A Mode Choice Model for the Trans Papua Highway Using the Multinomial Logit Model Approach

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ABSTRACT

Land transport accessibility in border regions shapes connectivity, equity in service provision, and population mobility, yet empirical evidence on mode choice behavior in areas with limited transport options remains scarce. This study aims to model transport mode choice along the pioneering Trans Papua Highway in Merauke Regency and to identify its principal determinants. A revealed preference approach was employed through a survey of 405 land transport users. The data were analyzed using a multinomial logit model to examine the effects of travel attributes, socio-economic characteristics, vehicle access, and travel culture on the vehicle choice among Damri bus, private car, and motorcycle. The results show that the determinants of mode choice do not operate uniformly across alternatives. In the comparison between motorcycle and private car, travel attributes, driving license ownership, trip destination, and, most notably, travel culture emerged as the key differentiating factors. In contrast, in the comparison between Damri bus and private car, socio-economic conditions and access to private vehicles exerted a stronger influence, particularly through education, income, driving license ownership, and vehicle ownership. These findings suggest that travel culture constitutes an important empirical explanation for choices between modes. This study extends the mode choice literature in remote areas by demonstrating that behavioral determinants are alternative-specific. The findings imply that transport policy in border regions should be designed more contextually, with greater attention to affordability, mobility access, and local travel patterns.

Keywords-transport mode choice; multinomial logit; Trans Papua Highway; border areas; travel culture

I. INTRODUCTION

Land transport accessibility in remote and border regions is central to interregional connectivity, circulation of goods and services, and everyday mobility. Yet, in such settings, mobility is shaped not only by infrastructure provision, but also by constrained service availability, travel distances, and unequal access to transport resources. Recent studies show that mode choice in rural, remote, and border areas is influenced by socio-economic conditions, geographical constraints, and service availability [1, 2] while preferences for particular modes are also associated with travel distance, comfort, safety, and quality of service [3]. These conditions make mode choice in peripheral regions a substantive policy issue rather than a simple extension of urban transport behavior.

The broader mode choice literature has consistently highlighted the importance of demographic and socio-

economic variables such as age, education, and income [1, 4], as well as trip purpose, flexibility needs, and perceptions of safety, comfort, and reliability [3, 5, 6] Methodologically, statistical models, particularly the Multinomial Logit (MNL) model, have been widely used to estimate mode choice probabilities and quantify the effects of these variables across different transport settings [2, 7-11]. In developing-country contexts, MNL remains especially useful because of its parsimonious structure and its capacity to capture behavioral responses under relatively constrained transport conditions [10]. However, the existing literature still leaves an important gap. Most empirical studies are grounded in urban or metropolitan settings, whereas remote, outermost, and border corridors remain comparatively underexplored [12-15]. This matters because constrained-choice corridors differ fundamentally from urban systems: modal alternatives are fewer, travel times are longer, service accessibility is weaker, and mobility decisions are more directly shaped by unequal access to transport resources [16-18]. At the same time, dominant explanatory frameworks continue to emphasize socio-demographic, economic, and built-environment factors, while giving less systematic attention to cultural and contextual influences on travel behavior [19-21]. Although some studies examine mode choice in settings such as urban areas, campus environments, or long-distance travel, they do not adequately capture the distinctive dynamics of remote and border regions [20, 22]. More importantly, the literature still tends to treat key determinants such as cost, time, socio-economic status, and behavioral variables as if they operate broadly across all modal contrasts. As a result, it offers limited explanation of whether the mechanisms shaping competition between private modes differ from those shaping competition between public and private modes in peripheral corridors. This limitation is particularly important in border regions, where travel behavior may be shaped not only by time, cost, and service attributes, but also by cultural norms, cross-border interactions, geopolitical position, and the socio-economic realities of marginal areas [19, 22]. Cultural and socially embedded travel practices therefore remain insufficiently integrated into quantitative mode choice models, particularly in Indonesia's border regions [28, 29]. The unresolved question is not simply whether conventional determinants matter, but whether their explanatory role changes according to the modal configuration being compared in constrained-choice settings.

