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Analysis Factors Influencing Motorcycle and Car Ownership in Medium-Sized Region in Developing Countries (A Case Study of Badung Regency, Bali-Indonesia)

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Abstract The economic growth of cities in developing countries is followed by the rapid growth of private vehicle ownership. The predicted exponential growth of vehicles will be followed by rapid growth in oil demand and a significant increase in environmental impact such as air pollution, traffic noise, and road traffic accidents. Therefore, it is important to understand the factors affecting car ownership. Studies on private vehicle ownership were mainly focused on the metropolitan area level. Using Badung regency as a case study, this study was focused on model car and motorcycle ownership in a medium-sized region by using Poisson regression. Data were collected from 180 households. The results indicated the characteristics of households with the highest percentage, namely car ownership per household of one unit (45.56%), and motorcycle ownership per household of three units (36.11%). For the motorcycle ownership model, there were three independent variables identified as significant predictors, i.e. monthly family income, monthly transport cost, and the number of family members. For the car ownership model, there were seven significant predictors, i.e. monthly family income ((MFI8, MFI7, MFI6), number of students in household, and other variables (safety, accommodating more family members, and social status).

Keywords Motorcycle, Car, Ownership, Medium-Sized Region, Poisson Regression

1. Introduction

The economic growth especially in developing countries is followed by the rapid growth of private vehicle ownership. The total number of vehicles was estimated to increase from 800 million (2002) and reach about two billion units in 2030, where developing countries will have more than 50% of the world's vehicles [1]. The predicted exponential growth of vehicles will be followed by rapid growth in oil demand and a significant increase in environmental impact such as air pollution, traffic noise, and road traffic accidents. By using traffic accident data in low-income regions (Karangasem regency in Bali province, Indonesia), [2] found that there were 172 accidents involving motorcycles. According to [3], more attention has been given to the adverse impact of road traffic noise on health in developing countries. The increase in traffic volume has been followed by the increase in road traffic noise, congestion, accidents, and air pollution.

In a developing country such as Indonesia, the total number of vehicles has continued to increase every year. According to [4], the total number of motorized vehicles in

Indonesia has increased by about 7.6%, from 133.617.012 (2019) to 143.797.227 (2021). The number of vehicles was dominated by motorcycle (about 84% of the total vehicles). The growth of private vehicle (car and motorcycle) ownership becomes the main concern of the government. Therefore, it is important to understand the factors affecting private vehicle ownership.

Many studies have focused to model private vehicle ownership. Car ownership was influenced by socioeconomic characteristics such as income levels [5, 6, 7]. Car ownership was also influenced by household size and composition [6]. The number of family members, adults, and employees in a household also influenced car ownership [8]. Car ownership was also influenced by education levels [9, 10]. Another study reported that population density was negatively correlated with car ownership [11]. However, [12] found that population density influenced car ownership in Manila city with low public transit services. Unlike an increasing vehicle ownership trend in developing countries, [13] found declining car ownership in the Puget Sound region, Washington State between 2002 and 2014. This was caused by the implementation of the compact city concept which was supported by a good public transport service.

One of the methods that are often used to model car ownership is the multinomial logit model. An investigation of car and motorcycle ownership has been done in Taipei, Taiwan [14]. They found that car ownership was influenced mainly by utility factors such as reliability and convenience, which has increased car ownership by 12-29%. However, the increase in convenience of a car has reduced motorcycle ownership. Another study [15], also applied the Multinomial Logit Model to study private vehicle ownership in Khon Kaen City, Thailand. They found that car ownership was influenced by household income. However, the income level did not influence motorcycle ownership. Other aspects that influenced motorcycle ownership include the limitation of using a car, the leniency of using a motorcycle, the friction of living quality, and level of education. An investigation on factors affecting car ownership has been conducted in Akure, South West, Nigeria based on a multinomial logit model [16]. They stated that car ownership was influenced by the household income level and members, where an increase in income and family members by 50% was followed by an increase in the car ownership by 51% and 0,8%, respectively. A recent study on factors affecting household car ownership based on the multinomial logit model has been conducted in Belgium [17]. They found that car ownership was influenced by income, residential location, ownership of the driving license, number of adults and children, education level, and age.

Other than the multinomial logit model, Poisson regression has also been used in transport studies. For example [18], have applied Poisson regression to study the relationship between the travel times of the individuals and the number of motorized trips. [16] used Poisson and negative binomial regression to model car ownership in Nigeria. They found that car ownership was influenced by income and household members. [13] investigated declining car ownership in the Puget Sound region, Washington State using Poisson regression. They stated that the decline in car ownership was influenced by the availability of good public transport services, the increase of young adults living in compact neighborhoods (smart growth policy) and mobility preferences.

Private vehicle dependency is common in Indonesian cities. Previous studies in the developed countries focused only to model car ownership. As the number of motorcycles has dominated private vehicles in Indonesia, this study investigated both car and motorcycle ownership. However, a lack of recent studies available. Previous studies were mainly focused on the metropolitan areas [19]. According to [20], car ownership was higher in suburban areas with a lower population density because of less access to public transit and other destinations. The objective of this study is to investigate car and motorcycle ownership in a medium-sized region and used Badung regency in Bali Province, Indonesia as a case study location. This study applied Poisson regression to develop car and motorcycle, ownership models. By understanding factors that influence car and motorcycle ownership in a medium-sized region, it is hoped to contribute to the government in preparing a policy intervention to reduce both car and motorcycle ownership.

