# AN EVALUATION OF THE EFFECT OF PUBLIC TRANSIT ON LABOR PARTICIPATION RATES IN AUSTIN, TEXAS, AND TUCSON, ARIZONA

THESIS

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# CHAPTER I

# INTRODUCTION

## Setting

Historically, transportation planners strived to liberate automobile owners by providing free and unfettered personal automobile travel options. For instance, in the name of economic growth, flexibility and convenience, engineers furiously designed technological superstructures to accommodate volumes of vehicles. The irony was that these *free* travel options only benefited individuals who could afford automobiles in the first place (Garrett and Taylor 1999; Wachs and Taylor 1998; Chen 1997).

Not surprisingly, for the populace as a whole, the vigorous pursuit of technological progress incurred social and environmental costs (Chen 1997; Stutz 1995). Aside from the pollution problems stemming from mass automobile use, automobile infrastructure construction also produced negative impacts to communities and the environment. Rampant highway building mauled urban and rural landscapes, amputated neighborhoods and diverted funds from public transit projects. Moreover, urban transportation systems designed singularly for the automobile triggered patterns of uneven development. Consequently, in most metropolitan areas now, residents *must* own an automobile, or otherwise endure often long and inconvenient commutes by public transit where public transit is available (Garrett and Taylor 1999; Wachs and Taylor 1998; Chen 1997; Masser et. al 1993).

For some, automobile ownership is impossible; for instance, low-income individuals still require public transit to reach crucial destinations such as jobs, schooling and medical care. The direct and indirect costs of owning an automobile pose a significant burden, thus, these individuals tolerate the inconveniences of public transit. For them, transit does not represent an alternative to the automobile; it represents a basic necessity (Garrett and Taylor 1999; Chen 1997).

Among the challenges posed to transportation planners and policy makers today is the provision of transit services to low-income communities. Although seemingly simple to conceptualize, the problem is not straightforward (Hodge 1995). Transportation is a derived demand. Aside from leisure driving, for the most part users need transportation not for its own sake, but to aid the user in completing other tasks such as shopping, vacationing, or working. Thus, the effectiveness of the system depends on its capacity to transport people to specific places (Miller and Shaw 2001; O'Sullivan and Sheaerer 2001; Hodge 1995). The objective, therefore, is not only to provide *mobility*, which refers to the potential for individuals to travel over distances; more exactly, the transportation planner's objective is to provide a means for individuals to *access* facilities (O'Sullivan and Shearer 2001). Furthermore, to be effective, transport systems must provide access to these places within a patron's budget constraint (Miller and Shaw 2001; O'Sullivan and Sheaerer 2001; Handy and Neimeier 1999; Kwan 1999). Decentralization of activities within urban areas further exacerbates the problem (Kasarda 1989). The issue is especially acute for transit dependent in low-income communities since individuals use transportation as one of many tools to attain employment. Thus, transportation planners face a formidable challenge providing adequate service in any neighborhood, especially low-income communities (Miller and Shaw 2001; Kasarda Ting 1996; Wilson 1996; Kasarda 1989; Wilson 1987; Kain 1968).

There are several other reasons why the distinctive needs of low-income communities are difficult to confront. To start with, transportation construction activities that improve the roads for automobiles or provide infrastructure for public transit are extremely costly and can impact an area both positively and negatively. The competition between neighborhoods for investment is tight, which in turn, instigates fierce political battles between communities (Hodge1995; Wachs 1995). Rarely do low-income communities possess political clout or even adequate political representation. More often these neighborhoods suffer undesirable health and social consequences from transportation progress. They lack the influence to attract positive transportation improvements such as road repair and supplemental transit routes in their neighborhoods and are powerless to oppose negative development such as grand highway infrastructures that bisect their communities. Typically, low-income communities bear a disproportionate burden of the social, economic and environmental costs of transportation progress. As a result of weak political muscle, low-income communities not only fail to benefit from transportation projects, they suffer from the repercussions of transportation projects designed to enhance the commuting experience of others (Black 2000; Chen 1997; Hodge1995; Wachs 1995).

**Transit Equity**

To counter the political obstacle, advocates for poor communities endeavor to instill the concept of *transit equity* in the transportation planning paradigm (Murray 2001;

Garrett and Taylor 1998; Hodge 1995). Loosely defined, transit equity does not conform to one definition of justice and fairness. In fact, the confusion about the specific definition of the term proves problematic. Because the concept requires moral and subjective judgment, it induces varied and distorted interpretations (Murray 2001; Masser et. al 1993). For instance, for some commentators, mobility represents a basic right; they believe government should provide comparable services to all communities at any cost. For others, fairness only corresponds to the shares paid for the benefits received; meaning, infrastructure and service may vary within urban areas, but areas should be expected to pay only an amount relative to the benefits received (Hodge 1995). Even the subtle difference between the two definitions can reap divergent results. While the former definition addresses the needs of all individuals regardless of the feasibility of serving them, adherence to the latter definition could produce unique distributions of transportation service dictated by people's ability to pay. The lack of universal agreement about the meaning of equity creates uncertainty in the field of transportation planning. This ambiguity poses another challenge proponents contend with when they attempt to encourage fairness in the transportation planning process (Murray 2001; Garrett and Taylor 1998; Hodge 1995).

For example, some critics note that poor communities cross-subsidize suburban transit activities (Grengs 2002; Garrett and Taylor 1999; Hodge 1995) From a per-mile basis, low-income bus users pay more than commuters transported from the suburbs to the central business district. This is because bus riders, with few alternatives are more reliant on public transit, and will pay the same at the farebox rate regardless of the length of the trip (Garrett and Taylor 1999; Cameron 1995). Since regular bus users need to journey to other destinations such as the grocery store or day-care, they tend to make extra trips besides their commute to work. All trips made in the day do not start from a single origination point; instead, many trips begin from various locations around the area (Kwan 1999). The duration of each journey may last longer than a transfer ticket allows. For many trips, therefore, bus riders pay out an additional fare. On the other hand, in an effort to appease the majority electorate in the suburbs and attract suburban commuters out of their cars, the cost per mile for a traveler on a commuter line is set at much less. Given that these commuters usually make only one long commute by public transit and use their cars for other trips, they pay less per unit of distance traveled. Consequently, more heavily patronized bus services sometimes cross-subsidize rail services (Garrett and Taylor 1999; Cameron 1995; Hodge 1995).

In addition to inequities in regressive fare structures, bus services receive fewer subsidies from the government despite the fact that they carry more unlinked passenger trips. In 1997, passenger trips by bus represented 60% of transit riders yet these services received only 30% of capital subsidies (Garrett and Taylor 1999). The level of government support distributed often depends on the neighborhood the transit serves. Most city neighborhoods are comprised of homogenous categories of class and race across space. Thus, the measure of support reveals a conspicuous geographic disparity between low and high-income areas (Garrett and Taylor 1999; Hodge 1995; Wachs 1995).

Underprivileged communities could organize grassroots campaigns to counteract inequities. One famous example includes the well-known Los Angeles Bus Riders Union (BRU) class action civil rights lawsuit (Grengs 2002, Mann 1997). In the lawsuit, litigants charged the Los Angeles Metropolitan Transit Authority with discrimination after bus fares were raised to help finance a costly commuter rail service that served primarily the more affluent. Moreover, plaintiffs reported a history of racial discrimination within the bus system as bus lines to predominantly white suburbs were furnished with more express buses and newer buses. Their case garnered attention from the media, and tangible benefits resulted from the resolution of the dispute (Grengs 2002; Mann 1997). More often, however, poor communities lack the organization and the activism to develop a forcible campaign comparable to the BRU.

Nevertheless, the circumstances described in the BRU lawsuit explain much of the disparity in any urban area; transit authorities justify the enhanced services in suburban areas because they must compete with the automobile to attract riders. As stated before, in poorer areas, the transit dependent will ride the bus regardless of the level of service (Garrett and Taylor 1999; Cameron 1995; Mann 1997). Thus, local governments do not need to provide high quality service to poor riders to 'lure' them onto public transit. Necessity forces low-income riders onto buses regardless of the quality of service.

Although government tends to fund light rail at the expense of bus service, even more striking inconsistencies exist when subsidies to all forms of public transit are compared to subsidies to automobile infrastructure. Clearly, government promotes automobile use tremendously more than all modes of public transit combined (Holmes 1995). Because so many Americans own cars, political pressure to maintain streets, highways and parking facilities compels policy makers to shift their focus and thus their funds and investment away from public transit. Policymakers require a compelling reason to support transit systems that are largely underutilized. It is argued that perhaps advocates overestimate mass transit's capacity to serve as an option for everyone (Fielding 1995).

**Sustainable Development**

The transit equity debate raises the question whether the crusade for improved social outcomes should occur in the transportation planning arena at all (Baeten 2000; Campbell 1996). Many planners appreciate equity as a goal for transportation planning. Nevertheless, politically and practically, they are unable to supplant increased efficiency and growth as the overriding aim of each project (Cameron 1997; Masser et. al 1993). In addition, concerns about the environment further complicate the issue. Although environment and equity advocates have recently attempted to a join their rhetoric on sustainable development policy, the holistic discourse cloaks the conflicting interests between the two camps (Baeten 2000; Garrett and Taylor 1999; Campbell 1996). Environmentalist's efforts to remove cars from the roads can undermine the goal of improved accessibility to jobs touted by equity advocates.

A policy initiative to control congestion by charging a toll to drivers for commutes during peak periods is deemed by one commentator as incompatible with transportation equity objectives (Black 2000). The commuting pricing scheme unintentionally functions as a regressive tax. Because higher paying occupations also offer greater flexibility, individuals in these occupations can choose whether they commute during an off peak period. Also, the tolls are less significant relative to their income. Often, lower skilled, lower paying occupations do not offer the same flexibility; therefore, individuals employed in these occupations do not have the same choices and may always be required to pay a significant tax relative to their income for the same commute (Black 2000).

For some advocates of sustainability, a tax that may inadvertently burden low-income populations is a necessary weight these populations must shoulder (Wachs 1995). Nevertheless, policies designed to lessen negative impacts to the environment run the risk of oppressing poor communities and "a situation that is less than equitable at present will worsen" (Black 2000, p. 146). One commentator asserts this is the most "challenging conundrum" of sustainable development; after all, "how could those at the bottom of society find greater economic opportunity if environmental protection mandates diminished economic growth? (Campbell 1996, p. 301). Presently, the conflict-avoiding vocabulary of sustainable development fails to tackle all intentions represented by the three points on the triangular paradigm of sustainable development: the economy, environment and equity (Baeten 2000; Campbell 1996).

Still, many researchers argue social equity and ecological sustainability share common goals. After all, public transit can act as an alternative to the automobile that is both safer for the environment and affordable for the poor (Holmes 1995). Perhaps, advocates should concentrate their efforts in areas that would benefit from both advantages. In effect, public transit could be the compromise that renders sustainable development useful (Campbell 1996).

The philosophy of sustainable development could act as a "lighting rod" that guides planners and policy makers; however, the current premise of sustainable development discourse requires further analysis and modification (Campbell 1996). The model, at present, lacks the force to bolster progress in transportation equity. If equity is a goal, then further research on the barriers to employment warrant attention. In order to justify the adequate provision of public transit in low-income communities, public transit advocates and advocates for the poor need to understand how transit can act as a "social agent" to relieve poverty (Schell 2000). Specifically, they need to ask the question, "does access to public transit matter?" In an effort to relieve poverty and increase the quality of life in low-income communities, advocates must confirm that access to public transit affects employment and thus encourages income redistribution and equity (Sanchez 1999; Pugh 1998). Empirical analysis could strengthen the arguments used by all camps, including transit equity and sustainable development activists.

# CHAPTER II

# STATEMENT OF THE PROBLEM

## Purpose

The purpose of this research is to determine if accessibility to job rich areas by public bus transit affects labor participation rates in low-income communities. Drawing from research methodology described by Sanchez (1999), various "mobility variables" derived from GIS analysis of U.S. Census Bureau data in conjunction with particular control variables are used to predict the average number of weeks worked per Census block group. It is expected that greater access to job rich areas by public transit will correlate positively with a greater number of weeks worked. Hopefully, this analysis will justify policy decisions regarding improvements to public bus transit systems in low-income neighborhoods.

## Significance of Study

Policy makers strive to develop large-scale strategies to combat poverty in urban areas. Furthermore, although sustainability and transit equity are on the political agenda, most current models lack the focus to suggest possible strategies to address these issues. Therefore, various tactics differ significantly and require extensive municipal resources to implement. Because there is little empirical evidence confirming the viability of any one strategy, policy makers continue to debate, yet continue to avoid sweeping action.

This research addresses the viability of a "mobility strategy" to affect employment rates in low-income neighborhoods.

This study is especially relevant now as the 1996 Personal Responsibility and Work Reconciliation Act (PWRORA) was reauthorized in 2002. The original piece of legislation radically transformed the welfare system by requiring participants to work in exchange for time-limited benefits. Thus, the bill has launched millions of people into an already strained urban labor market. As states strive to design better welfare-to-work programs, many participants still face spatial barriers to employment. Although this study does not focus on welfare participants solely, the results of the study could provide significant implications for program designers aiming to move low-income participants into employment.

**Theoretical Framework**

I hypothesize that by improving accessibility, public bus transportation could overcome the spatial barrier erected by the geographical isolation of impoverished communities from jobs and services. Theoretically, therefore, public bus transportation could serve as a change agent that facilitates income redistribution and reduces social inequality (Schell 2000). Is there literature support the hypothesis? The answer is that it varies considerably. Much of what is argued about the benefits of public transportation is inherently tied to the "spatial mismatch hypothesis." In short, the spatial mismatch hypothesis blames much of the joblessness problems in low-income communities on a combination of factors including housing segregation policies, restructuring of the US economy, job suburbanization and most importantly spatial barriers that hinder a neighborhood's access to suitable -- especially low-skilled -- employment.

Where observers stand regarding the spatial mismatch argument affects whether they believe public transit can function as a social change agent. Those that accept the tenets of spatial mismatch support strategies to "link" low-income residents to suitable jobs. Those that do not believe spatial mismatch affects employment potential in low-income communities are skeptical that "linking" strategies, such as public transit, could improve labor participation rates in low-income neighborhoods. Spatial mismatch, therefore, serves as an appropriate underlying theoretical framework of this research.

# CHAPTER III

# LITERATURE REVIEW

## Causes of Poverty and Economic Restructuring

Before reviewing the underlying premise of the spatial mismatch hypothesis itself, it is helpful to recognize the academic environment in which a revived interest in the hypothesis blossomed. A revival of interest in the spatial mismatch hypothesis manifested itself after two sociologists, John Kasarda and William Julius Wilson, began reinvestigating the impact of economic restructuring in low-income urban communities (Kain 1992). Their work and the work of other interested researchers were a response to a shift in public attitude about the causes of poverty (Rice 2001; Kasarda and Ting 1996). As reflected in the acceptance of the welfare reform law, The Personal Responsibility and Work Reconciliation Act of 1996 (PROWRA), taxpayers, bolstered by conservative theory, thought welfare recipients were not assuming enough responsibility for their own economic fortune. They blamed the plight of the poor on "personal" behavior ranging from criminal activity to out-of-wedlock births. Conservative theorists described the behavior as "the culture of poverty" (Wilson 1987). More importantly, the public assumed that reliance on welfare led to the aberrant behavior. It was thought that the availability of public assistance operated as a disincentive for participants to find jobs (Rice 2001; Kodras 1997; Kasarda 1989; Wilson 1987). The new welfare law was implicitly designed to liberate participants from their dependence on welfare and motivate them to take responsibility for their own economic situation (Rice 2001; Kodras 1997). However, scholars such as Kasarda and Wilson noticed that structural declines in the manufacturing economy, out of the control of most jobless individuals, also contributed to the worsening economic conditions in low-income communities. In fact, a map depicting clusters of impoverished neighborhoods, specifically in urban cores, indicated an explicit "geography" of poverty. Wilson (19870 and Kasarda (1989) noted that the similar patterns in the geography indicated a complex network of factors could have triggered severe social dislocation in metropolitan centers. Their observations expanded the theory of the root cause of poverty to include structural transformations in the economy; therefore, policy designed to ameliorate poverty required other solutions besides the dissolution of welfare. The problems, Wilson declared, required "bold comprehensive, and thoughtful solutions, not simplistic and pious statements about the need for greater personal responsibility" (Wilson 1996, p. 570).

