (both surveys). The highest score for the SQ attributes was found for the fixed routes attribute (average of 4.00 out of 5 across both surveys), while the lowest score related to crowding (average of 1.83 out of 5 across both surveys). The low scores for crowding in both surveys indicate that passenger crowding on buses in Tehran is perceived poorly, both before and during COVID-19.

4. Data analysis methods

Structural equation modelling (SEM) was used in this research to simultaneously examine the interdependence relationships between indicator variables and latent constructs (measurement model) and dependence relationships between latent constructs (structural model) (Hair et al., 2014). However, for a better understanding of relationships between the indicator variables and latent constructs, Principal Component Analysis (PCA) with varimax rotation was used following Confirmatory Factor Analysis (CFA). SPSS 26 (IBM Corp., 2019) was used to perform PCA, and AMOS 24 (Arbuckle, 2016) software was used to perform all other analyses. At the PCA stage, the number of constructs and their corresponding indicator variables were defined. The final decision about keeping or removing indicator variables was made in the measurement model (i.e. CFA). This is recommended for two reasons:

1. The magnitude of factor loadings in PCA and CFA are slightly different. The reason is that in PCA, indicator variables are related to all constructs, whereas in CFA, each indicator variable is only allocated to one construct (i.e. no cross-loadings).
2. Since every indicator variable includes valuable information, indicator variables with lower cross loadings (i.e. between 0.40–0.50) are kept as long as the goodness-of-fit (GOF) of the measurement model and the construct validity of each construct are not compromised.

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s test of sphericity were used to find out whether the data is suitable for factor analysis. A KMO value of >0.60 and a significant Bartlett’s test indicate that the data is ideal for PCA.

In CFA, GOF and construct validity were used to assess the measurement model and ensure that structures were well-measured for use in theory testing. Since the chi-square test, in addition to the residual between the observed and estimated covariance matrix, depends on the sample size and the number of indicator variables, this measure is not a good indicator of GOF in complex models. Therefore, Hair et al. (2014) suggests reporting an absolute fit index and incremental fix index for GOF. In this study, the Root Mean Square Error of Approximation (RMSEA) as an absolute measure and Comparative Fit Index (CFI) as an incremental measure were applied. An RMSEA value below 0.08 (ideally 0.05) and a CFI value above 0.90 indicate a good model fit. Convergent validity and discriminant validity of each construct were assessed to confirm the construct validity. A significant factor loading above 0.50 (ideally 0.70), Average Variance Extracted (AVE) (Eq. (1)) above 0.70, and acceptable reliability of the constructs indicate good convergent validity (Hair et al., 2014). In this study, composite reliability (CR) (Eq. (2)) and Cronbach’s (1951) alpha
(Eq. (3)) were used to explain the reliability of each construct. The reliability of each construct should be higher than 0.70 (Nunnally, 1978); however, a range of 0.60~0.70 is also considered acceptable in many studies (Allen et al., 2019b; van Griethuijsen et al., 2015; Zeithaml et al., 1996). To ensure the discriminant validity of each dual combination of constructs, the AVE for every construct should be higher than the square of the correlation between two constructs (Hair et al., 2014).

\[
\text{AVE} = \frac{\sum_{i=1}^{n} L_i^2}{n}
\]

\[
CR = \frac{(\sum_{i=1}^{n} L_i)^2}{(\sum_{i=1}^{n} L_i^2) + (\sum_{i=1}^{n} e_i)}
\]

\[
\alpha = \frac{n\tau}{\text{AVE} + (n - 1)\bar{e}}
\]

In the above equations, n represents the number of items (i.e. indicator variables), \(L_i\) represents the standard factor loading, \(e_i\) represents the error variance, and \(\bar{e}\) represents the average inter-item covariance among the items.

After determining the construct validity and ensuring the measurement model fits the data well, the research hypotheses were tested by developing the structural model. For this purpose, structural relationships (dependence or correlational) were formed

| Variable          | Category     | Survey 1 (before COVID-19) | Survey 2 (during COVID-19) | Pooled data |
|-------------------|--------------|----------------------------|----------------------------|-------------|
| Gender            | Male         | 381 (48.2%)                | 396 (48.3%)                | 777 (48.3%) |
|                   | Female       | 409 (51.8%)                | 424 (51.7%)                | 833 (51.7%) |
| Age               | <18 years    | 10 (1.3%)                  | 15 (1.8%)                  | 25 (1.6%)   |
|                   | 18-24 years  | 508 (64.3%)                | 408 (49.8%)                | 916 (56.9%) |
|                   | 25-40 years  | 195 (24.7%)                | 204 (24.9%)                | 399 (24.8%) |
|                   | 41-55 years  | 41 (5.2%)                  | 140 (17.1%)                | 181 (11.2%) |
|                   | >55 years    | 36 (4.6%)                  | 53 (6.5%)                  | 89 (5.5%)   |
| Occupation        | Student      | 574 (72.7%)                | 420 (51.2%)                | 994 (61.7%) |
|                   | Worker/clerk | 158 (20.0%)                | 264 (32.2%)                | 422 (26.2%) |
|                   | Retired      | 15 (1.9%)                  | 47 (5.7%)                  | 62 (3.9%)   |
|                   | Housewife    | 15 (1.9%)                  | 72 (8.8%)                  | 87 (5.4%)   |
|                   | Unemployed   | 28 (3.5%)                  | 17 (2.1%)                  | 45 (2.8%)   |
| Education status  | Lower than diploma | 23 (2.9%)                | 40 (4.9%)                  | 63 (3.9%)   |
|                   | Diploma      | 212 (26.8%)                | 309 (37.7%)                | 521 (32.4%) |
|                   | Bachelor     | 323 (40.9%)                | 361 (44.0%)                | 684 (42.5%) |
|                   | Higher than bachelor | 232 (29.4%)            | 110 (13.4%)                | 342 (21.2%) |
| Monthly income    | <5 million Tomans | 725 (91.8%)            | 648 (79.0%)                | 1373 (85.3%)|
|                   | 5-15 million Tomans | 58 (7.3%)                | 157 (19.1%)                | 215 (13.4%) |
|                   | >15 million Tomans | 7 (0.9%)                  | 15 (1.8%)                  | 22 (1.4%)   |
| Car ownership     | Yes          | 194 (24.6%)                | 326 (39.8%)                | 520 (32.3%) |
|                   | No           | 596 (75.4%)                | 494 (60.2%)                | 1090 (67.7%)|
| Trip purpose      | Work         | 233 (29.5%)                | 264 (32.2%)                | 497 (30.9%) |
|                   | Education    | 370 (46.8%)                | 115 (14.0%)                | 485 (30.1%) |
|                   | Shopping     | 29 (3.7%)                  | 114 (13.9%)                | 143 (8.9%)  |
|                   | Leisure      | 29 (3.7%)                  | 47 (5.7%)                  | 76 (4.7%)   |
|                   | Other        | 129 (16.3%)                | 280 (34.1%)                | 409 (25.4%) |
| Bus use frequency | 5+ days/week | 263 (33.3%)                | 79 (9.6%)                  | 342 (21.2%) |
|                   | 3-4 days/week | 254 (32.2%)                | 119 (14.5%)                | 373 (23.2%) |
|                   | 1-2 days/week | 127 (16.1%)                | 141 (17.2%)                | 268 (16.6%) |
|                   | Seldom       | 146 (18.5%)                | 481 (58.7%)                | 627 (38.9%) |

\(a\) A diploma is awarded after spending 3 years in high school in Iran, while a bachelor (of science) degree is awarded after spending 4 years and a maximum of 6 years in one of the university disciplines in Iran.

\(b\) 25,000 Tomans ~ 1 USD.
Table 2
Descriptive statistics of each indicator variable, with corresponding attributes and dimensions.

| Dimension        | Attribute                                      | Indicator variable                                                                 | Survey 1 (before COVID-19) | Survey 2 (during COVID-19) | Pooled data |
|------------------|-----------------------------------------------|------------------------------------------------------------------------------------|---------------------------|----------------------------|-------------|
|                  |                                               |                                     | Mean | S. D. | Skew | Kurt | Mean | S. D. | Skew | Kurt | Mean | S. D. | Skew | Kurt |
| Comfort          | Seating                                       | The seats on the bus are comfortable                                           | 2.34 | 1.09  | 0.38 | -0.85 | 2.51 | 1.04  | 0.19 | -0.89 | 2.43 | 1.07  | 0.27 | -0.89 |
|                  | Temperature/Ventilation                       | The temperature inside the bus is suitable for different weather conditions and the bus is well ventilated | 2.57 | 1.16  | 0.16 | -1.05 | 2.64 | 1.08  | 0.19 | -0.88 | 2.61 | 1.12  | 0.17 | -0.96 |
|                  | Bus appearance                                | The appearance of the bus is clean, appropriate and worthy of passengers             | 2.37 | 1.11  | 0.35 | -0.91 | 2.51 | 1.05  | 0.21 | -0.73 | 2.44 | 1.08  | 0.27 | -0.84 |
|                  | Bus station                                   | The stopping environment at the bus station is clean and comfortable                | 2.66 | 1.09  | 0.05 | -0.98 | 2.71 | 1.05  | -0.06 | -1.00 | 2.69 | 1.07  | 0.00 | -0.99 |
|                  | Crowding                                      | Crowding on the bus is appropriate and empty seats are normally available           | 1.75 | 1.01  | 1.27 | 0.76  | 1.91 | 0.98  | 0.89 | 0.03  | 1.83 | 1.00  | 1.07 | 0.33  |
|                  | Driver behaviour                              | The bus driver is friendly                                                        | 3.04 | 0.92  | -0.29 | 0.02  | 3.28 | 0.87  | -0.45 | 0.40  | 3.16 | 0.90  | -0.37 | 0.17  |
| Safety           | Inside bus security                           | When I am on the bus, I feel secure from possible crime                          | 2.58 | 1.16  | 0.15 | -1.05 | 2.74 | 1.14  | 0.06 | -0.98 | 2.66 | 1.15  | 0.10 | -1.02 |
|                  | Bus station security                          | When I am at the bus station, I feel secure from possible crime                   | 2.52 | 1.14  | 0.19 | -0.99 | 2.67 | 1.12  | 0.13 | -0.92 | 2.60 | 1.13  | 0.16 | -0.96 |
|                  | Accident safety                               | The bus has the necessary safety against possible accidents                        | 2.41 | 1.14  | 0.39 | -0.73 | 2.70 | 1.14  | 0.11 | -0.97 | 2.56 | 1.15  | 0.25 | -0.89 |
|                  | Smooth driving                                | Bus drivers drive smoothly and avoid sudden acceleration and braking              | 2.77 | 1.08  | 0.03 | -0.85 | 3.11 | 1.05  | -0.25 | -0.77 | 2.94 | 1.08  | -0.12 | -0.85 |
| Reliability      | Fixed routes                                  | The bus moves along fixed routes and does not exceed the bus stations             | 4.03 | 0.89  | -1.10 | 1.43  | 3.98 | 0.81  | -1.16 | 2.15  | 4.00 | 0.85  | -1.12 | 1.75  |
|                  | Breakdowns                                    | The bus service operates regularly and there are no breakdowns                     | 3.07 | 1.12  | -0.25 | -0.81 | 3.10 | 1.02  | -0.17 | -0.67 | 3.09 | 1.07  | -0.22 | -0.73 |
|                  | Speed reliability                             | The bus has a reliable speed to get me to my destination at the desired time     | 3.06 | 1.08  | -0.29 | -0.75 | 3.27 | 0.98  | -0.58 | -0.49 | 3.17 | 1.03  | -0.44 | -0.64 |
|                  | First/last bus timing                         | The time of the first/last bus is reasonable                                     | 3.11 | 1.11  | -0.35 | -0.59 | 3.40 | 0.94  | -0.72 | 0.00  | 3.25 | 1.03  | -0.55 | -0.33 |
| Information      | Inside bus information                        | Travel information inside the bus is sufficient                                   | 2.53 | 1.18  | 0.27 | -0.92 | 2.66 | 1.10  | 0.24 | -0.85 | 2.60 | 1.14  | 0.25 | -0.89 |
|                  | Bus station information                       | Travel information at bus stations is sufficient                                  | 3.06 | 1.16  | -0.25 | -0.87 | 3.13 | 1.07  | -0.27 | -0.79 | 3.10 | 1.11  | -0.26 | -0.82 |
|                  | Breakdown information                         | Information on breakdowns and alternative routes is appropriate                  | 2.13 | 0.97  | 0.51 | -0.44 | 2.35 | 0.98  | 0.40 | -0.37 | 2.24 | 0.98  | 0.45 | -0.41 |
| Convenience      | Bus station locations                         | The bus stations are reasonably located near my origin and destination            | 3.70 | 0.98  | -0.93 | 0.54  | 3.56 | 0.99  | -0.63 | -0.11 | 3.62 | 0.99  | -0.77 | 0.16  |
|                  | Transferring                                  | It is convenient to transfer between bus stations to reach my destination        | 3.24 | 1.04  | -0.43 | -0.55 | 3.32 | 0.99  | -0.39 | -0.50 | 3.28 | 1.02  | -0.41 | -0.52 |
|                  | Waiting time                                  | The waiting time at the bus station is reasonable                                | 2.58 | 1.14  | 0.24 | -1.00 | 2.78 | 1.07  | 0.04 | -1.03 | 2.68 | 1.11  | 0.13 | -1.03 |