These issues are especially salient in Merauke Regency, South Papua, where the pioneering Trans Papua Highway connects dispersed settlements in a disadvantaged, frontier, and border region adjacent to Papua New Guinea (PNG). Merauke is analytically important not merely because it is remote, but because it provides a revealing case of mobility under constrained modal choice. The corridor is characterized by limited transport alternatives, long travel times, and mobility patterns shaped not only by affordability and access, but also by local social practices. Evidence from Merauke suggests that comfort is not necessarily the main determinant of mode choice. More immediate considerations such as fare, travel time, and reliability appear to be more influential. At the same time, the Papuan context reveals episodes of collective travel associated with customary and social activities, such us "Pelepasan Tanah Adat", indicating that travel culture may play a role in structuring modal decisions.

Against this background, this study develops a transport mode choice model for the Trans Papua corridor in Merauke using three locally relevant alternatives: Damri bus, private car, and private motorcycle. The study contributes by addressing two limitations in the existing literature. First, it extends mode choice analysis to a constrained-choice border corridor that remains largely absent from the mainstream research. Second, it tests whether the determinants of mode choice are alternative-specific and explicitly incorporates travel culture as an explanatory variable. The novelty of the study therefore lies not simply in analyzing a remote border context, but in showing that the role of travel culture and other determinants must be interpreted in relation to the specific modal configuration being compared. In this way, the study provides a clearer basis for refining the interpretation of mode choice mechanisms in peripheral regions and for informing more targeted transport policy in disadvantaged and border-area settings.

II. METHODOLOGY

This study employed a quantitative survey design based on the Revealed Preference (RP) approach to analyze land transport mode choice behavior along the pioneering Trans Papua Highway in Merauke Regency, South Papua Province (Figure 1). The corridor connecting Merauke and Boven Digoel extends for approximately 422 km, with a travel time of around 10 to 15 hours depending on road and operational conditions. This corridor was selected because it represents a disadvantaged, frontier, and border area bordering PNG, while also functioning as an important transport link between the service center of Merauke and inland settlements with limited mobility options. The area is characterized by dispersed settlements, low service accessibility, long travel distances, and relatively few transport alternatives. These conditions make it a relevant setting for examining mode choice behavior in a constrained choice environment that differs from the urban and metropolitan contexts that dominate the literature.

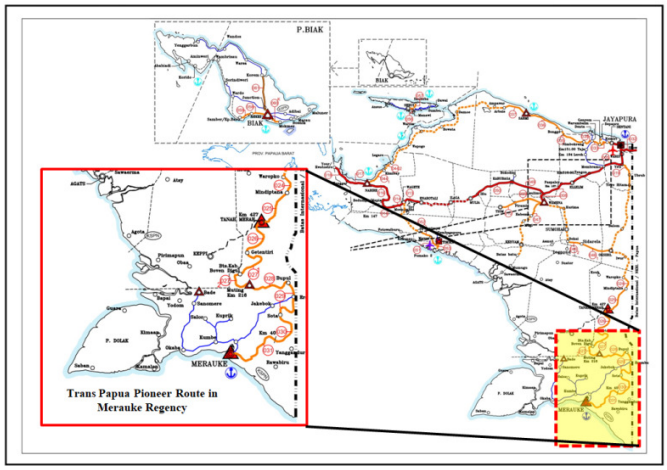

Fig. 1. The Trans Papua Highway in the South Papua Province.

Data were collected between May and June 2025 through a field survey of 405 land transport users travelling along the corridor. Respondents were actual users of the three transport modes operating on the route. A field-based intercept approach was used, whereby respondents were selected from actual travelers encountered along the corridor. Only individuals with direct experience using one of the observed modes on the study route were included. The minimum sample size was initially estimated using Slovin's formula for a population of 139,303 with a 10% margin of error, yielding an approximate minimum of 100 respondents [23]. The use of Slovin's formula in this study was intended to provide a practical minimum benchmark for field survey implementation in a geographically constrained setting, rather than to serve as the sole basis for inferential precision. The 10% margin of error was considered acceptable because the study was conducted in a frontier setting with limited accessibility, no complete formal sampling frame, and substantial field constraints. Nevertheless, the final sample of 405 respondents far exceeded this minimum benchmark and provided a strong basis for estimation.

