SPATIAL EVOLUTION OF THE TORONTO REGION & TRANSPORT

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INTRODUCTION

A commonly held belief is that public transport is a more socially desirable mode of transport in large metropolitan areas. Public transport is seen as promoting more compact land use, energy efficiency and environmentally friendly travel. High capacity and high speed roads and freeways are seen as stimulating long trip lengths, low density forms of urban development, inefficient levels of energy consumption and environmental degradation.

The Toronto region is often cited as one of the few post-automobile North American urban areas that has constructed effective public transport facilities and many transport policy advisors have argued that these facilities have promoted compact and public transport-supportive patterns of land use. Many studies of the impact of the different transport modes on urban development have concluded that transport accessibility is simply one of a number of factors influencing urban development (eg., see di Giampietro, 1989).

The purpose of this paper is to table the evidence on the differential impacts of the three major transport modes in the GTA and the implications that any differences in impact have for urban transport policy. The major modes are the Toronto Transit Commission (TTC) subway system, the Government of Ontario commuter rail system (GO Transit) and the freeway system and the structures of these systems are illustrated in Figure 1.

1. THE GREATER TORONTO AREA

The Greater Toronto Area (GTA) has grown rapidly since the 1950's and is currently the largest conurbation in Canada. Figure 1 illustrates the geographic extent of the GTA, the boundaries of urban development in 1988 and the regional municipal units. A second level of municipal government exists within the regional municipal structure shown in Figure 1. The GTA includes three census areas and these are the Toronto and Hamilton CMA's and the Oshawa CA. Hamilton is the major steel making centre of Canada and Oshawa, at the eastern end, contains a major General Motors automobile manufacturing complex. The Toronto CMA has a diverse economic base which includes the major Canadian financial institutions, strong business and personal services employment and manufacturing employment. The primary focus of this paper is with the Toronto CMA which extends from Oakville in the west to Ajax in the east and includes the urbanized area stretching north from Lake Ontario.

1.1 Population Growth

Figure 2 shows the population growth history of four sub-areas of the GTA between 1951 and 1986. The diagram illustrates that the population of Metropolitan Toronto (the original regional municipality created in 1953 from an amalgamation of the

