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TRANSIT ACCESSIBILITY AND LABOR FORCE PARTICIPATION RATE OF AT-RISK GROUPS: DADE COUNTY

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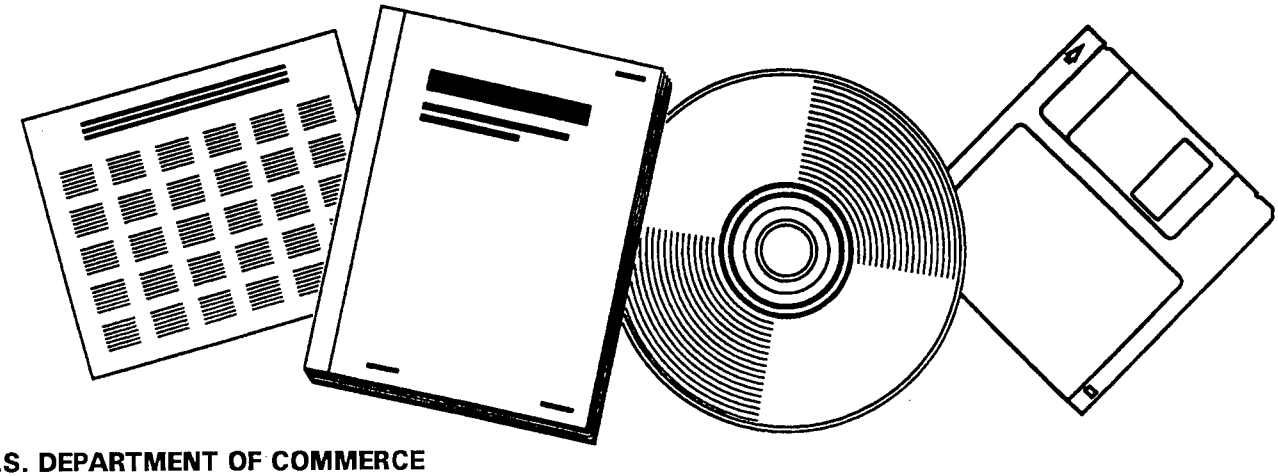

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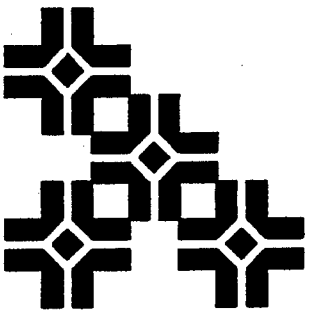
Transit Accessibility and Labor Force Participation Rate of At-Risk Groups: Dade County

Final Report



National Urban Transit Institute
at the University of South Florida's Center for Urban Transportation Research

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Preface

This project proceeds from results of an earlier National Urban Transit Institute study that used Sacramento data to determine transit trip production and attraction potential in suburban census tracts. That study showed that potential transit ridership was independent of the quality of transit service offered and depended upon demographic and land use characteristics of the census tracts. In contrast, observed transit ridership to and from each tract materialized from potential in direct proportion to transit accessibility of the tract to destinations to which potential transit users wished to go. In year one we conducted another study based on Orlando data that aggregated assessor parcel files to the census tract level and merged them with Census STF3 files. This enabled us to use land use variables in models of travel behavior, and we conducted trial estimations of simple models.

In this study we examine the relationship of transit accessibility and employment in Dade County, Florida.

Acknowledgments

This project is made possible through a grant from the U.S. Department of Transportation, University Research Institute Program. Their support is gratefully acknowledged. I also would like to thank the Florida Department of Transportation Public Transit Office and Systems Planning Office for assistance, and the Metro Dade Transit Authority and the Metro Dade Metropolitan Planning Organization for providing data, computer models, and assistance, without which this project would not have been possible.

Many individuals also provided invaluable help. I would like to thank Mr. Michael Moore of the Metro Dade Metropolitan Planning Organization for providing files for the 1990 Dade County transportation model, Mr. Wilson Fernandez of the Metro Dade Transit Authority and Mr. Harry Gramling of Florida Department of Transportation's Systems Planning Office for helping us to debug and run the model, Mr. Whitt Blanton of JHK & Associates in Orlando for providing us the 1990 Census Transportation Planning Package for Dade County, student intern and Transit Fellow Mr. Kevin Tilbury for running the Dade County transportation model, and finally student interns Messrs. Jon Sewell, Melvin Mitchell, and Matt Click for researching spatial mismatch theory.

I also would like to acknowledge the important role of a new program, the Transit Fellow Program, in conducting this work. The Florida Department of Transportation's Public Transit Office and the Department of Urban and Regional Planning at Florida State University set up a program in 1995 to entice bright students into the field of public transportation with tuition fee waivers and stipends for living support. Students named Transit Fellows are required to emphasize transit planning in their studies for a Master's of Science Degree in Urban and Regional Planning, and they are required to intern with transit authorities in Florida. The Transit Fellow Program placed one of its first fellows, Kevin Tilbury, with the Metro Dade Transit Authority's management intern program during the Summer 1996. During the following two semesters, Mr. Tilbury was able to use contacts developed during his internship to obtain the Metro Dade transportation simulation for 1990 and run it through to completion, thereby providing transit travel times for the accessibility indices central to this study.

Transit Accessibility and Labor Force Participation Rate of At-Risk Groups: Dade County

ABSTRACT

This report examines whether transit accessibility to jobs from individual traffic analysis zones has an impact on employment of different racial/ethnic groups. Demonstrations of cross-town bus routes making suburban employment more accessible have been well-used by people traveling to suburban jobs, supporting the idea that transit accessibility may make a difference. Earlier literature on spatial mismatch theory suggests that transit accessibility should make a difference in unemployment rates for African-Americans confined to inner city ghettos. In contrast, more recent literature uses theory to discount the importance of transportation accessibility in lowering unemployment, and empirical observation supports the theory. Because in all of these studies transit accessibility was not measures precisely, this study attempts to do so. Accessibility is measured as employment in all regional traffic analysis zones, each inversely weighted by the square of the door-to-door transit travel between the zone where the employment is and the zone whose accessibility is being measured. This measure of accessibility is then used as one of several explanatory variables in models of African-American, Hispanic white, and non-Hispanic white unemployment, work trip transit mode split, and automobile ownership in traffic analysis zones for Dade County, Florida. This research finds that transit accessibility does not explain African-American unemployment directly, but on the margin it explains African-American transit mode split to work, and it has a very important inverse relationship in models of automobile ownership in Dade County.

