1 **How does the environmental concerns affect the satisfaction of BRT and Metro users? A moderator**

2 **analysis**

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23 **ABSTRACT**

24 The increase in urban population density, car ownership, and car dependency, especially in developing countries

25 highlights the need for sustainable public transportation development. This paper aims to recognize factors affecting

26 people's satisfaction with public transportation services including, bus rapid transit (BRT) and metro with a focus on

27 the moderating effect of environmental concerns. Satisfaction is modeled using the structural equation modeling

28 approach developed on the preferences of 625 respondents in Tehran, Iran in 2020. The results show direct, and

29 significant, with conflicting impacts of the perceived values and service quality on the satisfaction of metro and

30 BRT users. Further, the results indicate that in contrast with BRT, service quality is more crucial affecting

31 satisfaction than the perceived value in metro. The service quality is also more affected by the core service than the

32 physical environment and the infrastructure in metro. While concerning BRT, these two variables have

similar impacts. Environmental concern negatively moderates the relationship between service quality and satisfaction while positively moderates the relationship between the perceived value and satisfaction of both transit systems.

**Keywords**: Environmental Concern, Satisfaction, Perceived Value, Service Quality, Moderator Analysis.

## 1. Introduction

Transport planners in metropolises employ different policies to solve transport problems, including reducing the use of private cars and promoting the use of public transportation to improve air quality, reduce traffic congestion, and air pollution [1-3]. However, factors such as increasing car ownership and dependence on cars, especially in developing countries, have increased the share of private cars and increased the use of online taxi services (such as Uber) over transit [4]. There is potential for increasing public transportation usage by retaining existing users and attracting new potential users [5-7]. Taking into account the number of satisfied passengers who use the transit service and who intend to continue to use it in the near future can be used to measure a transit service's success [8]. It is therefore common practice in the industry to collect customer satisfaction surveys on a regular basis in order to capture your customers' perceptions of service quality directly [9]. Customer satisfaction is a subjective measure of the quality of service a user experiences and is believed to play a significant role in determining their travel demand [10]. Passengers who are satisfied with the service are more likely to continue using it, and improvements in passenger satisfaction usually led to improved consumer loyalty.

Accordingly, to increase the modal share of transit, we aimed at identifying key factors that contribute to satisfaction with public transportation. Psychological factors play a significant role in influencing behavior, and by understanding the factors that influence behavior, numerous strategies can be adopted to encourage people to use public transportation in place of private cars. Previously, many of the research studies analyzed the factors influencing satisfaction with BRT and metros as a whole. However, since these two travel modes have different features, there might also be different factors affecting satisfaction with them [11]. Thus, the purpose of this study is to examine the latent constructs affecting satisfaction with public transportation, separately for BRT and metro, in Tehran, Iran. Previous studies [5, 12-14] indicated that satisfaction is influenced by service quality (core service and physical environment), and perceived value factors. Moreover, we have also taken environmental concerns into account to better explain satisfaction with transit since previous studies indicate that environmental concerns may affect individuals' intention to use mass transportation [15]. Researchers have studied the effect of environmental concerns on a wide range of subjects in transportation, such as mode choice [16 and 17], loyalty to metro systems [18], using buses [19], congestion pricing acceptance [20-23], and public acceptance of autonomous electric vehicles [24]. The moderating effect of environmental concerns on transit satisfaction, however, has not been investigated to the best of our knowledge. A moderator is defined as a qualitative or quantitative variable that influences the direction and/or strength of the relationship between an independent and dependent variable. Thus, by using a moderator variable, it is possible to determine whether there is heterogeneity in the effect of an independent variable

68　on a dependent variable [25]. Therefore, after analyzing the direction and significant effect of each variable,

69　environmental concern will be considered as a moderating variable, and it will be examined whether the relationship

70　between independent variables (service quality and perceived value) and dependent variables (satisfaction) can be

71　strengthened or weakened.

72　The aforementioned research gaps motivated the authors to examine how the explanatory variables affect

73　satisfaction with metro and BRT as separate cases. Therefore, this study contributes to the existing body of literature

74　through: 1) Two separate models are developed to determine the predictors of satisfaction in BRT and metro

75　exclusively; 2) Environmental concern is used as a moderator variable in order to analyze how it moderates the

76　relationship between each latent variable and satisfaction with both BRT and metro services.

77　This study is presented in five sections. After the introduction, the next section will discuss the

78　research background, considered variables and their effects on satisfaction. The descriptive analysis of examined

79　variables and the results and interpretation of modeling will be studied in the third and fourth sections, respectively.

80　In the last part, the conclusion is presented, and future research and implications for practice and policy will be

81　suggested.

82　**2. Factors affecting satisfaction with public transport and supported hypotheses**

83　Many researchers have studied the factors affecting the public transportation users' satisfaction. Table (1) shows a

84　selection of researches conducted in this field. In this part, the former studies on satisfaction with public transport

85　will be discussed and the supported hypotheses and conceptual model will be presented. In many studies, perceived

86　value, accessibility, reliability, safety and comfort of the vehicles and stations, costs, and frequency are considered

87　as factors affecting the satisfaction with public transport [5, 13, 14, 26, 27]. In the context of urban and metropolitan

88　transit, De Oña [5] examines the mediation effect exerted by satisfaction on behavior intention. A structural equation

89　modeling (SEM) has been used to compare two models that are based on data obtained from a single survey of

90　transit users in five European cities. One model examines satisfaction as a partial mediator, while the other assesses

91　satisfaction as a full mediator. In the context of urban and metropolitan public transportation, the results suggest that

92　the service quality is positively associated with satisfaction and behavioral intention. To investigate how commuter

93　satisfaction is influenced by different characteristics of public transportation journeys, Lunke evaluates commuters'

94　satisfaction with their last trip to work [28]. ANOVA results based on 7630 responses in Oslo, Norway suggest that

95　efficient transport routes with short waiting times and reliable time play a key role compare with short distances to

96　stations and direct routes. A structural equation modeling approach has been suggested by De ona [14] as a means of

97　gaining a deeper understanding of the role of involvement in public transportation, using data from a survey

98　conducted in five European cities. In addition, the study examines the effects of heterogeneity within the four

99　constructs (service quality, satisfaction, involvement, and behavioral intentions) using a structural equation

100　modeling approach involving multiple indicators and multiple causes. His findings indicate that involvement is the

101　factor most associated with behavioral intentions or loyalty, followed byservice quality and satisfaction. In another

102　study in Malaysa, Ha et al. [1] examined the relationship between satisfaction and loyalty in public transport and

