



CHAPTER 4

TRIP GENERATION AS RELATED TO MODE AND PURPOSE OF TRIPS

The preceding chapter dealt with the factors related to total trip generation by households. In that analysis, all trips were treated alike irrespective of travel mode or trip purpose. In a sense, that procedure implicitly assumed that all person trips were equally important with respect to the measurement of travel demands by urban residents. The analysis therefore pertained only to the frequency with which trips were made by the members of a household and ignored other interesting features of urban travel behavior, such as the timing of trips during the day, trip lengths, travel modes, and trip purposes.

In the present chapter, attention is turned to the composition of urban travel by mode and purpose, in relation to total trip generation rates. Four travel-mode categories - auto-driver, auto passenger, transit, and walking - are examined, and two trip-purpose categories - work and school - are then singled out for investigation.

Travel Mode and Trip Generation

Although responses in the O-D home interview survey may have identified as many as seven different travel modes, person trips can be conveniently classified by four major travel modes: (1) auto-driver trips; (2) passenger trips including auto-, truck-, and taxi-passengers; (3) Transit trips including bus,

train and boat; and (4) walking. Due to the wide range of income level and site condition of each housing estate, the travel mode will be investigated in two levels of socio-economic status. For the two statuses, the relative importance of each travel mode is summarized in Table 12 and shown in Fig. 17 for households grouped by car ownership. In both categories of socio-economic status, the dominant mode of trip generation was transit trips, which accounted for 70 and 41 percent of all trips in the low status and high status groups, respectively. the next most important mode was walking trips (23 percent of all trips) for the low status group, and auto-driver trips (32 percent of all trips) for the high status group.

In low status households, increasing the car ownership from zero to one caused auto-driver trips to increase from zero to 2.87 trips per dwelling unit, and auto-passenger trips to increase from 0.12 to 0.85 trips per dwelling unit. Conversely, transit trips and walking trips decreased from 6.44 to 5.25 trips/DU and from 2.17 to 1.55 trips per dwelling, respectively. In zero car households, transit trips accounted for 74 percent of all trips or 6.44 trips per dwelling unit, and walking trips were 25 percent of all trips or 2.17 trips per dwelling unit. In one-car households, transit trips were 50 percent and walking trips were 27 percent of all trips. For all households of the low socio-economic level, transit trips were 70 percent of all trips or 6.29 trips per dwelling unit, walking trips were 23 percent, and auto-driver trips accounted for 4.2 percent of all trips.

In the high status households, families owning one car generated 3.29 more auto-driver trips than the zero car households and two-car households generated

Table 12: Trip Generation and Travel Mode Classified by Vehicle Ownership

Low socio-economic status

Veh DU	No. of DU	Auto-Driver Trips		Auto-Passenger Trips		Transit Trips		Walking Trips		Total Person Trips	
		T/DU	%	T/DU	%	T/DU	%	T/DU	%	T/DU	%
0	267	0	0	0.12	1.4	6.44	73.8	2.17	24.8	8.73	100.0
1	40	2.87	27.3	0.85	8.1	5.25	49.9	1.55	14.7	10.52	100.0
Total	307	0.37	4.2	0.22	2.4	6.29	70.1	2.08	23.3	8.96	100.0

High socio-economic status

Veh DU	No. of DU	Auto-Driver Trips		Auto-Passenger Trips		Transit Trips		Walking Trips		Total Person Trips	
		T/DU	%	T/DU	%	T/DU	%	T/DU	%	T/DU	%
0	27	0	0	0.45	5.1	8.11	92.4	0.22	2.5	8.78	100.0
1	95	3.29	34.0	2.64	27.3	3.44	35.5	0.31	3.2	9.68	100.0
2	29	5.62	49.0	3.28	28.5	2.41	21.0	0.17	1.5	11.48	100.0
Total	151	3.15	32.0	2.37	24.0	4.08	41.3	0.27	2.7	9.87	100.0

