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## **WILLINGNESS TO MODAL SHIFT FROM PRIVATE TO PUBLIC TRANSPORTATION IN JAKARTA METROPOLITAN AREA**

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### **Abstract**

Commuter workers' primary mode of transportation in the Jakarta Metropolitan Area is still dominated by private vehicles (73.26 percent). The number of passengers on public transportation is recorded at 26.74 percent. It indicates that public transportation has not fully accommodated commuter activities, even though it has been strategized for an environmentally friendly mode. This paper analyzes the modal shifting of transport from private to public transport and the influencing factors. This research recommends the urgency of urban dwellers to use public transportation. The study used biner logistic regression analysis. The results showed commuter workers in Jakarta Metropolitan Area switched from private vehicles to public transportation. Most commuter workers are more likely to keep using personal vehicles. Factors that affect the willingness not to change modes from private cars to public transportation commuter workers include gender, income, work, Mileage, and travel time.

**Keywords:** Public transport, binary logistics, willingness to switch modes, commuting

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## **INTRODUCTION**

Work is an activity to do something to earn (Mcquaid et al., 2012) or profiting from such activities for at least one hour in the last week. In addition to work activities, traveling from home to work cannot be ignored. (Irfan & Nooraeni, 2021) one of Indonesia's main characteristics of the demographic mega-trend phenomenon is the change in population mobility patterns from permanent to non-permanent. The primary purpose of people commuting is predominantly for work (Susanto & Welly Udjiyanto, 2019). Commuter travel can be interpreted as moving residents across the territorial border and back within a day (Irfan & Nooraeni, 2021).

The study (Vioya, 2010) describes the concept of a region consisting of 2 main elements covering the city core and the suburbs around the center of the city, called the metropolitan area. The urban idea of space shuttle movement (commuting) is essential. Some studies argue that urbanization in poor areas of the country does not lead to urban growth (Agustina et al., 2022). The concept of transportation in the form of travel from the original location to the destination, according to (Sukarto, 2006), is referred to as (Yin et al. 2022) a home base trip if the actual site is home. A destination location is a place of activities carried out by commuters, such as social activities (school, sports, family, and so on) and business activities (work, trade, and so on).

On the other hand, (Mansyur, 2009) stated that transportation management policies in urban areas based on the environment and sustainable development are challenges in managing urban systems and, at the same time, transportation systems in urban areas. Theoretically, (Ravi Sekhar, 2014) describes the analytical framework of factors that influence a person's decisions in selecting modes of transportation used in his mobility in urban areas. Cities should develop green zones because they benefit citizens and the environment (Afriani et al., 2022). To answer the willingness of private vehicle users to use public transit using binary logistic regression analysis. Binary logistic regression, according to (Mansyur, 2009) (Ravi Sekhar, 2014) (Oliver & Gujarati, 1993), the book essentials of econometrics is one of the models of logistic regression. The advantage is that binary regression interpretation can be used to determine the magnitude of the chances of private vehicle users who are not willing to use public transportation due to an existing explanatory variable. Therefore, this study aimed to analyze the effect of the characteristics of users of private modes of transportation on the willingness to switch to public transportation modes.

## **RESEARCH BACKGROUND**

Several studies on model selection have been conducted in several countries, including (Ding & Zhang, 2016), (Triany & Chotib, 2021), (and Maharani Rajjaya & Chotib, 2020) reported that factors that affect the selection of public transportation modes are age, type of work, salary, travel time and travel distance of (Chotib, 2020). Empirically (Iriyanti et al., 2021) tested the factors that influence the decision to choose the mode of transportation of workers in the Jakarta Metropolitan Area following the characteristics of its users, such as the availability of private vehicles, income, and other factors such as travel time, transportation costs, availability of space and parking rates, as well as safety and comfort while using these modes of transportation.

The travel time of workers' commuters is influenced by several social aspects such as age, marital status, education level, employment status, and income level (Sari et al., 2015). In (Louis et al., 2019), age proved to be a significant factor explaining commuter behavior, and the effect of age on travel was non-linear. Younger and older people are more likely to travel at shorter distances than the age group among them (adults) (Mcquaid et al., 2012).

