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Transportation Needs of Disadvantaged Populations: Where, When, and How?

FEBRUARY 2013

FTA Report No. 0030
Federal Transit Administration

PREPARED BY

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Metric Conversion Table

SYMBOL	WHEN YOU KNOW	MULTIPLY BY	TO FIND	SYMBOL
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
NOTE: volumes greater than 1000 L shall be shown in m^3				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC

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13. ABSTRACT
Transportation needs of disadvantaged populations (persons with disabilities, older adults, and the poor) are explored, and a methodology to address transit markets is examined to determine where, when, and how to provide for basic mobility needs assuming pedestrian and transit-accessible community development. Interrelated and innovative strategies are suggested that weave together suggestions for both the disadvantaged and those who would support a growing economy. Consequently, pathways for the whole population are envisioned.

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FOREWORD

The Federal Transit Administration (FTA) sponsored this research to develop a better understanding of the following: 1) the transportation difficulties faced by low-income workers in their jobs and job-related trips, especially when dependent upon transit services; 2) where affordable housing might be built and transit supplies provided to minimize the difficulties of transit commutes; and 3) what innovative community designs might be employed to mitigate those difficulties over the long term.

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ABSTRACT

The transportation needs of the disadvantaged population (persons with disabilities, older adults, or the poor) are explored, and a methodology to address transit markets is examined to determine where, when, and how to provide for basic mobility needs assuming pedestrian- and transit-accessible community development. Interrelated and innovative strategies are suggested that weave together suggestions for both the disadvantaged and those who would support a growing economy. In the process, pathways for the whole population are envisioned.

EXECUTIVE SUMMARY

According to the 2010 census, 41.8 million Americans age 18+ have disabilities, 40 million are age 65+, and 32 million are living below the poverty level (for those above age 18) (U. S. Census Bureau 2010). Many of these people have very few mobility options to meet their basic travel needs and, as members of the transportation disadvantaged population, they face chronic problems that reduce their quality of life and productivity.

Providing adequate transit services to the disadvantaged population in most U.S. predominately sprawling areas has been hindered by a land-use pattern and community designs that are not supportive of public transit development. Urban sprawl has made people more and more dependent on driving privately-owned vehicles in their daily lives. Higher car usage reduces transit use. As job locations become increasingly dispersed, transit services in central business districts and corridors are no longer adequate.

The spatial mismatch of jobs and residences for low-income families has been a well-known problem that has not been dealt with effectively, given land-use patterns and community designs that suppress transit demand and a lack of capital and operating funding for transit properties. Two related problems faced by low-income households and workers are the rapid rise of the cost of housing, which has shrunk the choices of residences available that have transit access to jobs, and higher-capacity transit services that are typically provided more frequently during peak commuting hours and do not address access many service jobs that are often taken by low-income workers who do not have a regular 9-to-5 schedule.

Using a combination of data sources, this report suggests a methodology to assess transit markets in terms of the residential and job locations that provide choices for low-income households; determines the temporal distribution of transit demand; analyzes the housing availability to low-income families in relation to job location; and evaluates existing transit services for improvements and potential development opportunities in Miami-Dade County.

It is suggested that 1) the highway system and communities that are linked to it could be built to last; 2) demand can be adjusted to fit capacity; 3) the system of multimodal transport could be very simple to use; 4) the many people to be seen and things to be done could be accomplished best when traveling on foot; and 5) a mobility and accessibility computer program could improve use of a quickly-assembled multimodal transportation system that used Advanced Transit-Oriented Developments and express bus service to expand on existing transit and passenger rail services. By this means, the transportation needs of the general population and the transportation disadvantaged will be addressed.

By building a cost-effective, rapid, and financially self-sufficient multimodal system that assumes the last mile of every trip will be on foot or via community transit, both the general traveling public as well as the older adults, persons

with disabilities, and the poor will be lifted up and provided with affordable transportation choices and opportunities for economic success and an increasingly higher quality of life while adapting to the challenges of climate change and global competition.

SECTION 1

Introduction

According to the 2010 U.S. census, 41.8 million Americans age 18+ are persons with disabilities, 40 million are age 65+, and 32 million are living below the poverty level (for above age 18) (U. S. Census Bureau 2010). Poverty level is determined by comparing a person's total family income with the poverty threshold appropriate for that person's family size and composition. Many of these people have few or no mobility options to meet their basic travel needs. For example, many older adults are accustomed to the freedom and flexibility of car ownership, and persons with disabilities require special transportation options to accommodate specific disabilities. Low-income workers often require the most flexible transportation options, because many work second or third shifts when public transit level of services may be relatively low.

In a larger context, providing adequate transit services to the disadvantaged population in most U.S. urban areas has been hindered by a land-use pattern and community design that are not supportive of public transit development. Urban sprawl spreads low-density development over large geographic areas. Single-use zoning is a product of urban sprawl development, where commercial, residential, institutional, and industrial areas are separated from one another. Consequently, the distance between places where people live, work, shop, and recreate are too long to walk or bike. This pattern increases auto dependency in daily life and, as a result, transit use decreases. A number of reasons encourage urban sprawl, such as lower house prices, more comfort and freedom, and higher privacy. However, problems such as air and noise pollution, obesity, increase in the cost of personal transportation, and infrastructure, are reasons that make urban sprawl far from smart urban growth.

As job locations become increasingly dispersed, transit services at fewer central business district (CBD) oriented corridors are no longer adequate to support the transit needs for the transportation disadvantaged and low-income workers.

Dispersed housing, employment, and other destinations important for daily activities strain the limited resources of transit properties, requiring frequent stops at a multitude of dispersed destinations and preventing them from providing rapid or high-level services to all destinations at all times. This, in turn, reduces accessibility for low-income workers to jobs not concentrated in a CBD as well as accessibility for low-income families to services and other activities. The spatial mismatch of jobs and residences for low-income families has been a well-known problem, but has not been dealt effectively, given land-use patterns and community designs that suppress transit demand and a lack of capital and operating funding for transit properties. Two related problems faced by low-income households and workers are the rapid rise of housing, which has shrunk the choices of residences available that have transit access to jobs; and higher-capacity transit services that are typically provided more

frequently during peak commuting hours and do not address access to many service jobs that are often taken by low-income workers who do not have a regular 9-to-5 schedule.

Transit-oriented development (TOD) has been seen as effective for creating housing opportunities for low-income families and improving mobility and accessibility to jobs. For successful deployment, TODs need to be located near premium transit stations such as heavy rail, light rail, or bus rapid transit (BRT) services and should possess a number of characteristics: mixed land use; mixed-income housing; increased density; frequent and fast transit to desired destinations; parking supplies; adjacent transit stops that serve the needs of the automobile-oriented catchment areas located beyond ¼- to ½-mile walking distances; and a transit-accessible and safe built environment within ¼ to ½ mile from the transit stations and stops that support pedestrian access to transit.

The purpose of this project was to use a combination of data sources, including the Census Transportation Planning Package (CTPP), employment, and housing data, to develop a methodology to assess the transit markets in terms of residential and job locations for low-income households; determine the temporal distribution of transit demand, especially for off-peak periods; analyze the housing availability to low-income families in relation to job locations; and evaluate existing transit services for improvements and potential development opportunities.

The project aimed to develop a methodology to assess the transit markets in terms of residential and job locations and provide for basic mobility needs for the transportation disadvantaged population, especially for low-income working families, and suggest land development strategies to better manage transportation needs.

This study focuses on Miami-Dade County, where public housing and subsidized rental facilities are located outside the walking distance of Metrorail and Metromover. Also, many low-income jobs such as retail jobs are not near Metro stations. Traveling by bus is slow, less direct, and expensive. However, if each transit stop had a buffer area of ½ mile or less with an improved pedestrian orientation, a very high percent of residents within Miami-Dade County (80% or so) would find access to transit services and might find good reason to use public transit systems in higher numbers.

SECTION 2

Literature Review

Significant effort has been devoted to addressing the transportation needs of disadvantaged populations in the past by federal, state, and local governments and by researchers. This literature review covers the following topics:

- Definition of disadvantage populations
- Background of low-income working families
- Availability of affordable housing
- Transportation needs for low-income working families
- Mismatches between jobs and housing
- Factors affecting transit use
- GIS analysis of transit accessibility and job availability

Low-Income Working Families

Two poverty measures were explored in this study. The first is poverty threshold, which is the original version of the federal poverty measure. Poverty thresholds are updated each year by the U.S. Census Bureau and are used mainly for statistical purposes. The second measure is poverty guidelines, which are issued each year in the *Federal Register* by the U.S. Department of Health and Human Services (DHHS). The guidelines are a simplification of the poverty thresholds for use for administrative purposes—for example, for determining financial eligibility for certain federal programs. The 2006 poverty guidelines published by DHHS are shown in Table 2-1 (DHHS 2006).

Table 2-1
2006 DHHS Poverty Guidelines

Persons in Family or Household	48 Contiguous States and DC	Alaska	Hawaii
1	$ 9,800	$12,250	$11,270
2	13,200	16,500	15,180
3	16,600	20,750	19,090
4	20,000	25,000	23,000
5	23,400	29,250	26,910
6	26,800	33,500	30,820
7	30,200	37,750	34,730
8	33,600	42,000	38,640
For each additional person, add	3,400	4,250	3,910

The Working Poor Families Project (WPFP) was launched in 2002 by national philanthropic leaders who saw the need to strengthen state policies that may critically affect the lives of low-income working families. The purpose of WPFP is to strengthen state policies and help state policymakers understand the importance

of supporting low-income working families and the policies that lead to greater opportunities for low-income working families to progress and achieve economic security and mobility. In this project, the low-income working families refers to families earning up to 200 percent of the federal poverty guidelines because these families, although not in official poverty status, have trouble ensuring a basic quality of life for themselves. That is, for a family of four, an income up to $40,000 in 2006 would be considered low (Povich 2006).

Since 2002, WPFP has been working on the following four subjects:

- Improving the conditions of employment – provide worker protections, such as unemployment insurance and workers compensation. These policies are particularly crucial to low-income workers who historically have been much less likely to receive health insurance through their employers.
- Expanding education and training opportunities – translate increased educational attainment into higher wages and better workplace opportunities.
- Focusing economic development to benefit low-income workers.
- Strengthening performance standards and accountability - publicly report progress toward established goals, which can help policy makers and the public determine if desired objectives are being achieved.

The Urban Institute (2005) provided information on low-income working families and the challenges they face. They report the following facts, derived from data from the 2002 National Survey of American Families:

- One-quarter of America's children live in low-income families with a working parent.
- Low hourly wages explain why these working families have low-incomes.
- Low-income working families receive fewer job benefits than middle-income families.
- Low-income working families face greater food and housing hardships.
- Childcare can be a large expense for low-income working families in which the mother works.
- Compared to middle-income working families, low-income working families are disproportionately non-white and immigrant, although most are headed by native-born, white, and non-Hispanic adults.
- Health problems are more prevalent among low-income working families.
- On an average, children in low-income households fare worse than children in higher-income households on a host of indicators.

- With the job market downturn, families are working less and have lower incomes.
- Few low-income working families receive welfare benefits; half receive help with a parent's or child's health insurance.

The U.S. Bureau of Labor Statistics (BLS) (2005) defined the working poor in 2003 as workers who worked for 27 weeks or more but whose incomes fell below the official poverty threshold. Based on the 2004 Annual Social and Economic Supplement to the Current Population Survey (CPS), which was a monthly survey of 50,000 households conducted by the U.S. Census Bureau, the BLS provided the following profiles of the working poor:

- Fourteen million people were in the labor force for a minimum of 27 weeks in 2003. Of those who were employed full-time, 3.8 percent were classified as working poor, compared with 10.6 percent of part-time workers.
- Although working full time helps a worker avoid be working poor, 60 percent of the working poor worked full time.
- Higher levels of education help to reduce the likelihood of a worker being working poor. Among college graduates, only 1.7 percent were working poor, compared with 14.1 percent of people with less than a high school diploma.
- Women who maintain families were twice as likely as their male counterparts to be among the working poor.

As for children living in low-income households, the National Center for Children in Poverty (NCCP) of the Mailman School of Public Health at Columbia University found that the number of children living in low-income families had increased in 2004. After analyzing the March 2003 supplement of CPS survey, it was found (NCCP 2004):

- Parents of most children in low-income families were employed full-time and year-round.
- Many low-income parents who work part-year or part-time are unable to find full-time/year-round employment.
- Most low-income parents who did not work at all were either persons with disabilities or were unable to work because of the need to take care of their families.

For low-income single working mothers, Polit et al. (2001) found that even among women who had been working the most stably, the majority had low-wage jobs with earnings that put their families below the official poverty level despite strong economic growth in the late 1990s. The following story about a woman from one of the poorest neighborhoods in the country shows a clear picture:

> *Anna, age 39, emigrated from Cuba to Miami when she was 20. Separated from her husband, she was living with her two teenage children and worked 60 hours per week: 35 hours as a cook in a restaurant (where she had been working for 3*

years) and 25 hours in a retail sales job (which she had held for 8 months). Anna's take-home pay from her restaurant job, which offered paid vacation and health insurance but no sick pay, was $190 per week; her second job added about $100 weekly. Her total annual earnings to support herself and her two kids were about $15,000. She had left cash welfare and no longer got food stamps, although she appeared to be eligible. She got no housing assistance, either, and spent about 50 percent of her earnings on housing. Anna's two children did not have health insurance.

In the above story, Anna lived in Miami, where the median household income was $40,266 (compared to $44,853 nationally), and the median value of owner-occupied housing units was $124,000 (compared to $119,600 nationally), according to the 2000 census. The ratio of 3.08 between median housing value and median household income points to a lack of affordable housing. Note that a household income of $40,000 has been used as a threshold for low-income families.

Availability of Affordable Housing

The availability of affordable housing and accessibility to public transportation is a major problem confronting numerous metropolitan areas. According to the Department of Housing and Urban Development (HUD) (2005), Housing is affordable if a low- or moderate-income family can afford to rent or buy a decent-quality dwelling without spending more than 30 percent of its income on shelter. The availability of affordable housing in Miami-Dade County has come to the forefront of public interest and has sparked countywide attention.

Currently, the continuously rising housing prices in Miami-Dade County are not just a concern for low-income persons, older adults, and persons with disabilities in the county, but they also plague the people of middle class, who work as educators, policemen, firemen, and other public servants (Fields and Staletovich 2006). According to the Department of Planning and Zoning of Miami-Dade County, in the four-year span from 2000–2004, the cost of new homes and condominiums increased by 30 percent, and the cost of existing homes grew more than 70 percent. Yet the average incomes in the county have not increased proportionately. In the same four-year span, standard earnings increased only 6.1 percent (Miami-Dade County 2005).

In addition to increasing house prices, property taxes and insurance are the other two major components of the affordable housing debacle. In South Florida, a $500,000 house could have property taxes that easily surpass $12,000 per year or $230 per week (Fields and Staletovich 2006). Moreover, homeowner's insurance policy prices have tripled since Hurricane Andrew slammed South Florida in 1992.

Even though the storm seasons of the last five years have been calm, having eight storms hit Florida in 2004 and 2005 is a key reason why insurers are seeking

outsized rate increases. In Miami-Dade County, homeowners pay for windstorm insurance at about $24.84 per $1,000 of coverage from Citizens Property Insurance, a State-owned non-profit insurer. For example, buying $200,000 coverage for a home in Miami-Dade County could cost $4,968 per year (Garcia 2006).

According to Out of Reach, an annual report published by the National Low-income Housing Coalition (NLIHC 2009), in Miami-Dade County for a household to rent a two-bedroom apartment without spending more than 30 percent of its income, the annual income would be $46,240 annually in 2009; the county median income was $50,800. This means that even in 2009, after housing prices dropped significantly and returned to the 2004 level, a significant percentage of households were still unable to rent a two-bedroom apartment.

The Florida Housing Data Clearinghouse estimated that in Miami-Dade County, affordable housing demand in 2008 was 143,216 households, or 17.4 percent of 822,438 households, and this demand would continue to increase over the next 30 years (see Tables 2-2 and 2-3). For U.S. housing subsidies, households are categorized by federal law as follows:

- Very low-income households have an income no more than 50% of AMI
- Low-income households have an income between 50% and 80% of AMI
- Moderate income households have an income between 80% and 120% of AMI

Table 2-2

Projected Affordable Housing Needs for Renters, 2008–2030, Miami-Dade County

Household Income	2008	2010	2015	2020	2025	2030
0–30% AMI*	49,544	52,244	54,803	58,016	61,234	64,363
30.1–50% AMI	25,914	27,307	28,522	30,047	31,511	32,903
50.1–80% AMI	7,790	8,204	8,540	8,983	9,400	9,794
Total	*83,248*	*87,755*	*91,865*	*97,046*	*102,145*	*107,060*

*AMI = area median income

Table 2-3

Projected Affordable Housing Needs for Owners, 2008–2030, Miami-Dade County

Household Income	2008	2010	2015	2020	2025	2030
0–30% AMI*	20,795	21,985	23,273	24,872	26,588	28,329
30.1–50% AMI	19,706	20,820	21,940	23,343	24,809	26,303
50.1–80% AMI	19,467	20,516	21,381	22,445	23,497	24,506
Total	*59,968*	*63,321*	*66,594*	*70,660*	*74,894*	*79,138*

*AMI = area median income

The South Florida Community Development Coalition (SFCDC 2002) pointed out that the affordable housing crisis in Miami-Dade County was the result of an increase in the number of poor residents, a decrease in the number of housing units available, and high housing prices. Consequently, it is impossible for low-income workers and their families to live in safe, decent, and affordable housing.

To enhance housing opportunities for low- and moderate-income individuals and families, the Miami-Dade Housing Agency (MDHA) implemented a wide range of housing programs to assist individuals, families, developers, and community development corporations for encompassing acquisition, construction, rehabilitation, reconstruction, and permanent financing. MDHA uses county, state, and federal funds in conjunction with private funds. The following is a list of available programs (MDHA 2006):

- Public housing for the most disadvantaged members of the community, i.e., extremely low-income, older adults, or persons with disabilities.
- Subsidized rental housing for persons with low and moderate income. Housing is privately-owned, and residents generally pay 30 percent of their adjusted income towards rent.
- Get Help with Buying offers a variety of affordable housing services for low- and moderate-income individuals and families through MDHA's Development and Loan Administration Division (DLAD).

MDHA manages more than 11,000 units of public housing in 100 family and older-adult developments, has contractual agreements with 7 private companies for property management services, provides for subsidized payments for 16,000 units, and administers an array of specialized housing opportunities for special populations and the homeless (MDHA 2006). Table 2-4 shows the income limits adjusted by family size when determining the eligibility of application. In Miami-Dade County, at least 40 percent of new admissions must be of extremely low-income (30% of area median income or below) and the remaining 60 percent of new admissions can be up to the low-income level (80% of the area median income).

Table 2-4

Income Limits Adjusted by Family Size for Fiscal Year 2006, Miami-Dade County

Family Size	Extremely Low-income (30% of Median Income)	Extremely Low-income (50% of Median Income)	Low/Moderate Income (80% of Median Income)	Median Income
1	$11,750	$19,550	$31,300	$39,100
2	$13,400	$22,350	$35,750	$44,700
3	$15,100	$25,150	$40,250	$50,300
4	$16,700	$27,950	$44,700	$55,900
5	$18,100	$30,200	$48,300	$60,400
6	$19,450	$32,400	$51,850	$64,800
7	$20,750	$34,650	$55,450	$69,300
8+	$22,100	$36,900	$59,000	$73,800

Source: MDHA 2006

In addition to MDHA's programs, as approved by voters in a November 2, 2004, referendum, the Building Better Communities General Obligation Bond Program provided $2.9 billion in a 15–20 year time frame to fund more than 300 capital

improvements in Miami-Dade to provide low- and moderate-income residents of Miami-Dade County with quality affordable housing opportunities. These initial projects include community improvements in parks, recreation and green space; culture and education; affordable housing; public safety; infrastructure; healthcare; and business development. For the affordable housing program, commissioners presented a check for $5 million to the City of Hialeah to help fund construction of 300 new affordable housing units on 7.02 acres of Hialeah-owned or recently-acquired land (Miami-Dade County 2006).

To address the affordable housing problem, various strategies and programs have been proposed. Recognizing the importance of the land use–transportation connection, these strategies not only focus on housing and economic development policies, but also on transportation. In a report published by FIU/FAU Joint Center for Urban Studies (1999), 41 incentives were recommended to encourage infill development. The following recommendations are from the report:

- Public Entrepreneurship: involves public sector's activities in assembly and conveyance of land along with possible fiscal incentives for private investment.
- Land Banking: the purchase of land by a governmental entity with the intent of controlling its future use.
- Incentive Zoning: under incentive zoning, a developer may be encouraged to erect a building in a way that is not usually permitted in that district under the community's zoning ordinance in exchange for providing certain amenities.
- Inclusionary Zoning: to ensure the inclusion of very low, low, and moderate income housing within a given political jurisdiction.
- Mixed-use Zoning: combination of different land uses on the same or adjacent lots or within the same building or complex.
- Planned Unit Development: a device that allows a development to be planned and built as a unit.
- Joint Development: real estate development that is closely linked to public transportation services and stations and relies to a considerable extent on the market and locational advantages provided by the transit facility.
- Commuter Rail Service on FEC Corridor (potential): the FEC corridor is closer to many downtown areas but without commuter service.
- Transit-Oriented Development: an approach that emphasizes securing a high density level, combining a mix of uses, utilizing a hierarchy of streets and designing at a human scale to maximize the potential for transit use within a community.
- Traditional Neighborhood Development: similar to TOD and gives additional emphases on integrating civic uses (e.g., community center, church) and open space into the development.

- Section 380 Regional Activity Center: a compact, high density multi-use area designated as appropriate for intensive growth by the local government of jurisdiction.
- Regional Development District: a geographic area specifically designated as highly suitable for increased threshold intensity in the approved local comprehensive plan and the applicable strategic regional policy plan.
- Transportation Concurrency Exception Area: an area within which local government grants an exception from the concurrency requirement for transportation facilities.
- Area wide or Downtown Development of Regional Impacts: two alternative forms to the standard DRI process in addressing generally large areas or the downtown areas.
- Enterprise Zone: a specific geographical area with a set of policies designed to encourage local businesses to take advantage of tax incentives and other public assistance with the hope of generating investment that leads to employment growth.
- Enterprise Communities and Empowerment Zones: encourage investment in designated distressed areas by providing a combination of direct grants, tax incentives and priority consideration for flexibility in the use of funds.
- Tax Base Sharing (potential): a mechanism through which fiscal benefits of growth within a metropolitan area can be shared by all residents, regardless of where the actual development occurs.
- Preferential Taxation: the use of tax credits or deductions as incentives for preserving or creating socially desired land uses.
- Fee Reduction or Waivers: reductions of permit or impact fees for infill/ redevelopment projects.
- Community Development Block Program (CDBG): financing programs for both commercial and residential rehabilitation, construction of infill-housing, and infrastructure improvements in areas predominantly with low- and moderate-income residents.
- Neighborhood Improvement District: an area defined in Sec 163.503, F.S., where there is a plan to reduce crime through the implementation of environmental design, environmental security, or defensible space techniques for crime prevention.
- Expanded University Small Business Assistance Programs: providing expanded university small business assistance programs will help to nurture and retain small business within the Corridor.
- Community Policing: includes community activities to assist the delivery of policing programs.

Addressing rental housing challenges, the Joint Center for Housing Studies at Harvard University recommended that affordable housing developments be located in areas with poverty rates in the 10–20 percent range to avoid poverty concentration (2007). Among the many other recommendations, one was to condition federal transportation aid and other federal assistance on progress in reducing regulatory barriers, and another was to link housing development planning to transportation planning. For example, the federal government could provide funding to encourage Metropolitan Planning Organizations (MPOs) to form partnerships with regional housing agencies to develop regional housing strategies that would complement regional transportation plans. Such an approach was believed to be able to lead to increasing the returns of both housing assistance and transportation funds.

Transportation Needs for Low-Income Working Families

Low-income working families rely on public transportation not only to get to work, but also to access the many activities that are required to maintain employment, such as traveling to child care providers, health care facilities, and job training sites. Such transportation needs can be met in most American families by either driving their own cars or through the use of public transportation where it is provided (Friedman 2004). In typical sprawl communities, walking and bicycle trips are not a significant option, and in many such communities where transit services are limited and time-consuming, most families use car trips for most job and job-related trips.

Average Costs of Transportation

The high costs of car-based transportation (especially when configured as single-occupant trips) can trap low-income families in poverty, since the lack of transportation is a major disincentive to employment. Based on an analysis of the 2001 Consumer Expenditure Survey, Canby (2003) concluded that transportation costs had increased steadily over the past century and had become the second biggest expense after housing for American families. The author found that the poorest one-fifth of Americans spent approximately 39 percent of the average household income (less than $14,000 per year) on transportation in 2001. The following example was provided to illustrate the point that car ownership and use typically will cost more than the use of transit to work trips:

> *Transit typically costs $800 to $1,500 per worker, per year. By comparison, the average car costs more than $6,000 per year to own and operate, but even the least expensive car can cost $3,000 per year in insurance, fuel, repairs, and other miscellaneous expenses. Accordingly, a worker can spend at least 50% less, per year, by using transit services instead of personal vehicle.*

On the average, Americans spend nearly 60 percent of their incomes on housing and transportation, which is surprisingly constant, whereas the share of income devoted to housing or transportation varies from area to area (Lipman 2006). The average American household spends approximately 18 percent of its income on transportation, and lower-income families spend as much as 33 percent. In their search for lower-cost housing, working families often locate far from their place of work, dramatically increasing their transportation costs and commute times and creating a market for continued sprawl. After repeated cycles of moving housing outwardly from current jobs to reduce housing costs, it is easy to understand why, for many such families, their transportation costs exceed their housing costs (FTA-HUD 2008).

