

# Highways and Urban Decentralization

## Final Report

by

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## Executive Summary

This report documents a retrospective study of the relationship between highways and urban decentralization. We see decentralization as caused largely by the increased consumption of land by residents and businesses which occurs mainly because of higher incomes making land more affordable.

While highways might have contributed to this effect by increasing accessibility, an empirical analysis conducted in this study did not reveal a relationship between the regionwide rate of decentralization and the time of completion of the expressways (freeways and tollways) in the Chicago area.

We also find that some of the negative consequences of decentralization might have been overstated. For example, in the Chicago area average work-trip lengths have increased only slightly from 1970 to 1990. In addition, about three-quarters of the increases in vehicle miles traveled (VMT, a measure of congestion) is attributable to increases in the number of jobs and increases in truck travel.

We believe that attempts to reverse decentralization in order to bring about a compact growth pattern need to be considered carefully because such a reversal may come at a cost to residents and businesses in a region. Specifically, average housing costs in the region may increase and its economic vitality may suffer. However, we remain supportive of incentives and other similar strategies to promote more efficient use of land and, in particular, to promote productive use of vacant land [infill] in the central city and inner suburbs.

We have used a mixture of research methods to achieve these objectives. These include the development of a theoretical framework to explain the decentralization process, a review of the literature on various dimensions of the decentralization-transportation-economic development nexus and an empirical analysis of the nature and effects of the decentralization process in the Chicago area. Further, a survey of suburban businesses in the Chicago area revealed that if they needed to relocate from their current addresses, they would prefer to remain in a low-density area.

The report is structured into three major parts: (i) this executive summary (ii) a summary of the entire study including our major findings and (iii) a set of appendices that provide the details of each part of the study.

# 1 Introduction

When urban settlements first form they have modest populations and small territories. In subsequent decades, if the settlement prospers, the total urbanized land area expands. In this study decentralization is defined as the phenomenon of increasing average distance between pairs of residents in an urbanized area. This is an operational definition and allows us to measure the ‘spread’ of population over time. It is equivalent to a definition of decentralization as a decrease in average density. Typically decentralization results in a decrease in population in and near the central core of the urban area and growth in population in the outlying areas.

Numerous studies have defined decentralization, and these definitions vary. Many definitions are less general than ours, and include additional criteria; for example, some include the spatial distribution of employment. We did not include employment because of a lack of necessary data. Other definitions include consequences of decentralization particularly as they apply to the societal problems emblematic of cities in this country (but not necessarily common to the worldwide decentralization phenomenon).

In this project, titled *Highways and Urban Decentralization*, we explore the causes and effects of the decentralization of urban areas. This report provides a summary of the entire study.

In many instances, we have used the Chicago area as a case study. We have provided a theoretical framework that describes decentralization which is discussed in Section 2. The relationship of highways to the decentralization process is presented in Section 2.1. Decentralization trends in the Chicago area, given the advent of limited access highway systems in the region, are explored in Section 2.1.1. Although it is popularly believed that decentralization is a post limited-access highway system phenomenon, such patterns started in Chicago at the end of the nineteenth century. We present the early history of decentralization in Chicago in Section 2.1.2.

It is also commonly believed that decentralization leads to increased trip lengths and that it is a major cause of increased road congestion. We discuss the effects of decentralization of population and employment in the Chicago area on travel patterns in Section 2.1.4. Travel patterns considered include trip lengths and trip times as well as vehicle miles traveled (VMT). We also attempt to find relationships between urban growth in the six-county northeastern Illinois region and increases in highway capacity in those counties over time; this analysis is presented in Section 2.2. In the final section of Part 2 we investigate whether decentralization can occur without highways (Section 2.3).

Some scholars favor compact urban growth and have extensively documented the negative effects of decentralization. While a judgment of whether compact growth is a desirable planning goal is beyond the scope of this project, we do find that reversal of decentralization patterns may impose costs to residents and businesses in a region. Specifically, average housing costs may

increase (discussed in Section 3.1) and the economic vitality of the region may suffer (presented in Section 3.2).

## 2 Causes of Decentralization

Several factors have contributed, both interactively and iteratively, to the process of decentralization. But the primary cause of decentralization is increasing wealth, or more specifically, increase in incomes relative to prices (or increase in ‘real incomes’ or increasing ‘incomes at constant prices’). That incomes have this effect may be seen empirically as well as by an appeal to theory. Empirically, the phenomenon is verifiable with cross-sectional data.

Urban Cluster*	Density**	Per Capita GDP***
Lagos, Nigeria	142.8	230
Dhaka, Bangladesh	138.1	200
Jakarta, Indonesia	130.0	630
Bombay, India	127.5	380
Ho Chi Min, Vietnam	120.2	230
Cairo, Egypt	97.1	720
Shanghai, China	88.9	360
Manila, Philippines	54.0	720
Seoul, Korea	49.1	6,300
Sao Paulo, Brazil	41.5	2,540
Mexico City	40.0	3,200
Tokyo, Japan	25.0	19,100
Paris, France	20.2	18,300
New York	11.5	22,470
Los Angeles	9.1	22,470
Chicago	8.6	22,470

\* Portion of the urban area with at least 5000 residents per square mile

\*\* Persons per square mile within the urban cluster, in thousands, 1991

\*\*\* Per Capita Gross Domestic Product in urban cluster’s country, in US\$

Source: *U.S. Bureau of Census*

Table 1: Population densities and per capita GDPs of selected urban clusters

### 2.0.1 Empirical Evidence

Table 1 shows the relationship between per capita gross domestic product (GDP) and the population density in different cities around the world. It is quite clear that countries that are more affluent (as indicated by per capita GDP) generally have more decentralized metropolitan areas, as measured by population density (persons per square mile within only the urban cluster — the

area with at least 5000 persons per square mile). Metropolitan areas with the lowest densities are typically found in the United States and without question the U.S. has an exceptionally high standard of living. In Asia, Tokyo and Seoul exemplify the general pattern. By American standards Tokyo is a high-density metropolitan area; but it has a much lower density than Seoul, South Korea, a country where the level of affluence is much lower. Both countries have high population densities, but the greater affluence in Japan allows the average Tokyo resident to live in lower density conditions than the average resident of Seoul. The relationship between the standard of living in a country and the density of its cities can be particularly well seen in the developing nations. Lagos, Dhaka, Jakarta, Bombay and Ho Chi Min City, located in nations that have rather low levels of economic development, all have densities more than twice those found in Seoul or Manila.

*The population density of the country also plays a role.* The low density of the United States contributes to highly decentralized metropolitan area. A comparison of the Philippines and Korea illustrates this point. The density of Korea is more than twice as high as it is for the Philippines suggesting that Seoul should have a higher density than Manila. However, with a substantially higher GDP per capita the opposite is true; the density of Seoul is lower than the density of Manila.

## 2.0.2 Theoretical Background

Based on theory, if incomes increase relative to prices, we usually consume more goods and services. In particular, we consume more land. Urban economists refer to this fact by stating that land is a normal good (Fujita, 1989; to put it more precisely: as a household's ability to pay for land increases faster than the price of land, they tend to, *other things being equal*, consume more land). Thus, if population stays the same (or increases) in a city and residents grow to be wealthier, they would, other things being equal, consume more land. That is, the size of the urbanized area would increase.

Land consumption is determined both by the demand for land and its supply or by demand and prices. Although there is little doubt that with greater wealth we tend to consume more land, the mechanics of how this happens warrants some explanation. Since when we demand more land we cannot usually just encroach into our neighbors property, increased land consumption occurs in more subtle ways.

One way of consuming more land is by moving to areas where land is cheaper. Very often, this could be done more easily at the edges of the urban area, distant from the urban core.

Another way of increasing land consumption is by reducing household size. During the span of this century there has been a precipitous decline in household size. Table 2 shows the steady



decline in the average household size in the city of Chicago to 2.72 persons in 1990, almost half of the 1900 value of 4.81 persons. For a constant population there has been a 77 percent increase in the number of households during this period. It was not uncommon in the early twentieth century for many generations to live together. Today it is atypical. There are many reasons for this but increasing real income certainly made it possible. It is only logical that these new households add to the demand for housing and land.

Year	Household Size
1900	4.81
1910	4.62
1920	4.33
1930	4.01
1940	3.57
1950	3.33
1960	3.07
1970	2.96
1980	2.75
1990	2.72

Source: Computed from U.S. Bureau of Census data on population and the number of households.

Table 2: Average household size: city of Chicago.

It may be pointed out that there has been a large growth in the number of households which can be considered ‘middle-class’. Their buying power enabled them to emulate the preferences and life styles of the wealthy, including low-density housing away from the urban center.

With increased land consumption, boundaries of urbanized areas have pushed outward. Wealthier people have always had more life-style options and have been able to take advantage of physical developments that are newer and therefore better suited to contemporary life styles. Consequently, predominantly upper and middle class households moved out from the city. Because urbanized areas in the United States have a number of separate municipalities and other taxing jurisdictions, tax bases in the inner city and in close suburbs eroded. This in turn lead to declines in the quality of schools and/or other services or in increased tax rates. These factors act as push factors to further accelerate movement out of the central portions of metropolitan areas (see Mieszkowski and Mills, 1993).

As the building stock in central areas further deteriorates and becomes even less appealing for contemporary life styles, it may be replaced and eventual rejuvenation may occur, as is currently happening in many Chicago neighborhoods. These neighborhoods now have densities that are lower than densities that used to exist in these area decades ago. This issue, though interesting,

does not significantly alter the discussion on the increased demand for land.