Married commuters have a longer commute time when compared to a single (Nayka & Sridhar, 2019). In addition, marital status is also related to female commuters (Indriany et al., 2019). One of the variables in the study is that education level significantly impacts the occurrence of more extended commuter travel (Hu et al., 2015). A college education level increases the likelihood that a commuter will experience a longer commute time (Irfan & Nooraeni, 2021).

Formal employment status is considered to have a higher level than everyday work. (MacKerron et al., 2009) found a higher level of primary employment had relationships associated with longer commutes. Income levels have a connection to the length of commuting time. (Kumar & Hafiz, 2013) found that the most important thing for long trips is a weekly wage. Those on high salaries (gross weekly salaries at their primary jobs) are more likely to travel longer (North et al., 2019)

The most widely used commuting modes of transportation for round-trip activities are private vehicles, 73 percent public transportation, and 27 percent. This shows that public transit has not become the primary mode that supports commuter activities. The study aimed to identify how likely commuter workers in Jakarta Metropolitan Area were to choose public transportation over private modes of transportation on their daily commutes (Sudarmadi et al., 2001). Using data from the Jakarta Metropolitan Area Commuter Survey in 2019, the study looked at the characteristics of workers who use the choice of public or private transportation modes in the Jakarta Metropolitan Area.

Given the importance of mass public transportation as the primary mode of transportation in breaking down congestion and supporting environmentally-friendly transit, it is necessary to research the willingness of

Jakarta Metropolitan Area commuter workers of private vehicle users to move using public transportation?

## **METHODOLOGY**

The data source used in the study was taken from the Jakarta Metropolitan Area Commuter Survey conducted by BPS in 2019. The Commuter Survey in Jakarta Metropolitan Area was developed to produce data devices and monitoring systems that serve as inputs for preparing population mobility policies and regional development of origin and commuting destinations. The survey aims to provide data sets and monitoring systems that have a role as input for commuting policymakers. The Jakarta Metropolitan Area Commuter Survey collected 46,680 individual demographic, socioeconomic attributes, and travel characteristics. The study used 3,259 personal information.

The study was conducted in Jakarta Metropolitan Area. Jakarta Metropolitan Area consists of 13 districts/cities, namely Central Jakarta City, West Jakarta City, South Jakarta City, East Jakarta City, North Jakarta City, Bogor Regency, Bogor City, Depok City, Tangerang Regency, Tangerang City, South Tangerang City, Bekasi Regency, and Bekasi City. This study uses data from the Jakarta Metropolitan Area Commuter Survey in 2019, organized by BPS. The analysis unit used in the study included all working individuals and commuter status of private vehicle users.

The analysis unit in this study is workers who commutability by using private vehicles as the primary mode (Ashalatha et al., 2013). The primary mode of transportation is a means of transport commonly used to go/return to/from the place of activity. If using more than one mode of transportation (Niemeier et al., 1997), the primary mode of transportation is the mode of transportation for the furthest distance. If the space is the same, then the primary mode of transportation is the mode of transportation that takes the longest (Fahmi & Hands, 2016). The variables used in this study were divided into dependent variables and independent variables. Dependent variables are willing to use public transportation from private vehicles. The explanatory variable consists of 9 variables described in the following table.

**Table 1:** List of Research Variable

Code	Variable name	Definition
Y (dependent)	Shifting to Public transport	Number of respondents shift from private transport to public transport (percentage)
X1 (Independent)	Age1	Age of Respondent (percentage)
X2 (Independent)	Age2	Age of Respondent (percentage)
X3 (Independent)	Gender	Denoting gender.
X4 (Independent)	Education	Denoting the highest level achieved education.
X5 (Independent)	Income	Average monthly household income in millions of Rupiah
X6 (Independent)	Martial Status	Marital status of the respondent
X7 (Independent)	Type of Job	The activity of doing work with the intention of obtaining income
X8 (Independent)	Distance to work	Average commuting distance to work in kilometers
X9 (Independent)	Time to work	Average time to work in minutes

The analytical methods used are descriptive analysis and inference analysis. A descriptive study (Chotib, 2020) emphasizes bivariate analysis in describing free variables (respondents who are not willing to use public transportation) based on the characteristics of private vehicle users in the Jakarta Metropolitan Area in 2019. The study (Ding & Zhang, 2016) inferential analysis uses binary logistic regression analysis, whose purpose is to determine the characteristics and opportunities that affect respondents unwilling to switch to public transportation from private vehicle users in Jakarta Metropolitan Area in 2019 (Irjayanti et al., 2021).