Understanding Auto vs. Transit Mode

Of the 28 metropolitan areas in which data were available, places with sprawling land-use patterns had fewer transportation choices and higher transportation costs (Canby 2003). For example, in Tampa, Phoenix, and Dallas-Fort Worth, known for long commuting times in privately-owned vehicles, individuals spent 20–24 percent of the average household budget on transportation.

Transportation-related spending accounted approximately 15 percent of household income in Portland, Oregon, Washington, DC, and Honolulu. Glaeser et al. (2001) found that about 35 percent of people worked more than 10 miles away from home in the 100 largest metropolitan areas in 1996 while only 22 percent of people worked within 3 miles of the city center. Fisher and Weber (2002) conducted several studies of metropolitan labor markets and found that most new entry-level jobs are located in the suburbs. Welfare recipients and other low-skill workers who qualify for these jobs often do not own private vehicles due to maintenance and insurance costs to commute from the city to the suburbs. Further, public transit systems and schedules are often not designed for this type of commute.

Rice (2004) explored the role that vehicle and transit expenditures play in household budgets, both in California's metropolitan areas and in the Bay Area. She analyzed this expenditure data, estimated costs for various commutes in the Bay Area, and explored mode choices and other travel factors that influenced monetary costs. It was found that low-income households, defined as those in the lowest 25 percent of the income distribution in the state's urban areas, allocated a slightly smaller proportion of their household expenditures to transportation than did higher-income households. Across all forms of transportation, average annual expenditures among low-income households came to $2,164, which accounted for 13 percent of their household budgets. Higher-income households spent an average of $6,569 annually on transportation, which represented 15 percent of their budgets. Vehicle ownership rates were substantially lower for the low-income population than for others.

In the Bay Area, only 53 percent of low-income workers drove alone to work compared to 70 percent of higher-income workers. Low-income commuters were also more likely to carpool, walk, or travel by bus. Low-income households that used transit regularly spent an average of $360, or 2 percent of their total expenditures, on public transit. Factors such as route location, service frequency, and punctuality appeared to be more important than transit costs. About 17 percent of low-income workers carpooled compared to 12 percent of other workers; 12 percent took the bus to work compared to 5 percent of others; and 7 percent walked to work compared to 3 percent of higher-income workers. Use rates for light rail, trolley, ferry, and bicycle were similar across the two income groups.

Rice noted that although low-income households spent a slightly smaller share of their budgets on transportation than did more affluent households, the findings did not provide definitive answers about whether transportation was affordable, since affordability cannot be simply inferred from expenditure data alone. She also noted that no single policy solution was likely to make transportation affordable for all low-income families. Policies should, therefore, accommodate differences in the geographical distribution of jobs and workers, as well as the needs of specific subgroups, such as households with children or those with extremely low-incomes.

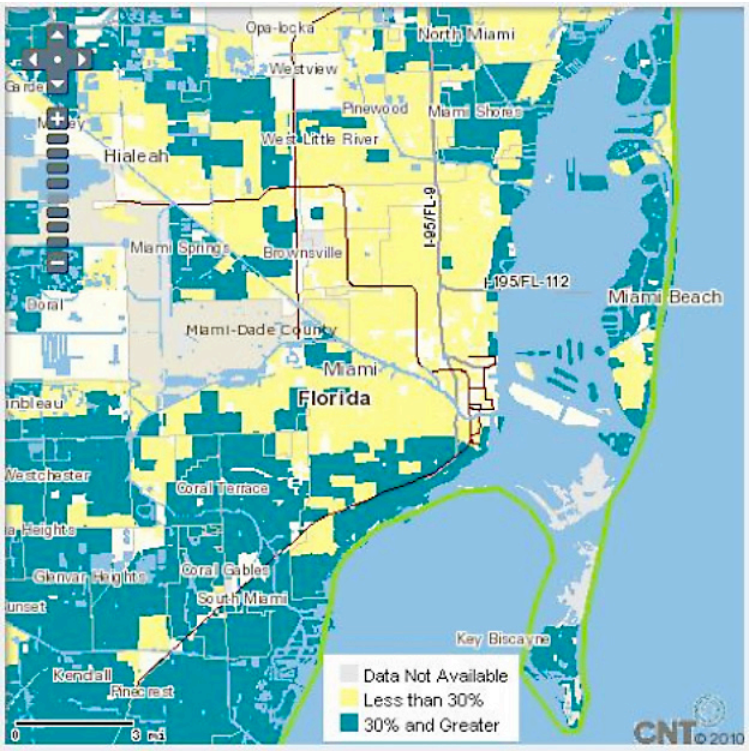
Housing and Transportation Issues

It is well understood that housing and transportation costs are simultaneously considered when people make decisions about choice of housing locations. Housing prices also reflect accessibility to jobs and other social and economic opportunities. To provide a more meaningful measure of affordability, the Center for Neighborhood Technology (CNT) developed a Housing + Transportation Affordability Index (CTOD/CNT 2006). Instead of using 30 percent of household expenditure on housing as a threshold measure of housing affordability, the Housing + Transportation Affordability Index also takes into account the cost of transportation costs associated with a given location (HTAI 2010), with affordability defined as an expenditure on housing and transportation of no more than 45 percent of household income.

The concept of Housing Affordability and Housing plus Transportation Affordability Index is illustrated in Figures 2-1 and 2-2, respectively. Figure 2-1 shows the areas where housing is considered affordable in Miami-Dade County based on the criterion of no more than 30 percent of household income being spent on housing. Figure 2-2 shows which areas in the county are considered affordable based on the criterion of no more than 45 percent of household income being spent on housing and transportation. The data used were from the 2000 census. It can be seen from Figure 2-1 that most of the central and northern parts of the county were affordable in 2000. However, when the transportation cost was considered, the areas that were affordable shrank considerably, as shown in Figure 2-2.

Figure 2-1

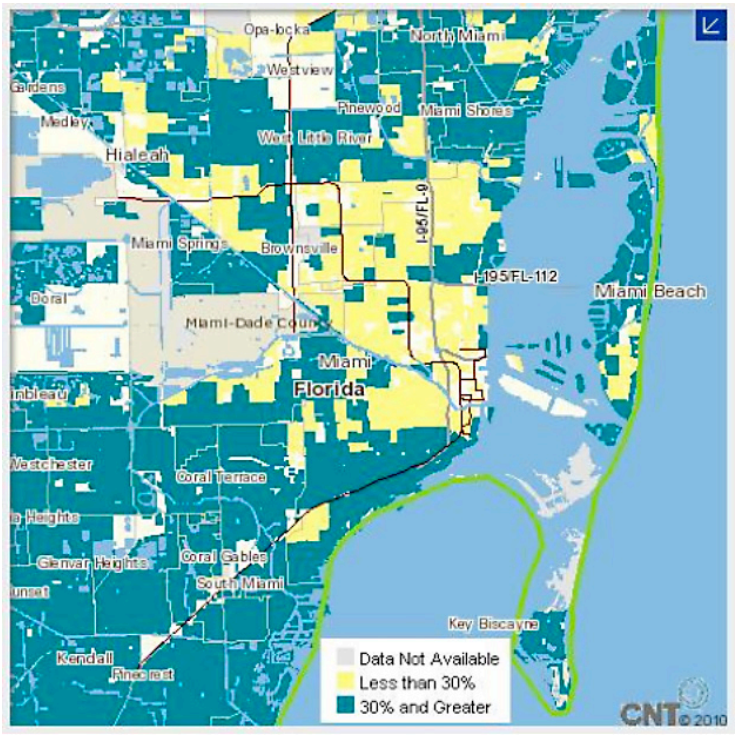
Housing Cost as a Percentage of Income, Miami-Dade County



Source: CNT web site, http://htaindex.cnt.org/mapping_tool.php#region=Miami%2C%20FL&theme_menu=0&layer1=23&layer2=24.

Figure 2-2

Housing and Transportation Cost as a Percentage of Income, Miami-Dade County



Source: CNT web site, http://htaindex.cnt.org/mapping_tool.php#region=Miami%2C%20FL&theme_menu=0&layer1=23&layer2=24.

Overcoming Barriers

The lack of reliable and affordable transportation was one of the reasons for low-income families staying in poverty. Canby (2003) suggested providing adequate public transit to give low-income families increased economic opportunities. However, it was observed fact that fewer than 50 percent of Americans reported living within ¼ mile of a transit stop (Canby 2003). Therefore, Canby suggested that low-income and minority communities be served by high-capacity transit investments pursued in more than 47 of the nation's 50 largest metro areas. Building a network of premium transit services that include rail or BRT is, however, difficult because of high costs, the lack of resources, existing land use unsupportive of high-capacity premium transit systems, and existing transit operational subsidies that stress local funding capabilities.

One contributing factor to the difficulty of low-income workers to find employment or better-paying jobs is the mismatch between jobs and housing, which increase the spatial separation between them and transportation costs. These mismatches have been a longstanding concern of urban economists and transportation planners and are often described in terms of affordability, especially when workers decide that they cannot afford to accept jobs that involve burdensome commutes. In the past, many studies have focused on the spatial mismatch of job and home locations of low-income workers, low-income single mothers' travel needs, and transit service planning for disadvantaged populations.

Rosenbaum (1995) found that geographic distances between home and work made job searches difficult and imposed high commuting costs on low-wage workers who are least able to afford these expenses. Ong and Blumenberg (1998) recommended policies in the areas of local economic development, transportation, and housing that would increase welfare recipients' access to low-wage jobs and lower commuting costs, and, consequently, to improve the employment prospects of low-wage workers.

Blumenberg and Manville (2004) stated that "spatial barriers" is a more suitable and broad term to describe the spatial mismatch problem. Spatial barriers are the result of either long travel distances or long commute times. In the central city, travel times may be quite long, even over short distances, especially for people who rely on public transportation due to the time spent on walking to and from stops, waiting at transit stops and for transfers, and frequent vehicle stopping along the way. Even in cities with good transit services, transit travel times are, on average, much longer than automobile travel times. Consequently, for welfare recipients relying on public transit, the jobs they can reach are fewer than those who travel by automobile. Bania et al. (2000) examined the number of entry-level jobs accessible by public transportation in Cleveland and showed the transit-dependent suffered heavily in comparison to those who had automobiles. For example, a 20-minute car commute gave a welfare recipient access to

12.8 percent of the area's entry-level jobs. That percentage dropped to 2 for a 20-minute transit commute.

Cervero et al. (2002b) conducted a regression analysis to examine whether private car ownership or transit services can better help improve the employment status of people lived in Alameda County, California. The authors specified a multinomial logit model to estimate the probability that someone found employment as a function of the explanatory variables of car ownership, transit service quality, and regional job accessibility by different transportation mode. The result indicated that car ownership significantly increased the odds that someone switched from welfare to work along with human-capital factors such as education level. Neither of the variables related to transit service quality nor was regional accessibility a significant predictor in explaining employment outcomes. The authors concluded that private car ownership was more effective in helping former welfare recipients find employment. This is not surprising given the higher mobility a car offers compared to public transit. However, the authors did find that people who lived within walking distances of transit stops or were able to ride to them had a better chance of finding employment.

Sanchez et al. (2004) conducted a similar regression analysis to examine the importance of transit access in explaining the ability of TANF recipients to find gainful employment in the Atlanta, Baltimore, Dallas, Denver, Milwaukee, and Portland (Oregon) metropolitan areas. An ordered multinomial logit model was estimated to predict the probability for TANF recipients to find employment as a function of explanatory variables of age, education, gender, race, number of children, marital status, transit access, and employment access. The results showed that transit mobility and regional employment access factors did not play a significant role in explaining changes in TANF employment status. In general, personal and household characteristics were more significant than transit and employment accesses in explaining the employment outcomes.

From late 1996 to early 2001, the U.S. Department of Housing and Urban Development (HUD) and the Ford, MacArthur and Rockefeller foundations sponsored a project called National Bridge to Work Demonstration to test whether providing inner-city workers with supportive services such as transportation and placement would give them better employment opportunities and earnings. To investigate the effectiveness of the strategy in helping inner-city job seekers overcome barriers to accessing suburban jobs, the project tracked 3,100 low-income workers in four metropolitan areas—Baltimore, Denver, Milwaukee, and St. Louis—for a four-year period. The participants were divided into two groups: a control group that did not receive assistance from the National Bridge to Work Demonstration project and a treatment group that did (Reardon 2001).

After analyzing the results, it was concluded that because of the complexities of providing services to meet the needs of workers and employers and the high costs to providers of operating such services and the costs to the workers in time spent commuting, the Bridges to Work did not produce a sustainable journey to work (Roder 2005). The important lessons learned from this project are summarized as follows:

- The assumption that the cities could create a reasonable, sustainable commute using multi-passenger vans or buses while covering great distances was untrue.
- The differential in wages and benefits that Bridges to Work model offered was not enough to offset the time and complexity of the commute.
- Unemployed inner-city residents who are unable to access employment on their own face barriers beyond transportation and information.
- Transportation service that meets the needs of workers and employers is very costly for a nonprofit service or planning agency to provide.

In the past, the transportation needs of low-income families were served mainly by public transit systems such as buses, subways, and light rail operations. Factors affecting transit use identified in literature are summarized in the next section.

Factors Affecting Transit Use

In this section, recent literature on factors affecting transit use is reviewed and summarized. The emphasis is on the factors that have been identified as statistically or empirically significant in relation to transit ridership.

At the metropolitan level, there seems to be a general consensus that urban population size and density, economic vitality, and transit supply affect the transit use (Kohn 2000, Yoh 2003, Taylor 2004). Using census data and the National Transit Database (NTD), Taylor et al. (2004) developed a least squares regression model to explain the transit use in 265 urban areas across the nation. The variables that were identified as significant included service revenue hours, population density, median income, median rent, average gas price, percentage of households without cars, percentage of low-income population, percentage of new immigrants, percentage of African American population, transit fare, route density, service level, and a dummy variable indicating a dominant operator. The parsimonious model was able to explain 97 percent of the variation in the data.

Chatterjee et al. (2002) performed a similar study using data from NTD for 121 urban areas and found that annual unlinked trips were associated with population, population density, annual revenue miles, and percentage of households without cars.

While models at the metropolitan area level are useful for financing and planning purposes, models that are able to explain transit demand variations within an urban area are needed for local officials, communities, and transit properties to develop strategies to increase transit mode share. Kikuchi and Miljkovic (2001) and Kikuchi et al. (2001) developed and compared three models based on fuzzy inference, artificial neural network, and multiple regression techniques to predict stop level transit boardings for one transit corridor with 74 stops. One-day boarding data from 1997, 1998, and 1999 were used to calibrate the models. The models included the following variables: auto ownership per household, number of households, average household income, bus stop condition, bus stop accessibility, commercial activities, and quality of transit service. The variables on bus stops and transit service quality were computed based on scores assigned to different measures; for instance, different scores were assigned to shelter, bench, lighting, and information, and the sum was assumed to represent the bus stop condition. The results showed that the neural network model and the fuzzy inference model tuned with the Sugeno's method performed better.

Because bus services are not constantly available and both service frequency and demand vary throughout a day, Polzin et al. (2002) proposed a method to refine the measurement of transit service availability by considering the daily demand and service distribution. Using this method, transit availability is measured in terms of the daily trips per capita in each traffic analysis zone exposed to transit service.

Johnson (2003) suggested that although the nature of the relationship between transit and land use is somewhat ambiguous, transit use may be increased through transit-friendly land-use planning. Findings from his research indicated that the area of maximum transit accessibility was clustered along major commercial corridors rather than at lower-density residential areas; people at the lower end of the income spectrum had the highest transit demand; and where there was a greater percentage of land designed for mixed use and retail commercial use within a ¼ mile of the bus stop, there was a greater demand for transit. Johnson concluded that transit ridership could be enhanced by concentrating mixed-use developments closer to transit corridors and increasing residential density in areas near the corridors.

Transit-Oriented Developments

Transit-oriented developments (TODs) have been advocated as one way to promote transit ridership, reduce traffic congestion and air pollution, provide affordable housing, curb urban sprawl, and improve quality of life (Cervero et al. 2002a). Other terms conveying the idea of TOD have also been used, such as transit villages, transit-supportive development, transit-friendly design, and transit joint development (Cervero et al. 2002a). TOD is primarily referred to as a coordinated development of land use and transit investment near a transit station. Central features of a TOD include a moderate to high density mixed-use

development, pedestrian-friendly street design and landscaping, and attractive public space.

According to Reconnecting America's Center for Transit-Oriented Development (CTOD 2004), consumers choose smaller, more compact housing in neighborhoods where shops and services are within walking distance and where high quality transit service is an option. Based on a model that estimated the national demand for housing within ½ mile of fixed guideway transit stations through 2025 for 27 existing and 15 future TOD regions, CTOD projected that the households living in transit zones will increase between 2000 and 2025 by 560 percent in Los Angeles, 560 percent in Charlotte, 540 percent in Memphis, 400 percent in Denver, 160 percent in Washington DC, and 78 percent in Chicago. Such demand would also indicate market conditions would favor high value real estate.

TODs and Affordability

The Center for Transit-Oriented Development pointed out that household income in transit zones is generally lower than that for a region as a whole; in some regions, it can be even significantly lower (CTOD 2007). In case studies of selected rail transit corridors in Boston, Charlotte, Denver, Portland, and St. Paul-Minneapolis, the median household income ranged from 30 to 80 percent of the areawide median household income. The percentage of owner-occupied housing was also lower in transit zones, according to 2000 census data. In the last decade, TOD regions, however, did not escape the national trend of increases in housing cost outpacing income growth, further exacerbating the problem of lack of affordable housing (CTOD 2007). When the housing boom was over, housing prices had not declined substantially enough to meet the needs of many working families (CTOD 2008a).

Rodney et al. (2009) points out that while environmentally beneficial, TODs are often expensive to build, leading to rents and home prices that are unaffordable to low- and moderate-income families. Some of the obstacles that limit opportunities to develop affordable housing within TODs include high land prices due to speculation after a new transit line is announced, the relative scarcity of near-transit building sites (within a ¼ or ½ mile radius of transit stops), lack of capital for a developer to acquire land before prices and increases, limited funding for building new affordable housing, and unnecessarily high parking requirement. The high cost to develop TODs is also due to rezoning costs at TOD building sites, the difficulty of land acquisition of contiguous lots, and various requirements for community permission processes (CTOD 2007).

One innovative way to provide affordable housing for low-income households is the development of mixed-income TOD. Affordable housing within a walkable ½-mile range of transit stations could be financed through housing subsidies such as Low-Income Housing Tax Credits, state bond financing proceeds, and rental

assistance, as well as the potential use of innovative mortgage finance techniques, such as location-efficient mortgages (FTA/HUD 2008). The inclusion of market-rate units was also suggested as a way to reduce subsidies required to build affordable units and help ensure there will be high-quality design and construction (CTOD 2009a).

The socio-economic diversity provided by mixed-income housing also enhances community stability and sustainability and ensures that low-income households are not isolated in concentrations of poverty. The mixing and mingling of people from diverse backgrounds and experiences may promote innovation by increasing the opportunities for people to share and combine ideas from different perspectives and traditions (CTOD 2009a).

Impact of TODs on Transit Ridership

The benefit of TOD, such as congestion relief and air quality improvement, can be achieved only when TOD is successful in attracting more new transit riders and encouraging auto drivers to switch to using transit. Surveys conducted in the late 1980s of residents near rail stations in the Washington, DC area found that the share of work trips made by rail ranged from 18–63 percent. More recent surveys in Arlington County, Virginia, found a 39 percent transit commute share, about three times higher than that in the county (Cervero et al. 2002a). An analysis of Metrorail survey data from 2002 and 2007 in the Washington, DC metropolitan area revealed emerging trends of growing transit ridership: much stronger growth in ridership in the central city than in the suburb, a significant increase in evening and weekend use of Metrorail for non-work related trips, and a large increase in the walking and the use of buses to access Metrorail stations (Jia 2009).

In an earlier study of California TODs, Bernick and Cervero (1997) found TOD residents, on average, were five times more likely to take rail transit to work than workers living in the surrounding cities. The share of all trips made by rail was 15 percent on average, ranging from 2–79 percent. A 2002 survey of residents living near light rail stations in Santa Clara Valley found that 19 percent of respondents used light rail and 4 percent used the bus to get to work at least one day a week. Sixty percent of the respondents never used rail or used it less than one day per month. Smaller shares of residents used rail for non-work trips than commuting (GRA 2003, Dill 2008). From a large-scale study of 26 TODs in California, Lund et al. (2004) found that 26.5 percent of TOD residents regularly commuted on transit, compared to 5.4 percent in the surrounding cities. However, significant differences existed between developments, ranging from 3.3–44.9 percent of transit commute mode share.

A survey of residents of Center Commons, a TOD in Portland, found that 46 percent of resident commute trips and 32 percent of non-work trips were made on transit (Switzer 2002). A survey of eight TODs in the Portland area found that, overall, 26 percent of respondents used transit for a majority of

their commute trips, with rates at each development ranging from 18–33 percent (Dill 2008). This is higher than city-wide transit mode shares for the Oregon cities of Hillsboro (7 percent), Beaverton (9 percent), and Portland (13 percent), where the TODs are located.

The higher average transit mode shares of TOD residents show the positive influence of TOD on promoting transit use. However, the wide range of share value for different TOD developments implies a different degree of the success of TODs. Many factors are likely to determine the eventual success of TOD.

Research has shown that living and working near transit stations correlates with higher ridership. A survey of residents living near the Portland MAX Orenco station revealed that nearly 80 percent of residents had increased their transit use since moving into their new residence (Arrington 2000). Dill's recent research about Portland showed that nearly 20 percent of the commuters switched from non-transit to transit modes and 4 percent did the opposite, with a net conversion of about 16 percent when they moved close to a rail station (Dill 2008). A California study (Cervero et al. 2004) found that 52.3 percent of those who drove to work and lived away from transit switched to transit commuting when they moved within a ½-mile walking distance of a rail station.

Crowley et al. (2009) studied the relationship of walking distance to rapid transit and mode choice and auto ownership. Auto ownership and use of an owned auto decreased when the development was closer to a planned subway station. At the same time, the mode share of subway was significantly higher. Ridership potential has been found to be the highest within about ⅓ mile of a station, although Canadian experiences showed that the distances people were willing to walk to transit could be stretched out to ½ mile or more (Cervero et al. 2002a, Bernick and Cervero 1997). Studies also suggest a TOD impact zone can be stretched considerably, as much as two times, by creating pleasant, interesting urban spaces and corridors (Untermann 1984).

The rise of transit ridership may also be a result of self-selection of residence. In a study of Santa Clara County's light rail corridor, 40 percent of respondents who moved close to transit stops said the presence of light rail transit influenced their decision to move (Gerston & Associates 1995).

Bernick and Cervero (1997) concluded that the two most important factors influencing whether a TOD residents commuted by rail were parking prices and transit availability at work destinations. Even higher capture rates have been found among those working near downtown and built-up urban rail stations (Cervero et al. 2002a).

Density and Transit Use

Research consistently shows that density has a significant influence on transit ridership. Ross et al. (1997) reported a connection between public transit mode share and population density based on 1995 Nationwide Personal Transportation Survey (NPTS) data. The transit mode shares are about 3 percent for density below 10,000 persons per square mile, and 11 percent for density above 10,000 per square mile. Ewing (1997) argued that a higher density is required to support rail service, with most TODs in the United States in the range of 20–30 units per acre. Three U.S. jurisdictions, San Diego, Washington County (Oregon), and Portland (Oregon), have proposed or adopted higher residential density threshold for TOD depending on TOD type and levels of transit services (Cervero et al. 2002a). Several TOD plans achieve a gross residential density of 18 units per acre.

Transit Supportive Density

A 1995 Transit Cooperative Research Program (TCRP) study of 261 light rail stations in 19 U.S. and Canadian cities showed an elasticity of nearly 0.60 between ridership and population density, controlling for other factors (Parsons et al. 1995, Cervero et al. 2002a). Every 10 percent increase in population density was associated with about a 6 percent increase in light rail transit boardings.

Besides residential density, higher employment densities may compensate for lower household densities. Transit ridership shares are highly correlated to employment density, especially in corridors that lead to central business districts and downtown areas. For instance, transit trips are 36 percent of all trips to jobs in downtown San Francisco, which is higher than mode shares of the commute trip in the San Francisco Bay Area of 10 percent (CTOD 2008b).

Along the Red Line in Boston, transit shares of commuter trips into downtown Boston are 49 percent, compared to 14 percent of all commuter trips in the region. Within ½ mile of the Red Line stops, the transit shares of commuter trips increase to 79 percent (CTOD 2008b). The Puget Sound Regional Council (PSRC 1999) contended that employment densities of 25 jobs per acre would support frequent, high-capacity transit services, and 50 jobs per acre were favored for light rail service. Parsons et al. (1995) estimated that downtown densities of 100 workers per acre translate, on average, into 300 boardings per day for suburban light rail stations 20 miles from a downtown surrounded by low-density residences.

In the past, most of the research and discussions have been about residential and retail development at stations. Less consideration has been given to where and how people who live and shop in transit-oriented neighborhoods get to work (CTOD 2008b). Reconnecting America's Center for Transit-Oriented Development suggested that a more fine-tuned analysis of linking multiple regional destinations and housing opportunities is important for achieving promised ridership and economic returns (CTOD 2009b).

Mixed Land Use

In addition to being compact, it is widely agreed that TODs should be diverse in their land-use compositions. Mixed land uses can internalize trips within neighborhoods, prompting residents to walk to convenience shops instead of driving outside the neighborhood. Research from Southern California estimates that mixed-use suburban work settings increased transit usage by, on average, 3.5 percent compared to otherwise single-use workplaces (Cambridge 1994).

Mixed uses are not necessary within one development. Porter (1997) discusses the necessity of an urban spatial structure that provides a compact form and having a discrete number of significant employment centers in the region that generate bi-directional flows on the transit system. In other words, it is not enough to have one or two TODs, but a network of TODs is needed, such as pearls in a necklace (Cervero et al. 2002a). When mixed-use TODs are aligned along linear corridors—like pearls in a necklace—trip origins and destinations are evenly spread out, producing efficient bi-directional flows. This has been the case in world-class transit metropolises such as Stockholm, Copenhagen, and Curitiba (Brazil), where mixed-use TODs have given rise to 55–45 percent directional splits (Cervero et al. 2004). This is in contrast to many U.S. settings, where peak-period trains and buses are filled to the brim in one direction but nearly empty in the other. Mixed and balanced land uses ensure mixed and balanced traffic flows (Cervero et al. 2004).