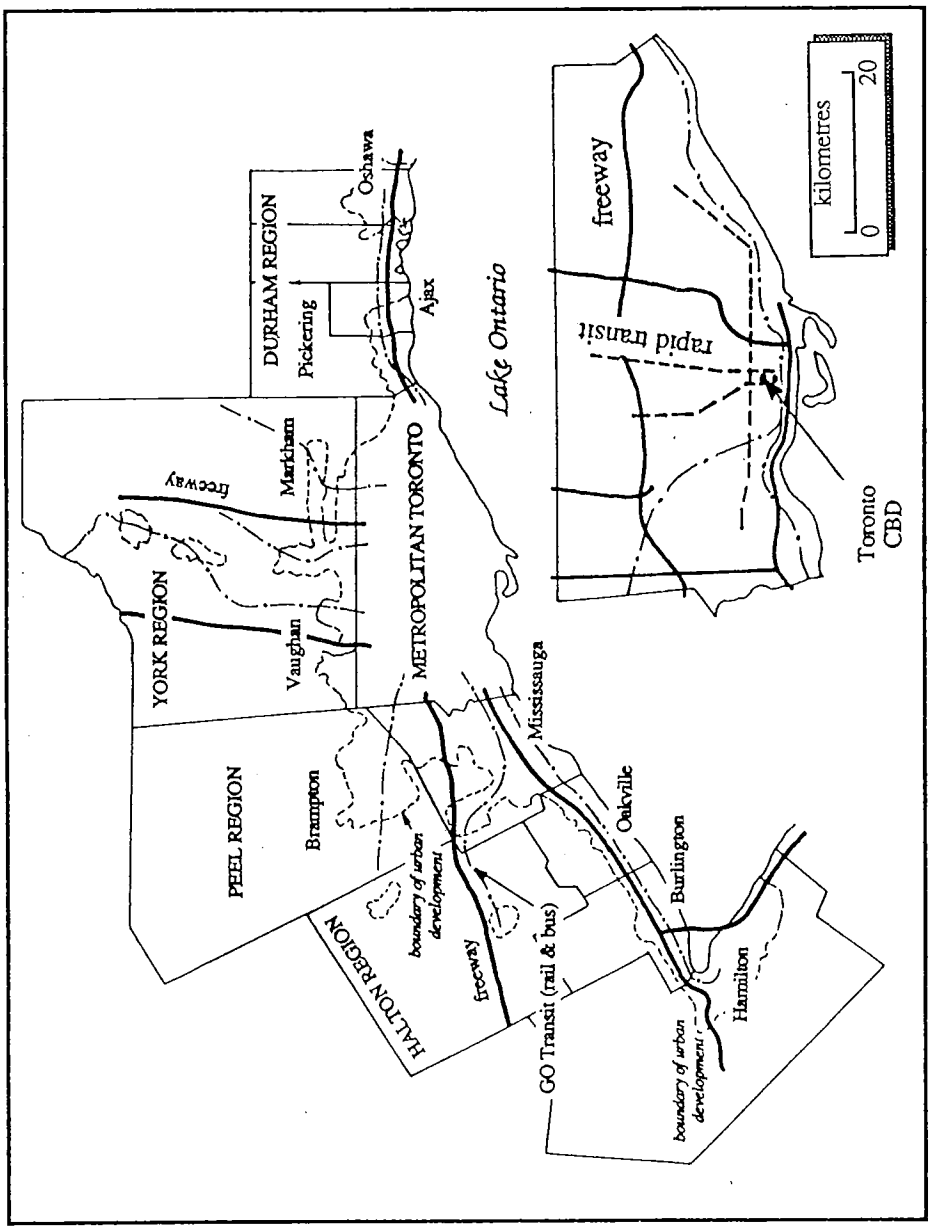

Figure 1. The Greater Toronto Area

smaller municipalities) increased by about 500,000 between 1951 and 1961, by about 470,000 between 1961 and 1971, and has remained relatively constant at just over 2,100,000 since 1971. The diagram illustrates that the population of the remainder of the Toronto CMA (that part external to Metropolitan Toronto) increased sharply between 1961 and 1971 and that the population of this sub-area has continued to grow rapidly.

The population stability within Metropolitan Toronto since 1971 is the result of fairly rapid population growth along the northern boundary and in the northeastern corner, combined with population decline in the inner suburbs. The population decline in the inner suburbs has not resulted in a decrease in resident labour force in these residential areas because the earlier larger blue collar households have been replaced by the smaller white collar households with higher labour force participation rates (particularly female).

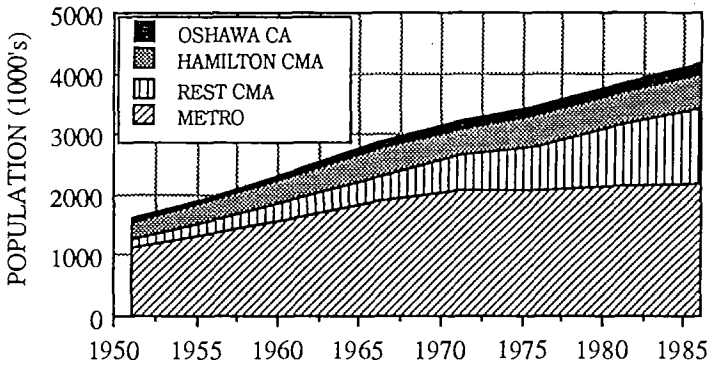

Figure 2. Population Growth by Sub-Area in the GTA

The composition of the labour force by industry type of the Toronto CMA has changed significantly during the same period. Manufacturing employment was the dominant sector in the 1950's and early 1960's but this sector now ranks third behind the business services and personal services sectors. This shift in the composition of the employment base has had significant impacts on job locations and through this on commuting and these effects are described in the following section of the paper.

2. SPATIAL STRUCTURE OF THE GTA

Figure 3 illustrates the spatial distributions of resident labour force and employment in the GTA in 1986 at the major planning district level within Metropolitan Toronto and at the municipal level outside of Metropolitan Toronto. The diagram shows that the major imbalances in resident labour force and employment in 1986 were (i) in Planning District # 1 (PD#1) containing the Toronto central business district (CBD) where the resident labour force was about one-fifth of the employment (about 400,000); (ii) in PD#'s 2, 3 and 6 where resident labour force has increased because of gentrification effects and where jobs in the older manufacturing industries have either disappeared decentralized; and (iii) in

PD#'s 8 and 16 and the municipalities adjacent to Metropolitan Toronto where resident labour force was greater than employment.

