TRAVEL BEHAVIOR OF RESIDENTS OF CONDOMINIUMS NEAR BANGKOK'S RAIL TRANSIT STATIONS

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ABSTRACT

A key premise of promoting transit-oriented development is that residents who live close to transit stations will use public transportation more than drive private cars. In this study, we survey travel behaviors of those living in the vicinity of rail transit stations in Bangkok in order to evaluate the validity of such a premise. Specifically, we examine how distance from transit stations and socio-economic characteristics of travelers affect commuting behaviors of residents in newly developed condominiums in the transit-served area, with the focus on their tendency to drive. We find that condominium residents who live within one kilometer from transit stations use the transit systems more than drive, and more than those who live further away. However, those who live within walking distance of 500 meters from transit stations tend to drive more than those who live between 500 and 1000 meters.

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Keywords: Transit-Oriented Development, Travel Behavior, Rail Transit, Developing Countries

INTRODUCTION

Rail transit systems have been hailed as the solution to Bangkok's legendary traffic congestion. This is based on the premise that a modal shift away from car travel would be significant after the rail systems are in place. Meanwhile, the recent Bangkok Comprehensive Plan has adopted the concept of transit-oriented development (TOD), which aims to increase densities of commercial and residential development within walking distance of transit stops. An implicit assumption, as well as the hope, is that more people who live along transit corridors will use the rail systems. In this study, we survey travel behaviors of those living in the vicinity of rail transit stations in order to evaluate the validity of such premises. Specifically, we examine how distance from transit stations and socio-economic characteristics of travelers affect commuting behaviors of residents in newly developed condominiums in the transit-served area, with the focus on their tendency to drive.

Following an overview about the development of transit systems in Bangkok, the paper reviews the existing literature on travel behaviors of residents along transit corridors. Then we describe the research methodology and data collection methods that we employed in this study. We explain the model specifications and results, and then discuss the results and their policy implications.

Bangkok Rail Transit Systems

Currently, there are three systems of rail transit in Bangkok metropolitan region. First, the Bangkok Transit System (BTS), also known as the "Sky Train" Green Line is an elevated heavy rail system, consists of two train lines and 30 stations, and first began operation in 1999. Second, the Mass Rapid Transit Authority (MRT) Blue Line Subway is an underground heavy rail system, has 18 stations, and began operations in 2004. Third, the Airport Rail Link (ARL) Red Line is part elevated, part underground, has eight stations, and began operations in 2010. The first two systems mainly serve commute travel, with relatively short station spacings between 800 to 1200 m. The ARL, on the other hand, mainly serve airport-oriented traffic, and has relatively long station spacings, between three to four kilometres. As of mid 2012, the riderships of the BTS, MRT, and ARL are approximately 500,000, 240,000, and 35,000, respectively. In this paper, the scope of the study include only the BTS and MRT corridors since they have been in service for much longer periods and their influence on condominium markets should be relatively more stabilized than the newly opened ARL.

Figure 1 – Bangkok Rail Transit Systems

(Source: http://johomaps.com/as/thailand/bangkok/bangkokmetro.html)