Transit Accessibility and Labor Force Participation Rate of At-Risk Groups: Dade County

INTRODUCTION

The McCone Commission (Governor's Commission, 1965) investigating the causes of the 1965 Watts riots identified insufficient public transportation to suburban employment sites as a contributing cause for the high unemployment rate of African-Americans. The McCone findings inspired policy initiatives to improve transit services for what became known as the transit disadvantaged. Federal policy also reflected this concern by requiring transit operators receiving federal capital and operating grants to show the extent to which the residences of targeted groups lived close to transit routes.

Results of such initiatives proved disappointing. While improved transit service to suburban employment sites did increase African-American employment, the newly employed used their new income to purchase autos and desert transit. In some areas it was suspected that nearby transit routes were irrelevant to many transit-dependent groups, who wanted to travel to places other than downtown. In many U.S. cities the range offered by CBD-oriented systems and new investment projects was so limited that public transportation was largely as irrelevant to transit disadvantaged groups as to other sectors of society (Warner, 1972, pp. 142-144).

Despite recognition that the range of destinations offered by transit from different neighborhoods is important to the lives of disadvantaged groups, there has been no formal study of this topic until recently. In recent years the transit disadvantaged have been redefined as the mobility-impaired. Federal policy has focused on how accessible transit services are to the mobility-impaired, using the limited definition of accessibility as access to bus and train stops. It ignored the equally important aspect of accessibility, which is whether transit service will take passengers to where they want to go once they are on board buses or trains.

In recent work (Thompson 1997a and 1997b) I have begun to study how important a range of destinations really is to transit users. This work concludes that the range of destinations available to potential users influences transit usage. It also shows that range of destinations that users can reach is influenced both by transit route configuration and land use configuration.

Building on my recent past and on-going work, this project goes a step further. It examines the extent to which a measure of transit accessibility, based on how easily transit users from any given area can reach jobs in the entire region, affects the unemployment rate of African-Americans, Hispanic whites, and non-Hispanic whites in a major metropolitan region, Dade County, Florida. The hypothesis tested is that areas of urban regions with more transit accessibility experience higher labor force participation rates among poorer workers.

In order to gain greater insight into possible links between transit accessibility and employment of different racial/ethnic grups, this study also tests two other hypotheses. One is that transit accessibility is important to transit ridership of different groups from different parts of the region. The other is that transit accessibility is inversely related to auto ownership of different racial/ethnic groups.

LITERATURE REVIEW

The idea that improved public transportation between central city ghettos and suburban employment centers would improve employment prospects for minority groups stems from two related sources. One source was an analysis of the Watts, California, riot of summer 1965, which identified inadequate public transportation from the ghetto to suburban jobs as a contributing factor. Following the Watts riots, other urban racial riots occurred, and from further study of their causes a more formal theory was put forward to explain the role of transportation in racial grievances. This was the spatial mismatch theory, which further strengthened the idea that improved transportation to suburban employment centers would improve the social and economic well-being of African-American and other minority groups. The following sections summarize the early demonstrations, transportation conclusions drawn from the racial riots of the later 1960s, the spatial mismatch theory, and sociological and economic literature empirically examining the validity of the spatial mismatch theory.

Early Suburban Transit Demonstrations

The federal government financed at least two suburban transit improvement initiatives before the summer 1965 Watts riots. A year after a public authority took over public transportation service from private operators in the St. Louis area in 1963, the United States Department of Housing and Urban Development financed a year-long demonstration of seven new express bus lines to the central business district from distant outer suburbs, as well as a new crosstown local line linking three of the same outer suburbs. The transit authority hired a consultant to document and evaluate the demonstration, which ran from May 1964 to May 1965 (Gilman, 1966). The consultant did not evaluate the new services from the standpoint of their impact on employment status but rather looked at ridership, revenues, volume of service, and origin and destination characteristics of riders during the course of the demonstration.

While nothing in the consultant's report mentions race in consideration of service design or evaluation, the results still are interesting in that they show the crosstown route to have had significant ridership. The seven express routes averaged revenue of 25.1 cents per bus miles at the beginning of the experiment and averaged 31.9 cents a year later, an increase of 27 percent. The crosstown began with revenue of 10.1 cents per bus mile and concluded with 19.7 cents, an increase of 95 percent. At the end of the demonstration, the crosstown carried more passengers per bus mile (.91) than the average for the expresses (.85), but because many of its passengers transferred to or from other routes, and also because the expresses charged a 10 cent supplement, each crosstown passenger brought in only half the revenue of passengers riding expresses. Few of the passengers riding expresses transferred. At the end of the demonstration a quarter of the crosstown riders were new, while the others benefitted from more direct service than they previously had. Forty percent of express riders were new, but express buses serving districts with high levels of suburban employment had only half the ridership per housing unit served compared to express buses serving districts with no suburban employment. This suggests that as suburban employment increased, express riding would decline. Also, while most express riders going to work traveled to jobs in the central business district, only one to two percent of crosstown bus riders going to work did so. Fifty to sixty percent of crosstown riders traveled to jobs along the crosstown route itself, while 30 to

35 percent transferred to routes that took them to jobs in other suburban locations (Gilman, 1966, pp. A-7 to A-10, B-36 and B-37, 50). These points suggest that the crosstown route was penetrating the suburban employment market, which was growing, while the central business district express buses failed to do so. At the same time, the crosstown's revenue generation was less than that of the express buses, but given the high cost of central city expresses, with their high demand on equipment and labor during the peak period compared to the base, compared to the much more even demand for the crosstown service, the crosstown's financial performance could have equalled or bettered that of the expresses (the report did not touch on this point). At the conclusion of the demonstration the transit authority continued operating five of the seven express routes as well as the crosstown.

Another suburban demonstration took place in Memphis, testing the idea that bus service inaugurated in suburbs as they opened for occupancy would attract greater ridership than service started some time after the suburb became established. Several radial local routes serving the central business district were extended farther out to suburbs under construction. One route also served a suburban employment site with a few hundred workers. Results proved lackluster; ridership to the suburban employment site was almost nil (Memphis, 1965).

Recent empirical work on transit ridership patterns in Sacramento County, California, reaches conclusions similar to those of the St. Louis demonstrations. In Sacramento about half of all morning peak period transit trips terminate in locations other than the central business district or more broadly defined downtown. An even greater proportion of transit trips made over an entire day terminate in suburban destinations. All trips with the home as one end are defined as beginning at home (Thompson 1997a and 1997b).

