

**EXPLORING PERSON TRAVEL TRENDS IN THE
GREATER TORONTO AREA**

*PART 2: CHANGES IN TRAVEL AND RELATIONSHIP WITH
FACTORS*

August 30, 1998

EXPLORING PERSON TRAVEL TRENDS IN THE GREATER TORONTO AREA

PART 2: CHANGES IN TRAVEL AND RELATIONSHIP WITH FACTORS

by

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Table of Contents

1. INTRODUCTION.....	1
2. CHANGES IN PERSON TRAVEL CHARACTERISTICS.....	2
2.1 TOTAL TRAVEL	2
2.1.1 Number of Trips	2
2.1.2 Trip Purpose	2
2.1.3 Trip Start Time.....	3
2.1.4 Spatial Distribution of Trips.....	4
2.1.4.1 Spatial Market	7
2.1.4.2 Self Containment.....	8
2.1.5 Trip Distance	9
2.1.6 Mode Split.....	9
2.2 TRIP PURPOSE	10
2.2.1 By Time of Day	10
2.2.2 By Spatial Market	11
2.2.3 By Travel Mode.....	12
2.3 TRIP START TIME	13
2.3.1 By Trip Purpose	13
2.3.2 By Spatial Market	14
2.3.3 By Mode of Travel.....	14
2.4 SPATIAL DISTRIBUTION OF TRIPS.....	15
2.4.1 By Trip Purpose	15
2.4.1.1 Spatial Market	15
2.4.1.2 Self-Containment	15
2.4.2 By Time of Day	17
2.4.2.1 Spatial Market	17
2.4.2.2 Self Containment.....	18
2.4.3 By Mode of Travel.....	20
2.4.3.1 Spatial Market	20
2.4.3.2 Self Containment.....	20
2.5 TRIP DISTANCE	22
2.5.1 By Trip Purpose	22
2.5.2 By Time of Day	23
2.5.3 By Spatial Market	23
2.5.4 By Mode of Travel.....	24
2.6 MODE SPLIT	24
2.6.1 By Trip Purpose	24
2.6.2 By Time of Day	25
2.6.3 By Spatial Market	26
3. RELATIONSHIP BETWEEN CHANGES IN TRAVEL AND CHANGES IN FACTORS	28
3.1 APPROACH.....	28
3.2 TRIP CHANGES ASSOCIATED WITH INCREASE IN POPULATION SIZE AND SHIFT IN OVERALL TRIP MAKING RATE..	30
3.3 TRIP CHANGES ASSOCIATED WITH SHIFT IN AGE DISTRIBUTION	33
3.3.1 Age Distribution.....	33
3.3.2 Daily Trip Rates.....	33
3.3.2.1 Total	33
3.3.2.2 By Trip Purpose	34
3.3.2.3 By Travel Mode	35
3.3.3 Trip Changes.....	37
3.4 TRIP CHANGES ASSOCIATED WITH SHIFT IN RESIDENTIAL LOCATION DISTRIBUTION	38
3.4.1 Residential Location Distribution.....	38
3.4.2 Daily Trip Rates.....	39

Table of Contents (Cont'd)

3.4.2.1	Total	39
3.4.2.2	By Trip Purpose	39
3.4.2.3	By Travel Mode	40
3.4.3	<i>Trip Changes</i>	40
3.5	TRIP CHANGES ASSOCIATED WITH SHIFT IN EMPLOYMENT STATUS DISTRIBUTION	41
3.5.1	<i>Employment Status Distribution</i>	41
3.5.2	<i>Daily Trip Rates</i>	42
3.5.2.1	Total	42
3.5.2.2	By Trip Purpose	42
3.5.2.3	By Travel Mode	43
3.5.3	<i>Trip Changes</i>	43
3.6	TRIP CHANGES ASSOCIATED WITH SHIFT IN AUTO MOBILITY DISTRIBUTION	44
3.6.1	<i>Auto Mobility Distribution</i>	44
3.6.2	<i>Daily Trip Rates</i>	45
3.6.2.1	Total	45
3.6.2.2	By Trip Purpose	45
3.6.2.3	By Travel Mode	46
3.6.3	<i>Trip Changes</i>	46
3.7	SUMMARY	47
3.8	IMPLICATIONS FOR FUTURE TRAVEL DEMAND	49

List of Exhibits

EXHIBIT 2.1: TOTAL DAILY PERSON TRIPS	2
EXHIBIT 2.2: DISTRIBUTION OF TRIP PURPOSE	3
EXHIBIT 2.3: DISTRIBUTION OF TRIP START TIME	3
EXHIBIT 2.4: 1986 ORIGIN-DESTINATION TRIP TABLE (TOTAL DAILY TRIPS)	4
EXHIBIT 2.5: 1991 ORIGIN-DESTINATION TRIP TABLE (TOTAL DAILY TRIPS)	5
EXHIBIT 2.6: 1996 ORIGIN-DESTINATION TRIP TABLE (TOTAL DAILY TRIPS)	6
EXHIBIT 2.7: DISTRIBUTION OF DAILY TRIP ORIGINS	7
EXHIBIT 2.8: DISTRIBUTION OF DAILY TRIPS BY SPATIAL MARKET	7
EXHIBIT 2.9: SPATIAL DISTRIBUTION OF DAILY TRIPS TO/FROM PD 1	8
EXHIBIT 2.10: REGIONAL SELF-CONTAINMENT OF DAILY PERSON TRIPS	8
EXHIBIT 2.11: MEDIAN STRAIGHT-LINE DISTANCE OF GTA TRIPS	9
EXHIBIT 2.12: MODE SPLIT OF GTA DAILY TRIPS	9
EXHIBIT 2.13: DISTRIBUTION OF TRIP PURPOSE BY TIME OF DAY	10
EXHIBIT 2.14: DISTRIBUTION OF TRIP PURPOSE BY SPATIAL MARKET	11
EXHIBIT 2.15: DISTRIBUTION OF TRIP PURPOSE BY TRAVEL MODE	12
EXHIBIT 2.16: DISTRIBUTION OF TRIP START TIME BY TRIP PURPOSE	13
EXHIBIT 2.17: DISTRIBUTION OF TRIP START TIME BY SPATIAL MARKET	14
EXHIBIT 2.18: DISTRIBUTION OF TRIP START TIME BY TRAVEL MODE	14
EXHIBIT 2.19: DISTRIBUTION OF SPATIAL MARKETS OF TRIPS BY TRIP PURPOSE	15
EXHIBIT 2.20: REGIONAL SELF-CONTAINMENT OF HOME-BASED WORK TRIPS	16
EXHIBIT 2.21: REGIONAL SELF-CONTAINMENT OF HOME-BASED SCHOOL TRIPS	16
EXHIBIT 2.22: REGIONAL SELF-CONTAINMENT OF HOME-BASED DISCRETIONARY TRIPS	16
EXHIBIT 2.23: REGIONAL SELF-CONTAINMENT OF NON-HOME BASED TRIPS	17
EXHIBIT 2.24: DISTRIBUTION OF SPATIAL MARKETS OF TRIPS BY TIME OF DAY	18
EXHIBIT 2.25: REGIONAL SELF-CONTAINMENT OF MORNING PEAK (6:00 AM - 8:59 AM) TRIPS	18
EXHIBIT 2.26: REGIONAL SELF-CONTAINMENT OF MID-DAY OFF-PEAK (9:00 AM - 2:59 PM) TRIPS	19
EXHIBIT 2.27: REGIONAL SELF-CONTAINMENT OF EVENING PEAK (3:00 PM - 5:59 PM) TRIPS	19
EXHIBIT 2.28: REGIONAL SELF-CONTAINMENT OF EVENING OFF-PEAK (6:00 PM - 5:59 AM) TRIPS	19
EXHIBIT 2.29: DISTRIBUTION OF SPATIAL MARKETS OF TRIPS BY PRIMARY MODE OF TRAVEL	20
EXHIBIT 2.30: REGIONAL SELF-CONTAINMENT OF AUTO-DRIVER TRIPS	21
EXHIBIT 2.31: REGIONAL SELF-CONTAINMENT OF AUTO-PASSENGER TRIPS	21
EXHIBIT 2.32: REGIONAL SELF-CONTAINMENT OF LOCAL TRANSIT TRIPS	21
EXHIBIT 2.33: REGIONAL SELF-CONTAINMENT OF GO RAIL TRIPS	22
EXHIBIT 2.34: MEDIAN STRAIGHT-LINE DISTANCE OF TRIPS BY TRIP PURPOSE	23
EXHIBIT 2.35: MEDIAN STRAIGHT-LINE DISTANCE OF TRIPS BY TIME OF DAY	23
EXHIBIT 2.36: MEDIAN STRAIGHT-LINE DISTANCE OF TRIPS BY SPATIAL MARKET	24
EXHIBIT 2.37: MEDIAN STRAIGHT-LINE DISTANCE OF TRIPS BY TRAVEL MODE	24
EXHIBIT 2.38: MODE SPLIT OF GTA DAILY TRIPS BY TRIP PURPOSE	25
EXHIBIT 2.39: MODE SPLIT OF GTA DAILY TRIPS BY TIME OF DAY	26
EXHIBIT 2.40: MODE SPLIT OF GTA DAILY TRIPS BY SPATIAL MARKET	26
EXHIBIT 3.1: DAILY TRIP MAKING RATE BY TRIP PURPOSE AND TRAVEL MODE	30
EXHIBIT 3.2: CHANGES ASSOCIATED WITH POPULATION INCREASE AND SHIFT IN TRIP RATE	31
EXHIBIT 3.3: CHANGES BY TRIP PURPOSE ASSOCIATED WITH POPULATION INCREASE AND SHIFT IN TRIP RATES	31
EXHIBIT 3.4: CHANGES BY TRAVEL MODE ASSOCIATED WITH POPULATION INCREASE AND SHIFT IN TRIP RATES	32
EXHIBIT 3.5: AGE DISTRIBUTION OF GTA POPULATION 11 YEARS OF AGE AND OLDER	33
EXHIBIT 3.6: TRIP MAKING RATE BY AGE	33
EXHIBIT 3.7: HOME-BASED WORK TRIP MAKING RATE BY AGE	34
EXHIBIT 3.8: HOME-BASED SCHOOL TRIP MAKING RATE BY AGE	34
EXHIBIT 3.9: HOME-BASED DISCRETIONARY TRIP MAKING RATE BY AGE	35
EXHIBIT 3.10: NON-HOME BASED TRIP MAKING RATE BY AGE	35
EXHIBIT 3.11: AUTO-DRIVER TRIP MAKING RATE BY AGE	36
EXHIBIT 3.12: AUTO-PASSENGER TRIP MAKING RATE BY AGE	36
EXHIBIT 3.13: TRANSIT (EXCLUDING GO RAIL) TRIP MAKING RATE BY AGE	37

List of Exhibits (Cont'd)

EXHIBIT 3.14: WALK/CYCLE TRIP MAKING RATE BY AGE.....	37
EXHIBIT 3.15: TRIP CHANGES ASSOCIATED WITH SHIFT IN AGE DISTRIBUTION	38
EXHIBIT 3.16: RESIDENTIAL LOCATION DISTRIBUTION OF GTA POPULATION 11 YEARS OF AGE AND OLDER	39
EXHIBIT 3.17: TRIP MAKING RATE BY RESIDENTIAL LOCATION.....	39
EXHIBIT 3.18: TRIP MAKING RATE BY TRIP PURPOSE AND RESIDENTIAL LOCATION.....	40
EXHIBIT 3.19: TRIP MAKING RATE BY TRAVEL MODE AND RESIDENTIAL LOCATION	40
EXHIBIT 3.20: TRIP CHANGES ASSOCIATED WITH SHIFT IN RESIDENTIAL LOCATION DISTRIBUTION	41
EXHIBIT 3.21: EMPLOYMENT STATUS DISTRIBUTION OF GTA POPULATION 11 YEARS OF AGE AND OLDER.....	41
EXHIBIT 3.22: TRIP MAKING RATE BY EMPLOYMENT STATUS	42
EXHIBIT 3.23: TRIP MAKING RATE BY TRIP PURPOSE AND EMPLOYMENT STATUS	42
EXHIBIT 3.24: TRIP MAKING RATE BY TRAVEL MODE AND EMPLOYMENT STATUS	43
EXHIBIT 3.25: TRIP CHANGES ASSOCIATED WITH SHIFT IN EMPLOYMENT STATUS DISTRIBUTION	44
EXHIBIT 3.26: AUTO MOBILITY DISTRIBUTION OF GTA POPULATION 11 YEARS OF AGE AND OLDER	44
EXHIBIT 3.27: TRIP MAKING RATE BY AUTO MOBILITY	45
EXHIBIT 3.28: TRIP MAKING RATE BY TRIP PURPOSE AND AUTO MOBILITY	45
EXHIBIT 3.29: TRIP MAKING RATE BY TRAVEL MODE AND AUTO MOBILITY.....	46
EXHIBIT 3.30: TRIP CHANGES ASSOCIATED WITH SHIFT IN AUTO MOBILITY DISTRIBUTION.....	46
EXHIBIT 3.31: SUMMARY OF TRIP CHANGES BETWEEN 1986 AND 1996	48

PART 2: CHANGES IN TRAVEL AND RELATIONSHIP WITH FACTORS

1. INTRODUCTION

This part of the study is concerned with changes in person travel in the GTA and relationships of these changes with changes in the travel-related factors examined in Part 1 of the study. The person travel attributes of common interest in transportation planning include the trip purpose, trip start time, trip origin, trip destination, mode of travel and route followed in the transportation network. The last attribute is not dealt with in this study. Excluding this attribute, the other attributes are usually combined as the number of trips between each origin and destination (i.e. Origin-Destination trip table) for each travel mode, principally auto and transit. Further decomposition of these tables is usually made by trip purpose (e.g. home to work trips, school trips, etc.) and time of day (e.g. a.m. peak, off peak, p.m. peak, etc.).

The analysis starts with examining changes in person travel. This part of the analysis examines changes in: (i) total number of trips; (ii) individual distributions of trip start time, trip purpose, spatial trip linkage, trip distance and travel mode; and (iii) distribution of each of the above attributes by each other attribute individually (e.g. mode split by trip purpose). The analysis proceeds with an investigation into the relationship between the changes in person travel and changes in the travel-related factors examined in Part 1 of the study. Specifically, it quantifies the portions of travel change (i.e. change in number of person trips) associated with population growth, change in overall trip rate and individual shifts in four distributions. The four distributions are for the variables: age, residential location, employment status and mobility by auto (i.e. household vehicles per licensed person in the same household). The number of trips examined here include the total number of trips, number of trips by purpose and number of trips by travel mode.

As mentioned earlier in the first report, some degree of under-reporting has been detected in the travel data, particularly in discretionary trips and during off-peak periods, since one person only from each household in the survey was requested to report on the trips made by all household members. No attempt is made in this study to correct for such under-reporting. Although the effect of under-reporting on the results is expected to be minor due to the generally consistent survey design in the three years, discrepancies in the results might be partly due to different under-reporting rates in the three surveys. Therefore, caution must be exercised in drawing conclusions with respect to changes in discretionary trips and during off-peak periods.

2. CHANGES IN PERSON TRAVEL CHARACTERISTICS

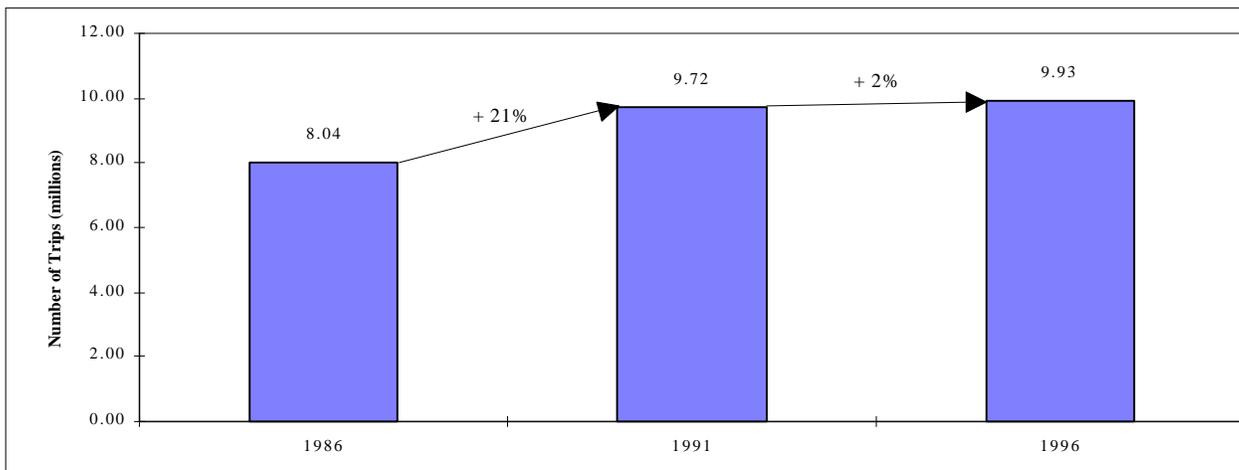
As in Part 1, information on persons living in the GTA only is included in this analysis. In other words, persons living outside the GTA but making trips within the GTA are excluded. In addition, only trips with both ends located in the GTA are analysed. Therefore, trips to or from locations outside the GTA are also excluded. The study does not include trips by persons 10 years of age or younger since information on such trips is not available (except in 1986 when the TTS collected information on trips by persons aged between 6 and 10). The changes in the volume of travel and marginal distributions of trip attributes are examined first, followed by a more detailed analysis of changes in the trip attributes.

2.1 TOTAL TRAVEL

2.1.1 Number of Trips

The total number of person trips made in the GTA on a typical weekday increased by 1.89 million trips between 1986 and 1996, as shown in Exhibit 2.1. In 1996, total person travel was slightly less than 10 million person trips, representing a 23.5% increase since 1986. However, the GTA experienced disproportionate travel increase in the two five-year periods. The number of trips increased by 21% in the first five years as opposed to the 2% increase in the following five years. As observed in Part 1 of this study, the GTA population increased by 12.5% between 1986 and 1991 and by 7.8% in the following five years, with a total increase of 21.3% from 1986 to 1996. These changes already indicate an increase in the trip rate (i.e. number of trips per person) between 1986 and 1991 followed by decline in the following five years. Changes in trip rates are explored in more detail later in the study.

Exhibit 2.1: Total Daily Person Trips

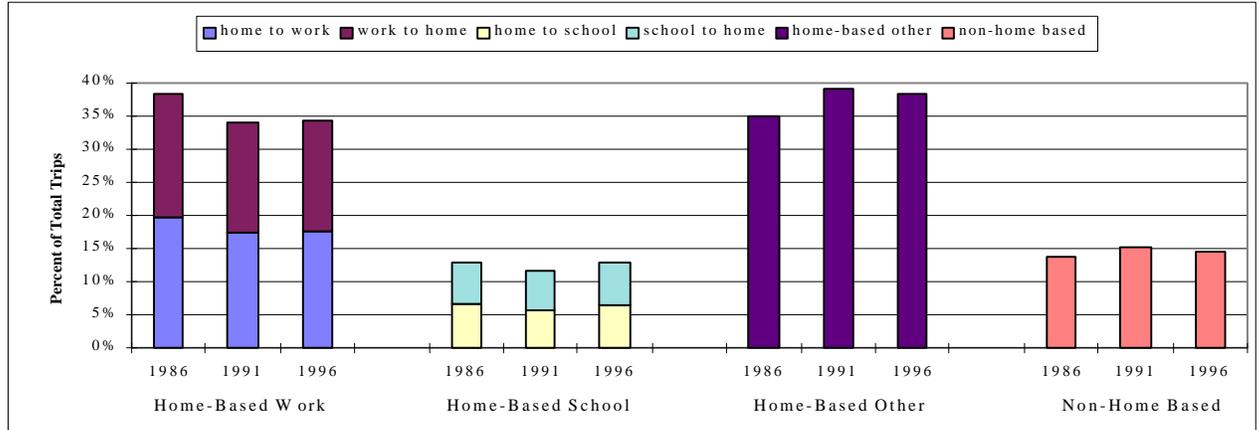


2.1.2 Trip Purpose

Trip purpose is identified here by the purposes of both trip ends. This analysis considers four major trip purposes, which are further decomposed where appropriate. These trip purposes are: (i) home-based work, which includes trips starting (ending) at home and ending (starting) at work; (ii) home-based school, which includes trips starting (ending) at home and ending (starting) at school; (iii) home-based discretionary, which includes all other trips starting or ending at home; and (iv) non-home based, which includes trips starting and ending outside home.

As shown in Exhibit 2.2, the proportion of home-based work trips declined from 38% in 1986 to 34% in 1991 and remained almost constant thereafter. In contrast, the proportion of home-based discretionary trips increased from 35% in 1986 to 39% in 1991 and declined slightly in the following five years. As mentioned in Part 1, The proportions of home-based school trips and non-home based trips changed slightly in the ten-year period.

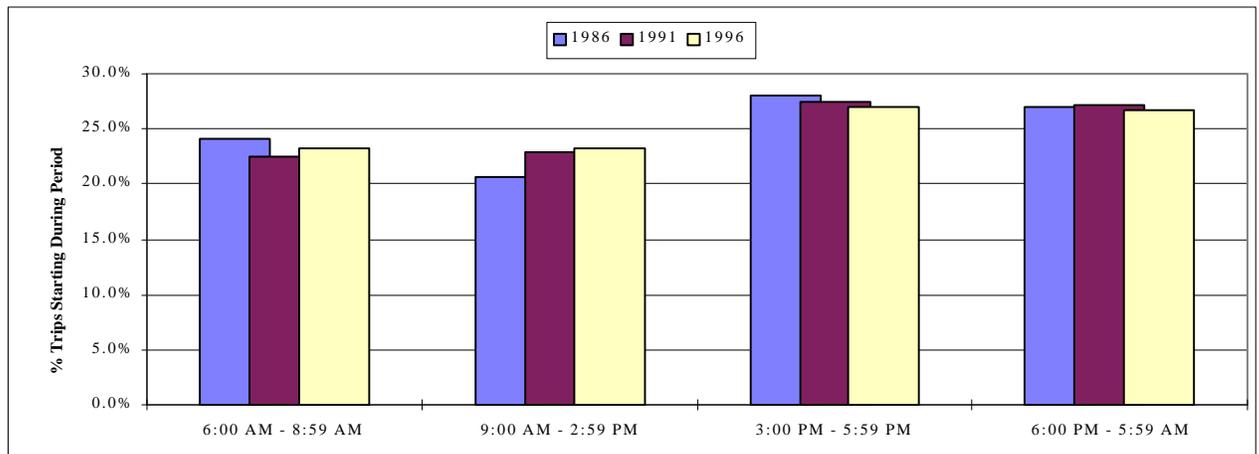
Exhibit 2.2: Distribution of Trip Purpose



2.1.3 Trip Start Time

As shown in Exhibit 2.3, the proportion of person travel starting during the typical morning peak period (i.e. 6-8:59 AM) declined by 1% between 1986 and 1996, as did the proportion of travel starting during the evening peak period (i.e. 3-5:59 PM). Also, the proportion of travel starting at 6:00 PM or any time during the following 12 hours declined, yet more slightly than during the peak periods. In contrast, the proportion of person trips starting between the two peak periods (i.e. 9:00 AM - 2:59 PM) increased from 20.2% in 1986 to 22.9% in 1991 and 23.2% in 1996. This indicates a spreading of the peak periods between 1986 and 1996.

Exhibit 2.3: Distribution of Trip Start Time



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Part 2: Changes in Travel and Relationship with Factors

2.1.4 Spatial Distribution of Trips

Exhibits 2.4-2.6 present the Origin-Destination tables for total daily trips in 1986, 1991 and 1996, respectively. The same spatial divisions of the GTA used in Part 1 of this study are also used here. In other words, Toronto is divided into five sub-regions, while the other five GTA regions remain undivided. The highlighted areas represent the largest ten cells. The discussion of these tables and of the changes that occurred between 1986 and 1996 follows.

