

TRANSPORT FINDINGS

When the Train Finally Comes: Impact of New Transit Opening on Urban *Kampung* Residents' Personal Motorized Vehicle Use

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Findings

We estimate the impact of the opening of Indonesia's first subway– the MRT Jakarta – on urban *kampung* residents' personal motorized vehicle use. We employed a quasi-experimental approach through a two-wave panel survey. We assigned residents living within the designated TOD boundaries into a treatment group and those living farther away into a control group. Using difference-in-differences models, we find insignificant effects of the MRT Jakarta opening where treatment respondents logged 7.5 fewer weekly vehicle kilometers traveled than control counterparts. There was no substantial difference in the respondents' self-assessed travel habits between treatment and control groups.

1. Questions

Following decades of planning, the MRT Jakarta, Indonesia's first subway, finally started operation in late March 2019. The project seeks to alleviate the region's infamous transportation problems by offering a reliable transit alternative to private vehicles. To this end, we consider it imperative to ask the following: To what extent does the MRT Jakarta reduce private motorized vehicle use? Researchers and policymakers have sought to address this line of question using cases around the world, e.g., Los Angeles (Boarnet, Wang, and Houston 2017; Spears, Boarnet, and Houston 2016), Xi'an, China (Huang et al. 2019), Minneapolis (Cao 2019), and Singapore (Dai, Diao, and Sing 2020).

In addressing that question, our hypothesis revolves around the expectation that the arrival of the MRT Jakarta would attract travelers to use transit instead of private vehicles. This notion entails that we ought to observe a reduction in kilometers traveled on private vehicles associated with new transit opening. Moreover, we also expect the observed VKT reduction would likely be more pronounced for the subset of the population living nearby the new transit stations than those living farther away. The designated TOD

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boundaries (i.e., 700-meter radius from the center of the stations) outlined by the MRT Jakarta (n.d.) provide a fitting natural experiment setting to test the hypothesis and evaluate the likely policy effects.

2. Methods

We fielded a two-wave panel survey two months before and five months after the system was fully operationalized on March 24, 2019. The first and second wave of the survey was conducted in January and August 2019, respectively. We designed the survey to capture relevant socioeconomic indicators and travel behavior outcomes across the waves.

Our study area encompasses predominantly informal residential neighborhoods, known as *kampungs*, surrounding the MRT Jakarta's elevated portion (five stations) ([Figure 1](#)). We focus our analyses on this study area, considering that the land uses surrounding the system's underground section are predominantly commercial and institutional/government. We developed isochrones that represent a 700-meter walking distance from the entrances of the five stations. We assigned respondents inside the isochrones and within the designated TOD boundaries as the treatment group. Respondents living outside of the isochrones are assigned to a control group.

In conducting the survey, we adopted the method as applied in the previous large-scale household travel surveys for the Jakarta metropolitan region, where the survey enumerators went door-to-door to obtain the samples (JICA 2012). We retrieved completed two-wave surveys of 158 adult individuals comprised of 74 respondents in the treatment group and the remaining 84 in the control group scattered evenly across the five station areas. A descriptive analysis of before and after opening sample characteristics indicates that the treatment and control groups are considerably similar (e.g., household size, vehicle ownership) within each survey wave ([Supp. Table 3](#)).

We use a difference-in-differences (DID) model to estimate the MRT Jakarta's effects on the combined total weekly vehicle kilometers traveled (VKT) on auto and motorcycle. Equation 1 indicates the approach:

$$y = \beta_0 + \beta_1 T + \beta_2 A + \delta TxA + \beta_3 SE + \beta_4 Area + e \quad (1)$$

where y is weekly VKT as the outcome of interest; *treatment* (T), a binary indicator of treatment status; *time* (A), indicating before and after the MRT Jakarta began full operation; and the interaction term (δ) between treatment (T) and time (A) as the DID estimator. We also incorporate additional covariates to control for socioeconomic (SE), including household size, presence of children, individual employment status, income, and motorized vehicle ownership, as well as station neighborhood (Area). To account for