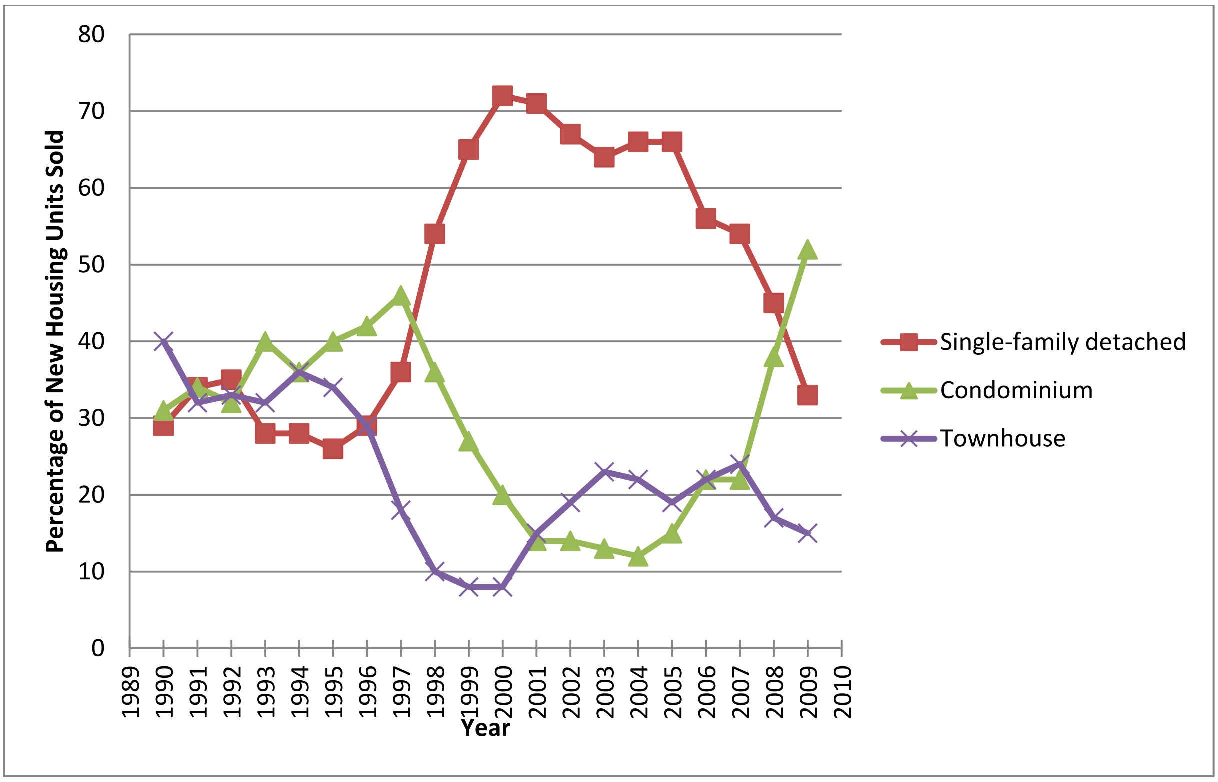

Figure 2 – Types of New Housing Units Sold in Bangkok Metropolitan Region from 1990 to 2009

(Source: Government Housing Bank (2010))

Densification of Transit Corridors

The development of rail transit systems has led to increasing densification of residential and commercial development along transit corridors. Since the BTS and MRT lines started their operation, major residential developers have substantially revamped their investment strategies from focusing on subdivision projects in the suburbs to condominium projects along the rail lines. From 2009 onwards, more condominium units have been built than detached houses in Bangkok (Figure 2). An increasing number, as well as the share of, new condominium units are now built close to transit stations (Figure 3).

Recognizing the trend of densification, the Bangkok Comprehensive Plan 2006, as well as the recent Comprehensive Plan 2012, adopted the concept of transit-oriented development (TOD). Since 2006, the zoning regulations have granted a bonus of additional Floor Area Ratios (FARs) for new development projects within 500 meters of a transit station to promote even higher density near transit stations. It is assumed that such densification will lead to more efficient land use, while promoting public transits that are more sustainable than private cars.