103　five factors including accessibility, reliability, perceived value, comfort, and safety and security. Their study

involved the estimation of a partial least squares structural equation model (PLS-SEM) using 179 users of public transportation in Kuching city. It was found that safety and security, as well as reliability, significantly influenced the satisfaction and loyalty of public transportation users. The relationship between accessibility, satisfaction, and loyalty, however, was not statistically significant. The study by Ingvardson & Nielsen [13] investigates the key factors associated with satisfaction with public transportation, and their relationship to the frequency of travel and the likelihood of recommending public transportation to others. In order to validate the framework, a comprehensive passenger satisfaction survey was conducted in six European cities, and structural equation modeling was utilized to develop a model that is applicable across a variety of travel cultures. They found that travel satisfaction is positively associated to (i) accessibility measures, including network coverage, speed, and frequency of services, (ii) perceived costs, such as reasonably priced tickets, and (iii) norms, such as perceptions regarding public transportation's importance to society and the environment. Li [29] explored how transit customer loyalty is influenced by satisfaction with transit services. Using explanatory factor analysis, he found the underlying latent contructs. He found that low levels of satisfaction with service reliability were associated with a decrease in transit use in San Francisco as a result of analyzing survey data collected across multiple points. As a result of the survey, four latent variables can be identified that summarize the set of satisfaction variables - satisfaction with reliability, travel environment, comfort, and schedule. In the study of Irtema et al. [12], public transport passengers in Kuala Lumpur have been examined in terms of their behavioral intentions. A number of other underlying factors have also been investigated, including quality of service, perceived value, involvement, and satisfaction of passengers. Results from SEM estimation suggest that service quality, perceived value, involvement, and satisfaction have positive effects on the behavioural intentions of public transportation users. In the study of Sumaedi et al. [30], perceived value, image, perceived ease of use, and perceived usefulness were all considered simultaneously when determining passenger satisfaction. A SEM model has been estimated based on 292 responses. Their findings show that perceived value, perceived usefulness, and image all have a significant impact on public transportation passengers' satisfaction, whereas perceived ease of use does not.

This research considered latent variables of satisfaction, service quality, perceived value, and environmental concerns. According to the previous studies, perceived value affects satisfaction, and service quality affects satisfaction and perceived value [12]. In the following subsection, we discussed the supported hypothese more deeply.

*2.1 Service Quality*

There is no clear and exact definition of service quality (SQ), and researchers have defined these variables from various perspectives. For instance, Grönroos [32] has defined service quality as the comparison between customer expectations and perceptions of service. It was also defined as the customer's comprehensive assessment of the superiority of the service over similar services with significant advantages [33]. Service quality in the current study is divided into two components: core service (general information facilities, service hours, fare, regulation, handling complaints, ticket sales network, and staff behavior) and physical environment (including restrooms, vehicle hygiene, vehicle safety, safety in stations and terminals, sustainability of the vehicle, and information on

4

140 display screens) [34]. A number of studies have found that higher service quality is associated with greater customer
141 satisfaction [5, 12, 14, 28, 35]. Therefore following hypotheses are formulated:

142       *H1: Service Quality is positively related to BRT users' satisfaction.*
143       *H2: Service Quality is positively related to metro users' satisfaction.*

144 *2.2 Perceived Value*

145       The perceived value (PV) of services is used as a criterion for comparing their quality from two different
146 points of view. According to one viewpoint, higher prices are associated with better quality. On the other hand, high
147 quality is perceived as being more expensive [36]. Generally, perceived value refers to a customer's perception of a
148 product's merit or desirability, compared to a competitor's product [33]. In more specific terms, perceived value
149 arises from the trade-off between perceived benefit and cost. Former studies suggest perceived value may be a better
150 predictor of repurchase than satisfaction or quality [30]. Moreover, previous studies show that service quality affects
151 perceived value positively [8, 37]. Therefore the following hypotheses are formulated:

152       *H3: Perceived Value is positively related to BRT users' satisfaction.*
153       *H4: Perceived Value is positively related to metro users' satisfaction.*
154       *H5: Service Quality is positively related to Perceived Value in BRT.*
155       *H6: Service Quality is positively related to Perceived Value in Metro.*
156

157 *2.3 Environmental Concerns*

158       Environmental concerns (EC) are defined in a wide range of ways, and there is no single definition that
159 encompasses them all [38]. A definition of environmental concerns could be "An individual's belief that humans
160 endanger the natural environment simultaneously with the intention to preserve it" [39]. As transportation has a
161 profound effect on emissions, it is expected that environmental concerns would moderate the relationship between
162 three latent constructs including perceived value, service quality, and satisfaction. Therefore, the following
163 hypotheses are formulated:

164    *H7: Environmental concerns moderate the service quality and satisfaction relationship in metro.*
165    *H8: Environmental concerns moderate the perceived value and satisfaction relationship in metro.*
166    *H9: Environmental concerns moderate the perceived value and service quality relationship in metro.*
167    *H10: Environmental concerns moderate the service quality and satisfaction relationship in BRT.*
168    *H11: Environmental concerns moderate the perceived value and satisfaction relationship in BRT.*
169    *H12: Environmental concerns moderate the perceived value and service quality relationship in BRT.*
170

171 *2.4 Satisfaction*

172    Satisfaction (SAT) refers to the difference between expectations before use and the perceived efficiency
173    after use of the product [40-42]. Literature typically conceptualizes satisfaction in terms of two methodological
174    approaches: transactional satisfaction (individual) and cumulative satisfaction (the use of customers' experiences
175    over time. According to the definition of customer satisfaction used in the field of public transportation, it refers to
176    the level of satisfaction in meeting the passengers' expectations [43] Several studies have shown that negative
177    experiences using public transportation have a considerable effect on customers' feelings [31].

178    Upon reviewing the aforementioned studies, it can be concluded that many of them did not make a
179    distinction between different forms of public transportation. With respect to the differences between BRT and
180    Metro, we have developed two separate models to identify the factors that contribute to customer satisfaction with
181    BRT and Metro. Consequently, a survey has been developed in which transit users will be asked to answer both
182    questions pertaining to BRT and Metro. Moreover, there have been studies in the past that examined how variables
183    such as involvement [44], loyalty [45], attitudes [45], and nationality [46] can serve as moderators in the relationship
184    between satisfaction and independent variables. However, there is still no study that has been conducted to examine
185    the moderating effect of environmental concerns on satisfaction. In light of the aforementioned hypothesis and
186    research objective, the research's conceptual model is illustrated in Fig. 1.

187    **3. Methodology**

188    *3.1 Structural equation modelling*

189    A structural equation model (SEM) is a set of statistical techniques for examining the relationships between one or
190    more independent variables (IV), either continuous or discrete, and one or more dependent variables (DV), either
191    continuous or discrete [47]. It is possible to use IVs or DVs as factors or as measured variables. An SEM consists of
192    two submodels, a structural model and a measurement model. The measurement model defines the relationship
193    between the measured variables ($X_i$ or $Y_i$) and the latent constructs. An analysis of hypothesized relationships
194    among latent constructs is tested in a structural model. The conceptual model containing the symbols in model is
195    presented in Fig 2. As it can be seen, the exogenous and endogenous latent constructs are shown by ξ and η,
196    respectively. The error term in the structural model is shown by ζ. However, in the measurement model, the error
197    terms in measuring the endogenous and exogenous latent constructs are shown by ε and δ. In addition, in a structural
198    model, the factor loadings are shown by γ (relationship between an exogenous variable and an endogenous variable)
199    and β (relationship between endogenous variables). However, in the measurement model, the factor loadings are
200    shown by λs. Equations (1) to (3) are used for illustrating the relationship between used variables in an SEM model.

$$\eta = B\eta + \Gamma\xi + \zeta \tag{1}$$

$$X = \Lambda_x\xi + \delta \tag{2}$$

$$Y = \Lambda_y\eta + \varepsilon \tag{3}$$

201

202  *3.2 Case Study*

203  As the largest metropolis in the Middle East, Tehran is faced with serious public transport problems. There
204  are many factors that contribute to the high usage of private cars in Tehran such as inefficient and unreliable transit
205  services, long waiting and travel times, various incentives for using private cars such as free parking and low fuel
206  costs [4].