This phenomenon relates not just to residential land-use patterns but also to industrial and commercial land use. Since land and labor are both factors of production, with increasing personal or employee incomes (and therefore, with increasing unit cost of labor) relative to land prices, businesses would substitute land (and perhaps also capital) for labor. *Thus space demanded by both industrial and commercial activity has increased in recent decades.*

The increase in land consumed by businesses has happened in two ways. First, the business community has grown, as measured by the number of employees. In the United States the percentage of the population in the labor force has increased from 36 percent in 1960 to 46 percent in 1990, suggesting that for a constant population there has been a 28 percent increase in the number of employees. Second, each employee now consumes more working space. While data on the amount of land each worker uses is not readily available, the average square feet per worker in commercial buildings is reported. In 1983 the average was only 675 square feet per worker (U.S. Energy Information Administration, *Commercial Buildings Characteristics*). By 1986 the average worker consumed 792 square feet increasing to 894 square feet in 1989. It reached 953 square feet in 1992. *Not only does the general population consume more space in their residences but also at the work place.* [More recently, there seems to be some anecdotal evidence that in some sectors and some areas space per worker has peaked].

The recent population growth forecasts endorsed by the Northeastern Illinois Planning Commission (NIPC) in March 1994 suggest the six-county area will grow from 7.26 million inhabitants to 9.05 million in the year 2020 or an increase of 25 percent. Employment is forecasted to increase by 37 percent in the same time period. Early indications from July 1995 census estimates for population indicate that the region is ahead of the forecasted pace, nearly reaching the year 2000 estimate. Where will these people live and work? *It is clear that, other things remaining the same, future economic growth will be associated with further decentralization.*

Undoubtedly, how much land is put into urban use is affected by several factors other than just demand. Certainly, two key variables are price and accessibility. Price in turn is affected by other variables such as the potential for land value appreciation, the amount of open space and the availability of water and sewer lines. Mechanisms such as zoning practices and impact fees could also play a major role. In several parts of the country topography has an effect. Environmental policies requiring extensive clean-ups tend to favor 'green grass' sites. Regulatory growth management strategies also have an effect on land prices. These include artificial growth boundaries around urban areas, implemented as a part of growth management plans. Land prices may also be affected by other regulatory practices such as protection of certain lands from development, payment for property development either by increasing the cost to build or sharing revenues for growth or restricting public infrastructure development.

Other things being equal, one can reduce the demand for urban land consumption by raising land prices through regulatory actions such as those identified above or increase the demand by lowering land prices. Land prices to the consumer have been effectively lowered through the subsidy afforded by making interest on mortgages tax deductible. Whether higher land prices with consequent lower per capita land consumption and its life style implications are desirable is a value judgment that is beyond the scope of this study. **It must be noted that, again other things being equal, attempts to curb the growth in urbanized land will lead to higher land prices** (this issue is further discussed in Section 3.1).

## 2.1 Relationship of Highways to Decentralization

Highways effectively increase the pool of accessible land, but they affect land prices in a complex way. They tend to increase the price of land in areas previously not well served by highways (Fujita, 1989), largely because these areas are now more accessible. Many studies have documented that land values tend to increase, sometimes dramatically, in areas that are in proximity to newly improved highways (Mohring, 1961). Since these land value increases are independent of the extent to which property owners use the highway facilities involved, such gains are labeled ‘non-user benefits.’ Moreover, highways tend to reduce the price of land in areas previously well served (for example see Fujita, 1989) and renders the central city more attractive to firms in other cities. This occurs because the supply of land usable for urbanized purposes increases. However, typically land prices in newly served areas remain below those in more centrally located city sites.

To investigate the effects of highway capacity, we conducted an empirical analysis of the relationship of highways and decentralization in the Chicago area. This analysis, presented in Section 2.1.1, revealed no evidence of a relationship between the regionwide rate of decentralization and the time of completion of the expressways in the Chicago region. In addition, as we will discuss in Section 2.1.2, the process of decentralization began in Chicago well before the coming of the limited-access highway system and in fact, before the large-scale use of automobiles for travel.

### 2.1.1 Decentralization and Highways in Chicago

Since development often occurs close to highways, one might conjecture that highways are a major cause of decentralization. However, decentralization is a *regionwide* phenomenon. In order to examine the effect of highways on *regionwide* decentralization, we conducted an empirical examination.

For this, we needed a measure of decentralization. Measuring decentralization is a complex subject; indeed entire research projects have been devoted to it. We chose a relatively straightforward

measure of decentralization: the average squared distance (the mean square distance) between every pair of residents in the Chicago area. Since we did not have the precise location of every resident, we estimated this quantity for the Chicago six-county area using township centroids and populations (see Appendix 3 for further details). One shortcoming in applying this measure is that it is difficult to estimate it before 1930 due to lack of suitable data (while Census tract data are available, our resources did not permit their use). We therefore examined the rate of decentralization for the decades after 1930.

Table 3 gives the decentralization measure (column 2) for the Chicago area and its change since 1930 (column 4). This measure provides considerable insight into the rate of decentralization over a sixty-year period, however, it does not show the high rate of decentralization in the 1910s and 1920s when the region was characterized by large gains in the outlying areas and losses in inner city neighborhoods.

Year	Decentralization Measure (sq. mi.)	Time Interval	Change in Decentralization
1930	334.1	1920-30	—
1940	348.0	1930-40	13.9
1950	392.7	1940-50	44.7
1960	490.3	1950-60	97.6
1970	560.1	1960-70	69.8
1980	620.6	1970-80	60.5
1990	665.7	1980-90	45.1

Table 3: Decentralization measure for the Chicago region.

There were two major events that affected the rate of decentralization during the earliest decades shown – the Depression and World War II. Understandably, Table 3 shows that decentralization proceeded relatively slowly during the Depression decade. As we will demonstrate later in Appendix 2, the percent change in population between 1930 and 1940 shows that the central area and the city of Chicago were already losing population during this decade.

After that first decade shown in Table 3, the annual growth in the decentralization measure (column 4) has increased until the 1950-60 decade and declined thereafter. This decline suggests that the rate of decentralization is decreasing, but rising real incomes, population growth, household formation and a preference for more land still are factors contributing to decentralization. Each of these factors stimulates housing starts, much of which is built in low-density suburban areas.

Both residential and commercial growth lead to decentralization. Nationally, residential construction added 1336 million square feet between the years 1941-1945, but 2807 million square feet were added after the war (1946-1950). Similarly, new commercial space grew from 276 to 527 million square feet during the two time periods, respectively. Commercial expansion after 1945

Expressway/ highway	Date first leg completed	Date completed
North Lake Shore Drive	1937	1954
Edens Expressway	December, 1951	October, 1959
Northwest Tollway	August, 1958	August, 1958
East-West Tollway	November, 1958	August, 1974
Tri-State Tollway	August, 1958	December, 1958
Kennedy Expressway	December, 1958	November, 1960
Eisenhower Expressway	August, 1956	October, 1960
Bishop Ford Expressway	August, 1956	December, 1962
Chicago Skyway	April, 1958	December, 1962
Dan Ryan Expressway	December, 1961	December, 1962
Stevenson Expressway	January, 1956	October, 1964
I-57 Expressway	November, 1963	December, 1970
I-290 Extension	December, 1961	November, 1971
North-South Tollway	December, 1989	December, 1989
Elgin-O'Hare Expressway	November, 1993	November, 1993

Table 4: Completion dates of major Chicago-area expressways.

was twice as large as before 1945. Clearly, the end of the war triggered a period of economic growth.

In the Chicago area there was also substantial growth after the war. Figure 1 shows the percent change in population between 1940 and 1950 with those parts of the expressway system highlighted *that were constructed in the 1950s*, approximately a decade later. It is clearly evident from the map that the Tri-State Tollway (I-294) was constructed (as shown in Table 4) in the late 1950s along a corridor of the Chicago area that was at the edge of urban growth in the early 1940s and therefore incurred substantial population growth in the latter part of the 1940s. The same is true for the East-West Tollway (I-88) that roughly follows a corridor that experienced substantial increase in population during 1940 to 1950. **In both cases, major population gains occurred in proximity to the expressways over a decade before the construction of the respective expressways.**

Throughout the 1950s, the city of Chicago continued to lose population and outlying areas outside the city registered large gains. The decade of the 1950s served as a continuation of the decentralization process restarted after the war in the mid-40s, following a period of dormancy attributable to the Depression and the Second World War. In fact, as we will show later in Appendix 2, the patterns of population change in the 1940s and the 1950s are rather similar. Perhaps due to the pent-up demand for single-family homes the largest increase in decentralization was between 1950 and 1960 (the value of the measure was 97.6). The 1950s also represented a period of population growth in the region. The population grew by more than 1 million, the largest single population gain in Chicago's history during a decade. The rapid migration from the southern states during

the 1950s contributed substantially to the increase in population.

As shown in Table 4, the Northwest, East-West and Tri-State Tollways were completed during the later part of the 1950s. It has been shown that *substantial population growth occurred in these highway corridors a decade before the construction of these highways* and was part of a wave-like population growth emanating outward from the Chicago CBD.

Population gains in the corridors continued in the 1950s. However, none of the four major radial expressways, namely, the Kennedy, Eisenhower, Stevenson or Dan Ryan, connecting the Chicago CBD with the suburbs, were complete. Much of the Tollway network was in place but it primarily functioned as an urban by-pass which also served suburb-to-suburb trips. Although the CBD was still the major center of activity, these expressways did not provide access to the Chicago downtown.

The decentralization measure increases at a declining rate during the 1960s, 1970s and 1980s. Figure 2 shows the percent change in population between 1970 and 1980. Although I-355 opened for traffic in late 1989, the growth in population around that corridor is evident an entire decade earlier and again is part of an outward wavelike growth process.