Exhibit 2.4: 1986 Origin-Destination Trip Table (total daily trips)

Number of Trips												
GTA %	Trip Destination:											
Trip Origin:	PD 1	PD 2-6	Etobicoke	North TO	Scarboro.	<i>Toronto</i>	Durham	York	Peel	Halton	Ham-Went	GTA
PD 1	176,141 2.2%	264,214 3.3%	45,585 0.6%	50,898 0.6%	65,809 0.8%	602,646 7.5%	12,953 0.2%	26,888 0.3%	43,981 0.5%	13,425 0.2%	4,283 0.1%	704,176 8.8%
PD 2-6	266,168 3.3%	724,916 9.0%	80,310 1.0%	134,460 1.7%	115,013 1.4%	1,320,867 16.4%	14,210 0.2%	54,394 0.7%	54,257 0.7%	6,848 0.1%	2,348 0.0%	1,452,924 18.1%
Etobicoke	46,473 0.6%	79,559 1.0%	308,547 3.8%	34,636 0.4%	10,764 0.1%	479,979 6.0%	2,645 0.0%	18,198 0.2%	97,645 1.2%	9,286 0.1%	2,000 0.0%	609,753 7.6%
North Toronto	50,475 0.6%	133,739 1.7%	34,616 0.4%	290,593 3.6%	51,822 0.6%	561,245 7.0%	6,781 0.1%	74,903 0.9%	26,565 0.3%	2,531 0.0%	1,043 0.0%	673,069 8.4%
Scarborough	65,857 0.8%	114,686 1.4%	11,058 0.1%	51,713 0.6%	518,727 6.5%	762,041 9.5%	28,076 0.3%	45,319 0.6%	12,148 0.2%	1,752 0.0%	639 0.0%	849,975 10.6%
<i>Toronto Total</i>	605,114 7.5%	1,317,114 16.4%	480,116 6.0%	562,299 7.0%	762,134 9.5%	3,726,777 46.4%	64,665 0.8%	219,702 2.7%	234,596 2.9%	33,843 0.4%	10,313 0.1%	4,289,897 53.4%
Durham	13,396 0.2%	14,232 0.2%	2,492 0.0%	7,087 0.1%	28,068 0.3%	65,275 0.8%	520,169 6.5%	12,959 0.2%	3,631 0.0%	617 0.0%	513 0.0%	603,164 7.5%
York	27,599 0.3%	54,282 0.7%	18,487 0.2%	74,132 0.9%	45,153 0.6%	219,652 2.7%	12,946 0.2%	400,307 5.0%	22,115 0.3%	2,411 0.0%	795 0.0%	658,226 8.2%
Peel	45,430 0.6%	54,427 0.7%	96,474 1.2%	25,915 0.3%	12,046 0.1%	234,292 2.9%	3,680 0.0%	22,886 0.3%	774,771 9.6%	44,472 0.6%	7,161 0.1%	1,087,261 13.5%
Halton	13,469 0.2%	7,043 0.1%	9,652 0.1%	2,558 0.0%	1,602 0.0%	34,325 0.4%	545 0.0%	2,364 0.0%	43,921 0.5%	429,688 5.3%	49,089 0.6%	559,932 7.0%
Hamilton-Wentworth	4,504 0.1%	2,620 0.0%	1,961 0.0%	962 0.0%	478 0.0%	10,524 0.1%	369 0.0%	828 0.0%	7,105 0.1%	49,057 0.6%	771,224 9.6%	839,107 10.4%
GTA	709,513 8.8%	1,449,718 18.0%	609,181 7.6%	672,953 8.4%	849,482 10.6%	4,290,846 53.4%	602,374 7.5%	659,046 8.2%	1,086,139 13.5%	560,087 7.0%	839,095 10.4%	8,037,587 100.0%

Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

Exhibit 2.5: 1991 Origin-Destination Trip Table (total daily trips)

Number of Trips GTA %	Trip Destination:											
	Trip Origin:	PD 1	PD 2-6	Etobicoke	North TO	Scarboro.	Toronto	Durham	York	Peel	Halton	Ham-Went
PD 1	222,030 2.3%	294,089 3.0%	41,574 0.4%	49,272 0.5%	70,326 0.7%	677,290 7.0%	17,904 0.2%	38,837 0.4%	50,385 0.5%	16,092 0.2%	6,327 0.1%	806,834 8.3%
PD 2-6	292,793 3.0%	843,160 8.7%	73,753 0.8%	144,467 1.5%	124,252 1.3%	1,478,426 15.2%	20,533 0.2%	67,459 0.7%	65,368 0.7%	7,648 0.1%	1,921 0.0%	1,641,355 16.9%
Etobicoke	43,036 0.4%	73,818 0.8%	328,898 3.4%	36,514 0.4%	10,365 0.1%	492,631 5.1%	3,613 0.0%	22,547 0.2%	100,451 1.0%	12,637 0.1%	2,979 0.0%	634,857 6.5%
North Toronto	49,475 0.5%	142,025 1.5%	36,331 0.4%	334,873 3.4%	62,539 0.6%	625,242 6.4%	10,037 0.1%	107,227 1.1%	35,446 0.4%	5,513 0.1%	885 0.0%	784,350 8.1%
Scarborough	71,036 0.7%	124,440 1.3%	11,409 0.1%	60,975 0.6%	616,172 6.3%	884,031 9.1%	43,460 0.4%	66,989 0.7%	15,105 0.2%	2,810 0.0%	1,064 0.0%	1,013,460 10.4%
Toronto Total	678,370 7.0%	1,477,531 15.2%	491,964 5.1%	626,101 6.4%	883,654 9.1%	4,157,620 42.8%	95,547 1.0%	303,059 3.1%	266,755 2.7%	44,699 0.5%	13,176 0.1%	4,880,856 50.2%
Durham	17,720 0.2%	23,201 0.2%	3,934 0.0%	10,314 0.1%	43,973 0.5%	99,141 1.0%	679,495 7.0%	24,418 0.3%	5,420 0.1%	1,058 0.0%	1,258 0.0%	810,790 8.3%
York	40,473 0.4%	68,027 0.7%	21,135 0.2%	106,919 1.1%	65,189 0.7%	301,744 3.1%	24,414 0.3%	642,581 6.6%	32,341 0.3%	2,463 0.0%	1,855 0.0%	1,005,398 10.3%
Peel	50,095 0.5%	63,325 0.7%	104,646 1.1%	35,936 0.4%	17,129 0.2%	271,131 2.8%	6,727 0.1%	32,293 0.3%	1,106,874 11.4%	57,438 0.6%	10,054 0.1%	1,484,518 15.3%
Halton	16,972 0.2%	7,478 0.1%	11,630 0.1%	4,597 0.0%	2,077 0.0%	42,754 0.4%	1,186 0.0%	3,001 0.0%	59,083 0.6%	493,918 5.1%	54,108 0.6%	654,050 6.7%
Hamilton-Wentworth	6,627 0.1%	1,406 0.0%	2,864 0.0%	1,459 0.0%	849 0.0%	13,205 0.1%	820 0.0%	1,826 0.0%	9,590 0.1%	54,015 0.6%	801,117 8.2%	880,573 9.1%
GTA	810,256 8.3%	1,640,967 16.9%	636,173 6.5%	785,326 8.1%	1,012,871 10.4%	4,885,594 50.3%	808,189 8.3%	1,007,178 10.4%	1,480,065 15.2%	653,592 6.7%	881,567 9.1%	9,716,184 100.0%

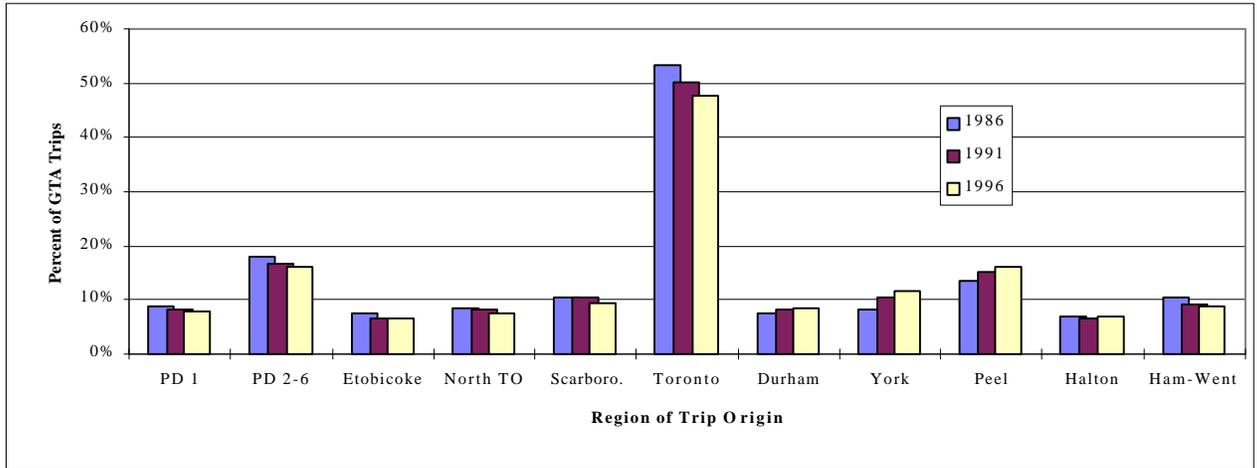
Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

Exhibit 2.6: 1996 Origin-Destination Trip Table (total daily trips)

Number of Trips GTA %	Trip Destination:											
	PD 1	PD 2-6	Etobicoke	North TO	Scarboro.	Toronto	Durham	York	Peel	Halton	Ham-Went	GTA
PD 1	217,533 2.2%	269,653 2.7%	38,903 0.4%	46,350 0.5%	62,740 0.6%	635,178 6.4%	19,806 0.2%	43,603 0.4%	54,598 0.5%	17,134 0.2%	4,802 0.0%	775,120 7.8%
PD 2-6	268,670 2.7%	837,618 8.4%	77,552 0.8%	141,086 1.4%	116,657 1.2%	1,441,583 14.5%	18,109 0.2%	73,423 0.7%	63,121 0.6%	8,296 0.1%	2,778 0.0%	1,607,310 16.2%
Etobicoke	38,455 0.4%	77,352 0.8%	341,839 3.4%	35,704 0.4%	10,086 0.1%	503,436 5.1%	3,252 0.0%	25,083 0.3%	108,424 1.1%	10,943 0.1%	2,438 0.0%	653,576 6.6%
North Toronto	46,657 0.5%	140,183 1.4%	35,737 0.4%	316,558 3.2%	58,080 0.6%	597,215 6.0%	10,599 0.1%	105,358 1.1%	37,211 0.4%	4,394 0.0%	1,335 0.0%	756,111 7.6%
Scarborough	63,487 0.6%	116,125 1.2%	10,139 0.1%	58,157 0.6%	575,234 5.8%	823,142 8.3%	42,658 0.4%	70,091 0.7%	16,205 0.2%	2,267 0.0%	640 0.0%	955,003 9.6%
Toronto Total	634,800 6.4%	1,440,932 14.5%	504,170 5.1%	597,855 6.0%	822,796 8.3%	4,000,553 40.3%	94,424 1.0%	317,557 3.2%	279,558 2.8%	43,034 0.4%	11,994 0.1%	4,747,120 47.8%
Durham	20,316 0.2%	17,659 0.2%	3,434 0.0%	11,102 0.1%	42,273 0.4%	94,784 1.0%	722,291 7.3%	24,247 0.2%	5,958 0.1%	1,131 0.0%	582 0.0%	848,993 8.5%
York	44,301 0.4%	73,089 0.7%	24,958 0.3%	104,722 1.1%	69,664 0.7%	316,733 3.2%	24,553 0.2%	765,827 7.7%	37,801 0.4%	3,569 0.0%	1,376 0.0%	1,149,859 11.6%
Peel	56,295 0.6%	63,662 0.6%	108,467 1.1%	37,167 0.4%	16,596 0.2%	282,187 2.8%	5,934 0.1%	38,336 0.4%	1,185,131 11.9%	70,568 0.7%	11,025 0.1%	1,593,181 16.0%
Halton	17,432 0.2%	8,119 0.1%	10,767 0.1%	4,323 0.0%	2,238 0.0%	42,878 0.4%	1,084 0.0%	3,887 0.0%	70,314 0.7%	525,816 5.3%	58,141 0.6%	702,120 7.1%
Hamilton-Wentworth	4,814 0.0%	2,658 0.0%	2,487 0.0%	1,412 0.0%	757 0.0%	12,127 0.1%	561 0.0%	1,430 0.0%	10,722 0.1%	58,663 0.6%	805,388 8.1%	888,891 9.0%
GTA	777,957 7.8%	1,606,118 16.2%	654,282 6.6%	756,582 7.6%	954,324 9.6%	4,749,262 47.8%	848,847 8.5%	1,151,283 11.6%	1,589,484 16.0%	702,781 7.1%	888,507 8.9%	9,930,164 100.0%

As shown in Exhibits 2.4-2.6 and summarised in Exhibit 2.7 below, the proportion of daily person trips originating in Toronto declined from 53% in 1986 to 50% in 1991 and 48% five years later. The proportion of trips from each Toronto sub-region declined in the ten years between 1986 and 1996. In particular, the belt of districts surrounding PD 1 (i.e. PD 2-6) produced the largest number of trips during a typical weekday in 1986. However, the proportion of these trips dropped from 18% in 1986 to 17% in 1991 and 16% in 1996. Similarly, the proportion of trips originating in Hamilton-Wentworth declined between 1986 and 1996, while the proportion of trips originating in neighbouring Halton changed slightly during the same period. In contrast, the proportion of trips from each of the three other regions increased, particularly from York (8% in 1986, 10% in 1991 and 12% in 1996) and from Peel (14% in 1986, 15% in 1991 and 16% in 1996).

Exhibit 2.7: Distribution of Daily Trip Origins

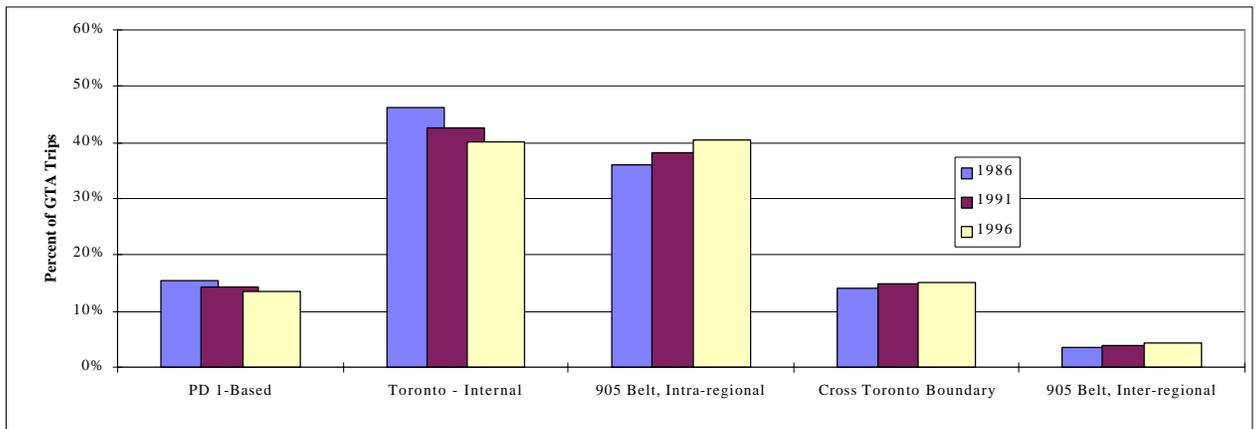


Note that the distribution of trip destinations for each year is almost exactly the same as the distribution of trip origins, which reflects the nearly equal number of inter-regional trips in each direction (i.e. inbound and outbound). This is clear in the almost symmetrical Origin-Destination table for each year.

2.1.4.1 Spatial Market

The proportion of PD 1-based daily trips (i.e. trips with at least one end in PD 1) declined from 15% in 1986 to 14% in 1991 and 13% in 1996, as shown in Exhibit 2.8. However, the proportion of trips starting and ending within Toronto, including those from/to PD 1, declined more substantially, from 46% in 1986 to 43% in 1991 and 40% in 1996. In contrast, the proportion of trips starting and ending within the 905 Belt, excluding inter-regional trips, increased from 36% in 1986 to 38% in 1991 and 40% in 1996 it matched the proportion of trips within Toronto at 40%. Also, the proportion of trips crossing the Toronto boundary to and from the 905 Belt increased slightly, as did the proportion of trips crossing regional boundaries with both ends inside the 905 Belt.

Exhibit 2.8: Distribution of Daily Trips by Spatial Market

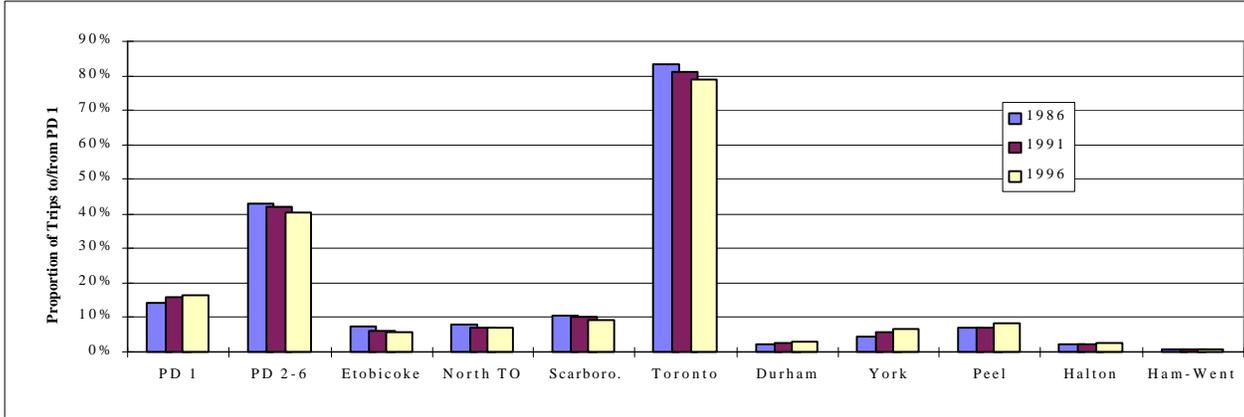


Exploring Person Travel Trends in the Greater Toronto Area

Part 2: Changes in Travel and Relationship with Factors

As shown in Exhibit 2.9, the proportion of trips to/from PD 1 from/to other locations within Toronto declined from 83% in 1986 to 81% in 1991 and 79% in 1996, while the proportions of internal trips within PD 1 and of trips to/from PD 1 from/to locations in the 905 Belt (particularly York and Peel) increased.

Exhibit 2.9: Spatial Distribution of Daily Trips to/from PD 1

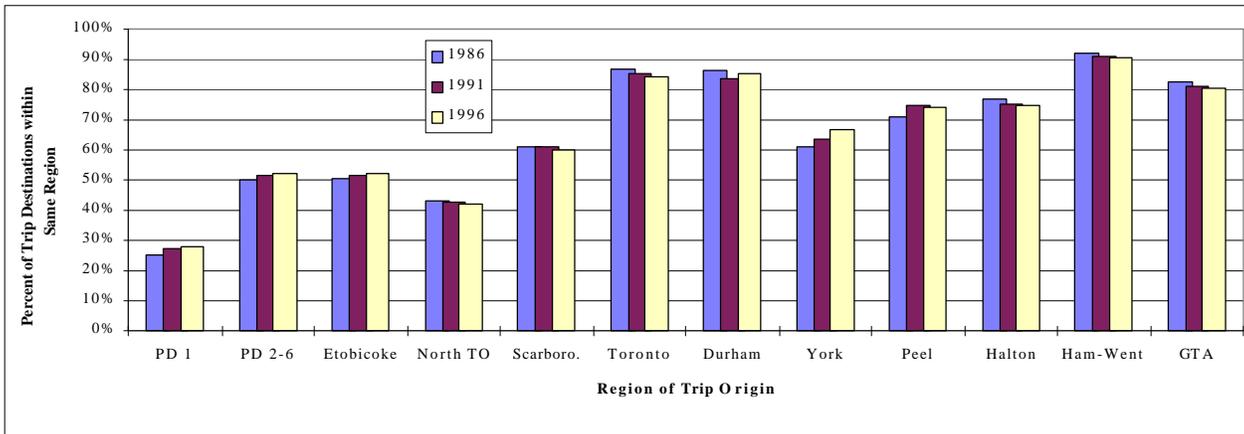


2.1.4.2 Self Containment

Self-containment is defined here as the trips starting and ending in a region as a proportion of the total number of trip origins in that region.

As shown in Exhibit 2.10, Hamilton-Wentworth, followed by Toronto and Durham, have the highest levels of self-containment in the GTA (close to 90% of all trips originating in each region are destined for locations within the same region). In general, these levels declined slightly between 1986 and 1996. Within Toronto, PD 1 has the lowest level of self-containment, which reflects the large number of return trips by persons travelling to the PD 1 from other locations. Scarborough has a moderate degree of self-containment with almost 60% of all trips from this Toronto sub-region terminating in the same sub-region. The other Toronto sub-regions have a lower degree of self-containment than Scarborough but higher than PD 1. Minor changes occurred in the self-containment level for each Toronto sub-region between 1986 and 1996.

Exhibit 2.10: Regional Self-Containment of Daily Person Trips

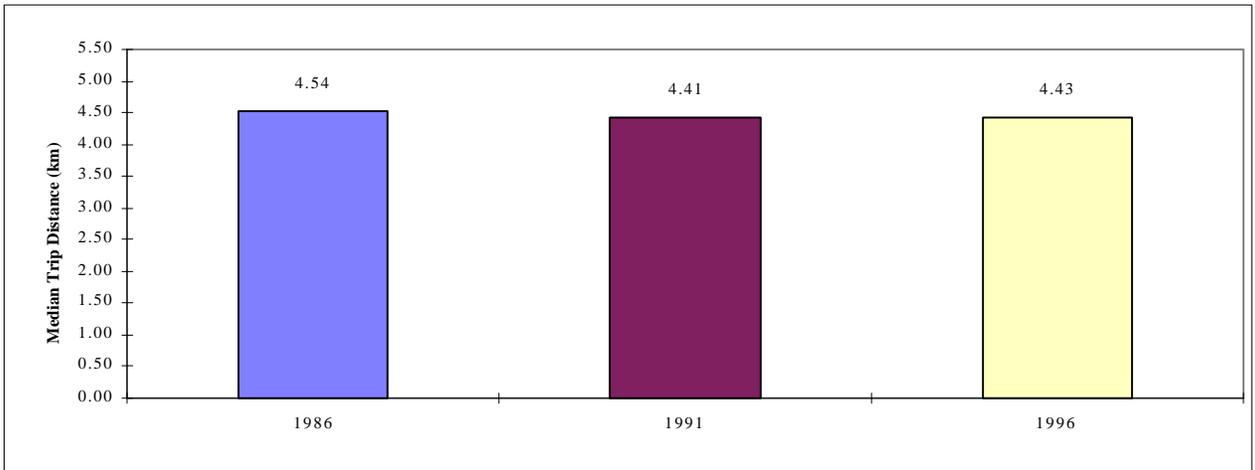


Self-containment in York and Peel improved between 1986 and 1996, while it deteriorated in Halton. Overall the proportion of the GTA trips starting and ending in the same region (considering Toronto as one region only) declined slightly from 82% in 1986 to 81% in 1991 and remained almost the same thereafter.

2.1.5 Trip Distance

The median distance of all GTA trips changed slightly between 1986 and 1996 as shown in Exhibit 2.28.

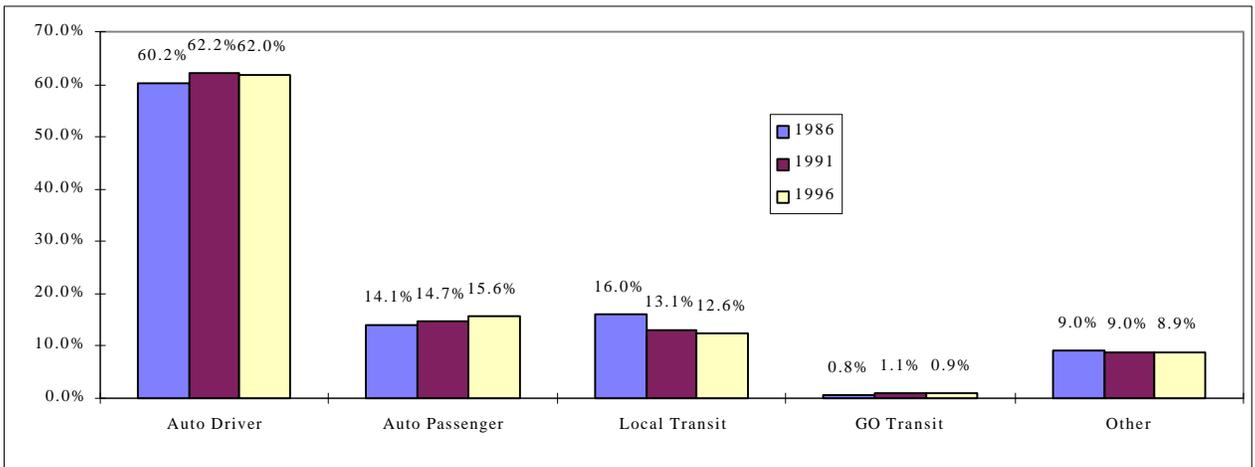
Exhibit 2.11: Median Straight-Line Distance of GTA Trips



2.1.6 Mode Split

The auto driver and auto passenger shares increased between 1986 and 1996, while the transit market share declined from 16% in 1986 to 13.1% in 1991 and 12.6% in 1996, as shown in Exhibit 2.12. The proportion of trips by the other modes changed slightly during the same period.

Exhibit 2.12: Mode Split of GTA Daily Trips



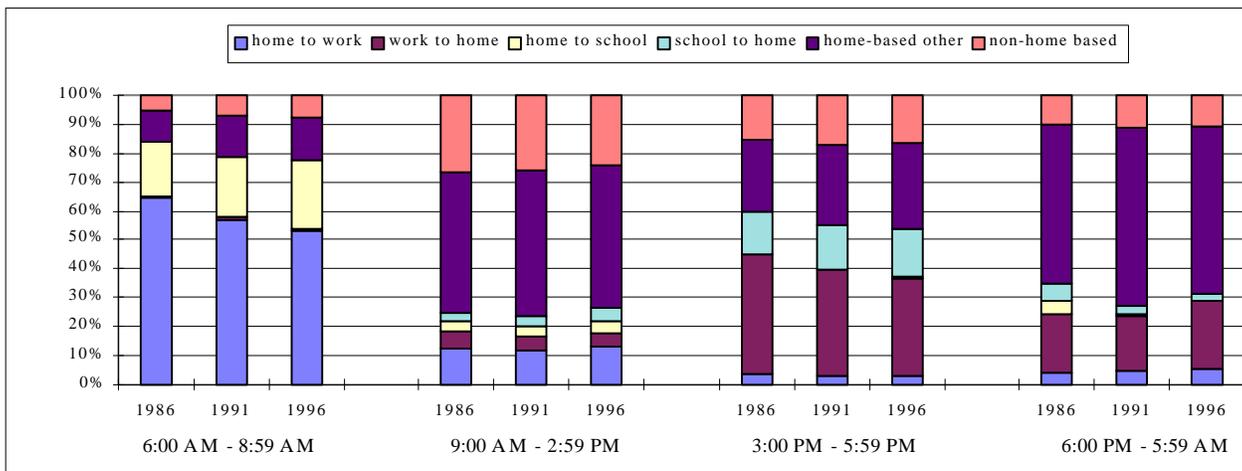
2.2 TRIP PURPOSE

As mentioned earlier, the proportion of home-based work trips declined on a typical weekday, while the proportion of home-based discretionary trips increased. The proportion of other trip purposes changed slightly. This section examines further the trip purpose distribution by time, spatial market and travel mode.

2.2.1 By Time of Day

As shown in Exhibit 2.13, the dominance of the work trip during the morning peak period (i.e. 6:00 AM - 8:59 AM) declined substantially between 1986 and 1996. The proportion of home-based work trips (mainly home to work trips) dropped from 65% in 1986 to 58% in 1991 and 54% in 1996. The proportion of each other trip purpose increased, particularly home-based school trips (from 19% in 1986 to 21% in 1991 and 23% in 1996) and home-based discretionary trips (from 11% in 1986 to 14% in 1991 and 15% in 1996).

Exhibit 2.13: Distribution of Trip Purpose by Time of Day



Not surprisingly, more than 75% of the trips starting after the morning peak period and before the evening peak period (i.e. 9:00 AM and 2:59 PM) consist of home-based discretionary and non-home based trips. The composition of the trips starting during this daytime period did not change substantially in the ten years between 1986 and 1996. The most notable change includes the decline of the proportion of non-home based trips from 27% in 1986 to 26% in 1991 and 24% in 1996.