207  A low share (26%) of urban trips in Tehran are undertaken by bus (both BRTs and regular buses) and
208  metro, while taxis and private cars account for a significant portion (66%). There are 121 stations in the Tehran
209  metro system, which is 228 kilometers long, and there are 728 million trips made by the metro system in a year. The
210  BRT lines in Tehran cover 183.6 kilometers, and there are 347 stations. The number of trips made by BRT is 560
211  million per year. Hence, the significant use of BRT and metro necessitates an analysis of the factors affecting
212  people's satisfaction. Figure 3 illustrates the urban transit system in Tehran and its coverage.

213

214  *3.3 Questionnaire*

215  In order to meet our research objectives, only travelers who utilize BRT and metro were surveyed. In order
216  to identify the factors affecting the satisfaction of people with public transportation (including BRT and metro), a
217  face-to-face survey was developed and distributed from January until March 2020. The questionnaire includes three
218  sections. There is a brief explanation of the purpose of the questionnaire in the first section. In the second section,
219  attitudinal questions were asked pertaining to satisfaction, perceived value, environmental concern, and service
220  quality. It is of note that respondents answered questions both related to BRT and Metro simultaneously. In other
221  words, each respondent answered each question twice, once for the subway and once for the BRT. On a five-point
222  Likert scale (ranging from strongly disagree: 1 to strongly agree: 5) respondents were asked to provide responses to
223  each question separately for both BRT and metro. In the last part of the survey, people were asked about their
224  socioeconomic status including gender, marital status, age, education, driver's license, monthly income (individual),
225  household car ownership, and household size. After omitting the invalid responses, 625 complete questionnaires
226  were used for the further analysis. Results of the statistical analysis (Table 2) demonstrate that men, married
227  respondents, 25 to 44 years old, bachelor education level, an income between 10 and 30 million Iranian Rials (IRR)
228  (40-120 USD), households without a private car, 4-member households, and respondents possessing a driving
229  license have the highest frequency among other groups.

230

231  **4. Results and Discussion**

232  In our study, we used structural equation modeling (SEM) to test the proposed hypotheses. It consists of
233  two main parts, the measurement model and the structural model. The relationship between the latent variables and
234  their indicators is examined by the measurement model while the simultaneous relationship between constructs and
235  hypotheses is examined by structural model analysis.

236    Using AMOS 26 and the maximum likelihood estimation (MLE) approach, the best fit model was
237 calibrated after excluding items that were insignificant or had a standard regression coefficient below the acceptable
238 range (lower than 0.5). Because of the use of MLE, it is important to note that the normality assumption was
239 checked by using the D'Agostino-Pearson test [48], and the values of Skewness and Kurtosis (ranging from -2 to 2)
240 indicate that the data are normally distributed.

241    *4.1 Measurement model analysis*

242    Two measurement models are proposed as a means to examine the relationships between indicators and
243 constructs of BRT and metro. Different criteria are examined for each part of the model in order to evaluate the
244 model goodness of fit. Table (3) and (4) present the standardized regression coefficients and their significant level,
245 average variance expected (AVE), Cronbach's alpha and Construct Reliability (CR). Cronbach's alpha is used to
246 assess the internal consistency of the questionnaire, and in the measurement model, reliability is evaluated by CR.
247 Accordingly, the threshold for both of these indicators should be greater than 0.7 and 0.6, respectively [49]. The
248 evaluation criteria for both indexes are satisfied in both Tables (3) and (4). To determine whether a reflective
249 construct is convergently valid, the indicator loadings and AVE must be evaluated. The majority of the factor
250 loadings of BRT and Metro are higher than 0.6, respectively, which is higher than the acceptable threshold of 0.5
251 proposed by Hair et al. [49]. All values in the AVE analysis exceed the necessary threshold of 0.5, indicating that
252 the construct describes more than half of the variance of its indicators.

253

254    *4.2 Goodness of fit indices*

255    In order to analyze the structural model, various criteria are presented in three categories: absolute (such as
256 GFI), comparative (such as CFI and TLI), and parsimonious (such as PNFI). Jaccard et al. [50] assert that if any of
257 the three groups of indicators (absolute, comparative, and parsimonious) are within acceptable thresholds, the
258 model's goodness of fit is satisfactory [50]. The derived values indicate that the data are fitted to the model properly
259 (Table (5)).

260

261    *4.3 Discriminant validity*

262    Table (6) presents the overall discriminant validity of proposed model of BRT and Metro. The absolute
263 inter-correlation of the structures in the overall proposed model ranges from 0.551 to 0.837 in metro and from 0.748
264 to 0.801 in BRT, which is less than the suggested threshold value of 0.85 [49]. Moreover, correlations are lower than
265 the square root of AVE, indicating that these factors have strong discriminant validity.

266

267    *4.4 Structural models*

8

268       After examining the validity of measurement models, two structural models (Figures (4) and (5)) proposed

269    for BRT and Metro to explore the relationship between the independent variables and the dependent variables.

270    People's satisfaction with both the metro and BRT are influenced by the two significant variables of perceived value

271    and service quality. It has been determined that the service quality of metro affects satisfaction more than the service

272    quality of BRT (Figure (4) & (5)). In light of this, improving metro facilities can result in a much higher level of

273    satisfaction for users. However, this is not true for BRT, where the effect of perceived value on satisfaction is more

274    influential than service quality. Consequently, improving the factors that increase the perceived value of BRT (such

275    as a reasonable ticket price) can result in higher customer satisfaction. Because of the large capacity of the metro,

276    people care more about service quality than BRT. Therefore, since most people travel by metro more than by BRT

277    for their mandatory trips (e.g., school or work), they value quality more than price [51].

278    Furthermore, we observe that service quality influences perceived value in both travel modes in a direct, significant,

279    but different manner (Figure 4 & 5). Compared with metro, results show that service quality has a more substantial

280    effect on perceived value for BRT. In addition, two latent variables are responsible for explaining service quality in

281    both modes. They are the core service and the physical environment. Comparison of coefficients shows that in the

282    metro, service quality is more affected by core service (rather than physical environment), whereas, for BRT, two

283    variables of core service and physical environment produce similar effects. Considering variables such as vehicle

284    regulation, service hours as well as information facilities which play an important role in the reliability of the vehicle

285    and also the great number of mandatory trips with metro, it is inferred that vehicle reliability and comfort in the

286    metro are important factors in satisfying metro users.