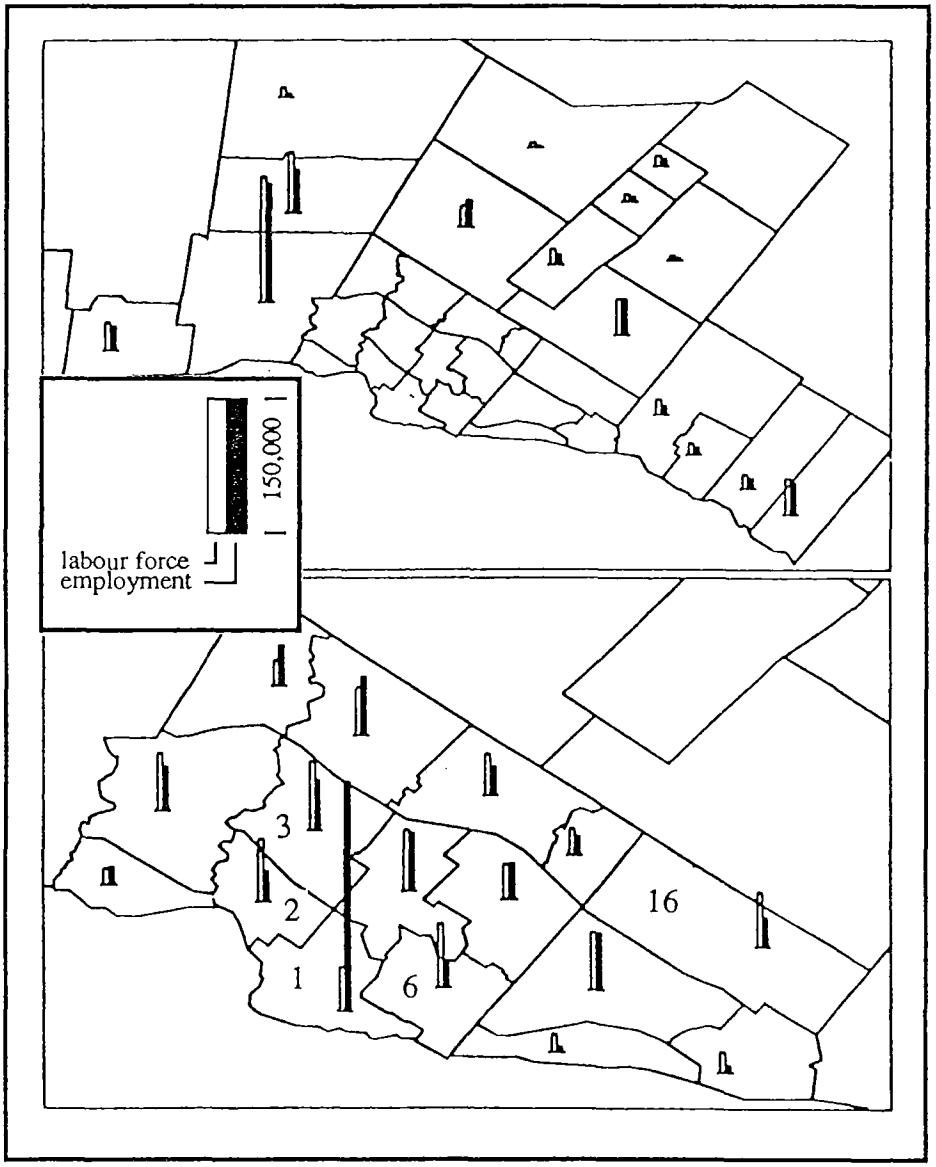

Figure 3. Resident Labour Force and Employment Distributions, 1986

2.1 Changes in Spatial Structure between 1971 and 1986

Figure 4 illustrates the changes in the spatial distributions of resident labour force and employment between 1971 and 1981 (the upper diagram) and between 1981 and 1986 (the lower diagram). The most important changes illustrated in the upper diagram are (i) the massive increase in employment in PD# 1 (about 100,000); (ii) job increases in most of the planning districts within Metropolitan Toronto and the large increases in resident labour force along the northern boundary of Metropolitan Toronto; and (iii) the large increases in both resident labour force in Peel Region to the west of Metropolitan Toronto. About one-third of the employment growth between 1971 and 1981 occurred within the domain of influence of the two public transport modes (TTC subway and GO Transit) and the other two-thirds within the domain of influence of the freeway system.