Some observers have pointed out that mixed use of TODs increased off-peak traffic flow, i.e., mixed use, all-day trip generators, such as entertainment complexes, restaurants, help fill up trains and buses at all hours of the day and in both directions (Bernick and Cervero 1997). Thus, an important benefit of TODs is that it enhances cost-effectiveness, in the sense of squeezing out efficiencies in the deployment of costly rail services.

The evidence from Taipei (Lin and Shin 2008) showed that land use diversity variables do not significantly increase metro ridership, but disperse transit ridership distribution in a timely manner.

In addition to these demand-side benefits, mixed-use provides supply-side benefits: shared parking possibilities that reduce overall parking supplies and expenses, reduced infrastructure loads and facility sizing, and bi-directional use of infrastructure (Bernick and Cervero 1997).

Quality of Transit

For higher ridership, transit must provide access near one's trip origin and destination as well as at or near the times required. This requires high transit coverage and high service in frequency (short headways) and duration throughout the day and week (Hendricks 2005).

Travel time by transit, including the time it takes to get to the station/stop, must be competitive with travel time by car. Transit vehicles must run at comparable fast speeds as car traffic because of the extra time added to stop and pick up passengers. Usually, this can only be achieved by dedicating separated guideways for transit, such as a rail corridor, a rapid busway dedicated traffic lane, or a high-occupancy-vehicle lane.

Beyond these essential features, transit must also compete with the automobile in safety and security, passenger amenities, attractiveness, comfort, and privacy (Hendricks 2005).

TODs cited most often in the literature occur near rail stations, but most definitions prefer to use the term "transit" to allow for the possibility of TOD at bus stations. Cervero and Duncan (2002) believe that the presence of rail may signal a higher level of transit service. Transit service using an exclusive guideway or dedicated traffic lane is generally more time-competitive with the private automobile than conventional bus services and provides enhanced mobility benefits when it spans across urbanized regions, especially during congested peak periods.

Besides rail station-based TOD, TODs associated with BRT has also emerged, such as Denver RTD's air rights lease at the southern end of the 14-block Transitway Mall, the Santa Ana Transportation Center in Orange County, California, and the Corpus Christi Staple Street Transit Center (Cervero et al. 2002a).

TOD Design

TODs are compact patterns developed along transit infrastructures or around transit stations, within a mixed-use residential and commercial area. Bernick and Cervero (1997) pointed out that since all transit trips involve some degree of walking, it follows that transit-friendly environments must also be pedestrian-friendly. A good design of pedestrian-friendly community may allure walk, bike, and transit use. It is recommended to use landscaping, public art, continuous sidewalks, street furniture, benches, lighting, public phones, bicycle racks, continuous awnings, weather protection, or street trees and other provisions in public spaces (PSRC 1999, Ewing 1999). Ewing (1999) commented that street trees spaced 30 feet apart provide an added benefit of creating visual enclosure.

Sidewalks should be located along or visible from all streets and allow comfortable, direct access to core commercial areas and transit stops (PSRC 1999). It has also been suggested to use grid-like street patterns, which allow many origins and destinations to be connected by foot and to use traffic-calming measures, such as narrow streets, on-street parking, vertical realignments (e.g., street tables), horizontal realignments (e.g., chicanes) (Ewing

1999, PSRC 1999). Ewing also suggested block lengths of 300 feet, straight streets, minimal building setbacks, pedestrian shortcuts, and ensuring safe, convenient, and frequent street crossings. Signalized crossings, bulb-outs, and mid-block crossings are recommended (PSRC 1997). He notes that smaller corner radii shorten crossing distances induce motorists to slow down at corners, and discourage rolling stops. Bus drivers, however, counter that tight turning geometries hamper bus movements.

To create a lively streetscape and minimize dead spaces created by parking lots, minimum floor-area ratios (FARs) need to be specified for retail and commercial uses. Calthorpe (1993) suggests a minimum FAR of 0.35, while the Puget Sound Regional Council (PSRC 1999) suggests a target of 0.5 to 1.0 for developments without parking structures and at least 2.0 for developments with parking structures.

TOD designers point out that such design elements cannot stand in isolation—indeed, they are co-dependent. Collectively, transit-sensitive design elements can create fundamentally different milieus in and around transit stations that make pedestrian-access to transit and transit riding a pleasant experience.

Reconnecting America's Center for Transit-Oriented Development has developed a guidebook of station area planning for different TOD place types, such as TOD for regional center, urban center, suburban center, transit town center, urban neighborhood, transit neighborhood, special use/employment district, and mixed-used corridor (CTOD 2008c). For TODs in each place type, the guidebook recommends suitable transit modes, transit service frequency ranging from 5–30 minutes, land-use mix and density, retail characteristics, housing density and number of units, and number of jobs. It also recommends a FAR ranging from 5.0 for regional centers to 1.0 for urban and transit neighborhoods, as well as configurations of mixed use/employment buildings.

FTA funds the design, construction, and maintenance of bicycle and pedestrian projects that enhance or are related to public transportation facilities.

Parking

Although abundant parking provides incentives to driving, in many typical suburban settings, park-and-ride lots are essential to rail ridership success, especially at terminal stations that draw customers from large suburban and sometimes exurban/semi-rural communities. Having ample parking is particularly important for terminal stations when they serve large catchments areas accessible by automotive traffic. Without sufficient supplies of parking, many more commuters would opt to drive than to take transit. In some places, it may be desirable to increase parking supplies to serve commercial development, as well as commuters in and around transit stations (Cervero et al. 2002a).

In contrast, the original design of both of Portland's light rail lines allocated fewer parking spaces than what the projected demand indicated were needed. Additionally, walking and feeder bus routes were given preference as modes of access to the stations. With just two exceptions, parking was located such that it would not separate the stations from the community (so as not to act as a barrier as between the station and community destinations). On the Westside Line, Tri-Met specifically agreed to the redesign of parking away from the platform at four stations (Hillsboro Government Center, Orenco, 185th, and Beaverton Creek) to maximize the opportunity for pedestrians within the TOD to access the light rail station (Cervero et al. 2002a).

It has been also suggested that some existing parking lots should be replaced by structured or managed parking notwithstanding the additional cost for conversion (Cervero et al. 2002a). The Puget Sound Regional Council (1999) recommends park-and-ride lots only in areas where immediate development is not expected. Ewing (1997) indicates that park-and-ride lots are only appropriate when there is a long commute to downtown.

Cooperation of All Involved Parties

Rodney et al. (2009) stated that community opposition to high-density development is sometimes hard to overcome. In addition to community concerns about adverse conditions that have often been associated with increased density, other planning and development challenges have been identified (CTOD 2008c), which are listed in Table 2-5.

Table 2-5
Planning and Development Challenges of TODs

Place Type	Planning and Development Challenges
Regional Center	Integrating dense mix of housing and employment into built-out context
Urban Center	Integrating high-density housing into existing mix of housing and employment to support local-serving retail
Suburban Center	Introducing housing into predominantly employment uses and improving connections/access to transit
Transit Town Center	Increasing densities while retaining scale and improving transit access
Urban Neighborhood	Expanding local-serving retail opportunities and increasing high-density housing
Transit Neighborhood	Integrating moderate density housing and supporting local-serving retail
Special Use/ Employment District	Creating sustainable off-peak uses and accommodating peak travel demand
Mixed-Use Corridor	Expanding local-serving retail opportunities and high-density housing opportunities

Based on the experience of existing TODs, the success of promotion of public transit ridership relies on cooperation of all involved parties. Portland shows a successful example of coordinated approaches of community development. Along its Westside line of MAX, stations are becoming a magnet for new transit-oriented communities, with a multitude of housing product-lines, a neighborhood retail district, and an attractive promenade that links residents to the rail stop (Arrington 2000, Cervero et al. 2002).

Along San Diego's Mission Valley Trolley corridor, the Hazard Center has become a successful mixed-use, pedestrian-scale community huddled around a light rail station. In downtown San Diego, mid-rise housing has been constructed near several Trolley stations, leveraged through initiatives undertaken by the Centre City Redevelopment Corporation (Cervero et al. 2002a).

Many failed experiences also show that the risks of TOD may be high. A report by the Urban Land Institute (1979) points out that, rather than theoretical misunderstandings of market phenomena, the main problems lie in the success of execution. Dallas DART system failed to spawn much new development in the first five years. In the words of DART's Manager for Systems Planning, "Nobody sees Dart as an asset" (Cervero et al. 2002a). Further, the Bay Area's BART system did not see TODs around stations initially develop with its opening in the early 1970s until there was public-sector encouragement or intervention (Cervero et al. 2002a)

Even when built, TOD success may depend on a variety of integrated design factors that cause potential transit users to congregate near transit stations, instead of dispersing throughout the TOD built environment. Full public participation in TOD design efforts will help develop community understanding and support for high quality TOD designs that promise community benefits and prosperity. A full understanding of community challenges and opportunities will better guide community planning efforts.

Summary

The definition of affordable housing has been the expenditure on housing of less than 30 percent of household income. However, the affordability of housing should take into account not only actual housing prices but also the cost of accessibility to jobs and other economic and social destinations and increases in traffic congestion and other reductions in mobility that lengthen travel times and costs.

Studies have shown that Americans have consistently spent, on an average, nearly 60 percent of their incomes on housing and transportation. To account for transportation costs when considering housing affordability, a Housing Plan Transportation Cost index has been proposed by the Center for Neighborhood

Technology (CNT), and affordability has been defined as an expenditure on housing and transportation of no more than 45 percent of household income.

Working poor families have been defined by Working Poor Families Project as those that earn up to 200 percent of the poverty income, which was $40,000 for a family of 4 in 2006 (Povich 2006). The Miami-Dade Housing Agency defined two extreme low-income levels as 30 percent and 50 percent of area-wide median household incomes and low and moderate income as 80 percent of area-wide median household income in 2006, all adjusted by family size. For example, for a one-person family, these income threshold values are $11,750, $19,550, and $31,300, respectively. For a family of three, there are $15,100, $25,150, and $40,250, respectively.

The spatial mismatch of housing for low-income workers and jobs and a lack of reliable and affordable transportation have been identified as one of the reasons for low-income families staying in poverty (Canby 2003, Blumenberg and Manville 2004). Low-income workers rely more on public transit due to limited access to automobiles and the cost of maintaining a car, but transit services in general require much longer travel time even when transit schedules operate during all hours of the day and night.

In some communities, transit operating schedules that do not provide for transit services 24 hours per day do not meet the travel needs of all employees (i.e., second- and third-shift employees who need transit after 11:00 PM and through the early morning hours). Efforts to match transit system assets, financial capabilities, economic impacts, and opportunities to increase off-rush hour demands are rarely undertaken.

The problem of limited access and mobility between affordable housing and jobs for low-income families has persisted in the U.S. despite government efforts in housing development, subsidized housing, and transit service improvements. In part, this is due to the fact that this problem arises from many factors, including suburbanization of America, the American car culture, land-use patterns unsupportive of public transit, slow or no real increase in income for low-income working families, traffic congestion, and increasing costs of providing transit services.

TOD has been seen by many as effective to create housing opportunities for low-income families and to improve mobility/accessibility to jobs. The methodology to speed development has been less frequently discussed. To undertake successful deployments, TODs need to be located near premium transit stations such as heavy rail, light rail or BRT services and possess a number of characteristics, such as mixed land use, mixed-income housing, increased density, frequent and fast transit to desired destinations, parking supplies adjacent transit stops that serve the needs of the automobile-oriented

catchment areas located beyond the ¼- to ½-mile walking distances, and a transit accessible and safe built environment within ¼ to ½ mile from the transit stations and stops that support pedestrian access to transit.

There have been successful examples of TODs, but there have also been challenges in their planning and implementation when it is assumed that pedestrian movements will always be limited to ¼ or ½ mile. Further, TODs have not yet occurred on their own through private sector initiatives and seem to require significant joint effort by government, communities, and private sector through coordination, collaboration, and public involvement.

The next section explores the conditions in Miami-Dade County, the unmet needs of the transportation disadvantaged, and an observation as to how needs might be addressed through an extension of walking conditions around stations sites.

SECTION 3

Miami-Dade County Case Study

In this section, Miami-Dade County is used as a case study to demonstrate the use of Geographic Information System (GIS) tools to examine affordable housing and transportation issues. In this study, $40,000 has been adopted as the upper limit threshold value of household income in analyzing transportation issues concerning low- and low-to-moderate income households. This is based on the definition of low to moderate income of $40,250 for a family of 3 in 2006 by the Miami-Dade Housing Agency, as well as for convenience, given the fact that $40,000 is one of the threshold values that define income levels in the 2000 census, which will be used in the analyses of this report.

Public and Low-Cost Housing Availability and Locations

The addresses and number of units of public housing facilities and subsidized rental housing properties in Miami-Dade County were obtained from the Miami-Dade Housing Agency (MDHA), which manages more than 11,000 units of public housing in 100 family and older-adult developments. GIS data were created by geocoding all of the facilities based on their addresses. Figure 3-1 depicts the locations of the public housing facilities, and Figure 3-2 shows subsidized rental properties. The maps shown in Figure 3-1 and 3-2 are overlaid with median household income data from the 2000 census. The alignments of Metrorail, an elevated heavy rail system, and Metromover, an elevated automated people-mover system, are also shown. It can be easily seen from the figures that, with very few exceptions, public housing and subsidized rental facilities are located in areas of very low income, where there is a high concentration of poverty. It can also be observed that most of these housing facilities are located outside the walking distance of the Metrorail and Metromover.

Figures 3-3 and 3-4 depict the number of owner- and renter-occupied housing units, respectively, that cost less than 30 percent of the income of households that make less than $20,000. The cost for owner-occupied housing is the selected monthly owner cost, which is the total payment for mortgages, deeds of trust, contracts to purchase, or similar debt on the property, including payments for first mortgage, second mortgage, home equity loans, and other junior mortgages; real estate taxes; fire, hazard, and flood insurance on the property; utilities (electricity, gas, and water and sewer); and fuel (oil, coal, kerosene, wood, etc.). It also includes, where appropriate, monthly condominium fees or mobile home costs (installment loan payments, personal property taxes, site rent, registration fees, and license fees).

The cost for renter-occupied housing is gross rent, which is the contract rent plus the estimated average monthly cost of utilities (electricity, gas, water, sewer) and fuels (oil, coal, kerosene, wood, etc.). Gross rent is intended to eliminate differentials that result from varying practices with respect to the inclusion of utilities and fuels as part of the rental payment. Figures 3-5 and 3-6 show the same types of information for household income of less than $35,000. It may be seen that in 2000, affordable housing units are scattered around the county, but more affordable rental properties were located close to Metrorail and affordable owner-occupied housing. In the Metrorail corridor, especially the southern portion of the Metrorail system, housing prices were generally out of reach for low-income workers and their families.

Figure 3-1

Locations of Public Housing, Miami-Dade County

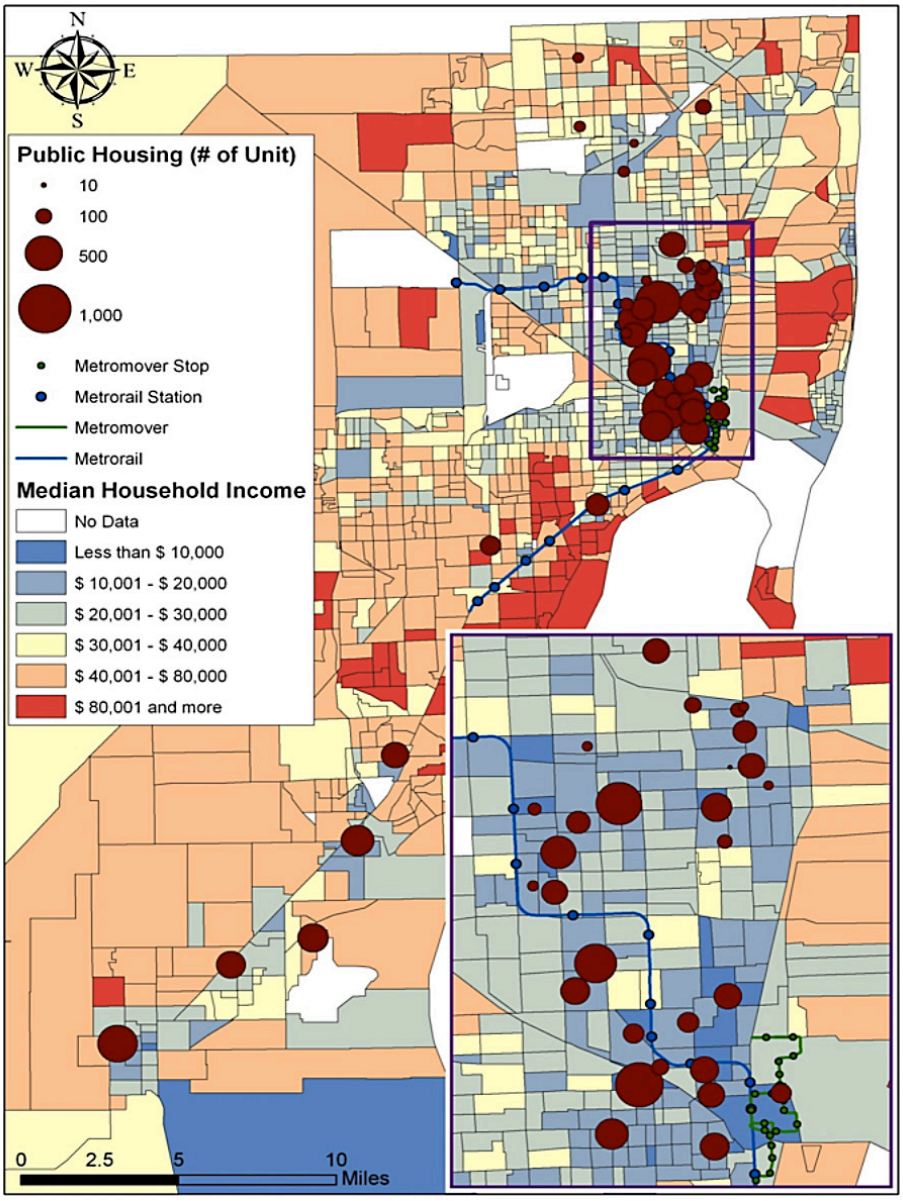


Figure 3-2

Locations of Subsidized Rental Units, Miami-Dade County

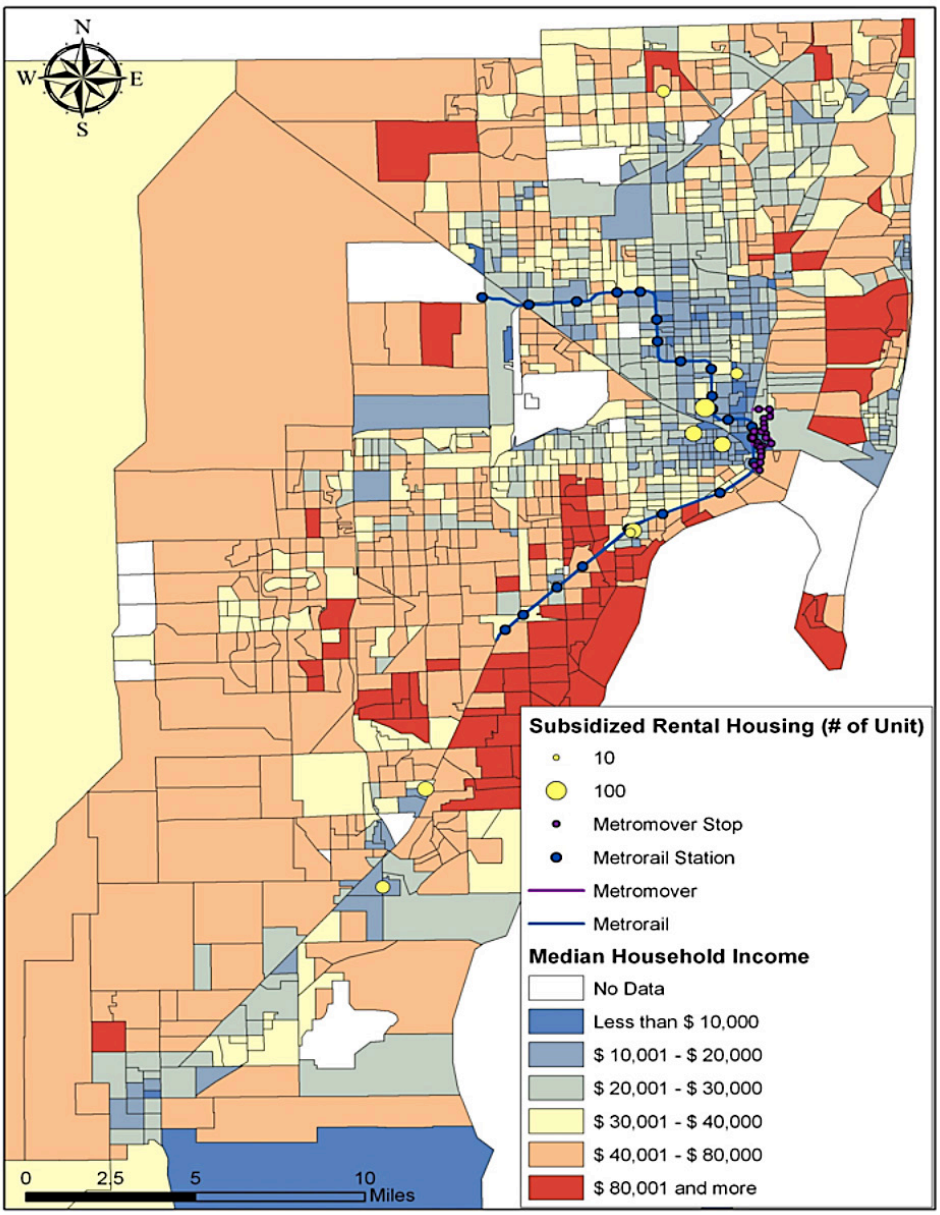


Figure 3-3

Distribution of Affordable Owner-Occupied Housing Units for Annual Household Income of $20,000 or Less, Miami-Dade County

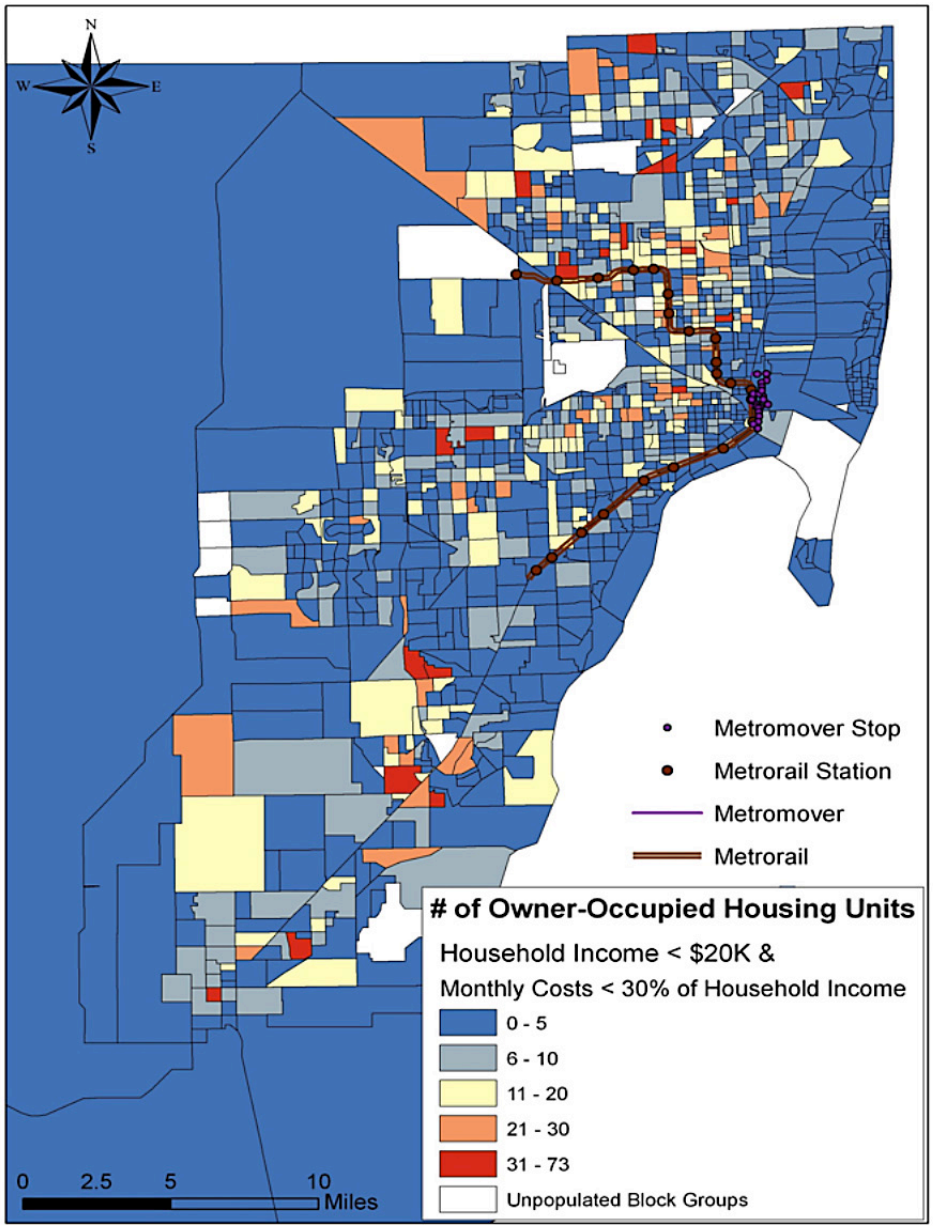


Figure 3-4

Distribution of Affordable Renter-Occupied Housing Units for Annual Household Income of $20,000 or Less, Miami-Dade County

