Analysis of Willingness to Pay for Toll Users in Central Java Province

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Abstract. Transportation infrastructure is a crucial component of national development. Road infrastructure development could lead to increased productivity, global competitiveness, employment opportunities, real sector growth, and reduced poverty. Therefore, this case study aimed to assess the willingness of toll road users in Central Java Province to pay for toll roads and the extent to which the parameters of gender, education, type of vehicle, and occupation affect the willingness to pay. The study also analyzed the variables influencing the toll user's willingness to pay (WTP). These variables include road conditions, income, age, type of vehicle, frequency of toll users, and travel destinations. Eviews software was used to analyze the economic impact of toll users through logistics regression. Furthermore, Stata software was used to conduct a descriptive analysis of the questionnaire data. The results showed that the frequency of toll users has the greatest impact on willingness to pay, surpassing traffic conditions, type of vehicle, purpose of travel, and travel time. The odds ratio value for the toll user's frequency was 66.85 [95% CI (13.02-343.07)]. It means that people using toll access more than 15 times are 66.85 times more willing to pay than those using the roads less frequently.

1 Introduction

Transportation infrastructure is an important part of national development. Transportation infrastructure increases productivity, global competitiveness, employment, and real sector growth, and helps reduce poverty [1], [2]. Solid road infrastructure should be balanced with increased quality in response to an important strategy scheduled by the Ministry of Public Works. Based on this strategy, sustainable development principles are applied to every road infrastructure development. Fulfillment of road infrastructure consumes many natural resources, requires large amounts of human capital, and affects the economy, specifically in areas around the development. Sustainable national development for economic improvement entails the construction of toll roads to distribute traffic flow and regional connectivity for

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trade centers [3]. Additionally, national strategies are needed to address increasing traffic volumes and overcome congestion to reduce travel time [4]–[8].

Central Java Province has experienced rapid economic, social, cultural, and other economic development. It is marked by a relatively high population and travel activities, especially since several cross-Java toll roads were operated at the end of 2018. Therefore, shopping and government administration centers, settlements, schools, hospitals, and entertainment facilities have been formed. However, the distribution of traffic and economy has not reached all areas, especially the suburbs. Toll roads are only built in the central trade area. The community has not received full service with the toll road tariffs that have been paid. In addition, the assessment of investment plans has not been adequate to prevent traffic problems [9]–[11].

This case study aimed to determine the willingness of toll road users in Central Java Province to pay for toll roads and to what extent the parameters of gender, education, type of vehicle, and occupation affect the willingness to pay. The government needs to analyze the effect of toll road networks on the willingness and ability of the community to pay toll fares. This research is important to determine the role of toll roads in contributing to economic growth in Central Java Province, which has become a trade center for the surrounding area.

2 Basic Theory

Transportation infrastructure impacts economic growth through increased productivity, technology overflow, and reduced production costs [12], [13]

2.1 Green Economy

Sustainable economic growth needs to continue to be developed through regional, subregional, and national forums. Government support in the form of macroeconomic policies to support the transition to a Green Economy can be achieved by increasing infrastructure development and prioritizing the integration of the green economy into development plans. Infrastructure development required modifications to online monitoring to ensure the safety of hydrogen energy concentrations by emphasizing fuel-cell commercial vehicles rather than passenger vehicles [14]–[17]. One of the green economy infrastructure development programs is the construction of the Trans Java toll road.

2.2 Economic Development

Economic development increases real per capita income to reduce poverty and income inequality. The development aims to increase the availability and distribution of basic goods such as food, clothing, health, and protection. Moreover, development improves living standards, including increased income, job availability, better education, and greater attention to human values.

2.3 Economy and Transportation

Low road infrastructure quality hinders economic growth, increases logistics costs, and disrupts efforts to reduce regional development disparities [18].

Bappenas (2020) identified the various domestic and global problems and challenges faced by the Indonesian economy in 2020 as follows:

1. encouraging low global economic growth in 2020. The main export destination countries are still experiencing an economic slowdown.
2. Increasing the financial ability to create jobs and reducing the number of poor people.