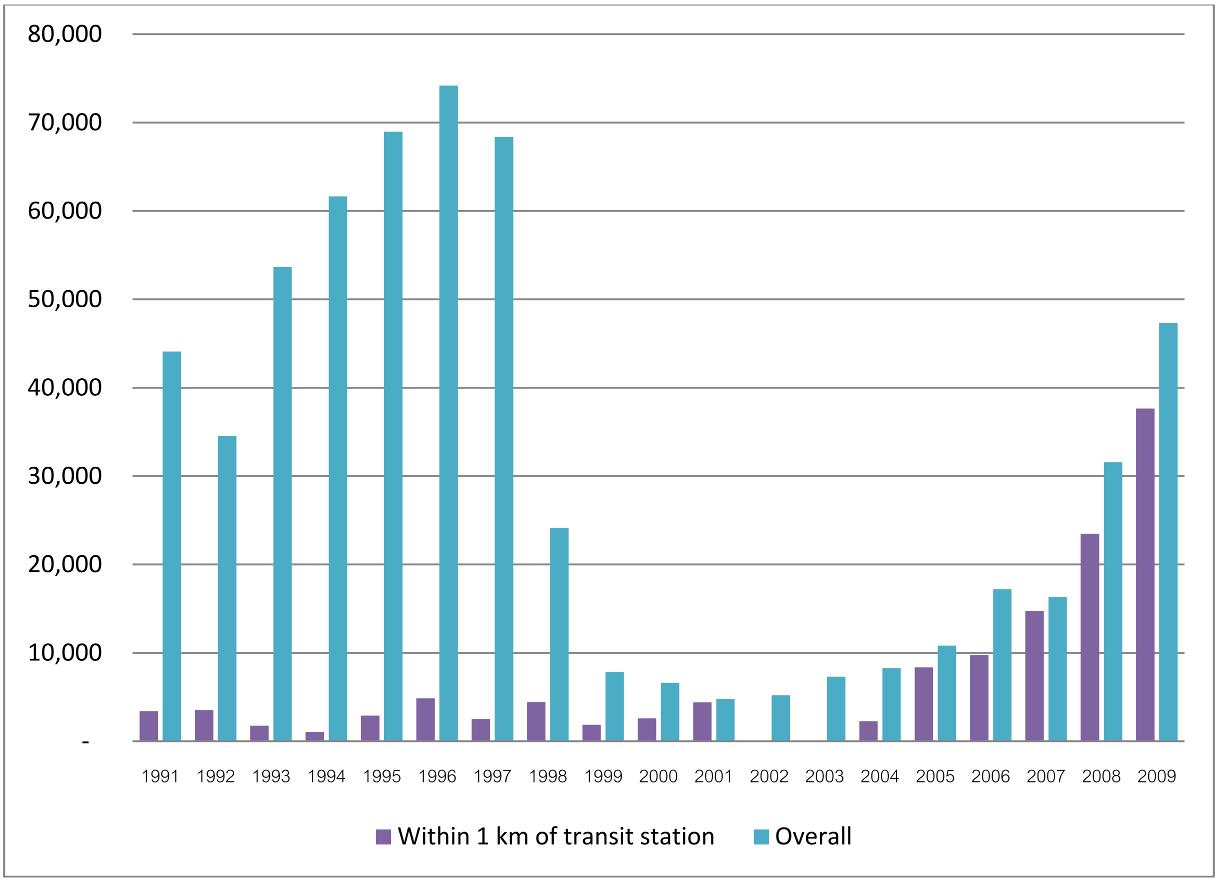

Figure 3 – Number of New Condominium Units by Locations Relative to Transit Station from 1991 to 2009

(Source: Chalermpong and Ratanawaraha (2011))

LITERATURE REVIEW

Empirical studies in developed countries, mostly the United States, have attempted to test whether residents in high density, mixed-use areas tend to use more non-motorized modes and drive less than those living in low-density, single-use areas. For instance, Crane and Crepeau (1998) analyze household travel diary and GIS data in San Diego, CA, and do not find that land use explains travel behaviour. Meanwhile, Cervero and Duncan (2003) examine travel behaviors across neighborhoods in the San Francisco Bay Area, and find that land-use diversity is the strongest predictor of walking, while density, diversity, and design affect bicycling, especially at the trip origin. In a study of travel behavior in California TODs, Lund, Cervero, and Willson (2004) find that people who live near transit stations are more likely to commute by transit than the average resident worker in the same city. Givoni and Rietveld (2007) examine passengers' access and egress trips to railway stations in the Netherlands and find that the overall passenger satisfaction of rail service depends significantly on the quality of access facilities. This finding shows that improvements in access facilities to rail stations, an important feature of TOD, can potentially increase rail ridership.

A few studies have empirically examined travel behaviors and socio-economic characteristics of transit users in Bangkok. For instance, Vichiensan (2008) examines the factors that influence residential location decision along the corridor of MRT Purple line that is currently under construction. Using a stated preference survey, he finds that the key factors include perceptions on price, size, design, convenience to work, and proximity to the MRT station. High-income people considering to buy detached houses are not sensitive to either price or proximity to a transit station but sensitive to access to main roads and parking.