Analysis of Watts Riots

The first major study addressing the Watts riots, the McCone Commission report (Governor's Commission, 1965), identified inadequate public transportation between the Watts ghetto and other parts of Los Angeles as a significant cause of social discontent. Among the inadequacies that it identified was the absence of east-west bus service linking Watts with suburban shopping and employment centers. The report recommended inauguration of east-west bus service as well as improved north-south bus service to downtown Los Angeles and perhaps to southerly employment centers. It also recommended free transfers between all bus routes in the area. At the time passengers who wanted to transfer between routes of different agencies or private companies, or even transfer between routes that at one time were operated by different private companies but in 1965 were operated by a public agency, had to pay additional full fares. Double-paying was not too much of a hinderance to residents wanting to travel to downtown Los Angeles, but it was a major hinderance to those wanting to travel to other destinations.

The report came out at the same time as the creation of the Urban Mass Transit Administration (Federal Transit Administration since 1993), which took over incipient mass transit demonstration projects previously within the U.S. Department of Housing and Urban Development. As a consequence of the report, the State of California used UMTA

funding for an east-west crosstown demonstration route linking Watts with other areas, as well as shared ride taxis, and other (what now are called) paratransit services to major suburban factories. The State of California Business and Transportation Agency later evaluated the service in a report, and while the study team could not locate a copy of it, the urban historian Sam Bass Warner summarized it as follows:

> After the Watts riots the transportation problems of the poor were made plain, and the state of California, with federal funding, set up a demonstration project in southeast Los Angeles to attempt to deal with the problem. A social science team intervened in behalf of the poor...they discovered that the last bus might leave a factory's gates a few minutes before the men finished their daily shift; they discovered routes that could be instituted or altered to reflect the commuting habits of the residents...The altering of existing public transportation was not sufficient...to this end the experiment rented buses for some new regular routes...The cost of these services was high, but could have been much reduced if established permanently. The demonstration project was a success, but in 1971, when the federal funds were gone, predictably the grant by the government was not renewed and the service was closed down. (Warner, 1972, pp. 143-144).[1]

According to Warner, the report also concluded that public transportation was important more for women and older people who lacked cars. Poor men, once they obtained a job with the benefit of improved crosstown transit, could obtain the credit to buy a car, and they did so (Warner, 1972, p. 143). From this conclusion the belief became widespread that the suburban jobs-oriented transit demonstration failed. While it enabled some previously unemployed African-Americans to find jobs, with earnings from their new-found jobs, the African-Americans bought autos and stopped using public transit.

Kerner Commission

A couple of years later the Kerner Commission more broadly examined the phenomenon of urban ghetto rioting, which by then had occurred in several of the nation's larger cities. The Kerner Commission's transportation recommendations echoed those of the McCone Commission, though they were not given nearly as much importance in relation to other factors. In order to better connect central city ghetto residents with jobs that were rapidly suburbanizing, the Kerner Commission report recommended:

> The existing experimental mobility program, under the Manpower Development and Training Act, should be greatly expanded, and should support movement from one part of a metropolitan area to another. Aid to local public transportation under the Mass Transportation Program should be similarly expanded on the basis of an existing experiment with subsidies for routes serving ghetto areas (Kerner, 1968, p. 418).

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[1]Warner (1972, p. 143, n. 48) gives the following citation for the report: State of California, Business and Transportation Agency, *Transportation-Employment Project, Interim Final Report*, Los Angeles, January 1970, pp. 85-90.

Spatial Mismatch Theory

In 1968 John Kain (1968), an economist examining the link between African-American unemployment, job suburbanization, and center-city-oriented mass transit systems, proposed what became known as the spatial mismatch theory. The spatial mismatch theory holds that the growing ratio between African-American and white unemployment rates results from urban job deconcentration coupled with housing discrimination against African-Americans. Poor transportation from center city ghettos to edge city jobs also figures in the theory. Job deconcentration takes low-skilled manufacturing and service jobs out of the central city to increasingly distant suburbs; housing discrimination keeps low-skilled African-American workers in central city ghettos. Increasingly costly commutes from the central city ghettos to edge city jobs depresses African-American employment.

The relevant statistic here is the ratio of African-American-to-white unemployment, particularly for males, which I will call the racial unemployment ratio. Since the 1960s the racial unemployment ratio for all workers as well as for youth has increased in most urban areas of the United States to somewhere between 2 and 3 to 1 (Lichter 1988, Shulman 1986; Lerman 1986). Because the high ratio likely contributes to hopelessness and crime, social scientists have sought to understand its persistence during the era of desegregation. Since the late 1960s the spatial mismatch theory has focused such research, leading more recently to counter hypotheses.

Because there is little disagreement about low-skill jobs moving to the periphery or about housing discrimination against African-Americans, the spatial mismatch theory found ardent supporters. It also led to policy prescriptions. Inclusionary housing programs and demonstration projects for improved transportation links from ghettos to suburban employment have grown out of it (Hughs 1987).

Despite such appeal, the spatial mismatch theory has aroused skepticism. Taylor and Ong (1995) examined the mismatch hypothesis using journey-to-work data from the American Housing Survey for African-Americans and Hispanics, residing in central city ghettos, and suburban whites in the mid-1970s and mid-1980s. If the mismatch hypothesis were true, commutes for African-Americans and Hispanics in the ghettos should be significantly longer than those for suburban whites, Taylor and Ong argue. Their analysis of the data shows, on the contrary, that commute distances for African-Americans and Hispanic whites are shorter than that of non-Hispanic whites and that relative commuting distances did not change between 1980 and 1990, a finding also reported by Gordon, Richardson, and Jun (1991). Taylor and Ong conclude from this that minorities are finding work close to home, and from this they discount the spatial mismatch theory. They observe that travel times for African-Americans and Hispanic whites were longer because of their greater reliance on public transportation.

The Taylor and Ong findings that African-Americans work closer to home than others could have another explanation. This is that the greater reliance of African-Americans on slow public transportation confines them to a job search that is closer to home. Some African-Americans find jobs within their restricted search radius; many do not and are unemployed, thus accounting for the much higher unemployment status of African-Americans compared to non-Hispanic whites. This explanation actually supports the spatial mismatch theory.

Others discount the spatial mismatch theory by arguing that transportation is a relatively small barrier to minority group employment compared to employer discrimination. Prior to the 1960s employers could pay African-Americans lower wages than comparable groups of whites. After the 1960s anti-discrimination laws prohibited this practice as well as discrimination in hiring, but wage discrimination was much easier to detect and prosecute than employment discrimination. Since that time, wages for African-American employees have risen comparatively to those for whites (though still not to parity), but relative unemployment for African-Americans also has increased (Shulman 1986; Lichter 1988; Danziger and Gottschalk 1987)[2].