LOW SOCIO-ECONOMIC STATUS

HIGH SOCIO-ECONOMIC STATUS

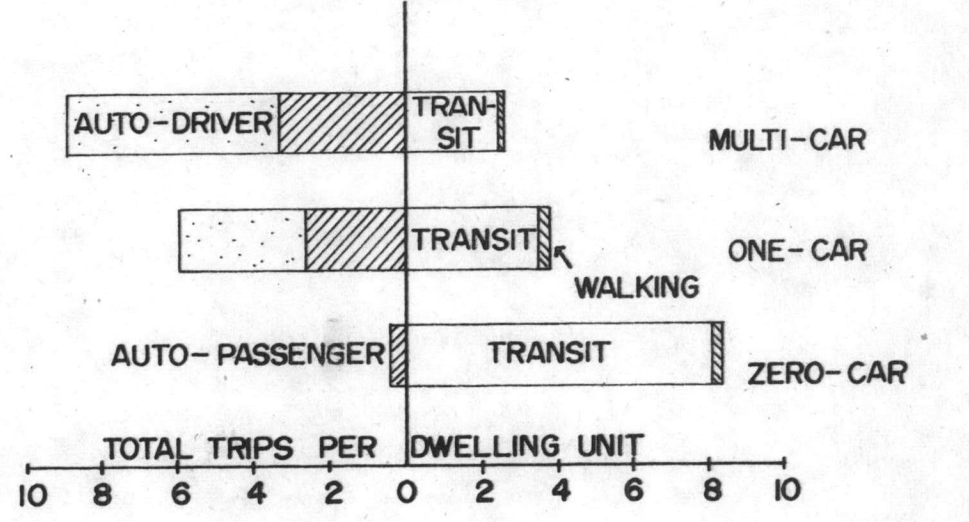
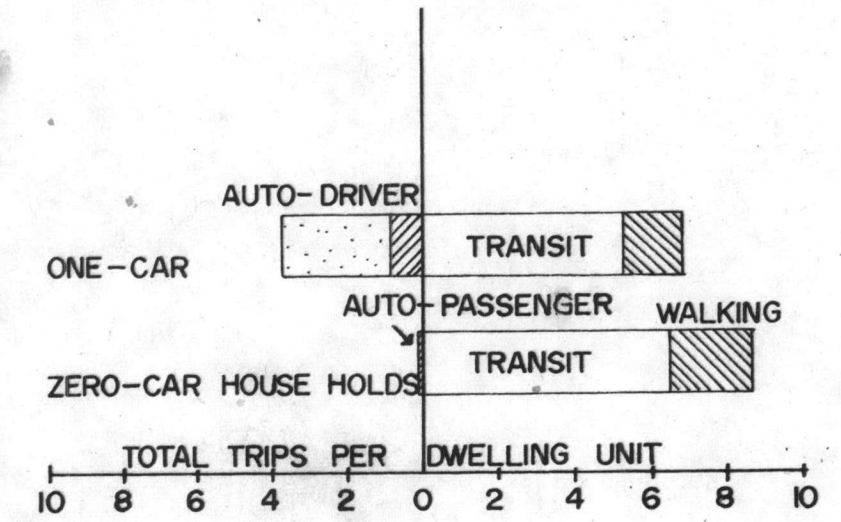
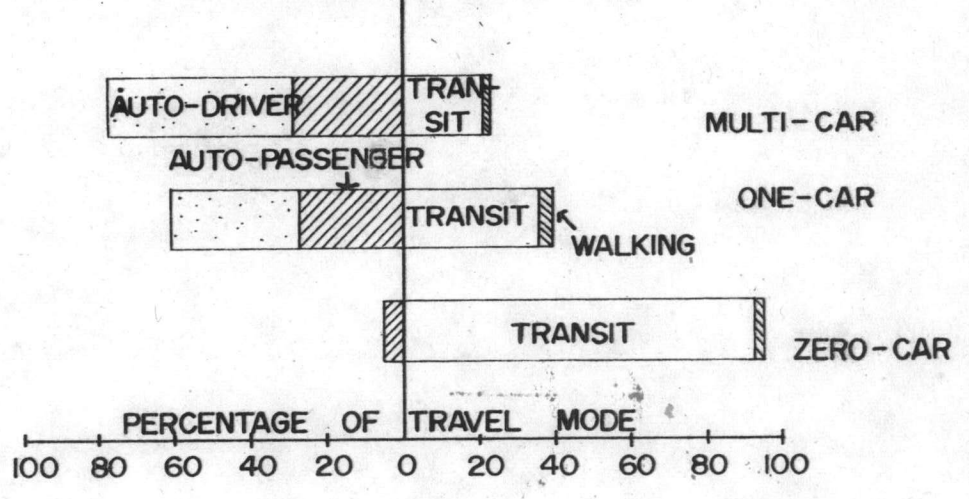
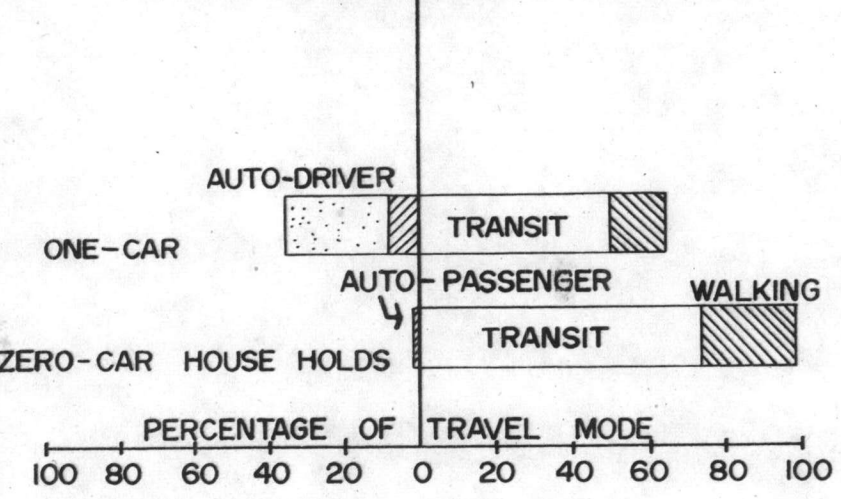


FIGURE 17 : TRIP GENERATION AND TRAVEL MODE CLASSIFIED BY VEHICLE OWNERSHIP

2.33 more auto-driver trips than the one-car households. Auto-passenger trips became important in the high status households, these trips increased from 5 percent for zero-car households to 27 percent for one-car households (from 0.45 trips per DU to 2.64 trips per DU), and up to 28.5 percent in two-car households (3.28 trips per DU). Transit trips are the dominant mode in zero car households with 92 percent of all trips being made by transit (8.11 trips/DU). This reduces to 35.5 percent in one-car households and to 21 percent in two-car households. For all high status households, transit trips were 41 percent, auto-driver trips were 32 percent, and auto-passenger trips were 24 percent of all trips.