2. Materials and Methods

The car ownership models have been classified into aggregate models (cross-sectional and time series models) and disaggregate models (Static and Semi- Dynamic models include Discrete Choice models such as Ordered Logit, Multinomial Logit, Nested Logit, Hierarchical Logit, Binary Logit, and Poisson regression) [21]. According to [13], Poisson regression is a relevant statistical technique to be used to model a count-dependent variable that takes into account nonnegative integer values or zero in many instances. The Poisson model can be used if the data set is free from over-dispersed issues. As an illustration of the principle of the poissson regression model, an opportunity or probability of the number of events yi per time period has the following formula [22]:

$$P(y_i) = \frac{\exp(-\lambda_i)\lambda_i^{yi}}{y_i!} \quad (1)$$

Where:

$P(y_i)$: the probability of the number of events per time period in a given place

i: observation in a certain place

λ_i: Poisson parameter for a specific place

The Poisson regression model is estimated by specifying the Poisson parameter i (or the expected number of events

per time period, E[yi]) as a function of the independent variables. The general form of the model stating the relationship between the independent variable and the Poisson parameter variable is the log-linear model as follows:

$$\lambda_i = \exp(\beta X_i) \text{ atau } \mathrm{Ln}(\lambda_i) = (\beta X_i) \quad (2)$$

Where:
$E[y_i]$: λ_i or the expected number of events per time period
X_i: independent variable vector
β: model parameter vector

To estimate the parameter value or parameter coefficient to use the principle maximum likelihood. The function of the log-likelihood (LL) is as follows [22]:

$$LL(\beta) = \sum_{i=1}^{n}[-\exp(\beta X_i) + y_i \beta X_i - Ln(y_i!)] \quad (3)$$

The significance level of each parameter of the Poisson model was approached using a t-test (a one-tailed t-test). Estimation is done by determining the parameter value significantly not 0 where the t-test distributed according to the t-distribution is as follows [22]:

$$t = \frac{\beta - 0}{S.E.(\beta)} \quad (4)$$

Where S.E.(β) is the standard error value of the model parameters. Furthermore, the last test is to test the feasibility of the overall model (goodness of fit) by using a comparison between deviance and degrees of freedom (dv/df) equal to or less than 1. If it is more than 1 then it is called overdispersion.

Bali Province consists of 9 cities/regencies, namely Denpasar, Badung, Gianyar, Tabanan, Klungkung, Bangli, Karangasem, Jembrana and Buleleng. Badung regency is the center of tourism area in Bali and has been selected as a case study location in this study. Figure 1 shows the case study location in Badung regency, Bali-Indonesia. Badung regency has an area of 418.52 km^2 with a total population of 670,200 people and a population density of 1,601.4 people/ km^2 [23]. Badung has been famous as a tourism center in Bali, especially in the Kuta Beach area. Its reputation has attracted many tourists to visit. This has generated high economic growth for the region. The gross regional domestic product (GRDP) has increased constantly from IDR 42,429.25 billion in 2015 to IDR 62,794.58 billion in 2019. This GRDP is the highest among 9 regions in Bali Province. As the economy continues to grow, motorcycle and car ownership has also increased. However, it has been followed by an increase in the number of traffic accidents and has reached 205 accidents in 2019 with 62 deaths [23]. Unfortunately, there is no good public transport service available and the people are highly dependent on using private motor vehicles for their daily mobility. The largest residential area in Badung regency is Dalung Permai residential area which is located in the North Kuta District. The total population living in Dalung Permai residential area is 12,144 people in an area of 107.79 Ha with a total of 3,130 households. The Dalung Permai residential area has been selected as a case study location in this study.

The first stage of this study has been a preliminary study and the identification of the study location. This study has used generalized Poisson regression to analyze factors that influence motorcycle and car ownership. The independent variables considered include socioeconomic and demographic data of each household. The secondary data collected include the total population and households. The primary data have been collected based on a home interview survey method.