Similar to the morning peak period, the proportion of home-based work trips (mainly work to home trips) during the evening peak period (i.e. 3:00 PM - 5:59 PM) declined substantially from 45% in 1986 to 39% in 1991 and 37% in 1996, while the proportion of each other trip purpose increased, particularly home-based discretionary trips (from 25% in 1986 to 28% in 1991 and 30% in 1996).

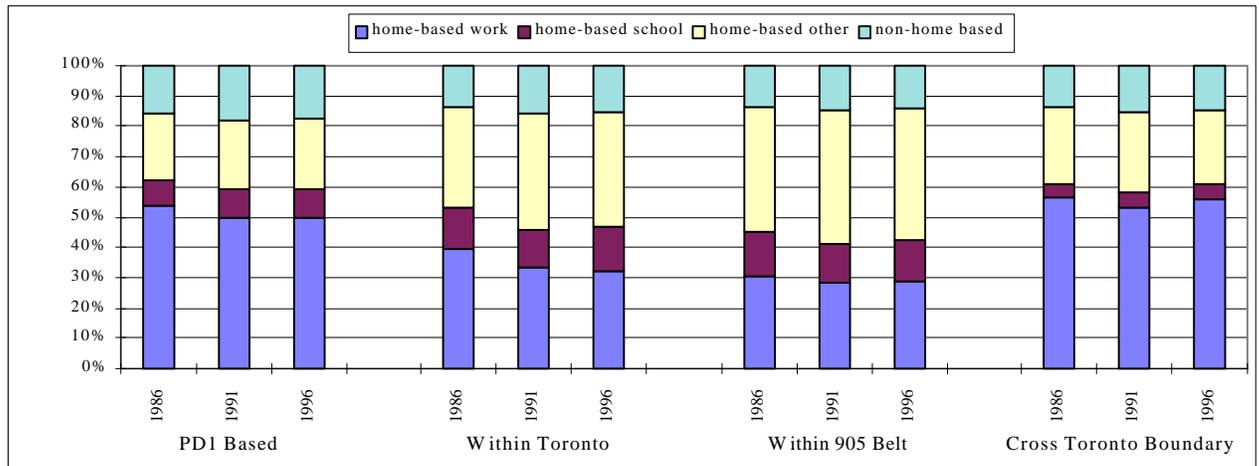
During the 12 hours after the evening peak period and before the morning peak period on the next day (i.e. 6:00 PM - 5:59 AM), the proportion of home-based work trips remained constant between 1986 and 1991, at 24%, but increased to 29% in the following five years. This might be due to workers starting their work trip earlier in the morning or going home later in the evening than they did before 1996. During the same period, the proportion of home-based school trips declined from 10% in 1986 to 3% in 1996, while the proportion of home-based discretionary increased from 55% in 1986 to 62% in 1991 but declined to 57% in

the following five years. The proportion of non-home based trips remained almost the same between 1986 and 1996.

2.2.2 By Spatial Market

As shown in Exhibit 2.14, home-based work trips constitute about half of the daily PD 1-based trips. The proportion of these trips declined from 54% in 1986 to 50% in 1991 and remained almost constant thereafter. The proportion of PD 1-based trips with other trip purposes increased, particularly non-home based trips (17% in 1986, 19% in 1991 and 19% in 1996), many of which start or end at the work location.

Exhibit 2.14: Distribution of Trip Purpose by Spatial Market



Within Toronto, the proportion of home-based work trips declined substantially from 39% in 1986 to 33% in 1991 and 32% in 1996. In contrast, the proportion of home-based discretionary trips increased from 33% in 1986 to 38% in 1991 but declined slightly in the following five years. Since 1991, home-based discretionary trips have taken the 1986 position of home-based work trips as the largest market of trips within Toronto. The proportion of home-based school trips declined between 1986 and 1991, but increased in the following five years, almost back to its 1986 level. Similarly, the proportion of non-home based trips changed insignificantly in the ten-year period.

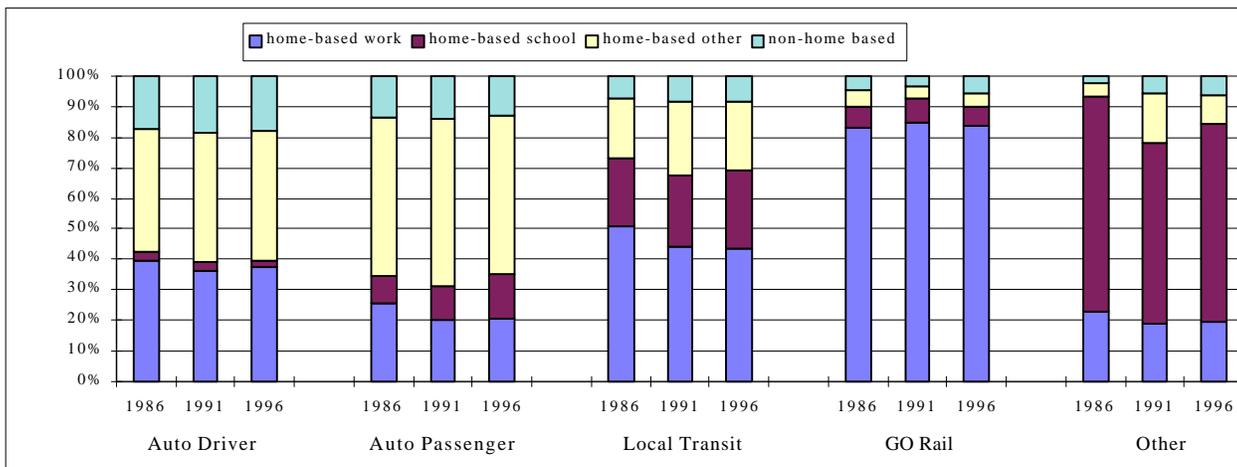
Within the 905 Belt, the proportion of home-based work trips declined between 1986 and 1996, yet less substantially than the decline in the corresponding proportions of trips to/from PD 1 and trips within Toronto. In 1996, this proportion in the 905 Belt was 29%, down from 31% in 1986. The proportions of home-based school trips and non-home based trips, each at about 14%, almost did not change between 1986 and 1991. Home-based discretionary trips strengthened their position as the largest market of trips with a share of 43% in 1996, up from 41% in 1986.

Home-based work trips constitute more than half the travel across the Toronto boundary, at about 56%. Home-based discretionary trips and home-based school trips constitute about 25% and 5% of the travel, respectively. This trip purpose composition remained almost the same between 1986 and 1996.

2.2.3 By Travel Mode

As Exhibit 2.15 shows, the auto drivers of 1986 made almost the same number of home-based work trips and home-based discretionary trips, with each trip purpose representing almost 40% of all trips made by the auto drivers. However, the proportion of home-based work trips declined to 37% in 1991 and increased slightly in the following five years, while the proportion of home-based discretionary trips increased to 43% in 1991 and remained almost the same in the following five years. The proportion of each other trip purpose changed minimally.

Exhibit 2.15: Distribution of Trip Purpose by Travel Mode



Almost 52% of all trips made by the auto passengers in 1986 started/ended at home and ended/started at locations other than work or school. This proportion increased to 55% in 1991 but declined back to 52% in the following five years. The proportion of home-based work trips declined substantially from 26% in 1986 to 20% in 1991 and 21% in 1996, while the proportion of home-based school trips increased from 9% in 1986 to 11% in 1991 and 15% in 1996. The proportion of non-home based trips changed minimally.

Almost 51% of all transit trips in 1986 started/ended at home and ended/started at work. This proportion declined to 44% in 1991 and 43% in 1996. Between 1986 and 1996, the proportion of home-based school trips increased from 22% to 26% and the proportion of home-based discretionary trips increased from 20% to 23%, while the proportion of non-home based trips increased only from 7% to 8%.

GO Rail serves mainly the work trip, from or to home. Home-based work trips constitute about 84% of all the trips carried by GO Rail. The trip purpose composition of GO Rail trips changed minimally between 1986 and 1996.

In contrast to GO Rail, more than 60% of all trips made by other modes (e.g. walk, cycle) start/end at home and end/start at school. However, the proportion of home-based school trips declined from 71% in 1986 to 60% in 1991 but recovered again to 65% in 1996. Similarly, the proportion of home-based work trips declined from 23% in 1986 to 19% in 1991 and remained almost the same thereafter. The proportion of the other trip purposes more than doubled between 1986 and 1996. Home-based discretionary trips increased from 4.3% in 1986 to 16% in 1991 but declined to 10% by 1996, while non-home based trips increased in percentage terms from 2.3% to 6% in 1991 and remained the same thereafter.

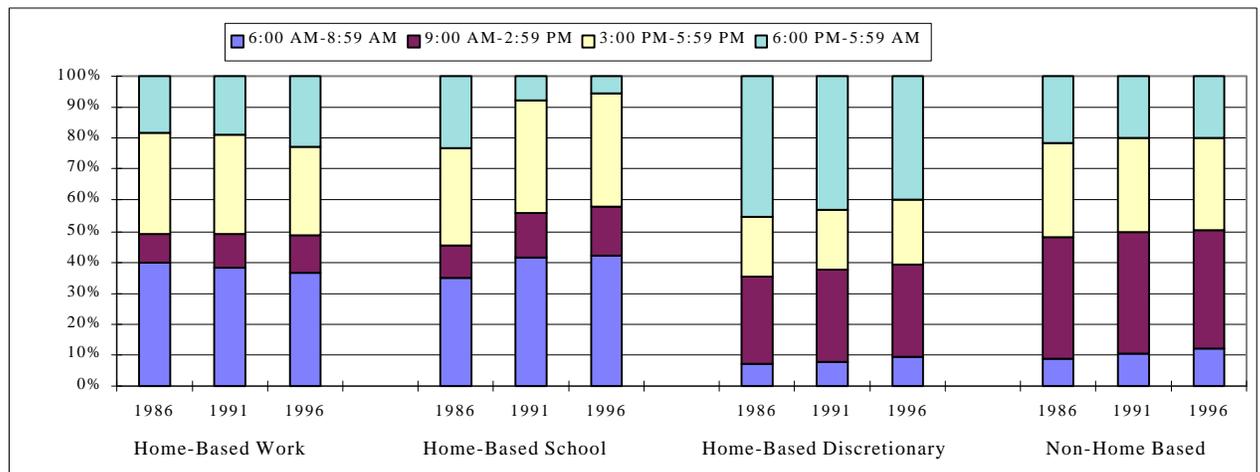
2.3 TRIP START TIME

As mentioned earlier, the proportion of person trips starting between 9:00 AM and 2:59 PM increased while the proportion of the trips starting at the other time periods declined. This section examines further the trip start time distribution by trip purpose, spatial market and travel mode.

2.3.1 By Trip Purpose

Exhibit 2.16 shows that 72% of the home-based work trips in 1996 started during the morning and evening peak periods. This proportion declined to 66% by 1996. During this ten-year period, the proportion of home-based work trips starting between 9:00 AM and 2:59 PM increased from 9.6% to 12.1%, while the proportion of home-based work trips starting between 6:00 PM and 5:59 AM increased from 18.3% to 22.4%. This means that a larger proportion of the GTA workers are trying to avoid commuting to/from work during the peak periods, by starting their trips either before or after the peak period. This may also reflect a growing trend of flexible work hours enjoyed by a larger proportion of the GTA workers.

Exhibit 2.16: Distribution of Trip Start Time by Trip Purpose



In 1986, almost one of each four home-based school trips started either early in the morning (i.e. before 6:00 AM) or late in the evening (i.e. 6:00 PM or later). By 1996, this proportion declined to 6%. The proportions of home-based school trips starting during other time periods increased almost equally. However, caution should be exercised in interpreting these dramatic changes since the 1986 TTS did not record the start time for some school trips made by persons under the age of 14.

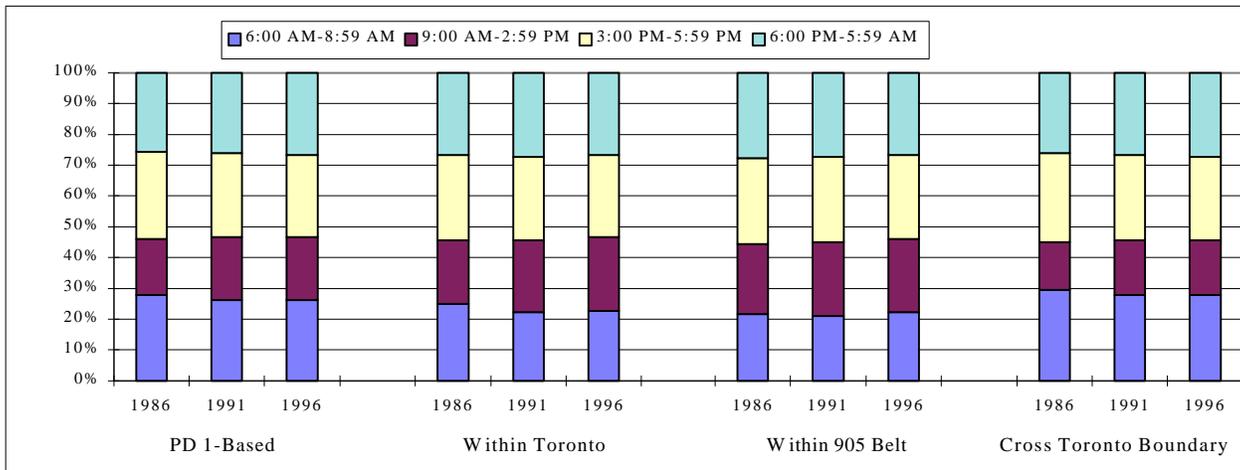
Almost 73% of the home-based discretionary trips in 1986 (e.g. shopping trips) started outside the peak periods. This proportion declined slightly to 70% by 1996. In contrast, the majority of non-home based trips (i.e. around 69%) start between 9:00 AM and 2:59 PM (many of which are linked to worker lunch-hour activities and post-school activities) and during the evening peak period (many of which are made by workers on way to home). The start-time distribution of non-home based trips changed slightly between 1986 and 1996.

Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

2.3.2 By Spatial Market

The start-time distributions of trips in each spatial market changed slightly between 1986 and 1996, as shown in Exhibit 2.17. The start-time distributions of the trips within Toronto and the trips within the 905 Belt are almost the same. Trips to PD 1, however, have a higher proportion of trips starting during the morning peak period than the corresponding proportions for trips within Toronto and trips within the 905 Belt.

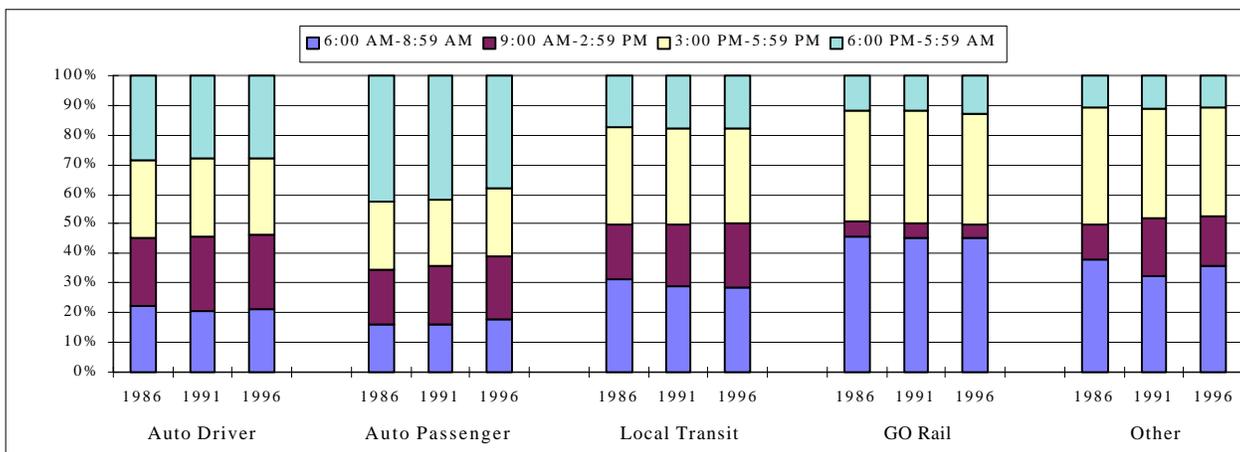
Exhibit 2.17: Distribution of Trip Start Time by Spatial Market



2.3.3 By Mode of Travel

Exhibit 2.18 shows the distribution of trip start time for each mode of travel. The most notable changes include: (i) a decline of the proportion of auto passenger trips starting after 5:59 PM or before 6:00 AM from 42.4% in 1986 to 37.9% in 1996 (a corresponding increase occurred mainly for the proportions of trips starting between 9:00 AM and 2:59 PM and during the evening peak period); and (ii) an increase in the proportion of the local transit trips starting between 9:00 AM and 2:59 PM from 18% to 22% (a corresponding decline occurred mainly for trips starting during the peak periods).

Exhibit 2.18: Distribution of Trip Start Time by Travel Mode



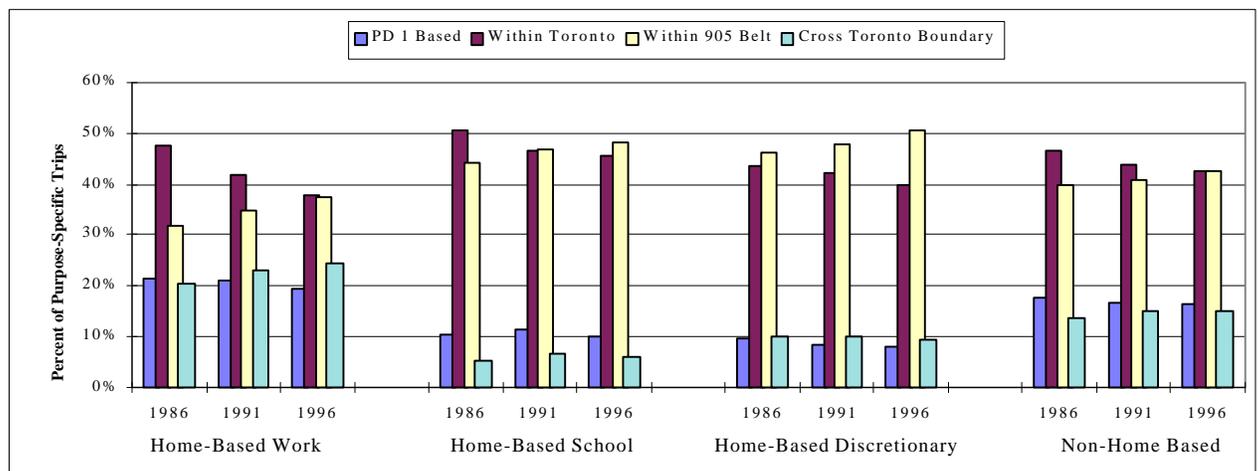
2.4 SPATIAL DISTRIBUTION OF TRIPS

2.4.1 By Trip Purpose

2.4.1.1 Spatial Market

In 1986, 22% of home-based work trips had either one or both ends in PD 1, as shown in Exhibit 2.19. The corresponding proportions for non-home based, home-based school and home-based discretionary trips were 18%, 10% and 10%, respectively. With the exception of home-based school trips, each of the above proportions declined by 2% in 1996.

Exhibit 2.19: Distribution of Spatial Markets of Trips by Trip Purpose



In 1986, 48% of all home-based work trips were made within Toronto and 32% were made within the 905 Belt. During the following five years, the gap between the two proportions grew narrower, and by 1996 the number of trips within Toronto was almost equal to the number of trips within the 905 Belt, each representing 38% of the home-based work trips. The same trend could be observed for home-based school and non-home based trips. However, the gap between the number of trips within Toronto and that within the 905 Belt for each type of trips was much smaller than the corresponding gap for the home-based work trips in 1986. In 1986, the proportion of home-based discretionary trips made within the 905 Belt, at 46%, was already larger than the proportion of trips made within Toronto (i.e. 44%), and these proportions changed respectively to 48% and 42% in 1991 and to 51% and 40% in 1996.

As the exhibit shows, the proportion of home-based work trips which crossed the Toronto boundary, at more than 20%, is larger than the corresponding proportions for the other trip purposes. This proportion increased from 21% in 1986 to 23% in 1991 and 25% in 1996, while the corresponding proportions for the other trip purposes changed very slightly.

2.4.1.2 Self-Containment

Exhibits 2.20-2.23 present self containment levels by region for home-based work, home-based school, home-based discretionary and non-home based trips, respectively.

Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

Exhibit 2.20: Regional Self-Containment of Home-Based Work Trips

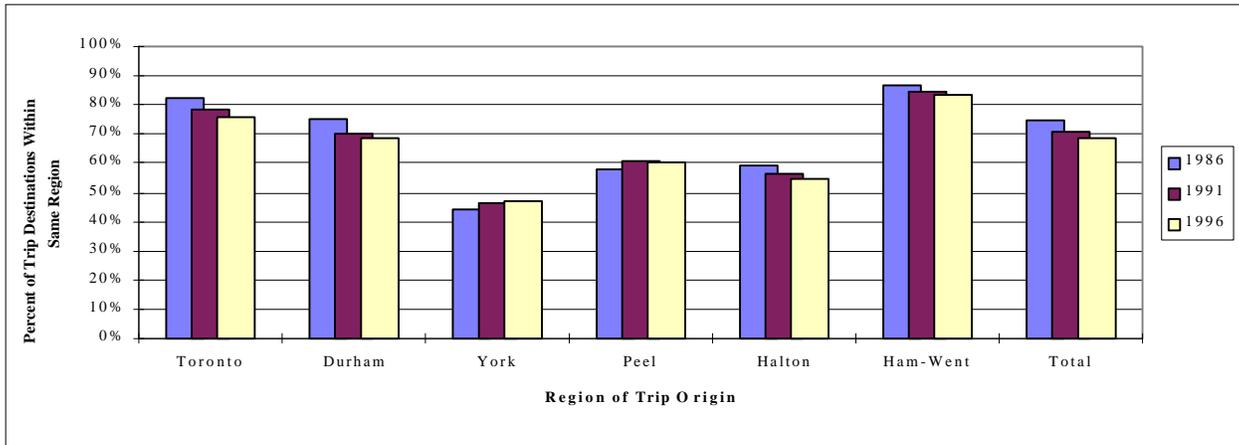


Exhibit 2.21: Regional Self-Containment of Home-Based School Trips

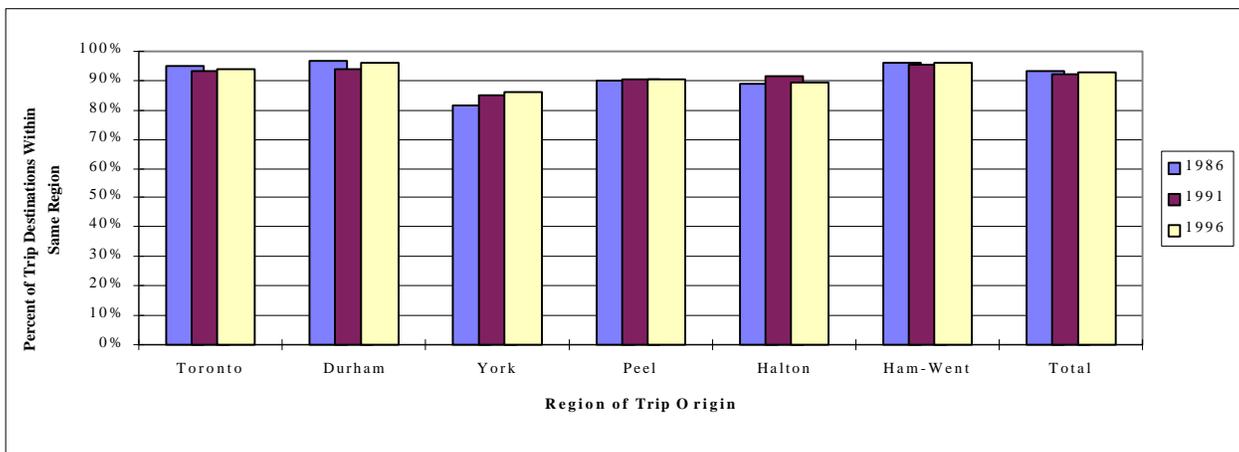


Exhibit 2.22: Regional Self-Containment of Home-Based Discretionary Trips

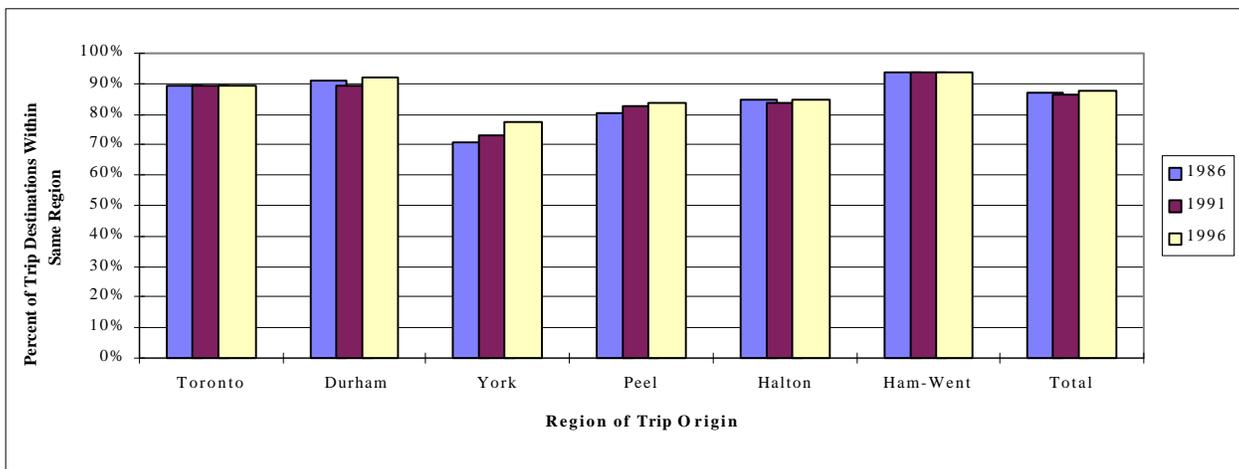
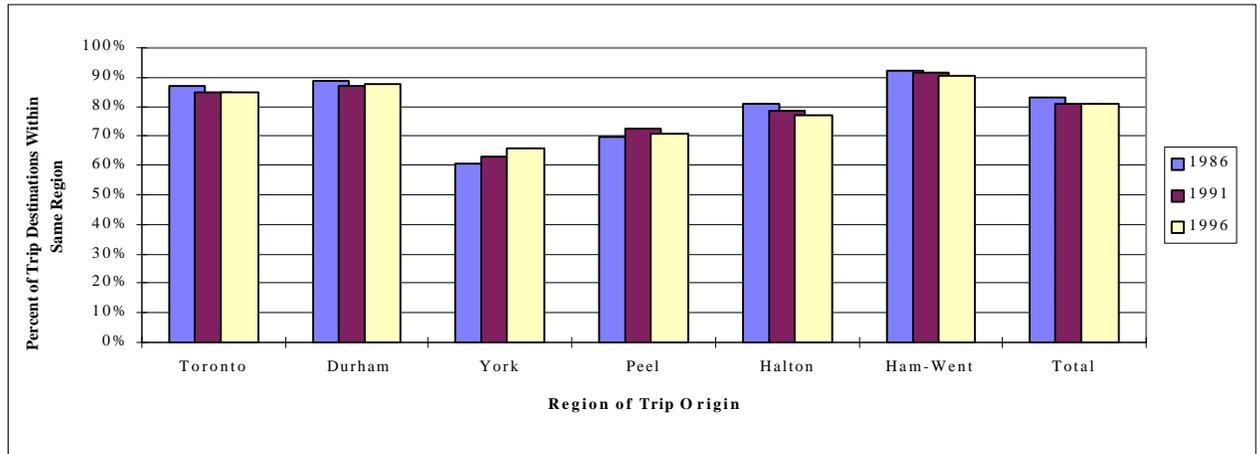


Exhibit 2.23: Regional Self-Containment of Non-Home Based Trips



In general, the self containment levels for home-based work trips are lower than the self containment levels for the other trip purposes. The proportion of home-based work trips starting and ending within the same region declined from 75% in 1986 to 71% in 1991 and 69% in 1996. The decline was largest in Toronto (76% in 1996 vs. 82% in 1986) and Durham (69% in 1996 vs. 75% in 1986) and at a lower degree in Halton (55% in 1996 vs. 59% in 1986), while self containment of home-based work trips improved in York (47% in 1996 vs. 44% in 1986) and Peel (60% in 1996 vs. 58% in 1986).

