FINAL REPORT

Nonwork and Off-Peak Trips by Transit, Walk and Bicycle Modes--An Understanding of Existing and Potential Markets

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16. Abstract

This study identifies the characteristics of neighborhoods that contribute to off-peak transit, walk or bike use. The emphasis is on off-peak and nonwork trips and how to promote modes other than the automobile. By producing thirty maps illustrating socioeconomic and travel behavior patterns in the Chicago area, the potential for stabilizing and then increasing the utilization of these modes is examined. Substantial amounts of data were processed and reported. For example, off-peak trips, accounting for 48% of daily travel, are shorter than trips during the peak (in miles and minutes) for travel by both public transit and by private vehicle. Regionally, walking trips vary from 42% of all trips made by Chicago CBD residents (mainly to shop and work), 17% in the rest of the city and less than 5% in surburban Chicago. Bicycle ownership is related to the number of vehicles in the household, household income, household size and distance from the Chicago CBD. Thses data and field observations of three case-study neighborhoods revealed that differences in modes used are related to the land-use patterns and the socioeconomic characteristics of the resident population. While areas with low automobile ownership rates might suggest walking and bicycling, these nonmotorized modes are more common in affluent neighborhoods with a large number of nearby commerical and recreational destinations.

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EXECUTIVE SUMMARY

Non-Work and Off-Peak Trips by Transit, Walk, and Bicycle Modes--An Understanding of Existing and Potential Markets

Project IIB-H1, 95/96
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The purpose of this study is to identify the special characteristics of neighborhoods that contribute to their suitability for off-peak transit, walking or bike use in the six-county Chicago area. The emphasis is on off-peak and nonwork trips and how to promote modes other than the automobile. The potential for stabilizing and then increasing the utilization of these modes is examined. Case studies have been conducted to better understand the reasons for mode choices.

Data Sources. The two primary sources of information for this study are the Chicago Area Transportation Study's Household Travel Survey (CATS HHTS) and the U.S. Bureau of the Census' Transportation Planning Package. The data were used "as is," except for the creation of a "derived speed" variable, the airline travel distance divided by the travel time.

Defining the Peak Period. After a summary chapter the study begins with a definition of off peak. The length of the weekday off peak is very dependent upon the characteristics of the traveler, the trip purpose, the mode used and to a lesser extent the location of the trip. We identified 6:30 to 9:30 a.m. and 3:00 to 7:00 p.m. as the peak periods.

Characteristics of Off-peak Trips. Off-peak trips account for 48 percent of daily travel in the six-county Chicago area. These trips are shorter than trips during the peak (miles and minutes) for both travel by public transit and by private vehicle. For both peak and off-peak periods, travel by public transit is approximately 40 percent longer in miles than travel by private vehicle, but more than twice as long in travel time.

Derived Speeds. In the aggregate, derived speeds of travel are effectively the same during the peak and off-peak periods but vary by mode and place of residence. While derived speeds for private vehicles are 14.4 miles per hour (mph) in contrast to 8.8 mph for public transit, the highest average speeds are for public transit in outlying counties. McHenry county, in the northwest corner of the metropolitan region, has the highest travel speeds, 25.6 mph and 19.6 mph, for public transit (largely commuter rail) and private vehicle, respectively.

By contrast, the speeds for public transit users in the city of Chicago are approximately half those for private vehicle users. Moreover, these city public-transit speeds are considerably less than speeds in the suburbs, but are *shorter* in travel time. Chicago residents travel approximately 45 minutes by public transit in contrast to 55 to 90 minutes for suburban residents.

Peak and Off-peak: Characteristics of Travelers. In affluent neighborhoods a high percentage of trips are made during the peak period. In west- and south-side minority neighborhoods the off-peak constitutes a much higher *percentage* of the daily volume, as much as two-thirds of the daily transit use to work. By contrast, in the near north side of Chicago the level of off-peak use is less than one-third. In all of the case-study areas the lack of automobile ownership was an important factor contributing to off-peak transit use in the work trip.

Characteristics of Walking Trips. Of the approximate 20 million recorded trips in the CATS HHTS, 8.4 percent are by foot. The percentage varies from 42 percent of all trips made by Chicago CBD residents to less than five percent of the trips by residents of outlying counties. In the city of Chicago walking represents 17 percent of trips and five percent in suburban Cook county. In the CBD 56 percent of shopping trips, 46 percent of the work trips and 35 percent of the recreational trips are by walking. By contrast, in suburban Chicago recreation was the most common trip purpose.

Patterns of Bicycle Ownership. Bicycling does not require destinations in close proximity but does require a bicycle. This study shows that there is a statistically significant positive relationship between bicycle ownership and household characteristics, namely number of motor vehicles in the household, household income, household size and distance from the Chicago CBD. The lower the population density the higher the bicycle ownership rate. Consequently there are households in many inner-city neighborhoods without bicycles.

Field Observations of Walking and Bicycling. In addition to data collected in a park along Lake Michigan, three neighborhoods were selected for field observations. A regression analysis was used to make the selections and the model was also utilized to identify which variables were associated with walking and off-peak transit use to work. Walking was associated with a measure of the intensity of urban activity and the presence of multiworker households. Off-peak transit use was associated with lack of household vehicle and presence of a minority population (Black or Hispanic).

The field observations revealed a difference in modes used in the two major minority communities. The Black communities have fewer commercial or industrial sites than the Hispanic communities. Consequently walking in the Black areas seemed to be largely restricted to personal and social activity. A very different picture was evident in Hispanic neighborhoods; these areas have a much wider range of walking destinations. Retailing and a variety of services are intermingled within the residential areas and both walking and bicycling are practical means of transportation exercised by many residents. A large number of people were visible on the streets and nonmotorized travel appeared to be a way of life.

Finally, the use of the Chicago lakefront was observed to be a popular location for nonmotorized activity and the field observations underscore that walkers, bikers, runners and skaters extensively used the lakefront at different times of the day. Each had their peak usage periods and together they constituted a relatively steady stream of activity.

Stabilization of Market Shares. The stabilization of the market for off-peak transit and the use of walking and bicycling would appear to be based on promoting the type of neighborhoods where these kinds of trips are found. To this end the report includes thirty maps of both socioeconomic characteristics and mode-use patterns.

These maps illustrate the association between mode use and socioeconomic characteristics of the resident population and the demand for transportation services. The map of multiworker households shows their concentration in suburban Chicago, particularly in areas between commuter rail lines. These neighborhoods likely generate a large number of private vehicle trips during the peak period. Multiworker households are far less common in the core of the city of Chicago except in the west side Hispanic community (Pilsen). In this core area the potential use of transit during the off-peak period seems to exist (by nonworkers). With appropriate levels of service and fares this market could potentially be further developed.

Areas where a high proportion of the population is without a household vehicle would seem to be areas where walking and bicycling might be common. These nonmotorized modes, however, are more common in more affluent neighborhoods where there are a larger number of nearby commercial and recreational destinations. Walking and bicycling are more conducive in mixed land-use environments.

In sum, it appears that the most frequent users of the three modes studied are immigrants, mainly Hispanics in pedestrian-friendly neighborhoods. There are numerous reasons for their mode choice. Their neighborhoods have mixed land-use patterns that make walking and bicycling to nearby locations practical. Residents may also come from countries where the use of each of these three modes is a practical option and they do not need to be educated to their use.

Summary. Nonmotorized means of travel could be promoted as a means of slowing growing congestion. People and bicycles consume less space than cars. Mitigating congestion during peak periods is a difficult challenge, but encouraging land-use patterns with a mix of residential, recreational and commercial uses is an important initial step. By providing a pleasant and safe environment with a multitude of nearby destinations, travelers can choose from a greater range of modes. The Chicago CBD is the prime example. Walking is the predominant mode and travel is relatively short (both time and distance). The challenge lies in creating this type of neighborhood throughout the Chicago area and educating urban residents to the advantages of these neighborhoods and the use of nonmotorized modes and transit in the off peak.

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Chapter One

Study Summary

1.0 Introduction

This study examines off-peak and nonwork trips and where the use of modes other than automobile may be promoted for such trips. This is done by studying the patterns of travel, particularly trip purposes, the characteristics of travelers and the neighborhoods in which these trips are conducted.

The fundamental objective is to study the special characteristics of an area (e.g., traffic analysis zone or county) that determine its transit, walk or bike usability for various trip purposes and travel times. The potential for stabilizing and then increasing the utilization of these modes is examined. Case studies are conducted to identify characteristics of the study neighborhoods to better understand reasons why mode choices are made and to explore the possibilities of encouraging walking and the use of bicycles and off-peak transit.

2.0 Organization of This Report

This report is divided into eight chapters, this summary being the first. Chapter 2 examines time profiles of trip starts and ends with the objective of defining the off-peak period. That chapter shows that each mode has a different time profile and these profiles also vary by trip purpose and by characteristics of the traveler. In the aggregate, however, a peak period is defined and this definition is used in subsequent chapters.

Chapter 3 includes an overview of travel behavior in the Chicago metropolitan area including mode use, trip purposes, trip lengths and travel times. That chapter also contrasts travel between the peak and off-peak periods. The Chicago Area Transportation Study Household Travel Survey used in that chapter was restructured to make this examination possible. Many of the aspects of travel behavior examined in that chapter are presented in map form in Chapter 4. Together the maps in that chapter constitute a mini-atlas of socioeconomic and travel characteristics and can stand as a separate report.

After establishing the background in the first four chapters the subsequent four chapters cover special topics. The first of these chapters provides an overview of bicycle ownership. It (Chapter 5) concludes that bicycle ownership is highly related to a variety

of household characteristics and that ownership rates increase with several measures of affluence such as household income and the number of vehicles in the household.

The information in that chapter, together with that of Chapter 6, shows that bicycle use is most prevalent in city neighborhoods where ownership rates are high. Chapter 6 also includes a regression analysis that is used to select sites for case studies. The regression analysis demonstrates the relationships between neighborhood and household characteristics as independent variables and travel mode as the dependent variable. The model provides the basis for selecting three case-study neighborhoods and these are studied in Chapter 7.

Each of the three case-study neighborhoods is a large residential area encompassing many square miles and field observations were conducted in each (a drive-through consisting of several hours each). An attempt was made to select a suburban neighborhood but because of the extremely low usage levels of the target modes, all of the case study neighborhoods were in the city of Chicago. South, west and north side areas were represented. To contrast these residential neighborhoods we also collected data on nonmotorized modes used on the Chicago lakefront and discussed these findings in Chapter 8. The Chicago lakefront is an important arterial for a host of nonmotorized means of conveyance.

3.0 Data Sources

An ideal data set for the fundamental questions addressed in this study would include (1) detailed travel behavior information and (2) household characteristics by (3) small zones throughout the Chicago area. It is possible to achieve all three elements but not in one data set. Two sources provided the data for most chapters, the 1990 Chicago Area Transportation Study (CATS) Household Travel Survey (HHTS) [Ghislandi, Fijal and Christopher, 1994] and the U.S. Bureau of the Census' Census Transportation Planning Package (CTPP). Each of the desirable data characteristics listed above are described below.

3.1 Travel Behavior

The principal advantage of the CATS HHTS over the CTPP is the availability of information on all trips in contrast to only work trips in the census product. The HHTS is a one-day diary of trips conducted between 4 a.m. on a selected Thursday and the same time the following morning. It includes information on start and end times, the zone of origin and destination, the mode, trip length in miles and minutes and the purpose at both the origin and destination. For this study the major limitation is the treatment of bicycle trips. There were several choices for mode but bicycling was not a separate check-off category (it was included in the "other" category). The respondent had the opportunity to specify bicycle by writing it in a provided blank but there is no way of telling how many

actually followed this option. On the other hand, information on bicycle ownership was collected as part of household characteristics.

The CTPP includes information on trip start time, trip duration in minutes (trip length in miles can be computed) and modes used for work trips. Bicycle use is a separate check-off choice.

3.2 Household Characteristics

Both data sets contain information on households and although the CTPP has a much richer selection of variables it has a major disadvantage. In the CTPP it is not possible to determine the characteristics of the traveler, only the characteristics of the zone at each end of the trip. It reports the number of trips between zones, not information on each individual traveler. The CATS file has a separate record for each trip and each trip can be attached to both household and person characteristics.

3.3 Zone Size

Both files use the same zonal network based on traffic analysis zones. The CTPP reports information for the six-county metropolitan area and has approximately 10,000 reporting zones. With 19,314 households participating in the CATS HHTS it could not be used for small-area analysis. The CTPP, however, is based on a large sample and throughout most of the study area there are sufficient numbers of records to use traffic analysis zones. As a whole the data used in this study proved to be very useful as will be apparent in the subsequent seven chapters.

4.0 Summary of Off-peak Travel Market

4.1 Defining the Off-peak Period Using Travel-time Profiles

This part of the study examines at some length the definition of off-peak period. In this effort it becomes immediately evident that the length of the weekday off-peak period (Thursday is the travel day in this study) is very dependent upon the characteristics of the traveler, the trip purpose, the mode used and to a lesser extent the location of the trip. While work-trip time profiles have the classical bimodal distribution, shopping trips have a wide multi-hour peak. They do not generally begin until after 9:00 a.m., peak at 10:00 a.m. and decline slightly but remain relatively high from 11:00 a.m. to 7:00 p.m. This wide, flat profile is similar to the travel by nonworkers, although for this group the mini-peak occurs between 2:30 p.m. and 3:30 p.m., just before the major portion of the afternoon peak for all travel.

In differentiating trips by mode, public transit trips are the most peaked, walking exhibits a fair amount of peaking and automobile travel is the most ubiquitous throughout the day. Lastly, travel by Chicago residents tends to be more concentrated in the peak periods than trips by inner-suburban or outer-suburban residents.

In the aggregate the afternoon peak period is higher and broader than the morning peak period. *We have identified the 6:30 a.m. to 9:30 a.m. period as the morning peak and the afternoon peak to run from 3:00 p.m. to 7:00 p.m.* Consequently any comparison of travel between these two periods, then, needs to acknowledge the longer evening peak period.

The afternoon peak period has been longer for several decades but contrasting 1956 and 1990 travel time profiles reveals two noticeable differences. First, in 1990 there is a sizeable peak during the lunch period that was absent in 1956. There was a considerable amount of personal business conducted during this period. Second, in 1956 there was a high degree of social and recreational activity after 6:00 p.m., much more than was evident in 1990.

4.2 Derived Travel Speeds

Although travel speeds are unavailable, we can divide airline distance computed from zone centroid to zone centroid by travel time to obtain "derived" speed.

Derived speeds of travel are effectively the same during the peak and off-peak periods but these speeds vary by mode and by place of residence. Almost no differences in derived speed are seen when comparing the peak and off-peak outside of Cook county. Within city limits, however, off-peak speeds are slightly higher and in suburban Cook off-peak speeds are modestly lower.

Conversely, mode use is a factor in the difference between derived speeds of peak and off-peak periods. While automobile derived speeds are equal for peak and off-peak periods regionwide, public transit shows an off-peak decrease in speed. Higher speeds for public transit during the peak period could be the result of high ridership of commuter rail, the fastest of any mode.

4.3 Characteristics of Off-peak Trips

Off-peak trips account for 48 percent of daily travel in the six-county Chicago area. While peak periods are commonly associated with work trips, 41 percent of all daily work trips occur during the off-peak. Although some of these may represent return-home trips leaving work, it is obvious that any shift in off-peak work trips to the peak period could worsen congestion. Nonwork trips are evenly distributed between both periods.

Since off-peak trips are shorter than peak period trips in both miles and minutes regionwide, they collectively account for less travel. This is true for travel by public transit and private vehicle. Comparing modes, public transit trips are approximately 40 percent *longer* in miles than travel by private vehicle during the peak while the difference is less than 20 percent during the off-peak. However, travel time by public transit is more than twice that by private vehicle during both periods.

There are major regional differences in mode use throughout the Chicago area. Off-peak transit use in the work trip is highest on the north side of Chicago near Lake Michigan. In this area there are high usage levels throughout the day including the peak period. Both the Howard branch of the Red Line and the Brown (Ravenswood) Line, in areas of recognized higher incomes, have large *numbers* of off-peak users. Both ends of the Blue Line also have high off-peak ridership levels.

In west-side and south-side minority areas, however, the off-peak use constitutes a much higher *percentage* of the daily volume. In many Hispanic neighborhoods near the Cermak Branch of the Blue Line over two-thirds of the transit use is in the off-peak. By contrast, in Howard branch neighborhoods the level of off-peak use is less than one-third. In all of the case-study areas the lack of automobile ownership was the principle variable accounting for the off-peak use of transit in the work trip. In many households transit functions as the only car or as the second car.

In the aggregate, off-peak travel appears to 1) have a minimal effect on derived speed, 2) show highest public transit use in minority and higher-income areas and 3) account for less travel distance than trips during the peak period. In addition, off-peak trips constitute a considerable portion of all work trips.

5.0 Summary of Nonmotorized Travel Market

Walking and bicycling are very different modes and each needs to be evaluated separately. They are similar in that these modes are not always completely reported in travel diaries. Many respondents may not consider some walking activity as constituting a trip. This is typically true in travel diaries and, while work trips are not the focus of this study, the problem of not reporting trips is less applicable to work trips.

For walking, mode destinations must be in close proximity to the home or the origin of the trip. Not all Chicago-area neighborhoods have mixed land-use patterns that are conducive to walking and therefore there are major variations in the use of this mode.

5.1 Characteristics of Walking Trips

Of approximately 20 million trips in the Chicago area 8.4 percent are by foot. The percentage varies from 42 percent of all trips made by residents of the Chicago CBD to

less than five percent of trips by residents of the outlying counties. In the city of Chicago walking represents 17 percent of trips and 5 percent in the suburban portion of Cook county. In the CBD 56 percent of shopping trips are by walking, 46 percent of work trips and 35 percent of recreational trips. In suburban Chicago recreation was the destination accounting for the greatest walking share, 8 percent in suburban Cook, DuPage and Kane counties.

Perhaps the most unique element of walking trips is that there is little regional variation in trip lengths. Regionwide they average 0.5 miles in length and vary from 0.4 miles in suburban Cook, DuPage, and McHenry counties to 0.7 miles in Lake county. Average walking trip lengths vary from 12.3 minutes to 14.8 minutes except for Will county where they average 17.0 minutes. While the trip generation rates vary, the lengths are remarkably similar across the study area.

5.2 Patterns of Bicycle Ownership

Bicycling does not require destinations in close proximity but it requires a vehicle. This study shows that there is a statistically significant relationship between household characteristics and bicycle ownership. Bicycle ownership is related to

- the number of motor vehicles in the household,
- household income,
- household size and
- distance from the Chicago CBD.

The lower the population density the higher the ownership rate. Consequently there are households in many inner-city neighborhoods that do not have enough bicycles to allow travel by this mode. It is beyond this study to determine whether bicycle ownership rates are a factor of economics or choice but many minority neighborhoods have few cyclists.

5.3 Field Observations of Walking, Bicycling and Off-peak Transit

Three neighborhoods were selected for field observation. A regression analysis was used to make the selections and the model also was utilized to identify which variables were associated with walking and off-peak transit use to work. Walking was associated with a measure of urban activity (the population of a zone times the number of jobs in the zone) and the presence of multiworker households. Off-peak transit use was associated with the lack of a household vehicle and the presence of a minority population (Black or Hispanic).

The field observations revealed a difference in the modes used in the two major minority communities in the city of Chicago. The Black communities observed in this study had fewer commercial or industrial sites than found in the Hispanic communities. Walking in

the Black areas seemed to be largely restricted to personal and social activity. A very different picture was evident in Hispanic neighborhoods. While not affluent these areas have a much wider range of walking destinations. Retailing and a variety of services are intermingled within the residential areas and both walking and bicycling are practical means of transportation exercised by many residents. A large number of people were visible on the streets and nonmotorized travel appeared to be a way of life in these neighborhoods. Maps depicting walking to work, much more common in Hispanic than Black neighborhoods, also supports the field observations.

5.4 Field Observations at the Chicago Lakefront

Finally, the use of the Chicago lakefront was observed to ascertain usage patterns. The lakefront is a popular location for nonmotorized activity and for completeness this area was also studied. The field observations conducted here revealed that walkers, bikers, runners and skaters extensively used the lakefront. Each had their peak usage periods and together they constituted a relatively steady stream of activity. While there were more males than females observed, on one of the observation days females represented the majority of skaters.

6.0 Stabilization of Market Shares

A key strategy to stabilize the market for off-peak transit and the use of walking and bicycling is based on promoting the types of neighborhoods where these types of trips are found. To this end Chapter 4 includes thirty maps of both socioeconomic characteristics and mode-use patterns. While the mode use is for work trips, the mode-use patterns for other trip purposes are likely to resemble these maps.

These maps illustrate the association between socioeconomic characteristics of the resident population and the demand for transportation services. The chapter is extensive and only a few examples can be discussed here. For example, the map of multiworker households shows their concentration in suburban Chicago particularly in areas between commuter rail lines. These neighborhoods likely generate a large number of private vehicle trips during the peak period. Multiworker households are far less common in the core of the city of Chicago except in the west-side Hispanic community (Pilsen). In this core area the potential use of transit during the off-peak period seems to exist (by nonworkers). With appropriate levels of service and fares this market could be served.

Conversely areas where a high proportion of population that do not have access to their own household vehicle would seem to be areas where walking and bicycle might be common. These nonmotorized modes, however, are more common in more affluent neighborhoods where there are a large number of nearby commercial and recreational destinations. This was also evident in the fieldwork conducted in this study.

In summary, it appears that the most frequent users of the three modes studied are Hispanics. There are numerous reasons for their mode choice. Their neighborhoods have mixed land-use patterns that make walking and bicycling to nearby locations practical. Residents may also be immigrants from countries where the use of each of these three modes is a practical option and they do not need to be educated to their use.

There are also some other factors that were beyond the scope of this study but deserve further inquiry. Some of these items are discussed below.

There is considerable discussion locally regarding public transit fare structure. One of the greatest differences in automobile and public transit use is the fare payment requirement on public transit. Studies have shown that travel behavior has changed in the last several decades and more and more trips are combined together into a longer sequence of trips resulting in trip chaining. If each trip in a chain requires a separate fare then it would be difficult to attract such travelers to public transit. The monthly pass should facilitate this type of travel even if it encourages use during the peak period.

Education also includes the communication of the benefits of using nonmotorized transportation. The 1995 TRB Special Report 245 indicates that on a 20-mile trip the cold start at the beginning and the cool-down at the end account for approximately half of the volatile organic compounds emitted. Neither of these two are related to the trip length and if more automobile users were aware of this, and specifically how much each short automobile trip pollutes, then some short trips may be conducted by nonmotorized means or by public transit.

With declining energy efficiency in public transit, the pollution argument becomes more important. Because buses are now less energy efficient per vehicle mile than in the past (perhaps due to a higher proportion with air conditioning and other features adding to the weight of the bus) and because ridership levels are declining, nationally automobile travel has been more energy efficient than transit for most of this decade. Transit ridership, particularly in the off-peak, needs to be stimulated to reinstate the energy advantage of transit.

7.0 Summary

The lowest levels of service on transportation systems are during the peak periods. The congestion on our transportation system has dramatically increased in recent decades. From 1970 to 1990 the population of the six-county metropolitan area grew by less than 300,000 inhabitants but the number of workers increase by more than 650,000. Workers have considerably added to the congestion on the highways during the peak periods and the crowded conditions on many public transit vehicles. Nonmotorized means of travel could be promoted as a means of dampening the effect of congestion. People and

bicycles consume less space than cars and transit vehicles. Mitigating congestion during peak periods is a difficult challenge but encouraging land-use patterns with a mix of residential, recreational and commercial uses are an important initial step. By providing a pleasant and safe environment with a multitude of nearby destinations travelers can choose from a greater range of modes. The Chicago CBD is the prime example. Walking is the predominant mode and travel is relatively short, measured in both time and distance. The challenge lies in creating these type of neighborhoods in other locations throughout the Chicago area and educating urban residents to the advantages of these neighborhoods and nonmotorized modes as well as the use of transit in the off-peak.

Much of the north side of Chicago near Lake Michigan is indicative of the requisite neighborhood. It is in these neighborhoods that all three target modes are widely used. The appropriate incentives and ingredients need to be in place to allow these and other neighborhoods to grow in a manner that is conducive to increasing the market share for walking, bicycling and off-peak transit use.

Chapter Two

Chicago Area Travel-Time Profiles: The 1990 CATS Household Travel Survey

1.0 Introduction

Transportation systems commonly perform well during the majority of the day or year but there are typically short bursts of demand, peak periods, that are difficult to accommodate. Personal travel within urban areas is no exception. Traditionally, travel volumes are very low during the night hours but rise rather dramatically to exceptionally high levels in the early morning and decline quickly in the late morning, with a similar cycle repeated in the afternoon. While this pattern held true for many decades, recent changes in travel behavior reflecting society's changing values, life styles, and demographics demand a re-examination of temporal variations in urban travel.

The purpose of this chapter is to (1) define the off-peak, and (2) to better understand why a simple definition masks the great variations in the trip purpose and the travel mode time profile that together make both the peak and off-peak. We will systematically examine approximately a few dozen travel time profiles to highlight the relationship between the mode or trip purpose and the shape of the time profile. In this manner the traditional peak, for example, does not apply to the way in which shoppers travel or when we conduct our recreational activities. Similarly automobile travel has a different peak profile than public transportation. We will also describe the current flow of traffic over a twenty-four-hour period and examine how this pattern of travel has changed since 1956.

The profiles vary substantially by time of travel, mode used and trips purpose and provide a summary of the various components that collectively yield the current travel time profiles experienced by the highway and public transportation systems. While there are numerous time profiles and they vary considerably, we have defined the morning peak to run from 6:30 a.m. to 9:30 a.m. and the evening peak to extend from 3:00 p.m. to 7:00 p.m. Since there is more traffic in the evening peak it is also defined as a four-hour period in contrast to the three-hour morning peak.

This chapter begins with a very brief overview of the literature on travel time profiles. This is followed by a description of both the 1956 and 1990 Chicago Area Transportation Study (CATS) Household Travel Surveys, the source of information for the profiles examined. After the 1956 and 1990 profiles are compared the majority of this chapter concentrates on

the multitude of profiles that together constitute travel today.

2.0 Literature Review

The Chicago Area Transportation Study conducted the earliest comprehensive survey of travel in the Chicago area in 1956. It represented a hallmark in transportation studies pioneering new techniques of data analysis and presentation. The 1956 CATS travel survey predicted that the existing patterns of travel would shift as people adjusted to new land uses. This study was followed by efforts in Pittsburgh, New York, Philadelphia, and other major metropolitan areas. All collected primary travel data and examined the daily profile of travel activity.

Travel profiles were the subject of studies in the academic community. Gordon *et al.* (1990) and Oster (1979) have observed that over time traffic patterns have remained highly concentrated but "traditional" morning and evening rush hour commutes have become more complex. These changes can be associated with suburban growth and social changes that include an increase in automobile use, a longer and more spread-out evening peak period, changes in the demographics of households and the work force, and a restructuring of shopping patterns (Gordon *et al.*, 1990, Kim, 1994, Prevedouros, 1991, Stratham, 1994).

Nonwork trips are an important and perhaps overlooked element of peak period travel that affect scheduling decisions and the level of overall congestion (Hatcher, 1992, Kim, 1994, Small, 1982, Stratham *et al.*, 1994). There are indications that the many travelers prefer to schedule nonwork trips during the peak periods, on the way to and from work, but nonworkers prefer alternate travel schedules in an effort to avoid rush hour traffic (Small, 1982, Hatcher, 1992). In this manner there is a trend toward increasing chain complexity and linking shopping to work chains (Kim *et al.*, 1994, Oster, 1979). The combination of these trends contributes to an increase in congestion despite an improvement in scheduling efficiency for individuals (Kim *et al.*, 1994). By chaining trips together, a person travels fewer miles; however, most of the travel occurs during the peak period. As a consequence, efforts to decrease travel during the peak period may divert travel to non-peak periods but it could have the undesirable effect of increasing the number of miles driven by prompting travel after a worker has arrived home.

3.0 Study Area and Data

This study uses data from both the 1956 and 1990 CATS Household Travel Surveys. The 1956 survey study area encompassed the city of Chicago and a half-circle area including most of Cook and fragments of Lake, DuPage, and Will counties, totaling 1,236 square miles. Home interviews, popular during this period, were the means of data collection, supplemented by interviews of truck and taxi drivers. Information on 49,591 households was obtained yielding 9,931,638 daily trips.

The 1990 survey area includes the six-county area comprised of Cook, DuPage, Kane, Lake, McHenry, and Will counties, totaling approximately 3700 square miles. It includes information on over 162,755 person trips weighted to a regional total of approximately twenty-one million trips (Ghislandi *et al.* 1994). There is also information on the 19,314 households and 40,568 persons fourteen years of age and older; not all of these people traveled on the survey day. The data were collected in spring and fall for a twenty-four hour time period between 4 a.m. Thursday morning and 4 a.m. the following morning using a mail-out-mail-back survey form.

Trip records for both surveys include information such as origin, destination, travel time, distance, mode of travel, and trip purpose. Personal records contain information such as age, gender, employment status, and relationship to head of household. Household records identify location of household, number of persons, income class, and a weight variable based on the survey response rate in the area of residence and the number of persons and vehicles in the household.

3.1 Time of Day Data

The 1990 respondents were asked to specify the departure and arrival times for each trip. Survey forms allowed precision to the minute, but there was a tendency to report by increments of fifteen and thirty minutes. To compensate, the data were aggregated into fifteen-minute intervals. Moreover, to minimize the thirty-minute effect the fifteen-minute data were smoothed using a three-point averaging method. Figures 2 and 4 are the exceptions in that data was collected by the hour in order to conform to the 1956 graphs.

The time intervals were assigned attributes derived from the CATS file, including physical trip attributes and social data based on frequency counts. Our focus was to record and identify temporal differences in departure and arrival times for trips and trip chains as defined by trip purpose, mode of transportation, sex, employment, and the location of residence defined by the following geography: outer suburbs, inner suburbs, and the city of Chicago.

In an effort to characterize daily travel patterns, data are aggregated by fifteen-minute intervals. Studies that focus on social aspects of travel often assign peak travel periods arbitrarily, based on the traditional perception of "rush hours" occurring around nine-to-five work schedules. By using 15-minute time intervals as observations, we define peak periods based on characteristics related to traffic volume and social attributes and to associate regional peak periods with their characteristics.

3.2 Trips and Trip Chains

The 1990 Household Travel Survey defines a trip as "a one-way movement from one location to another" by a person fourteen years of age and older. Travel to a destination and back home constitutes two trips. Any series of trips starting at home and ending at home is in this

report defined as a trip chain. There may be sub-chains within a chain, such as a series of trips starting at work and returning to work, but a chain must start and end *at home*. In this regard, since the travel day started and ended at 4 a.m. a few of the trips were not part of a chain, e.g., those in which a person left home on the travel day but did not return on the same day.

Transit travel was subject to specific rules. Travel on two buses with a transfer was defined as one trip but a transfer from a bus to the CTA rail was defined as two trips. Also, travel to and from rail facilities required an access and egress trip, e.g., a walking trip.

4.0 Comparison of 1956 and 1990 Survey Data

The landmark CATS study in the mid-1950s included two figures that are of interest in this study (Figures 1 and 2). One illustrates the profile of mode use during the 24-hour day and the other shows variations in trip purpose. The 1990-travel survey was processed to replicate these two figures and, while there were differences in definitions and data collection techniques, this comparison provides some insight into how travel behavior has changed over thirty years.

4.1 Changes in Mode Use

In comparing the 1956 mode use (Figure 1) with the 1990 pattern (Figure 2), it appears that the two profiles are similar in many regards while distinctive differences exist. The most noticeable difference is that in 1956 there was much more late evening activity and less travel during the midday. Other differences are reported below by mode.

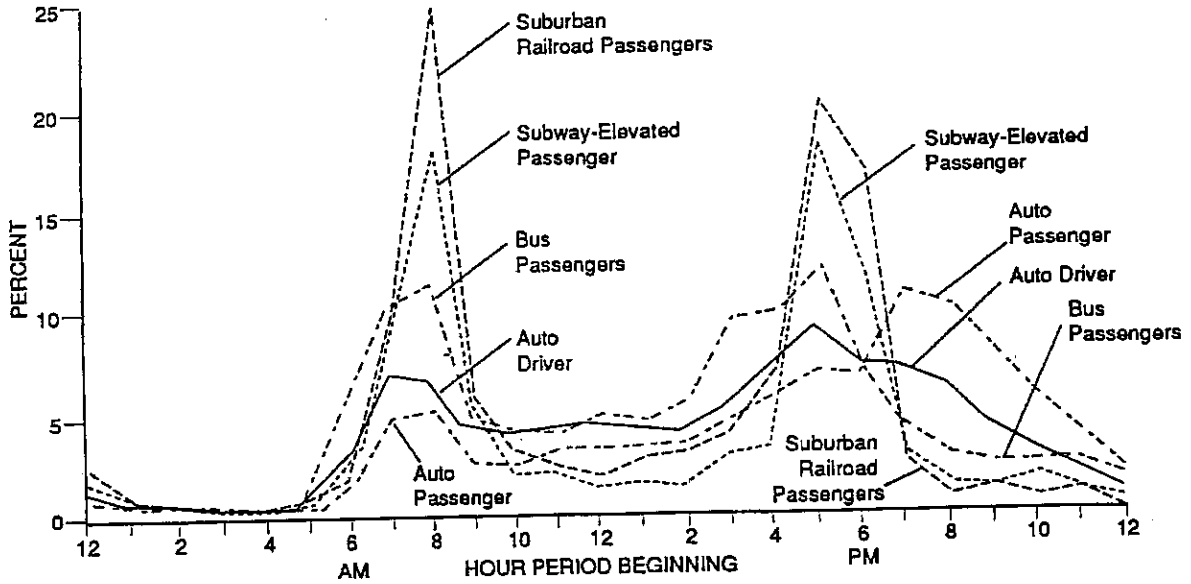
Note that since both use hourly data the average would be approximately 2.5 percent, i.e., 100 percent divided by 24 hours. The 1990 data are expressed in decimal form, not in percent.

Commuter Rail (Suburban Railroad vs Metra):

- the highest peaks were about the same at 25 percent of the daily traffic,
- the highest peak has shifted from the morning to the evening,
- in both surveys the p.m. peak occurred at 5:00 p.m.,
- the shapes of the a.m. and p.m. peaks have switched, but
- the midday remains very low.

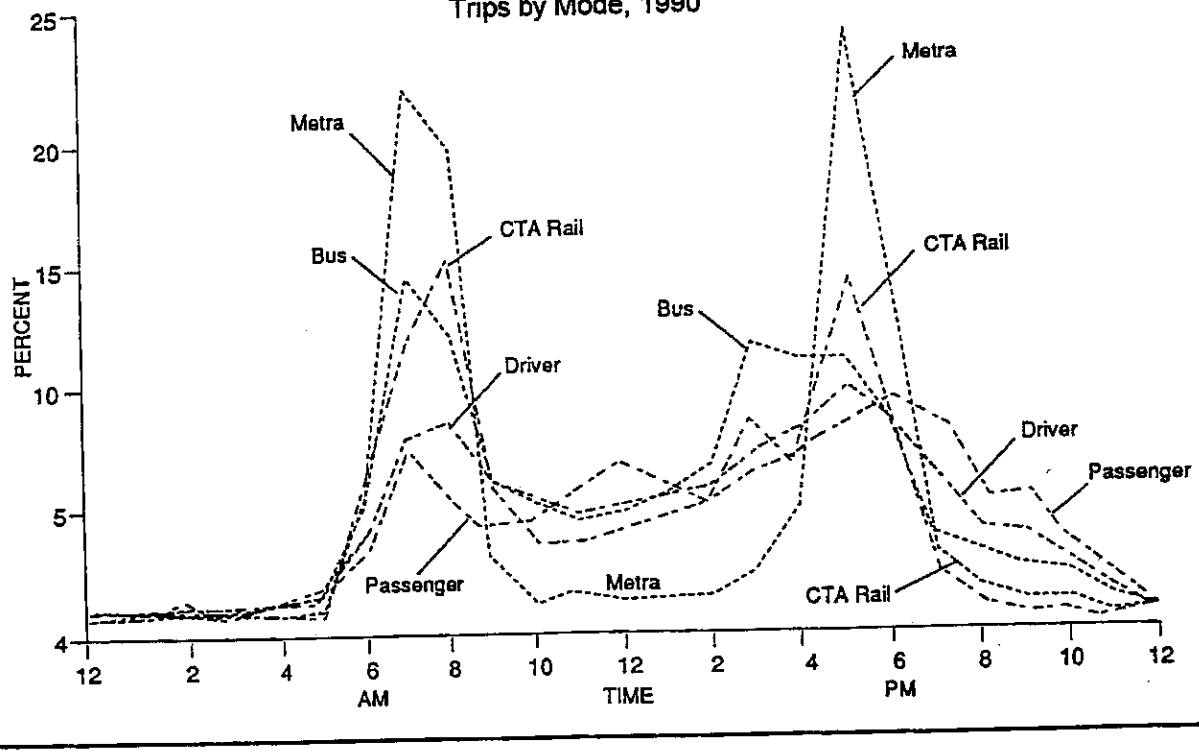
The 1990 profile continues to underscore the advantages of commuter rail; it can move large number of passengers within a short period. Therefore the evening peak is even more pronounced. Starting times, however, have spread over a longer period.

Figure 1
Hourly percentage of Total Daily Trip Volume of Each Mode of Travel, 1956



Source: Chicago Area Transportation Study (1959). Survey Findings, Volume One, Chicago, Illinois.

Figure 2
Trips by Mode, 1990



CTA Rail:

- the 1990 a.m. and p.m. peaks are much lower, now considerably less than 15 percent,
- within each study the a.m. and p.m. peaks are of equivalent height, and
- the 1990 profile shows much more activity in the early p.m. period (3 p.m.).

CTA rail use is now less concentrated in the peak periods with proportionately more riders during the lunch and evening hours.

Bus (CTA and Pace):

- the a.m. peak is now much higher,
- the a.m. peak now matches the peak for CTA rail but is earlier, and
- the p.m. peak is now much earlier, at 3 p.m. rather than 5 p.m.

Bus travel shows the greatest change. The a.m. peak is now much higher and the p.m. peak is lower and more diffused. The highest p.m. level now is much earlier, suggesting perhaps earlier work schedules and bus use by nonworkers for a variety of trip purposes before the onset of the p.m. rush period. Even though buses may not be full, riders may try to conduct travel before traffic volumes rise.

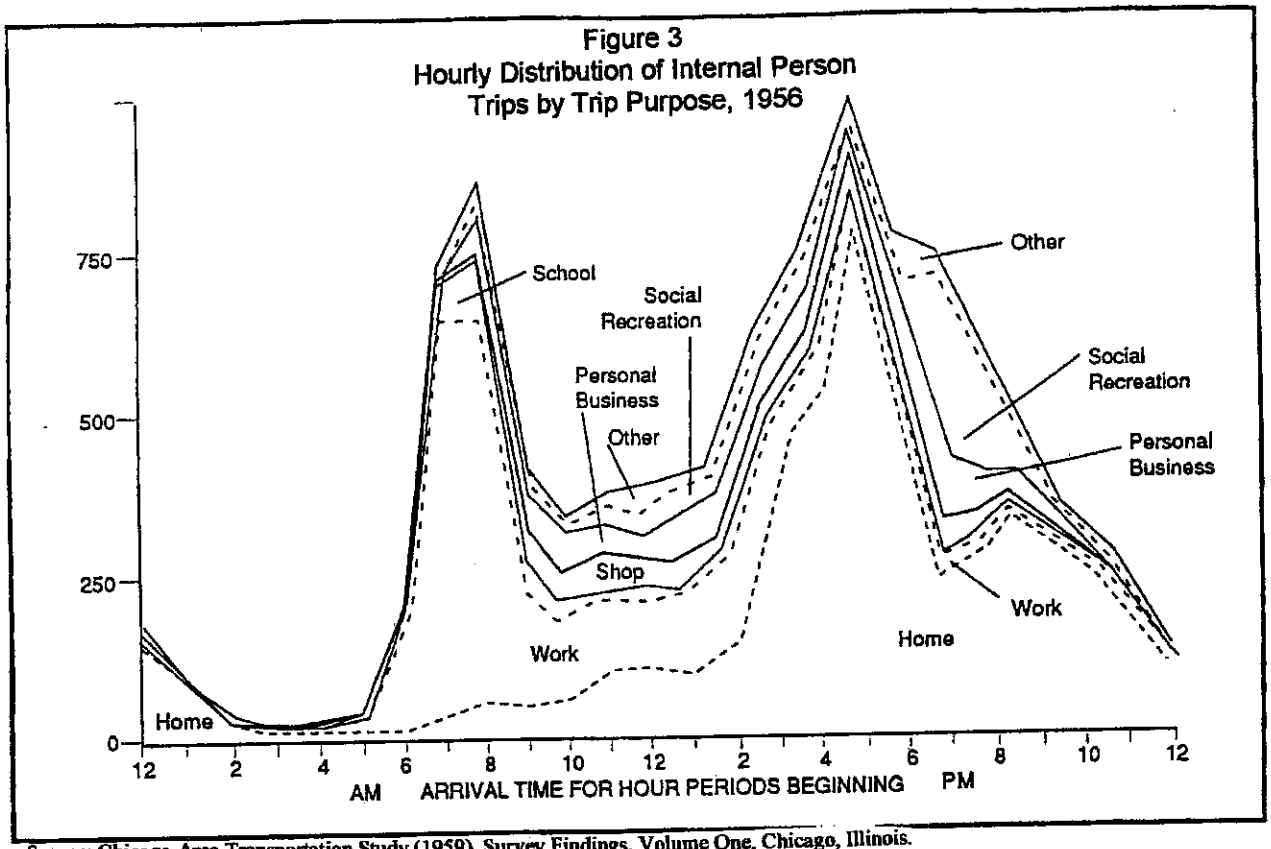
Drivers:

- there is slightly more activity in 1990 during the lunch period but
- in general there is little difference between the 1956 and 1990 profiles.

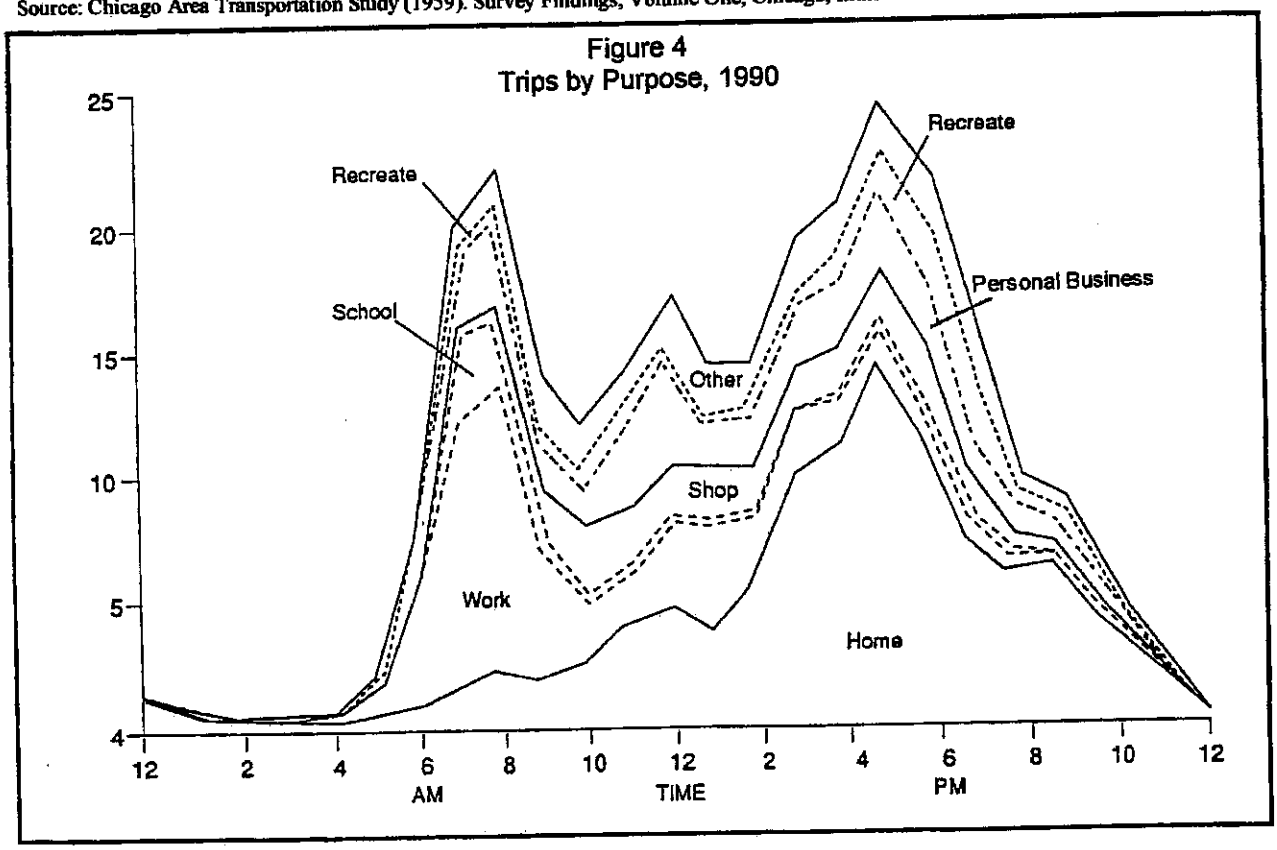
While automobile vehicle miles driven (VMT) has increased the survey profiles are rather similar. Despite the similarities in the profiles, there may now be more roads that have exceeded peak-period capacity, defined by volume/capacity (V/C) ratios. Even though the study area is now larger, the number of trips in 1990 is more than twice the number in the original survey, suggesting by itself higher travel volumes. Some of this increase has been accommodated by the freeway construction that occurred in the 1960s, in the city of Chicago and inner suburbs, but there has been little expansion of the highway network since the late 1960s.

4.2 Changes in Trip Purposes

Figures 3 and 4 show the composition of the daily profile differentiated by trip purpose. The most notable difference between the 1956 and 1990 data is the recent importance of travel during the lunch period. The 1990 profile shows the growing number of midday trips, especially for shopping, work, and personal business purposes. This may well be due to a combination of changes in lifestyle and more detailed data collection in 1990. The increase in



Source: Chicago Area Transportation Study (1959). Survey Findings, Volume One, Chicago, Illinois.



the number of multiworker households led to more travel on the way to and from work and during working hours, especially the lunch period.

In 1956 shopping trips occurred in relatively limited numbers and usually fell within the lunch period and early evening. By 1990 shopping occurred throughout the day. It started after 9:00 a.m. and continued steadily until approximately 8:00 p.m. Likewise, recreation and social travel, which was very common in the early evening in 1956, is also now much more evenly distributed throughout the day.
The evening volume has clearly declined. Perhaps the pace of life is much faster and there is less ability to recreate and socialize after work. The increase in multiworker households may play a role here, with both working members being less inclined to recreate outside the home. In house entertainment options have also increased with TVs, video games, stereos and home computers (internet).

5.0 The 1990 Travel Profiles

The previous section (Section 4) examined hourly variations; we now turn to a more detailed examination by shortened data intervals. Frequency counts of start and end times (within fifteen-minute intervals) were taken for both trips and chains with respect to specific characteristics such as region, gender, mode, travel purpose, and employment. These start and end time frequencies were plotted along a time line of fifteen-minute intervals using a three-point mean smoothing method to create a graphic profile of activity.

Chain types are defined according to purpose as follows: work chains are defined as chains that include at least one trip to work regardless of the number of other trips in the chain. By definition a work chain must have purposes other than "to work" in the chain, namely the trip back home. Similarly shopping chains include at least one shopping trip regardless of how many other trips are included. Work/shopping chains include both work and shopping trips as well as other travel. The "other" category includes all chains that do not include work or shopping.

Mode types include driving (all private vehicle use), public transit (CTA rail and bus, Metra, and Pace bus), and mixed mode, which employs both driving and public transit. Alternate modes of transportation fall into an "other" category that is not included in the findings of this paper. Three Chicago area sub-regions are defined and examined: the city, inner suburbs, and outer suburbs.

Finally, it is important to be aware of *scale* when examining figures presented in this study. The scale changes from figure to figure and may communicate a false impression of equal importance. Using the same scale on all figures, however, is not practical. Some figures would be very hard to interpret. With a common scale some graphs would be almost flat (horizontal straight lines).

5.1 All Trips

We begin with a discussion of all trips in the 1990 survey. In subsequent sections the profiles are examined by trip purpose and mode.

5.1.1 Trips

A profile for all trips made is shown in Figure 5. This figure should resemble Figure 4 except that now we see fifteen-minute interval data rather than hourly data. In order to define the peak periods we see that morning trips experience highest levels between 6:30 and 9:30 a.m. During this period all of the fifteen-minute readings are above 250,000 trips (Figure 5). There is a distinct but smaller lunch-hour peak between eleven and one o'clock but at its highest levels travel surpasses the 300,000 level. The evening peak, sharpest between 3 and 7 p.m., is clearly the busiest with a combination of returns home and subsequent departures totaling over 600,000 trips at its peak. This evening peak is much broader with a more gradual drop-off of traffic levels when contrasted with the morning's rapid decline.

5.1.2 Chains

Figure 6 shows a profile of all trip chains in the data set. The graph shows the steep peak of the morning departures from home and the lower, wider curve of evening returns. The morning peak period is shorter, from 6 to 9:30 a.m., when compared to the 3 to 8 p.m. return peak period. The wider time frame and lower peak of the evening rush indicates a more varied travel pattern while the sharper, taller morning peak represents the rigid time constraints of the trip to work.

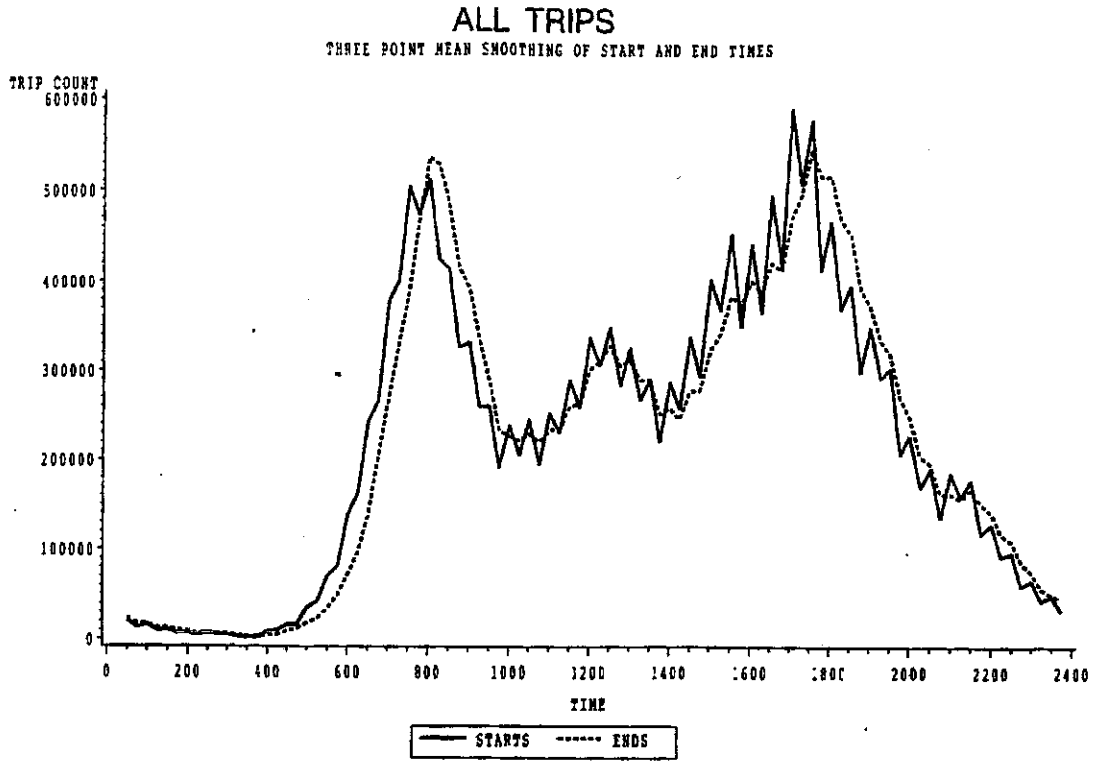
The peak for morning trips (Figure 5) corresponds closely with that for morning chains (Figure 6), indicating that people traveling in the morning make few stops and that most arrive at their morning destinations within a brief time interval. There is little resemblance between the p.m. peak period (trips and chains).

A small departure peak occurring between 5 and 7 p.m. appears to be mirrored by an 8 to 10 p.m. return peak of similar size and breadth. The very pronounced differences in the "all trip" and "all trip chain" graphs are results of "trip" and "trip chain" definitions. Trip profiles plot the times of departure and *arrival at a destination* while trip chain profiles plot the times of departure from and *arrival at home.*

5.2 Work Trips

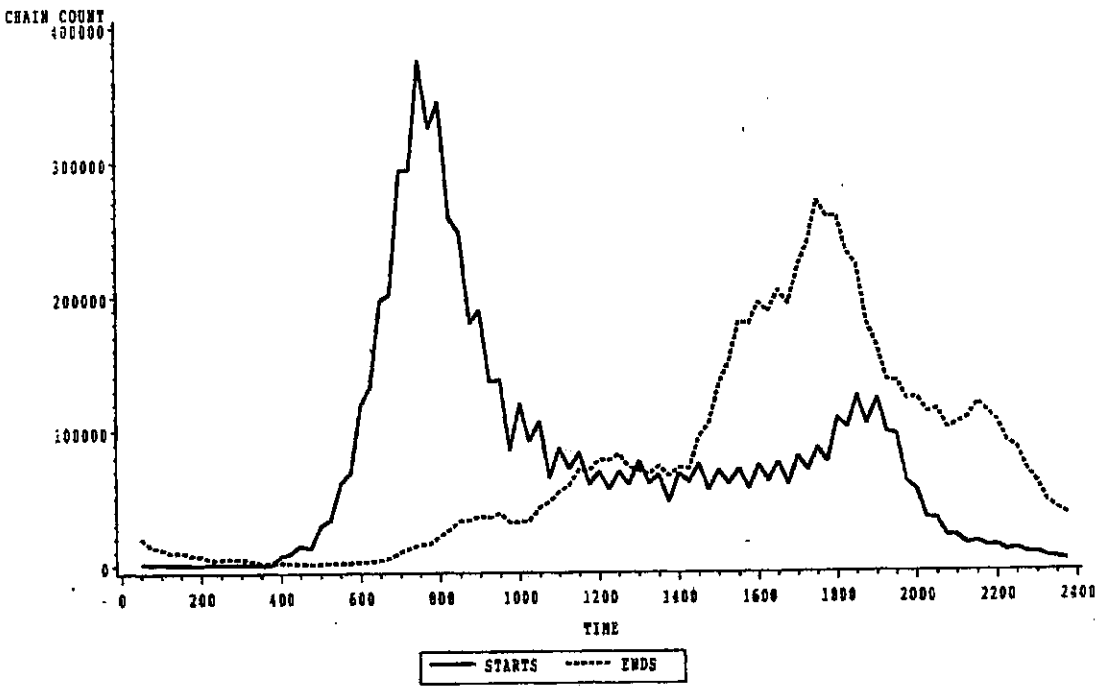
We will continue the practice of examining first trips and then chains. Note that the section of the paper on trips in work chains includes all travel in the work chain regardless of the trip purpose. In the "trips" section the start and end times of each trip are examined, while in the

Figure 5



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 6



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

"chain" section the beginning of the first trip in the chain constitutes the start and the end of the last trip defines the end of the chain.

5.2.1 Trips in Work Chains

Two distinct peaks of work trips are shown in Figure 7. The morning peak, from about 6 to 9 a.m., and evening peak, from 3 to 7 p.m., are very similar in length and intensity though the evening period is slightly longer. The lunch peak is also apparent between 10 a.m. and 2 p.m. although the volume of travel is much lower. As a whole the profile is very distinct; work trips display very clear peaks and, while there is no longer a "rush hour" but rather "rush hours", they can be relatively easily defined. People continue to leave home for work in the morning and return at the end of the day.

The jagged nature of the beginning of the p.m. peak is also understandable. Figure 7 displays fifteen-minute data and every other period is on the half hour. These half-hour departures from work are clearly evident and unlike any other part of the profile, both start and end times.

5.2.2 Work Chains

As Figure 8 demonstrates, work chain peak periods are dramatic with extremes of very high volumes rising quickly from periods of almost no activity. This is true during the morning hours between 5:30 and 9 a.m. and in the evening from 3 to 7 p.m. Unlike the "all trips chain" graph in Figure 6, the work profile has a valley of low volumes between 10 a.m. and 2 p.m.

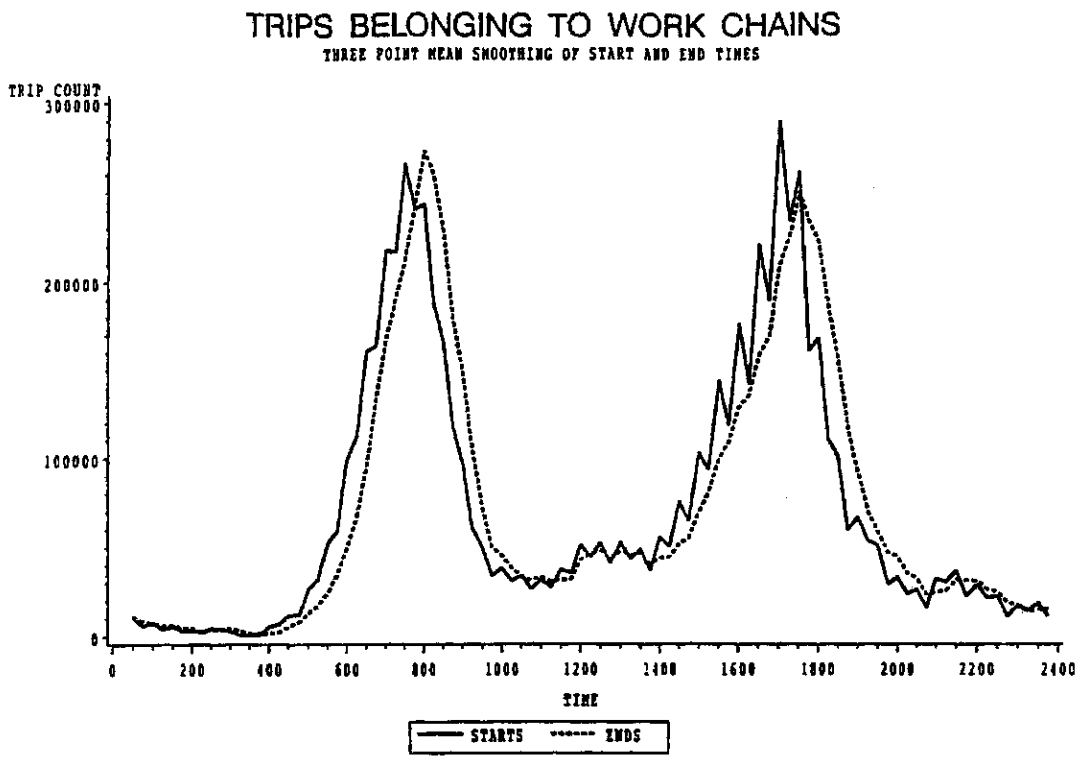
Figure 8 also shows the effect of the chaining phenomenon in the evening. Many of the morning departures are within a relatively narrow time window but the returns start at approximately 3 p.m. and continue until after 10 p.m.

5.3 Shopping Trips

5.3.1 Trips in Shopping Chains

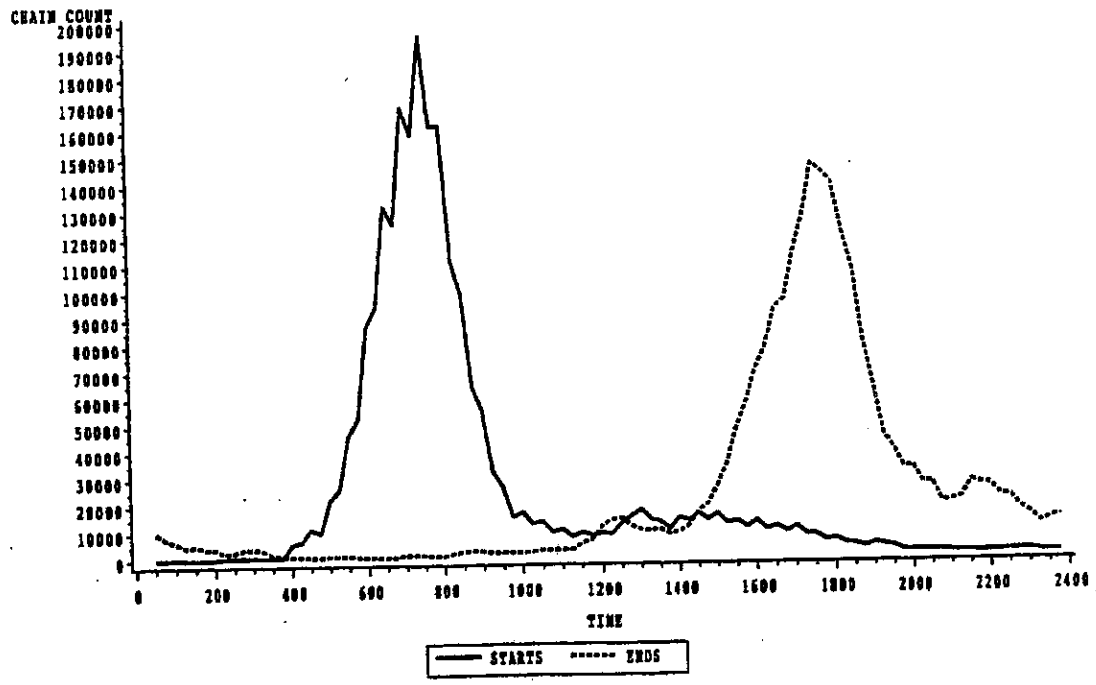
In contrast to the "all trips" and "work" graphs above, the shopping trips profile in Figure 9 is quite unique. Most trips don't begin until 9 or 9:30 a.m., hours when many stores are opening. Shopping trips increase quickly in numbers through the early morning, peaking around 10 a.m. The number of trips shows a slight downward trend through the day with no real off-peak period. Midday shopping is clearly the largest contributor to travel between ten and two o'clock. Shopping trips rise to a frequency of 130,000 and stay above 100,000 for this period. As stores close shopping trips drop off rapidly between 8 and 10 p.m.

Figure 7



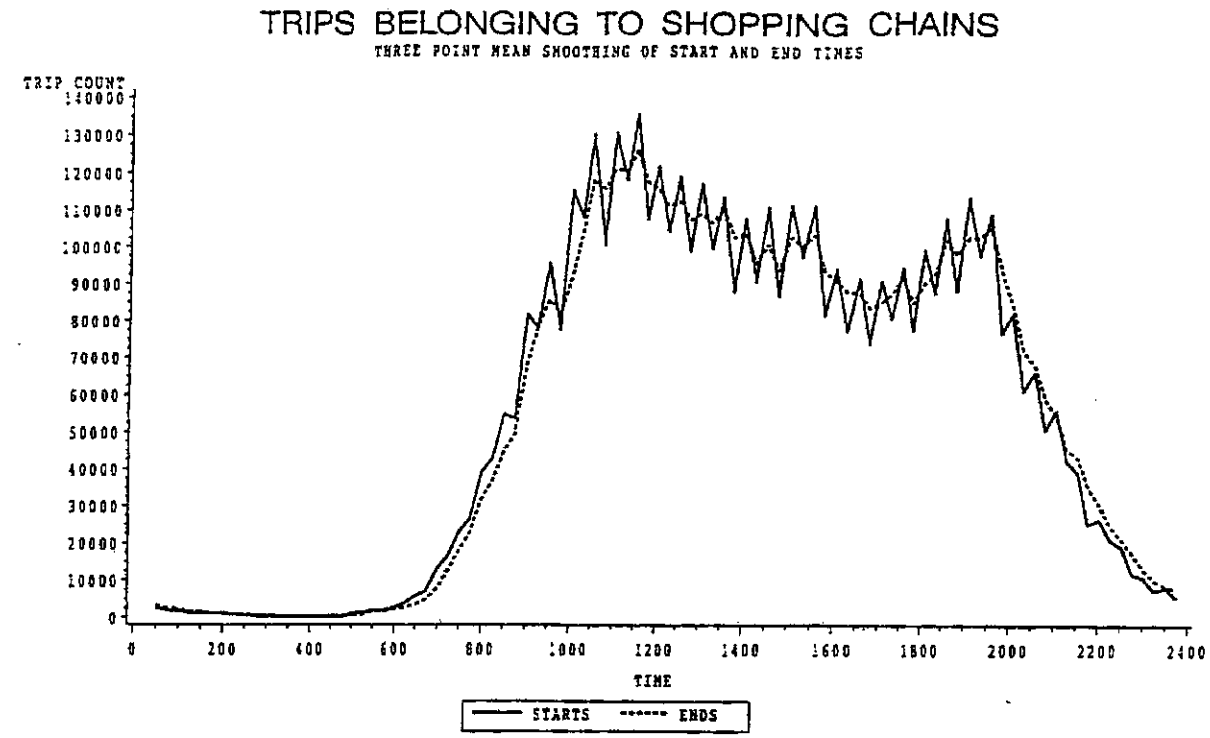
SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 8



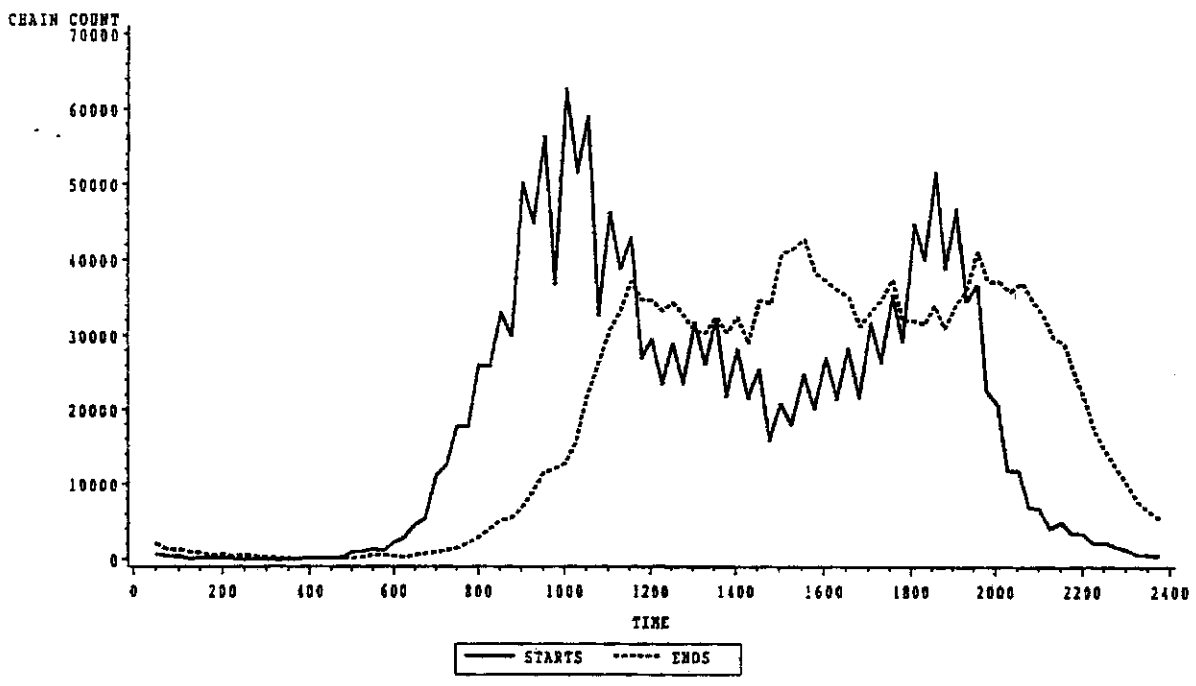
SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 9



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 10



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

5.3.2 Shopping Chains

Figure 10 presents two peak periods for the starts of shopping chains, occurring in the morning and post-work hours. Most chains begin between 8 and 11 a.m. or 5 and 8 p.m. Far fewer shoppers leave home midday, seemingly dividing the trips into two "shifts."