Another study by Wibowo and Chalermpong (2010) examines the characteristics of mode choice within mass transit catchment areas in Manila and Bangkok. In the case of Bangkok, they find that total travel time, out-of-pocket cost, and distance to station have influence over decisions to shift travel modes to mass transit. The mass transit mode is slightly preferred to car even when a car is available, probably because the mass transit has advantages in the term of time saving for the pair of origin destination within mass transit corridors.

Proximity to transit station

Individuals may have different perceptions as to what distance is considered close to a transit station. Some studies have used the maximum walking distance as the coverage area of a transit station, ranging from 1,200 meters (Stringham, 1982) to 2,000 meters (Halden 2000). Other studies have found the distance to be shorter, e.g., 800 meters (Hilman, 1997) and 1,000 meters in the case of Singapore (Wibowo, 2005). In this study, we categorize the distance into three groups: less than 500 meters from a transit station, 500-1000 meters, and more than 1,000 meters. We choose the first cut-off distance of 500 meters to reflect the zoning incentive for bonus floor space mentioned earlier.

METHODOLOGY AND DATA

In this research, we hypothesize that commute travel behaviors of residents in newly developed condominiums are dependent not only on their socioeconomic characteristics, but also on their proximity to a rail transit station. Specifically, we focus on the tendency to use private motorized modes (car and motorcycle) of residents who live in condominiums that are located in three groups of areas according to proximity to transit perception discussed earlier: within 500 meters of a transit station, 500 to 1,000 meters, and over 1,000 meters. To test this hypothesis, we estimate the logistic regression model as shown in equation (1).

$$ln\left(\frac{p}{1-p}\right) = X\beta + L\gamma + \varepsilon \qquad (1)$$

where p = probability that the condominium resident commutes by private motorized modes, X = vector of the resident's socioeconomic characteristics variables, L = vector of the condominium location characteristics variables, ε = logistically distributed error, and $\beta,\ \gamma$ = vectors of model parameters.

To estimate the logistic regression model, we collected travel behavior data of residents in condominiums near transit stations in Bangkok by an on-line questionnaire survey. The survey was conducted in two stages. First, approximately 10,000 flyers were distributed in residents' mail boxes in approximately 100 condominiums along rail transit corridors in Bangkok. The flyer describes the objective of the survey and provides a link to the on-line questionnaire. Second, survey respondents would go on-line and complete the questionnaires. Respondents who completed the survey were compensated with mobile phone credit in the amount of 50 Baht (approximately US$1.60). Data collected from the survey include mode choice of commuting trip, trip characteristics, such as travel time and costs, socio-economic characteristics of respondents, such as age, income, and car ownership. After discarding incomplete questionnaires, the total of 185 records are used for further analysis.

We acknowledge that the sample size in this study (185 observations) is relatively small, and the sample may not closely represent the population in certain aspects as we might hope. One potential sample bias is attributed to the data collection method. The use of an on-line questionnaire is likely biased towards younger condominium residents who are more technologically savvy. That being said, condominium units in Bangkok built in the past decade tend to be small (30-60 square meters), as they target single or small households who are young professionals. In other words, the types of residence possibly already determine the characteristics of the population for the survey.

While we acknowledge this limitation of our study, we believe that the results presented in the following section form a useful first step of our effort to understand the travel behaviors of residents in newly developed area near transit stations.

DESCRIPTIVE STATISTICS

Tables 1 show descriptive statistics of the survey data. The sample average income of approximately US$ 12,534 per year (US$1 = 30 Baht), is somewhat higher than the national average of US$ 5,394, but similar to Bangkok's per capita income of US$12,187, as reported by the National Statistical Office (NSO, 2010). The age of respondent in the sample ranges from 14 to 65, with the average age of 31.37 years. The average values of dummy variables show the percentage of the sample belonging to each group. For instance, 41.62, 74.05, and 24.86 percent of the sample are male, single, and students, respectively. In addition, Table 1 shows location characteristics of respondents. For example, 25.41 percent of respondents live in condominiums that are located within 500m of rail transit stations, and 31.89 percent between 500 and 1000m from stations. Also summarized in Table 1 are the dummy variables for locations of condominium residence and office relative to the CBD, as defined by their proximity to stations in the CBD (Siam, Asok-Sukhumvit, Saladaeng-Silom stations, and the stations between them). As can be seen, 10.27 percent of the respondents live in condominiums that are located near CBD stations, and 29.19 percent work or study near CBD stations.