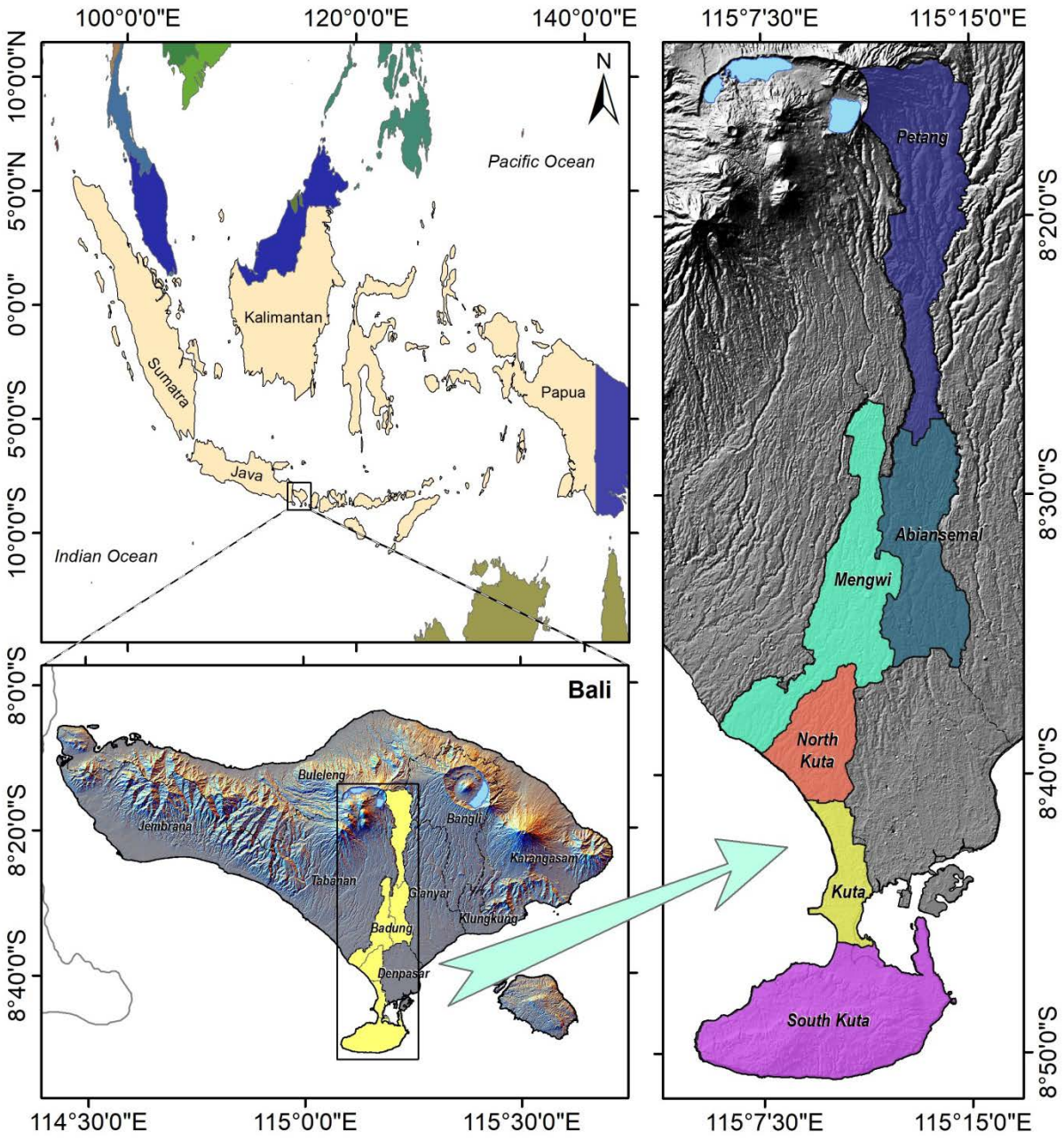


Figure 1. Study location in Badung Regency, Bali-Indonesia

The second stage has been conducting a pilot survey. During the pilot survey, 30 households have been analyzed and from the total of 3,130 households, it has been calculated statistically the minimum sample size required. It has been found that the total number of samples required was 180 households. The sample has been collected based on a stratified random sampling method. There were two dependent variables considered in this study, namely motorcycle ownership and car ownership. Table 1 shows the independent variables considered.

After the data from 180 households were obtained, the third stage has been the data compilation. The next stage has been the data analyses including a description of variables based on descriptive statistics, a multicollinearity test for the continuous variables, a reduction of dummy variables, and finally the analysis of factors influencing motorcycle and car ownership based on a Generalized Poisson Regression model using SPSS software.

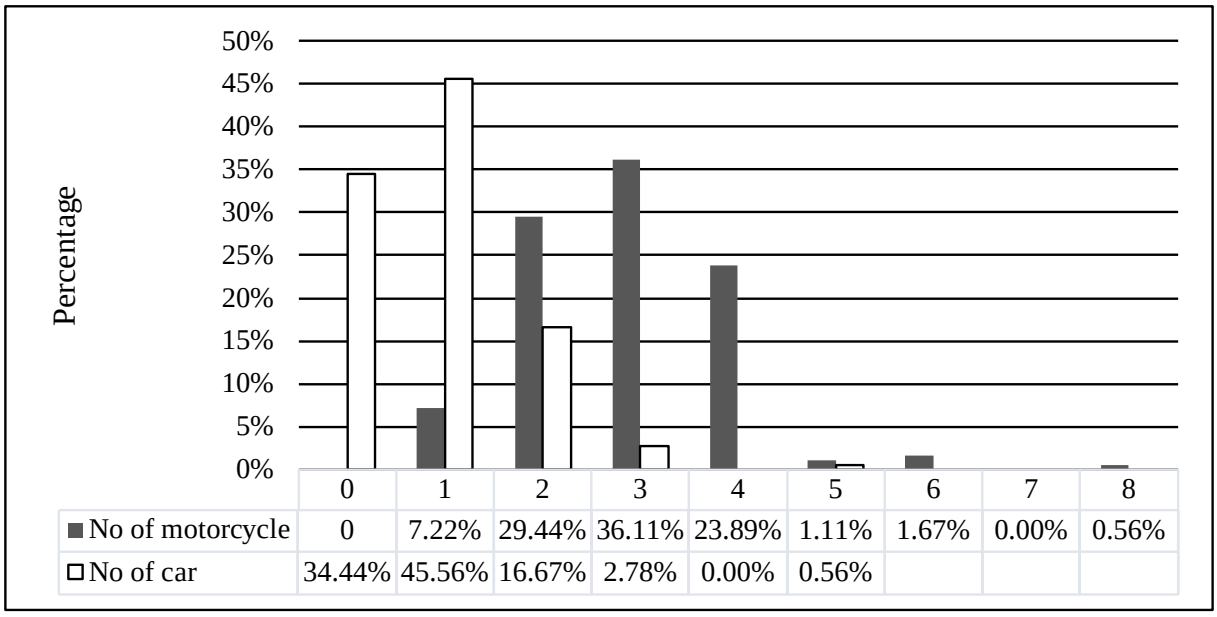
Table 1. Independent variables (household characteristics)