*The principal conclusion of this section is that decentralization started well before the advent of the limited-access highway system. Population gains, in areas now in proximity to major limited-access highways, occurred long before the construction of the highways and these highways were located in areas where future growth was anticipated. Given these points, it is difficult to argue that highways caused the decentralization of population.*

However, we need to warn the reader it is risky to infer causality from an empirical analysis. In the context of this analysis, anticipatory behavior by residents could affect any study based on temporal comparisons. Also, the results depend on what happened in other cities and perhaps on several other factors. However, the findings above need to be included in any discussion on decentralization in the Chicago area.

### **2.1.2 Nineteenth and Early Twentieth Century Decentralization**

Decentralization in the Chicago area has occurred for a long time. In the early part of this century, living in the outlying areas was largely confined to the wealthy, but with rising standards of living a larger portion of the population could participate in the decentralization process. This is evident in our measure of the rate of decentralization. It changes very little during the depression of the 1930s but had its largest increase during one of the most prosperous periods in our history, the 1950s.

The desire to move to the edge of the urban region was not only characterized by residential shifts

Figure 1  
Percent Change in Population, 1940-1950

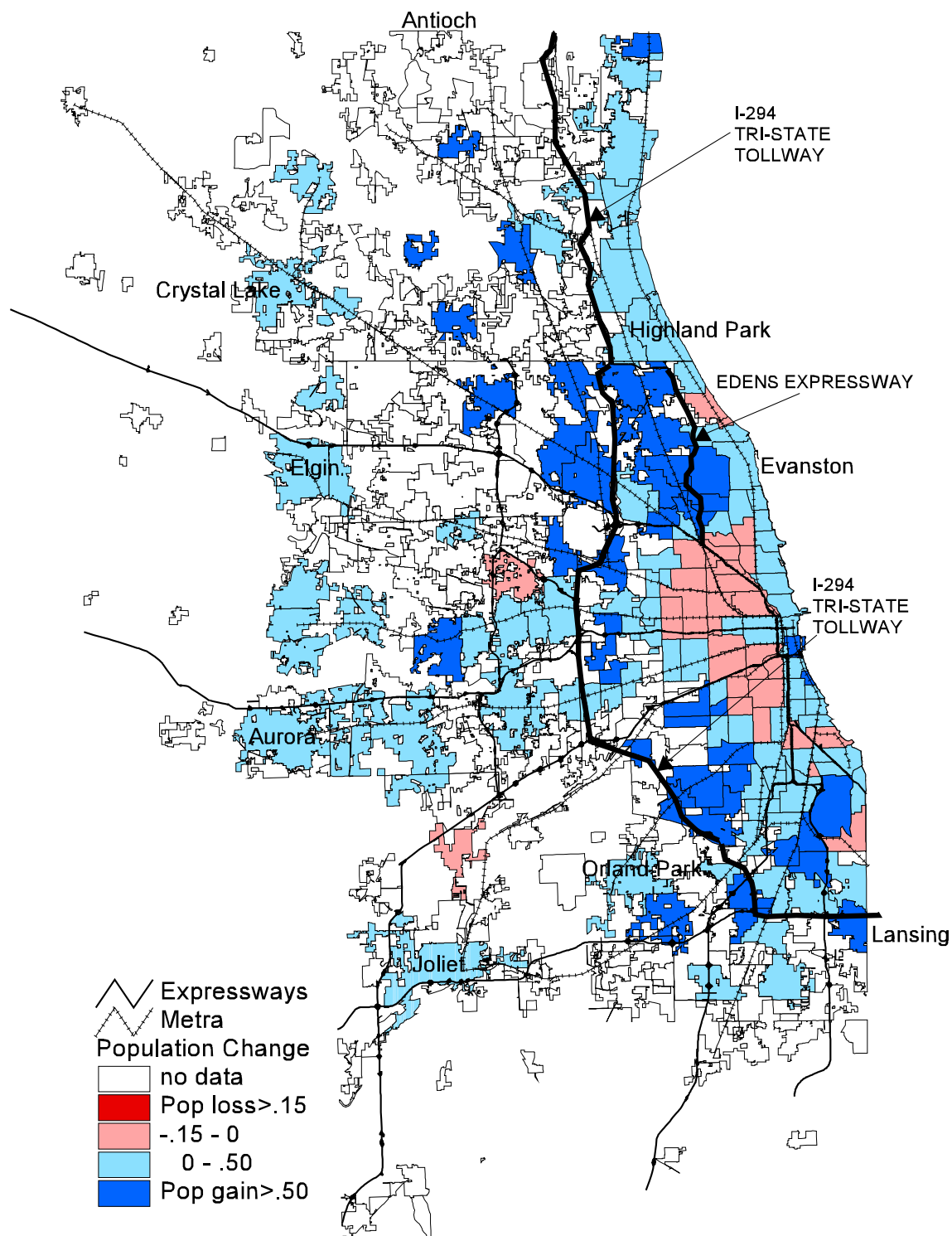


Figure 1: Percent change in population from 1940 to 1950.

Figure 2  
Percent Change in Population, 1970-1980

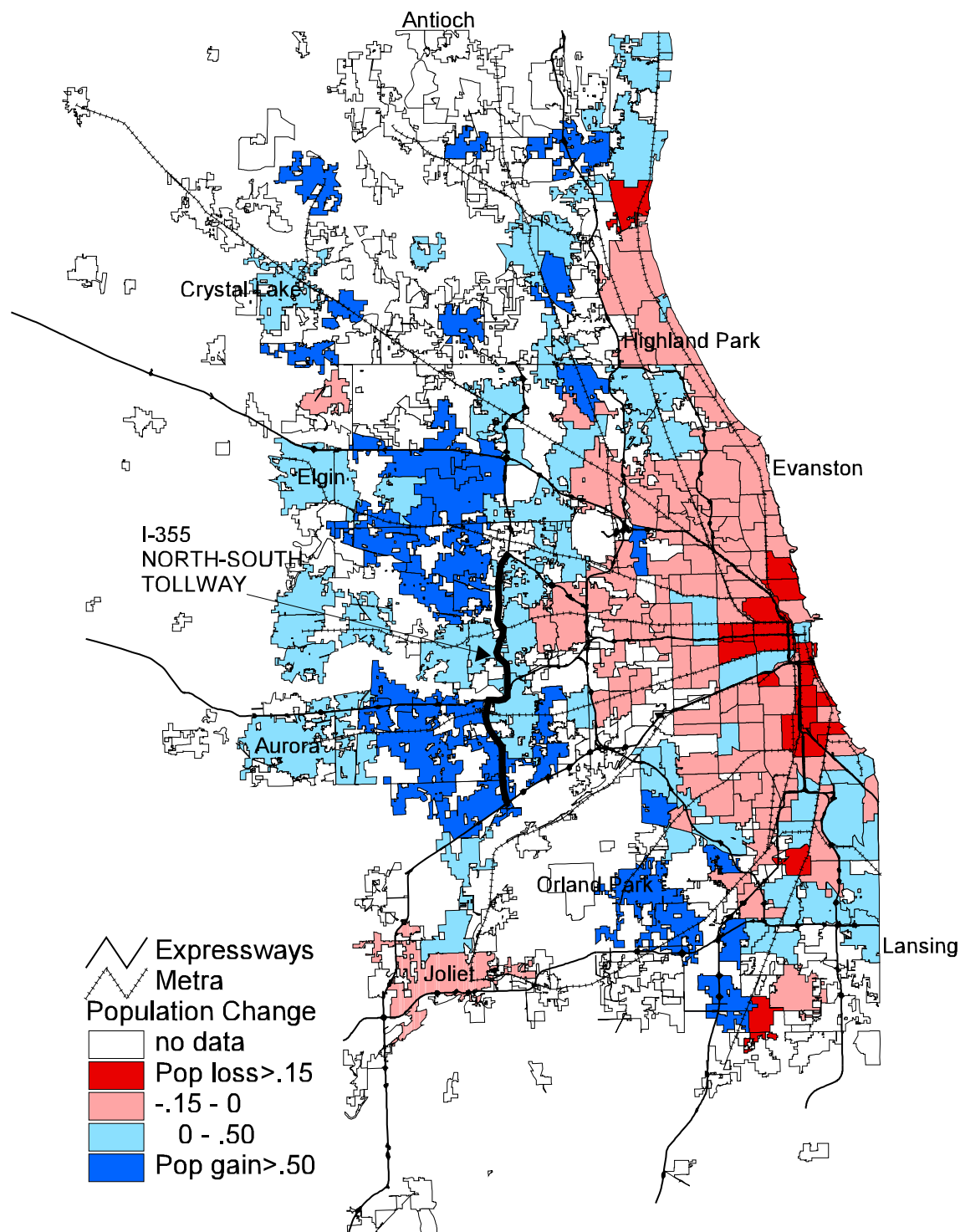


Figure 2: Percent change in population from 1970 to 1980.



but also by shifts in employment location. Before the beginning of the twentieth century many manufacturing concerns were seeking lower-cost locations on the fringe of the city. This was the basis for constructing the Outer Belt Line connecting Joliet, Aurora, Elgin and Waukegan. This line is now the Elgin, Joliet and Eastern (EJ&E) Railroad and is being explored by Metra as a circumferential commuter line. In many ways, this line which was built in 1896, established the outer boundary of the Chicago metropolitan region. Now, after one hundred years we have inhabited much of the territory within this rail line.

The radial rail lines also contributed to shaping the region. Much of the early decentralization was based not only on rising incomes but was facilitated by technological improvements in transportation systems. The railroads, many of which were built in the 1850s, established the fundamental pattern of urban growth. Much of this pattern is still evident today. The rail lines to each of the four satellite cities on the circumferential, mentioned above, and to other destinations such as Geneva, Harvard and University Park (Metra Electric line) have shaped the distribution of population by forming radiating corridors. The automobile facilitated development between these radiating corridors but it is interesting to speculate what the region would look like if the automobile did not perform this function. Perhaps we would have more radial rail lines and the spaces between the lines would be equally covered with inhabitants.