The equation model is used as follows:

$$\ln(\rho_1/\rho_0) = \beta_0 + \beta_1 * Age1 + \beta_2 * Age2 + \beta_3 * Gender + \beta_4 * Education + \beta_5 * Income + \beta_6 * Martial Status + \beta_7 * Type of Job + \beta_8 * Distance to Work + \beta_9 * Time to Work... (1)$$

Where:

- P1 = Opportunities for private vehicle users to switch to public transport
- P0 = Chances are private vehicle users do not switch to public transport
- Age1 = 0 ref. age  $\leq 24$  years; 1 if 25-44 years old
- Age2 = 0 ref. age  $\leq 24$  years; 1 if  $\geq 45$  years old
- Gender = 0 if male; 1 if women
- Education = 0 if  $\leq$  junior high; 1 if  $\geq$  high school
- Income = 0 if Medium (3.9 M down); 1 if High (4 M and above)

Marital Status	=	0 if not married; 1 if married
Type of Job	=	0 if the work is informal (other than formal); 1 if formal employment (Labor/Employee/Employee)
Distance to work	=	0 if Near ( $\leq 29$ km); 1 if Far ( $\geq 30$ km)
Time to work	=	0 if the journey is Fast Duration ( $\leq 89$ minutes); 1 if a long-duration trip ( $\geq 90$ minutes)

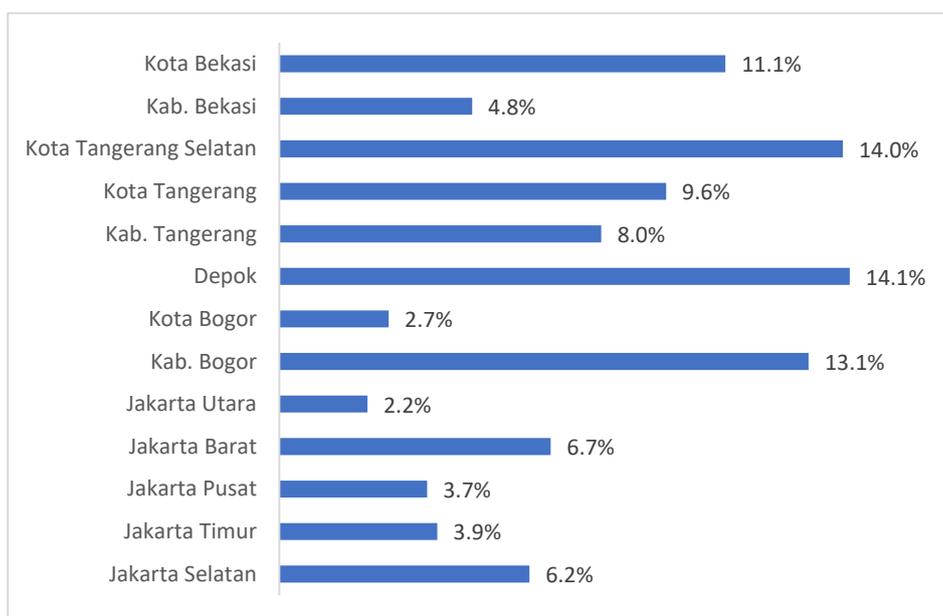
In the category of Mileage, the place of activity is a one-way distance from home to the place of activity, not the distance round trip. Empirical research (Ravi Sekhar, 2014), the length of travel from the residence to the place of activity is the length of travel calculated from the place of residence to the place of activity, including the waiting time for public transportation (for those who use public transportation). While the travel time category, according to (Badan Pusat Statistik, 2019), is the length of travel calculated from the place of activity to the place of residence, including the waiting time for public transportation (for those who use public transportation).