No	Independent variables	Code and description
1	Number of family members	No of family
2	Number of workers	No of worker
3	Number of students	No of student
4	Trip frequency per day	No of trip
5	Travel distance	Distance
6	Monthly family income	MFI 1 (total income < IDR 2 million) MFI 2 (2 ≤ total income < IDR 3 million) MFI 3 (3 ≤ total income < IDR 4 million) MFI 4 (4 ≤ total income < IDR 5 million) MFI 5 (5 ≤ total income < IDR 6 million) MFI 6 (6 ≤ total income < IDR 7 million) MFI 7 (7 ≤ total income < IDR 8 million) MFI 8 (total income ≥ IDR 8 million)
7.	Monthly transport cost	MTC 1 (total cost < IDR 500,000) MTC 2 (IDR 500,000 ≤ total cost < IDR 1 million) MTC 3 (IDR 1 million ≤ total cost < IDR 1.5 million) MTC 4 (IDR 1.5 million ≤ total cost < IDR 2 million) MTC 5 (2 ≤total cost < IDR 2.5 million) MTC 6 (IDR 2.5 million ≤ total cost < IDR 3 million) MTC 7 (IDR 3 million≤ total cost < IDR 3.5 million) MTC 8 (total cost ≥ IDR 3.5 million)
8.	Factors influencing motorcycle ownership	MC1 = low maintenance cost (1 = yes, 0 = no) MC2 = high maneuverability (1 = yes, 0 = no) MC3 = spare vehicle for car (1 = yes, 0 = no) MC4 = no public transport service (1 = yes, 0 = no) MC5 = poor public transport quality (1 = yes, 0 = no) MC6 = social status (1 = yes, 0 = no)
9.	Factors influencing car ownership	CAR1 = protected from heat and rain (1 = yes, 0 = no) CAR2 = safety (1 = yes, 0 = no) CAR3 = accommodate more family member (1 = yes, 0 = no) CAR4 = no public transport service (1 = yes, 0 = no) CAR5 = poor public transport quality (1 = yes, 0 = no) CAR6 = social status (1 = yes, 0 = no)

3. Results and Discussion

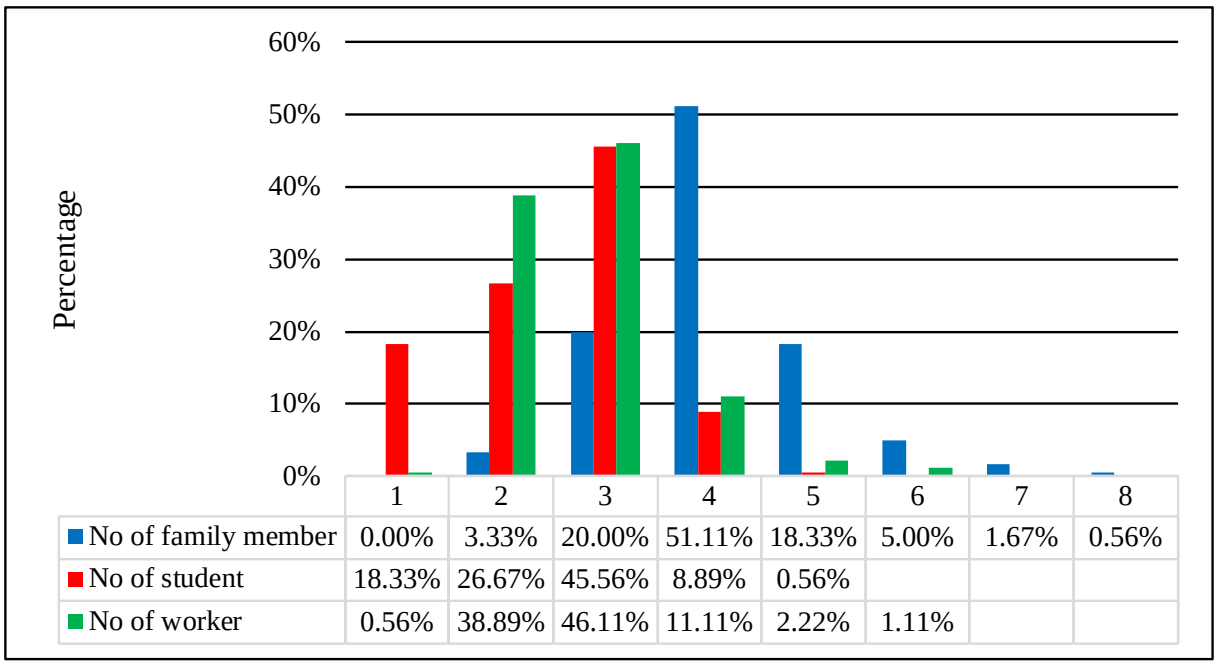
3.1. Household Characteristics

From Figure 2 it can be seen that the majority of households (45.56%) have one car and 36.11% own three motorbikes. Figure 3 shows that the number of family members of four people has the largest percentage of 51.11% followed by family members of three 20.00%, the majority of households (46.11%) have three working family members, and the majority of households (45.56%) with two students.



	0	1	2	3	4	5	6	7	8
No of motorcycle	0	7.22%	29.44%	36.11%	23.89%	1.11%	1.67%	0.00%	0.56%
No of car	34.44%	45.56%	16.67%	2.78%	0.00%	0.56%			

Figure 2. Percentage of motorcycle and car ownership



	1	2	3	4	5	6	7	8
No of family member	0.00%	3.33%	20.00%	51.11%	18.33%	5.00%	1.67%	0.56%
No of student	18.33%	26.67%	45.56%	8.89%	0.56%			
No of worker	0.56%	38.89%	46.11%	11.11%	2.22%	1.11%		