(continued on next page)
| Dimension         | Attribute                          | Indicator variable                                                                 | Survey 1 (before COVID-19) | Survey 2 (during COVID-19) | Pooled data |
|-------------------|------------------------------------|------------------------------------------------------------------------------------|---------------------------|---------------------------|-------------|
|                   |                                    |                                                                                    | Mean | S.D. | Skew | Kurt | Mean | S.D. | Skew | Kurt | Mean | S.D. | Skew | Kurt |
| Economy           | Ticket cost                        | Bus fare is cheap and appropriate                                                 | 3.25 | 1.15 | -0.49 | -0.65 | 3.66 | 1.04 | -0.80 | 0.15 | 3.46 | 1.12 | -0.65 | -0.32 |
|                   | Fare collection                    | Method of fare collection is convenient                                           | 3.72 | 0.99 | -1.04 | 0.91  | 3.80 | 0.94 | -1.04 | 1.15 | 3.76 | 0.96 | -1.04 | 1.03 |
|                   |                                    |                                                                                    |                            |                           |               |               |               |               |               |               |               |               |               |
| Customer          | CS1                                | The service provided by the bus system is within my expectations                  | 2.43 | 1.02 | 0.36  | -0.58 | 2.66 | 0.94 | 0.14  | -0.68 | 2.54 | 0.98 | 0.23  | -0.66 |
| Satisfaction      | CS2                                | Overall, I am satisfied with the bus system                                        | 2.78 | 1.02 | -0.12 | -0.72 | 2.94 | 0.90 | -0.22 | -0.64 | 2.86 | 0.97 | -0.19 | -0.65 |
|                   | CS3                                | I get my desired service from using the bus system                                 | 2.68 | 1.03 | 0.11  | -0.80 | 2.80 | 0.93 | -0.06 | -0.77 | 2.74 | 0.98 | 0.02  | -0.78 |
| Customer          | CL1                                | I recommend travelling by bus to others                                           | 2.88 | 1.14 | -0.16 | -0.87 | 2.80 | 1.00 | -0.12 | -0.52 | 2.84 | 1.07 | -0.13 | -0.70 |
| Loyalty (CL)      | CL2                                | I will continue to use the bus in the future                                       | 3.27 | 1.06 | -0.65 | -0.29 | 3.20 | 1.01 | -0.59 | -0.19 | 3.24 | 1.03 | -0.62 | -0.25 |
|                   | CL3                                | I would like to travel by bus                                                     | 2.71 | 1.17 | 0.02  | -1.06 | 2.70 | 1.07 | 0.10  | -0.88 | 2.70 | 1.12 | 0.06  | -0.97 |
|                   | CL4                                | If other modes of transport are available, the bus is still my first choice       | 2.13 | 1.09 | 0.76  | -0.27 | 2.19 | 1.01 | 0.71  | -0.04 | 2.16 | 1.05 | 0.73  | -0.17 |
| Car Attractiveness| CA1                                | I love driving and the feeling of driving                                         | 3.43 | 1.20 | -0.41 | -0.72 | 3.79 | 1.04 | -0.59 | -0.27 | 3.61 | 1.13 | -0.54 | -0.47 |
|                   | CA2                                | Driving a car makes me feel successful                                           | 3.20 | 1.24 | -0.20 | -0.86 | 3.50 | 1.05 | -0.31 | -0.52 | 3.35 | 1.15 | -0.30 | -0.66 |
|                   | CA3                                | I hope I can travel by car                                                        | 3.43 | 1.23 | -0.37 | -0.89 | 3.90 | 0.97 | -0.77 | 0.07  | 3.67 | 1.13 | -0.62 | -0.45 |
|                   | CA4                                | Cars can give me better travel quality than buses                                 | 3.89 | 1.04 | -0.90 | 0.31  | 4.10 | 0.95 | -1.14 | 1.14  | 4.00 | 1.00 | -1.02 | 0.68 |
| SwitchingCost (SC)| SC1                                | It costs me a lot to buy a car                                                    | 3.99 | 1.11 | -1.06 | 0.42  | 4.20 | 0.99 | -1.05 | 0.29  | 4.10 | 1.06 | -1.08 | 0.49 |
|                   | SC2                                | It costs me a lot to use a car                                                   | 3.65 | 1.13 | -0.65 | -0.27 | 3.74 | 1.03 | -0.43 | -0.64 | 3.70 | 1.08 | -0.56 | -0.38 |
|                   | SC3                                | I’m worried that traveling by car is not as easy as I thought, and it may cause unexpected events | 2.67 | 1.15 | 0.11  | -0.85 | 2.81 | 1.08 | 0.07  | -0.85 | 2.74 | 1.12 | 0.08  | -0.84 |
|                   | SC4                                | Changing my travel mode from bus to car disrupts my schedule and daily life      | 2.63 | 1.16 | 0.27  | -0.47 | 2.70 | 1.00 | 0.24  | -0.47 | 2.67 | 1.08 | 0.24  | -0.42 |
|                   | SC5                                | Traveling by car takes a lot of time and energy from me                            | 2.90 | 1.19 | 0.10  | -0.85 | 2.80 | 1.07 | 0.30  | -0.62 | 2.85 | 1.13 | 0.20  | -0.74 |

a Average attribute scores (out of 5).
b Standard deviation statistic.
c Skewness statistic.
d Kurtosis statistic.
Table 3
Measurement model results with goodness-of-fit and construct validity measures.

| Component          | Attribute* | Code | Estimate | S.E.  | Z-value | Std. Coef. | $R^2$ | AVE | CR | $\alpha$ |
|--------------------|------------|------|----------|-------|---------|------------|-------|-----|----|----------|
| Comfort            | Seating    | Comf1| 1.00     |       |         | 0.64       | 0.40  | 0.35| 0.73| 0.72     |
|                    | Temperature/Ventilation | Comf2| 1.01     | 0.05  | 19.60   | 0.61       | 0.37  |     |     |          |
|                    | Bus appearance | Comf3| 1.09     | 0.05  | 21.29   | 0.68       | 0.47  |     |     |          |
|                    | Bus station  | Comf4| 0.92     | 0.05  | 18.86   | 0.58       | 0.34  |     |     |          |
|                    | Crowding    | Comf5| 0.62     | 0.04  | 14.40   | 0.42       | 0.18  |     |     |          |
| Safety             | Inside bus security | Saf1| 1.00     |       |         | 0.83       | 0.69  | 0.74| 0.85| 0.85     |
|                    | Bus station security | Saf2| 1.04     | 0.05  | 21.05   | 0.88       | 0.78  |     |     |          |
| Reliability        | Driver behaviour | Reli1| 1.00     |       |         | 0.53       | 0.29  | 0.28| 0.70| 0.69     |
|                    | Smooth driving | Reli2| 1.05     | 0.07  | 14.33   | 0.47       | 0.22  |     |     |          |
|                    | Fixed routes  | Reli3| 0.78     | 0.06  | 13.76   | 0.44       | 0.20  |     |     |          |
|                    | Breakdowns   | Reli4| 1.32     | 0.08  | 16.79   | 0.59       | 0.35  |     |     |          |
|                    | Speed reliability | Reli5| 1.38     | 0.08  | 17.58   | 0.64       | 0.41  |     |     |          |
|                    | First/last bus timing | Reli6| 1.00     | 0.07  | 14.28   | 0.47       | 0.22  |     |     |          |
| Information        | Inside bus information | Inf1| 1.00     |       |         | 0.73       | 0.53  | 0.41| 0.67| 0.66     |
|                    | Bus station information | Inf2| 0.85     | 0.05  | 17.97   | 0.63       | 0.40  |     |     |          |
|                    | Breakdown information | Inf3| 0.64     | 0.04  | 16.50   | 0.54       | 0.30  |     |     |          |
| Convenience        | Bus station locations | Conv1| 1.00     |       |         | 0.68       | 0.46  | 0.42| 0.68| 0.64     |
|                    | Transferring  | Conv2| 1.15     | 0.06  | 19.69   | 0.75       | 0.57  |     |     |          |
|                    | Waiting time  | Conv3| 0.80     | 0.05  | 15.51   | 0.48       | 0.23  |     |     |          |
| Economy            | Ticket cost  | Eco1| 1.00     |       |         | 0.63       | 0.39  | 0.42| 0.59| 0.59     |
|                    | Fare collection | Eco2| 0.92     | 0.08  | 12.34   | 0.67       | 0.45  |     |     |          |
| Customer Satisfaction (CS) | CS1 | CS1 | 1.00 |       |         | 0.87       | 0.76  | 0.73| 0.89| 0.89     |
|                    | CS2          | CS2 | 0.96     | 0.02  | 42.73   | 0.85       | 0.72  |     |     |          |
|                    | CS3          | CS3 | 0.96     | 0.02  | 42.00   | 0.84       | 0.70  |     |     |          |
| Customer Loyalty (CL) | CL1    | CL1 | 1.00 |       |         | 0.83       | 0.68  | 0.58| 0.85| 0.85     |
|                    | CL2          | CL2 | 0.86     | 0.03  | 31.01   | 0.74       | 0.54  |     |     |          |
|                    | CL3          | CL3 | 0.99     | 0.03  | 33.06   | 0.78       | 0.61  |     |     |          |
|                    | CL4          | CL4 | 0.85     | 0.03  | 29.78   | 0.71       | 0.51  |     |     |          |
| Car Attractiveness (CA) | CA1    | CA1 | 1.00 |       |         | 0.83       | 0.69  | 0.44| 0.75| 0.77     |
|                    | CA2          | CA2 | 0.99     | 0.04  | 24.32   | 0.80       | 0.65  |     |     |          |
|                    | CA3          | CA3 | 0.61     | 0.03  | 18.31   | 0.51       | 0.26  |     |     |          |
|                    | CA4          | CA4 | 0.46     | 0.03  | 15.55   | 0.43       | 0.19  |     |     |          |
| Switching Cost (SC) | SC1          | SC1 | 1.00 |       |         | 0.70       | 0.49  | 0.69| 0.81| 0.79     |
|                    | SC2          | SC2 | 1.39     | 0.11  | 12.32   | 0.94       | 0.89  |     |     |          |
| Switching Discomfort (SD) | SC3 | SD1b | 1.00 |       |         | 0.56       | 0.31  | 0.43| 0.60| 0.59     |
|                    |              | SD3c | 1.36     | 0.10  | 13.07   | 0.75       | 0.56  |     |     |          |
| Chi-square (df)    | 2200.16 (538)|     |         |       |         | 0.044      | 0.916 |     |     |          |