The lower part of Figure 4 shows that the spatial changes in resident labour force and employment between 1981 and 1986 had a very different character from those that occurred between 1971 and 1981. Employment growth occurred mainly in the suburbs, although significant employment growth did occur in the Toronto central area and along the Yonge Street subway corridor to the north. An important feature illustrated by the lower part of Figure 4 is the growth in resident labour force in the Toronto central area, the result of efforts by the City of Toronto to expand the supply of housing in the centre. The employment growth in the Toronto area was in the domain of influence of the transit systems while the bulk of the employment growth between 1981 and 1986 was in the domain of influence of the freeway system.

2.2 Regional Commuting Demands

Three principal commuting regimes may be identified in the GTA and these are (i) travel to the Toronto CBD, (ii) other longer distance commuting between suburban residential and employment centres, and (iii) commuting of a more local nature within both Metropolitan Toronto and within the adjacent regional municipalities. About 80 percent of the labour force needs of the Toronto central area are obtained from labour force resident within Metropolitan Toronto and about 20 percent from residential areas in the surrounding municipalities, particularly from residential areas adjacent to the GO Rail system and the freeway network. The average trip length to jobs in the Toronto CBD increased from about 9.5 km in 1964 to about 13 km in 1986 as the larger and more affluent households employed in the CBD sought larger and cheaper households on the urbanizing fringe.

Figure 2 has shown that the population in the area spilled over into the municipalities adjacent to Metropolitan Toronto beginning in about 1971. Most of these new areas were "bedroom" communities during the 1970's but developed strong local employment bases in the late 1970's and 1980's. This growth of local jobs has resulted in lower average trip lengths by the labour force living in these outer suburbs. Hutchinson and El-Khodary (1991) and Hutchinson and Kumar (1990) provide detailed descriptions of the commuting patterns in the GTA and their changes between 1971 and 1986.

4. A CONCEPTUAL FRAMEWORK

Urban location theory offers a theoretical perspective on the forces conditioning the amount of commuting effort required to support an urban area. The simplest version of an urban location model assumes that all jobs are in the CBD and that households are willing

to commute longer trip lengths in order to reduce their housing costs and/or to increase their consumption of housing space.