The overall self containment levels for the other trip purposes changed slightly between 1986 and 1996. The most notable changes occurred for home-based school trips in York (81% in 1986, 85% in 1991 and 86% in 1996), for home-based discretionary trips in York (71% in 1986, 73% in 1991 and 78% in 1996) and Peel (80% in 1986, 83% in 1991 and 84% in 1996), and for non-home based trips in York (61% in 1986, 63% in 1991 and 66% in 1996) and Halton (81% in 1986, 79% in 1991 and 77% in 1996).

2.4.2 By Time of Day

2.4.2.1 Spatial Market

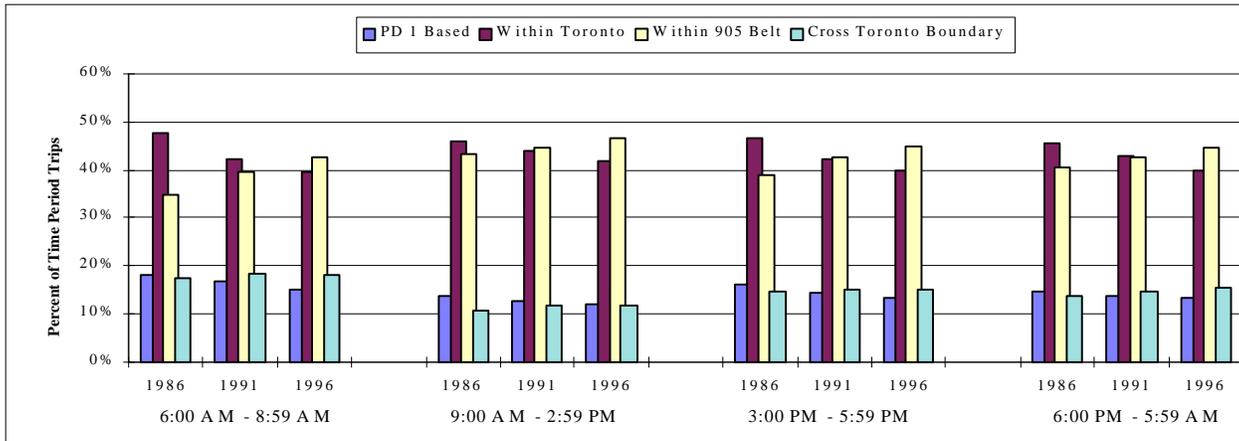
The proportion of PD1-based trips during the morning peak period (mainly destined for PD 1) declined from 18% in 1986 to 17% in 1991 and 15% in 1996, as shown in Exhibit 2.24. The proportion of PD1-based trips during each other period of the day was slightly lower than during the morning peak period. These proportions also declined slightly between 1986 and 1996.

During each time period of the day considered here, the proportion of trips starting and ending in Toronto in 1986 was higher than the proportion of trips starting and ending in the 905 Belt, but by 1996 the former proportion declined while the latter proportion increased to a higher level than that for the former. Most notably, 48% of all 1986 trips starting between 6:00 AM and 8:59 AM were made within Toronto while 35% of the trips starting during the same period were made within the 905 Belt, and by 1996 these proportions changed to 39% and 43%, respectively.

The proportion of trips crossing the Toronto boundary during the morning peak is larger than the corresponding proportions during other time periods. However, minor changes occurred in these proportions.

Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

Exhibit 2.24: Distribution of Spatial Markets of Trips by Time of Day



2.4.2.2 Self Containment

Exhibits 2.25-2.28 present self containment levels by region for the morning peak, day off-peak, evening peak and evening off-peak trips, respectively.

In general, the self containment levels between 9:00 AM and 2:59 PM are higher than the self containment levels during other the time periods. The overall self containment levels during the four time periods considered here changed slightly between 1986 and 1996. The most notable changes occurred during the morning peak in York (50% in 1986, 56% in 1991 and 61% in 1996) and Peel, (62% in 1986, 67% in 1991 and 68% in 1996), during the morning off-peak in York (67% in 1986, 69% in 1991 and 72% in 1996), during the evening peak in York (61% in 1986, 66% in 1991 and 69% in 1996) and Peel (73% in 1986, 77% in 1991 and 77% in 1996), and during the evening off-peak in Toronto (86% in 1986, 84% in 1991 and 82% in 1996), York (62% in 1986, 66% in 1991 and 66% in 1996) and Halton (79% in 1986, 77% in 1991 and 76% in 1996).

Exhibit 2.25: Regional Self-Containment of Morning Peak (6:00 AM - 8:59 AM) Trips

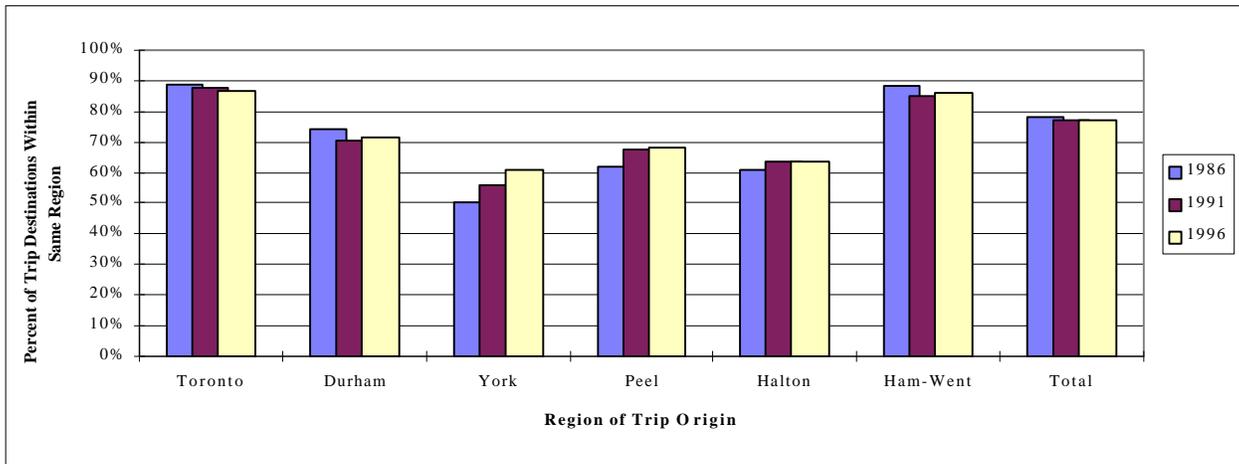


Exhibit 2.26: Regional Self-Containment of Mid-Day Off-Peak (9:00 AM - 2:59 PM) Trips

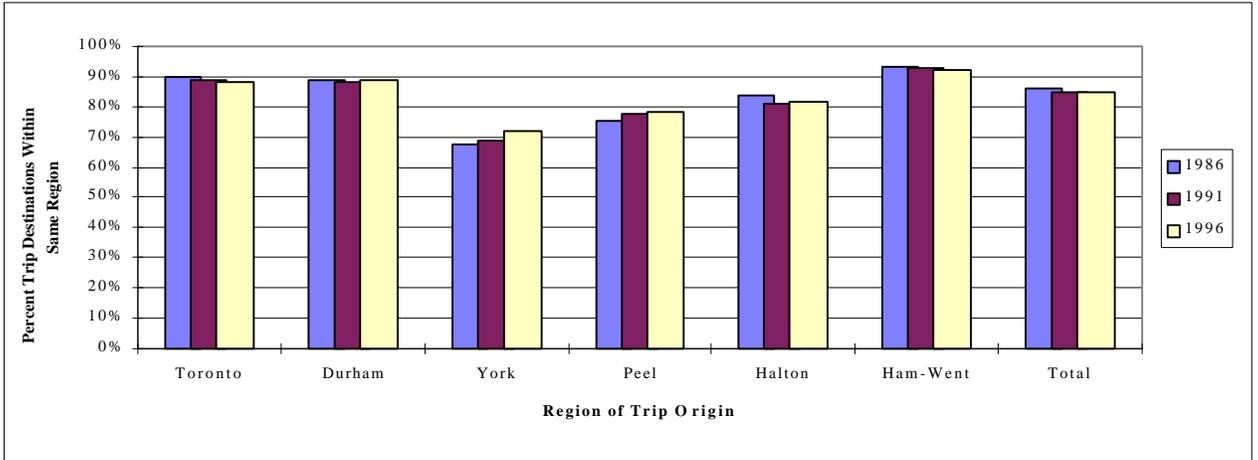


Exhibit 2.27: Regional Self-Containment of Evening Peak (3:00 PM - 5:59 PM) Trips

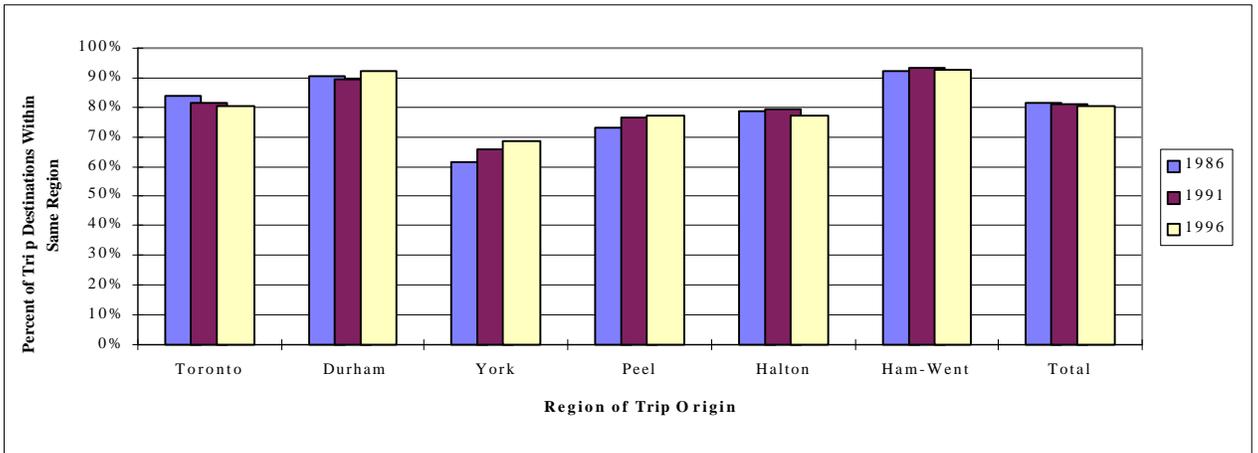
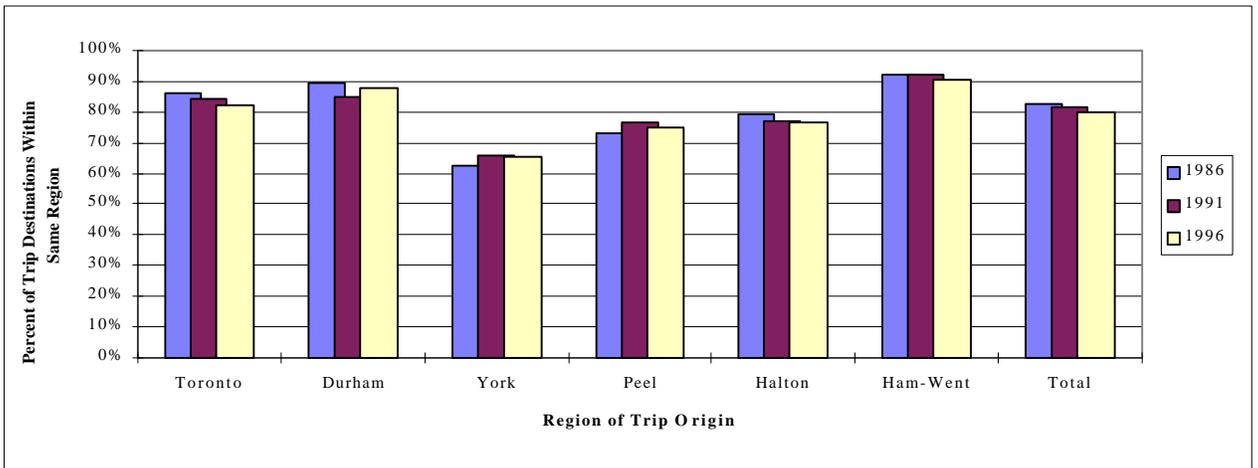


Exhibit 2.28: Regional Self-Containment of Evening Off-Peak (6:00 PM - 5:59 AM) Trips

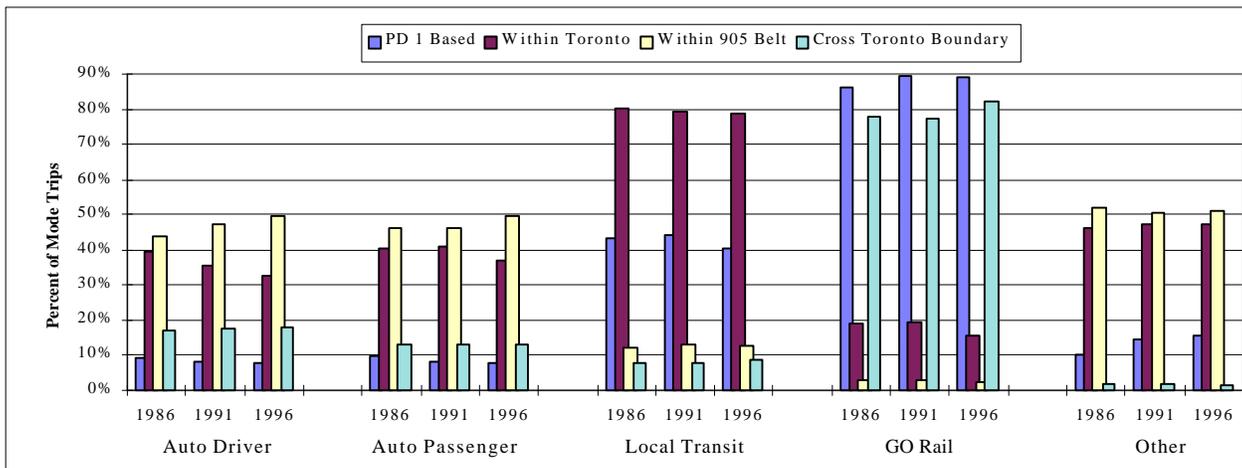


2.4.3 By Mode of Travel

2.4.3.1 Spatial Market

Only about 9% of the daily trips by auto drivers and nearly the same proportion of the auto-passenger trips start or end in PD 1, as shown in Exhibit 2.29. In contrast, over 40% of all transit trips and close to 90% of GO Rail trips start or end in PD 1. These proportions changed slightly between 1986 and 1996. The corresponding proportion of trips made by the other modes increased from 10% in 1986 to 15% in 1991 and 16% in 1996.

Exhibit 2.29: Distribution of Spatial Markets of Trips by Primary Mode of Travel



In 1986, the proportion of auto-driver trips made within the 905 Belt (44%) was higher than the proportion of trips made within Toronto (39%), and by 1996 the former proportion increased to 50% while the latter declined to 33%. Similar patterns could be observed for the auto-passenger trips. In contrast, about 80% of the local transit trips are made within Toronto, while only 12% of the transit trips are made within the 905 Belt. These proportions changed slightly between 1986 and 1996. As shown above, over 40% of all transit trips start or end at PD 1, and most of these trips have the other end within Toronto. This means that more than half the transit trips within Toronto have either one end or both ends in PD 1.

GO Rail is a radial commuter rail network with the Union Station in PD 1 as its focal point. As such, it serves mostly trips to/from PD 1. As indicated above, close to 90% of all GO Rail trips start or end at PD 1, and they mainly come from outside Toronto, as shown in Exhibit 2.29.

2.4.3.2 Self Containment

Exhibits 2.30-2.33 present self containment levels by region for the auto driver, auto passenger, local transit and GO Rail modes, respectively.

Exhibit 2.30: Regional Self-Containment of Auto-Driver Trips

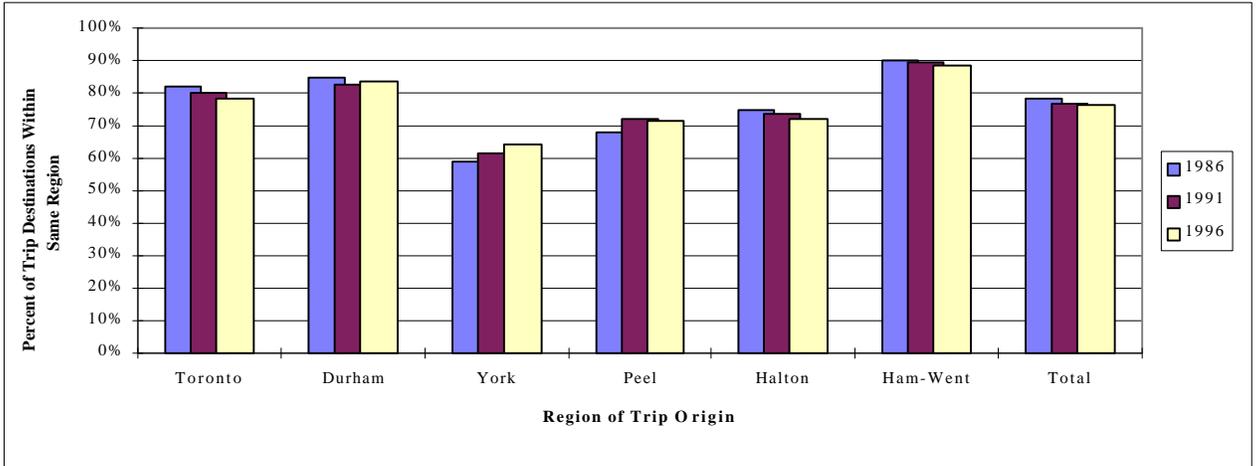


Exhibit 2.31: Regional Self-Containment of Auto-Passenger Trips

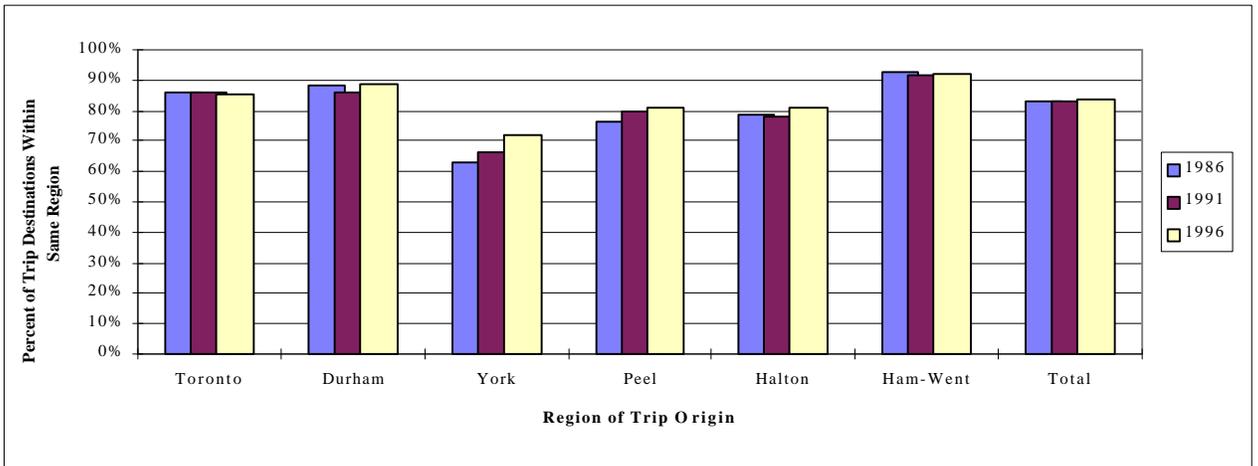


Exhibit 2.32: Regional Self-Containment of Local Transit Trips

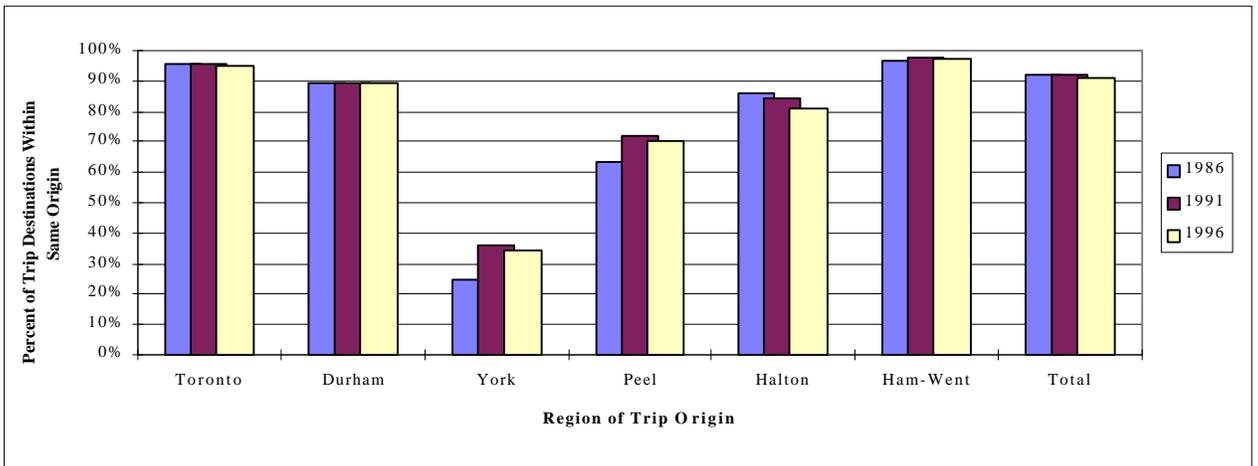
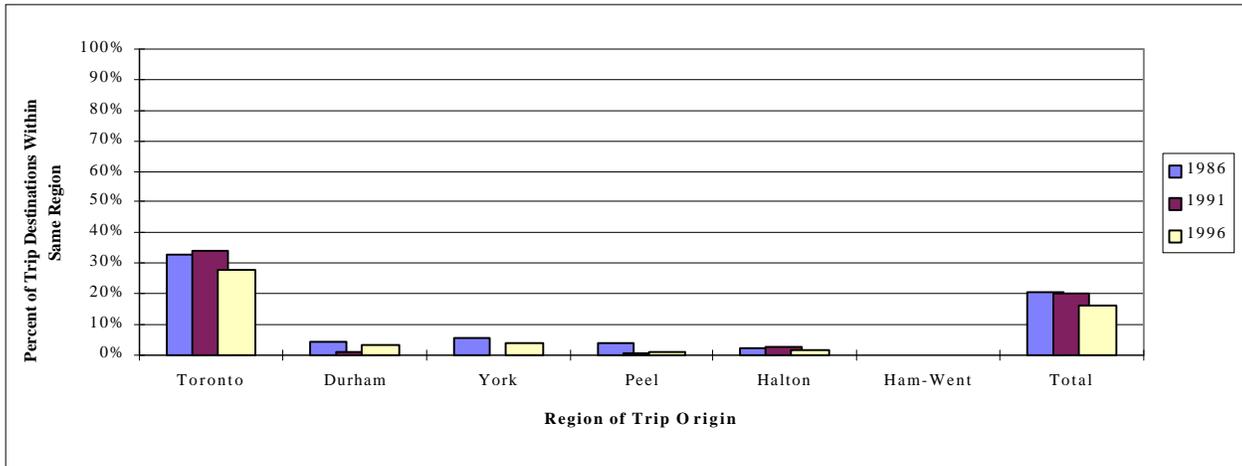


Exhibit 2.33: Regional Self-Containment of GO Rail Trips



As expected, transit, compared to the other motorised modes, has the highest level of self containment, at 92% in 1986, and GO Rail has the lowest level, at nearly 20% in 1986. By 1996, the self-containment level of the transit trips declined to 91%, and the self-containment level of the GO Rail trips declined to 16%. About 78% of the auto-driver trips in 1986 started and ended in the same region, and this proportion declined to 76% by 1996. About 83% of the auto-passenger trips in 1986 started and ended in the same region, and this proportion remained the same in the following ten years.

Similar to the patterns observed before, self containment levels in York, and to a lesser degree in Peel, increased across the auto-driver, auto-passenger and transit modes.