The research instrument was a structured questionnaire designed to capture socio-economic characteristics, trip attributes, actual mode choice behavior, and travel culture. The questionnaire was administered directly to respondents in the field and structured to ensure that each variable corresponded to the analytical needs of the mode choice model. The RP approach was considered more appropriate than the Stated Preference approach for a border area with limited transport alternatives because it captures actual behavior rather than hypothetical responses [4, 24]. Travel culture was included in the questionnaire as a behavioral variable to reflect locally embedded travel practices, particularly collective mobility habits, travel related to social and customary activities, and community-based travel patterns. Operationally, this variable was measured through several questionnaire items capturing the tendency to travel collectively, the role of social or customary obligations in shaping travel decisions, and the extent to which mode choice followed established community travel habits. Instrument testing showed validity coefficients ranging from 0.61 to 0.82, while the reliability test yielded a Cronbach's Alpha of 0.70, indicating acceptable internal consistency.

The dependent variable was transport mode choice, classified into three categories: Damri bus, private car, and motorcycle. The independent variables included travel cost, travel time, age, gender, travel culture, educational attainment, occupation, income, driving license ownership, vehicle ownership, trip destination, and trip purpose. These variables were selected based on the literature, which identifies cost and time as major trip attributes, socio-economic characteristics as determinants of mobility capacity, and behavioral factors as relevant influences on modal decisions [1, 3-7].

The data were analyzed using the Multinomial Logit (MNL) Model in STATA 19. This model was chosen because the dependent variable is nominal with more than two mutually exclusive alternatives, and the model allows the estimation of the relative probability of choosing each mode against a reference category. It has been widely used in mode choice studies due to its parsimonious structure, interpretability, and suitability for developing-country contexts with limited modal options [2, 10, 25]. Before estimation, the data were checked for completeness and consistency. Multicollinearity among the independent variables was assessed before estimation through diagnostic checks to ensure that no serious collinearity problem affected the parameter estimates. The Independence of Irrelevant Alternatives (IIA) assumption was also considered as part of model validation, given the structure of the three transport alternatives analyzed. Accordingly, the choice of the MNL model was based not only on the categorical nature of the dependent variable, but also on the study's objective of obtaining an interpretable and parsimonious baseline model for a constrained-choice setting. Formal post-estimation testing of the IIA assumption was incorporated into the model evaluation procedure and is reported in the analytical results. Model adequacy was evaluated using the likelihood ratio test, overall model significance, and pseudo R^2. Given the limited number of observed alternatives and the objective of explaining relative mode choice behavior in a remote border-region setting, the MNL model was considered an appropriate analytical framework for this study, while more flexible models such as nested or mixed logit remain relevant for future research.

III. RESULTS AND DISCUSSION

A. Socio-Economic Conditions of the Community

The findings of this study depict the socio-economic profile of the users of the Trans Papua Highway in Merauke Regency, which represents a disadvantaged, frontier, and border region (3TP). The demographic profile of respondents indicates a clear predominance of males, accounting for 66.7% of the sample, while females represented 33.3%. The age distribution was concentrated in the productive age groups, with 34.6% of respondents aged 19–25 years and 41.5% aged 26–35 years. This concentration in the productive age range is consistent with mobility demands associated with economic and social activities.

In terms of educational attainment, the largest group consisted of junior secondary school graduates (59.0%), followed by respondents with tertiary education qualifications at 28.1%, senior secondary school graduates at 10.6%, and primary school graduates at 2.2%. Respondents' occupations were also diverse. Students accounted for the largest share at 27.9%, followed by civil servants, military personnel, and police officers at 21.2%, teachers and lecturers at 15.1%, private-sector employees at 12.3%, traders at 10.1%, and farmers or plantation workers at 7.7%. This occupational diversity helps explain the range of trip purposes identified in the survey, including family visits (26.7%), recreation or tourism (20.2%), educational activities (20.0%), work-related travel (14.6%), business trips (11.6%), and official travel (6.9%).