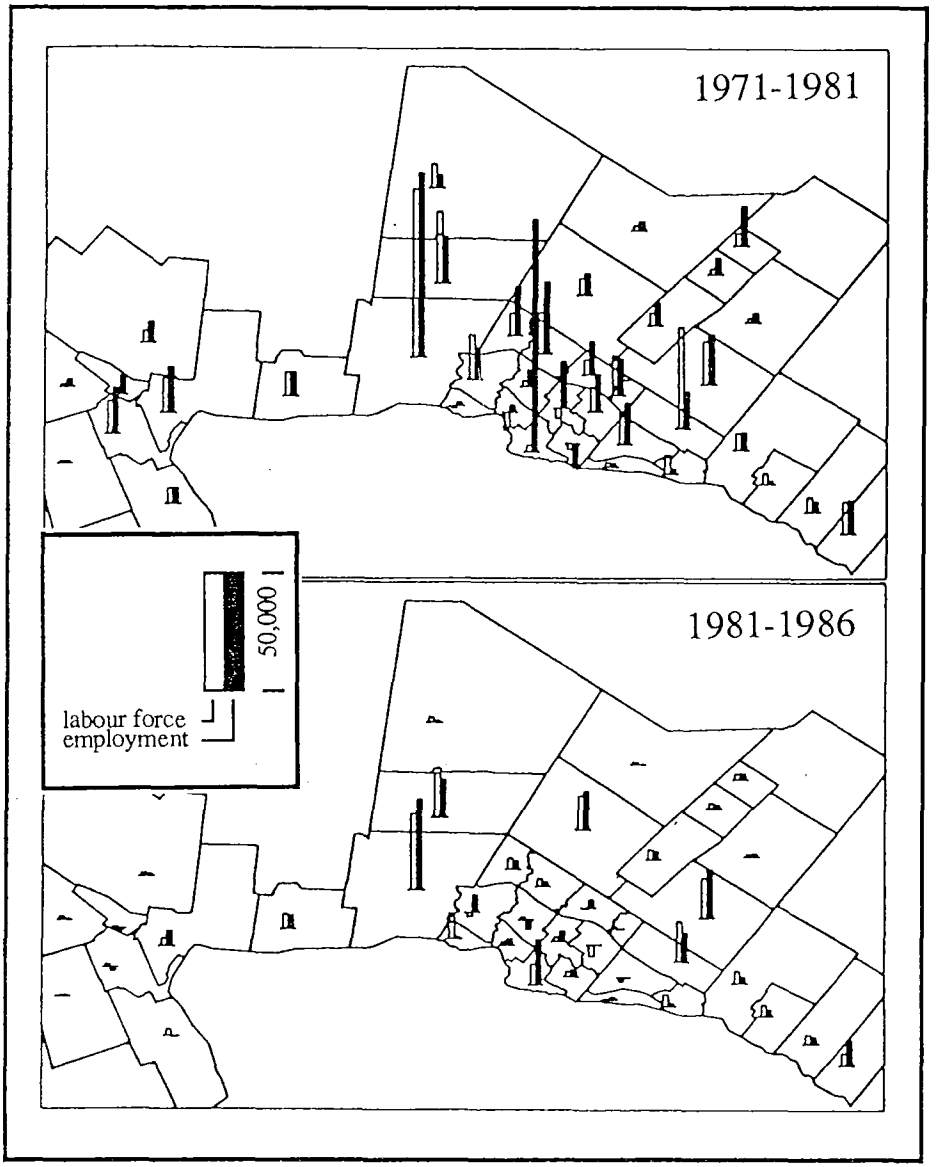

Figure 4. Spatial Changes in Labour Force and Employment

Commuting and residential location behaviour are usually described in terms of a rent offer curve where the rent per unit of land consumed for housing decreases at a decreasing rate with increasing commuting distance. When job location is fixed in the CBD workers choose a trip length so that the cost of a marginal increase in work trip length would be equal to the marginal reduction is housing expenditure achieved by the longer trip length (eg., White, 1988).

In a monocentric city with higher and lower income workers, the lower income workers are seen as outbidding higher income workers for land close to the city centre and the higher income households outbid lower income households in the suburbs. The lower income households would be concentrated in higher density housing forms close to the city centre and higher income households in lower density housing forms in the suburbs. This spatial differentiation of households is result of the assumption that the income elasticity of demand for residential space is greater than the income elasticity of commuting effort. The rent offer curve of the lower income households is steeper than that for higher income households in spite of the lower valuation of travel time by lower income households. This is because the higher income households have a higher demand for housing space than the lower income households at any distance from the CBD. In other words, the lower income households cannot improve their consumption of housing space sufficiently to justify increased commuting trip lengths.

White (1988) has also analyzed theoretical location behaviour in urban areas with polycentric employment centres. Figure 5 illustrates a case of interest from White (1988) in which the rent offer curves become steeper with the suburbanization of jobs. A steeper rent offer curve implies that the suburban jobs offer lower wages and the lower income households have fewer opportunities to increase housing consumption through longer work trip lengths. Suburban worker households would outbid CBD worker households in zone II in the vicinity of the suburban employment centre while CBD workers would outbid in zones I and III.

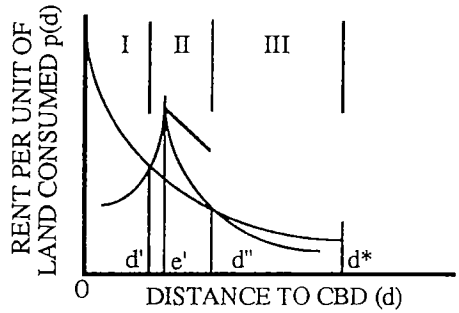

Figure 5. Rent Offer Curves for CBD Workers and Suburban Workers with Lower Paying Jobs

It is well known that commuters value excess travel time (ie., travel time outside of a line haul vehicle) at two to three times the in-line haul vehicle time. This would suggest that the geographic domain of impact of the public transport modes would be much narrower than the road and freeway modes where excess travel times are negligible except at the work place end of the trip. The many studies of modal choice have shown that this

valuation of excess time is modified at destination locations where significant parking charges exist (such as in the CBD).

4. MODAL INFLUENCES ON TRAVEL AND LOCATION BEHAVIOUR

Section 2 of this paper has shown that employment growth in the GTA between 1971 and 1981 had a strong CBD component which is clearly within the domain of public transport (TTC subway and GO Transit). Mohamed (1991) has shown that the two major central area employment zones in Toronto account for about 55 percent of all commuting trips by public transport. Most of the growth in residential employment between 1971 and 1981 was along the northern fringe of Metropolitan Toronto and in the adjacent regional municipalities. The section also showed that employment growth between 1981 and 1986 was more concentrated in the suburbs and therefore in the domain of the freeway system.