* Detailed descriptions of attributes are given in Table 2.

b, c, SD1 and SD3 correspond to SC3 and SC5 in Table 2, respectively.
between constructs. To determine the practical significance of structural relationships, standard structural coefficients less than 0.1 indicate a very small effect size, between 0.10 and 0.30 indicate a small effect size, between 0.30 and 0.50 indicate a medium effect size, and above 0.50 indicate a large effect size (Allen et al., 2018, 2019b; Currie and Delbosc, 2017).

Multiple Indicators Multiple Causes (MIMIC) models (Joreskog and Goldberger, 1975) were used to assess observed heterogeneity in measuring latent constructs. In this method, the difference in perception of latent variables was estimated through various regressors. These regressors were the sample-derived socio-demographic and travel pattern variables. As categorical variables must be included in MIMIC models as dummy variables, a category has to be removed from the model as the reference category.

Table 4
Structural model results with goodness-of-fit measures.

| Structural weight                      | Estimate | S.E.  | Z-value | p-value | Std. Coef. |
|----------------------------------------|----------|-------|---------|---------|------------|
| Customer Satisfaction (CS)             | 1.26     | 0.06  | 20.40   | <0.01   | 0.84       |
| Customer Loyalty (CL)                  | 0.64     | 0.03  | 23.01   | <0.01   | 0.62       |
| Customer Loyalty (CL)                  | 0.09     | 0.03  | 3.30    | <0.01   | 0.07       |
| Customer Loyalty (CL)                  | 0.31     | 0.05  | 5.84    | <0.01   | 0.22       |
| Comfort                                | 1.00     |       |         |         | 0.84       |
| Safety                                 | 0.82     | 0.06  | 13.46   | <0.01   | 0.48       |
| Reliability                            | 0.74     | 0.05  | 15.61   | <0.01   | 0.87       |
| Information                            | 0.89     | 0.06  | 14.93   | <0.01   | 0.61       |
| Convenience                            | 0.73     | 0.05  | 6.10    | <0.01   | 0.63       |
| Economy                                | 0.61     | 0.06  | 10.75   | <0.01   | 0.50       |

| Structural covariance                  | Estimate | S.E.  | Z-value | p-value  |
|----------------------------------------|----------|-------|---------|----------|
| Car Attractiveness (CA)                | 0.07     | 0.02  | 3.51    | <0.01   |
| Car Attractiveness (CA)                | 0.15     | 0.02  | 7.13    | <0.01   |
| Switching Cost (SC)                    | 0.08     | 0.01  | 6.50    | <0.01   |
| Switching Discomfort (SD)              | 2368.50 (578) | 0.044 |

Chi-square (df) 2368.50 (578)
RMSEA 0.044
CFI 0.910
R² (Customer Satisfaction (CS)) 0.711
R² (Customer Loyalty (CL)) 0.525

Fig. 3. Structural model relationships and effect sizes.
regression relationship between a category and a latent construct becomes significant, then that category, compared to the reference category, has a different factor mean (i.e. latent construct perception) in the direction of the relationship’s sign. Additionally, Differential Item Functioning (DIF) is another feature of MIMIC models, which by creating a direct regression relationship between regressors and items, reveals whether there is a difference in item intercepts regarding the proposed regressor. Fig. 2 shows an example of a MIMIC model for a single regressor and a single latent construct.

Due to the limitations of SEM-MIMIC, which cannot take into account heterogeneity in measurement or structural paths, Multi-Group Analysis (MGA) was used to assess the role of socio-demographic and travel pattern variables in moderating these paths. In SEM-MGA, measurement weights and structural relationships can be freely estimated across the groups of a categorical variable. The moderating variables are chosen by testing measurement invariance (MI) and structural invariance (SI).

MI is evaluated through a series of equality constraints applied to the measurement model that assesses whether a metric score has the same meaning across different data collection and respondent conditions (de Oña, 2022). Put it another way, if the GOF of the measurement model is significantly reduced by intensifying MI restrictions, the MI is not held, and the variable should be tested for structural invariance. Allen et al. (2019a) state that ΔCFI is the most popular criterion for testing MI, and if this measure is more than 0.01 (Cheung and Rensvold, 2002), then equality constraints degrade the fit model significantly, and MI is not held. The following are four different types of MI that were used in this study (Widaman and Reise, 1997):

1. Configural invariance: This is the first step in the hierarchy of MI types, in which only the number of constructs as well as their corresponding indicator variables are assumed constant across groups and all the model parameters are estimated freely.
2. Weak invariance: This step is also known as metric invariance, and is checked by imposing equality constraints on factor loadings across groups. In other words, this MI implies that each indicator variable contributes to the latent construct to the same degree across the groups (Putnick and Bornstein, 2016).
3. Strong invariance: This step, also known as scalar invariance, involves constrained item intercepts across groups. Holding this MI means that various groups perceive the items as having the same value at a certain level of the latent construct. After ensuring that item intercepts are invariant, an omnibus test is used to examine whether factor means are equal (Brown, 2006).

Table 5
SEM-MIMIC model results (regression results for service quality components).

| Component | Variable | Regressor | Estimate | S.E. | Z-value | p-value | Std. Coef. |
|-----------|----------|-----------|----------|------|---------|---------|------------|
| Comfort   | Age      | 25–40 years | 0.12     | 0.05 | 2.38    | 0.02    | 0.07       |
|           | Occupation | Retired  | 0.31     | 0.11 | 2.82    | <0.01   | 0.08       |
|           | Survey   | During COVID-19 | 0.12 | 0.04 | 2.72    | <0.01   | 0.08       |
|           | Survey   | During COVID-19 | 0.10 | 0.05 | 1.99    | 0.05    | 0.05       |
| Crowding (DIF) | Safety | Age | 41–55 years | 0.16 | 0.07 | -2.23 | 0.03 | -0.01 |
|           | Car ownership | Yes  | 0.01     | 0.10 | 2.19    | 0.03    | 0.00       |
|           | Survey   | During COVID-19 | 0.10 | 0.05 | 2.14    | 0.03    | 0.01       |
| Reliability (R² = 0.671) | Gender | Male | 0.10     | 0.03 | 3.43    | <0.01   | 0.10       |
|           | Age      | 41–55 years | 0.11     | 0.05 | 2.43    | 0.02    | -0.07      |
|           | Occupation | Student | -0.06   | 0.03 | -2.16   | 0.03    | -0.06      |
|           | Retired  | 0.31     | 0.08     | 4.16  | <0.01   | 0.12      |
|           | Unemployed | 0.22   | 0.09     | 2.56  | 0.01    | 0.07      |
|           | Car ownership | Yes  | 0.09     | 0.03 | 2.98    | <0.01   | 0.09       |
|           | Trip purpose | Education | -0.09  | 0.03 | -2.97   | <0.01   | -0.08      |
| Information (R² = 0.391) | Survey | During COVID-19 | 0.20 | 0.03 | 6.83    | <0.01   | 0.20       |
|           | Gender   | Male | -0.14    | 0.05 | -2.63   | <0.01   | -0.07      |
|           | Age      | 25–40 years | 0.17     | 0.06 | 2.77    | <0.01   | 0.08       |
|           | Occupation | Retired | 0.36     | 0.14 | 2.57    | 0.01    | 0.07       |
|           | Education status | Lower than diploma | 0.50  | 0.14 | 3.59    | <0.01   | 0.10       |
|           | Survey   | During COVID-19 | 0.17 | 0.05 | 3.11    | <0.01   | 0.09       |
| Convenience (R² = 0.430) | Gender | Male | 0.10     | 0.04 | 2.63    | <0.01   | 0.07       |
|           | Age      | >55 years | -0.42    | 0.09 | -4.81   | <0.01   | -0.14      |
|           | Occupation | Retired | 0.51     | 0.10 | 4.90    | <0.01   | 0.14       |
|           | Housewife | 0.20    | 0.09     | 2.23  | 0.03    | 0.06      |
|           | Unemployed | 0.33    | 0.12     | 2.75  | <0.01   | 0.08      |
|           | Trip purpose | Other | -0.17    | 0.05 | -3.75   | <0.01   | -0.11      |
|           | Bus use frequency | Seldom | -0.17   | 0.04 | -4.10   | <0.01   | -0.12      |
|           | Gender   | Male | 0.16     | 0.05 | 2.97    | <0.01   | 0.07       |
|           | 41–55 years | -0.44  | 0.08 | -5.22   | <0.01   | -0.12      |
|           | >55 years | -0.50   | 0.12     | -4.27 | <0.01   | -0.10      |
|           | Occupation | Student | -0.28   | 0.06 | -5.06   | <0.01   | -0.12      |
|           | Housewife | 0.44    | 0.12     | 3.70  | <0.01   | 0.09      |
|           | Unemployed | -0.66   | 0.16     | -4.06 | <0.01   | -0.09      |
|           | Car ownership | Yes  | 0.19     | 0.06 | 3.30    | <0.01   | 0.08       |
|           | Bus use frequency | 5+ days/week | -0.18  | 0.07 | -2.71   | <0.01   | -0.06      |