Returns home are relatively even after 10 a.m. with a small peak between 2 and 4 p.m. The end of the first shopping shift and the beginning of the second occur largely after the morning and evening peak periods, suggesting a desire to avoid heavy peak period traffic. This willingness to schedule presumably optional trips during the morning peak period supports Small's (1982, p.478) conclusion that the preference for morning departures competes with the desire to avoid traffic and that measures to relieve traffic congestion create a response of increase in travel during these most desired departure times.

5.3.3 Shopping and Recreational Trips

For some, optional shopping trips might be considered a form of recreation. Figure 11 shows that while shopping and recreational activities ends at about the same time, recreational activities clearly peak during the evening, after work. Recreational trips follow the same pattern as the second shopping "shift" shown in Figure 10, suggesting that shopping and recreational activities are combined in the evening.

5.4 Work/Shopping Trips

As stated above this section examines trips made in chains that have at least one work and one shopping trip. Figure 12 provides insight into when these trip activities may be linked.

5.4.1 Trips in Work/Shopping Chains

Work/shopping trips experience a distinct trimodal distribution. Three separate peak periods of almost equal intensity are seen in Figure 12. The evening peak, from 3 to 7 p.m., is slightly greater than that of the morning (6-9 a.m.) or afternoon (11 a.m.-2 p.m.) and the lunch peak is even higher than the morning peak. It can be assumed that these peaks represent three distinct groups--morning departure, lunch-hour shopping and return home trips.

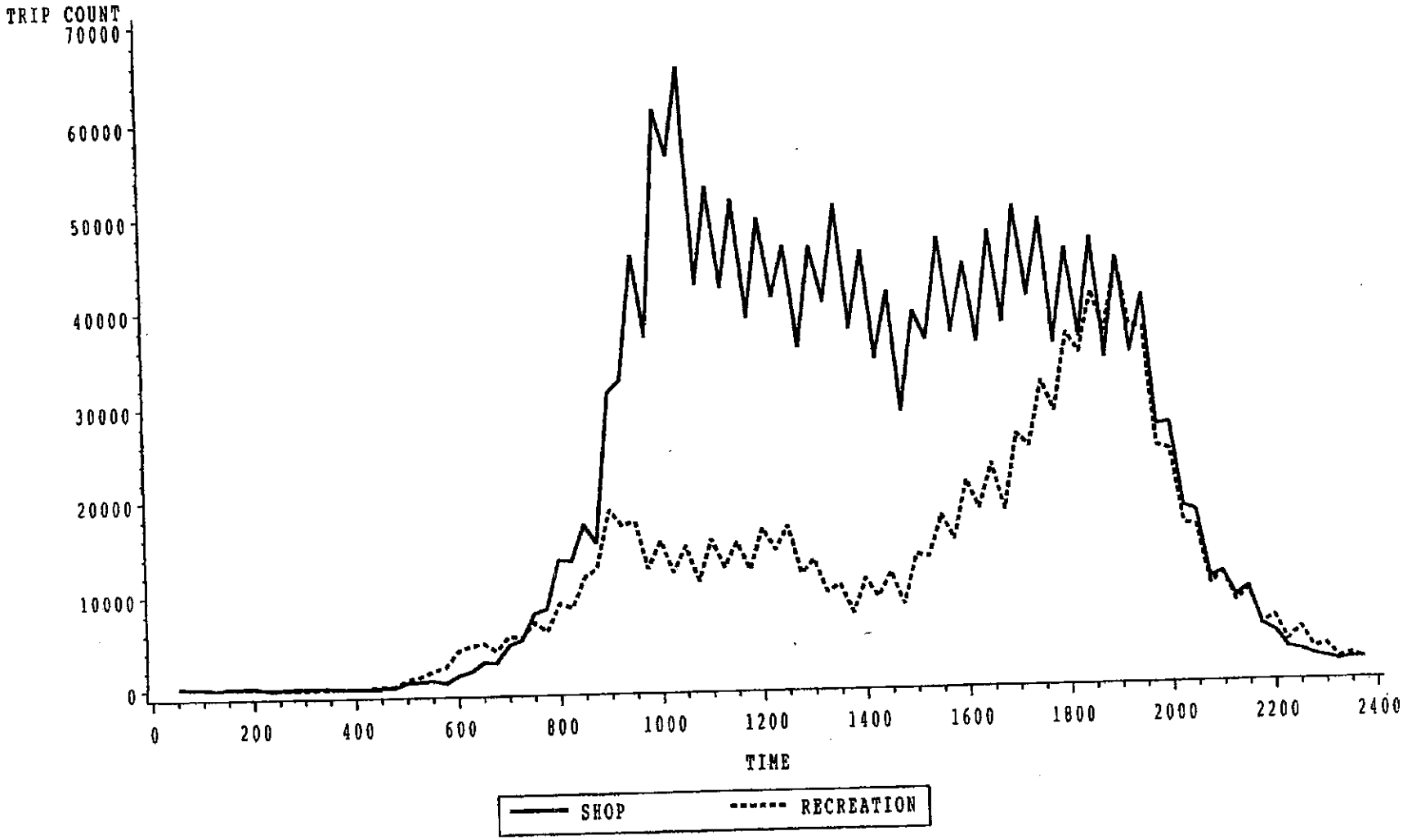
5.4.2 Work/Shopping Chains

The work/shopping chains of Figure 13 have morning and afternoon peak periods similar to those of the work chains of Figure 8. A sharp morning peak is visible from 6 to 9 a.m. and a longer, less intense afternoon peak lasts from 4 until 7 p.m. While these graphs are similar to those of work chains it is important to note that volumes are much lower, just over 60,000, for work/shopping chains in contrast to 190,000 for work chains on Figure 8.

Figure 11

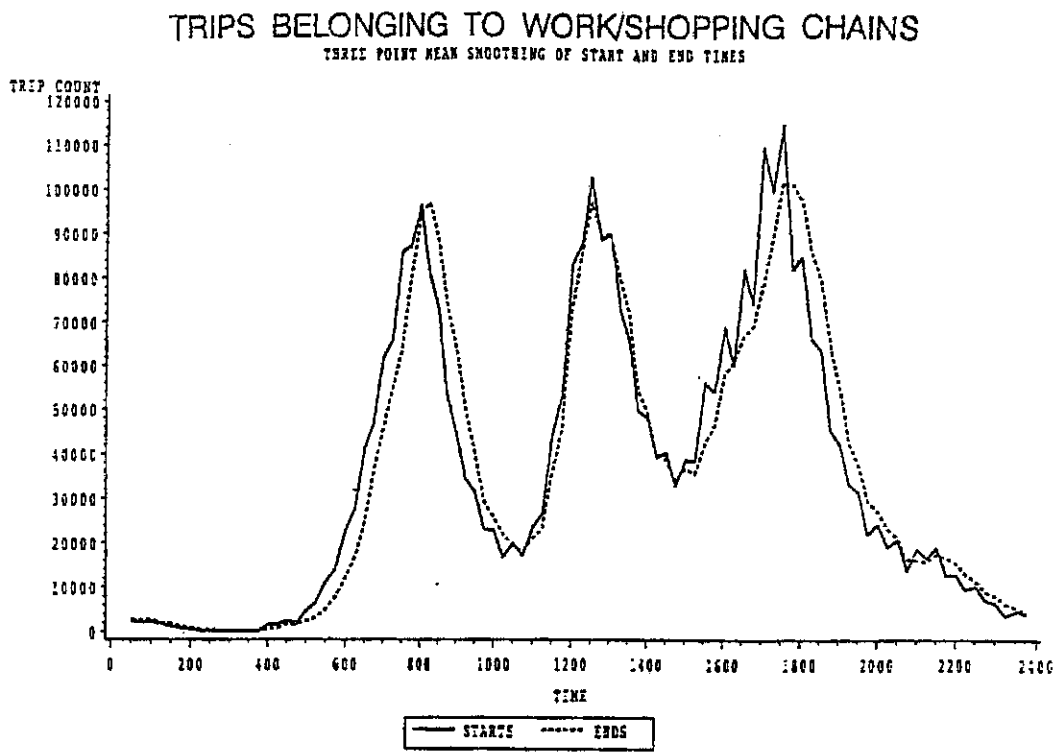
SHOPPING AND RECREATIONAL TRIPS

THREE POINT MEAN SMOOTHING OF START TIMES



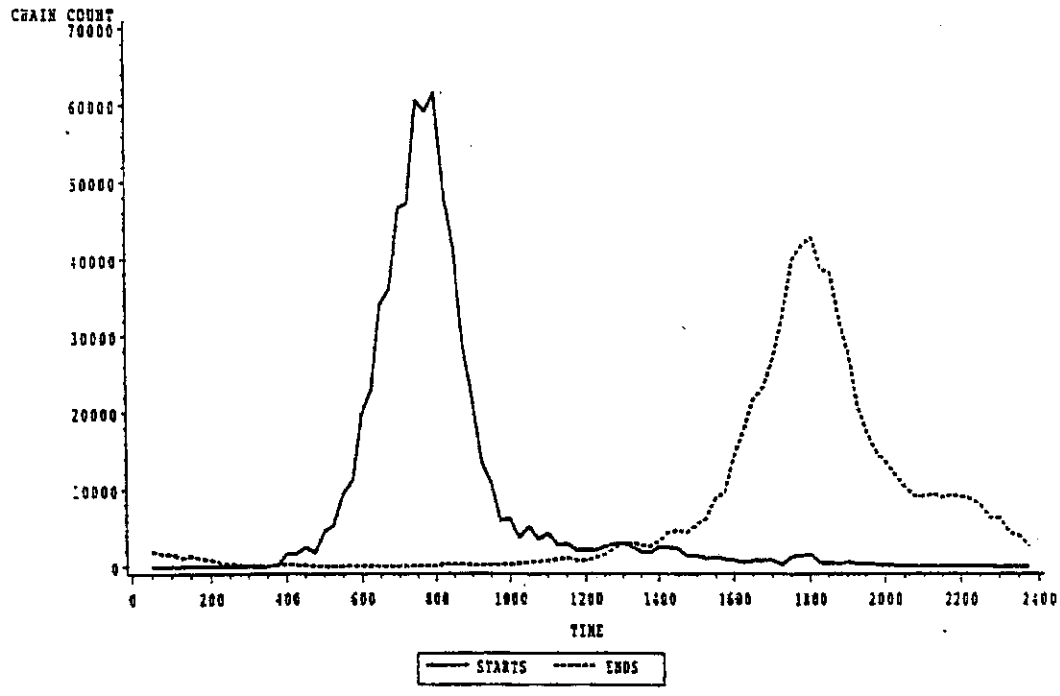
SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 12



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 13



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

The combination of Figures 12 and 13 indicates that a large part of the trip chaining activity occurs during the lunch period. Figure 13 indicates that most chains begin and end during the morning and evening peak periods respectively but that a considerable amount of travel is conducted between these periods (Figure 12).

5.5 "Other" Trips

Other trips are those in a chain that does not include work or shopping. School, recreation, eating, and banking are some of the travel purposes that are included in the "other" category shown in Figure 14.

5.5.1 Trips in "Other" Chains

Figure 14 shows a pattern of five peaks for trips comprising "other" chains. The largest peak can account for over 140,000 trips per fifteen-minute segment and occurs between 2 and 4 p.m., followed in size by periods between 7 and 9 a.m. and 5 and 7 p.m. Smaller peaks between 10 a.m. and 2 p.m. and in the late evening between 8 and 10 p.m. are also substantial, sometimes numbering 80,000 trips. Figure 4 suggested that no single activity dominates the "other" category and both recreation and other trips were started throughout the day. Only school trips and those for personal business, banking, and eating out (in the 1990 survey), showed some temporal concentrations. Personal business travel peaked at noon but since this was not a major peak on Figure 14 the cumulative effect of all trips in this category is more important.

5.5.2 "Other" Chains

"Other" trip chain start times peak between 6 and 9 a.m. with a secondary peak between 5 and 7 p.m. (Figure 15). Return times peak between 2 and 4 p.m. when schools end and work chain ends dramatically increase. A smaller peak between 8 and 10 p.m. seems to represent recreational chain end times. Taking the school, recreational, eating, and banking aspects of "other" trips into account can give meaning to the peak periods of these chains. School drop-offs and pick-ups are common in the morning and early afternoon hours, breakfast and dinner hours produce high traffic volumes, after work recreation is seen in the evening peaks with perhaps banking and eating out resulting in efficient trip chaining.

5.6 Regional Variations

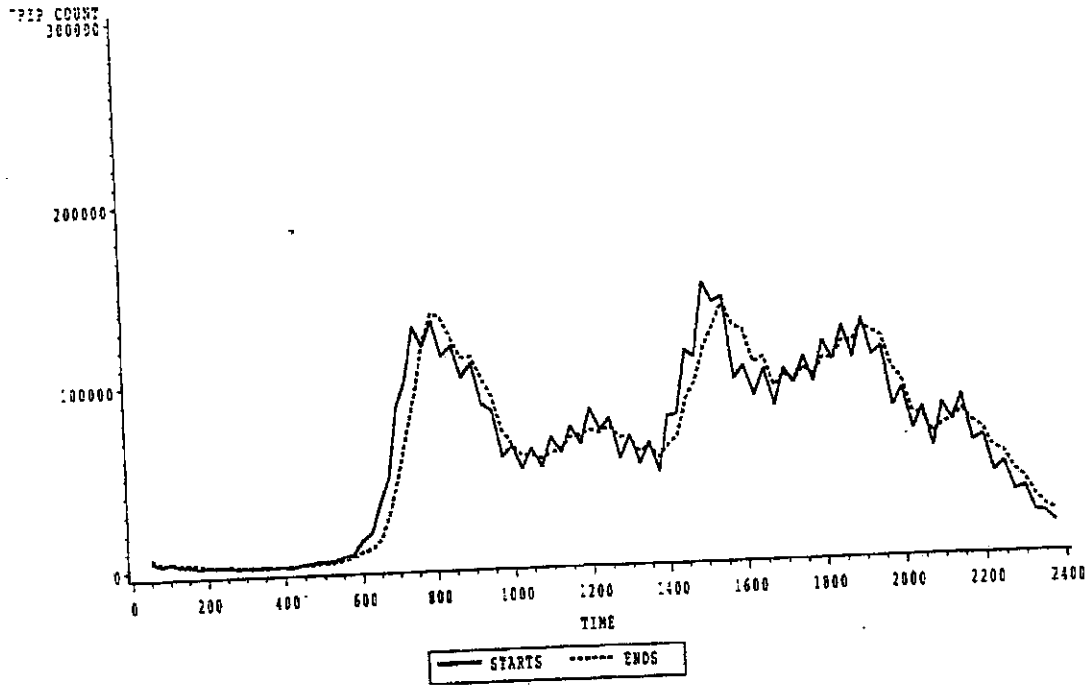
Figures 16, 17 and 18 show profiles for city, inner suburb, and outer suburb trips as percentages of all trips. By presenting the profiles as percentages the three figures can be more easily compared.

The graphs all have morning start peak periods from about 6 to 9 a.m. and peak returns of even higher volumes between 3 and 7 p.m. The city profile stands out with peaks of more

Figure 14

TRIPS BELONGING TO 'OTHER' CHAINS

THREE POINT MEAN SMOOTHING OF START AND END TIMES

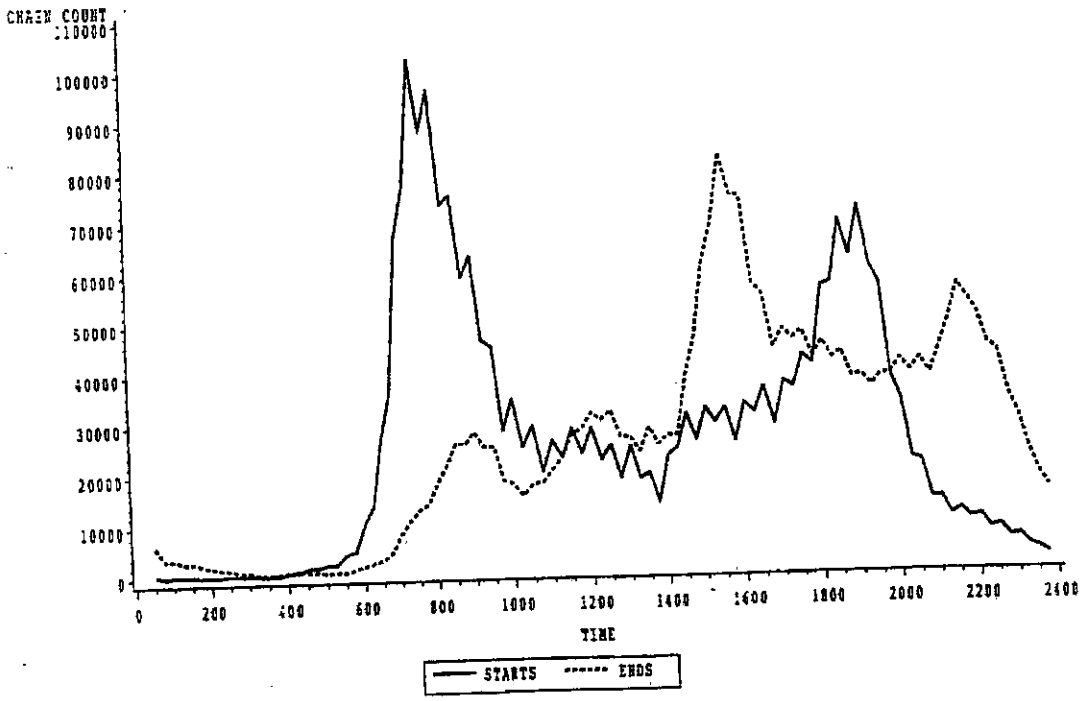


SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 15

'OTHER' CHAINS

THREE POINT MEAN SMOOTHING OF START AND END TIMES



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 16

CHICAGO TRIPS

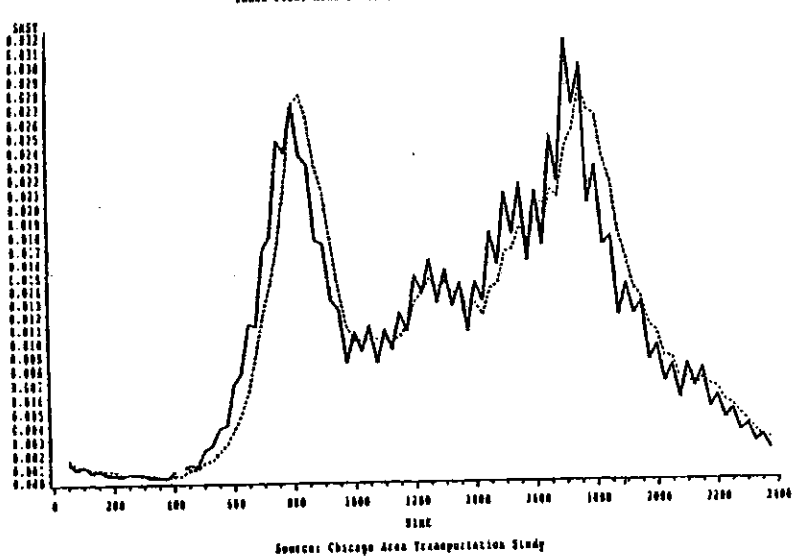


Figure 17

INNER SUBURBS TRIPS

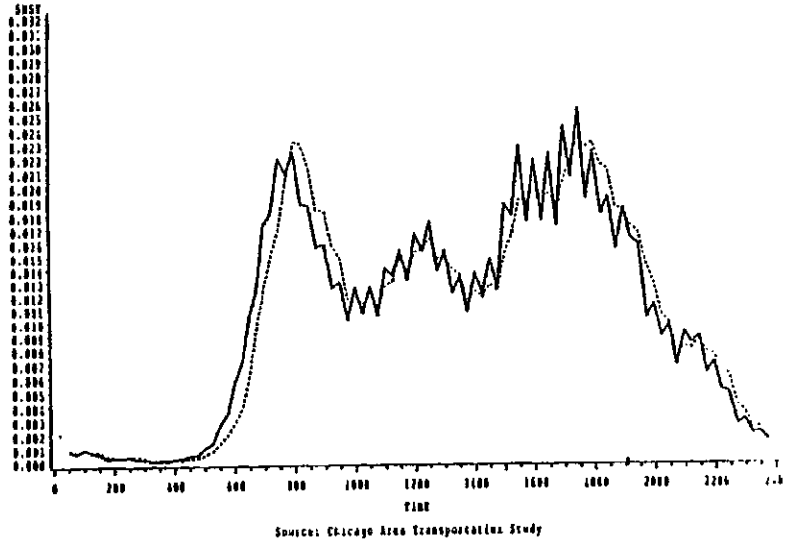
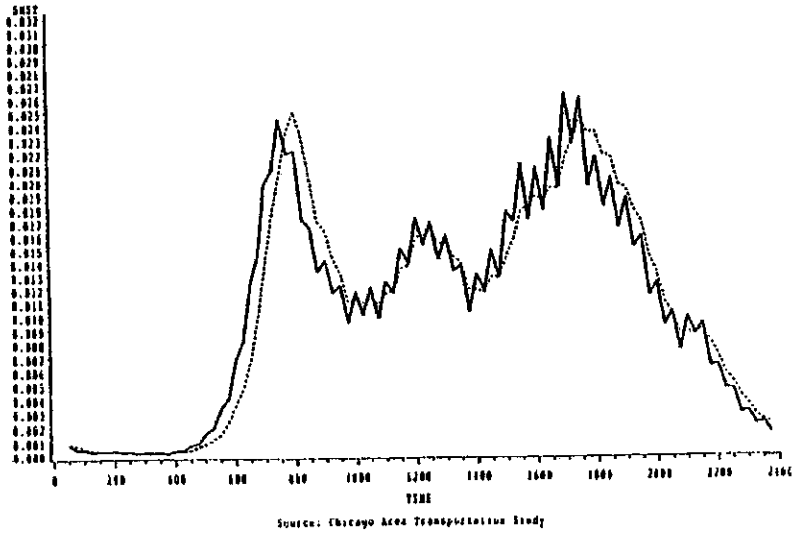


Figure 18

OUTER SUBURBS TRIPS



pronounced intensity and greater volumes. Evening travel in the city peaks at over 31 percent while suburban peaks do not exceed 27 percent. The lunch hour peaks of the suburbs, however, show higher numbers and longer durations. The city profile shows a steep drop-off of trips between 9:30 and 11 a.m., hours when suburban lunch trips are beginning. The city profile is also unique with relatively few trips occurring in the later evening hours.

These three figures show the role of public transit in the city profile. Transit is a high volume mode that permits the high peaks evident in the city figure. The higher midday volumes in the suburbs illustrate both the lower peaks and the necessity to use the highway system when it is less congested. This phenomenon is most evident in the inner suburbs where streets are most congested. In many of the outer suburbs highways are not yet as congested and peaking is a little more evident.

5.7 Travel Variations Between Workers and Nonworkers

Nonworkers tend to generate far fewer trips than workers do, as is shown in Figure 19. Workers experience an evening peak of almost 500,000 trips per fifteen-minute interval while nonworkers have a high of less than 170,000. As workers follow the morning, lunch, and evening peak patterns closely, nonworkers have a more relaxed profile. Nonworkers begin travel later in the morning (7:30 a.m.), and maintain a constant level through the midday. A peak from 2 to 4 p.m. may show a desire to avoid congestion produced later by workers. Beginning after the 4 p.m. peak, nonworker trips steadily diminish as the evening progresses.

5.8 Travel Variations by Sex

Figure 20 illustrates the differences in trip start times between men and women. While the two profiles appear very similar, women generate a greater number of trips. In the early morning, 4:00 a.m. to 7:30 a.m., men outnumber women but later in the morning women dominate. By 8:00 a.m. women far exceed men in trip starts and the pattern continues through the day and into the early evening. After 8 p.m. trip starts by both sexes become almost identical and by 9:30 p.m. trips by males outnumber trips by females.

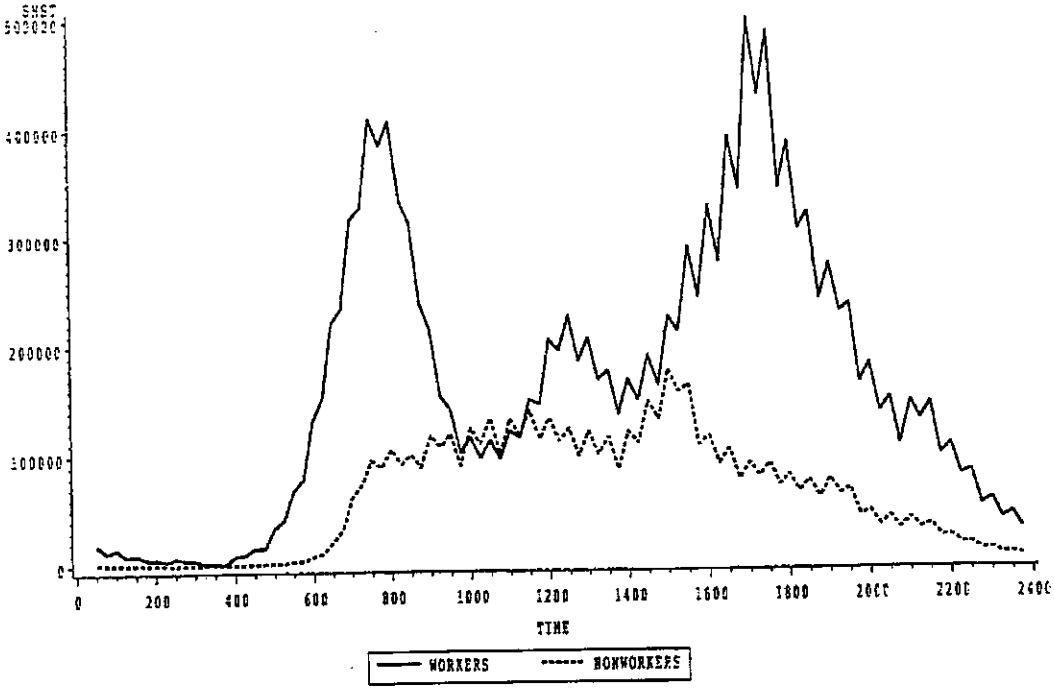
Figures 21 and 22 show trip differences for men and women using public transportation and walking. While these follow patterns are similar to that found on Figure 20, there are some differences. On the public transit profile men almost never outnumber women. The early morning numbers are very similar but after about 7:00 a.m. the women clearly demonstrate large volumes. This holds true for nearly the entire day, only in the late evening are the two gender groups again equally represented.

While the profile for walking trips is different than the profile for public transit (Figures 21 and 22), the gender differences are almost identical. Only in the late evening is there a modest difference. There are more late evening male walkers than female walkers, a point not true for public transit.

Figure 19

TRIP STARTS: WORKERS AND NONWORKERS

THREE POINT MEAN SMOOTHING OF START TIMES

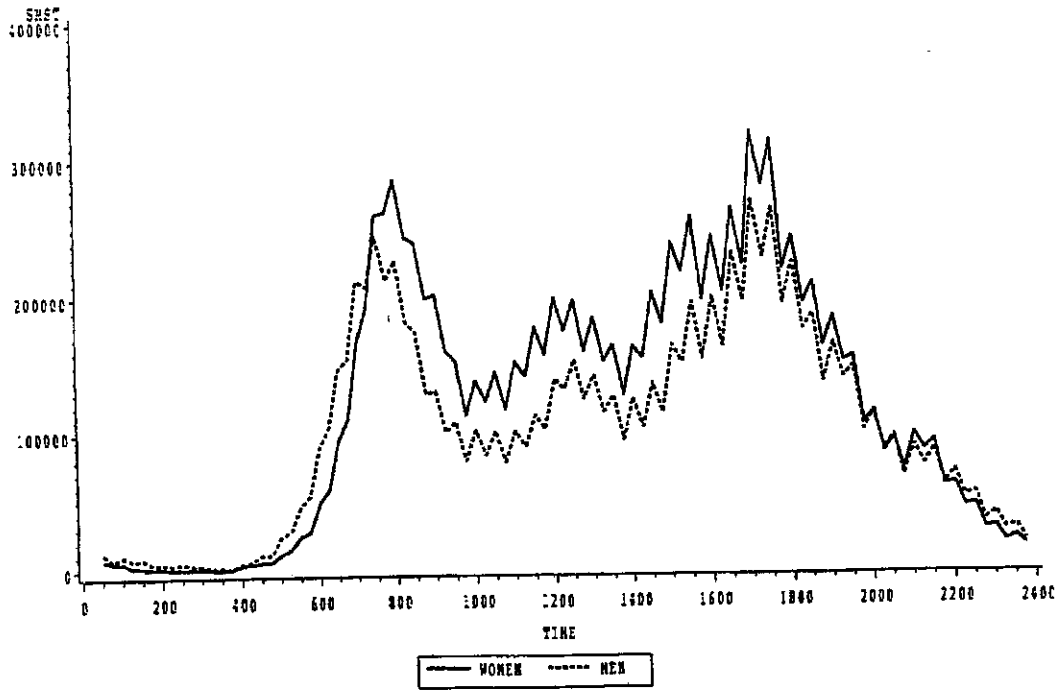


SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 20

TRIP STARTS: MEN AND WOMEN

THREE POINT MEAN SMOOTHING OF START TIMES

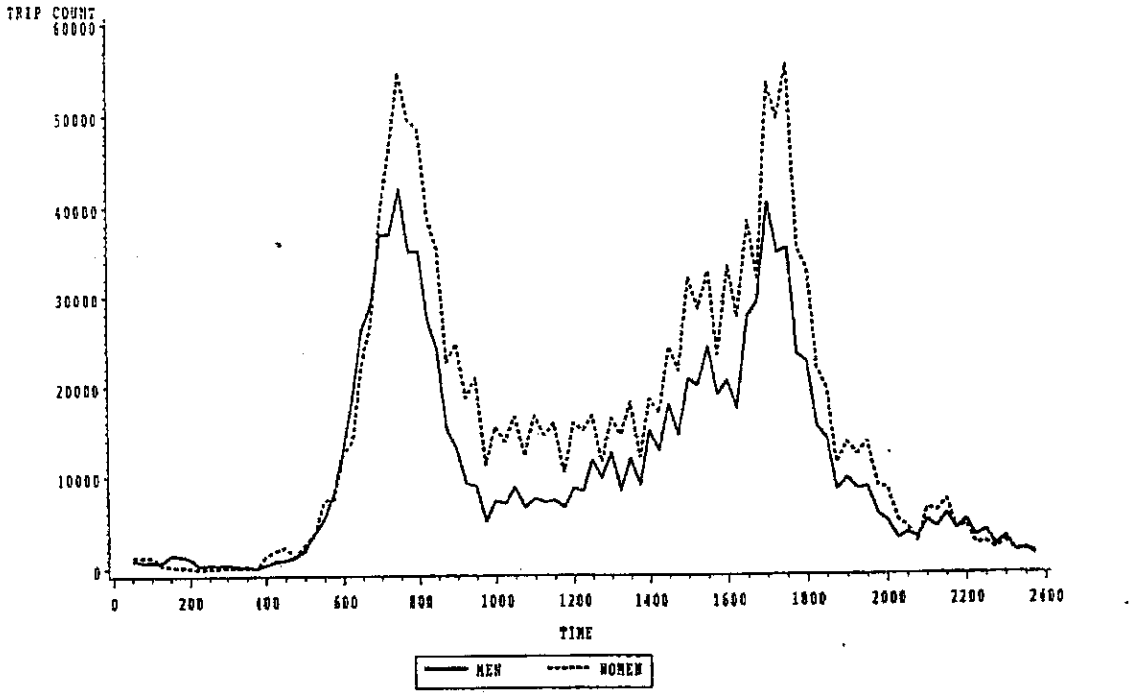


SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 21

PUBLIC TRANSIT TRIPS FOR MEN AND WOMEN

THREE POINT MEAN SMOOTHING OF START TIMES

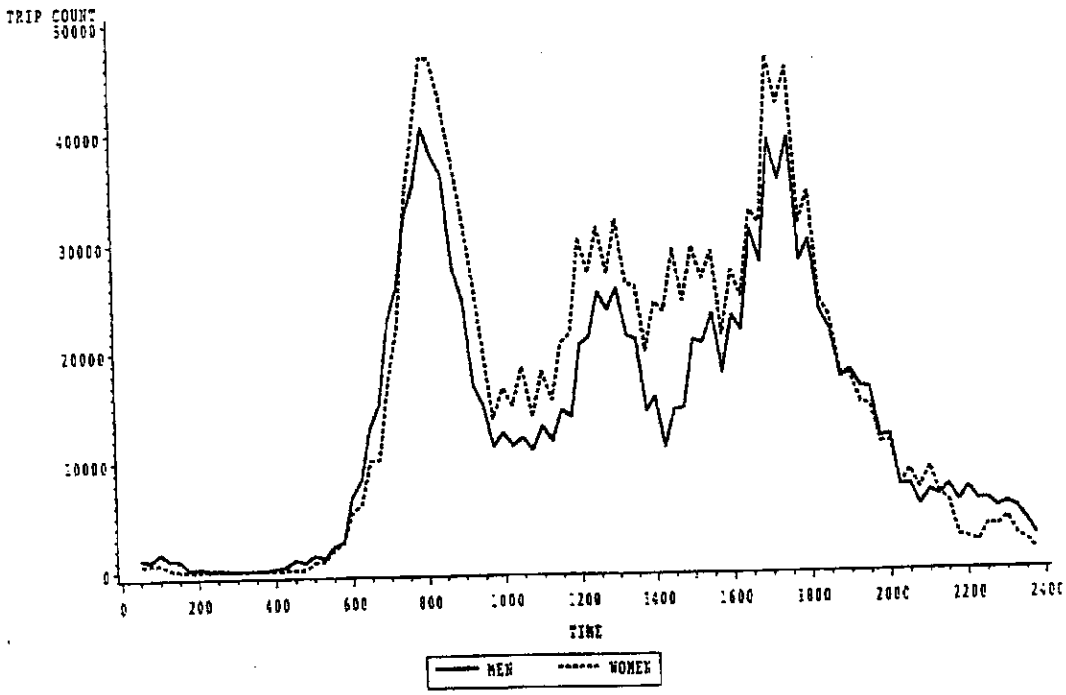


SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 22

WALKING TRIPS FOR MEN AND WOMEN

THREE POINT MEAN SMOOTHING OF START TIMES



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

5.9 Mode Usage

In this section we examine the nature of profiles by mode of transportation. We begin with the automobile (drivers) followed by public transit. Note again that the trips examined in the section on driving include all trips made in a chain in which there is at least one trip as a driver.

5.9.1 Trips in Driving Chains

An examination of the profiles for mode usage underscores the role of automobile use as the major factor in the 6:30-9 a.m. and 3-7 p.m. peak periods of travel and congestion. As a consequence the profile for all trips, Figure 5, very much resembles Figure 23.

5.9.2 Driving Chains

Driving chains (Figure 24) again resemble the profile for all trip chains (Figure 6). It is another reminder of why the evening rush period is so long and intense. The figure clearly shows that a large number of persons start their travel from home during the evening peak period. In fact there is a low of from-home travel at approximately 2 p.m. and the rate increases until 7 p.m. Because travel occurs in nearly all directions, not just toward the CBD in the morning and away from the CBD in the evening, this added travel makes the evening peak more intense and longer.

5.9.3 Trips in Public Transit Chains

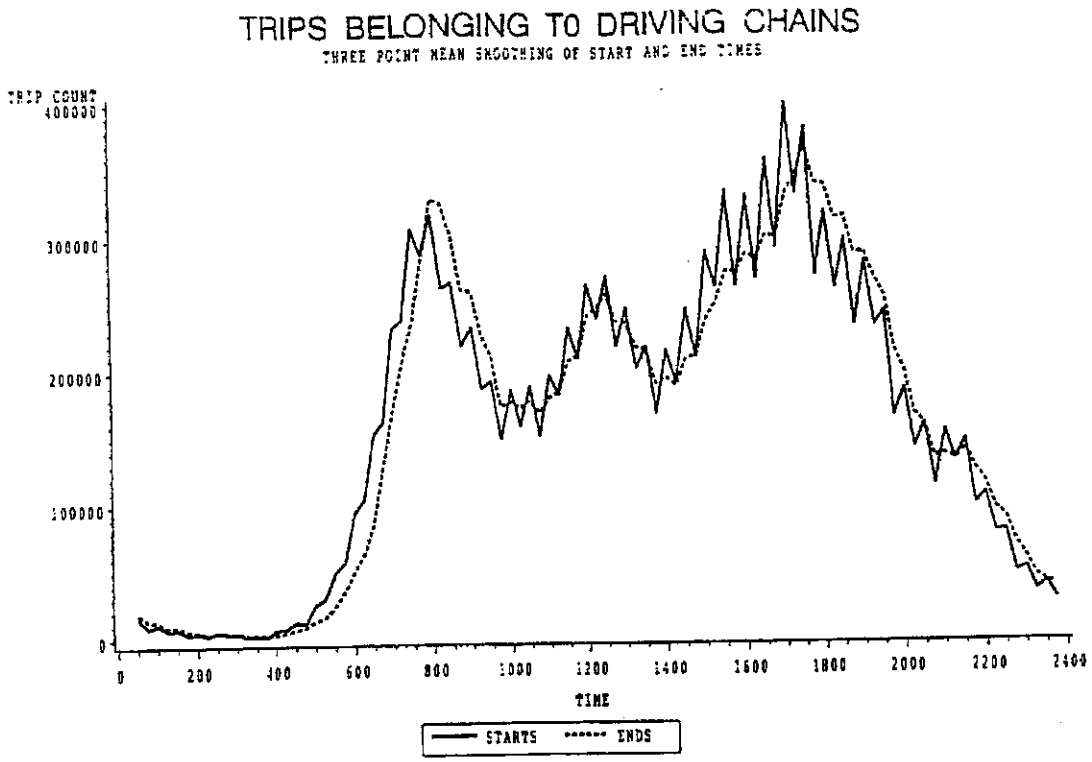
As might be expected trips in public transit chains exhibit a high degree of peaking (Figure 25). Most of the morning starts and ends are confined to the 6:30 to 9:30 a.m. period and there is again a peak in the afternoon from approximately 3 to 7 p.m. While the morning roughly resembles the peak for driving the afternoon driving peak is much longer (Figure 23).

The other distinguishing features are the very low transit use in the midday and again the low use in the evening after 7 p.m. Some suburban bus services terminate at this time of the evening, and not only special feeder routes.

5.9.4 Public Transit Chains

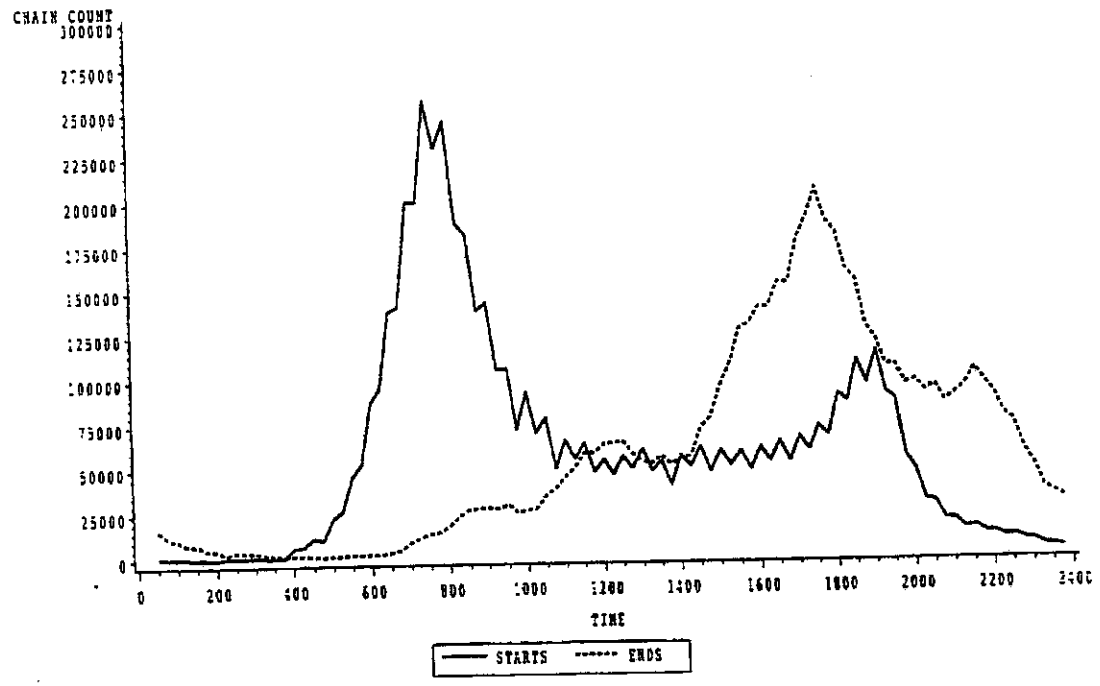
The public transit chain profile shown in Figure 26 is interesting in its clean division of chain start and end times. A peak between 6:30 and 9 a.m. contains almost all of the daily chain starts while the 3 p.m. to 7 p.m. peak comprises the great majority of all chain ends. Public transit use is clearly an efficient mode for work chains, but is far less frequently used in the evening for recreational and shopping trips. The convenience of the automobile is particularly noticeable in the evening. The mini peak seen at 7 p.m. for driving (Figure 24) is completely

Figure 23



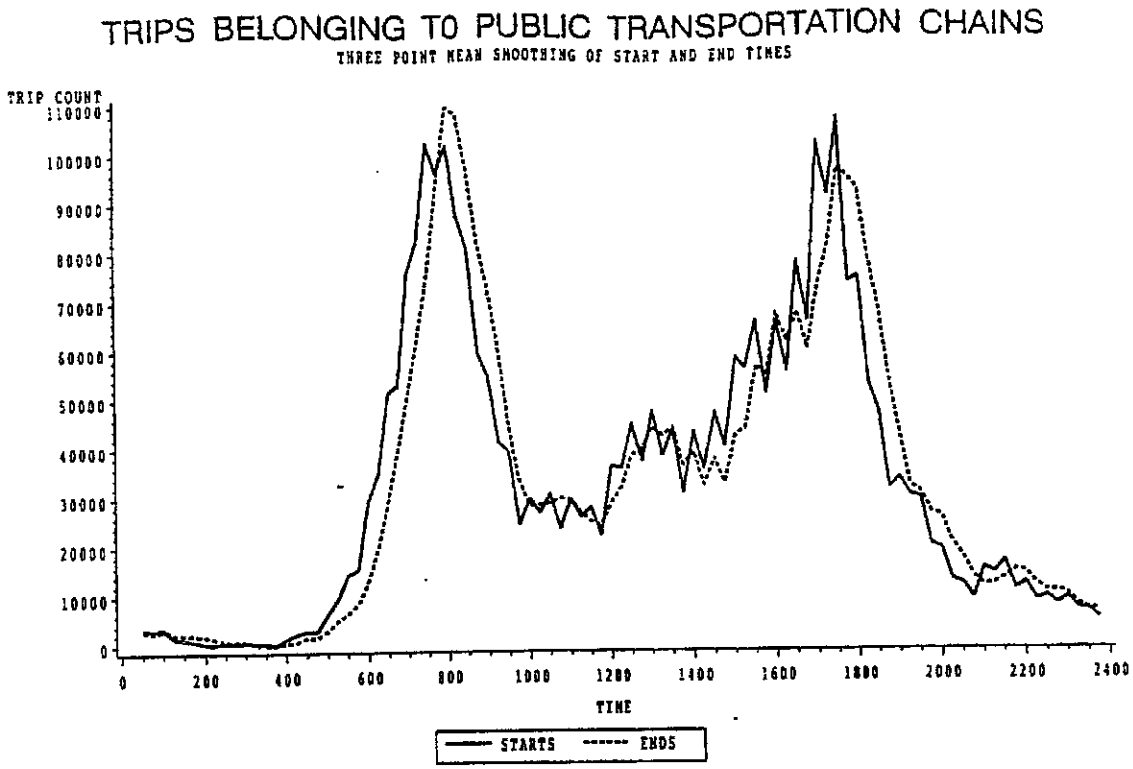
SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 24



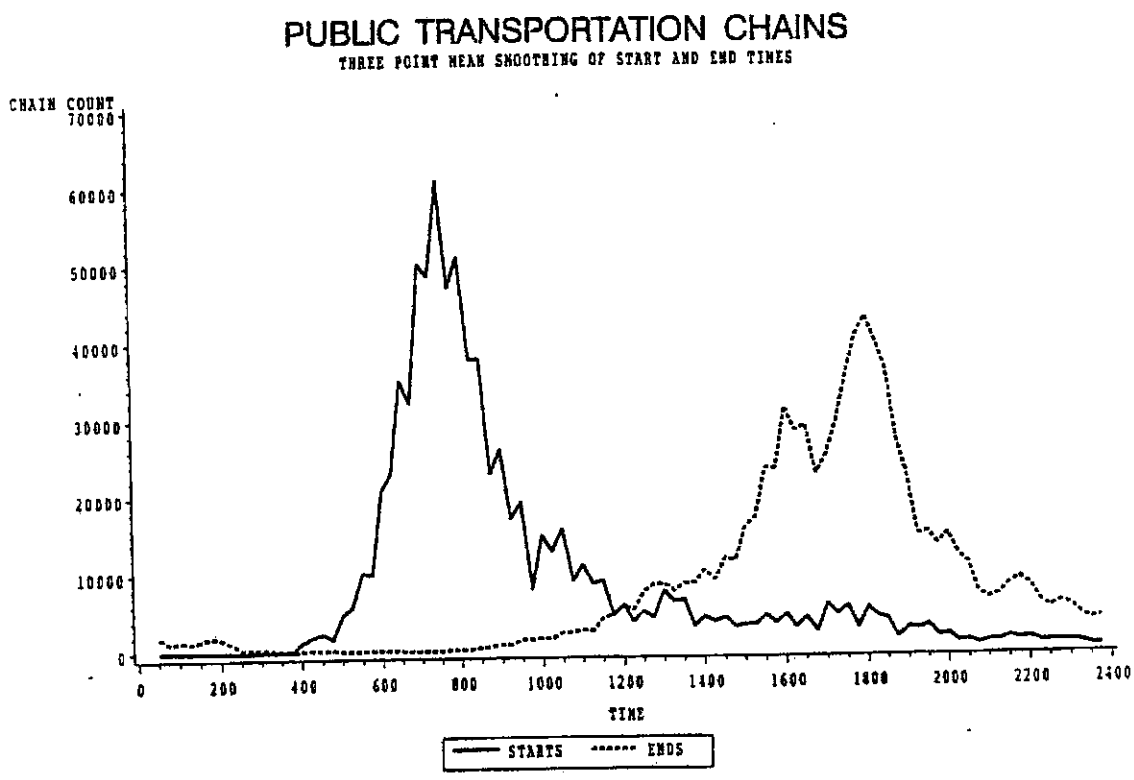
SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 25



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 26



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

absent on the public transit profile (Figure 26). This pattern prevails for both rail and bus usage.

5.9.5 Non-Auto Trips

Non-auto travel includes public transportation, school bus trips, walking and "other" modes. Figure 27 shows that walking trips conform to a pattern very reminiscent of motorized travel. The morning peak is high and pronounced and as high as the evening peak, but the latter is much broader. There is a very clear lunch-period rise and the afternoon off-peak is higher than the morning off-peak.

Combining all non-automobile trips yields a similar profile (Figure 28). The noon peak is much less pronounced, probably due to the extreme peaks of public transportation trips. Activity increases during the mid-afternoon between 2 and 4 p.m., as it did for public transit chains (Figure 26), perhaps reflecting school trips and a rush home before the real peak begins. Although school trips have an effect on many of these figures, it is mitigated by the fact that only persons fourteen and older are included in the CATS data.

5.9.6 Summary for Mode Use

With morning volumes of almost 260,000, driving-chain starts far surpass the public transit use peak starts of around 60,000 and the mixed mode peak of under 30,000 trip starts. Driving-chain peaks are almost bimodal, with the evening return peak being spread out over a longer period of time. Driving chain starts also have a substantial peak after 5 p.m. until about 7 p.m. and a return peak of similar value between 7 and 10 p.m. The independence offered by the automobile allows for post-work trips at relatively high levels, increasing congestion in the evening hours.

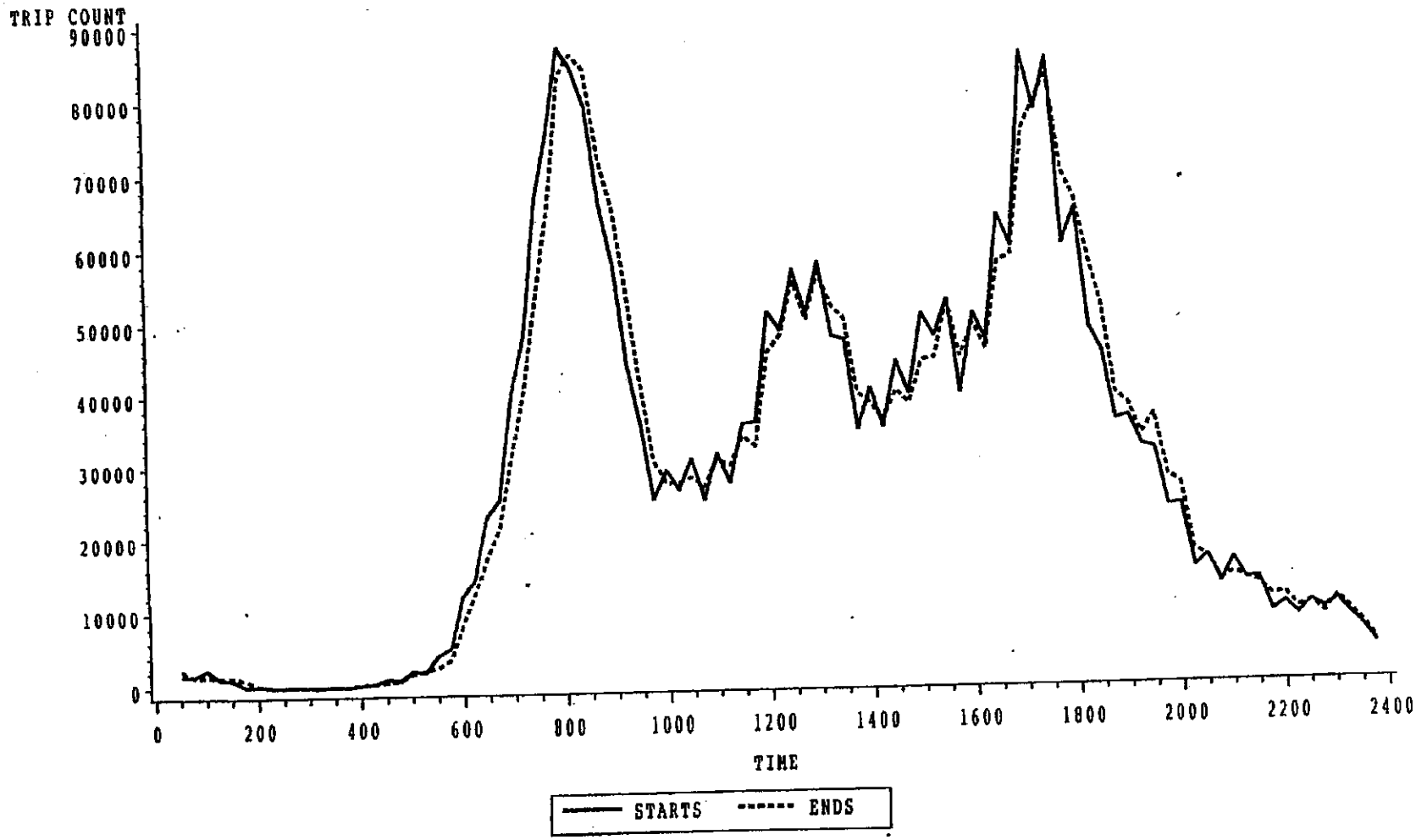
6.0 Conclusions

In the decades since the 1956 CATS survey travel behavior has seen many changes; however, work trips and chains in 1990 still conform to "traditional" peak patterns around the nine-to-five workday. Morning traffic of all types tends to confine itself to the peak period until shopping becomes prevalent at about ten o'clock. There are shifts in the declining degree of peaking with CTA rail and more peaking associated with bus use but the largest change seems to be in the midday. There is now much more activity during the extended lunch period. Partly to compensate for this there is now less travel in the evening. In the evening there is much more trip chaining, travel to destinations other than home. In 1956 there was much more of a tendency to go home after work and then to go out to socialize and recreate. By 1990 travelers reached home much later in the day and were far less likely to go out for social and recreational purposes. Some of these changes may, however, be attributable to differences in the 1956 and 1990 data collection procedures.

Figure 27

WALKING TRIPS

THREE POINT MEAN SMOOTHING OF START AND END TIMES

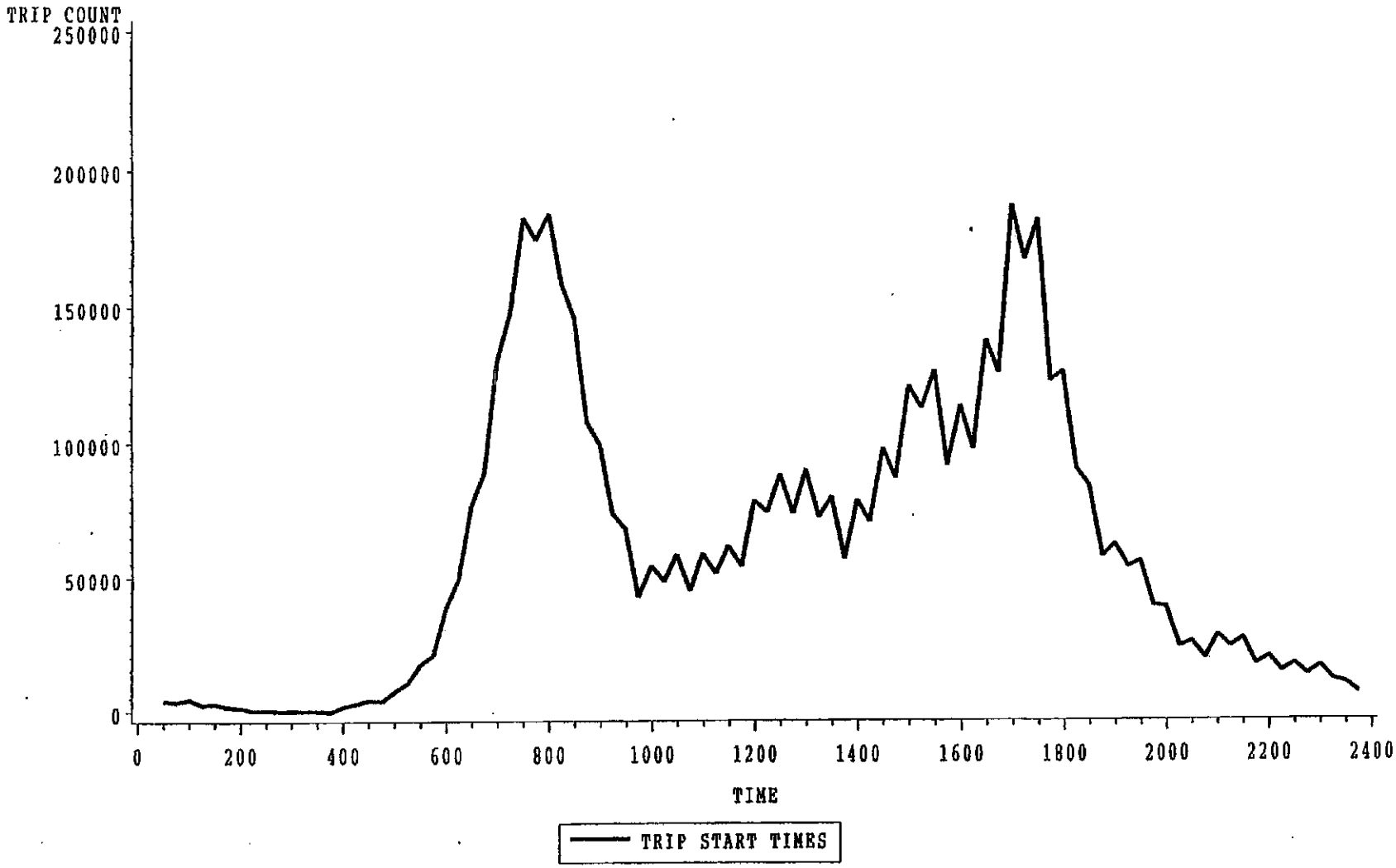


SOURCE: CHICAGO AREA TRANSPORTATION STUDY

Figure 28

TRIPS MADE WITHOUT USE OF AUTOMOBILES

THREE POINT MEAN SMOOTHING OF START TIMES



SOURCE: CHICAGO AREA TRANSPORTATION STUDY

While the trips to and from work conform to the very strong morning and evening peaks, shopping activity starts after 9 a.m. and remains nearly steady until approximately 8 p.m. Combining recreation, banking, eating out and other trip purposes into one category yields a mixed profile of trips. Expectedly most travelers know the peak travel times and nonworkers avoid the peaks especially the evening peak which is longer and more intense.

The peaking is also much more associated with public transit than use of the automobile. One of the clear advantages of public transit is that it can readily accommodate more peaking than highways. This can be seen in profiles depicting trips by mode as well as on profiles for the more transit-oriented city of Chicago in contrast to the more automobile oriented suburban areas. The outer suburbs, however, have slightly more peaking than the inner suburbs, suggesting a greater highway capacity, which does not as quickly reach saturation.

Finally, the travel profiles imply that gender parity has been achieved in transportation. There are more females than males in Chicago and they account for more travel, however, their travel profiles are very similar. Nevertheless there is a tendency for males to travel earlier in the morning and later in the evening.

These profiles illustrate that there remain great variations within daily travel. The morning peak, largely from 6:30 to 9:30 is shorter and has less traffic than the 3:00 to 7:00 p.m. peak. Within the aggregate there are individual trip purposes and travelers that display very different profiles. Any statement, therefore, about the length of the peak versus off-peak period, then, needs to clarify which travel activity is being described.

Chapter Three

Overview of Nonwork and Off-peak Travel in the Chicago Metropolitan Area

1.0 Introduction

To promote the use of public transit and nonmotorized forms of travel during off-peak periods and for purposes other than work, we need to understand the fundamental characteristics of travel behavior, most importantly mode split, trip purpose and time of travel. This chapter provides that overview.

The overview consists initially of a discussion of the principal data source and the definitions of key terms. This is followed by an examination of a) modes used, b) travel by time of day and c) trip purpose. Before the conclusions are presented there is a section devoted to work-related trips, an area of growing importance but one that is not extensively studied. In developing this chapter an effort is made to divide the discussion into logical sections and subsections but there will be considerable, unavoidable overlap between sections.

2.0 Data and Definitions

2.1 Data

The only data set that provides comprehensive information on nonwork travel throughout the Chicago area is the 1990 Chicago Area Transportation Study Household Travel Survey (CATS HHTS). The survey contains information on 19,314 households, 40,568 travelers and over 162,755 trips. For bus trips, information about the number of blocks to the bus stop and the number of blocks from the bus to the final destination is included as information about the bus trip. The CATS HHTS, however, includes access to and egress from rail transit (Chicago Transit Authority's rapid transit system and the Metra commuter rail) as separate trips; this is done for the purpose of studying access and egress travel. "Change of mode", therefore, is reported as the trip purpose at both the beginning and end of the rail trip. The desire for a meaningful rail-trip purpose (other than change of mode) and equal treatment of bus and rail trips called for restructuring the CATS HHTS data.

A new data structure was created in which trips to and from rail were linked to and defined as one with the rail trips. The access origin and the egress destination information replaced the location of the train station in the new configuration. This achieved both the desired symmetry between bus and rail trip information and the ultimate destination as the purpose of the rail trip.

There were approximately four and one-half thousand rail trip records in the original file. With one access and one egress record for each rail trip, there was a drop of approximately nine thousand records from 162,755 to 153,603. The modified file, when factored to include all the trips in one day in the seven-county study area totaled 19.7 million trips. This modified file was prepared for this chapter and all tables are derived from the modified file. Neither the CATS HHTS person nor household files were altered. Use of the original CATS HHTS data would produce different results than those presented here.

2.2 Definitions

While most of the terms used in this report are relatively common in transportation literature, they still need operational definitions to clarify their use in this study. Four terms are defined: mode, trip purpose, off-peak period and derived speed.

2.2.1 Modes Used

This study includes ten modes: walk, priva
te vehicle driver, private vehicle passenger, school bus, Pace bus, Chicago Transit Authority (CTA) bus, CTA rail, Metra commuter rail, taxi and "other". In this report the four public transit modes, Pace, CTA bus, CTA rail and Metra, are usually combined into one "public transit" mode; school bus is not included as a public transit mode. Bicycle use was not provided as a separate check-off category but respondents were presented with option of using the choice "other" and also with a blank field to fill in the word bicycle or any other word as the mode. Since it was not possible to ascertain how often bicycle users checked the category "other" but did not write anything in the blank field, we did not tally bicycle use in this chapter. It would have resulted in numerous unresolved questions.

2.2.2 Trip Purpose

The CATS HHTS reports trip purpose at the start and end of each trip in eleven categories. These are: work, work related, school, shopping, eat meal, banking, recreational, pick up/drop off passengers, change of mode, return home and "other". "Personal business" was used in the 1970 CATS HHTS and it has been used in other surveys but was replaced by banking, eat meal and "other". Deleting "personal business"

as a purpose clarified the choices for the respondents, but the "other" category is now larger including other personal activities such as visiting a physician or a personal attorney in addition to non-personal "other" activities.

Despite the improvement in trip-purpose information, each trip has two ends and is frequently linked to subsequent trips, so it is not always obvious how to categorize a trip. For example, a work trip includes at least all trips that end at work. Trips that have work as their starting point, however, have a variety of destinations. Over 40 percent (Table 1) are to nonhome destinations, even to another job. Should all trips from work be considered as work trips? If the answer is yes, then the large percentage of trips by walking to shopping, eating, banking and recreational destinations would noticeably decrease work-trip lengths. For this reason, in most of this chapter only trips *to work* are examined and reported.

Table 1

Destinations of Trips from Work
(in percent)

Mode → / Purpose ↓	Walk	Private Vehicle	Public Transit	Other	Total
Work	5.8	89.9	2.4	1.9	4.0
Shop/eat/bank	16.9	78.7	3.2	1.2	15.8
Recreation	14.5	79.0	5.1	1.4	2.9
Home	4.0	86.9	7.9	1.2	52.8
Other	29.5	60.0	8.0	2.4	24.5
Total	**12.7**	**78.9**	**6.9**	**1.5**	**100.0**

Another important relationship made clear in Table 1 is the number of trips from work that utilize public transit. Trips home and to "other" destinations show the highest use of public transit, albeit only 7.9 and 8.0 percent, respectively. If personal business is the destination (shop, bank or eat) then the percentage drops to 3.2. This indicates that public transit is used less frequently if there are intermediate stops on the way home from work. This supports the conventional wisdom that public transit is not as conducive for trip chaining as other modes, particularly the automobile.

Conversely, walking is more frequently used for these intermediate stops than public transit. Walking is used for 14.5 percent of the recreation destinations and 16.9 percent of the shopping, eating out and banking destinations. The respective levels for public transit are 5.1 and 3.2.

2.2.3 Off-peak versus Peak Period

Based on the data examined in Chapter 2, the peak periods are defined as the morning 6:30 to 9:30 a.m. period and the afternoon 3:00 to 7:00 p.m. period. The afternoon peak is an hour longer than the morning peak since it includes a greater variety of travelers, such as retired persons and others not in the work force. The off-peak includes travel during the middle of the day, as well as evening and night travel.

2.2.4 Speed Derived from Trip Length and Travel Time

Data on average trip lengths and average travel times can be used to estimate travel speeds. There are several reasons why this calculation may not reflect actual speeds. First, the travel times are self-reported and may not be accurate. Second, the trip length is computed from a traffic analysis zone system in which the zones are approximately one-half mile by one-half mile. The trip lengths are estimated from zone centroid to zone centroid. Third, there is no route information.

Nevertheless, converting travel time into hours and dividing it into the trip length yields a number that approximates relative speed. This can be used to compare between trip purposes and between counties. In this comparative context its use is appropriate since it is not a statement of actual speeds, thus we use the term *derived speed.*

3.0 Variations in Mode Use

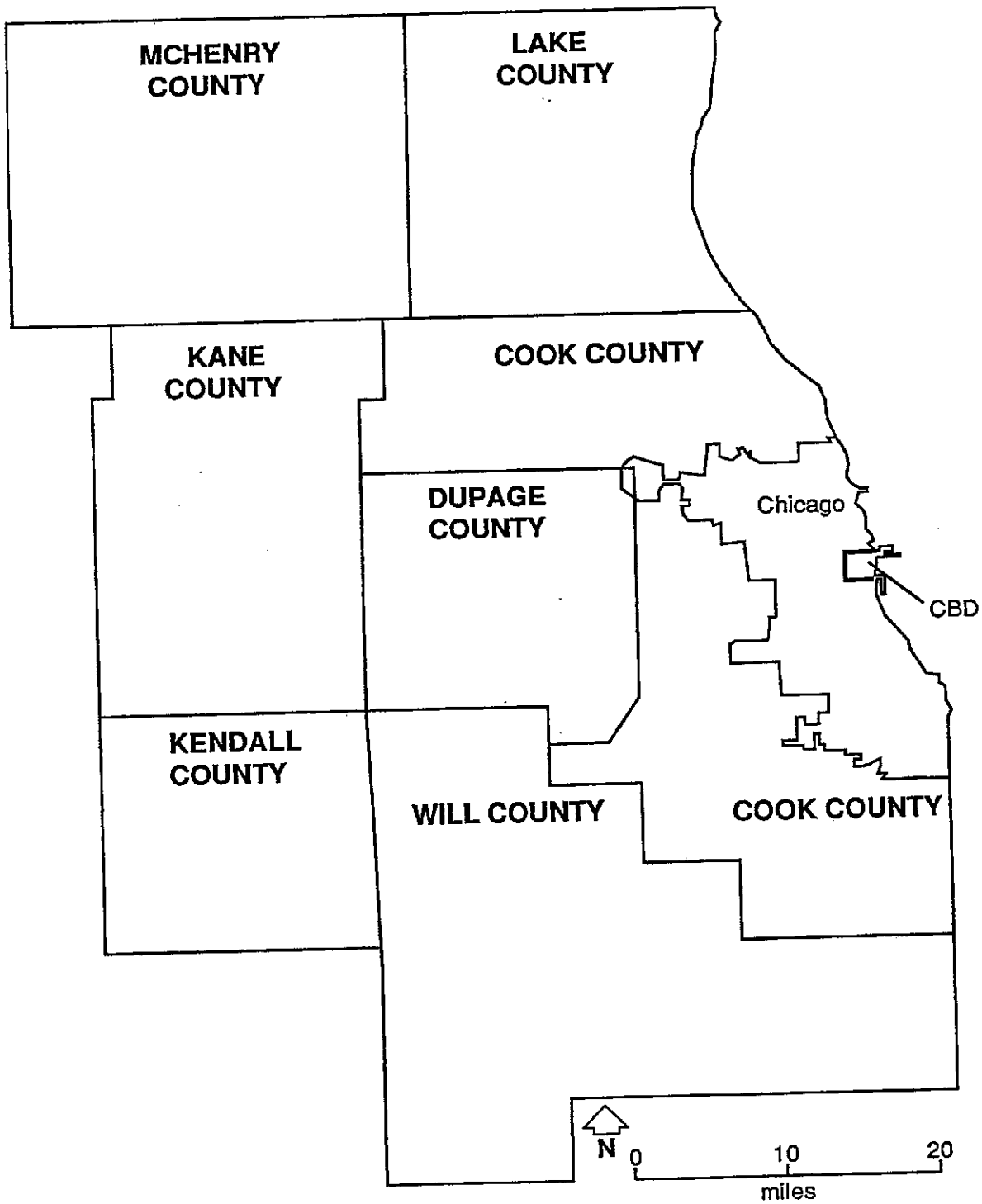
3.1 Mode Use by Place of Residence

Table 2 shows the regional variation in the use of three modes: walk, private vehicle (automobile) and public transit. The table lists data for seven counties with Cook county being divided into the Chicago CBD, the rest of Chicago and suburban Cook county (Figure 1). Eight of nine of these places are ranked in order of population density. The Chicago CBD, an area with more workers than residents, is the exception. The rank order is intended to reflect the distance from the Chicago CBD and the intensity of urban activity in the nine places. The distance from the CBD is a surrogate for a number of measures including the density of the public transportation network.