Table 13 shown the percentage of person trips by purpose classified by mode of trip and socio - economic status. In the auto-driver trips, the percentage of work trips were 28.8 and 29.6 for the high and low status groupings, respectively. The highest fraction of auto - driver from high status households was to serve passengers (36.6 percent); this purpose was 14 percent for low status households. From low socio-economic status households, 36.8 percent of auto-passenger trips were work trips. School trips were 30.4 percent of auto-passenger trips from high status households.

Travel by transit for going to work and school are about 46 percent and 44 percent from low and high status categories, respectively. Many children living in low status walk to school, trips for this purpose were 28.3 percent of all walking trips. Although the corresponding figure for walking trips to school

Table 13 Percentage of Person Trips by Trip Purpose and Travel Mode at Low and High Socio-economic Status

Purpose \ Mode	Auto-Driver Trips		Auto-passenger Trips		Transit Trips		Walking Trips		Total Person Trips	
	Low	High	Low	High	Low	High	Low	High	Low	High
Work	29.6	28.8	36.8	19.6	25.0	17.5	5.0	2.5	20.9	21.2
School	1.7	1.0	14.7	30.4	21.5	26.8	28.3	25.0	22.0	19.4
Business	9.6	0.8	1.5	0.3	0.7	0	0.3	0	1.0	0.3
Serve passenger	13.9	36.6	0	2.2	0.1	0.8	0	0	0.7	12.6
Shopping	0	0.2	0	0.6	1.3	1.5	15.9	20.0	4.6	1.3
Social Recreation	6.9	2.1	1.5	6.1	1.9	2.8	0.5	2.5	1.8	3.4
Home	38.3	30.5	45.5	40.8	49.5	50.6	50.0	50.0	49.8	41.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

for high status households was 25 percent, it should be borne in mind that the walking mode represented only 3 percent of all trips in the high socio-economic status category. It is concluded that the dominant mode is transit and that the use of this mode decreases with increasing car ownership and an improved socio-economic level. Both auto-driver trips and auto-passenger trips increased with increasing car ownership and improved socio-economic status. Following transit, walking is the second most important mode in low status households; this mode is especially significant for school trips from low status households.

Determinants of Work Trip Generation

In the O-D studies, each person trip was classified by purpose at its destination. Table 13 shows the percentage of person trips by purpose and mode. About 21 percent of all trips were found to be work trips. Work trips per household are positively correlated to family size as presented in Table 14 and Fig. 18. Work trips per dwelling increased from 0.71 at one and two person households to 3.66 at ten and more person households, but the trips for purposes other than work increased at faster rates with increasing family size. Work trips per resident declined with increasing family size, indicating lower labor force participation rates for the larger families. This phenomenon is primarily attributable to the changing age composition of households; the larger households typically contain higher proportions of children. Indeed, from Table 14, one finds that the proportion of wage earners to residents declined from

Table 14: Frequency of Work Trips, Non-work Trips, and Total Trips by Household Size

No. of Persons/DU	No. of Households	No. of Work Trip per DU	No. of Total Trips per DU	No. of Non-work Trip per DU	Work Trips as Percent of Total Trips	% of Wage Earners to Residents
1&2	17	0.71	2.74	2.03	25.9	46.9
3	59	1.17	4.61	3.44	25.4	47.4
4	64	1.42	6.67	5.25	21.4	40.6
5	82	1.89	8.52	6.63	22.2	41.0
6	83	1.76	9.55	7.79	18.4	30.7
7	60	2.23	11.10	8.87	20.1	35.9
8	40	2.45	12.85	10.40	19.1	32.8
9	18	3.11	14.11	11.00	22.0	35.1
10 or more	35	3.66	16.31	12.65	22.4	34.5
Total	458	AV.=1.94	AV.=9.26	AV.=7.32	AV.=21.0	AV.=36.4