287       Among satisfaction indicators, the indicator "in this vehicle, it is tried to satisfy people" has the

288    greatest standardized regression coefficient both in metro and BRT (Table 3 & 4). This shows that in contrast with

289    other factors, bringing customers' satisfaction is a stronger indicator of their satisfaction. To satisfy users, a

290    customer-oriented approach is recommended to meet customers' needs and to resolve defects, shortcomings, and

291    difficulties in providing services. Among the indicators of perceived value, "affordable ticket price" in metro and

292    "proper service quality" in BRT have the highest standardized regression coefficients. Hence, keeping both the ticket

293    price and service quality moderate for the metro and BRT will have a more noticeable impact on perceived value.

294    The comparison of the standardized regression coefficients (Table 3 & 4) related to the core service show that the

295    most influential item for metro is "Service regularity" and for BRT is "overall information facilities". Therefore, it is

296    suggested that the following solutions are necessary for satisfying the passengers: developing intelligent systems

297    that shows the timetable of Metro and increase the reliability in travel time and waiting time in metro, and for BRTs,

298    improving information facilities such as schedules, routes, stations, waiting time,  ,arrival timeand the system for

299    announcing the names of stations. Among the indicators of physical environment, "vehicle security" in metro and

300    "hygiene" in BRT have the greatest regression coefficients. This is due to the fact that travelers are often exposed to

301    dangers such as harassment, theft, and crime. As a result, by setting up police and security units at stations and

302    installing advanced cameras in trains and stations, the metro will be more secure and people will be more satisfied.

303

304     *4.5 Environmental concerns as moderator*

305     In Fig. 6, environmental concerns are shown as a moderator of the relationships between independent and

306     dependent variables. On the basis of the estimation results, it can be concluded that taking this variable into account

307     moderates the relationship between service quality and perceived value with satisfaction in both metro and BRT.

308     According to the comparison of regression coefficients, environmental concern is a significant moderator of the

309     relationship between perceived value and satisfaction for both metro and BRT systems. This value is much higher in

310     BRT (regression coefficient = 0.166) than in metro (regression coefficient = 0.100). Both for metro and BRT, the

311     relationship between perceived value and satisfaction for people with great environmental concerns is greater than

312     its relationship for people with less environmental concerns. By improving the perceived value of BRT and metro,

313     people with higher environmental concerns are more satisfied than those with lower environmental concerns. As a

314     result, it is easier to satisfy those with more environmental concerns due to the perceived value of both the metro and

315     BRT options.

316     Moreover, environmental concerns may play a negative role in moderating the relationship between service

317     quality and satisfaction in both modes. Thus, the positive effect of service quality on customer satisfaction is likely

318     to be reduced significantly as the level of environmental concern increases. This reduction is greater in BRT

319     (regression coefficient = - 0.165) than in metro (regression coefficient = - 0.061). Due to the use of clean fuels, such

320     as electricity, metros produce significantly less pollution than BRTs. Therefore, the relationship between service

321     quality and satisfaction for metro users is less weakened than for BRT users. Moreover, the moderating effect of

322     environmental concerns on service quality and perceived value is only significant for BRT.

323     In Table (7), the path coefficients and results of hypothesis testing are summarized. It was determined that

324     11 of the 12 hypotheses (H1-H12) were supported.

325

326     **5. Conclusion**

327     This paper aimed to determine the factors affecting individuals' satisfaction with public transportation

328     services including bus rapid transit (BRT) and metro with a focus on the moderating effect of environmental

329     concerns using Structural Equation Modeling (SEM).

330

331     *5.1 Findings and Inferences*

332     Estimation results of SEM of indicate that people's satisfaction with metro and BRT is significantly,

333     positively, but differently influenced by two factors of perceived value and service quality. Using standard

334     regression coefficients, it has been determined that, in the metro, service quality has a higher impact on satisfaction

335     than perceived value. In contrast, for BRT, perceived value has a greater impact on satisfaction. In addition, metro

336     completes a great deal of mandatory trips, which is due to its on-time schedule. In addition, the consideration of

environmental concerns indicates that it is a negative moderator of the relationship between service quality and satisfaction. Since clean fuels like electricity are used in the metro, it produces less pollution than BRT. Therefore, the relationship between service quality and satisfaction for metro users is less weakened than for BRT users. Environmental concern is also a positive moderator of the relationship between perceived value and satisfaction in both metro and BRT (for BRT, the relationship is stronger). It means that by improving the perceived value of BRT and metro, people with environmental concerns are more satisfied than people with lower environmental concerns.

*5.2 Implications for practice and policy*

According to the findings, a series of policy implications are suggested to enhance the satisfaction of BRT and Metro users: 1) More attention should be paid to service quality-related factors in Metro such as security inside the vehicle and at stations, service regularity, and dealing with complaints. The authorities can use CCTVs and police to make Metros and stations more secure. Additionally, developing a website or application for dealing with users' complaints can play a vital role in improving the satisfaction of Metro users; 2) Additionally, in order to increase the satisfaction of BRT users, factors related to service quality, such as general information facilities, complaint handling and vehicle hygiene, should be given priority. In this regard, the government could develop a website or application for dealing with users' complaints, regular cleaning of buses, as well as increasing information facilities for users, such as development of a smartphone application and using smart electronic bus stops to inform the arrival time of buses; 3) Local authorities can also use environmentally friendly measures in both metro and BRT, such as using clean fuels [52], removing paper tickets and promoting digital ticket usage, using exhaust filters, and installing trash cans at stations to increase user satisfaction, especially individuals with higher environmental concerns.


*5.3 Limitations and recommendations for further studies*

Considering the psychological nature of satisfaction, this study only examines attitudinal (latent) variables, while socioeconomic and travel-related factors have been ignored. The moderating effect of these variables could therefore be explored as part of future research. It is true that the research period spanned most trips with different purposes, but another limitation of this research was the analysis of satisfaction in a specific time frame.

We recommend that future studies analyze the satisfaction of people during different periods, such as different seasons or the period of COVID-19. Finally, in future studies, the conceptual model of this study can be developed by considering the effect of satisfaction on the intention to use, the recommendation to friends, and loyalty.