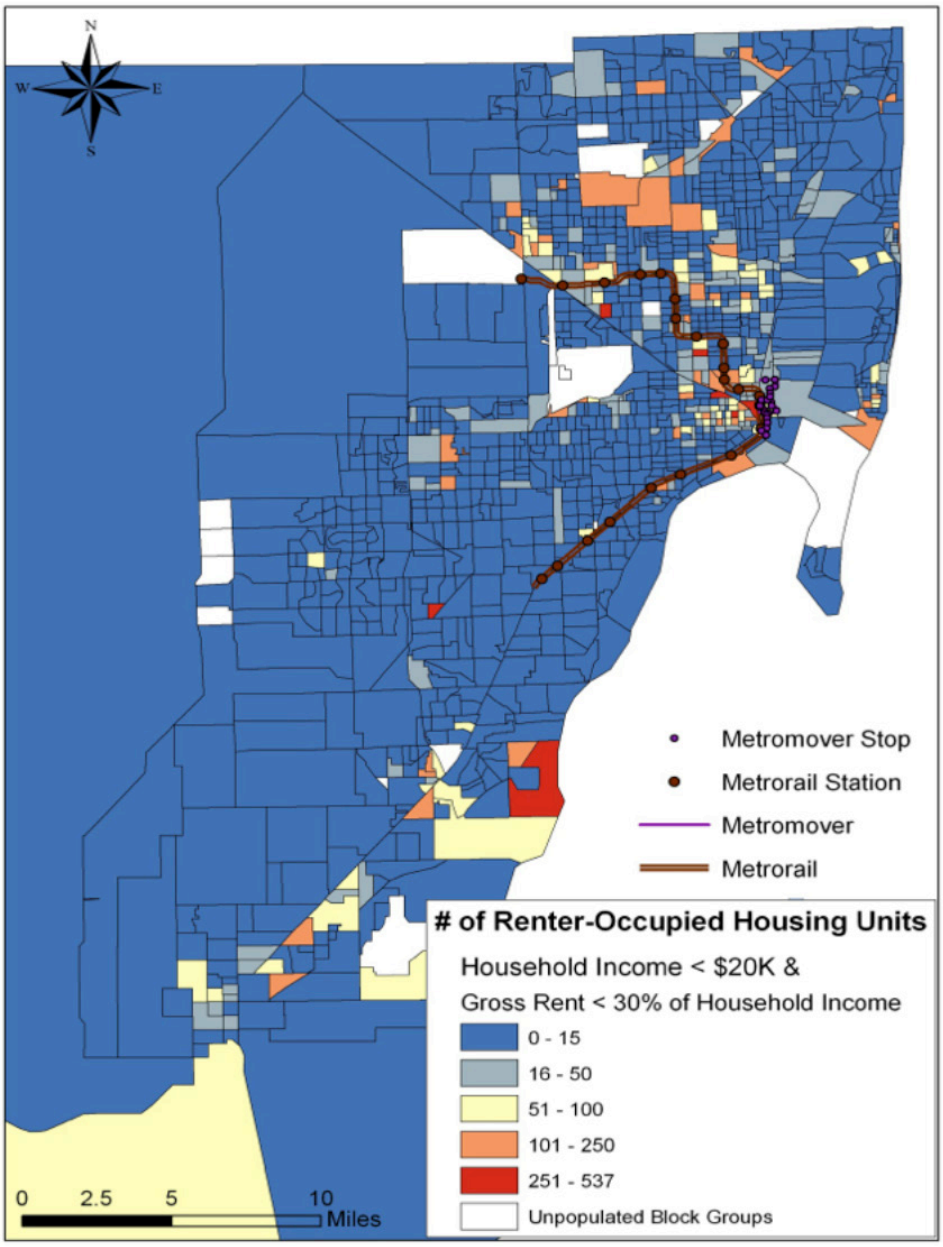


Figure 3-5

Distribution of Affordable Owner-Occupied Housing Units for Annual Household Income of $35,000 or Less, Miami-Dade County

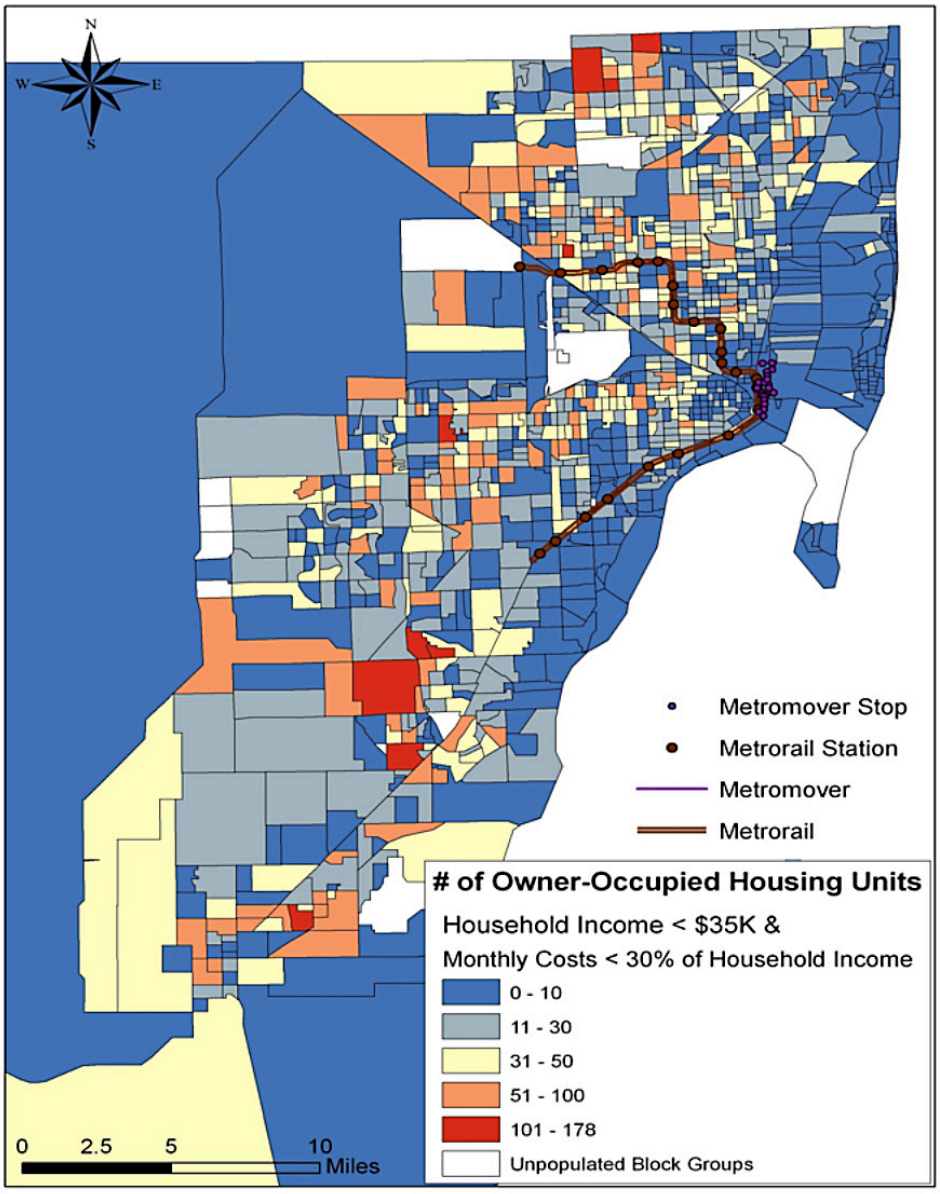
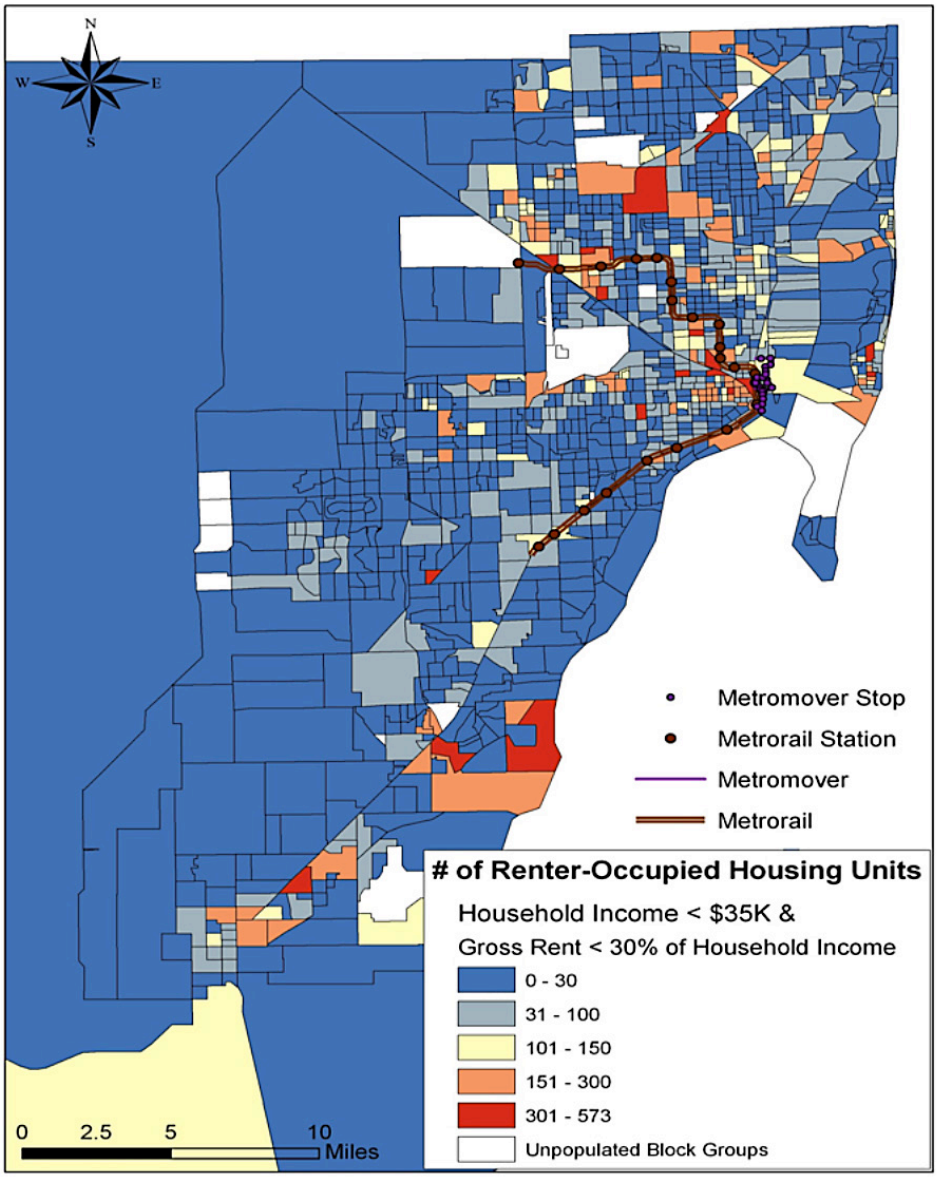


Figure 3-6

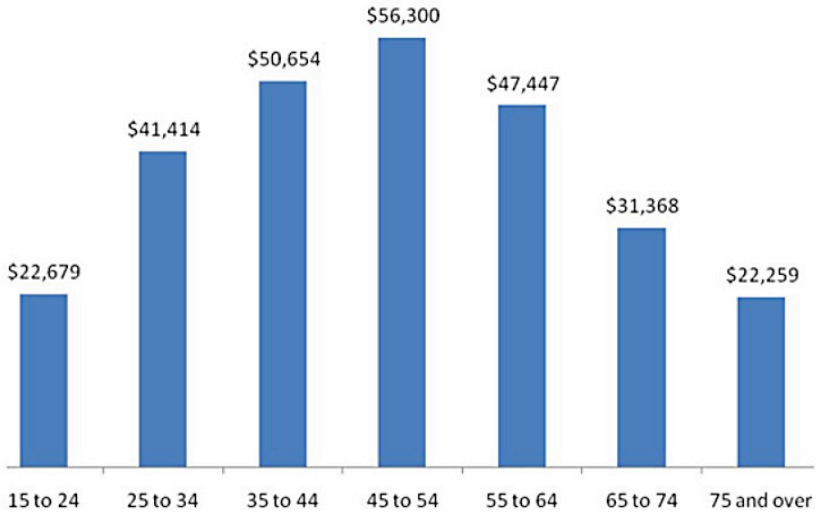
Distribution of Affordable Renter-Occupied Housing Units for Annual Household Income of $35,000 or Less, Miami-Dade County



In addition to the working poor, older adults may also feel the pressure of securing affordable housing. According to the 2000 census, the national median income of households with a householder age 65–74 was $31,368, compared to the median household income of $44,900. Figure 3-7 shows the median household income by age of householder. As a result of the recent recession, many retired workers have been forced to return to the job market and are also facing the challenges of affordable housing and transportation.

Figure 3-7

Median Annual Household Income by Age of Householder, Miami-Dade County



Employment

The spatial mismatch of housing and jobs for low-income families has been cited in the literature as causing significant hardship to low-income workers to secure sustainable employment, increase their earnings, or reduce their travel budget. In this section, the spatial pattern of employment is analyzed. Employment and income data are analyzed to identify jobs that are likely to be taken by low-income workers, and the locations of these jobs are described.

The Southeast Florida Regional Travel Characteristics Study (CSC 2000) provides data from a regional household survey of the tri-county area of Miami-Dade, Broward, and Palm Beach counties. In the survey, employment was classified into 11 categories. Household annual income was determined at increments of $5,000 beginning at $0, which resulted in a total of 21 income levels. In the tri-county area, 5,114 of the 11,426 personal records had valid income information. Table 3-1 gives the number of job by employment type for the 5,114 useful survey records.

Table 3-1

Surveyed Workers by Job Type in Tri-County Area

Type of Work	Persons	Percent (%)
Retail trade	361	7.06
Service industry	1,055	20.63
Commercial business	348	6.80
Industry	195	3.81
Government	260	5.08
Professional	1,471	28.76
Self-employed	17	0.33
Church	3	0.01
Homemaker	1	< 0.01
College work study	1	< 0.01
Farming	1	< 0.01
No data	1,401	27.40
Total	*5,114*	*100.00*

The majority of jobs fell into the first six categories. The income distributions for these six job categories are illustrated in Figures 3-8 through 3-13. Figure 3-8 shows the percentage of persons having a job in the retail trade category by income level.

The corresponding average household income was $31,281. Figure 3-9 shows the same statistics for the service employment category, which had an average income of $31,637. Figures 3-10 to 3-12 illustrate the percentage of persons by income level for the industrial, governmental, and commercial employment categories, respectively. The corresponding average incomes were $41,422, $39,205, and $40,923, respectively.

Figure 3-13 shows the statistics for the professional employment category, with an average income of $47,945. The data suggest three broad income categories based on employment sectors—low-income for retail and service workers; medium income for industrial, government, and commercial workers; and high income for professional workers. This means that people with lower income were more likely to travel to destinations with more retail and service employment for work.

Figure 3-8

Income Distribution of Workers with Retail Trade Jobs, Miami-Dade County

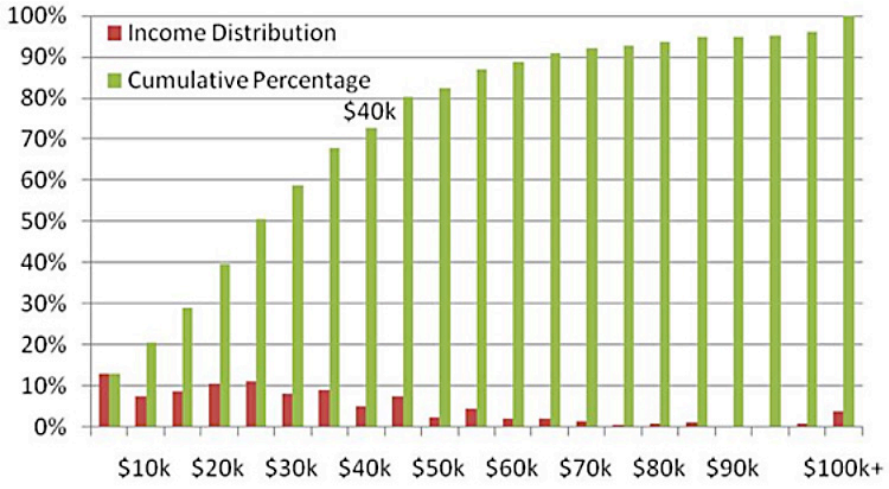


Figure 3-9

Income Distribution of Workers with Service Jobs, Miami-Dade County

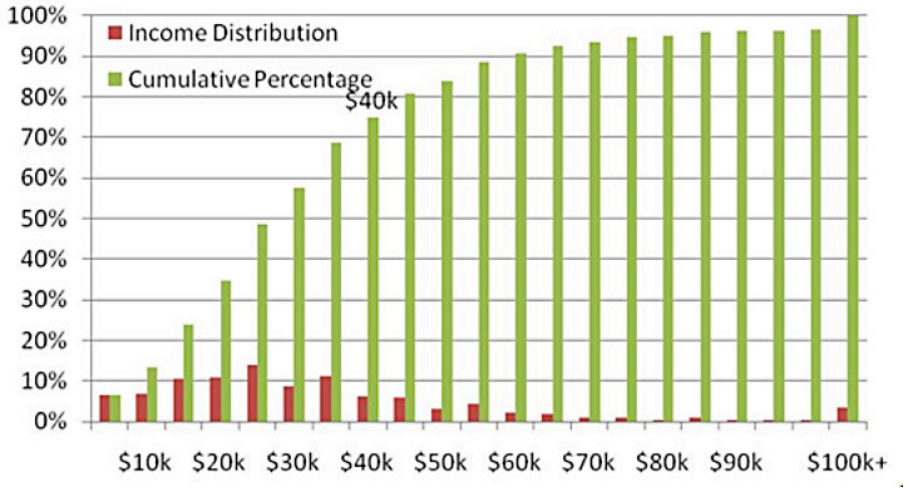


Figure 3-10

Income Distribution of Workers with Industrial Jobs, Miami-Dade County

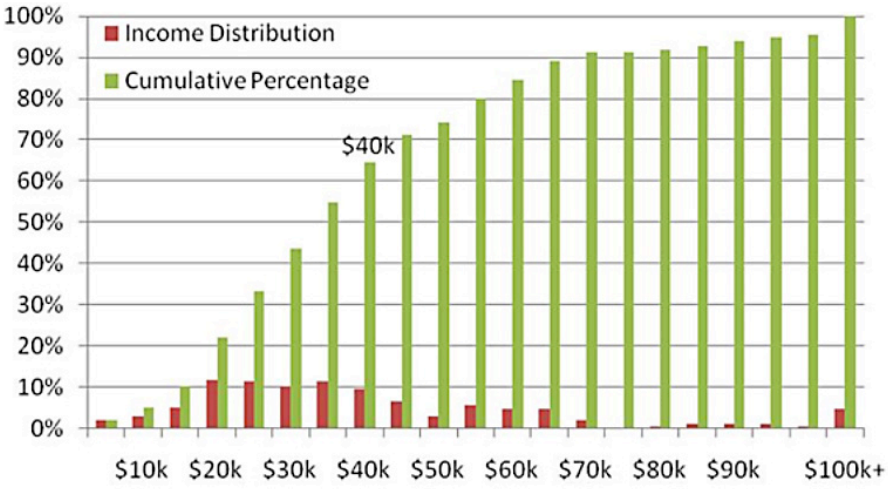


Figure 3-11

Income Distribution of Workers with Government Jobs, Miami-Dade County

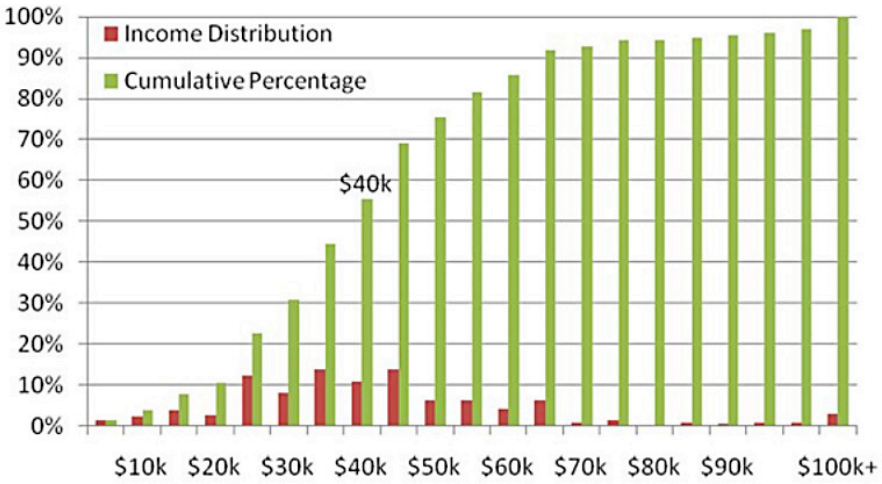


Figure 3-12

Income Distribution of Workers with Commercial Jobs, Miami-Dade County

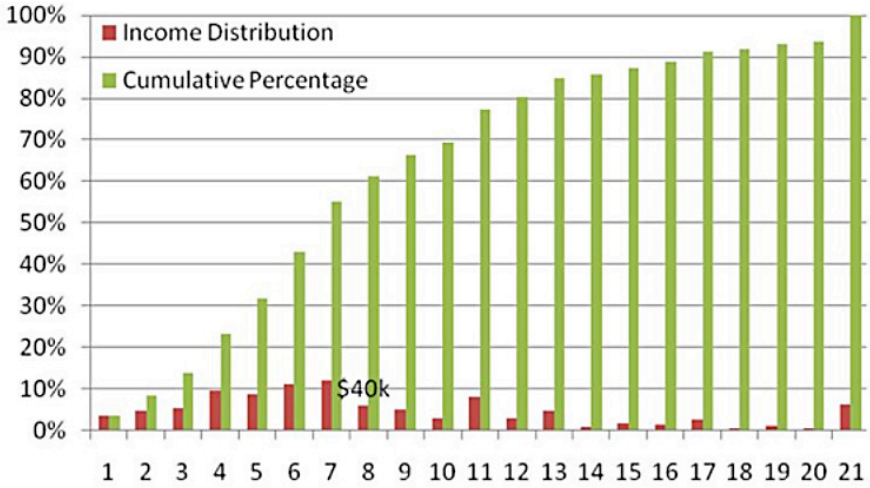


Figure 3-13

Income Distribution of Workers with Professional Jobs, Miami-Dade County

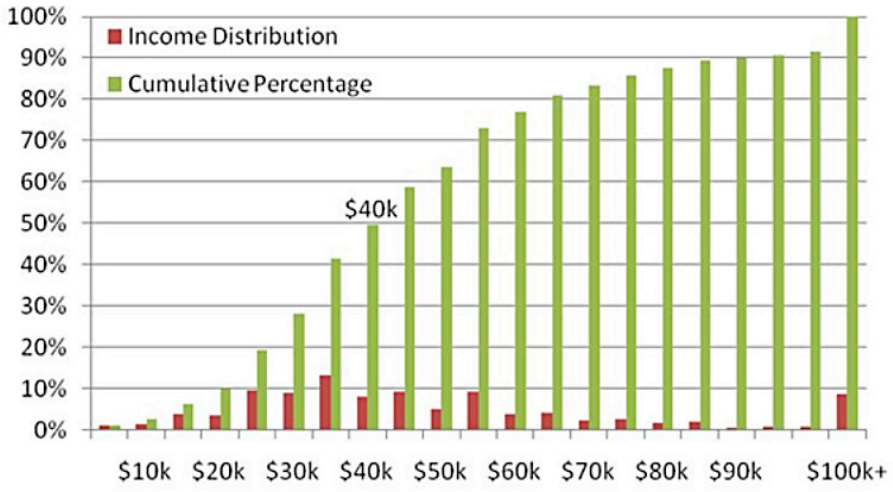


Table 3-2 lists the percentage of workers with an income less than $40,000, by employment sector. It is clear that service and retail sectors employ the most low-income workers.

Table 3-2

Percentage of Low-Income Workers by Employment Type, Miami-Dade County

Employment Type	Percentage of Workers with Income Less than $40,000
Service	75%
Retail	73%
Industrial	65%
Commercial	61%
Government	55%
Professional	49%

To determine the location of retail and service jobs, employment data from a 2005 employment database purchased by the Florida Department of Transportation were analyzed. Employment was classified based on the Standard Industry Classification (SIC) (see Table A-1 in Appendix A). In 2005, there were approximately 800,000 jobs in Miami-Dade County.

Table 3-3 gives the percentages of employment by type. Figure 3-14 shows the employment locations of retail and service jobs by census block groups. Locations of high concentration of retail and service jobs (500+ jobs) are indicated on the maps. The map shows that the largest concentrations of service and retail jobs were not in low-income areas, nor were they close to the Metrorail line.

Table 3-3

Percentage of Jobs by Employment Type, Miami-Dade County

Employment Sector	Percentage
Retail	19.22%
Service	32.90%
Commercial & Industrial	25.15%
Government	7.63%
Professional	15.10%
Total	100.00%

To measure the spatial mismatch of residence and jobs for low-income workers, an index was developed for each census tract to reflect the availability or competition for low-income jobs. To calculate the index for a given census tract, all census tracts within 30 minutes of travel time from the given tract were first identified. Median travel time between each pair of tracts is available from the Census Transportation Planning Package (CTTP) and was used here to represent the travel time between a census tract and the given one.

Next, the total number of workers with a certain household income level who either live in the given tract or in all the tracts that have a 30 minutes or less median travel time to the given tract were obtained. Similarly, the number of retail and service jobs in these tracts was also tallied.