In summary, advocates for the urban poor observed that low-skilled individuals became victims rather than beneficiaries of technological progress in the latter half of the twentieth century. In the earlier half of the century, the mechanization of farming practices and demand for manufacturing labor lured scores of migrants from surrounding rural areas to urban centers. At that time, the heterogeneous ghetto served as an institutional residential force fueling industrial labor demands. When the United States economy transformed from a manufacturing economy to service and speculative ventures economy, domestic labor production jobs disappeared (Kodras 1997). In their place, additional high-skilled technical positions emerged. Urban economic centers transformed into information and administration hubs (Wilson 1987). Unfortunately, education in the inner-city failed to respond to the demand for more skilled labor. What ensued was a "skills mismatch" between urban residents and the new economy (Kasarda 1989). More significantly, the dissolution of the manufacturing economy terminated labor shortages. Thus, the bargaining power of labor dissolved. Labor no longer influenced policy; correspondingly, policy designed to uphold social organization in the inner city dissipated (Rice 1997). Consequently, institutional ghettos, once thriving centers of the industrial economy, deteriorated into poverty stricken places (Wilson 1987).

The structural theory of poverty set the stage for a reintroduction of the spatial mismatch hypothesis into academic discussion because the structural theory delineated an economic environment by which spatial mismatch was possible. If suitable jobs did indeed disappear from the inner-city than it was justified to conclude that inner-city residents lacked *access* to jobs, therefore, inner-city residents were unable to obtain jobs. Although, the concept appears seemingly obvious, efforts to confirm the spatial mismatch hypothesis with empirical verification are tricky (Kain 1992).

Much of the ambiguity stems from the fact that it is difficult to "separate out locational effects from other effects" (Hodge 1996, p. 419). Even more difficult is separating out varying characteristics of locational effects (O'Regan and Quigley 1998). For example, a comparable theory, the "neighborhood effects" theory, also considers the effects of spatial isolation.

**Neighborhood Effects**

One key argument borne out of the structural theory of poverty included a "neighborhood effects" or "concentration effects" theory, elaborated by Wilson (1987) in his famous book *The Truly Disadvantaged.* The neighborhood effects theory bears a striking resemblance to the spatial mismatch theory in that it assigns importance to place effects. However, the spatial mismatch hypothesis and a concentration effects theory differ fundamentally. Whereas the spatial mismatch hypothesis refers to the spatial barriers that prevent low-skilled workers access to jobs, "concentration effects" describes negative externalities produced by neighborhood isolation. Certainly, one problem may compound the other. Many researchers, therefore, discuss the two processes as if they operate in conjunction with each other. Many of these researchers, however, believe that the result of concentration effects influences the continuation of poverty more than the spatial mismatch effect (O'Regan and Quigley 1998; Kasintz and Rosenberg 1996; Pastor and Adams 1996). For that reason, concentration effects deserve a short mention here.

As explained in the "Causes of Poverty and Economic Restructuring section, the transformation of the American economy altered the geography of poverty in modern metropolitan areas. Because the mass exodus of middle-class working professionals from the inner-city left behind increasing proportions of underprivileged families stranded in densely populated class-homogenous neighborhoods, the neighborhoods suffocated in an isolated environmental vacuum characterized by social problems (Wilson 1987). According to Wilson (1987), the departure of the working middle classes eliminated a social buffer that previously connected ghetto neighborhoods to mainstream society. Even in times of great recession, the middle classes supported local churches, schools and other institutions that contributed to social organization in these isolated neighborhoods. As the economic shift displaced suitable jobs and encouraged the withdrawal of the middle classes from these areas, social problems increased. Wilson theorized social dislocation further intensified because inner-city youth lacked role models that demonstrated behavior associated with individuals that hold jobs (Wilson 1987). For instance, Wilson speculated, youth might judge education as unprofitable if adults in their neighborhoods were unable to obtain jobs regardless of their level of education. The withdrawal of support for social institutions compounded the problem because youth no longer gained exposure to mainstream values scarce opportunity from their local organizations (Wilson 1987).

Modern research confirms neighborhoods play a role in shaping individual outcomes (O'Regan and Quigley 1998; Cutler and Glaeser 1997; Ellen and Turner 1997; Pastor and Adams 1996). However, scholars note the degree to which poverty is determined by neighborhood effects is disputable (Ellen and Turner 1997). O'Regan and Quigley (1998) cite the high correlation between variables as one of the limitations to studies that examine neighborhood effects therefore it is difficult to pinpoint precisely which aspects of neighborhoods affects the outcomes of individuals. Furthermore, it is difficult to discern whether family characteristics offset neighborhood influence. As Turner and Ellen point out, families with the means to surround themselves with aspects of mainstream society may avoid negative influences of impoverished neighborhoods. This may not discount the neighborhood effects argument entirely but certainly does place more emphasis on the significance of individual family characteristics. Nevertheless, although neighborhood effects studies typically find that an individual's residential location in an impoverished neighborhood is associated with diminished wages as indicated by regression analysis, most concede that the impoverished neighborhood's inaccessible location in terms of job rich areas probably amplifies any behavioral predictors that influence wage and employment rates (Ellen and Turner 1997; Pastor and Adams 1996). In fact one review speculated that neighborhood effects probably influence youth outcomes more so than adults; whereas, spatial access and a limited job network probably impact adult outcomes more strongly (Ellen and Turner 1997).

The distinction between spatial mismatch and concentration effects is subtle but significant. If policy makers regard dampening concentration effects a top priority, than they will rally behind policy prescriptions that differ from policy prescriptions to improve access. For example, the famous Gautreaux program in Chicago which by court mandate ordered the Department of US Housing and Urban Development to redistribute poor families into affordable homes all over the city has shown that employment rates improve as families are integrated into mainstream society (Rosenbaum 1995). However, other commentators note the enormous political obstacles facing redistribution policies and the faint likelihood of the feasibility of a widespread program (Hughes 1995). Most importantly, neighborhood effects studies demonstrate that another possible strategy for ameliorating poverty, economic development or "ghetto gilding", for instance, programs such as "enterprise zones" which attempt to lure business to impoverished neighborhoods with tax incentives, may fall short of its intended goal of providing jobs for the poor if neighborhood affects have already degraded the quality of the workforce. Many researchers that examine neighborhood effects agree with spatial mismatch studies that suggest policy makers should explore policy solutions that aid workers to commute out of impoverished neighborhoods (Kain 1992; Immergluck 1998; Pastor and Adams 1996; Hughes 1995).

**Spatial Mismatch Hypothesis**

Specifically, the spatial mismatch hypothesis refers to a controversial inference made famous by economist John Kain in his seminal paper, "Housing segregation, Negro employment, and metropolitan decentralization" (1968). In the paper, Kain used data describing residential and employment locations for years 1952 and 1956 in Chicago and Detroit. His data showed a pattern of reduced employment levels for black residents concentrated in the inner city. Foreseeing arguments by structuralist scholars, Kain concluded that distinctive patterns of low employment were caused by housing policies that segregated Blacks from jobs emerging in the suburbs. Kain believed that Blacks suffered from poor access to jobs; therefore, Blacks were unable to obtain jobs due either to high commuting costs or lack of information about job openings (Pugh 1998; Kain 1968). Kain suggested then, and has maintained since, that to improve the economic welfare of inner city Blacks, government must eliminate housing policies that negatively affect the spatial distribution of low-income minority households (Kain 1992; Kain 1968). His observation came to be known as the spatial mismatch hypothesis and set the standard for similar observations (Pugh 1998).

Curiously, Kain, himself, did not initially use the term "spatial mismatch" to describe the phenomena he observed. As well, his was not the first comment about the suburbanization of low-skilled employment (Pugh 1998). In fact, his analysis did not even pretend to establish a defined set of principles and effects associated with spatial mismatch. Nevertheless, Kain's paper initiated a vigorous debate. For many years following his first statement, numerous scholars responded with a flurry of empirical studies to either substantiate or refute his assertion (Gobillion et. al 2003; Arnott 1997).

The results of these studies vary widely, especially since the original theoretical foundation of the hypothesis remains incomplete. Kain expounded on the effect of housing discrimination and job suburbanization on urban labor markets, but failed to provide a standard economic model to buttress his arguments. Perhaps because Kain's hypothesis emerged before economists and sociologists fully recognized the structural metamorphosis of the economy, Kain's conceptualization of the model lacked an account all economic interdependencies. For instance, Arnott (1998) points out Kain's theory neglected to elaborate on the forces driving the suburbanization of jobs. According to Arnott, job suburbanization is not exogenous. It may only be part of a circular process that in turn affects urban labor participation rates, rather than the primary agent determining employment rates in the inner city. Indeed, jobs may have fled to the suburbs to escape the negative externalities produced by low-income communities. The ambiguity surrounding cause and effect, Arnott claims, complicates any empirical framework for examining the problem (Arnott 1998). Because of the lack of clear definition for the spatial mismatch hypothesis, scholars employ a range of measurement techniques to address the spatial mismatch topic. The disparate methods employed by these scholars produce conflicting conclusions (Pugh 1998).

Some commentators proclaim the spatial mismatch debate is still unresolved (Holzer 1991; Jencks and Meyer 1990); others contend that although the studies offer conflicting findings, most of the recent studies at least indicate that spatial mismatch plays a limited role in the economic well-being of particular segments of society (Preston and McLafferty 1999; Ihlanfeldt and Sjoquist 1998). Indeed, most researchers would agree space matters, "but it matters in ways that are complex and often mutually reinforcing," as demonstrated by the confusion between which aspects of space, neighborhood effects or access effects, hold more significance (Hodge 1996 p. 419). For this reason, it is important to differentiate between the individual implications in Kain's argument (Gobillion et. al 2003).

Most importantly, Kain's hypothesis formally declared that two separate processes affected poor Black communities. The first process forced poor Black residents to live in clustered neighborhoods disconnected from jobs suitable for their skill level. Specifically, Kain referred to the racial segregation in housing markets that confined poor Blacks to the inner city. Even now, modern qualitative studies still find frequent evidence of discriminatory practices in housing that constrain residential choices of poor minorities (Yinger 1986; 1998). The second process Kain referred to was the means by which decreased accessibility negatively affects employment levels. For instance, because location often determines social networks, Kain postulated that isolation not only affected a resident's physical access to jobs but also hindered the poor resident's ability to attain information about job openings (Gobillion et. al 2003).

What was most striking about the theory was not simply his attempt to describe the relationship between neighborhoods, space and potential employment but also his attempt to explain how labor market processes enhanced spatial impediments (Preston and McLafferty 1999). Many factors, Kain said, contributed to the lower employment levels of Blacks (Gobillion et. al 2003; Preston and Mclafferty1999; Kain 1968). In his theory, space played a significant role in labor market outcomes but did not represent the *sole* reason for low employment levels in these neighborhoods (Gobillion et. al. 2003; Kain 1968). Kain explained that economic dynamics affected space, and space affected many facets of economic life, all of which contributed to lower employment levels of Blacks (Gobillion et. al 2003; Preston and Mclafferty1999; Kain 1968). Herein the crux of the argument reveals itself; spatial mismatch occurred because of economic restructuring of metropolitan areas. Metropolitan economic structure influenced spatial mismatch and spatial mismatch further exacerbated economic spatial distributions which in turn affected metropolitan form. This is the key to the "mutually reinforcing" cause and effect aspect of space (Hodge 1996). For instance, as discussed in the Neighborhood Effects section, space can influence employment rates in many ways. Spatial separation can hinder access to jobs, but other spatial difficulties, distinct from distance, produce negative consequences. For example, spatial isolation can give rise to ubiquitous negative neighborhood conditions that can be blamed for influencing individual outcomes (O'Regan and Quigley 1998; Ellen and Turner 1997; Kasintz and Rosenberg 1996; Pastor and Adams 1996; Rogers 1998). The first difficulty amounts to an obstacle, the second difficulty describes a behavioral effect resulting from the location of the individual. Though many commentators accept that consequences from either effect will bear a striking resemblance, policy prescriptions for either problem will differ greatly.

Kain did not intend for the spatial mismatch hypothesis to replace other theories of poverty. Undeniably, other critical factors, such as race alone, likely correlate with hardship; however, Kain did perceive the spatial access imbalance as a primary obstacle for low-income communities. Most importantly, Kain aimed to provoke researchers and policymakers to consider policy prescriptions that might contend with the problem of access (Kain 1992). Unfortunately many studies attempting to test the validity of the hypothesis endeavor only to substantiate the viewpoint of the authors about the effects and importance of space rather than accede that many distinctive processes are simultaneously at work.

## Varying Methodological Approaches in Current Spatial Mismatch Studies

The spatial mismatch hypothesis is still hotly contested in the academic literature (Pugh 1998; Preston and Mclafferty 1999). Even more than thirty years after the hypothesis was first introduced, researchers continue to struggle with proving or disproving the validity of the hypothesis (Gottleib and Lentnek 2001; Cohn and Fossett 1996; Holloway 1996; Mclafferty and Preston 1996; Immergluck 1998; Taylor and Ong 1995; Shen 2001). It remains difficult to derive definitive conclusions about the validity of the hypothesis from the literature.

One of the chief reasons it is difficult to derive conclusions from the studies involves the varying assumptions and myriad methods used to calculate the existence of a spatial mismatch problem. For example, researchers use data at varying levels of geographic scale. Some choose to use disaggregated data such as the Public Use Microdata Samples (PUMS) to gain insight about individual attributes (Cooke 1997; Cutler and Glaeser 1997; Kasarda and Ting 1996; Holloway 1996; Wyly 1996; Taylor, and Ong 1995; Blackley 1980). This level of disaggregation, however, is restricted to areas larger than 100,000 people; therefore, studies that focus on neighborhood descriptors must use aggregated data (Boardman and Field 2002; Kaplan 1999; Sanchez 1999; Immergluck 1998; Pastor, and Adams 1996). Others are restricted to aggregate data because of data availability limitations. Still others make differing assumptions about commuting and job opportunity that would inevitably skew the results of their analysis. For instance, many studies compare commuting times of Blacks and Whites to understand the severity of the mismatch (Boardman and Field 2002; Gottleib and Lentnek 2001; Mclafferty and Preston 1996; Holloway 1996; Kasarda and Ting 1996; Taylor and Ong 1995). However, as Durango (2000) points out, commuting time or distance does not indicate a spatial mismatch if there is not adequate public transportation in the area to take residents to remote employment locations in the first place. A study that finds shorter minority commuting times or distances may only be a function of the lack of commuting options. Simply put, commute time studies often suffer from sample-selection bias since they exclude the unemployed. Although this point is seemingly obvious, most commuting studies testing the spatial mismatch hypothesis fail to provide variables that would account for transportation limitations (Chung, Myers and Saunders 2001; Durango 2000; Cooke and Ross 1998; Ihlanfeldt and Sjoquist 1998)

Furthermore, as in most research, how researchers approach particular variables in their analysis affects the results of spatial mismatch investigation. This point is especially evident regarding the commute time variable. For instance, it is difficult to clarify the reasons why commute times are short or long (Kwan 1999). Long commute times may be a response to employment availability in the area or they might indicate the preference of commuters to live far away from their place of employment. Certainly many suburban residents choose to live farther from their place of employment not because they can not afford to live closer but because they wish to live on larger lots of land that are available in the suburbs. Researchers note that in many cases, commute times rise with an increase in income (Ihalnfeldt and Sjoquist 1998; Ellwood 1986) Also, mode choice affects commute times; therefore, longer public transit trips may appear farther away than trips made by automobile (Boardman and Field 2002; Ihlanfeldt and Sjoquist 1998). Moreover, some researchers find the space-time constraints and travel patterns of women differ from men significantly, thereby altering the meaning behind length of the commute trip (Kwan 1999; McLafferty and Preston 1997) Women often make stops to pick children up from day care facilities or to undertake other domestic duties still argued by researchers such as Kasarda and Ting (1996) to be within the realm of female duty. Researchers that explore empirical analysis of *individual* accessibility find commute times do not adequately indicate job access because often they are not simply measures of "journey to work" as much as they are measures of the space-time constraints of individuals to work *and* tend to familial duties. As the domestic burden falls disproportionately on females, commute times obscure other social and economic processes affecting poor households (Kwan 1999). The varying processes that affect the commute variable prove problematical when attempting to interpret the results of an analysis that depends on the variable.