Interestingly, the proportion of transit trips from York which are destined to other locations in York is quite low. In 1996, about two thirds of the transit trips from York were destined to other regions, mostly Toronto. Many of such trips are made by people who access the subway system, either driving or dropped off, at stations with park-and-ride or kiss-and-ride facilities.

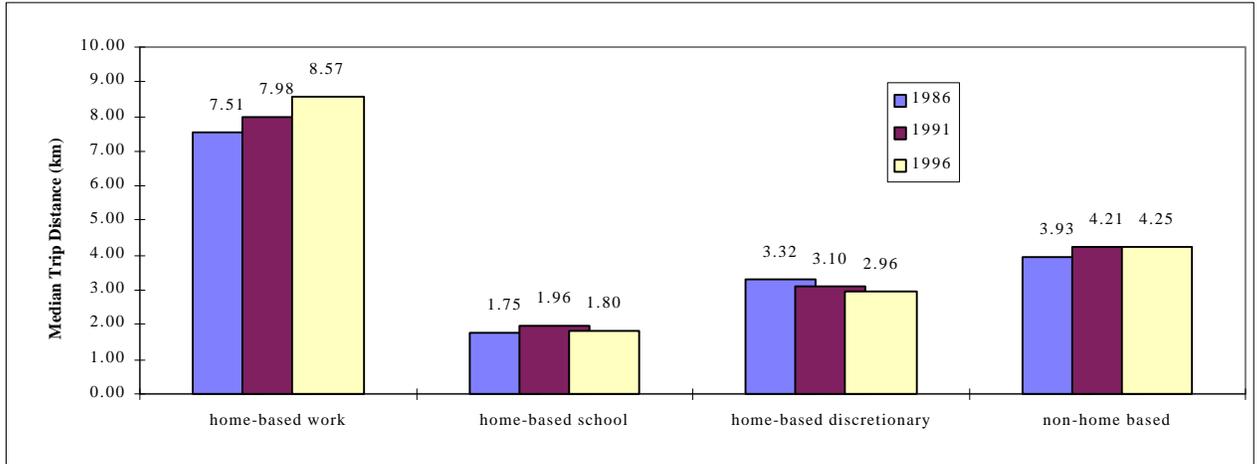
2.5 TRIP DISTANCE

As mentioned earlier, the median distance of all GTA trips changed slightly between 1986 and 1996. This section examines further the changes in trip distance by trip purpose, time of day, spatial market and travel mode.

2.5.1 By Trip Purpose

In general, home-based work trips have the longest distance compared to other trip purposes, as shown in Exhibit 2.34. The median of this distance increased by nearly one kilometre, from 7.51 km in 1986 to 8.57 km 10 years later. Also, non-home based trip distance increased slightly while home-based discretionary trip distance dropped slightly. It appears that the increased distance of home-based work trips were offset by the increased proportion of home-based discretionary trips (which are generally shorter than home-based work trips), resulting in the slight change in the overall trip distance observed earlier.

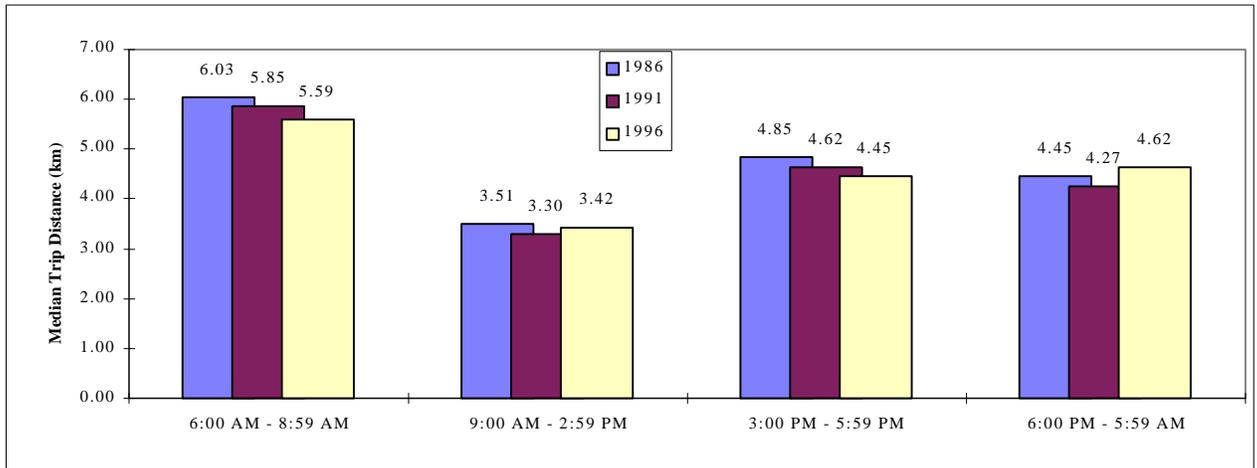
Exhibit 2.34: Median Straight-Line Distance of Trips by Trip Purpose



2.5.2 By Time of Day

As the proportion of home-based work trips during the peak periods declined, the trip distance during these periods also declined, as shown in Exhibit 2.35. During the other periods, the trip distance changed slightly between 1986 and 1996.

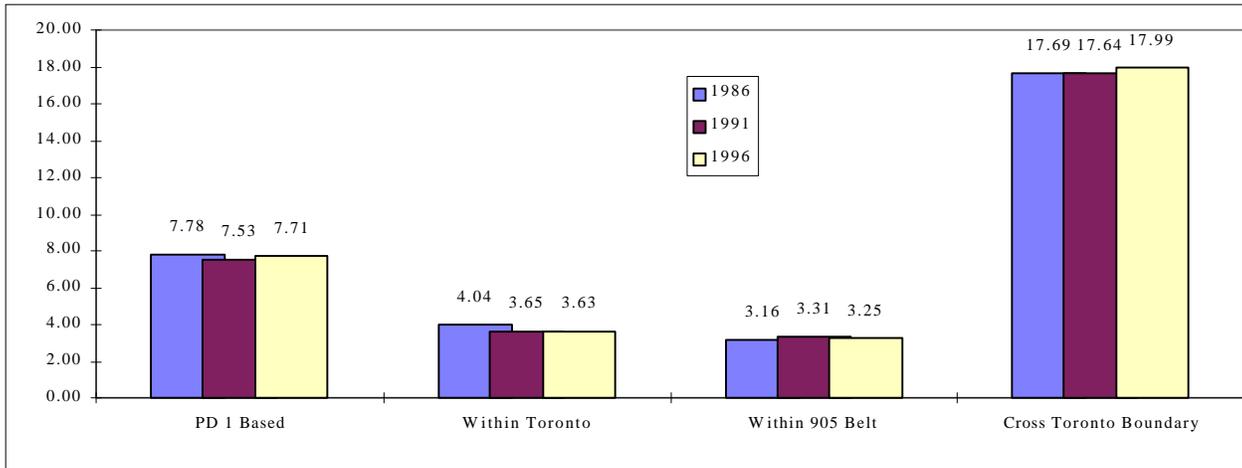
Exhibit 2.35: Median Straight-Line Distance of Trips by Time of Day



2.5.3 By Spatial Market

Even though the proportion of trips to/from PD 1 from/to locations outside Toronto increased, the distance of PD 1-based trips remained almost the same between 1986 and 1996, as shown in Exhibit 2.36. This could be attributed to the fact that the proportion of internal trips within PD 1 also increased which may have offset the effect of the above increase. The trips in the other spatial markets also changed slightly with respect to travel distance.

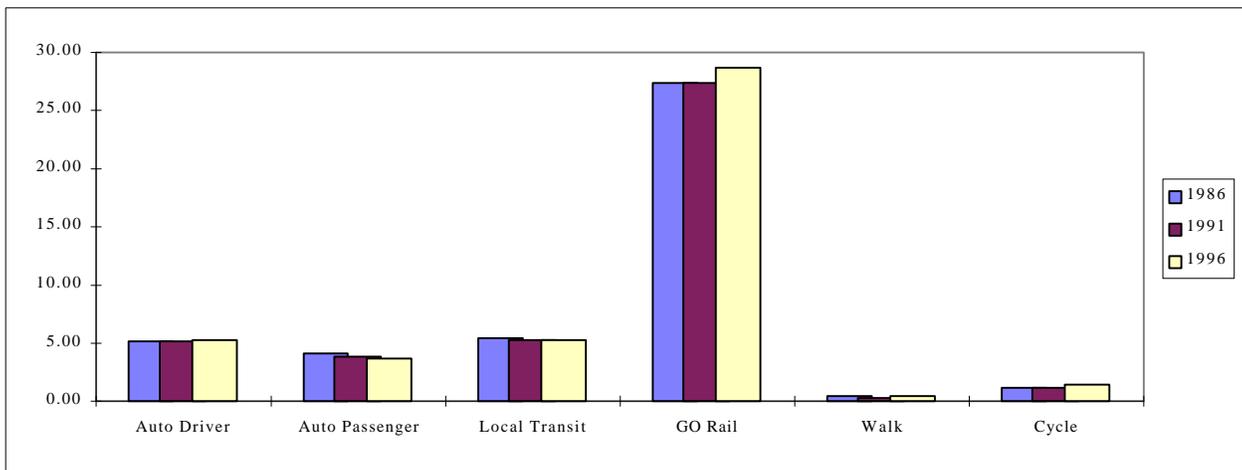
Exhibit 2.36: Median Straight-Line Distance of Trips by Spatial Market



2.5.4 By Mode of Travel

Also, the trip distance for each mode considered here changed insignificantly between 1986 and 1996, as Exhibit 2.37 shows.

Exhibit 2.37: Median Straight-Line Distance of Trips by Travel Mode



2.6 MODE SPLIT

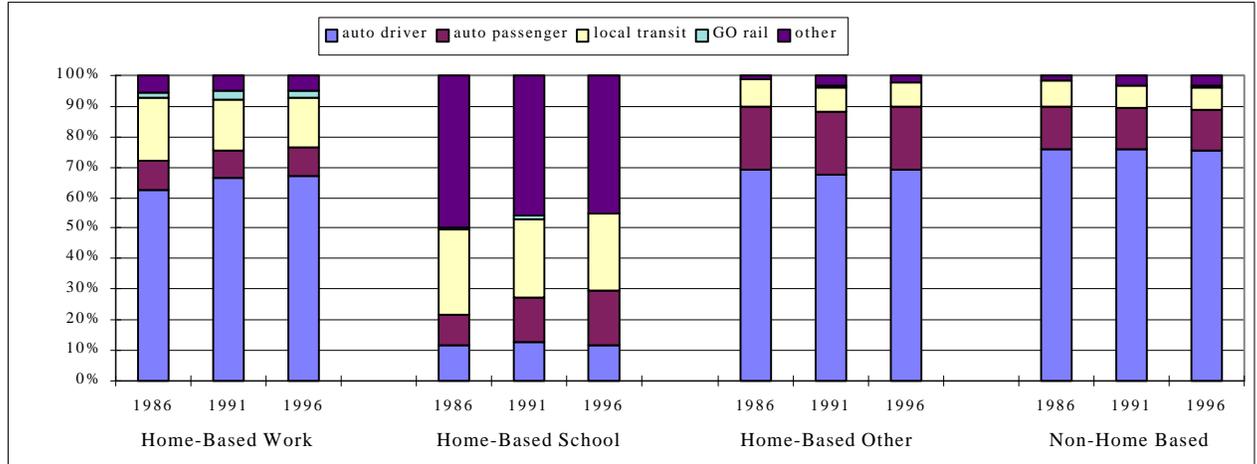
It is shown earlier that the major changes in mode split include an increased auto-driver and auto-passenger shares and a reduced local transit share. This section examines further the changes in mode split by trip purpose, time of day and spatial market.

2.6.1 By Trip Purpose

The market of home-based work trips experienced the largest decline in transit mode share, from 21% in 1996 to 16% in 1986, as shown in Exhibit 2.38. That 5% decline in transit share of the home-based work

trip market was gained almost entirely by the auto-driver trips, the share of which increased from 62% in 1986 to 67% in 1996. The shares of the other travel modes changed very slightly between 1986 and 1996.

Exhibit 2.38: Mode Split of GTA Daily Trips by Trip Purpose



The mode split for home-based school trips also changed between 1986 and 1996. The proportion of these trips made by auto passengers increased from 10% in 1986 to 14% in 1991 and 18% in 1996. During the same decade, the proportion of home-based school trips made on transit declined from 28% in 1986 to 25% in 1996, and the proportion trips made by the “other” modes (e.g. walk, cycle, etc.) declined from 50% in 1986 to 45% in 1996.

The home-based discretionary trips and non-home based trips are dominated by the auto-based modes (i.e. 90% of each trip type are made by either auto drivers or auto passengers). The modal distribution of these trip types remained almost the same between 1986 and 1996.

2.6.2 By Time of Day

The transit mode share is largest during the peak periods, as shown in Exhibit 2.39. The decline in the transit market share during the peak periods was more severe than the decline in other time periods. In each peak period, the transit market share declined and the shares of trips by auto passengers and the “other” modes mainly increased, while the auto-driver market share changed slightly. For example, the proportion of trips made by transit during the morning peak period declined from 21% in 1986 to 15% in 1996, and the proportions of trips by auto passengers and the “other” modes increased respectively by 2.5% (from 9.7% in 1986 to 12.2% in 1996) and 2.1% (11.6% in 1986 to 13.7% in 1996), while the proportion of trips by auto drivers increased by 0.6% only (from 56.4% in 1986 to 57% in 1996). The GO Rail share increased between 1986 and 1991 but declined again in the following five years, resulting in a slight increase in the GO Rail share between 1986 and 1996.

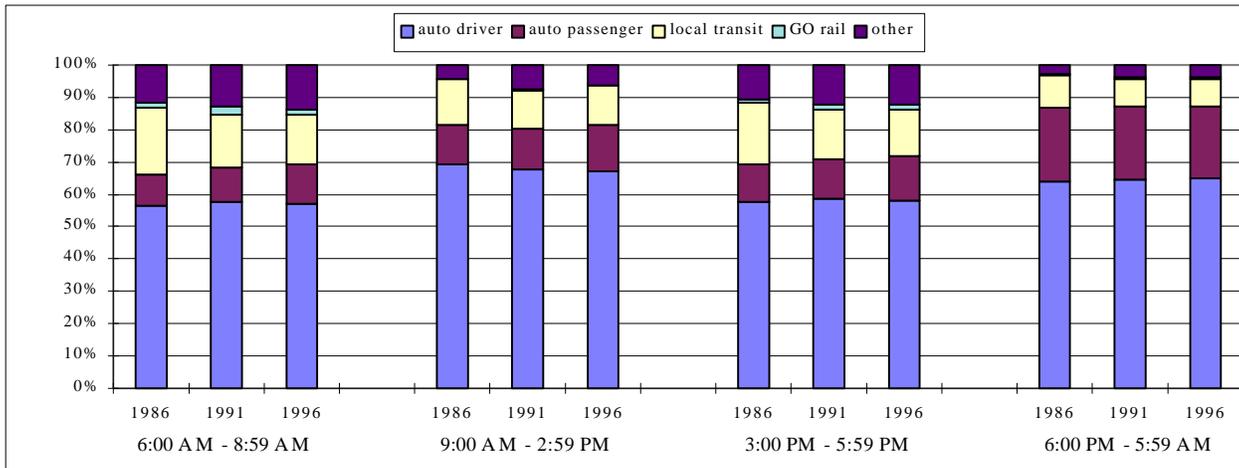
The auto-driver share for the trips starting between 9:00 AM and 2:59 PM is higher than during other periods. However, each of the auto-driver share and the transit mode share during this period declined by 2% between 1986 and 1996, while each of the auto-passenger share and the share of the “other” modes increased by 2%.

Exploring Person Travel Trends in the Greater Toronto Area

Part 2: Changes in Travel and Relationship with Factors

The auto-driver share for the trips starting between 6:00 PM and 5:59 AM is higher than during other periods. This share remained almost the same between 1986 and 1996, at 22%. The transit mode share for the trips starting between 6:00 PM and 5:59 AM declined from 10.3% in 1986 to 8.6% in 1996, while the auto-driver share increased from 64.3% in 1986 to 65.2% in 1996.

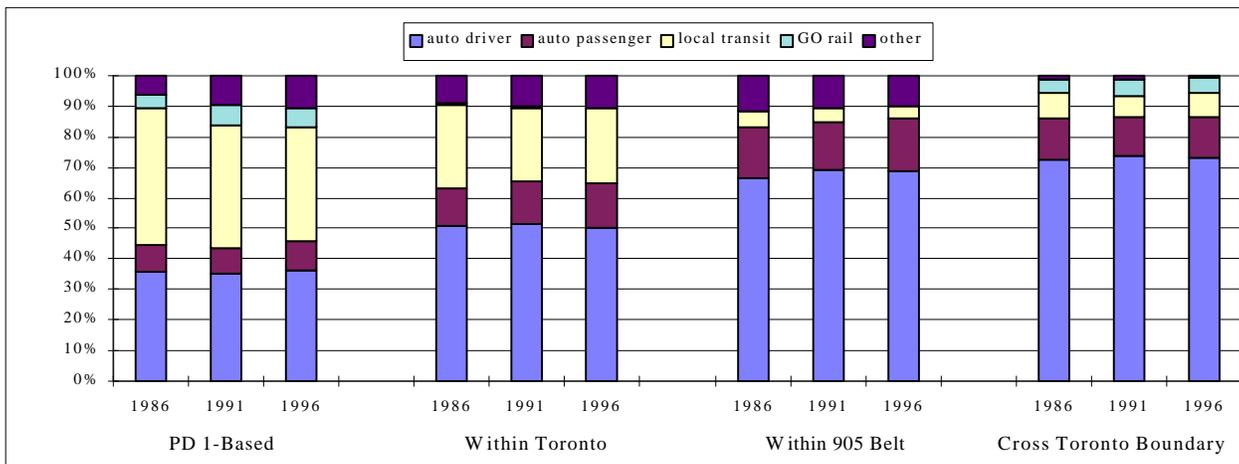
Exhibit 2.39: Mode Split of GTA Daily Trips by Time of Day



2.6.3 By Spatial Market

Exhibit 2.40 presents mode split for the various spatial markets examined in this study. The transit mode share is largest in the spatial market of trips with at least one end in PD 1, compared to the other markets. However, the transit mode share in this market declined from 45% in 1986 to 38% in 1996. This decline was accompanied by an increase in the GO Rail share from 4.3% in 1986 to 6.1% in 1996 and an increase in the share of the “other” modes from 6.1% in 1986 to 10.4% in 1996. The shares of the auto-based modes in this market changed slightly between 1986 and 1996.

Exhibit 2.40: Mode Split of GTA Daily Trips by Spatial Market



Also, the transit market share declined in the “Within Toronto” market, from 27.6% in 1986 to 24.6% in 1996. However, unlike the previous market, this market experienced an increase in the auto-passenger share from 12.3% in 1986 to 14.4% in 1996, as well as an increase in the share of trips by the “other” modes from 8.9% in 1986 to 10.5% in 1996.

The trips within the 905 Belt are made mostly by the auto-based modes. This pattern even became more prominent as the each of auto-driver and auto-passenger shares increased to account together for 86.3% of the 1996 total trips in this market, up from 83.1% ten years earlier. This happened at the expense of local transit and the “other” modes which declined in market share between 1986 and 1996.

The trips crossing the Toronto boundary are made mostly by the auto-based modes (i.e. slightly less than 90% in 1996). This market experienced a slight reduction in the transit mode share and an increase in the auto-driver share between 1986 and 1996.

3. RELATIONSHIP BETWEEN CHANGES IN TRAVEL AND CHANGES IN FACTORS

This section is concerned with relating the changes in person travel, discussed in the preceding section, to the changes in travel-related factors, discussed in Part 1 of the study. In particular, it attempts to quantify the portion of travel increase associated with population increase and with changes in the individual distributions of major travel-related factors.

3.1 APPROACH

The change in the number of trips during each 5-year period can be decomposed into two components: change related to population increase/reduction and change related to change in trip making rate (i.e. number of daily trips per person). The trip making rate is related in part to the personal and household characteristics of the urban residents and to other characteristics of the transportation and urban activity systems. For example, a middle-aged person makes more trips per day than an elderly, all else being equal. Similarly, a person with a driver's licence and an available car makes more trips per day than a person without a car, all else being equal. Therefore, the trip making rate changes in part as a result of changes in the composition of the population caused by shifts in the population distributions (e.g. age distribution, residential location distribution, employment status distribution, etc.) However, even if the distributions of all travel-related factors do not change over time, the trip making rate might not remain the same. This is because two persons at different points in time (say 1986 and 1991) with exactly the same characteristics could have different daily trip rates due to personal travel idiosyncrasies. For example, people with certain personal characteristics in 1986 (e.g. aged between 25 and 30) might carry over their travel habits to 1991; these people with their new characteristics in 1991 (e.g. aged between 31 and 35) could have different travel habits from those of people who had the same personal characteristics in 1986.

Therefore, the analysis presented in this section seeks to decompose the change in the number of trips during each 5-year period, say between 1986 and 1991, into the change associated with population increase/reduction and the change associated with change in trip making rate which reflects shifts in the distributions of travel-related factors and shifts in travel habits. The former component (i.e. change associated with population increase/reduction) for the period 1986-1991 can be computed as:

$$Change_{86-91}(pop) = Rate_{86} * Population_{91} - Trips_{86}.$$

In other words, it is the number of extra trips in 1991 over the 1986 trips if the population size only increases between 1986 and 1991, while the 1986 overall trip rate remains unchanged during the same period. The above equation can also be expressed as:

$$Change_{86-91}(pop) = \frac{Trips_{86}}{Population_{86}} * Population_{91} - Trips_{86} = Trips_{86} \left(\frac{Pop_{91}}{Pop_{86}} - 1 \right),$$

which represents the 1986 trips multiplied by the percentage increase in population size. Therefore, it reflects the increase in number of trips if their rate of change was similar to that of the population.

The second component represents the change in daily trips associated with the change in trip making rate. It can be expressed as:

$$Change_{86-91}(rate) = Trips_{91} - Rate_{86} * Population_{91} = Trips_{91} - \frac{Trips_{86}}{Pop_{86}} * Pop_{91}$$

$$Change_{86-91}(rate) = Trips_{86} * \frac{Pop_{91}}{Pop_{86}} \left(\frac{Trips_{91} / Pop_{91}}{Trips_{86} / Pop_{86}} - 1 \right),$$

which represents the 1991 trips assuming no change in trip rate (i.e. $Trips_{86} * Pop_{91}/Pop_{86}$) multiplied by the percentage increase in trip rate between 1986 and 1991.

The above equations indicate that the change in number of trips between 1986 and 1991 can be decomposed into a two-step process: (i) the change in the 1986 trips associated with population increase/reduction only (this change brings the number of trips to a certain level); and (ii) the change in that level of trips associated with trip rate changes between 1986 and 1991.

The last equation reflects the change in the number of trips associated with shifts in the distributions of all travel-related factors and shifts in travel habits, which are both reflected in trip rate change. Now, consider the change in the number of trips associated with the distribution shift of one variable only, say age. Suppose age is not correlated with any other travel-related variable and we have n age cohorts. Suppose also that between 1986 and 1991 changes happened only in the population size and the distributions of other travel-related variables, while the age distribution remained the same. In such scenario, the number of trips in 1991 would be

$$\sum_{i=1}^n [Pop_{91} * \frac{Pop_{86}(i)}{Pop_{86}}] * [\frac{Trips_{91}(i)}{Pop_{91}(i)}].$$

The first bracket in the above equation represents the population of age cohort i if the age distribution in 1991 were the same as the 1986 distribution. The second bracket represents the 1991 trip rate for age cohort i . The 1991 trip rate is used to reflect the distribution shifts of other variables. If the 1986 trip rate is used, the number of trips will be equal to $(Trips_{86} * Pop_{91}/Pop_{86})$, which corresponds to the scenario of population increase/reduction but unchanged trip rate. The above equation can be restructured as

$$\sum_{i=1}^n Trips_{91}(i) * \frac{Pop_{86}(i) / Pop_{86}}{Pop_{91}(i) / Pop_{91}}.$$

In words, the above equation represents the number of trips in 1991 by persons in the age cohort i multiplied by the ratio of the 1986 population share of age cohort i to the 1991 share of the same cohort, summed over all age cohorts. The difference between the total number of trips in 1991 and the above equation would be attributed to the shift in age distribution, as shown in the following equation:

$$Change_{86-91}(age) = Trips_{91} - \sum_{i=1}^n Trips_{91}(i) * \frac{Pop_{86}(i) / Pop_{86}}{Pop_{91}(i) / Pop_{91}}.$$

Two points merit some discussion here. First, the use of the 1991 trip rates above reflects not only the distribution shifts of other variables but it also reflects differences in trip making between the same age cohort at different points in time, as noted earlier. For example, persons aged 35-40 in 1986 may have

Exploring Person Travel Trends in the Greater Toronto Area

Part 2: Changes in Travel and Relationship with Factors

different trip making patterns than persons aged 35-40 in 1991, all else being equal. Therefore, the change in number of trips between 1986 and 1991 associated with the shift in age distribution, as calculated by the above equation, reflects strictly the change associated with the shift in age distribution only during that period and does not include the effect of changes in travel habits.

The second point is regarding the assumption made earlier that age is not correlated with other travel-related variables. Obviously, this is a strong assumption, since age is expected to be correlated with factors such as employment status and car ownership. Therefore, in this analysis, any change in trips associated with a shift in an individual variable distribution should not be attributed to that variable alone but to other correlated variables as well.