In terms of mobility assets, motorcycle ownership emerged as the dominant form of vehicle access, accounting for 62.2% of respondents, followed by car ownership at 27.4%, while 10.4% reported owning both a motorcycle and a car. Driving license ownership also showed a relatively strong level of motorized mobility access: 51.1% of respondents held both

Class A and Class C licenses, 27.4% held a Class A license only, 9.6% held a Class C license only, 0.2% held a Class B1/B1 public license, and 11.7% had no driving license. The income distribution revealed two main groups: an upper-middle income group earning at least IDR 3.5 million per month (60.0%) and a lower-income group earning below that threshold (40.0%).

The spatial distribution of respondents' residence was heavily concentrated in Merauke Regency, which accounted for 89.6% of the sample, while the remainder came from Boven Digoel (2.2%), Mappi (6.2%), and Asmat (2.0%). The dominance of Merauke residents is consistent with the location of the study corridor and corresponds with the concentration of trips towards specific service nodes. The data further indicate that Sota was the primary destination (41.7%), followed by Muting (23.0%), Bupul (17.5%), and Erambu (16.3%), while Rawahayu (0.5%) and Kumaaf (1.0%) accounted for only a small proportion of trips.

B. Multinomial Logit Model Estimation

The mode choice analysis compared private motorcycle and Damri bus against private car, which was specified as the base outcome. The estimation was conducted using 405 observations, allowing the model to reflect the actual behavior of transport users in Merauke. Defining private car as the reference category made it possible to assess how changes in socio-economic characteristics, trip attributes, and access to mobility resources altered respondents' relative likelihood of choosing a motorcycle or a Damri bus instead of a car. The estimation results show that the model is statistically robust, with an LR chi-square of 360.40 (df = 24) and a probability value of 0.0000, indicating that the independent variables jointly make a significant contribution to explaining variation in mode choice. The pseudo R^2 value of 0.4079 further suggests that the model has adequate explanatory power for analyzing travel behavior along a pioneering corridor with limited modal alternatives. A summary of the final estimation results is presented in Table I.

In the comparison between private motorcycle and private car, the significant variables were cost, travel time, gender, travel culture, driving license ownership, and trip destination. By contrast, age, education, occupation, income, vehicle ownership, and trip purpose were not statistically significant. Among the significant predictors, cost, travel time, and driving license ownership exhibited the most pronounced effects. The negative coefficients for cost, travel culture, driving license ownership, and trip destination indicate a lower relative likelihood of choosing a motorcycle over a car, whereas the positive coefficients for travel time and gender suggest a higher relative likelihood. One notable finding in this comparison is the significance of travel culture, implying that this behavioral dimension has clear empirical relevance in explaining choices between the two private modes.

In the comparison between the Damri bus and the private car, a larger number of predictors were found to be statistically significant. These included cost, travel time, age, education, occupation, income, driving license ownership, vehicle ownership, and trip destination. In contrast, gender, travel culture, and trip purpose were not significant. Among the significant variables, cost, travel time, income, and driving license ownership showed the strongest effects. Negative coefficients for cost, education, occupation, income, driving license ownership, vehicle ownership, and trip destination indicate a reduced relative likelihood of choosing a Damri bus over a private car, whereas travel time and age displayed positive relationships. The direction of the travel time effect should be interpreted in accordance with the operational definition used in the survey instrument.