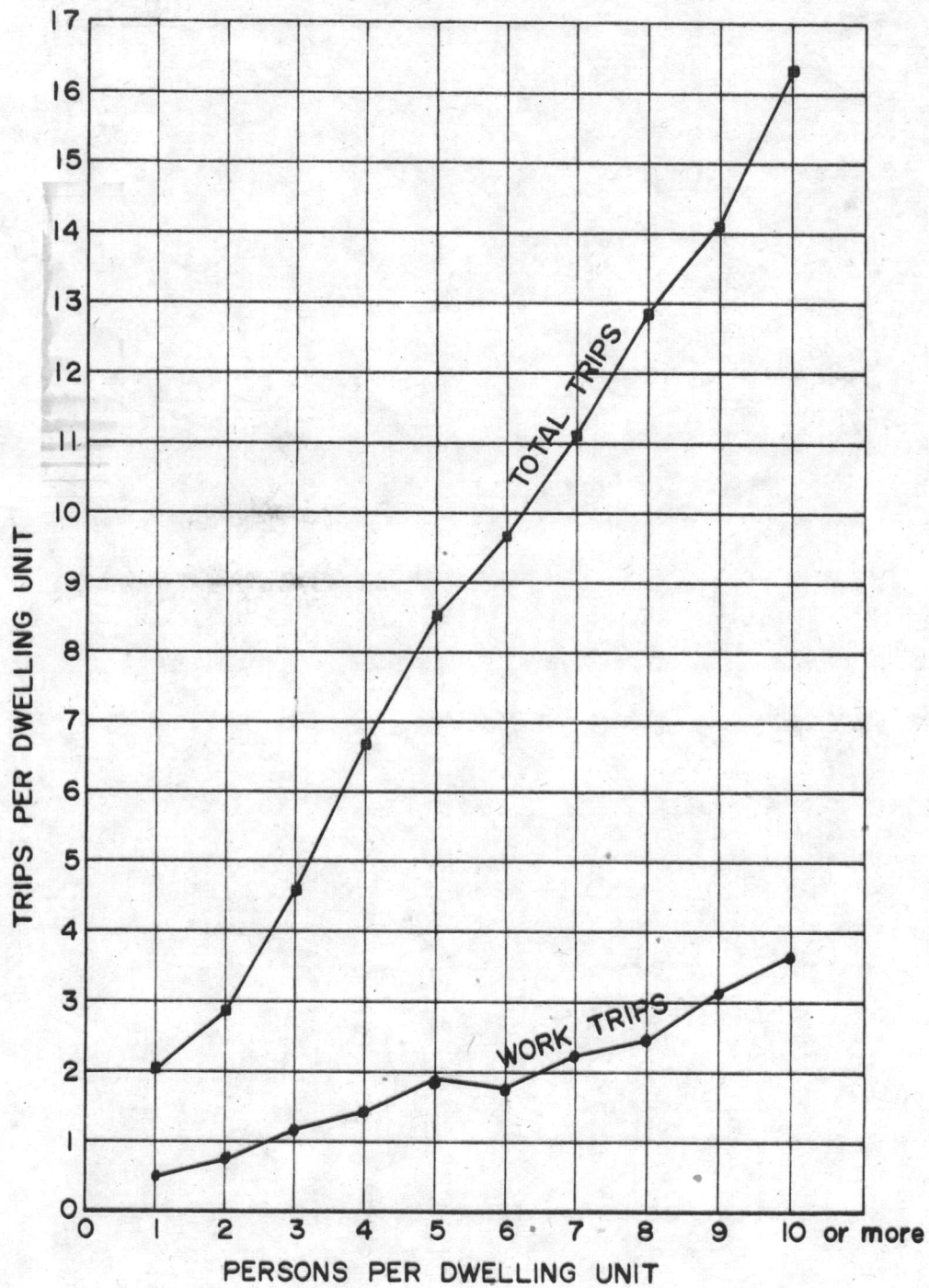


FIGURE 18: FREQUENCY OF WORK TRIPS AND TOTAL TRIPS PER DWELLING UNIT AT VARIOUS LEVELS OF FAMILY SIZE

46.9 percent in one and two person households to 34.5 percent for ten and more persons in the household. Thus, when family size is defined by the number of wage earners, a linear relation is observed between mean work-trip generation rates and the number of wage earners in a household; this pattern is shown in Fig. 19 and the data summarized in Table 15. Work trip frequency increased uniformly from zero to four wage-earner households, then the rate of work trips per dwelling unit continued to increase but at a flatter slope for five and six or more wage-earner households. It was found that all six and over wage-earner households, and some five wage earner households, occur in the low-income estates where most wage earners are laborers who are hired uncertainly on a day-by-day, or week-by-week basis. Thus, the growth of work-trip frequency diminished at five and six or over wage-earner households.

Work - trip generation and travel mode classified by vehicle ownership are summarized in Table 16 for low and high socio-economic status households. Work trip generation rates increased with increasing car ownership and an improved socio-economic level. From the low socio-economic status, 84 percent of all work-trip travel was done by transit, and 5.6 percent walked to work. In the high socio-economic status households, 43.7 percent drove to work, 34.2 percent travelled by transit, and 21.8 percent travelled as auto-passengers.

Determinants of School Trip Generation

According to the high percentage of population aged 20 years and less

Table 15: Frequency of Work Trips and Total Trips by Number of

Wage Earners per Dwelling Unit

No. of wage earners per DU	0	1	2	3	4	5	6 or more	AV=2.11
No. of households	21	139	153	83	41	17	4	$\Sigma = 458$
Work Trips per DU	0	0.98	1.84	2.67	3.56	4.94	5.00	AV=1.94
Total Trips per DU	4.62	7.62	8.80	10.76	12.58	15.35	16.50	AV=9.26