Assumptions about job opportunity also complicate the controversy surrounding the spatial mismatch hypothesis. Some studies use job growth rates to determine the location of job openings (Shen 2001). Other studies consider positions resulting from job turnover a more appropriate measure of job opportunity for low-skilled workers (Raphael 1997; Rogers 1997).

For example, Shen (2001) deems job turnover the more appropriate determinant of job locations. In his analysis of Boston, Massachusetts, Shen's measure of job nearness combined with job turnover showed a spatial *advantage* in the inner city.

Another researcher, using the variable job growth but otherwise similar methodology, may not find the same results (Raphael 1997; Rogers 1997). For instance, Raphael 1997 finds that low-skilled minorities suffer the most economic *disadvantage* when the communities they live in are isolated from job growth areas. He explains that although low-skilled workers may live near jobs, vacancies created by turnover produce additional job-seekers. The number of jobs may be great but the number of job seekers reduces opportunities; many vacancies are first offered to friends and family of employees within the company (Raphael 1997). If as Wilson (1987) posits, the flight of the middle-class to the suburbs has stalled informal information networks in the inner city, then it is justified to assume that low-skilled individuals with fewer connections to other employed individuals are unlikely to hear of these vacancies. Employment levels or job turnover, therefore, may not adequately measure employment opportunity. In fact, it is argued that employment levels do not all adequately describe the spatial structure of employment in low-income areas (Rogers 1997). Nevertheless Shen (2001) counters, in the case of Boston, removing job turnover as a measurement of employment opportunity eliminates 95% of possible vacancies in the area. He claims that studies that focus only on employment change will bias the results and thus overstate the advantage in the suburbs (Shen 2001). The differing opinions about the appropriate jobs measure highlight inconsistencies in spatial mismatch studies. As stated before, the diverse methodological approaches produce highly varying results.

Further complicating the controversy is the replacement of production jobs by the service economy (Hodge 1995). As discussed in a previous section, urban industrial restructuring has changed the nature of the jobs available to low-skilled workers. These jobs pay less than the manufacturing jobs previously available. As well, many of the jobs in the new economy are part-time positions that do not offer benefits (Kasarda 1989). Thus, many studies find only a minor spatial magnitude separating low-income workers from jobs; but these jobs are of lesser quality (Wyly 1996). The impact of the new economy may at first appear less damaging from a purely physical spatial perspective; still, current circumstances warrant a closer examination of the relationship between space and the contemporary urban labor market.

**Implications of the Spatial Mismatch Hypothesis**

In any case, opposition to the spatial mismatch hypothesis carries enormous implications. If researchers find that there is no spatial mismatch and there are indeed employment opportunities located near low-income populations then there must be other, perhaps unrelated, factors controlling the employment levels of low-income populations. For instance, some critics regard race not space as the chief factor influencing employment levels due to the discriminatory hiring practices of employees (Gottleib and Lentnek 2001; Cohn and Fossett 1996; Ellwood 1986). Others consider the lack of job readiness skills the primary reason for low employment levels in low-income communities (Pugh 1998; Kasarda 1989). If spatial separation is not a factor in employment levels of low-income populations, then policies attempting to effectively link workers to jobs (such as improved public transit access) will do little to improve the employment situation.

It is noted, however, that few scholars completely discount the relative influence of the "spatial gap" as at least one factor affecting inner-city joblessness. Moreover, much of the research indeed empirically supports the spatial mismatch hypothesis (Pugh 1998; Preston and Mclafferty 1999). Therefore, we can safely assume that improving mobility strategies will enhance the employment opportunities of low-income communities. To further examine our specific hypothesis about the connection between public transit and poverty a more specialized analysis of job procurement and accessibility is needed.

**Sanchez Study**

Few studies exist that specifically test the likelihood of improved labor participation rates due to greater access to public transit. In his analysis of the connection between public transit and employment in Portland and Atlanta, Thomas Sanchez (1999) used GIS to gather spatial measures for use in a two-stage least squared regression. His results suggest there is a correlation between public transit and employment. Furthermore, his study, more than other spatial mismatch studies, provides a direct methodology to evaluate the effect of public transit on labor participation rates.

In his regression, Sanchez used the average number of weeks worked for each block group as the dependent variable indicating labor participation rates. He input the data addressing transit stop accessibility as well as other independent variables that included five additional variables to express mobility and job access. For both cities, he then compared the results of the regression using the total population figures with results from the regression using only the Non-white block groups.

In Portland, for the total population, five of the seven mobility variables were significant in explaining the variance in labor participation. However, in the Non-White category only one variable, predicted number of vehicles owned, was significant in explaining the variance in labor participation. Curiously, access to bus and rail stops did not influence the dependent variable. Sanchez explained this may be a function of the "relative uniformity" of Non-White residential distances to public transit in Portland. In Atlanta, Sanchez found that excluding one variable, service frequency, all other mobility and access variables were significant in explaining the variance in labor participation for both the total population and Non-whites. The coefficient of the distance to bus stops variable was especially high indicating the importance of access to bus transit in explaining block group employment levels. From his overall analysis, Sanchez concluded that improvements to public transit access potentially correlate with increased employment levels.

**Motivation**

As mentioned previously, although the controversy regarding spatial mismatch generates significant evidence supporting the hypothesis, and even though most observers agree the spatial separation of low-income communities from jobs presents a formidable barrier to employment, and finally, even as "increased transit mobility" is touted as a notable strategy for linking poor communities to employment opportunities—few studies exist that test the *direct* impact of access to jobs by public transit on labor participation rates (Sanchez 1999; Pugh 1998; Hughes 1995).

Amidst the academic flurry to prove or disprove the significance of space and access as an impediment to employment, researchers resist exploring the potential for a valuable resource such as public transit to overcome the spatial obstacle. Most studies in my review of the literature focus on the development, determination, and the geographical and employment outcomes of spatial mismatch (Preston and McLafferty 1999). Consequently, policy makers currently possess few sources for information that delineate the potential for public transit to improve the quality of life in low-income communities (Murray 2001; Pugh 1998). Indeed, many activists doubt the capacity of public transit to improve social equity (O'Regan and Quigley 2000; Wachs and Taylor 1998; Ong 1996; Taylor and Ong 1995). The lack of encouraging evidence renders decision-makers who support investment in unprofitable and underutilized bus systems vulnerable to criticism. In practice, moral drive is not enough to convince voters of the importance of public transit. Policy makers require tangible evidence to address transit equity needs (Murray 2001).

If academics are to begin a dialogue with policy makers about public transit, it is imperative that researchers begin to present relevant studies that verify whether transit does improve the economic circumstances of low-income communities (Pugh 1998). I intend my research to clarify the significance of public transit as a viable policy option to address the spatial divide between low-income communities and jobs. With my study design, I purposefully bypass the dispute between scholars about what or who is responsible for the growing concentration of poverty in metropolitan areas, meaning I do not focus on the controversy about whether spatial mismatch affects employment outcomes. Instead, I focus on the possibility of improving the lives of the transportation disadvantaged, and the benefits that may accrue from that improvement, by investigating whether a connection between labor participation rates and access to jobs by public transit exists.

# CHAPTER IV

# STUDY DESIGN

The methodology employed in this analysis of public transit and employment closely resembles Sanchez's (1999) technique used to estimate the relationship between public transit and employment levels in Atlanta, Georgia and Portland, Oregon. In his study, Sanchez applied a two-stage least squares regression to various public transit mobility and access variables to predict employment levels for Census block groups in each city. He found that, in general, access to transit stop locations as well as other "access" variables correlated with increased labor participation rates. Results garnered from his analysis provide a reasonable incentive to support policies to improve public transit. Thus, empirical analysis in the same vein as the Sanchez study may present a credible argument to decision-makers for investing in public transit.

## Overview

To test the influence of public bus transit on employment levels, a multiple regression model closely resembling Sanchez's (1999) two-stage least squares regression was applied to a collection of variables explained to predict labor participation rates for Census block groups in two cities, Austin, Texas and Tucson, Arizona. More specifically, the regression tested the significance of four variables indicating mobility and job access by public transit to predict the magnitude of the dependent variable (average annual weeks worked, as reported by the 1990 Census). Controlling for vehicle ownership and neighborhood and household characteristics, I expected higher employment levels from workers who have better access to jobs by public transit. Variables requiring distance measures were derived from analysis in TansCAD, a transportation specific geographic information system (GIS-T). All other variables were gleaned from information in the 1990 U.S. Census, including demographic information from Summary Tape Files 3 extracted using *American FactFinder*, the interactive Web site tool for accessing Census data and employment location information from the Census Transportation Planning Package (CTPP) located at, *Transtats*, the Bureau of Transportation Statistics online Intermodal Transportation Database page.

Two linear least-squares multiple regression analyses were performed on the variables in each city. The first regression was executed with observations from Census block groups within one mile of bus transit routes in each city. Workers living more than a mile from the nearest bus route may deem public transit an impractical mode of commuting. The goal was to estimate employment levels based on the degree of functional access to public transit; therefore, workers with no practical access to bus routes were excluded to eliminate bias in the results (Sanchez 1999). The new set of Census blocks located within one mile of transit routes comprised the complete study area of investigation for each city. Since I am interested in public transit access in low-income communities, another regression analysis was applied to selected block groups in the bottom quartile of median income for each area. The second procedure mirrored the first analysis on the complete study areas.

It is important to mention a distinctive aspect of my study that differs from the Sanchez study. It concerns the lack of prominence of race in the regression. Sanchez also runs his independent regression analyses on two sets of Census block groups. He first performs the regression on all block groups and then he executes another regression restricted to predominantly non-white neighborhoods. I chose to emphasize access in low-income communities regardless of their racial composition; therefore, the first analyses considered all block groups and the second contended with block groups restricted to the bottom quartile of median income. Certainly, when Kain developed the hypothesis, he intended for it to apply almost singularly to inner-city Blacks (1968, 1974). However, as time progresses, studies demonstrate that other races, especially Hispanics, are also affected by access problems (Ihlanfeldt 1993). Indeed, some studies have found less skilled Whites suffering from the same degree of spatial mismatch as minorities (Kassarda, and Ting 1996). In fact, researchers suggest the spatial mismatch can even burden lower-income neighborhoods in the suburbs. Neighborhoods can suffer from geographic isolation and access problems anywhere across the urban landscape (Raphael 1997; 2002). The problem is now associated with class distinctions rather than racial segregation (Ihlanfeldt and Sjoquist 1998), partly because race, in many employer's minds, correlates highly with residence and class (Kirschenman and Neckerman 1991). Nevertheless, nearly all low-income communities in my study are predominately non-Anglo. Still, my aim was to focus on the spatial barriers facing low-income communities located anywhere across the urban landscape regardless of the predominant racial makeup of the community.

It is important to mention that I was limited to 1990 data because datasets from the most recent 2000 CTPP are not yet available to the public. However, I do not assume findings from my analysis directly apply to present circumstances. Rather, I wanted to understand how access can affect employment levels in general. 1990 data is simply the data set available to me to test my hypothesis.

**Study Areas**

The objective of this study is to analyze service in urban areas. Urbanized Areas are defined by the Census Bureau as areas of land that are home to a population to at least 50,000 or more and a population density of at least 1,000 people per square mile. Two cities of similar size and composition in 1990, Austin, Texas and Tucson, Arizona were chosen for analysis. The table below illustrates the similarities between the two areas:

Table 1: 1990 Demographics – The table below describes the similarities between Austin, TX and Tucson, AZ

| **Demographics – (Urbanized Area)** | **Austin, TX** | **Tucson, AZ** |
|---|---|---|
| Population [3] | 562,008 | 579,235 |
| Land Area [3] | 273.2 sq. mi. | 246.5 sq. mi. |
| Land Area Ranking US [3] | 49 | 55 |
| Population Density [3] | 2,057 per sq. mi. | 2,350 per sq. mi. |
| Population Growth 1950-1990 [2] | 546.9% | 570.4% |
| Land Area Growth 1970-1990 [2] | 187.4 sq. mi. | 141.8 sq. mi. |
| Percent Non-white [1] | 35% | 32% |
| Persons of Hispanic Origin [1] | 115,723 | 146,460 |
| Median Household Income [1] | $27,371 | $25,102 |
| Per Capita Income [1] | $14,884 | $13,105 |
| Public Transport Journey-to-Work Share [3] | 5.1% | 4.2% |

Sources:

[1] Bureau of the Census. Online. Summary Tape Files 1 and 3 at American FactFinder. Available: http://factfinder.Census.gov/servlet/BasicFactsServlet.

[2] US Bureau of Census Data on Urbanized Areas. Online. Sprawl City. Available: http://www.sprawlcity.org/about.html.

[3] Demographia. Online. All 396 Urbanized Areas: 1990 Population and Area. Available: http://www.demographia.com/db-ua90.htm#notes.

As seen from the table, both study areas maintain similar population and land area levels. Interesting to note, both areas experienced explosive growth from 1950 to 1990. Correspondingly, growth in land area (sprawl) in both cities rapidly increased between 1970 and 1990. Additionally, ratios between the white to non-white population in both cities illustrate further similarities. Moreover, the public transport journey-to-work market shares in 1990 were also at comparable levels. Austin's public transport share ranked 36 in the US at 5.1% and Tucson's public transport share ranked 42 in the US at 4.2% (See Table 1).

**Justification**

Again, although my study draws from techniques presented in the Sanchez study, there are several conceptual distinctions. Most of the methodological differences are due to the study areas I chose to examine. I felt they would offer comparisons that the Sanchez study fails to address. For that reason, justification of my study areas deserves further comment as demonstrated below.

First, the two cities in Sanchez's study are not similar enough to make an effective comparison. It proves difficult to demonstrate whether public transit actually affects employment rates if other geographic and demographic factors more vigorously influence employment rates. The two cities in my study serve as the study area for this particular analysis because their similar size and composition function as an underlying control that allows me to further interpret my findings about labor participation rates.