Since a large proportion of CBD destinations are in close proximity, those who reside there are much more inclined to walk to their destinations than residents of other places. In fact, over 40 percent of the trips are on foot. In the rest of Chicago, this percentage drops to approximately one in six trips and to only one in twenty in suburban Cook county.

Figure 1

Nine Places of Residence Used in the CATS Household Travel Survey



Outside Cook county the percentage of trips by walking is largely a function of the existence of large older downtown areas. Kane county has two large urban clusters, Aurora and Elgin, and the highest percentage of trips by walking, albeit only 3.7. DuPage county has a number of old communities such as Hinsdale and Elmhurst with thriving downtown areas, although they are smaller than those of the other satellite cities. Will and Lake counties both have large cities, Joliet and Waukegan respectively, while neither McHenry nor Kendall counties have established large cities. These latter two counties have the lowest percentages of trips by walking.

Table 2

Modes Used for All Trips
(Trips in percent by place of residence and 'All Trips' in millions)

Mode → / Place ↓	Walk	Private Vehicle	Public Transit	All Trips*
Chicago CBD	42.4	32.6	17.4	0.2
Rest of Chicago	16.3	58.5	22.9	6.5
Suburban Cook	5.2	88.6	4.1	6.6
DuPage	3.3	92.1	2.6	2.4
Lake	2.6	93.7	1.8	1.5
Kane	3.7	93.0	1.4	0.9
Will	3.1	92.5	1.5	1.0
McHenry	1.8	94.6	1.2	0.6
Kendall	2.4	95.4	0.4	0.1
Total	**8.4**	**79.8**	**9.5**	**19.7**

* Includes "other" trip modes not shown in the rest of the table.

Suburban Chicago has almost equal percentages of trips by walking and public transit; nearly all of the percentages are less than five. This is not true in the city of Chicago where walking is far more common than public transit use in the CBD, although transit use is higher than walking in the rest of the city. There are also some exceptions in suburban Chicago. Kane county shows slightly less public transit use than would be predicted from the intensity of urban activity and walking. Kendall county does not follow the pattern either, but has very limited transit service and is by far the county with the fewest residents and survey respondents.

Travel by private vehicle shows a consistent pattern, increasing with distance from the Chicago CBD. Based on the order adopted for Table 1, Will county is the biggest exception. With 92.5 percent of trips by private vehicle, it is the only county out of order by one percentage point or more.

3.2 Trip Mode by Travel Purpose

While most of the tables in this chapter combine all public transit modes into one category, Table 3 shows both the mode detail for the four modes that constitute public

Table 3

Trip Mode and Trip Purpose at Destination
Values in percent except the last column and row
Trip length in miles and travel time in minutes in **bold** type

Purpose→ / Mode ↓	Work	Shop/Eat /Bank	Recreation	Home	Other	Total	Length **Time**
Walk	6.6	10.5	12.1	8.0	8.4	8.4	0.5 **13.4**
Auto	78.6	83.5	79.5	78.9	79.4	79.8	5.0 **20.8**
Pace	0.3	0.6	0.3	0.5	0.6	0.5	4.3 **32.6**
Metra	3.2	0.2	0.3	1.6	0.5	1.3	20.0 **67.2**
CTA Bus	5.7	3.5	3.6	6.1	5.8	5.4	3.7 **41.0**
CTA Rail	4.2	1.0	0.7	2.7	1.7	2.4	7.6 **55.1**
Public Transit	*13.4*	*5.2*	*4.9*	*10.9*	*8.6*	*9.5*	6.9 **47.6**
Total	100.0	100.0	100.0	100.0	100.0	100.0	--
Share	17.9	16.4	5.4	36.0	24.2	100.0	--
Length **Time**	7.2 **29.1**	2.9 **15.8**	4.9 **22.6**	4.8 **24.3**	4.4 **21.5**	- -	4.8 **23.0**

transit and the four modes combined. It shows that the rail modes are much more work-trip oriented than the bus modes. Metra is the best example. Whereas 3.2 percent of all work trips in the Chicago area are by Metra, only 1.3 percent of all trips are by this rail mode. By contrast, Pace work and total trip percentages, 0.3 and 0.5 respectively, exhibit the opposite relationship; Pace is used more for nonwork trips than for work trips. On the other hand, only a small portion of Metra trips are for shopping or recreation. CTA rail has higher shopping and recreation percentages but it still only accounts for one trip in a hundred.

As a whole, public transit accounts for 9.5 percent of all trips in the region. Work trips contribute substantially to this total, with approximately one in seven work trips using public transit. Shopping and recreational trips are far less important with just over one in twenty trips using public transit.

The pattern for walking is rather different. Walking to recreational destinations is relatively common and shopping, eating out and banking also have over ten percent of their trips by foot. Work destinations, however, attract a smaller percentage of trips by walking. This suggests that recreational destinations are the most ubiquitous and work sites are either more clustered or that there is more separation, i.e., between homes and places of work.

3.3 Modes Used by Work and Nonwork Trips

Since one of the major themes of this study is nonwork trips it is necessary to establish the differences in mode split between work and nonwork trips. Nonwork trips include, unless otherwise stated, all trips except those to work. It also includes work-related trips, trips made from work and the shopping and recreation trips discussed in Section 3.4.

Common wisdom suggests that public transit is used for work trips and the use of private vehicles is much more common for other trip purposes. This common wisdom holds in suburban areas but is less evident in the city of Chicago (Table 4). In the Chicago CBD the use of transit is almost as prevalent for nonwork trips as it is for work trips, 16.4 percent and 20.4 percent respectively. In the rest of the city work-trip public transit use is about seven percentage points higher than nonwork-trip public transit use. While the absolute differences are smaller in suburban areas, there are approximately two to three times as many work trips as nonwork trips by transit.

The private vehicle usage pattern is the complement of the public transit trip pattern. The use of private vehicles in most places is higher for nonwork trips than for work trips, or else the percentage is so high for both that the difference is minor. In Kane and Will counties the percentage of work trips by private vehicle is higher than for nonwork trips, but in both counties there is a substantial amount of nonwork travel on foot.

Walking trips are generally more common for nonwork trips. Work trips tend to be the longest of all conventional trips, and thus less suitable for walking. Only in the Chicago CBD and in Kendall county are there higher percentages of work than nonwork trips by foot. In Kendall county the higher value for work trips could well be attributed to the small sample size.

3.4 Mode Use for Shopping and Recreational Trips

Regionwide there were approximately 13 percent of work and 9 percent of nonwork trips by public transit (Table 4), but only 5 percent of shopping and recreational trips were by

Table 4

Modes Used by Place of Residence to Work and Nonwork Destinations
Percentages summed across total 100
Work trips are in regular font and nonwork trip percentages are in **Bold** type

Mode → / Place ↓	Walk	Private Vehicles	Public Transit	Other	Total
Chicago	46.0	26.7	20.4	6.9	1.5
CBD	**41.2**	**34.6**	**16.4**	7.7	**1.0**
Rest of Chicago	11.2	58.5	28.0	2.2	33.3
	17.5	**58.5**	**21.7**	**2.3**	**31.9**
Suburban Cook	4.6	86.6	7.7	1.2	31.9
	5.3	**89.1**	**3.4**	**2.3**	**34.3**
DuPage	2.6	90.9	6.0	0.6	12.6
	3.4	**92.4**	**1.8**	**2.4**	**12.2**
Lake	1.9	94.0	3.7	0.4	7.7
	2.3	**93.6**	**1.3**	**2.3**	**7.4**
Kane	1.8	95.6	2.2	0.4	4.6
	4.1	**92.4**	**1.2**	**2.4**	**4.7**
Will	1.4	95.1	2.9	0.7	5.0
	3.5	**91.9**	**1.2**	**3.4**	**5.1**
McHenry	1.2	95.0	2.8	0.9	2.9
	2.0	**94.5**	**0.8**	**2.7**	**2.8**
Kendall	2.7	95.2	1.1	1.0	0.6
	2.3	**95.4**	**0.2**	**2.1**	**0.6**
7-county Total	6.6	78.6	13.4	1.4	100.0
	8.9	**80.0**	**8.7**	**2.4**	**100.0**

public transit (Table 5). Only in the city of Chicago were the percentages for shopping and recreation in the teens and there is little difference between the two trip purposes in the use of public transit. In suburban Cook county only 2.2 and 1.1 percent of the shopping and recreational trips were by public transit, respectively. While these percentages are low, they are even lower in the other counties.

Table 5

Modes Used by Place of Residence to Shopping and Recreational Destinations

Percentages summed across total 100

Shopping trips are in regular font and recreational trips are in **Bold** type

Mode → / Place ↓	Walk	Private Vehicle	Public Transit	Other	Total
Chicago CBD	56.4 **34.8**	29.4 **42.5**	11.1 **11.0**	3.1 **11.7**	0.9 **1.4**
Rest of Chicago	24.3 **22.0**	60.0 **59.2**	14.5 **14.6**	1.3 **4.3**	28.6 **27.8**
Suburban Cook	5.6 **8.4**	91.5 **87.3**	2.2 **1.1**	0.7 **3.2**	36.8 **42.8**
DuPage	3.3 **8.6**	95.8 **88.2**	0.5 **0.2**	0.4 **3.1**	12.5 **10.7**
Lake	2.8 **4.4**	96.1 **91.2**	0.7 **0.9**	0.5 **3.5**	7.8 **6.4**
Kane	2.5 **8.3**	96.4 **86.8**	0.8 **2.4**	0.3 **2.5**	4.6 **4.0**
Will	2.7 **6.9**	95.0 **89.9**	0.7 **0.0**	1.6 **3.2**	5.1 **3.6**
McHenry	1.7 **4.4**	97.4 **92.9**	0.3 **0.2**	0.6 **2.5**	3.1 **2.8**
Kendall	1.5 **4.4**	98.1 **92.6**	0.1 **0.0**	0.3 **3.1**	0.6 **0.4**
7-county Total	10.5 **12.1**	83.5 **79.5**	5.2 **4.9**	0.9 **3.6**	100.0 **100.0**

The values for walking, however, are higher for shopping and recreational trips. In both the Chicago CBD and in the rest of the city recreation-destined walking was less prevalent than walking to shop. In places like DuPage, Kane and Will counties the walking percentage for recreation was more than double the percentage for shopping. This suggests that there are more recreational activities than shopping destinations close to home or simply that private vehicles are preferred for shopping.

The tendency to use private vehicles for shopping is well documented in Table 5. In each of the collar counties, outside of Cook, the mode share for private vehicles was over 95 percent. Generally the order of private vehicle use seems to be for shopping, nonwork, work and recreation (both shopping and recreation are subcategories of nonwork).

3.5 Mode Use and Trip Lengths

Measured in both travel time and trip length the longest trips are by public transit. The popularity of both Metra and CTA rail contribute to the high average study-area values at 6.9 miles and 47.6 minutes (Table 6). The effect of Metra can be seen in the average public-transit-trip length increase from 3.4 miles for CBD residents to 37.2 miles for Kendall county residents, where Metra is nearby but CTA is unavailable. Average public transit travel times grow from half an hour in the CBD to an hour and a half in Kendall county. McHenry county is similar but with several Metra stations and some local bus service the average transit travel time is slightly less.

Perhaps one of the most interesting outcomes in this study is found in the private vehicle column (Table 6). This shows a pattern of increasing trip lengths but declining travel times with increasing distance from the Chicago CBD. The longest average trip lengths are in low-density counties such as McHenry, Will and Kendall. The shortest are in the city of Chicago outside the CBD. CBD residents are not automobile users like suburbanites and therefore when they use a private vehicle it is for a long trip. In fact the CBD residents have the highest average private vehicle trip lengths. They also have the highest travel times.

The shortest private vehicle travel times are in four suburban places: Kane, Lake, Kendall and DuPage counties. Close-in DuPage county has a high density of urban destinations and it is not unexpected that residents have short trip lengths. Kane is a great distance from Chicago but has two large urbanized areas - Aurora and Elgin. Apparently many destinations are relatively close (4.7 miles), but despite these higher density cities the travel times are also low. DuPage county does not have large central cities, but it has an almost uniform distribution of residents, jobs and other urban travel destinations. *All of the suburban counties have lower average travel times by private vehicle than Chicago residents.* Given the rising standard of living and the rising value of leisure time, travel time may well be more important to travelers than trip length.

The travel time advantage is even greater when all trips and modes are considered. Even though suburban public transit trips are exceptionally long they are relatively few in number and do not greatly influence the overall average trip lengths or times. While most suburban counties' average travel time hovers near twenty minutes, the average in the city of Chicago is approximately 27 minutes. Private vehicle travel time in the city of Chicago is only about two minutes higher than that in the suburbs. Thus, a major reason for longer average travel times in the city of Chicago is that more trips are by transit.

Table 6

Trip Lengths and Travel Times by Mode Used
and Place of Residence for All Trips
Trip length in miles, travel time in minutes in **Bold**
and derived speed in miles per hour in *italics*

Mode →	Walk	Private Vehicle		Public Transit		Other	Total
Place ↓	Length **Time**	Length **Time**	*Derived Speed*	Length **Time**	*Derived Speed*	Length **Time**	Length **Time**
Chicago CBD	0.6 **14.8**	7.4 **28.0**	*15.9*	3.4 **33.5**	*6.1*	4.0 **19.9**	3.6 **22.7**
Rest of Chicago	0.4 **13.2**	4.5 **22.9**	*11.8*	4.9 **45.4**	*6.5*	5.5 **32.0**	4.0 **26.7**
Suburban Cook	0.5 **13.2**	4.8 **20.7**	*13.9*	12.1 **54.0**	*13.4*	6.8 **30.8**	4.9 **21.9**
DuPage	0.4 **12.6**	4.8 **19.1**	*15.1*	19.7 **61.1**	*19.4*	7.0 **30.7**	5.0 **20.2**
Lake	0.7 **13.7**	5.8 **20.4**	*17.1*	22.1 **68.0**	*19.5*	6.7 **31.9**	6.0 **21.3**
Kane	0.6 **14.3**	4.7 **17.8**	*15.8*	15.0 **52.0**	*17.3*	5.7 **26.0**	4.7 **18.3**
Will	0.5 **17.0**	6.2 **20.8**	*17.9*	20.9 **68.3**	*18.4*	6.1 **29.1**	6.3 **21.6**
McHenry	0.4 **12.3**	6.6 **20.8**	*19.0*	37.3 **87.5**	*25.6*	5.4 **29.8**	6.8 **21.6**
Kendall	0.6 **12.3**	5.9 **19.6**	*18.1*	37.2 **91.9**	*24.3*	4.0 **28.3**	5.9 **19.9**
7-county Total	0.5 **13.4**	5.0 **20.8**	*14.4*	6.9 **47.6**	*8.7*	6.1 **30.5**	4.8 **23.0**

4.0 Travel by Time of Day: Peak versus Off-peak

4.1 Trip Lengths and Travel Times by Mode During the Peak and Off-peak Periods

Table 7 shows trip length and travel time differences for peak and off-peak travel. Similar to other metropolitan areas the peak period exhibits longer trips and higher travel times. While the derived speeds do not reflect actual speeds they approximate relative speeds. This average derived speed is slightly greater in the peak period than in the off-peak period.

There may be several explanations for this. First, the extent to which all trips have fixed

and variable components, on shorter trips the fixed time element (i.e., warming the engine) is higher. Second, work trips are very familiar and the quickest route is known. Third, there are more people driving during the off-peak period who may not be as determined as peak-period travelers to reach their destination quickly. And finally, derived speeds are greater during the peak period because of the performance of public transit; commuter rail is the fastest mode and these trips are typically during the peak period. Table 7 shows that while peak-period transit trips are only slightly longer in duration they are much longer in length.

Table 7

Trip Lengths and Travel Times during the Peak and Off-peak Periods by Mode of Travel

Trip length in miles, travel time in minutes in **Bold**
and derived speed in miles per hour in *italics*

Mode →	Walk	Private Vehicle		Public Transit		Other	Total	
Time ↓	Length **Time**	Length **Time**	*Derived Speed*	Length **Time**	*Derived Speed*	Length **Time**	Length **Time**	*Derived Speed*
Peak Period	0.5 **14.0**	5.2 **21.2**	*14.4*	7.5 **47.8**	*9.4*	6.0 **32.0**	5.2 **24.6**	*12.7*
Off-peak Period	0.3 **11.4**	4.8 **19.6**	*14.4*	5.9 **47.3**	*7.5*	6.3 **28.3**	4.4 **21.2**	*12.5*
Total	0.5 **13.4**	5.0 **20.8**	*14.4*	6.9 **47.6**	*8.7*	6.1 **30.5**	4.8 **23.0**	*12.5*

4.2 Peak and Off-peak Periods of Travel: Regional Variation

Despite the unusual periods constituting the off-peak period (midday from 9:30 a.m. to 3:00 p.m. and again from 7:00 p.m. to 6:30 a.m.) and while there have been substantial differences in each of the previous tables, there is little regional variation in the proportion of trips made during the peak period (Table 8). The peak period accounts for roughly 46 percent of all trips in all places. The deviations are so minor that they are not statistically significant and an explanation of differences does not seem appropriate. Trip lengths, however, vary by place of residence. In contrast to the off-peak period, longer trips and greater travel times occur during the peak period except for trip lengths in

Table 8

Trip Lengths and Travel Times during the Peak and Off-peak Periods by Place of Residence

Trip length in miles, travel time in minutes in **bold** and derived speed in miles per hour in *italics.*

Place ↓	Peak Period ↓	Peak Period		Off-peak Period	
		Length **Time**	*Derived Speed*	Length **Time**	*Derived Speed*
Chicago CBD	46.4%	3.4 **24.5**	*8.3*	3.8 **20.8**	*11.0*
Rest of Chicago	45.8%	4.1 **28.6**	*8.6*	3.8 **24.6**	*9.3*
Suburban Cook	44.6%	5.4 **23.4**	*13.8*	4.4 **20.3**	*13.0*
DuPage	45.6%	5.6 **22.6**	*14.9*	4.4 **17.6**	*15.0*
Lake	46.7%	6.5 **23.0**	*17.0*	5.4 **19.4**	*16.7*
Kane	45.5%	4.9 **19.1**	*15.4*	4.5 **17.4**	*15.5*
Will	46.5%	6.7 **22.3**	*18.0*	5.8 **20.8**	*16.7*
McHenry	47.9%	7.4 **23.5**	*18.9*	6.2 **19.6**	*19.0*
Kendall	45.3%	5.9 **20.4**	*17.4*	5.8 **19.3**	*18.0*
Total	45.8%	5.2 **24.6**	*12.7*	4.4 **21.2**	*12.5*

the Chicago CBD. The small number of respondents, approximately 400, may have contributed to this exception. Otherwise the pattern is rather uniform and only a few noteworthy examples appear. First, Kane and DuPage counties have the shortest travel times, both during the off-peak periods, 17.4 and 17.6 minutes respectively. Second, the longest travel time, 28.6 minutes, is during the peak period in the city of Chicago outside of the CBD. Third, the longest average trip length is in McHenry county (7.4 miles) but the average travel time is a shade less than in suburban Cook county (23.5 versus 23.4 minutes) where the average distance is two miles less (5.5 miles). Fourth, the highest derived speeds are in the most distant counties (Will, Kendall and McHenry) while the lowest speeds are in the two Chicago sub-areas. In the outlying counties highway

capacity may not have matched urban growth, resulting in peak-period congestion, while in Chicago the concentration of jobs may cause peak-period speeds to be low. Fifth, derived speeds, however, are not consistently higher during the peak period. Peak-period speeds are higher in three places, suburban Cook, Lake and Will counties. Off-peak speeds are higher in places with mixed densities. Sixth, the most rural county, Kendall, exhibits little difference between the peak and off-peak period.

5.0 Trip Purpose: Work versus Nonwork Trips

Trips to work are here defined as trips with work as the destination. As discussed in Section 2.0, we have chosen to focus only on those trips to work. Because of the high degree of trip chaining the inclusion of trips from work would have affected conclusions relating to trip length and duration.

5.1 Work and Nonwork Trips: Regional Variations

It is evident from Table 9 that there is relatively little geographic variation in trip purpose by place of residence. Only the Chicago CBD shows a noteworthy level outside the range from 16.9 percent in suburban Cook to 18.5 percent in Chicago outside the CBD. If the trip from work is added to double these figures it is evident that work accounts for just over one third of all trips.

5.1.1 Work and Nonwork Trips: Trip Purpose

Examining the trips to and from work more closely (the last two columns of Table 9) indicates that they have far different impacts on the morning and afternoon peak periods. In the morning work trips are close to the majority of trips in all places and in DuPage county and in the Chicago CBD they account for more than half of the trips. The afternoon peak percentages are approximately one third lower. During the afternoon peak work trips tally just under one third of all trips. Only Chicago and DuPage county have levels over one third. Since the lowest percentages are in Will and Kendall counties there appears to be a relationship between population density and the proportion of the afternoon trips from work. Perhaps there is less traffic in the more rural parts of the Chicago area and more nonwork trips are made during the evening peak period,whereas in the city congestion may push some trips outside the peak period.

Personal business destinations of shopping, eating out and banking show an all-day pattern similar to work trips in that there is little regional variation. The difference is that the city of Chicago shows lower levels than the suburban counties. At least for the Chicago CBD recreation accounts for part of the reason why the shopping percentage is low. In interpreting the shopping, eating out and banking category it is important to note

that the survey was conducted on a Thursday and for many residents shopping trips are conducted on weekends.

Table 9

Trip Purpose for All Trips by Place of Residence*

Purpose → / Place ↓	Work	Shop\ Eat\ Bank	Rec-reation	Home	Other	Trips to work as a % of all a.m. peak trips	Trip from work as a % of all p.m. peak trips
Chicago CBD	25.3	13.4	7.3	34.8	19.2	73.6	46.7
Rest / Chicago	18.5	14.6	4.6	37.3	25.0	45.3	35.8
Sub. Cook	16.9	17.9	6.8	35.8	22.6	46.3	32.4
DuPage	18.4	16.8	4.7	35.4	24.7	50.7	34.0
Lake	18.4	17.1	4.6	34.4	25.5	47.7	32.2
Kane	17.8	16.3	4.6	35.8	25.6	46.2	30.6
Will	17.6	16.6	3.8	34.9	27.0	42.0	30.1
McHenry	18.0	17.7	5.2	35.5	23.6	47.5	32.1
Kendall	18.3	16.0	4.0	34.9	26.9	42.5	28.6
Total	**17.9**	**16.4**	**5.4**	**36.0**	**24.2**	**45.8**	**33.5**

*Percentages for these five columns sum to 100 percent (rounding may yield exceptions).

The last point of interest on Table 9 is the trips-home percentage. A low figure expresses a high degree of trip chaining. When a trip chain is defined as a collection of trips starting and ending at home, complex chains have a low percentage of trips home. The simplest chain has one trip to a destination and another back home (50 percent). When there are two stops the percentage drops to 33. None of the places average more than two out-of-home stops per chain but the highest levels of trip-chaining are found in Lake, Will, and Kendall counties and the Chicago CBD. In the city of Chicago outside the CBD, where public transit use is the highest in the study area, the chaining phenomenon is the lowest.

5.1.2 Work and Nonwork Trips: Trip Length, Travel Time and Derived Speed

While the percentages of trips by purpose are relatively uniform throughout suburban Chicago the trip lengths and durations exhibit a discernible pattern (Table 10). Both

Table 10

Trip Lengths and Travel Times to Work and to Nonwork Destinations by Place of Residence

Trip length in miles, travel time in minutes in **bold**

Derived speed is length divided by travel time in hours

Purpose →	Work Trips		Nonwork Trips	
Place ↓	Length **Time**	*Derived Speed*	Length **Time**	*Derived Speed*
Chicago CBD	3.8 **23.2**	*9.8*	3.5 **22.5**	*9.3*
Rest of Chicago	5.7 **32.3**	*10.6*	3.6 **25.4**	*8.5*
Suburban Cook	7.5 **28.2**	*16.0*	4.4 **20.6**	*12.8*
DuPage	7.6 **26.7**	*17.1*	4.5 **18.8**	*14.4*
Lake	8.9 **27.3**	*19.6*	5.3 **20.0**	*15.9*
Kane	7.0 **22.6**	*18.6*	4.2 **17.4**	*14.5*
Will	10.6 **29.8**	*21.3*	5.4 **19.9**	*16.3*
McHenry	10.9 **29.7**	*22.0*	5.9 **19.8**	*17.9*
Kendall	8.5 **25.2**	*20.0*	5.3 **18.7**	*17.0*
Total	7.2 **29.1**	*14.8*	4.3 **21.6**	*11.9*

work trips and nonwork trips increase in length with distance from the Chicago CBD. Work trips peak in length in the semi-rural counties of McHenry and Will. The most remote county, Kendall, shows a drop to 8.5 miles, close to the metropolitan average but down considerably from the 10.6 and 10.9 miles in Will and McHenry counties.

Nonwork trips are shorter in all places of residence with the greatest difference occurring in places with high trip lengths,. In the Chicago CBD nonwork trips are approximately 10 percent shorter (3.5 miles versus 3.8 miles) than work trips but in both Will and McHenry counties they are almost half the length (Table 10). These two counties again have the longest trips, and the positive correlation between CBD distance and work-trip

length also holds for CBD distance and nonwork-trip length.

As in previous tables, however, shortest trips in time duration are in the outlying counties. For work trips Kendall and Kane counties have the shortest duration trips. The fast-growing community of Aurora straddles the two counties and the nearby community of Naperville, also growing in population and jobs, may contribute to the short travel times. Relatively low-density areas surround both communities.

Again nonwork trips have smaller magnitudes, this time in trip duration. On this measure DuPage county joins Kane and Kendall counties with the lowest values. Also as found earlier, both trip lengths and travel times for nonwork trips are lower than for work trips but trip length drops more than travel time.

Derived speeds are consistently higher for work trips than for nonwork trips. Regionwide the speeds are 14.8 versus 11.9 miles per hour, or over 30 percent higher for work trips. Both also increase with distance form the Chicago CBD. Only Kendall county remains a noticeable exception.

5.2 Work and Nonwork Trips: Peak versus Off-peak

Almost 60 percent of the trips to work are during the seven-hour peak period (Table 11; 10.7 percent divided by 18.0 percent). This suggests that if a higher percentage were during this period traffic during the peak would be even worse. There are also more

Table 11

Trip Purpose during the Peak and Off-peak Periods
in percent of all trips

\ Period Purpose \	a.m. Peak	p.m. Peak	**Peak**	Mid-Day	Night	**Off-Peak**	**Total**
Work	9.4	1.3	**10.7**	4.2	3.1	**7.3**	**18.0**
Nonwork	10.9	30.5	**41.4**	25.6	15.0	**40.6**	**82.0**
Total	20.3	31.8	**52.1**	29.8	18.1	**47.9**	**100.0**

nonwork trips during the peak than the off-peak period, although many of these are trips from work. If one were to subtract an equivalent 10.7 percent (to account for trips from work) from the 41.4 percent nonwork trips one would still have over 30 percent of daily trips being conducted during the peak period for purposes other than to or from work.

Throughout the Chicago area, however, there is relatively little difference in the portion of the peak period accounted for by work trips (Table 12). With the exception of the

Chicago CBD the rest of the study area shows approximately 20 percent of the peak period trips being travel to work. Similarly there is some variation in the work trip share of the off-peak but all of the values are in the teens, even for the CBD. Again, if one were to double the work-trip percentage (to account for trips from work), then it is apparent that less than half of the peak-period trips (or off-peak trips) are to or from work, except for CBD residents.

Table 12

Number of Trips to Work and to Nonwork Destinations during the Peak and Off-peak Period by Place of Residence
in percent of peak or off-peak period trips

Purpose →	Peak Period		Off-peak Period	
Place ↓	Work	Nonwork	Work	Nonwork
Chicago CBD	31.4	68.6	18.6	81.4
Rest of Chicago	20.6	79.4	16.3	83.7
Suburban Cook	19.9	80.2	13.6	86.4
DuPage County	21.8	78.2	14.8	85.2
Outer Collar Counties	19.8	80.2	16.0	84.0
7-county Total	**20.4**	**79.6**	**15.2**	**84.8**

Regionwide, Table 13 shows a progressive decrease in public transit use from left to right, from peak to off-peak and from work to nonwork, for both peak and off-peak travel. The highest use of public transit is for peak-period work trips (15.1 percent) and the lowest is for the off-peak nonwork trips (7.0 percent) for a difference of more than two fold. The two remaining percentages (10.4 and 11.0) are rather similar indicating that public transit use is nearly equally probable for either peak period nonwork trips and for off-peak period work trips. In both cases it is marginally higher than the 9.5 percent figure for all trips (Table 2).

The decline in public-transit ridership share, from left to right in Table 13, holds for two of the largest suburban areas, suburban Cook and DuPage counties. In suburban Cook county the share drops from 9.1 percent by public transit for peak-period work trips to 2.0 percent for nonwork trips during the off-peak period. There is a 4.6 to 1 ratio between the highest and lowest percentages. In DuPage county this ratio is more than 10 to 1 (7.0 versus 0.5 percent). A high ratio indicates that the peak-period work trips dominate the use of public transit. Conversely the lowest ratios are in the city of Chicago. It is 1.6 to 1 in the CBD and 1.7 to 1 in the rest of the city. The use of public transit remains high during the off-peak period even for nonwork trips. In the city outside the CBD the

public-transit share is 18.6 percent for nonwork trips, or twice the transit share for peak-period work trips in suburban Cook, the highest suburban share.

In the outer collar counties all four values are below 5 percent with the highest share for work trips during the off-peak period. Many off-peak work trips are to entry-level and blue-collar jobs and this high share reflects this potentially transit-dependant population. The high level of off-peak transit use to work holds in DuPage county, even though the peak share is higher (7.0 percent versus 4.3 percent).

Table 13

Percent of Trips by Public Transit
by Place of Residence

Time →	Peak Period		Off-peak Period	
Place ↓	Work	Nonwork	Work	Nonwork
Chicago CBD	23.6	18.4	14.5	14.6
Rest of Chicago	31.8	24.8	23.0	18.6
Suburban Cook	9.1	4.7	5.3	2.0
DuPage County	7.0	3.1	4.3	0.5
Outer Collar Counties	2.8	1.6	3.2	0.7
7-county Total	**15.1**	**10.4**	**11.0**	**7.0**

In contrasting work trips and nonwork trips during the peak and the off-peak it is clear that work trips are longer but faster than nonwork trips. Table 14 shows no exceptions. Nonwork trips consistently have slower derived speeds than work trips. During the peak the work trips are 20 percent faster while during the off-peak work trips are 33 percent faster. In fact the highest derived speeds are for work trips during the off-peak period.

Regionwide the standard relationship with CBD distance seems to hold for trip length, travel time and derived speed. Trip length and speed increase with CBD distance while travel time decreases. The major exceptions are associated with the CBD and with the outer collar counties.

Table 14

Trip Lengths and Travel Times to Work and to Nonwork Destinations by Place of Residence for All Trips

Trip length in miles, travel time in minutes in **Bold** and derived speed in miles per hour in *italics*

Time →	Peak Period				Off-peak Period			
Purpose →	Work Trips		Nonwork Trips		Work Trips		Nonwork Trips	
Place ↓	Length **Time**	*Derived Speed*	Length **Time**	*Derived Speed*	Length **Time**	*Derived Speed*	Length **Time**	*Derived Speed*
Chicago CBD	3.4 **23.8**	*8.6*	3.4 **24.8**	*8.2*	4.6 **22.1**	*12.5*	3.6 **20.5**	*10.5*
Rest of Chicago	5.7 **33.5**	*10.2*	3.7 **27.3**	*8.1*	**5.7** **30.6**	*11.2*	3.4 **23.5**	*8.7*
Suburban Cook	7.6 **29.2**	*15.6*	4.8 **21.9**	*13.2*	7.3 **26.6**	*16.5*	4.0 **19.3**	*12.4*
DuPage County	7.8 **28.3**	*16.5*	5.0 **21.0**	*14.3*	7.3 **24.1**	*18.2*	3.9 **16.5**	*14.2*
Outer Collar Counties	8.9 **27.1**	*19.7*	5.7 **20.7**	*16.5*	9.5 **27.2**	*21.0*	4.6 **17.8**	*15.5*
7-county Total	7.2 **30.0**	*14.4*	4.7 **23.3**	*12.1*	7.2 **27.8**	*15.6*	3.9 **20.0**	*11.7*

6.0 Work-related Travel

Increasingly workers find it necessary to either run company errands or attend business meetings away from the workplace. In this information age fewer workers are confined to the place of work and with an increasing number of multi-worker households, family business is conducted during the lunch hour and to and from work. These activities add substantially to travel during the average day.

6.1 Work-related Trips: Trip Lengths and Duration

The CATS HHTS reports just over three-quarters of a million daily work-related trips (Table 15). While this is a substantial number of trips the more important factor is length of the average trip. On average work-related trips are more than 5 miles longer than the average of all other trips. In aggregate they account for approximately 10.5 million daily miles (using a conversion factor of 1.3 to route miles from airline miles; all other trips in the report use airline distance). This represents almost 5 percent of the daily VMT in the Chicago area, including truck travel and travel from external origins. It is a much larger

percentage of the local travel by Chicago-area residents.

Table 15

Trip Length and Travel Time: Work-related Trips and All Other Trips

Trip purpose	Number of trips (000s)	Trip length* (airline miles)	Travel time (minutes)
Work related	755	6.90	26.7
All other trips	18,626	4.72	22.8

* Trip length is airline distance in miles between zone centroid (origin and destination zones).

6.2 Modes of Work-related Trips

Table 16 shows that a disproportionately high percentage of trips are by automobile and conversely fewer trips are by walking and by public transit. Almost by definition walking trips are short and the flexibility of the automobile can allow longer trips. Also, public transit trips are frequently long, especially by rail, but the low portion of trips by this mode does not seem to affect trip lengths.

Table 16

Modes Used in Work Related Trips and All Other Trips

Mode	Work-related trips	All other trips
Walk	6.7%	8.5%
Automobile	86.4%	79.5%
Public Transit	4.2%	9.8%
Other	2.8%	2.2%
Total number of trips (000s)	**755**	**18,626**

6.3 Work-related Trips During the Peak and Off-peak Periods

Contrasting peak and off-peak travel (Table 17), work-related trips during the peak period are longer in length and duration but they also have higher speeds than work-related trips

during the off-peak. As a consequence, even though there are far more work-related trips during the off-peak, the total airline miles are almost equivalent, 2.44 million during the peak and 2.76 million miles in the off-peak.

Table 17

Work-related Trips during the Peak and the Off-peak

Time	Number of trips (000s)	Average trip length (miles)	Average travel time (minutes)	Derived Speed (mph)	Total miles (Trips x Length)
Peak	323	7.56	28.2	16.1	2.44 mil.
Off-peak	432	6.40	25.6	15.0	2.76 mil.

6.4 Work-related Trips: Regional Variations

The pattern shown in Table 18 is similar to the regional variation seen for other trips in the earlier part of this chapter. Trips by city residents are shorter in length than trips by suburban residents, but travel times are not shorter, with some exceptions. The greatest

Table 18

Work-related Trip Lengths and Travel Time by Place of Residence

Place of Residence	Number of Trips (000s)	Average Trip Length (miles)	Average Travel Time (minutes)	Derived speed (mph)
Chicago CBD	13	4.9	24.4	12.0
Rest of Chicago	186	5.1	26.1	11.7
Suburban Cook	264	7.2	27.9	15.5
DuPage county	106	8.3	28.0	17.8
Lake County	70	8.2	26.1	18.9
Kane County	36	7.0	23.8	17.6
Will county	51	7.2	24.0	18.0
McHenry County	24	8.1	26.2	18.5
Kendall county	5	7.0	23.6	17.8
7-county Total	**755**	**6.9**	**26.7**	**15.5**

exception is DuPage county, which has both the longest trips in miles and in time. It also has higher speeds than work-related trips in Chicago but not as high as other suburban counties. Highest speeds are for residents of Lake and McHenry counties. Perhaps one of the reasons why the pattern here is not as consistent as found on Tables 10 and 14 is

that like Tables 10 and 14 the data are reported by place of residence but trips are made from the place of work.

7.0 Conclusions

The CATS HHTS has proven to be a valuable data source for understanding the patterns of nonwork and off-peak travel. The following items summarize the principal findings in this study.

Regarding travel time:

- Trips to and from work account for approximately 36 percent of all daily trips and less than half of all trips made during the peak period are to and from work.
- The seven-hour peak period defined in Chapter 2 accounts for 52.1 percent of all daily trips.
- Work-trip derived speeds are faster than nonwork-trip derived speeds, during both the peak and the off-peak period.
- Nonwork trips are marginally faster during the peak in comparison to off-peak derived speeds.
- Work trips are faster during the peak than during the off-peak.
- Considering all trips, peak and off-peak derived speeds are effectively the same.
- Trips to work are similar to work-related trips; 7.2 versus 6.9 miles in average length and 29.1 versus 26.7 minutes. Work-related travel, however, is more likely to be by private vehicle, 86.4 versus 78.6 percent, suggesting a vehicle needs to be available for this trip.

Regarding mode use:

- The private automobile carries 79.8 percent of Chicago-area travelers and public transit carries another 9.5 percent. Walking accounts for 8.4 percent of the trips reported.
- Public transit trips are short in the city of Chicago and, due to the predominance of Metra (commuter rail), exceptionally long in the suburbs.
- The market share for nonwork trips by public transit during the peak period (10.4 percent) is approximately the same as for work trips by public transit during the off-peak period (11.0 percent).
- Work trips dominate transit use in the suburbs while transit has a high market share for all trips in the city of Chicago even during the off-peak period.
- There is effectively no difference in derived speed by automobile between the peak and off-peak periods, but due partly to the use of commuter rail, transit derived speeds are approximately 25 percent higher in the peak period.
- The highest average trip derived speeds are for suburban public transit users.
- Considering all trips, suburban trips are longer in length but shorter in travel time.

- Average travel times for residents of the city of Chicago (outside the CBD) are longest due to the large share of transit trips.
- Walking is frequently used for shopping, eating out, banking and recreational trips on the way home from work.

The study has revealed some unexpected results, particularly relating to the derived speed measure. While not reflecting actual speed it provides a means to compare different categories of trips. As a whole, work trips are very different from nonwork trips and travel during the peak has different characteristics than travel during the off-peak period. Lastly, public transit trips, though relatively few in number in many suburban communities, have high average performance characteristics (derived speed and trip length). These findings can be used to encourage the use of modes other than the private vehicle.

Chapter Four

Geographic Patterns of Travel and Demographics: The 1990 Census Transportation Planning Package

1.0 Introduction

The Chicago metropolitan area is well known as a region with sharp sociodemographic differences. These differences contribute to a distinct mosaic of travel behavior. Some neighborhoods are characterized by bicycle use and walking, while others are dominated by automobile use. Additionally, it is self-evident that many, but not all, neighborhoods with good public transit service have correspondingly high uses of these facilities.

The purpose of this chapter is to discuss some of these broad patterns by presenting a series of maps encompassing the six-county northeastern Illinois metropolitan area. The chapter begins with a discussion of the data used (Section 2.0) and is followed by an overview of selected socioeconomic and demographic patterns in Section 3.0. The last two sections include an examination of mode use and conclusions.

2.0 Study Area and Data

2.1 Study Area and Maps

The data for this chapter are derived from the 1990 Census Transportation Planning Package (CTPP) Urban Element. This package includes data on 10,060 traffic analysis zones (one-half by one-half-mile square zones also known as TAZs) in the six-county Chicago metropolitan area, also known as quarter sections. Due to very low residential and arterial system densities in the urban fringe, the coverage is most complete within the urbanized area (census-defined contiguous area with at least one thousand inhabitants per square mile). In many fringe areas there are no longer roads every half-mile and the TAZ grid assumes a highly irregular pattern. Also, confidentiality restrictions limit the number of zones in the sparsely populated areas; data are not released if too few residents reside in a zone.

In the developed areas these TAZs are generally bound by major arterials and therefore frequently follow demographic boundaries. This is particularly true in the city of Chicago where some arterials, because of their broad scope, represent important spatial delimiters.

The maps use data divided into four categories; some express data as count values, others use percentages to express mode usage. For example, Figure 1 divides "Number of Persons by Place of Residence" into four ranges of count data: 1-1000, 1001-2000, 2001-5000 and more than 5000. Since some of the maps use the same categories certain comparisons between maps are permitted. In other cases the categories were changed because the values are very different. However, the objective remains the same; to portray the major regional variations in each of the variables examined.

The maps also have the built-in advantage of an easily read distance scale. Each symbol represents a zone approximately one-half-mile by one-half-mile so that, on a linear scale, two symbols typically represent one mile. Likewise, most townships are twelve symbols by twelve symbols, or six-by-six miles.

2.2 Data

The data include most of the demographic variables available in the Census of Population and Housing tabulations. Information on ethnicity (other than Hispanic language) and migration are not available in the CTPP. Conversely there is very detailed information about the work trip and the location of the work place. While information on travel times is also available, this is not pertinent in this report.

3.0 Demographic Patterns

3.1 Population and Jobs

The maps illustrating the distribution of population and jobs can be used to better understand other figures analyzed in this report. Together they represent a large portion of trip starts and ends in the Chicago area and the intensity of urban activities throughout the study region.

3.1.1 Population

The distribution of population is shown in Figure 1. Because the TAZs are approximately the same size, except in the fringe areas, the figure shows not only the number of persons per zone but also the density of population. This map exhibits several general relationships.

- Population density declines with distance from the Chicago Central Business District (CBD). While the transportation system has influenced the distribution of the population there are rather high densities in the city and very low densities in the outer fringe.
- There are higher populations north of the CBD than south of the CBD even though the area to the south is larger.

• Some transportation corridors, such as the Kennedy, Eisenhower and Ryan expressways, are visually evident as are numerous industrial areas, large parks and both major airports, Midway and O'Hare. All of these areas have low population densities.

• Waukegan, Elgin, Aurora and Joliet still stand as satellite communities and the decentralization of the population from the Chicago core has not yet reached these communities, although it is very close to Elgin and Aurora.

3.1.2 Jobs

Since approximately 46 percent of the population is classified as workers, Figure 2 has a legend of roughly half the levels used in Figure 1. This was done to make the two maps more comparable.

Jobs are clearly concentrated in fewer zones but these high-concentration job zones are geographically much more scattered than concentrations of population, which are largely found within the city of Chicago (Figure 1). It is also evident that there are many more jobs on the north side of the city than the south side. With the exception of the Hyde Park area and the neighborhood within a few miles southwest of the CBD (near Pershing Road between Halsted and Ashland), there are few concentrations of jobs south of the Chicago CBD. While the west-side employment density is also somewhat sparse the north side has a heavy concentration throughout. The west-side employment concentration extends to at least Western Avenue (West Side medical complex), but beyond Kedzie there are far fewer jobs within the city.

In suburban Chicago the O'Hare-to-Schaumburg area stands out. Schaumburg is directly northwest of O'Hare and just west of the Ned Brown Forest Preserve, the large blank area about eight miles northwest of O'Hare. The highest number of workers is in O'Hare; the two solid dots account for just over 40,000 jobs.

The I-88 corridor is also evident, just north of a line connecting Aurora with the Chicago CBD. With at least six zones exceeding 3,000 employees there are large numbers of workers employed in this corridor. The map also illustrates that it is not one continuous corridor but rather two segments with a one-mile break. The eastern segment has a high concentration of jobs near Oak Brook and the western segment has the highest job density in Naperville.

The Lake-Cook corridor is also evident, with four 3000+ zones on the township line approximately ten miles northwest of Evanston (note that each symbol typically represents a one-half by one-half mile square). Lake-Cook Road forms the boundary between Lake and Cook counties. Most jobs are on the south side of the road although

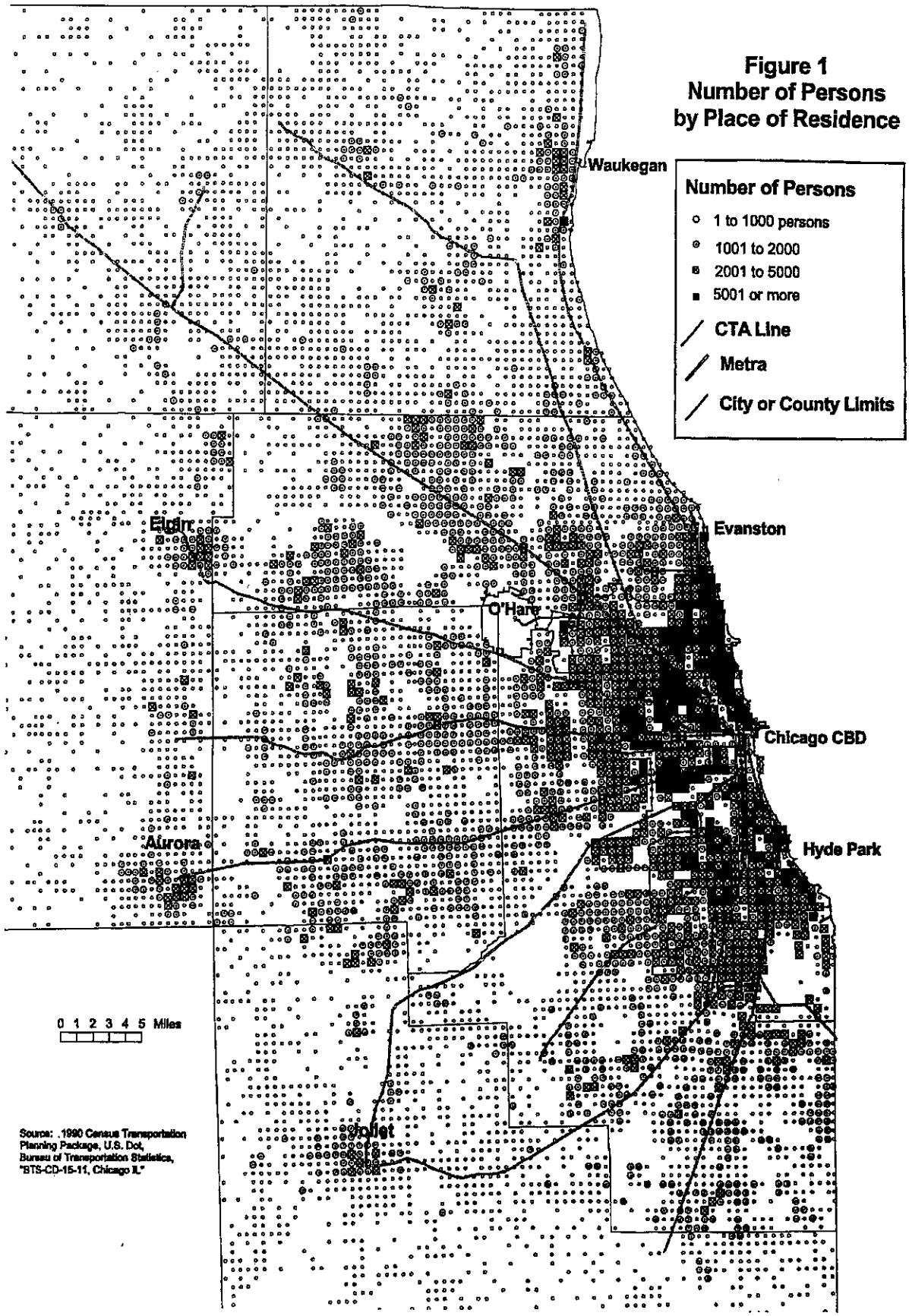


Figure 1
Number of Persons by Place of Residence

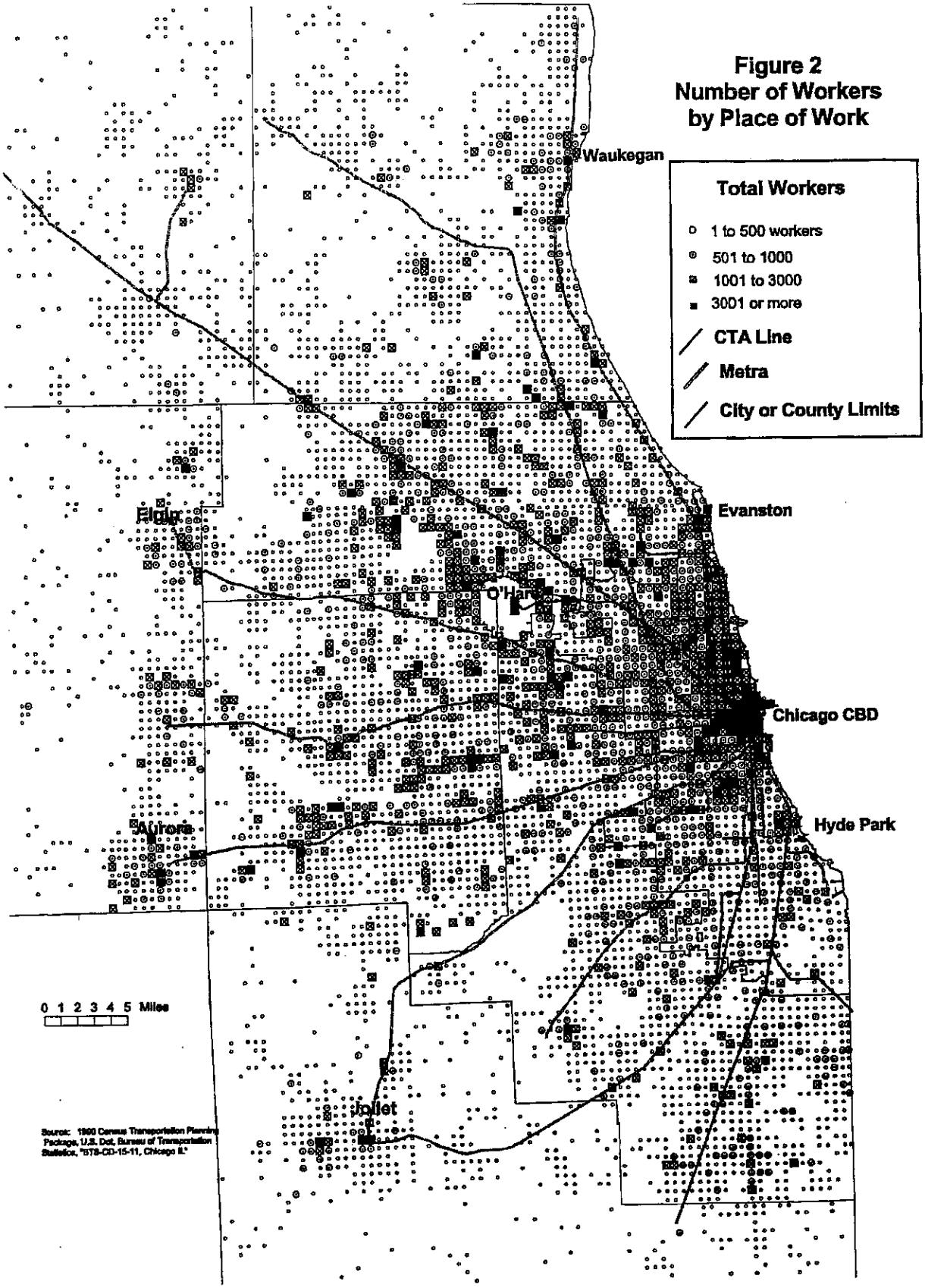


Figure 2
Number of Workers
by Place of Work
Total Workers
1 to 500 workers
501 to 1000
1001 to 3000
3001 or more
CTA Line
Metra
City or County Limits
Waukegan
Evanston
Elgin
O'Hare
Chicago CBD
Hyde Park
Aurora
Joliet
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "STS-CD-15-11, Chicago IL"

several large facilities (national headquarters) are found on the west end near the Tri-State Tollway (I-294).

3.2 Race and Ethnicity

Chicago, like many other northeastern cities, has had a history of neighborhoods defined by their racial and ethnic composition. Today the largest ethnic populations are of Blacks and Hispanics respectively. In 1990 there were 1,425,000 Blacks in the Chicago metropolitan area (six counties in northeastern Illinois) and 837,000 Hispanics. The census also reports a decline of approximately 2,000 Blacks from 1980 to 1990 and an increase of 256,000 Hispanics.

The third largest group, the Asian and Pacific Islander population, is not available in the CTPP and is therefore not included in this report. Other census tabulations show that they have increased from 141,000 in 1980 to 251,000 in 1990, or by 78 percent; forty-one percent of this population is in the city. Skokie has the second largest share with over 9,000 and Schaumburg is third with approximately 4,500.

3.2.1 Blacks

There are two distinct Black communities in the Chicago area, one on the south side and another on the west side of the city (Figure 3). The south side Black community has grown substantially in recent decades and with the southern expansion the south-side community it is generally more affluent than the west side. The level of affluence also tends to increase with distance from the CBD.

While this southern end of the south-side Black community is relatively affluent, it also has the highest average work-trip lengths (in minutes) in the Chicago area (Figure 4). Many of these residents work in the Chicago CBD and commute by public transit. By contrast Figure 4 shows Hyde Park, located near the number 35, is characterized by very short average travel times. This community around the University of Chicago stands out distinctly on both Figures 3 and 4 and will be prominent on several maps later in this report.

There are other major areas of Black population in the southern suburbs (particularly Harvey and Markham) and in the close-in western suburbs near Maywood and Bellwood (both are respectively just beyond the west- and south-side communities in the city).

There is also a narrow band of Blacks along Lake Michigan north of Montrose extending into Evanston. In addition to another pocket in northwestern Evanston each of the four satellite municipalities (Waukegan, Elgin, Aurora and Joliet) have neighborhoods with Blacks representing more than a third of the population.

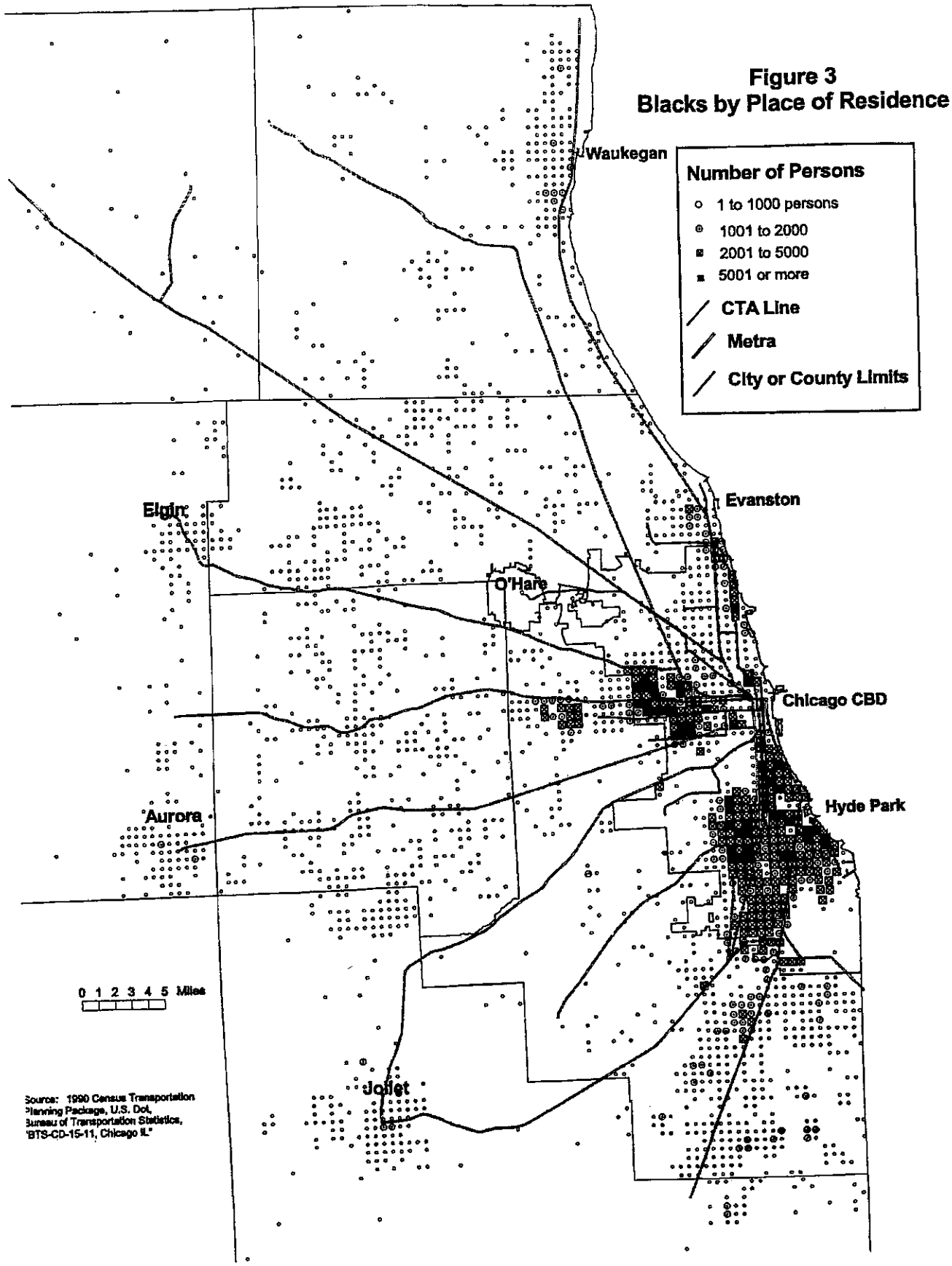
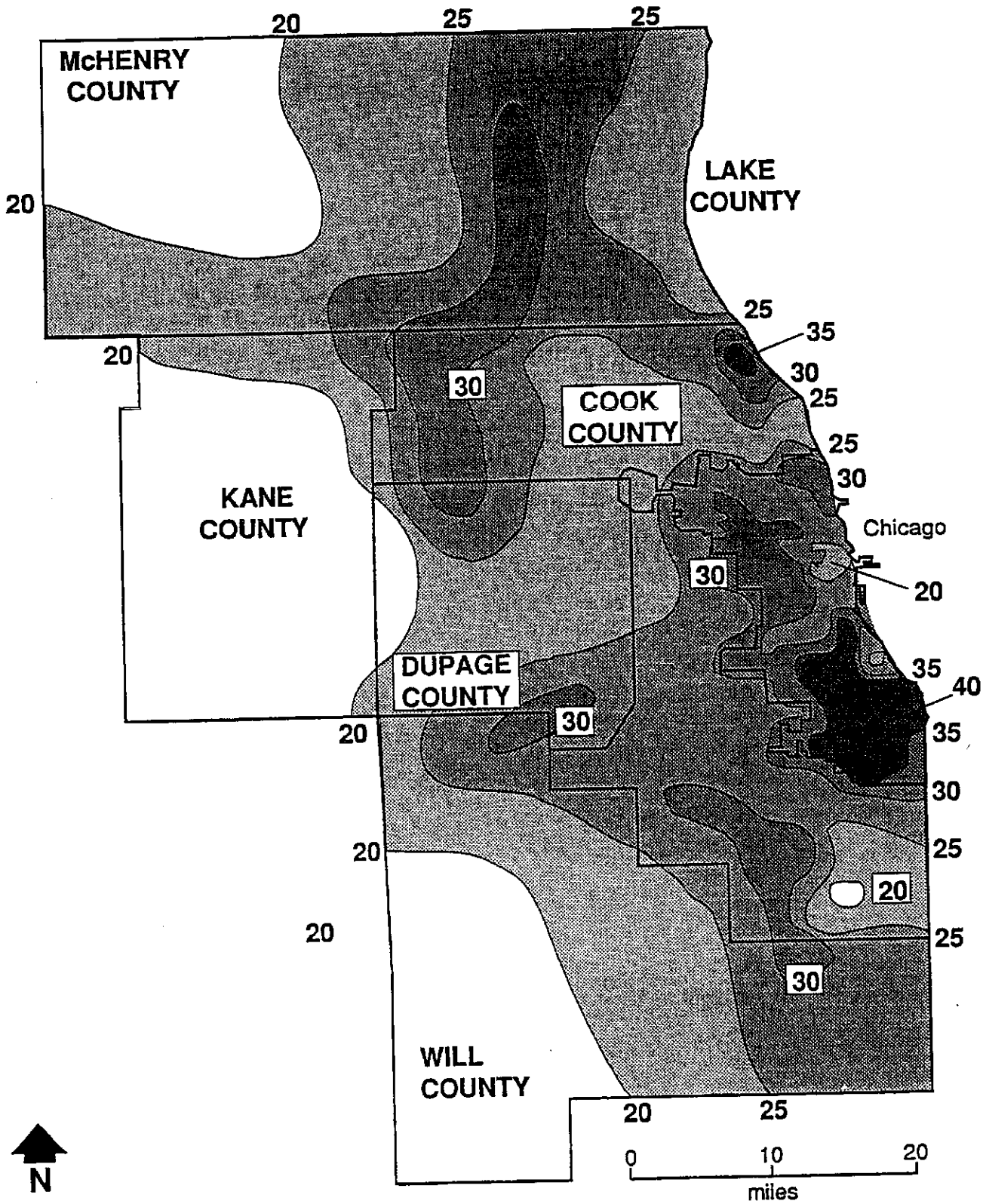


Figure 3
Blacks by Place of Residence
Waukegan
Number of Persons
1 to 1000 persons
1001 to 2000
2001 to 5000
5001 or more
CTA Line
Metra
City or County Limits
Evanston
Elgin
O'Hare
Chicago CBD
Hyde Park
Aurora
0 1 2 3 4 5 Miles
Joliet
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

Figure 4

1990--Mean Travel Time To Work
(in minutes)



3.2.2 Hispanic

The second largest minority population is made up of the 837,000 Hispanics living in the six-county area. Many of these people live in one of several communities in Chicago (Figure 5). There are two large Hispanic communities. The Pilsen district is southwest of the CBD and has ten TAZs with over 5,000 Hispanics. It is a linear east-west neighborhood just south of the west-side Black community. Discussions of mode use later in this report will highlight the distinctiveness of this community.

There is another slightly larger neighborhood to the northwest of the CBD along the CTA Blue line to O'Hare Airport (see Figure 18 for the names of the CTA rail lines). This district has thirteen TAZs with more than 5,000 Hispanics each. There are other communities on the north side along the Ravenswood Line, near Lake Michigan north of Devon, in the southwestern part of the city north of Marquette Park and a smaller group southeast of Hyde Park.

While there are large numbers of Hispanics in suburban Chicago they are not found in the same concentrations as in the city. Cicero has the largest population (almost 25,000) but there are also over five thousand Hispanics in Melrose Park and Blue Island. Each of the four satellite cities has substantial numbers of Hispanics, ranging from 9,700 (in Joliet) to 22,900 (in Aurora).

3.3 Age

In many cases transportation demand is age related. The needs and destinations of the young are very different from those of older travelers. This section examines the distributions of two the ends of the population spectrum.

3.3.1 Under Sixteen Years of Age

Concentrations of persons of less than sixteen years of age are mainly found in two areas (Figure 6):

- in the minority communities discussed in the previous section and
- in the more distant suburbs.

In both of these areas many neighborhoods have more than a third of their populations in this age range; in some cases more than half of the population. In the city of Chicago the near north side is characterized by low percentages as is the Hyde Park neighborhood. Similarly, the areas near the two airports, O'Hare and Midway, particularly toward the CBD, have low percentages (Midway is not marked but is near the end of the southwest CTA transit line).