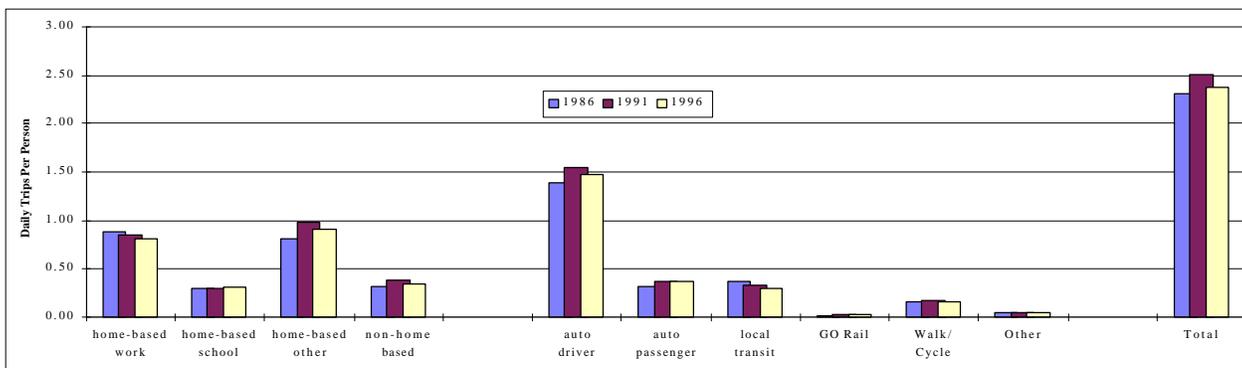
The above equations are used in this section to develop estimates of the change in number of trips associated with the population increase, change in overall trip rate and individual shifts of four distributions during the periods 1986-1991, 1991-1996 and 1986-1996. The four distributions are for the variables age, residential location, employment status and mobility by auto (i.e. household vehicles per licensed person in the same household). The number of trips examined here include the total number of trips, number of trips by purpose and number of trips by travel mode.

3.2 TRIP CHANGES ASSOCIATED WITH INCREASE IN POPULATION SIZE AND SHIFT IN OVERALL TRIP MAKING RATE

The analysis presented in this and the following sections considers only the characteristics of GTA residents aged 11 or above and their travel within the Greater Toronto Area.

The GTA population of age 11 or above increased from 3.46 millions in 1986 to 3.85 millions in 1991 and 4.16 millions in 1996, representing an 11% increase between 1986 and 1996 and 8% increase during the following five years. The total daily trips made by that population increased from 8 millions in 1986 to 9.6 millions in 1991 and 9.9 millions in 1996, representing a 21% increase between 1986 and 1996 and 3% increase during the following five years. These changes are reflected in the daily trip making rate (i.e. number of trips per person) which increased from 2.31 in 1986 to 2.50 in 1991 but declined to 2.38 trips per person in 1996, as shown in Exhibit 3.1.

Exhibit 3.1: Daily Trip Making Rate by Trip Purpose and Travel Mode



The exhibit also shows that the number of home-based work trips per person declined in both periods, while each of the home-based discretionary and non-home based trip rates increased during the first period but declined in the following five years. With respect to travel mode, the exhibit shows that the number of daily

transit trips per person declined in both periods from 0.37 in 1986 to 0.33 in 1991 and 0.30 in 1996. During the same period, the auto-driver trip rate increased in the first five years but declined in the following five years, while the number of auto-passenger trips per person increased between 1986 and 1996 and remained constant thereafter.

Exhibit 3.2 shows that the impact of population increase alone on the number of trips was comparable in the two five-year periods, resulting in extra 1.67 million trips per day in 1996 over the 1986 level. In other words, had there been no change in the overall trip rate, the number of daily trips would have experienced the same percentage increase as the population, rising by 1.67 million trips per day between 1986 and 1996. However, the increase in the overall trip rate between 1986 and 1991 (caused by changes in population composition and travel habits) resulted in extra 0.75 million trips per day, and the decline in the overall trip rate between 1991 and 1996 reduced the number of daily trips by 0.5 million trips. These changes caused the discrepancy between the relatively large increase in the total number of trips between 1986 and 1991 compared to the much smaller increase during the following five years, as shown in the exhibit.

Exhibit 3.2: Changes Associated with Population Increase and Shift in Trip Rate

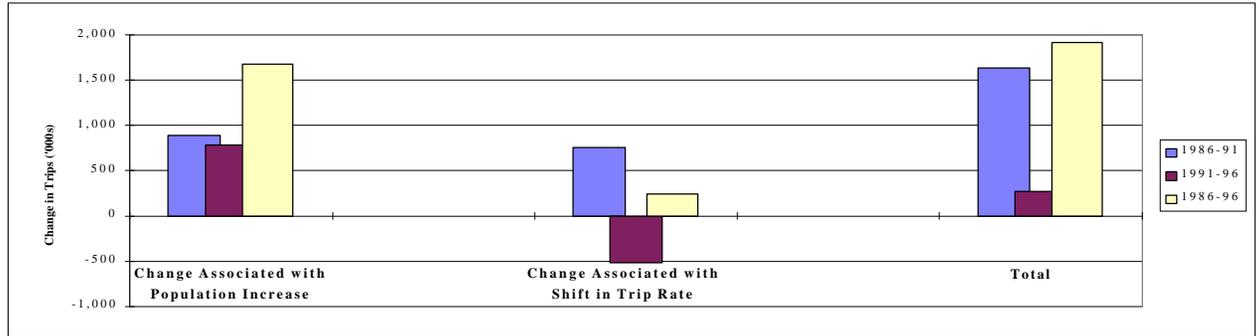
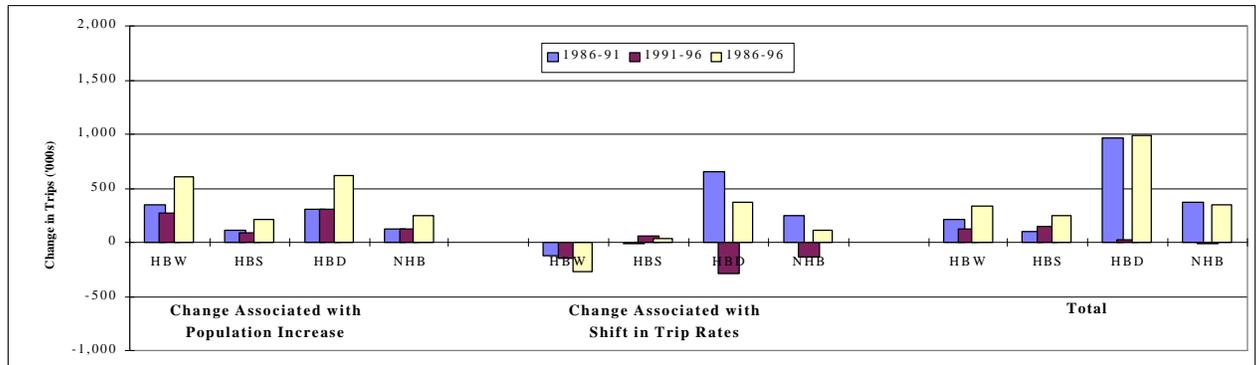


Exhibit 3.3 shows the above changes disaggregated by trip purpose. The population increase between 1986 and 1996 resulted in a larger increase in home-based work and home-based discretionary trips than home-based school and non-home based trips.

Exhibit 3.3: Changes by Trip Purpose Associated with Population Increase and Shift in Trip Rates



HBW: Home-Based Work; HBS: Home-Based School; HBD: Home-Based Discretionary; NHB: Non-Home Based

Exploring Person Travel Trends in the Greater Toronto Area

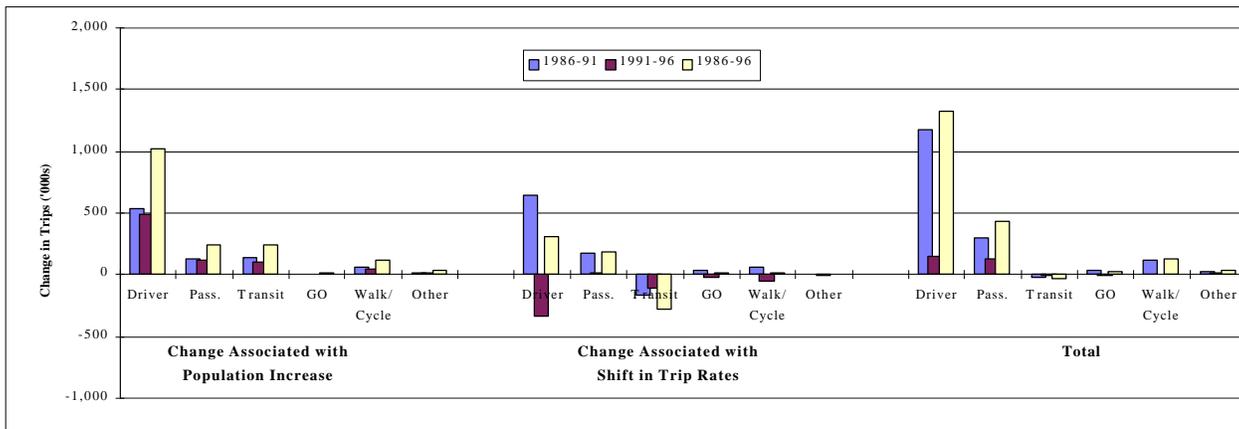
Part 2: Changes in Travel and Relationship with Factors

As a result of the drop in the home-based work trip rates during both five-year periods, the number of home-based work trips associated with these changes declined in both periods. The changes in trip rates of other trip purposes resulted in increased home-based discretionary and non-home based trips during the first period which were offset partially by reduction of these trips during the following five year periods, while the home-based school trips experienced slight changes associated with the relatively small change in their trip rates.

The above changes associated with population increase and changes in trip rates resulted in an overall trip increase for each trip purpose. However, it should be noted that the increase was mainly due to the population increase, while the trip rate changes caused increase only in home-based discretionary and non-home based trips during the first five-year period. It is interesting to see the increase in each of home-based discretionary and non-home based trips associated with the population increase during the second five-year period was almost entirely offset by the trip reduction caused by the respective changes in trip rates during that period.

About half a million auto-driver trips per day were introduced every five years due to the population increase alone, as shown in Exhibit 3.4. The corresponding number of auto-passenger trips was about 120 thousand trips, almost similar to the extra number of daily transit trips introduced due to the population increase alone each five-year period. However, the drop in transit trip rates in both periods resulted in reduction of the daily transit trips which balanced the increase in transit trips due to the population increase, with a net effect of an overall small decline of the daily transit trips. The increase in the auto-driver trip rate between 1986 and 1991 introduced an extra 642 thousand auto-driver trips per day, more than the 534 thousand trips introduced by the population increase. However, the auto-driver trip rate dropped during the following five years, reducing the number of auto-driver trips per day by 339 thousand trips. The net effect of these changes was a much larger increase of almost 1.2 million auto-driver trips per day between 1986 and 1991 than the much lower increase of 150 thousand trips per day during the following five years. The auto-passenger trip rate increased between 1986 and 1991, resulting in an increase of these trips, but it changed very slightly during the following five years, causing small changes in the number of auto-passenger trips during that period.

Exhibit 3.4: Changes by Travel Mode Associated with Population Increase and Shift in Trip Rates



As noted earlier, trip rates change as a result of changes in the population composition (i.e. population distributions) and shifts in travel habits. The following sections examine the change in the number of trips

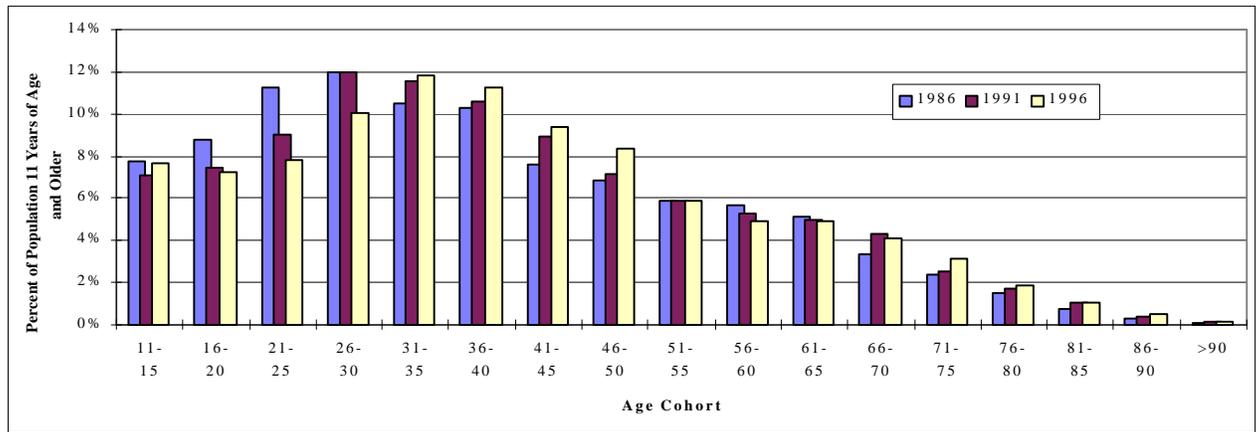
associated with the individual shifts of four distributions. These four distributions are for the variables age, residential location, employment status and mobility by the car.

3.3 TRIP CHANGES ASSOCIATED WITH SHIFT IN AGE DISTRIBUTION

3.3.1 Age Distribution

Exhibit 3.5 shows the ageing of the “baby boom” generation and its effect on the population age composition. The proportion of persons aged 16-25 declined between 1986 and 1991 more than its decline during the following five years, while the decline in the proportion of persons aged 26-30 happened almost entirely between 1991 and 1996. The proportions of the four age cohorts between 31 and 50 increased, but disproportionately in the two five-year periods.

Exhibit 3.5: Age Distribution of GTA Population 11 Years of Age and Older

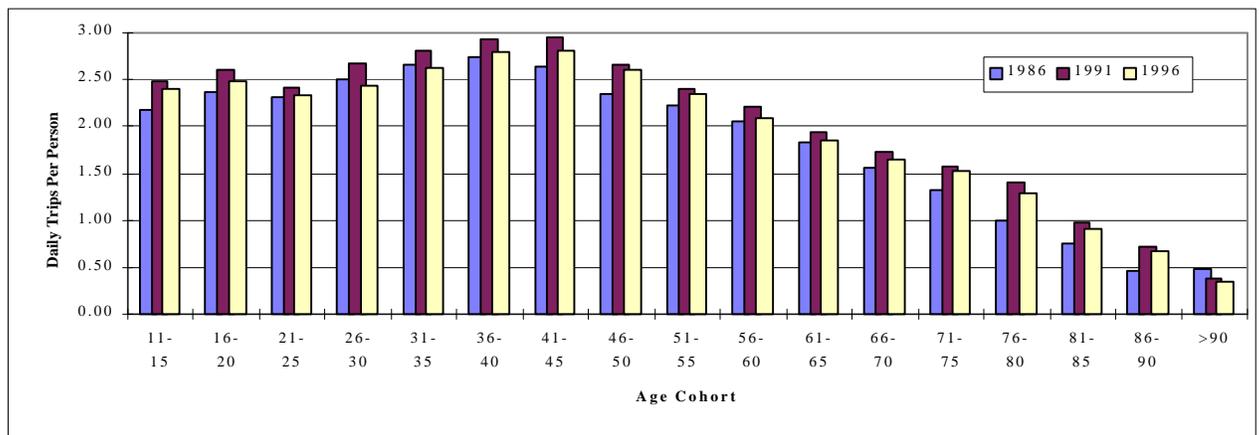


3.3.2 Daily Trip Rates

3.3.2.1 Total

Exhibit 3.6 shows that the trip rate across all age cohorts increased between 1986 and 1991 but declined during the following five years, with the exception of the trip rate for persons aged 90 or over.

Exhibit 3.6: Trip Making Rate by Age



Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

3.3.2.2 By Trip Purpose

Exhibits 3.7-3.10 present the daily trip rates by age for home-based work, home-based school, home-based discretionary and non-home based trips, respectively. The first exhibit shows that the number of home-based work trips per person increases quickly with age but remains almost constant for persons aged over 20 up to the mid fifties, beyond which the trip rate declines quickly. In general, there were slight changes in the trip rate across the age cohorts between 1986 and 1996, with the exception of the cohorts 16-20, 21-25, 56-60 and 61-65 where the trip rate declined, more so for the younger cohorts.

Exhibit 3.7: Home-Based Work Trip Making Rate by Age

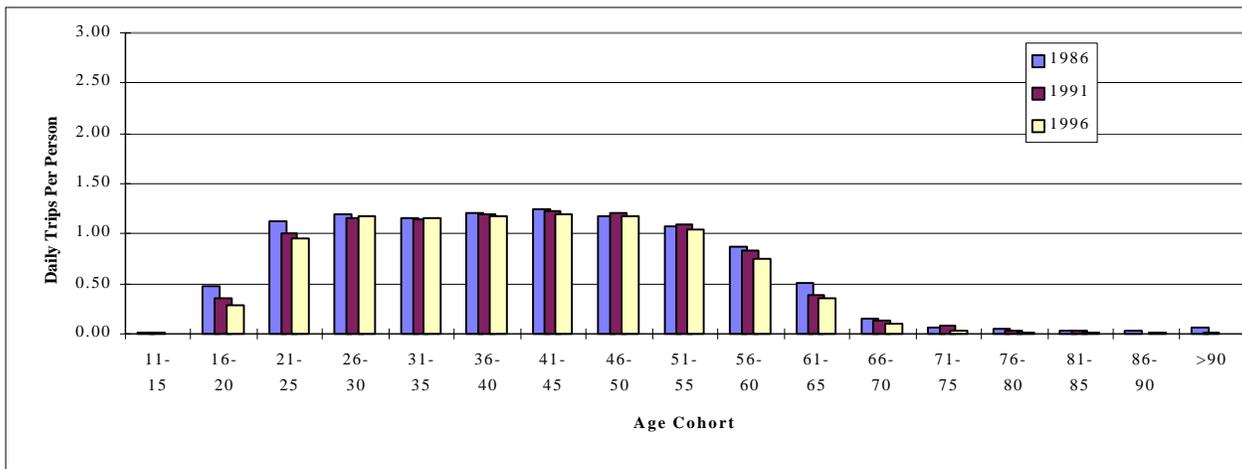
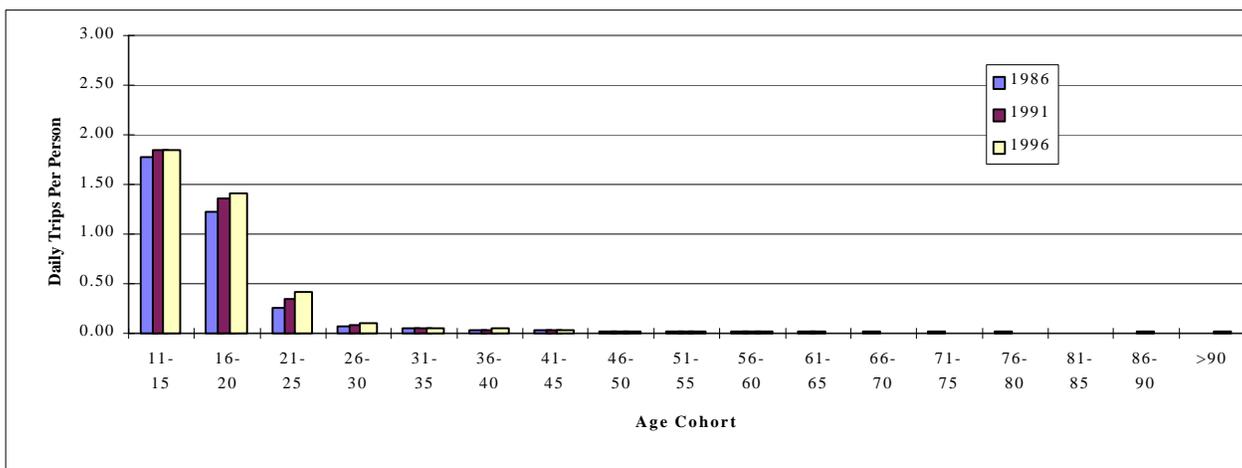


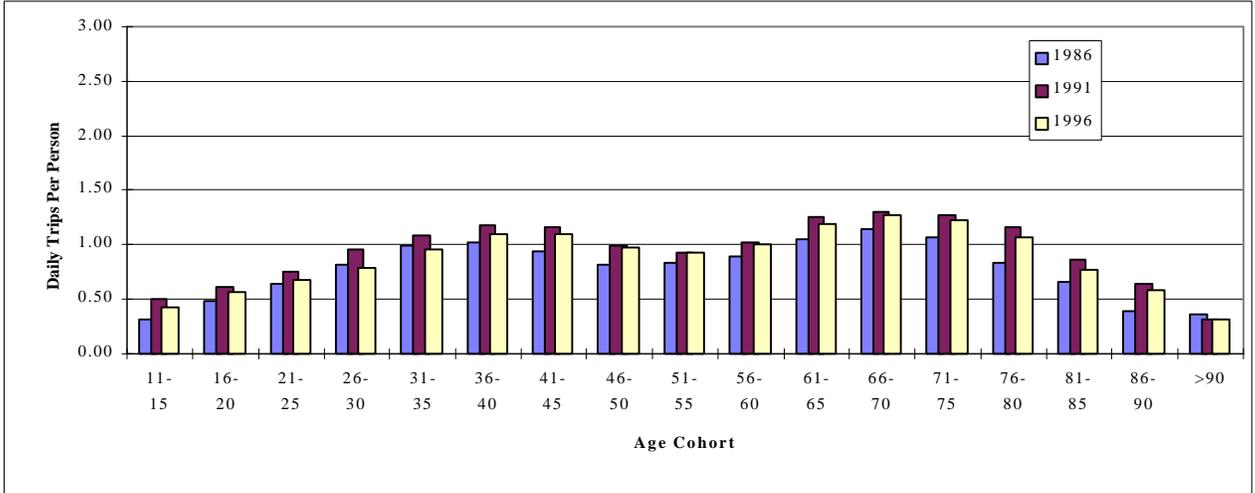
Exhibit 3.8 shows that the number of home-based school trips per person declines quickly with age. The exhibit shows an increase in the number of home-based school trips per person across the three significant age cohorts (i.e. 11-15, 16-20 and 21-25).

Exhibit 3.8: Home-Based School Trip Making Rate by Age



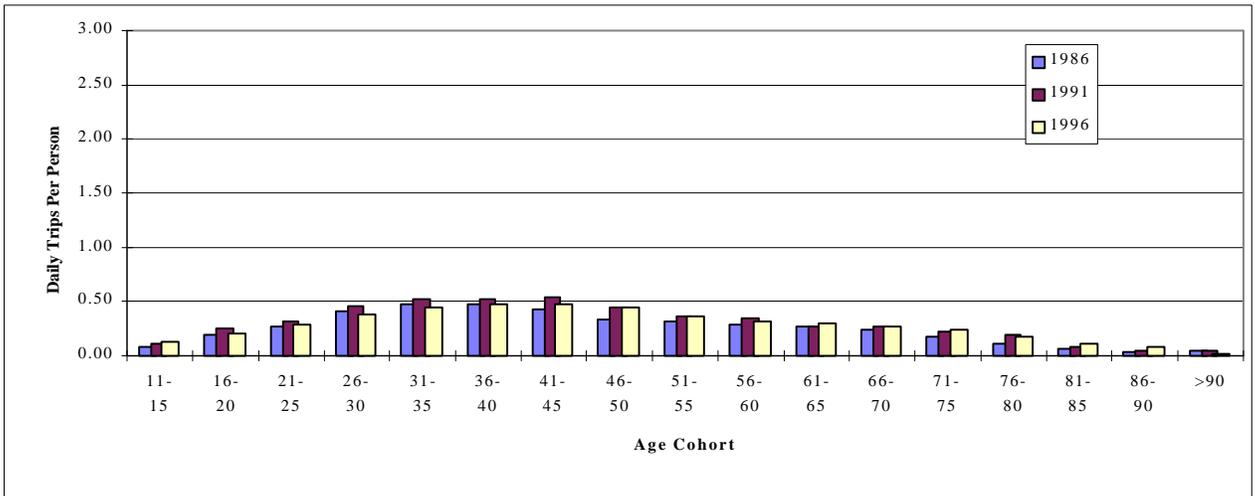
The home-based discretionary trip rate peaks twice across age, first in the mid thirties of age and second in the mid sixties of age, as displayed in Exhibit 3.9. Most of the age cohorts experienced increase in the trip rate between 1986 and 1991 followed by decline during the following five years.

Exhibit 3.9: Home-Based Discretionary Trip Making Rate by Age



Similarly, for many age cohorts the number of non-home based trips (many of which are discretionary trips linked to the job location) per person increased between 1986 and 1991 but declined between 1991 and 1996, as shown in Exhibit 3.10.

Exhibit 3.10: Non-Home Based Trip Making Rate by Age



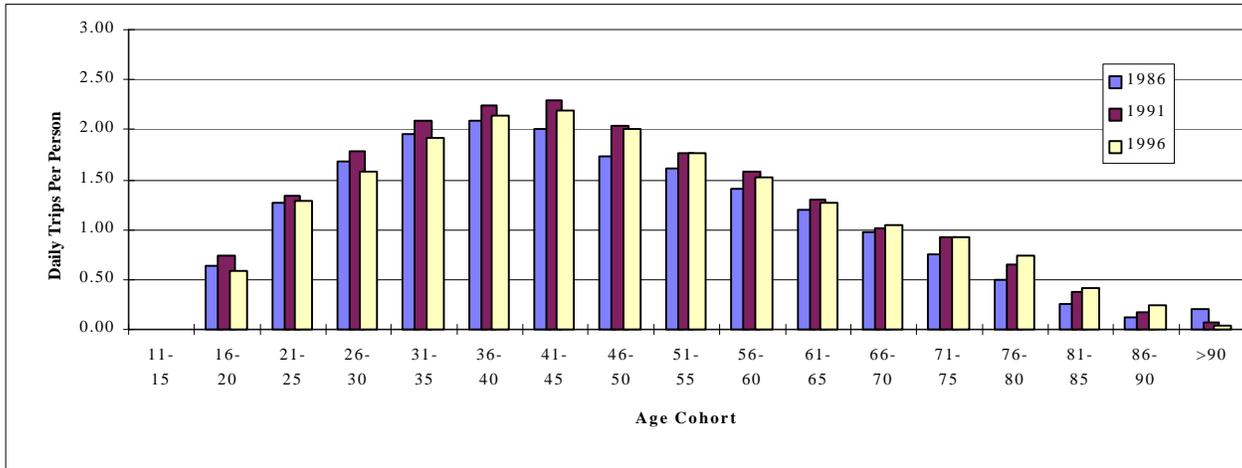
3.3.2.3 By Travel Mode

Exhibits 3.11-3.14 present the daily trip rates by age for auto driver, auto passenger, local transit and walk/cycle trips, respectively. Exhibit 3.11 shows that the number of auto-driver trips per person increases with age and peaks at the mid forties, beyond which it declines rapidly. The age cohorts spanning the range

Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

11 to 65 experienced increase in the trip rate between 1986 and 1991 followed by decline during the following five years, while the older age cohorts experienced trip rate increase in both periods.