I also decided to test two cities lacking a rail system. Light Rail, and its emphasis on ferrying passengers from the suburbs to the central core of the city, fails to adequately address the needs of low-income residents (Grengs 2002; Wachs and Taylor 1998, Garrett and Taylor 1999). Since I am concerned with the benefits of access in low-income communities, there is no need to introduce any interrelated effects that may arise from the inclusion of a rail variable. Nonetheless, the outcome of this analysis is especially relevant for either city in terms of the rail variable because voters in both Tucson and Austin are considering the issue. It is doubtless that already scarce funds will be diverted from the public bus systems that serve low-income communities to the expensive light rail systems that serve middle income communities (Grengs 2002, Garrett and Taylor 1999, Hodge 1995). If the regression uncovered a correlation between employment levels and public bus access, and serving low-income communities is a priority of transit agencies, then decision-makers from cities in similar positions would need to rethink their transit policies.

My study also diverges from the Sanchez study because with careful intent, I examine two cities smaller in population and land area. My contention was that if, as the literature asserts, extreme spatial mismatch between residence and employment presents a daunting obstacle difficult to overcome by public transit, it may prove impossible to overcome spatial obstacles in areas where the spatial mismatch is so great that the distance between residences and jobs prove impossible to bridge within normal time-budget constraints. It stands to reason that efforts to link residents to jobs should be focused on areas less burdened by spatial barriers and these which *could* feasibly benefit from improved transit (Ong and Blumenberg 1998). Furthermore, successful poverty programs such as the Gatreaux program suggest that programs are most likely to do well if targeted at people most likely to profit (Rosenbaum 1995). For this reason, I chose to emphasize the potential benefits of public transit in metropolitan areas likely to be less hindered by extreme spatial mismatch.

Many researchers note that the degree of spatial mismatch differs greatly between metropolitan areas (Sawicki and Moody 2000; Ihlanfeldt, and Sjoquist 1998; Pugh 1998; Hodge 1996; Holzer 1991). For instance, Pugh 1998 declares that new metropolitan areas with populations fewer than 1,000,000 suffer from a lesser degree of spatial mismatch. She contends younger cities shaped by the automobile tend to encompass lighter, suburb–like densities of jobs and people throughout the area. Although public transit is usually designed for higher densities, medium densities hold advantages for public bus transit. The lighter densities and smaller geographic size allow cities to include both affluent neighborhoods and low income communities within their tax boundaries, thus strengthening their tax base; there is less opportunity for the proliferation of concentrated areas of poverty. Moreover, in cities of smaller land area size, most workers will likely incur shorter commuting distances, even if they are traveling outside of their immediate neighborhood. Because of the size and composition of younger, smaller cities, job-rich areas are likely to be distributed more evenly around the area. Therefore, populations in these cities will suffer less from the burden of spatial mismatch. Consequently, these cities should presumably benefit the most from public transit that links poor residents with jobs, as should be justified below. I feel that concentrating my study on two metropolitan areas that are more likely to realize employment rate benefits further enhances the legitimacy of the study.

My two study areas, Austin, Texas and Tucson, Arizona are relatively recently developed areas. Moreover, 1990 population levels in both cities fall within the classification of a medium sized city, with a population of less than 1,000,000 people. A map of Census block groups in each city reveals that low-income communities are spatially concentrated; however, a visual inspection of an analogous map of job opportunities suited to low-skilled individuals illustrates that job rich areas are dispersed throughout both cities. Therefore, both cities are appropriate candidate areas on which to focus public transit strategies.

**Data**

One of the compelling aspects of this study concerns the Census block as the unit of analysis. As mentioned in the literature review, some commentators criticize the gross scale at which other parallel studies perform their analysis (Pastor, and Adams 1996; Immergluck 1998; Ihlanfeldt, and Sjoquist 1998; Kaplan 1999). Often studies evaluate employment or wage outcomes resulting from spatial mismatch using a pooled set of metropolitan areas drawing on individual data from sources such as the Wyly 1996; Sample (PUMS) (Cooke 1997; Cutler and Glaeser 1997; Kasarda and Ting 1996; Holloway 1996; Taylor, and Ong 1995; Blackley 1980). Due to confidentiality concerns, the Census reports data about individuals using large geographic units to indicate residential location. For instance, the five-percent PUMS dataset geographically identifies data in a Public Use Microdata Area (PUMA). PUMAs include 100,000 residents. The geographic unit of reporting constrains researchers to merely tag "residential" households as "suburb" or "central city" locations within a metropolitan area. Although, the data capture important observations about the individual unavailable at the neighborhood level, the definition of location masks the varying levels of job opportunities distributed within and around neighborhoods throughout the metropolitan area (Kaplan 1999; Pastor, and Adams 1996). The scale of much of this research muddies the results because the studies lack the small area neighborhood descriptors required to accurately depict access to jobs.

To capture the geographic detail of the neighborhood, I collected most of my data at the block group level. At this level, the needed data is available and interpretable at an appropriate scale. Only one variable, "Access to Low-Skilled Employment", was derived from information collected at a different administrative unit level. Employment locations in Tucson and Austin were only available at the Transportation Analysis Zone (TAZ) level. Nevertheless, this administrative unit was deemed appropriate for use in my model since the scale of resolution at which TAZs are determined in Tucson and Austin are similar to Census block group boundaries. More details about the generation of this variable are provided later in the paper.

The dependent variable, "Average Number of Weeks Worked", indicates labor participation rates per block group. Originally, the variable appeared in the downloaded spreadsheet from the U.S. Census as a summary of responses from persons in each block group 16 years and over to the question (Weeks Worked in 1989). The responses were summed by the Census in range categories including:

- 50 to 52 Weeks
- 48 to 49 Weeks
- 40 to 47 Weeks
- 27 to 39 Weeks
- 14 to 26 Weeks
- 01 to 13 Weeks
- Did not Work

Due to the range nature of the data, a Grouped Approximation to the Mean method was used to calculate the "Average Number of Weeks Worked" per block group. The following formula describes the method:

$$\overline{X} = \frac{\sum_{k} F_k X_k}{n} \tag{1}$$

where:

$F_k$ is the frequency of group k
$X_k$ is the midpoint of group k
$n$ is the number of respondents in each block group

The method determines a weighted average by summing midpoints of each category per block group multiplied by the relative frequency of responses in each group. The resulting quantities are then divided by the total number of responses in each block group (Younger 1985).

The independent variables included in the original analysis represent mobility, concentration of poverty, as well as variables that control for dominant demographic characters.

The access variables include:

- [ACCESS] Relative Access to Low-Skill Employment by Public Transit (total number of jobs)
- [COMM] Average Commute Time (minutes)
- [DIST] Distance to Nearest Public Bus Route (miles)
- [FREQ] Average Service Frequency at Nearest Timepoints (interval minutes)

The concentration of poverty variable includes:

- [POV] Persons For Whom Poverty Status is Determined (percent of total population)

The control variables include:

- [EDUC] Adults with a Bachelor's Degree (percent of population age twenty-five years and older
- [KIDS] Percent of the Population Fifteen and Younger
- [WHITE] Persons that are Non-Hispanic White Residents (percent of total population)
- [FEMHH] Single Female Heads of Household with Children Fifteen Years and Younger in the Household (percent of total households)
- [CORE] Distance from the Urban Core (miles)
- [VEHIC] Number of Vehicles Per Capita (per person sixteen years and older)
- [NLF] Persons that are Ages Associated with Non-Labor Force Residents (percent of total population that are of the ages between sixteen to eighteen years old or sixty five years and older)

The "Access to Low-Skill Employment Variable" determines the relative number of low-skill jobs accessible to every block group. It was argued in the literature that increased access to low-skill employment increases labor participation (Sanchez 1999; Pugh 1998; Hughes 1995). To assess relative access to employment by Public Transit, data about the locations of jobs per Traffic Analysis Zone (TAZ) were gleaned from the 1990 Census Transportation Planning Package. The information about job locations was used to calculate an index of access in each lock group using a distance decay function. Access to low skilled employment on the bus network was calculated with the following formula (Sanchez 1999):

$$p_i = \sum_{j=1}^{n} W_j d_{ij}^{\ -\beta} \qquad (2)$$

where:

$P_i$ is the access to employment index of block group i
$W_j$ is the number of jobs in TAZ j
$d_{ij}$ is the travel distance between i and j
$\beta$ is the exponent for distance decay
$n$ is the number of TAZs in each city

In this formula, each block group centroid acts as an origination point from which to measure a weighted number of jobs in every TAZ, the centroids of which act as the destination points. In this context, the number of jobs between origin point i and destination point j is inversely calculated by each unit of travel distance on the network from the origin point. For instance, a TAZ containing 10 jobs located miles away by bus carries a greater weight in the calculation than a TAZ containing 10 jobs located 50 miles away by bus (Sanchez 1999; Handy, and Neimeyer 1997). The $\beta$ value that was used for the calculation was 2 which is a standard value for $\beta$ in many distance decay models.

In order to calculate the mentioned gravity equation, a distance measure based on the bus route network was necessary. Since 1990 bus routes in either city were not available in digital format, routes were digitized in TransCAD using historical 1990 bus schedules as a guide for determining the path of each route. A unique operation available in TransCAD allows the user to essentially draw lines from point to point by means of a shortest path algorithm. The feature allows the user to clip the corresponding streets layer to fit the paths of each bus route. The resulting geographic file accurately matched the geography of the routes layer. The clipped street layer served as the network to compute relative distances to the TAZ centroids. Both the Block Group and TAZ centroids were connected to nodes on the new clipped street theme and a cost matrix that minimized length between the centroids was computed. The cost matrix was migrated into a spreadsheet in Microsoft Excel that multiplied the number of jobs per TAZ by the unit of distance specified by the gravity formula. The accessibility measure was calculated for every repeated for every employment category considered low-skill including:

- Sales occupations
- Administrative support occupations, including clerical
- Service occupations, except protective and household
- Machine operators, assemblers, and inspectors
- Transportation and material moving occupations
- Handlers, equipment cleaners, helpers, and laborers

After the computations were completed, all subtotals were aggregated to establish the total number of low-skilled employment accessible to each Census block group.

Since the clipped street network used to generate the access variable in this model does not incorporate the actual travel-time or route connections it may overstate the number of jobs accessible to block groups. Nevertheless, the variable is a “relative” measurement; therefore, exact measures of access are unnecessary. Moreover, as will be discussed later in the paper, because the study design incorporates access as a whole, during the morning peak, bus connections are frequent enough to assume that the clipped street network itself provides a reasonable impression of access by public transit. As well, because the study examines access during the morning peak it was justified to use the rather crude technique of "minimizing length" measured in miles instead of incorporating the speed limits of the streets. Speed limits, especially in Austin are insignificant during high volume traffic periods.

As discussed in the literature review, although commute time is considered by many an imperfect measure of job access, many other studies do use the length of commute variable to determine accessibility to jobs (Boardman and Field 2002; Gottleib and Lentnek 2001; Mclafferty and Preston 1996; Holloway 1996; Kasarda and Ting 1996; Taylor and Ong 1995). In this study "Average Commute Time" was estimated by dividing the aggregate travel time (in minutes) of each Census block group by the number of workers sixteen years and older.

To measure the distance to nearest bus route variable, the bus route network developed in TransCAD was utilized again. Using Euclidean measurement, the distance from each block group centroid to the nearest bus route was computed by "tagging" each block group record with the "Distance to Feature" tool. Since bus stops are numerous and it is likely pedestrians will use shortcuts and stray off the street network to reach a bus stop, it is acceptable to use straight-line distance rather than Manhattan distance (Sanchez 1999). However, it would be preferable to determine the distance to the nearest *bus stop* instead of the nearest *bus route*; unfortunately, 1990 digital bus stop data is not available from either transit agency. Although bus stops are not evenly spaced, they occur frequently over the length of the route. The measure should not have affected the underlying aim of the study. In other studies examining accessibility, researchers deemed it acceptable to use distance to the bus route as an accessibility measure (O'Sullivan

2000). I note, however, that this measurement may have overestimated the access of some Census block groups to public bus transit.

Physical access is not the only significant variable for testing access. The frequency of service also influences mobility and access (Sanchez 1999; Hodge 1995). Many riders complain that bus service may deliver them to their job sites but that the length of the commute trip is increased due to the infrequent service that delays bus transfers. To understand how the level of service can affect employment levels in each block group, it was necessary to assess the average frequency of service of each route. The bus schedules provided information about the location of timepoints, which are recorded departure and arrival times at selected bus stops along the routes. Although the booklets did not take account of every bus stop, there were enough timepoints (262 in Austin and 148 in Tucson) to estimate general service levels. Because service frequency varies somewhat depending on the time of departure, the frequency of service was calculated at every timepoint by averaging the interval minutes between the appearances of buses at that timepoint during the morning peak. Morning peak was indicated in the Census by the time period at which the greatest number of persons left home for work (6:30 a.m. to 8:30 a.m.). The timepoints were then digitized on a "Routes Timepoints" layer in TransCAD and the averages were input into the attribute table. Then, a point in polygon overlay operation was used to find the average number of minutes recorded at every timepoint located a mile around each block group centroid. Thus, the "Frequency of Service" variable represented a general estimation of the level of service offered in each block group.

The poverty variable was included in the analysis to account for the phenomenon described in literature review as "concentration effects" (Wilson 1987). The Census codes an individual with Poverty Status if the household income does not meet the Poverty Threshold for a household of a given size in that year. Poverty Thresholds are defined for a household of three or more individuals as three times the costs of food consumption for a year. The Poverty Threshold is modified each year as the Cost of Living Index changes.

Interestingly, household size is a function of the poverty variable that is not accounted for in a variable such as median income. A map of the poverty variable overlaid with block group boundaries that delineate the bottom quartile of median income illustrates some divergence from the poverty variable. Small size households that earn low-incomes may contribute to a total lower median income value for a block group, but the Census may not code the individuals in the household as in poverty if their earnings meet the Poverty Threshold for a household of their size. For instance students often earn less relative to individuals that are not burdened by the responsibilities of an education, however, the Census does not code them with the poverty status. Inclusion of this variable, therefore, is important not only for its reference to the "concentration effects" Wilson theorizes about, but it also controls for census blocks that are largely populated by, as an example, students. Although it may seem that the correlation between a variable that indicates income may bias results from an analysis about labor participation, the poverty variable, as suggested above, identifies other important characteristics about a population that I deemed important for the investigation.

Finally, a collection of control variables were implemented in the model to facilitate improved interpretation of the regression. The variables provide controls for, race, income, type of household, distance to the urban core and vehicle ownership. My focus in this study was to examine the predictive power of my mobility and access variables, but I also wanted to ensure that the regression included controls for predominant socioeconomic characteristics present in the block groups. As discussed in the literature review, control variables are critical to the study since any predictive influence detected in the employment variable could be attributed to socioeconomic characteristics of the individual or household (O'Regan and Quigley 1998; Pastor and Adams 1996). Except for the "Distance to the Urban Core" variable, all of my control variables were downloaded from the US Census.

The "Percent Ages Associated with Non-Labor Force" variable was especially relevant as a control since the dependant variable was calculated by averaging the number of weeks worked in 1989 of all persons 16 and over, including individuals that did not work. The Census does not indicate whether these individuals, such as retired individuals or students, were consciously choosing not to participate in the labor force. Indeed the Census does ask respondents in the questionnaire to indicate whether they are participating in the labor force or simply unemployed but that particular question refers to the present time and four weeks before that particular Census questionnaire is enumerated. A person, therefore, could state they are not part of the labor force at that particular time but still indicate a number of weeks, perhaps seasonal employment, that they worked earlier in that year. The discrepancies necessitated that the inclusion of persons that did not work in the calculation of the dependant variable; the control variables were expected to account for non-labor force individuals.