Figure 3. Percentage of a family members, students, and worker

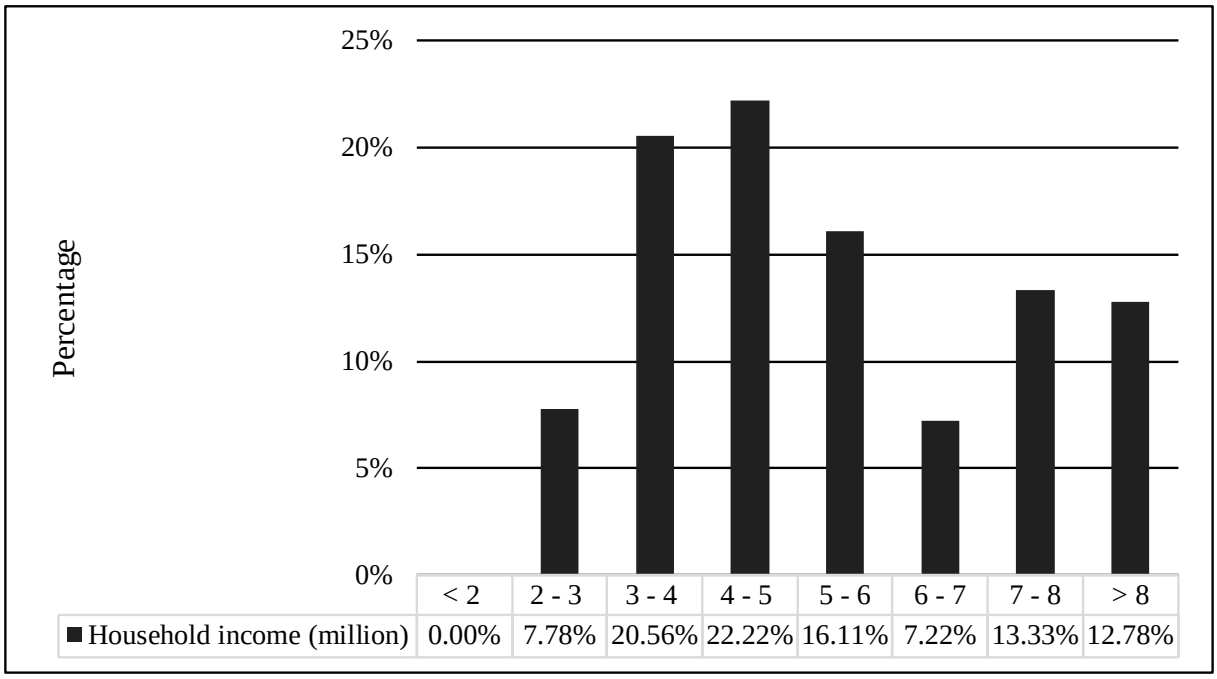


Figure 4. Percentage of household income (million)

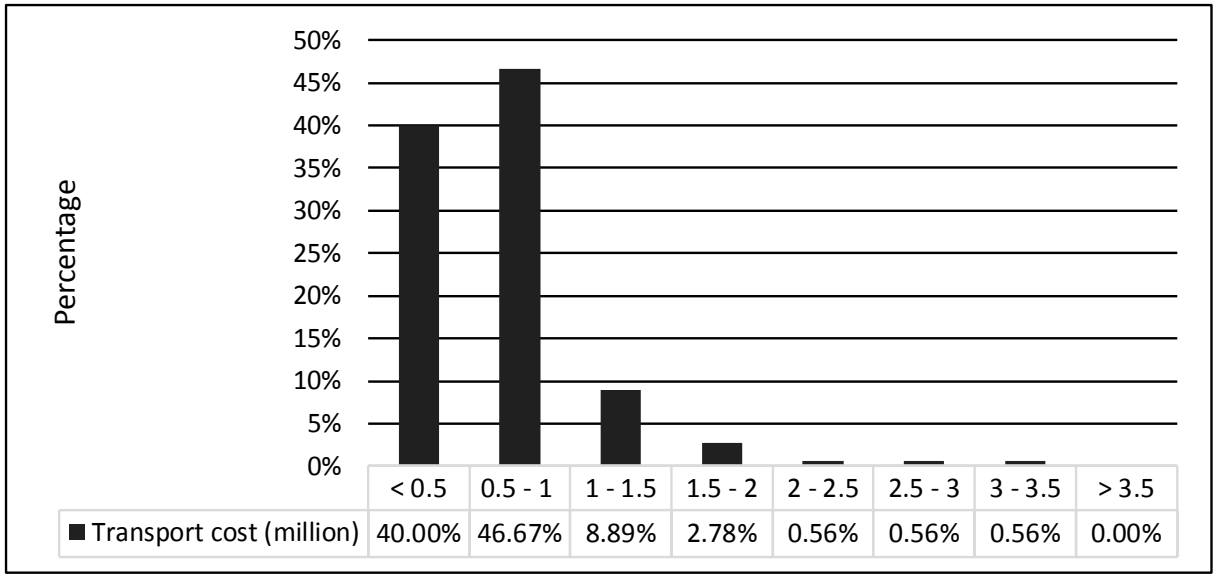


Figure 5. Percentage of transport cost (million)

If viewed from the total family income per month, Figure 4 shows that the majority of households (22.2%) have an income of IDR four million to five million.

In Figure 5, it can be seen that the total transportation cost of all family members per month under IDR five hundred thousand is 40.00%, then IDR five hundred thousand to one million is 46.67%, IDR one million to one million five hundred thousand is 8.89%, IDR one million five hundred thousand to two million by 2.78%, IDR two million to two million five hundred thousand by 0.56%, IDR two million five hundred thousand to three million 0.56%, IDR three million up to three million five hundred thousand by 0.56%, and the figure also shows that no household has transportation costs of more than IDR three million five hundred thousand.

For factors that influence buying a motorcycle, respondents are allowed to answer more than one factor. It was found that most of the households (51.94%) stated that the main reasons for owning a motorbike are because motorbikes have high maneuverability in traffic jam conditions (MC2). The reason for having a car, the majority of households (52.24%) stated because the car can accommodate more family members for certain purposes, 23.88% have a car because the car is more comfortable and can avoid heat and rain, 10.45% because the car has a higher level of safety compared to motorcycles, 8.96%

because there is no public transportation route, 1.49% the quality of public transportation is not adequate and 2.99% other factors.

The distance traveled is the total distance traveled by all family members per day either by motorbike or car. From the survey results, it was found that the average distance traveled was 48 km, while the shortest distance was 9 km and the farthest distance was 124 km. Meanwhile, the average number of household trips per day was seven trips a day, the smallest number of trips was once, while the highest number of trips was 20 trips per day.