Two interpretations have been placed on these findings. Danziger and Gottschalk interpret these results as indicating that African-Americans are increasingly being assimilated into the white middle class suburban culture. As African-Americans in ghettos obtain well-paying jobs, they move to the suburbs. Increasing joblessness in the ghettos is caused because those who get jobs leave. The policy implication is that the ghetto should be the recipient of policy intervention.

This finding can be true only if African-Americans who move to the suburbs have employment rates comparable to whites. If the spatial mismatch theory were true, the racial unemployment ratio should approach unity for groups of African-Americans and whites living in the suburbs, controlling for skill levels, education, and family structure. Research looking into this question found that parity does not exist. African-American/white unemployment ratio is about the same regardless of the residential location of either African-Americans or whites (Ellwood 1986; Lichter 1988; Blackley 1990). Poorly-educated, low-skilled whites living in proximity to central city African-American ghettos have only half the unemployment rate of African-Americans in the same area; African-Americans living in the suburbs have double the unemployment rate of nearby whites having similar skill and education levels. Moreover, if transportation costs from ghettos to edge city jobs were to account for the 2 to 1 ratio, transportation costs would have to be many-fold higher than they already are. Some other cause is at the root of African-American unemployment (Ellwood 1986; Blackley 1990).

Shulman (1986), who unlike Danziger and Gottschalk recognizes high African-American unemployment in the suburbs, concludes that in the context of increasing national unemployment, firms discovered that hiring discrimination was profitable in all areas. As firms have increased wages for African-Americans, they have hired fewer African-Americans, particularly for low-skilled jobs. A possible rationale for firms relocating back offices and other activities requiring low-skilled labor to the suburbs is to tap the large pool of white suburban housewives.

Where does this leave us regarding the role that improved public transportation might play in increasing labor force participation? None of the literature explicitly examined the impact of transit linkages on labor force participation rates, but several findings touch on transportation policy measures. The finding that the racial unemployment ratio is relatively unaffected by housing location with respect to employment suggests that improved transportation will have little impact on alleviating African-American or other unemployment. The proximity between jobs and housing is just not the issue here. This

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[2]Lichter (1988) does not make this argument, but his table 1 results confirm it.

finding is consistent with that of unrelated research showing that urban structure, and particularly the proximity of housing and jobs, has little impact on travel behavior in general (Giuliano and Small 1993).

On the margin, though, transportation improvement could have some impact. Blackley (1990) and Ellwood (1986) both found that difficult access between ghettos and employment centers could explain a small part of the racial unemployment ratio. Blackley suggested that the employment rate of African-American females (but not males) could be improved marginally with better public transportation links from ghettos to suburban jobs. Hughes (1987), who accepts spatial mismatch theory, recommended that based on assimilation theory from the Chicago School of Sociology, improved transportation links would be preferable policy to inclusionary housing policies as a means for redressing the racial unemployment ratio.

DADE COUNTY STUDY OF IMPORTANCE OF TRANSIT ACCESSIBILITY

Hypothesis and Means for Testing

None of the statistical analyses of the spatial mismatch theory directly addressed the question of whether improved public transportation could affect labor force participation rates. They suggested that if such a study were done, however, that it should not focus narrowly on linkages between a given area of residence and nearby jobs, or distant jobs in one location, such as a cluster of aerospace manufacturing plants. The supply of jobs throughout an metropolitan area is what is important to people in a given neighborhood who are looking for work. Thus, statistical analyses need to incorporate explanatory variables that measure how well *all* jobs of a particular type (such as manufacturing or service) are linked to the neighborhood by public transportation; not jobs just in one area. None of the statistical analyses examined here have done this; neither have the demonstration projects.

This research develops an accessibility measure indicating how well a part of a census tract (traffic analysis zone) is connected by public transportation to all jobs in the region. This measure then is added to other explanatory variables to explain the probability of a person of a particular type (race, gender, age group) obtaining employment. If the coefficient for the accessibility measure is significant, the hypothesis is accepted that public transportation accessibility matters.

Study Site

Dade County, Florida is used as the site for this research, because it is home to large numbers of African-Americans and Hispanic white people, and it also is the only county in Florida with a well-developed transit system. The Metro Dade Transit Authority operates a large system of bus routes and one rail rapid transit route within the county. Bus routes include traditional local and express radial routes focused on the central business district; in addition, there are several crosstown local routes. Other local and express routes act as feeders to rapid transit stations. The rapid transit route (called Metrorail) skirts the central business district at its mid-point, so it functions effectively as two radial central business district-oriented routes. Because the rapid transit line and some

of the radial bus routes do not go through the center of the central business district, many CBD-bound transit passengers get from their radial routes to their final destinations by walking lengthy distances or transferring to an elevated circulator mini-rapid transit line in the central business district. Called the Metromover, the mini-rapid-transit service recently had two spurs added to it, doubling its length. Collectively the Metro Dade Transit Authority services account for almost half of all transit passenger trips in Florida and probably well over half of Florida transit passenger miles. System traffic also has been growing. In 1985 Metro Dade Transit Authority traffic totalled 307 million passenger miles, distributed 267 million to buses, 1 million to Metromover, and 39 million to Metrorail. In 1990 345 million passenger miles used the system, distributed 232 million to buses, 3 million to Metromover, and 110 million to Metrorail (MacDorman & Associates 1992; Center for Urban Transportation Research 1996).

In addition, private owner-operators provide a large collection of jitney services in several areas of the county. I have no written information on these, but jitney services are included in the Metro Dade transportation model. Their travel times, which are faster than fixed route travel times between a large number of pairs of traffic analysis zones, are used in this study along with fixed route travel times as further described below.

Study Design

Following on the method of Ellwood's (1986) analysis of the impact of accessibility on African-American unemployment in Chicago census tracts, this study postulates unemployment rates in a sample of traffic analysis zones of a large metropolitan area (in this case, Dade County, Florida) as a function of race, education level, and accessibility. The study differs from Ellwood's in its definition of accessibility measures and in using traffic analysis zones rather than census tracts as the unit of analysis. It also differs by adding binomial logit analysis of the variables in addition to ordinary least squares analysis, while it also looks at the influence of transit accessibility on transit mode split for African-Americans, Hispanic whites, and non-Hispanic Whites, and finally it looks at the relationship between transit accessibility for all three groups and automobile ownership rates.

Sample Size

The data set that I used includes all traffic analysis zones with 80 percent or more of its population being African-Americans (about 90 traffic analysis zones), additional traffic analysis zones east and south of the central business district, and in addition every tenth traffic analysis zone not otherwise selected. Such considerations yielded a sample size of 237 traffic analysis zones, and for each of these I calculated the three accessibility indices as defined by equation 1.