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480 **Table (1) Selected satisfaction in public transportation studies**
481 **Table (2) Statistical analysis of socioeconomic characteristics of respondents**
482 **Table (3) Estimation results of Metro measurement model**
483 **Table (4) Estimation results of BRT measurement model**
484 **Table (5)  Structural model's evaluation criteria in proposed models**
485 **Table (6) Discriminant validity of overall models by BRT and Metro**
486 **Table (7) Results of the constructs' hypothesized causal impact.**
487 **Fig. (1) Research's conceptual model and hypotheses**
488 **Fig. (2) Illustration of the structure of the research SEM conceptual model**
489 **Fig. (3) Tehran's urban transit network**
490 **Fig. (4) Proposed model with standard regression coefficients for metro**
491 **Fig. (5) Proposed model with standard regression coefficients for BRT**
492 **Fig. (6) Examining the environmental concerns as a moderator in factors affecting the satisfaction with BRT**
493 **(Top) and Metro (Below)**

494 **Table (1) Selected satisfaction in public transportation studies**

| Author(s) | Construct | | | | | | Location | Sample size | Method |
|---|---|---|---|---|---|---|---|---|---|
| | Service Quality | Perceived value | Satisfaction | Behavioral intention/ Loyalty | Involvement | Other | | | |
| Fellesson and Friman [32] | | | ✓ | | | ✓ | Nine European cities | 9,542 | Factor analysis |
| Sumaedi et al. [30] | | ✓ | ✓ | | | ✓ | Jakarta | 292 | SEM |
| Irtema et al. [12] | ✓ | ✓ | ✓ | ✓ | ✓ | | Kuala Lumpur | 412 | SEM |
| Li [29] | | | ✓ | | | ✓ | San Francisco | 257 | SEM |
| Ingvardson & Nielsen [13] | | | ✓ | | | ✓ | Six European countries | 38,537 | SEM |
| Ha et al. [1] | | ✓ | ✓ | ✓ | | ✓ | Kuching | 179 | SEM |
| De Oña [14] | ✓ | | ✓ | ✓ | ✓ | | Five European cities | 2,579 | SEM-MIMIC |
| Lunke [28] | | | ✓ | | | ✓ | Oslo, Norway | 7,630 | ANOVA |
| De Oña [5] | ✓ | | ✓ | ✓ | | | Five European cities | 2,579 | SEM-MIMIC |

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**Table (2) Statistical analysis of socioeconomic characteristics of respondents**

| Variables | Values | Count | Frequency (%) |
|---|---|---|---|
| Gender | Female | 301 | 48.2 |
| | Male | 324 | 51.8 |
| Marital status | Married | 340 | 54.4 |
| | Single | 285 | 45.6 |
| Age | <18 | 59 | 9.5 |
| | 18-24 | 157 | 25.1 |
| | 25-44 | 286 | 45.8 |
| | 45-64 | 101 | 16.2 |
| | 65+ | 22 | 3.4 |
| Education | Under high school diploma | 163 | 26.1 |
| | High school diploma | 173 | 27.6 |
| | Associate Degree and Bachelor | 209 | 33.4 |
| | Masters and PhD | 80 | 12.9 |
| Driving License Status | Owning a driving license | 399 | 63.8 |
| | Not owning a driving license | 226 | 36.2 |
| Monthly income | <10 Million IRR[*] | 182 | 29.2 |
| | $10 q - < 30$ Million IRR | 204 | 32.6 |
| | $30 q - < 60$ Million IRR | 143 | 23.0 |
| | $60 q - < 90$ Million IRR | 68 | 10.9 |
| | $\geq 90$ Million IRR | 28 | 4.3 |
| Household car ownership | 0 | 413 | 66.1 |
| | 1 | 134 | 21.4 |
| | 2+ | 78 | 12.5 |
| Household Size | 1 | 10 | 1.6 |
| | 2 | 109 | 17.6 |
| | 3 | 170 | 27.2 |
| | 4 | 197 | 31.5 |
| | 5+ | 139 | 22.1 |

* 1 USD equivalent to 130,000 IRR at the date of survey.

**Table (3) Estimation results of Metro measurement model**

| Constructs | Items | λ | P-value | AVE | Cronbach's alpha | CR |
|---|---|---|---|---|---|---|
| PV | The fare is reasonable | 0.897 | - | 0.529 | 0.834 | 0.868 |
| | service quality received reasonable | 0.764 | *** | | | |
| | It is cheap | 0.647 | *** | | | |
| | I feel that this vehicle meets my needs with high quality and low price. | 0.594 | *** | | | |
| | I feel that this vehicle meets my needs at a reasonable price | 0.796 | *** | | | |
| | This vehicle is a comfortable means of transportation for me. | 0.617 | *** | | | |
| CSQ | Service regularity | 0.780 | *** | 0.525 | 0.714 | 0.767 |
| | Deals with Complaint | 0.758 | *** | | | |
| | Staffs behavior | 0.627 | - | | | |
| PSQ | Vehicle hygiene | 0.670 | - | 0.570 | 0.830 | 0.839 |
| | Vehicle security | 0.859 | *** | | | |
| | Security at terminals and stops | 0.828 | *** | | | |
| | Vehicle stability | 0.639 | *** | | | |
| SQ | CSQ | 0.996 | - | 0.805 | 0.859 | 0.891 |
| | PSQ | 0.786 | *** | | | |
| SAT | Feeling cosines while waiting at station stops | 0.680 | - | 0.536 | 0.748 | 0.761 |
| | The staff performs very well according to my expectations. | 0.664 | *** | | | |
| | In this vehicle, it tries to satisfy the passengers. | 0.759 | *** | | | |

**Table (4) Estimation results of BRT measurement model**

| Constructs | Items | λ | P-value | AVE | Cronbach's alpha | CR |
|---|---|---|---|---|---|---|
| PV | service quality received reasonable | 0.758 | - | 0.515 | 0.830 | 0.809 |
| | I feel that this vehicle meets my needs with high quality and low price. | 0.734 | *** | | | |
| | I feel that this vehicle meets my needs at a reasonable price | 0.668 | *** | | | |
| | This vehicle is a comfortable means of transportation for me. | 0.707 | *** | | | |
| CSQ | General information facility | 0.832 | *** | 0.585 | 0.716 | 0.807 |
| | Deals with Complaint | 0.790 | *** | | | |
| | Staffs behavior | 0.662 | - | | | |
| PSQ | Vehicle hygiene | 0.782 | *** | 0.563 | 0.884 | 0.866 |
| | Vehicle security | 0.764 | *** | | | |
| | Security at terminals and stops | 0.725 | *** | | | |
| | Vehicle stability | 0.718 | *** | | | |
| | On board information facility | 0.761 | - | | | |
| SQ | CSQ | 0.934 | - | 0.882 | 0.891 | 0.937 |
| | PSQ | 0.944 | *** | | | |
| SAT | I can usually sit on a seat in this vehicle on my trips. | 0.653 | - | 0.554 | 0.852 | 0.861 |
| | Feeling cosines while waiting at station stops | 0.765 | *** | | | |
| | Overall, I find satisfaction with this vehicle. | 0.787 | *** | | | |
| | The staff performs very well according to my expectations. | 0.711 | *** | | | |
| | In this vehicle, it tries to satisfy the passengers. | 0.796 | *** | | | |

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**Table (5)  Structural model's evaluation criteria in proposed models**

| Indices | Acceptable range [44] | The value obtained in this study for BRT | The value obtained in this study for Metro |
|---|---|---|---|
| GFI | >0.80 | 0.891 | 0.901 |
| TLI | >0.85 | 0.919 | 0.897 |
| CFI | >0.85 | 0.938 | 0.919 |
| PNFI | >0.50 | 0.696 | 0.686 |
| RMSEA | <0.08 | 0.076 | 0.078 |