**Conventional wisdom holds that population decentralization and suburbanization is a recent phenomenon. However, in the Chicago area, decentralization began around the end of the nineteenth century and we have now experienced this process for approximately one-hundred years.**

Although there were strong decentralization patterns before 1910, the decade of 1910 to 1920 showed more than a 50 percent growth in many close-in suburbs, including Wilmette, Park Ridge, Oak Park, Cicero, Berwyn, Evergreen Park and Oak Lawn. *In the 1920s, a forty-square-mile area in the Chicago core lost population while several dozen suburbs registered more than a 50 percent growth in population — including all of the suburbs mentioned above.* The only exception was the one suburb closest to the Chicago CBD, Cicero. *During the prosperous 1920s large-scale decentralization was evident throughout the Chicago metropolitan area.* It is a pity that we were unable to measure the rate of decentralization from the beginning of this century.

Another way to examine the conventional wisdom that decentralization and suburbanization are only post WWII phenomena is to calculate when the city of Chicago would have started to lose population if its boundaries were smaller or larger than the current limits.

Table 5 shows when the population of Chicago would have reached its maximum had the city limits contained the current land area of the cities of Miami, San Francisco, Milwaukee and so forth. The table shows that, given its current size, the population of Chicago ‘maxed out’ in 1950 and has been ‘losing population’ ever since. Had Chicago only had 47 square miles, similar to San

Area* (square miles)	City of this size	Year of Maximum Population in Chicago if its city limits were of this size
35	Miami	1910/1920
45	San Francisco	1920
100	Milwaukee	1930
225	Chicago	1950
500	Los Angeles	1960
750	Jacksonville	1970

Table 5: Year of Maximum Population with Different City Limits.

\* Land area within 1990 city limits.

Francisco and Boston, it would have started losing population in the 1920s. If it were the size of Jacksonville then suburbanization would have started around 1970.

### 2.1.3 Literature on Decentralization

It is useful to place this analysis in the context of the literature on the relationship between land use and transportation. Although we are concerned with decentralization, it is a good idea to start by reviewing whether highways have been found to affect land use patterns. Most studies are concerned with corridor-type land-use impacts and regional land-use (but not *decentralization*) impacts. A number of authors have indicated that the interstate highway system is so ubiquitous and mature at this time that any effect on land use is perhaps no longer discernible. Two generations of empirical studies have been conducted to assess the land-use impacts of highways (Giuliano, 1989). The first generation of studies were conducted during the highway construction era, in the 1950s and early 1960s. The second generation of studies were conducted in the 1980s.

Notable among the earlier generation of impact assessment was the work by Mohring (1961) and Adkins (1959). These studies showed that highways significantly and positively affect *land values*. The highways examined in these cases were the first interstate highways in the region. This literature dealt with *land values* and not *decentralization* per se. Overall, highways were found to affect land values which, by implication, means that people found land near expressways to be preferable. The implications of this line of research on decentralization per se is not clear.

The most representative of the second generation of work was a study called ‘The Land Use and Urban Development Impact of Beltways’ (1980) conducted by Payne-Maxie Consultants and Blayley-Dyett for the U.S. Department of Transportation and U.S. Department of Housing and Urban Development. The study relied on prior research, a comparative statistical analysis of 54 metropolitan areas and detailed case studies of eight beltways (circumferential highways). This

study reported that there is no consistent relationship between the presence of beltways and land use. **The study also concluded that beltways have little or no consistent relationship on central city population growth rates.**

Despite these prior studies and the lack of firm quantitative evidence that highways affect region-wide decentralization, the perception persists that highways create decentralization. Our primary investigations into the decentralization trends in the Chicago area showed no obvious causal relationship between decentralization and expressway completion dates. Decentralization in Chicago started well before the advent of the limited-access highway system and during normal economic periods within the period of measurement, the rate of decentralization has remained about the same.

#### 2.1.4 Decentralization and Travel Behavior in Chicago

*Conventional wisdom suggests that as cities decentralize and urban activities become more dispersed, trip lengths increase. However, in the Chicago area these increases have been very modest.*

**A. Average Work-Trip Lengths by Automobile:** While there has been a modest increase in trip lengths from 1970 to 1990, some of this may be attributable to increases in income and changes in life style. Work trips illustrate a decline in the number of very short trips, with those less than five miles decreasing from 54.1 percent in 1970 to 50.8 percent in 1990 (Table 6). This decline in short trips can also be seen in a modest decrease in trips under ten minutes in duration. Work trips by automobile under twenty minutes, however, show almost no change between 1970 and 1990 (Table 7). In fact, the average travel time even shows a slight decrease (Table 8). *In the aggregate, work-trip lengths by automobile show relatively little change from 1970 to 1990. This is true for both travel time and trip length.*

Why have work-trip lengths effectively not changed from 1970 to 1990? One reason is that employment has decentralized, so that cities have become multi-nucleated or polycentric [although, even in the past there had been major employers outside the CBD; e.g., Western Electric and International Harvester]. Another reason is an increase in trip chaining, allowing travelers to reach more destinations and fulfill more activities in the same trip away from home. These are discussed in more detail at the end of this section (Items E and F, below).

*A principal reason why our highways are becoming increasingly congested is that the number of workers has risen dramatically.* While the population in the six-county metropolitan area only increased from 1970 to 1990 by a mere 4 percent the number of workers rose by over 20 percent. Stated differently, we experienced a labor-force increase of more than 600,000 workers at a time in which the population increased by approximately half this number. As part of a worldwide trend in developed countries most of these workers commute by automobile. This growth in private

vehicular traffic, largely during the peak travel periods, is obvious to most motorists.

Trip Length (miles)	% of Trips	
	1970	1990
0 to 5	54.1	50.8
5 to 10	23.6	23.0
10 to 15	11.2	12.5
15 to 20	5.4	6.7
20 to 25	3.1	3.6
25 to 30	1.3	1.7
30 to 35	0.7	0.7
> 35	0.6	1.0
	100.0	100.0

Table 6: Changes in trip-length frequency distribution for work trips by automobile (airline distance in miles).

Trip Duration (minutes)	% of Trips	
	1970	1990
0 to 10	24.8	24.3
10 to 20	26.5	26.8
20 to 30	22.4	21.4
30 to 40	7.0	10.2
40 to 50	9.3	8.7
50 to 60	6.2	5.1
> to 60	3.8	3.5
	100.0	100.0

Table 7: Changes in trip duration for work trips by automobile (in minutes).

**B. Average Automobile Trip Lengths by Trip Purpose:** Trip lengths and durations have also changed relatively little for other trip purposes. Table 8 gives the changes in automobile travel times between 1970 and 1990 by trip purpose. The largest increases have been in return trips home and shopping trips. Since there are many more work trips, and they have the greatest trip lengths, it is logical that the lengths of the trip back home would increase.

Shopping-trip length increases may well reflect how we shop, conducting more retail business in large shopping centers and at ‘big box’ stores that are typically more distant than smaller retailing facilities. Indeed, this is a part of a long term phenomenon starting with local stores in the 1940’s to the supermarkets in the 1950’s to the shopping centers of the 1960’s and 1970’s and megacenters today. The emergence of shopping complexes like Ford City, North Riverside Mall and the Brickyards typify this trend. All are new facilities in old and established areas where the prevailing shopping activity was previously conducted at neighborhood- and community-level shopping areas close to home. There may be fewer trips to these shopping centers than to local

Trip Purpose	Length (in miles)		Travel Time (in minutes)	
	1970	1990	1970	1990
Work	7.07	7.34	26.54	25.81
Work related	6.42	6.29	22.39	23.73
Shop	2.71	3.14	13.51	14.50
Recreation	4.49	4.62	18.73	18.75
School	5.98	5.06	23.21	20.98
Return home	4.73	5.08	20.20	20.64
All purposes	4.73	4.96	19.69	19.75

Table 8: Changes in average automobile trip lengths (airline distance in miles) and travel time by trip purpose.

stores but the average trip length is undoubtedly longer.

**C. Average Travel Times by Subregion and Trip Purpose:** We have seen that trip lengths and travel times have not changed much in twenty years. Since most travelers select destinations based on travel time it is also useful to examine the variation in travel times by subregions within the metropolitan area. With growing prosperity travel time becomes increasing more important and this may partially account for some decentralization. Table 9 shows that average travel times (for all modes) are lowest in the moderate-density suburban areas. Considering all trips, DuPage county has the lowest average travel times followed by suburban Cook county (one-day travel diary; CATS 1990 Household Travel Survey). By contrast the longest trips are in Chicago outside the downtown. *Decentralization does not seem to contribute to higher travel times, in fact, in some areas the opposite appears true.*

*Given the large number of jobs in the Chicago downtown this area has the shortest work trips followed by DuPage county. Again the rest of the city of Chicago has the highest travel times. One might argue that jobs have moved to the suburbs but this does not explain the high travel times for non-work trips. The traditional advantage of the central city (Chicago) with its proximity to a variety of urban opportunities is not evident in average travel times.*

We have chosen to report statistics on all trips; for automobile-only travel, the pattern would be similar, except the CBD would have the highest travel times. That is, on average, drivers from downtown residences face longer travel times than those from other residential areas. [Table 9].