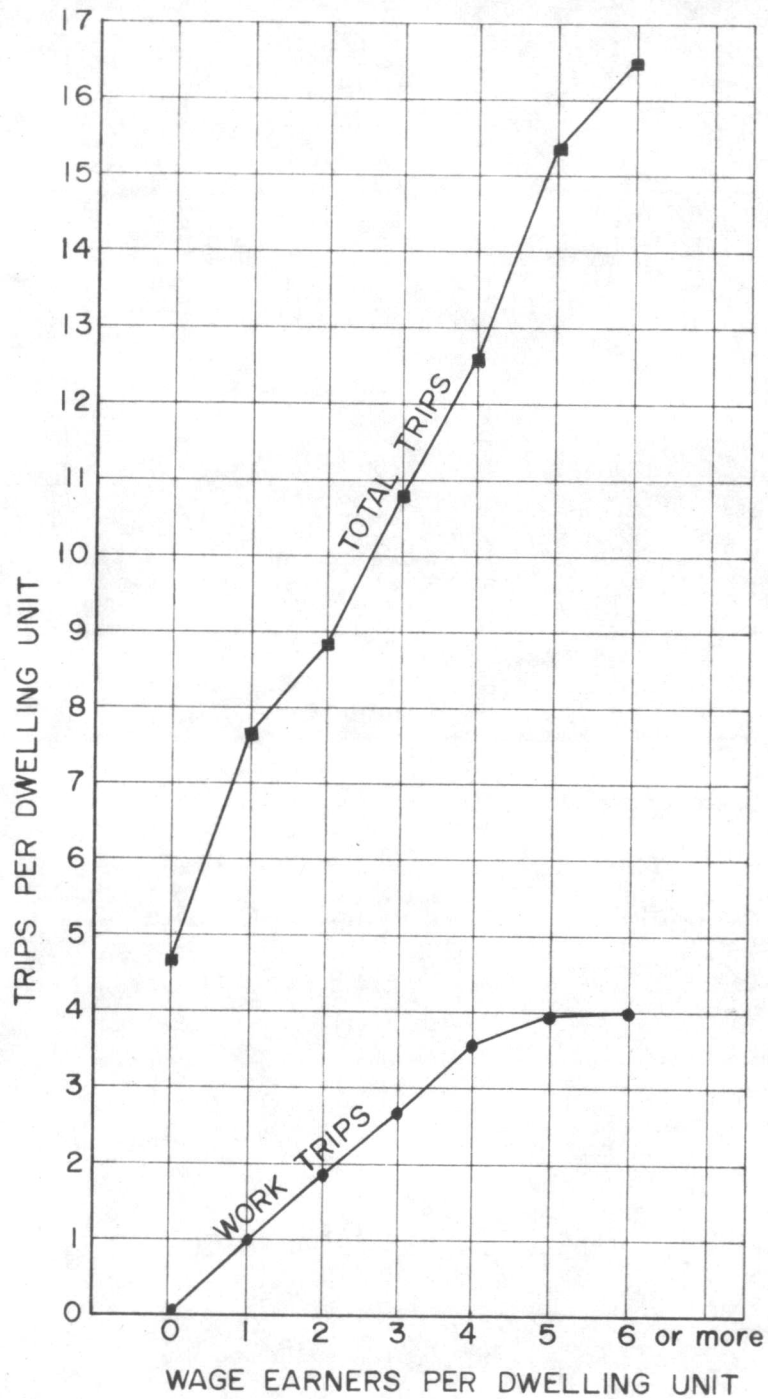


FIGURE 19: FREQUENCY OF WORK TRIPS AND TOTAL TRIPS PER DWELLING UNIT AT VARIOUS LEVELS OF WAGE EARNERS PER DWELLING UNIT

Table 16: Work Trip Generation and Travel Mode Classified by Vehicle Ownership

Low socio-economic status

Veh / DU	No. of DU	Auto-Driver Trips		Auto-Passenger Trips		Transit Trips		Walking Trips		Total person Trips	
		T/DU	%	T/DU	%	T/DU	%	T/DU	%	T/DU	%
0	267	0	0	0.05	2.8	1.68	90.0	0.12	6.3	1.85	100.0
1	40	0.85	43.0	0.30	15.2	0.80	40.5	0.03	1.3	1.98	100.0
Total	307	0.11	5.9	0.08	4.5	1.57	84.0	0.11	5.6	1.87	100.0

High socio-economic status

Veh / DU	No. of DU	Auto-Driver Trips		Auto-Passenger Trips		Transit Trips		Walking Trips		Total person Trips	
		T/DU	%	T/DU	%	T/DU	%	T/DU	%	T/DU	%
0	27	0	0	0.11	6.0	1.74	94.0	0	0	1.85	100.0
1	95	0.93	45.1	0.58	28.2	0.54	26.2	0.01	0.5	2.06	100.0
2	29	1.72	70.4	0.38	15.5	0.35	14.1	0	0	2.45	100.0
Total	151	0.91	43.7	0.46	21.8	0.71	34.2	0.01	0.3	2.09	100.0

in Bangkok in 1974.* School trips are the dominant type of trip from home in the Bangkok metropolitan area. About 21 percent of total trips are school trips, as shown in Table 13. Mean school trip generation rates for all households are presented in Table 17 and Fig. 20 for households classified by household size. Similar to work trips, school trips per household are related to family size. School trips per household increase with increasing family size, but not uniformly so, as shown in Fig. 20 because of the variation in percentage of students to residents in each household. The larger households typically contain higher proportions of students. As shown in Table 17, the proportion of students to residents increases from 15.6 percent for one and two person families to 34.5 percent for ten and more persons per family. Thus, when family size is defined by the number of students, a linear relation is observed between mean school trip generation rates and students; this pattern is shown in Fig. 21 and summarized data are presented in Table 18.

Table 19 presents school trip generation and travel mode classified by car ownership. In low socio-economic level households, 68.4 percent of school trips were transit trips and 29.7 percent were walking trips. Walking trips to school are relatively high in the low socio-economic level households because

* National Statistical Office, Office of the Prime Minister and Office of the Under-Secretary, Ministry of Education, 1974 Statistics on General Stream of Education by Province, Bangkok, 1976.

Table 17 Frequency of School Trips and Total Trips by Household Size

No. of Persons/DU	No. of DU	No. of School Trips/DU	No. of Total Trips/DU	% of Student to Residents
1 & 2	17	0.29	2.74	15.6
3	59	0.58	4.61	20.9
4	64	1.31	6.67	36.3
5	82	1.78	8.52	39.5
6	83	2.25	9.55	41.8
7	60	2.43	11.10	38.8
8	40	3.15	12.85	43.8
9	18	2.89	14.11	35.2
10 or more	35	3.31	16.31	34.5
Total	458	Av = 1.96	Av = 9.26	Av = 37.5