Note: DIF = Differential Item Functioning.
SEM-MIMIC model results (regression results for components other than service quality).

| Component               | Variable            | Regressor | Estimate | S.E.  | Z-value | p-value | Std. Coef. |
|-------------------------|---------------------|-----------|----------|-------|---------|---------|------------|
| Customer satisfaction (CS) | Gender              | Male      | 0.13     | 0.05  | 2.98    | <0.01  | 0.08       |
| (R² = 0.719)            | Age                 | 41–55 years | −0.14   | 0.07  | −1.96   | 0.05   | −0.05      |
|                         | Occupation          | Student   | −0.16   | 0.05  | −3.46   | <0.01  | −0.09      |
|                         |                     | Retired   | 0.25    | 0.12  | 2.16    | 0.03   | 0.06       |
|                         | Education status    | Lower than diploma | 0.51 | 0.12 | 4.44 | <0.01 | 0.11 |
|                         |                     | Diploma   | 0.13    | 0.05  | 2.74    | <0.01  | 0.07       |
|                         | Trip purpose        | Education | −0.21  | 0.05  | −3.95   | <0.01  | −0.09      |
|                         |                     | Other     | −0.12   | 0.05  | −2.23   | 0.03   | −0.06      |
|                         | Bus use frequency   | Seldom    | −0.15   | 0.05  | −3.29   | 0.00   | −0.08      |
|                         | Survey              | During COVID-19 | 0.20 | 0.05 | 4.40 | <0.01 | 0.11 |
| Customer Loyalty (CL)   | Gender              | Male      | 0.20    | 0.05  | 4.53    | <0.01  | 0.12       |
| (R² = 0.540)            | Occupation          | Retired   | 0.28    | 0.12  | 2.40    | 0.02   | 0.06       |
|                         | Trip purpose        | Other     | −0.23   | 0.05  | −4.51   | <0.01  | −0.12      |
|                         | Bus use frequency   | 5+ days/week | 0.13 | 0.06 | 2.43 | 0.02 | 0.06 |
| Car Attractiveness (CA) | Gender              | Male      | −0.14   | 0.05  | −2.79   | <0.01  | −0.07      |
| (R² = 0.195)            | Age                 | 41–55 years | −0.21 | 0.08 | −2.54 | 0.01 | −0.07   |
|                         | Car ownership       | Yes       | 0.31    | 0.06  | 5.53    | <0.01  | 0.15       |
|                         | Survey              | During COVID-19 | 0.32 | 0.05 | 6.25 | <0.01 | 0.17 |
|                         | Education status    | Diploma   | 0.13    | 0.06  | 2.31    | 0.02   | 0.06       |
|                         | Occupation          | Retired   | −0.27   | 0.13  | −2.04   | 0.04   | −0.05      |
|                         |                      | Housewife | 0.37    | 0.11  | 3.20    | <0.01  | 0.09       |
|                         |                      | Unemployed | −0.34 | 0.16 | −2.18 | 0.03 | −0.06 |
|                         | Income              | 5–15 million Tomans | −0.47 | 0.07 | −6.77 | <0.01 | −0.16   |
|                         | Car ownership       | Yes       | −0.66   | 0.05  | −12.96  | <0.01  | −0.32      |
|                         | Trip purpose        | Education | 0.13    | 0.05  | 2.53    | 0.01   | 0.06       |
|                         | Bus use frequency   | Seldom    | −0.18   | 0.05  | −3.82   | <0.01  | −0.09      |
|                         | Survey              | During COVID-19 | 0.45 | 0.05 | 9.57 | <0.01 | 0.23 |
|                         | Gender              | Male      | 0.15    | 0.04  | 3.41    | <0.01  | 0.11       |
|                         | Age                 | 25–40 years | 0.14  | 0.05  | 2.71    | <0.01  | 0.09       |
|                         | Income              | 5–15 million Tomans | −0.13 | 0.06 | −2.00 | 0.05 | −0.06 |
|                         | Car ownership       | Yes       | −0.14   | 0.05  | −2.92   | <0.01  | −0.10      |
|                         | Trip purpose        | Education | 0.11    | 0.05  | 2.29    | 0.02   | 0.07       |
|                         |                      | Other     | −0.12   | 0.05  | −2.42   | 0.02   | −0.08      |
|                         | Bus use frequency   | 5+ days/week | 0.13 | 0.05 | 2.46 | 0.01 | 0.08 |

4. Strict invariance: This step is also known as invariance of residuals/measurement errors; it constrains the items’ error variances and covariances (in the case of presenting within- and between-construct error covariances) to be the same across groups. A MI of this type indicates that all items have the same measurement error across groups.

In order to warrant the use of SEM-MGA, the SI must be tested once the MI has been examined. While Kline (2015) suggested the SI should be investigated after strict invariance is no longer held, Kos Koklic et al. (2017) and de Oña (2022) used weak invariance for this purpose. In this study, the method proposed by Allen et al. (2019a) was used to test SI, which generated a structural model in two ways: firstly, where all parameters are estimated freely across groups, and secondly, where all parameters including structural weights, intercepts, and residuals are constrained to be equal across groups. Allen et al. (2019a) labelled the first model as ‘all loose multi-group’ and the second one as ‘all fixing parameters’. The same terminology is used in this paper for these two models. If the model degradation of GOF (i.e. ΔCFI) caused by constraining the parameters across groups is more than 0.02, then the SI is not held, and the variable is considered suitable to enter SEM-MGA.

5. Results and discussion

5.1. Principal Component analysis (PCA)

In this study, two separate Principal Component Analyses (PCAs) were run: one for Service Quality (SQ) attributes and one for all other indicator variables. The reason was that including all attributes in a single PCA led to strong cross-loadings and counterintuitive relationships between some items and latent constructs. For both PCAs, the KMO value was higher than 0.60, and Bartlett’s test was significant (p < 0.01). Rotated component matrices, total variance explained by the components, and a scree plot of SQ components is provided in Appendix A.

For the PCA with SQ attributes only, five components had an eigenvalue higher than 1, while the eigenvalue of the sixth component
was very close to 1 (0.99). Six factors for SQ were therefore selected for the measurement model. This decision was supported by two reasons: the scree plot became relatively horizontal after six components (Cattell, 1966), and the six components were supported by theory as SQ attributes. Some SQ attributes indicated degrees of cross loading, but as noted in Section 4, the decision about keeping or removing these items was not made until the CFA. Additionally, the ‘driver behaviour’ and ‘smooth driving’ variables, which are theoretically part of the comfort and safety components, respectively, were found to have a considerable factor loading on the reliability component. This is not unexpected given the theory-based attributes of reliability suggest that driver performance can be a significant determinant of reliability.

For the PCA with all other indicator variables (i.e. other than SQ attributes), which relate to the four constructs of Customer Loyalty (CL), Customer Satisfaction (CS), Car Attractiveness (CA), and Switching Cost (SC), five components showed an eigenvalue of higher than one. In this regard, the SC construct was divided into two separate components: two variables representing the monetary cost of shifting from bus to car, and three variables representing psychological aspects of shifting from bus to car. For the measurement model in the CFA, the first two (monetary) variables were retained in the SC component, while the other three (psychological) variables were transferred into a new component called Switching Discomfort (SD). Thus, for SC1 and SC2, the indicator variables were coded in the same way, whereas for SC3, SC4, and SC5, the indicators were coded correspondingly using SD1, SD2, and SD3 codes.

5.2. Confirmatory factor analysis (CFA)

After conducting the PCA and determining the general pattern of constructs and their corresponding items, the measurement model was designed and validated through Confirmatory Factor Analysis (CFA). Details of the measurement model with goodness-of-fit (GOF) measures and construct validity are provided in Table 3. The attributes ‘Accident safety’ and ‘SD2’ were removed due to very low loading factors (below 0.40). For the attribute ‘crowding’, which in PCA showed notable factor loadings on both comfort and safety components, the measurement model has better GOF measures when ‘crowding’ is related to comfort (factor loading of 0.42) rather than safety (factor loading of 0.35). As ‘crowding’ is theoretically more of a comfort-related attribute, in the final measurement model, this attribute was regarded as connected to the comfort construct.

Overall, five attributes had a loading factor of 0.40–0.50, although these variables were retained for modelling purposes as they contained valuable information and still resulted in an acceptable GOF. Between-construct error covariances were not used in the model due to their adverse effect on construct validity and the congeneric form of the model. The model had only one within-construct error covariance in the Car Attractiveness (CA) component between the attributes ‘CA3’ and ‘CA4’. This covariance was added to the model due to its very high modification index (286.30) and considerable impact on improving the GOF of the model.

The RMSEA (0.044) and CFI (0.916) values were both in line with suggested cut-off values (below 0.05 and above 0.90, respectively), which indicated that the measurement model fit the data well. Also, all components had acceptable reliability, while some had an AVE of lower than 0.50. This is due to some variables having a loading factor of 0.40–0.70 in the model. Fornell and Larcker (1981) note that components with an AVE less than 0.50 are acceptable if they show a high degree of reliability. The discriminant validity also showed that all constructs were perfectly distinguished, except for the two components of comfort and reliability that showed a high correlation. Consequently, it can be concluded that almost all of the components have acceptable construct validity and can therefore
be used for testing the theoretical hypotheses in the structural model.

5.3. Structural model

The structural model (Fig. 3) was formed by creating dependence and correlational relationships between constructs based on the research hypotheses introduced in Section 2. In addition to the theory-based relationships, correlations between exogenous variables (i.e. service quality (SQ), car attractiveness (CA), switching cost (SC), and switching discomfort (SD)) were also added to the model in order to improve the reliability of dependence relationships (Hair et al., 2014). Moreover, since non-significant relationships should not be included in the final structural model (Kline, 2015), non-significant correlations between exogenous variables (i.e. CA <--> SQ and SC <--> SQ) were removed. It is important to note that both monetary and psychological aspects are involved in the switching cost construct in the initial hypothesis for a correlation between service quality and switching cost (H6). Based on the results of PCA, the initial switching cost construct was decomposed into two structures, SC for the monetary aspect and SD for the psychological aspect. The mentioned hypothesis was applied in the form of a correlation between SQ and SD in the final structural model. Table 4 shows the structural model results along with GOF measures. Both the RMSEA (0.044) and CFI (0.910) values are in line with the suggested cut-off values; therefore, the structural model fits the data well.