In suburban Chicago there seems to be a relationship between the concentrations of

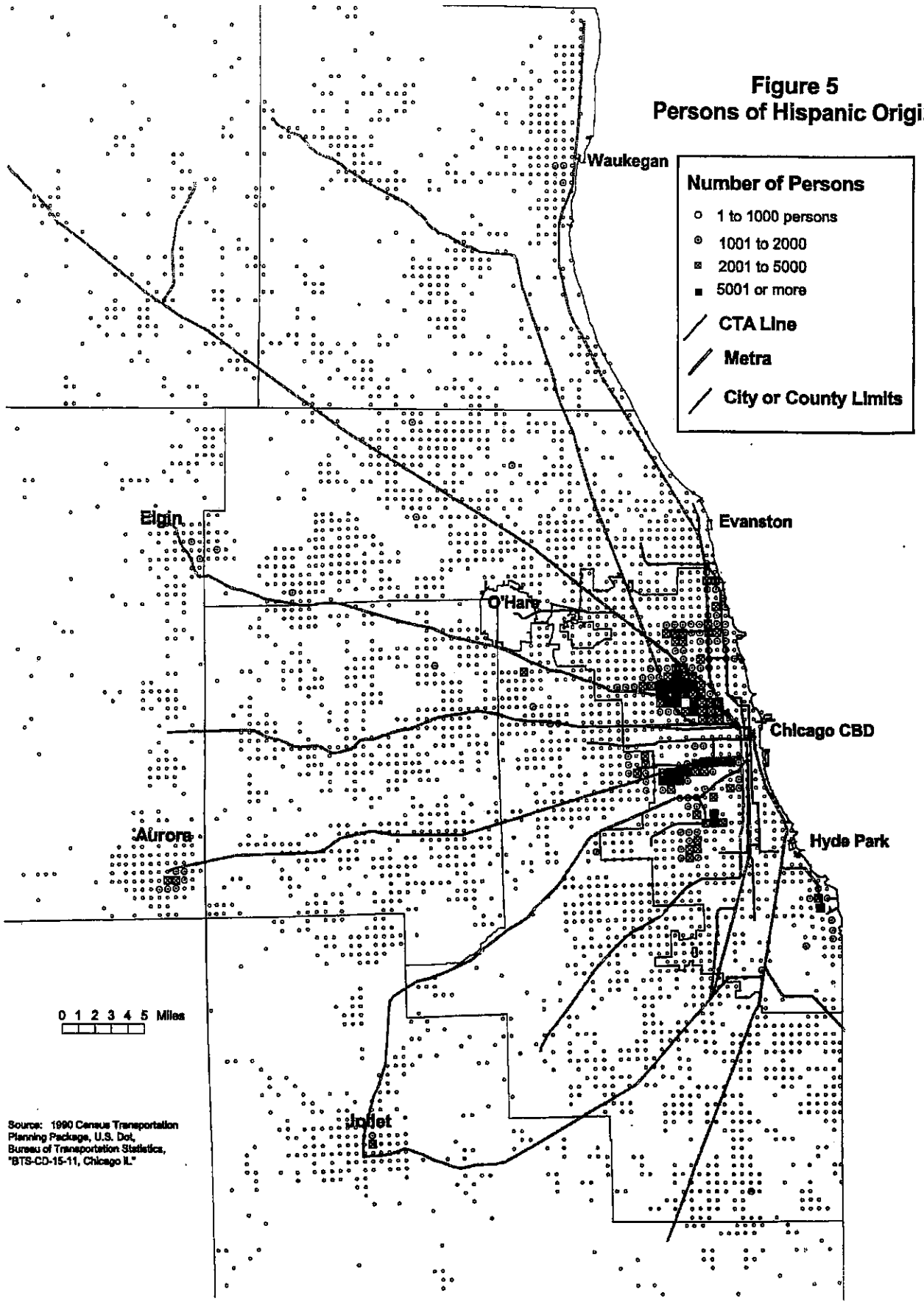


Figure 5
Persons of Hispanic Origin
Waukegan
Number of Persons
1 to 1000 persons
1001 to 2000
2001 to 5000
5001 or more
CTA Line
Metra
City or County Limits
Elgin
Evanston
O'Hare
Chicago CBD
Aurora
Hyde Park
0 1 2 3 4 5 Miles
Joliet
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

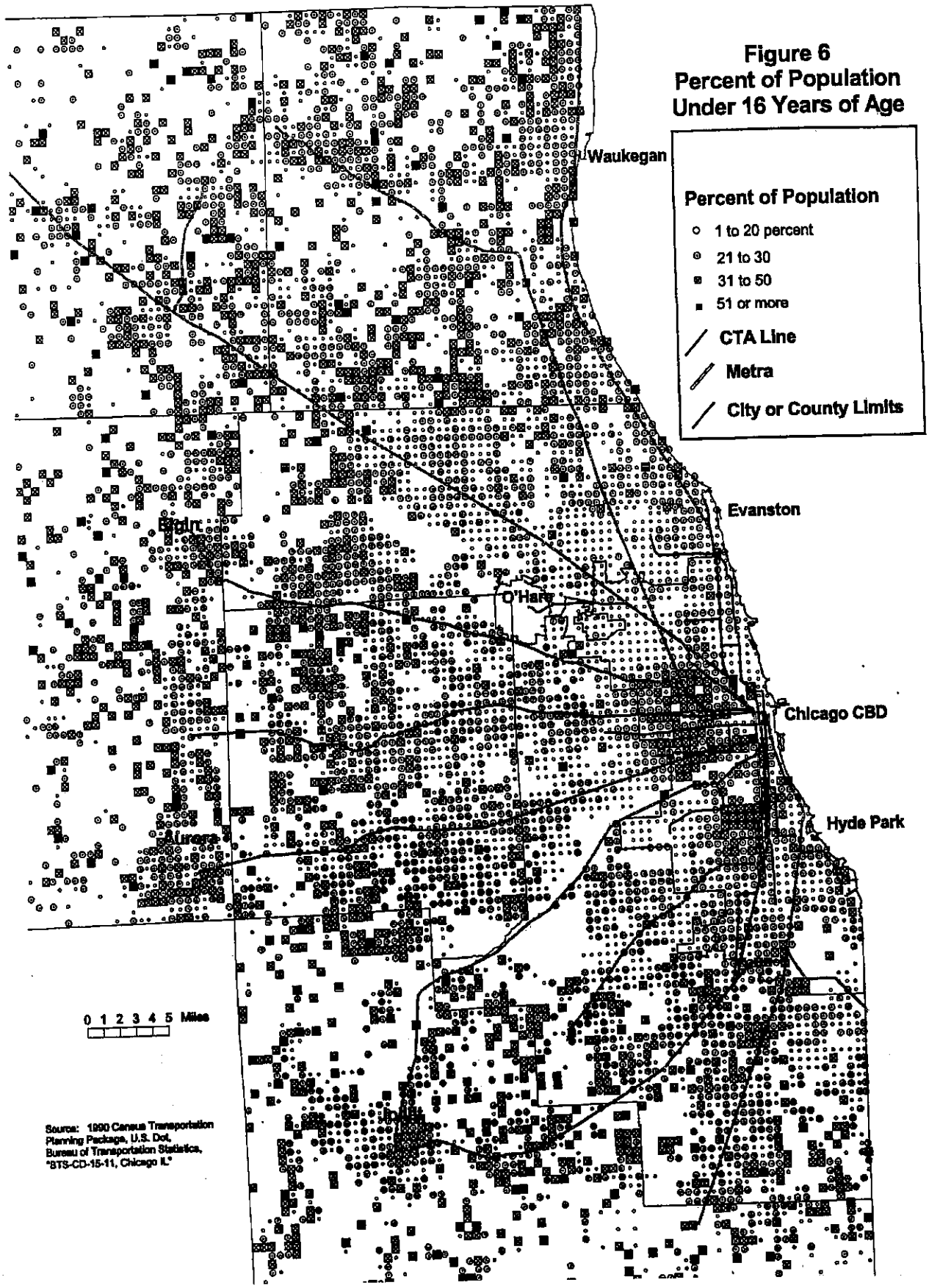


Figure 6
Percent of Population Under 16 Years of Age

young people and population-growth rates. The north-south band approximately two townships wide west of O'Hare Airport corresponds closely with the highest growth rates in the 1980s. Most of these neighborhoods had a ten-year growth rate of over 40 percent (compare figures 6 and 7).

3.3.2 Over Sixty-five Years of Age

The population over 65 tends to be most concentrated in a band ranging from eight to ten miles from the Chicago CBD (most townships are six miles wide--Figure 8). Many of these neighborhoods are located near the ends of CTA lines and grew rapidly in the 1950s and 60s, today many residents are in the empty-nest stage of in their retirement years. These tend to be stable middle-class neighborhoods with considerable local or nearby urban activities, both retail facilities and employment sites.

In the outer suburbs the pattern is not clear. The are many areas with both very high and low percentages of population over 65 in close proximity to each other. This is largely an artifact of low population levels and the sampling nature of the census long form used in collecting these data. Many of these are just above the confidentiality threshold. It is therefore difficult to draw substantive meaning regarding the outer suburbs.

3.4 Income and Employment Status

Household income is frequently cited as a factor in determining both the quantity and type of travel service consumed. Similarly, employment status is important and thus both income and employment status are discussed in this section.

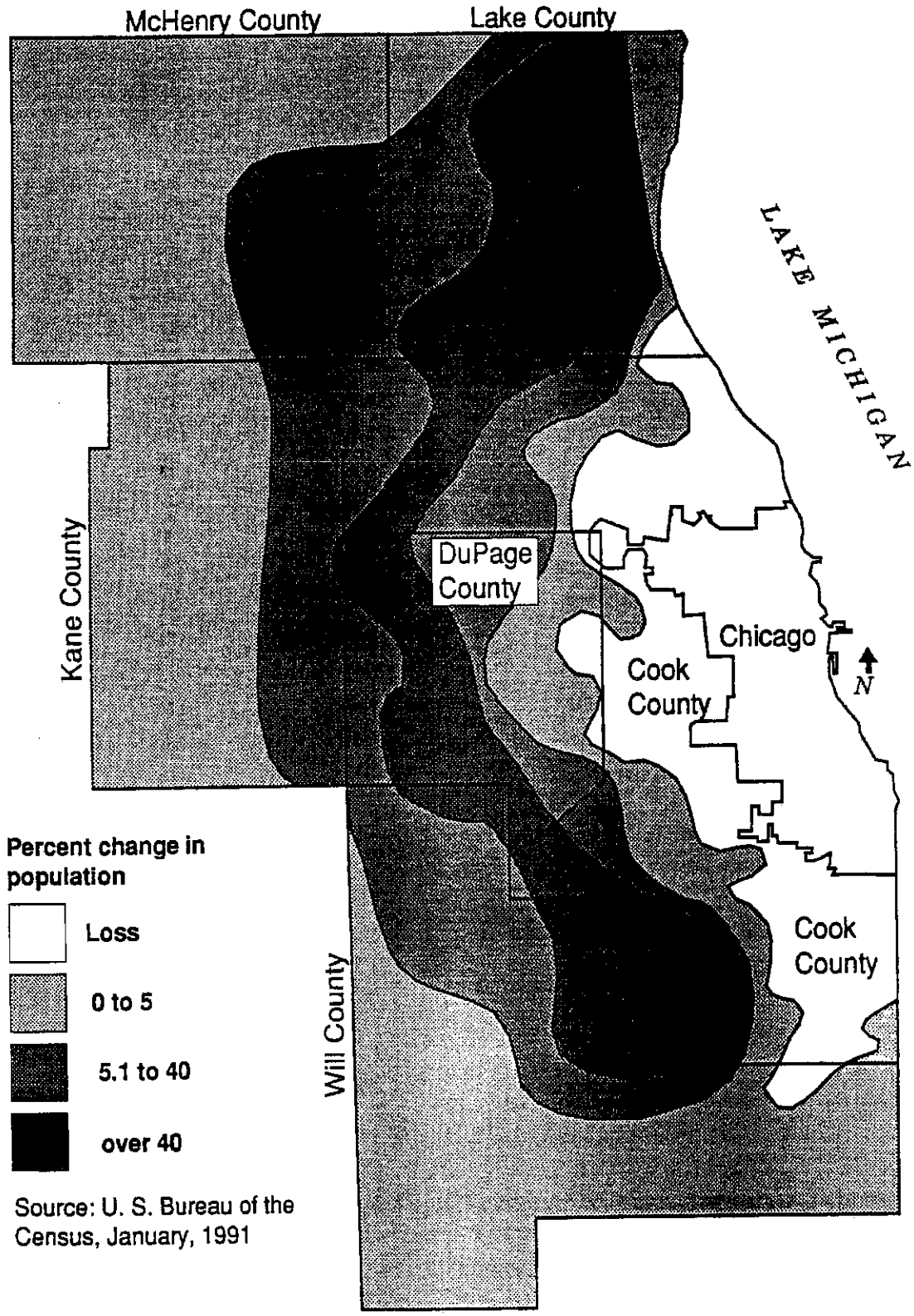
3.4.1 Household Income Less Than $10,000

The greatest clusters of households with incomes less than $10,000 are located in west and south side Chicago communities (Figure 9). In both cases there is a decline in this variable with increasing distance from the CBD. By the ends of the CTA rail lines the percentage of the population in this category has declined to less than thirty percent and in some cases less than ten percent.

There are also a few suburban concentrations of households with incomes less than $10,000, namely in southern Cook County southwest of the Lake Calumet area (the extensive blank area just south of Hyde Park). Likewise there are similar concentrations found in each of the four satellite cities, particularly in Joliet. Evanston is another concentration as is the area near Forest Park, at the end of the CTA rail line (Blue Line Forest Park Branch) running west from the CBD.

Figure 7

CHANGE IN POPULATION, 1980-1990
NORTHEASTERN ILLINOIS



Cartography Laboratory, Geography Program, UIC

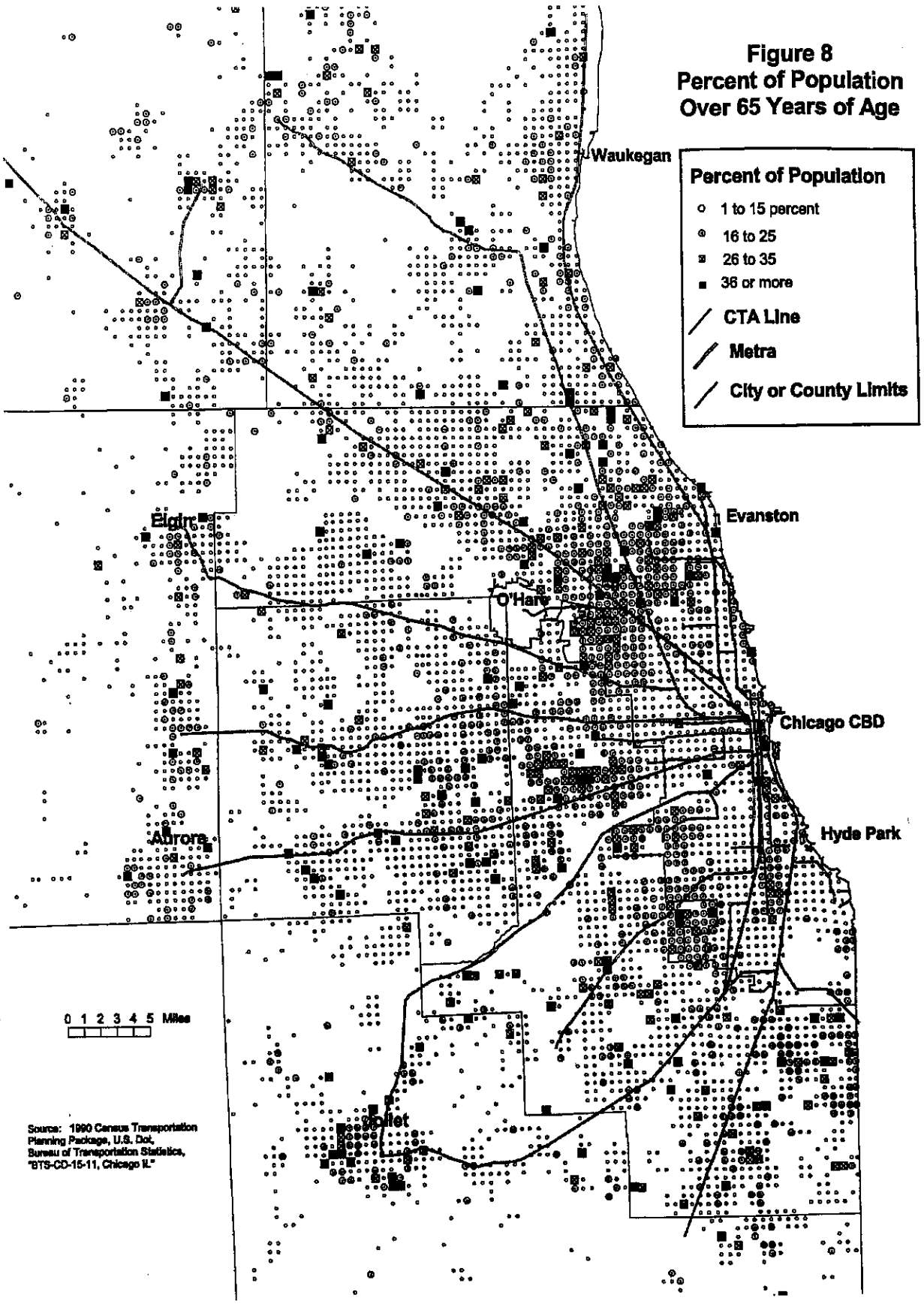


Figure 8
Percent of Population
Over 65 Years of Age
Percent of Population
1 to 15 percent
16 to 25
26 to 35
36 or more
CTA Line
Metra
City or County Limits
Waukegan
Evanston
Elgin
O'Hare
Chicago CBD
Hyde Park
Aurora
Joliet
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

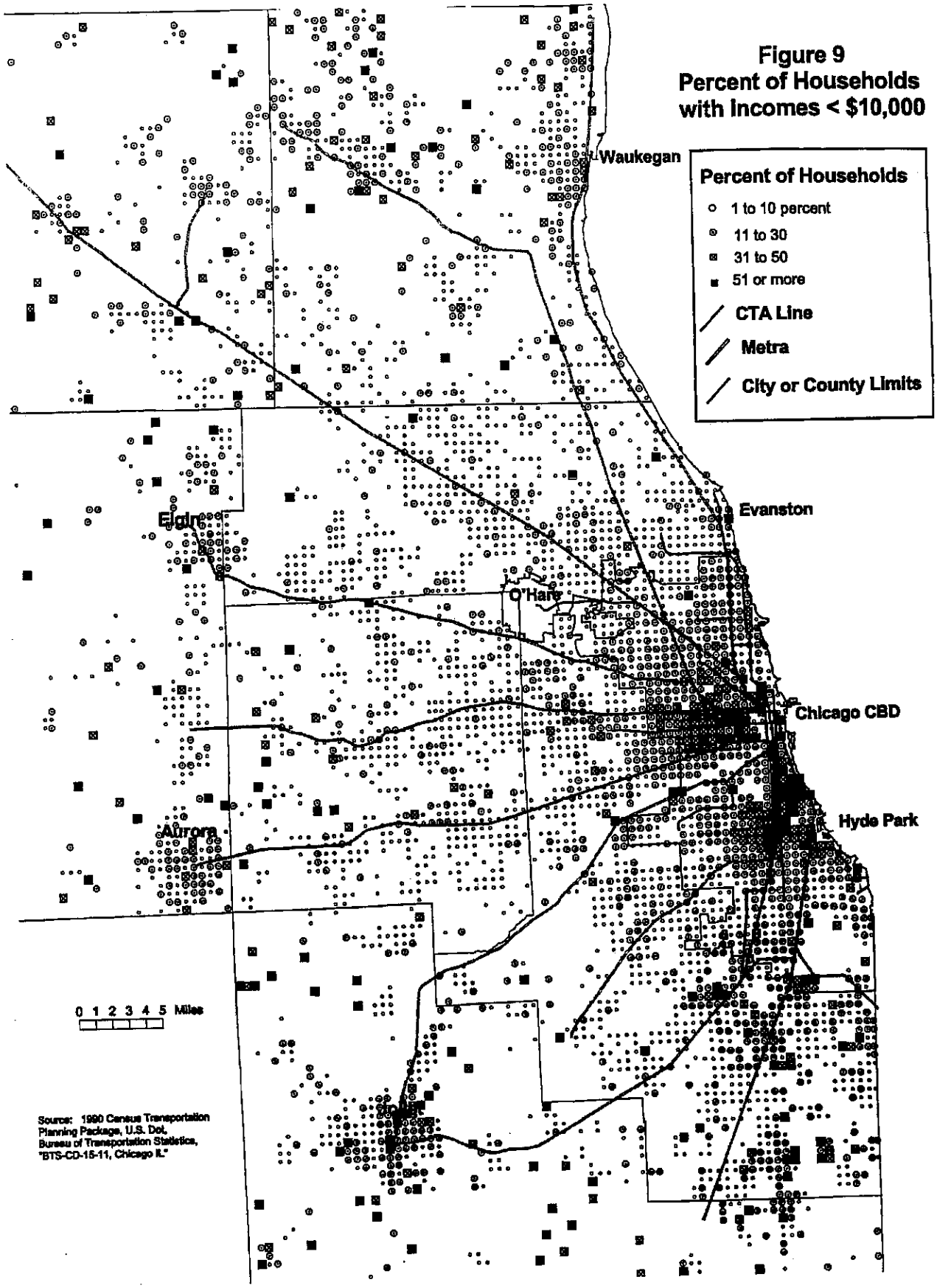


Figure 9
Percent of Households
with Incomes < $10,000
Percent of Households
1 to 10 percent
11 to 30
31 to 50
51 or more
CTA Line
Metra
City or County Limits
Waukegan
Evanston
Elgin
O'Hare
Chicago CBD
Hyde Park
Aurora
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

The majority of the rest of the suburban areas have very low percentages of households in this category. As in the case of population over sixty-five, there are isolated neighborhoods with values over 50 percent but these are low-population neighborhoods and, as is evident on Figure 9, they are typically not surrounded by other high-percentage areas. This is particularly true in areas within a ten miles radius around both Aurora and Joliet. A single isolated symbol suggests a few people in a semi-rural or otherwise undeveloped area.

3.4.2 Household Income over $100,000

To a large extent the map portraying the distribution of households with incomes over $100,000 (Figure 10) is a complement of the previous map. The largest concentration is along Lake Michigan, north of Evanston centered on Lake Cook Road. This area is popularly known as the North Shore, but as the map illustrates, the affluence extends considerably inland. Another area of high household incomes is found in the northwestern suburbs. Much of this area is defined by the Northwest Metra service. Most of this area is located north of the Northwest Tollway northwest of Schaumburg.

Another major affluent area is found in the eastern portion of DuPage County (one of the highest median income counties in the nation). The area just west of the Cook County line, running south through the letter H in O'Hare, has two foci, Oak Brook and Hinsdale.

There are smaller areas of affluence to the southwest (in and near Darien and Burr Ridge) and to the south (Olympia Fields and Flossmor). Both Olympia Fields and Flossmor have a long tradition while Burr Ridge is more an artifact of recent suburbanization.

An important area of affluence not particularly noticeable on Figure 10 is just north of the Chicago CBD. These are among the highest density neighborhoods in the study area and there are many more households in these zones than in suburban zones. Perhaps the reason there are not higher percentages in this area is that there are a large number of single-person households and they do not need to earn in excess of $100,000 to be affluent. Many of these individuals are over sixty-five years of age and are probably retired.

3.4.3 Two or More Workers per Household

In some cases multiple workers in a household achieve high incomes. This is also a sign of high peak-period transportation demand, assuming that most of these trips are during this period. On a per capita basis the multiworker household areas would cause more stress on the transportation system than areas with a low proportion of the household in the work force.

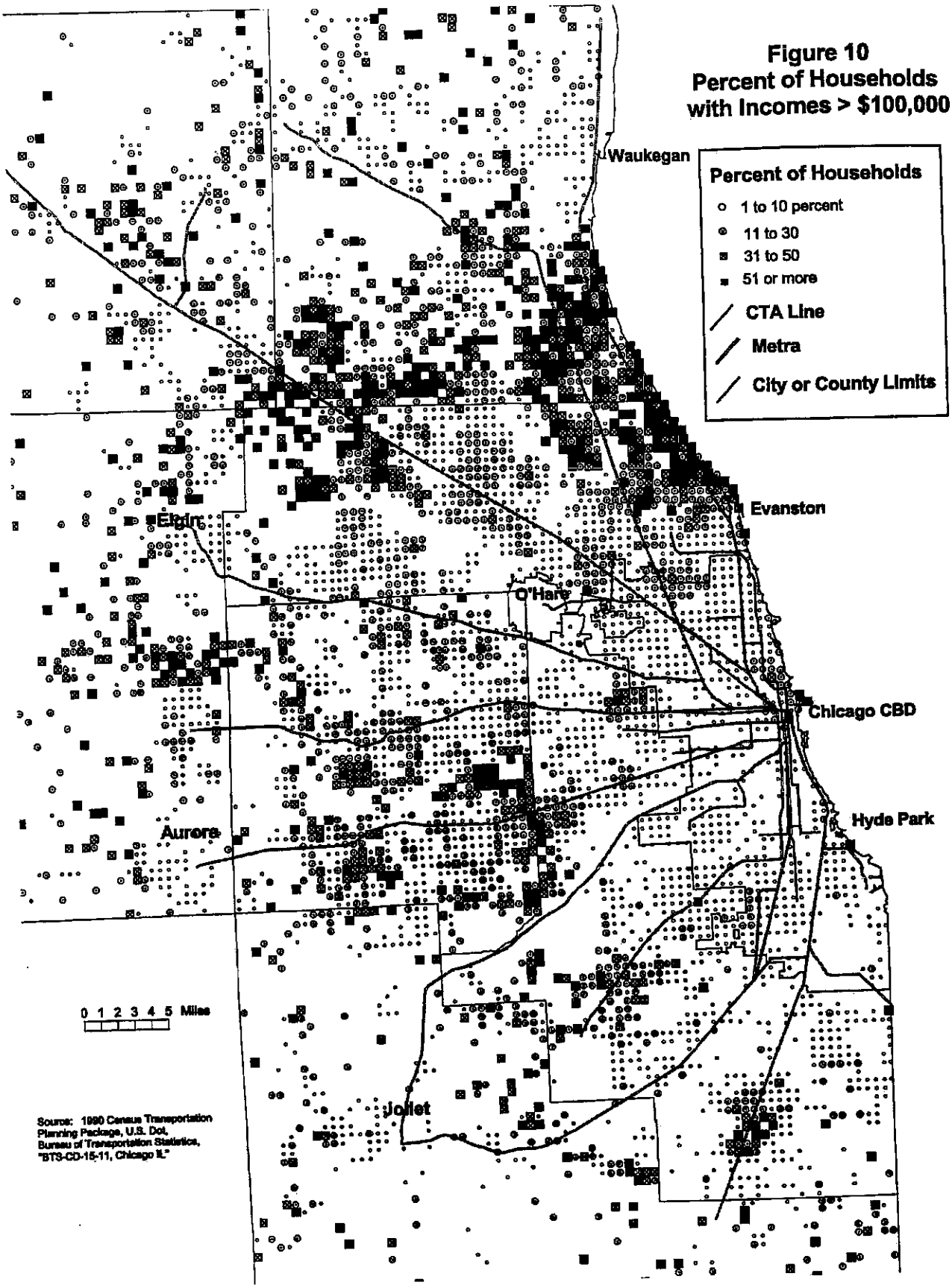


Figure 10
Percent of Households
with Incomes > $100,000
Percent of Households
1 to 10 percent
11 to 30
31 to 50
51 or more
CTA Line
Metra
City or County Limits
Waukegan
Evanston
Elgin
O'Hare
Chicago CBD
Hyde Park
Aurora
Joliet
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

Figure 11 shows that the lowest percentages are in the city of Chicago. There are several plausible explanations. First, the average household size in Chicago, 2.67, is lower than the metropolitan average, 2.72, and considerably lower than some suburbs with values over 3.25, such as South Barrington, Long Grove, Maywood, Bolingbrook, Hanover Park and Harvey. Second, high proportions of city residents are retired. Third, many city residents work in the Chicago CBD, an area with high earning levels. Fourth, there are many single-parent households in the city.

In the city and throughout the region there is an increase in the percentage of multiworker households with distance from the CBD. With values in the 41 to 60 percent range, the Pilsen neighborhood southwest of the CBD is a modest exception. This is the only Hispanic community with high percentages, but perhaps because there are many local jobs, there are greater opportunities for employment, particularly for the second and third wage earners in the household.

In suburban Chicago the pattern is mixed but is consistently higher than the 'less than 40 percent' level found in the city. Again many of the greater than 90 percent symbols represent zones with low population levels.

3.4.4 Unemployment

The map of unemployment (Figure 12) depicts a pattern reminiscent of the minority areas shown in Figures 3 and 5. Most prominent are the inner-city neighborhoods just west and south of the CBD. These neighborhoods are close to the job-rich CBD, but residents may not have the skills to qualify for the large number of white-collar jobs or the contacts to reach the entry-level positions in the CBD. While the Hispanic neighborhoods have much lower unemployment levels than the Black communities, the unemployment is still higher than in most non-minority neighborhoods.

There are also other pockets of high unemployment, particularly in southern Cook County. In this area there are relatively few jobs, unlike the Maywood area twelve miles directly west of the Chicago CBD where unemployment is high despite large numbers of nearby jobs. This latter area, however, has levels much lower than those found in the city. Lastly, several of the satellite cities have neighborhoods with high unemployment levels, particularly Joliet near the southwestern corner of the map.

3.5 Transportation

The previous section provided the background for understanding the patterns of transportation demand in the Chicago area. Many of the maps in this section show patterns reminiscent of the sociodemographic characteristics seen in Figures 1-12.

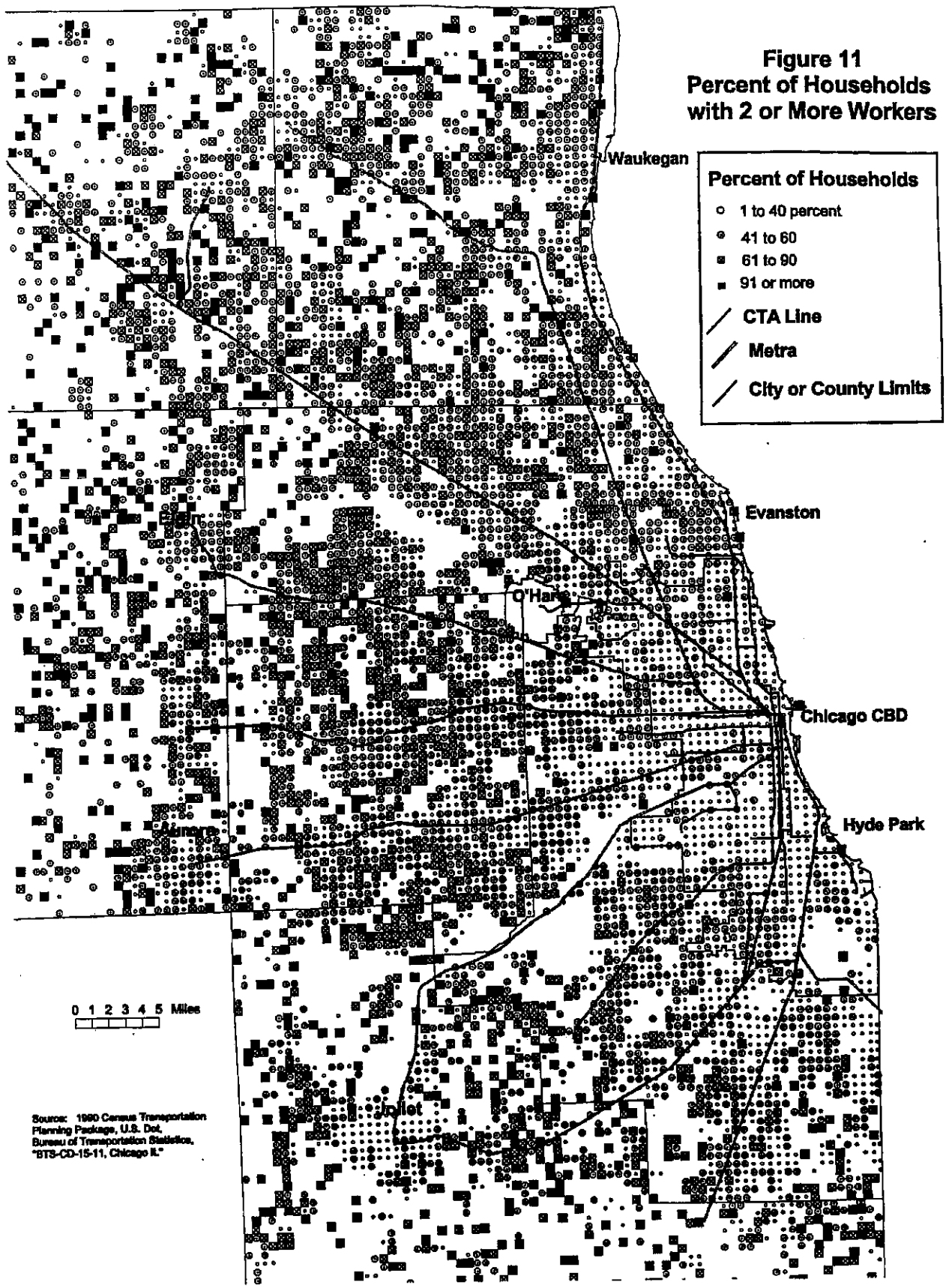


Figure 11
Percent of Households
with 2 or More Workers
Waukegan
Percent of Households
1 to 40 percent
41 to 60
61 to 90
91 or more
CTA Line
Metra
City or County Limits
Evanston
O'Hare
Chicago CBD
Hyde Park
Aurora
Joliet
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

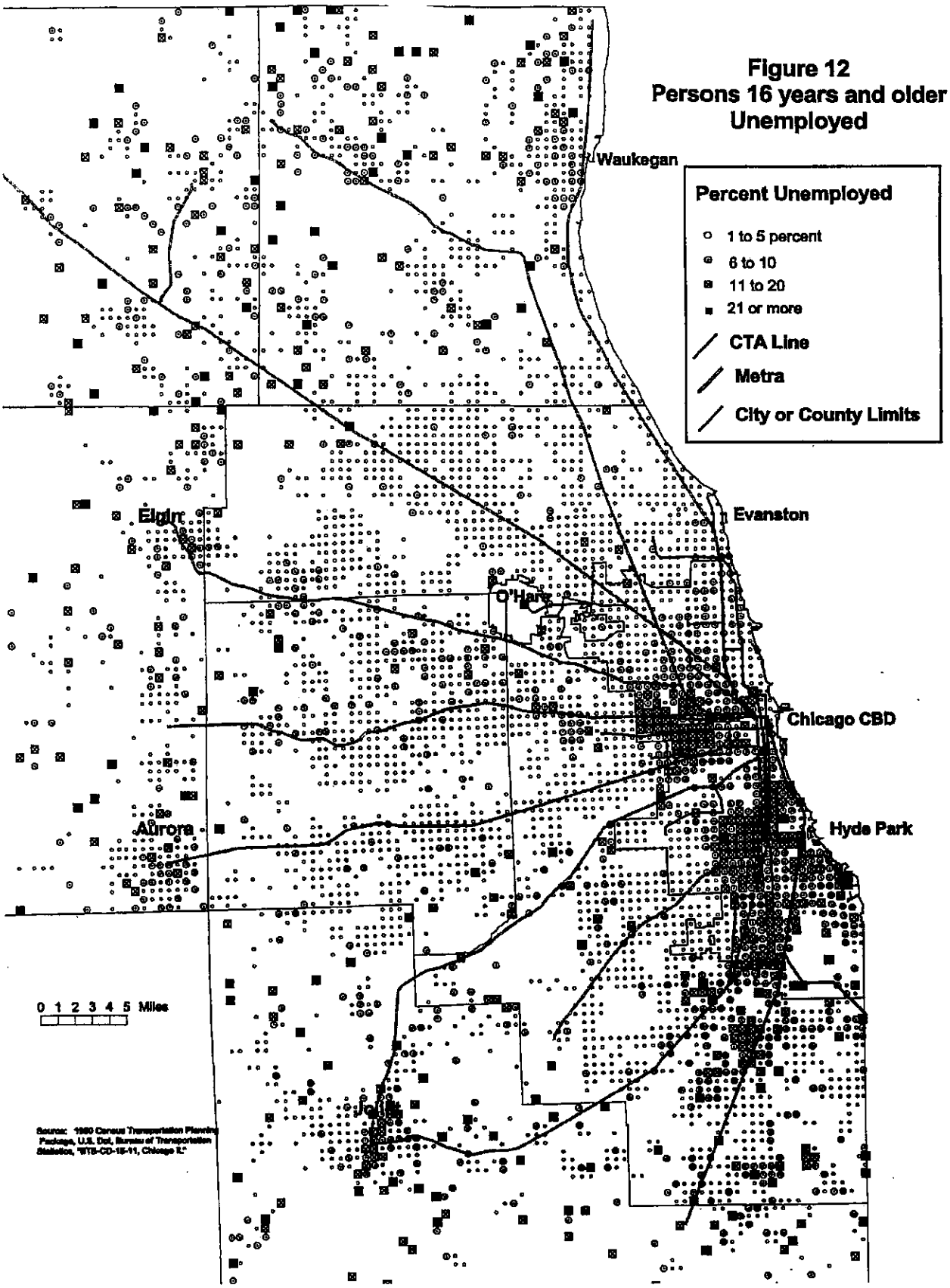


Figure 12
Persons 16 years and older
Unemployed
Waukegan
Percent Unemployed
1 to 5 percent
6 to 10
11 to 20
21 or more
CTA Line
Metra
City or County Limits
Elgin
Evanston
O'Hare
Chicago CBD
Aurora
Hyde Park
0 1 2 3 4 5 Miles

3.5.1 Households Without Vehicles

There are many places in Chicago where it is practical to live without a household vehicle. Much of the city of Chicago falls into this category, particularly neighborhoods close to the established CTA rail system. This is most noticeable on the south side where over half of the households along the Dan Ryan (Red) Line and the Englewood/Jackson Park (Green) Line do not own vehicles (Figure 13).

Even on the much more affluent north side there are a large number of households without vehicles. In most neighborhoods along the Evanston (Red) Line service more than a third of the households are carless. The Orange Line, running southwest, is a new line opened in the last few years. Already, pockets of high percentages of no-vehicle ownership have appeared.

Beyond the CTA rail service the most extensive area of households without vehicles is in southern Cook County. Many of these neighborhoods are in close proximity to the Metra Electric service running largely straight south of the CBD.

Each of the four satellite cities, Joliet, Aurora, Elgin and Waukegan, have substantial portions of their central cities with carless households. Each has good local bus service as well as Metra rail operations to Chicago.

3.5.2 Persons with Limited Mobility

Special transportation needs are also found among persons with mobility limitations. The pattern shown in Figure 14 is reminiscent of the previous figure portraying households without vehicles. While the percentages are much lower, the CTA rail service lines along the three cardinal compass directions from the Chicago CBD have communities with over ten percent of the population having mobility limited status.

There are also areas in the northwestern part of the city of Chicago with levels over five percent. The area is extensive but tends to be centered on Harlem Avenue, the north-south township line five miles east of O'Hare Airport. Much of this area is distant from the CTA rail system.

The levels of limited mobility in suburban Chicago are lower and much more sporadic. Much of the irregularity of the pattern can be traced to small populations in zones showing high percentages.

4.0 Mode Use in the Work Trip

Even though the focus of this study is on nonwork trips, the only data that allow us to examine mode use variation by small area are in the U.S. Bureau of the Census

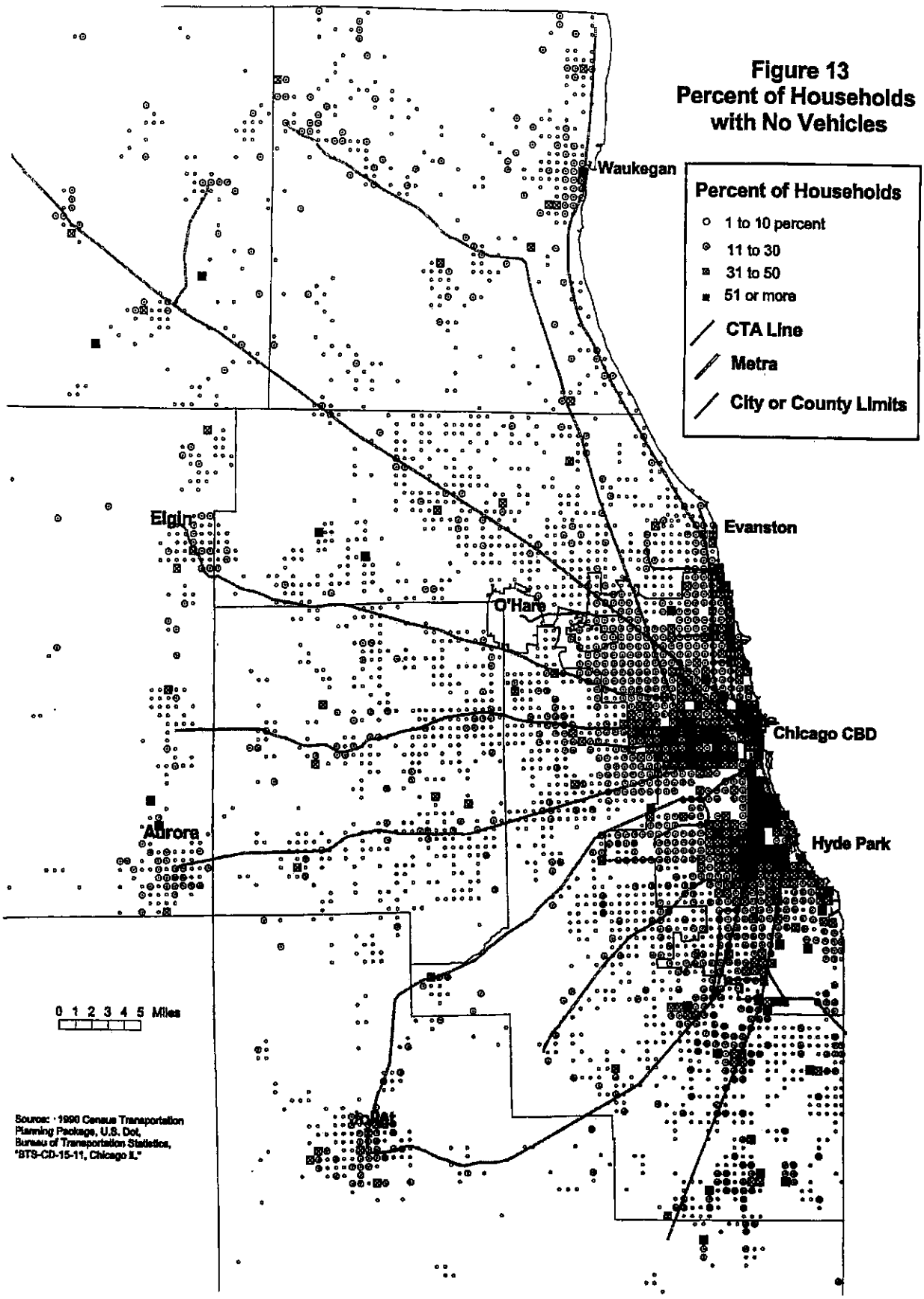


Figure 13
Percent of Households
with No Vehicles
Percent of Households
1 to 10 percent
11 to 30
31 to 50
51 or more
CTA Line
Metra
City or County Limits
Waukegan
Elgin
Evanston
O'Hare
Chicago CBD
Aurora
Hyde Park
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

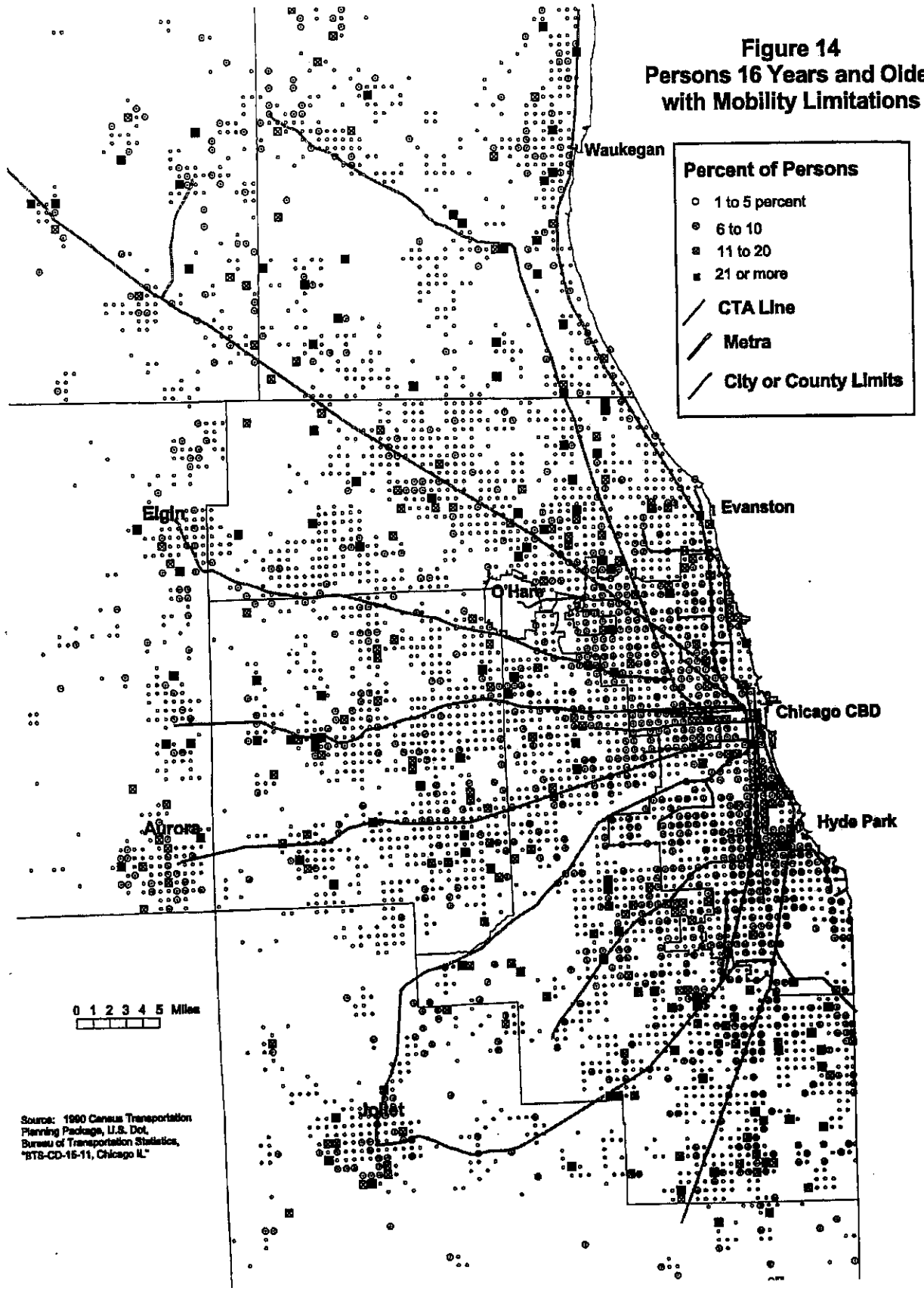


Figure 14
Persons 16 Years and Older
with Mobility Limitations
Waukegan
Percent of Persons
1 to 5 percent
6 to 10
11 to 20
21 or more
CTA Line
Metra
City or County Limits
Elgin
Evanston
O'Hare
Chicago CBD
Hyde Park
Aurora
Joliet
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

Transportation Planning Package (CTPP). Moreover, these data provide an excellent picture of where walking and biking to work are found. It may not be inappropriate to assume that where people walk and bike to work they also walk and bike to other destinations. This may be more true for walking trips since bicycling is induced in places where paths are provided.

4.1 Working at Home

Not surprisingly working at home is relatively prevalent in and near the Chicago CBD (Figure 15). This is particularly true along Lake Michigan and the near north side just south of North Avenue. Many of these residents live in close proximity to a large number of businesses and find it practical to work at home.
There is also a corridor east of Halsted and north of Armitage with a large number of workers employed at home. Each of the five zones in this corridor has over 200 persons working at home. The neighborhoods just to the west along the CTA Red Line also have high levels. The density of urban activity in this general corridor makes working at home a practical choice.

Other pockets of home workers are located near Devon east of Ashland (near Lake Michigan). There are also neighborhoods with more than one hundred people working at home in Evanston, Hyde Park (University of Chicago) and Oak Park. Although not shown on Figure 15, there are also large numbers of persons working at home in the four satellite cities.

4.2 Walking and Bicycling

The two nonmotorized forms of transportation considered here are walking and bicycling. Both have very limited markets.

4.2.1 Walking to Work

Walking to work is much more common than working at home. In the Chicago CMSA just over 150,000 walk to work but only approximately 80,000 work at home. They constitute 4.01 percent and 2.10 percent of the workers in the Chicago area and 3.90 percent and 2.96 percent of the workers in the nation respectively. Within the thirty-nine metropolitan areas with populations over one million the respective numbers are 3.76 and 2.57 percent. Walking, then, is more common in the Chicago area than in many other parts of the country.

Since walking to work is more common than working at home, the scale for Figure 16 is larger than the scale for Figure 15. There are more neighborhoods in the higher categories on Figure 16, although the spatial patterns are similar. Walking is common in the near north side and throughout the lakefront neighborhoods up to Evanston. In most

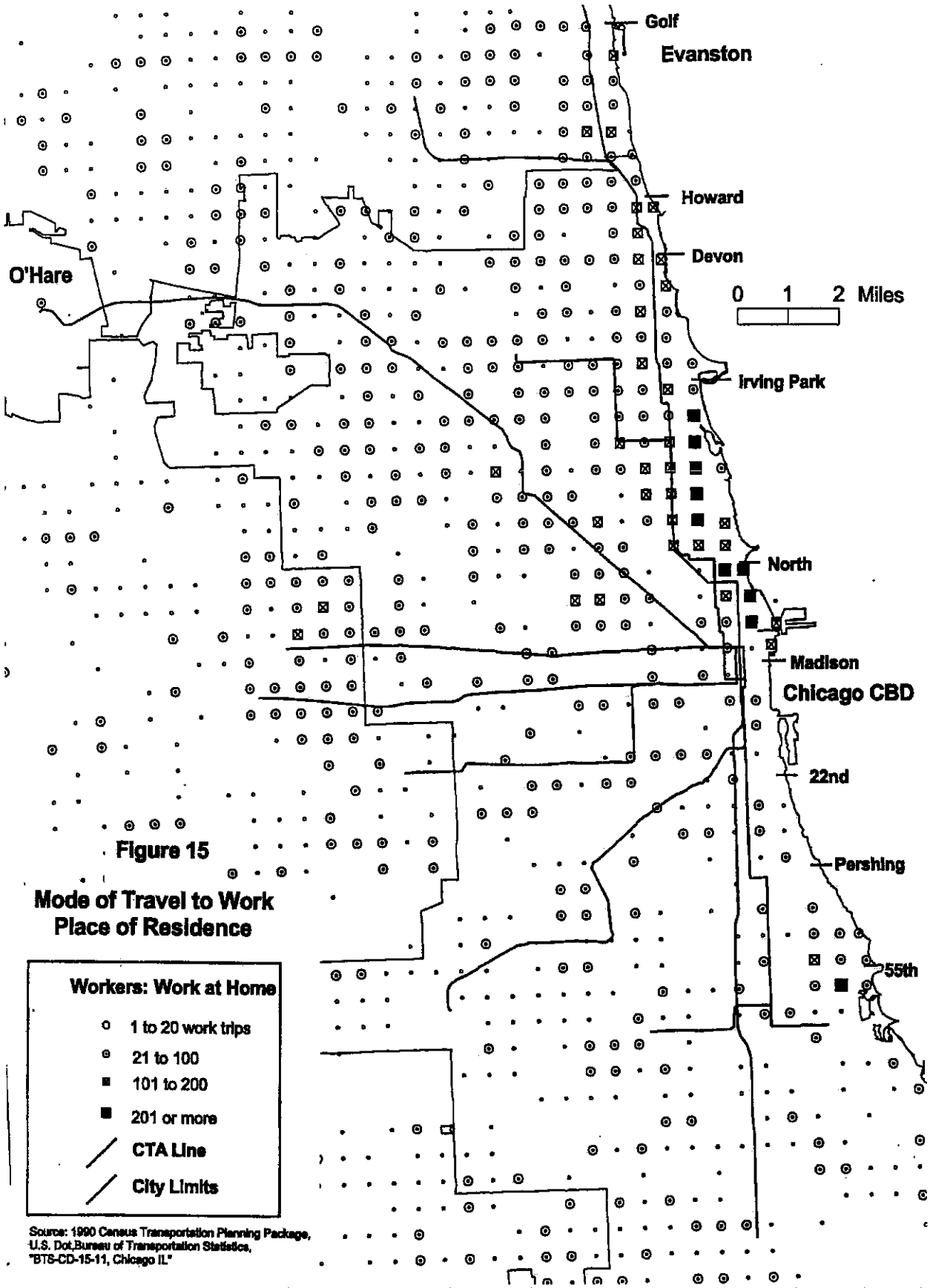


Figure 15

Mode of Travel to Work Place of Residence

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

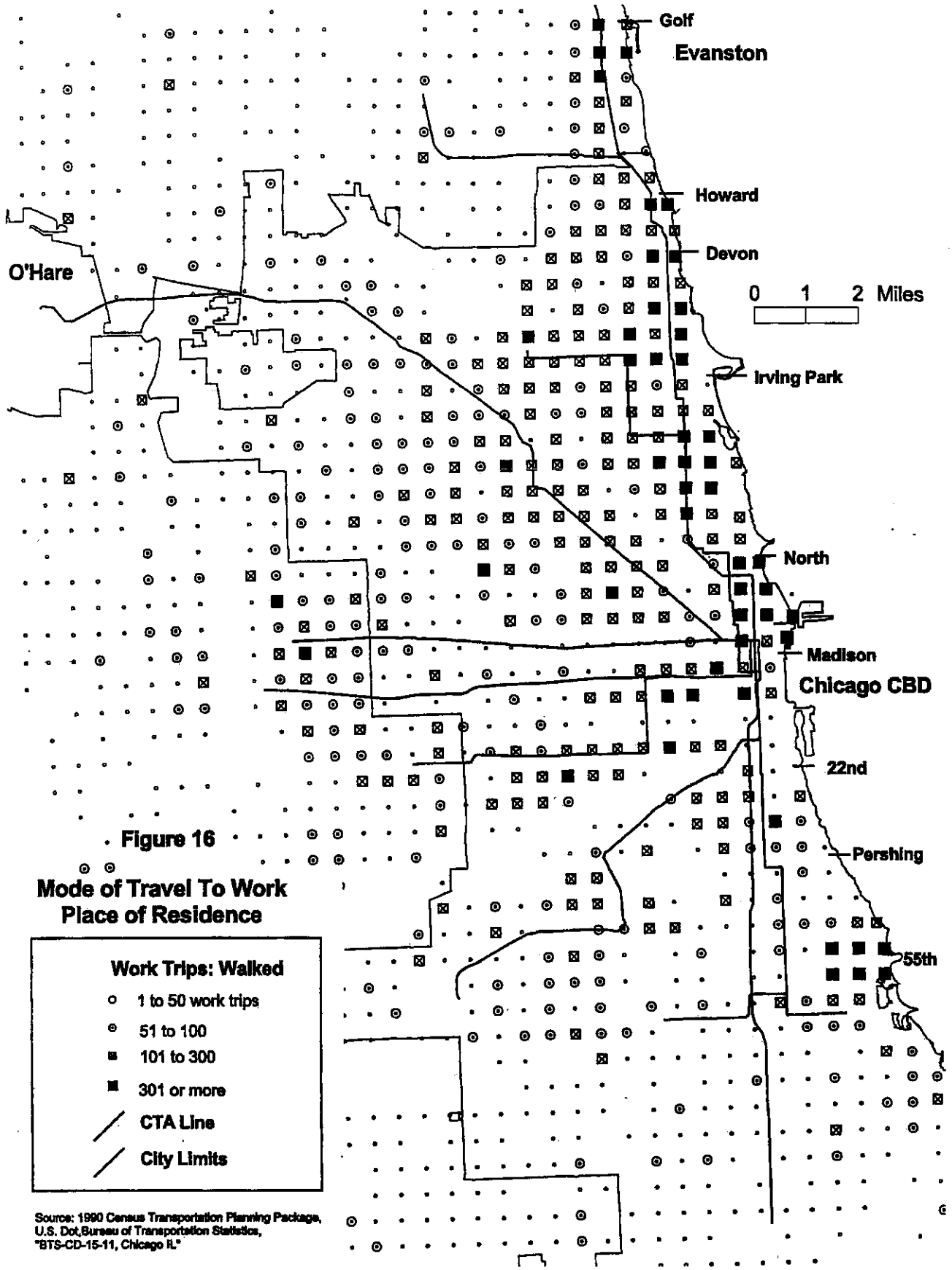


Figure 16

Mode of Travel To Work Place of Residence

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

of the neighborhoods near the CBD the portion of the work force walking is in excess of 25 percent and in five zones it is over 50 percent. Throughout much of the rest of the city it is less than ten percent. Conversely Oak Park, Berwyn, Cicero and Hyde Park (near 55th Street) have a large number of walkers.

Within the city of Chicago the west side is distinctive in the number of people walking to work. The lack of local employment is likely the major reason for few residents walking to work. The same is true for the far south side. The area south of 67th Street has very few walkers. This is true for both minority and majority neighborhoods.

Beyond the range of Figure 16 each of the satellite cities has workers walking to work. Other lesser pockets are in Wheaton and in the Brookfield and LaGrange communities.

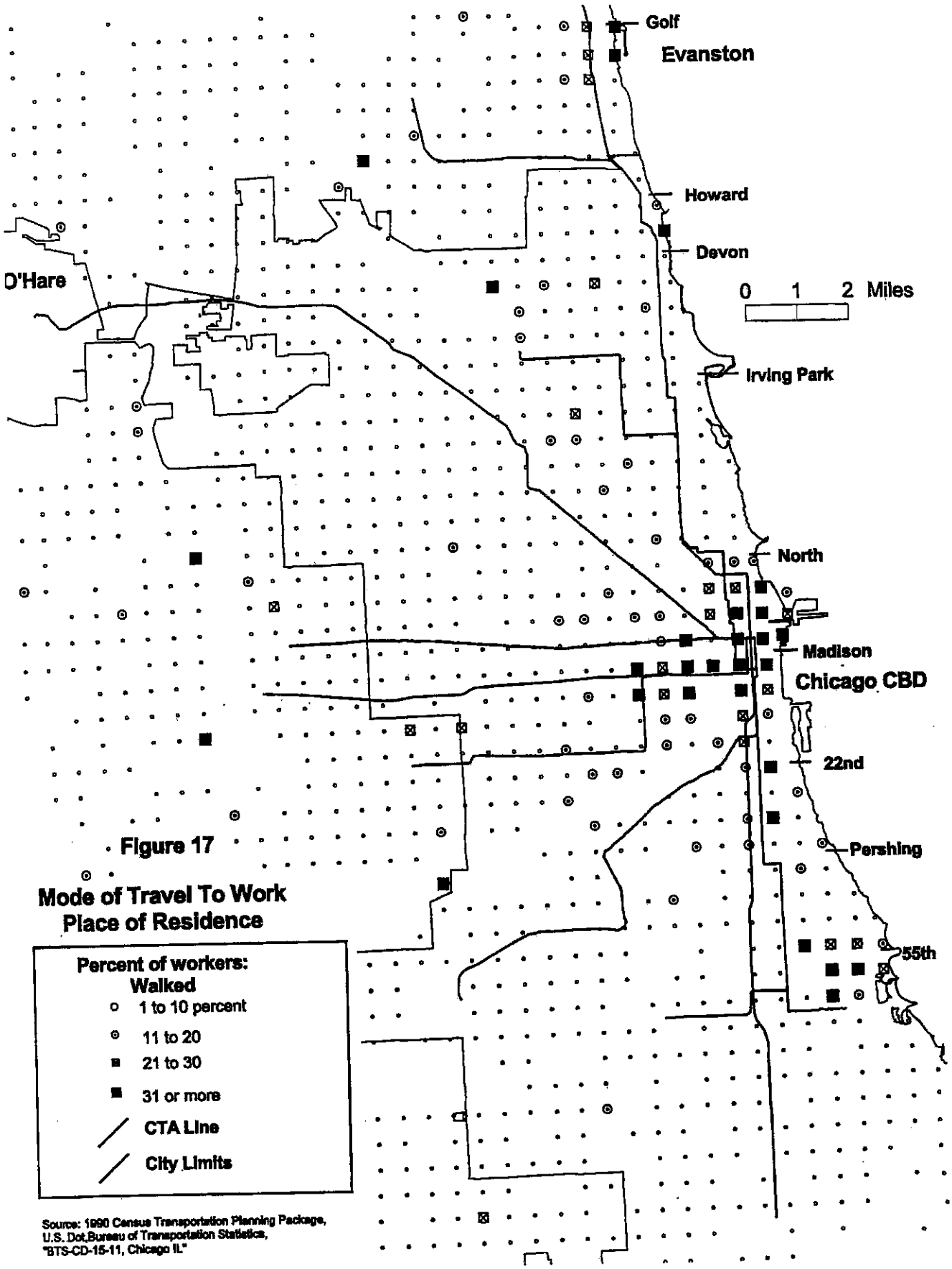
Figure 17 shows walking trips as a percent of all work trips. We observe high percentages near the Chicago downtown and around major universities. The residents who live and work near the urban campuses define Northwestern University in Evanston, University of Illinois at Chicago and the University of Chicago near 55th Street.

4.2.2 Bicycling to Work

Bicycling is less common than walking, accounting for only 0.21 percent of the work trips in the consolidated metropolitan area. This is approximately half of the national rate of 0.41 percent and the 0.43 percent level among the thirty-nine largest metropolitan areas. Still, within Chicago bicycling (Figure 18) and walking (Figure 17) exhibit similar patterns with some noticeable differences.

The difference is that the major concentration is on the north side rather than on the north fringe of the CBD. Among central-area residents (greater CBD) there are many walkers but few bicyclists. The largest bicycling community seems to be centered on an area near Irving Park Road, east of Western Avenue. Irving Park Road (4000 north) is five miles due north of the core of the CBD and for most bikers it is a very convenient distance from the Chicago CBD. Since there is a lakefront bike path almost up to Devon Street a large number of these bikers can use this route. As a consequence the near northwestern communities in Chicago have relatively few bikers while there are a large number of walkers.

The similarities are many including the large numbers in Evanston, Oak Park and Hyde Park. As with walking, there are few bikers in the suburban areas beyond the territories mapped on Figure 18. There are even very low levels in the four satellite cities; Joliet only has one neighborhood reporting more than ten bikers. Given the sampling nature of the data it is even possible that only one person responded as a biker and it was weighted more than other responses. The weights are assigned using a random procedure and are generally less than ten.


Golf
Evanston
Howard
Devon
O'Hare
0 1 2 Miles
Irving Park
North
Madison
Chicago CBD
22nd
Pershing
55th
Figure 17
Mode of Travel To Work
Place of Residence
Percent of workers:
Walked
1 to 10 percent
11 to 20
21 to 30
31 or more
CTA Line
City Limits
Source: 1990 Census Transportation Planning Package,
U.S. Dot,Bureau of Transportation Statistics,
"BTS-CD-15-11, Chicago IL"

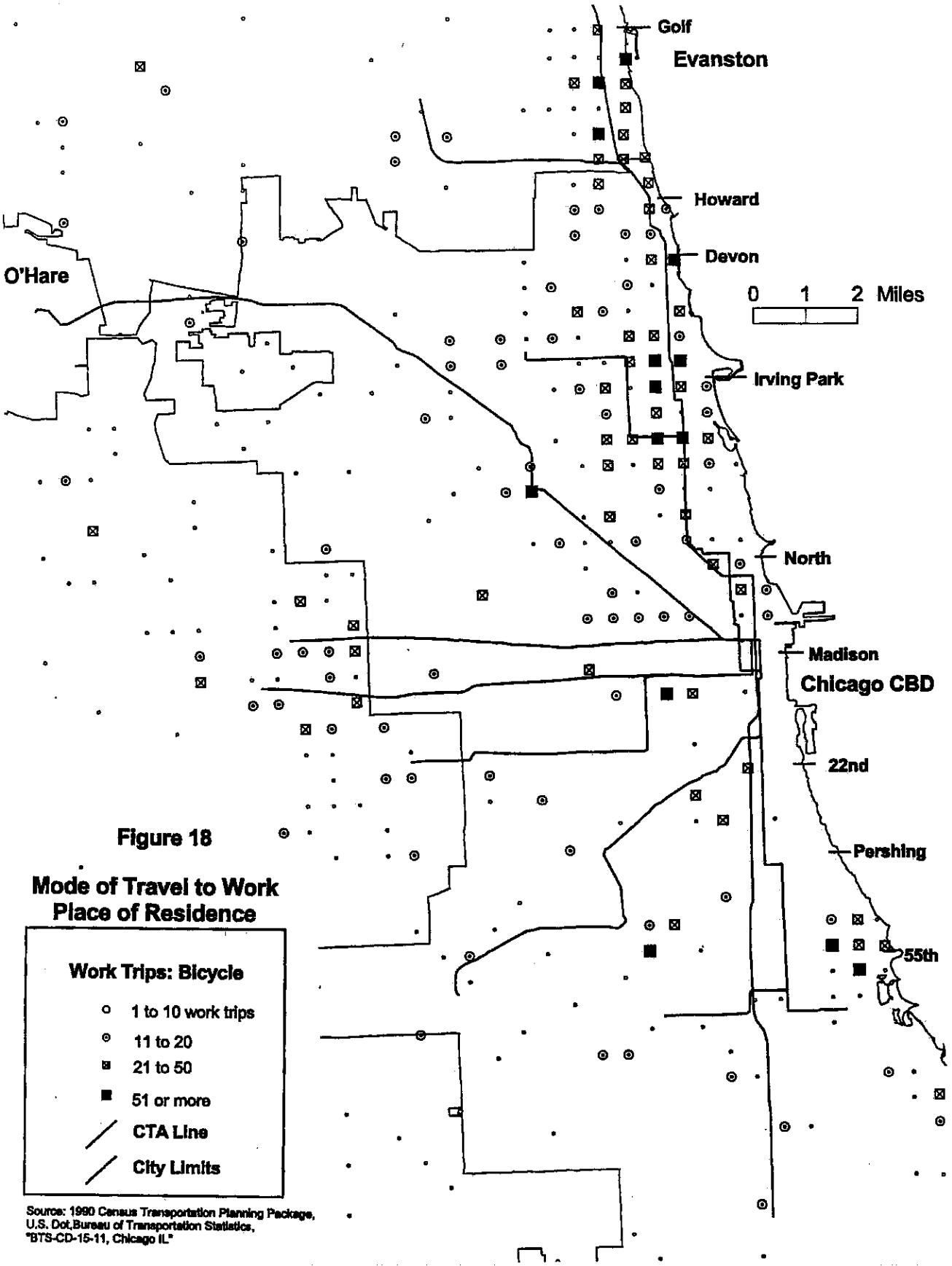


Figure 18

Mode of Travel to Work
Place of Residence

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

The only other municipalities with two adjacent zones with over twenty bikers each are in the far southern sections of Rolling Meadows and Arlington Heights along the Northwest Tollway (again beyond the range of Figure 18). These two areas, separated by approximately two miles, have both high population and employment levels.

4.2.3 Bicycling and Walking During the Off-peak: *Place of Work*

The map showing work trips by foot or by bicycle during the off-peak (defined as the twenty-one hour period excluding 6:30 to 9:29 a.m.) largely resembles the trip patterns by these modes for the entire day (Figures 16 and 18). Note that while Figures 16 and 18 map the places of residence Figure 19 shows places of work. This suggests, as would be expected, that many of these trips are exceedingly short.

From south to north the major destinations are Hyde Park, the CBD, several neighborhoods on the north side on or near the Red Line and Evanston. During this off-peak period Evanston is the only area with more than one zone of more than 500 trips. Northwestern University undoubtedly contributes to this phenomenon.

The last community worth noting is the Hispanic area (Pilsen) southwest of the CBD. This wedge-shaped area is to some extent is self-contained, with the Spanish language providing the bond. There are a variety of Spanish-language businesses offering employment to the local population.

4.3 Public Transit Use During the Entire Day

This section is divided into four parts. The first examines all public transportation modes collectively. The second considers percentage use. The third compares CTA rail usage with bus usage and the fourth examines public transit during the morning peak period.

Compared nationally, Chicago, with 13.4 percent of work trips by transit, ranks behind New York and just ahead of Washington D.C. The national figure is 5.3 percent and it is 9.0 percent for the thirty-nine largest metropolitan areas. Considering only bus use, both CTA and Pace combined, the Chicago area does not fare as well. With 6.8 percent of the commuting market, the Chicago area ranks behind New York, Pittsburgh and New Orleans and again just ahead of Washington D.C. This lower share for bus services in Chicago may simply reflect the existence of rail service as an alternative to bus use.