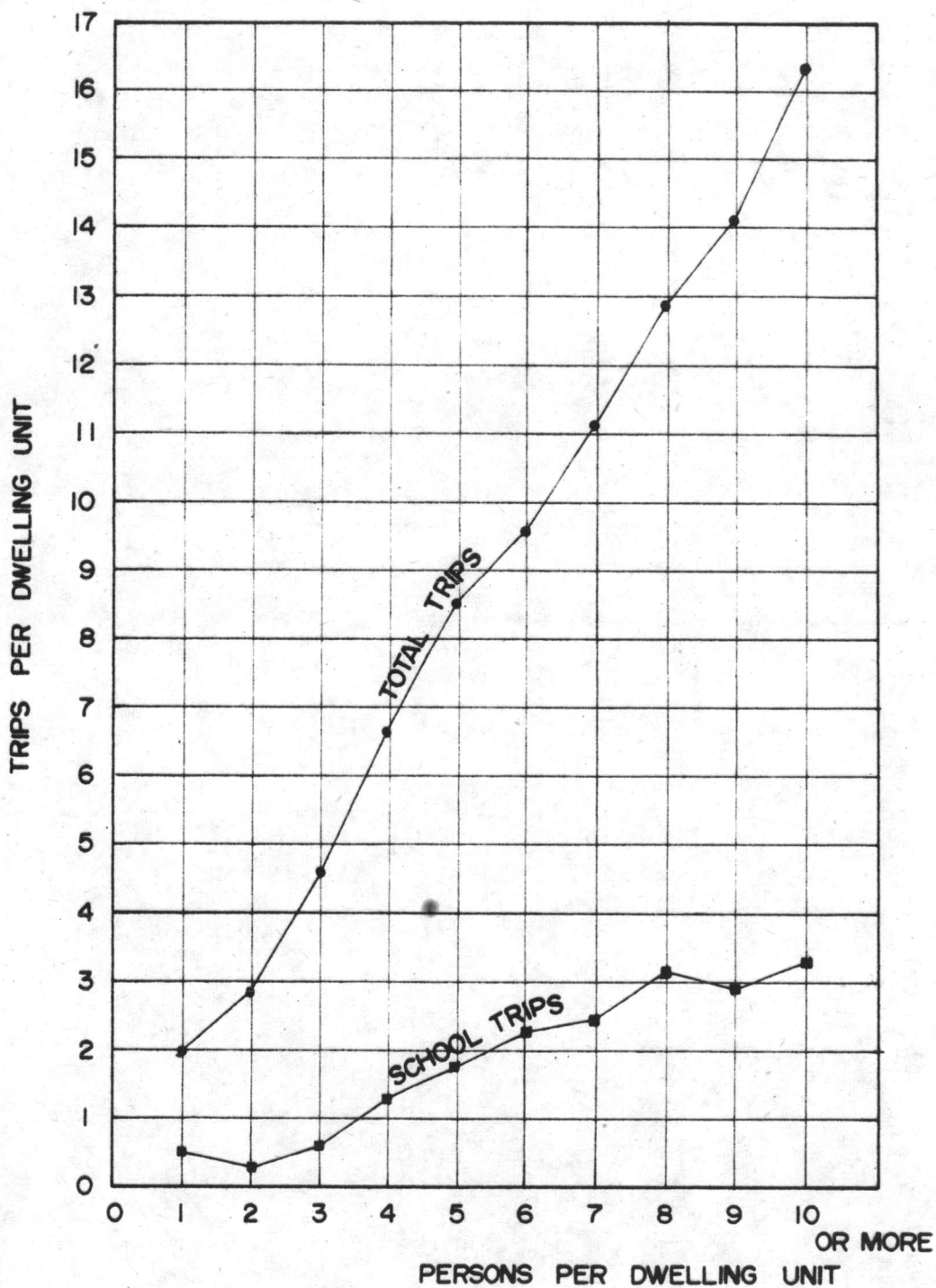


FIGURE 20 : FREQUENCY OF SCHOOL TRIPS AND TOTAL TRIPS
AT VARIOUS LEVELS OF FAMILY SIZES

Table 18 Frequency of School Trips and Total Trips by Number of Students per Dwelling Unit

No.of Students per DU	0	1	2	3	4	5	6	7	$A_v = 2.17$
No.of Dwelling Units	81	110	106	87	43	27	3	1	$\Sigma = 458$
No.of School Trips per DU	0	0.97	1.97	2.95	3.86	4.89	6.00	7.00	$A_v = 1.96$
No.of Total Trips per DU	5.38	7.29	8.47	11.71	13.47	15.52	21.67	24.00	$A_v = 9.26$