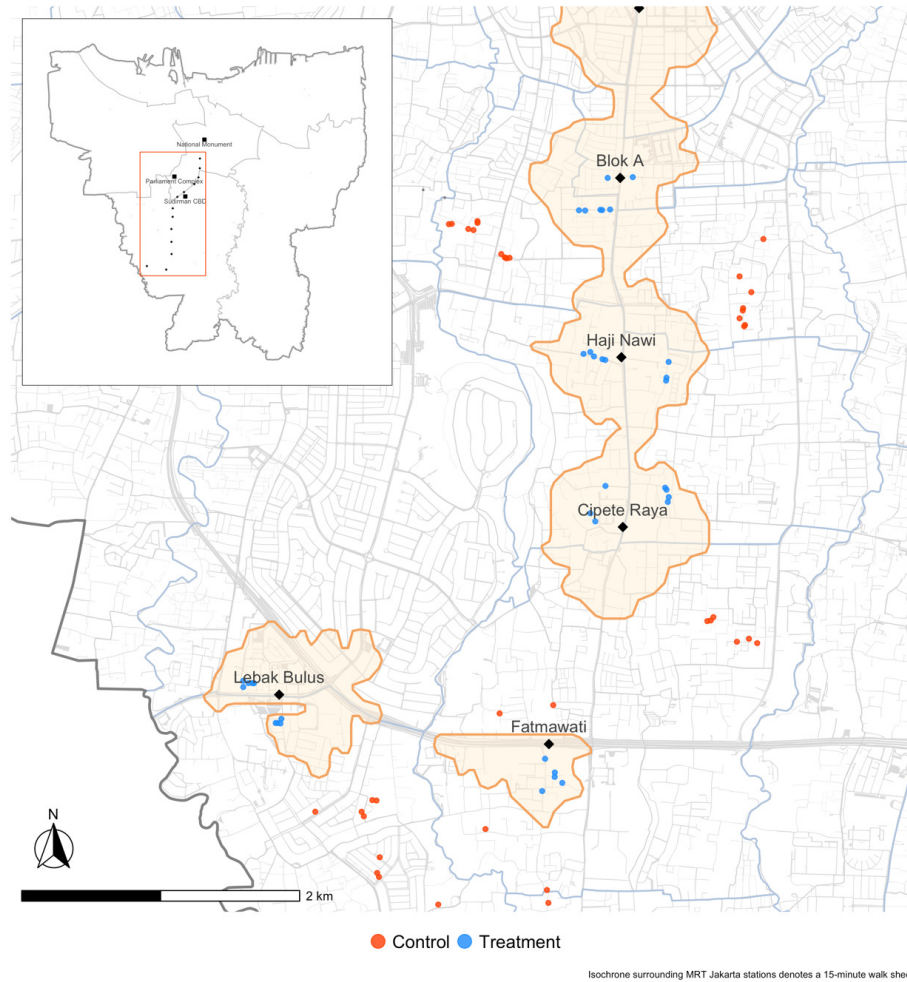


Figure 1. Study area

Isochrones denote a 700-meter distance from the stations.

the outliers, we exclude households whose weekly VKT was more than 300 kilometers. Therefore, the sample size in the dataset is 154 (72 treatment; 82 control) instead of 158.

3. Findings

Prior to presenting findings from the DID models, [Table 1](#) shows the within-group differences in the weekly VKT of treatment and control respondents across survey waves. On the one hand, the descriptive statistics show that treatment respondents' average weekly VKT *slightly* increased after the MRT Jakarta opening from the baseline values. On the other hand, we observe an even larger increase in average weekly VKT for the control respondents than treatment individuals across survey waves. Our data suggest that notable increases in employment participation for treatment and control groups across survey waves likely explain this observation. We subsequently used a t-test and found that the within-group mean difference of weekly VKT was statistically insignificant in both groups ([Table 1](#)).

Table 1. Comparison of weekly VKT on personal vehicles (auto + motorcycle)

Respondents	N	Period	Weekly VKT (km)	
			Average	Changes
Control	82	Before MRT	61.15	31.19
		After MRT	92.34	
Treatment	72	Before MRT	89.29	6.33
		After MRT	95.62	

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2. Difference-in-differences regression