4.3.1 Number of Public Transit Users

The highest levels of transit use in the work trip are on the north side of the city (Figure 20). The CTA corridor along the Red Line in particular has very high usage levels. This rail line and distance from Lake Michigan seem to be the principal determinants. Distance from the lake is a surrogate for density of public transit service (including

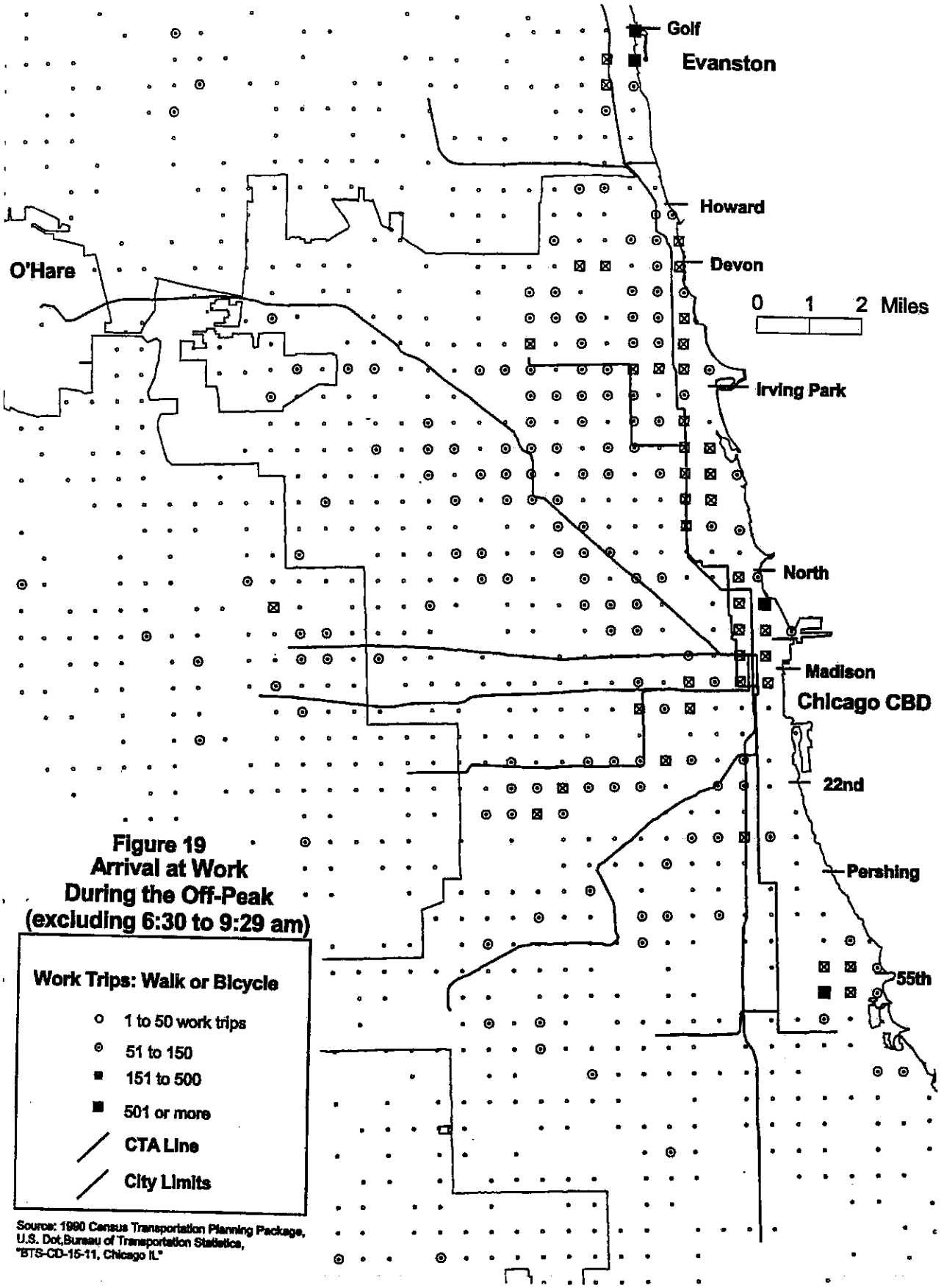


Figure 19
Arrival at Work
During the Off-Peak
(excluding 6:30 to 9:29 am)

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

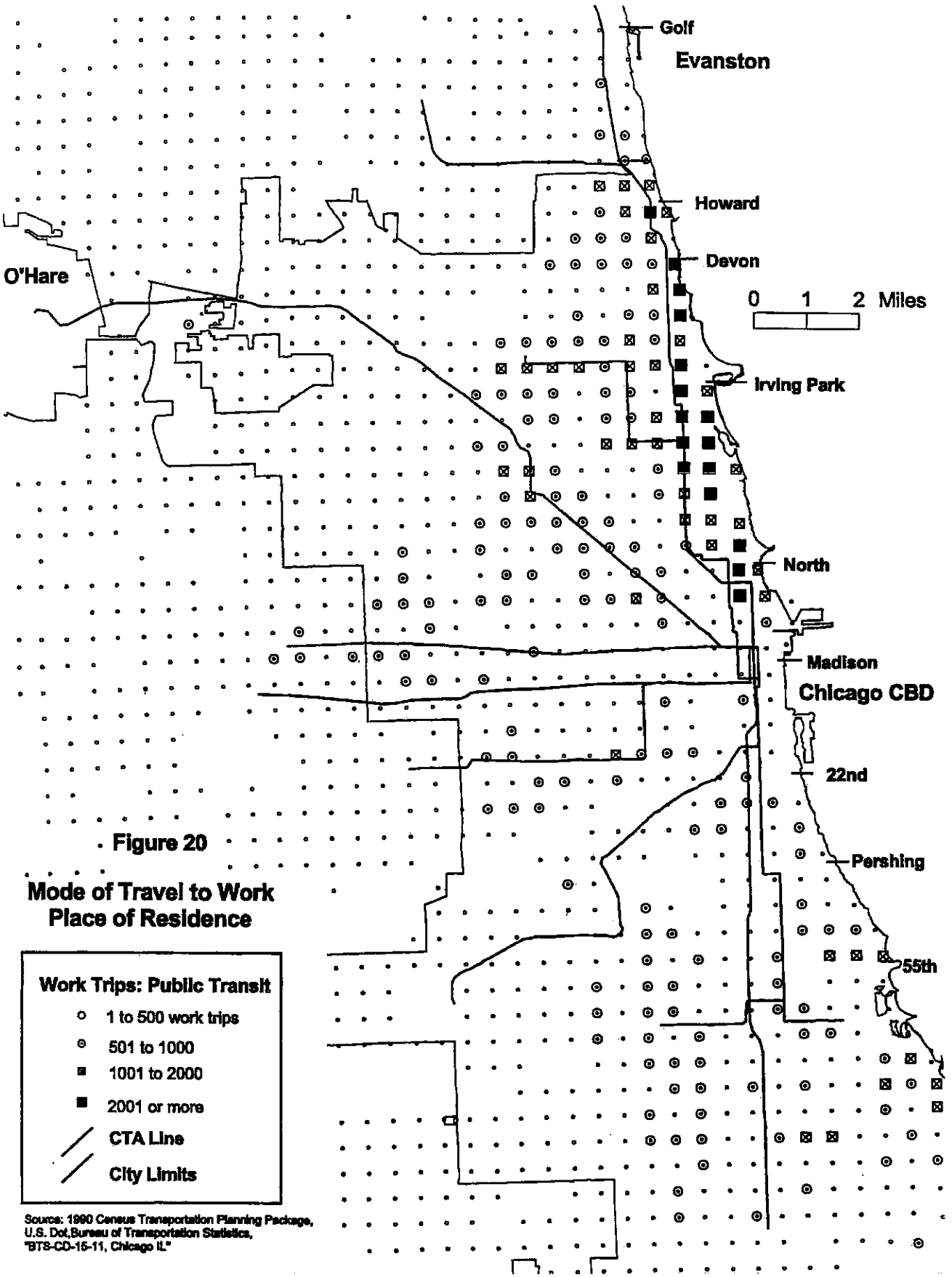


Figure 20

Mode of Travel to Work Place of Residence

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

express bus routes). Since downtown jobs are frequently associated with high salaries, the higher rents close to the lake are then affordable for many workers.

Some of the neighborhood stations on the Ravenswood (Brown) Line have recently been renovated and they also have high usage levels. The highest concentrations are:

- between Belmont and Addison near the Southport stop and
- between Lawrence and Montrose west of Western Avenue.

Another pocket of high use is near the Belmont and Logan Square stations on the O'Hare (Blue) Line.

While the south leg of the Red Line, extending to 95th Street, also has high levels, oddly most of the users reside a mile or more west of the rail line. Many of these users reside between Halsted and Damen and therefore it appears that either walking is less frequently used as an access mode to the rail system or these riders are bus users.

4.3.2 Public Transit's Market Share

Converting these data to percentages shows a rather different picture (Figure 21). This stems from the variations in population density. The north side of the city has higher densities than the south side and in some cases low percentages may yield high numbers.

There are high usage levels throughout the principal CTA service area and north along Lake Michigan up to Glencoe and parts of Highland Park. To the south usage extends well beyond the 95th terminus of the Red Line, but not to the end of the O'Hare Blue Line neither to the west nor the Skokie Swift line west of Evanston. Both serve lower density areas than found in the high usage areas and perhaps their work destinations may not be conveniently served by public transit, e.g., scattered suburban locations.

The lowest-use area is just southwest of the CBD along the new Orange Line to Midway Airport, perhaps because the line opened after the 1990 Census data were collected. There are areas of high use in the corridor but also very low levels. Parts of the Pilsen neighborhood (Figure 5) where walking was common (Figure 16) have relatively low levels. Conversely, the high transit usage conforms remarkably well on the south side to the shape of the neighborhood (Figure 3).

Beyond the immediate city of Chicago area there are a few areas where more than twenty percent of the work force use public transit. Three Metra lines are evident, the north line to Waukegan, the Burlington service through Hinsdale to Aurora and the Metra Electric line south through Homewood and Flossmor to University Park. There are also other scattered locations, but many of these are attributable to low population levels.

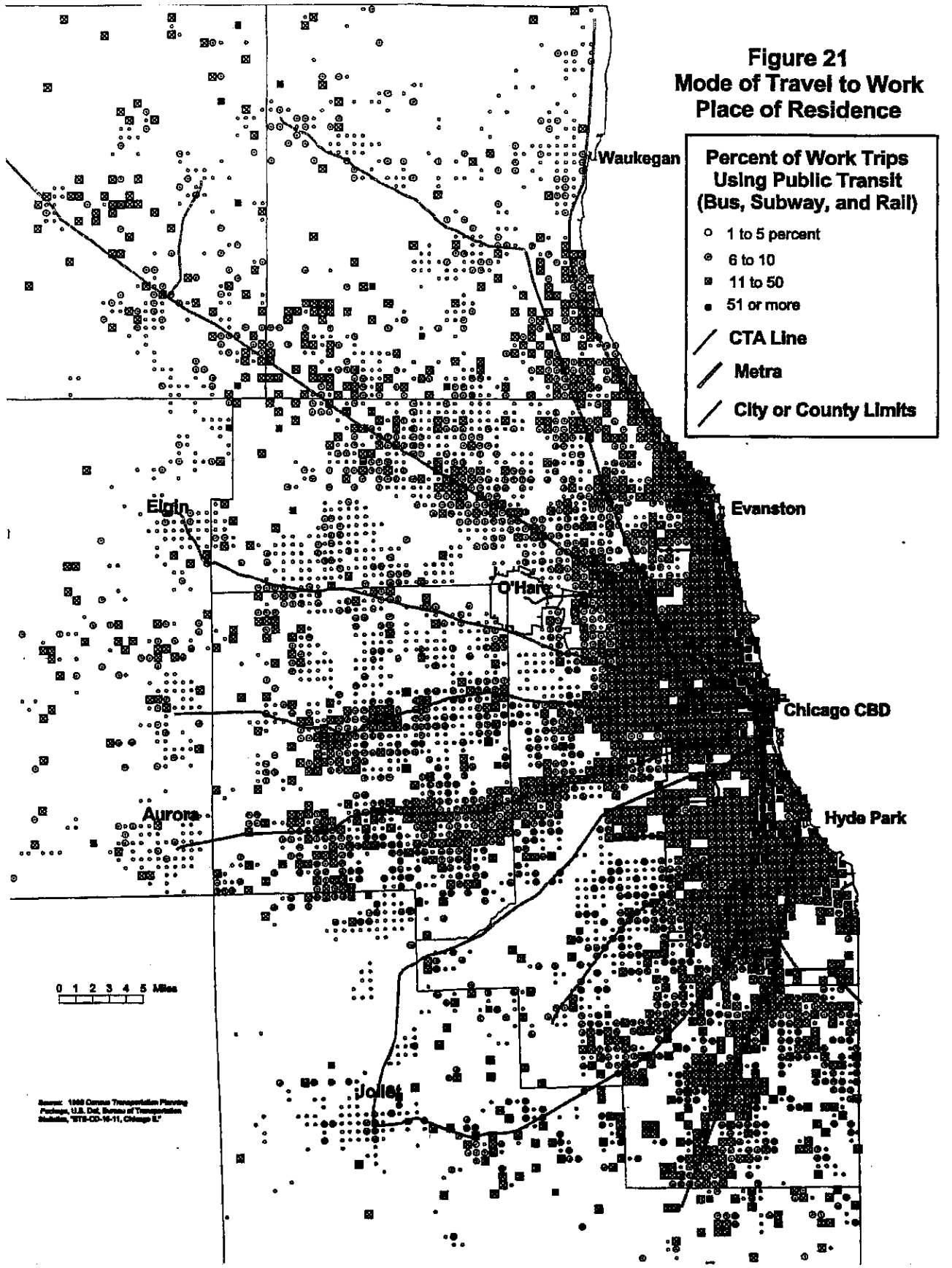


Figure 21
Mode of Travel to Work
Place of Residence
Percent of Work Trips
Using Public Transit
(Bus, Subway, and Rail)
1 to 5 percent
6 to 10
11 to 50
51 or more
CTA Line
Metra
City or County Limits
Waukegan
Evanston
Elgin
O'Hare
Chicago CBD
Aurora
Hyde Park
Joliet
0 1 2 3 4 5 Miles

4.3.3 Comparison of Bus and CTA Rail Usage

Figures 22 and 23 show the split between CTA rail and bus service. Except for the north side along the lake, where both modes are widely used, the two maps are fairly complementary. As one might expect, bus usage is distributed throughout the city, conforming to city limits, while CTA rail usage is dominated by residents living close to transit lines, including suburban terminal points.

Some interesting exceptions include the Blue Line and the Green Line. On the west side, the CTA rail market share on the Blue and Green Lines is high only at the end of the lines. These areas include Austin, Oak Park, Cicero and Berwyn, where bus usage is low. Moving east, the market share for bus service is high for residents living along these lines, indicating possible job destinations to the north or south.

The southern legs of the Red and Green lines between Pershing and 63rd Street show a similar pattern of bus usage, which might also indicate a work trip to south side employment. These areas of high bus usage, even near CTA rail lines, are in the western and southern minority neighborhoods. Perhaps these workers are travelling to jobs in the southern industrial sector rather than downtown.

As mentioned earlier, CTA usage along the Red Line is high, especially between North Avenue and Irving Park, as shown in Figure 23. CTA rail usage here is high in terms of both numbers and percentages, as is bus usage east of the rail service. Percentages fall off north of Irving Park for rail usage and north of Montrose for bus service. Longer travel times to reach downtown on the CTA and lower percentages of CBD employment in these areas may promote a higher rate of automobile use in these northern city neighborhoods.

Percentages are relatively high along the north leg of the Blue Line, particularly around Logan Square, and at the last three residential stops; Harlem, Cumberland and Rosemont. Bus service falls off dramatically at O'Hare, which has the lowest market share for bus service, in spite of its role as a major employer. Bus access to O'Hare may be more difficult, especially when compared to CTA rail or automobile access. In this regard the mode split in this northwestern corner of Chicago more resembles Evanston than other Chicago neighborhoods. Bus use is low, but rail use is high.

4.3.4 Public Transit Use During the Rush Hour

Figure 24 shows the portion of all home-to-work public transit work trips departing the home during the morning 6:30 to 9:29 a.m. peak period. High levels point toward standard working hours while low percentages indicate that work begins earlier or later.

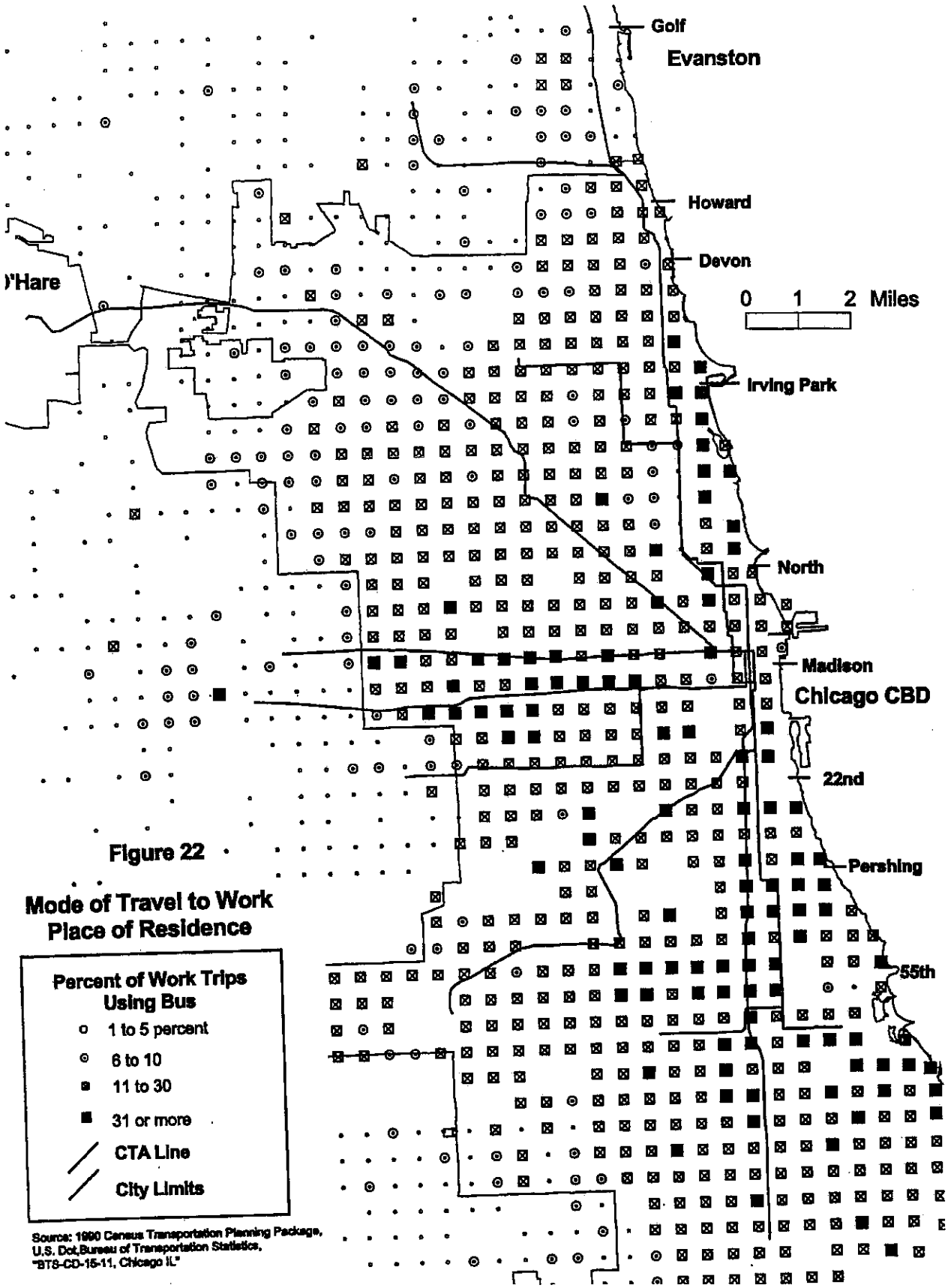


Figure 22

Mode of Travel to Work Place of Residence

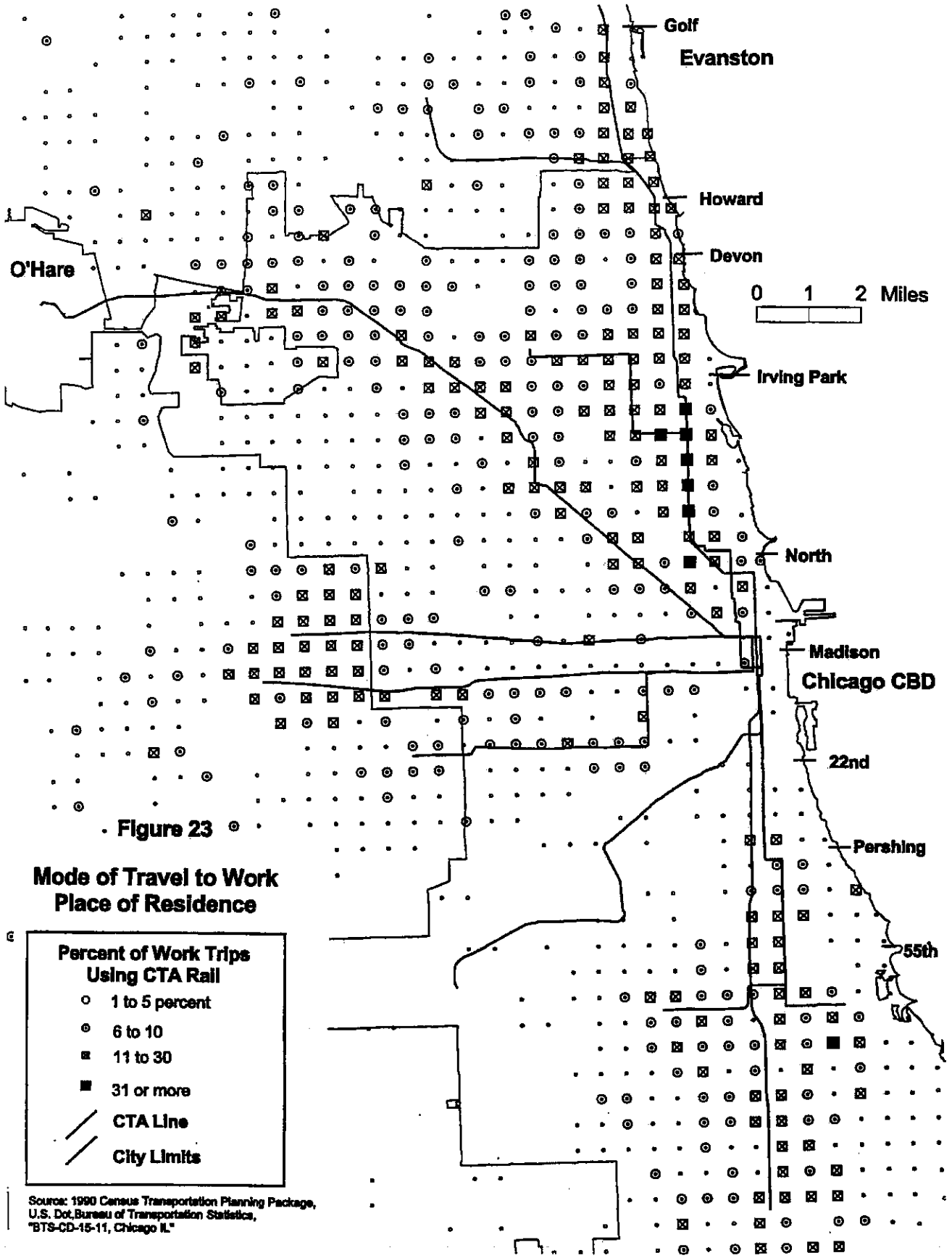


Figure 23

Mode of Travel to Work Place of Residence

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

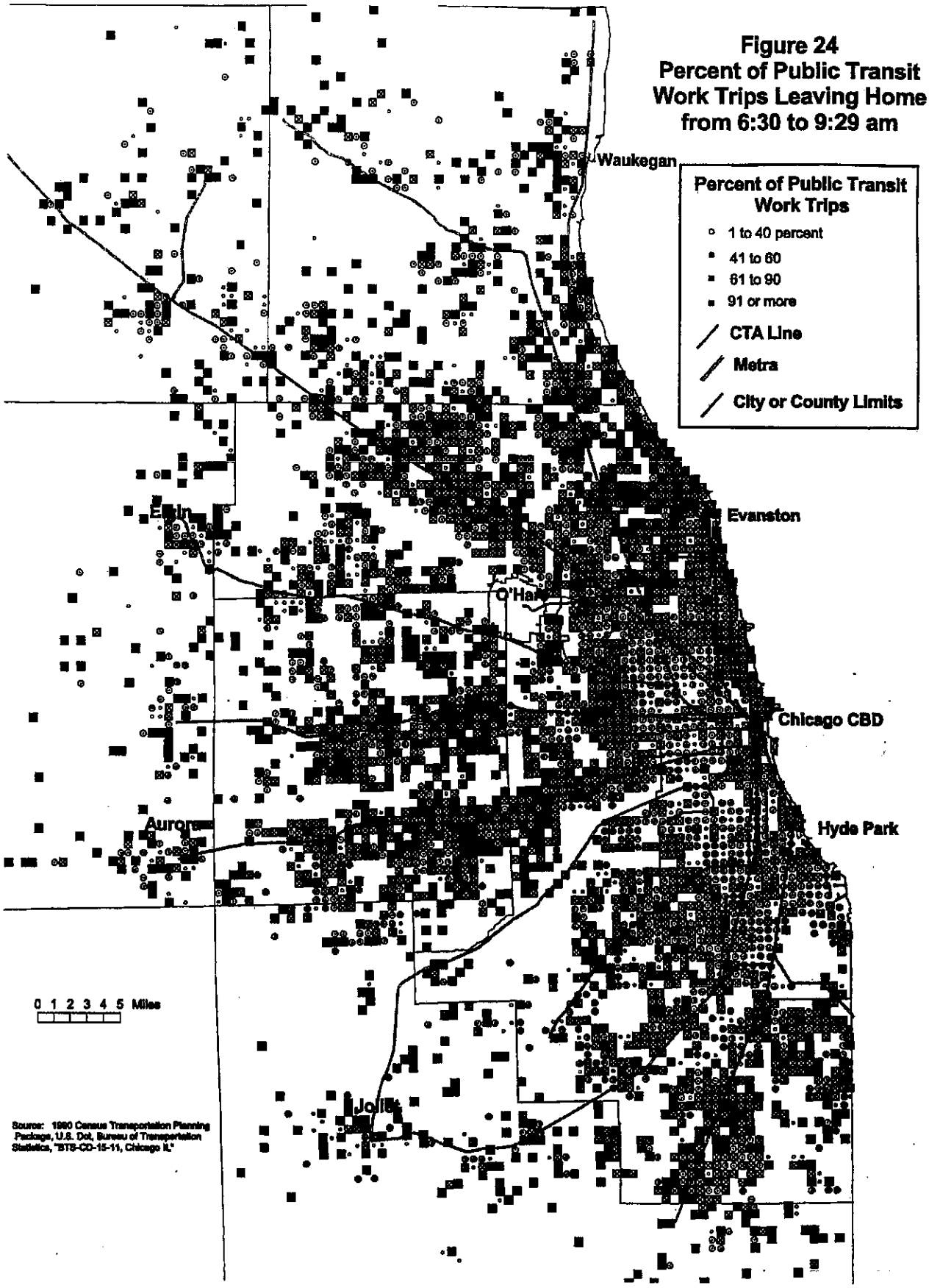


Figure 24
Percent of Public Transit Work Trips Leaving Home from 6:30 to 9:29 am
Waukegan
Percent of Public Transit Work Trips
1 to 40 percent
41 to 60
61 to 90
91 or more
CTA Line
Metra
City or County Limits
Elgin
Evanston
O'Hare
Chicago CBD
Aurora
Hyde Park
0 1 2 3 4 5 Miles
Joliet
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

Extremely high percentages dominate the suburbs, especially along Metra lines, where CTA rail use is high along the lakefront neighborhoods. Most of the businesses in the Chicago downtown have standard operating hours and the residential areas of these employees are likely to have high levels on Figure 24.

Lower market shares for public transit in the city are found in a north-south elliptical-shaped area west of the Chicago downtown. Many of these individuals are engaged in manufacturing with second and third shifts. The urban environment is also a contributing factor. Ubiquitous public transit and diverse employment opportunities produce a more evenly distributed pattern of travel throughout the day. It is important to remember, however, that the differences in population density mean that lower city percentages may mean equal or higher numbers of travelers (see Figure 20).

4.4 Public Transit Use During the Off-peak

The off-peak period is defined as all departures from home excluding the period from 6:30 to 9:29 a.m. This section examines public transit, bus, CTA rail and a combination of both walking and bicycling focusing on the proportion of the day's trips by these modes during the off-peak.

4.4.1 Public Transit Use During the Off-peak

The highest percentage of public transit use during the off-peak seems to be located in minority neighborhoods (Figure 25). The lowest percentages are in traditional white neighborhoods on the far north side of the city of Chicago and along the north shore suburbs.

In Chicago west and south side Black neighborhoods are most pronounced, but the Hispanic community on the near northwest side is also evident. In west suburban Chicago the Maywood area also has high off-peak use. Note the resemblance within the city of Chicago between Figure 3 (Black population) and Figure 25.

Figure 26 shows trip counts rather than percentages. Here we notice the striking return of high usage levels on the north side. Some southern lakeshore communities also have substantial number of off-peak transit work trips. Population densities within high rise communities along the lake create activity throughout the day, even if the majority of these residents commute during the rush hour. Still, there are large numbers of off-peak transit users throughout the minority neighborhoods. These off-peak users account for a large percentage of all work trips from these neighborhoods, making off-peak transit an important factor in their economic livelihood. This is particularly evident in the Hispanic neighborhoods, especially along the Blue Line, both in the near northwest neighborhoods and in Pilsen (Cermak Branch).

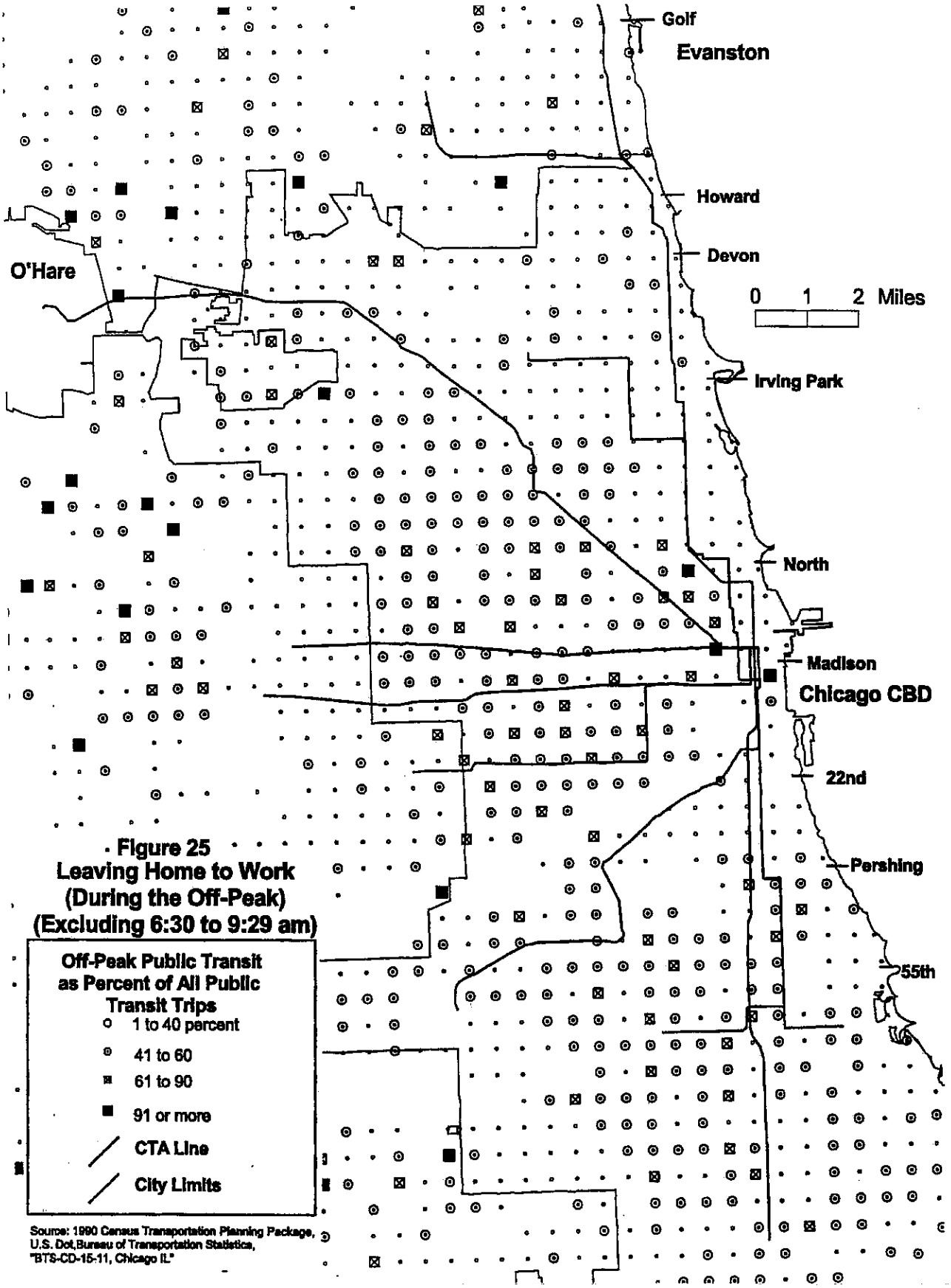


Figure 25
Leaving Home to Work
(During the Off-Peak)
(Excluding 6:30 to 9:29 am)

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

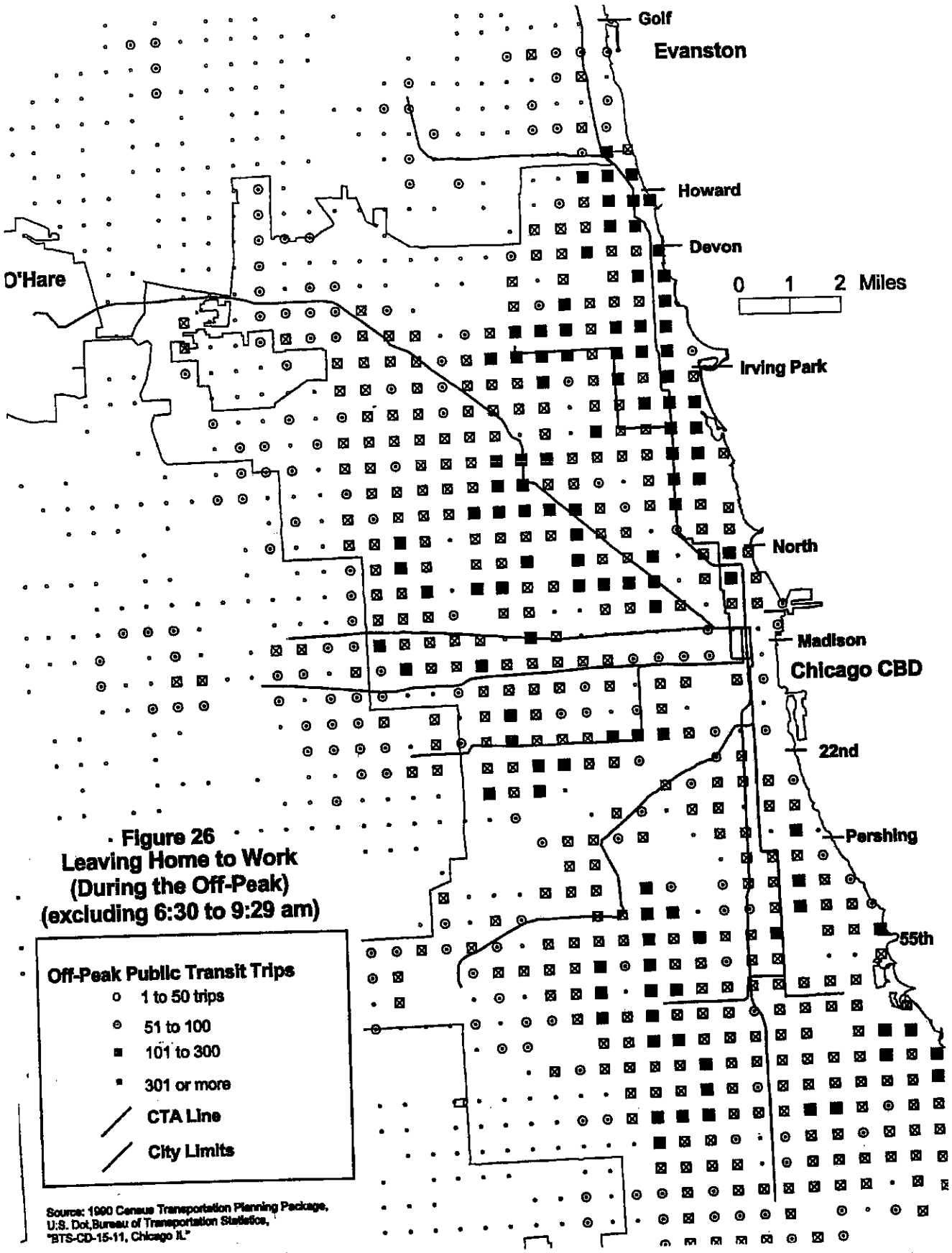


Figure 26
Leaving Home to Work
(During the Off-Peak)
(excluding 6:30 to 9:29 am)

Further insight into off-peak travel can be gained by examining early morning starts regardless of mode. Figure 27 depicts the percentage of all work trips occurring between 5:30 a.m. and 6:29 a.m. It is similar to Figure 25 and it clearly indicates that the Pilsen neighborhood to the southwest of the Chicago downtown has many neighborhoods with more than a third of the workers departing before 6:30 in the morning. This is also true for many south-side city neighborhoods but uncommon on the north side where more standard working hours prevail.

4.4.2 Bus Use During the Off-peak

We have seen from Figure 22 that bus use is rather ubiquitous throughout the city of Chicago. Off-peak bus use, however, is much more concentrated in selected areas (Figure 28). Not surprisingly this figure resembles the previous one showing the early morning starts. Figure 28 appears to have high values in nearly all minority communities. By contrast the near north side and the neighborhoods on the Orange Line close to the Chicago CBD have very low levels. Off-peak bus service is not important to the vast majority of workers in these neighborhoods.

4.4.3 CTA Rail Use During the Off-peak

The off-peak CTA rail use map (Figure 29) resembles the previous map (off-peak bus use) much more than it does the public transit map (Figure 23). Again the highest off-peak use is found in the minority neighborhoods. The percentages are particularly high on the near west and south sides. In the Blue Line neighborhood, between the Cermak and Forest Park branches, many of the percentages are over sixty. Similarly there are the same high levels scattered throughout the south side Black community.

This map, then, clearly indicates how these neighborhoods would be disproportionately affected by off-peak service cuts. Currently the decline in CTA use is precipitating reductions in service and the off-peak service is frequently a target.

4.4.4 Walking and Bicycling During the Off-peak

Off-peak walkers and bikers together (Figure 30) do not account for nearly as many commuters as any of the previous three discussed in this section. Since small numbers characterize these trips, a discussion of discernable pattern should carry this caveat. Figure 30 does suggest that there is evidence of a relationship between CBD distance and walking and bicycle off-peak use. Walking and bicycling to work near the Chicago CBD is relatively uncommon outside the three-hour peak period but the portion of all such trips rises with increasing distance from the downtown. The highest levels are in suburban Chicago, although again it should be noted that here there are particularly low values and many high percentages may be a product of sample sizes.

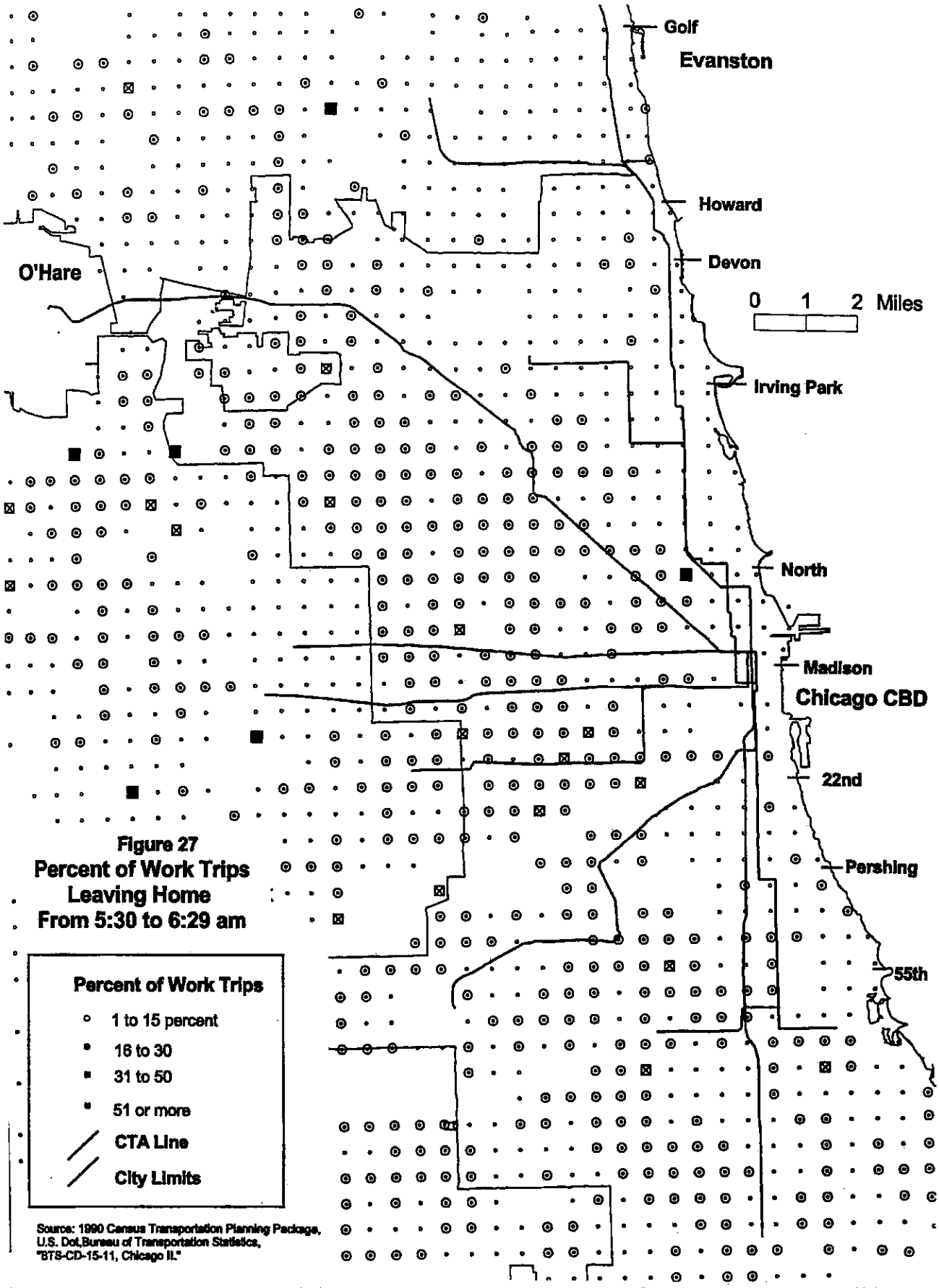


Figure 27
Percent of Work Trips Leaving Home From 5:30 to 6:29 am

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

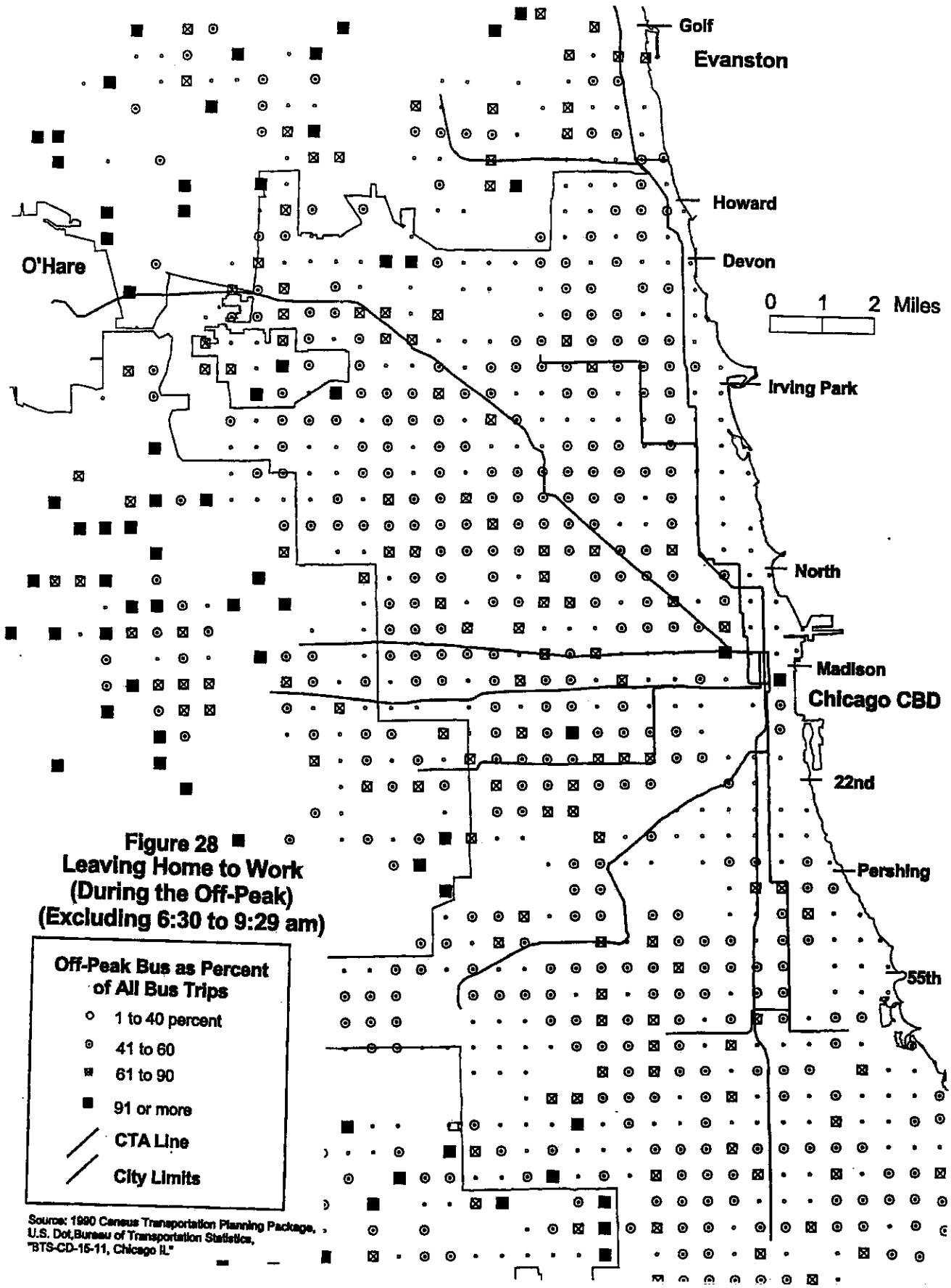


Figure 28
Leaving Home to Work
(During the Off-Peak)
(Excluding 6:30 to 9:29 am)

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

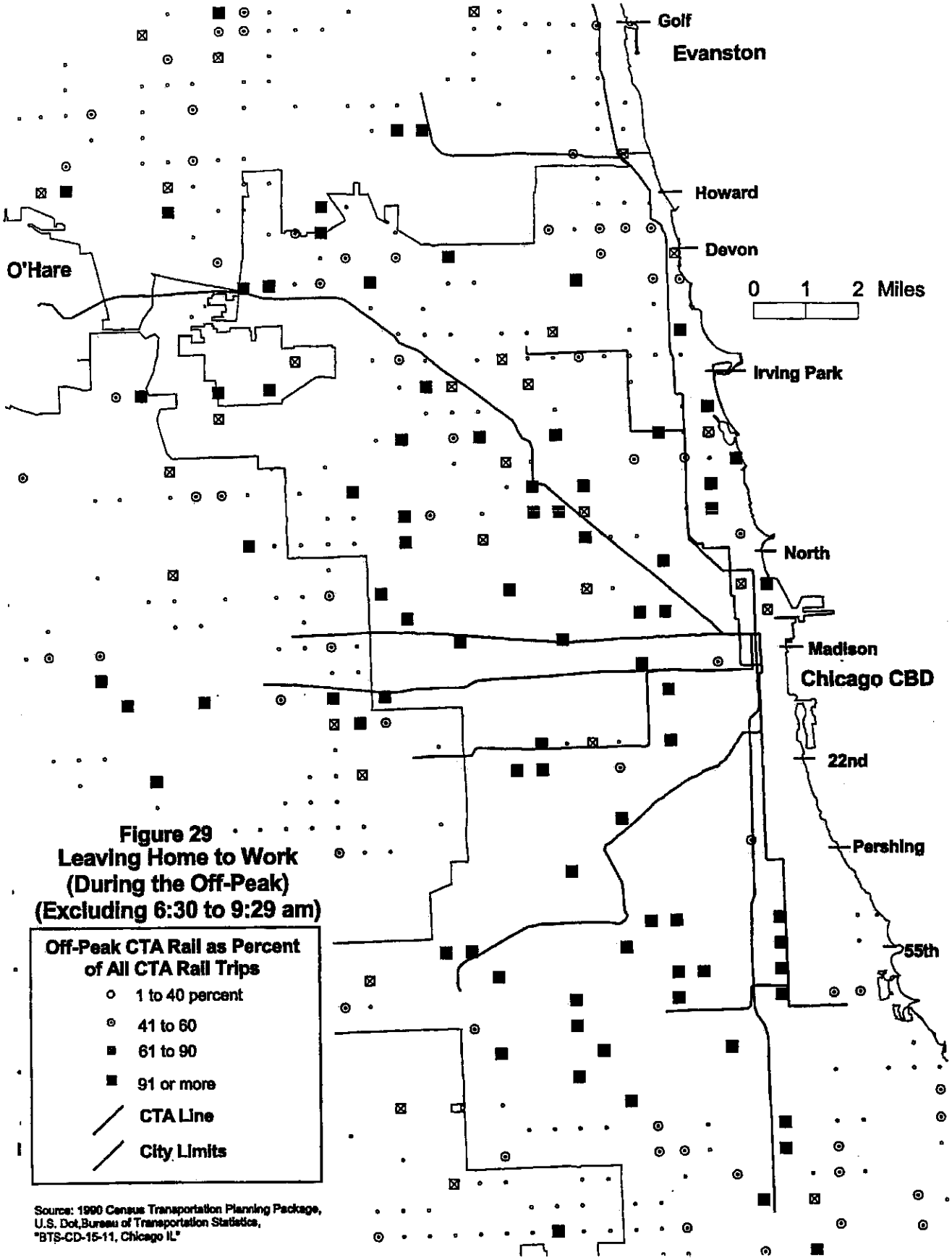


Figure 29
Leaving Home to Work
(During the Off-Peak)
(Excluding 6:30 to 9:29 am)

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

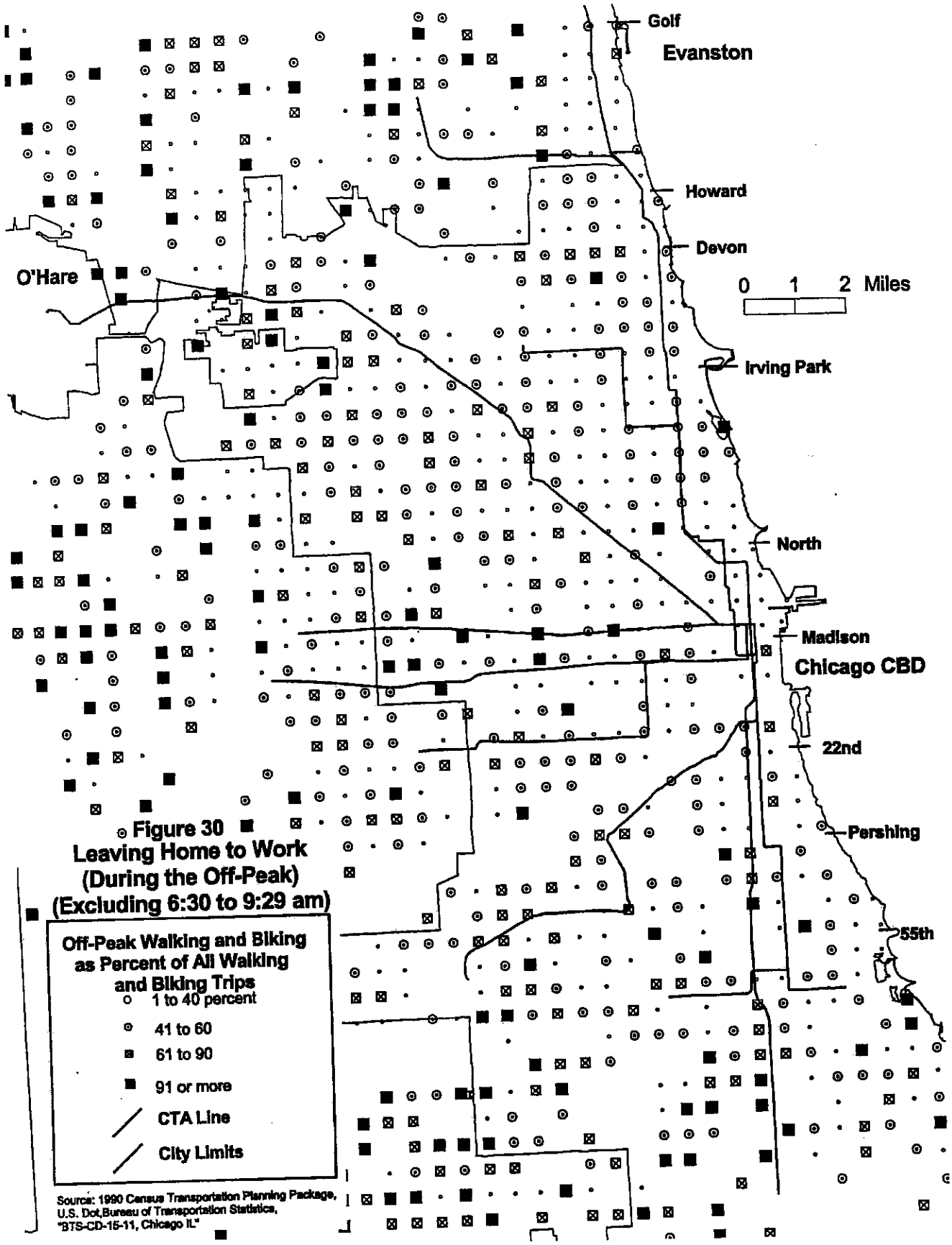


Figure 30
Leaving Home to Work
(During the Off-Peak)
(Excluding 6:30 to 9:29 am)

4.4.5 Summary of Off-Peak Travel

Early starts dominate off-peak travel, as can be seen by comparing Figure 27 with Figures 28-30, which show off-peak travel for specific non-auto modes during the 21-hour off-peak period. The lakefront and the north side (delimited by the Kennedy and Ravenswood service) have relatively few early starts, as do neighborhoods in Oak Park near the west end of the Green Line. These areas tend to be white-collar neighborhoods. By contrast, areas that show high levels of early morning work trips correspond to less-affluent minority populations shown in Figure 3 and Figure 5. These are particularly high along the Blue Line Cermak Branch, where percentages of early starts are in the 30-50 percent range. A comparison with Figure 24 (public transit trips) shows that most of these are trips using public transportation. We have already observed a high level of bus usage for work trips in these areas. These early starts may be attributable to work which begin before 7:00 a.m., as is typical of manufacturing jobs.

5.0 Conclusions

With the objective of identifying the association between travel behavior and general sociodemographic characteristics, this chapter examined the spatial patterns of travel behavior in the Chicago area using several dozen maps. This provides the background for understanding how to plan for peak and off-peak service.

The study used the 1990 Census Transportation Planning Package. While the information pertained strictly to the work trip, these data provide important clues about mode use for other purposes. Moreover, it is the only comprehensive data source that permits an examination of the Chicago metropolitan area using approximately 10,000 zones.

The maps suggest several relationships between sociodemographic characteristics and mode use. These may be summarized as follows:

- Households without vehicles tend to be concentrated on the south and west sides close to CTA rail lines.

- Persons with mobility limitations live near the Dan Ryan CTA rail service and along the Congress service to the west.

- Bicycle use is most common in affluent neighborhoods; more on the north side of Chicago than on the south side.

- Walking to work is most prevalent in high-density affluent neighborhoods along Lake Michigan north of the Chicago CBD. This is an area where a large number of workers are employed at home.

• With the notable exceptions of Oak Park, Cicero, Berwyn and Evanston walking and bicycling to work are relatively uncommon in the suburbs.

• By far the largest number of persons walking and bicycling to work during the off-peak period are found within half a mile of the Red Line (Howard service) north of the Chicago CBD.

• The largest number of public transit users, regardless of time of day, live near the Howard and Ravenswood services.

• Three suburban Metra services, Union Pacific North Line, Burlington Service and the Metra Electric South Line have high market shares.

• Off-peak transit use is highest in minority neighborhoods. This is particularly true of CTA rail service but also for bus use.

In sum these maps provide useful insight into the variations in travel behavior and how this reflects the socioeconomic characteristics of the population. These underscore the fact that the region is heterogeneous and that travel demand is not uniform.

Chapter Five

Bicycle Ownership in the Chicago Region

1.0 Introduction

While there have been improvements in the air quality of many Chicago area neighborhoods the region is still designated as an ozone non-attainment area. This increases the interest in non-polluting modes of transportation, including the use of bicycles.

The purpose of this chapter is to study bicycle ownership patterns in the Chicago area. Specifically, the number of bicycles in a household is compared with characteristics such as household income, number of private vehicles and household size. The geographical pattern is also examined by considering the ownership propensity with distance from the Chicago CBD and the variations in ownership by county.

The study finds that there is a strong positive relationship between the number of bicycles in a household and household income. Since vehicle ownership also increases with income, this suggests that bicycles may not be an alternative mode of travel for low-income households as is the case in many Third World countries. The study also finds that bicycle ownership increases with distance from the Chicago CBD and with household size, particularly with the number of children.

These findings are based on an analysis of the 1990 Chicago Area Transportation Study (CATS) Household Travel Survey (HHTS). The survey includes a one-day trip diary for over 19,000 households, over 40,000 persons who together complete over 160,000 trips. These data are weighted to account for over 20 million trips in the seven-county metropolitan area (including Kendall County).

The CATS HHTS is a rich source of personal and household socioeconomic information. Of particular interest for this report, the survey provides information on the number of bicycles in the household.

The report begins with a discussion of the geographic dimensions of bicycle ownership including the effect of distance from the Chicago CBD and the county-by-county variations in bicycle ownership. This is followed by an examination of the relationships between household characteristics and bicycle ownership. The third section of this report focuses on one-person households. Since there is not general information about bicycle use in the

CATS data the single-person household allows an opportunity to consider the relationship

between personal data and bicycle ownership. This is followed by an examination of the differences in bicycle ownership characteristics between one-person and larger households. The report concludes with a summary section.

2.0 Geographical Characteristics

2.1 Distance from the Chicago CBD and Bicycle Ownership

Bicycle ownership increases with distance from the downtown business district (the Loop). Households within one mile of the center of the CBD have a bicycle ownership rate of less than 20 percent (Figure 1). At five miles it is at 30 percent and ownership steadily increases to 52 percent at a distance of 30 miles from the CBD. After this distance the rate of bicycle ownership remains relatively constant.

Among households with bicycles, the number owned varies with distance from the CBD. One-bicycle households are the most frequent for the first 15 miles from the CBD. This rate begins at 14 percent near the Loop, peaks at 17 percent 5 miles from the loop and steadily diminishes to 10 percent in the outlying areas of the region (30-50 miles from the CBD). The most variable frequencies are associated with households that own three or more bicycles. Within 5 miles of the Loop, this group represents 8 percent of the households. The rate increases to 24 percent at a distance of 30 miles and remains relatively constant out to 50 miles and beyond. Regardless of the CBD distance, the two-bicycle household seems to represent an average percentage between the one-bicycle and three-or-more-bicycle household.

A summary statistic for the relationship is the correlation coefficient. The Pearson correlation coefficient between the number of bicycles in a household and the distance to the Loop is 0.16, significant at the 0.01 level. The correlation coefficient may seem low, but this is more an artifact of the number of observations, 19,314 households, than the strength of the relationship. The important point is its level of significance (i.e., we are 99 percent confident that there is a relationship between bicycle ownership and CBD distance).

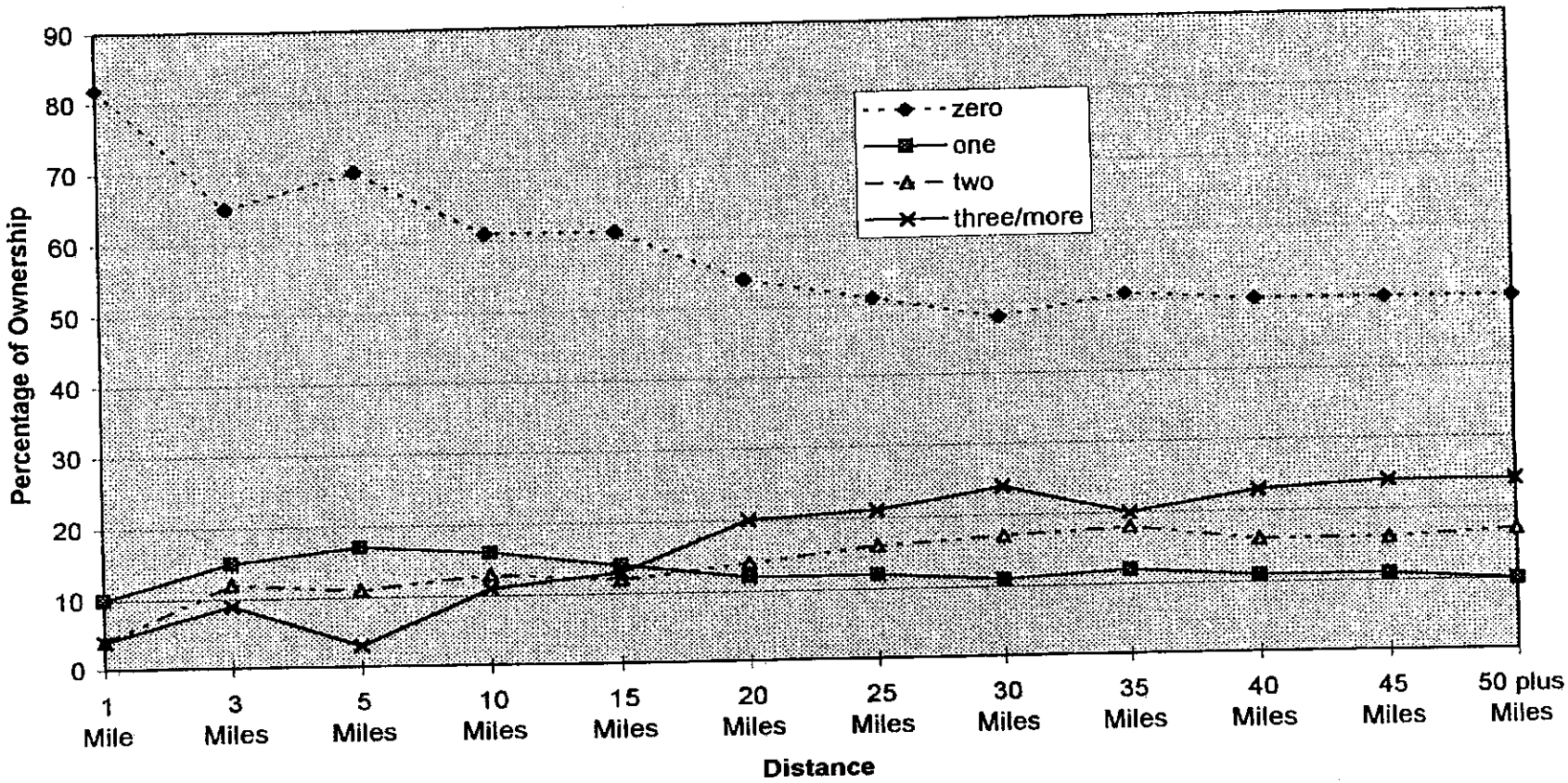
2.2 Population Density and Bicycle Ownership

There is also a clear relationship at the county level. Table 1 presents the percentage of households that own zero and three or more bicycles for counties and other sub regions in the Chicago metropolitan area. This illustrates the relationship between population density and bicycle ownership; the proportion of households without bicycles increases with density.

Conversely, density is inversely related to the proportion of households with three-or-more bicycles.

Figure 1

Household Bicycles and Distance from the Chicago CBD



Note that Kendall and McHenry counties, which have the lowest densities, have the highest percentage of households with three or more bicycles (28 and 24 percent). Both DuPage and

Table 1

Bicycle Ownership and Population Density by Subregions in Northeastern Illinois Ranked by Ownership of Three-or-More Bicycles

Place / County	Zero Bicycles	Three-or-More Bicycles	Gross Population Density*
Kendall	45%	28%	123
McHenry	47%	24%	303
Kane	49%	23%	610
Will	53%	23%	427
Lake	51%	22%	1153
DuPage	49%	22%	2337
Suburban Cook	55%	18%	3183
Chicago	63%	9%	12,251
CBD	68%	2%	-

*Population divided by land area (square miles)

Lake Counties are almost fully settled but have low densities and have lower percentages (22 percent). The density of population and overall development continues to climb into suburban Cook and the City of Chicago, and is the highest in the Chicago CBD. Multiple bicycle ownership rates continue to decline through these areas as density increases.

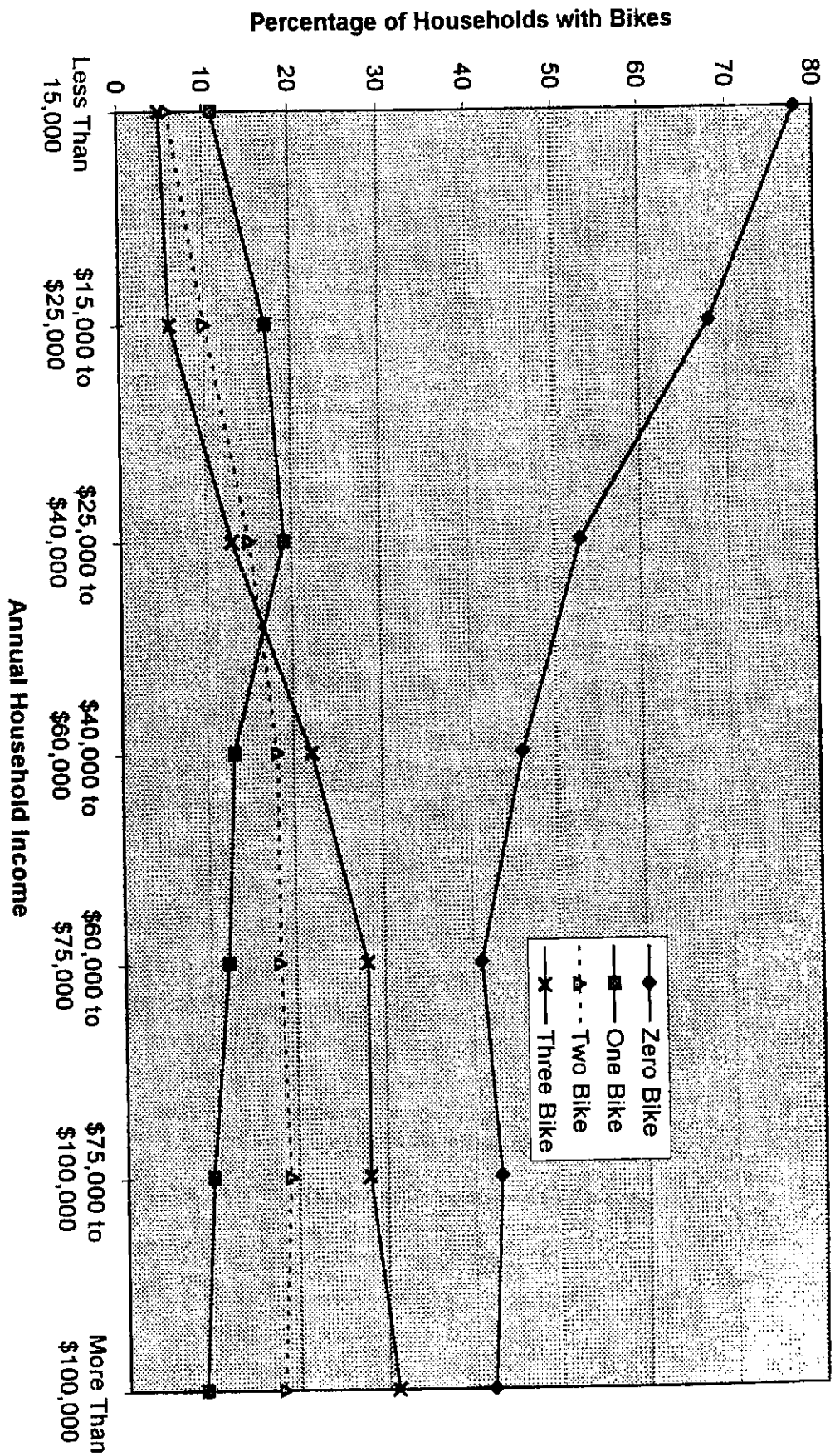
3.0 Household Characteristics

3.1 Bicycle Ownership and Household Income

The ownership of bicycles increases with household income. Only 21 percent of households with incomes less than $15,000 own bicycles (Figure 2). The percentage increases to just over 30 percent for household incomes between $15,000 and $25,000 and further to 47 percent for households with incomes between $25,000 and $40,000.