Exhibit 3.11: Auto-Driver Trip Making Rate by Age



As shown in Exhibit 3.12, the auto-passenger trip rate is highest for persons aged 11-15 but declines quickly with age and peaks again at later age cohorts, mainly for persons in their sixties and seventies. However, that peak is smaller than trip rates at young age cohorts. The auto-passenger trip rate of the young age cohorts increased in both five-year periods, while the rate of mid-age cohorts changed very slightly.

Exhibit 3.12: Auto-Passenger Trip Making Rate by Age

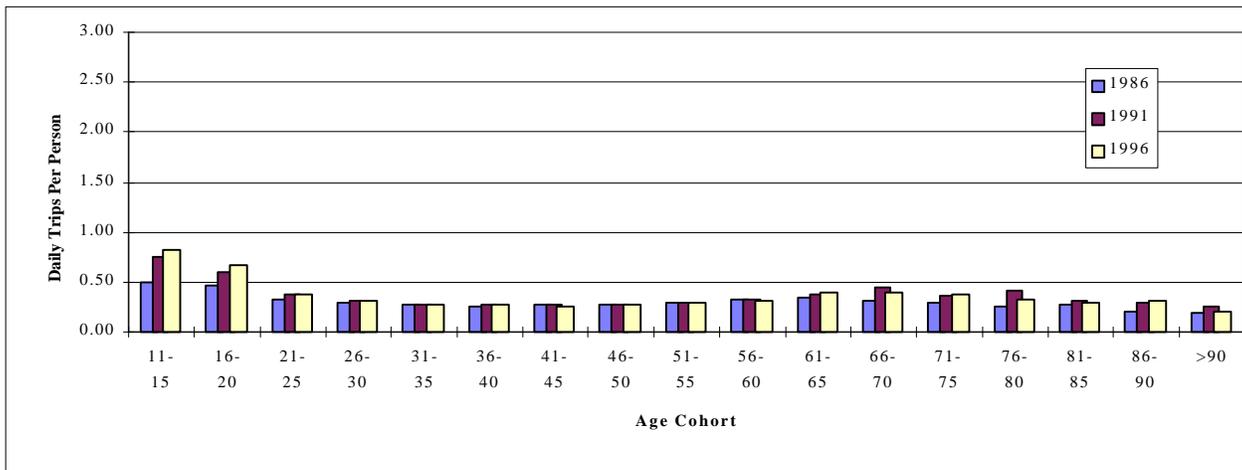


Exhibit 3.13 shows that the number of transit trips per person peaks at the age cohort 16-20 and declines thereafter with age. The exhibit shows that the trip rate for most age cohorts declined slightly in both five-year periods.

Exhibit 3.13: Transit (excluding GO Rail) Trip Making Rate by Age

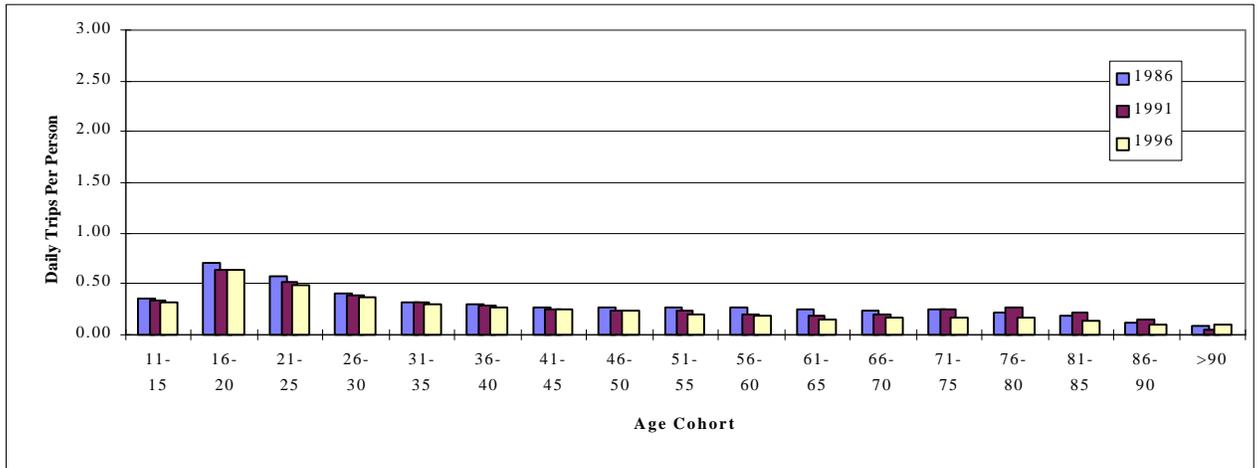
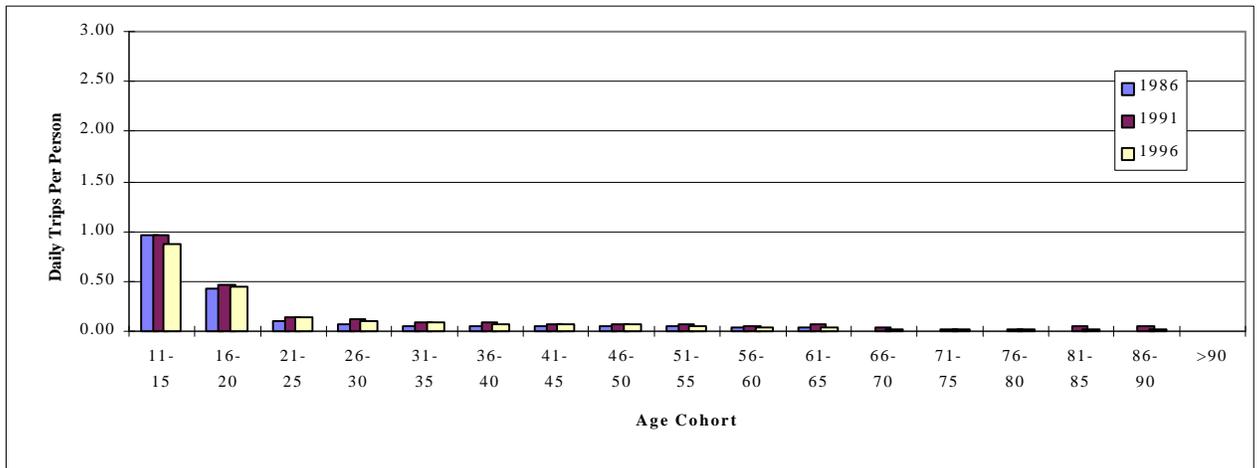


Exhibit 3.14 shows that the number of walk/cycle trips per person is highest for persons aged 11-15 and declines by half for persons in the next age cohort. People aged 21 or above make much less walk/cycle trips per person than the younger age cohorts. The trip rate of persons aged 11-15 remained almost constant between 1986 and 1991 but declined in the following five years, while the trip rate of persons aged 16-20 changed slightly during the two five-year periods.

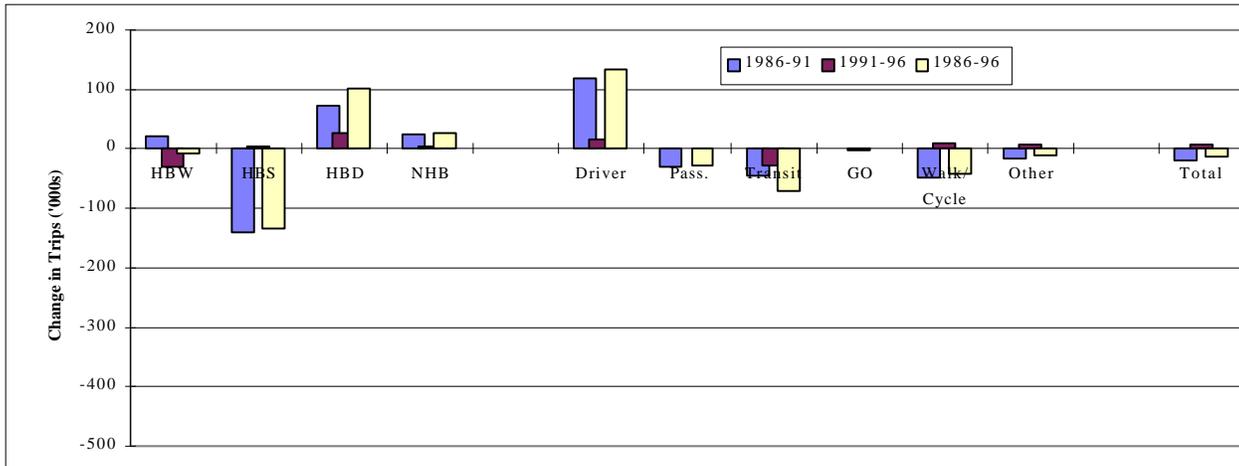
Exhibit 3.14: Walk/Cycle Trip Making Rate by Age



3.3.3 Trip Changes

As shown earlier, the main changes in the age distribution between 1986 and 1996 include a reduction in the proportion of persons aged 16-30 and increase in the proportions of persons aged 31-50 and persons aged 66 and over. The overall trip rate of the persons aged 16-30 is generally lower than that of the persons aged 31-50 but higher than the trip rate of the persons aged 66 and over. Consequently, minor changes occurred in the total number of trips in association with the shift in age distribution, as shown in Exhibit 3.15.

Exhibit 3.15: Trip Changes Associated with Shift in Age Distribution



HBW: Home-Based Work; HBS: Home-Based School; HBD: Home-Based Discretionary; NHB: Non-Home Based

However, the number of trips of certain purposes and the number of trips made by specific travel modes changed substantially in association with the age distribution shift. For example, while the number of home-based school trips dropped substantially, mainly due to the lower proportion of persons aged 16-30 who have higher home-based school trip rates than at later ages, the number of home-based discretionary trips increased, mainly due to the higher proportions of persons aged 31-50 and 66+ who correspond to the two peaks of the home-based discretionary trip rate profile. Interestingly, almost all the decline in the home-based discretionary trips occurred between 1986 and 1991. This is mainly due to the fact that the proportions of the three age cohorts 11-15, 16-20 and 20-25 all declined between 1986 and 1991. Persons aged 11-15 have the highest home-based school trip rates, followed by persons aged 16-20, while the persons aged 21-25 have a much lower rate. Persons of older ages have very small home-based school trip rates. Between 1991 and 1996, the proportion of persons aged 11-15 increased slightly while the proportions of persons aged 16-20 and 21-25 declined slightly, resulting in very minor changes in the number of home-based school trips associated with the age distribution shift between 1991 and 1996. The exhibit also shows relatively small changes in the number of home-based work and non-home based trips associated with the age distribution shift.

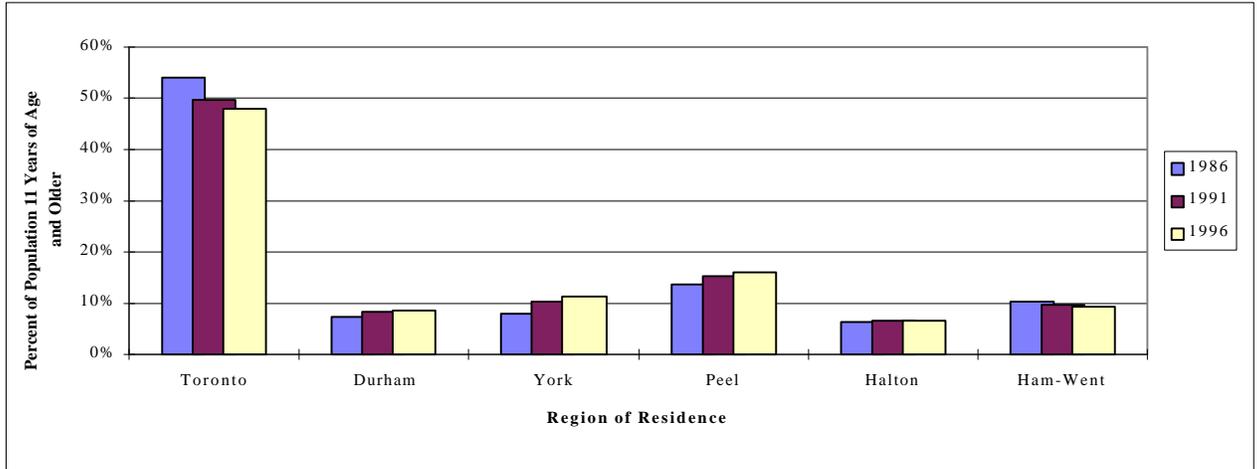
The number of auto-driver trips increased substantially, particularly between 1986 and 1991, while the numbers of auto-passenger, transit and walk/cycle trips dropped, in association with the decline of the proportions of younger persons and the increase in the proportions of older persons.

3.4 TRIP CHANGES ASSOCIATED WITH SHIFT IN RESIDENTIAL LOCATION DISTRIBUTION

3.4.1 Residential Location Distribution

Exhibit 3.16 shows the decline in the proportion of GTA residents living in Toronto from 54% in 1986 to 50% in 1991 and 48% in 1996. During the same period, the neighbouring regions of Durham, York and Peel experienced increase in the proportion of the GTA residents in each region.

Exhibit 3.16: Residential Location Distribution of GTA Population 11 Years of Age and Older

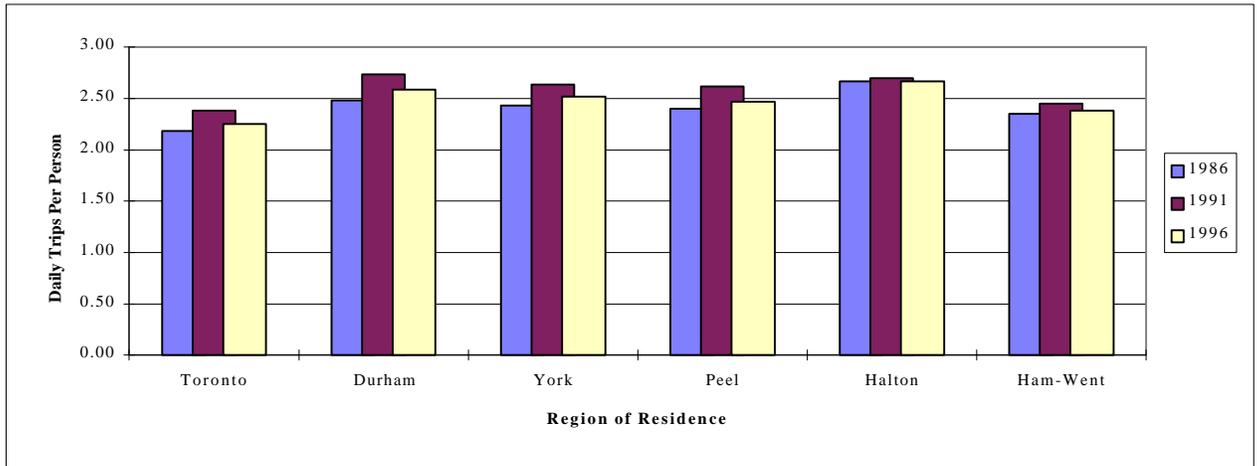


3.4.2 Daily Trip Rates

3.4.2.1 Total

Exhibit 3.17 shows that the trip making rate is in general comparable across the GTA, with the residents of Toronto and Hamilton-Wentworth making slightly less trips per person than the residents of the other regions. The trip rates across the GTA increased between 1986 and 1991 but declined during the following five years.

Exhibit 3.17: Trip Making Rate by Residential Location

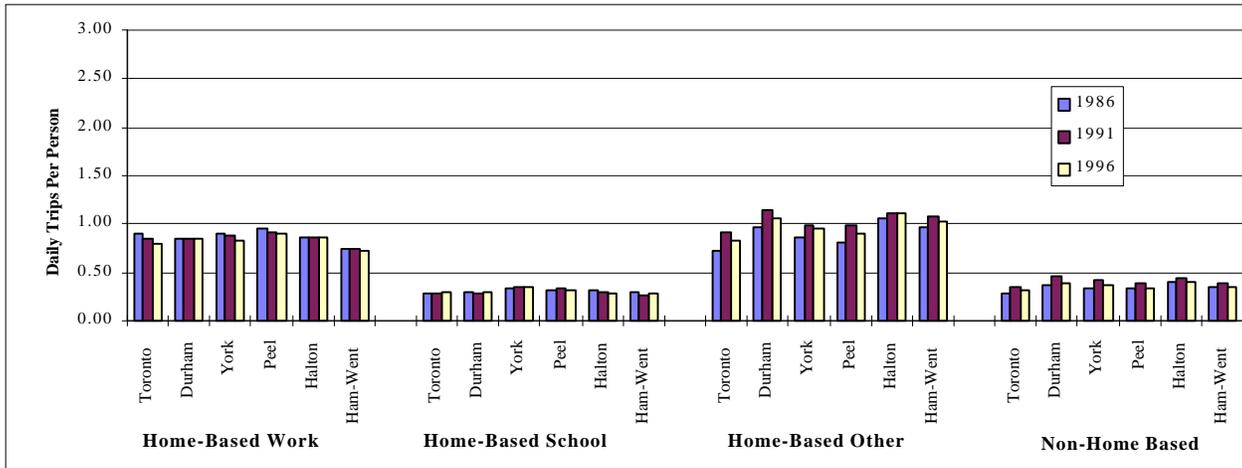


3.4.2.2 By Trip Purpose

Exhibit 3.18 shows that the home-based work, home-based school and non-home based trip rates are almost the same across the six regions, while the home-based discretionary trip rate is higher in Durham, Halton and Hamilton-Wentworth than the other regions.

Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

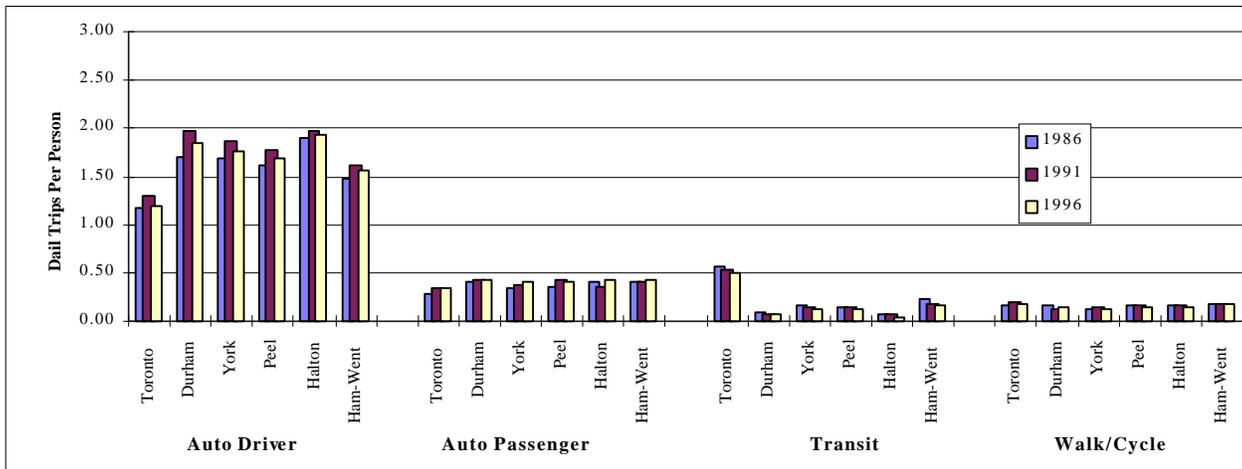
Exhibit 3.18: Trip Making Rate by Trip Purpose and Residential Location



3.4.2.3 By Travel Mode

Exhibit 3.19 shows that the residents of Toronto make less auto-driver trips per person than the residents of the other regions. However, the residents of Toronto make substantially more transit trips per person than the residents of the other regions. The auto-passenger trip rate is comparable across the GTA, and so is the walk/cycle trip rate.

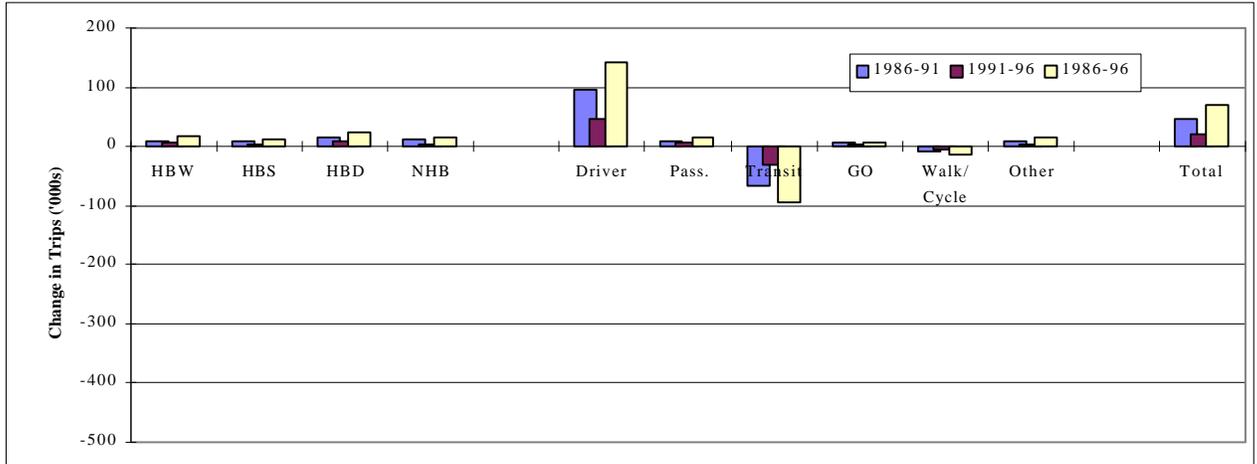
Exhibit 3.19: Trip Making Rate by Travel Mode and Residential Location



3.4.3 Trip Changes

As shown in Exhibit 3.20, the number of trips for each purpose increased slightly in association with the increased proportion of GTA residents living outside Toronto. However, the number of auto driver trips increased substantially between 1986 and 1996 while, the number of transit trips declined in association with the shift in the residential location distribution. Minor changes happened in the number of trips by other travel modes in conjunction with the shift in the residential location distribution. These changes resulted in a net increase in the total number of trips of slightly less than 69 thousand trips between 1986 and 1996.

Exhibit 3.20: Trip Changes Associated with Shift in Residential Location Distribution



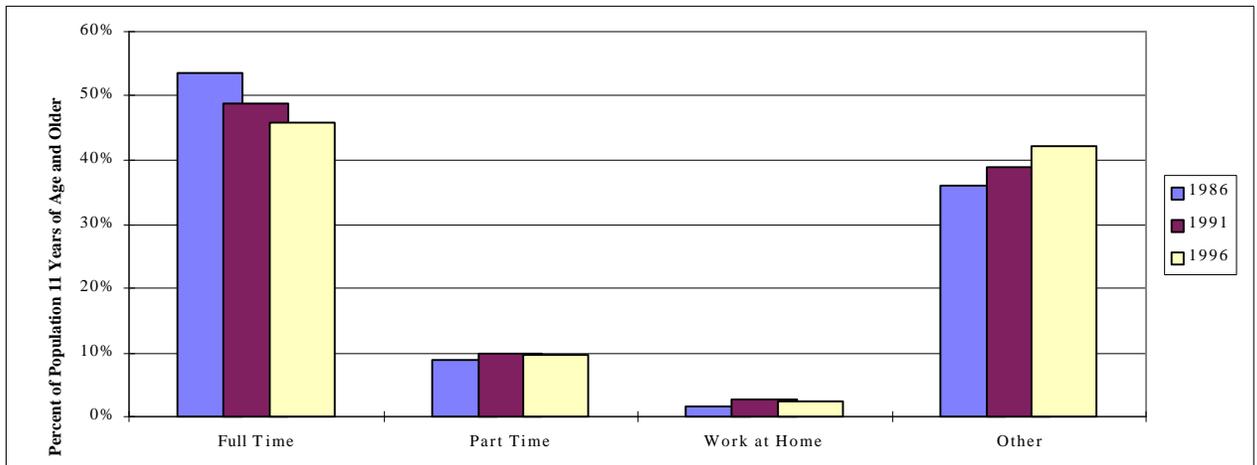
HBW: Home-Based Work; HBS: Home-Based School; HBD: Home-Based Discretionary; NHB: Non-Home Based

3.5 TRIP CHANGES ASSOCIATED WITH SHIFT IN EMPLOYMENT STATUS DISTRIBUTION

3.5.1 Employment Status Distribution

Exhibit 3.21 shows that the proportion of the full-time employed population dropped from 54% in 1986 to 49% in 1991 and 46% in 1996, while the proportions of part-time and work-at-home employees changed slightly during the same period. The proportion of “other” persons, mainly unemployed or students, increased from 36% in 1986 to 39% in 1991 and 42% in 1996. These changes are caused mainly by the economic recession that hit the GTA in the early nineties.

Exhibit 3.21: Employment Status Distribution of GTA Population 11 Years of Age and Older

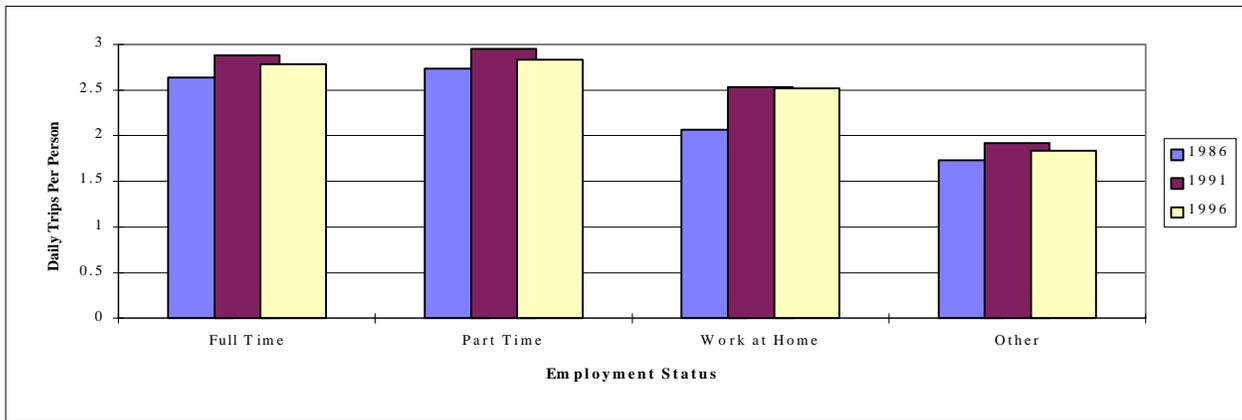


3.5.2 Daily Trip Rates

3.5.2.1 Total

Exhibit 3.22 shows that full-time and part-time workers make almost the same number of trips per person, but make more trips per person than work-at-home workers, who in turn make more trips per person than non-workers. The trip rates increased between 1986 and 1991 but declined during the following five years.