TABLE I. MNL MODEL

Variable	p> |z|	RRR	explanation
Private motorcycle			
Cost	0.001	0.192428	Significant
Travel time	0.030	3.122792	Significant
Age	0.299	1.584585	Not significant
Gender	0.003	2.811454	Significant
Travel culture	0.008	0.357213	Significant
Education	0.080	0.494278	Not significant
Occupation	0.651	1.130759	Not significant
Income	0.278	0.694626	Not significant
Driving license ownership	0.000	0.206249	Significant
Vehicle ownership	0.164	0.698093	Not significant
Trip destination	0.043	0.341402	Significant
Trip purpose	0.853	0.968079	Not significant
Private car (base outcome)			
Damri bus			
Cost	0.000	0.013087	Significant
Travel time	0.000	17.451158	Significant
Age	0.021	4.693521	Significant
Gender	0.256	1.640096	Not significant
Travel culture	0.179	0.478580	Not significant
Education	0.001	0.154166	Significant
Occupation	0.028	0.388092	Significant
Income	0.000	0.044292	Significant
Driving license ownership	0.000	0.054354	Significant
Vehicle ownership	0.019	0.249063	Significant
Trip destination	0.029	0.240061	Significant
Trip purpose	0.699	1.108960	Not significant

Overall, the estimation results reveal four main empirical patterns. First, cost and driving license ownership were significant in both modal comparisons and consistently showed a negative association with the relative likelihood of choosing either a private motorcycle or the Damri bus over a private car. Second, travel time was significant in both comparisons and had a positive coefficient, although its magnitude was substantially larger for the Damri bus. Third, socio-economic predictors such as education, income, and vehicle ownership were especially salient in the comparison between the Damri bus and the private car. Fourth, trip destination was significant in both comparisons, while travel culture was significant only in the comparison between the private motorcycle and the private car.

C. Model Interpretation: Private Motorcycle vs Private Car

In the comparison between the private motorcycle and the private car, findings indicate that modal competition occurs primarily between the two private modes. As a result, the differentiating factors are more closely related to utility, individual mobility readiness, and established travel practices. From the perspective of random utility theory, the decision to

choose a motorcycle or a car can be understood as the outcome of an evaluation of trip attributes and the user's capacity to access each alternative. The negative and significant effect of cost suggests that as the perceived sacrifice associated with travel increases, the relative likelihood of choosing a motorcycle over a car declines. This result is consistent with the literature identifying cost as a key determinant of mode choice, while also extending it by showing that cost sensitivity in border regions does not necessarily translate into a stronger preference for the mode that is generally assumed to be cheaper [2, 3]. In the case of Merauke, cost appears to function not merely as a financial burden, but also as an indicator of utility screening linked to the stability and suitability of a mode for meeting travel needs.

Travel time was also significant. The model indicates that an increase in the value of the time variable raises the relative likelihood of choosing a motorcycle over a car. Because travel time is commonly associated with lower utility in transport studies, this result should not be interpreted literally without reference to the operational definition used in the survey instrument. Within the limits supported by the model, it can be stated that time is a strong predictor of motorcycle choice and that the temporal dimension of travel plays an important role in the structure of private mode choice. This interpretation remains consistent with studies showing that travel behavior in non-urban settings is strongly shaped by spatial conditions and actual accessibility efficiency, rather than by service attributes in the conventional sense alone [1, 26].

The most notable contribution of this analysis is the significance of travel culture. This finding is important not simply because an additional variable proved significant, but because it indicates that competition between the two private modes is not shaped solely by cost, time, and demographic characteristics. It is also influenced by behavioral and cultural dimensions embedded in everyday mobility practices. In this respect, the present study extends the literature, which has largely emphasized perceptions of safety, comfort, and reliability as the main psychological mediators of modal decisions [5, 6]. In the context of Merauke, travel culture suggests that the choice between motorcycle and car is shaped by social habits emerging from culturally driven activities. Importantly, this dimension does not operate uniformly across all transport alternatives; rather, it appears in an alternative-specific manner, being significant only in the competition between the two private modes. This finding also addresses a gap in the literature concerning the limited quantitative exploration of cultural and institutional factors in mode choice models for Indonesia's border regions [27, 28].