The total number of retail and service jobs divided by the total number of workers results in the value of the index. This index is plotted in Figures 3-15 and 3-16 for workers with a household income not exceeding $30,000 and $40,000, respectively. A ratio of 1.50 or smaller means that there were 1.5 retail or service jobs per worker for a given census tract. Of course, this does not mean that there are actually 1.5 jobs available for each low-income worker, as some of these jobs would be taken by workers living outside the areas being considered.

In Figure 3-15 and Figure 3-16, it can be seen that there are relatively few areas where there are more than 1.5 jobs for low-income workers. Comparing these maps with the map in Figure 3-14, it can also be seen that transit services via the existing 22.4 miles of Metrorail services routing does not optimize opportunities for transit services transport of low-income workers to available jobs.

Figure 3-14

Employment Distribution of Retail and Service Jobs, Miami-Dade County

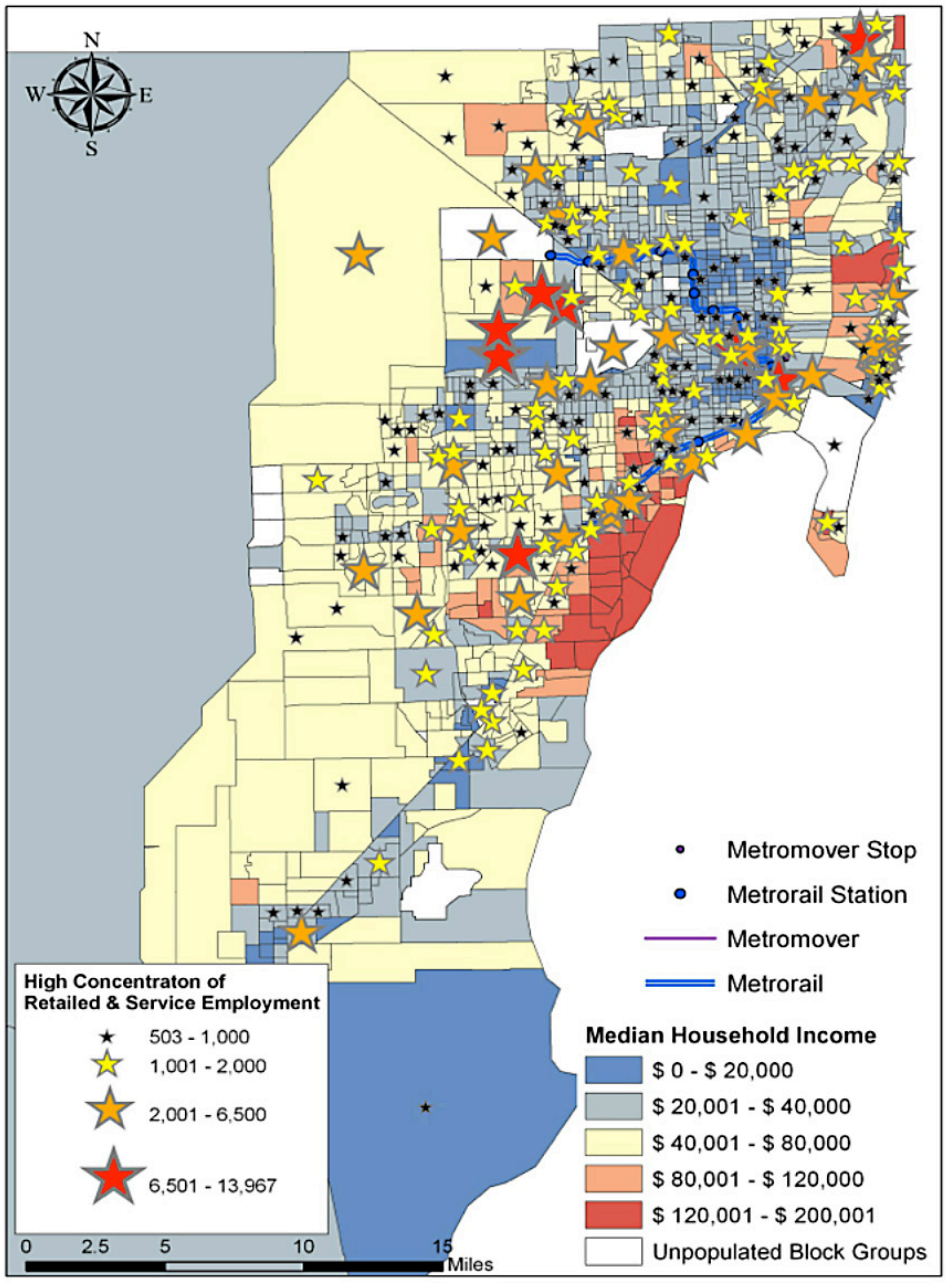


Figure 3-15

Ratio of Retail and Service Jobs to Low-Income Workers with 30-Minutes of Travel Time (Annual Household Income Less than $30,000), Miami-Dade County

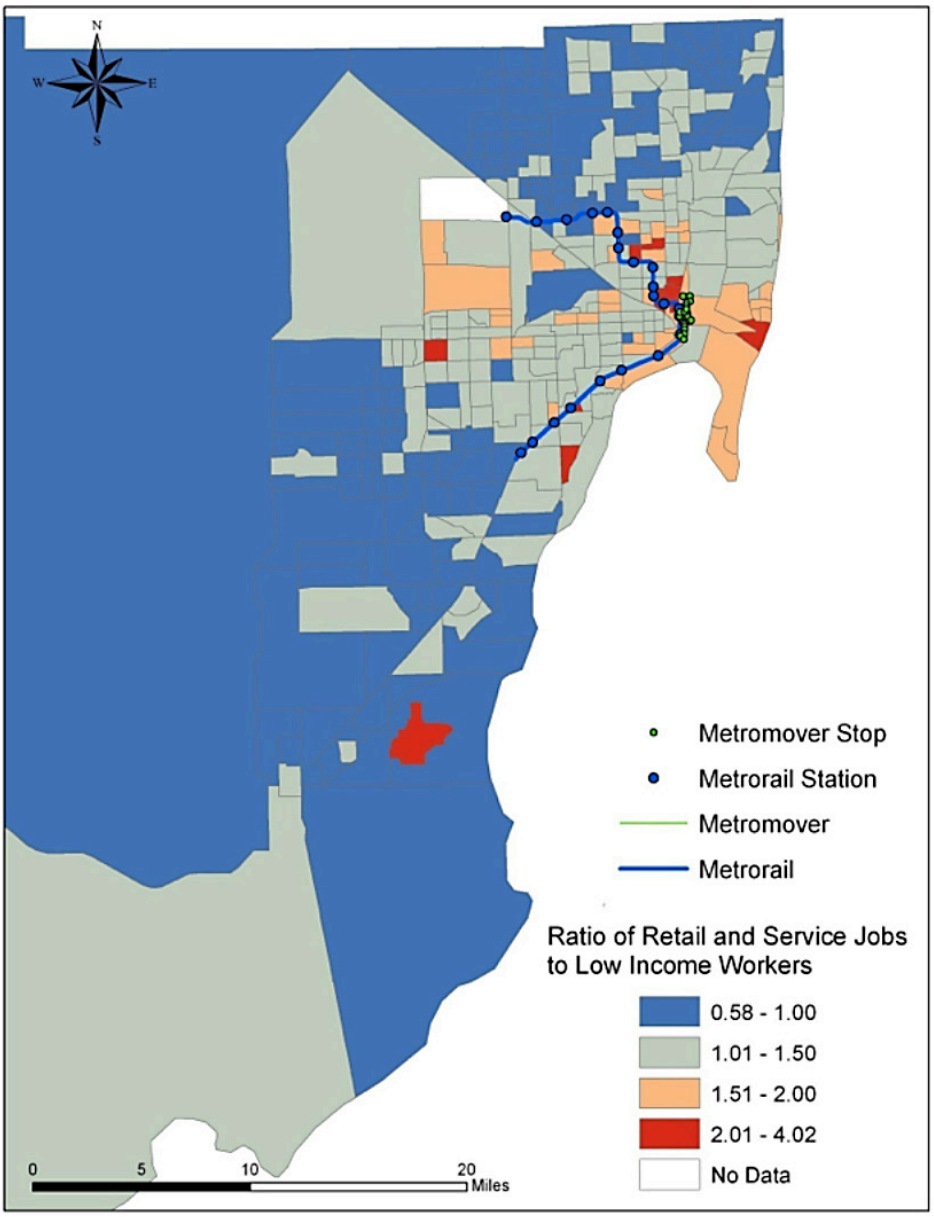
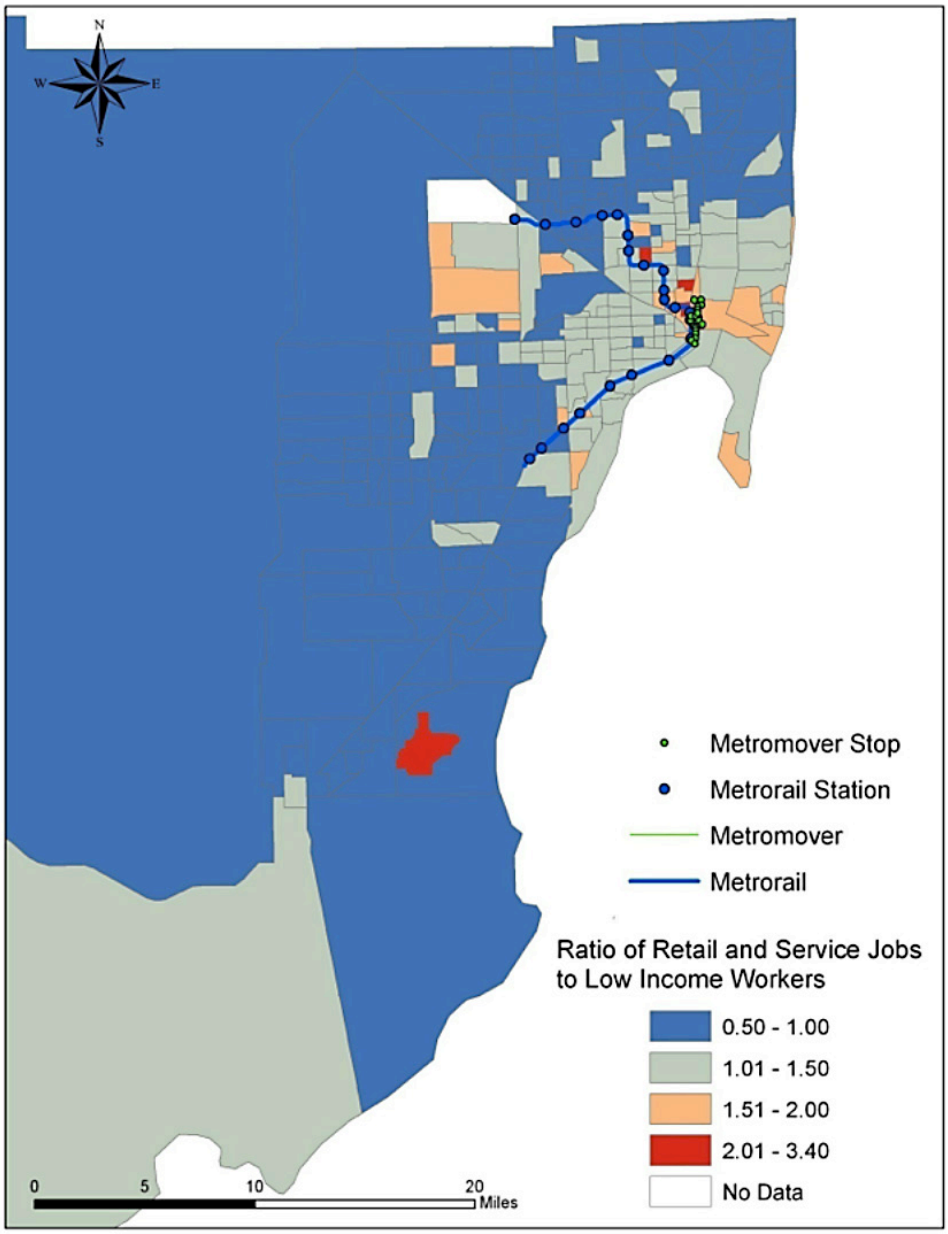


Figure 3-16

Ratio of Retail and Service Jobs to Low-income Workers with 30 Minutes of Travel Time (Annual Household Income Less than $40,000), Miami-Dade County



Transportation Needs of Low-Income Workers

The previous two sections discussed housing and job availability and locations. In this section, the transportation needs of low-income workers to access jobs are examined. This analysis uses the 2000 CTPP.

The CTPP 2000 is a special tabulation of responses to the decennial census long-form questionnaire and was mailed to one of every six households in the country. The special tabulation includes detailed breakdown of journey to work data and was intended to support a wide range of transportation planning studies, such as access to jobs and environmental issues. It summarizes data by place of residence and work and tabulates the flow of workers between home and work.

CTPP 2000 consists of three parts that contain information for different geometrical boundaries such as TAZ or county:

- Part 1: Place of Residence
  - (1) Characteristics of Persons
  - (2) Characteristics of Households
  - (3) Characteristics of Workers
  - (4) Characteristics of Workers by Residence Type
  - (5) Characteristics of Housing Units
- Part 2: Place of Work
  - (1) Characteristics of Workers
  - (2) Characteristics of Workers in Households
- Part 3: Worker flow tables, which provide information on the number of workers from the residence to the workplace, their household characteristics, and their work travel behavior.

Figures 3-17 and 3-18 show the distribution of workers at residence and work places, respectively, who have annual earnings of less than $15,000. Workers in this income bracket were mostly from areas in northern and southwestern parts of the county. Figure 3-18 indicates that there was a high concentration of low-income workers employed in Downtown/Brickell/seaport area as well as the area west of Miami International Airport. Figures 3-19 through 3-22 show similar information for workers with annual earnings of less than $30,000 and $40,000.

Figure 3-17

Distribution of Workers with Annual Household Income Less than $15,000 at Place of Residence, Miami-Dade County

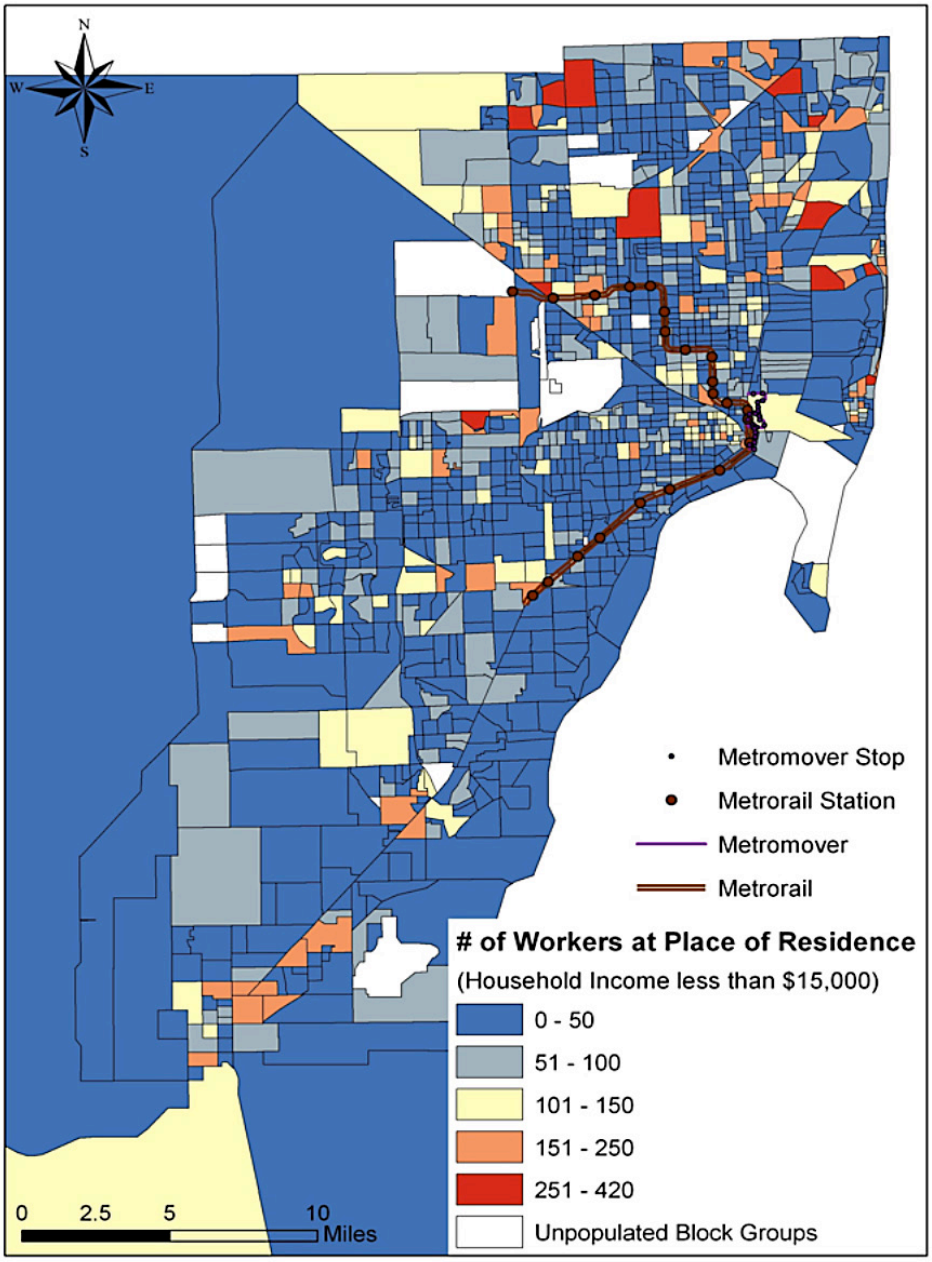


Figure 3-18

Distribution of Workers with Annual Household Income Less than $15,000 at Place of Work, Miami-Dade County

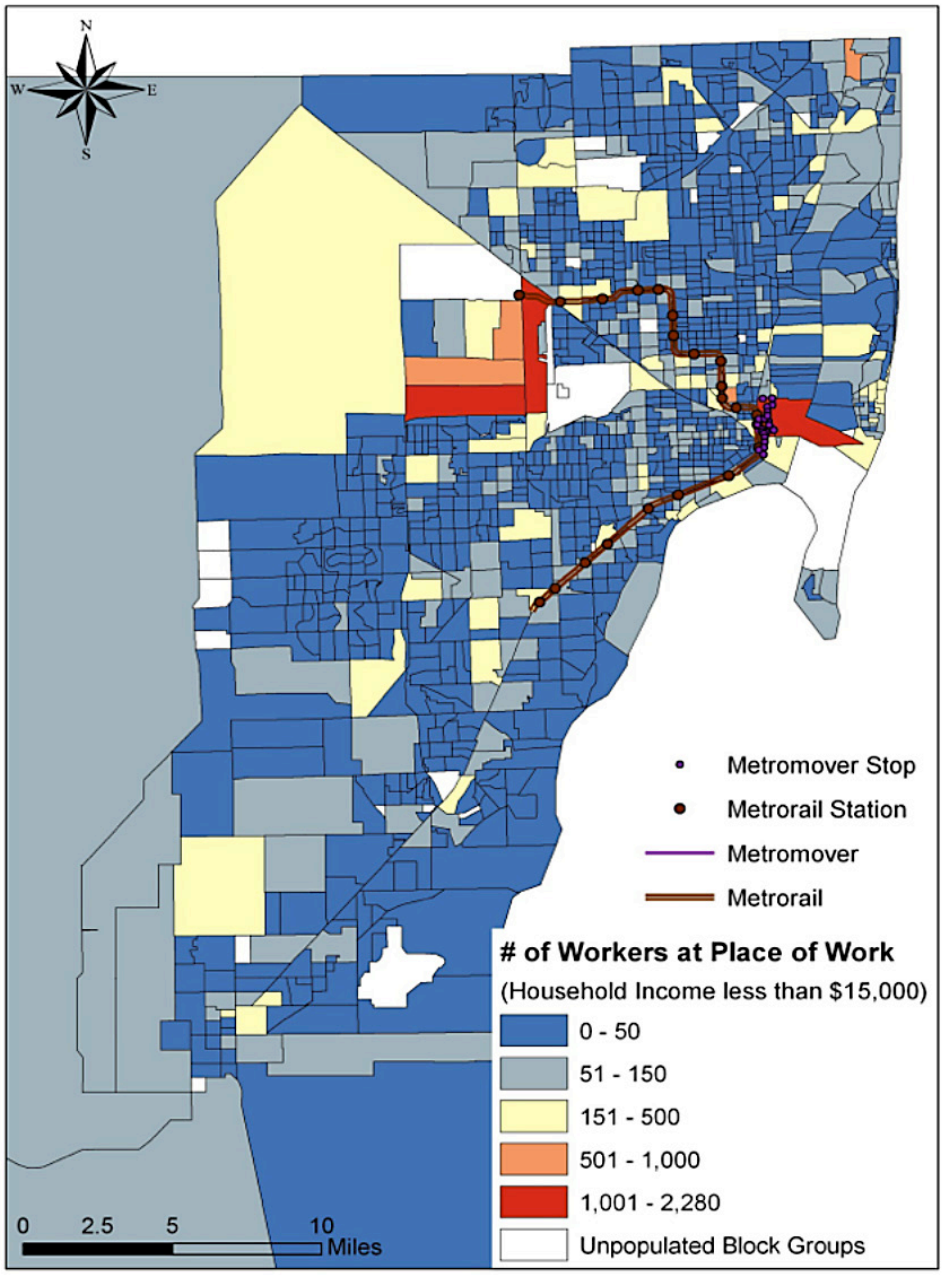


Figure 3-19

Distribution of Workers with Annual Household Income Less than $30,000 at Place of Residence, Miami-Dade County

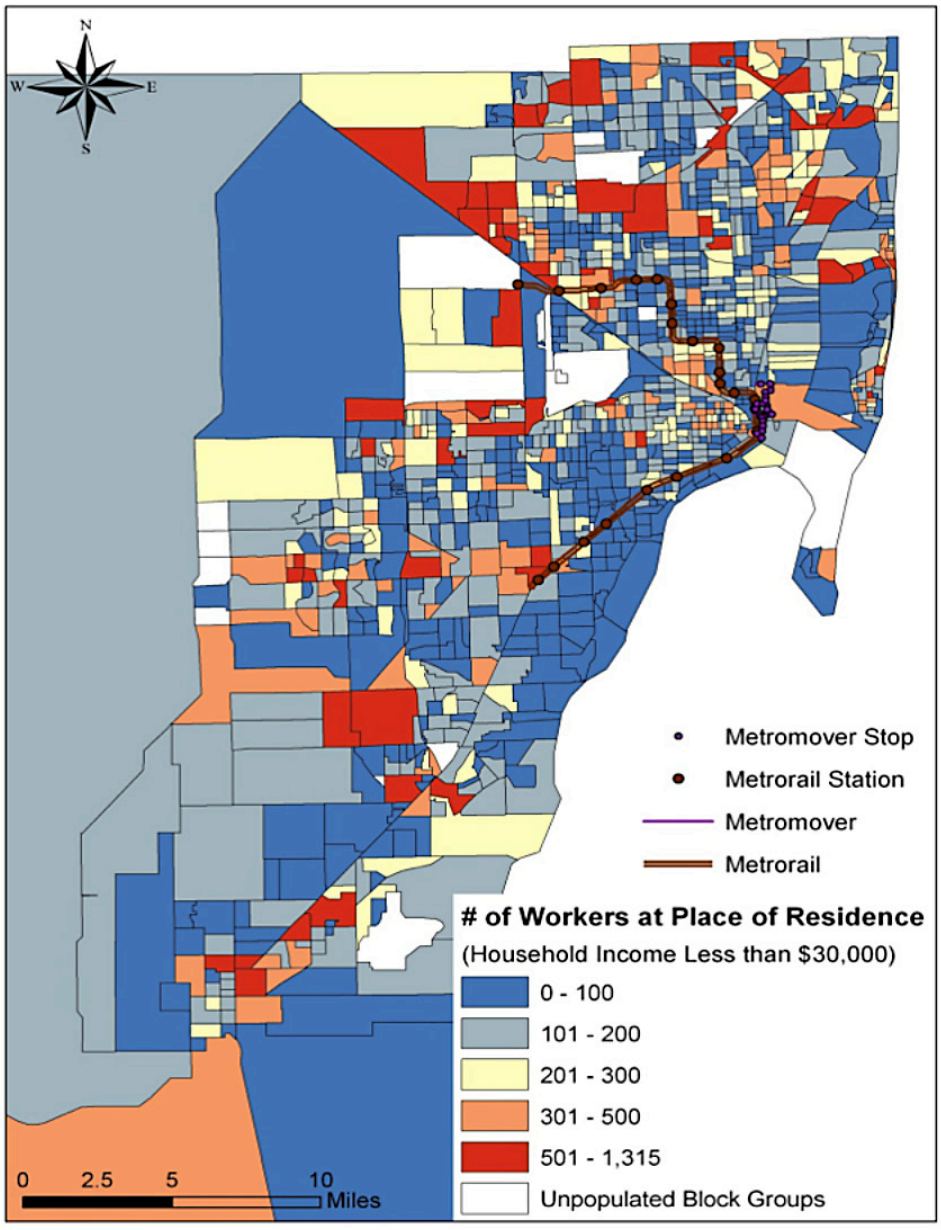


Figure 3-20

Distribution of Workers with Annual Household Income Less than $30,000 at Place of Work, Miami-Dade County