## **RESULTS AND DISCUSSIONS**

### **Descriptive Analysis**

Results from the Jakarta Metropolitan Area commuter survey of the Central Statistics Agency (2019) showed that as many as 72% of Jakarta Metropolitan Area commuter workers use private vehicles as the main mode of transportation for commuting and returning. Of the total users of private vehicle commuter workers, as many as 91.6% have no desire to switch to using public transportation modes, while 8.4% are willing to switch to public transportation.

Based on figure 1 contains information about the willingness to switch modes from private vehicles to public transportation per region in Jakarta Metropolitan Area in 2019, presented in graphic form. The results of the Jakarta Metropolitan Area commuter survey of the Central Statistics Agency (2019) reported that the willingness of commuter workers who are willing to switch modes from private vehicles to public transportation per region in the Jakarta Metropolitan Area is as follows.



**Figure 1:** Willingness to switch modes from private vehicles to public transportation per region in Jakarta Metropolitan Area year 2019

Source: Jakarta Metropolitan Area Commuter Survey 2019, processed 2021

It is generally known that the willingness of commuter workers willing to switch to using public transportation based the highest area in Depok City with a percentage of 14%, while the region with the lowest willingness to switch to using public transportation is the North Jakarta area with a percentage of 2% of the total respondents who are willing to switch to using public transportation. In the following table, a descriptive analysis of the explanatory variables and the willingness to switch to using public transportation.

**Table 2:** Characteristics of private vehicle users who are willing to switch to public transportation based on research variables

Variable	Category	Switching to Public Transport		Observation (100%)
		Yes (%)	No (%)	
Age Group	≤24 years	6,6	93,4	949
	25-44 years	8,6	91,4	1521
	≥45 years	9,5	90,5	842
Gender	Male	7,9	92,1	2557

Variable	Category	Switching to Public Transport		Observation (100%)
		Yes (%)	No (%)	
	Female	9,4	90,6	755
Education	≤ junior high school	6,3	93,7	601
	≥ high school	8,7	91,3	2711
Income	(3.9 million down)	6,5	93,5	1759
	(4 million and above)	10,2	89,8	1553
Marital Status	Not mating.	7,5	92,5	1355
	Marry	8,8	91,2	1957
Work	Informal Work	4,4	95,6	611
	Formal work	9,1	90,9	2701
Mileage	Near (≤29 km)	7,1	92,9	2809
	Far (≥30 km)	14,9	85,1	503
Travel Time	Fast Duration Trip (≤89 minutes)	7,2	92,8	2753
	Long Duration Trip (≥90 minutes)	13,6	86,4	559

The table above shows a descriptive analysis between explanatory variables and bound variables, namely the willingness to switch to using public transportation. The results of this analysis show, in general, the proportion of willingness to switch to using public transportation. Of the total respondents, as many as 3,312 showed that the age group over 45 years was more willing to switch to using public transportation by 9.1% compared to the age group of 25-44 years by 8.6%, and the proportion reduced to 6.6% in the age group under 24 years who are willing to switch to using public transportation.

Willingness to switch to using public transportation according to gender, 9.4% of women are more interested in switching to public transportation than men, who are willing to move by 7.4%. The proportion of willingness to use public transportation according to the last education completed tended to be dominated by respondents with education groups more than high school or by 8.7%, while the education group under junior high school equivalent of 6.3% who were willing to switch to using public transportation.

Willingness to use public transportation was also influenced by respondents' income. The results of the Jakarta Metropolitan Area commuter survey 2019 showed that workers with incomes of more than 4 million are more willing to switch to using public transportation with a percentage of 10.2%. This is in line with research conducted by (Setyodhono, 2017) which states that the increasing income, the increasing computer wants to switch to public

transportation, while in the group of respondents with income below 3.9 million, only 6.5% are willing to switch to using public transportation.