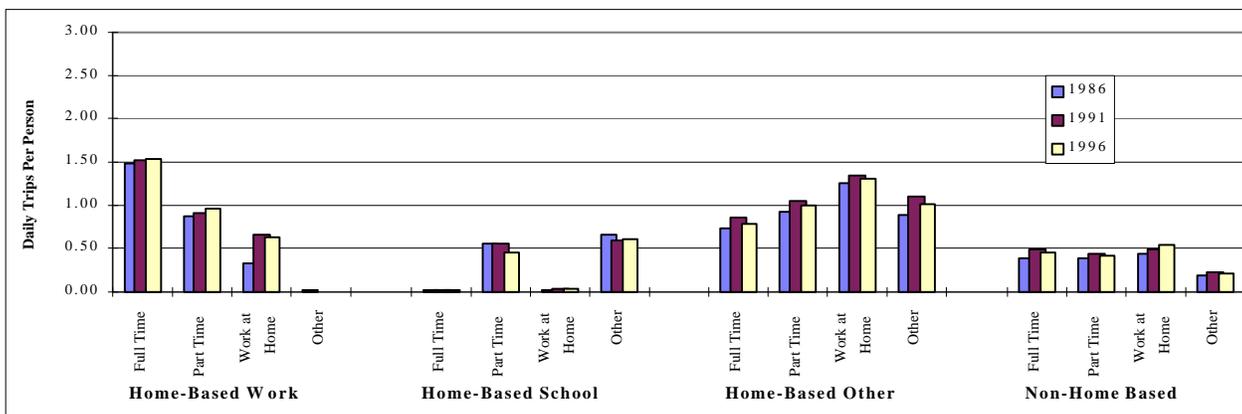
Exhibit 3.22: Trip Making Rate by Employment Status



3.5.2.2 By Trip Purpose

Exhibit 3.23 shows that full-time workers make about 1.5 home-based work trips per person, part-time workers make slightly less than one home-based work trips per person and home-workers about half a home-based work trip per person. With respect to home-based school trips, part-time workers and non-workers make slightly more than half a trip per person. Home-workers make the largest number of home-based discretionary trips per person, at about 1.3, followed by part timers and non-workers, at about one trip per person, and full-time workers making about 0.8 trips per person. Full-time, Part-time and work-at-home workers make almost half non-home based trips per person, higher than the trip rate of non-workers.

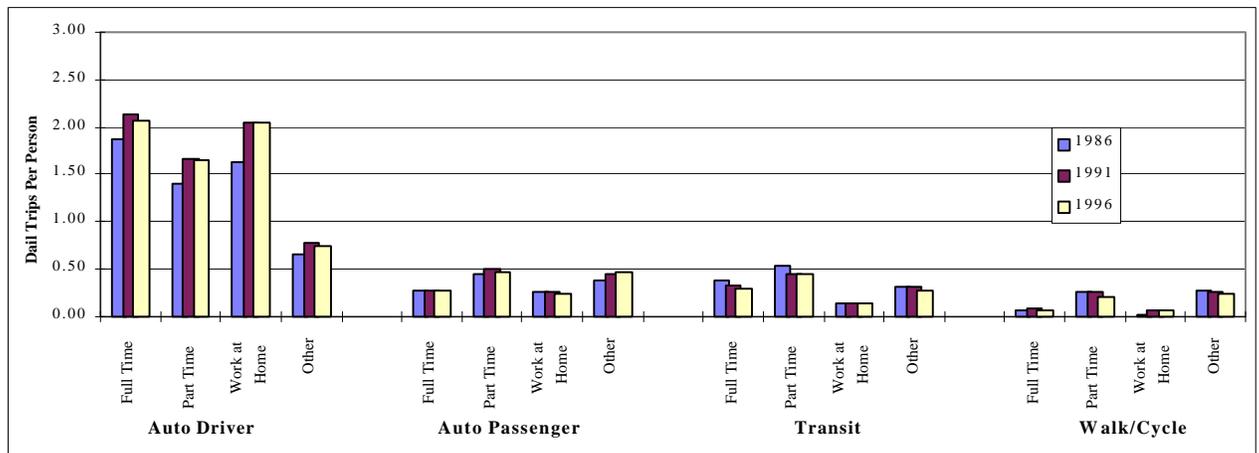
Exhibit 3.23: Trip Making Rate by Trip Purpose and Employment Status



3.5.2.3 By Travel Mode

Exhibit 3.24 shows that full-time and work-at-home workers make the largest number of auto-driver trips per person, closer to three times the number of auto-driver trips per person by non-workers. The number of auto-driver trips per person by part-time workers is almost twice that by non-workers. Part-time workers and non-workers make almost equal auto-passenger trips per person, which is higher than the number of auto-passenger trips per person made by full-time and work-at-home workers. Part-time workers make the largest number of transit trips per person, followed by full-time workers and non workers, who make more transit trips per person than work-at-home workers. The patterns of walk/cycle trips per person by employment status are similar to those of auto-passenger trips per person.

Exhibit 3.24: Trip Making Rate by Travel Mode and Employment Status

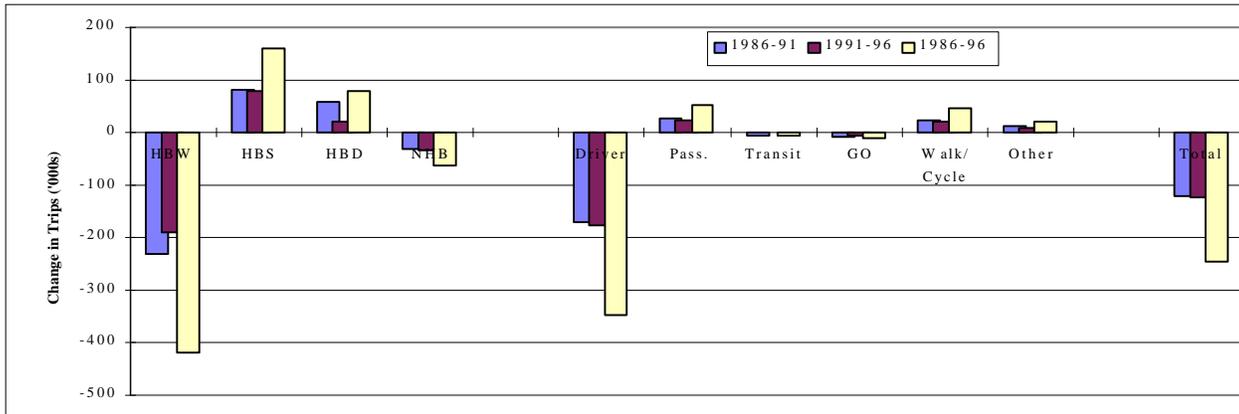


3.5.3 Trip Changes

The decline of the proportion of full-time workers and the increased proportion of non workers resulted in a substantial reduction in the number of home-based work trips (230 thousand trips between 1986 and 1991 and 190 thousand trips between 1991 and 1996), reduction in the number of non-home based trips, and increase in the number of home-based school trips and the number of home-based discretionary trips, as shown in Exhibit 3.25. The number of auto-driver trips also declined substantially (by 171 thousand trips between 1986 and 1991 and by 175 thousand trips between 1991 and 1996), while the number of auto-passenger trips and the number of walk/cycle trips increased. Since the transit trip rates for full-time workers and non workers are comparable, small changes happened in the number of transit trips in association with the employment status distribution, as shown in the exhibit.

The above changes resulted in a net reduction in the total number of trips of 122 thousand trips between 1986 and 1991 and 124 thousand trips during the following five years.

Exhibit 3.25: Trip Changes Associated with Shift in Employment Status Distribution



HBW: Home-Based Work; HBS: Home-Based School; HBD: Home-Based Discretionary; NHB: Non-Home Based

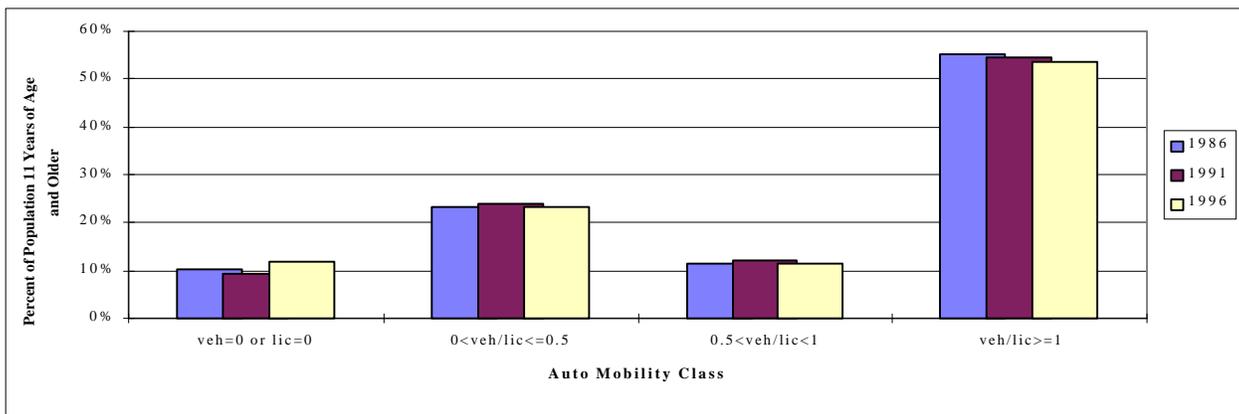
3.6 TRIP CHANGES ASSOCIATED WITH SHIFT IN AUTO MOBILITY DISTRIBUTION

3.6.1 Auto Mobility Distribution

Auto mobility refers to the degree of availability of a driver’s licence and personal car. Four classes of auto mobility are defined and used here: (1) persons from households where either no household cars or no licensed drivers available; (2) persons from households where the number of household vehicles per licensed driver is greater than 0 but less than or equal to 0.5; (3) persons from households where the number of household vehicles per licensed driver is greater than 0.5 but less than 1; and (4) persons from households where the number of household vehicles per licensed driver is at least 1.

Exhibit 3.26 displays the auto mobility distribution. It shows that the proportion of persons from households with at least one vehicle per licensed driver declined slightly between 1986 and 1996, while the proportion of persons from households where either no household cars or no licensed drivers available declined slightly between 1986 and 1991 but increased slightly during the following five years. In contrast, the proportions of the two other classes increased slightly between 1986 and 1991 then declined slightly during the following five years.

Exhibit 3.26: Auto Mobility Distribution of GTA Population 11 Years of Age and Older



3.6.2 Daily Trip Rates

3.6.2.1 Total

Exhibit 3.27 shows an increasing number of trips per person with increasing degree of auto mobility. The overall trip rate for each mobility class increased between 1986 and 1991 but declined during the following five years.

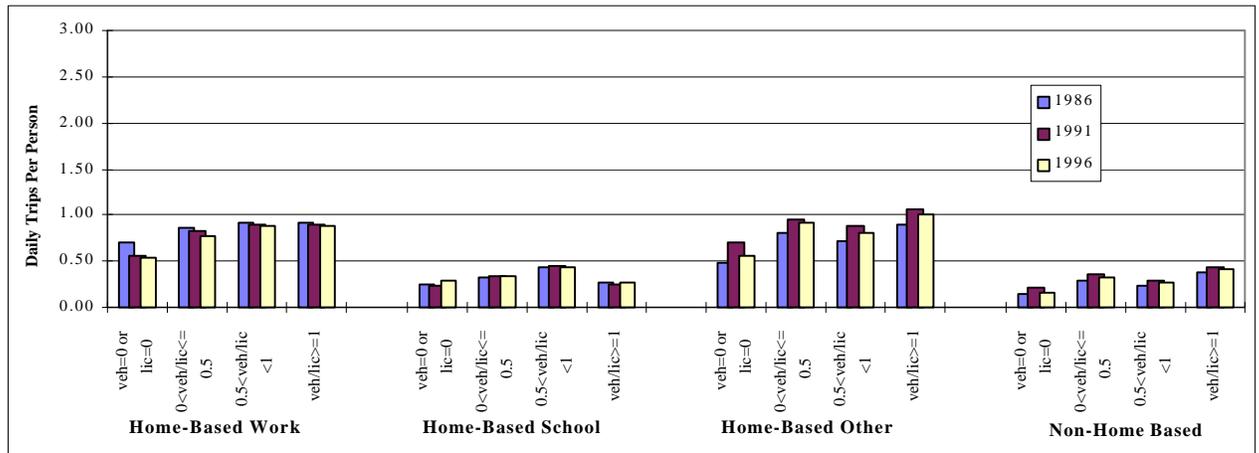
Exhibit 3.27: Trip Making Rate by Auto Mobility



3.6.2.2 By Trip Purpose

In general, Exhibit 3.28 shows that classifying the trips by trip purpose does not result in different trip making patterns from the one displayed above in Exhibit 3.27, as one would expect.

Exhibit 3.28: Trip Making Rate by Trip Purpose and Auto Mobility



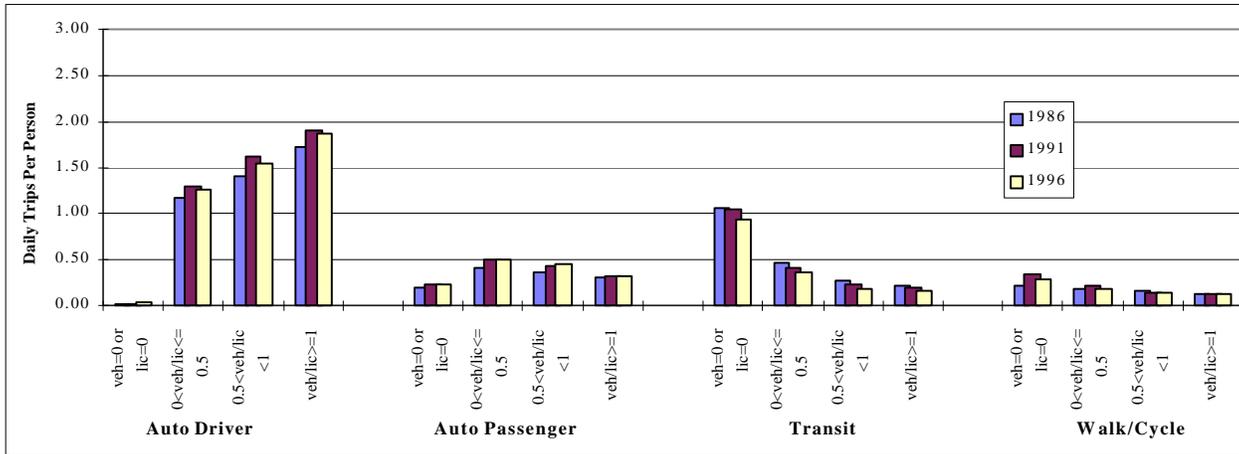
Exploring Person Travel Trends in the Greater Toronto Area

Part 2: Changes in Travel and Relationship with Factors

3.6.2.3 By Travel Mode

Exhibit 3.29 shows that as the auto mobility class advances, the number of auto-driver trips per person increases and the number of transit trips per person declines as does the number of walk/cycle trips per person. The number of auto-passenger trips per person is larger in households with at least one car and one licensed driver but it declines as the auto mobility class advances.

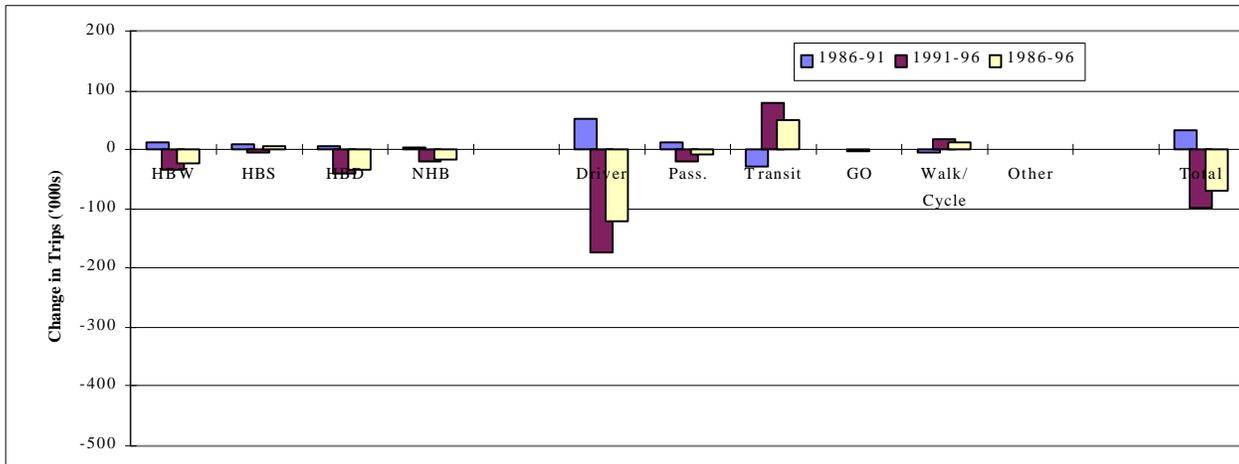
Exhibit 3.29: Trip Making Rate by Travel Mode and Auto Mobility



3.6.3 Trip Changes

Exhibit 3.30 shows that the number of auto-driver trips increased between 1986 and 1991 but declined substantially during the following five years in association with the increased proportion of persons from households with either no licensed drivers or no vehicles available. In contrast, the number of transit trips declined between 1986 and 1991 but increased again during the following five years. The number of trips by other modes experienced small changes between 1986 and 1996 in association with the auto mobility distribution shift. The above changes resulted in a net increase in the number of trips between 1986 and 1991 followed by a larger decline in the number of trips between 1991 and 1996.

Exhibit 3.30: Trip Changes Associated with Shift in Auto Mobility Distribution



3.7 SUMMARY

Exhibit 3.31 summarises the changes in trips associated with population increase, changes in overall trip rate and individual shifts of four distributions. As mentioned earlier, these four variables have some degree of correlation between one another. Therefore, the trip changes associated with individual shifts of the four distributions are not additive. However, even if we were to add the trip changes associated with the four distribution shifts for each five-year period, the sum would be much less than the change in number of trips associated with the overall trip rate change. This indicates that the difference (i.e. unexplained number of trips) is due to distribution shifts of other variables (e.g. income, occupation, transportation system characteristics, etc.) and changes in travel habits. The level of disaggregation used for some of the four variables examined here might also be responsible in part for the difference.

The table shows that increases in both population and overall trip rate between 1986 and 1991 contributed to the total travel growth during that period. However, the total travel growth due to population increase during the following five years was substantially reduced by the decline in the overall trip rate, resulting in a much smaller overall growth between 1991 and 1996 compared to the overall growth during the previous five years.

Not all changes by trip purpose or travel mode followed the above pattern for total travel. For example, the number of home-based work trips declined in both five-year periods in association with the decline in the respective trip rates which mitigated to a large degree the increase in the home-based work trips associated with the population increase in both periods. With respect to transit, the number of transit trips not only declined in both five-year periods in association with the reduction in the respective transit trip rates but this reduction outnumbered the increase in transit trips associated with the population growth, resulting in an overall reduction in transit trips in both five-year periods. In contrast, the number of auto-passenger trips increased in both periods in association with population increase as well as overall trip rate increase.

The table also shows that the shift in employment status distribution resulted in the largest change in the total number of trips, followed by the shift in auto mobility distribution. The increase in the proportion of non workers reduced greatly the number of home-based work trips in both periods as well as the number of non-home based trips, while it raised the numbers of home-based school and home-based discretionary trips. Other major changes in trips by purpose associated with the individual changes in the four distributions include (i) reduction in home-based school and increase in home-based discretionary trips, particularly between 1986 and 1991, associated with the age distribution shift (i.e. the reduced proportion of young persons); (ii) reduction in the number of home-based discretionary trips between 1991 and 1996 associated with the auto mobility distribution shift (i.e. reduced proportion of persons from households with the at least one vehicle per licensed driver).

With respect to changes by travel mode, the shift in the employment status distribution resulted in the largest change, reducing the number of auto-driver trips by more than 170 thousand trips each five-year period. The shift in the auto mobility distribution also caused a large reduction in the number of auto-driver trips between 1991 and 1996, even though it resulted in an increase in such trips during the previous five years. The individual shifts of both age and residential location distributions resulted in a substantial increase in the number of auto-driver trips. While population ageing resulted in a decline in the number of auto-passenger trips between 1986 and 1991, the increased proportion of non-workers resulted in an increase in the number of these trips during the same period and during the following

Exploring Person Travel Trends in the Greater Toronto Area
Part 2: Changes in Travel and Relationship with Factors

Exhibit 3.31: Summary of Trip Changes Between 1986 and 1996

	Change in Trips ('000s) Associated with						Overall Change ('000s)			Change in Trips ('000s) Associated with Shift in Distribution of												
	Population Increase			Trip Rate Change						Age			Residential Location			Employment Status			Auto Mobility			
	86-91	91-96	86-96	86-91	91-96	86-96	86-91	91-96	86-96	86-91	91-96	86-96	86-91	91-96	86-96	86-91	91-96	86-96	86-91	91-96	86-96	
Trip Purpose																						
HBW	340	267	607	-126	-146	-271	214	121	335	23	-31	-9	10	7	17	-230	-190	-420	12	-33	-22	
HBS	114	92	206	-18	56	38	97	147	244	-141	5	-135	10	3	13	82	77	160	10	-5	5	
HBD	312	307	619	652	-287	366	964	21	985	75	28	103	15	8	23	57	22	79	7	-41	-34	
NHB	122	120	242	245	-136	109	367	-16	351	24	4	28	12	3	15	-31	-33	-64	3	-20	-17	
Travel Mode																						
Driver	534	488	1,023	642	-339	303	1,176	150	1,326	120	15	135	96	46	142	-171	-175	-346	51	-173	-122	
Passenger	125	116	241	172	14	186	297	130	427	-31	3	-28	9	6	15	27	25	52	13	-20	-8	
Transit	142	102	244	-161	-112	-274	-20	-10	-30	-44	-26	-70	-65	-31	-96	-6	-1	-6	-28	78	50	
GO Rail	7	9	15	36	-22	15	43	-13	30	1	-1	0	5	2	8	-8	-4	-12	1	-2	-1	
Walk/Cycle	60	54	114	60	-50	10	120	4	123	-49	8	-41	-8	-4	-13	24	22	46	-6	16	11	
Other	20	17	37	6	-4	2	26	13	39	-16	7	-10	10	4	14	12	10	22	0	2	2	
Total	888	786	1,673	754	-512	241	1,641	274	1,915	-20	6	-13	47	22	69	-122	-123	-245	31	-99	-68	

five years. The changes in the number of walk/cycle trips followed the same pattern as the number of auto-passenger trips. Urban sprawl (i.e. shift in residential location distribution), and to a slightly lesser degree population ageing, contributed greatly to the reduction in the number of transit trips in both five-year periods. The shift in the employment status distribution had a much less effect on the number of transit trips. The auto mobility distribution shift (i.e. increase in the proportion of persons with either no driver's licence or no household vehicle) between 1991 and 1996 caused a large increase in the number of transit trips during that period, reversing the trend of the previous five years.

3.8 IMPLICATIONS FOR FUTURE TRAVEL DEMAND

The above analysis shows that the population ageing resulted in increased auto-driver trips and reduced transit, auto-passenger and walk/cycle trips. The "Baby Boom" generation now is between the early thirties and the early fifties of age, which corresponds to the highest age range with respect to auto-driver trip rate. While the "Baby Boom Echo" generation has the potential to reverse the above trends associated with the population ageing, it will take at least one decade until the last Baby Boomer is older than the age group with the highest auto-driver trip rate. By that time, the "Baby Boom Echo" generation will reach the age of the highest auto-passenger and transit trip rates. Therefore, it is expected that the above travel trends associated with population ageing between 1986 and 1996 will continue for the next decade. As mentioned earlier in Part I of the study, immigrants to the GTA are mostly between 11 and 50 years of age. Many of these immigrants correspond to the low scale of income and are likely transit dependent. Therefore, the travel trends of less transit use and more auto dependency are expected to be less severe if future immigration levels increase and vice-versa.

Urban sprawl, as indicated in the shift in residential location distribution, between 1986 and 1996 resulted in increased auto-driver trips and reduced transit trips. There is no indication that this urban sprawl is changing course. Unless public policy mitigates urban sprawl, the associated trends of more travel by auto and less travel by transit are expected to continue in the future.

The declining economy between 1986 and 1996, as reflected in the changed employment status distribution, caused a large reduction in the number of auto-driver trips and an increase in the number of auto-passenger and walk/cycle trips. As the economy is currently picking up, the number of auto-driver trips is expected to increase in association with such changes.

In summary, although the number of transit trips may experience growth in the next decade due to population growth, changes in other factors are expected to counter that increase. On the other hand, auto travel is expected to grow due to both population increase and changes in other factors such as improved economy, population ageing and urban sprawl.

Although the number of trips changed in association with the distribution shifts of the above four factors, these trip changes constituted a relatively small portion of the trip changes associated with the changes in overall trip rates. This suggests that distribution shifts of other factors and changes in travel habits are responsible for a larger portion of trip changes than the distribution shifts of the four factors examined in this study.

Furthermore, the results show that consistently over each five-year period, the absolute change in the total number of trips associated with population increase was slightly larger than the absolute change in the total number of trips associated with the change in trip rate. However, over the longer term of ten years, the total trip change associated with the population increase (i.e. 1.67 million trips) was far much larger than the total

Exploring Person Travel Trends in the Greater Toronto Area

Part 2: Changes in Travel and Relationship with Factors

trip change associated with the change in trip rate (0.24 million trips). This suggests that the number of daily trips might increase relatively substantially in the short term in association with both population increase and distribution shifts of factors, but it is the population change that produces the more significant trip changes in the longer term. However, for almost each trip purpose and travel mode, the trip change associated with population increase was comparable with the trip change associated with the change in the respective trip rate, during each five-year period and over the longer term of ten years. Therefore, for long-term forecasting of total daily travel, more emphasis should be placed on population changes than shifts in population distributions, while both factors should be considered for long-term forecasting of travel by purpose and by mode.