Table 1 – Socioeconomic, household, and location characteristics of respondents

Variable	Mean	S.D.	Minimum	Maximum
Income (Baht per month)	31335.14	22375.41	3000	70000
Age (Year)	31.37	9.89	14	65
Male dummy	0.4162	0.4943	0	1
Single dummy	0.7405	0.4395	0	1
Student dummy	0.2486	0.4334	0	1
No. of cars owned by household	0.9676	0.8002	0	3
No. of motorcycles owned by household	0.2757	0.5755	0	2
No. of household members	2.1892	1.0331	1	4
No. of years of residency	2.64	1.53	1	5
Rent unit dummy	0.2865	0.4533	0	1
Location characteristic dummies				
Condo located within 500m of station	0.2541	0.4365	0	1
Condo located 500-1000m from station	0.3189	0.4673	0	1
Condo located near CBD stations	0.1027	0.3044	0	1
Office located near CBD stations	0.2919	0.4559	0	1

Mode share

Table 2 shows the summary of mode share in the sample as well as descriptive statistics of trip time and costs of commuters by each mode. The mode with the largest share is rail transit, followed by car and bus. Bus commuters endure the longest travel time, on average, but spend the second lowest amount on their trips after motorcycle commuters. Drivers, on average, spend the most by far on their commute trips, followed by taxi and rail transit commuters. As can be expected, non-motorized commuters, including people who walk and bicycle, experience the lowest amount of travel time and pay no out-of-pocket cost for their commute trips.

Table 2 – Commuting trip mode share and trip characteristics

			Travel time (min.)		Travel cost (Baht)	
Mode	Frequency	Percent	Average	S.D.	Average	S.D.
Rail	63	34.05	29.21	15.61	51.30	23.36
Car	47	25.41	33.72	21.05	99.19	36.38
Bus	41	22.16	39.54	22.40	23.97	36.85
Taxi/ motorcycle taxi	13	7.03	17.23	11.52	54.00	53.02
Motorcycle	11	5.95	16.18	10.31	22.35	36.72
Non-motorized modes	10	5.41	10.81	6.02	-	-
Total	185	100				