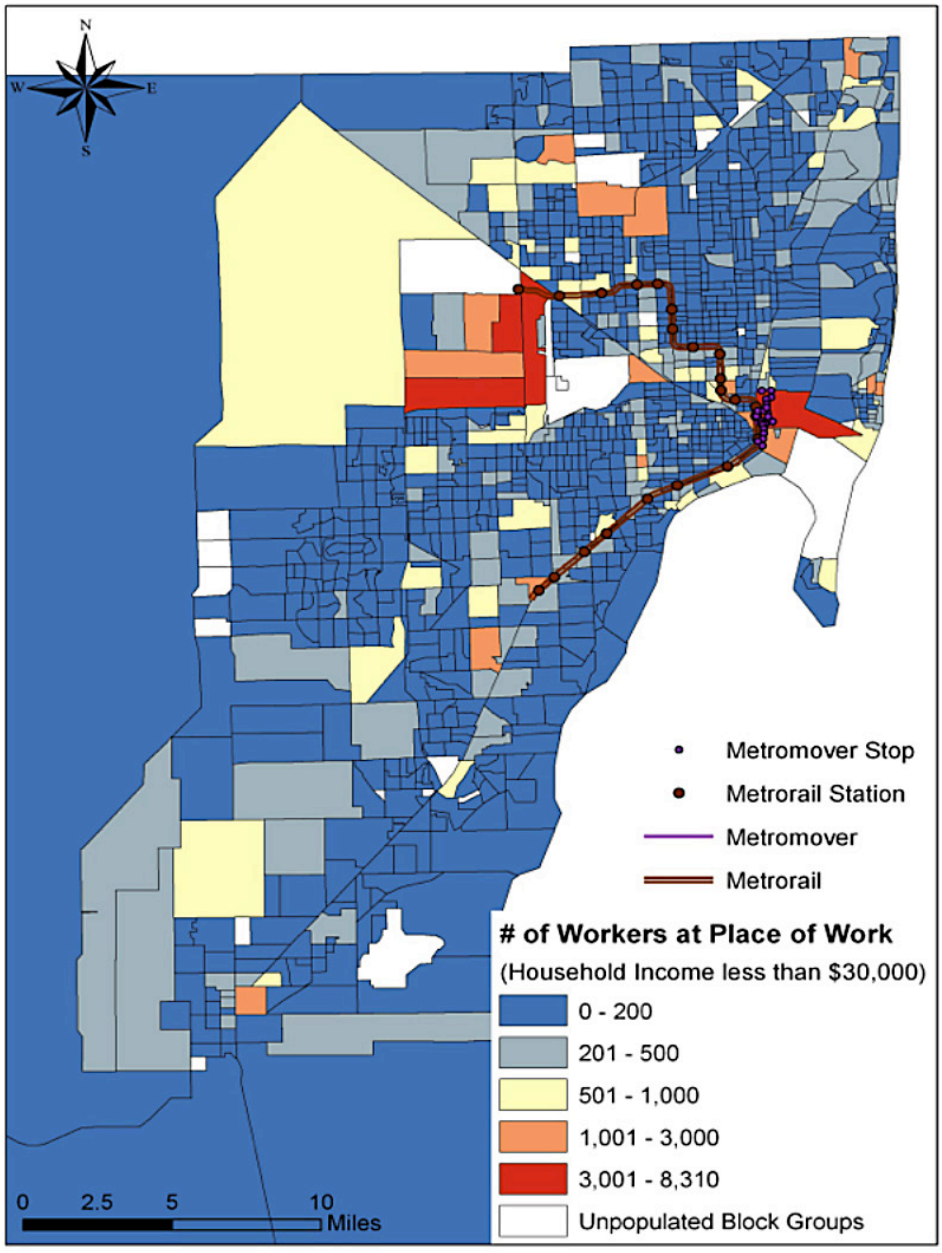


Figure 3-21

Distribution of Workers with Annual Household Income Less than $40,000 at Place of Residence, Miami-Dade County

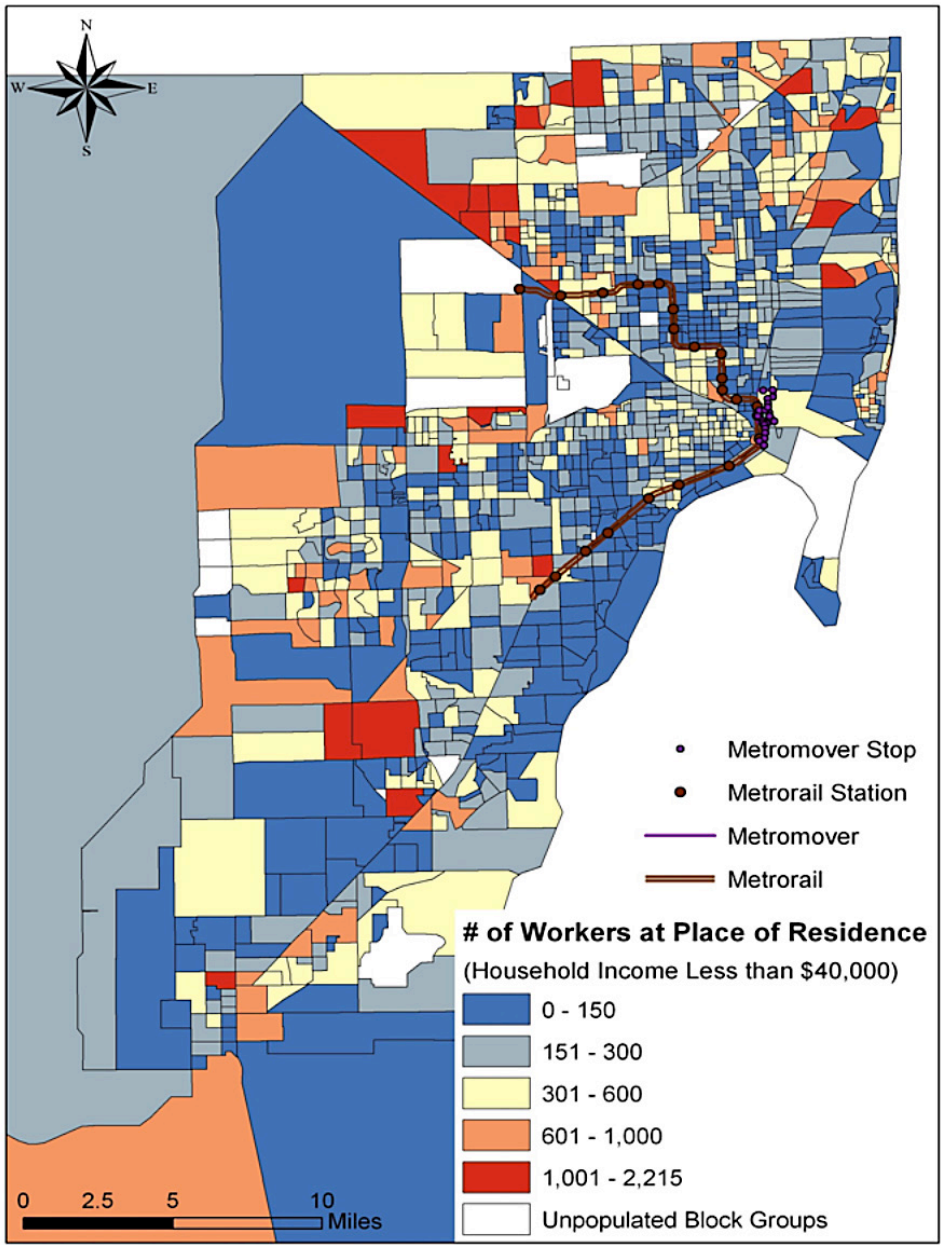


Figure 3-22

Distribution of Workers with Annual Household Income Less than $40,000 at Place of Work, Miami-Dade County

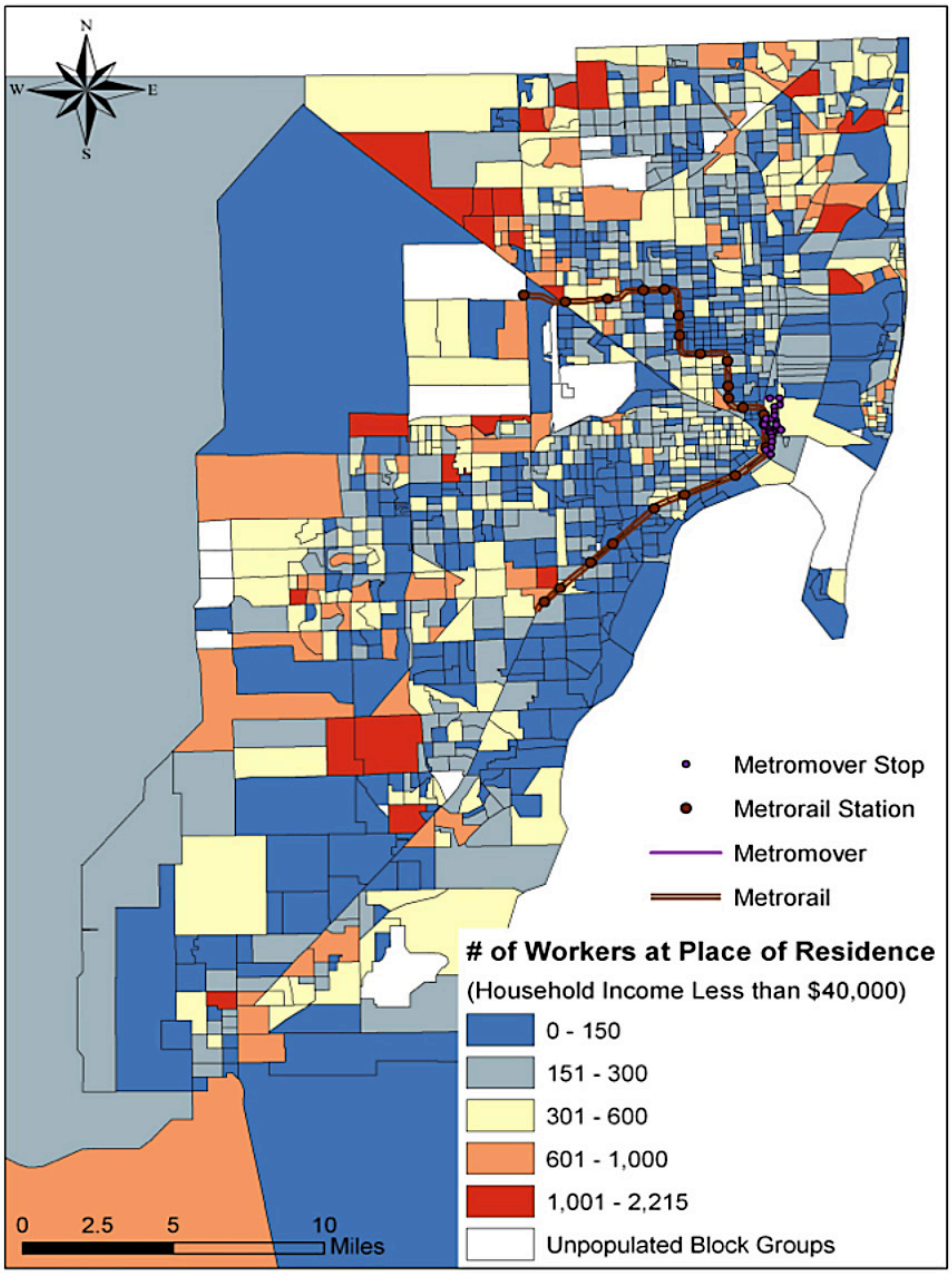


Table 3-4 compares the distribution of households without vehicles in Miami-Dade County based upon owner-occupied housing units and renter-occupied housing units and summarizes the percentage of housing units by number of vehicles available. Among 776,774 occupied housing units, no vehicle was available in 111,323 housing units (14.3%. This population would require transportation assistance in the event of a major evacuation.

This table indicates the percentage of housing units without any vehicles and that renter-occupied housing (when compared to owner-occupied housing) had almost four times the percentage of households without vehicles.

Table 3-4

Number of Housing Units by Number of Vehicles Available, Miami-Dade County

Vehicles Availability	Owner Occupied Housing Units		Renter Occupied Housing Units		Total Housing Units	
	Housing Units	*Percentage*	*Housing Units*	*Percentage*	*Housing Units*	*Percentage*
0	29,059	6.5%	82,264	25.1%	111,323	14.3%
1	148,947	33.1%	152,553	46.6%	301,500	38.8%
2	187,586	41.7%	75,670	23.1%	263,256	33.9%
3	60,280	13.4%	12,953	4.0%	73,233	9.4%
4	18,021	4.0%	2,589	0.8%	20,610	2.7%
5 or more	5,440	1.2%	1,412	0.4%	6,852	0.9%
Total	*449,333*	*100.0%*	*327,441*	*100.0%*	*776,774*	*100.0%*

Figure 3-23 and Figure 3-24 show the distribution of households without vehicles in owner-occupied housing and renter-occupied housing. Figure 3-25 and Figure 3-26 show the average number of vehicles per owner-occupied housing and renter-occupied housing. These figures indicate that households without a vehicle were concentrated in the areas near downtown Miami, Hialeah, Miami Beach, Miami Lakes, and North Miami Beach. Because low-rent housing is also located at these areas with more households having no car, it can be concluded that the lack of access to a vehicle is strongly correlated with lower incomes.

The 2000 census presents number of vehicles available in a housing unit based on a sample survey of occupied housing units. Vehicles available refer to vehicles kept at home and available for the use of household members, including passenger cars, vans, and pickup or panel trucks of 1-ton capacity or less. Vehicles rented or leased for one month or more, company vehicles, and police and government vehicles kept at home and used for non-business purposes were also considered vehicles available.

Figure 3-27 through Figure 3-30 show average travel time for workers with annual earnings of less than $10,000, $10,000–$20,000, $20,000–$30,000, and $30,000–$40,000. They collectively show a dispersal of longer commutes away from central Miami-Dade and shorter commutes generally for those below $10,000 annual income compared to higher incomes.

Figure 3-23

Distribution of Households without Vehicles in Owner-Occupied Housing Units, Miami-Dade County

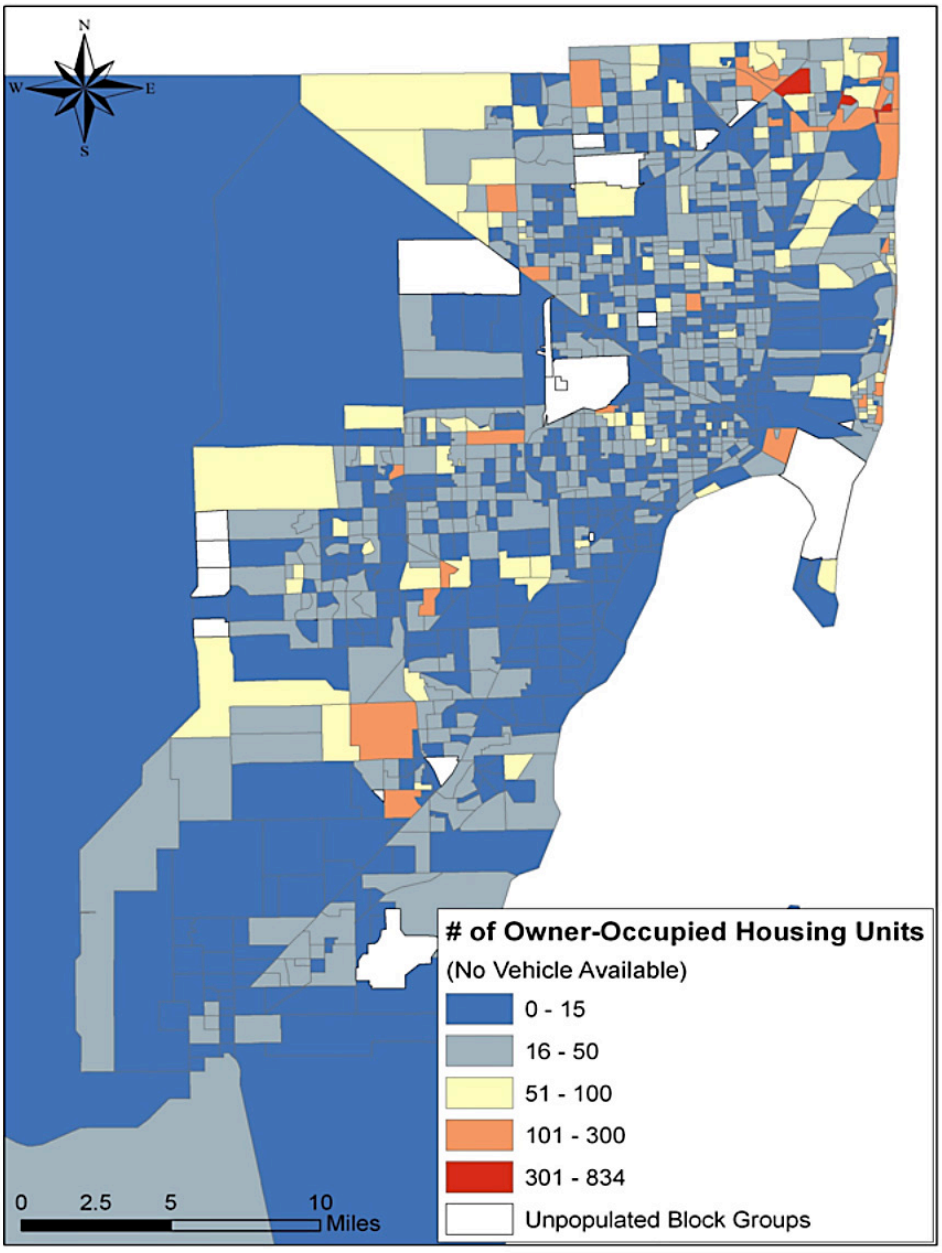


Figure 3-24

Distribution of Households without Vehicles in Renter-Occupied Housing Units, Miami-Dade County

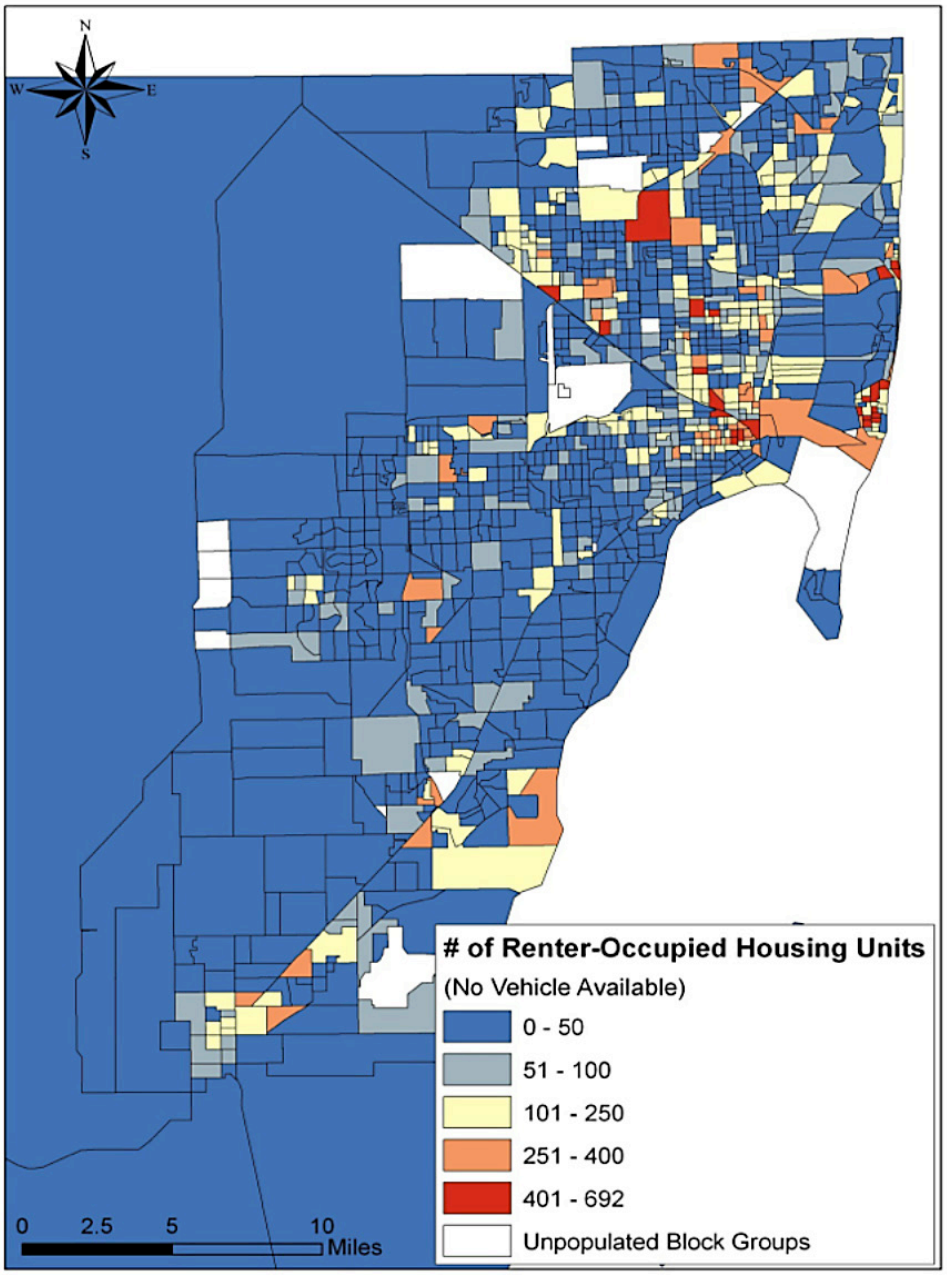


Figure 3-25

Average Number of Vehicles per Owner-Occupied Housing Units, Miami-Dade County

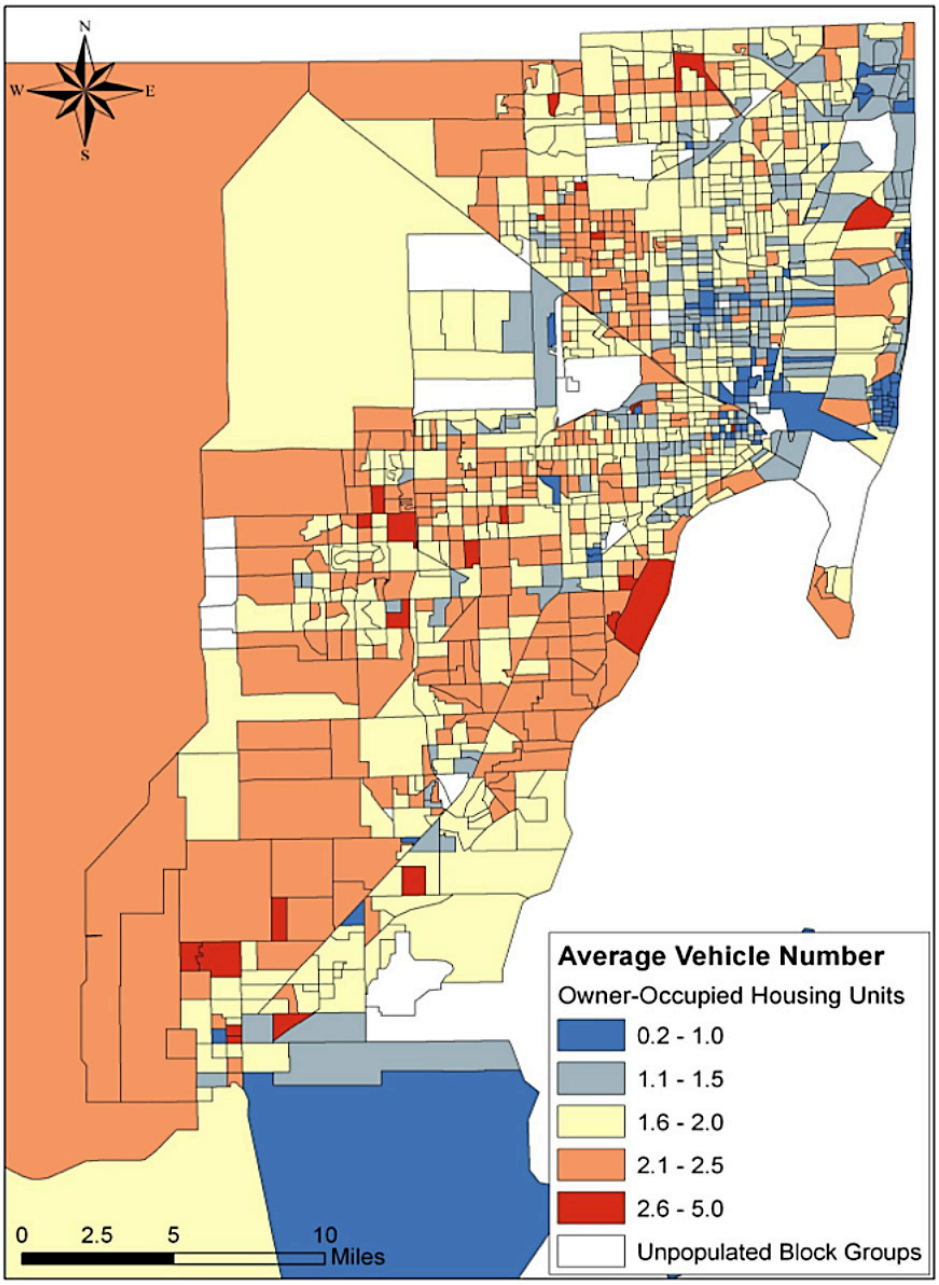


Figure 3-26

Average Number of Vehicles per Renter-Occupied Housing Units, Miami-Dade County

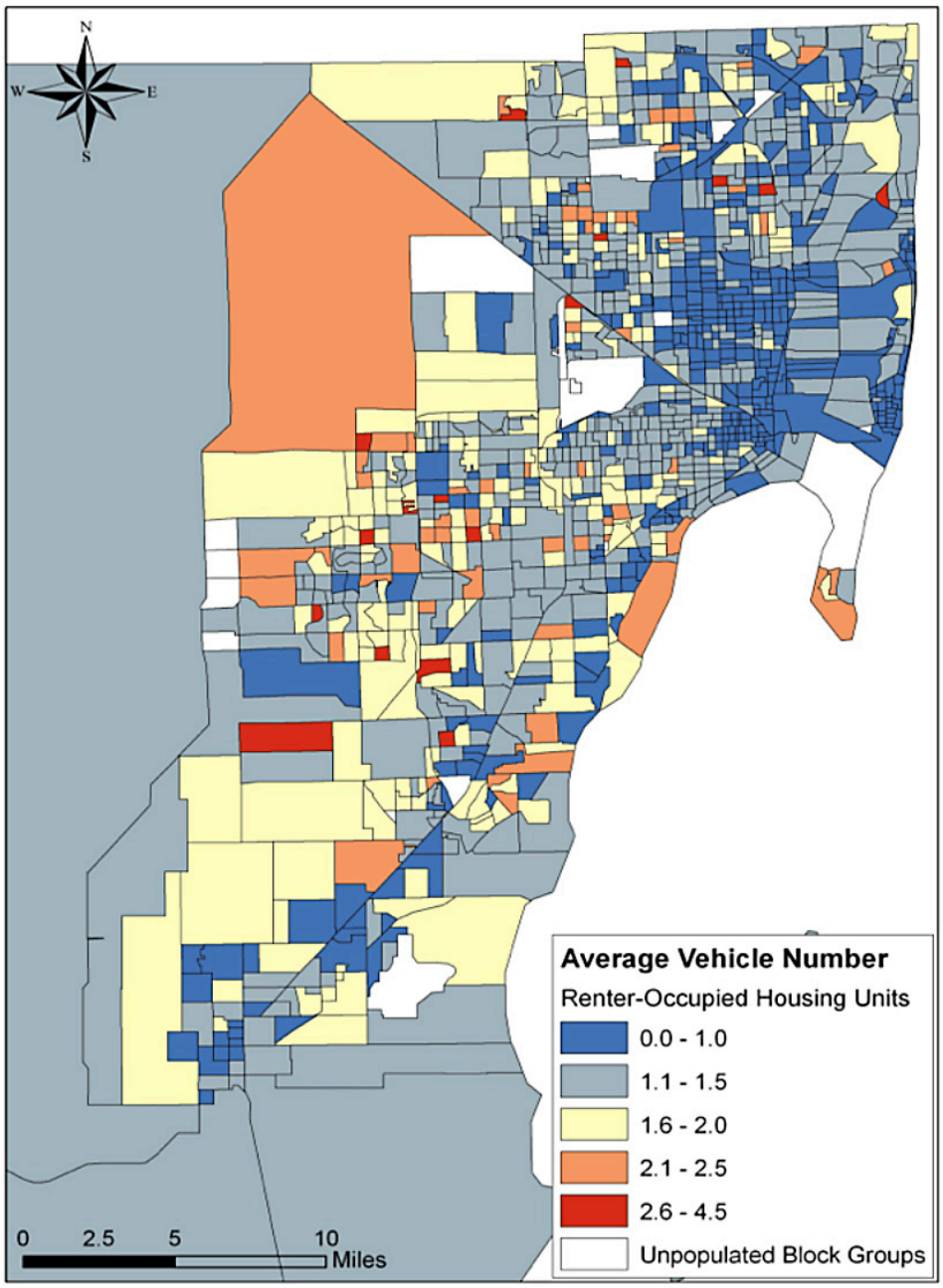


Figure 3-27

Average Travel Time for Workers with Annual Earnings of Less than $10,000, Miami-Dade County