**Limitations**

I recognize methods presented in this study thus far are not without the same limitations that plague other studies evaluated in the literature review. For instance, I did not account for the possibility of people self-selecting their residence near employment or in areas with better access to public transit, meaning, the dependent variable, employment, may influence the locations of workers and therefore the measure of access rather than the other the way around (Ihlanfeldt, and Sjoquist 1998; Cutler and Glaeser 1997; Cooke 1996; Holzer 1991; Jencks, and Mayer 1990).

Researchers employ different techniques to avoid the bias produced by the coincidence of employment and residential location. For instance, Rogers (1997) analyzed a sample of males who had submitted applications for unemployment insurance. She compares the duration of unemployment and spatial distribution of jobs procured by the applicants. She contends her sample restriction overcomes the simultaneity problem because their residential locations were determined by their previous employment rather than the location of their new place of employment (Rogers 1997). Certainly, her technique circumvents the simultaneity problem but this kind of data is not available to me. Also, this technique can only avoid the simultaneity problem when examining job procurement possibilities; it is less successful for job retention investigation.

By far, most researchers concentrate their analysis exclusively on youth, since typically youth do not choose their residential location (Perle et. al. 2002; O'Regan, and Quigley 1998; Ihlanfeldt, and Sjoquist 1998; Raphael 1997; Cutler and Glaeser 1997; Holloway 1996; Ihlanfeldt 1993). However, other researchers question the legitimacy of this method. Critics claim the individual characteristics of youth are highly correlated with the characteristics of the family and the neighborhood; consequently, an endogenous residential choice by the family holds true for the child (Preston and McLafferty 1999; Ihlanfeldt and Sjoquist 1998). Indeed, other researchers claim, that for many poor workers, residential location is fixed, meaning, for different reasons low-income individuals choose their residential locations before they attain employment. One survey in Worcester, Massachusetts found most residents acquired their place of residence *before* they secured employment. In fact, for married women this was almost always the case since the locational decision was largely based on the husband's employment possibilities (Hanson and Pratt 1988).

In my analysis I concede to one of the assumptions of spatial mismatch theory: in the short term, low-income families are unable to respond to spatial shifts in labor market demand by relocating (Holloway 1996). For that reason, I am also assuming that low-income individuals do not self-select their residence in areas with good access to public transit. I assume the predicted employment levels in each block group are a function of the independent variables and not the other way around.

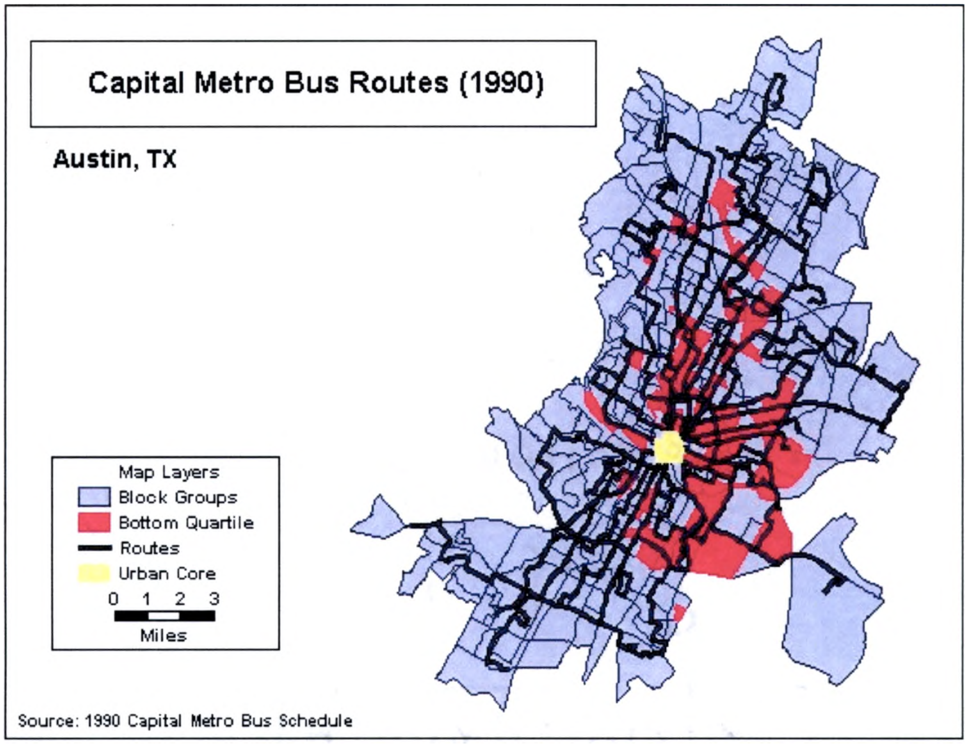
# CHAPTER V

# RESULTS AND ANALYSIS

## Evaluation of the Distribution of Key Variables

The figures provided in the following pages illustrate the spatial distribution of key variables. Although, the two cities boast overall demographic similarities that justify their selection as study areas for comparison, maps of both cities allow the reader to visually compare the internal spatial distribution of key variables by census block group. In all maps the block groups in the bottom quartile of median income were highlighted. As well, it is important to note that in all maps, nested averages, a classification method that emphasizes natural breaks in the data, was used to classify the number of responses per measurement range. The numbers of observations per measurement range are indicated in parentheses in the legends. The distinctions of each figure are discussed following the presentation of the maps.

Fig. 1. Maps: Bus Routes (1990). The maps below illustrate the configuration of 1990 Bus Transit Routes in Austin, TX and Tucson, AZ.



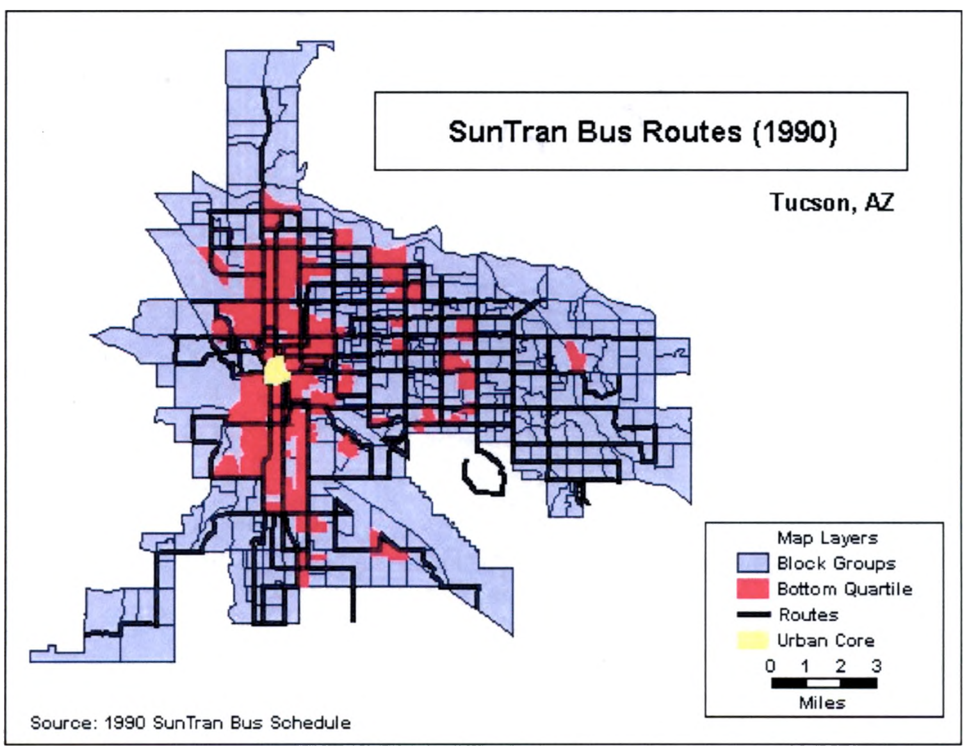
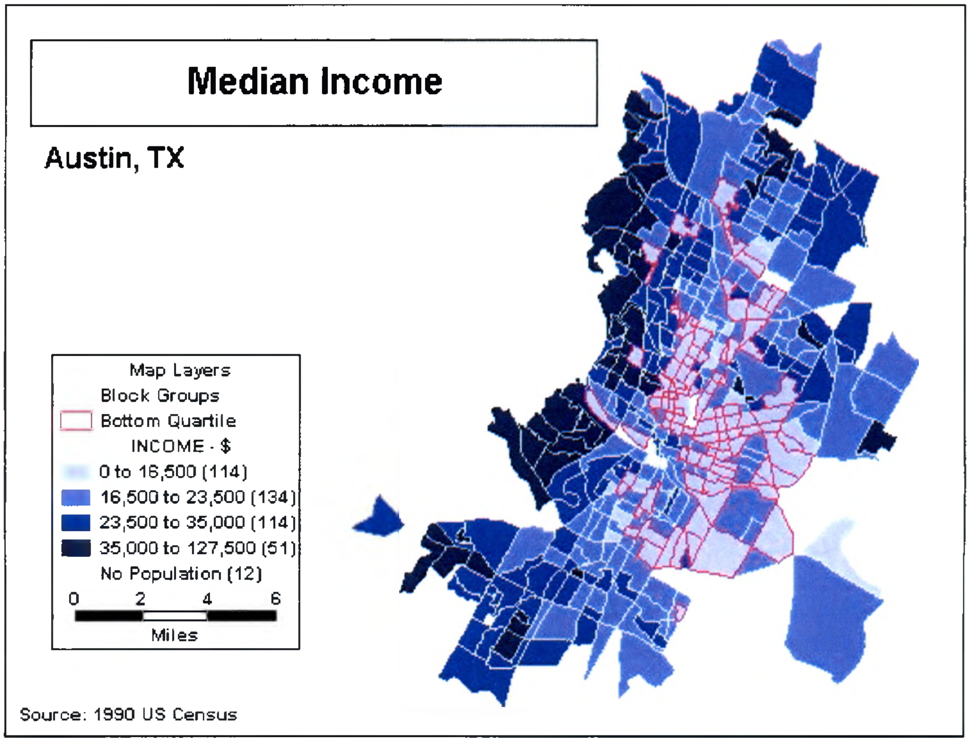



Fig. 2. Maps: Median Income. The maps below illustrate the distribution of median income in Austin, TX and Tucson, AZ.



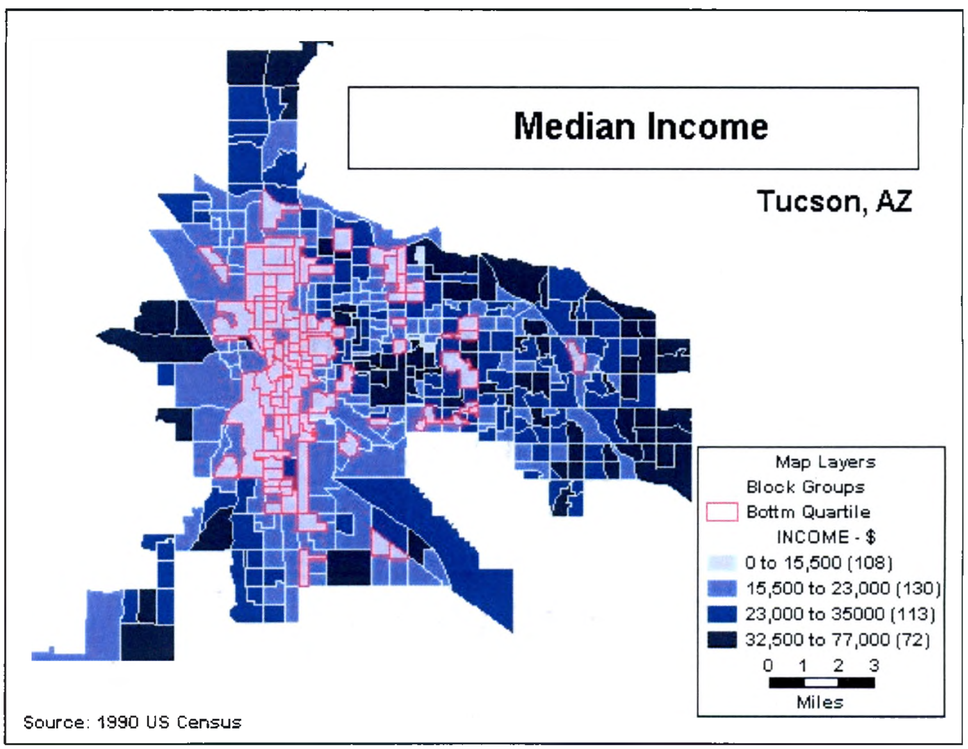
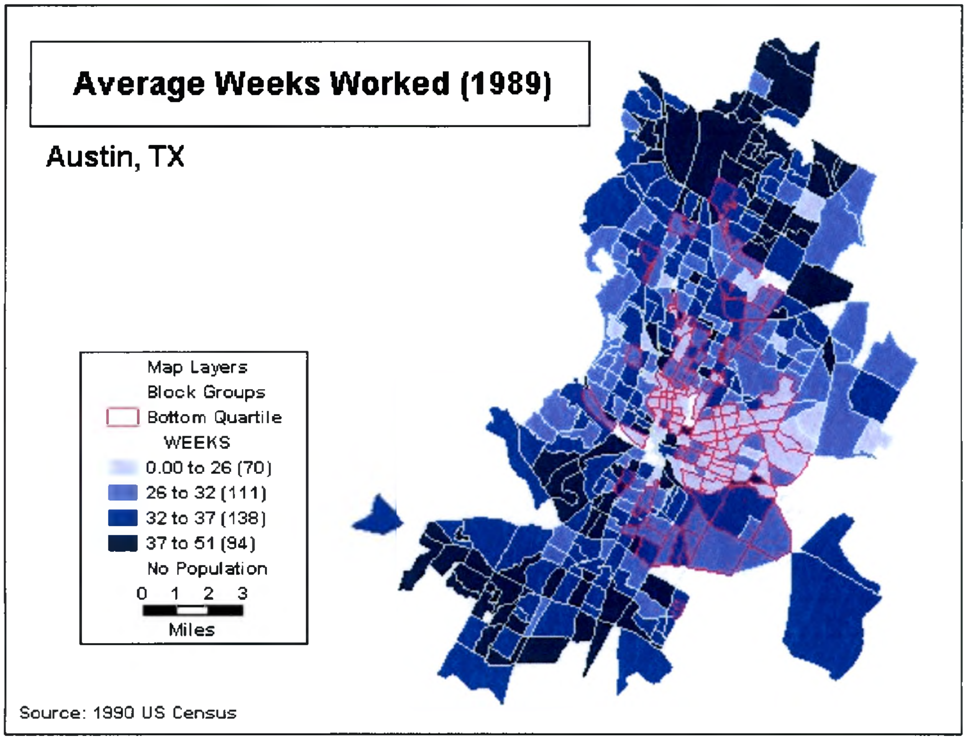



Fig. 3. Maps: Average number of Weeks Worked (1989). The maps below illustrate the distribution of the labor participation variable, “Average Number of Weeks Worked,” in Austin, TX and Tucson, AZ.