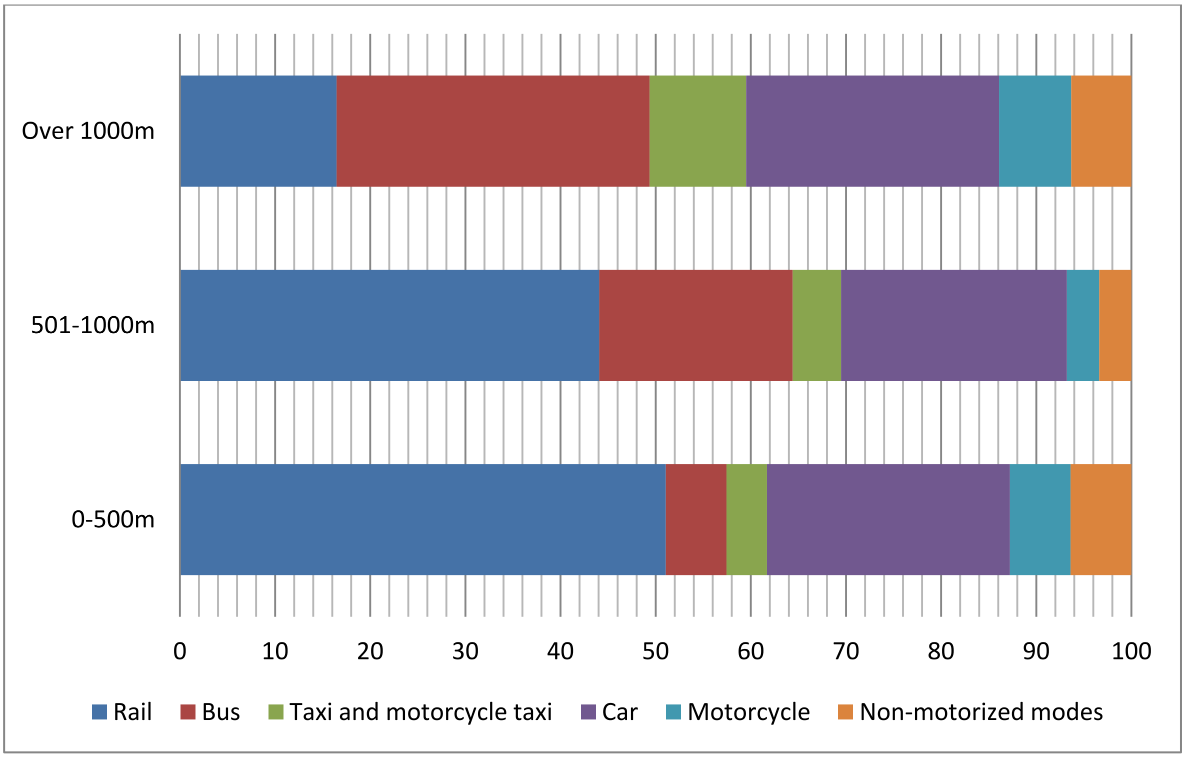

Figure 4 – Mode share of residents of condominiums located at different ranges of distances from rail transit stations

Figure 4 shows the mode share of residents who live in condominiums at different distances from rail transit stations. The farther the distance from transit stations, the lower the share of rail transit use and the higher the share of bus use. The share of car use remains relatively stable as the distance becomes farther, although the share of car use is higher in areas within walking distance of 500 meters than the areas between 500 and 1000 meters. Also, interestingly, overall share of public transportation (rail, bus and taxi) in the areas within 500 meters of transit stations and the share in the areas between 500 and 1000 meters from transit stations are quite similar, as are the shares of car and motorcycle in these areas. Interestingly, the areas between 500 and 1000 meters from transit stations are where the overall public transportation share is the highest, and the private motorized mode share is the lowest.

MODEL ESTIMATION RESULTS

The estimation results of the logistic regression model are reported in Table 3. Coefficient estimates for socioeconomic variables have expected signs. For example, the coefficient estimates imply that higher income commuters tend to use private modes, while single commuters, students, and renters tend not to do so. In addition, while most coefficient estimates are statistically significant at the 10% level, some, including age, gender, and household car ownership are not. This is so probably due to the problem of multicollinearity that exists among these variables and income. However, we include in the model these variables, which we feel are important determinants of mode choice, despite their lack of statistical significance, to prevent biases that might result from omission of relevant variables.

As for location variables, the dummy variable for areas between 500 and 1000 meters is negative and statistically significant, implying that the residents of condominiums between 500 and 1000 meters from a rail transit station are less likely to use private motorized modes than those living farther away. Surprisingly, the same cannot be said for the residents of condominiums in close proximity to a rail transit station, as the dummy variable for condominium locations within 500 meters of a rail transit station is, albeit negative, not statistically significant. While the coefficient for the condo-near-CBD dummy variable is positive but not significant, the coefficient for the office-near-CBD dummy variable is negative and significant, implying that condominium residents, who commute to work or study near the CBD are, as can be expected, less likely to drive.

Table 3 – Logistic regression results

Explanatory Variables	Coefficient	S.E.	Z	P
Socioeconomic characteristics				
Income	0.0000221	0.0000109	2.02	0.04
Age	0.0215356	0.0274957	0.78	0.43
Male dummy	0.2024106	0.4017318	0.50	0.61
Single dummy	-0.8466607	0.5129848	-1.65	0.10
Student dummy	-1.4153860	0.7790139	-1.82	0.07
No. of cars owned by household	0.3694211	0.2628248	1.41	0.16
No. of motorcycles owned by household	0.8816106	0.3506503	2.51	0.01
No. of household members	-0.3656444	0.2269649	-1.61	0.10
Rent unit dummy	-0.8239329	0.4692986	-1.76	0.08
Location characteristics				
Condo located within 500m of station	-0.7447276	0.5360472	-1.39	0.17
Condo located 500-1000m from station	-0.9124619	0.4859939	-1.88	0.06
Condo located near CBD stations	1.0080730	0.7193373	1.40	0.16
Office located near CBD stations	-0.8113568	0.4862634	-1.67	0.10
Constant	-0.6453943	1.3618620	-0.47	0.64
Number of observations	185			
χ^2_{13}	57.12			
Prob > χ^2_{13}	0.0000			
Pseudo R^2	0.2482			
Log likelihood	-86.49			