3.2. Correlation Analysis and Dummy Variable Reduction

The results of the correlation test for the metric independent variables are shown in Table 2 using SPSS software analysis. It can be seen that all independent variables are statistically independent (do not have a dependence on other independent variables) because all of the correlation values are below 0.8.

Based on the multiple linear regression analysis, Table 3 shows that the independent variables that affect motorcycle ownership were Income7, Income8, Cost1, and Cost7. Merging categories were carried out for the total independent variable of income, namely by combining the categories of Income1 to Income6 into the category of Income7. Therefore, Income7 indicated the total income which was below IDR 8 million per month. Meanwhile, for the category of Income8, there was no change. The merger also applied to the independent variable total transportation costs per month (Cost) by increasing the upper limit of the Cost1 category to a total transportation cost of below IDR 3 million per month, for the Cost category 8 it was combined with the Cost category 7, therefore Cost 7 was the total transportation cost above or equal to IDR 3.5 million per month.

Table 2. Independent Variable Correlation Test

	No of family	**No of workers**	**No of students**	**No of trips**	**Travel distance**
No of family	1	0.171	0.446	0.211	0.240
No of workers	0.171	1	0.368	0.155	0.184
No of students	0.446	0.368	1	0.298	0.210
No of trips	0.211	0.155	0.298	1	0.458
Travel distance	0.240	0.184	0.210	0.458	1

Table 3. Motorcycle Ownership Dummy Variable Coefficient

Model		**Unstandardized coefficient**		**Standardized coefficient**		
		B	**Std Error**	**Beta**	**t**	**Sig**
1	(Constant)	2.872	0.075		38.20	0.000
	Cost7	5.218	1.009	0.356	5.09	0.000
2	(Constant)	3.112	0.093		33.38	0.000
	Cost7	4.888	0.969	0.339	5.04	0.000
	Cost1	-0.598	0.147	-0.274	-4.07	0.000
3	(Constant)	3.009	0.102		29.64	0.000
	Cost7	4.991	0.957	0.347	5.21	0.000
	Cost1	-0.529	0.148	-0.242	-3.57	0.000
	Income7	0.478	0.200	0.162	2.39	0.018
4	(Constant)	2.892	0.115		25.25	0.000
	Cost7	4.617	0.963	0.321	4.79	0.000
	Cost1	-0.425	0.154	-0.194	-2.75	0.007
	Income7	0.577	0.203	0.195	2.84	0.005
	Income8	0.491	0.229	0.153	2.15	0.033

In Table 4 it can be seen that the independent variables that affect car ownership were Income2, Income6, Income7, Income8, Cost1, and Cost7. Merging categories was done for the independent variable total income, namely by combining the category Income1 into the category Income2, so that Income2 represented the total income that was below IDR 3 million per month, then for the categories of Income3 to Income5, they were combined into Income6 so that Income6 indicated a total income of IDR 3 million to less than IDR 7 million per month. Meanwhile, the categories of Income7 and Income8 did not change. The merger also applied to the independent variable total transportation costs per month (Cost) by increasing the upper limit of the Cost1 category to a total transportation cost of below IDR 3 million per month, for the Cost category 8 it was combined with the Cost category 7, therefore Cost 7 was the total transportation cost above or equal to IDR 3.5 million per month. The factors that influence car ownership included more comfortable cars to avoid heat and rain (FICAR1), higher safety levels (FICAR2), loading more family members for certain purposes (FICAR3), and other factors (FICAR6).

3.3. Poisson Regression Model

The independent variables that have been freed from multicollinearity and the reduced categories of nonmetric independent variables were then used as estimators in the model of car and motorcycle ownership in the study area. The Poisson regression model was assumed to be statistically feasible to represent data if it had a ratio between deviance and degrees of freedom (dv/df) equal to or less than 1. From Table 5, it can be seen that ownership of motorbikes and cars was feasible to be modeled using Poisson regression.

Table 6 shows the results of the omnibus test. The omnibus test is a likelihood ratio chi-square test which is used to test whether the model with the full set of predictors fits significantly better than a null (intercept only) model. The results for motorcycle and car ownership models were significant, therefore these models were a significant improvement in fit over a null model.

Table 4. Car Ownership Dummy Variable Coefficient

Model	Unstandardized coefficient		Standardized coefficient		
	B	Std Error	Beta	t	Sig
(Constant)	0.644	0.107		6.033	0.000
Cost1	-0.259	0.117	-0.151	-2.214	0.028
Cost7	3.442	0.651	0.305	5.283	0.000
Income8	0.527	0.161	0.210	3.267	0.001
Income2	-0.347	0.154	-0.141	-2.254	0.025
Car1	0.388	0.132	0.176	2.928	0.004
Car3	0.350	0.108	0.203	3.250	0.001
Car6	0.922	0.326	0.162	2.833	0.005
Car2	0.464	0.180	0.148	2.571	0.011
Income7	0.344	0.141	0.148	2.445	0.016
Income8	0.445	0.206	0.127	2.153	0.033

Table 5. Model Feasibility Evaluation

Model	*Deviance (Dv)*	*Degree Of Freedom (df)*	*Dv/df*
Car ownership (Car)	105.472	166	0.635
Motorcycle ownership (MC)	53.413	172	0.311

Table 6. Results of the Omnibus Test

Dependent variables	Likelihood ratio chi-square	df	Sig.
Motorcycle ownership	268.138	5	0.000
Car ownership	59.186	13	0.000

Table 7 shows the motorcycle ownership model. There were three independent variables identified as significant predictors (MFI7, MTC1, and No of family). The Exp(B) column indicates the incidence rate ratio (IRR). The IRR indicates the estimated change in the incidence rate per unit increase on the independent variables as a predictor. If the IRR > 1, shows that an increase on the predictor's scores will be followed by the change in the incidence rate by a factor of the IRR. The IRR < 1 indicates that an increase of the predictor's scores will be followed by a decrease in the incidence rate by a factor of the IRR.