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**Table (6) Discriminant validity of overall models by BRT and Metro**

| | Metro | | | BRT | | |
|---|---|---|---|---|---|---|
| | SQ | PV | SAT | SQ | PV | SAT |
| Service Quality (SQ) | **0.897** | | | **0.939** | | |
| Perceived Value (PV) | 0.551 | **0.727** | | 0.793 | **0.718** | |
| Satisfaction (SAT) | 0.837 | 0.63 | **0.732** | 0.748 | 0.801 | **0.744** |

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**Table (7) Results of the constructs' hypothesized causal impact.**

| Hypotheses | $\lambda$ | Supported? |
|---|---|---|
| H1: SQ → SAT (BRT) | 0.293 ** | Yes |
| H2: SQ → SAT (METRO) | 0.703 *** | Yes |
| H3: PV → SAT (BRT) | 0.566 *** | Yes |
| H4: PV → SAT (METRO) | 0.243 ** | Yes |
| H5: SQ → PV (BRT) | 0.793 *** | Yes |
| H6: SQ → PV (METRO) | 0.551 *** | Yes |
| H7: EC MODERATE (SQ → SAT (METRO)) | -0.061 ** | Yes |
| H8: EC MODERATE (PV → SAT (METRO) | 0.100 *** | Yes |
| H9: EC MODERATE (SQ → PV (METRO) | 0.070 [NG] | No |
| H10: EC MODERATE (SQ → SAT (BRT)) | - 0.165 ** | Yes |
| H11: EC MODERATE (PV → SAT (BRT) | 0.166 *** | Yes |
| H12: EC MODERATE (SQ → PV (BRT) | 0.165 * | Yes |