Accessibility Indices

Ellwood (1986) used three measures of accessibility: jobs within a thirty minute transit ride of a neighborhood, the ratio of jobs-to-people within each neighborhood, and the average travel time to a job from a given neighborhood. He rejected accessibility

measures for each census tract, using planning-department-defined neighborhoods instead, because he did not have the means to calculate finer measures, and he considered a census tract too small to be a viable labor market. None of his accessibility measures had any statistical impact on employment rates for census tracts.

Unlike Ellwood, I calculate transit accessibility measures for individual traffic analysis zones, which are smaller than census tracts. The output of transit models now in use by most metropolitan planning organizations, including the Metro Dade County MPO, makes TAZ transit accessibility measures calculable. My study question, whether transit connections to jobs throughout the region makes any different in employment status, also demands a precise measure. This is because transit users will not walk very far to a transit stop---typically no more than a quarter mile. This means that adjacent traffic analysis zones could have very different transit connectivity to the region, which could give their residents very different employment opportunities.

The Metro Dade County MPO transportation model output includes transit door-to-door travel times, including walk and transfer times, between all pairs of traffic analysis zones in the county. From such data, I used typical gravity model measures for transit accessibility:

$$A_{ik} = \sum_{j}^{n} TTIM_{ij}^{-2} * JOBS_{jk}$$

Equation 1

where A_{ik} is the transit accessibility from traffic analysis zone i to jobs of type k in all of the region, n is the number of traffic analysis zones in the region, $TTIM_{ij}$ is door-to-door transit travel time in the morning peak period from traffic analysis zone i to traffic analysis zone j, and $JOBS_{jk}$ are the number of jobs of type k located in traffic analysis zone j. I used three types of employment: industrial, service, and commercial, which sum to total employment. Each traffic analysis zone used in the study thus has three transit accessibility indices, one for each type of employment. These are indicated as A_IND, A_COMM, and A_SER in the rest of the study.

This approach differs from earlier work that I conducted on Sacramento, California transit data, where I extracted gravity-like accessibility measures from an estimated direct demand model of transit in the area. That study showed that while higher density suburban employment would attract transit ridership, lower density employment would do so at a far lower rate. I chose a different measure for this study, because I explicitly am examining the hypothesis that transit linkages to all employment makes a difference.

Miami/Dade County Metropolitan Planning Organization made available to this study their input data to their 1990 alternative A TRANPLAN transportation simulation model. A student Transit Fellow, Kevin Tilbury, ran this to obtain transit travel times between all pairs of Dade County traffic analysis zones during the morning peak period for use in equation 1. The model yields travel times by several competing transit modes between all pairs of traffic analysis zones. I was interested in only those alternatives that did not rely on auto access: jitney, all local bus, and various combinations of local bus and either

express bus or rail. For this reason, I defined $TTIM_{ij}$ as the shortest transit travel time from each of the three transit possibilities between each i and j. I did not consider fares in the accessibility calculations.

Extracting travel times from intermediate files of the model's output proved difficult. Ultimately, it proved feasible to do so only on the basis of one traffic analysis zone at a time. I could select any traffic analysis zone i and after about a minute of fortran calculations have the three accessibility indices shows in equation 1 calculated for that traffic analysis zone. Table 1 presents summary data statistics for the three measures for the 237 zones used in the study.

Other Variables and Weighting

The 1990 Census Transportation Planning Package (CTPP) for Dade County provided the other variables used in the study. Table 1 defines these and presents summary statistics for the 237 zone sample. Unfortunately, the Census Transportation Planning Package offers only rudimentary socio-economic variables. It would have been desirable, for example, to have unemployment rates, median incomes, and auto ownership separately for African-Americans, Hispanic whites, and non-Hispanic whites for each zone, but the CTPP provides unemployment rates only for males and females and median incomes and auto ownership aggregated over all races and households in each zone. Use of the Public Use Microsample (PUMS Data) from the census would overcome this limitation, but PUMS data are stripped of geographic location except at gross levels, making impossible the definition of accessibility indices, which is the heart of this study. So CTPP data were used. To partially compensate for the absence of unemployment rates for each ethnic group, I ran analyses of the same data three times, each time weighted by the population of the ethnic group in whose behavior I was investigating.

The first three variables in table 1 are the transit accessibility variables. Each of these exhibits a high degree of variance, showing that transit accessibilities vary widely over the sample of traffic analysis zones. Although I developed three accessibility measures in the belief that transit accessibility to different types of work might differ widely, the three measures are highly collinear for the 237 zone sample: the correlation coefficient between A_IND and A_SER is .8658, that between A_IND and A_COMM is .9401, and that between A_COMM and A_SER is .9703. In the analyses that follow, I use A_COMM as an index representing transit accessibility to all jobs.

MEDHHINC is median household income, and it also has a high degree of variance. I include it in analysis of automobile ownership, VEH_HH. Income is often presented as the most significant explanatory variable for auto ownership, and auto ownership often is used as a proxy variable for income because the two variables are often so highly correlated. Despite such relationships, for the 237 zone sample used here the correlation coefficient between MEDHHINC and VEH_INC is only .5885, moderate but not high correlation. The relatively low correlation may represent a saturated auto market; the variance for VEH_HH relative to its mean is a third lower than that for MEDHHINC, probably reflecting a relatively high degree of auto ownership in poorer households.

TOT_POP is total population in each traffic analysis zone, while PAFAM, PHW, and PNHW represent the proportion of each tract's population that is African-American, Hispanic white, and non-Hispanic white. The relatively high mean for PAFAM reflects the

choice of sample including all traffic analysis zones in Dade County with 80 percent or more African-American population, about 91 zones. The correlation coefficient between PAFAM and PHW is -.7720, between PAFAM and PNHW is -.6137, and between PHW and PNHW is -.0258 for the 237 zone sample, indicating a moderate amount of segregation between African-American and Hispanic white and non Hispanic white populations, but no segregation between Hispanic white and non Hispanic white populations.

P12_17NE is the proportion of youngsters between 12 and 17 years of age who are not enrolled in school. Ellwood (1986) and Blackley (1990) found that variables reflecting education and family status (proportion of families with a single mother) were significant predictors of employment status. Areas with an education tendency, indicated by a high proportion of school-age children being in school, had much lower unemployment. Areas with a two parent household head also had lower unemployment. From the CTPP I could extract a variable reflecting education status but not one reflecting family status.

PM_UM and PF_U are the proportions of males and females, respectively, seeking work but who cannot find it. Finally, TMS_AFAM, TMS_HW, and TMS_NHW are the proportions of African-American, Hispanic white, and non Hispanic white workers in each zone who use any type of transit to get to work.