Figure 2

Household Bicycle Ownership Compared to Household Income



The rate of bicycle ownership continues to increase to 59 percent for households with incomes of $60,000 to $75,000 and remains constant for wealthier households. There is little change with increasing household income.

Among those households that own bicycles, one-bicycle households are more prevalent for the group with annual incomes of up to $40,000. Their share peaks at 19 percent for the category $25,000 to $40,000 and declines to 9 percent for those households with incomes above $100,000 per year.

Households that own two bicycles increase steadily from 6 percent for income levels below $15,000 to 18 percent for household earning up to $60,000 per year. At higher incomes, the share remains constant between 18 and 19 percent.

Ownership of three or more bicycles is highly correlated with household income. At incomes less than $15,000 only 5 percent of the households owned three or more bicycles. There is a slight increase for the next income category, but there is a remarkably steady climb for the next three categories, until the $60,000 to $75,000 level when ownership of three or more bicycles hits almost 30 percent. After this point the percentage increases but much more slowly and peaks at 31 percent among household with annual earnings over $100,000.

Not surprisingly, the mean number of bicycles owned per household also increases steadily with increased household income. Like Figure 2, Table 2 shows ownership of

Table 2

Household Income and Mean Number of Bicycles Owned in Northeastern Illinois

Household Income	Mean Number Bicycles
<$15,000	0.42
15-24	0.58
25-39	1.01
40-59	1.39
60-74	1.57
75-99	1.56
100,000+	1.70

one bicycle to be average in households with incomes between $25,000 and $39,000. This average jumps to 1.56 bicycles per household for incomes of $75,000 to $99,000, and reaches a high of 1.70 for incomes over $100,000.

It appears that among Chicago-area households, bicycle ownership is more a matter of affluence than necessity. *The majority of low-income households have no bicycles.* Conversely, multiple bicycle ownership climbs steadily with annual household income.

This suggests that bicycles are used more for discretionary activities and trip making and are not part of the necessary travel activities of low-income households.

3.2 Vehicle Ownership and Bicycle Ownership

In order to further explore the suggested discretionary nature of bicycle use, it is important to examine the potential substitution of bicycles for autos, i.e., whether affluence again, indicated by multiple automobile ownership, is an indicator of the number of bicycles in a household. Figure 3 shows a direct relationship between the number of household vehicles and the number of bicycles. More than three-quarters of the households (77 percent) that do not own a vehicle do not own a bicycle. This suggests that in most cases the bicycle is not seen as a surrogate for an automobile.

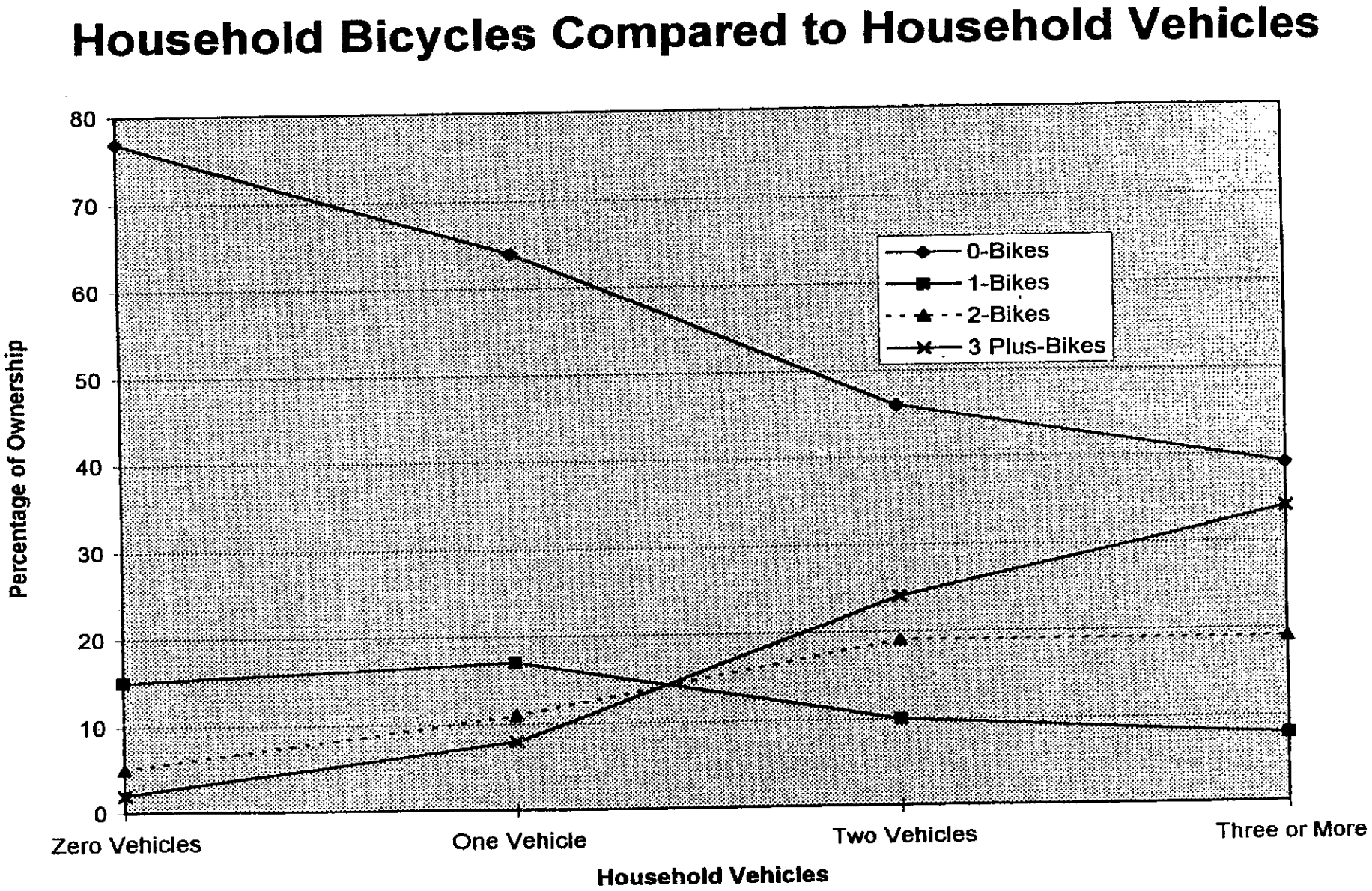
The percentage of households without bicycles drops to 64 percent for households that own one household vehicle and down to 46 percent for households with two vehicles. The bikeless percentage further declines to 39 percent for those households with three or more vehicles. Clearly the number of households without bicycles declines with increasing household vehicle ownership.

When there are bicycles in the household there is a fairly consistent match between the number of vehicles and the number of bicycles. Among zero- and one-vehicle households the most common number of bicycles is one. Once a household has at least two vehicles then three or more bicycles are more common. Among households with three or more vehicles it is almost as likely that they will have at least three bicycles as not having any.

Table 3 further describes the relationship between household bicycles and vehicle ownership described above. Households with no vehicles have an average bicycle ownership of only 0.34. One-vehicle households have an average of 0.68 bicycles and this figure more than doubles to 1.44 with an additional vehicle in the household. The highest average for bicycles owned is for the 4-plus vehicles category. Households with four or more cars have an average of 1.98 bicycles. Clearly Table 3 suggests a correlation between the number of vehicles and the number of bicycles in a household.

The Pearson correlation coefficient between the number of bicycles in a household and the number of vehicles is 0.34, significant at 0.01. This is a considerably higher

Figure 3


Household Bicycles Compared to Household Vehicles
Percentage of Ownership
80
70
60
50
40
30
20
10
0
0-Bikes
1-Bikes
2-Bikes
3 Plus-Bikes
Zero Vehicles
One Vehicle
Two Vehicles
Three or More
Household Vehicles

correlation than the 0.16 between bicycle ownership and CBD distance. In other terms, the number of vehicles in a household is a much better indicator of the number of bicycles owned than is the distance of a household from the CBD. In general, bicycles do not replace vehicles but complement them.

Table 3

Household Vehicles and Mean Bicycle Ownership in Northeastern Illinois

Number of Vehicles	Number of Bicycles
0	0.34
1	0.68
2	1.44
3	1.76
4+	1.98

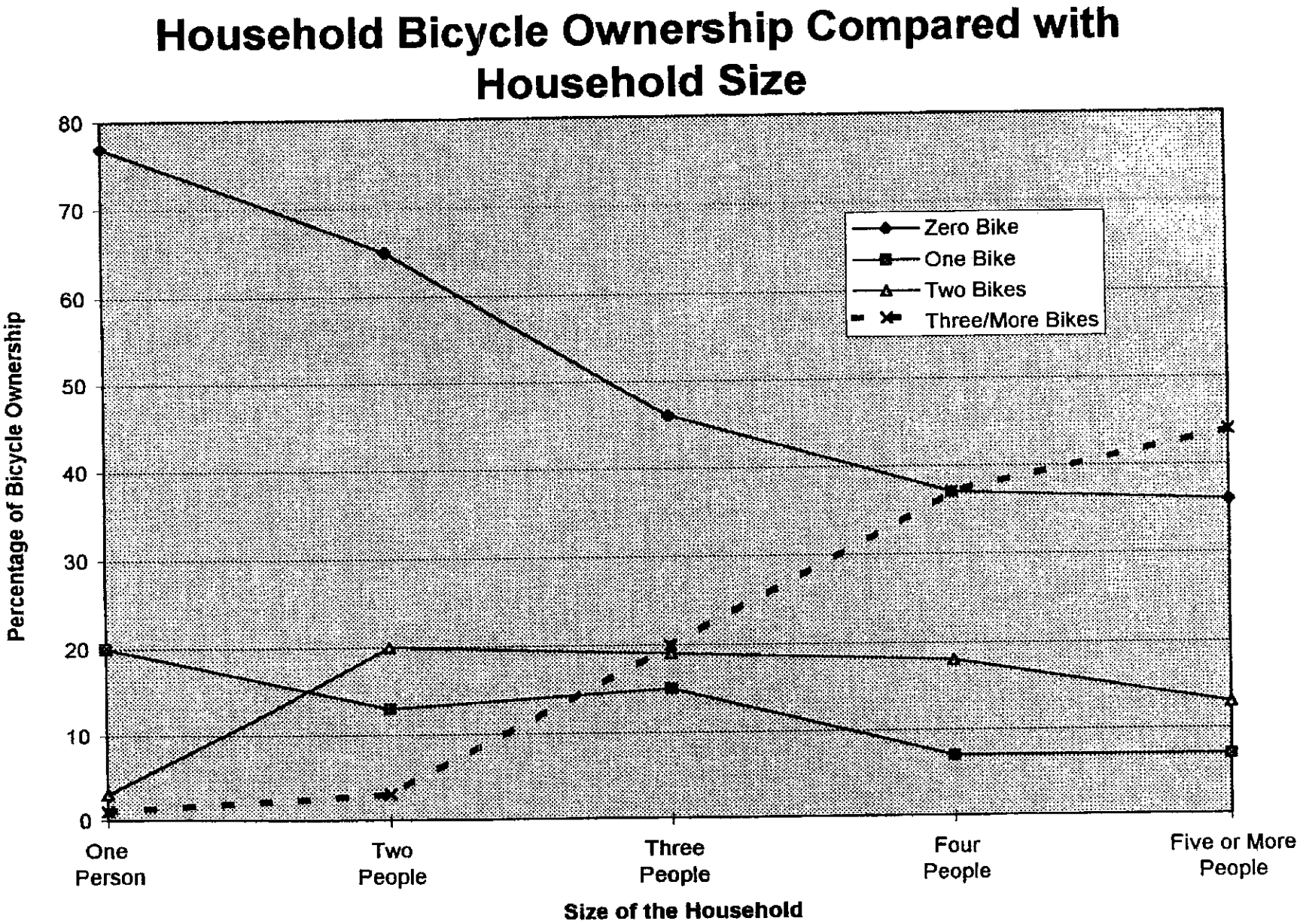
3.3 Bicycle Ownership and Household Size

As may be expected, the number of bicycles in a household increases with household size (Figure 4). While 77 percent of one-person households do not own bicycles, this amount steadily decreases for two-person households (65 percent), three-person households (46 percent), and four-or-more-person households (37 percent). As household size increases so does the propensity to own at least one bicycle.

Within households that own bicycles, the number of bicycles increases with the size of the household. Households with two persons more frequently own two bicycles (20 percent of all households) than one bicycle (13 percent). For households with three persons, ownership of two and three bicycles each make up 19 percent of the population and one-bicycle households add an additional 15 percent to the bicycle ownership category.

Ownership of three bicycles is as likely as owning zero bicycles (37 percent) for households with four persons. Among other households of this size two-bicycle households make up 18 percent and one-bicycle households account for 7 percent of the households. The predominant category for households with more than four people is the ownership of three or more bicycles (44 percent of households). Of these larger households, 13 percent own two bicycles and 7 percent own one bicycle.

Figure 4


Household Bicycle Ownership Compared with Household Size
Percentage of Bicycle Ownership
80
70
60
50
40
30
20
10
0
Zero Bike
One Bike
Two Bikes
Three/More Bikes
One Person
Two People
Three People
Four People
Five or More People
Size of the Household

While one would expect the number of bicycles to increase with household size, even the number of bicycles per person increases with household size, at least up to households of four people (Figure 5). Stated differently, in larger households each person is more likely to have their own bicycle than in smaller households.

Table 4 also shows this positive relationship between household size and average number of bicycles owned. Single-person households are shown to have an average of 0.27 bicycles. This figure more than doubles to 0.62 for two-person households, and almost doubles again (1.18) for households of three persons. The average continues to increase dramatically to 1.88 for four-person households and reaches 2.30 for households of five or more.

The largest increase in bicycles occurs from household size three to four and the other increases are smaller. These increases seem to grow and decline with the maximum change being from 1.18 to 1.88. There seems to be a point on this table at which bicycle ownership continues to increase but at a declining rate.

The Pearson correlation coefficient between the number of bicycles and the number of people is 0.45. Understandably this is the strongest correlation between the number of

Table 4

Household Size and Average Number of Bicycles in Northeastern Illinois

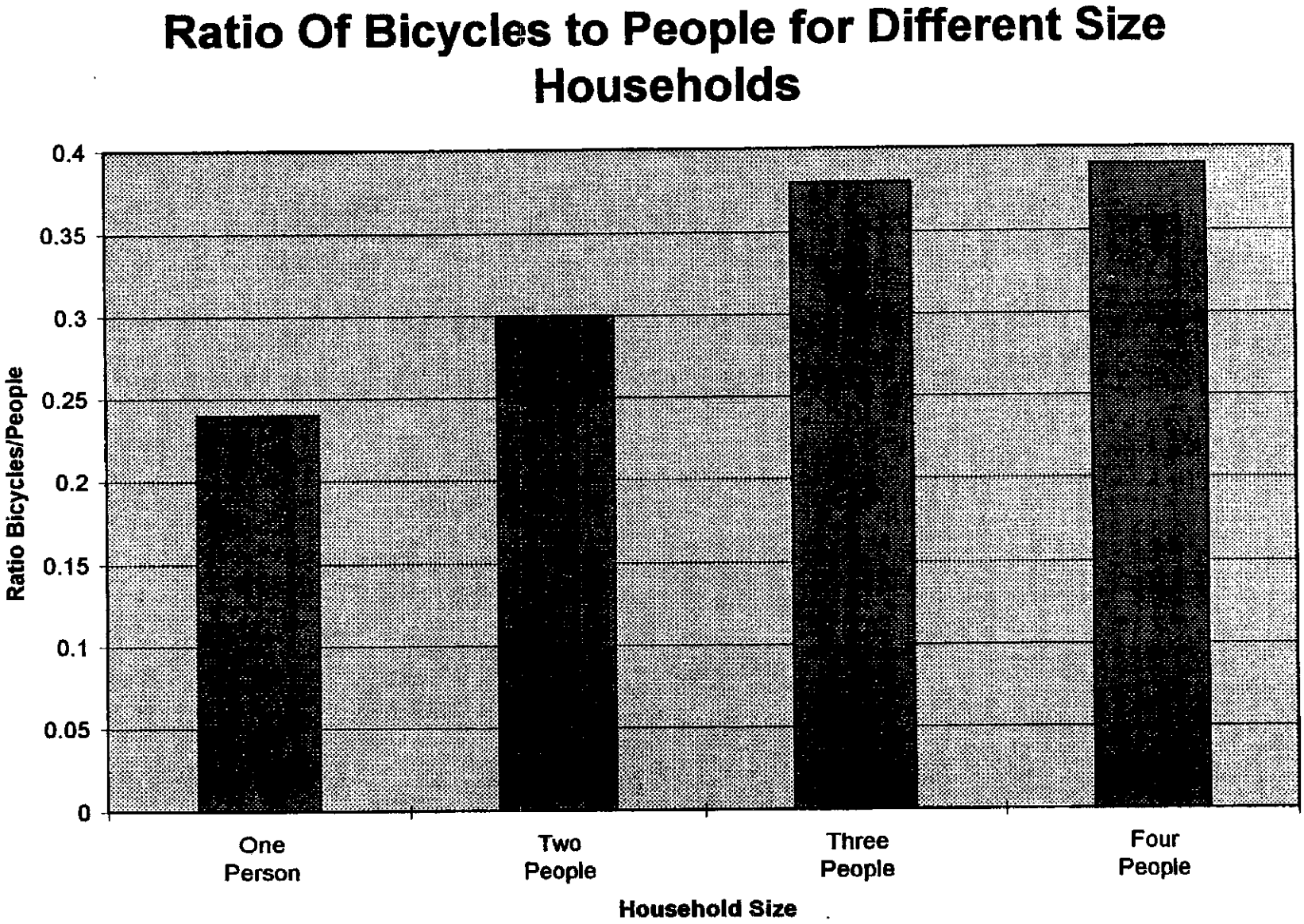
Household size	Average Number of Bicycles
1	0.27
2	0.62
3	1.18
4	1.88
5+	2.30

bicycles in the household and any of the variables in the CATS Household Travel Survey. Therefore, the relationship is explored further in the next subsection.

3.4 Effects of Children and Adults on Bicycle Ownership

In addition to the number of persons in a household affecting the number of household

Figure 5


Ratio Of Bicycles to People for Different Size Households
Ratio Bicycles/People
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
One Person
Two People
Three People
Four People
Household Size

bicycles, the demographic mix in the household also has an effect. In Figure 6 the effect of additional children is compared to the effect of additional adults. Additional children have little effect on the presence of a bicycle in a household but greatly increases the number of bicycles that are present. The trend is probably a result of the appropriateness of bicycles for the neighborhood and family budget. If one child is given a bicycle, then the other children will likely have one also.

As adults are added to households the likelihood of a bicycle being present increases more than for the addition of a child. If a household has one child and two parents, there will be a bicycle present 61 percent of the time. If there are three adults present (and possibly some children) there is only a bicycle present 54 percent of the time. The one child household and the three-adult household have similar ownership rates of three or more bicycles.

Table 5

Children Under 14, Persons Over 14 and Average Number of Bicycles Owned in Northeastern Illinois

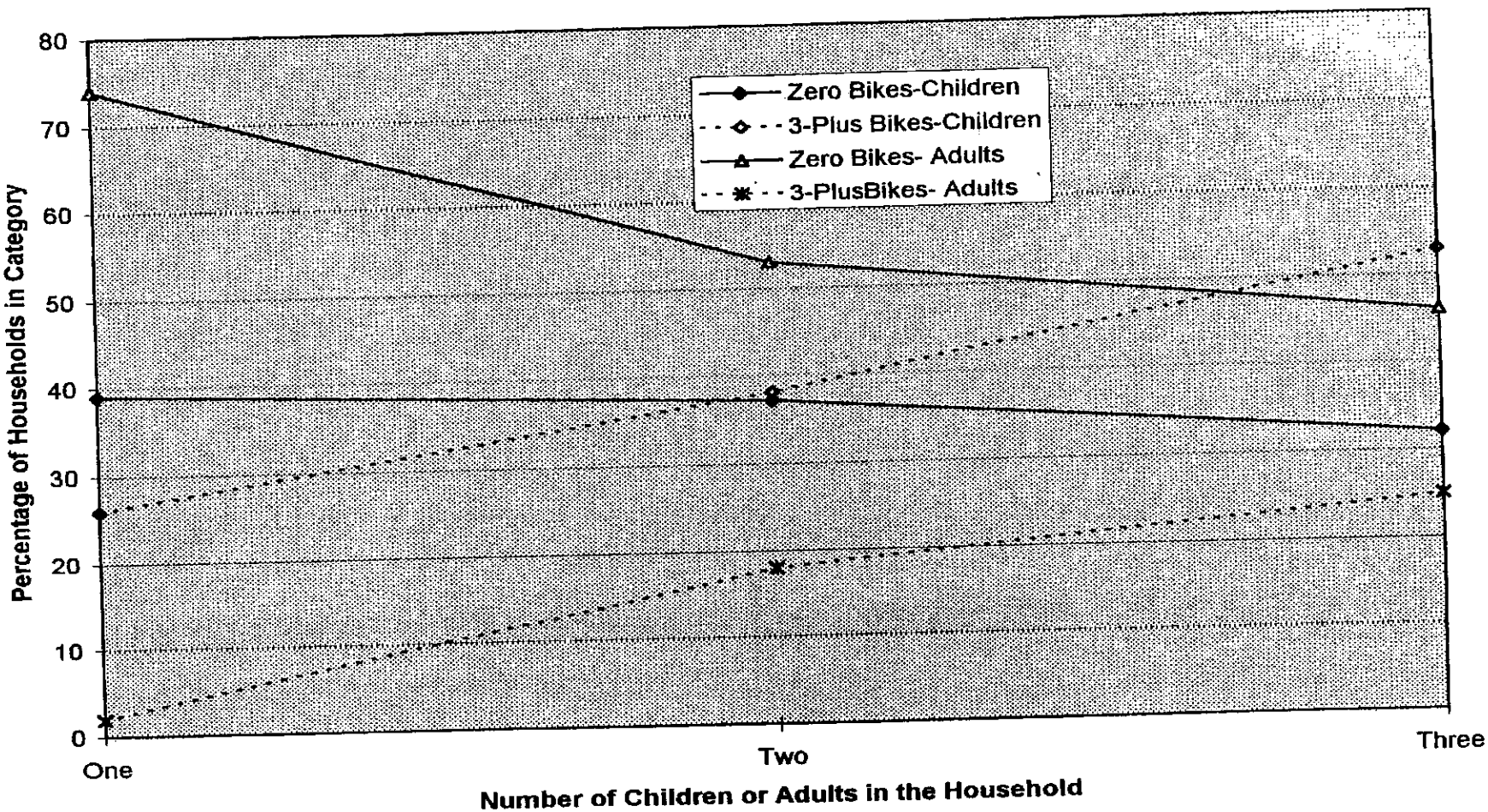
Children Under 14	Average Bicycles Owned	Persons 14 and Over	Average Bicycles Owned
0	0.64	1	0.35
1	1.54	2	1.17
2	1.94	3	1.43
3+	2.62	4+	1.87

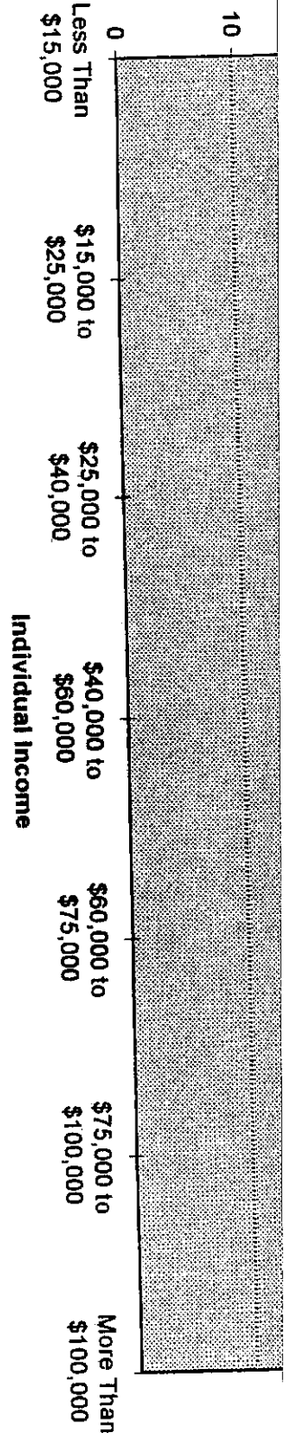
Table 5 examines the effect of the number of householders over and under 14 years of age on the average number of bicycles owned. The number of children in a household tends to have a strong impact on the average number of bicycles. When no children are present only 0.64 bicycles are owned per household. One child increases the average to 1.54, and the addition of a second child brings the average to 1.94. Families with three or more children have an average of 2.62 bicycles. The number of householders over 14 has a smaller, yet still significant, effect on average bicycle ownership. A household with only one adult has an average of 0.35 bicycles. A two-adult household sees a dramatic increase in this average, reaching 1.17 bicycles. The average continues to increase to 1.43 for three-adult households and to 1.87 for households of four or more adults.

For the analysis of the correlation coefficient the household size is expressed in the number of persons fourteen years and younger and the number of persons over fourteen.

Figure 6

Effects of Additional Children Compared to Additional Adults on Bicycle Ownership





The correlation coefficient between the number of bicycles and the number of persons under 14 is higher (0.36) than it is for those above 14 years of age (0.29). Both correlations are significant at 0.01.

4.0 Personal Characteristics of One-Person Households

The CATS household data were combined with the files on personal and trip information. This allows us to examine not only data describing individuals but also travel behavior. The following discussion includes the weighted survey data. These data suggest that while 23 percent of one-person households own bicycles, these individuals account for 30 percent of the trips. Individuals who own bicycles take more trips than those who do not. It is important to keep in mind that trips are being analyzed along with the households that make these trips.

The one-person household accounts for 4116 out of 40,568 persons in the raw data. When these data are properly weighted, these individuals account for about 9 percent of the population, 12 percent of the trips and 26 percent of the households.

In order to examine more directly the effects of personal attributes on bicycle ownership, one-person households were studied to determine how bicycle ownership varies among different groups. While this analysis will not show when bicycles are used, it will provide a profile of which adults choose to invest in bicycles.

4.1 Effect of Household Income on One-Person Bicycle Ownership

The relationship between individual income for a person who lives alone and their ownership of a bicycle is depicted in Figure 7. This graph shows that individuals who earn between $40,000 and $60,000 a year are over two and a half times as likely to own a bicycle as those who earn less than $15,000 per year (44 percent vs. 16 percent). As individuals increase earnings, the likelihood that they will also own a bicycle increases constantly up to $60,000. After this income range there are mixed signals about bicycle ownership. Between $60,000 and $75,000 the rate of bicycle ownership decreases to 26 percent, but this is followed by an increase to 52 percent for individuals earning $75,000 to $100,000. The groupings after $40,000 to $60,000 are no more than one-third the sample size of the first four groups and these small sample sizes may account for the irregular patterns of the three highest income categories of Figure 7.

As seen in Figure 2, bicycle ownership rises with increased income. The relationship in the first four income groups is rather similar. Expectedly, however, there are more bicycles in larger households with equivalent incomes.

4.2 Bicycles and Age

The one-person household data set was examined to find if there is a relationship between age and the ownership of bicycles. Since these data pertain only to one-person households the age data start with adulthood. The householders 20-40 years old have a bicycle ownership rate of 44 percent (Figure 8). The following two ten-year age groups each reduce bicycle ownership by 8 percent (36 percent and 28 percent for those 40-50 and 50-60 years old respectively). After age 60 bicycle ownership falls to about 11 percent. Young persons living in single-person households, then, are more than four times as likely to own a bicycle as older households.

The Pearson correlation coefficient between bicycles and age is (-.27), again significant at 0.01. This statistical relationship supports the conventional wisdom that bicycle ownership declines with age.

4.3 The Purpose of Trips and Ownership of Bicycles

A further examination of travel behavior provides more information on bicycle ownership. In Figure 9, both one-person households and households that have more than one person were graphed to determine if bicycle ownership rates were consistent between small and larger households by trip purpose.

The two largest differences in bicycle ownership for different trip purposes arose in the categories of school and serve passenger. Both of these are under represented in the smaller files on one-person households and most of their variation may be caused by this limited sample. A third category that resulted in unanticipated low bicycle ownership rates was banking trips. Banking trips are the smallest trip category in the CATS data set.

The high percentages of bicycle ownership shown for trip purposes of both school and servicing passengers for households of more than one person is not very surprising. These figures correspond directly to the idea of large households with many children owning several bicycles. It is not hard to imagine a household making several trips to school or to drop-off and pick-up children would own bicycles.

In Figure 9 the purpose of the trips taken are charted against the ownership of bicycles for one-person households. The most frequent association with bicycle ownership in one-person households was trips for work, recreation and change of mode. If banking, serve passenger, and school trips are thrown out because of small sample size then there is no strong indicator against bicycle ownership among one-person households.

Figure 8

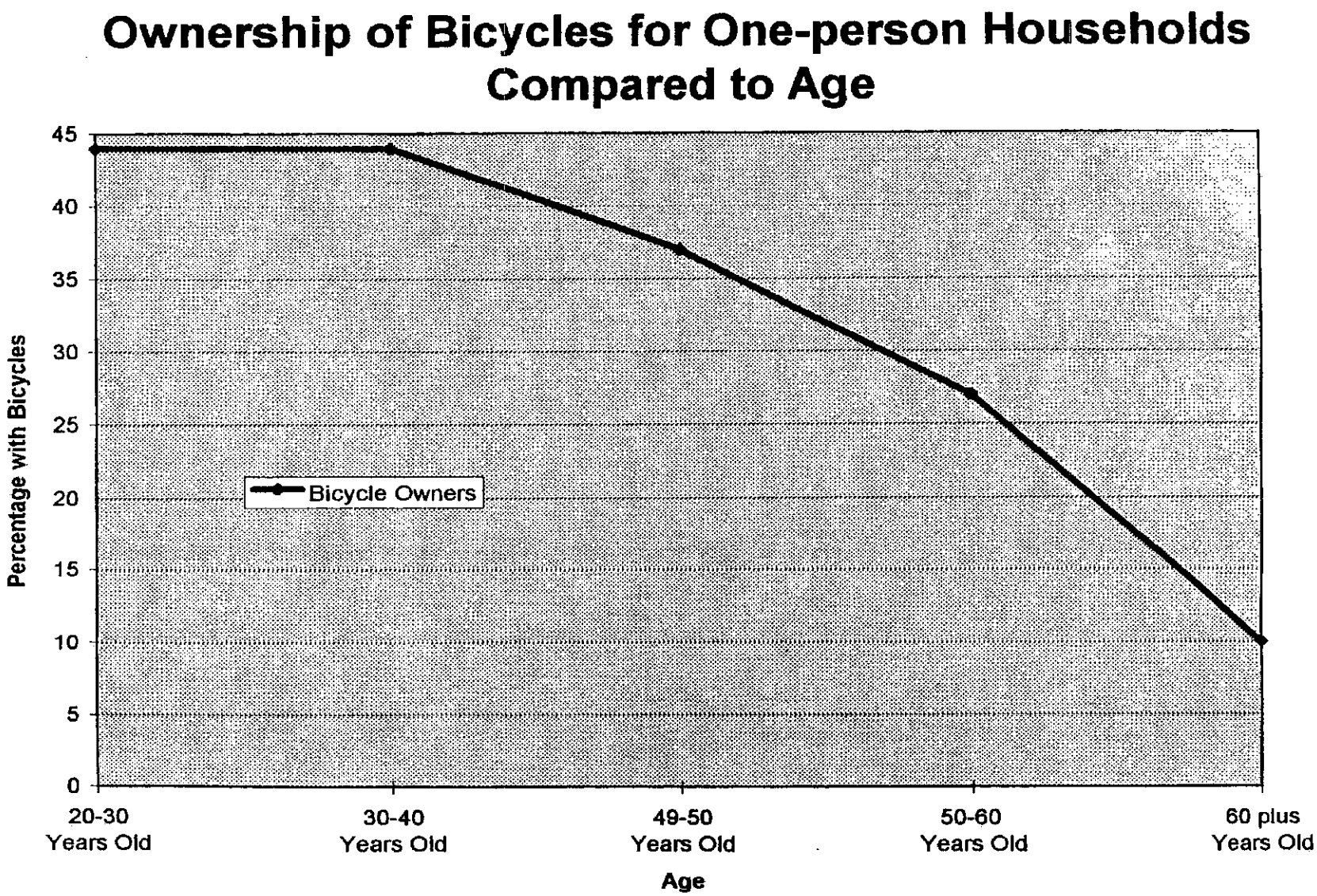
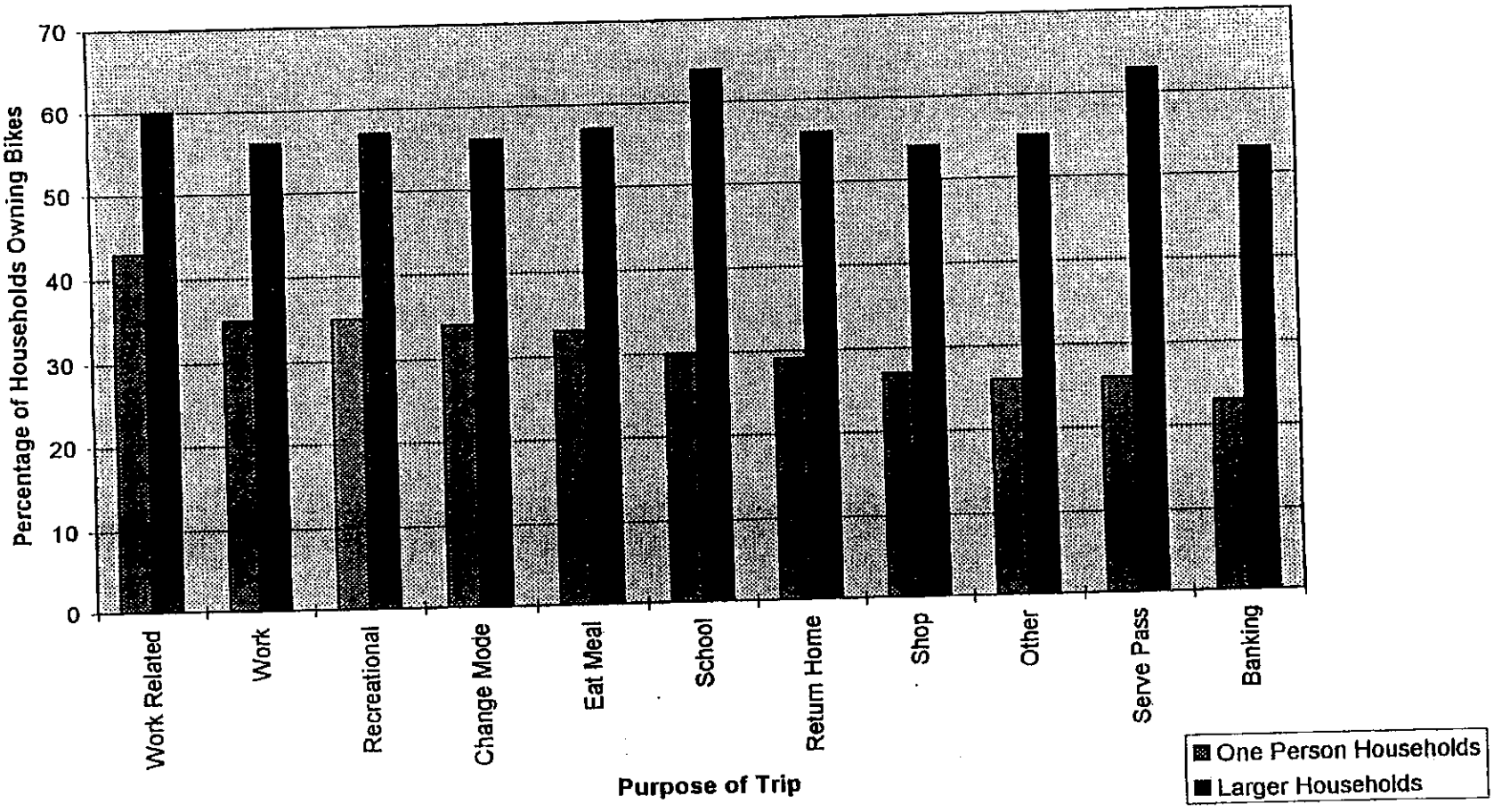

Ownership of Bicycles for One-person Households Compared to Age
Percentage with Bicycles
45
40
35
30
25
20
15
10
5
0
Bicycle Owners
20-30 Years Old
30-40 Years Old
49-50 Years Old
50-60 Years Old
60 plus Years Old
Age

Figure 9

Bicycle Ownership by Purpose of Trip and Household Size



4.4 Occupation and the Ownership of Bicycles

The CATS survey also included information on occupation. We considered the eleven categories on Figure 10. The occupation categories farmer, household worker and 'other' each accounted for less than 0.2 percent of the population and because of the small sample size are not considered in this study.

The ownership of bicycles is tracked compared to occupation for one-person households and households with more than one person by the number of trips taken. This section of the survey allows only one choice of occupation. Again the data were weighted by the number of trips taken on the survey day.

Occupations described as professional, craftsman, sales and manager had the highest levels of bicycle ownership. Retired-unable, clerical and service job sectors had the lowest rates of bicycle ownership.

The rates of bicycle ownership for students and housewives are very different in one-person households compared to larger ones. While the relative rates of bicycle ownership are consistent between one-person households and larger ones, housewives, students and, to some extent, people in service industries, all have low rates of ownership when alone and high rates when they are part of a larger household.

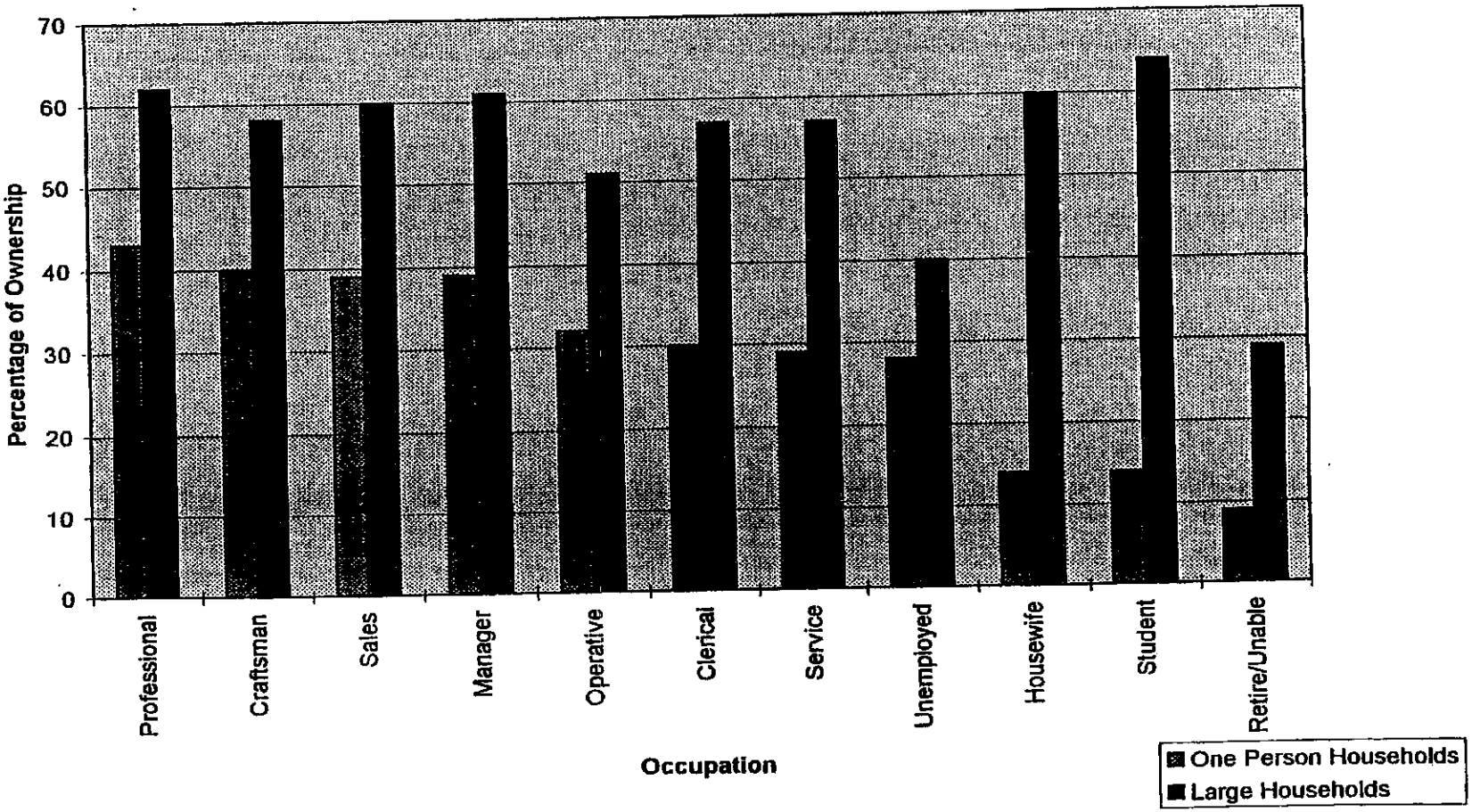
5.0 Conclusion

Bicycle ownership in the Chicago area was analyzed using the 1990 CATS Household Travel Survey. Household ownership of bicycles was positively related to increased income, the number of children, household size, ownership of vehicles and the distance from the CBD. Bicycles are more a sign of affluence than an indication of the lack of automobile ownership. Since there are fewer bicycles in the city of Chicago, it appears that they are in greater number where there are few alternatives to automobile use, as in low-density suburbs.

For one-person households, there is also a positive relationship between bicycle ownership and income, but a negative correlation with age over 40. The purpose of trips seemed to have little influence on bicycle ownership, with work trips and recreational trips being possible exceptions. Higher incidences of bicycle ownership were found in the occupations manager, sales, craftsman and professional. Lower rates of bicycle ownership were associated with clerical and service occupations. The unemployed and those who are retired or unable to work had the lowest rates of bicycle ownership. Students and housewives owned very few bicycles when they lived alone, but had the highest rates of ownership when they were in larger households.

Figure 10

Bicycle Ownership by Occupation and Household Size



Not only are there more bicycles in larger households but the ratio of bicycles to number of persons in the household increases with household size. This implies that bicycles are more useful when others in the household also own them. This trend diminishes for households with more than five members, but these households constitute a relatively small portion of the overall population. This may be due to the additional cost of the bicycles, but after three or four bicycles storage begins to become a factor.

When analyzing the occupation of travelers and the purpose of trips, one-person households were associated with bicycle ownership less often (one-half to two-thirds as often) than larger households. Individuals who listed their main occupation as students or housewives seldom owned a bicycle when they lived alone, but when living in larger households had a bicycle present 60 to 65 percent of the time.

For the household data set (not based on total trips), 43 percent of the households owned a bicycle while 23 percent of one-person households owned a bicycle. In these one-person households bicycle ownership, however, appears to be related to the mobility of the person; 30 percent of these households own bicycles when weighted by the number of trips taken on the survey day.

According to the data presented here, the typical household with multiple bicycles lives in a suburban location, is mobile, is a large family, has children and is relatively affluent. Conversely low ownership rates are small households found near the Chicago CBD with low household incomes and they have only one or no private vehicles.

Chapter Six

Variations in Walking, Bicycling and Off-Peak Transit Trips to Work: A Regression Analysis

1.0 Introduction

Some communities in the Chicago area, such as Schaumburg and Hoffman Estates, have high automobile-use levels while others, such as Oak Park and Evanston, are much more pedestrian oriented. In the city of Chicago the Hyde Park and the Near North Side community areas have far more walking and bicycling than Edison Park in the far northwest or Beverly in the southwest. The variations in mode use largely reflect the people and the overall characteristics of the respective communities.

It is the purpose of this chapter to develop the association between (1) walking, bicycling and public transit use in the off-peak and (2) the descriptive characteristics of these neighborhoods that account for the variation in mode use.

2.0 Study Area and Data

The 1990 Census Transportation Planning Package was used as the primary data source. This provides journey to work mode-use information and sociodemographic characteristics on over 8000 zones in the Chicago area. While it only includes work trips, it is the only comprehensive data set that provides detailed information by small zones. The zones in this package are approximately one-half by one-half mile squares known as traffic analysis zones (TAZs).

The variables selected from this data set include (all data are "Number of ..." in each of the 8490 zones):

Trip Data (Dependent Variables)

WALK: Number of walking work trips by residents in the zone
BIKE: Number of persons bicycling to work by residents in the zone
PUBTRNT: Number of public transit work trips during the off-peak period, defined here as the period excluding 6:30 to 9:30 a.m.

Sociodemographic data

BLACK: Black population
HISPANIC: Population with Hispanic origins
AGE: Population with age of 21-34

POP: Number of persons residing in the zone
EMP: Number of workers employed in the zone

COLLEGE: Number of persons enrolled in college
WORKER2: Households with 2 or more workers
GOVERN: Number of government workers
EXEC: Number of workers in executive, administrative, or professional occupations

SELF: Number of self-employed workers
SINGLE: Number of single-person households

NOVEHIC: Households without vehicles
MANYVEH: Households with 3 or more vehicles
INC: Households with annual incomes over $100,000
MEDINC: Median household income

Departure times

EARLY: Workers leaving home before 6:30 a.m.
POSTMORN: Workers leaving home during the post-morning peak: 9:30 to 12:00 a.m.

Neighborhood characteristics

PEF: Pedestrian environment factor
UNIT: Housing units in one unit structure (detached and attached)

Product terms

POPEMP: Product term of POP*EMP
POWER: Product term of AGE*EXEC*PEF

We anticipated that the variables in this list would be associated with travel by nonmotorized means or by transit during the off-peak. It includes a mix of variables describing individuals, households, and neighborhoods. There are also product terms, e.g., POPEMP. This is the value of the population times the number of employees in a zone. This variable is included because it reflects the magnitude of urban activity. Where the value is high one would expect short trips and therefore greater potential for nonmotorized transportation.

3.0 Regression Analysis

3.1 Walk-to-Work Regression Model

The regression model for walking to work included approximately 8500 zones and yielded an R-square of 0.48. With this many observations the model was clearly significant well beyond 0.01 level of significance (Table 1).

Table 1

MODEL PARAMETERS

Variable	Parameter Estimate	T for Null Hypothesis
Intercept	1.006	12.3
HISPANIC	-0.00738	-10.3
MANYVEH	-0.105	-18.4
UNIT	-0.420	-20.5
POPEMP	0.00000630	29.7
COLLEGE	0.112	18.2
WORKER2	0.0646	18.2
GOVERN	0.157	16.7
SELF	0.0966	9.75
SINGLE	-0.0219	-4.69

The T statistic shows that the POPEMP product variable is highly associated with walking, as suggested earlier. Negative relationships are with high automobile ownership rates (MANYVEH) and with single family housing (UNIT). If any variables have counter intuitive signs it must be remembered that they interact with the other variables and a simple relationship may have a result different than expected.

3.2 Bike-to-Work Regression Model

Several attempts were made to complete a regression model for bicycle use but we had difficulties because of the irregular nature of the data. Bike use was the lowest of the three modes studied and, because of the sampling used by the census, fewer than 10 percent of the zones had bicycle trips. Table 2 shows the number of zones with wok trips by bicycle. See Chapter 2 for a more detailed discussion of bicycle use.

Table 2

NUMBER OF WORK TRIPS BY BICYCLE
(7617 Bicycle Trips)

Number of Bicycle Work Trips	Number of zones
0	8230
1-10	424
11-20	134
21-30	40
31-40	15
41-50	8
51-100	12
> 100	2
Total	8865

3.3 Off-Peak Public Transit Regression Model

The off-peak transit model had the same number of observations (8490) but a slightly higher R-square (0.64). Again the model was highly significant.

The high positive association is with zones that have large numbers of households with no automobiles, white-collar workers (EXEC), early commuters, Hispanics and Blacks. Negative relationships are with zones with large numbers of multicar households and high POPEMP values (Table 3). This generally suggests that off-peak transit use tends to occur in minority neighborhoods with low local employment opportunities.

Table 3

MODEL PARAMETERS

Variable	Parameter Estimate	T for Null Hypothesis
Intercept	-1.36	-13.4
BLACK	0.0227	17.2
HISPANIC	0.0220	27.6
AGE	-0.00764	-5.48
NOVEHIC	0.142	31.8
MANYVEH	-0.0933	-20.6
EXEC	0.0471	30.9
EARLY	0.115	28.2
PEF	-0.0444	-3.01
POPEMP	-0.000000656	-13.2
POWER	0.000000357	7.29
POSTMORN	0.0726	8.50
SINGLE	-0.0394	-10.1

4.0 Residuals

The residuals from the models provide us with clues as to where there are unusually high and low levels of mode use. They are therefore useful in suggesting neighborhoods for further study.

4.1 Walking Trips

Figure 1 illustrates the distribution of exceptionally high and low residuals. Only the highest and lowest ten percent of the zones are mapped, or a total of 20 percent of all the zones--other zones are not mapped. These are zones that do not fit the regression model. They have higher or lower than expected levels of walking as predicted by the combination of variables in the regression model.

The largest cluster of high negative values (less than expected) is located on the south side of Chicago south of 63rd Street (an enlargement of Figure 1 is provided on Figure 2). Other negative clusters are on the west side and in scattered locations near the Red Line. These are areas where workers tend not to walk to work and may be places where more walking should be encouraged. More data are needed to determine if walking is equally unpopular for other trip purposes. In some of these neighborhoods walking is uncommon simply because there are few local jobs.

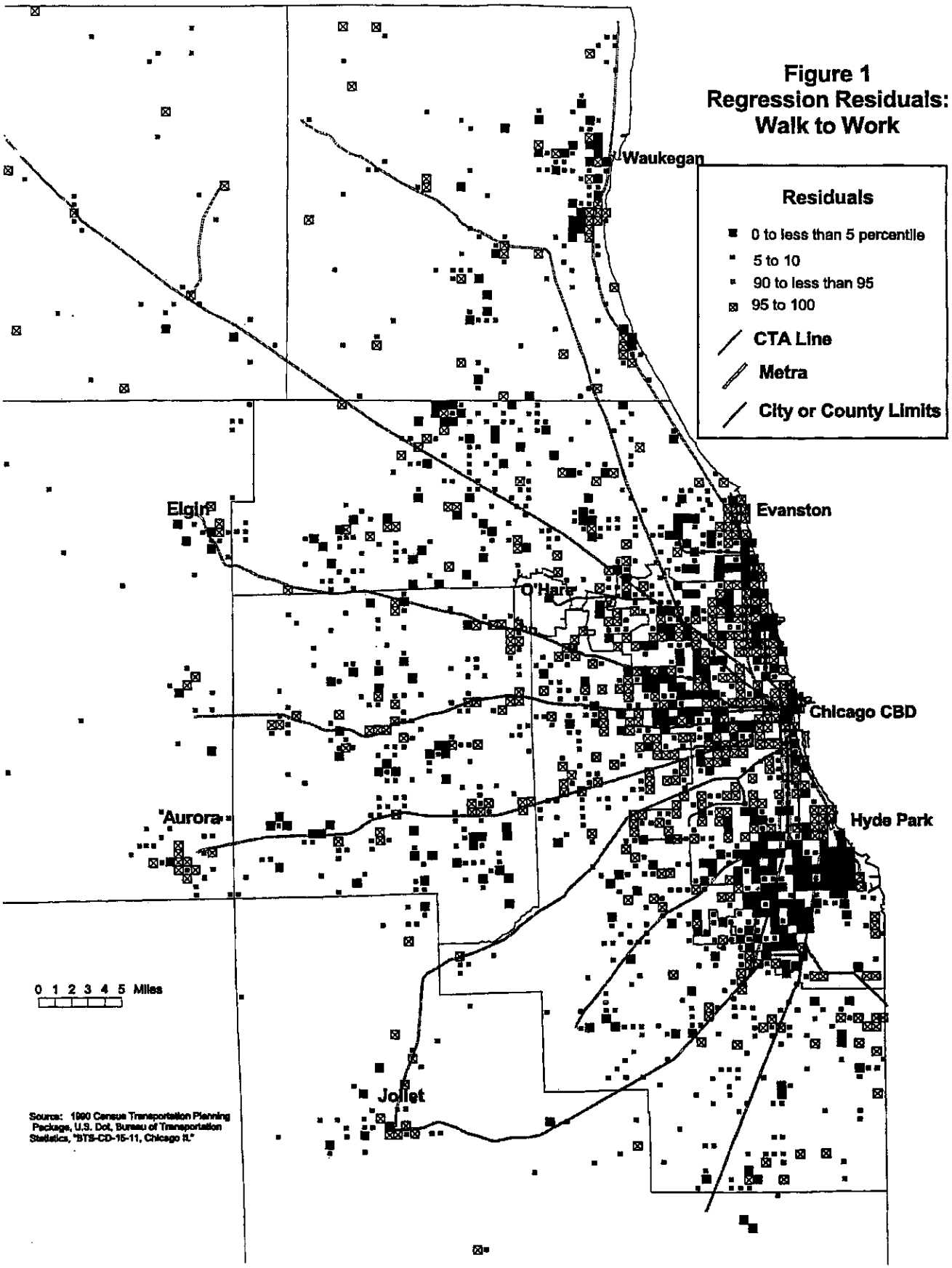


Figure 1
Regression Residuals:
Walk to Work
Residuals
0 to less than 5 percentile
5 to 10
90 to less than 95
95 to 100
CTA Line
Metra
City or County Limits
Waukegan
Elgin
Evanston
O'Hare
Chicago CBD
Aurora
Hyde Park
Joliet
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

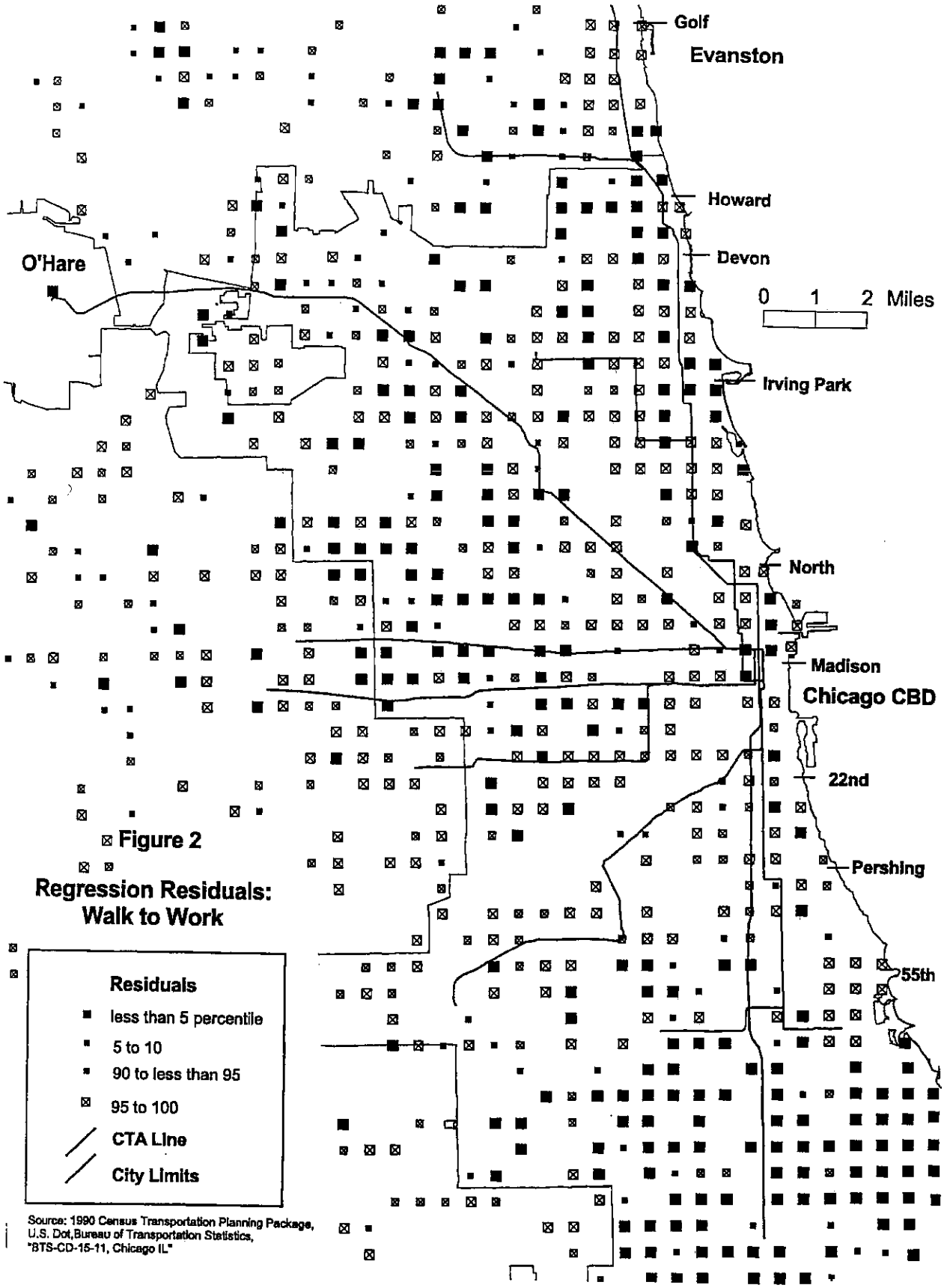


Figure 2

Regression Residuals: Walk to Work

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

As might be expected walking is more common in Evanston and Hyde Park than what the model predicts. It is also higher than expected near much of the Howard Service and near the Orange Line (to Midway).

4.2 Bicycling Trips

Since we did not complete a regression model for bicycle use we are including a map of bicycle use (Figure 3). It shows that the great majority of the 7617 work trips by bicycle are on the north side of Chicago where the Ravenswood CTA Line branches form the Red Line (Howard Service). Northwestern University (Evanston), Oak Park and the University of Chicago area (Hyde Park) also have high levels. Most of the rest of the west side and the south side of the city is relatively devoid of bicycle use in the work trip.

4.3 Off-Peak Transit

Off-peak transit residuals are highest (negative values) in the core of the city of Chicago and in each of the four satellite communities (Figure 4 with an enlargement on Figure 5). These are areas with low-income populations and a variety of jobs in the immediate area. In many of these areas there are more than expected number of off-peak transit trips. The most noticeable areas are south of North Avenue particularly in the west and south side minority neighborhoods.

By contrast high positive residuals (higher than expected) are located mainly in the fringe of the city of Chicago and in the inner suburbs. Other than the lakefront the area north of North Avenue has high positive residuals and again south of the area here the Green Line branches to run east west (near south 63rd Street).

5.0 Conclusions

The three commute modes, walking, biking and public transit in the off-peak, display substantial variations throughout the Chicago metropolitan area. After the major contributing factors have been accounted for there are still discernable patterns of variations from the expected. The communities with higher and lower than expected use are, therefore, candidates for further analysis. This then is the basis for the selection of case studies found in Chapter 7.

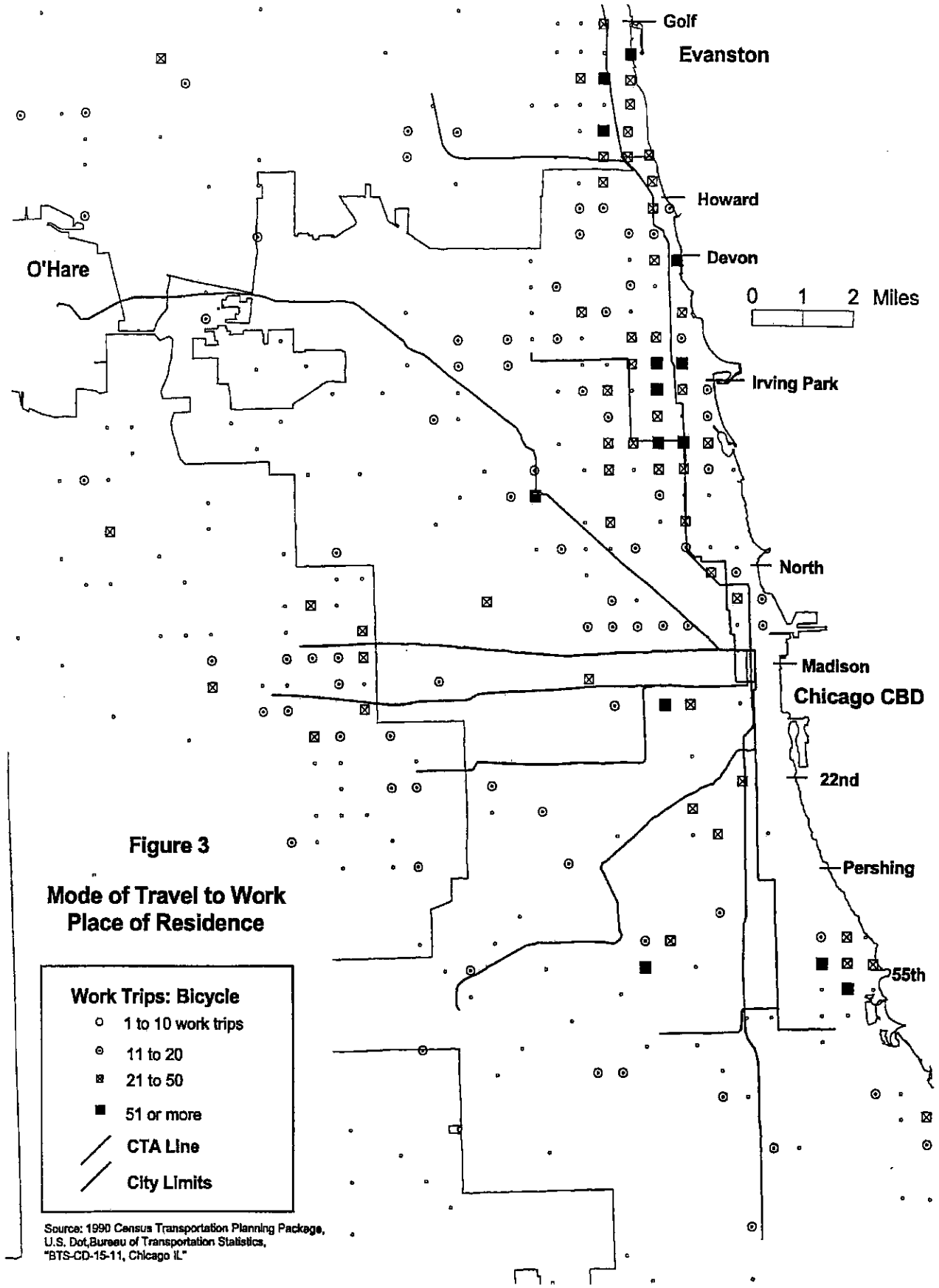


Figure 3

Mode of Travel to Work Place of Residence

Source: 1990 Census Transportation Planning Package, U.S. Dot,Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

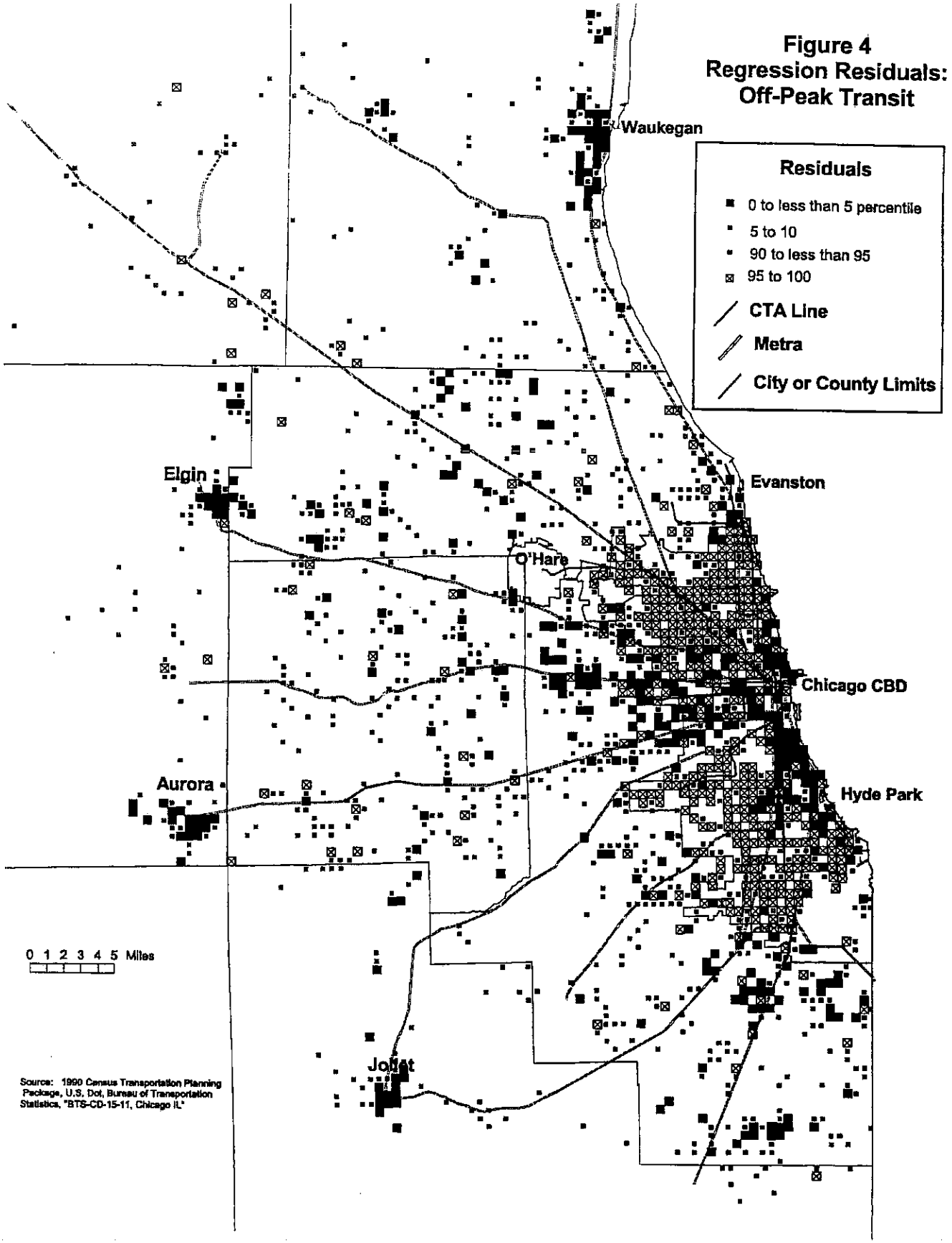


Figure 4
Regression Residuals:
Off-Peak Transit
Residuals
0 to less than 5 percentile
5 to 10
90 to less than 95
95 to 100
CTA Line
Metra
City or County Limits
Waukegan
Elgin
Evanston
O'Hare
Chicago CBD
Aurora
Hyde Park
Joliet
0 1 2 3 4 5 Miles
Source: 1990 Census Transportation Planning Package, U.S. Dot, Bureau of Transportation Statistics, "BTS-CD-15-11, Chicago IL"

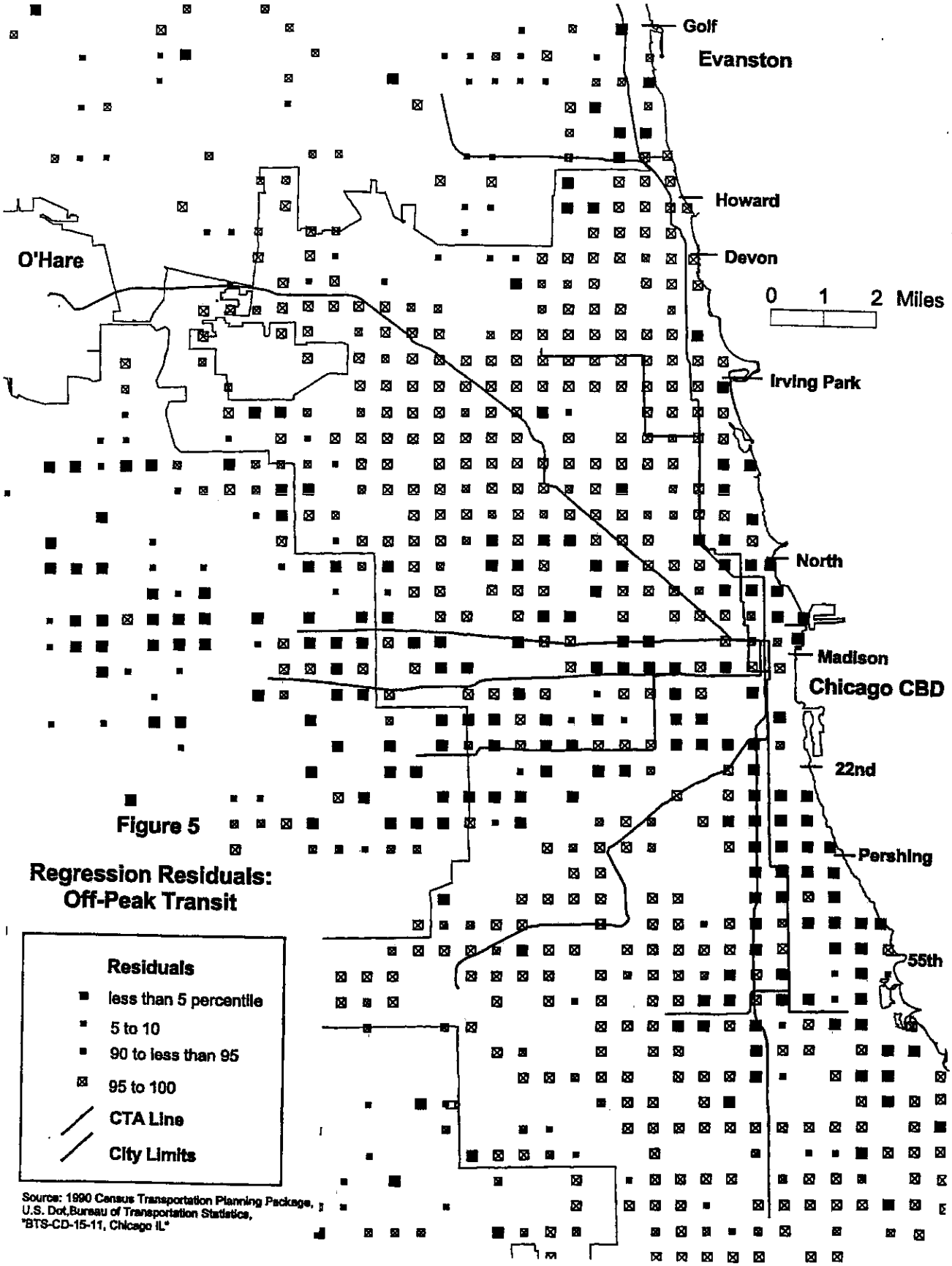


Figure 5

Regression Residuals: Off-Peak Transit

Chapter Seven

Case Studies

1.0 Introduction

The previous chapters have documented the great diversity in population characteristics and travel behavior found in the Chicago area. This diversity has been recognized for many decades and it was the basis in the 1920s for the delimitation of seventy-five community areas. Over time the city has undergone a substantial residential and commercial turnover, and the neighborhood boundaries have changed even while we maintain the original seventy-five community areas. Nevertheless, the city and suburbs still consist of a multitude of ethnic and socioeconomic subregions.