	Weekly VKT (km)					
	(1)		(2)		(3)	
	Coef.	t	Coef.	t	Coef.	t
Treatment (Control:0, Treatment:1)	31.19** (12.38)	2.12	16.93 (15.40)	1.18	14.33 (15.32)	1.16
Time (Pre-MRT: 0, Post-MRT:1)	28.14** (13.58)	2.43	16.23 (14.67)	1.18	16.04 (14.65)	0.99
DID (Treatment*Time)	-24.86 (18.82)	-1.33	-8.634 (19.59)	-0.46	-7.52 (19.48)	-0.40
Socioeconomic	N		Y		Y	
Station area fixed effects	N		N		Y	
N	308		308		308	
R ²	0.03		0.15		0.16	
Adjusted R ²	0.02		0.11		0.11	

Note: *p<0.1; **p<0.05; ***p<0.01

Robust standard error in parentheses (clustered at the household level)

Table 2 reports the findings from the DID models. We test whether a new transit opening, by itself, could have a statistically significant effect, as shown in the base model (column 1). We gradually expanded the model by including additional variables. As can be seen, the addition of these additional variables improves the models' predictive power, which was also confirmed by the ANOVA tests.

As shown in column 3 of **Table 2** ($R^2=0.164$), our final estimate suggests a statistically insignificant effect indicating that treatment respondents may have logged 7.5 less weekly VKT than control counterparts associated with the MRT Jakarta opening, all else equal. This finding suggests a lower magnitude than the 10.9 miles (17.5 kilometers) driving reductions found in Spears et al.'s (2016) study. Albeit the statistically insignificant result, this study highlights the relative importance of a quasi-experimental approach. That is, in the absence of a control group, we might instead observe a slight increase in the average VKT of treatment respondents (**Table 1**) and thus draw a partial picture of the MRT Jakarta's impact.

Table 3. Self-assessed travel habits before-after the MRT Jakarta's opening

	Treatment		Control	
	Count	Percent	Count	Percent
Use alternative modes more	29	40.3	33	40.2
Unchanged	18	25.0	22	26.8
Use personal vehicles more	25	34.7	27	32.9
	72	100.0	82	100.0

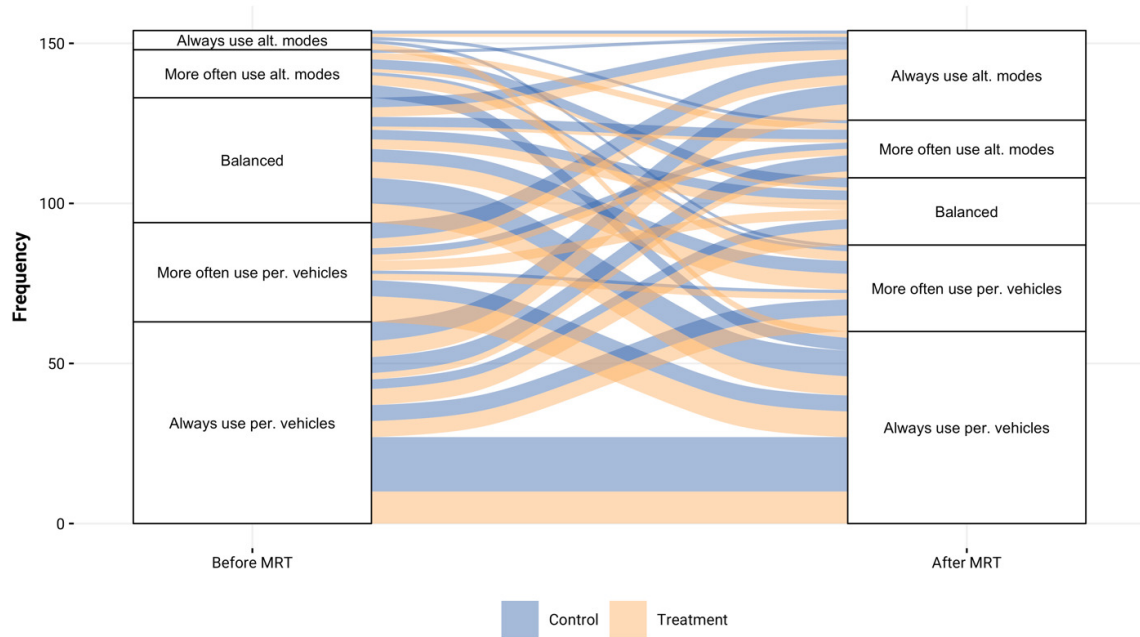


Figure 2. Respondents' self-assessed travel habits before and after the MRT Jakarta's opening

Furthermore, we probe the between-group differences in the self-assessed travel habits across survey waves based on a Likert-style question asking whether the respondents relied more on personal vehicles or alternative modes (i.e., non-motorized transport and transit) ([Table 3](#), [Figure 2](#)). We find a considerably similar pattern in mode utilization between the two groups. These findings suggest that proximity to stations may be inadequate to explain the between-group differences in travel outcomes, further substantiating the statistically insignificant finding. Accordingly, it also indicates that policymakers would need to (re)consider TOD beyond a specified short-distance measure surrounding the stations.