Results

Table 2 presents the results of an ordinary least squares (OLS) analysis of variables thought to be responsible for employment, similar to that Ellwood (1986) presented in his table 4.5. The major difference is that I used three weightings for the ordinary least squares, one for each of the three racial/ethnic groups under study. Another is that I introduced vehicles per household (VEH_HH) as an explanatory variable, because it would be difficult to interpret the impact of transit accessibility unless auto ownership were controlled for. One would expect transit accessibility to have no explanatory power in areas with high auto ownership.

Results for all three weightings are similar. Higher auto ownership rates are highly related to lower unemployment, and the relationship is significantly stronger for African-Americans (particularly African-American females) than it is for either Hispanic or non-Hispanic whites of either gender. These results are consistent with the transit service demonstration in the wake of the Watts riot, suggesting that those with income buy autos, and that employment is a greater threshold for auto ownership for African-Americans, particularly females, than it is for other groups. These results also could suggest that the higher the auto ownership in a zone, the greater the likelihood of employment and that auto ownership is particularly important for the employment of African-American females.

Similar to Ellwood's findings, table 2 results suggest that race or ethnicity also affects unemployment rates. In zones that are predominately African-American, the inclusion of either Hispanic or non-Hispanic whites significantly reduces the rate of unemployment for males, but not for females. In zones that are predominantly Hispanic white, the inclusion of African-Americans significantly increases unemployment, while the inclusion of non-Hispanic whites significantly decreases unemployment. In zones that are

predominantly non-Hispanic white, the inclusion of African-Americans or Hispanic whites increases unemployment, although the results are not significant for Hispanic white males.

The variable for education (the percentage of 12-17 year-olds not enrolled in school) is somewhat important, though importance varies by ethnic groups and gender. For all groups, there is a tendency for zones that are more education-oriented, as indicated by this variable, to have lower unemployment, but the result is highly significant for Hispanic white and non-Hispanic white females. It is not quite significant at the five percent level for Hispanic white and non-Hispanic white males, it is somewhat less significant for African-American females, and it is insignificant for African-American males.

As Ellwood found, transit accessibility generally has insignificant power in explaining unemployment levels, but where it does have some significance, its sign is contrary to *a priori* expectations. As discussed further below with insight from the remainder of the tables, these results tend to show that transit accessibility is not important for increasing employment levels, except possibly for African-Americans to a limited extent. However, transit accessibility is important to the well-being of all three groups in other ways, as discussed below.

First, we need to consider whether table 2's results are valid. It is shown so that results from Dade County can be compared with Ellwood's results. Despite the close comparison, the table 2 results are suspect, because the models from which they derived are likely misspecified. The dependent variables are proportions whose potential ranges are from 0 to 1, and OLS is generally considered an inappropriate explanation for such a dependent variable. A more suitable specification for such dependent variables is the binomial logit model, which in this case can predict the probability of two conditions: unemployment or employment. The two probabilities sum to one. The form of the model estimated here is:

$$PM(UM) = \frac{\exp(b_0 + \sum_{k=1}^{m} b_k * X_k)}{1 + \exp(b_0 + \sum_{k=1}^{m} b_k * X_k)}$$

Equation 2

where PM(UM) is the probability of male unemployment, b_0 is a constant to be estimated, and each b_k is a coefficient to be estimated for each explanatory variable X_k. There are m explanatory variables.

Table 3 presents results of the logit estimations of unemployment probabilities for males and females for each of the three racial/ethnic groups, using the same explanatory variables and weighting systems as in table 2. The Chi-square statistics show that each of the models has significant explanatory power, but none of the coefficients for the explanatory variables is significant at the five percent level. The signs of the variables, however, are in the same direction as those in table 2. In general table 3 shows the same tendencies of variable relations as table 2, but none of the relations are statistically

significant or even close to statistically significant. There is no evidence from table 3 that transit accessibility affects unemployment for either gender for either racial/ethnic group.

Table 4 examines the hypothesis that transit accessibility is important to transit ridership. Here the dependent variable is work trip transit mode split for each racial/ethnic group in each traffic analysis zone used in the study. Again the variable is in the form of a proportion that can vary from 0 to 1. By specifying the dependent variable as a function of a binomial logit relation shown in equation 2, I estimate the probability of a work trip being undertaken by transit compared to the probability of it being undertaken by all other modes.

Again the Chi-squared statistics indicate that all of the models shown in table 4 have explanatory power, but none of the individual explanatory variables are significant at the five percent level. The explanatory variable that comes closest to the five percent level is transit accessibility to commercial employment in the model explaining transit mode split for African-Americans. This variable's coefficient has a 94.2 percent probability of being drawn from a distribution whose mean is greater than zero. Transit accessibility to commercial employment has much less explanatory power for non-Hispanic white work trip transit modes split and even less for Hispanic white work trip transit mode split, but these variables still go farther than any others (except the constants) in explaining transit mode split.

Table 5 shows results for explaining automobile ownership using ordinary least squares analysis. Here results are very strong. Median household income is highly significant for all three racial/ethnic groups, as is transit accessibility. Higher transit accessibility is associated with lower auto ownership. The impact here is particularly strong for Hispanic and non-Hispanic whites. Ethnic composition also appears important, all else equal; Hipanic whites have a higher propensity to own autos than Afro-Americans or non-Hispanic whites. Finally, the unemployment rate for African-American females has a highly significant negative impact on auto ownership in tracts that are populated primarily by African-Americans.

Table 6 also explains automobile ownership, but it uses Poisson regression to do so. I have included table 6, because ordinary least squares (OLS) may not be an appropriate model for explaining a dependent variable whose lower bound is 0. Poisson regression is suitable for such a variable, but for Poisson regression the dependent variable must be in the form of a count variable. The model estimated is:

$$VEH(HH) = \exp(b_0 + \sum_{k=1}^{m} b_k * X_k),$$

Equation 3

where VEH(HH) are vehicles per household and the explanatory variables are as given in equation 2.

To estimate equation 3 with Poisson regression, the dependent variable VEH_HH must be in the form or a count or integer variable. Ideally, this type of equation should be estimated with individual records taken from the U.S. Census Public Use Microsample, but

again because such records have location stripped from them, that course could not be followed in a study where the importance of accessibility is being investigated. As a second best course of action, I recoded VEH_HH to an integer variable: traffic analysis zones with 0 to 0.499 autos per household were assigned 0 autos per household, 0.500 to 1.499 autos per household were assigned 1 vehicle per household, 1.500 to 2.499 were assigned 2, 2.500 to 3.499 were assigned 3, and 3.500 to 4.499 were assigned 4. The recoding created a new dependent variable VEH_HH. This is an integer variable that ranges from 0 to 4. Its mean is 1.4895 and its standard deviation is 0.6549 over the 237 cases in the sample.