Motorcycle ownership was significantly influenced by monthly family income level. Controlling for the remaining predictors, it was found that motorcycle ownership would be 1.175 times greater (17.5% increase) for each increase of households with a monthly family income between IDR 7-8 million (MFI7). This finding is slightly different from the study conducted by [15] in Thailand who found that income level influenced car ownership but did not influence motorcycle ownership. The motorcycle ownership was also significantly influenced by monthly transport costs. For the low-income household especially with monthly transport costs of less than IDR 500.000 tended to use a motorcycle for their daily mobility. The motorcycle ownership would be 1.276 times greater (27.6% increase) for each increase of households with monthly transport costs < IDR 500.000 (MTC1). However, this finding is different from the [14] study who stated that the cost was not the main factor influencing motorcycle and car ownership. The increase in family member also influenced motorcycle ownership. The motorcycle ownership would be 1.219 times greater (21.9% increase) for each increase in the number of family members in a household. This is consistent with the study in Akure, South West Nigeria by [16] who found that the increase in household members has been followed by the increase in car ownership.

However, the trip distance and the number of trips were not significantly influenced motorcycle ownership as the people were highly dependent on using motorcycle no matter of distance and number of trips. When the insignificant predictors were excluded from the model, parameters for the intercept and significant variables were remained the same (only a little change occurred).

Table 8 shows the car ownership model. There are seven significant predictors for the car ownership model such as monthly family income ((MFI8, MFI7, MFI6), the number of students in the household (No of student), and other variables (CAR2, CAR3, and CAR6). The higher the income level of a household, the higher probability of having a car. Controlling for the remaining predictors, the IRR suggests that for every one unit increase on the household with monthly family income $\geq$ IDR 8 million (MFI8), the predicted incidence rate of car ownership changes by a factor of 5.855. For every one-unit increase in the household with monthly family income between IDR 7-8 million (MFI7), the predicted incidence rate of car ownership changes by a factor of 5.169. For every one-unit increase in household with monthly family income between IDR 6-7 million (MFI6), the predicted incidence rate of car ownership changes by a factor of 3.629. This finding is in line with the study by [15, 16, 17] who stated that family income has influenced car ownership in Thailand, Nigeria, and Belgium.

Another factor such as the increase in the number of students in a household with a sufficient income level was followed by the increase in the need to have a car. The car ownership would be 1.298 times greater (29.8% increase) for each increase in the number of students.

Table 7. Motorcycle Ownership Model

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	0.181*	0.0839	0.031	1.198
[MFI7]	0.162*	0.0634	0.011	1.175
[MFI8]				
[MTC1]	0.241*	0.0459	0.000	1.276
[MTC7]				
No of family	0.198*	0.0221	0.000	1.219
No of trip	- 0.004	0.0059	0.535	0.996
Distance	0.001	0.0007	0.116	1.001

Note: * significant at 95% level of confidence

Other factors such as safety issues, the need to accommodate more family members, and social status also influenced car ownership. For every one-unit increase in the household concerned with safety (CAR2), the predicted incidence rate of car ownership changes by a factor of 1.696. For every one-unit increase in the household concerned with accommodating more family members (CAR3), the predicted incidence rate of car ownership changes by a factor of 1.587. For every one-unit increase in the household concerned with social status (CAR6), the predicted incidence rate of car ownership changes by a factor of 2.667.

However, several variables such as monthly transport cost (MTC7), no of family, no of worker, no of trip, and distance were not significantly influenced car ownership. As there was no public transport service available, a family in the middle to high income level tended to own a car. Therefore, the car ownership was not influenced by the transport cost. The increase in the no of family and no of worker tended to be followed by the increase of using motorcycle and did not influence car ownership. The car ownership was also not influenced by no of trip and distance as the people had no other transport mode options. Similar to the motorcycle model, when the insignificant predictors were excluded from the model, parameters for the intercept and significant variables were remained the same (only a little change occurred).

For the motorcycle ownership model, the constant with the expected value log of the number of motorcycle ownership is 0.181 with all independent variables both influencing the model and not having an effect. Families with differences in the expected value log of motorcycle ownership are estimated to be 0.198 higher for the number of family members assuming other independent variables are constant. The number of trips with a difference in the expected value log of motorbike ownership is estimated to be 0.004 lower for the number of trips for family members assuming other independent variables are constant. Travel distance with the difference in the expected value of motorbike ownership is estimated to be 0.001 higher for the distance traveled by all family members assuming other independent variables are constant. Income 7 with the difference in the expected value log of motorcycle ownership is estimated to be 0.162 lower for a total family income of less than IDR eight million assuming the other independent variables are constant. Cost 1 with the difference in the expected value log of motorcycle ownership is estimated to be 0.241 lower for total family transportation costs of less than IDR 500 thousand assuming other independent variables are constant.