Examination of the structural weights in Table 4 shows that all of the dimensions related to SQ have positive and significant relationships with this construct. Additionally, the relationships of these dimensions with SQ have large effect sizes (above 0.50), except for ‘Safety’ which has a medium effect size (0.48). By assessing the relationships between SQ, CS, and CL, it can be concluded that SQ has a positive, significant dependence relationship with CS with a large effect size (0.84), and CS has a positive, significant dependence relationship with CL with a large effect size (0.62). That is to say, the higher the quality of bus service, the greater the level of customer satisfaction, and increasing customer satisfaction, in turn, increases customer loyalty towards bus services. While the direct relationship between SQ and CL is not significant, the indirect relationship between these two constructs through CS is positive and has a

| Yes | Structural weight |
|-----|-------------------|
| Customer Satisfaction (CS) | Service Quality (SQ) | 1.38 | 0.13 | 10.78 | <0.01 | 0.83 |
| Customer Loyalty (CL) | Customer Satisfaction (CS) | 0.57 | 0.10 | 5.86 | <0.01 | 0.54 |
| Customer Loyalty (CL) | Car Attractiveness (CA) | -0.08 | 0.05 | -1.41 | 0.16 | -0.07 |
| Customer Loyalty (CL) | Switching Cost (SC) | 0.04 | 0.06 | 0.67 | 0.50 | 0.03 |
| Customer Loyalty (CL) | Switching Discomfort (SD) | 0.27 | 0.10 | 2.80 | <0.01 | 0.20 |
| Comfort | Service Quality (SQ) | 1.00 | | | | 0.86 |
| Safety | Service Quality (SQ) | 1.02 | 0.13 | 7.89 | <0.01 | 0.51 |
| Reliability | Service Quality (SQ) | 0.67 | 0.05 | 12.63 | <0.01 | 0.86 |
| Information | Service Quality (SQ) | 0.87 | 0.11 | 7.79 | <0.01 | 0.55 |
| Convenience | Service Quality (SQ) | 0.87 | 0.11 | 8.11 | <0.01 | 0.59 |
| Economy | Service Quality (SQ) | 0.62 | 0.10 | 6.02 | <0.01 | 0.50 |

### Structural covariance

- Car Attractiveness (CA) <-> Switching Cost (SC) | 0.10 | 0.04 | 2.54 | 0.01 | 0.14 |
- Car Attractiveness (CA) <-> Switching Discomfort (SD) | -0.21 | 0.04 | -5.16 | <0.01 | -0.37 |
- Switching Cost (SC) <-> Switching Discomfort (SD) | 0.22 | 0.04 | 5.10 | <0.01 | 0.41 |
- Switching Discomfort (SD) <-> Service Quality (SQ) | 0.10 | 0.02 | 4.26 | <0.01 | 0.30 |

| No | Structural weight |
|-----|-------------------|
| Customer Satisfaction (CS) | Service Quality (SQ) | 1.22 | 0.07 | 17.13 | <0.01 | 0.85 |
| Customer Loyalty (CL) | Customer Satisfaction (CS) | 0.64 | 0.08 | 8.26 | <0.01 | 0.62 |
| Customer Loyalty (CL) | Car Attractiveness (CA) | -0.10 | 0.03 | -3.06 | <0.01 | -0.11 |
| Customer Loyalty (CL) | Switching Cost (SC) | 0.11 | 0.05 | 2.37 | 0.02 | 0.08 |
| Customer Loyalty (CL) | Switching Discomfort (SD) | 0.30 | 0.07 | 4.55 | <0.01 | 0.20 |
| Comfort | Service Quality (SQ) | 1.00 | | | | 0.82 |
| Safety | Service Quality (SQ) | 0.76 | 0.07 | 10.89 | <0.01 | 0.47 |
| Reliability | Service Quality (SQ) | 0.92 | 0.10 | 8.95 | <0.01 | 0.88 |
| Information | Service Quality (SQ) | 0.90 | 0.07 | 12.66 | <0.01 | 0.63 |
| Convenience | Service Quality (SQ) | 0.69 | 0.06 | 12.23 | <0.01 | 0.67 |
| Economy | Service Quality (SQ) | 0.58 | 0.07 | 8.67 | <0.01 | 0.50 |

### Structural covariance

- Car Attractiveness (CA) <-> Switching Cost (SC) | 0.11 | 0.03 | 4.45 | <0.01 | 0.18 |
- Car Attractiveness (CA) <-> Switching Discomfort (SD) | -0.20 | 0.03 | -6.77 | <0.01 | -0.36 |
- Switching Cost (SC) <-> Switching Discomfort (SD) | 0.09 | 0.02 | 4.86 | <0.01 | 0.25 |
- Switching Discomfort (SD) <-> Service Quality (SQ) | 0.07 | 0.02 | 4.62 | <0.01 | 0.21 |

Chi-square (df) | 3053.32 (1156) | Yes | No |

RMSEA | 0.032 | Yes | 0.721 |
CFI | 0.905 | 0.721 |

Table 8: SEM-MGA results for car ownership.
large effect size (0.84 × 0.62 = 0.52). In other words, this study considers a full mediating role for CS between the relationship of SQ and CL, which aligns with the findings of de Ona (2021). Both SC and SD increase CL with a positive and significant dependence relationship, except that the effect size of SD (0.22) is higher than that of SC (0.07). This implies that the psychological cost of switching from bus to car is more important in explaining passenger loyalty than the monetary cost. Finally, CA leads to reduced CL with a negative, significant and small effect size (-0.10).

Examination of the structural covariances indicates that SQ has a positive and significant correlation with SD, while SQ has no significant correlation with SC. Thus, the current study augments the hypothesis of the correlation between service quality and switching cost expressed by Li et al. (2018), that higher quality of service in one alternative increases the perception of switching cost with a negative, significant and small effect size (-0.10).

5.4. Multiple Indicators Multiple Causes (MIMIC) model

A total of 23 dummy variables were created for inclusion in the Multiple Indicators Multiple Causes (MIMIC) model as regressors (reference category in parentheses): one regressor for gender (female), four regressors for age (18–24 years old), four regressors for occupation (worker/clerk), three regressors for education (bachelor), two regressors for income (<5 million Tomans), one regressor for car ownership (no), four regressors for trip purpose (work), three regressors for bus use frequency (3–4 days/week) and one regressor for survey (before COVID-19). SEM-MIMIC model was presented in this section in terms of regressions between latent

| Table 9 | SEM-MGA results for bus use frequency (5+ days/week and 3–4 days/week). |
|---------|-------------------------------------------------------------------------|
| **5+ days/week** | Estimate | S.E. | Z-value | p-value | Std. Coef. |
| Structural weight | | | | | |
| Customer Satisfaction (CS) | Service Quality (SQ) | 1.34 | 0.13 | 10.06 | <0.01 | 0.88 |
| Customer Loyalty (CL) | Customer Satisfaction (CS) | 0.60 | 0.15 | 3.96 | <0.01 | 0.60 |
| Customer Loyalty (CL) | Car Attractiveness (CA) | -0.10 | 0.04 | -2.33 | 0.02 | -0.10 |
| Customer Loyalty (CL) | Switching Cost (SC) | 0.15 | 0.05 | 3.24 | <0.01 | 0.15 |
| Customer Loyalty (CL) | Switching Discomfort (SD) | 0.37 | 0.12 | 3.21 | <0.01 | 0.19 |
| Comfort | Service Quality (SQ) | 1.00 | | | | 0.81 |
| Safety | Service Quality (SQ) | 0.71 | 0.12 | 5.89 | <0.01 | 0.45 |
| Reliability | Service Quality (SQ) | 0.92 | 0.14 | 6.84 | <0.01 | 0.91 |
| Information | Service Quality (SQ) | 1.00 | 0.15 | 6.52 | <0.01 | 0.68 |
| Convenience | Service Quality (SQ) | 0.80 | 0.10 | 7.74 | <0.01 | 0.68 |
| Economy | Service Quality (SQ) | 0.74 | 0.13 | 5.82 | <0.01 | 0.55 |
| **3–4 days/week** | | | | | |
| Structural weight | | | | | |
| Customer Satisfaction (CS) | Service Quality (SQ) | 1.24 | 0.13 | 9.84 | <0.01 | 0.82 |
| Customer Loyalty (CL) | Customer Satisfaction (CS) | 0.60 | 0.11 | 5.48 | <0.01 | 0.63 |
| Customer Loyalty (CL) | Car Attractiveness (CA) | -0.06 | 0.06 | -1.08 | 0.28 | -0.06 |
| Customer Loyalty (CL) | Switching Cost (SC) | 0.02 | 0.07 | 0.32 | 0.75 | 0.02 |
| Customer Loyalty (CL) | Switching Discomfort (SD) | 0.43 | 0.13 | 3.20 | <0.01 | 0.24 |
| Comfort | Service Quality (SQ) | 1.00 | | | | 0.85 |
| Safety | Service Quality (SQ) | 0.71 | 0.12 | 6.11 | <0.01 | 0.44 |
| Reliability | Service Quality (SQ) | 0.59 | 0.09 | 6.58 | <0.01 | 0.88 |
| Information | Service Quality (SQ) | 0.80 | 0.12 | 6.91 | <0.01 | 0.64 |
| Convenience | Service Quality (SQ) | 0.67 | 0.12 | 5.56 | <0.01 | 0.67 |
| Economy | Service Quality (SQ) | 0.51 | 0.11 | 4.78 | <0.01 | 0.47 |
| **Structural covariance** | | | | | |
| Car Attractiveness (CA) | Switching Cost (SC) | 0.06 | 0.04 | 1.55 | 0.12 | 0.10 |
| Car Attractiveness (CA) | Switching Discomfort (SD) | -0.14 | 0.05 | -3.04 | <0.01 | -0.30 |
| Switching Cost (SC) | Switching Discomfort (SD) | 0.06 | 0.03 | 2.20 | 0.03 | 0.21 |
| Switching Discomfort (SD) | Service Quality (SQ) | 0.06 | 0.02 | 2.57 | 0.01 | 0.22 |