**D. Vehicle Miles Traveled (VMT):** Since there have been only modest increases in trip lengths the question arises: *What has contributed to the large increase in VMT over the last few decades?* Figure 3 identifies the major contributors to the increase in daily VMT in the six-county Chicago metropolitan area. Between 1973 and 1993 the area VMT grew from 85.9 million miles per day to 135.4, or an increase of 49.5 million miles per day, almost a sixty percent jump (we were unable to obtain a six-county VMT figure for 1970 to make a 1970 to 1990 comparison). With

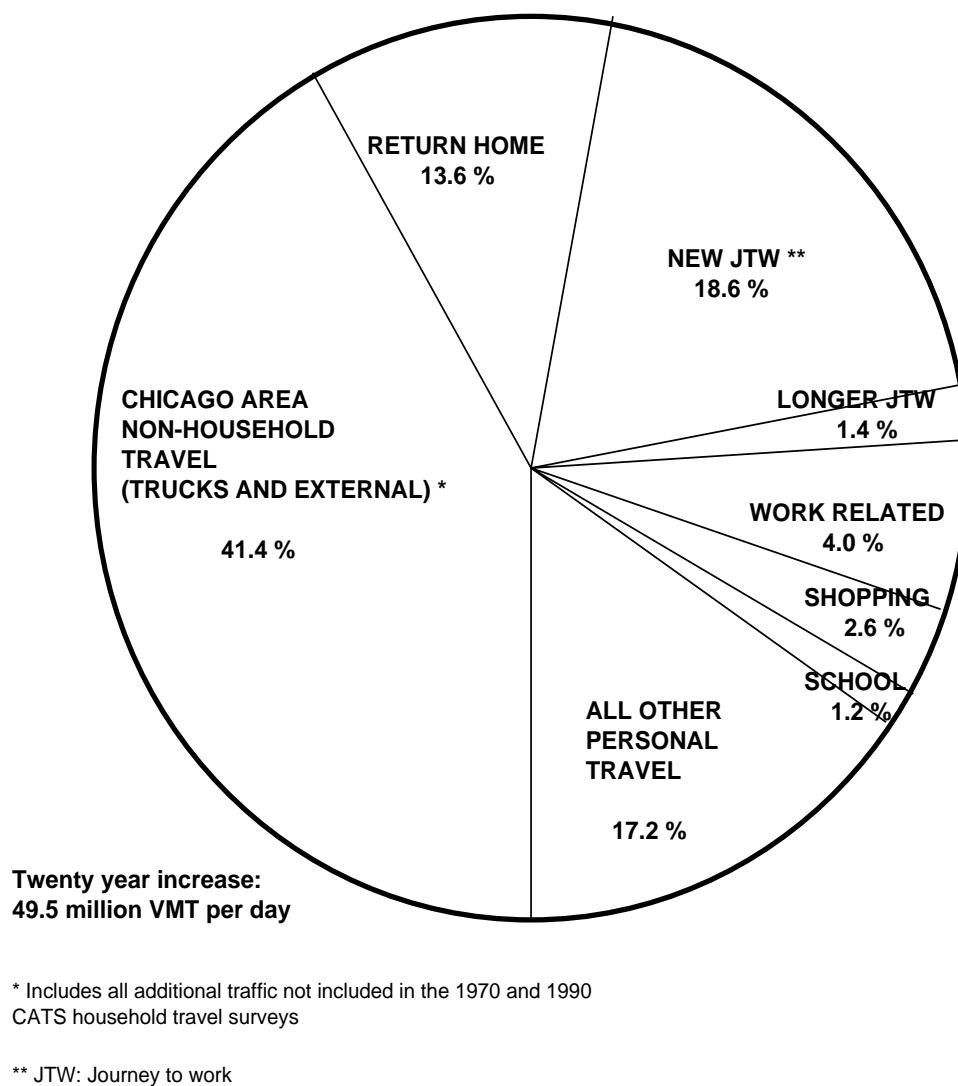


Figure 3: Major contributors to the percentage increase in VMT in the Chicago area from 1973 to 1993.

the CATS 1970 and 1990 household travel surveys we can estimate the contribution attributable to increases in locally-generated household travel. The remainder is then attributed to external and non-household traffic, mainly trucks. This figure shows that **almost three-quarters of the increase in VMT between 1973 and 1993 can be attributed to an increase in the size of the labor force, increased external traffic and growth in trucking.** Moreover, since trucks have an automobile equivalence of two and three, their contribution to activity on the road is even greater than their VMT indicates.

Household VMT can increase in two ways: trip length and the number of trips. Since we have seen that trip lengths have increased only very little, the bulk of the rise in VMT comes from an increase in the number of trips. Shopping is the only exception; an increase in trip length

Location	Work and Work Related Trips	Non-Work Trips	All Trips
Chicago CBD	21.9	20.9	21.4
Rest of Chicago	26.9	23.0	23.7
Suburban Cook	25.1	19.9	20.1
DuPage County	24.7	18.4	19.7
Outer Counties	25.4	19.7	20.8

Table 9: Average travel times by place of residence and trip purpose.

contributed more to VMT growth than a growth in the number of trips. The reason for this was described above. By contrast, the largest increase in household VMT is attributable to the expansion of the Chicago-area labor force. Figure 3 shows that the growth in the number of workers accounts for 18.6 percent of the increase in VMT. On the other hand, longer work trips only account for 1.4 percent. Also, since a substantial amount of the growth in return-home activity is due to many more persons traveling to work, the growth in the labor force may directly account for well over a quarter of the increase in VMT. Also, the growth in truck traffic is at least partially due to the larger number of workers in the metropolitan area and the growing purchasing power. Overall, approximately three quarters of the increase in travel is attributable to more truck traffic, more traffic from external sources, and a major increase in the size of the region's labor force. All of these are signs of growing affluence.

**E. Changed Urban Structure:** These changes in VMT occurred at a time in which the region has undergone major structural changes. Many of the structural changes account for the modest changes in trip lengths.

In the last century, cities had a well defined core — its central business district [CBD]. While some commercial activity occurred elsewhere, the dominant economic life of the city was focused on its CBD. The rest of the city could be considered its hinterland. This is no longer true.

Now there are several activity centers in an urban area. This is the outcome of both population and employment decentralization. For example, in the Chicago area the I-88 corridor and other suburban activity centers such as the O'Hare Airport area, Schaumburg, Oak Brook and the Old Orchard area have given the region a polycentric structure; these places have significant economic activity without the immediate presence of a CBD. Indeed, one could visualize that each of these activity centers play a role similar to a nineteenth century CBD [although the set of activities, for obvious reasons, are not as complete as that of a nineteenth century CBD], but with overlapping hinterlands. That lengths of commuting trips have not substantially increased from 1970 to 1990 is partially true.

One could claim that expressways had something to do with these activity centers and indeed

several of them are close to expressways. A number of descriptive studies have documented land-use development along expressways. These studies have pointed out that activity centers start out near expressway interchanges or by locating along the expressway corridor. However, there are enough such centers not on expressways to indicate that such activity centers might have arisen with or without expressways. Downtown Evanston is an example. While it is a considerable distance from the nearest interchange on the Edens Expressway, it is a healthy and growing downtown area. Orland Park is a more contemporary example. Other examples include Stratford Square, Fox Valley, Randhurst and Hawthorne. Similarly there are industrial areas such as Franklin Park and Elk Grove Village that grew without immediate access to the expressway systems. We conjecture that without expressways, we would have more activity centers outside the CBD — only their hinterlands might be more compact. Indeed, if transportation links between activity centers had been weak, then self-sustaining developments, each with their own core, may have formed side by side, thus occupying a large amount of total urbanized land with a low population density over the entire area.

**F. Trip Chains and Adaptive Travel Behavior:** Another reason why there was relatively little change in trip lengths is the change in travel behavior. Over the last few decades the Chicago area has continued to decentralize and travel patterns and travel behavior have changed. Accordingly, with a more dispersed distribution of people, jobs, retailing and other urban functions there is a distinct possibility that travel distances can increase. *Our research suggests that travel behavior is changing in a manner that allows travelers to reach more destinations with the same amount of travel or even less in some cases.* They accomplish this by combining trip destinations in a series of trips, a practice called trip chaining. Consequently, decentralization appears to have contributed little to increased VMT.

A trip chain is defined as a sequence of trips starting at home and ending at home. The simplest chain consists of travel to a destination, e.g., work, and back home without making an intermediate stop. This has a chain size of two and one out-of-home destination. A chain size of six would include five out-of-home destinations before returning home. Figure 4 illustrates three chains, ranging from a simple shopping chain (Example 1) to Example 3 with seven out-of-home stops.

In addition, travelers may exhibit different activity patterns, an illustration of which is given in Figure 5. A traveler in Household A engages in five different activities in the same trip chain taking six trips. A traveler in Household B takes six trips for only three activities. It would appear that the individual in Household A behaves more efficiently than the one in Household B because she accomplishes more tasks in probably less time. This efficiency, however, may occur at the expense of prolonging the peak hour traffic or increasing congestion levels.