CONCLUSION AND POLICY IMPLICATIONS

The empirical findings in this paper show that people who live close to transit stations do indeed use the transit systems more than those who live further away. Since most of the survey respondents have moved to their current residences within the past three years, it is highly likely that the high transit use results from self-selection processes in terms of residential location choice. In other words, they have moved to the condominiums because they want to use the transit systems. Still, the evidence that a quarter of these residents still drive cars to work also indicate the limitation of the premise that people who live close to transit stations will use the transit systems.

One would also expect that people who do not own private vehicles would choose to live closer to transit stations and use the transit systems. But our empirical results suggest that those who live within walking distance of a transit station drive more than those living further out but still within one kilometre. This is perhaps because condominiums located close to transit stations tend to more expensive than those located further away. This raises a question about the affordability of residential projects that are close to transit stations.

The results also show that the locations of offices that are close to transit stations, particularly those in the CBD area, may be more important in terms of shifting people away from driving to using rail transits than residential locations. In other words, in the case of Bangkok, TOD instruments that focus on commercial development near transit stations may be more significant than residential development in inducing modal shifts from private cars to transit uses.

The results also raise other questions regarding policy implications for land use and transport planning in Bangkok, as follows:

Housing affordability: If people who live farther way, but not too far, from transit stations have a greater tendency to use transit systems, would it be more efficient to implement land and housing policy instruments that would allow relatively lower income people to live closer to transit stations? Currently, the housing market in Bangkok is mostly left to market forces; the private sector is the key actor that provides housing units. It is difficult for the state to intervene in the land market in Bangkok, especially because the city and national governments do not own land in the city, particularly in the areas close to transit stations.

Parking regulations: Bangkok's Building Codes currently require that any building with floor space of more than 2,000 sq.m. provide one parking slot per 120 sq.m of floor space. Developers have claimed that such provision increases the costs of condominium units, making them less affordable to lower-income people. The city government may have to reconsider and adjust its building codes on parking requirement, which may have increased the cost of condominium units. Further empirical research is needed to quantify the effect of having additional parking slots on the cost of condominium units and the resulting impact on housing affordability.

ACKNOWLEDGMENTS

The authors would like to thank the Rockefeller Foundation for financial support. We also thank Marakot Worachairungreung for help with data collection. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Rockefeller Foundation. Any errors are our own.

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Responses to reviewers

One of the main problems is the availability of relevant data and on-line surveys are a solution. In this case, the sample is rather small but what is more important, authors do not mention if the characteristics of the sample can produce any bias in findings.

- We acknowledge this limitation in p. 7, last paragraph.

For example, in their sample, three quarters of respondents are single and rather young and existing literature shows evidence that life cycle (age, married/not married, children at home, their age, etc.) is one of the factors having a significant influence on mode choice.

- In Thailand, traditionally residents of condominium are unmarried or young family as larger, more mature families tend to prefer single-family detached residential units (although the trend is changing recently). This might explain the large share of singles in the sample. We note this important characteristic of the sample and will try to better control for them in our future work.

What might be the share of individuals not using the same mode of transport for the forward journey and the return journey (commuting trip) or change the mode of transport according to the weekday? Was this information collected in the on-line questionnaire?

- Approximately 17 percent of the sample uses different modes for the forward and return trips. We do not have information about individuals who use different modes on different days of week.

Table 2: travel cost is calculated per trip? How did authors calculate out-of pocket cost for car and motorcycle?

- In the questionnaire, the respondent was asked to estimate their average travel expenses including fuel, parking, and tolls. The sum of these expenses is divided by the estimated number of commuting trips per months.

Bibliography: see for example Givoni´s articles on access to railway stations (even though it is in the Netherlands).

- See p. 5, last paragraph.