The location theory principles introduced in Section 3 suggested that lower income households would tend to cluster around the CBD or suburban employment centres in higher density housing forms. The theory also suggests that these more local commuter-sheds would be embedded in a much longer distance commuting field generated by the higher income households which used commuting to obtain more housing space at lower unit prices. This section of the paper provides evidence on the differential impacts of the three major transport modes operating in the GTA within the spatial and location-theoretic contexts just described. The paper length constraints only allow a limited amount of illustrative material to be introduced and a full description of the modal influences on travel and location behaviour is provided in Hutchinson, Meth and Chartier (1992).

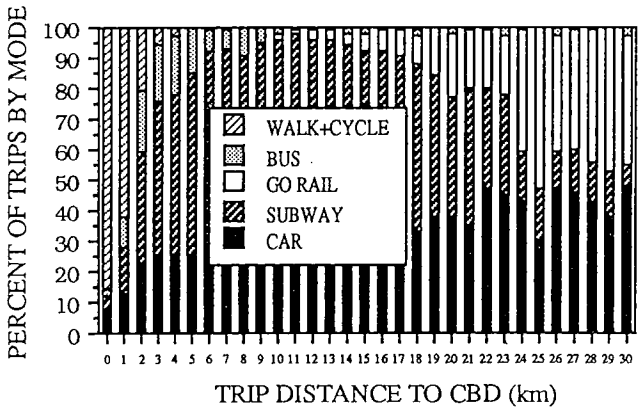

Figure 6. Modal Transport Usage with Increasing Commuting Distance

4.1 Modal Influences on CBD Employee Behaviour

Figure 6 illustrates the percent of work trips generated by residential areas located at various distances from the CBD that use the various transport modes. Pedestrian and cyclists dominate for the very short distances and the diagram shows that the use of cars

for commuting increases gradually with increasing commuting distance to the CBD. The diagram illustrates that commuting by GO Rail gradually takes over from commuting by TTC subway for the very long trip lengths from residential areas beyond the boundary of Metropolitan Toronto (20-25 km from the CBD) where commuters can only use the subway by using feeder bus services to the end of the subway lines. The aggregate logit choice models constructed by Mohamed (1991) showed that the most important variables influencing modal transport choice to the major employment centres within Metropolitan Toronto were trip distance (increases favouring automobile travel) and parking charges (increases favouring public transport).

The linkage between housing space consumption and commuting distance suggested by the location-theoretic principles introduced in Section 3 is reflected in Figure 7 which shows the trip length frequency distributions for CBD employees living in houses and apartments, respectively. The diagram shows the much higher share of CBD employees living in apartments close to the CBD. The bulk of the households living in apartments are 1 to 2 person households with much higher proportions of females. Income data are not available from the 1986 travel survey and the effects of household income on housing type and location choice cannot be illustrated more directly.

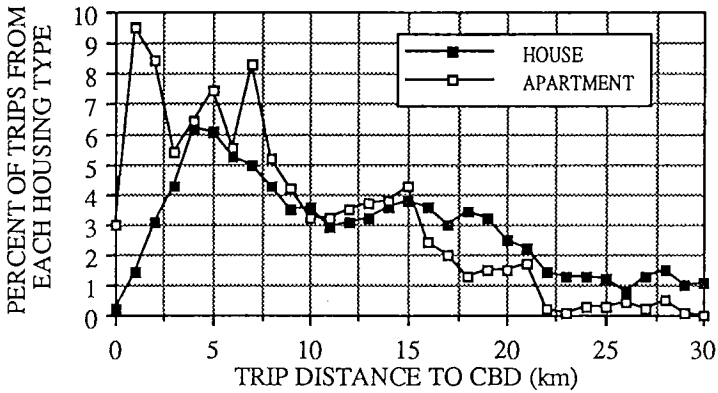

Figure 7. Location Patterns of Households in Houses and Apartments

The influence of the TTC subway on participation in the CBD labour force (or on residential location given employment in the CBD) is illustrated in Figure 8. The diagram shows that most of the residential zones with high CBD employment participation are located along the subway system with the north-south legs of the system with direct service to the CBD having the greatest influence. There are some exceptions for a few zones located north of the east-west freeway corridor and along the radial corridor which runs northwest from the Toronto CBD. This corridor contains GO Rail services which attract commuters from this area to jobs in the CBD. The diagram illustrates that participation in CBD jobs, and therefore higher probabilities of using public transport, decreases significantly with increasing excess travel time to the subway system.