3. Maintaining economic or price stability of goods and services and the rupiah exchange rate. The Indonesian government is accelerating infrastructure development by providing financing and incentives through the Public Private Partnership scheme [19].

2.4 Analysis of Toll Road Development for Road Users

Government Regulation No. 15 of 2005 concerning toll roads defines a toll road user as anyone using a motorized vehicle by paying for the toll road. In this study, the economic analysis of toll users was explained as follows:

1. Income
   An employee's income for a certain period is based on the work performed. This study analyzed the income of toll road users in rupiah units. There is a significant relationship between the income of toll road users and their willingness to pay for the services [20].
2. Traffic conditions
   The traffic conditions describe the situation of toll road users and are an important factor in supporting the user's willingness to pay. The toll road is an alternative road for reducing congestion.
3. The purpose of the trip
   This study divided travel destinations into big, medium, and small cities. Government Regulation No. 26 of 2008 concerning the National Spatial Plan categorizes urban areas into large, medium, and small towns.
4. Type of vehicle
   Characteristics of toll road users based on the type of vehicle used, including private and public vehicles [21].
5. Frequency of use of toll roads
   The indicator of how often people use toll road services in one year analyzed was the impact of toll road use frequency on the user's willingness to pay [22].
6. Travel time
   Travel time is the total time required to travel from one area to another.
7. *Willingness to pay*.
   Willingness to pay is based on the products or services the user gets.

3 Methods

3.1 Sites

The locations used as the study objects were toll and national roads in the Central Java Province.

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Fig. 1. Study locations for toll and national roads in Central Java Province

3.2 Data Analysis Method

Primary data were collected by asking questions directly or through field surveys using a non-probability sampling technique. In this technique, each element in the population does not have the same opportunity to be selected as a sample. Sampling was performed using accidental and purposeful methods. The accidental method is the selection of samples that meet and match the required respondent criteria. Meanwhile, purposive sampling involves determining respondents who meet certain criteria. The questionnaire results described the toll road users, including gender, education, occupation, type of vehicle, purpose of the trip, and frequency of use.

Toll road users in Central Java Province were to meet certain criteria to qualify as respondents, including 1) users domiciled in Central Java Province and 2) users of private or office vehicles.

The study analyzed the variables that possibly influence the toll user's *willingness to pay*, including road conditions, income, age, type of vehicle, toll users' frequency, and travel destinations. Eviews software analyzed the economic impact on toll users through logistic regression. Furthermore, Stata software was used to perform a descriptive analysis of the questionnaire results. The results were interpreted and compared with relevant previous studies.

4 Results and Discussion

4.1 Analysis of Central Java Province Toll Users

The results of the questionnaires distributed online and offline in Central Java Province showed a general description of toll road users. The independent variable was the number of toll users in 15 cities and regencies in Central Java Province. The study collected data from 122 respondents, of whom only 116 were used after the variables were processed because the information was valid.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std Dev	Min	Max
Income	116	1.41e+07	4.74E+07	200000	5.00e+08
Gender	116	0.75	0.434913	0	1
Age	116	41.31897	9.360973	24	62
Traffic conditions	116	0.9310345	0.2544948	0	1
Traveling time	116	0.9655172	0.1832572	0	1
Transportation type	116	0.9137931	0.281887	0	1

Variable	Obs	Mean	Std Dev	Min	Max
Frequency of toll users	116	0.3448276	0.4773741	0	1
Travel purpose	116	0.327586	0.4444392	0	1

Source: research data (processed)

The results showed that the income variable for toll users in Central Java Province had an average of IDR 13,518,033. The respondents using toll roads had an average of 0.75, meaning that the male gender dominates toll users. The respondents were 41, and most drove on toll roads in smooth and fast traffic conditions. It was shown in the average traffic condition variable of 0.93. Moreover, travel time averaged 0.96, and most destinations were big cities. The variable for using toll roads in Central Java Province is frequent, on average of 5-14 times a month.

The study also conducted a univariate analysis of willingness to pay on toll roads. Willingness to pay was categorized into ≥ IDR 100,000 and < IDR 1000,000.

Table 2. Descriptive analysis of users' *willingness to pay* tolls.