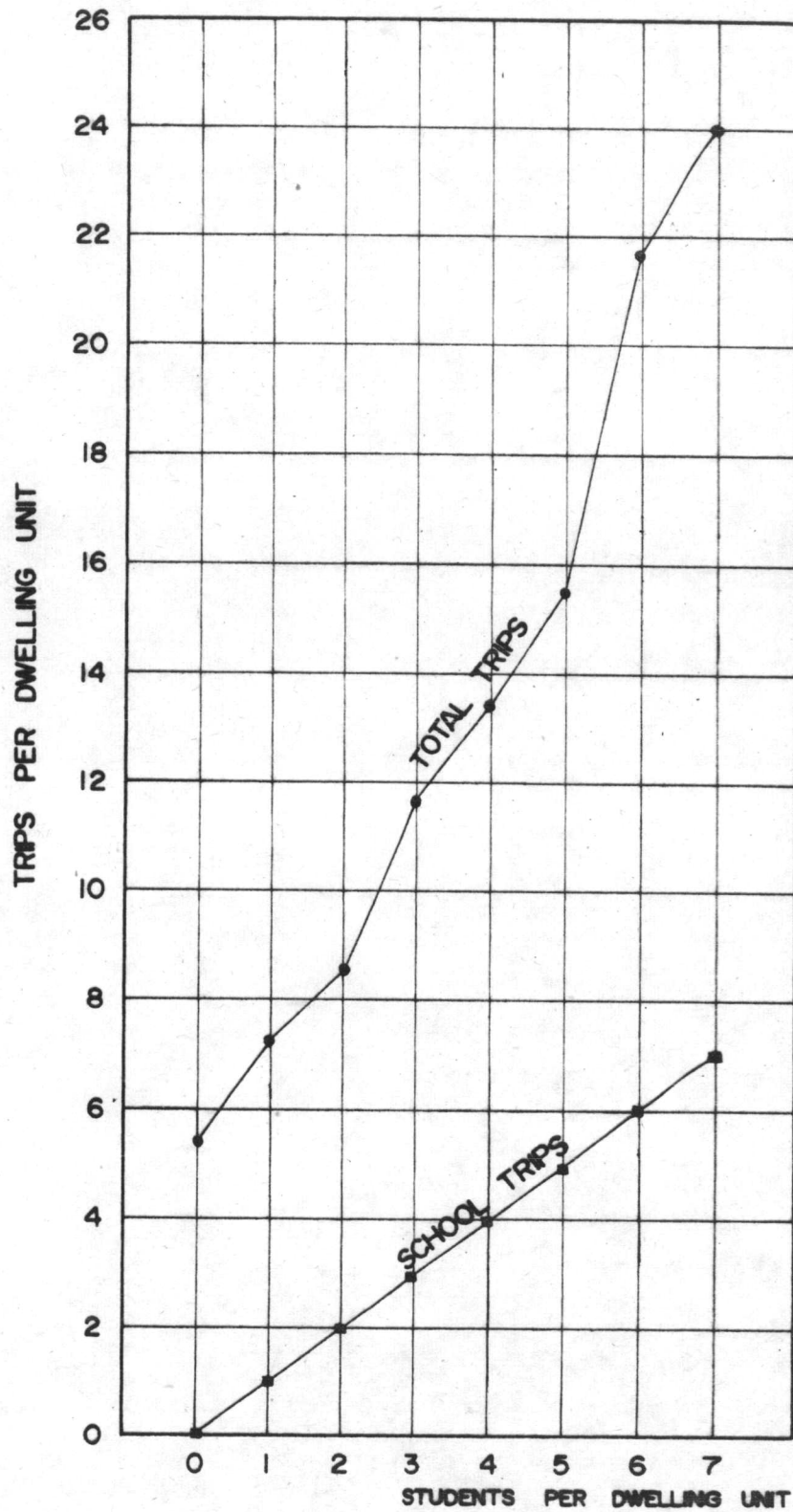


FIGURE 21 : FREQUENCY OF SCHOOL TRIPS AND TOTAL TRIPS
AT VARIOUS LEVELS OF STUDENTS PER DWELLING UNIT

Table 19 School Trip Generation and Travel Mode Classified by Car Ownership

Low-Socio-economic Level

Veh/DU	No. of DU	Auto-Drive Trips		Auto-Passenger Trips		Transit Trips		Walking Trips		Total School Trips	
		T/DU,	%	T/DU	%	T/DU	%	T/DU,	%	T/DU	%
0	267	0	0	0.01	0.6	1.37	68.8	0.61	30.6	1.99	100.0
1	40	0.05	2.7	0.18	9.3	1.22	65.3	0.43	22.7	1.88	100.0
Total	307	0.01	0.3	0.03	1.6	1.35	68.4	0.59	29.7	1.98	100.0

High-Socio-economic Level

Veh/DU	No. of DU	Auto-Driver Trips		Auto-Passenger Trips		Transit Trips		Walking Trips		Total School Trips	
		T/DU,	%	T/DU	%	T/DU	%	T/DU,	%	T/DU	%
0	27	0	0	0.04	1.6	2.11	91.9	0.15	6.5	2.30	100.0
1	95	0.02	1.2	0.79	44.9	0.89	50.3	0.06	3.6	1.76	100.0
2 or more	29	0.10	5.0	1.14	55.0	0.83	40.0	0	0	2.07	100.0
Total	151	0.03	1.7	0.72	37.7	1.09	57.1	00.7	3.5	1.91	100.0

there frequently are primary schools within walking distance of these housing estates. In high socio-economic level households, 91.9 percent of school trips in zero-car households were transit trips and 6.5 percent were walking trip trips. The percentage of school trips by auto-driver and auto-passenger trips, increased with increasing car ownership: auto-driver trips increased from 1.2 percent in one-car households to 5.0 percent in multi-car households, and auto-passenger trips increased from 44.9 percent to 55.0 percent. For all households of high socio-economic level, 57.1 percent of school trips (1.09 trips/DU) were transit trips, 37.7 percent (0.72 trips/DU) were auto-passenger trips, and the others were walking trips and auto-driver trips.

It was concluded that the overall generation rate of school trips is related to family size and to the number of students in a household, but is not related to car ownership or socio-economic level. However, the selection of mode of transport for school trips was found to be a function of the socio-economic level of the household and of the level of car ownership.