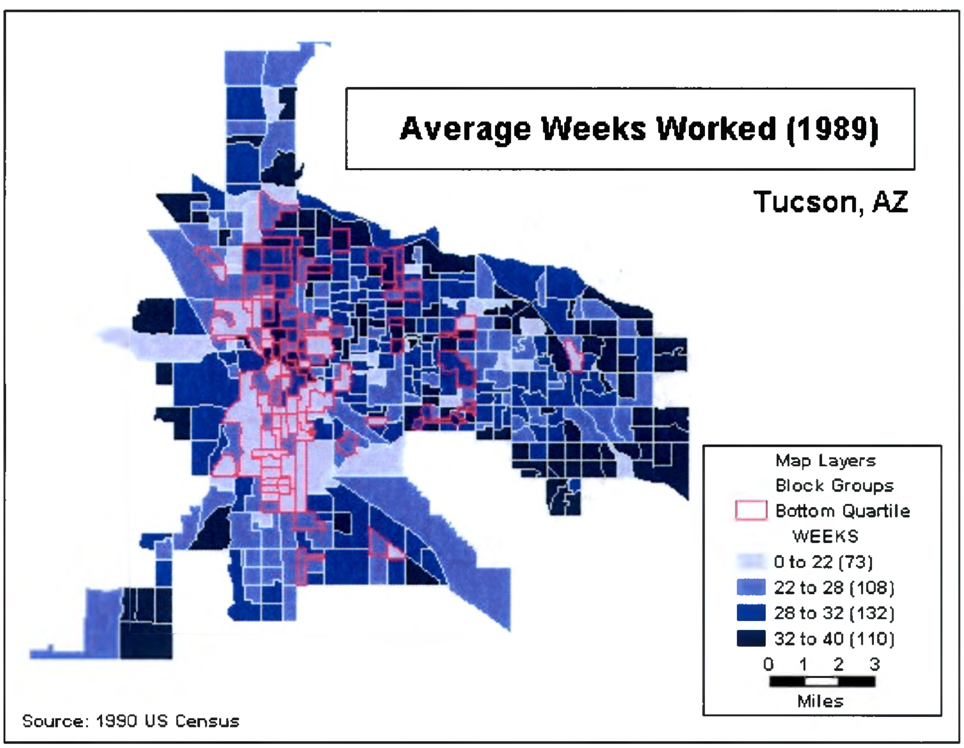
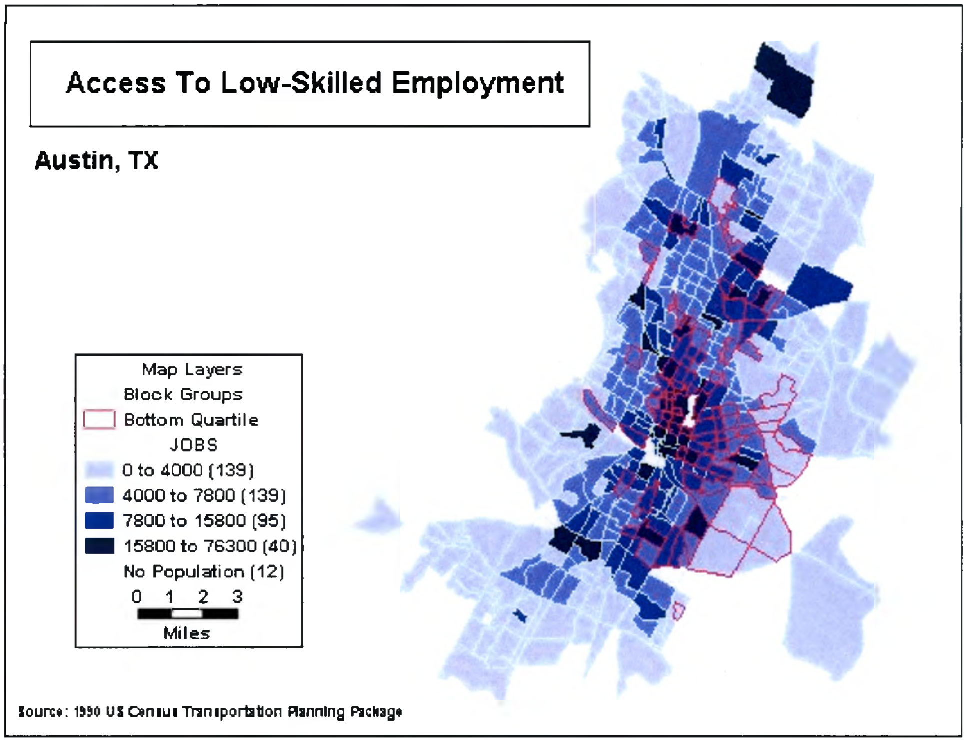



Fig. 4. Maps: Access to Low-Skilled Employment. The maps below illustrate the distribution of the variable, "Relative Access to Low-Skill Employment by Public Transit," in Austin, TX and Tucson, AZ.



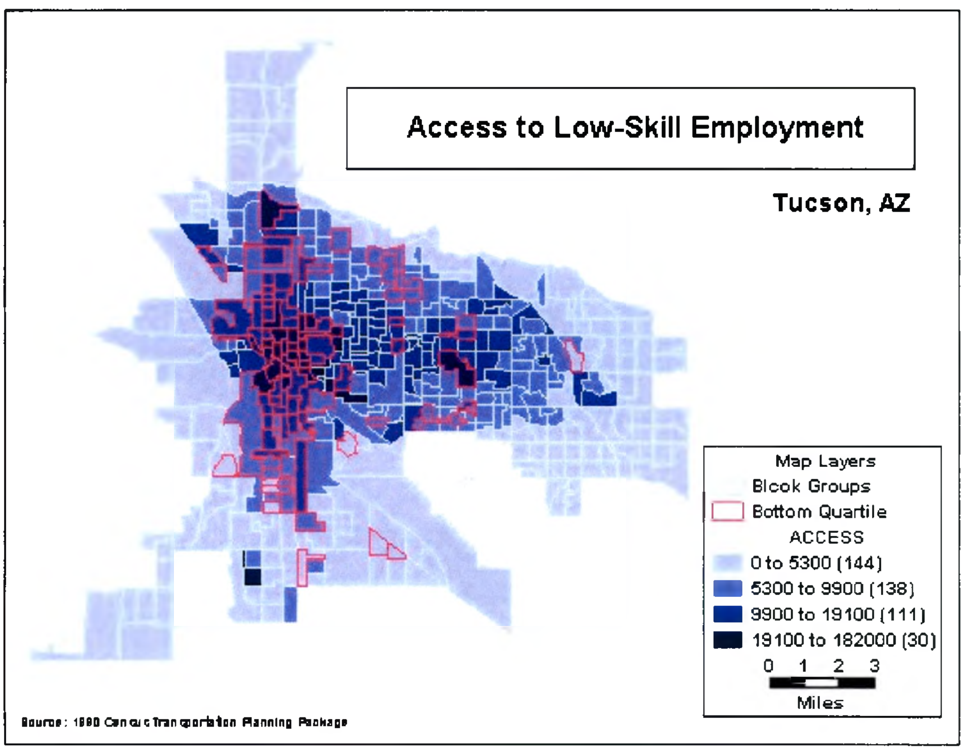
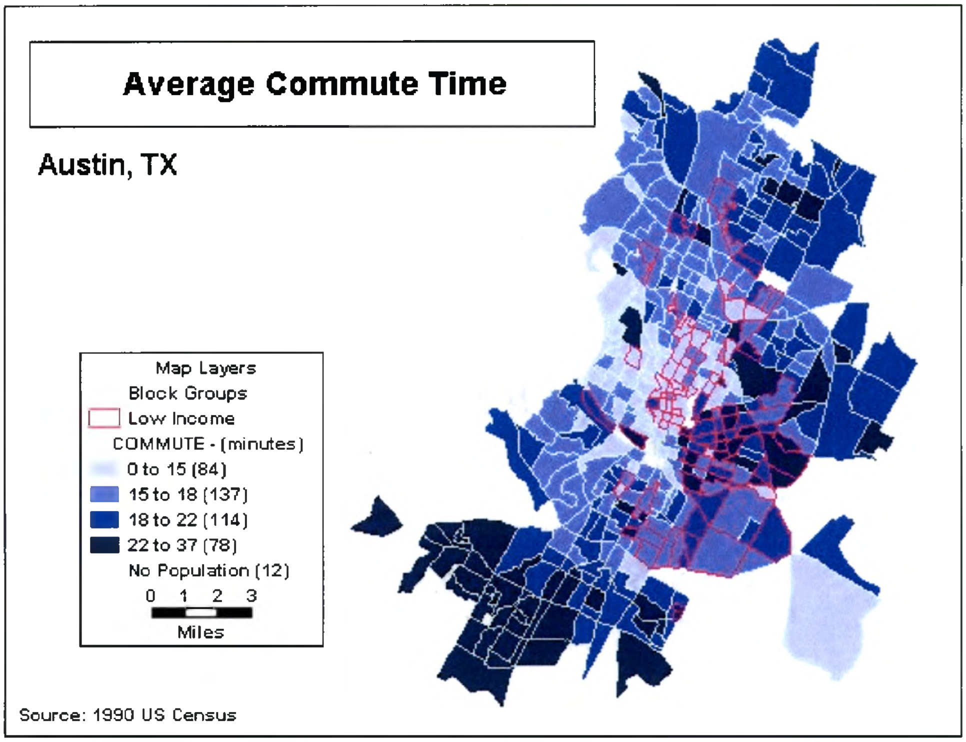



Fig. 5. Maps: Average Commute Time. The maps below illustrate the distribution of the variable, "Average Commute Time," in Austin, TX and Tucson, AZ.



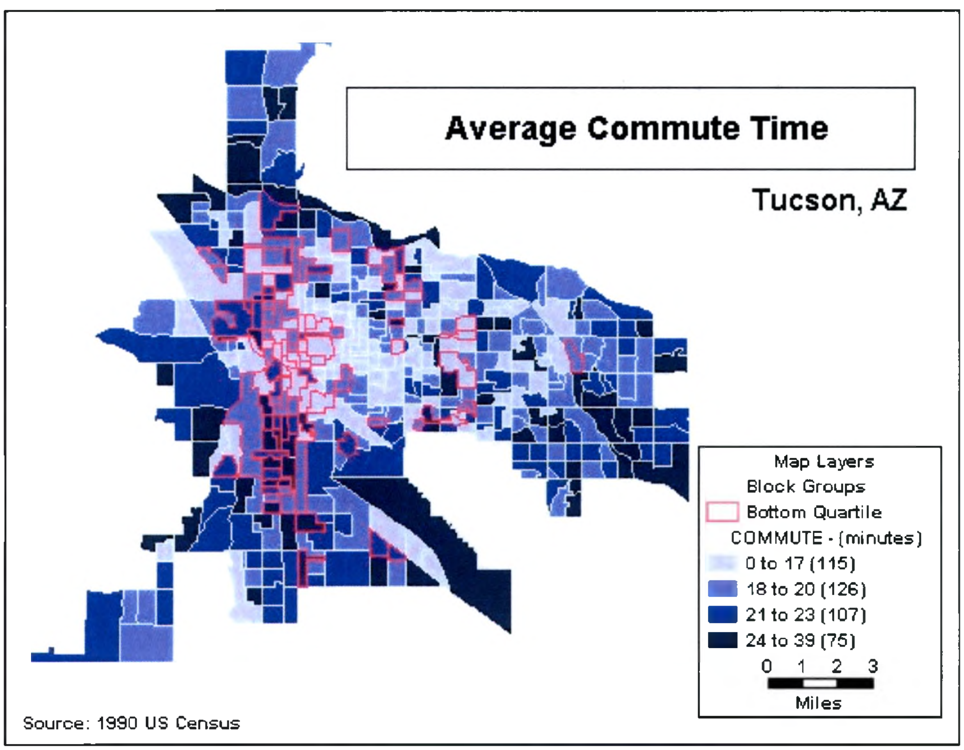
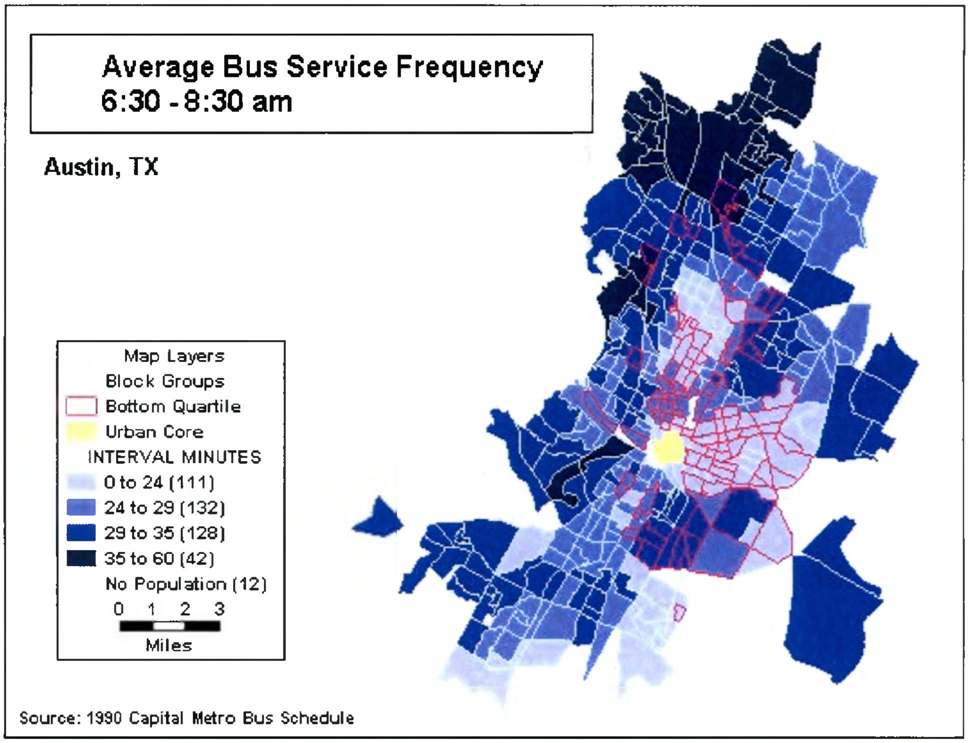



Fig. 6. Maps: Average Bus Service Frequency. The maps below illustrate the distribution of the variable "Average Service Frequency at Nearest Bus Stops," in Austin, TX and Tucson, AZ.