The significance of gender, driving license ownership, and trip destination further reinforces the argument that the choice between motorcycle and car is influenced by individual mobility readiness and activity context. The effect of driving license ownership, in particular, can be interpreted through the concept of mobility capital, namely an individual's formal and practical capacity to access a given mode. In this study, license ownership is associated with a lower relative likelihood of choosing a motorcycle over a car, suggesting that legal access to the driving system increases the tendency to opt for the more dominant private mode. Meanwhile, the significance of trip destination is in line with the literature showing that mode choice is closely related to the type of activity being undertaken and the degree of flexibility required by the traveler [3]. By contrast, the non-significance of age, education, occupation, income, vehicle ownership, and trip purpose indicates that in the choice between the two private modes, broader socio-economic capacity is not always the main differentiating factor. What matters more are trip attributes, legal access, and established mobility habits.

D. Model Interpretation: Damri Bus vs Private Car

Unlike the motorcycle category, the comparison between the Damri bus and the private car reveals a more complex pattern. Substantively, this result reflects the competition between public and private transport in a setting where modal options are limited. The model indicates that the decision to use the bus is not determined solely by service attributes, but is also strongly shaped by the distribution of socio-economic resources and by actual access to private modes. Cost emerged as the strongest determinant, with a sharply negative coefficient, confirming that the competitiveness of public transport is highly sensitive to changes in user-perceived travel costs. This finding reinforces earlier studies showing that in areas with limited services, cost functions as a primary filter in the decision to use public transportation [2, 29]. In the context of Merauke, however, the result also reveals how narrow the competitive space for bus services becomes when they are evaluated against private car use.

Travel time was likewise a very strong predictor in the bus category. As in the motorcycle model, however, the direction of this effect should be interpreted with caution and in accordance with the operational definition used in the survey instrument. What can be stated with confidence is that the temporal dimension has substantial discriminating power in explaining the choice between the bus and a car. This finding remains consistent with the literature emphasizing the importance of users' assessments of the temporal performance of transport services, including regularity, predictability, and the extent to which travel can be synchronized with everyday activity needs [12, 13]. In other words, the result should not be treated as a deviation from theory, but rather as an indication that in border-region contexts, the temporal dimension may operate through a broader practical meaning than travel duration alone.

The most important finding in the bus category is the dominant role of education, income, driving license ownership, and vehicle ownership. These four variables consistently reduce the relative likelihood of choosing the bus over the car, indicating that the greater an individual's mobility capital, the less likely they are to rely on public transport. In this respect, the study not only confirms that higher-income groups tend to have wider travel options [1, 4], but also extends this argument to a border-area context by showing that public transport choice is embedded in a structure of unequal access. Damri bus services in Merauke can therefore be understood not merely as a technical alternative, but as a mode whose position is shaped by the relationship between affordability, constrained choice, and the user's ability to secure travel flexibility through private

modes. This interpretation is inferentially stronger than attributing symbolic meanings to private cars, because it remains grounded in what the model actually demonstrates regarding access and mobility capacity.

The significance of age, occupation, and trip destination further suggests that bus choice is highly contextual. Age may reflect different life-course stages in travel preference, while occupation and trip destination indicate that activity demands shape whether the bus is seen as a viable option. By contrast, the non-significance of travel culture in this category actually sharpens the conceptual contribution of the study: the behavioral-cultural dimension that proved significant in the competition between private modes does not automatically operate in the same way when the comparison is between public and private transportation. Thus, the novelty of this study lies not only in the inclusion of travel culture as a variable, but also in the finding that its influence depends on the structure of the alternatives being compared. This extends the mode choice literature by showing that behavioral-cultural factors are not universal across all modes, but instead operate within specific choice configurations.

E. Sensitivity of Cost and Time to Mode Choice Probabilities

A sensitivity analysis was conducted to examine how mode choice probabilities change when the two most influential trip attributes in the model, namely cost and travel time, vary progressively. Within a multinomial logit framework, these effects should not be interpreted in isolation, because changes in one attribute alter the relative utility of all available alternatives simultaneously.