	Willingness to pay		
	≥1 million (N=45)	<1 million (N=71)	Total
What are the traffic conditions when using the toll road?			
Congested	5	3	8
Fluent	40	68	108
What is the travel time when using the toll road?			
Faster	43	69	112
Just the same	2	2	4
How often do toll users use toll roads in one month?			
Rarely (1-4 times	5	43	48
Often (5-14 times)	15	25	40
Very often (>15 times)	25	3	28
What type of vehicle do you use when crossing the toll road?			
Private vehicle	43	62	105
Public transport	0	5	5
Rental vehicle	2	3	5
What is your purpose for using toll roads as accessibility?			

	Willingness to pay		
	≥1 million (N=45)	<1 million (N=71)	Total
Big city	37	48	85
Medium city	5	12	17
Small town	3	11	14

Source: research data (processed)

Table 2 shows that 45 of 116 respondents are willing to pay more than one million rupiahs (n = 45, WTP ≥ IDR. 1,000,000), while 71 are willing to pay less than one million (n = 71, WTP < 1 IDR 1.000.000). Furthermore, 40 respondents are willing to pay one million rupiahs or more when traffic conditions are smooth, while 68 are willing to pay less. Based on the results, 85 percent of respondents feel that accessibility is faster when traveling to big cities using a toll road. Moreover, 37 respondents are willing to pay more than 1 million (WTP> IDR 1,000,000), while 48 are willing to pay less (WTP < IDR 1,000,000). These results indicate that respondents need a faster transportation mode to increase time efficiency. Table 2 shows that 105 respondents use private vehicles, 5 use public vehicles such as buses, travel, and trucks, and 5 use rental vehicles. The descriptive analysis showed that the willingness to pay toll road fees averages less than 1 million. People are willing to pay more toll road fees because it is faster and more efficient with smooth traffic conditions.

4.2 Multivariate Analysis

Multivariate analysis was used to explain the effect of age, gender, traffic conditions, travel time, frequency of toll users, purpose of travel, and type of vehicle on the willingness to pay for toll road services.

4.2.1 Multicollinearity Test

The multicollinearity test was performed by analyzing the *Variance Inflation Factor* (VIF) value. Table 3 shows the test results.

Table 3. Multicollinearity Test Results

Variable	VIF
Income	307,25
Gender	4,29
Age	22,70
Smooth traffic conditions	121,73

Variable	VIF
Traffic jam conditions	6,96
Fast travel time	
Type of private vehicle	23,33
Common types of vehicles	2,99
The frequency of toll users is very high.	1,96
The frequency of toll users is frequent	
The frequency of toll users is rare	2,47
Big city travel destinations	8,87
Moderate city trip destination	2,43

Source: STATA data processing (2023)

The value of the *variance inflation factor* used in the multicollinearity test obtained is VIF <10. This value indicates no multicollinearity problem or significant correlation between the independent variables. The results showed that the variables of income, age, type of private vehicle, and smooth traffic conditions have a VIF value > 10. Therefore, these variables do not correlate with other independent variables. It means that the variables of income, age, type of private vehicle, and smooth traffic conditions have multicollinearity problems. However, logistic regression showed indications of multicollinearity problems, meaning the model is not good.

4.2.2 Parameter Significance Test Simultaneously and Partially

The parameter significance test was performed simultaneously with the G^2 test to assess the significance of the independent variables. The following is the calculation of G^2:

Table 4. Test results Likelihood ratio Null model with Conditional model

LR chi2	49,96
Probability>chi2	0,0000
Pseudo R^2	0,3288

Source: STATA data processing (2023)

Table 4 shows the simultaneous significance test from the probability value> chi2 of 0.0000. It means Ho was rejected, indicating that the independent variables affected the independent variables. The coefficient of determination was aimed at the pseudo-r-square value of 0.3288. Therefore, 32.88% of the variation could be explained by age, gender, traffic conditions, type of vehicle, frequency of toll users, travel time, and destinations. The partial significance test is described in Table 5:

Table 5. Partial Test Result

Variable	Coefficient	P-Value	Description
Constant	-2,548823	0,598	Not significant
Income	0,0915172	0,751	Not significant
Gender	0,0767195	0,892	Not significant
Age	-0,0003897	0,989	Not significant
Smooth traffic conditions	-13,76388	0,993	Not significant
Fast travel time	13,28986	0,993	Not significant
Type of private vehicle	-0,358622	0,764	Not significant
The frequency of toll users is very frequent	4,202415	0,000**	Significant
The frequency of toll users is frequent	1,694068	0,006**	Significant
Big city travel destinations	-0,3980214	0,659	Not significant
Moderate city trip destination	0,033697	0,974	Not significant

Source: STATA data processing (2023)
Description: ** significant to alpha = 0.01

The partial test on the income variable has a coefficient and p-value of 0.091 and 0.751, respectively. This result confirms Ho that income does not significantly affect the *willingness to pay* for the toll road. Furthermore, gender has a coefficient and p-value of 0.0767 and 0.892, respectively, meaning it does not significantly influence the willingness to pay for the toll road.

The traffic condition variable has a coefficient of -13.76 with a p-value of 0.993, meaning it does not significantly affect *the willingness to pay* for the toll road. The same result was obtained for the travel time variable, which has a coefficient of 13.29 with a p-value of 0.993. Furthermore, the private vehicle variable with a coefficient of -0.39 and a p-value of 0.764 has no significant effect on *the willingness to pay* for toll road services. The toll road user variable has a coefficient of 4.20 with a p-value of 0.000. The frequency category has a coefficient and p-value of 1.69 and 0.006, respectively. Therefore, the toll user frequency significantly affects the *willingness to pay* for the toll road. The travel destination variable for big cities has a coefficient of 0.398 with a p-value of 0.659, implying no significant effect on the *willingness to pay*. Additionally, the travel destination variable as the city has a coefficient of 0.033 with a p-value of 0.974, indicating no significant effect on the *willingness to pay* for toll roads in Central Java Province.

4.2.3 Parameter Interpretation and Discussion

The odds ratio value describes the tendency of a part of the population in a certain category to a part of another category in an independent variable that significantly affects the dependent variable. These values are described in the upper and lower categories. An increase or decrease in the ratio is the tendency for each addition of one independent and continuous variable.

Table 6. Odds ratio calculation results

Variable	Odds ratio value	95% Confidence Interval	
		Lower limit	Upper limit
Income	1,09	0,62	1,93
Gender	1,07	0,35	3,28
Age	0,99	0,94	1,05
Smooth traffic conditions	1,05	0	-
Fast travel time	591169,5	0	-
Type of private vehicle	0,69	0,67	7,24
The frequency of toll users is very frequent	66,85	13,0	343,07
The frequency of toll users is frequent	5,44	1,63	18,05
Big city travel destinations	0,67	0,11	3,93
Moderate city trip destination	1,03	0,13	7,70

Source: STATA data processing (2023)

4.3 Economic Interpretation

The odds ratio results in Table 6 describe the impact of independent variables on the willingness to pay. These results are explained in the economic interpretation as follows:

4.3.1 Analysis of Income on Willingness to Pay for toll roads in Central Java Province

The results showed that the income variable has the opportunity to pay toll fees of 1.09[95% CI (0.62-1.93)]. A 1% increase in toll user income increases WTP 1.09 times. The regression results showed that income does not significantly affect willingness to pay for toll roads. This finding contradicts [20] that income affects willingness to pay for toll roads. However, high income does not determine willingness to pay high because they consider travel time and relatively higher fuel usage. As for the reasonableness of toll users when drivers do not agree with the prices given. Especially during certain situations, namely long holidays where traffic conditions are high. According to [23], income significantly affects willingness to pay because using toll roads is faster with smooth traffic conditions.

4.3.2 Age Analysis of Willingness to Pay for toll roads in Central Java Province

The age variable showed an odds ratio of 0.99 [95% CI (0.94-1.05)]. It means that a one-year increase in age increases WTP by one 1 unit. Furthermore, the age variable does not significantly affect the willingness to pay for the toll road. This result supports [21] that demographic conditions such as age, gender, and education do not significantly affect the willingness to pay for toll road services. In this study, the age variable represented toll road users aged 40 years on average, ranging between 24-62 years.