By using the information on the interregional variations within the Chicago area, particularly mode choice variations, the purpose of this chapter is to select several neighborhoods for further study. These neighborhoods demonstrate substantial differences in travel behavior and therefore each represents a case study. These case studies are selected to better understand mode choice and the factors that contribute to travel behavior.

This chapter relies extensively on Chapter 6 that used regression analysis to produce expected levels for off-peak transit and walking trips for each of over eight thousand neighborhoods. Contrasting these expected levels with the actual levels is the basis for the selection of case study sites. The regression for bicycle use was not successful and therefore is not available for this chapter.

The principal finding of these case studies is that the propensity to use non-motorized transportation and off-peak transit is more a function of the socioeconomic characteristics of the population than it is the physical characteristics of the neighborhood and the range of available mode choices. Changing the economic conditions of the residents and the neighborhood may well contribute more to promote travel and to affect mode choice than building walkways and bikeways and adding off-peak transit service. This point, however, needs further research.

2.0 Selection of Case Studies

The selection of case studies is based on regression models from data obtained from the

1990 Chicago-area Census Transportation Planning Package (CTPP). There are several advantages and disadvantages in using these data. On the positive end, the data are based on a large sample allowing analysis by small geographic areas. The basic data unit is a traffic analysis zone (TAZ) which in most areas can be characterized as half-mile-by-half-mile squares and therefore is approximately a quarter of a square mile in area. As such the zone is sufficiently small to be generally homogeneous within. Larger zones are likely to have socioeconomically mixed populations and it would be more difficult to generalize about the characteristics of the neighborhood in which the travel is conducted.

On the negative end, the data only include work trips. Although no information is available on other trip purposes, it is evident from fieldwork conducted in this study that work trips reflect mode choices made for other trips purposes. For example, in Chicago's inner-city neighborhoods, where very few people walk to work, there are few shopping and recreational destinations and therefore there are few walking trips to these types of locations. These destinations are not within walking distance. Similarly, the lack of local jobs reduces the resources available to conduct some trips, e.g., eat out and bank (two trip purposes used in the recent CATS Household Travel Survey). As a whole, the journey to work provides a fair amount of information about a neighborhood and its mode-choice behavior.

2.1 Expected Levels of Mode Use

We use the results of the regression analyses conducted in Chapter 6 as a basis for selecting neighborhoods for case studies. The characteristics of the neighborhood (data) are inserted into the regression model and the model provides the expected number of users, for the mode being examined.

The expected is a combination of the region-wide relationships applied to the local characteristics. Perhaps separate city and suburban models could have been created but the local population characteristics provide estimates reflecting local conditions and minimizing the need for two separate models.

2.2 Deviations from Expected Mode Use

The unusual deviations from the regression model suggest places where a given mode is used more often and less often than expected. If there is a community where there are both positive and negative deviations from the expected level, provided by the regression model, then these communities deserve closer examination to ascertain the reasons for these conflicting deviations. In this manner we address the question: what contributes to positive deviations in one neighborhood when there are negative deviations in adjacent neighborhoods or in neighborhoods in close proximity?

The model applies to the entire Chicago area and in some communities there are only positive or only negative residual values. Throughout the six-county study area, however, there should be roughly equal numbers of positive and negative residuals.

3.0 Case Studies

Using the regression residual maps (Figures 1 and 2, see also Figure 1 - 4 in Chapter 6), three case studies were initially selected for further study; Areas A, B and C. The first is a suburban site and the other two are city locations.

Area A partially covered a military facility in northern suburban Chicago. Figure 1 shows the higher than expected number of walkers in and near the military base on the east side of the study area (square symbols with an X in the middle) and the sharp contrast to the west (solid black squares). Even though there were a great number of walkers and generally great diversity of mode use in Area A, its very special nature suggested that another area be selected in its place. The conclusions drawn from such an area would be too obvious and would likely not be helpful suggestions for other neighborhoods. Area D in the city was drawn to replace Area A.

In contrast to the walk-to-work model of Figure 1, Figure 2 maps the residuals from the off-peak transit regression model and the boundaries of the three case studies areas selected for further study. Since no zones were selected in the suburban fringe, where off-peak transit is little used, the map covers only the city and inner ring of suburbs.

The author spent many hours spanning several days conducting a visual survey of the three study areas. This was done in an effort to discern the local characteristics, which may provide an explanation for the varying mode-choice environments, depicted by the residual maps. This field inspection provided the basis for many of the observations made in this chapter.

3.1 North Side: Area B

The area selected on the north side of the city of Chicago is bounded, in a clockwise sequence, by Bryn Mawr on the north, Sheridan Road and Lake Shore Drive on the east, Diversey Parkway on the south and Western Avenue on the west. It includes all of Uptown and Lake View and parts of Edgewater, Lincoln Square and North Center (the latter two are just to the west of Uptown and Lake View). Both the CTA Brown Line (Ravenswood Service) and the CTA Red Line (Figure 3) serve Area B. There are also seven east-west bus lines and approximately ten north-south and diagonal bus lines. Some of these buses run express to the Chicago downtown.

It is the most affluent of the three case-study communities but there are substantial socioeconomic variations within the area. The southeastern corner, in particular, is a

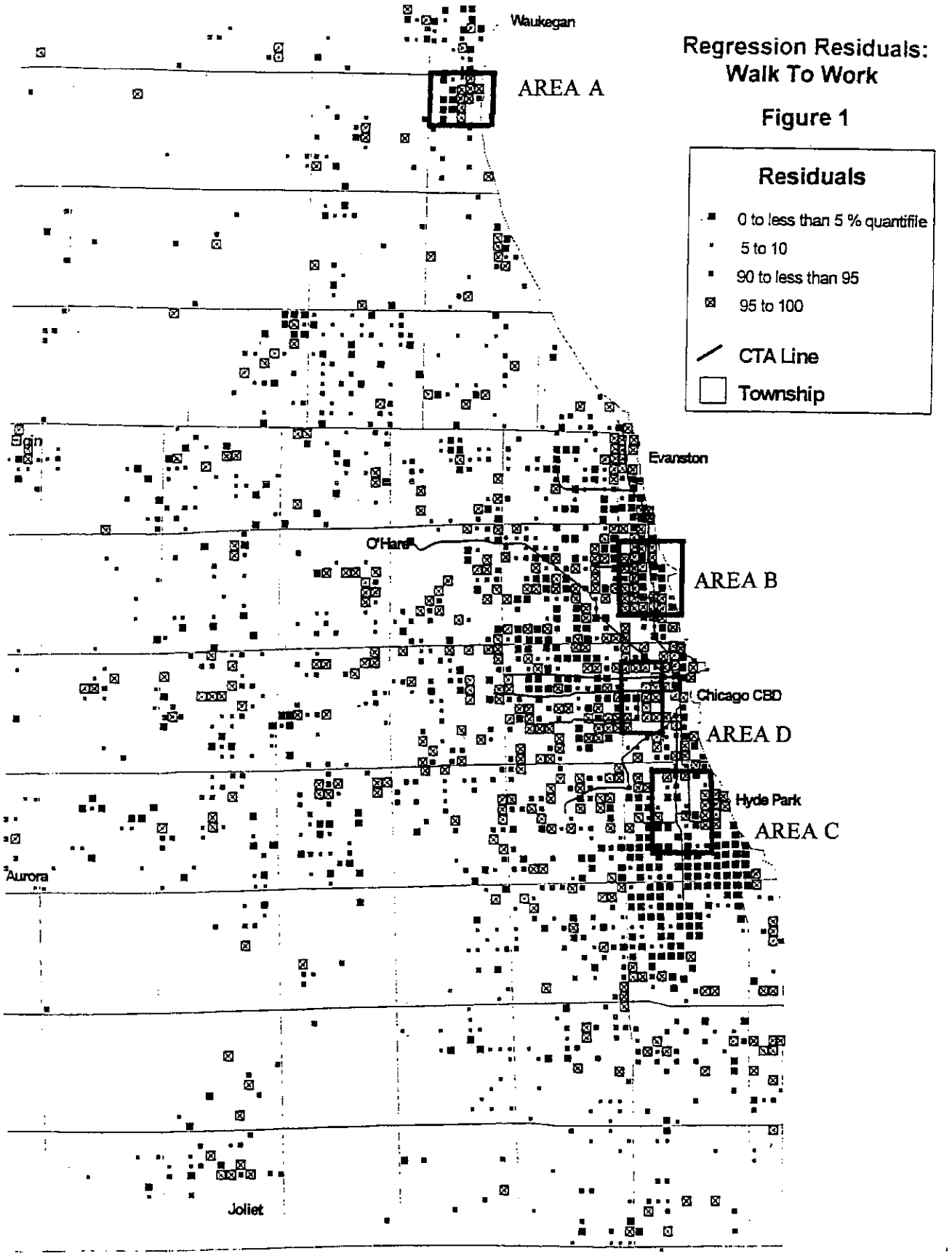

Regression Residuals:
Walk To Work
Figure 1
Residuals
0 to less than 5 % quantifile
5 to 10
90 to less than 95
95 to 100
CTA Line
Township
Waukegan
AREA A
Evanston
O'Hare
AREA B
Chicago CBD
AREA D
Hyde Park
AREA C
Aurora
Joliet

Figure 2

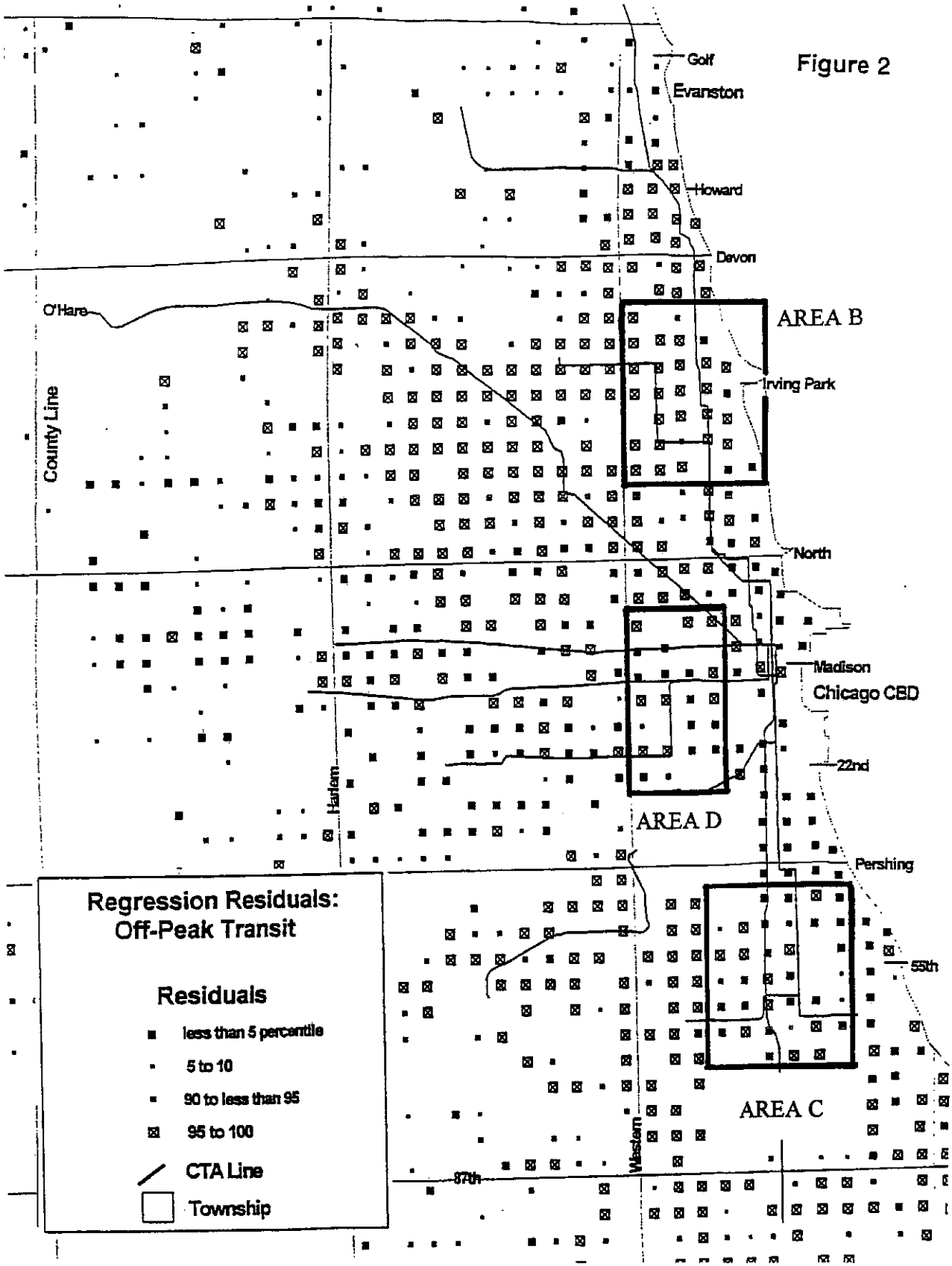
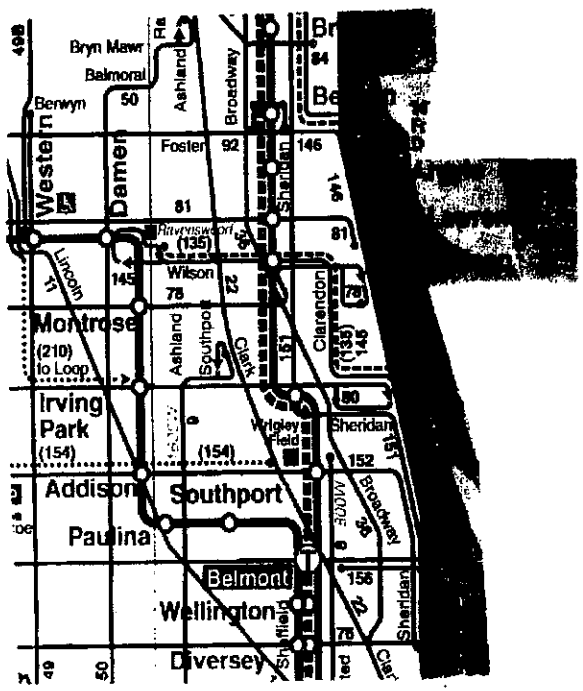

Golf
Evanston
Howard
Devon
O'Hare
AREA B
Irving Park
County Line
North
Madison
Chicago CBD
22nd
Harlem
AREA D
Pershing
55th
Western
87th
AREA C
Regression Residuals:
Off-Peak Transit
Residuals
less than 5 percentile
5 to 10
90 to less than 95
95 to 100
CTA Line
Township

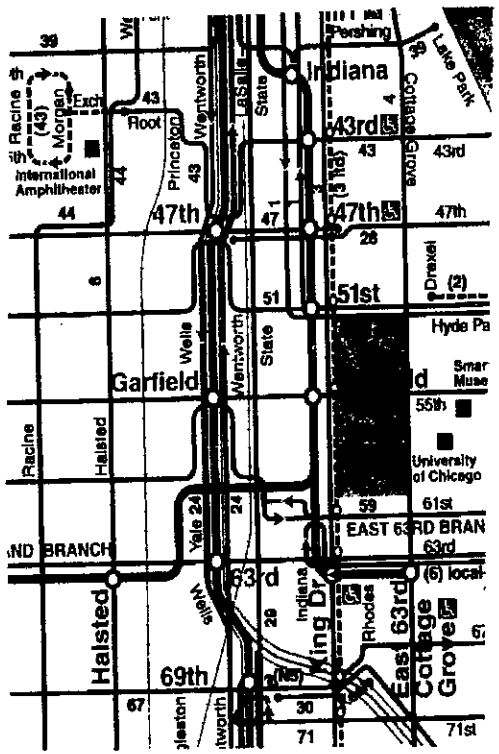
Figure 3

Transit System in the Three Study Area

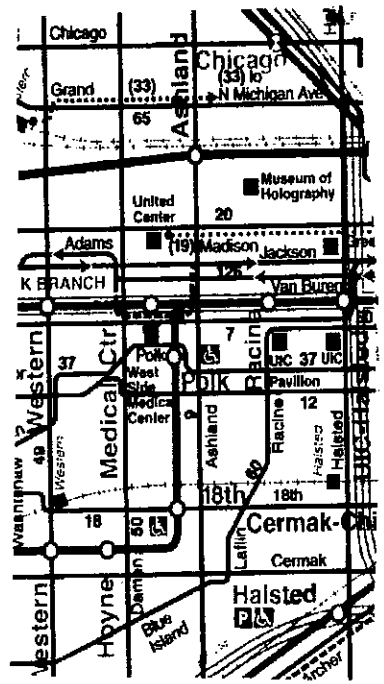
AREA B



AREA C



AREA D



trendy neighborhood in which rents are high, buildings have been renovated, empty lots are being developed and there is substantial redevelopment. It is a popular residential area for young professionals. The north-central part of the study area has higher densities and consists of mainly rental units. The highest density is found in the northeastern part of the area, along Lake Shore Drive.

3.1.1 Area B Regression Model: Off-peak Transit Trips

In multiple regression the independent variables interact in sometimes-unpredictable ways and therefore caution needs to be exercised in interpreting the individual components of the model. Still, some insight can be gained by examining how the residuals are computed for the individual zones in Area B. The residual is defined as:

Residual = Actual - Predicted

where,

Actual is the number of daily trips made by the residents of the zone by mode (off-peak transit) and

Predicted is the number of daily trips estimated by the regression model.

The regression model described in Chapter 6 is used with the data for Area B to produce Table 1. This table includes information for all thirty-eight zones in Area B. Starting from the left, the table includes the CATS zone ID number, the total number of workers living in the zone, the predicted number of off-peak transit users (the regression model estimate), the residual and the products of the variable values for the zone times the model coefficients.

The values in the right portion of the table are not the values for the independent variables, e.g., the first value for LATINO, 41.7, is not the number of Latinos nor the percentage but rather the number of Latinos in the zone times the model coefficient (0.022; see Table 3 in Chapter 6). These values, then, represent the contributions of each of the variables in computing the predicted value. For each additional Latino we expect 0.022 additional off-peak trips or twenty-two additional trips for each increment of a thousand additional Latinos. While this number seems low the thousand additional Latinos would also contribute to ridership increases through other variables such as households without vehicles (NOVEH).

In the first line of Table 1, all of the values from 41.7 for LATINO to -8.7 for SINGLE (the number of single-person households) *sum to 167.3, the predicted value.* It is evident that the number of households without vehicles (NOVEH) is the largest contributor with a value of 87.4. Not surprisingly number of household with three-or-more automobiles has a negative effect, contributing a -7.9 (MANYVEH, the number of households with three or more vehicles). For most of the zones approximately half of the predicted value is attributable to the NOVEH variable.

Table 1
Regression Model Estimates and Contributions by Each Independent Variable

			CASE STUDY AREA B: OFF-PEAK PUBLIC TRANSIT TRIPS													
CATS ID	TOTAL	PUBTRNT	PREDICTED	RESIDUAL	LATINO	BLACK	AGE	NO VEH	MANYVEH	EXEC	EARLY	PEF	POPEMP	POWER	POSTMORN	SINGLE
14114022	1734	203	167.3	35.7	41.7	13.2	-8.6	87.4	-7.9	13.4	36.3	-1.2	-3.7	3.1	3.7	-8.7
14114041	3475	419	217.1	201.9	45.6	2.7	-15.2	87.4	-9.2	46.3	55.7	-1.2	-1.0	19.6	9.9	-22.0
14114042	2723	150	142.8	7.2	13.6	0.7	-10.2	77.0	-9.8	43.4	31.0	-1.2	-1.8	12.2	4.8	-15.9
14114051	2470	190	145.1	44.9	26.3	0.2	-9.8	65.1	-14.1	34.2	44.4	-1.3	-4.6	9.9	12.7	-16.7
14114052	2914	262	195.9	66.1	29.5	0.4	-11.6	113.4	-9.5	38.0	43.9	-1.3	-2.2	13.1	9.0	-25.5
14114071	2506	219	135.1	83.9	29.5	0.4	-10.3	61.6	-6.9	25.5	38.1	-1.3	-1.8	7.8	8.9	-14.9
14114072	1436	116	70.0	46.0	8.0	0.9	-5.5	29.7	-5.7	18.7	28.0	-1.1	-1.0	2.5	7.4	-10.6
14124022	1633	179	118.7	60.3	30.6	1.8	-6.3	51.6	-3.6	16.2	36.3	-1.3	-5.6	3.0	7.2	-10.0
14124041	2890	297	197.2	99.8	37.3	5.2	-12.9	99.0	-6.8	43.8	40.1	-1.5	-2.5	19.0	4.4	-26.6
14124042	2662	215	168.8	46.2	26.6	2.1	-13.0	79.2	-14.4	40.8	43.8	-1.5	-3.1	17.4	16.0	-23.8
14124051	2752	343	182.8	160.2	31.4	3.2	-12.6	84.0	-7.6	43.3	50.7	-1.4	-6.8	16.7	9.1	-26.1
14124052	3634	423	277.6	145.4	53.1	10.7	-17.0	150.4	-7.3	47.4	54.8	-1.2	-16.4	21.6	15.5	-32.6
14124071	4248	585	374.0	211.0	71.4	14.3	-19.7	175.7	-7.9	43.8	98.7	-1.2	-10.8	23.1	13.7	-25.8
14124072	2348	146	136.5	9.5	27.6	3.6	-9.4	57.4	-4.8	24.5	43.7	-0.9	-4.4	4.8	8.9	-13.1
14214022	3301	276	199.1	76.9	21.4	3.8	-16.7	83.4	-7.7	63.0	43.2	-1.5	-7.6	35.6	13.9	-30.3
14214041	3652	250	229.4	20.6	13.2	3.3	-17.9	102.0	-8.1	81.5	33.7	-1.6	-6.5	52.3	16.8	-37.9
14214042	3657	347	274.9	72.1	22.6	5.2	-19.4	139.3	-8.9	76.4	38.4	-1.5	-4.1	48.6	11.4	-31.8
14214051	1882	183	143.0	40.0	29.9	4.9	-8.1	57.1	-6.6	36.8	30.1	-1.2	-1.4	8.3	7.4	-12.7
14214052	4192	712	451.7	260.3	65.3	40.8	-22.9	254.0	-5.8	51.0	66.3	-1.1	-8.7	27.8	20.0	-33.8
14214071	2749	372	217.9	154.1	38.8	13.4	-13.0	114.1	-9.2	23.8	61.8	-1.1	-11.1	7.7	15.0	-21.0
14214072	2989	216	203.9	12.1	27.8	6.8	-12.1	86.4	-9.0	58.9	42.2	-1.0	-5.2	15.5	18.4	-23.5
14224022	4574	326	318.7	7.3	16.6	7.0	-27.1	138.6	-10.4	118.3	39.8	-1.4	-23.4	98.8	18.1	-55.1
14224041	5156	542	416.7	125.3	23.3	7.9	-31.5	195.4	-9.6	112.4	48.2	-1.4	-11.3	108.8	28.9	-53.2
14224042	4470	737	397.7	339.3	40.9	15.4	-26.5	210.8	-5.5	85.4	51.4	-1.1	-5.8	56.1	26.3	-48.2
14224051	4120	635	507.8	127.2	41.9	46.1	-22.8	331.8	-3.4	67.9	60.4	-0.9	-6.2	32.3	14.7	-52.7
14224052	4450	895	628.0	267.0	42.5	121.2	-27.6	391.7	-3.0	51.6	73.9	-0.7	-25.0	21.2	19.5	-36.1
14224071	4344	630	711.4	-81.4	31.6	80.8	-23.5	506.9	-5.1	63.5	72.2	-0.8	-11.5	26.7	20.8	-50.8
14224072	5559	651	648.6	2.4	18.9	63.2	-24.3	407.7	-3.6	112.4	81.8	-0.8	-9.1	51.6	30.6	-78.3
14414022	9223	699	926.0	-227.0	13.4	15.0	-53.5	573.4	-10.4	225.7	57.7	-1.0	-18.6	263.7	31.9	170.0
14414041	10167	1265	1039.3	225.7	28.4	22.5	-49.6	638.8	-7.4	224.6	97.6	-0.9	-12.1	232.4	42.7	176.3
14414042	8897	1011	831.9	179.1	14.0	37.8	-41.8	517.2	-13.6	217.5	84.5	-0.8	-8.7	162.5	34.2	169.5
14414051	3037	114	194.2	-80.1	6.5	11.8	-11.2	138.1	-4.8	69.9	22.3	-0.7	-2.1	11.7	6.5	-52.4
14414052	563	51	18.9	32.1	0.7	5.7	-2.0	5.9	-1.1	13.7	5.9	-0.5	-1.3	0.3	0.0	-7.1
14414071	.	.	.	.	.	.	.	.	.	.	.	-0.6	.	.	.	.
14424022	2941	157	225.0	-68.0	1.5	2.1	-10.2	177.7	-3.3	87.0	20.0	-0.6	-5.7	12.4	10.9	-85.4
14424041	268	18	20.8	-2.8	0.6	0.0	-0.3	9.8	0.0	9.3	1.7	-0.6	0.0	0.0	2.9	-1.3
14424042	.	.	.	.	.	.	.	.	.	.	.	-0.4	.	.	.	.
14424052	.	.	.	.	.	.	.	.	.	.	.	-0.2	.	.	.	.

The next most important variable is the number of workers employed in executive, administrative or professional occupations (EXEC). The POWER variable is also important. This is the product of AGE*EXEC*PEF (number of residents aged 21-34 *times* the number of persons in executive, administrative and professional occupations *times* the pedestrian environment factor). This describes older established neighborhoods with a high proportion of executives that have a favorable walking environment (to transit and to other destinations).

The other noteworthy variable is BLACK. While the number of Latinos has a modest effect for all zones, by contrast the number of Blacks is rather variable and contributes substantially to zones in the bottom half of the table. Among other things, this suggests that the Latino population is more integrated throughout Area B.

3.1.2 Area B Regression Model: Walking Trips

The most important variable in this model is the product term POPEMP, population times employment (Table 2). It seems obvious that a combination of population and employment would yield the largest number of walking trips to work. This variable is also important in many parts of the city in expressing the potential for not only walking to work but also walking to a number of other destinations. If there are jobs in the neighborhood then there are also numerous other potential walking destinations. In many low-income neighborhoods, however, there are few commercial and business sites and therefore commensurately few walking trips.

The number of persons enrolled in college is even more important in some neighborhoods. College students tend to live in places where urban amenities are in close proximity and where densities are high, suggesting walkable neighborhoods. Almost as important is the number of multiworker households (WORK2). In a few zones WORK2 has the highest value, e.g., CATS ID 14114042 in the third line of Table 2. This may suggest that multiworker households are more likely to seek places where employment opportunities are close by or a second person in the household works because job opportunities are close.

Finally, the number of government workers is also a contributing factor (GOVERN). Federal, state and local governmental offices tend to be scattered throughout the city, e.g., libraries and post offices, and they not only attract workers by foot but clients as well.

It is perhaps unexpected that the Pedestrian Environmental Factor, PEF, was not a significant variable in this model whereas it was in the off-peak transit model. This variable is a count of the number of blocks in each zone and was created to reflect the walkability of a zone. Consequently the PEF does not change very much in most city of Chicago TAZs and therefore is not a significant contributor to the model.

Table 2

Regression Model Estimates and Contributions by Each Independent Variable

			CASE STUDY AREA B: WALKING TRIPS										
CATS ID	TOTAL	WALK	PREDICTED	RESIDUAL	BLACK	MANYVEH	UNIT	POPEMP	COLLEGE	WORK2	GOVERN	SELF	SINGLE
14114022	1734	182	100.2	81.8	-4.4	-8.9	-12.3	35.2	28.6	29.8	30.8	5.3	-4.8
14114041	3475	264	160.5	103.5	-0.9	-10.4	-14.8	9.2	59.2	63.1	50.2	16.1	-12.2
14114042	2723	187	132.2	54.8	-0.2	-11.0	-9.9	14.9	45.0	56.5	34.7	10.0	-8.8
14114051	2470	176	153.8	22.2	-0.1	-15.9	-18.1	43.6	47.5	43.9	43.2	17.9	-9.3
14114052	2914	258	135.1	122.9	-0.1	-10.7	-10.9	20.8	48.2	51.4	33.6	16.0	-14.2
14114071	2506	233	117.6	115.4	-0.1	-7.8	-12.9	17.5	46.0	43.7	26.4	12.1	-8.3
14114072	1436	69	71.3	-2.3	-0.3	-6.4	-11.0	9.4	24.3	25.7	30.0	4.4	-5.9
14124022	1633	198	120.3	77.7	-0.6	-4.1	-13.9	53.2	13.9	29.7	33.0	13.5	-5.6
14124041	2890	198	127.7	70.3	-1.8	-7.7	-14.4	24.1	39.0	48.9	32.2	21.0	-14.8
14124042	2662	195	157.0	38.0	-0.7	-16.2	-15.2	29.7	53.1	49.3	53.3	15.8	-13.2
14124051	2752	254	197.4	56.6	-1.1	-8.5	-12.9	65.2	54.5	50.0	48.4	15.2	-14.5
14124052	3634	361	323.6	37.4	-3.6	-8.2	-11.8	156.7	69.4	63.8	64.2	10.2	-18.1
14124071	4248	373	290.2	82.8	-4.8	-8.9	-10.4	103.4	65.3	81.1	64.9	12.9	-14.3
14124072	2348	216	156.9	59.1	-1.2	-5.5	-10.8	41.7	54.4	43.0	31.3	10.1	-7.2
14214022	3301	309	209.6	99.4	-1.3	-8.7	-14.2	72.4	54.0	64.3	32.1	26.9	-16.8
14214041	3652	164	190.9	-26.9	-1.1	-9.1	-8.6	62.0	50.8	66.2	32.7	18.0	-21.0
14214042	3657	130	219.5	-89.5	-1.7	-10.0	-11.0	39.4	62.3	71.7	55.3	30.1	-17.7
14214051	1882	62	116.2	-54.2	-1.7	-7.5	-7.3	13.7	37.1	37.7	37.0	13.2	-7.1
14214052	4192	318	281.5	36.5	-13.7	-6.5	-6.0	82.9	82.8	71.6	64.5	23.9	-18.8
14214071	2749	141	281.0	-140.0	-4.5	-10.4	-3.5	106.0	79.1	51.4	57.7	15.9	-11.7
14214072	2989	329	203.0	126.0	-2.3	-10.2	-9.3	49.6	62.1	56.1	45.1	23.9	-13.1
14224022	4574	452	422.1	29.9	-2.3	-11.7	-10.9	223.9	74.9	80.7	68.2	28.8	-30.6
14224041	5156	488	316.7	171.3	-2.7	-10.8	-11.5	108.3	86.7	96.8	51.9	26.6	-29.5
14224042	4470	227	237.9	-10.9	-5.2	-6.2	-5.9	55.1	88.7	77.8	37.9	21.4	-26.8
14224051	4120	207	259.4	-52.4	-15.5	-3.8	-4.0	59.7	96.3	57.8	76.6	20.5	-29.2
14224052	4450	437	481.6	-44.6	-40.7	-3.4	-1.7	239.2	145.9	89.3	71.2	20.8	-20.0
14224071	4344	399	332.0	67.0	-27.1	-5.8	-3.2	110.1	125.1	65.9	64.5	29.9	-28.2
14224072	5559	419	351.6	67.4	-21.2	-4.1	-0.8	87.3	92.2	83.3	119.7	37.6	-43.5
14414022	9223	569	461.2	107.8	-5.0	-11.7	-10.6	178.3	163.0	132.7	63.2	44.6	-94.4
14414041	10167	581	528.8	52.2	-7.6	-8.3	-4.4	116.2	188.1	146.2	134.1	61.3	-97.9
14414042	8897	220	431.5	-211.5	-12.7	-15.3	-4.5	82.9	183.3	118.2	118.1	54.6	-94.1
14414051	3037	19	137.2	-118.2	-4.0	-5.4	-2.4	19.8	47.5	37.9	55.7	16.1	-29.1
14414052	563	0	42.5	-42.5	-1.9	-1.3	0.0	12.1	5.5	11.4	13.5	6.1	-3.9
14414071	.	.	.	.	.	.	.	.	.	.	.	.	.
14424022	2941	124	157.0	-33.0	-0.7	-3.7	-1.4	54.2	41.5	35.2	40.4	26.8	-36.3
14424041	268	0	18.3	-18.3	0.0	0.0	0.0	0.0	2.2	3.9	5.8	6.0	-0.7
14424042	.	.	.	.	.	.	.	.	.	.	.	.	.
14424052	.	.	.	.	.	.	.	.	.	.	.	.	.

If a zone has large blocks, as in many new suburban developments, the opportunities for walking are far less than in city zones where blocks tend to be small and walking is more common. In the walking model there are apparently other variables that better capture this factor, at least for walking to work. Clearly the presence of both large numbers of jobs and residences, high POPEMP values, suggest a high-density neighborhood where walking is common. In the off-peak transit model the PEF variable acts as a surrogate for density (population as well as other urban densities).

3.1.3 Off-peak Transit Trips

Study Area B has the highest concentration of transit use in the Chicago area (see Figure 4 in Chapter 6). Consequently, there are large numbers of off-peak as well as peak transit users.

Figure 4 shows the locations of the highest positive and negative residuals for the off-peak regression model. Each zone with a large residual has two numbers, the upper number is the residual and the lower number is the value predicted by the regression model. The denominator provides a sense of the size of the relative prediction error. The two numbers added together represent the actual number of daily off-peak transit users (work trips only).

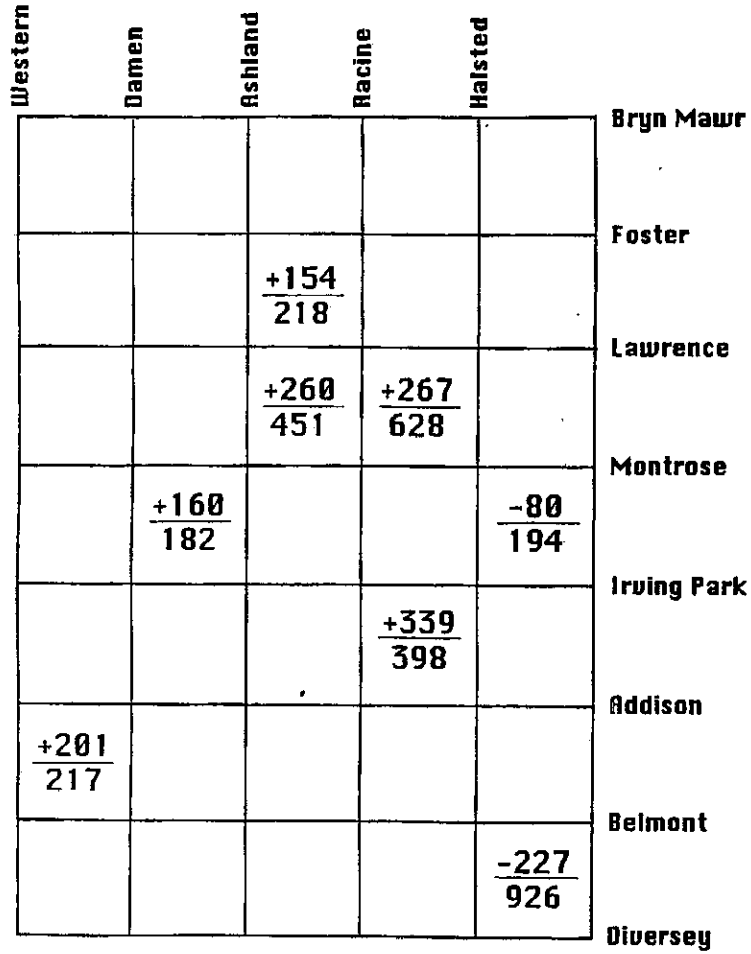
For ease of interpretation there are only two negative residuals and six positive residuals shown, the highest relative values. Due to the high usage level in this study area there are far more positive than negative residuals. Since the regression model is based on the entire six-county area, beyond the study area the number of negative and positive residuals is comparable.

A drive through the neighborhood did not reveal obvious reasons for the variations in the residual values. The large number of positive residuals may well reflect the level of service in this study area. The population density is high and the density and frequency of service is high. The high values may also reflect the number of multiworker households. The second worker in the household may well have atypical working hours. Also since parking is difficult throughout most of Area B the second worker may find off-peak transit to be a more practical alternative than driving.

3.1.4 Walking Trips

The residuals from the walking-trip regression model are more balanced; on Figure 5 there are six positive values and four negative values. Because the number of walkers is smaller the residuals are also smaller. In many zones the size of the residual reflects the size of the zone, measured by the number of workers residing in the zone.

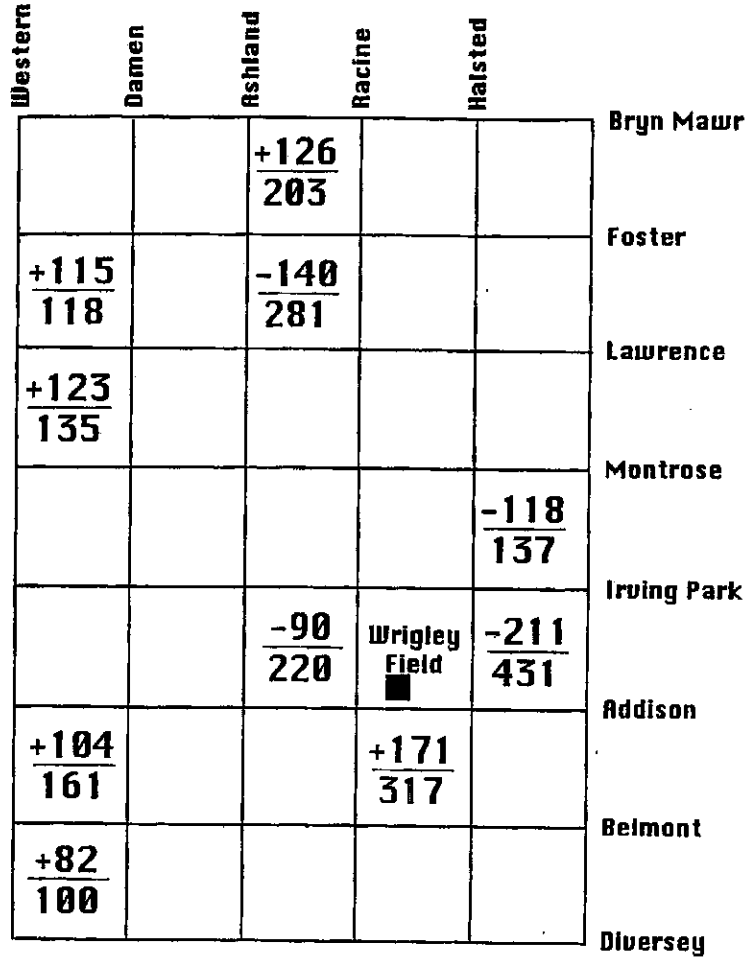
Figure 4
HIGH POSITIVE AND NEGATIVE RESIDUALS
Area B: Off-Peak Transit Trips



Legend:

residual / predicted Residuals + Predicted = actual number of trips

Figure 5
HIGH POSITIVE AND NEGATIVE RESIDUALS
Area B: Walking Trips



Legend:

residual / predicted Residuals + Predicted = actual number of trips

The positive residuals are found in well-maintained older neighborhoods with a mix of single-family residences and apartment buildings. That description applies to all positive residuals west of Damen (Figure 5). It also applies to the positive value of 171 just south of Wrigley Field and west of Halsted.

There are few walking destinations in the middle of these zones but the commercial activities on each of the arterials bounding the zones attract a large number of pedestrians. Since most of these bounding arterials have businesses in every block nearly all residents would be within walking distance (less than ten minutes) from some commercial activity.

The negative residuals in the eastern part of the study area (east of Halsted) are in exceedingly high-density neighborhoods along Lake Shore Drive near Lake Michigan. With the exception of Halsted Street, there are few commercial destinations in these zones. In this regard, despite the higher densities and greater overall purchasing power, they are not surrounded by businesses as is true throughout much of the rest of Study Area B. Other than recreation and social purposes the lake front communities have fewer walking destinations. Walking is very important in these neighborhoods but there would even be more walking if land use were more mixed.

The zone north of Lawrence Street and east of Ashland Avenue, with a negative residual of 140 on Figure 5, is a socioeconomically and racially mixed area. Further it is unique in Study Area B in that the walking residual is a high negative and the off-peak transit residual is a high positive. This is consistent with the general finding in this study that minority neighborhoods are more likely to have off-peak transit users but less likely to have workers walking to their employment sites.

3.2 South Side: Area C

The largest case study is a 10.5 square-mile area on the south side of the city of Chicago. It is bounded by 43rd Street on the north, Woodlawn on the east, 71st Street on the south and Racine on the west. It is centered on the Fuller Park, Grand Boulevard and Washington Park Community Areas but also includes parts of New City, Kenwood and Hyde Park.

It is a diverse area with lower-middle-class whites in the northwestern corner (just south of Bridgeport) and a mixed middle- and upper-middle class near the Hyde Park area. Most of the rest of this study area is African American. Many of the neighborhoods have been declining in population for most of this century and have less than half of the population of the peak years. This is evident in a drive through these neighborhoods. Nearly every block has vacant properties formerly occupied by buildings and in many blocks more than half of the overall land area is vacant. There has not only been a

decline in population in these neighborhoods but also a substantial decline in jobs and amenities that characterize vibrant communities.

Two parallel CTA Rail Lines serve the area (Figure 3). The Red Line has four stops in the median of the Dan Ryan Expressway including the 47th, Garfield, 63rd and 69th Street Stations. The Green Line runs north south until approximately 63rd and then branches both east and west. In 1990 when data used in this study were collected there were eight stations on the Green Line in the study. There were also nine north-south bus lines and six running east west through the area. The area is well served by public transit.

3.2.1 Area C Regression Model: Off-peak Transit Trips

As in the case of Area B the number of households without automobiles (NOVEH) is again the most important variable but in Area C there are several zones in which the number of Black is more important (Table 3). In several of the zones in which Blacks are most important there are substantial overestimates, suggesting that this group contributed to off-peak transit use but the relationship may not be linear.

Few other variables exhibit large contributions. Consequently this area is easier to understand than the other study areas; the list of important contributing variables is short. The lack of automobiles is a contributing factor but variables such as EXEC and POWER (AGE*EXEC*PEF) contribute very little, unlike Area B.

3.2.2 Area C Regression Model: Walking Trips

There is a stark contrast between Areas B and C. Area C is characterized by high levels of unemployment and poverty and therefore, in comparison to Area B, far fewer walking trips to work. There appear also to be fewer commerce-oriented walking trips (shopping, eating out, etc.) except in the five zones with more than one hundred walking trips. Three zones with the highest number of walkers, ranging from 295 to 653 (Table 4) are in the Hyde Park and the adjacent community area to the south, Woodlawn. The fourth zone is in New City just south of Bridgeport. It is a white, well-maintained neighborhood with modest single-family homes. The fifth zone, with 109 walkers, is northeast of the corner of State and 63rd Streets.

With relatively few commercial walking destinations, the number of government workers (GOVERN) provides the greatest contribution of walking trips in more than half of the zones (Table 4). For people without jobs and resources, many governmental facilities are important destinations, not just for work but for other purposes.

The other three variables, POPEMP, COLLEGE and WORK2, are important in this area as they were in Area B, but much less so. These variables tend to be related to the economic well being of the neighborhood and Area C values for these variables are

Table 3
Regression Model Estimates and Contributions by Each Independent Variable

			CASE STUDY AREA C: OFF-PEAK PUBLIC TRANSIT TRIPS													
CATS ID	TOTAL	PUBTRNT	PREDICTED	RESIDUAL	LATINO	BLACK	AGE	NO VEH	MANYVEH	EXEC	EARLY	PEF	POPEMP	POWER	POSTMORN	SINGLE
14223841	1440	261	266.4	-5.4	1.8	126.4	-10.6	111.2	-3.0	8.5	37.1	-1.5	-1.4	2.9	1.5	-5.4
14223842	1432	230	264.6	-34.6	0.5	116.1	-8.6	123.9	-4.4	9.8	28.7	-1.4	-1.2	2.7	4.4	-4.6
14223851	1085	126	218.5	-92.5	0.0	94.9	-7.5	102.4	-4.4	5.5	33.3	-1.5	-1.6	1.4	0.9	-3.5
14223852	1008	219	200.2	18.8	0.3	95.6	-8.0	88.5	-5.0	6.6	23.2	-1.4	-1.1	1.7	3.6	-2.4
14223871	1345	311	228.1	82.9	1.7	109.0	-9.6	79.4	-3.3	8.1	41.7	-1.3	-0.3	2.3	3.0	-1.4
14223872	323	47	63.3	-16.3	9.2	26.0	-2.4	23.8	-1.0	1.4	9.2	-1.1	-0.7	0.1	0.9	-0.7
14223881												-1.0				
14413841	989	200	200.5	-0.5	0.9	90.2	-7.1	92.6	-1.7	6.4	19.1	-1.4	-1.5	1.9	3.9	-3.5
14413842	926	295	253.9	41.1	0.3	92.3	-6.4	139.6	-5.0	1.6	37.9	-1.4	-1.9	0.3	2.8	-4.8
14413851	780	141	184.9	-43.9	0.0	80.0	-6.0	92.6	-6.8	4.0	23.5	-1.5	-0.5	0.8	2.8	-2.6
14413852	512	76	134.6	-58.6	0.0	68.5	-4.8	56.2	-2.0	3.3	14.2	-1.4	0.0	0.5	3.3	-1.8
14413871	494	111	72.3	38.7	0.0	40.0	-3.5	26.2	0.0	0.8	12.9	-1.2	-0.4	0.1	0.0	-1.3
14413872	388	61	21.2	39.8	4.7	5.0	-2.4	11.8	-3.0	0.7	7.8	-1.1	-0.9	0.0	0.8	-0.8
14413881	1615	83	76.2	6.8	11.9	0.1	-7.6	47.3	-15.0	6.5	36.7	-1.1	-0.9	1.2	3.5	-5.0
14423841	808	113	163.7	-50.7	1.3	66.8	-5.5	76.8	-1.8	10.1	22.9	-1.2	-3.3	1.5	0.4	-2.9
14423842	406	56	83.6	-27.6	0.2	31.4	-1.9	48.7	-0.8	1.8	8.3	-1.2	-1.0	0.1	0.9	-1.5
14423851	405	157	63.4	93.6	0.0	25.3	-2.3	28.9	-0.5	1.1	10.5	-1.3	-0.8	0.1	3.6	0.0
14423852	661	182	128.9	53.1	0.0	58.2	-4.7	57.8	-0.5	3.4	18.1	-1.3	-0.2	0.5	0.5	-1.6
14423871	426	130	230.2	-100.2	0.4	106.7	-9.2	133.4	-0.7	1.3	6.2	-1.2	-6.2	0.3	0.4	0.0
14423872	319	72	244.2	-172.2	0.3	107.6	-8.1	139.1	-0.6	2.0	6.5	-1.3	-1.7	0.5	1.2	0.0
14423881	569	110	181.3	-71.3	0.3	82.7	-6.2	97.9	-1.3	3.4	8.0	-1.4	-1.9	0.7	1.4	-0.8
14513841	1462	264	240.7	23.3	0.2	89.4	-6.1	108.9	-6.3	13.1	45.9	-1.2	-0.6	2.1	6.5	-9.9
14513842	553	110	128.3	-18.3	0.0	49.1	-3.1	65.4	0.0	5.2	17.0	-1.2	-0.5	0.4	1.1	-3.8
14513851	1062	296	336.7	-40.7	0.6	123.1	-9.9	204.3	-0.8	6.0	17.4	-1.1	-2.0	1.5	3.8	-4.8
14513852	1103	285	307.6	-22.6	0.7	104.5	-8.4	181.8	-3.0	3.9	36.6	-1.1	-3.0	0.8	3.0	-6.8
14513871	1150	321	257.7	63.3	0.5	93.2	-5.9	140.3	-2.3	8.4	30.2	-1.1	-3.9	1.2	2.5	-4.0
14513872	927	234	213.3	20.7	1.0	81.8	-4.9	107.2	-2.8	9.4	28.4	-1.2	-2.2	1.3	2.1	-5.3
14513881	893	244	365.6	-121.6	0.0	131.1	-8.0	226.0	-1.1	7.0	19.7	-1.4	-3.1	1.7	2.2	-7.1
14523841	1073	190	144.6	45.4	0.9	58.0	-3.7	74.6	-6.8	8.2	19.7	-1.1	-0.9	0.7	3.8	-7.7
14523842	1368	296	257.6	38.4	1.4	101.7	-5.9	125.2	-5.4	9.3	34.7	-1.1	-1.0	1.3	2.2	-3.5
14523851	1613	300	340.8	-40.8	0.0	126.2	-8.8	199.5	-4.1	15.2	19.5	-1.0	-0.6	3.1	2.4	-9.2
14523852												-0.9				
14523871	6	0	0.2	-0.2	0.0	0.5	-0.1	2.1	0.0	0.0	0.0	-1.0	0.0	0.0	0.0	0.0
14523872	1436	351	384.6	-33.6	0.7	126.4	-8.1	233.1	-4.1	13.9	31.6	-1.2	-0.5	3.0	3.5	-12.3
14523881	876	309	245.6	63.4	0.6	99.8	-7.4	137.8	-3.0	4.1	16.8	-1.3	-2.4	0.9	3.9	-2.9
14713841	48	0	7.1	-7.1	0.0	3.7	-0.4	5.2	0.0	0.0	1.7	-1.2	0.0	0.0	0.0	-0.6
14713842	1320	273	323.6	-50.6	0.9	121.9	-8.5	176.6	-6.7	12.7	32.9	-1.2	-2.4	2.8	3.1	-7.1
14713851	919	161	177.6	-16.6	0.4	60.0	-6.3	102.5	0.0	10.0	16.0	-1.1	-1.4	1.5	3.7	-6.4
14713852	941	14	27.4	-13.4	1.7	6.6	-5.6	21.6	-0.8	19.9	4.4	-0.9	-19.1	2.3	4.8	-6.2
14713871	3167	251	318.2	-67.2	2.0	95.8	-16.6	153.5	-4.7	59.4	30.4	-0.9	-10.4	20.6	13.5	-23.0
14713872	1666	211	261.6	-50.6	0.7	86.9	-7.3	150.2	-3.8	28.5	15.0	-1.0	-0.5	4.6	4.5	-14.8
14713881	985	117	269.2	-152.2	0.5	98.1	-7.4	164.0	-3.1	10.0	16.6	-0.9	-2.1	1.5	0.4	-7.2

Table 4

Regression Model Estimates and Contributions by Each Independent Variable

			CASE STUDY AREA C: WALKING TRIPS										
CATS ID	TOTAL	WALK	PREDICTED	RESIDUAL	BLACK	MANYVEH	UNIT	POPEMP	COLLEGE	WORK2	GOVERN	SELF	SINGLE
14223841	1440	50	48.9	1.1	-42.4	-3.4	-13.7	13.0	33.0	21.8	39.3	3.1	-3.0
14223842	1432	20	54.1	-34.1	-39.0	-4.9	-13.9	11.1	17.0	22.8	60.1	2.5	-2.6
14223851	1085	81	35.9	45.1	-31.8	-4.9	-9.9	15.6	18.6	15.2	29.6	4.7	-2.0
14223852	1008	24	45.6	-21.6	-32.1	-5.7	-11.2	10.8	21.6	15.4	44.3	2.7	-1.3
14223871	1345	53	45.7	7.3	-36.6	-3.7	-16.6	3.2	23.6	22.7	50.2	2.7	-0.8
14223872	323	16	8.6	7.4	-8.7	-1.2	-8.2	6.4	7.4	5.1	7.2	0.0	-0.4
14223881	.	.	.	.	.	.	.	.	.	.	.	.	.
14413841	989	36	50.9	-14.9	-30.3	-1.9	-10.3	14.3	34.4	14.9	30.0	0.6	-1.9
14413842	926	16	42.3	-26.3	-31.0	-5.7	-9.1	18.2	19.3	15.3	31.8	5.2	-2.7
14413851	780	19	16.9	2.1	-26.8	-7.7	-12.3	5.1	12.4	11.3	34.3	1.1	-1.5
14413852	512	0	9.3	-9.3	-23.0	-2.2	-13.0	0.3	15.7	8.3	20.3	2.9	-1.0
14413871	494	0	28.0	-28.0	-13.4	0.0	-8.0	3.4	7.6	9.5	26.9	1.6	-0.7
14413872	386	4	27.7	-23.7	-1.7	-3.4	-4.6	9.0	9.4	6.3	11.0	1.1	-0.5
14413881	1615	154	66.9	87.1	0.0	-16.9	-16.0	8.9	20.0	28.6	42.6	1.5	-2.8
14423841	808	26	80.4	-54.4	-22.4	-2.0	-6.6	31.9	25.4	12.2	40.3	2.2	-1.6
14423842	406	28	21.1	6.9	-10.5	-0.9	-2.4	9.4	5.7	5.3	14.5	0.0	-0.8
14423851	405	23	18.3	4.7	-8.5	-0.5	-4.0	7.5	6.7	6.7	9.4	0.0	0.0
14423852	661	17	14.1	2.9	-19.5	-0.5	-8.4	2.4	12.9	8.9	18.2	0.0	-0.9
14423871	426	6	49.4	-43.4	-35.8	-0.7	-3.6	59.2	10.3	5.7	13.4	0.0	0.0
14423872	319	12	-2.2	14.2	-36.1	-0.6	-5.2	15.9	7.5	4.3	10.1	1.0	0.0
14423881	569	46	30.7	15.3	-27.7	-1.5	-5.9	18.3	16.3	7.2	22.5	0.9	-0.5
14513841	1462	25	99.5	-74.5	-30.0	-7.1	-15.2	6.1	25.3	23.9	94.0	7.0	-5.5
14513842	553	21	38.5	-17.5	-16.5	0.0	-1.7	4.5	14.9	7.8	29.1	1.5	-2.1
14513851	1062	109	59.1	49.9	-41.3	-0.9	-3.2	18.7	26.7	15.7	42.1	3.0	-2.7
14513852	1103	35	53.4	-18.4	-35.1	-3.4	-1.1	29.0	15.7	16.5	32.4	2.2	-3.8
14513871	1150	76	86.0	-10.0	-31.3	-2.6	-2.3	37.8	20.0	14.7	50.5	0.4	-2.2
14513872	927	73	63.3	9.7	-27.4	-3.2	-3.3	21.4	17.5	11.5	44.8	4.0	-2.9
14513881	893	87	41.7	45.3	-44.0	-1.3	-3.8	30.1	23.6	10.7	27.2	2.1	-3.9
14523841	1073	45	55.5	-10.5	-19.5	-7.7	-7.6	8.6	23.7	20.5	38.5	2.1	-4.2
14523842	1368	53	78.8	-25.8	-34.1	-6.1	-9.1	9.9	35.5	23.0	59.4	1.2	-1.9
14523851	1613	59	113.9	-54.9	-42.4	-4.6	-1.4	6.1	51.4	23.9	81.1	3.9	-5.1
14523852	.	.	.	.	.	.	.	.	.	.	.	.	.
14523871	6	6	3.1	2.9	-0.2	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0
14523872	1436	52	65.4	-13.4	-42.4	-4.6	-10.8	4.8	35.5	15.1	70.9	2.8	-6.8
14523881	876	24	53.4	-29.4	-33.5	-3.4	-8.8	23.3	30.6	12.7	31.0	2.0	-1.6
14713841	48	0	3.7	-3.7	-1.2	0.0	-1.0	0.0	1.9	1.0	2.4	0.0	-0.3
14713842	1320	98	67.5	30.5	-40.9	-7.6	-9.0	23.3	29.8	19.7	53.1	2.0	-3.9
14713851	919	295	107.7	187.3	-20.1	0.0	-2.0	13.7	76.8	7.6	31.9	2.3	-3.5
14713852	941	581	298.4	282.6	-2.2	-0.9	-2.6	183.3	87.6	13.8	18.6	3.4	-3.5
14713871	3167	653	360.6	292.4	-32.1	-5.3	-12.8	100.0	138.2	57.3	107.5	19.6	-12.8
14713872	1666	82	99.0	-17.0	-29.1	-4.3	-11.0	5.1	54.0	26.6	56.3	8.7	-8.2
14713881	985	40	51.9	-11.9	-32.9	-3.5	-9.0	20.3	20.8	13.2	43.9	2.1	-4.0

relatively low. For example in Line 5, Zone 14223871 (Table 4), with 1345 workers and 53 walkers the models predicts 45.7 walkers or less than one percent. The contributions of the POPEMP, COLLEGE and WORK2 variables are only 3.2, 23.6 and 22.7 respectively.

3.2.3 Off-peak Transit Trips

The highest positive residuals for off-peak transit use were in African-American neighborhoods that visually appeared to be stable and seemed to have economic opportunities (Figure 6). Whereas the more affluent areas of the city, as in the Lincoln Park neighborhoods, have very low levels of off-peak transit use relative to peak transit use, the south side minority areas seemed to require some economic opportunities to generate off-peak transit use. Between 43rd and 47th Streets, east of State Street, the one zone with a positive residual exhibited signs of development and appeared marginally more prosperous than the adjacent zones.

The largely white area in the northwest appears to be the one of the most prosperous parts of Area C but there are no distinguishing residuals in that part of the study area. This suggests that in the minority areas off-peak transit use is a sign of minimal economic resources that contribute to the use of transit. At a price of over a dollar per ride, the cost of using public transit may well be a limiting factor in transit use.

This can best be seen along the four zones west of State Street in the middle of the study area. The Robert Taylor Public Housing complex starts on the west side of State Street just north of 55th Street (Figure 6). As one travels north on State Street one passes by an area with moderately high positive residuals (economically stable) only to move into a zone of negative residuals at the point where the public housing complex begins.

3.2.4 Walking Trips

The most obvious finding regarding walking is that the area on the western edge of Hyde Park clearly has the highest positive residuals. Three zones in this area registered the highest residuals in the study area (Figure 7). The presence of the University of Chicago and related activities and the mix of land uses make walking an attractive option for many.

There were also two very different positive residuals along Halsted Street. Near the south end the +45 residual is in a vibrant area with new State of Illinois facilities, e.g., a Children and Family Services Building and an active shopping complex on the corner of 63rd and Halsted. While there are a few vacant stores, suggesting some economic hardships, the overall vitality of the area is compatible with the high walking residual.

Figure 6

HIGH POSITIVE AND NEGATIVE RESIDUALS
Area C: Off-Peak Transit Trips

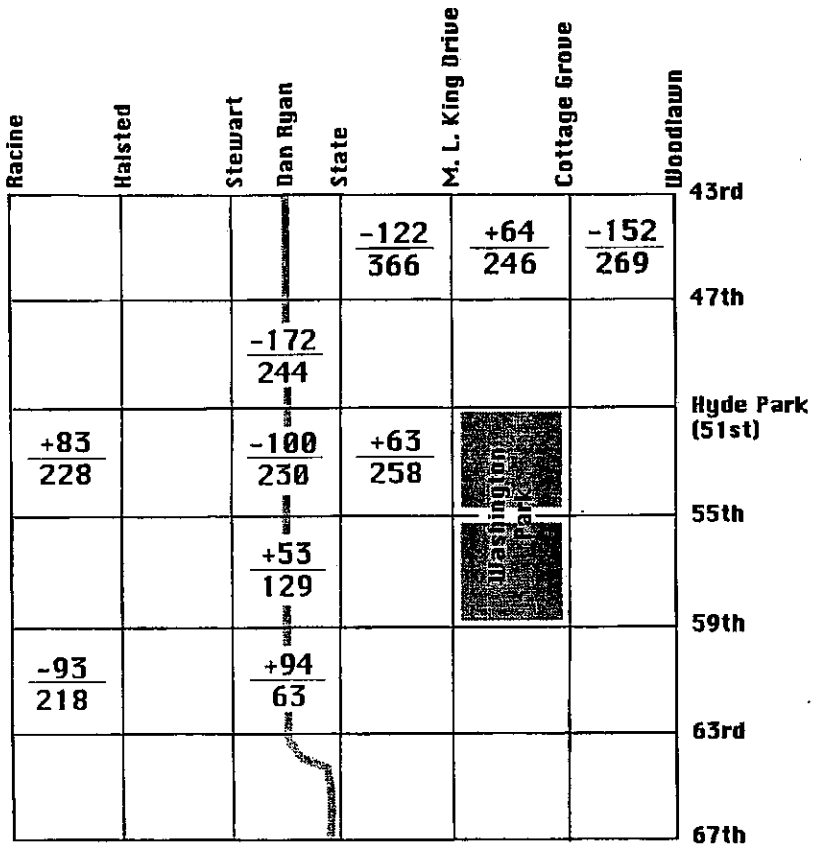
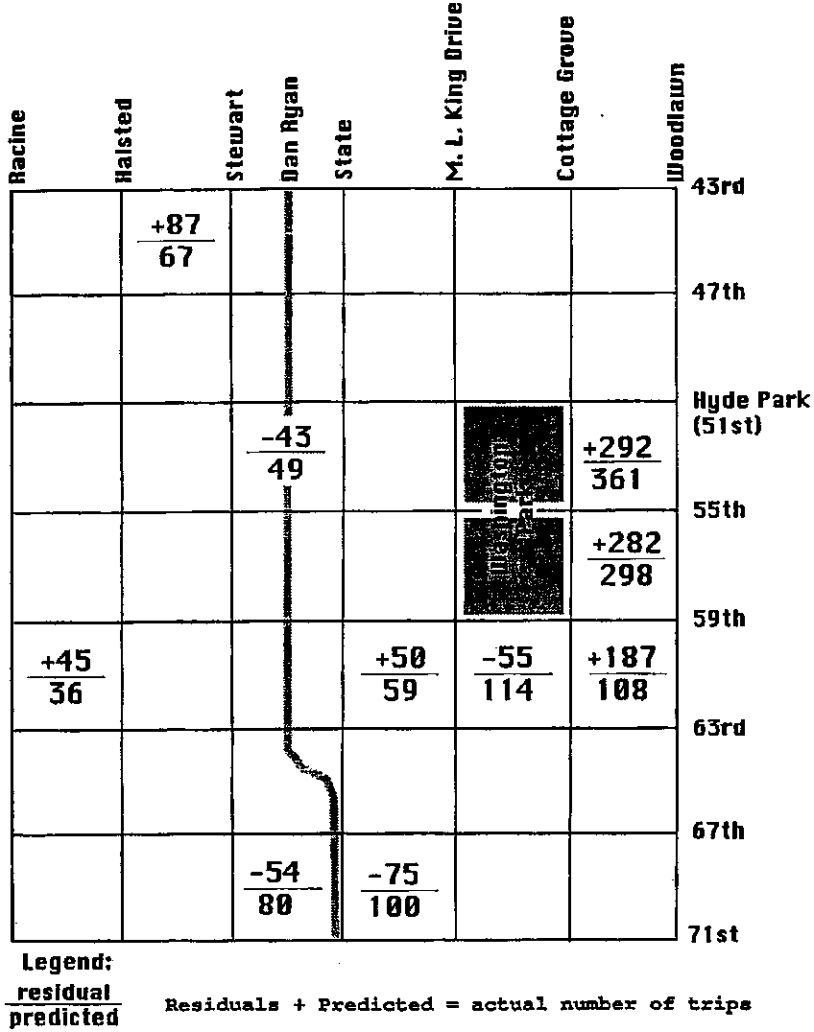


Figure 7

HIGH POSITIVE AND NEGATIVE RESIDUALS
Area C: Walking Trips



The other positive-residual zone (+87), on the north end is close to the International Amphitheater near the corner of 43rd Street and Halsted. This is an Irish-American neighborhood with modest but well maintained homes. The neighborhoods appear to be well maintained and many of the building facades have recently been remodeled. As a whole it provides a good walking environment.