Based on simulations using incremental changes from 5% to 30%, both cost and travel time exerted strong effects on shifts in mode choice probabilities (Figure 2), although their response patterns differed. On the cost side, the most visible changes occurred in the competition between the Damri bus and the private car. Lower costs tended to increase the probability of choosing the Damri bus, whereas higher costs strengthened the probability of choosing a private car. This pattern confirms that affordability remains a central determinant of public transport competitiveness in border corridors where modal options are limited and travel distances are long.

A similarly high level of sensitivity was observed for travel time (Figure 3). Variations in time generated substantial shifts in the probabilities of choosing both the Damri bus and the private car, while the probability associated with the private motorcycle changed more moderately. In this context, travel time should not be interpreted merely as the raw journey duration, but as a broader expression of effective travel burden and temporal competitiveness. The stronger response observed in the Damri bus versus private car comparison indicates that temporal considerations become especially salient when users evaluate whether public transport can remain functionally competitive with private mobility under long-distance corridor conditions. By contrast, the more moderate response associated with private motorcycle suggests that this mode may retain a comparatively stable utility, likely due to its greater individual flexibility and immediacy of access.

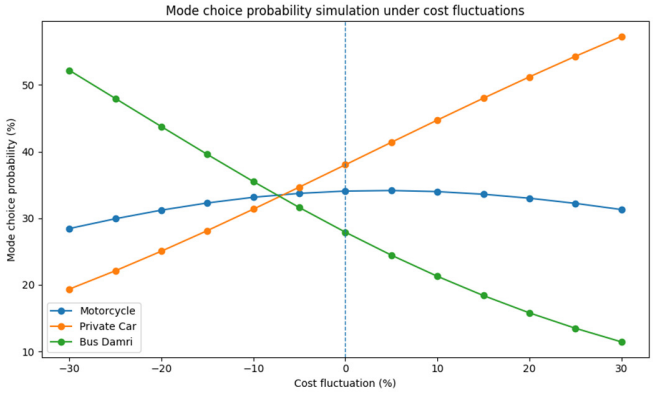

Fig. 2. Sensitivity of cost to changes in mode choice probabilities.

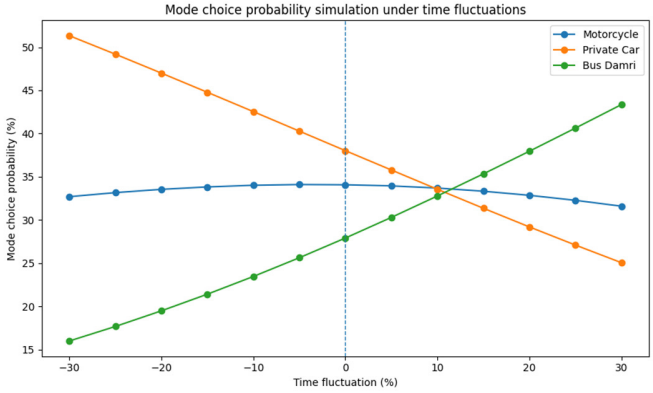

Fig. 3. Sensitivity of travel time to changes in mode choice probabilities.

Taken together, these results show that cost and travel time do not operate independently. They rather jointly reshape the relative attractiveness of each transport mode. More importantly, the sensitivity analysis indicates that the most policy-relevant competition occurs between the Damri bus and the private car and not uniformly across all alternatives. This finding supports the relevance of fare policy and affordability measures on one hand, and improvements in service reach, operational reliability, and the reduction of effective travel-time burdens on the other. In this sense, gradual changes in cost and travel time can produce meaningful shifts in mode choice probabilities, particularly in the public–private competition that defines mobility options in remote border corridors such as Merauke.

F. Theoretical and Practical Implications

The main contribution of this study is not restating the familiar proposition that cost, income, and vehicle access influence mode choice, but showing that their effects are segmented by the structure of modal competition in a constrained-choice border corridor. On the Trans Papua corridor in Merauke, the competition between the use of the private motorcycle and the private car is shaped primarily by trip attributes, legal access, and travel culture, whereas the competition between the Damri bus and the private car is driven more strongly by socio-economic resources and private mobility access. This indicates that mode choice in border

regions is governed by alternative-specific mechanisms rather than by a single general pattern.