Table 6 presents the results from the Poisson regression. Results generally are similar to those for table 5, though they are not as strong, and fewer explanatory variables have significant coefficients. In column 1, the model results with African-American weighting, transit accessibility is not statistically significant for explaining auto ownership, though household income is. None of the other explanatory variables are significant. In column 2, the model with Hispanic white weighting, transit accessibility is an important depressant for auto ownership; income is not statistically important, and the remaining explanatory variables are even less significant. In column 3, the model with non-Hispanic white weighting, income and Hispanic white presences are highly significant, and transit accessibility is also significant. This means that non-Hispanic white zones that have low income but high transit accessibility, auto ownership is depressed. Increasing the proportion of Hispanic whites in such zones increases auto ownership, suggesting a cultural affinity of Hispanic whites for car ownerhip, all else being equal. Even so, results from column 2 suggest that Hispanic whites may reduce car ownership if theyh live where there is high transit accessibility.

DISSCUSSION AND CONCLUSIONS

On first impression, tables 2 and 3 seem to disprove the hypothesis that transit accessibility decreases unemployment for African-Americans and Hispanic whites. To the extent that there is any statistical relationship, it is in the wrong direction. Despite first impressions, however, tables 4 and 5 or 6 offer additional information that must be considered before making conclusions.

The positive relationship between accessibility and unemployment shown in tables 2 and 3 suggests somehow that the provision of high transit accessibility increases unemployment, at least for African-Americans. A possible way that transit service could do this is that households with limited numbers of automobiles and higher levels of unemployment locate in areas with high transit accessibility, in order to increase their own mobility. This explanation is consistent with tables 2 and 3, as well as tables 5 or 6. Tables 5 or 6 generally show a very strong inverse relationship between automobile ownership and transit accessibility (except for African-Americans in the case of table 6). Some of the auto-limited households that located to take advantage of transit accessibility, particularly African-American households, may have members who use transit to go to work, consistent with table 4. Other auto-limited households may send their employed members, if any, to work in the few cars available. All such households may find transit's principle mobility advantage for non-work trips.

There is another possible explanation for the weak link in the wrong direction between unemployment and transit accessibility. This may be that transit agencies supply more transit service to areas with high unemployment. That is, transit agencies and/or jitney operators may consciously provide more service to areas that they perceive as auto-deprived, consistent with tables 5 or 6. Such areas may have higher levels of unemployment. The services may not make much of an impact on unemployment, though the fact that African-Americans appear to take advantage of higher levels of transit accessibility to travel more to work by transit, as indicated by table 4, suggests that it may have some importance for alleviating unemployment. Despite that, the more important impact of the services may be for non-work trips.

Both explanations are consistent in concluding that transit accessibility to the rest of the region is more important for non-work trips than work trips. Consistent with results from Blackley (1990) and Ellwood (1986), this study shows at best weak links between region-wide transit accessibility and work trips, but it also shows very strong, inverse links between transit accessibility and auto ownership. This latter linkage suggests that transit accessibility has to have importance to some aspect of mobility, and the non-work trip is left by default. I found, but did not comment on, similar results from work in Sacramento. In Thompson (1997a) the analysis was based upon transit 24 hour week day travelers and transit mid-day service levels. In Thompson (1997b) the analysis was based on morning peak period transit travel (mostly work trips) and service levels from the morning peak period (as in this study). In the Sacramento work, the link between transit accessibility and transit usage was found to be much stronger for the all-day analysis (1997a) than for the peak period analysis (1997b).

More work needs to be done here to determine how transit service is provided in Dade County, by both regular and jitney operators. More work also could be done on the accessibility measures. Transit fares could be included; measures also could be defined to isolate the effect of jitney services as well as the accessibility of the central business district compared to suburban jobs.

In general, it can be concluded tentatively that:

1. Transit accessibility is important in explaining African-American transit travel to work. That is, the more broadly is cast the transit net from a particular traffic analysis zone, the more likely it is that African-Americans will use that net to travel to work. Transit accessibility, though, does not appear to have an impact of reducing unemployment for African-Americans or other groups.

2. Transit accessibility is important to Hispanic white and non-Hispanic whites primarily for non-work trip mobility. Lower income members of both groups appear to use high transit accessibility to lower the number of autos in their households.

Firmer conclusions must await investigation into how changes to the defintion of accessibility affect outcomes (such as using employment density in the measure), as well as investigation into how transit agencies and other service providers decide where to place transit service.

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TABLES

Table 1. Means and Standard Deviations of Variables Used in Regressions

Variable	Description	Mean	Standard Deviation	Cases
from FSUTMS model of Metro Dade Transit and jitney service, alternative 90A				
A_IND	transit accessibility to industrial employment	35.30	23.20	237
A_COMM	transit accessibility to commercial employment	72.69	46.27	237
A_SER	transit accessibility to service employment	196.98	142.72	237
from census transporation planning package, Dade County, 1990				
MEDHHINC	median household income	$38,044	$22,959	237
VEH_HH	vehicles per household	1.40	0.58	237
TOT_POP	total population	2,673	2,086	237
PAFAM	proportion African-American	0.44	0.42	237
PNHW	proportion non-hispanic white	0.22	0.26	237
PHW	proportion hispanic white	0.30	0.31	237
P12_17NE	proportion of 12 to 17 year old not in school	0.08	0.10	237
PM_UM	proportion of males in work force unemployed	0.09	0.07	237
PF_U	proportion of females in work force unemployed	0.11	0.10	237
TMS_B	transit mode split-African American	0.12	0.14	237
TMS_W	transit mode split-non-hispanic white	0.04	0.13	237
TMS_H	transit mode split-hispanic white	0.05	0.10	237