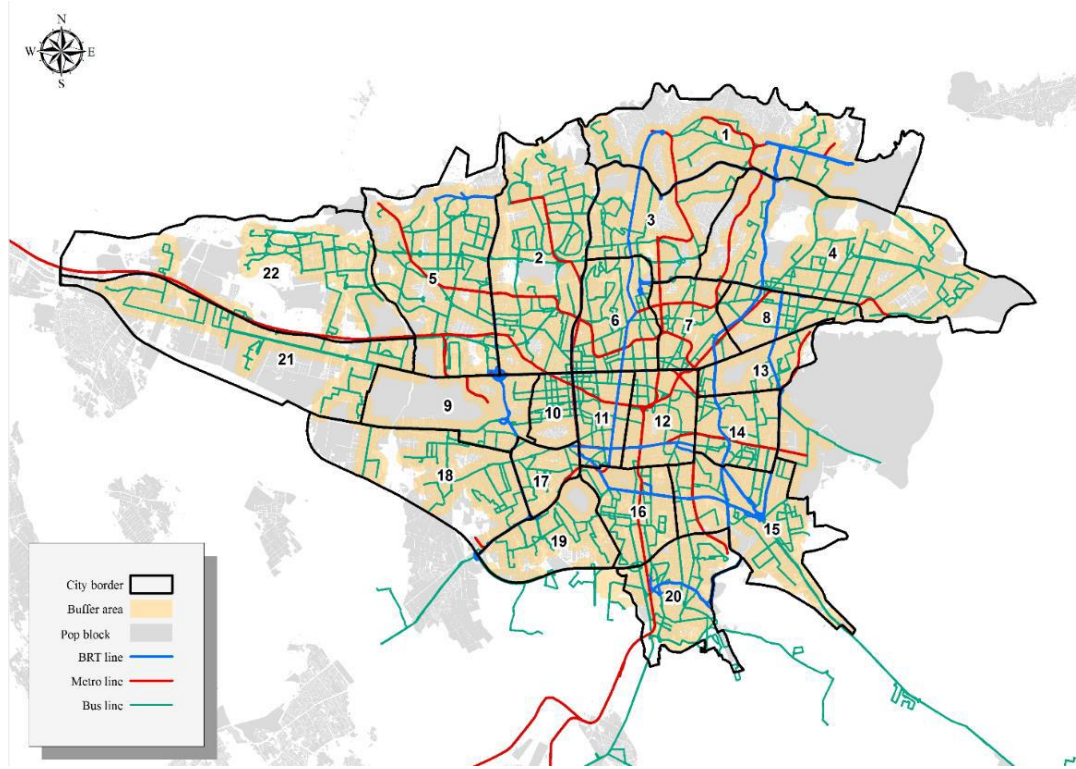SQ: Service Quality; SAT: Satisfaction; PV: Perceived Value; EC: Environmental Concerns.
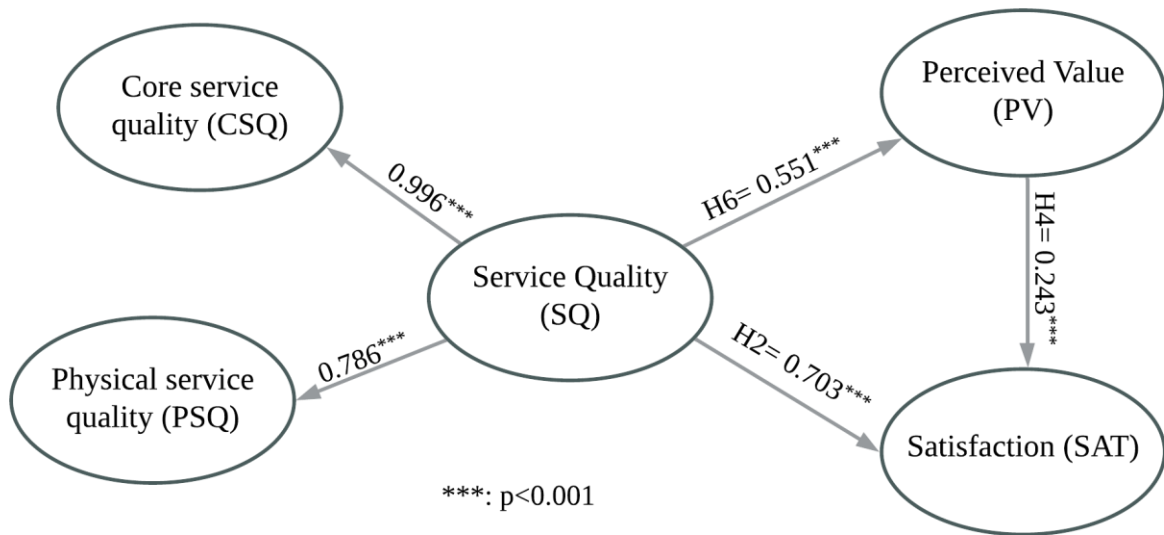
*: p<0.05; **: p<0.01; ***: p<0.001; NG: Not Significant.
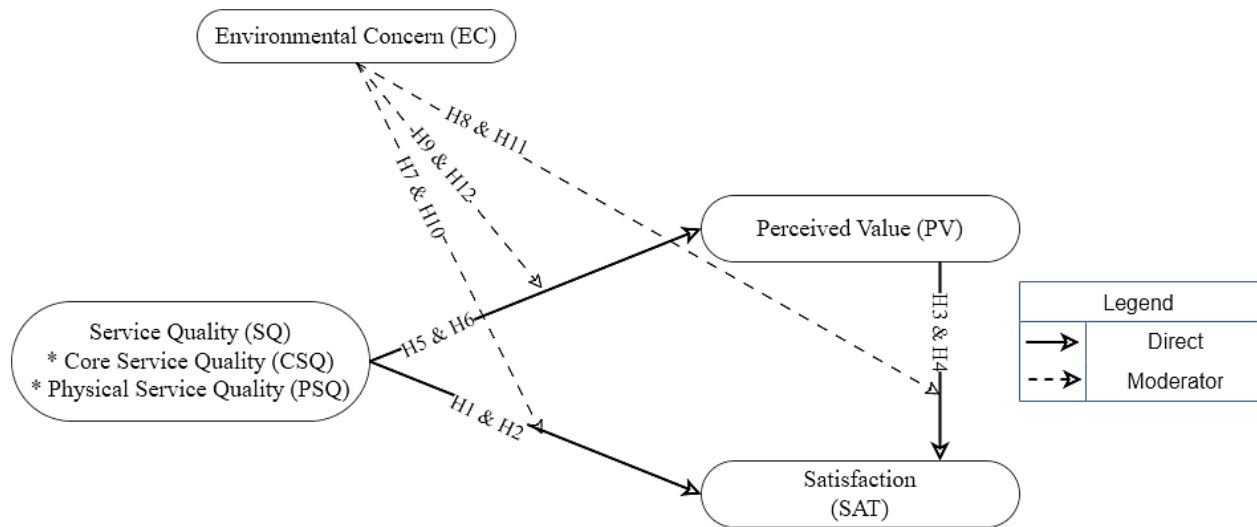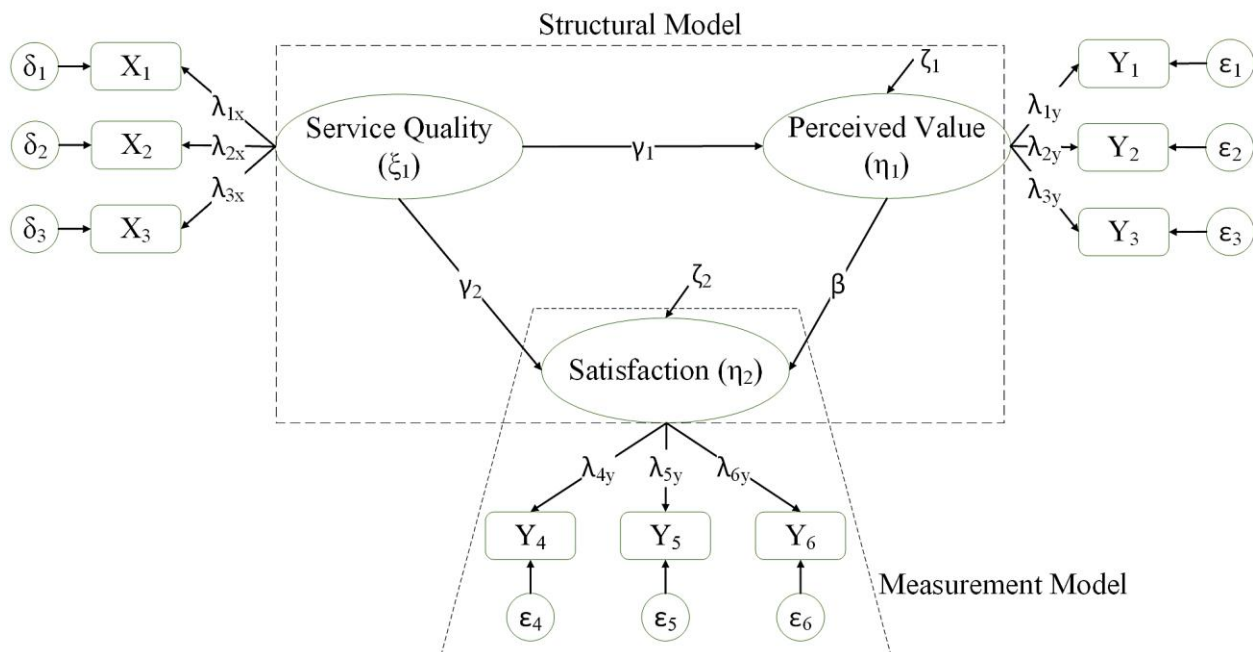
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515 **Fig. (1) Research's conceptual model and hypotheses**
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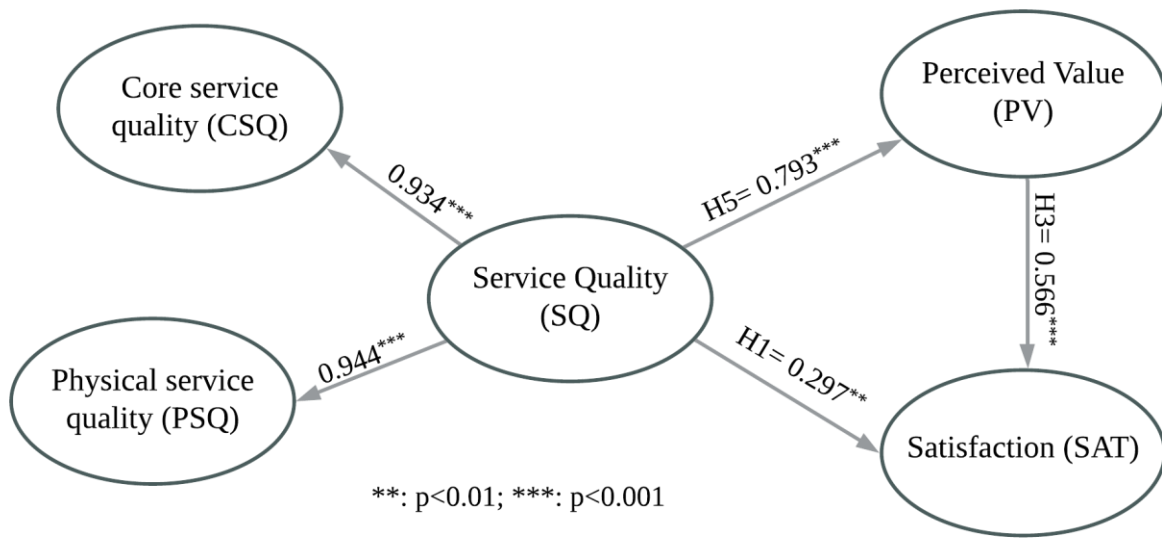519 **Fig. (2) Illustration of the structure of the research SEM conceptual model**
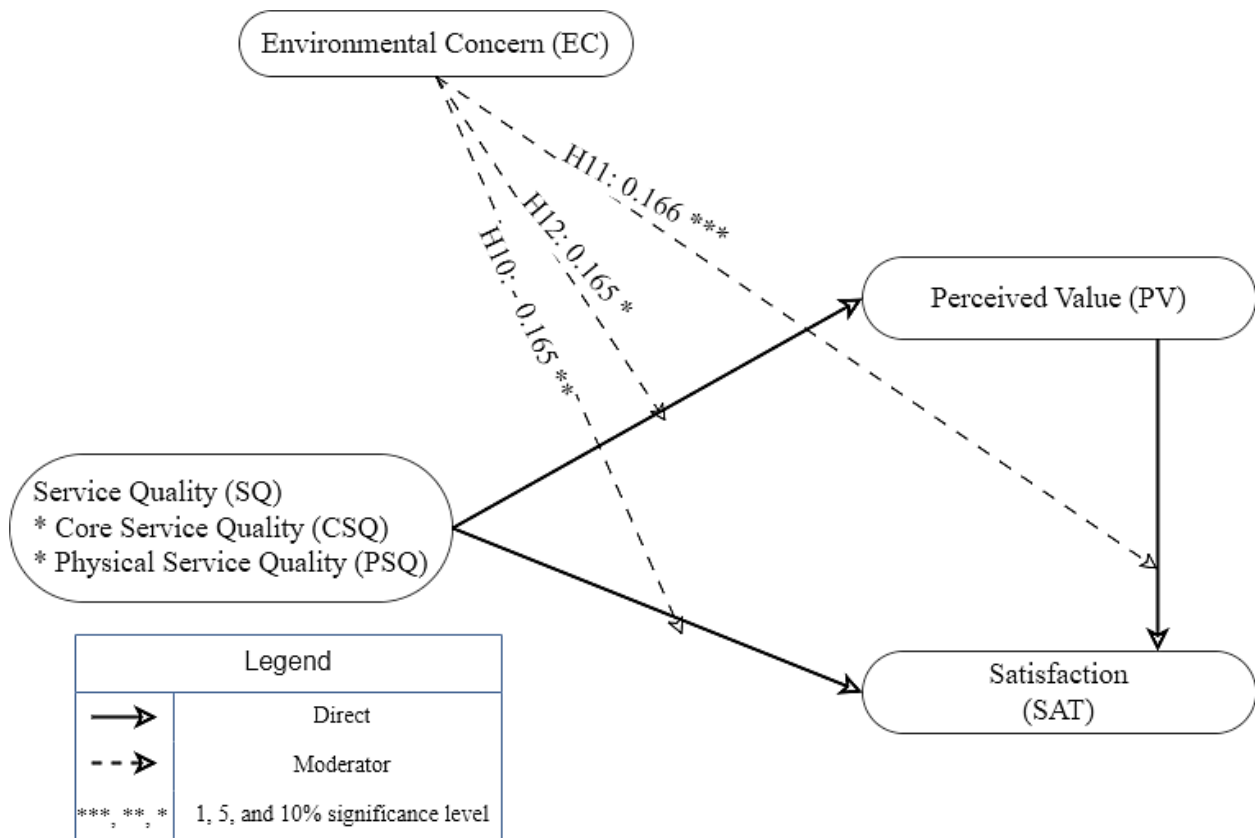
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521 **Fig. (3) Tehran's urban transit network**