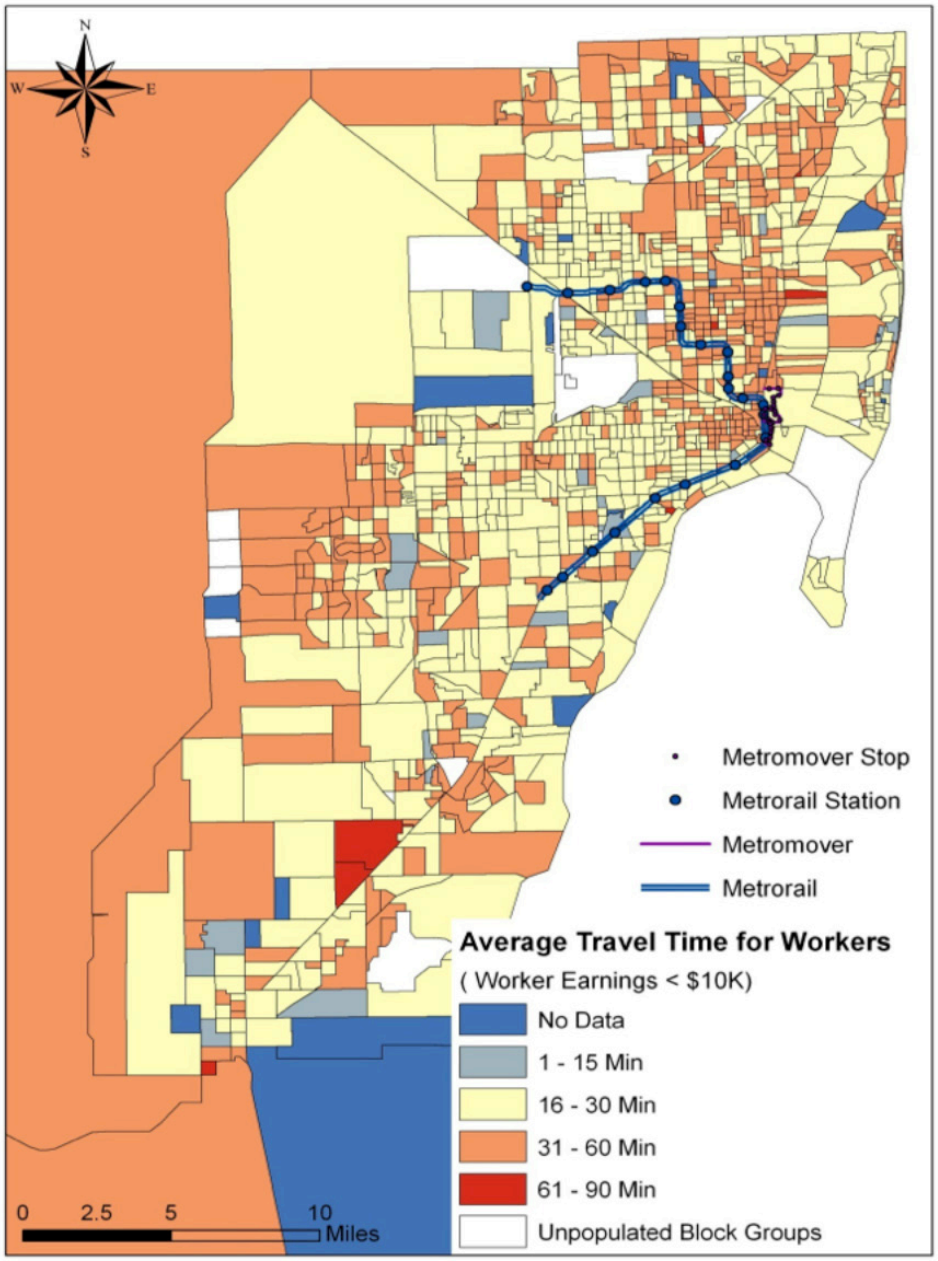


Figure 3-28

Average Travel Time for Workers with Annual Earnings of $10,000–$20,000, Miami-Dade County

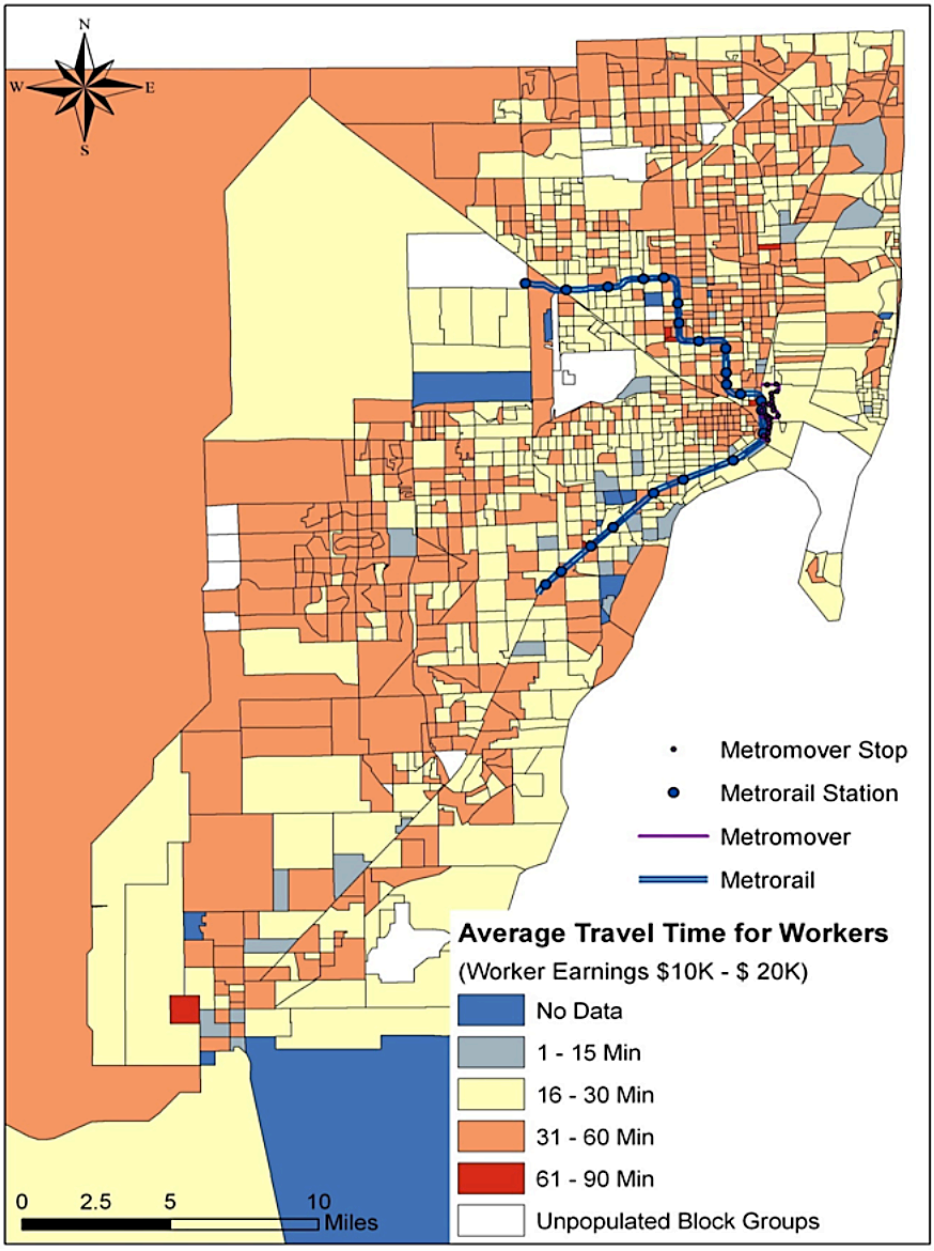


Figure 3-29

Average Travel Time for Workers with Annual Earnings of $20,000–$30,000, Miami-Dade County

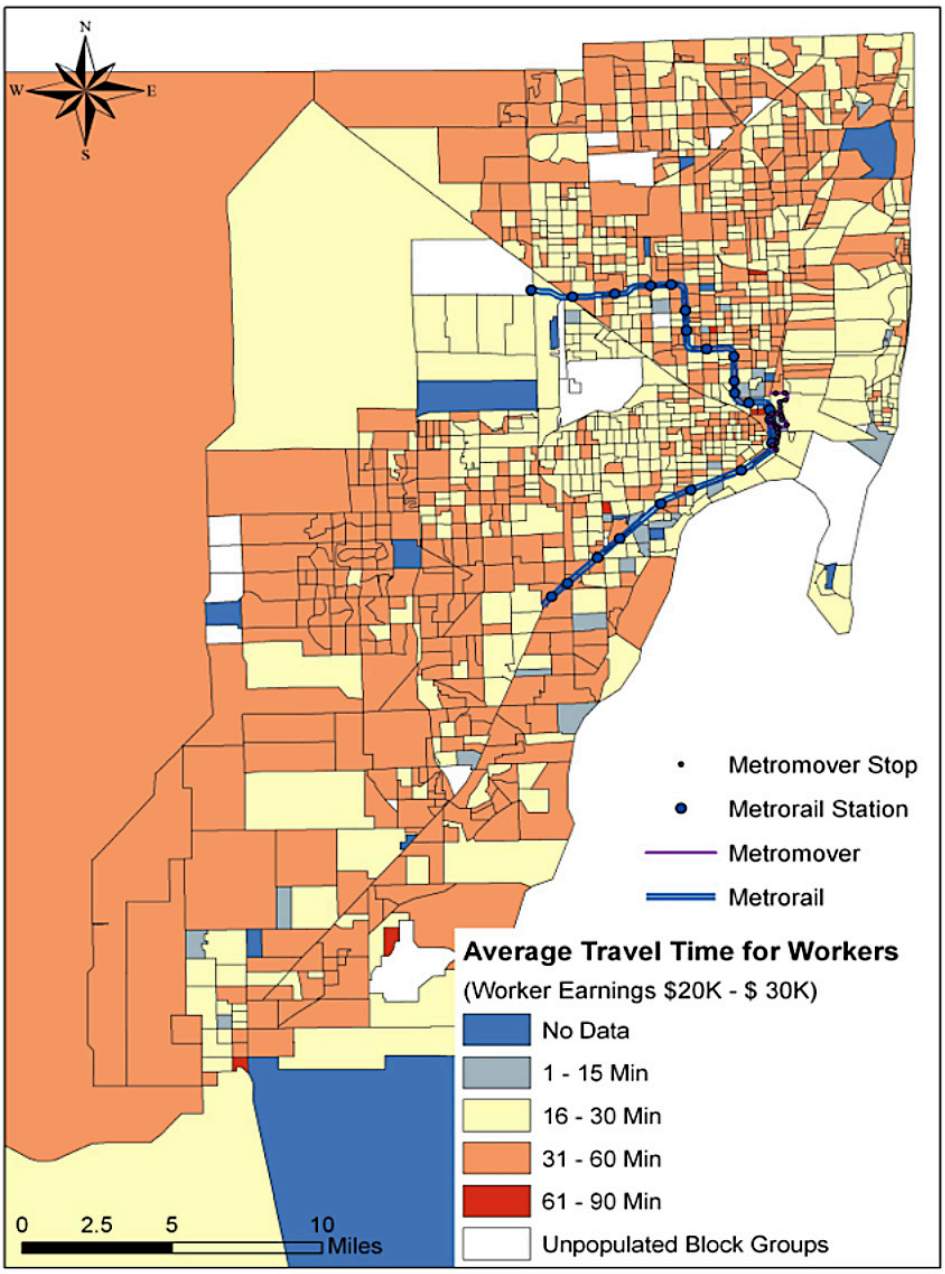
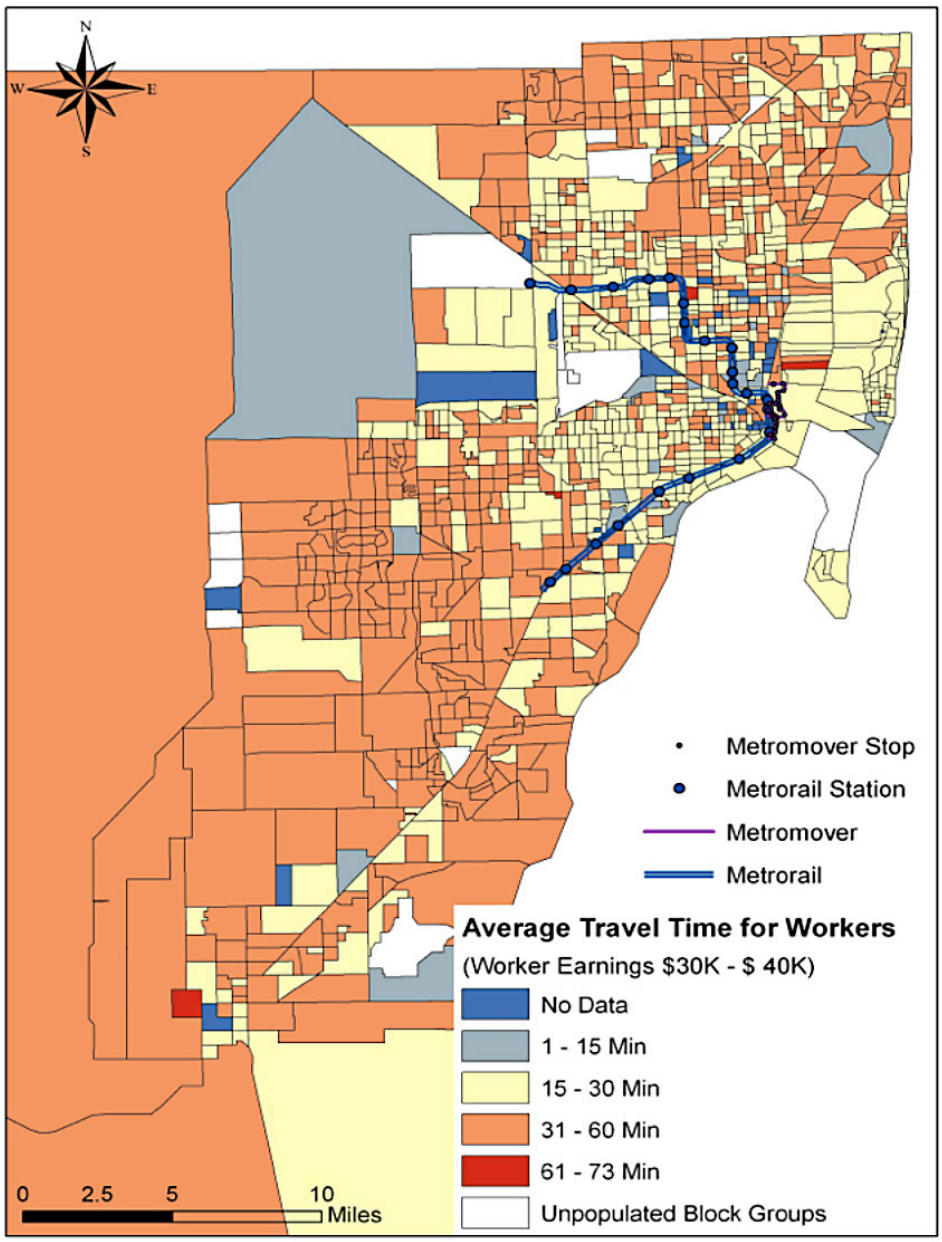


Figure 3-30

Average Travel Time for Workers with Annual Earnings of $30,000–$40,000, Miami-Dade County



CTPP Part 3 provides the journey-to-work trip data by the means of transportation, travel time, and socio-economic characteristics of household or worker. However, applied to some tables in Part 3, data disclosure rules caused errors in working trips exchanging between zones. First, the numbers in the CTPP Parts 1 and 2 tables had been rounded; cell values from 1–7 been rounded to 4 and values of 8 or greater been rounded to the nearest multiple of 5.

Additionally, the tables of Part 3 were subjected to a minimum size criterion of three workers for each working trip interchange. After rounding and stratification by different categories, such as traffic mode or time of day, the values of worker flows in Part 3 tables became very small.

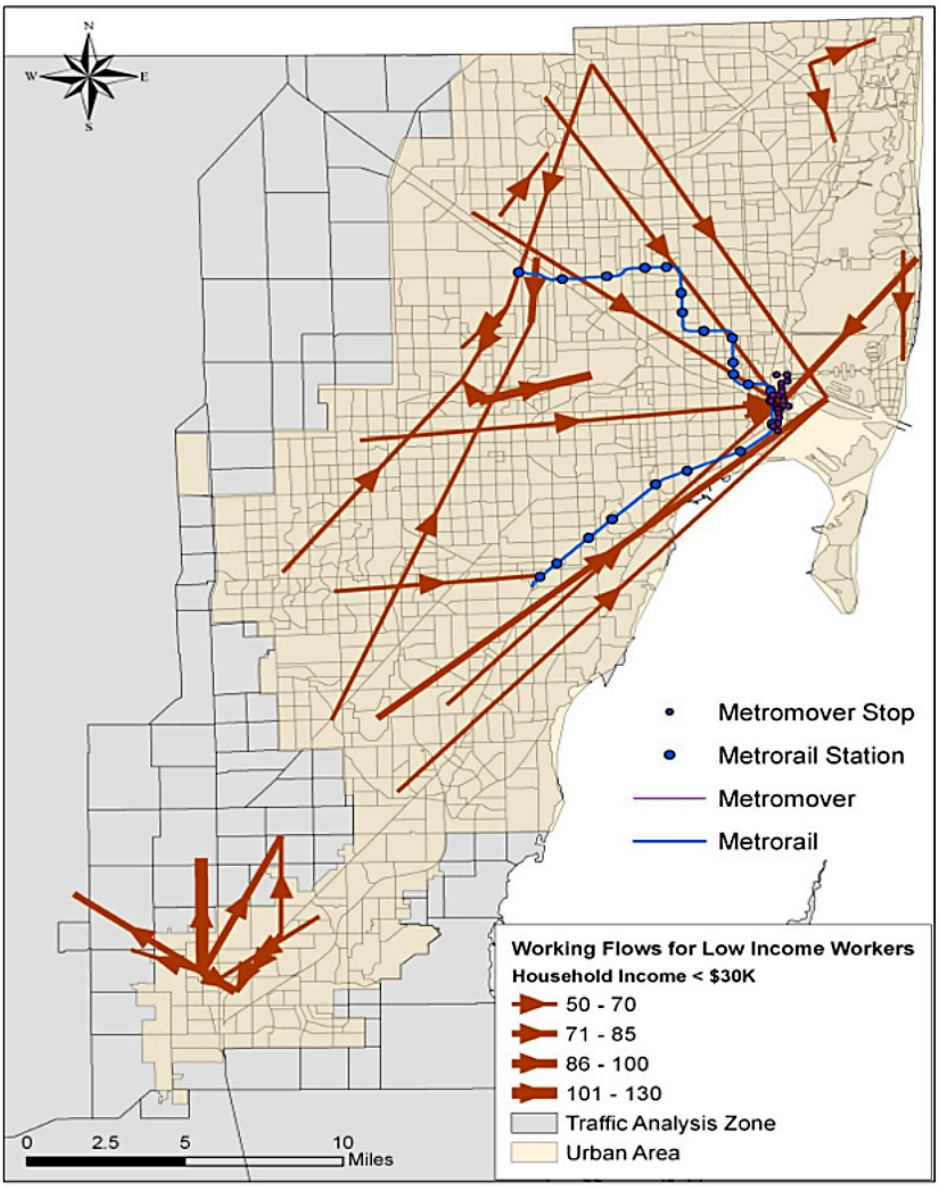
Zakaria (2006) checked the work flow by the means of transportation and found that more than 3 percent of the journey-to-work data in the region were lost due to the rounding requirement, and about 62 percent were lost due to the disclosure threshold. Although Zakaria claimed that the missing work flow made Part 3 tables unusable, these tables can still provide important information for this study since the work flows that had been lost were small journey-to-work trips between zones.

This study mainly focuses on the majority of trip changes for low-income workers. Server journey-to-work tables were retrieved from CTPP for Miami-Dade County. Scripts were developed in a GIS environment to display the zonal interchanges.

Figure 3-31 displays the trip flows with more than 50 trip interchanges for workers with annual household income less than $30,000. Figure 3-32 displays 2006 transit routes and stops in Miami-Dade County. Figure 3-33 shows low-income worker origins and destinations. Collectively, these figures suggest that there may be an imbalance as between the transportation needs of the low-income employees and available transportation choices.

Figure 3-31

Work Trip Zonal Interchanges for Low-Income Workers, Miami-Dade County



Transit Services

Miami-Dade Transit (MDT) provides Metrorail, Metromover, Metrobus, and Paratransit services for the 2.5 million Metro-Dade residents and 12+ million annual visitors to Miami-Dade County. While Metrobus service extends everywhere in Miami-Dade County, north into Broward County and south into Monroe County, it is slowed by frequent stops and roadway congestion. Metrorail's rapid and heavy rail transit service is limited to 22 service miles, and no current feasible plan suggests how major extensions to the north, west, or east will occur. Although the downtown Miami Metromover operates as a free service, it does not serve all major downtown destinations. Paratransit operates 24 hours per day throughout a 7-day week, but along with all MDT services, it must be heavily subsidized.