Chi-square (df) 4376.61 (2312)  5+ days/week 3–4 days/week

RMSEA 0.024  R² (Customer Satisfaction (CS)) 0.773  0.676
CFI 0.897  R² (Customer Loyalty (CL)) 0.519  0.549
Table 10
SEM-MGA results for bus use frequency (1–2 days/week and seldom).

| 1–2 days | Estimate | S.E. | Z-value | p-value | Std. Coef. |
|----------|----------|------|---------|---------|------------|
| **Structural weight** |          |      |         |         |            |
| Customer Satisfaction (CS) | <—> | Customer Satisfaction (CS) | 1.26 | 0.16 | 8.14 | <0.01 | 0.82 |
| Customer Loyalty (CL) | <—> | Customer Satisfaction (CS) | 0.42 | 0.12 | 3.59 | <0.01 | 0.45 |
| Customer Loyalty (CL) | <—> | Car Attractiveness (CA) | −0.07 | 0.06 | −1.18 | 0.24 | −0.09 |
| Customer Loyalty (CL) | <—> | Switching Cost (SC) | 0.02 | 0.07 | 0.33 | 0.74 | 0.02 |
| Customer Loyalty (CL) | <—> | Switching Discomfort (SD) | 0.35 | 0.12 | 2.94 | <0.01 | 0.32 |
| Comfort | <—> | Service Quality (SQ) | 1.00 | | | | |
| Safety | <—> | Service Quality (SQ) | 1.00 | | 7.15 | <0.01 | 0.87 |
| Reliability | <—> | Service Quality (SQ) | 0.69 | | 1.07 | <0.01 | 0.87 |
| Information | <—> | Service Quality (SQ) | 0.81 | | 1.12 | <0.01 | 0.57 |
| Convenience | <—> | Service Quality (SQ) | 0.55 | | 0.09 | 6.40 | <0.01 | 0.60 |
| Economy | <—> | Service Quality (SQ) | 0.65 | | 0.15 | 4.50 | <0.01 | 0.49 |
| **Structural covariance** |          |      |         |         |            |
| Car Attractiveness (CA) | ——> | Switching Cost (SC) | 0.02 | 0.03 | 0.55 | 0.58 | 0.03 |
| Car Attractiveness (CA) | ——> | Switching Discomfort (SD) | −0.27 | 0.07 | −4.12 | <0.01 | −0.40 |
| Switching Cost (SC) | ——> | Switching Discomfort (SD) | 0.15 | 0.06 | 2.63 | 0.01 | 0.34 |
| Switching Discomfort (SD) | ——> | Service Quality (SQ) | 0.12 | 0.04 | 3.12 | <0.01 | 0.30 |

| Seldom | Estimate | S.E. | Z-value | p-value | Std. Coef. |
|----------|----------|------|---------|---------|------------|
| **Structural weight** |          |      |         |         |            |
| Customer Satisfaction (CS) | <—> | Service Quality (SQ) | 1.23 | 0.10 | 12.24 | <0.01 | 0.84 |
| Customer Loyalty (CL) | <—> | Customer Satisfaction (CS) | 0.70 | 0.11 | 6.42 | <0.01 | 0.62 |
| Customer Loyalty (CL) | <—> | Car Attractiveness (CA) | −0.08 | 0.05 | −1.64 | 0.10 | −0.08 |
| Customer Loyalty (CL) | <—> | Switching Cost (SC) | −0.01 | 0.07 | −0.20 | 0.85 | −0.01 |
| Customer Loyalty (CL) | <—> | Switching Discomfort (SD) | 0.16 | 0.08 | 2.19 | 0.03 | 0.13 |
| Comfort | <—> | Service Quality (SQ) | 1.00 | | | | |
| Safety | <—> | Service Quality (SQ) | 0.91 | | 0.11 | 8.65 | <0.01 | 0.50 |
| Reliability | <—> | Service Quality (SQ) | 0.81 | | 0.08 | 10.17 | <0.01 | 0.86 |
| Information | <—> | Service Quality (SQ) | 0.95 | | 0.10 | 9.38 | <0.01 | 0.58 |
| Convenience | <—> | Service Quality (SQ) | 0.81 | | 0.09 | 9.01 | <0.01 | 0.61 |
| Economy | <—> | Service Quality (SQ) | 0.55 | | 0.09 | 6.15 | <0.01 | 0.48 |
| **Structural covariance** |          |      |         |         |            |
| Car Attractiveness (CA) | ——> | Switching Cost (SC) | 0.09 | | 0.04 | 2.15 | 0.03 | 0.11 |
| Car Attractiveness (CA) | ——> | Switching Discomfort (SD) | −0.27 | | 0.04 | −6.23 | <0.01 | −0.39 |
| Switching Cost (SC) | ——> | Switching Discomfort (SD) | 0.24 | | 0.04 | 5.57 | <0.01 | 0.36 |
| Switching Discomfort (SD) | ——> | Service Quality (SQ) | 0.09 | | 0.02 | 3.81 | <0.01 | 0.22 |
| Chi-square (df) | 4376.61 (2312) | | | | |
| RMSEA | 0.024 | | | | |
| CFI | 0.897 | | | | |

constructs and regressors only, and the results of structural relationships between latent constructs were not discussed. This is because the results pertaining to structural weights are similar to those stated in Section 5.3. Moreover, structural covariances (for testing H6) cannot be imposed on the SEM-MIMIC model due to the endogenous nature of all latent constructs.

Because of the extensive number of variables in the SEM-MIMIC model, the CFI (0.791) is much lower than the proposed cut-off value (0.90), as seen in the model used in Allen et al. (2018). In the aforementioned study, RMSEA was used as the main criterion for determining whether the model fits the data well as the CFI has a relatively high sensitivity to the number of model variables (Kenny and McCracken, 2003). The RMSEA (0.063) for the SEM-MIMIC model is lower than the threshold (0.08), indicating that the model can reliably describe the heterogeneity in latent structure perception. Table 5 and Table 6 show the results of significant regressors for Service Quality (SQ) components and other survey components, respectively. A discussion of heterogeneities on the perception of latent constructs is provided below, in terms of the effect of socio-demographic characteristics, travel pattern characteristics, and COVID-19.

5.4.1. Effect of socio-demographic characteristics
The results show that females and passengers over 40 years old tend to have a more negative perception of SQ provided by the bus system, a finding similar to that reported by Allen et al. (2018). Furthermore, males tend to be more satisfied with the bus system and are also more loyal to the system. Moreover, males and older passengers (>55 years old) expressed a more negative perception of Car Attractiveness (CA).

The findings also show that workers/employees and students who usually use the bus for work and study purposes, and must be present at their destination at a certain time (i.e. compulsory trips) (Allen et al., 2018), tend to have a weaker perception of SQ, especially in terms of reliability. Additionally, bus users with a lower educational level exhibit higher satisfaction with the bus system than others. This result is consistent with a previous importance-performance analysis of the Tehran bus system (Esmailpour et al., 2020), where higher levels of education were associated with lower perceptions of bus service performance. Finally, for those with car ownership...
and higher income, the psychological and monetary costs of using a car are lower, with the car being perceived as more desirable for car owners. Regarding SQ components, passengers who own private vehicles have a higher perception of economy and reliability, and a lower perception of safety.

5.4.2. Effect of travel pattern characteristics

Bus users with an education-related trip purpose were found to have a more negative perception of reliability and tend to also be less satisfied with the bus system. They also tend to have a higher perception of the monetary and psychological costs of buying and using a car. The reason for lower satisfaction among these users is likely to be related to the inverse relationship between education level and satisfaction.

The findings also show that regular users of bus services (5+ days/week) tend to have greater loyalty towards the system and find it more challenging to switch from bus to car. Conversely, occasional users (frequency of ‘seldom’) tend to have lower satisfaction and loyalty towards the system, consistent with previous studies (Allen et al., 2018). Furthermore, occasional users tend to have a lower perception of the monetary cost of buying and using a car, which may be due to a greater proportion of users with car ownership among this group.

5.4.3. Effect of COVID-19

During COVID-19, perceptions of Service Quality (SQ) improved compared to before the pandemic. This improvement was observed in the components of comfort, safety, reliability, and information. Despite the fact that the perception of crowding was lowest in both surveys (see Table 2), a Differential Item Functioning (DIF) review of comfort-related attributes reveals that perceptions of crowding have improved during COVID-19. Possible reasons for this include:
1. An overall reduction in urban travel during the COVID-19 pandemic and a further decrease in public transport ridership compared to other modes of transport.
2. Passenger avoidance of crowded buses due to the psychological burden associated with crowding during the pandemic.
3. Actions implemented during the pandemic to maintain social distancing in buses, such as reducing bus headways and marking seats to prevent passengers from sitting next to each other.

A key finding is that, during COVID-19 compared to before the pandemic, while satisfaction with bus services has increased, along with perceptions of monetary costs of switching from bus to car, there has not been an increase in passenger loyalty towards the bus system. This is due to a significant increase in car attractiveness during the pandemic. This finding is supported by De Vos (2020), who found increased car attractiveness and better perception of travel quality by car during COVID-19.

5.5. Multi-Group analysis (MGA)

Results for variables with at least one type of measurement invariance (MI) that is not held across their groups are shown in Table 7. As for the variables ‘car ownership’, ‘bus use frequency’, and ‘survey’, strong invariance is not held ($\Delta$CFI $\geq$ 0.01), and structural invariance (SI) should be tested. The SI results (Table 7) for each of these variables indicate that the $\Delta$CFI between models with equality constraints (all fixing parameters) and without equality constraints (all loose multi-group) is $>$0.02, suggesting that the structural model should be considered separately. As a result, the variables ‘car ownership’, ‘bus use frequency’, and ‘survey’ were selected as the final candidates for conducting SEM-MGA.

Table 8 shows the SEM-MGA results for the variable ‘car ownership’. For users with car ownership, the effect sizes for information (0.55), convenience (0.59), and reliability (0.86) are found to be smaller than those of users without car ownership (0.63, 0.67, and 0.88, respectively), while the effect sizes for comfort (0.86) and safety (0.51) are found to be more (0.82 and 0.47, respectively). In this regard, van Lierop and El-Geneidy (2016) found that reliability has a strong impact on passengers with no access to a car. However, the aforementioned article and de Oña (2022) state that car owners place a higher priority on information and a lower priority on safety, which is in conflict with the results of this study. As such, the perception of quality of services by individuals with car access is context-specific and can vary depending on the conditions that govern how public transport is administered. Given the above conditions, this study recommends that more attention should be given to the comfort and safety components of Service Quality (SQ) to encourage greater uptake of the Tehran bus service by car owners.