4.3.3 Analysis of the frequency of toll users on willingness to pay for toll roads in Central Java Province

The frequency of toll users has an odds ratio of 66.85 [95% CI (13.02-343.07)]. It means that people using toll access more than 15 times have a 66.85 likelihood of paying compared to those using it less frequently. The results showed that the frequency of toll road users in the very often category influences the willingness to pay. It indicates that the community prefers toll roads when traveling long distances between cities and districts. Furthermore, 25 respondents stated that the impact of the frequency of toll users on the willingness to pay is in the very frequent category. In line with this, 15 respondents stated that the impact is often, while five said it is rare. The results are consistent with [9] that the frequency of toll users significantly affects the willingness to pay.

4.3.4 Analysis of vehicle types on Willingness to Pay for toll roads in Central Java Province

The type of vehicle has an odds ratio value of 0.69 [95% CI (0.67-7.24)]. It means that people using toll access with private vehicles are 1% more willing to pay toll road fees than those using rental and public vehicles. Therefore, the type of vehicle does not significantly affect the willingness to pay for toll roads in Central Java Province. The types of vehicles are categorized as follows: private cars, rental vehicles, and public transportation. The results showed that 43 respondents using private vehicles are willing to pay the toll road levy of <1 million, while 62 are willing to pay >1 million. It means people are willing to pay toll road fees with private vehicles because traveling long distances is faster and easier. According to [24], private and other such as buses and trucks significantly influence the willingness to pay for toll road services.

4.3.5 Analysis of traffic conditions on willingness to pay for toll roads in Central Java Province

Traffic conditions describing user traffic when using toll roads were divided into smooth and bad. The results showed that traffic conditions do not significantly affect the willingness to pay for toll roads in Central Java Province. The descriptive analysis showed that 40 respondents were willing to pay ≥ 1 million, and 68 would pay <1 million. It means that the people of Central Java are willing to pay more fees to use barrier-free roads. The public's willingness to pay toll fees is low because most users perceive the fares paid as expensive. Therefore, the community could be more supportive when users receive discounts on rest area parking fees

4.3.6 Analysis of travel destinations on willingness to pay for toll roads in Central Java Province

Travel destinations have an odds ratio of 0.67 [95% CI (0.11-3.93)]. It means that people traveling to big cities are 1% more willing to pay for toll road services than those traveling to other destinations. The purpose of the trip was categorized into big, medium, and small cities. The results showed that the travel destination variable does not significantly affect the willingness to pay. It is in line with [24] that business and weekend and holiday leisure do not significantly affect the willingness to pay for toll roads.

4.3.7 Analysis of travel time on Willingness to Pay for toll roads in Central Java Province

Travel time has two categories, including faster and jammed. The descriptive analysis showed that 68 respondents are willing to pay <1 million toll roads when they get a faster travel time, while 40 would pay < 1 million. Moreover, the regression analysis showed that the travel time variable does not significantly affect the *willingness to pay* for the toll road, contravening the study hypothesis. The reason is not significant because the length of the road taken by road users is longer than the national road. After all, the location of the toll road tends to be farther away. There is a speed limit of 100 km/hour on toll roads so that the difference through national roads is not too significant with the additional expense of toll road users. According to [22], travel time significantly affects the willingness to pay for the toll road.

5 Conclusion

Based on the analysis and discussion, conclusions were made as follows:

1. The study analyzed the variables that possibly impact the toll road user's willingness to pay for toll road services (WTP).
2. The results showed that the frequency of toll users has the greatest impact on the willingness to pay, surpassing traffic conditions, type of vehicle, the purpose of travel, and travel time.
3. The odds ratio value for the toll user's frequency was 66.85 [95%CI (13.02-343.07)]. It means that people using toll access more than 15 times are 66.85 times more willing to pay than those using the roads less frequently.
4. The travel destination variable as the city has a coefficient of 0.033 with a p-value of 0.974, indicating no significant effect on the willingness to pay for toll roads in Central Java Province. The reason is not significant because the length of the road taken by road users is longer than the national road. After all, the location of the toll road tends to be farther away. There is a speed limit of 100 km/hour on toll roads so that the difference through national roads is not too significant with the additional expense of toll road users.

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