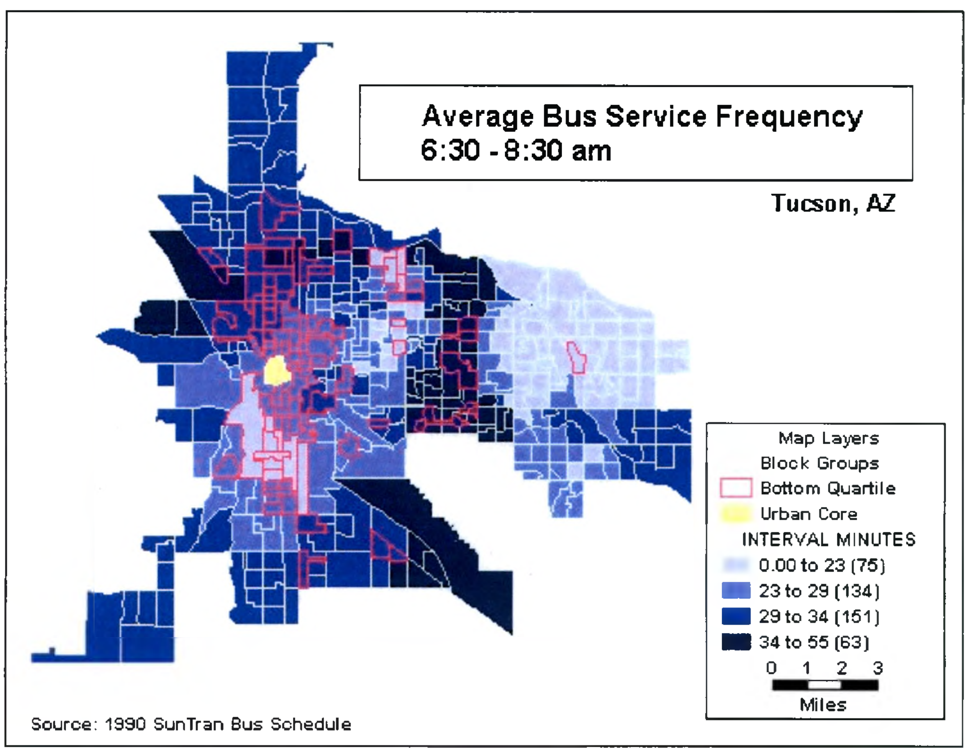
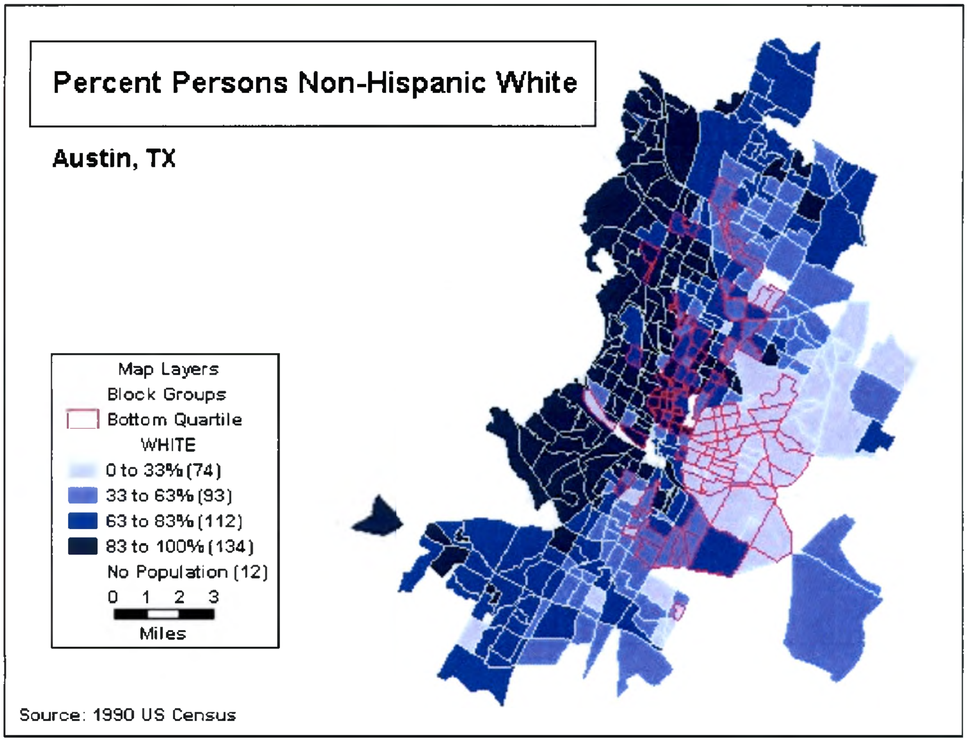



Fig. 7. Maps: Percent Persons Non-Hispanic White. The maps below illustrate the distribution of the variable, "Percent Persons Non-Hispanic White," in Austin, TX and Tucson, AZ.



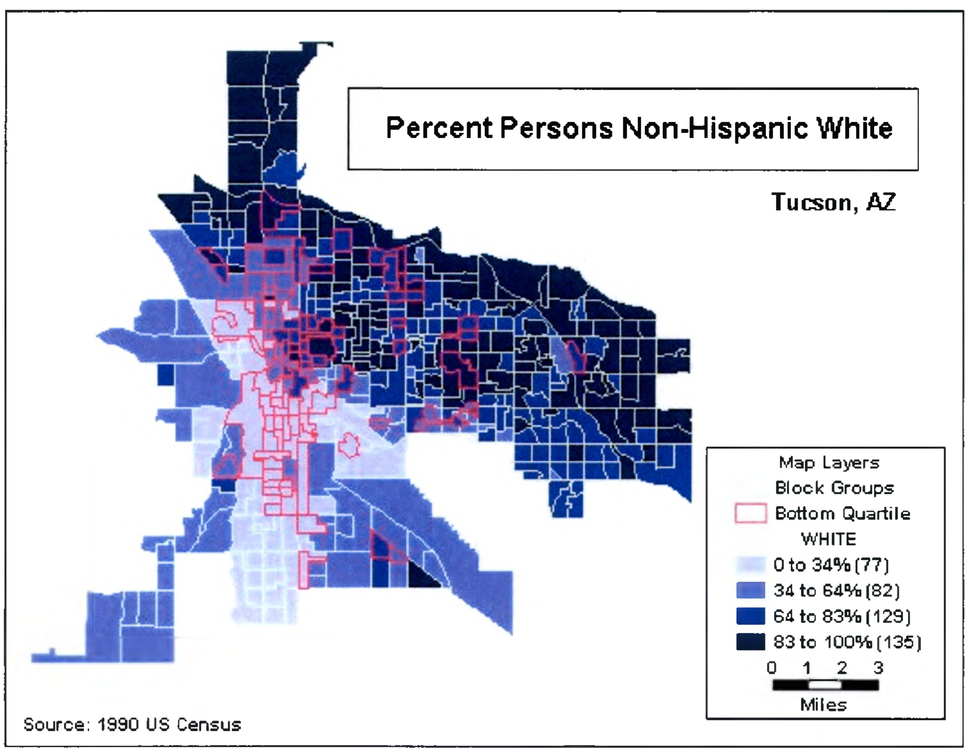
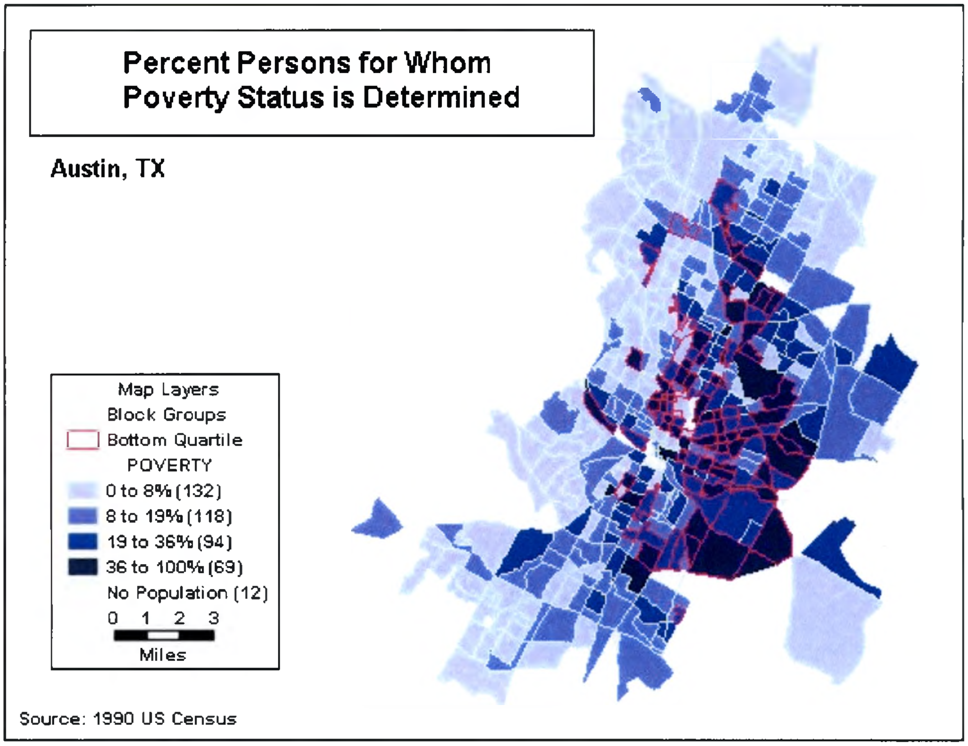



Fig. 8. Maps: Percent Persons for Whom Poverty Status is Determined. The maps below illustrate the distribution of the variable, "Percent Persons for Whom Poverty Status is Determined," in Austin, TX and Tucson, AZ.



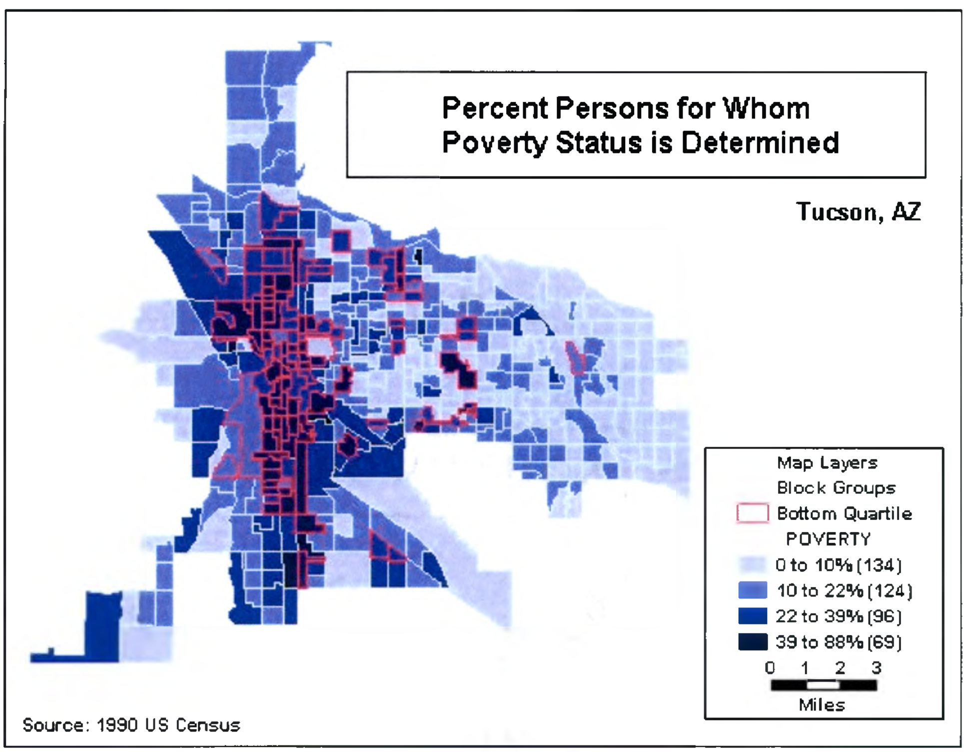
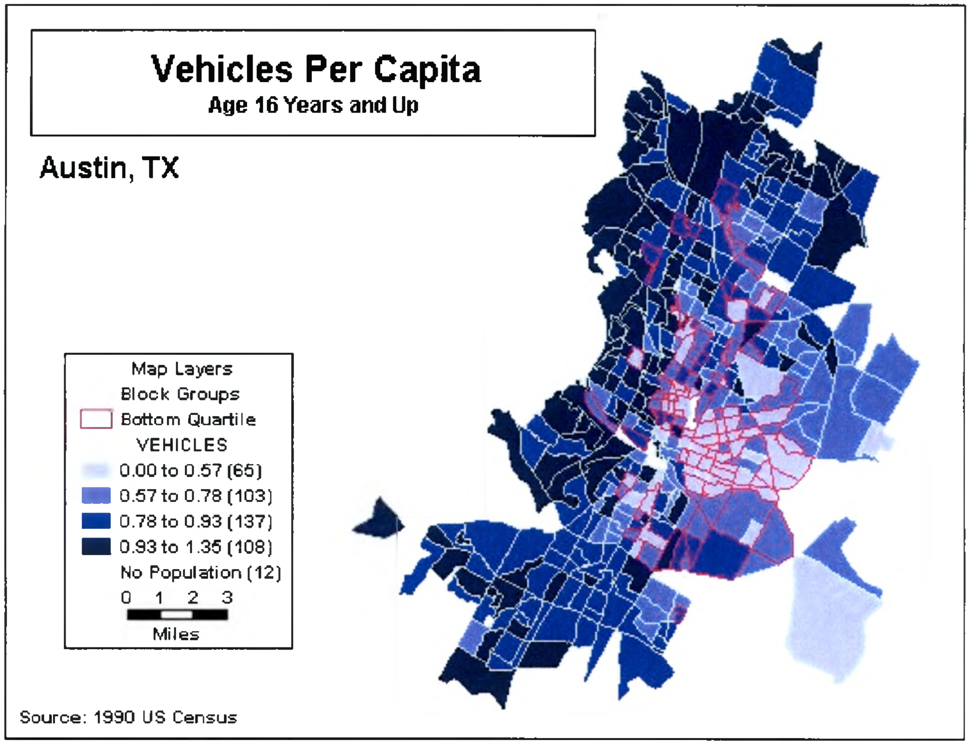



Fig. 9. Maps: Vehicles Per Capita. The maps below illustrate the distribution of the variable, "Vehicles Per Capita," in Austin, TX and Tucson, AZ.