3.3 West Side: Area D

Area D is a seven square mile area west and southwest of the Chicago CBD. It is bounded by Chicago Avenue on the north, Halsted on the east, 26th Street on the south and Western Avenue on the west. It encompasses the Near West Side and Lower West Side Community Areas and parts of West Town, North Lawndale and South Lawndale. It is mixed neighborhood including UIC, the West Side Medical Complex, the United Center and a large Latino community.

This study area is served by both the Blue and Green Lines of the CTA (Figure 3). The Green Line runs east west through the northern part of the area but the Blue Line is found in three different areas. It cuts the northeastern corner and also has two branches on west side, the Forest Park Branch and the Cermak Branch. Eleven east-west bus lines and five north-south lines also service the area. The area is well served by public transit.

3.3.1 Area D Regression Model: Off-peak Transit Trips

In Area D the number of household vehicles again plays a major role in accounting for the variation in off-peak transit use, however, the number of Latinos in many cases is more important. Four of the six zones, from the top of Table 5, have larger values for LATINO than for NOVEH. This underscores the importance of the interdependence of this population and off-peak transit use.

In the use of off-peak transit, the product term of employment times population, POPEMP, is not very important. Transit is a long-distance mode and local employment does not substantially add to the number of off-peak transit users.

3.3.2 Area D Regression Model: Walking Trips

This study area has far more walking trips than Area C but less than Area B. It is also an area with substantial internal variation. Some zones are sparsely populated and there is little walking activity of any kind. Except during United Center events, the home arena for both the Chicago Bulls and Black Hawks, there is little walking activity.

The four most important variables are again the same, POPEMP, COLLEGE, WORK2 and GOVERN (Table 6). Each of these four variables, however, is the most important in at least one zone. *This suggests that the study area is very diverse and characteristics*

Table 5
Regression Model Estimates and Contributions by Each Independent Variable

			CASE STUDY AREA D: OFF-PEAK PUBLIC TRANSIT TRIPS													
CATS ID	TOTAL	PUBTRNT	PREDICTED	RESIDUAL	LATINO	BLACK	AGE	NO VEH	MANYVEH	EXEC	EARLY	PEF	POPEMP	POWER	POSTMORN	SINGLE
14113922	2402	237	264.0	-27.0	108.8	1.8	-12.8	88.5	-7.3	16.1	75.4	-1.1	-6.1	4.9	6.7	-9.3
14113941	3671	695	449.1	245.9	184.8	0.5	-19.2	122.8	-10.2	11.3	158.2	-1.4	-3.3	6.9	5.5	-5.4
14113942	190	28	44.2	-16.2	0.0	17.8	-1.5	25.2	-1.3	1.5	6.8	-1.5	-1.4	0.1	0.4	-0.4
14113951	1134	140	94.1	45.9	35.5	6.4	-7.2	25.5	-4.1	13.0	33.4	-1.5	-5.5	3.1	1.4	-4.7
14113952	515	127	205.7	-78.7	1.9	63.8	-4.7	135.8	-1.8	2.8	11.1	-1.6	-1.2	0.5	2.1	-1.6
14113971	181	8	102.5	-94.5	0.2	40.1	-4.0	66.8	0.0	1.1	4.7	-1.6	-2.6	0.2	0.0	-1.1
14113972	1826	254	181.9	72.1	58.0	0.8	-8.5	82.0	-6.1	10.8	51.8	-1.6	-5.4	3.2	6.7	-8.4
14123922	538	67	54.8	12.2	25.7	0.0	-3.3	13.5	-3.2	3.3	21.9	-1.1	-2.0	0.3	1.9	-0.8
14123941	3587	539	428.8	110.2	197.4	0.0	-20.3	128.2	-12.2	9.5	125.5	-1.3	-6.7	5.5	7.9	-3.3
14123951	437	31	-1.0	32.0	2.7	8.1	-7.0	7.8	0.0	7.0	0.0	-1.4	-19.9	1.6	3.1	-1.5
14123952	504	52	138.9	-86.9	0.6	33.8	-3.2	113.3	-1.4	7.1	6.5	-1.5	-14.7	0.8	2.8	-3.7
14123971	386	34	137.9	-103.9	0.0	61.5	-4.4	78.9	0.0	2.7	3.8	-1.7	-2.9	0.5	1.7	-0.8
14123972	1693	216	217.3	-1.3	94.2	5.8	-11.4	75.9	-5.8	7.2	62.9	-1.7	-7.7	3.1	2.8	-6.6
14213922	37	0	-2.7	2.7	0.0	0.0	-0.2	0.0	0.0	0.2	0.0	-1.2	-0.1	0.0	0.0	0.0
14213941	3379	405	426.5	-21.5	199.6	0.6	-19.9	137.8	-5.2	11.7	109.9	-1.3	-11.4	6.9	8.3	-9.1
14213942	372	101	311.1	-210.1	0.2	113.1	-8.1	203.4	0.0	1.7	5.8	-1.5	-1.8	0.5	0.7	-1.5
14213951	2826	298	395.5	-97.5	13.1	74.9	-17.9	222.2	-4.1	56.0	35.4	-1.4	-1.9	31.9	9.1	-20.4
14213952	554	52	78.2	-26.2	2.5	18.7	-3.6	55.2	-2.5	6.6	10.7	-1.6	-4.1	0.8	0.7	-4.0
14213971	97	6	3.1	2.9	0.0	2.0	-0.6	3.3	0.0	2.0	0.3	-1.9	-0.5	0.0	0.0	-0.2
14213972	2495	371	280.9	90.1	89.4	4.8	-11.9	122.5	-6.1	12.7	77.8	-1.9	-7.3	6.3	7.0	-11.2
14223922	80	0	0.1	-0.1	0.7	0.0	-0.2	0.0	0.0	0.7	0.0	-1.4	-0.1	0.0	1.7	0.0
14223941	2820	272	357.7	-85.7	153.8	5.9	-15.2	107.8	-3.7	11.6	103.6	-1.3	-7.1	5.2	4.4	-5.9
14223942	288	49	137.4	-88.4	0.8	56.6	-3.7	85.4	0.0	0.7	3.7	-1.4	-3.6	0.1	0.3	0.0
14223951	1577	120	80.9	39.1	8.2	6.8	-8.2	41.9	-3.2	27.8	6.8	-1.4	-13.2	7.0	14.8	-7.2
14223952	464	65	27.3	37.7	1.8	9.0	-2.9	6.1	0.0	11.9	11.4	-1.6	-4.3	1.3	1.5	-5.4
14223971	94	0	-1.0	1.0	0.0	2.7	-0.8	0.9	0.0	1.1	0.0	-2.0	-0.8	0.0	0.0	-0.7
14223972	897	165	59.4	105.6	14.4	8.4	-5.5	24.2	-0.6	8.5	19.8	-1.9	-4.7	2.0	2.6	-6.5

Table 6

Regression Model Estimates and Contributions by Each Independent Variable

			CASE STUDY AREA D: WALKING TRIPS										
CATS ID	TOTAL	WALK	PREDICTED	RESIDUAL	BLACK	MANYVEH	UNIT	POPEMP	COLLEGE	WORK2	GOVERN	SELF	SINGLE
14113922	2402	294	169.1	124.9	-0.5	-8.2	-8.7	58.6	38.9	44.1	40.7	8.4	-5.2
14113941	3671	253	152.9	100.1	-0.2	-11.4	-9.9	31.9	42.0	67.7	22.5	12.3	-3.0
14113942	190	0	17.6	-17.6	-5.9	-1.5	-3.9	13.3	2.0	2.7	10.1	0.0	-0.2
14113951	1134	109	134.3	-25.3	-2.1	-4.6	-6.3	52.7	38.9	20.4	31.8	5.2	-2.6
14113952	515	28	33.0	-5.0	-21.4	-2.0	-10.5	11.8	22.2	6.1	25.6	1.0	-0.9
14113971	181	9	31.0	-22.0	-13.5	0.0	-1.8	24.7	10.1	2.0	9.1	0.0	-0.6
14113972	1826	163	113.7	49.3	-0.3	-6.8	-7.8	52.2	26.2	27.9	20.8	5.1	-4.6
14123922	538	38	39.3	-1.3	0.0	-3.6	-3.2	19.3	5.2	11.4	6.8	2.8	-0.4
14123941	3587	213	192.5	20.5	0.0	-13.8	-5.1	63.9	47.4	64.3	30.0	6.7	-1.8
14123951	437	266	312.4	-46.4	-2.7	0.0	0.0	191.1	105.9	0.3	17.6	0.0	-0.8
14123952	504	168	175.4	-7.4	-11.3	-1.6	-1.7	140.7	11.3	7.8	31.3	0.0	-2.1
14123971	386	26	40.3	-14.3	-20.6	0.0	-6.0	27.6	13.3	6.8	18.6	0.0	-0.4
14123972	1693	218	136.7	81.3	-1.9	-6.5	-5.8	73.8	25.1	28.5	19.6	6.5	-3.7
14213922	37	0	4.4	-4.4	0.0	0.0	-1.0	1.4	1.5	0.6	0.9	0.0	0.0
14213941	3379	454	249.3	204.7	-0.2	-5.9	-5.0	109.0	52.7	53.1	31.9	17.7	-5.0
14213942	372	42	-8.7	50.7	-38.0	0.0	-31.7	16.9	13.8	2.9	27.2	0.0	-0.9
14213951	2826	713	294.2	418.8	-25.1	-4.6	-25.3	18.5	138.4	51.1	143.2	8.3	-11.3
14213952	554	124	91.1	32.9	-6.3	-2.8	-3.1	39.1	31.1	6.6	26.7	1.0	-2.2
14213971	97	12	11.3	0.7	-0.7	0.0	-0.3	4.5	0.0	2.2	1.4	3.3	-0.1
14213972	2495	273	144.4	128.6	-1.6	-6.8	-5.2	69.5	25.0	42.9	20.1	5.7	-6.2
14223922	80	0	8.6	-8.6	0.0	0.0	-0.9	0.7	3.8	2.3	0.9	0.8	0.0
14223941	2820	262	212.7	49.4	-2.0	-4.2	-5.6	67.8	51.7	56.0	39.8	11.3	-3.3
14223942	288	39	50.0	-11.0	-19.0	0.0	-2.1	34.7	14.2	4.0	17.1	0.0	0.0
14223951	1577	559	355.2	203.8	-2.3	-3.6	-9.0	126.2	165.7	23.1	54.9	3.3	-4.0
14223952	464	215	51.3	163.7	-3.0	0.0	0.0	41.4	6.6	3.3	5.0	0.0	-3.0
14223971	94	71	9.9	61.1	-0.9	0.0	0.0	7.6	0.0	0.4	0.0	2.2	-0.4
14223972	897	76	95.6	-19.6	-2.8	-0.6	-1.4	44.9	21.5	16.9	18.1	1.7	-3.6

change substantially between zones. For example, with a value of 67.7, the number of multiworker households, WORK2, is the most important for Line 2, CATS ID 14113941; this is also true for the adjacent Zone 14123941. Conversely, the number of college enrollees is the most important for Zone 14213951, with a contribution of 138.4.

3.3.3 Off-peak Transit Trips

The northern part of the study area is a mixed land-use community with old warehouses, light industry and residence scattered through. Currently there is loft conversion activity. Between Kinzie and Chicago Avenues there are positive residuals but there are also two high negative residuals just south of Kinzie (Figure 8). The irregular nature of the land uses seems to account for the major differences in the residuals in the northern part of this study area. The drive through the area did not prove to be fruitful in identifying the variations in off-peak transit use.

3.3.4 Walking Trips

There are two factors that contribute to the high levels of walking in this study area. First, the University of Illinois at Chicago and the ancillary health-care facilities contribute to the highest positive residual in the study areas (+419, Figure 9).

Second, the Pilsen Latino area shows signs of being a partially self-contained community southwest of the Chicago downtown (see Figure 5 in Chapter 2). There are a large number of Latinos in this area and many work, shop and conduct their daily activities in the community. This is particularly evident in some of the zones in the southern portion of Figure 9.

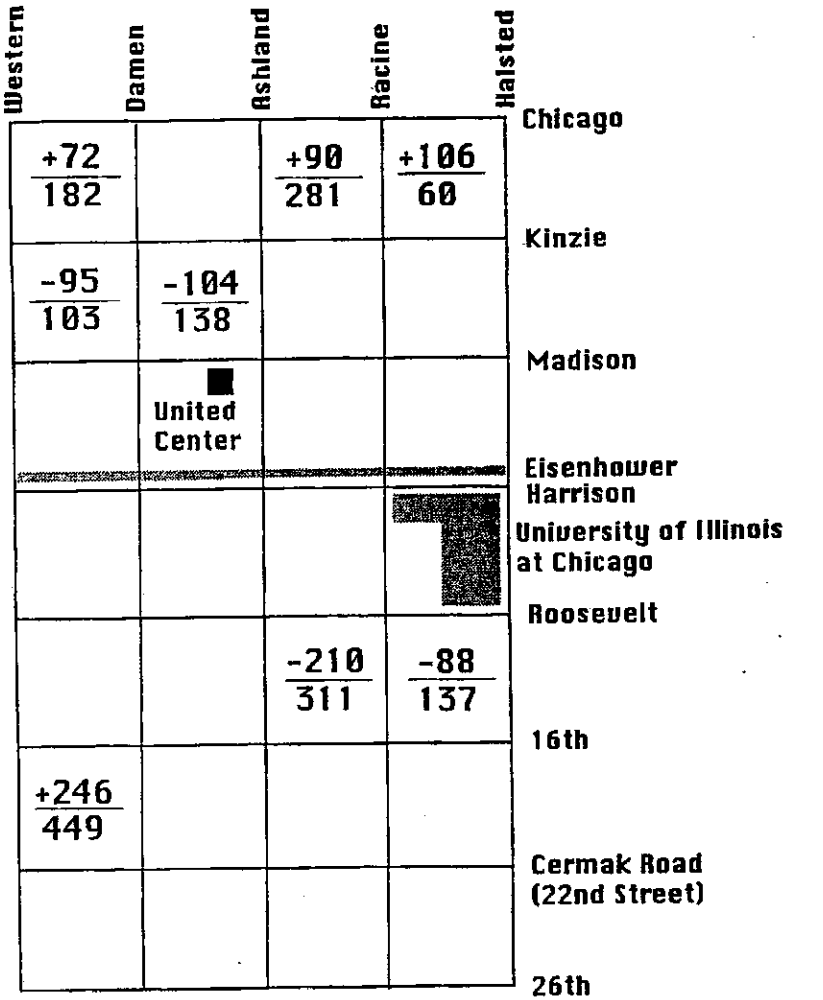
4.0 Summary

The examination of the three study areas indicates that they are very different communities and they have varying socioeconomic conditions and travel behavior. Table 7 summarizes the most important contributors to the estimates of walking and off-peak transit use in the three study areas. Two conclusions emerge. First, the walking model is more complex and more variables are necessary to describe the largest variations in the walking estimates. Second, NOVEH dominates the off-peak transit model and while POPEMP is important in all walking study areas, it is not the most important in all three.

It is quite likely that walking to the home of friends and relatives may be hard to encourage. Walking to jobs, shops and other businesses, however, seems to be a matter of land use and the economic status of the population. In several of the areas studied the amount of foot traffic was certainly a function of population density. Equally important was the number of businesses in and near the neighborhood and the level of prosperity of the population. This may not be a linear relationship (this is beyond the scope of this

Figure 8

HIGH POSITIVE AND NEGATIVE RESIDUALS
Area D: Off-Peak Transit Trips

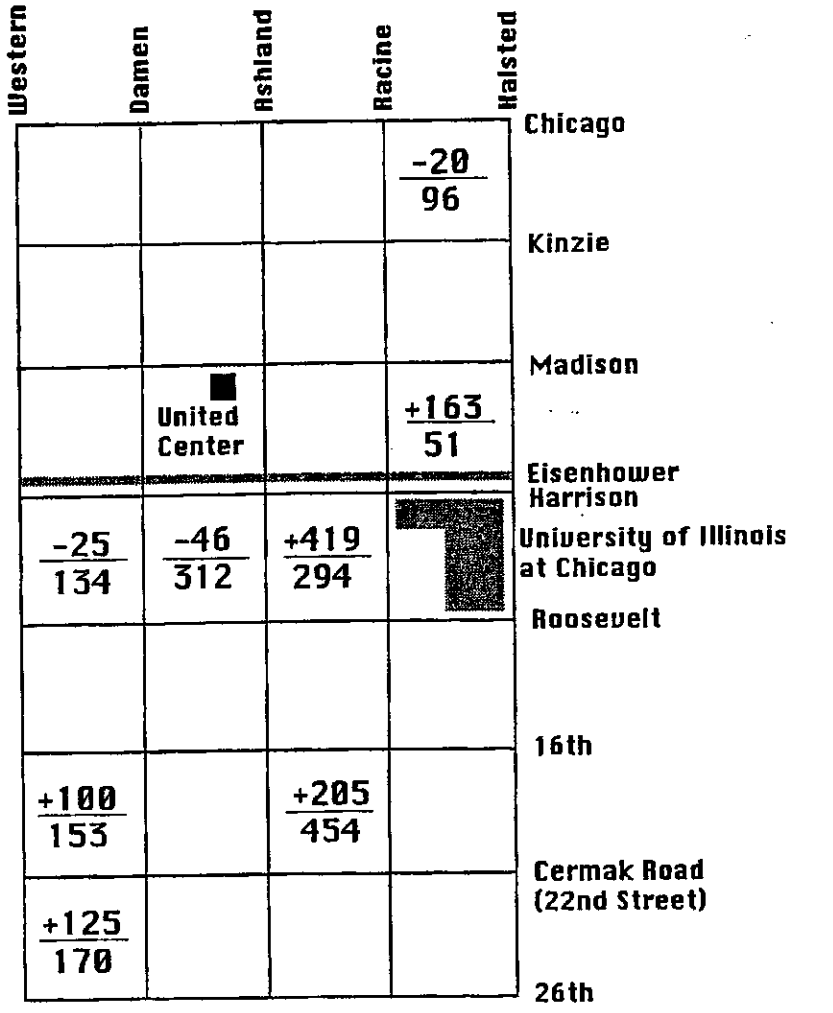


Legend:

residual / predicted Residuals + Predicted = actual number of trips

Figure 9

HIGH POSITIVE AND NEGATIVE RESIDUALS
Area D: Walking Trips



Legend:

residual / predicted Residuals + Predicted = actual number of trips

study), however in the lower profile of the economic spectrum it appeared that walking is related to the economic viability of the residents and the size of the commercial community serving the neighborhood.

Table 7

Major Contributors to Mode Use
By Study Area
(in order of importance)

Study Area	Walking	Off-peak Transit
B	POPEMP WORK2 COLLEGE GOVERN	NOVEH AGE*EXEC*PEF EXEC BLACK
C	BLACK** GOVERN POPEMP COLLEGE WORK2	NOVEH BLACK
D	POPEMP COLLEGE WORK2 GOVERN	NOVEH LATINO

** Negative relationship, all others are positive

Off-peak public transit use is more difficult to observe in the field, but the data suggest that at least for work trips two relationships seem to hold:

- proportionately few off-peak trips occur in middle and upper income neighborhoods, and
- within the minority community the use of off-peak transit seems to be a function of economic prosperity of the population and the businesses in the immediate area.

While this study concentrates on walking and off-peak transit trips to work, the factors contributing to work trips also contribute to other trip purposes by these two modes. Improving the supply and physical facilities for the use of these modes seems important but economic livelihoods of the population appears to be a very important element.

Chapter Eight

Time Profiles of Four Nonmotorized Modes of Travel on the Chicago Lakefront

1.0 Introduction

Chicago was settled along the shore of Lake Michigan, utilizing the body of water as a lifeline to the rest of the world. Today the lake may have lost some of its strength as a commercial focal point, but it has only increased in value as a social and recreational destination. With high population densities in close proximity, the lakefront has been set aside as a refuge for Chicagoans, even if only for a few hours. Every day, thousands gather along the narrow strip of shoreline for the opportunity to travel miles along the scenic lakefront without the interruption of motorized vehicles.

The purpose of this chapter is to study nonmotorized traffic patterns on the Chicago lakefront on a day during the week and on a weekend to draw comparisons between these two days. Specifically, (1) walking, (2) running, (3) bicycling, and (4) skating were monitored along Lake Michigan. The use of all four modes in relationship to time of week and time of day was studied, as were gender differences. Lakefront congestion was also observed.

The lakefront provides a unique opportunity to study nonmotorized traffic. No other area in the city is defined for many miles as a no-auto zone open to the public and offering so many different paths to travel. The lakefront presents a rare opportunity to observe the nonmotorized traffic that exists in this "test-tube" kind of environment. Studies like the one presented here allow us to understand the growing importance of nonmotorized transit.

While all four modes of travel may be forms of recreation, walking and biking are more likely to be chosen as a means of transportation. Running is usually part of an exercise program and skating is typically a recreational and fitness activity and both are less likely to be a means of conveyance.

The study finds that nonmotorized traffic on the lakefront follows a strong pattern based on mode, time of day, time of week, and gender. Biking tends to have the highest volumes, dominating weekday travel. Bikers are out in greatest numbers in the early

hours, with decreases after rush hour. Walking is next in volume, growing steadily throughout the day and peaking in the afternoon. On weekends walking surpasses biking in volume later in the day.

Running is an early morning activity both weekdays and weekends. Runners even outnumber walkers early Friday, the only instance this happens. By contrast, skating has very low participation in the morning, rising after noon both Friday and Saturday. Skating is also the only mode in which men did not outnumber women on both days; there were more female skaters on Friday than male skaters.

The chapter begins with an examination of time profiles of the individual modes. These profiles portray the percentages of the total daily traffic for that mode during short time intervals. Both Friday and Saturday counts are discussed. This is followed by an examination of time profiles of the total daily volumes for all modes for both days. The effect of gender on mode choice is then presented, and the idea of lakefront congestion is discussed. A conclusion section closes the chapter.

2.0 Data Collection

Data collection took place at two separate points along the lakefront path. The first area, at Lake Shore Drive and North Avenue in Lincoln Park, was monitored on a Friday. The second area was monitored on a Saturday between Lake Shore Drive and the Chicago Yacht Club at Monroe Street. While the points are both part of the lakefront path system and are located approximately only a mile apart, the two locations are very different. The North Avenue study point is in close proximity to a dense residential area while the Yacht Club is just east of the Loop. The North Avenue location is adjacent to a heavily visited beach while the Yacht Club is at the center of a large harbor. These locational differences will be taken into consideration throughout the study.

The Yacht Club site has a set of two paths, allowing higher volumes of travel through this area. Both paths were counted and totaled for our study. The observations took place during sunny August days with temperatures near 80 degrees. The weather was nice but not unusual for that time of the year.

The studies range from 8:15 a.m. to 4:15 p.m. and are divided into fifteen-minute intervals. Observations were made during five- and six-hour periods for maximum returns, 8:15 a.m. to 2:30 p.m. on Friday and 10 a.m. to 5 p.m. on Saturday. The data sets share a four-and-a-half hour period from 10 a.m. to 2:30 p.m. that will be used in later comparisons.

Four types of nonmotorized traffic were monitored: walking, bicycling, running, and skating. Traffic moving in both directions was counted and summed for a total figure for

each interval. It is important to note that total volumes for a mode do not necessarily represent the total number of people using that mode since return trips may also be counted. The counts also recorded gender for all modes. Consequently, there were eight different numbers recorded during each fifteen-minute period.

3.0 Proportion of Daily Traffic

3.1 Walking

3.1.1 Friday (Lincoln Park)

Figure 1 shows a steady increase in walking as a percentage of daily traffic between 8:15 a.m. and 2:30 p.m. The six-hour-plus time period contains twenty-five 15-minute intervals, giving each 15-minute interval an average share of 4% of the observed total recorded traffic. Walking peaks at 12:15 with about 5.5 percent of the six-hour day. This is higher than the average share of 4 percent. High percentages between 12 and 2 p.m. most likely represent lunch-hour traffic spilling over from the Chicago CBD.

Even as Figure 1 shows a 2:1 ratio between the lowest percentage (2.5) and the highest (just over 5) and while walking increases steadily throughout the day, the total increase is less impressive when compared to other profiles. The growth from 2.5 to 5 percent on Friday is small compared to the 1 to 7 percent walking increase of Saturday.

3.1.2 Saturday (Chicago Yacht Club)

As one might expect, the daily walking totals are markedly greater on Saturdays. However, as Figure 2 illustrates, daily percentages for Saturday were lower than those of the same period on Friday. Since the Saturday volumes are higher, the lower percentage in the early morning only indicates that the number of pedestrians during this time of day are roughly equivalent and do not vary substantially between weekday and weekend.

Saturday seems to conform to the pattern found in many shopping areas where pedestrian traffic volumes are low in the early morning but build steadily during the day. While Friday walking traffic accounts for 3 percent of the total at 10 a.m., the same period Saturday is only marginally greater than 1 percent. Figure 2 illustrates a continued increase in walking as a part of late afternoon lakefront traffic, still climbing at 4:30. This steady rise indicates that walking is a popular activity late into the afternoon, while the weather is nice.

Figure 1

Walk Traffic Profile in Lincoln Park (Lake Shore) at North Ave.

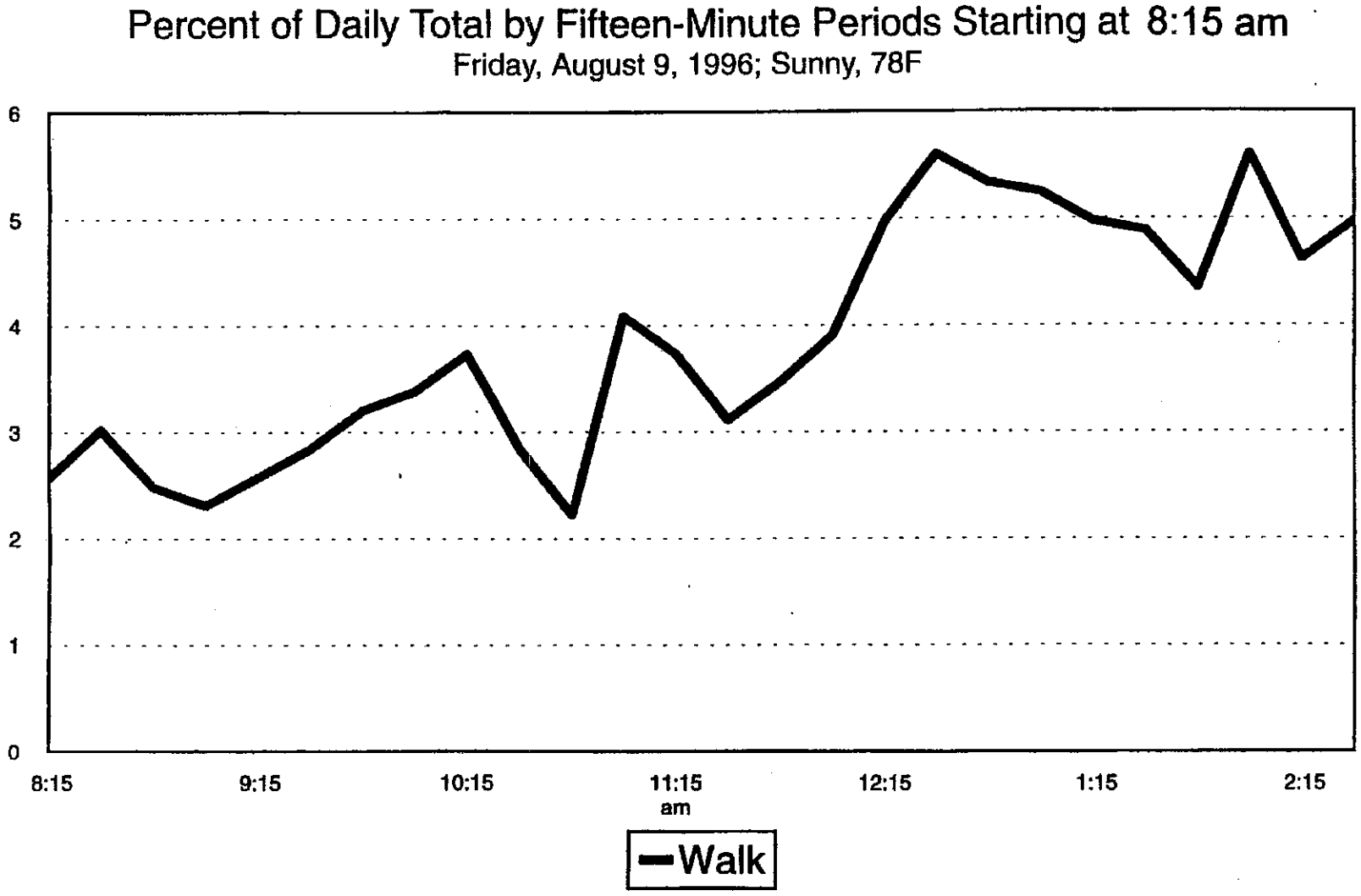
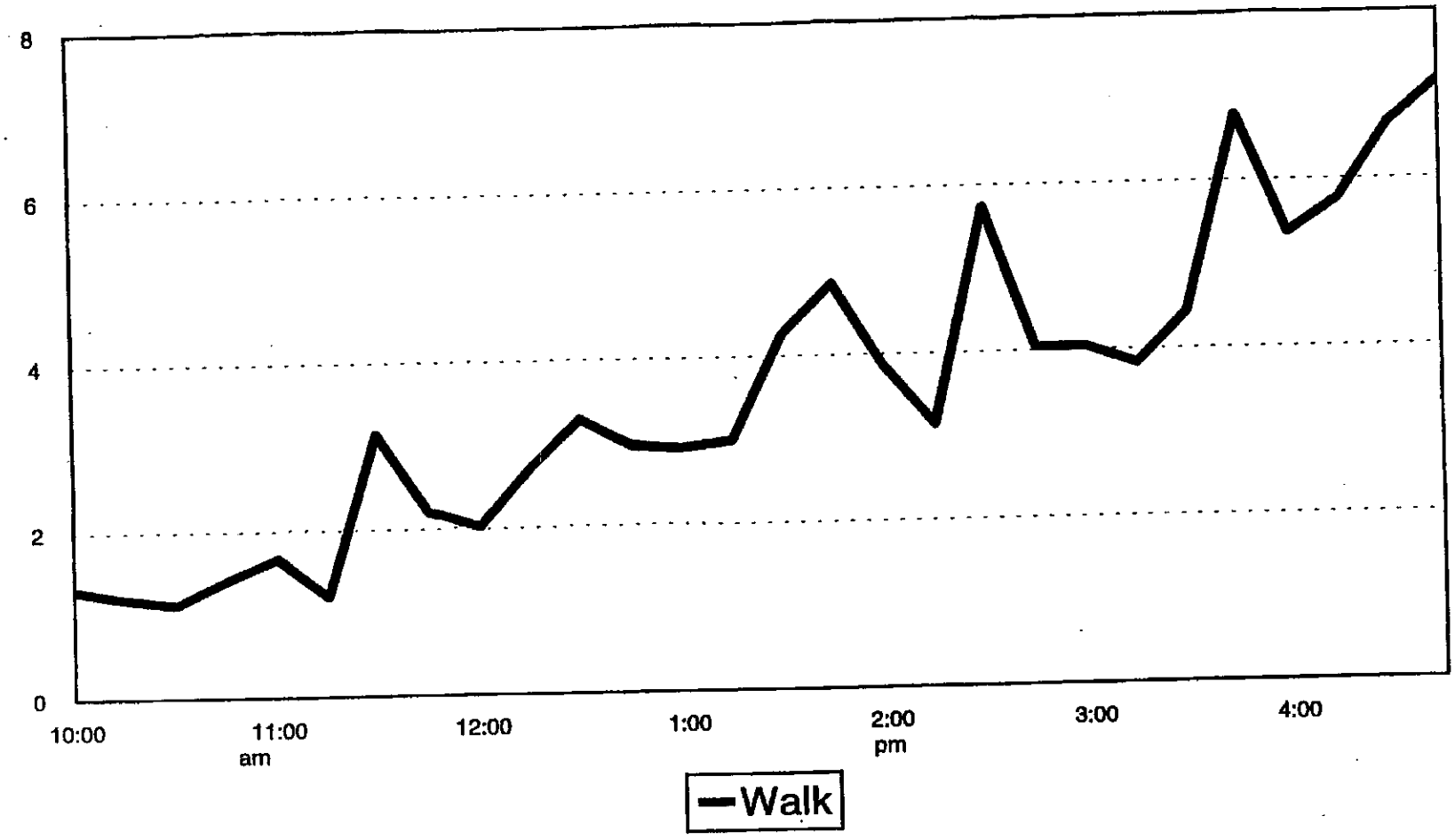


Figure 2

Walk Traffic Profile in Front of Chicago Yacht Club*

Percent of Daily Total by Fifteen-Minute Periods Starting at 10 am

Saturday, August 17, 1996; Sunny, 78F



*Between Chicago Yacht Club and Lake Shore Dr. at Monroe St.

3.2 Biking

3.2.1 Friday

Even early in the morning, fifteen-minute periods account for over 4 percent of the Friday bicycling traffic (Figure 3). This is a great contrast to the small number of morning walkers. The bicycling numbers quickly decline, staying relatively low until about 11 a.m. when numbers reach about 120 per interval. The period after 12 seems to be the most intense for bicycling, plateauing at around 5 percent. The correlation with the morning-motorized traffic seems to suggest that many of the bicyclists are commuting to work.

3.2.2 Saturday

Lakefront bicycle trips are more constant on Saturdays but still show rising numbers through the day. Small peaks form between 1 and 2 p.m. but then taper off until 4 p.m. (Figure 4). This is the time that the day's high point of over 5 percent is reached.

It is interesting to note that while Saturday's total bicycling volume is higher, the percentage of daily traffic is higher for similar periods on Friday. This may reflect the practicality of bicycle use on workdays.

3.3 Running

3.3.1 Friday

Running has the highest percentage of daily total traffic throughout the early morning until 10 a.m., reaching up to 5 percent (Figure 5). The period between 10 and 11:30 a.m. shows a fairly evenly distributed mix of modes, none falling below 2.5 percent or reaching 4.5 percent.

Running reaches its peak around noon with over 6.5 percent of the daily total. The figures quickly diminish after 1 p.m. as other modes gain in numbers. The noontime peak with an average of 37 runners per interval, could possibly represent dedicated lunch-hour athletes from Loop offices.

3.3.2 Saturday

Figure 6 shows the intensity of lakefront running on Saturday morning in comparison to other nonmotorized modes. Peaking at over 9 percent by 10:30 a.m., running declines steadily until 2 p.m. After this period running sees only small percentages and is overshadowed by increases in walking and skating. As an activity that is physically

Figure 3

Bicycle Traffic Profile in Front of Lake Shore at North Ave.

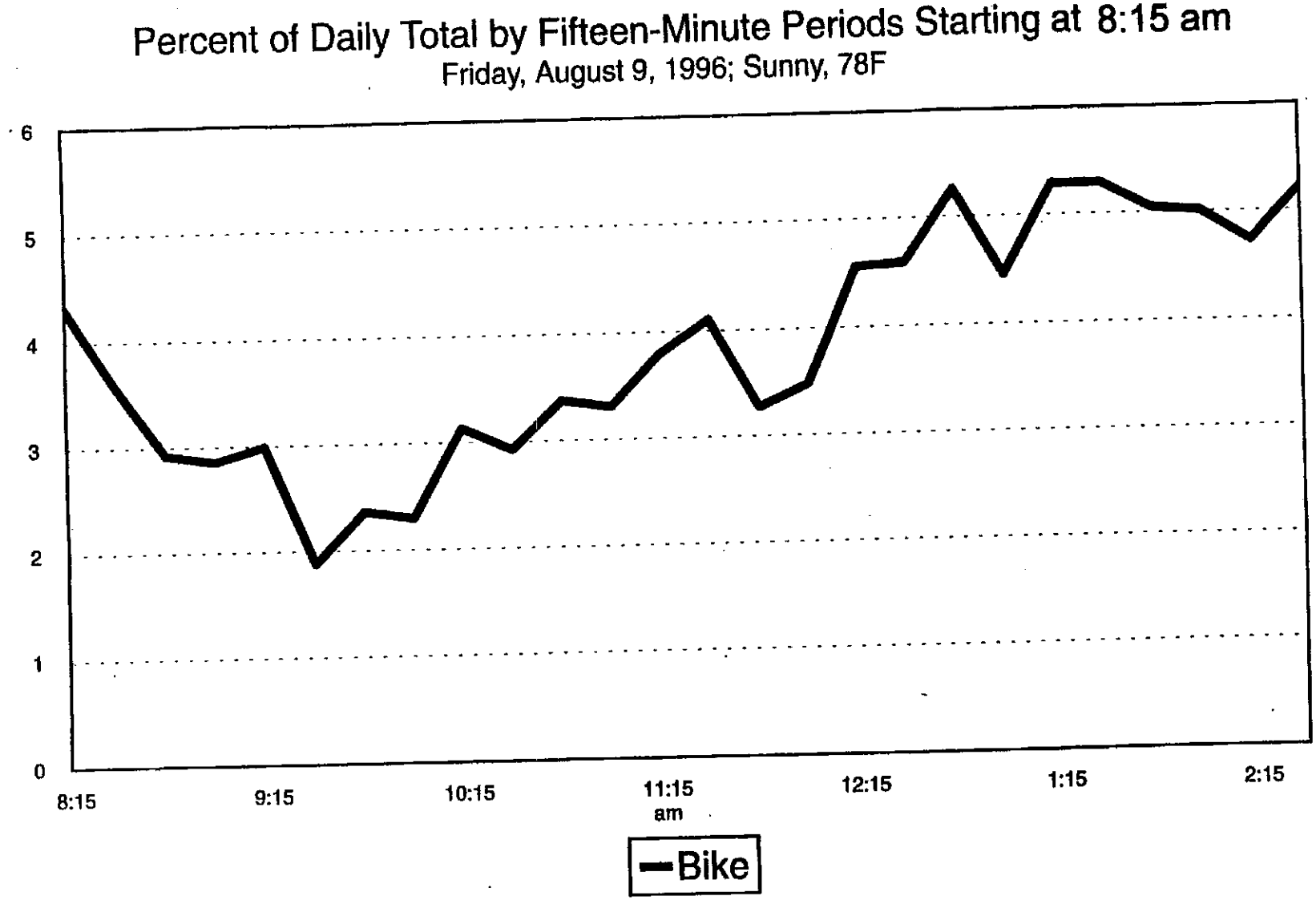
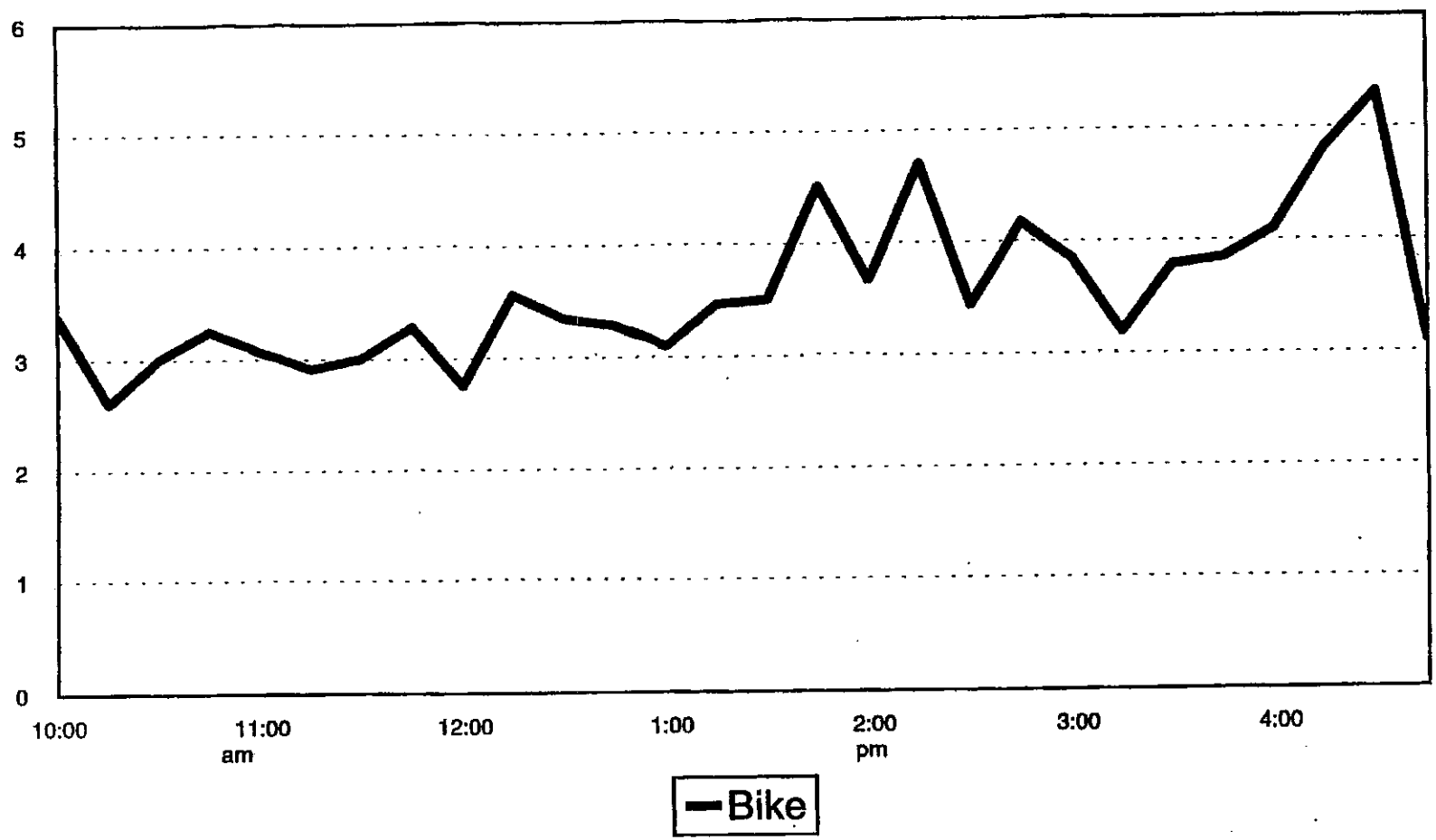


Figure 4

Bicycle Traffic Profile in Front of Chicago Yacht Club*

Percent of Daily Total by Fifteen-Minute Periods Starting at 10 am

Saturday, August 17, 1996; Sunny, 78F



*Between Chicago Yacht Club and Lake Shore Dr. at Monroe St.

Figure 5

Traffic Profile in Lincoln Park (Lake Shore) at North Ave.

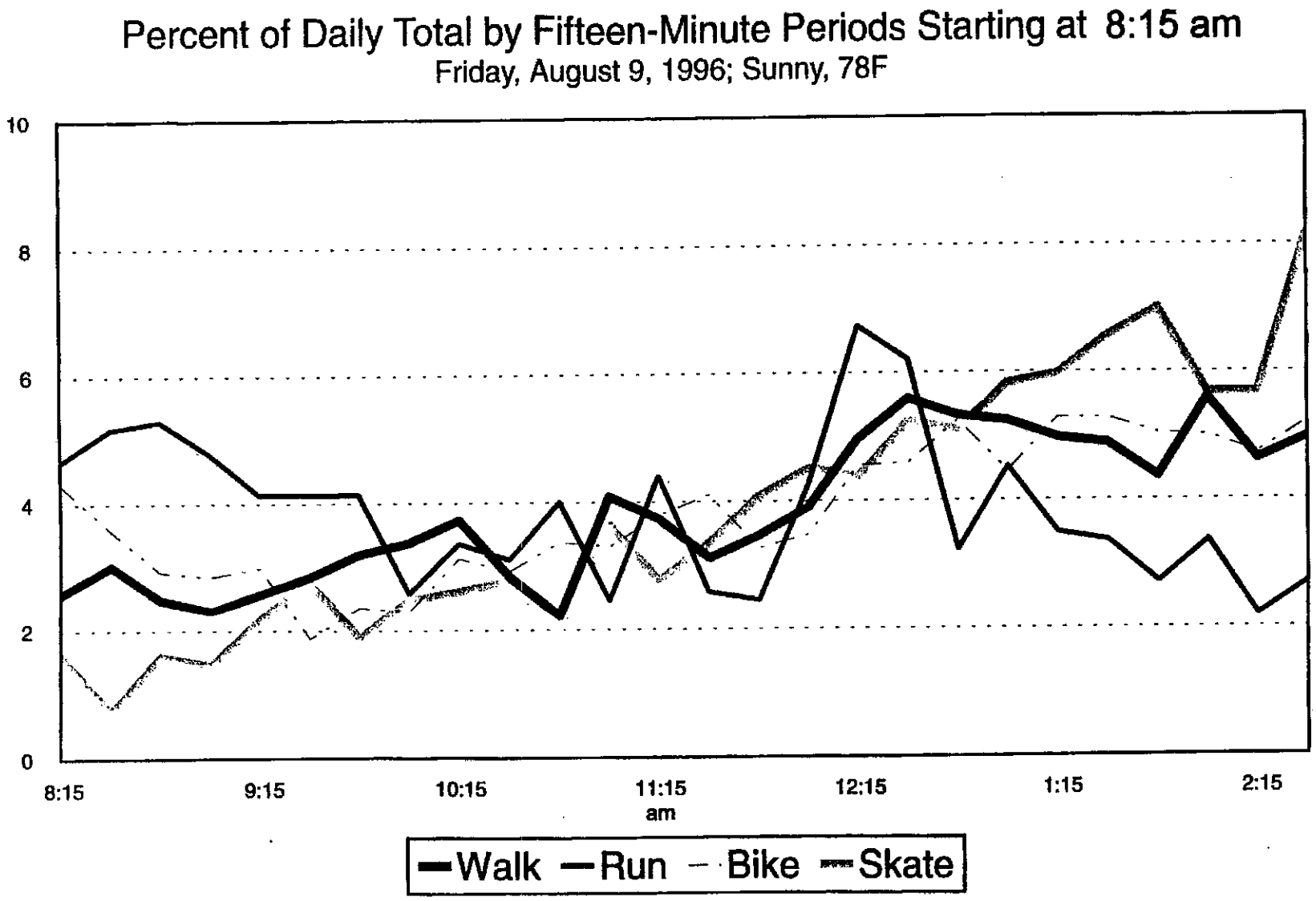
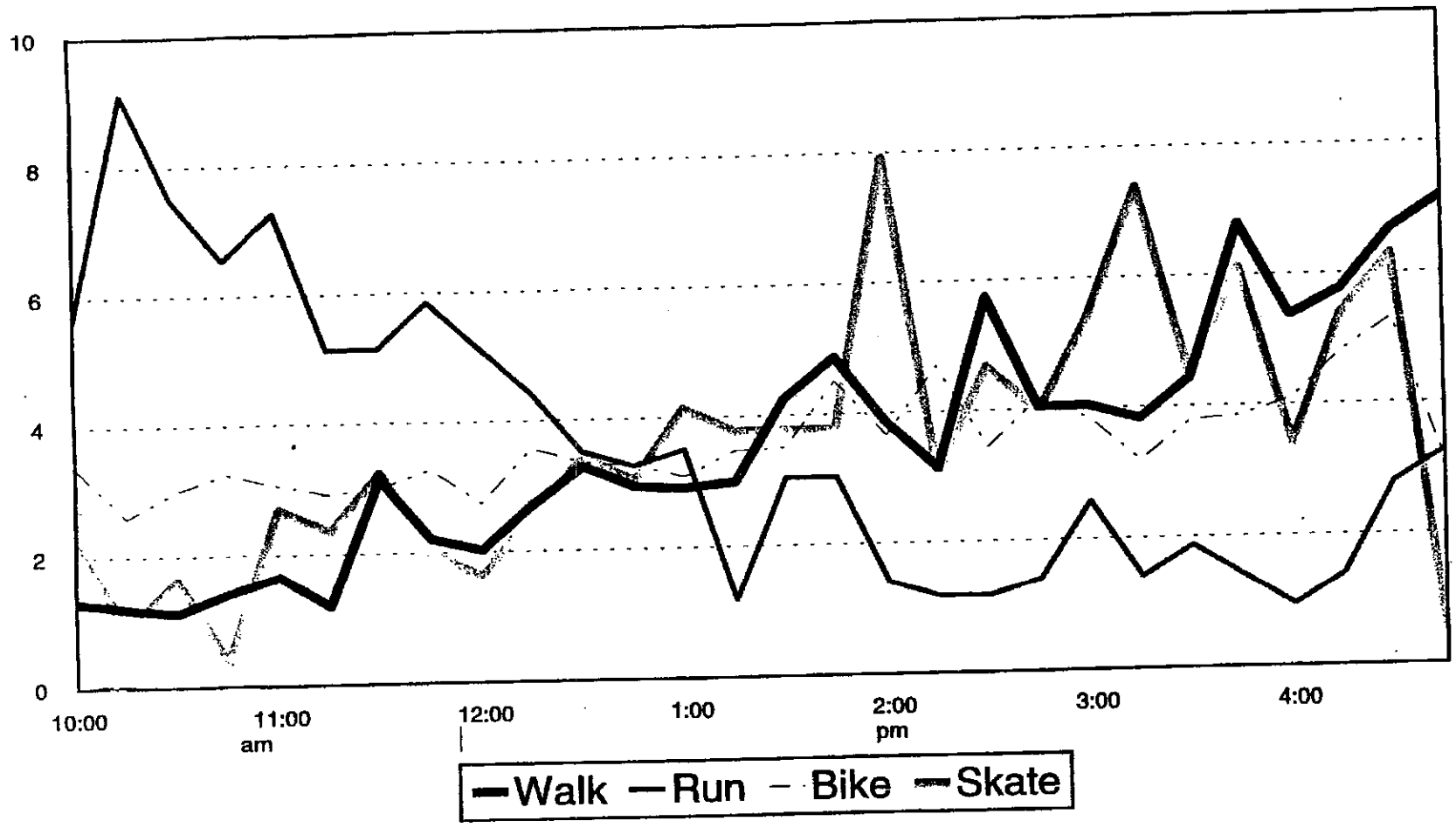


Figure 6

Traffic Profile in Front of Chicago Yacht Club*

Percent of Daily Total by Fifteen-Minute Periods Starting at 10 am

Saturday, August 17, 1996; Sunny, 78F



*Between Chicago Yacht Club and Lake Shore Dr. at Monroe St.

intense, running is more temperature sensitive and therefore the peak occurs in the morning.

3.4 Skating

3.4.1 Friday

Skating is predominantly an afternoon activity on Chicago's lakefront. Figure 5 shows daily percentages hovering around 2 percent before 10 a.m. and below 4 percent until after 12 p.m. After this period increases are dramatic, jumping to 6 percent at 1 p.m. and peaking at over 8 percent after 2:15 p.m. with 39 skaters per interval. Some conclusions that can be drawn from these low volumes during the morning peak period are that skating is not a common mode for work trips nor does it draw early morning enthusiasts.

3.4.2 Saturday

Skating seems to have an even later start on Saturdays (Figure 6). While levels remain under 4 percent until 1 p.m., very irregular peaks of between 7 and 8 percent characterize 2 and 3 p.m. The high percentages continue until a sharp falling-off of skaters around 4:30. Only 10 skaters were present during the interval from 4:45-5:00 p.m. This profile characterizes skating as a leisure activity, practiced mainly during the late afternoon and declining quickly during the early evening.

4.0 Total Volumes

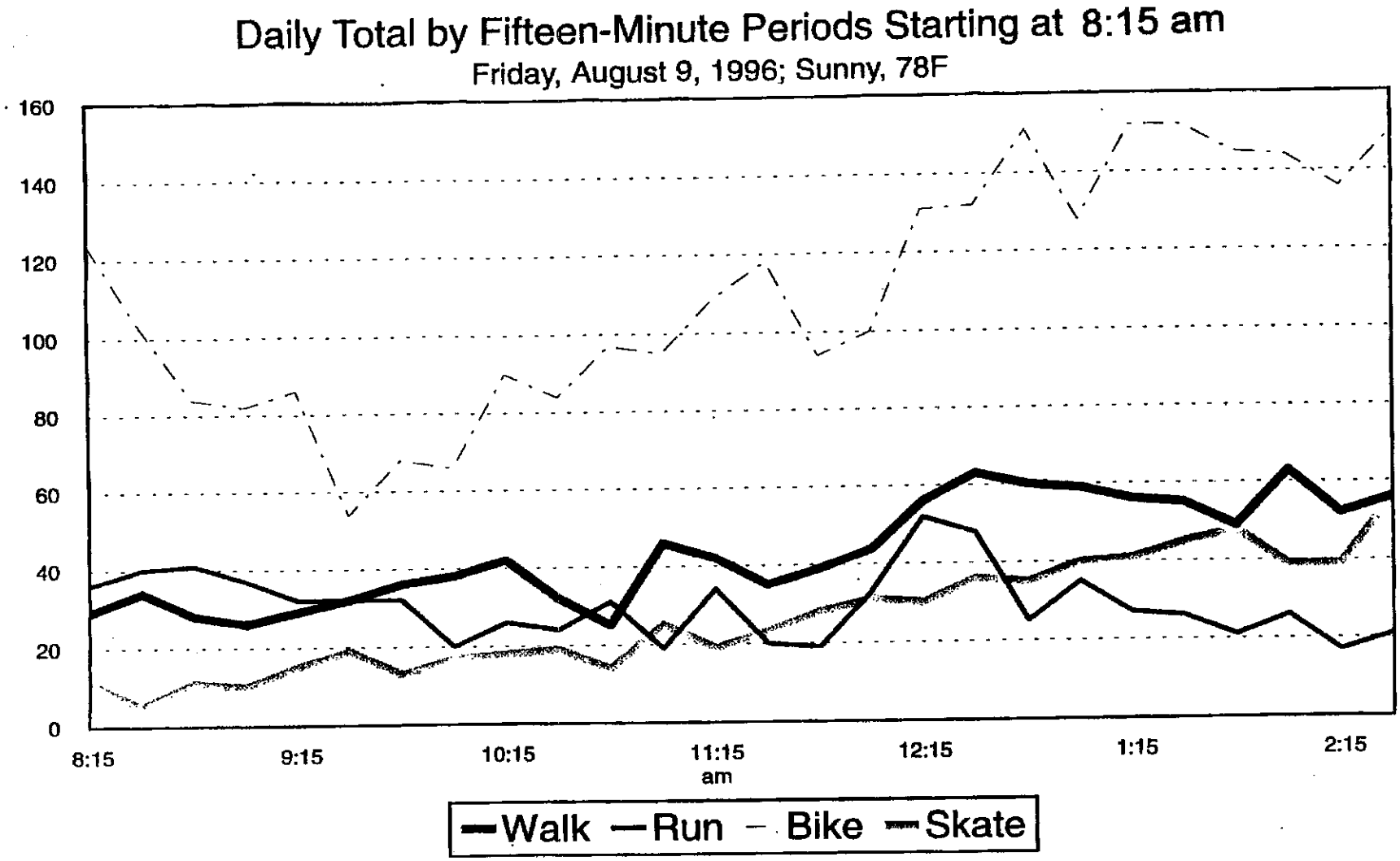
In this section we will move from percentages to the actual number of users during the same fifteen-minute periods. This provides a very different perspective to mode choice on the Chicago lakefront.

4.1 Friday

Figure 7 shows the great disparity between the number of bicycle trips and other nonmotorized modes used. Bicycles account for over 150 trips at the 1 p.m. interval peak, more than twice as many as the next-most chosen mode, walking (peaking at a little over 60 at 12:30 p.m.). At these rates an average of ten bicyclists per minute pass through the study area, or one every six seconds. Even at their lowest point of less than 60 at 9:30 a.m., bicycles register greater numbers than skating or running at their peaks. Again, the early morning bicyclists are large in number (over 120 at 8:15 a.m.) although many more bicyclists are present in the 12-12:30 period. Bicycling is definitely the mode of choice for many Chicagoans at the lakefront on Fridays.
The lunch-hour peak of 50-60 walkers per interval extends from 12 to 1:30 p.m. Runners begin the day at 40 per interval, but peak around 12:15 with 50. After 1 p.m. there are far

Figure 7

Traffic Profile in Lincoln Park (Lake Shore) at North Ave.



fewer runners than users of the other three modes. Skaters show very weak numbers (20 or less) until noon when they quickly overcome runners, reaching more than 50 at 2:30.

4.2 Saturday

Lakefront traffic patterns appear somewhat different for Saturdays. Figure 8 illustrates this change in bicycling choices. Between 10 a.m. and 1 p.m. bicyclists occur at about 100 per 15-minute interval. For the same period Friday a low of 80 and a high of 140 were reached. After 1 p.m. Saturday's bicycling numbers grow in small spurts, reaching only about 170 at the 4:30 peak.

The walking profile for Saturday is dramatically different than the weekday. A steady climb throughout the morning allows walkers to outnumber bicyclists by 2:30 (160 walkers) and peak with the highest overall count of almost 200, or about 13 per minute, with numbers still growing at 4:30 p.m. Saturday runners are fewer in number than those Friday. A very small peak occurs at about 40 participants at 10:15 a.m. A steady decline ensues, and by 2 p.m. very few runners remain. Not surprisingly, skaters are barely present before 1 p.m. on Saturday. Their numbers peak at around 2 p.m. with just under 50 per interval and remain about the same until 4:30 when they almost disappear.

5.0 Differences in Mode Use by Gender

Gender is another variable in the pattern of nonmotorized traffic along Lake Michigan. Table 1 shows total counts by sex for each mode for the shared period of 10:00 a.m. to 2:30 p.m. for both Friday and Saturday.

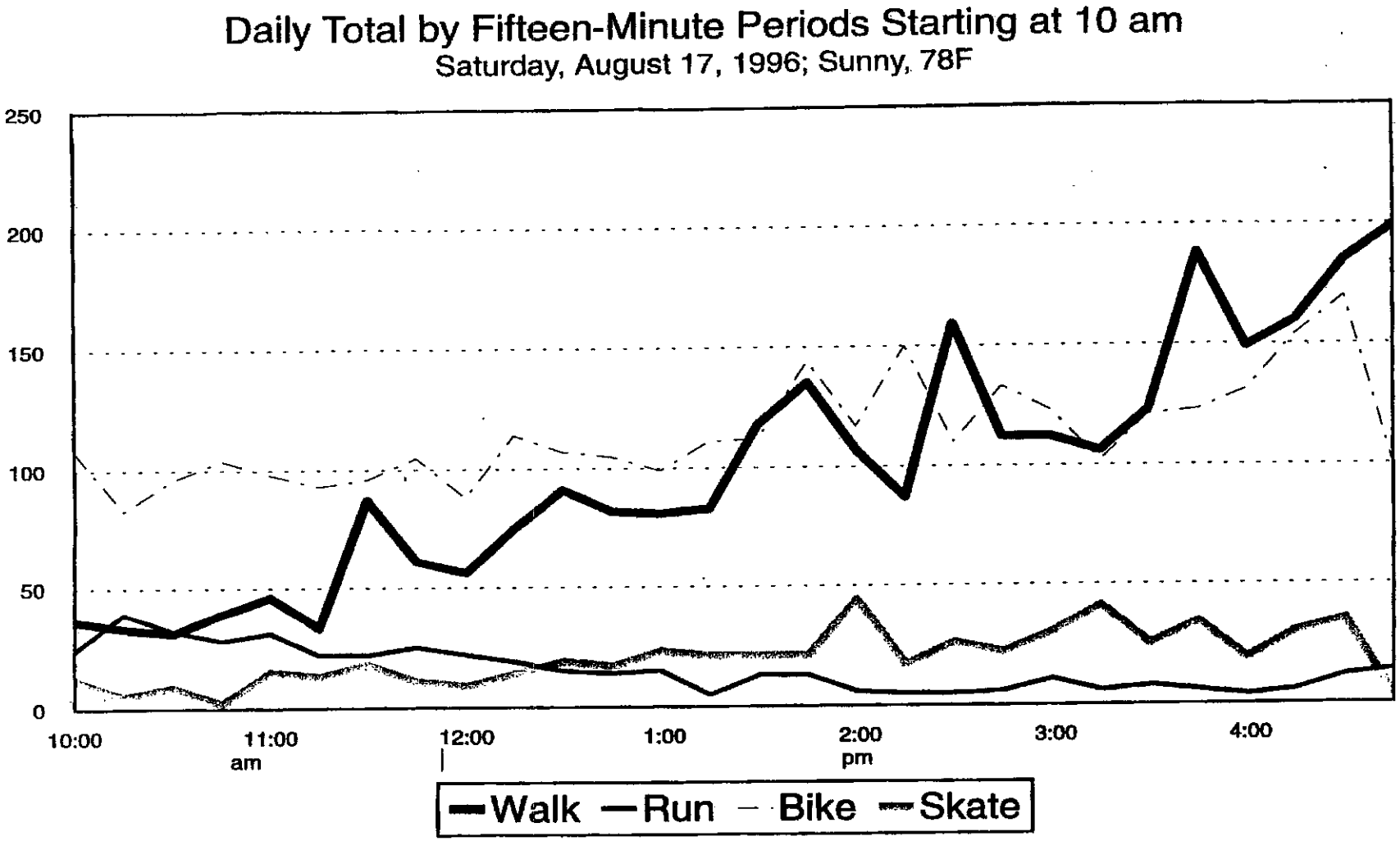
Men outnumber women in almost every mode on each day. The most notable difference occurs with bicycling. There are over 50 percent more male bikers than female on Friday and Saturday. Only 731 female bicyclists were counted on Friday in comparison with 1543 male. The male to female ratio on both Friday and Saturday was greater than 2:1.

Running has the second highest difference between genders. Friday saw 44 percent more male than female runners, and Saturday 29 percent more male runners. As Friday has a lunchtime running peak, it may be possible that women are less apt to run during work hours.

Skating is the only activity in which women surpass men in the number of participants. This only occurred on Friday, however, when 9 percent more skaters are female. On Saturday men again outnumber women, this time by 30 percent.
Walking is the most neutral of the nonmotorized traffic modes studied here. Men still had a higher turnout, but only by 15 percent on Friday and 9 percent on Saturday.

Figure 8

Traffic Profile in Front of Chicago Yacht Club*



*Between Chicago Yacht Club and Lake Shore Dr. at Monroe St.

Table 1

Mode Totals by Gender for Period 10:00 a.m. to 2:45 p.m., Friday, August 9, and Saturday, August 17

	Male	Female
Walk Friday	493	419
Walk Saturday	755	685
Bike Friday	1543	731
Bike Saturday	1381	659
Run Friday	335	189
Run Saturday	208	147
Skate Friday	288	**315**
Skate Saturday	186	131
TOTAL	**5189**	**3276**

6.0 Level of Service

Level of service in nonmotorized travel relates to the number of conflicts encountered. A conflict typically occurs when a traveler needs to stop, slow down or change course when encountering a slower traveler. When there are a large number of users on a relatively narrow path then the potential for conflict is great. This is important when assessing the adequacy of the lakefront path system. While we did not record information on conflicts, the number of users during a thirty-minute period provides some clues as to when the period of conflict might be the greatest.

Table 2 shows totals for all four modes by thirty-minute intervals for both Friday and Saturday. These figures represent the amount of traffic passing through the study area during these intervals.

Table 2

Totals for All Modes by Fifteen-Minute Intervals
for Friday, August 9, and Saturday, August 17, 1998
(larger number in bold-face type)

Interval	Friday Total	Saturday Total
10:00-10:30	337	**340**
10:30-11:00	326	**341**
11:00-11:30	**389**	350
11:30-12:00	376	**425**
12:00-12:30	**467**	397
12:30- 1:00	**517**	450
1:00- 1:30	**538**	448
1:30- 2:00	541	**577**
2:00- 2:30	516	**533**
Total	**4007**	3861

It is not surprising that the least congested periods are found in the morning hours. Before 11 a.m. the greatest level is less than 350 people per interval, or about 12 per minute. The early afternoon has a range of 397 people from 12:00-12:30 on Saturday to 577 people an hour and a half later when the most congested period was recorded. This is a rate of approximately 19 person per minute, with some spurts being considerably higher.

The difference in the total for all modes is minimal, 4007 on Friday versus 3861 on Saturday, for the hours presented here. These totals represent the sum of four very different means of using the lakefront paths, nevertheless they are very similar. The major difference in Table 2 is the sizeable Friday lunch period. The two-and-a-half hour lunch period with higher numbers encompasses an extended lunch period, from 11:00 a.m. to 1:30 p.m.

Congestion may have some effect on mode choice. The less congested morning hours have more runners, possibly due to the increased safety that seems to come with low

levels of other activity. Bikers and walkers have the option of leaving the path if traffic becomes too heavy, choosing instead the grass or sand shoulders. Skaters are forced to compete with other modes for space in heavily traveled areas.

7.0 Conclusions

This study focused on two aspects of mode use:

- what portion of the daily traffic occurred during which part of the day and
- how the volumes compared between the three modes.

The conclusions below reflect this two-part analysis.

7.1 Portion of the Daily Traffic

Nonmotorized lakefront traffic can be easily divided into four mode-use categories, each with a unique pattern for weekday and weekend.

- Walking occurs at a steadily increasing rate during weekdays and weekends, with a high portion of the weekend trips occurring in the late afternoon.

- Weekday bicycling reflects an early-morning commuting activity but it has higher numbers later in the afternoon. Bicycling on the weekend appears to increase more constantly throughout the day with peaks in late afternoon.

- Running showed substantial weekday and weekend differences. On the weekday there was only a minor early-morning surge with the dominant peak occurring during the lunch period. On the weekend the runners out in large number in the morning and some afternoon periods had only one-eighth the morning level.

- On both the weekday and the weekend day skating was largely an afternoon activity, although the weekend exhibited higher later-hour percentages.

7.2 Traffic Volumes

The total volume of lakefront traffic is astounding and reflects the demand for scenic auto-restricted areas in the city.

- The weekday showed an overwhelming number of bicycle trips, during some intervals more than double those of other modes. Walking was the

next-most chosen weekday mode, though still far less used than bicycling. Running and skating account for similar volumes of trips during the week, though they had very different peak periods. Runners were seen in the morning and skaters in the afternoon.

- Bicycling was very popular during the weekend. In the afternoon, however, the number of walkers often surpasses bikers. Skating and running again had similar levels of participants, with peaks at opposing extremes of the day.

The level of use was shown to increase throughout the day, with little variance between weekend and weekday. At times in the afternoon the paths became rather congested. The level of service and the number of conflicts need to be studied further, but preliminary observations show that a wider or second path would be useful during peak periods.

7.3 Gender Differences

Gender was also a factor in nonmotorized lakefront travel. With one exception men had dramatically higher uses of all modes on both days. Only Friday skating had more female than male participants and only by a relatively small amount. There were twice as many male bicyclists as female bicyclists on both days.

7.4 Summary

This study has illustrated the importance of nonmotorized travel along Lake Michigan. Walking, biking, running, and skating are all popular lakefront activities. Both the weekday and the weekend day exhibited high usage. There were more walkers on Saturday but more bicyclists on Friday. Runners appeared in the morning and skaters used the paths in the afternoon.

This preliminary study suggests an underlying regime in the use of the lakefront characterized by the four modes examined. In this chapter we have only observed the surface of a usage pattern that deserves considerably more study.

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