A similar restricted domain of influence also exists for the GO Rail system. Ninety percent of the commuting demand on the GO Rail system is attracted to jobs in a few CBD zones close to the downtown commuter rail station. The influence of excess travel time on location and use of GO Rail is illustrated in Figure 9 which shows the location of the residential zones that generate significant GO Rail demand in the eastern lakeshore corridor. Surveys of GO Rail riders (Williams, McLeod and Gorys, 1991) have shown that about 60 percent of GO Rail commuters live within 1 km of a GO Rail station.

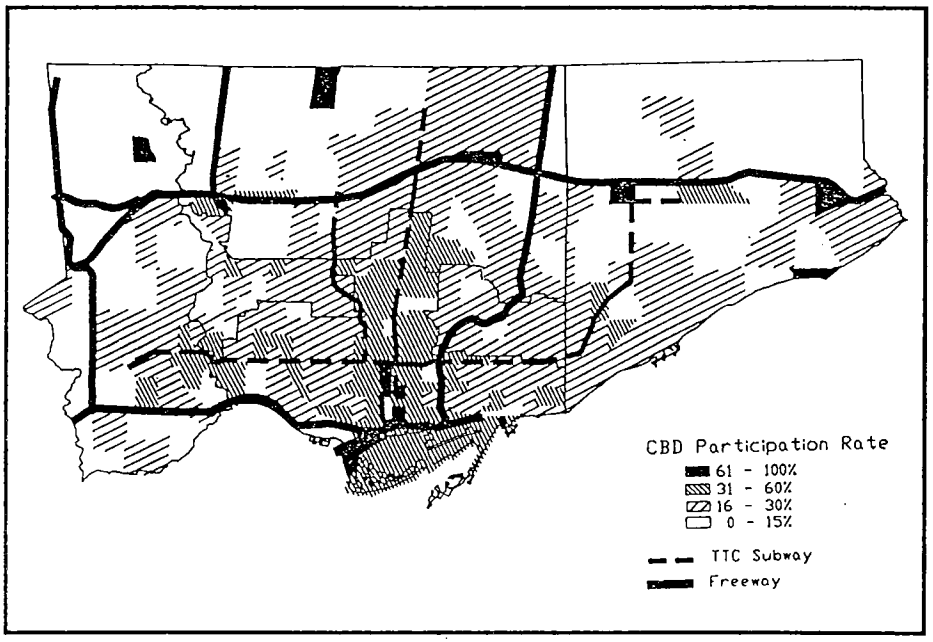

Figure 8. Domain of Influence of the TTC Subway System

Figure 10 shows the very different character of the domain of influence of the freeway system. It shows the origins of the users of a freeway link close to the Toronto CBD. It demonstrates very clearly the very diffuse nature of the origins of central employment area commuters who use cars. The lower generation of commuting trips by car from within Metropolitan Toronto reflect the higher shares of trips captured by the TTC subway system. The freeway-based commuting market is dominated by workers living in houses and males in the middle and older age groups are the dominant group followed by older females also living in houses.

Length constraints do not permit the travel characteristics of commuters to other employment locations to be illustrated. However, the diffuse origins of CBD employees illustrated in Figure 10 are representative of the travel patterns associated with other employment locations. Analyses of the trip length frequency distributions by housing type show that the smaller, lower income households living in higher density housing forms commute significantly shorter distances than the those living in single family houses

reflecting the location behaviour suggested by the location theory introduced earlier in this paper.