Determinants of Other Trip Generation Rates

In the O-D studies, each person trip was classified by purpose. In addition to the previously described work and school trips, the others are business, serve passenger, shopping, social-recreation, and home trips. The average percentages by trip purpose shown in Table 13 indicate that 47 percent were home trips, 21 percent were school trips, 21 percent were work trips, and other trip

purposes were 11 percent. The distribution of these trip-purpose, at various levels of family size are shown in Fig. 22 and the data are summarized in Table 20. The frequency of home trips is the same as from home trips. The frequency of other trips is not related to family size; these trips recur less frequently than work trips and school trips. The main purpose of other trips is to serve passengers in high socio-economic level households. At this level, serve passenger trips accounted for about 12.6 percent of total trips by all modes, and was 36.6 percent of total auto-driver trips, as presented in Table 13. These serve-passenger trips generally serve to transport children to and from school. It may be stated that these other trips are not related to either family size nor car ownership, except those serve-passenger trips which were found to be related to car ownership. These other trips represent on average about 11 percent of total trip generation.

Table 20 Frequency of Various Trip Purposes at Various Levels of Family Size

Persons per DU	No. of DU	No. of Work Trips per DU	No. of School Trips per DU	No. of Home Trips per DU	No. of Other Trips per DU	Total Trips per DU
1 & 2	17	0.50	0.29	1.29	0.66	2.74
3	59	0.73	0.58	2.15	1.15	4.61
4	64	1.17	1.31	3.08	1.11	6.67
5	82	1.42	1.78	3.82	1.50	8.52
6	83	1.89	2.25	4.41	1.00	9.55
7	60	1.76	2.43	5.15	1.76	11.10
8	40	2.23	3.15	6.25	1.22	12.85
9	18	2.45	2.89	6.67	2.10	14.11
10 or more	35	3.11	3.31	7.66	2.23	16.31
Total	458	Av = 1.94	Av = 1.96	Av = 4.30	Av = 1.06	Av = 9.26

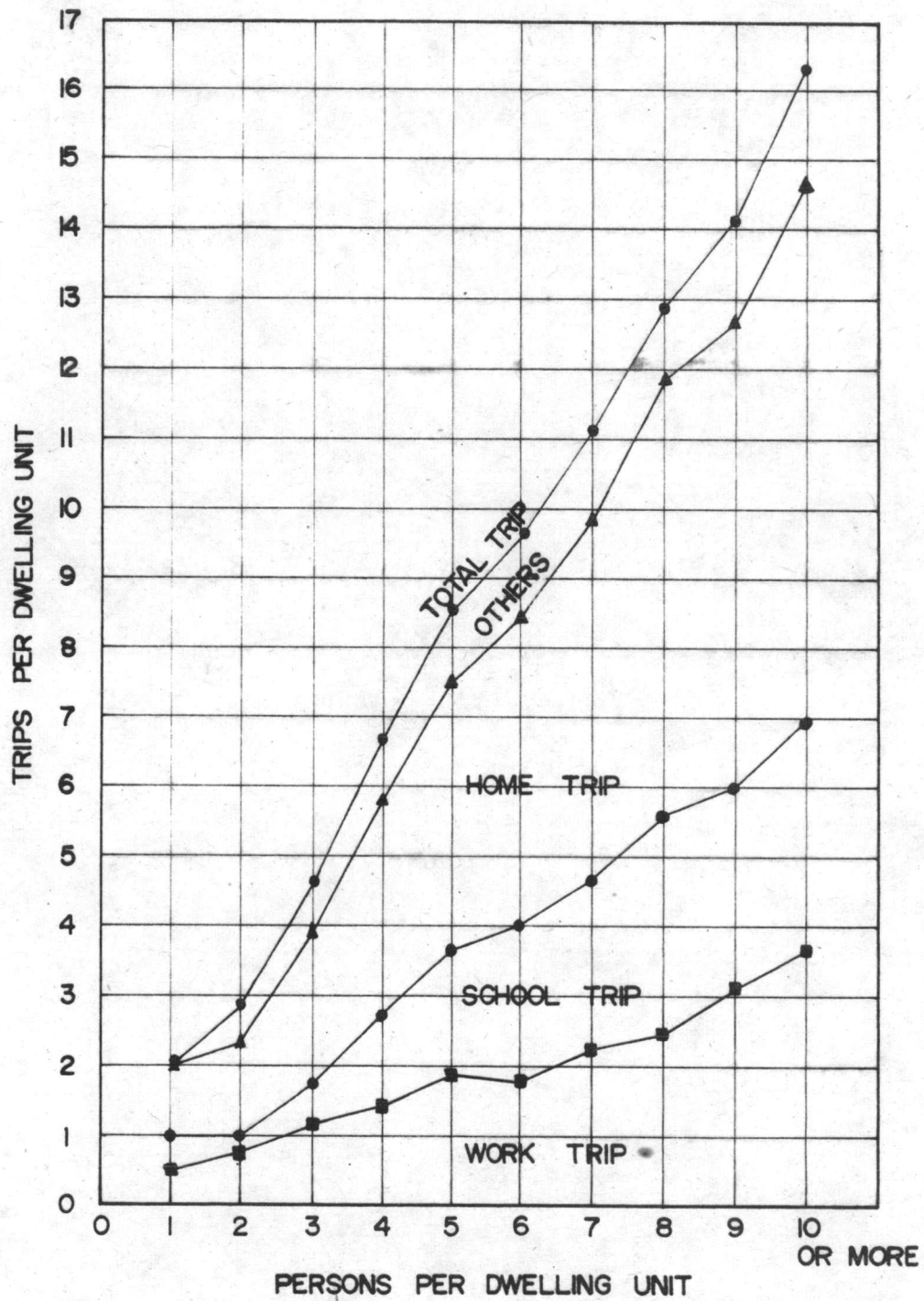


FIGURE 22 : FREQUENCY OF TRIP-PURPOSE AT VARIOUS LEVELS OF FAMILY SIZES