Table 8 also shows that, for passengers who don’t possess a private vehicle, the effect size of SQ on customer satisfaction (CS) (0.85) and the effect size of CS on customer loyalty (CL) (0.62) are both larger than those for users who possess one (0.83 and 0.54, respectively). In other words, increasing the quality of bus services for users without car ownership increases satisfaction and then loyalty more than it does for users with car ownership. In addition, the negative effect of car attractiveness (CA) and the positive effect of switching cost (SC) on CL are only significant for users without car ownership.

Table 9 and Table 10 show the SEM-MGA results for the variable ‘bus use frequency’. The effect of comfort on SQ for those using buses 1–2 days/week (0.86) and 3–4 days/week (0.85) is more than that for those using buses 5+ days/week (0.81) and seldom (0.81). This may be due to seldom users not having a precise perception of comfort due to their occasional use of the service, especially in uncomfortable conditions, and regular users (5+ days/week) paying less attention to comfort because they make a lot of bus trips and are more accustomed to the comfort levels provided (Allen et al., 2019a).

Another key finding from Table 9 and Table 10 is that the higher trip frequencies are generally associated with larger effect sizes for reliability, information, and convenience on SQ. As noted earlier, these three components are of high importance for users without car ownership, as well as for the timely and reliable performance of compulsory trips. Furthermore, for the users with bus use frequency of seldom and 1–2 days/week, the effect of safety on SQ (0.50 and 0.56, respectively) is greater than that for 3–4 and 5+ days/week (0.44 and 0.45, respectively). This implies that for occasional users of the bus system, safety on buses and at bus stops is more important than for people who use the system regularly. Finally, the effect of economy on SQ for regular users (5+ days/week) (0.55) is greater than that for other users (0.47~0.49). This is intuitive given that for regular users, the bus is considered their main form of transport and so the price of tickets is particularly important.

Also, based on Table 9 and Table 10, for regular users (5+ days/week), the effect size of SQ on CS (0.88) is higher than that for other users (0.82~0.84). In other words, by increasing the quality of bus services, regular passengers become more satisfied than other users. Finally, the effect of CA and SC on CL is only significant for regular users (5+ days/week), which is considered to be due to the prominence of users without car ownership in this group.

Table 11 shows the SEM-MGA results for the variable ‘survey’. The effect size for comfort on SQ during COVID-19 has increased compared to before COVID-19 (0.88 vs. 0.83). In other words, during the pandemic, bus users are more concerned about the cleanliness and crowding in buses and at bus stations. These results are consistent with the results of Aghabayk et al. (2021) on the greater sensitivity of travellers to crowding and the increased disutility of this attribute during the pandemic. In contrast, the effect size for reliability (0.86), information (0.54) and convenience (0.58) on SQ during COVID-19 has decreased compared to before (0.89, 0.66 and 0.67 respectively). As noted earlier, these three components are of key importance to compulsory trips, such as education and work, which decreased as the main trip purpose of bus users from 76.3% (before COVID-19) to 46.2% (during COVID-19) (see Table 1).

According to Table 11, while the effect size of SQ on CS slightly increased (from 0.83 to 0.85) during COVID-19, the effect size of CS on CL decreased significantly (from 0.66 to 0.44). Thus, the indirect effect of SQ on CL decreased from 0.55 ($=0.83 \times 0.66$; before COVID-19) to 0.37 ($=0.85 \times 0.44$; during COVID-19). In other words, during the pandemic, quality of service attributes was slightly more influential on user satisfaction, but satisfaction has played a much smaller role in explaining loyalty towards the bus system.
Furthermore, the fact that the detrimental effect of CA on CL gained significance during COVID-19 (effect size of −0.10), as well as the fact that the SEM-MIMIC model showed a significant rise in the perception of CA in this period, have further strengthened the argument that private vehicles pose a greater threat to bus loyalty during COVID-19. Finally, the positive effect of SC and SD on CL was slightly reduced during COVID-19 (from 0.08 and 0.22 to 0.07 and 0.20, respectively), meaning that the monetary and psychological cost of owning and using a car during COVID-19 play less of a role in increasing loyalty to the bus system than before.

6. Conclusions

Understanding user perceptions is of key importance when there are significant changes in the status of public transport systems (Allen et al., 2019b). Using a case study of Tehran’s bus system and collecting 1610 questionnaires in two similar periods before and during COVID-19, this paper has contributed to understanding how passenger perceptions of loyalty to public transport have changed due to COVID-19. Besides three key characteristics of public transportation – service quality, customer satisfaction, and customer loyalty – the conceptual model also included factors related to private vehicles, such as car attractiveness, switching cost, and switching discomfort. The results of the structural model showed that service quality is fully mediated by passenger satisfaction, so improving service quality increases customer loyalty through increasing passenger satisfaction. Additionally, the attractiveness of using a car had a negative relationship, and the monetary and psychological costs of switching from bus to car had positive relationships with passenger loyalty. To account for the effects of heterogeneity on latent construct perceptions and structural paths, SEM-MIMIC and SEM-MGA were applied. The results of the invariance tests indicated that it is better to include the three variables of car ownership, bus use frequency, and the survey (effect of COVID-19) as moderating variables in SEM-MGA.

The results of SEM-MIMIC showed that men were more satisfied and loyal to the system, and women and passengers over 40 had a lower perception of service quality. Moreover, passengers with higher education levels had a lower satisfaction with the bus service, and those with an educational trip purpose had a lower perception of reliability. In addition, passengers who own a private car had a lower perception of switching costs and discomfort, and they also perceived the utility of using a car as more attractive. According to the SEM-MGA results, the higher the frequency of bus use, the greater the importance of information, convenience, and reliability components to explain service quality. In this study, the three above-mentioned components were determined to be the factors involved in the quality of compulsory trips. In addition, safety for seldom bus users, comfort for moderate users (1–4 days per week), and economy for frequent users (5+ days per week) played a more significant role in explaining service quality. Lastly, passengers who own personal vehicles placed less emphasis on information, convenience, and reliability components in defining service quality (similar to passengers who use buses less frequently), and more significance on comfort and safety components.

In order to answer how the explanation of loyalty to the Tehran bus system has changed due to COVID-19 and how public transport administrators should act to improve it, it is necessary to track the effects of COVID-19 on explaining passenger loyalty. The SEM-MGA results showed that the comfort dimension has become more important in explaining service quality during COVID-19, and in contrast, the importance of information, convenience, and reliability dimensions have decreased. Additionally, SEM-MIMIC showed that the perception of service quality components, particularly comfort, increased during COVID-19. Also, passengers in this period are more satisfied with bus services, and the perceived cost of switching from bus to car has increased. However, the above-mentioned scenarios did not improve the loyalty of passengers to the bus system due to the significant increase in the attractiveness of the car during COVID-19. Furthermore, COVID-19 negatively moderates the effect of private cars on passenger loyalty in SEM-MGA models. So that in this period, car attractiveness has more effect size on reducing passenger loyalty to the bus system, and the monetary and psychological costs of using cars have been less effective in encouraging people to use the bus.

In view of the increasing utility of private vehicles in urban transportation during COVID-19, it is apparent that bus services should focus on meeting the expectations of car owners. The results obtained from SEM-MGA indicate that the components of comfort and safety are more important in predicting the quality of bus services and resulting in satisfaction and loyalty. Suggestions for how to improve these two aspects of bus service, taking into account the need to strike a balance between public health and economic goals (Jones et al., 2021), are described further below. In the case of COVID-19, this can increase the confidence of car owners in using the bus system, showing them that the bus system can also deliver an acceptable level of quality compared to private vehicles.

For car owners to be satisfied with the comfort dimension of the bus service during COVID-19, public transportation authorities can take a number of practical measures to improve the cleanliness of buses and bus stops, and on-board crowding. A key action for the Tehran bus system could include using smart cards to enable the recording of real-time boarding and alighting data. This information can help to inform how many passengers are on-board so that other users can adapt their trip to less crowded services (Shelat et al., 2022). Furthermore, high-demand stations can be avoided by crowded services. In this regard, Gkiotsalitis (2021) offers a model for serving or skipping bus stations based on current bus crowding levels, bus station demand, and imposed COVID-19 capacity constraints. Nevertheless, the performance of these actions depends on reducing headways at peak hours to reduce crowding, in conjunction with regular cleaning and disinfection inside buses.

Safety is another factor to consider for attracting car owners to the Tehran bus system during COVID-19, which includes two indicators related to the feeling of security against possible crime on the bus and at the bus station. As public transportation can bring people to many places, including high crime areas, it can be associated with the occurrence of crime (Newton, 2014). In addition, crime rates have increased in Iran primarily because of problems related to people’s livelihoods, with this worsening during COVID-19. During a meta-analysis of transit environment crime, Ceccato et al. (2022) concluded that investigating a crime only after it is reported or focusing on a single aspect of the environment does not increase the perception of safety, but rather calls for a dynamic perspective of safety that includes all spatial and temporal levels of the trip. Studying crime hotspots and introducing appropriate countermeasures can be an effective way to gain the trust of car owners with respect to the safety of bus services.
While this research has contributed to understanding passenger loyalty towards public transport during COVID-19, it is also subject to some limitations, providing a framework for future research. A key limitation is that it is unclear whether the measured changes in passenger loyalty are specific to this period or some degree of these changes will remain afterwards. It is therefore suggested that a similar study be conducted after the pandemic to provide a more comprehensive perception of the impacts of COVID-19 on passenger loyalty. Also, the study of the effect of COVID-19 on the other structures studied in the public transport literature can lead to a better understanding of the effect of the pandemic on travel behavior. While public transport ridership is expected to recover in the longer term, understanding the mechanisms of how COVID-19 can change user perceptions can help in better managing future crises that negatively affect public transport use (Dong et al., 2021).

CRediT authorship contribution statement

Javad Esmailpour: Investigation, Methodology, Data curation, Writing – original draft. Kayvan Aghabayk: Conceptualization, Investigation, Methodology, Writing – review & editing, Supervision. Mohammad Aghajanzadeh: Data curation, Investigation. Chris De Gruyter: Investigation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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None.

Appendix A

See Fig. A1.
See Tables A1-A5.