From a theoretical perspective, the findings refine the application of the random utility theory in remote border settings. Modal utility is formed not only through cost and travel time, but also through the interaction between mobility capacity and the competitive structure of the alternatives being compared. The clearest novelty of this study lies in showing that travel culture has explanatory value only under a specific modal configuration. It is significant in the motorcycle-versus-car comparison, but not in the bus-versus-car comparison. This suggests that behavioral-cultural influences are selective rather than universal, and are more relevant when users choose between private modes that both offer flexibility but carry different meanings in local social practice. The study therefore extends the mode choice literature by showing that behavioral variables in border regions are context-dependent and configuration-specific.

The practical implications are strongest in the competition between Damri bus and private car. Because cost, travel time, income, driving license ownership, vehicle ownership, and trip destination significantly shape the probability of choosing the bus, policy should be more targeted. First, fare support and affordability measures are especially relevant for users with limited private mobility access, since the sensitivity analysis shows that the relative position of the Damri bus is highly responsive to cost changes. Second, service accessibility should be improved through greater service reach, boarding convenience, and operational reliability under long-distance corridor conditions, not through infrastructure expansion alone. Third, the Damri bus should be positioned primarily as a critical mobility option for users with constrained access to private vehicles and legal driving access, rather than as a mode expected to compete equally across all user groups.

The significance of travel culture in the private-mode comparison further implies that mobility policy in Merauke cannot be based solely on assumptions of individual cost minimization. Some travel decisions are shaped by collective and socially embedded mobility practices. These implications are especially relevant for remote border corridors characterized by dispersed settlements, long travel times, limited modal options, and unequal access to private mobility resources.

IV. CONCLUSION

This study demonstrates that the mode choice on the Trans Papua Highway in Merauke is structured by alternative-specific mechanisms rather than by a single general decision pattern. In this constrained-choice border setting, the competition between private motorcycle and private car follows a different logic from that between the Damri bus and the private car. The former is shaped more strongly by trip attributes, legal driving access, trip destination, and travel culture, whereas the latter is driven more by socio-economic capacity and private mobility resources, particularly education, income, driving license ownership, and vehicle ownership.

The main theoretical contribution of this study lies in showing that behavioral-cultural factors are contingent rather than universal in mode choice analysis. Travel culture is significant only in the motorcycle-versus-car comparison and not in the bus-versus-car comparison, indicating that its explanatory power emerges under a specific modal configuration, namely when users choose between private modes that both provide flexibility but are embedded differently in local social practice. This finding refines the application of random utility theory in border corridors by showing that utility is shaped not only by cost and time, but also by the interaction between mobility capacity and the competitive structure of alternatives.

The practical implication is equally clear. In remote border corridors such as Merauke, the Damri bus should be treated not as a universally competitive mode, but as a targeted mobility service for users with limited access to private vehicles and legal driving access. Because the model and sensitivity analysis show strong responses to cost and travel time, policy should prioritize fare affordability, service reach, and operational reliability rather than relying on service provision alone. At the same time, mobility policy for private modes should remain sensitive to collective and socially embedded travel practices that continue to shape local travel behavior.

More broadly, the study suggests that transport policy in disadvantaged, frontier, and border regions should be differentiated according to the structure of modal competition rather than framed through uniform assumptions about user behavior. Future research should test whether this alternative-specific pattern recurs in other frontier corridors and apply richer model specifications to deepen the interpretation of behavioral and policy mechanisms.

DECLARATION OF COMPETING INTERESTS

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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DATA AVAILABILITY

The data used in this study were collected by the authors through a primary survey. The data are available from the corresponding author upon reasonable request.

AI USE AND DECLARATION OF GENERATIVE AI USE

During the preparation of this paper, the authors used Trinka AI to support language editing and grammar improvement. The tool was used only for language refinement and was not used in the research methodology, data analysis, interpretation of results, or to create or modify images. After using this tool, the authors reviewed, edited, and verified the content as needed and take full responsibility for the content of the publication.

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