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Supplementary materials

Supp. Table 1. Comparison of weekly VKT on personal vehicles (auto + motorcycle), household-level

Respondents	N	Period	Weekly VKT (km)	
			Average	Changes
Control	48	Before MRT	104.46	53.30
		After MRT	157.75	
Treatment	39	Before MRT	164.85	11.69
		After MRT	176.54	

Note: *p<0.1; **p<0.05; ***p<0.01

Supp. Table 2. Difference-in-differences regression, household-level

	Weekly VKT (km)					
	(1)		(2)		(3)	
	Coef.	t	Coef.	t	Coef.	t
Treatment (Control:0, Treatment:1)	53.29** (21.73)	2.36	46.72 (33.31)	1.73	45.04 (33.76)	1.66
Time (Pre-MRT: 0, Post-MRT:1)	60.39** (29.38)	2.20	38.89 (30.28)	1.41	36.43 (30.73)	1.32
DID (Treatment*Time)	-41.60 (36.93)	-1.15	-27.76 (40.44)	-0.73	-25.61 (40.34)	-0.70
Socioeconomic	N		Y		Y	
Station area fixed effects	N		N		Y	
N	174		174		174	
R ²	0.05		0.12		0.15	
Adjusted R ²	0.04		0.06		0.07	

Note: *p<0.1; **p<0.05; ***p<0.01

Household-level analyses

In addition, we also run the analyses using a household-level dataset. Out of the total 87 households in the dataset, 39 households reside in the treatment areas and the remaining 48 households live farther away. Similar to the individual-level observations, descriptive statistics show a comparatively larger increase in VKT for control households than treatment households ([Supp. Table 1](#)). Using a DID approach, our estimate ([Supp. Table 2](#)) suggests that households near the stations may have logged 26 fewer weekly VKT than households living farther away, all else equal. However, the coefficient was statistically insignificant ($p\text{-value} > 0.1$).

Sample characteristics

Supp. Table 3. Before-after MRT sample characteristics

	Before MRT				After MRT			
	Treatment		Control		Treatment		Control	
	N	percent	N	percent	N	percent	N	percent
Employment								
Employed (Full-time)	47	65.3	52	63.4	64	88.9	78	95.1
Employed (Part-time)	12	16.7	7	8.5	4	5.6	0	0.0
Unemployed	13	18.1	23	28.0	4	5.6	4	4.9
Total	72	100	82	100	72	100	82	100
Gender								
Male	35	48.6	42	51.2	35	48.6	42	51.2
Female	37	51.4	40	48.8	37	51.4	40	48.8
Total	72	100	82	100	72	100	82	100
Household income								
Less than IDR 3 Mil	6	8.3	18	22.0	0	0.0	0	0.0
IDR 3-5 Mil	29	40.3	48	58.5	16	22.2	15	18.3
IDR 5-10 Mil	18	25.0	5	6.1	32	44.4	29	35.4
IDR 10-20 Mil	13	18.1	11	13.4	24	33.3	37	45.1
More than IDR 20 Mil	6	8.3	0	0.0	0	0.0	1	1.2
Total	72	100	82	100	72	100	82	100
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Household size	4.5	1.3	3.8	1.2	4.5	1.3	3.8	1.2
Number of vehicles								
Car	1.0	0.7	0.8	1.0	1.1	0.7	1.1	0.6
Motorcycle	1.9	1.0	1.7	1.0	1.5	0.8	1.6	0.7
Car and Motorcycle	2.5	1.4	3.0	1.3	2.7	0.9	2.8	0.8
Age	36.5	9.8	35.7	11.2	36.5	9.8	35.7	11.2

Note: US\$ 1 = IDR 14,000