A comparison of 1970 and 1990 travel behavior shows that trip chains are becoming more and more complex. In this manner it is quite possible to reach more destinations while traveling fewer miles. In the 1970s there were many more households with one adult working and the other



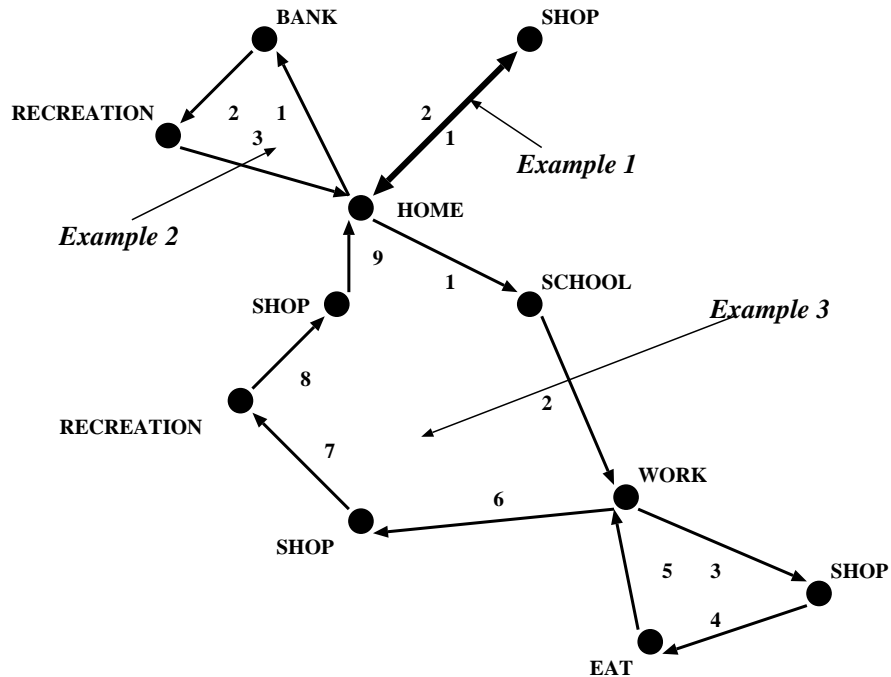


Figure 4: Hypothetical trip chains

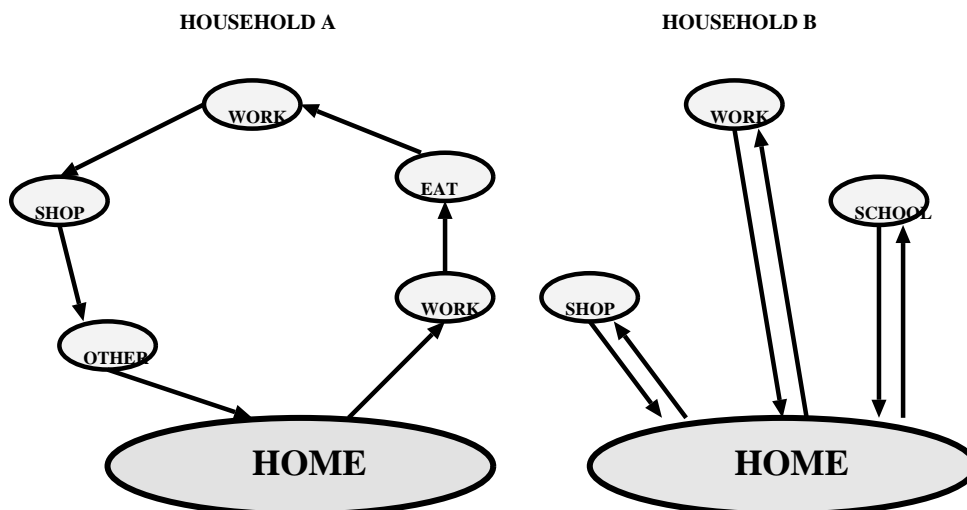


Figure 5: Hypothetical trip chain patterns for different households

adult performing household errands and chores. This permitted more simple chains. Now, with a greater number of multiworker households, many of the errands are performed in association with other travel activities. A comparison of automobile travel indicates that average chain size increased from 2.4 trips in 1970 to 2.8 trips in 1990. With a rise of 0.4, on average four out of every ten chains had an extra stop.

Although this is a regionwide phenomenon we decided to focus on DuPage County. By providing resources to the Chicago Area Transportation Study (CATS), DuPage County arranged to have data collected for a larger sample in the CATS 1990 Household Travel Survey. As a result, we could conduct more detailed analysis on trip chains with the DuPage county data.

In the twenty-year time span (1970-1990) the county increased in population by 59 percent and the number of resident workers by 113 percent. The county grew rapidly and many previously undeveloped spaces were inhabited. Although the suburbanization process was in full swing the household size exhibited the same decline as described earlier for the city of Chicago. By 1990, the average household size was 2.76 members, down from 3.41 in 1970. The former figure is very similar to the Chicago figure. On this statistic, and several others, we see the same trends in the suburbs that we see in the city.

Also in the twenty-year period, the number of trip chains conducted by DuPage County residents increased by 28 percent but the simple chains (size two) increased by only 4 percent. On the other hand, the most complex chains had the greatest percentage increases. Chain size five grew by 222 percent and chain size six or more grew by 300 percent. Examining only shopping trips reveals that despite the increase in population and level of affluence, simple shopping chains actually decreased by 30%. The more complex shopping chains had major increases.

This change in travel behavior has resulted in substantial increases in trip efficiency. Despite the fact that automobile ownership rates and incomes rose during the 1970 to 1990 period, the number of trips per person declined, albeit by a slight amount from 4.3 trips to 4.2 trips. However, since many of these trips were segments of complex chains, the average number of out-of-home destinations actually rose by approximately 5 percent.

*If mobility is defined as the per capita number of destinations visited, then these trends indicate that the average individual travels less but is more mobile. Travelers typically desire to fulfill several activities in the same journey away from home and in this regard the traveling public has become more efficient.*

A decrease in travel is also seen on a per household basis, although much of this can be attributed to declining household size. Still, the decrease from 10.3 to 9.1 trips per household has implications on trip generation models that depend upon estimating the volume of traffic produced by traffic analysis zones.

While trip chaining contributes to more efficient travel for individuals it also contributes to traffic congestion. Many of the additional destinations are associated with trips to work. More than half of the trips in the evening peak period are trips other than those directly home from work. *By stopping at destinations from work to home, this form of travel contributes to the number of miles driven during the peak period and the length of the peak. Therefore, the peak period, once known as the rush hour, is now longer and has more traffic.*

## 2.2 Relationship between County Growth and Increases in Highway Capacity

In understanding the role of highways in the growth of the region it was necessary to study the county-level relationship between the number of lane miles and several measures of urban activity. We chose four measures of urban activity to analyze:

- population,
- employment,
- number of registered passenger vehicles, and
- number of retail sales employees.

Expectedly Cook County has the fewest lane miles per unit of measure for each of the four variables listed above (Table 10). For example, in 1995 Cook County had 5.2 lane miles for every one thousand residents, while the suburban figures ranged from 8.4 miles for DuPage County to a high of 16.9 for McHenry County. The semi-rural nature of the both Will and McHenry counties accounts for the high number of lane miles per capita. Rural counties in general tend to have very high ratios of lane miles per capita.

The difference between DuPage and Cook counties is smaller for the other three variables. The number of lane miles per thousand employees is 11.2 for Cook County versus 14.0 for DuPage County. Lane miles per thousand vehicles are 9.7 and 11.7 for Cook and DuPage counties respectively, an even smaller difference. There is virtually no difference in the number of lane miles per million dollars of wages paid in retailing, both being 4.1 (Table 10). Despite the great difference in population and density the differences in lane miles per unit of urban activity are rather small.

While there are higher values in the “collar” counties these values have been dropping in all cases. In the last twelve years McHenry County has had more than a 25 percent drop in the number of lane miles per person (Figure 6). Other counties have also had declines in this ratio, 17 percent in both Kane and Will Counties, 10.2 percent in Lake County and 9.4 percent in DuPage County. Cook was the only county that registered an increase, 3.4 percent. The increase in Cook County

is attributable to a decline in the population. This indicates that over time the highway systems in suburban areas are becoming better utilized. Even though rural counties have traditionally had the highest ratios, this has not caused these counties to increase in population, in fact many rural counties are experiencing population losses.

County	POP*	EMP**	VEH***	RET****
Cook	5.2	11.2	9.7	4.1
DuPage	8.4	14.0	11.7	4.1
Kane	12.5	29.4	20.3	10.7
Lake	10.3	22.5	16.5	7.0
McHenry	16.9	55.3	26.7	20.3
Will	14.9	56.2	25.5	19.8

- \* POP = number of lane miles per thousand inhabitants
- \*\* EMP = number of lane miles per thousand employees
- \*\*\* VEH = number of lane miles per thousand vehicles
- \*\*\*\* RET = number of lane miles per million dollars of retail wages

Table 10: Number of lane miles (1995) per unit for four measures of traffic generation: population, employment, vehicles and retail wages.

### 2.3 Can Decentralization Occur Without Highways?

Since decentralization began several decades before the arrival of the automobile and before the first Chicago-area expressway was built, it appears that decentralization requires factors other than urban expressways. An interesting question is, given the current size of the Chicago area, could decentralization still occur, if we did not build highways? We believe that the answer to this second question is yes.

In recent years, residential, commercial and industrial development has been occurring in the Chicago area away from expressways. The best example is the Orland Park area. The Orland Square Shopping Center is located in a triangle formed by I-80, I-55 and I-294. *The closest expressway interchange is approximately four miles to the south on I-80.* This is one of the fastest growing commercial and residential areas in the Chicago area and it is happening without the benefit of easy expressway access in close proximity. There are several other regional shopping complexes located some distance from an expressway interchange, such as Hawthorne Center in Lake County and Stratford Square. Some of the largest traffic generators in DuPage County are distant from expressways, namely the county office complex and the College of DuPage. The college is the largest institution of higher learning (measured by the number of students) in the metropolitan area and it is not situated close to an expressway interchange.