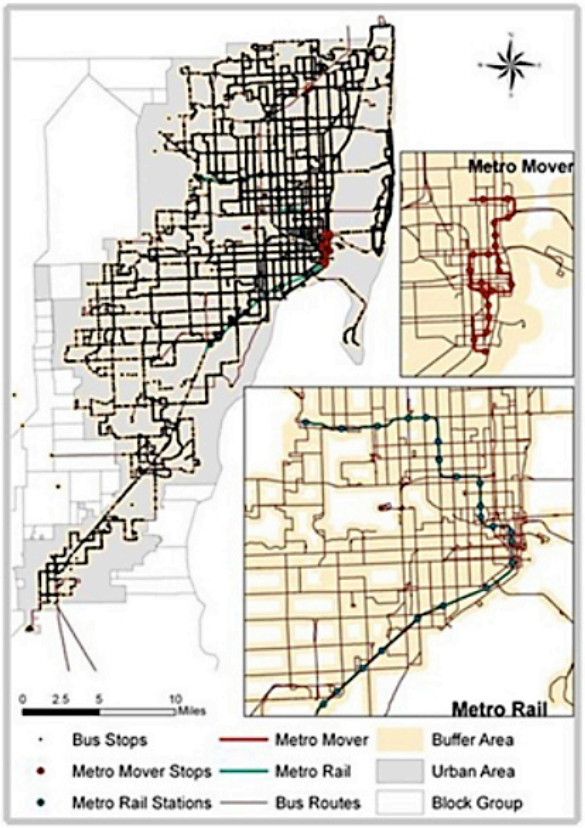
Recent improvements significantly enhance transit service:

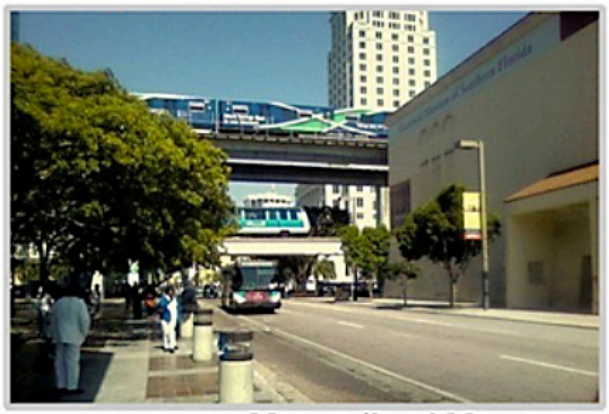
- connecting Metrorail to the Miami Intermodal Center (MIC)
- initiating MIA Mover service between MIC and the Miami International Airport (MIA)
- expanding express bus services on selected routes (836 Express service from MIC to western Miami-Dade/FIU along the Dolphin Expressway, 75 Express service from Sunrise to the Metrorail Palmetto Station on I-75, and similar routes) to join existing South Miami-Dade Busway, Airport Flyer, Kendall Cruiser, and 95 Express service

While plans for northern and western extensions of Metrorail are on hold, efforts to launch express enhanced bus services are can create near-term multimodal capacity. Further, the South Florida Regional Transportation Authority operates a commuter rail service (Tri-Rail) between MIC and West Palm Beach/Mangonia Park and Amtrak service and is available at the Miami station near the Tri-Rail/Metrorail transfer station (and by 2014 will be providing service to the MIC).

Figure 3-32

Transit Routes and Stops in Miami-Dade County



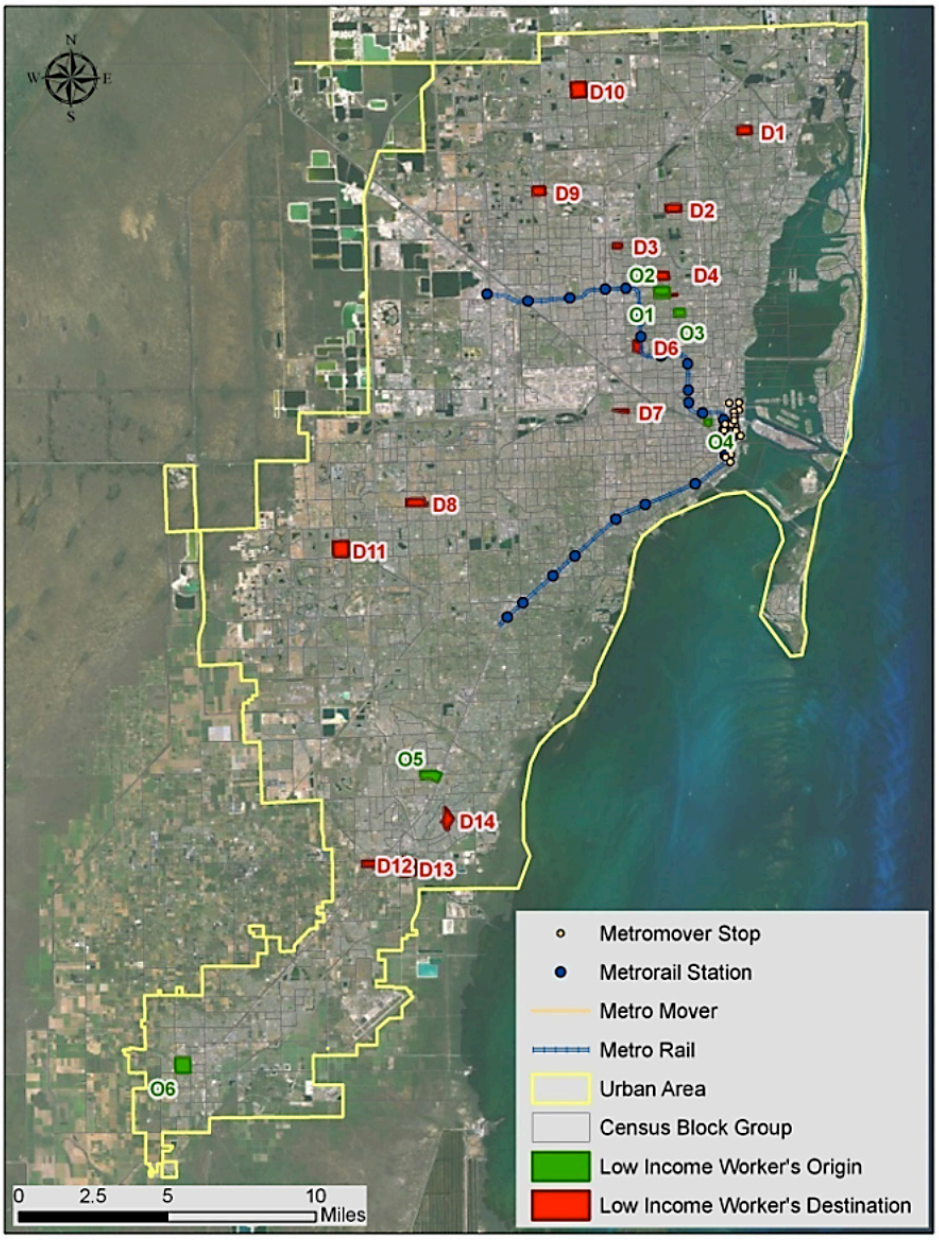


Metrorail and Metromover

Miami Intermodal Center

Figure 3-33

Low-Income Worker Origins & Destinations, Miami-Dade County



In Tables 3-5 through 3-9, it can be seen that travel times are long, rarely less than 30 minutes and most often 1 hour or longer. Most trips also require transfers, which often involve at least one bus ride, and more for some origin-destination pairs. Walking distance between transit stops is frequently more than ½ mile between selected origins and destinations for low-income workers. Cost per one-way trip for low-income workers ranges from $1.50 to $4.10. Travel by bus is slow (due to congestion, frequent stops, and less direct routes) and expensive.

Table 3-5

Air Distance for Selected Origins & Destinations in Miles, Miami-Dade County

Destination	Origin					
	(01)	*(02)*	*(03)*	*(04)*	*(05)*	*(06)*
(D1)	6.26	6.09	6.53	9.93	24.23	36.77
(D2)	3.00	2.81	3.54	7.32	20.84	33.29
(D3)	2.27	2.13	3.09	6.70	18.98	31.27
(D4)	0.69	0.50	1.40	5.19	18.59	31.11
(D5)	0.38	0.41	0.64	4.46	18.18	30.78
(D6)	1.88	2.05	1.82	3.50	16.09	28.66
(D7)	4.11	4.28	3.86	2.96	13.90	26.54
(D8)	10.78	10.90	10.92	10.17	9.27	20.56
(D9)	5.46	5.33	6.28	9.66	20.09	31.83
(D10)	7.52	7.34	8.26	12.04	23.71	35.50
(D11)	13.76	13.88	13.92	13.08	8.27	18.21
(D12)	21.51	21.67	21.30	18.72	3.57	9.29
(D13)	21.04	21.21	20.79	18.06	3.11	10.11
(D14)	19.04	19.22	18.77	15.99	1.53	12.18

Table 3-6

Transit Travel Time for Selected Origins & Destinations—Low-Income Workers, Miami-Dade County

Destination	Origin											
	(01)		*(02)*		*(03)*		*(04)*		*(05)*		*(06)*	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
(D1)	49.5	45.5	49.5	45.5	43.5	52.0	53.5	43.0	103.5	89.5	163.0	159.5
(D2)	10.5	9.5	10.5	9.5	13.5	12.5	43.5	36.5	93.5	78.0	135.0	140.0
(D3)	13.5	15.0	14.5	16.5	22.0	23.0	26.0	29.0	78.0	72.5	134.0	135.0
(D4)	0.0	0.0	1.5	1.5	5.0	4.5	40.0	33.5	74.0	67.0	118.0	121.5
(D5)	0.5	1.0	1.0	0.5	2.5	2.5	35.0	31.0	71.5	66.5	120.5	124.0
(D6)	13.0	13.5	13.0	13.5	10.5	11.5	10.0	10.0	58.5	55.5	105.5	137.0
(D7)	37.0	39.5	37.5	40.5	42.5	36.0	17.5	16.5	93.5	86.5	115.0	116.5
(D8)	78.5	83.0	78.5	83.0	99.0	94.5	49.0	55.5	51.5	64.5	126.0	126.0
(D9)	38.5	39.0	38.5	39.0	44.0	46.0	39.5	40.5	122.5	111.0	149.0	161.0
(D10)	41.0	36.5	41.0	36.0	44.0	39.5	73.0	52.0	135.5	103.0	157.5	160.5
(D11)	74.0	70.0	74.0	70.5	94.0	71.0	46.5	55.5	78.5	86.5	131.5	142.5
(D12)	82.5	77.0	83.5	78.0	90.5	75.5	67.0	58.5	14.5	15.0	49.0	45.0
(D13)	80.0	77.0	81.0	77.0	83.5	75.0	61.0	55.5	10.0	9.0	52.0	47.0
(D14)	78.5	76.0	77.0	76.5	81.5	75.5	55.5	54.0	7.0	12.5	76.5	84.0

Table 3-7

Average Bi-Directional Transfers for Selected Origins & Destinations—Low-Income Workers, Miami-Dade County

Destination	Origin											
	(01)		(02)		(03)		(04)		(05)		(06)	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
(D1)	0.0	0.0	1.0	0.0	2.0	3.0	0.0	0.0	1.0	0.0	2.0	3.0
(D2)	0.0	0.0	0.0	1.0	2.5	3.0	0.0	0.0	0.0	1.0	2.5	3.0
(D3)	1.0	1.0	1.0	1.0	2.0	3.0	1.0	1.0	1.0	1.0	2.0	3.0
(D4)	0.0	0.0	0.0	0.0	2.0	3.0	0.0	0.0	0.0	0.0	2.0	3.0
(D5)	0.0	0.0	0.0	0.0	2.0	3.0	0.0	0.0	0.0	0.0	2.0	3.0
(D6)	1.0	1.0	1.0	0.0	1.0	3.0	1.0	1.0	1.0	0.0	1.0	3.0
(D7)	1.0	1.0	1.0	0.0	1.5	3.0	1.0	1.0	1.0	0.0	1.5	3.0
(D8)	1.0	1.0	1.0	1.0	1.5	2.5	1.0	1.0	1.0	1.0	1.5	2.5
(D9)	1.0	1.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	2.0
(D10)	1.0	1.0	1.0	0.5	2.5	3.5	1.0	1.0	1.0	0.5	2.5	3.5
(D11)	2.0	2.0	2.0	1.0	1.0	2.0	2.0	2.0	2.0	1.0	1.0	2.0
(D12)	2.0	2.0	2.0	1.0	0.0	0.0	2.0	2.0	2.0	1.0	0.0	0.0
(D13)	2.5	2.5	2.5	1.0	0.0	0.0	2.5	2.5	2.5	1.0	0.0	0.0
(D14)	2.0	2.0	2.0	1.0	0.5	2.0	2.0	2.0	2.0	1.0	0.5	2.0

Table 3-8

Walking Distance (Miles) to Transit Stops for Selected Origins & Destinations—Low-Income Workers, Miami-Dade County

Destination	Origin											
	(01)		(02)		(03)		(04)		(05)		(06)	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
(D1)	0.45	0.45	0.59	0.59	0.49	0.49	0.85	0.82	0.77	0.84	0.72	0.72
(D2)	0.62	0.62	0.48	0.48	0.50	0.50	0.56	0.24	0.48	0.48	0.48	0.56
(D3)	0.52	0.44	0.46	0.48	0.37	0.37	0.57	0.57	0.57	0.57	0.58	0.54
(D4)	0.66	0.66	0.62	0.62	0.54	0.54	0.61	0.66	0.60	0.60	0.55	0.72
(D5)	0.46	0.46	0.48	0.48	0.29	0.29	0.38	0.38	0.36	0.48	0.32	0.50
(D6)	0.68	0.72	0.72	0.71	0.64	0.52	0.76	0.76	0.76	0.76	0.70	0.77
(D7)	0.76	0.82	0.76	0.72	0.76	0.66	0.65	0.65	0.68	0.46	0.54	0.69
(D8)	0.53	0.53	0.67	0.67	0.43	0.42	0.80	0.76	0.60	0.66	0.55	0.66
(D9)	0.52	0.52	0.66	0.66	0.51	0.51	0.62	0.62	0.77	0.77	0.60	0.80
(D10)	0.78	0.79	0.64	0.64	0.64	0.66	0.54	0.71	0.60	0.72	0.60	0.73
(D11)	0.42	0.60	0.55	0.55	0.34	0.36	0.52	0.60	0.46	0.61	0.63	0.57
(D12)	0.42	0.32	0.44	0.42	0.22	0.32	0.48	0.48	0.47	0.47	0.45	0.45
(D13)	0.74	0.72	0.76	0.76	0.54	0.64	0.80	0.80	0.76	0.76	0.46	0.47
(D14)	0.40	0.49	0.51	0.54	0.30	0.34	0.47	0.58	0.60	0.61	0.54	0.50

Table 3-9

Average One-Way Fare for Selected Origins & Destinations—Low-Income Workers, Miami-Dade County

Destination	Origin											
	(01)		(02)		(03)		(04)		(05)		(06)	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
(D1)	1.50	1.50	1.50	1.50	2.00	2.00	1.50	1.68	2.93	2.68	3.00	3.68
(D2)	1.50	1.50	1.50	1.50	1.50	1.50	2.00	2.00	2.75	2.75	3.92	3.68
(D3)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.50	2.50	3.00	3.68
(D4)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	2.50	2.50	3.68	3.68
(D5)	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	2.50	2.50	3.68	3.68
(D6)	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	2.00	2.00	3.18	3.68
(D7)	2.00	2.00	2.00	2.00	2.00	2.00	1.50	1.50	2.25	2.25	3.68	3.68
(D8)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.25	2.25	2.78
(D9)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.68	2.50
(D10)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.93	2.50	3.10	3.92	4.10
(D11)	2.50	2.50	2.50	2.50	2.50	2.50	2.25	2.00	2.25	2.25	2.50	2.50
(D12)	3.18	3.18	3.18	3.18	2.50	3.18	2.00	2.68	1.50	1.50	1.50	1.50
(D13)	2.50	2.92	2.50	2.92	2.50	2.92	2.00	2.00	1.50	1.50	1.50	1.50
(D14)	2.50	2.50	2.50	2.50	2.50	2.50	2.25	2.00	1.50	1.75	2.25	2.50

The following analysis estimates the number of population by households.

The source of demographic and socioeconomic data was CTPP Part 1 data. Each census tract was described in terms of its demographic and socioeconomic characteristics. The low-income households were further stratified by the age of the head of the household. The low-income household distribution for age groups in Figure 3-7 is 15–24, 25–34, 35–44, 45–54, 55–65, 65–74, and 75+.

The low-income households were also stratified by household size. The low-income household distribution for 4 groups is displayed as households with 1 to 4 persons.

In the first step, the data of population, household and worker are listed in the following tables for the whole area of Miami-Dade County.

Table 3-10

Population, Miami-Dade County

Total Population	POOR POP	EMP POP	Population Over 65
2,253,685	396,995	922,720	300,634

Table 3-11

Household/Workers, Miami-Dade County

Total Households	HH0k 1K	HH1k 2k	HH2k 3k	HH3k 4k
777,698	108,218	113,549	108,489	93,835
100%	13.9%	14.6%	14.0	12.1%
Total Workers	**W0k 1K**	**W1k 2k**	**W2k 3k**	**W3k 4k**
899,432	145,436	222,602	175,491	181,280

In the second step, the buffer areas were set as 0.5 miles for Metrorail station. The data related to population, household and worker in the buffer areas are listed in Tables 4, 5, and 6, respectively. In those tables, the data in the first row stand for the corresponding data in the buffer areas, and the data in the other rows represent the percentage of the number in the buffer areas compared to the number for the total Miami-Dade County.

Table 3-12

Population, Miami-Dade County

	TOT POP Buffer	POOR POP Buffer	EMP POP Buffer	Over 65 Buffer	Disabled Buffer
NO.	110247	30603	37199	159054	27425
%	4.9	7.7	4.0	52.9	5.8

Table 3-13

Household, Miami-Dade County

	Total HH Buffer	HH0k 1K Buffer	HH1k 2k Buffer	HH2k 3k Buffer	HH3k 4k Buffer
NO.	38263	9681	7368	5613	4061
%	4.9	8.9	6.5	5.2	4.3

Table 3-14

Worker, Miami-Dade County

	Total W Buffer	W0k 1K Buffer	W1k 2k Buffer	W2k 3k Buffer	W3k 5k Buffer
NO.	36141	7896	5680	6385	5710
%	4.0	5.4	2.6	3.6	3.1

In the third step, the buffer areas were set as 0.5 miles for Metrorail station, 0.25 miles for the stops of Metromover and all bus routes in Miami Dade County. The data related to population, household and worker are listed in the Table 7, 8, and 9, respectively. In those tables, the data in the first row stand for the corresponding data in the buffer areas, and the data in the other rows represent the percentage of the number in the buffer areas compared to the number for the total Miami Dade County.

Table 3-15

Population, Miami-Dade County

	TOT POP Buffer	POOR POP Buffer	EMP POP Buffer	Over 65 Buffer	Disabled Buffer
NO.	1719975	335787	695586	242843	384690
%	76.3	84.5	75.4	80.8	81.1

Table 3-16

Household, Miami-Dade County

	Total HH Buffer	HH0k 1K Buffer	HH1k 2k Buffer	HH2k 3k Buffer	HH3k 4k Buffer
NO.	604175	93213	95334	88579	74245
%	77.7	86.1	84.0	81.6	79.1

Table 3-17

Worker, Miami-Dade County

	Total W Buffer	W0k 1K Buffer	W1k 2k Buffer	W2k 3k Buffer	W3k 5k Buffer
NO.	677325	115630	177866	134266	130407
%	75.3	79.5	79.9	76.5	71.9

What the data clearly show is if such buffer areas were improved to be more pedestrian-oriented and had community transit and other means to extend likely pedestrian movements for ½ mile more were consistently applied to all Metrorail, Metromover, and Metrobus stops, a significant number of the total population, including low-income, older adults, and persons with disabilities, would find the transit is more accessible. With such improvements at transit stops, ridership will likely increase depending on the quality of the walking experience to be defined in the next section.

Summary

In Miami-Dade County, public housing and subsidized rental facilities are located in areas of very low-income, where there is a high concentration of poverty. Most of these housing facilities are also located outside the walking distance of the Metrorail and Metromover. In the Metrorail corridor, especially the southern portion, housing prices are generally outside the reach of low-income workers and their families.

Data show that retail and service jobs were the dominant low-income occupations. The places of these jobs were neither in the low-income areas nor near Metrorail stops. This causes the problem of spatial mismatch of residential location and job location for low-income workers. As can be seen in GIS maps, Metrorail cannot provide necessary links between house and job location for this group of people, many of whom do not have a car. Traveling by bus is not a considerable option, because it is slow, less direct, and expensive; however, if each transit stop had a buffer area of ½ mile or less with an improved pedestrian-orientation, a very high percent of residents within Miami-Dade County (80% or so) would find access to transit services and might find good reason to use transit systems in higher numbers.

SECTION 4

Conclusions and Recommendations

According to the 2010 Census, 41.8 million American over age 18 were persons with disabilities, 40 million were age 65+, and 32 million were living below the poverty level (poverty level for people above age 18) (U.S. Census Bureau 2010). Many of these people have very few mobility options to meet their basic travel needs and, as a transportation disadvantaged population, they face chronic problems that reduce their quality of life and productivity.

Providing adequate transit services to disadvantaged populations in most U.S. urban areas has been hindered by a land-use pattern and community designs not supportive of public transit development. Urban sprawl has made people more and more dependent on driving privately-owned vehicles in their daily lives. Higher car usage reduces transit use. As job locations become increasingly dispersed, transit services at central business districts and corridors are no longer adequate.

The spatial mismatch of jobs and residences for low-income families has been a well-known problem that has not been dealt with effectively, given land-use patterns and community designs that suppress transit demand and a lack of capital and operating funding for transit properties. Two related problems faced by low-income households and workers are that the rapid rise of housing cost has shrunk the choices of residences available that have transit access to jobs, and higher-capacity transit services that are typically provided more frequently during peak commuting hours do not address access to many service jobs often taken by low-income workers who do not follow a regular 9-to-5 schedule.

Using a combination of data sources, this paper suggests a methodology to assess the transit markets in Miami-Dade County in terms of residential and job locations. It provides choices for low-income households, determines the temporal distribution of transit demand, analyzes the housing availability to low-income families in relation to job locations, and evaluates existing transit services for improvements and potential development opportunities in Miami-Dade County.

It is suggested that 1) the highway system and communities that are linked to it could be built to last; 2) demand can be adjusted to fit capacity; 3) the system of multimodal transport could be very simple to use; 4) the many people to be seen and things to be done could be accomplished best when traveling on foot; and 5) a mobility and accessibility computer program could improve use of a quickly-assembled multimodal transportation system that uses Advanced Transit-Oriented Developments and express bus service to expand on existing transit and passenger rail services. By this means, the transportation needs of the general population and the transportation disadvantaged will be addressed.

By building a cost-effective, rapid, and financially self-sufficient multimodal system that assumes that the last mile of every trip will be on foot or via community transit, both the general traveling public and the older adults, persons with disabilities, and the poor will be lifted up and provided with affordable transportation choices and opportunities for economic success and an increasingly high quality of life while adapting to the challenges of climate change and global competition.

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APPENDIX

A

Table A-1

Employment Classification and Percentage by Employment Type

SIC	Description	Employment		
		%	*Type*	%
52	Building Materials & Hardware	3.20	Retail	19.22
53	General Merchandise Stores	7.00		
54	Food Stores	14.00		
55	Automotive Dealers & Service Station	8.83		
56	Apparel & Accessory Stores	7.35		
57	Home Furniture & Furnishings Stores	7.30		
58	Eating & Drinking Places	39.20		
59	Miscellaneous Retail	13.11		
40	Railroad Transportation	0.25	Service	32.90
41	Local/Suburban Transit & Hwy Passenger	0.97		
42	Motor Freight Transportation/Warehouse	3.37		
44	Water Transportation	1.70		
46	Pipelines Except Natural Gas	0.00		
47	Transportation Services	6.12		
49	Electric Gas & Sanitary Services	0.89		
70	Hotels Rooming Houses & Camps	5.58		
73	Business Services	13.40		
75	Auto Repair Services & Parking	3.36		
78	Motion Pictures	0.64		
79	Amusement & Recreation Services	4.23		
80	Health Services	29.40		
82	Educational Services	19.57		
83	Social Services	5.07		
84	Museums Art Galleries & Gardens	0.06		
86	Membership Organizations	5.17		
88	Private Households	0.00		
89	Miscellaneous Services	0.21		
1	Agricultural Production-Crops	0.22	Commercial & Industrial	25.15
2	Agricultural Production-Livestock	0.43		
7	Agricultural Services	1.88		
8	Forestry	0.00		
9	Fishing Hunting & Trapping	0.03		
10	Metal Mining	0.00		
12	Coal Mining	0.00		
13	Oil & Gas Extraction	0.07		
14	Mining & Quarrying-Nonmetallic Miner	0.48		
15	Building Construction-Gen Contractor	3.20		
16	Building Construction-Gen Contractor	1.94		
17	Construction-Special Trade Contractor	8.77		
20	Food & Kindred Products Manufactures	2.49		

Table A-1
(continued)

Employment Classification and Percentage by Employment Type

SIC	Description	Employment		
		%	*Type*	%
21	Tobacco Products Manufactures	0.11	Commercial & Industrial	25.15
22	Textile Mill Products Manufactures	1.46		
23	Apparel & Other Finished Products Manufactures	3.86		
24	Lumber & Wood Prods Except Furniture Manufactures	0.77		
25	Furniture & Fixtures Manufactures	1.72		
26	Paper & Allied Products Manufactures	1.17		
27	Printing Publishing & Allied Industry	5.00		
28	Chemicals & Allied Products Manufactures	2.88		
29	Petroleum Refining & Related Industries Manufactures	0.21		
30	Rubber & Miscellaneous Plastics Manufactures	1.29		
31	Leather & Leather Products Manufactures	0.36		
32	Stone Clay Glass & Concrete Products Manufactures	1.36		
33	Primary Metal Industries Manufactures	0.57		
34	Fabricated Metal Products Manufactures	2.22		
35	Industrial & Commercial Machinery Manufactures	2.62		
36	Electronic & Other Electrical Equipment Manufactures	2.10		
37	Transportation Equipment Manufactures	1.89		
38	Measuring & Analyzing Instruments Manufactures	3.27		
39	Miscellaneous Manufacturing Industries Manufacturers	1.50		
48	Communications	5.62		
50	Wholesale Trade-Durable Goods	34.04		
51	Wholesale Trade-Nondurable Goods	6.46		
43	United States Postal Service	10.89	Government	7.63
91	Executive Legislative & General Government	21.38		
92	Justice Public Order & Safety	45.66		
93	Public Finance & Taxation Policy	3.03		
94	Administration-Human Resource Programs	4.78		
95	Admin-Environmental Quality Programs	3.46		
96	Administration Of Economic Programs	9.14		
97	National Security & International Affair	1.66		
45	Transportation By Air	10.37	Professional	15.10
60	Depository Institutions	9.37		
61	Non-depository Credit Institutions	4.94		
62	Security & Commodity Brokers	3.96		
63	Insurance Carriers	1.23		
64	Insurance Agents Brokers & Service	9.15		
65	Real Estate	23.80		
67	Holding & Other Investment Offices	0.62		
72	Personal Services	10.98		
81	Legal Services	11.80		
87	Engineering & Accounting & Management Services	13.79		

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