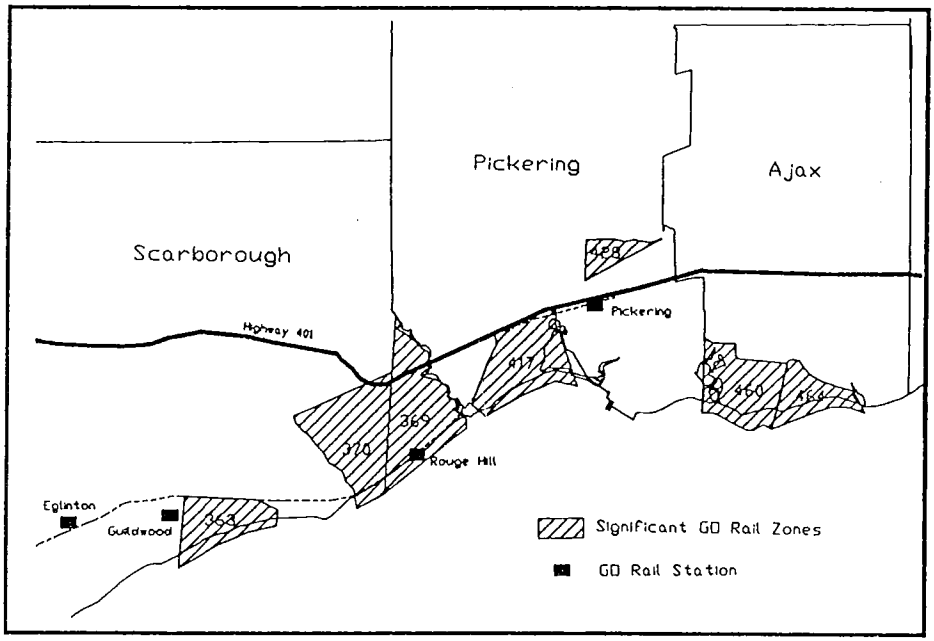

Figure 9. Domain of Influence of GO Rail in the Eastern Corridor

5. REGIONAL TRANSPORT POLICY IMPLICATIONS

The evidence on the differential impacts of the three transport modes on travel and location behaviour suggest a number of directions for regional transport policy given the environmental targets that have been established for the GTA. The evidence available for the GTA shows that significant increases in the use of public transport are unlikely with the current policy instruments. The principal determinant of transit use are parking charges with service variables having a fairly limited impact. The evidence shows that the geographic domain of influence of the two public transport modes is quite limited (particularly GO Transit) and that this limited domain is conditioned mainly by the very high sensitivity of commuters to excess travel time. Further significant increases in transit ridership are unlikely until strenuous efforts are devoted to coordinated spatial planning geared to encouraging transit-supportive development. The decentralized employment location trends during the 1980's show that transit access is a relatively weak policy variable in encouraging firms to locate adjacent to the transit system. It seems fairly clear that if the environmental goals set for the GTA are to be achieved than greater emphasis will have to be placed on link-based road pricing, parking surchages and other constraints to automobile travel.

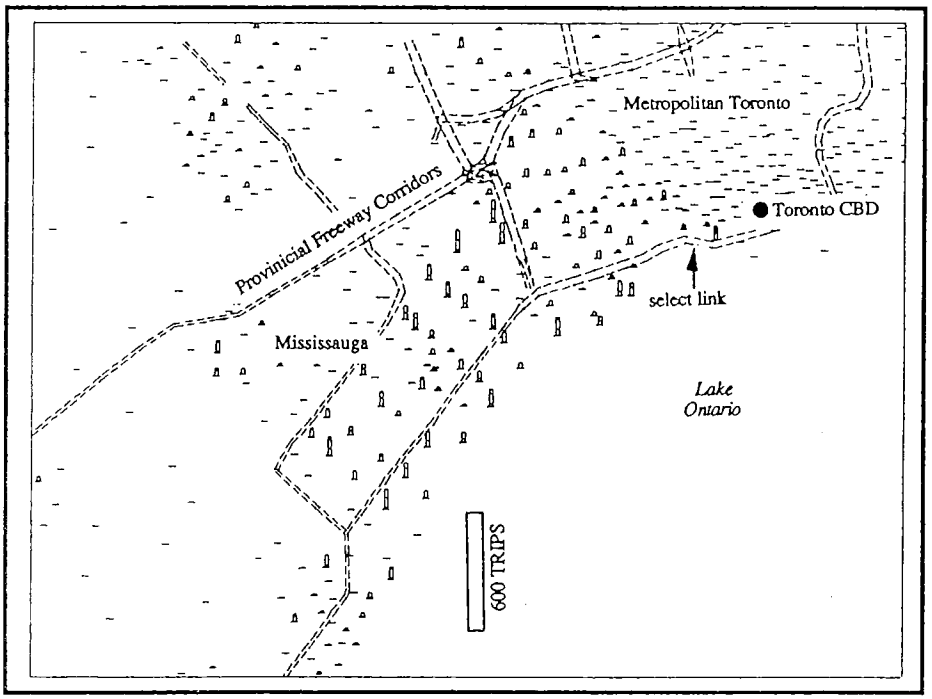

Figure 10. Domain of Influence of CBD-Focussed Freeway Link

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