Table 8. Car Ownership Model

Parameter	B	Std. Error	Sig.	Exp(B)
(Intercept)	-1.914*	0.5775	0.001	0.148
[MFI8]	1.767*	0.5135	0.001	5.855
[MFI7]	1.643*	0.4915	0.001	5.169
[MFI6]	1.289*	0.4701	0.006	3.629
[MTC7]	0.948	0.5413	0.080	2.581
No of family	-0.069	0.1112	0.533	0.933
No of student	0.261*	0.1277	0.041	1.298
No of worker	0.055	0.1173	0.642	1.056
No of trip	-0.021	0.0297	0.481	0.979
Distance	-7.993E-5	0.0036	0.982	1.000
CAR2	0.528*	0.2550	0.038	1.696
CAR3	0.462*	0.1753	0.008	1.587
CAR6	0.981*	0.4366	0.025	2.667

Note: * significant at 95% level of confidence

For the car ownership model, a constant with a log of the expected value of the number of car ownership of -1.914 with all independent variables, both influencing the model and not having an effect. Families with differences in the expected value log of car ownership are estimated to be 0.690 lower for the number of family members assuming other independent variables are constant. Students with differences in the expected value log of car ownership are estimated to be 0.261 higher for the number of family members as students assuming the other independent variables are constant. Workers with differences in the expected value log of car ownership are estimated to be 0.055 higher for the number of family members as workers assuming other independent variables are constant. The number of trips with a difference in the expected value of the log of car ownership is estimated to be 0.021 lower for the number of trips for family members assuming other independent variables are constant. Income 6 with the difference in the expected value log of car ownership is estimated to be 1,289 higher for the total income of all family members with IDR 3 million – 7 million assuming the other independent variables are constant. Income 7 with the difference in the expected value log of car ownership is estimated to be 1.643 higher for the total income of all family members with IDR 7 million – 8 million assuming the other independent variables are constant. Income 8 with the difference in the expected value log of car ownership is estimated to be 1.767 higher for the total income of all family members higher or equal to IDR 8 million assuming the other independent variables are constant. Cost 7 with the difference in the expected value log of car ownership is estimated to be 0.948 higher for the total transportation costs of all family members higher or equal to IDR 3.5 million assuming other independent variables are constant. FICAR 2 with a difference in the expected value log of car ownership is estimated to be 0.528 higher for cars having a higher safety level assuming other independent variables are constant. FICAR 3 with a difference in the expected value of car ownership is estimated to be 0.462 higher for cars containing more family members for certain purposes assuming other independent variables are constant. FICAR 6 with a difference in the expected value log of car ownership is estimated to be 0.981 higher for other factors assuming the other independent variables are constant.

The next step is to identify each independent variable that affects the ownership of cars and motorcycles at a 95% confidence interval. There is one independent variable that affects motorcycle ownership, namely transportation costs per month of less than IDR 500 thousand. The independent variable of transportation costs per month is less than IDR 500 thousand and has a negative relationship with motorcycle ownership. Meanwhile, there are eight independent variables that affect car ownership, namely: Number of family members who are students; Total income IDR 3 million Income < IDR 7 million per month (Income6); Total income IDR 7 million Income < IDR 8 million per month (Income7); Total family income IDR 8 million per month (Income8); The car factor is protected from heat and rain (FICAR1); Higher safety factor (FICAR2); Factor containing more family members (FICAR3); and Other factors (FICAR6).

The independent variables of car ownership all have a positive relationship with car ownership. This means that as the number of family members with student status increases, the possibility of increasing the family's preference for owning a car increases. In addition, income and car ownership factors can also increase the family's preference for adding a car. From each of these influential independent variables, it can be seen that there is not one variable that has an effect at the same time, both on car and motorcycle ownership. In other words, every family has a specific preference for owning a motorcycle and a car. The next step is to determine the probability of the independent variable that affects the 95% confidence interval. The independent variables analyzed were only those that had a positive relationship with motorcycle and car ownership. This activity is carried out by assuming the other independent variables are constant and only taking into account the independent variables whose probability is to be calculated. The probability values that affect motorcycle and car ownership are shown in Table 9.

Probability analysis is a sensitivity analysis that measures the extent to which there will be a change in motorcycle ownership and car ownership if there is a change in the independent variables. From Table 9, it can be seen that if there is a change of 50% in the variable number of students, it is likely that there will be an increase in car ownership by one unit, while for income6, income7, and income8, there may be an additional two units of car ownership.

Table 9. The Probability Value of the Independent Variable

Model	Independent variable	Probability
Motorcycle ownership	Transportation cost < IDR 500.000	(negatif)
Car ownership	Students	1.14
	Income6	1.91
	Income7	2.27
	Income 8	2.42

4. Conclusions

This study investigated factors influencing car and motorcycle ownership in the medium-sized region of Badung Regency, Bali Province, Indonesia. Characteristics of households with the highest percentage, namely car ownership per household of one unit (45.56%), motorcycle ownership per household of three units (36.11%), the number of family members of as many as four people (51.11%), monthly household income in the range of IDR four million to five million (22.22%), transportation costs in the range of IDR five hundred thousand to one million (46.67%), the number of household members who work as many as two people (46.11%), the number of students which is two people (45.56%), the motorcycle ownership factor with a higher level of maneuvering or FIMC2 (51.94%), and the car ownership factor because contains more family members or FICAR3 (52.24%). Motorcycle ownership was found to have a positive relationship with the household members, income, and transport cost. The car ownership model was found to be influenced by income level, no of students, and other conditions such as safety, the ability to accommodate more family members, and social status. The probability value of the motorcycle ownership model with the independent variable of transportation costs per month is less than IDR 500 thousand and is not counted because it has a negative relationship with motorcycle ownership. While the probability value for the car ownership model with the independent variable the number of students is 1.14, the total income is IDR 3 million income < IDR 7 million per month at 1.91, total income is IDR 7 million income < IDR 8 million per month of 2.27, total family income IDR 8 million per month at 2.42. As the increase in income and family members of the household was followed by the increase in vehicle ownership, policy intervention is required to reduce private vehicle ownership by improving accessibility through promoting compact development and supported by a good public transport service. In order to attract people to use public transport, it is required to limit the use of private vehicles by implementing several transport policies such as restricting and rising parking fees, reducing subsidy of the gasoline, and increasing license fees. Future research direction is to evaluate the effectiveness of implementing compact development and public transport to reduce vehicle ownership in the medium-sized regions.

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