Table 2. Regression Results - OLS weighted as indicated

Independent Variable	Dependent Variable					
	African-American Weighting		Hispanic White Weighting		Non-Hispanic White Weighting	
	PM_UM	PF_U	PM_UM	PF_U	PM_UM	PF_U
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.1801 **	0.2129 **	0.1080 **	0.1348 **	0.0511 **	0.0616 **
	(9.513)	(10.260)	(6.974)	(7.941)	(4.558)	(5.074)
VEH_HH	-0.0477 **	-0.0740 **	-0.0227 **	-0.0324 **	-0.0185 **	-0.0267 **
	(-4.795)	(-6.791)	(-3.429)	(-4.455)	(-3.253)	(-4.333)
PAFAM			0.0641 **	0.0395 **	0.1131 **	0.1004 **
			(5.196)	(2.922)	(9.939)	(8.156)
PHW	-0.0597 *	-0.0072			0.0514 **	0.0597 **
	(-2.204)	(-0.242)			(4.920)	(5.280)
PNHW	-0.0784 *	-0.0071	-0.0538 **	-0.0849 **		
	(-2.340)	(-1.941)	(-4.119)	(-5.929)		
P12_17NE	0.0116	0.0686	0.0553	0.0349 **	0.0448	0.1116 **
	(.227)	(1.232)	(1.738)	(3.287)	(1.775)	(4.085)
A_COMM	0.0003 **	0.0002	0.0000	0.0002 *	0.0001	0.0001
	(2.830)	(1.530)	(0.372)	(1.997)	(.739)	(1.581)
n	237	237	237	237	237	237
F	25.2	26.7	23.7	43.7	31.47	36.13
adjusted r-squared	0.34	0.35	0.32	0.47	0.39	0.43
(t-statistics in parentheses)						

Table 3. Logit Results - Weighted as indicated

Independent Variable	Dependent Variable					
	African-American Weighting		Hispanic White Weighting		Non-Hispanic White Weighting	
	PM_UM	PF_U	PM_UM	PF_U	PM_UM	PF_U
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	-1.4688	-1.1934	-1.9550	-1.6513	-2.8554 *	-2.6585 *
	(-1.472)	(-1.218)	(-1.077)	(-0.989)	(-2.012)	(-2.009)
VEH_HH	-0.4181	-0.6568	-0.3501	-0.4140	-0.3894	-0.4966
	(-0.765)	(-1.201)	(-0.443)	(-0.567)	(-0.526)	(-0.713)
PAFAM			0.6903	0.3618	1.7015	1.4788
			(0.583)	(0.317)	(1.356)	(1.205)
PHW	-0.6049	-0.0732			1.0712	1.1305
	(-0.355)	(-0.047)			(0.771)	(0.864)
PNHW	-0.9478	-0.8186	-0.9515	-1.3691		
	(-0.417)	(-0.375)	(-0.538)	(-0.800)		
P12_17NE	0.1569	0.6394	0.6856	1.0918	0.8270	1.6459
	(0.058)	(0.241)	(0.198)	(0.357)	(0.265)	(.597)
A_COMM	0.0021	0.0012	-0.0001	0.0010	-0.0001	0.0005
	(0.436)	(0.247)	(-0.007)	(0.139)	(-0.013)	(0.063)
n	237	237	237	237	237	237
Chi-squared	25.8	43.5	87.0	86.5	106.4	115.7
significance level	0.00	0.00	0.00	0.00	0.00	0.00

(z-statistics in parentheses)

Table 4. Transit Mode Split Results

Independent Variables	Transit Mode Split		
	TMS_AFAM (1)	TMS_HW (2)	TMS_NHW (3)
Constant	-1.643	-2.202	-3.191
	(-1.247)	(-1.021)	(-1.693)
VEH_HH	-0.018	-1.047	-0.541
	(-0.021)	(-0.885)	(-.493)
MEDHINC	-0.000	-0.000	-0.000
	(-0.752)	(-0.069)	(-0.120)
P12_17NE	0.387	0.509	1.468
	(0.151)	(0.122)	(.393)
PM_UM	-0.745	4.214	-0.033
	(-0.230)	(0.545)	(-0.003)
PF_U	0.877	-0.589	-1.751
	(0.299)	(-0.076)	(-0.171)
A_COMM	0.009	0.007	0.012
	(1.890)	(0.887)	(1.165)
weighting	Afro-American population	Hispanic white population	Non-Hispanic white population
n	237	237	237
Chi-squared	43.300	38.409	66.216
Significance level	0.000	0.000	0.000
(z-statistics in parentheses)			

Table 5. Explaining Auto Ownership - OLS Analysis

Independent Variable	VEH_HH (1)		VEH_HH (2)		VEH_HH (3)	
Constant	0.61281	**	1.50980	**	0.93632	**
	(6.213)		(15.833)		(11.348)	
A_COMM	-0.00221	**	-0.00470	**	-0.00558	**
	(-5.911)		(-10.603)		(-9.240)	
P12_17NE	0.04178		-0.48244	*	0.05411	
	(0.197)		(-1.949)		(0.241)	
PM_UM	-0.14298		-0.33188		-0.46381	
	(-0.503)		(-0.612)		(-0.794)	
PF_U	-1.01630	**	-0.59013		-0.97984	
	(-4.089)		(-1.185)		(-1.825)	
PHW	0.35297	**			1.02820	**
	(3.083)				(11.736)	
PNHW	-0.23938		-0.85305			
	(-1.674)		(-7.523)			
PAFAM			-0.23600	*	0.77626	**
			(-2.376)		(6.662)	
MEDHHINC	0.00003	**	0.00002	**	0.00001	**
	(15.581)		(11.145)		(12.767)	
weighting	African-American population		Hispanic white population		Non-Hispanic white population	
n	237.000		237.000		237.000	
F-statistic	113.990		89.100		69.040	
Significance level	0.000		0.000		0.000	
Adjusted r-squared	0.770		0.723		0.669	

Table 6. Explaining Auto Ownership - Poisson Regression Analysis
(Dependent variable VEH_HH has been recoded to 0, 1, 2, 3, 4)

Independent Variable	VEH_HH (1)		VEH_HH (2)		VEH_HH (3)	
Constant	0.01562		0.54459		0.04347	
	(0.044)		(1.903)		(0.180)	
A_COMM	-0.00225		-0.00464	**	-0.00453	*
	(-1.442)		(-3.070)		(-2.453)	
P12_17NE	0.12394		-0.49428		-0.02974	
	(0.148)		(-0.589)		(-0.042)	
PM_UM	-0.74533		-0.07007		-0.66798	
	(-0.638)		(-0.039)		(-0.397)	
PF_U	-0.62805		0.71270		-0.07313	
	(-0.595)		(0.445)		(-0.048)	
PHW	0.22363				0.79302	**
	(0.540)				(3.163)	
PNHW	-0.22891		-0.48558			
	(-0.449)		(-1.320)			
PAFAM			-0.24077		0.62926	
			(-0.720)		(1.891)	
MEDHHINC	0.00002	**	0.00001		0.00001	**
	(2.731)		(1.857)		(2.874)	
weighting	African-American population		Hispanic white population		Non-Hispanic white population	
n	237.000		237.000		237.000	
Chi-squared	75.719		24.559		24.750	
Significance level	0.000		0.001		0.001	
R>>_p	0.547		0.610		0.572	

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