Users of private vehicles as a whole turned out to be very dominated by formal workers, including Workers/Employees/Government employees and other instances with the number of private vehicle users of 2706 respondents while informal workers of private vehicle users amounted to 611 respondents. From the data, it is known that as many as 9.1% of formal workers are more willing to switch to using public transportation than informal workers. Only 4.4% are willing to switch to using public transportation.

The distance used in this study is the distance from residence to work. This study is divided into two categories, which are less than equal to 29 km included in the category of close and more than 30 km included in the far category. Users of private vehicles with short distances are much more willing to switch to using public transportation, which is 14.9%, compared to private vehicle users with short distances, 7.1%. This is in line with research (Irfan & Nooraeni, 2021), where most commuters are motorcycle users who are a less comfortable mode of transportation to be used mode of transportation with long distances. At the same time, travel time is distinguished into fast duration travel and long duration travel. Private vehicle users with long-duration trips are more willing to switch to using public transportation by 13.6% compared to fast-duration private vehicle users by 7.2%. This is in line with research (Hu et al., 2015) that trains are more in demand for long-distance travel.

### Inferential Analysis

Inference analysis is done using logistic regression analysis. This is because the bound variables used there are 2 (two) options (switching and not switching to public transportation). In this regression, it is not willing to "0" and willing to move using public transportation, given the code "1" as a reference category. Simultaneous test results show negative and significant calculation results, where the results of binary logistic regression analysis can be seen in the following table.

**Table 3:** Logistic regression of binary's willingness to use public transportation

Bound Variable	B	S.E.	Wald	Df	Sig.	Exp(B)
	0 = Not ready; 1= Willing to switch to Public Transportation					
Age			0.860	2	0.651	
Age1	-0.132	0.211	0.396	1	0.529	0.876
Age2	-0.230	0.252	0.839	1	0.360	0.794
Gender	-0.422	0.154	7.473	1	0.006**	0.656
Education	-0.083	0.191	0.187	1	0.666	0.921
Income	-0.318	0.147	4.703	1	0.030**	0.728
Martial Status	0.142	0.186	0.580	1	0.446	1.152

	B	S.E.	Wald	Df	Sig.	Exp(B)
Bound Variable	0 = Not ready; 1= Willing to switch to Public Transportation					
Type of Job	-0.677	0.213	10.122	1	0.001**	0.508
Distance to work	-0.618	0.175	12.502	1	0.000*	0.539
Time to work	-0.340	0.173	3.856	1	0.050	0.712
Constant	3.559	0.265	179.840	1	0.000	35.136

Description: \*,\*\*\* significant at  $\alpha < 1\%$ ,  $\alpha < 10\%$

(De Witte et al., 2013) defines mode selection as the decision process of choosing between various transportation alternatives determined by a combination of individual socio-demographic factors and spatial characteristics and influenced by socio-psychological factors. Based on the data above, female workers who are commutable by using private vehicles are more willing to switch to using public transportation than men. This is the same as empirical research (Irjayanti et al., 2021). Along with the many needs of women, they prefer a more flexible model of transportation, so public transportation services are needed to be provided in accordance with the wider travel range and working hours and safety and comfort in travel.

Income variables show a significant relationship but negatively affect the willingness to switch modes. So that the greater a person's income, the more likely they are to choose not to be willing to use public transportation. The more formal workers in Jakarta Metropolitan Area who are commuters, the fewer will be willing to switch to using public transportation. Travel mileage shows a significant value where commuter workers tend to stick to using private vehicles to carry out their activities.

## CONCLUSION

The results of this study revealed that the chances of willing commuter workers in the Jakarta Metropolitan Area to switch from private vehicles to public transportation amounted to 8.4% of private vehicle users willing to switch to public transportation and 91.6% of commuter workers more likely to stick with private vehicles. Based on the results of the inferential analysis, the factors that affect commuter workers are not willing to switch to using public transportation are gender, income, employment, Mileage, and travel time. This finding is an important insight to be considered by Jakarta's authority in strategizing the policy and development of public transportation.

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