Fig. A1. Scree plot of Service Quality (SQ) components.
Table A1
Rotated component matrix of Service Quality (SQ) attributes.

| Component   | Attribute          | 1   | 2   | 3   | 4   | 5   | 6   |
|-------------|--------------------|-----|-----|-----|-----|-----|-----|
|             | Seating            | 0.78| 0.03| 0.12| 0.11| 0.05| 0.06|
|             | Temperature/Ventilation | 0.71| 0.11| 0.15| 0.04| 0.05| 0.10|
|             | Bus appearance     | 0.70| 0.12| 0.22| 0.18| 0.05| -0.02|
|             | Bus station        | 0.46| 0.35| 0.08| 0.21| 0.16| 0.09|
|             | Inside bus security | 0.05| 0.84| 0.11| 0.11| 0.10| 0.08|
|             | Bus station security| 0.08| 0.84| 0.11| 0.14| 0.11| 0.04|
|             | Accident safety    | 0.31| 0.44| 0.38| 0.05| -0.03| -0.01|
|             | Crowding           | 0.38| 0.43| -0.04| 0.04| 0.09| 0.07|
|             | Driver behaviour   | 0.21| 0.17| 0.65| 0.04| 0.00| 0.08|
|             | Smooth driving     | 0.06| 0.41| 0.63| 0.05| 0.00| -0.01|
|             | Fixed routes       | 0.00| -0.05| 0.59| 0.04| 0.21| 0.02|
|             | Breakdowns         | 0.26| -0.03| 0.51| 0.32| 0.17| 0.09|
|             | Speed reliability  | 0.32| 0.02| 0.46| 0.28| 0.27| 0.07|
|             | First/last bus timing | 0.30| -0.07| 0.35| 0.06| 0.16| 0.33|
|             | Inside bus information | 0.16| 0.06| 0.03| 0.80| 0.09| 0.02|
|             | Bus station information | 0.07| 0.05| 0.15| 0.73| 0.10| 0.10|
|             | Breakdown information | 0.10| 0.20| 0.08| 0.67| 0.02| 0.04|
|             | Bus station locations | 0.05| 0.05| 0.08| 0.05| 0.85| 0.02|
|             | Transferring       | 0.07| 0.15| 0.11| 0.11| 0.82| 0.06|
|             | Waiting time       | 0.32| 0.16| 0.23| 0.17| 0.40| 0.07|
|             | Ticket cost        | 0.08| 0.12| 0.07| 0.09| 0.00| 0.81|
|             | Fare collection    | 0.06| 0.05| 0.18| 0.05| 0.06| 0.79|

Note: Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser Normalisation. Rotation converged in 7 iterations.

Table A2
Rotated component matrix of other indicator variables (i.e. other than SQ attributes).

| Component   | Attribute          | 1   | 2   | 3   | 4   | 5   |
|-------------|--------------------|-----|-----|-----|-----|-----|
|             | CL1                | 0.79| 0.32| -0.06| 0.05| 0.08|
|             | CL2                | 0.77| 0.27| -0.07| 0.16| 0.21|
|             | CL3                | 0.76| 0.27| -0.10| 0.06| 0.12|
|             | CL4                | 0.74| 0.21| -0.12| 0.00| 0.13|
|             | CS1                | 0.27| 0.86| -0.01| -0.01| 0.06|
|             | CS2                | 0.34| 0.82| 0.04| -0.04| 0.00|
|             | CS3                | 0.34| 0.82| 0.01| -0.02| 0.07|
|             | CA1                | 0.01| -0.01| 0.87| -0.05| -0.02|
|             | CA2                | -0.02| 0.01| 0.85| 0.03| 0.03|
|             | CA3                | -0.27| 0.05| 0.63| 0.17| -0.26|
|             | CA4                | -0.22| 0.00| 0.55| 0.25| -0.33|
|             | SC1                | 0.10| -0.04| 0.13| 0.87| 0.01|
|             | SC2                | 0.11| -0.04| 0.06| 0.84| 0.17|
|             | SC3                | -0.02| 0.20| -0.13| 0.27| 0.69|
|             | SC4                | 0.22| -0.17| 0.06| -0.16| 0.66|
|             | SC5                | 0.08| 0.15| -0.31| 0.25| 0.61|

Note: Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser Normalisation. Rotation converged in 8 iterations.

Table A3
Total variance explained by the Service Quality (SQ) components.

| Component | Initial eigenvalues | Extraction sums of squared loadings | Rotation sums of squared loadings |
|-----------|--------------------|------------------------------------|----------------------------------|
|           | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % |
| 1         | 5.58  | 25.36         | 25.36        | 5.58  | 25.36         | 25.36        | 2.53  | 11.49         | 11.49        |
| 2         | 1.63  | 7.43          | 32.78        | 1.63  | 7.43          | 32.78        | 2.26  | 10.27         | 21.76        |
| 3         | 1.43  | 6.50          | 39.29        | 1.43  | 6.50          | 39.29        | 2.16  | 9.83          | 31.60        |
| 4         | 1.40  | 6.36          | 45.65        | 1.40  | 6.36          | 45.65        | 1.99  | 9.05          | 40.64        |
| 5         | 1.26  | 5.71          | 51.35        | 1.26  | 5.71          | 51.35        | 1.81  | 8.23          | 48.88        |
| 6         | 0.99  | 4.51          | 55.86        | 0.99  | 4.51          | 55.86        | 1.54  | 6.98          | 55.86        |
| 7         | 0.90  | 4.10          | 59.96        |       |               |              |       |               |              |
| 8         | 0.88  | 3.98          | 63.93        |       |               |              |       |               |              |
| 9         | 0.83  | 3.75          | 67.68        |       |               |              |       |               |              |
| 10        | 0.74  | 3.38          | 71.07        |       |               |              |       |               |              |

(continued on next page)
### Table A3 (continued)

| Component | Initial eigenvalues | Extraction sums of squared loadings | Rotation sums of squared loadings |
|-----------|---------------------|-------------------------------------|----------------------------------|
|           | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % |
| 11        | 0.71  | 3.25         | 74.31        |       |              |              |       |              |              |
| 12        | 0.67  | 3.05         | 77.36        |       |              |              |       |              |              |
| 13        | 0.65  | 2.97         | 80.33        |       |              |              |       |              |              |
| 14        | 0.61  | 2.77         | 83.10        |       |              |              |       |              |              |
| 15        | 0.57  | 2.57         | 85.67        |       |              |              |       |              |              |
| 16        | 0.53  | 2.43         | 88.10        |       |              |              |       |              |              |
| 17        | 0.51  | 2.32         | 90.42        |       |              |              |       |              |              |
| 18        | 0.50  | 2.26         | 92.68        |       |              |              |       |              |              |
| 19        | 0.48  | 2.19         | 94.87        |       |              |              |       |              |              |
| 20        | 0.45  | 2.05         | 96.92        |       |              |              |       |              |              |
| 21        | 0.42  | 1.92         | 98.84        |       |              |              |       |              |              |
| 22        | 0.26  | 1.17         | 100.00       |       |              |              |       |              |              |

Bartlett’s test of sphericity

Approx. Chi-Square (df) | 8931.64 (231)
Sig.                  | <0.01
KMO Measure of Sampling Adequacy | 0.86

### Table A4
Total variance explained by the other components (i.e. other than SQ components).

| Component | Initial eigenvalues | Extraction sums of squared loadings | Rotation sums of squared loadings |
|-----------|---------------------|-------------------------------------|----------------------------------|
|           | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % | Total | % of variance | Cumulative % |
| 1         | 4.52  | 28.26         | 28.26        | 4.52  | 28.26         | 28.26        | 2.84  | 17.74         | 17.74        |
| 2         | 2.49  | 15.57         | 43.83        | 2.49  | 15.57         | 43.83        | 2.44  | 15.24         | 32.98        |
| 3         | 1.86  | 11.62         | 55.45        | 1.86  | 11.62         | 55.45        | 2.35  | 14.66         | 47.64        |
| 4         | 1.03  | 6.46          | 61.91        | 1.03  | 6.46          | 61.91        | 1.76  | 10.98         | 58.62        |
| 5         | 1.01  | 6.31          | 68.22        | 1.01  | 6.31          | 68.22        | 1.54  | 9.60          | 68.22        |
| 6         | 0.87  | 5.41          | 73.63        | 0.87  | 5.41          | 73.63        |       |              |              |
| 7         | 0.84  | 5.25          | 78.88        | 0.84  | 5.25          | 78.88        |       |              |              |
| 8         | 0.58  | 3.63          | 82.51        | 0.58  | 3.63          | 82.51        |       |              |              |
| 9         | 0.54  | 3.36          | 85.87        | 0.54  | 3.36          | 85.87        |       |              |              |
| 10        | 0.41  | 2.53          | 88.40        | 0.41  | 2.53          | 88.40        |       |              |              |
| 11        | 0.38  | 2.38          | 90.78        | 0.38  | 2.38          | 90.78        |       |              |              |
| 12        | 0.33  | 2.05          | 92.83        | 0.33  | 2.05          | 92.83        |       |              |              |
| 13        | 0.32  | 2.00          | 94.83        | 0.32  | 2.00          | 94.83        |       |              |              |
| 14        | 0.31  | 1.92          | 96.76        | 0.31  | 1.92          | 96.76        |       |              |              |
| 15        | 0.28  | 1.77          | 98.53        | 0.28  | 1.77          | 98.53        |       |              |              |
| 16        | 0.24  | 1.47          | 100.00       | 0.24  | 1.47          | 100.00       |       |              |              |

Bartlett’s test of sphericity

Approx. Chi-Square (df) | 10268.42 (120)
Sig.                  | <0.01
KMO Measure of Sampling Adequacy | 0.81

### Table A5
SEM-MIMIC model results (structural model and goodness-of-fit measures).

| Structural weight | Estimate | S.E. | Z-value | p-value | Std. Coef. |
|-------------------|----------|------|---------|---------|------------|
| Customer Satisfaction (CS) | <— Service Quality (SQ) | 1.24 | 0.06 | 20.23 | <0.01 | 0.83 |
| Customer Loyalty (CL) | <— Customer Satisfaction (CS) | 0.65 | 0.03 | 24.55 | <0.01 | 0.65 |
| Customer Loyalty (CL) | <— Car Attractiveness (CA) | −0.08 | 0.02 | −4.09 | <0.01 | −0.10 |
| Customer Loyalty (CL) | <— Switching Cost (SC) | 0.07 | 0.02 | 3.35 | <0.01 | 0.08 |
| Customer Loyalty (CL) | <— Switching Discomfort (SD) | 0.30 | 0.04 | 7.31 | <0.01 | 0.21 |
| Comfort | <— Service Quality (SQ) | 1.00 | | | | 0.83 |
| Safety | <— Service Quality (SQ) | 0.83 | 0.06 | 13.47 | <0.01 | 0.48 |
| Reliability | <— Service Quality (SQ) | 0.71 | 0.05 | 15.39 | <0.01 | 0.85 |
| Information | <— Service Quality (SQ) | 0.89 | 0.06 | 14.97 | <0.01 | 0.60 |
| Convenience | <— Service Quality (SQ) | 0.72 | 0.05 | 14.64 | <0.01 | 0.61 |
| Economy | <— Service Quality (SQ) | 0.61 | 0.05 | 11.51 | <0.01 | 0.45 |
| Chi-square (df) | 10818.84 (1510) | 0.063 |
| RMSEA | 0.791 |
| CFI | 0.86 |