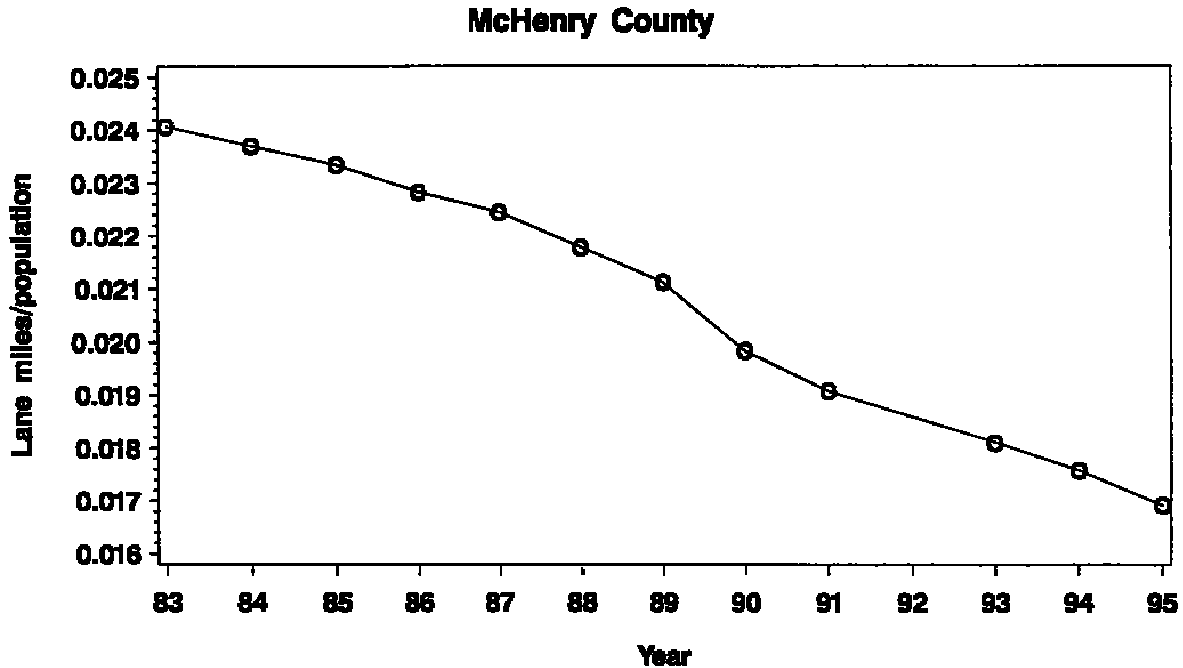


Figure 6: Lane miles per population in McHenry County: 1983-1995.

It is also noteworthy that the fastest growing county in the state, McHenry County, does not have an expressway interchange within its boundaries. One could successfully argue that the Northwest Tollway provides the route to the city of Chicago, but only about a quarter of McHenry County workers are employed in Cook county and many of them can utilize Metra trains. Since over half of McHenry county workers are employed in the county, many residents do not require expressway access to the rest of the metropolitan area. Further, in the last twenty years, jobs in the county have been growing more rapidly than population and in time there may even be a larger portion of the labor force employed locally.

### 3 Effects of Decentralization

If continued decentralization of urban areas is viewed as undesirable then a number of strategies may be used to contain decentralized growth. One approach has been the institution of growth management plans such as urban boundaries. Another is limiting highway capacity additions. Irrespective of the type of approach used to curb decentralization, it is important to review what aspects of the urbanized area would be affected by control on growth. Moreover, the final strategy used to control decentralization would have to be a many-pronged approach — it is unlikely that any single approach will yield a much more compact urban region without significant penalties to residents and businesses. The penalties could include high housing prices and weak or decreased

economic development.

### 3.1 Decentralization and the Cost of Housing

The data we analyzed regarding the relationship between decentralization and the cost of housing indicate that *metropolitan areas, such as Chicago, with a high degree of decentralization have high levels of housing affordability.*

In deriving this conclusion, we analyzed the association between the affordability of housing and several metropolitan characteristics. The affordability measure is an index identifying what portion of the housing is affordable to a household earning an income equivalent to the median household income in that metropolitan area. The cost of housing includes the mortgage as well as taxes and insurance. As such, the higher the index value the higher the percentage of housing an average household can afford in their home purchase search. These data were provided by the Home Builders Association.

Among the highest affordability indexes were metropolitan areas in the Midwest. Small metropolitan areas such as Rockford and Champaign-Urbana have a high index of affordability. Since we are interested in the largest metropolitan areas we confined our analysis to the 35 largest metropolitan areas (essentially metropolitan areas with populations over one million). Among these metropolitan areas, the index of affordability ranged from 82.7 in Kansas City and 80.2 in Minneapolis-St.Paul to a low of 23.0 in San Francisco. The figure for the Chicago area is 64.0.

We collected approximately a dozen variables describing the respective metropolitan areas and found that *two were most instrumental in accounting for the variations in affordability. These two were urbanized area density and population growth from 1990 to 1995*, the most recent data available. The relationship between urbanized area density and the index of affordability is shown on Figure 7.

High urban densities and high growth rates have negative effects on affordability. High densities suggest that there is a constraint on the supply of land causing the price to rise. This is the case in many of the Californian metropolitan areas where topography is the constraining agent, e.g., San Francisco, San Jose, San Diego and Los Angeles. Each has a very low index of affordability. Other examples include Miami, surrounded by wetlands, and Portland, Oregon, which has a state stipulated urban growth boundary. In Portland the restriction posed by the urban growth boundary approximately twenty years ago is now being felt; the amount of developable land has diminished, resulting in sharp increases in the cost of housing. While the Chicago area is not seriously contemplating an urban growth boundary, this type of action is rather easy to evaluate.

Further, the index of affordability needs to be interpreted in the context of important recent trends in the housing market. First, home ownership has been increasing in recent decades and is now

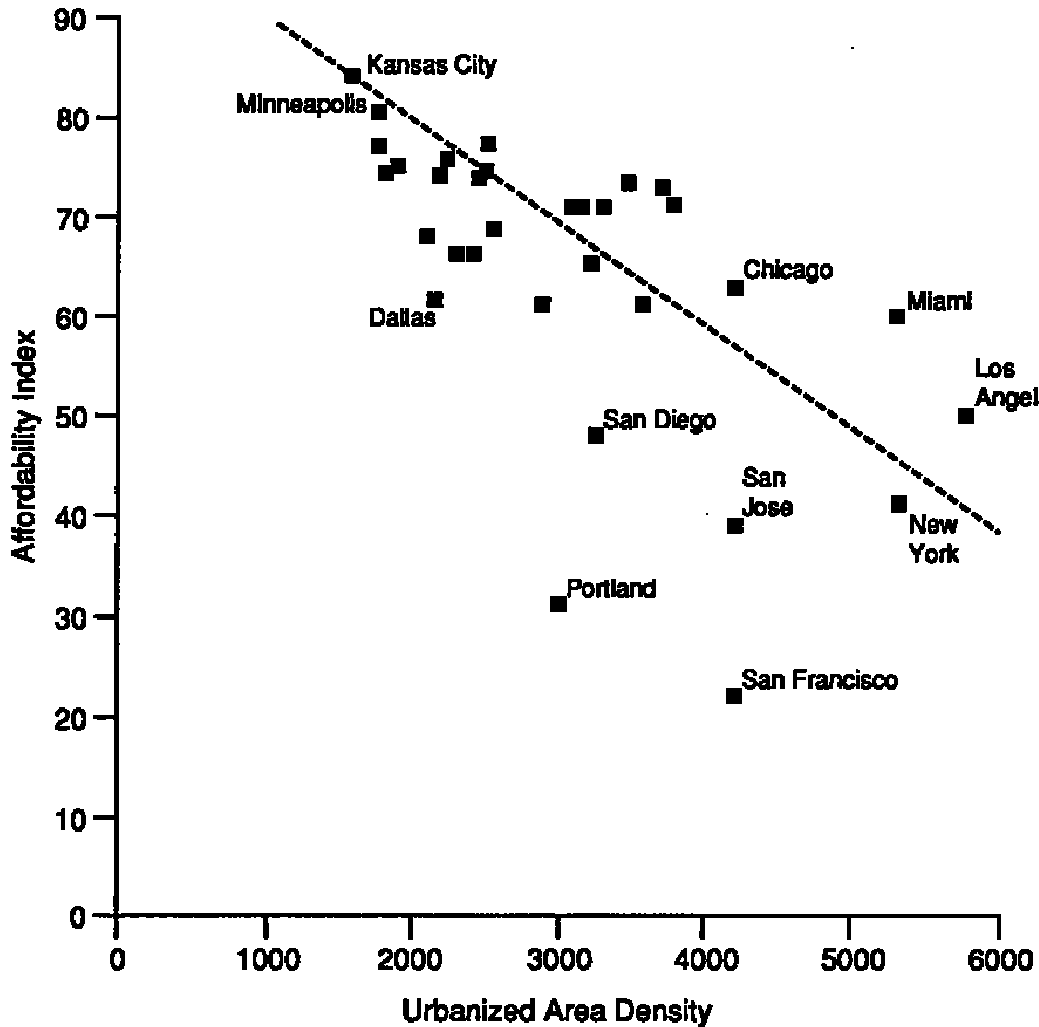


Figure 7: Urbanized area density and index of affordability.

at an all-time high of 66 percent. Second, in the last twenty years, 1975-1995, the median home has increased in size from just over 1,500 square feet to approximately 1,900 square feet. These two statistics demonstrate the rising standard of living in the nation. Third, median lot size has shown a modest decline in the last twenty years. This small change suggests a balance between the economic ability to purchase more land versus the finite amount of urban land. *This further suggests that much of the decentralization may be attributed to increased real income resulting in rising home ownership rates. This is especially true since median lot sizes have changed little in the last twenty years.*

## 3.2 Highways and Economic Development

It has been commonly held for a long time that highways lead to economic development and, conversely, that an inadequate highway capacity would be detrimental to economic activity.

A primary function of the highway system is to promote economic development and to remain nationally competitive. Transportation systems allow specialization of production. Highways enable industry to operate and maintain a distribution system of goods and products, allow labor to be mobile and thus provides the groundwork for a great variety of labor skills to be utilized. In addition, they provide access to specialized inputs into the production process and can contribute to an increase in market size. The greater the variety of labor skills and input products available to an industry, the more likely it is that a specialized labor or input is available that can reduce business costs.