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524 **Fig. (4) Proposed model with standard regression coefficients for metro**
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Core service
quality (CSQ)

Perceived Value
(PV)

0.934***

H5= 0.793***

Service Quality
(SQ)

H3= 0.566***

Physical service
quality (PSQ)

0.944***

H1= 0.297**

Satisfaction (SAT)

**: p<0.01; ***: p<0.001

528
529 **Fig. (5) Proposed model with standard regression coefficients for BRT**
530

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Environmental Concern (EC)

H11: 0.166 ***

H12: 0.165 *

H10: -0.165 **

Perceived Value (PV)

Service Quality (SQ)
* Core Service Quality (CSQ)
* Physical Service Quality (PSQ)

Satisfaction
(SAT)

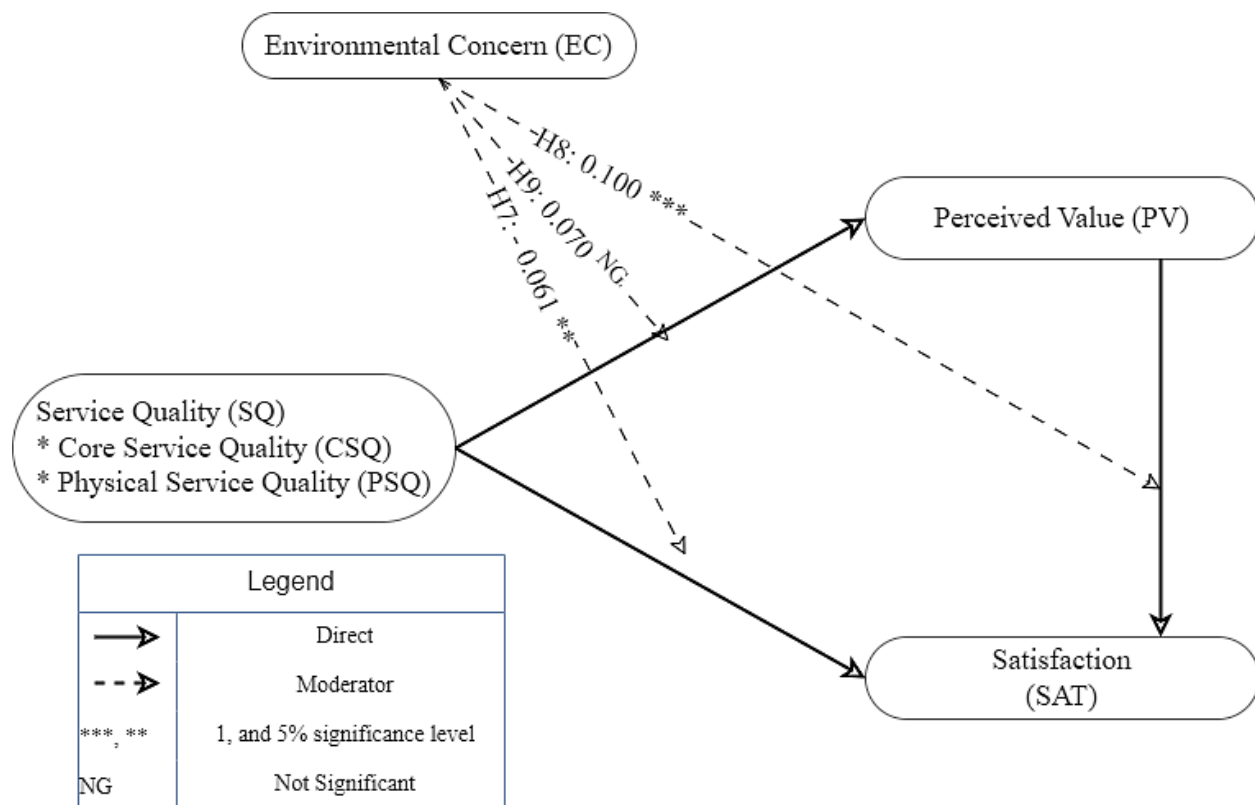| Legend | |
|---|---|
| → | Direct |
| - -▶ | Moderator |
| ***, **, * | 1, 5, and 10% significance level |

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**Fig. (6) Examining the environmental concerns as a moderator in factors affecting the satisfaction with BRT (Top) and Metro (Below)**

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