There are a large number of secondary benefits that may accrue due to lower transportation costs to businesses. Lower transportation costs may be passed on to consumers as lower prices for consumer goods, to workers as higher wages and to businesses as higher net income.

While theoretically these arguments are sound, empirical analyses have often yielded somewhat conflicting evidence. The earliest analysis (in the 1950s and 1960s) supported the claim that the economic health of country is dependent upon its transportation system. Since some of the studies involved international or regional comparisons and it was impossible to determine if good transportation leads to good economic status or the other way around, focus shifted to the examination of a single country [usually the US] over time. The initial studies of this kind, too seemed to support the claim. However, these studies came under scrutiny and were criticized on methodological grounds (see for example, Gramlich, 1994). Subsequent studies showed little dependence of economic development on transportation — at a national level — although these studies also had potential flaws.

There have been a number of efforts to reconcile these diverse findings. One overview by McGuire (1992) states ‘a consensus that public capital (including highways) has a weak, positive effect on private economic activity is emerging among the researchers involved.’ Another different but related view is that investment in transportation, by itself, is not capable of creating new economic development. Hence, *transportation is said to be a necessary but not a sufficient condition for economic development*. A number of other factors also affect economic development and if those conditions are not met, there may be no visible evidence of aggregate measures of highway construction on the economy. There is also temporal issue to be considered; the highway system is well-developed in virtually all areas of the United States. This idea is consistent with the studies that assessed the relationship of transportation to land use which we described in Section 2.1. Forkenbrock *et al.* (1990) reviewed a number of studies on the topic and concluded that the impact of highway investments on economic development today, with a mature highway system,



may not be the same as it was in earlier periods.

However, a third attempt to reconcile these studies might be most germane to our current discussion. This attempt seeks to reconcile the national-level studies mentioned above with regional level studies that typically show fairly strong impacts of highway development on the regional economy. For example, Boarnet (1996), using data from 1969 to 1988, found that economic output in California counties is positively related to the amount of highway capital in the county but negatively related to highway capital in nearby but non-contiguous counties. Stephanades and Eagle (1987) found evidence that highways contributed to economic growth in urban Minnesota counties in part at the expense of other counties. Thus the conclusion that emerges in this line of thinking is that while highway construction might only slightly affect the national economy, *investment in transportation gives regions competitive economic advantage and may shift economic activity from one region to another* (Boarnet, 1998). That is, **highways give a region a competitive edge in economic development.**

### 3.3 Highways and Firm Location

If highways give a region a competitive advantage it must mean that the region attracts more businesses and that businesses located there prosper. In this section we further examine this issue. Traditional firm location literature would suggest that a good business climate is based on cost of inputs, the cost of shipping products and the desire to cluster with related firms (agglomeration). Inputs include physical products from suppliers, land cost, cost of labor (including the ability to recruit and retain people with appropriate skills) and perhaps intangibles like the general ambience. It is easily seen that transportation, accessibility and factors like congestion play a key role in all of these. For example, a recent study of 390 foreign-owned firms located in the greater Chicagoland area showed that air transportation and proximity to key industries and markets (with current strengths in air, road, rail and water) from the Chicago region are the first and second ‘most persuasive’ reason for the selection of Chicago (KPMG Peat Marwick and Associates, 1994).

A detailed study to quantify such factors is currently underway (Cambridge Systematics, 1998). While this study plans to use an analytical approach, we, as a part of this project have sought the opinions of businesses as to what determines their location decisions and the choices they prefer. In particular, we seek to isolate the land-use and transportation factors that have a bearing on firm location by means of a survey of businesses in DuPage county, Illinois. The results of this survey are discussed in Section 3.3.2.

The responses of firms to transportation costs are reviewed in Section 3.3.1. Lack of adequate highway capacity certainly imposes an economic cost on firms; however the responses of firms vary with firm attributes such as type and ownership of firms.

### 3.3.1 Effect of Highway Capacity on Business Costs and Firm Location

Adequate transportation may be a function of two factors: the lane miles of highway that an area has (or a static inventory of transportation) and the operating conditions of those highway miles (such as congestion). The average benefits to productivity associated with historical highway spending (which is the scope of the macroeconomic line of thinking) will not necessarily be a good predictor of the marginal benefits to productivity from future investments to improve transportation systems. Some index of the operating conditions of the network, such as the level of congestion, would affect business productivity more directly. Congestion also induces significant variation in transportation costs among locations and can significantly affect accessibility.

The most direct cost that congestion imposes on economic activity is lost time to employees, although such costs are internalized perhaps not by firms but by the employees themselves (Cambridge Systematics, 1994). However, congestion does directly affect business productivity in one or more ways: (i) by increasing business costs of delivery operations (ii) by limiting or reducing business sales through a reduction in effective market size (iii) by increasing unit costs through loss of opportunities for scale economies in production and delivery processes (iv) by reducing accessibility to a greater variety of specialized labor markets and (v) by decreasing the access to specialized inputs of production.

The empirical literature on business location preferences implies that congestion along specific routes and highway developments to alleviate that congestion can have important effects on spatial location preferences of firms. The most often cited reasons for firm location decision are availability of skilled labor, accessibility to key markets, potential for agglomeration effects, taxes and social/organizational factors such as unionization and education. Accessibility to labor and product markets are very much transportation issues. But survey respondents do not always directly identify the highway system as a major reason for firm location in urban areas. This could be due to many reasons. First, it is probably access provided by the highway system as opposed to the presence of a highway system in an area that matters to firms. Some respondents may feel that congested highways are of little help.

Second, it seems to the authors that it is critical that the type of business be considered when analyzing the level of dependency of the business on the highway system. For instance, service industries tend to serve mostly an intra-metropolitan area-wide market; if congestion is an externality associated with inadequate transportation, then there is a feeling that it affects all competitors equally and there is a 'level playing field' (Cambridge Systematics, 1994). Hence, although urban congestion may significantly impact business in the service sector, it is viewed as a part of doing business in urban areas. The above-mentioned study also found that congestion costs were passed through to business and because firms do not internalize for those costs of congestion, they do not account for and measure those costs in ways that directly influence decisions.

These firms may be trading-off the benefits of agglomeration economies, which are very relevant to service activities, against the costs of congestion. Markets for manufacturing industries, on the other hand, have shifted to national and international levels. For these industries, the distribution of the national level system and access to the interstate system and major airports may be very important.

A parallel issue to be considered is: if transportation costs and congestion become very high, will firms relocate to some other location? The answer is not straightforward because relocation costs can be significant. In addition to the long life and immobility of fixed capital, relocation costs include less quantifiable considerations such as search costs for a better location and possible loss of key employees. The expected benefits of a new location must be at least as great as the cost of moving before a firm can be rationally expected to relocate.

Thus, several factors determine the manner in which firms react to congestion. Effects are likely to vary by type of industry and by perceived relocation costs. The empirical literature on firm location shows that adequate highway capacity is a factor for new firm location but in certain cases, other factors such as perceived agglomeration benefits may override high costs imposed by inadequate highway capacity.

### **3.3.2 Survey of Companies in DuPage County, Illinois**

To find the land-use and transportation characteristics that impact firm location, we conducted a survey of a random sample of businesses in DuPage County, Illinois. The objective was to understand firm relocation patterns in the Chicago area (where firms currently located in DuPage County came from). Firms were also asked to indicate if their firm had to relocate, which location they would relocate in.

The survey also identified patterns of preferences in land use and transportation by type of industry. One of the major points of interest in the survey was that it included stated preference questions to elicit from respondents the type of land-use attributes that would be an attraction for location. Firms were asked to indicate their preference for one of six subareas in the six-county region: (A) Chicago CBD, (B) Rest of Chicago, (C) Inner suburbs, (D) Outer suburbs, (E) Any of the above and (F) None of the above. Respondents were also asked to rank economic, cultural and regulatory factors that affect location choice.

The survey indicated that if the firms currently located in the suburbs had to relocate within the six-county greater Chicago region, they would mostly prefer to relocate to another site in the suburbs, with a greater preference stated for the outer suburbs. This includes firms that had moved out from the City of Chicago at some time in the past.

Relocation choices within the six-county region are significantly related to where firms relocated

from, to their current DuPage County location ( $\chi^2 = 18.24, p = 0.05$ ). About 87% of the firms that started their businesses in their current locations continued to prefer inner or outer suburbs. About 67% of the firms that relocated from Chicago would prefer be in the inner or outer suburbs. Only about 17% of these firms indicated a preference for the city of Chicago. If the firms had a choice to move to an alternative site anywhere (including overseas), most would move to the outer suburb of a large city. Inner suburbs of large cities and suburbs of medium and small cities were also indicated to be preferable over locating in the central city.

The survey found that firms would consider many different factors in selecting a new location. Proximity to customers, employees and production inputs are the major dimensions determining stated company location preferences. Transportation and land are also important. Needless to say, firm location decisions are related to the type of industrial sector that a firm belongs to.

In addition to the survey which yielded a rich, quantitative dataset that was analyzed to understand patterns of factors affecting firm location, we also conducted some detailed interviews of individuals who are intimately familiar with firm location criteria. These interviews revealed that access to skilled labor, access to key markets and the transportation system are still the major reasons firms locate in the Chicago area. One of the reasons why firms do not like to locate in the central city is a perceived lack of available land and lack of potential for physical expansion of facilities. The size of the parcel of land was definitely an issue with firms, since many of them aspire to have 'campus-like' developments. Detailed questioning also revealed that perceived crime and congestion issues were disincentives in the central city.

*A survey of firms currently located in a suburban area of Chicago indicated that if they had to move from their current location, they would prefer to move to another site which had the same land-use and transportation characteristics as their current location. If this is not possible and they had to move out of the area altogether, they would prefer to move to outer suburban areas of large cities or the suburbs of small or medium cities.*

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