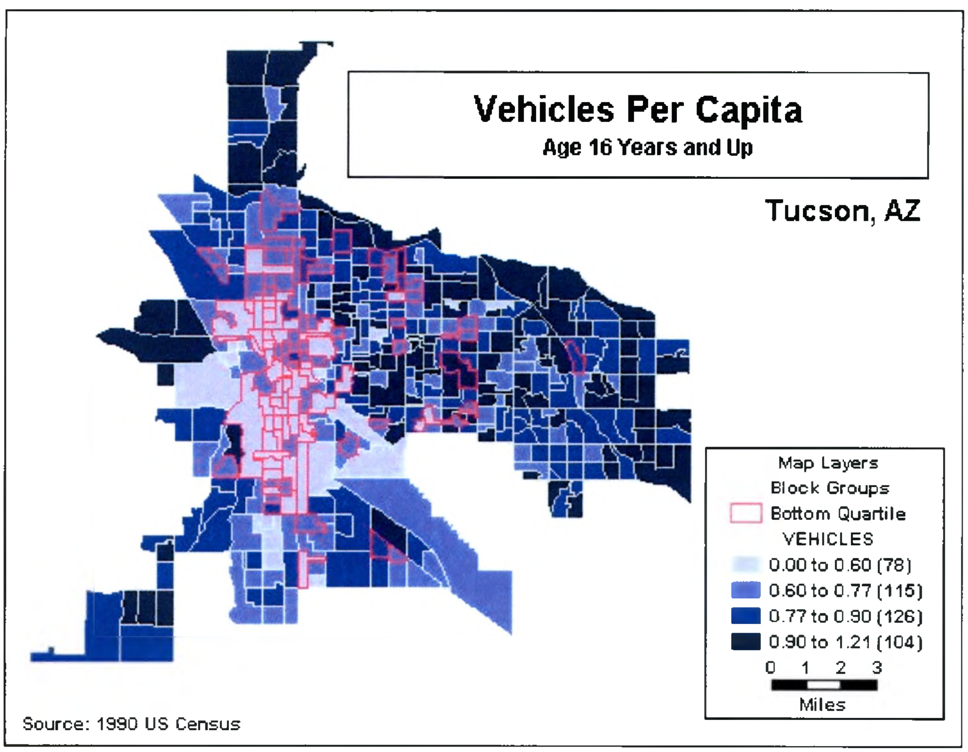
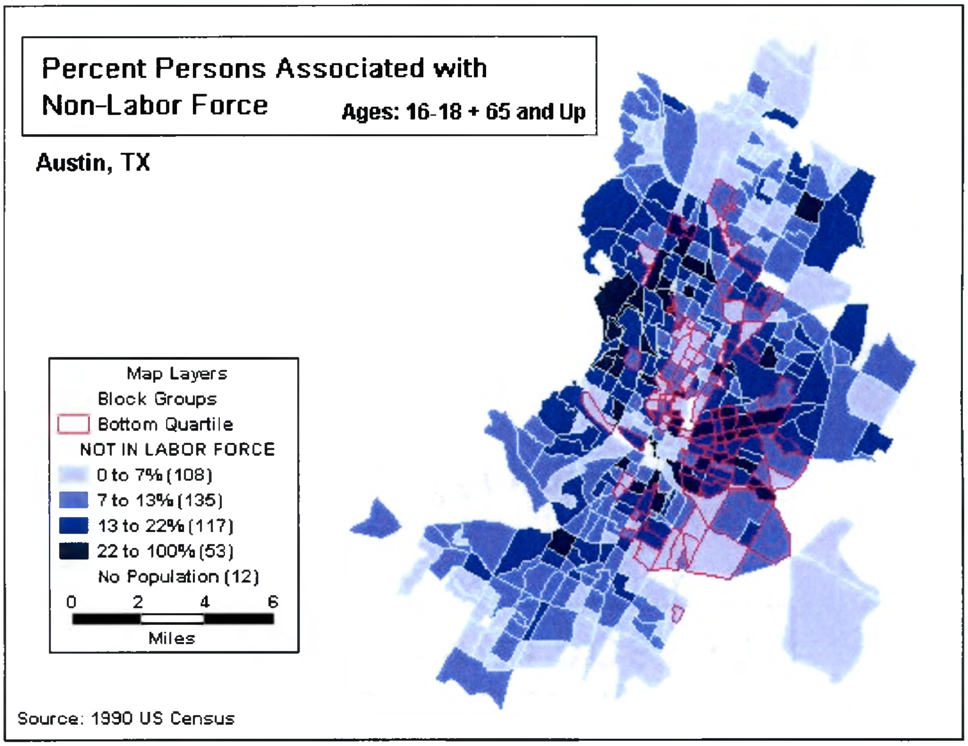
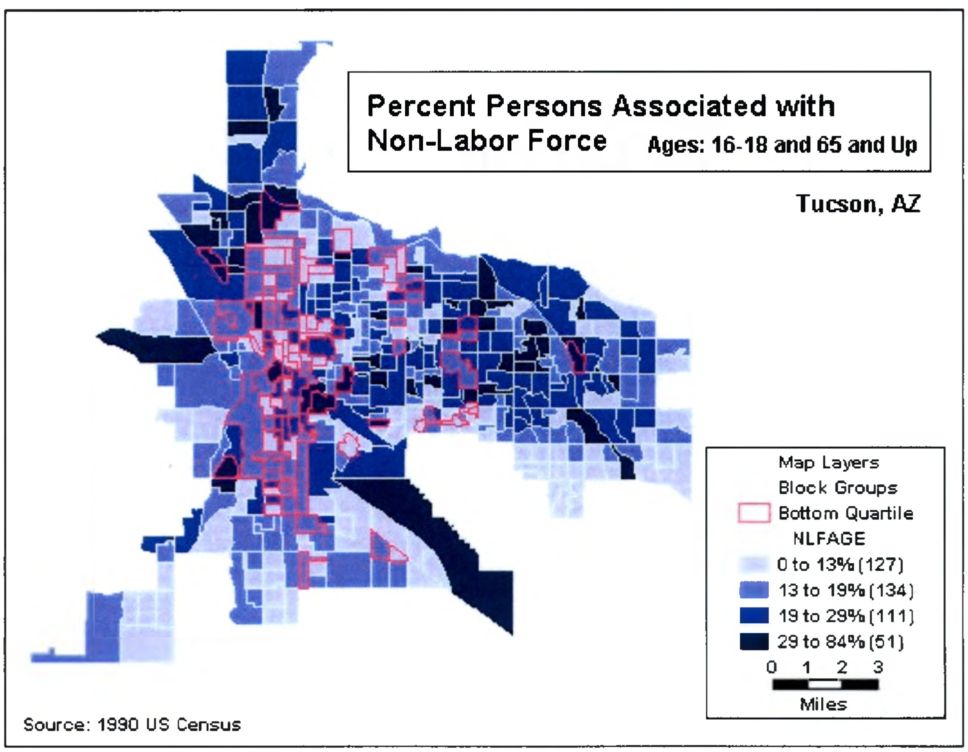



Fig. 10. Maps: Percent Persons Associated with Non-Labor Force. The maps below illustrate the distribution of the variable, "Percent Persons Associated with Non-Labor Force," in Austin, TX and Tucson, AZ.



At first glance the transit systems in the cities of Austin, TX and Tucson, AZ appear physically distinct (See Fig. 1). Austin's transit system follows more of a radial pattern that concentrates its service along the north-south parallels of the city. Tucson's service represents a grid pattern that extends to the north and south to some degree, but the mass of the grid service expands far west from the urban core. Census block groups within one mile of the routes are presented in the maps. It appears that in both cities most census block groups in the bottom quartile of median income are located near bus routes (See Fig. 1).

Although income is not by itself a contributing variable in regression analyses for either city, maps depicting the spatial distribution of median income by census block group were provided to demonstrate the spatial concentration of neighborhoods within the same median income range (See Fig. 2). In Austin, block groups with a higher income range are concentrated in the far West and block groups in the lowest median income range are concentrated around the urban core. In Tucson, block groups in any income range, with the exception of the lowest range, are distributed unevenly across the urban landscape. Only the block groups in the lowest income range show a spatial concentration north and south of the urban core (See Fig. 2).

The maps that illustrate the distribution of the labor participation variable, "Average Number of Weeks Worked," show again, differing levels of spatial concentration (See Fig. 3). In Austin, the bulk of block groups in the two highest ranges of number of weeks worked emerge in the areas north and south of the urban core; whereas, block groups in the lowest range appear just north and east of the urban core. The number of average weeks worked in Austin does not seem to directly correspond with the spatial distribution of median income. Block groups in the highest range of income do not necessarily hold the highest range values for average number of weeks worked (See Fig. 2). In Tucson, the distribution is less concentrated. Even among the bottom quartile of median income block groups, the distribution of the average number of weeks worked is divided. Bottom quartile block groups located immediately surrounding the urban core show ranges of average weeks worked in the highest category. While bottom quartile block groups farther south of the urban core show range values within the category of the lowest range of average weeks worked (See Fig. 3).

In both cities, the block groups in the urban core enjoy relative accessibility to the most number of low-skilled jobs (See Fig. 4). In Austin, however, there are block groups outside of the urban core that also benefit from accessibility to a high number of low-skilled jobs. In Tucson, the spatial pattern of "Relative Accessibility to Low-Skilled Employment" is more uniform around the urban core and gradually decreases as distance to the urban core increases. The decrease in accessibility is more gradual east of the urban core as it seems that a greater accessibility to jobs is enjoyed by block groups within the eastern corridor of the urban core than in other areas of the city (See Fig. 4).

The illustration of the distribution of the "Average Commute Time" variable in both cities portrays differing spatial manifestations of commute times in the two cities (See Fig. 5). The bulk of the highest commute time range values are shared by block groups in the farthest south of the city and immediately east of the urban core. Block groups sharing the lowest range of commute time values are located immediately west of the urban core. Interestingly, average commute times in the bottom quartile of median income block groups are starkly divided. Bottom quartile block groups immediately north of the urban core hold the lowest range of commute time values. While bottom quartile block groups east of the urban core hold the highest range of commute time values. A corresponding map of Austin that illustrates the spatial distribution of the "Non-Hispanic Whites," demonstrates that the same block groups that endures longer commute times also shows block groups that contain the highest range of Non-White populations (See Fig. 10). Although, the "Average Commute Time variable seems less concentrated in Tucson, the highest range of commutes times appear, for the most part, on the fringes of the city boundaries; whereas, the block groups that show the lowest range of average commute times are located around the urban core and within the corridor east of the urban core (See Fig.5)

The level of bus service was described by the "Frequency of Service at the Nearest Timepoints" variable. Maps that illustrate the spatial distribution of the level of bus service appear in Figure 6. In Austin, for the most part, the frequency of bus service corresponds with the distance to the core. In Tucson, the variable seems less spatially concentrated and, peculiarly, the frequency of service is slightly higher in the urban core than in areas farther from the core. The derivation process of the variable might explain this discrepancy. In some instances, buses do not visit all timepoints at regular intervals. For example, if the bus stop is part of an express bus route, the frequency of the service may decrease. Express routes allow bus riders to reach their destinations quicker by passing over bus stops along the route. It is important to note that express routes were only included in the analysis if that part of the route constituted an integral component of a standard route (See Fig. 6).

The maps for both cities demonstrating the distribution of the variable "Percent of Persons for Whom Poverty Status is Determined" shows the expected spatial distribution (See Fig. 8). In both cities concentration of poverty emerges in the same areas populated by low-income block groups (See Fig. 2). As well, the maps depicting the variable, "Vehicles Per Capita," show the expected spatial distribution (See Fig. 9). In both cities the number of vehicles per capita correlates with median income (See Fig. 2). The last variable illustrated, "Percent Persons Associated with Non-Labor Force," also shows an expected spatial distribution for each city (See Fig. 10). In both cities, no dominant spatial concentration patterns emerge. However, it should be noted that in Austin, a cluster of high-range values for this variable appear in block groups east of the urban core. Moreover, in Tucson, a cluster of low-range values for this variable appears around the urban core.

**Results and Analysis of the Regression**

A linear least squares regression was run for each city on total block groups within one mile of each route and a separate regression was performed on the bottom quartile block groups of median income of both areas. The intention was to test the predictive qualities of the same variables in both cities. It was decided, therefore, to remove variables that indicated a high incidence of multicollinearity from all regressions even if the high correlations occurred in only one regression analysis. For instance, the education variable, "Percent Adults with a Bachelor's Degree" variable was removed since, as expected, the simple correlation matrix illustrated a high degree of connection with "Percent Persons Non-Hispanic White." The variable describing the "Percent of the Population Fifteen and Younger" was removed because of its correlation with the "Female Head of Household" variable. The variables that remained in the final analyses are resistant to criticisms of muticollinearity since only a few variables show a higher simple correlation coefficient than 0.40.

The data presented in this section reveal that the variables designed to describe the influence of public transit on employment levels are rarely significant in multiple regression analyses in Austin, Texas and Tucson, Arizona. In most instances, only specific control variables are statistically significant in t tests used to evaluate the significance of the coefficients of the regression coefficients. The t tests ensure that the relationships of the independent variables to the dependent variable are statistically significant and are not due to chance. A test that is significant below .05 is acceptable for social-science research. Since the accessibility variables are not significant, the regression analyses do not indicate there is a strong relationship between access to public transit and the dependent variable, labor participation rates.

In the regression performed on all block groups in Austin, TX, results show the adjusted $R^2$ value as 0.611, meaning, 61% of the variance is explained by relationships between independent variables with the dependent variable. The degrees of freedom in the test, which measure the difference between the number of observations and independent variables, is 412 which produces a high F test score of the whole analysis of 65.721. Similar to the pair-wise t tests, the F test determines whether the change in the dependent variable is due to chance. Since the F test score is significant at <.0005 it is likely that at least one of the variables significantly explains the change in the dependent variable and that the relationship is not due to chance. The following table specifies the coefficients of the Beta weights and the corresponding t test values:

Table 2: Regression Coefficients for Analysis for Total Block Groups in Austin, TX

| Variable Aliases | B | Std. Error | Beta | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 25.057 | 1 885 | | 13 293 | 0 000 |
| ACCESS | 2.29082E-05 | 0 000 | 0 027 | 0 717 | 0 474 |
| COMM | 0.153 | 0 055 | 0 099 | 2.800 | 0 005 |
| DIST | -4 673 | 1 392 | -0 123 | -3 358 | 0 001 |
| FREQ | 0 020 | 0 037 | 0.023 | 0.541 | 0.589 |
| VEHIC | 11.985 | 1.275 | 0 393 | 9.401 | 0 000 |
| CORE | 0 232 | 0 141 | 0.082 | 1.648 | 0.100 |
| FEMHH | 2.693 | 4.287 | 0 024 | 0 628 | 0 530 |
| NLFAGE | -31 660 | 2 221 | -0 456 | -14 255 | 0.000 |
| POV | -12.361 | 1 707 | -0 291 | -7 241 | 0 000 |
| WHITE | 0.256 | 1.146 | 0.010 | 0 223 | 0.823 |

The table above illustrates the strong relationship between specific control variables to the dependent variable. The variable "Persons Associated with Non-Labor Force" reveals the strongest relationship between an independent variable and the variable depicting labor participation rates. As expected the standardized Beta of -0.458 indicates that census blocks with a higher percentage value of this variable will likely show a lower value for the "Average Weeks Worked" variable. Conversely, the "Vehicles Per Capita" variable shows an opposite relationship to the dependant variable that at Beta weight of 0.393 also suggests a strong correlation. Finally, the recording of "Percent of Persons for Whom Poverty Status is Determined," in the table also indicates a statistically significant relationship to the dependent variable that at a Beta weight of -0.291, also indicates a solid correlation with the dependent variable. The "Distance to the Nearest Bus Routes" and the "Average Commute Time" variable is statistically significant in the model but the standardized Beta scores uncover weaker relationship to changes in employment levels (See Table 2).

In the regression performed on the bottom quartile of median income groups in Austin, TX, results show the adjusted $R^2$ value as 0.463, meaning, 46% of the variance is explained by relationships between independent variables with the dependent variable. This score reveals a great decrease in the explanatory power of the independent variables on the dependent variable from the regression in all block groups of Austin, TX. The degrees of freedom in the test, is 102 which produces an F test score of the whole analysis at 9.780. The F test score is significant at <.0005 level. The following table specifies the coefficients of the Beta weights and the corresponding t test values:

Table 3: Regression Coefficients for Analysis for the Bottom Quartile of Median Income Block Groups in Austin, TX.

| Variable Aliases | B | Std. Error | Beta | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 17 430 | 4 451 | | 3 916 | 0 000 |
| ACCESS | 2 22798E-05 | 0 000 | 0 033 | 0 371 | 0 712 |
| COMM | 0 411 | 0 110 | 0 322 | 3 728 | 0 000 |
| DIST | -2 599 | 6 226 | -0 035 | -0.417 | 0 677 |
| FREQ | 0 033 | 0 162 | 0 019 | 0 202 | 0 840 |
| VEHIC | 8 394 | 2 777 | 0 267 | 3 022 | 0 003 |
| CORE | 0 935 | 0 499 | 0 172 | 1 873 | 0 064 |
| FEMHH | -0 069 | 9 058 | -0 001 | -0 008 | 0 994 |
| NLFAGE | -23 690 | 4 419 | -0 412 | -5 361 | 0 000 |
| POV | -12 097 | 3 613 | -0 276 | -3 348 | 0 001 |
| WHITE | 2 500 | 2 920 | 0 102 | 0 856 | 0 394 |

What is interesting to note from the above table is the increased standardized Beta weight of the “Average Commute Time Variable” at 0.322 revealing a stronger relationship between commute times in the Bottom Quartile of Median Income Block

Groups in Austin, TX. Also interesting is the disappearance of the influence of "Distance to the Nearest Bus Route" variable. The variable t test evaluation is no longer significant. This may be due to a more uniform distribution of low-income block groups located near bus-routes. Or perhaps, although there is not sufficient data to tell us, the following is in the realm of speculation: maybe the effect of students, who do not live in the lowest quartile of median income block groups but who do use public transit to commute to work, emerge in the regression of all block groups but not in the regression of the bottom quartile block groups (See Table 3).

In the regression performed on all block groups in Tucson, AZ, results show the adjusted $R^2$ value as 0.754, meaning, 75% of the proportion of variance in the dependant variable is related to changes in the independent variables. Again, just as in the regression on all blocks in Austin, TX, this score indicates the independent variables are powerful predictors of the variance in the average number of weeks worked. The degrees of freedom in the test at a score of 422 produces a high F test score of the whole analysis at 130.537. Since the F test score is significant at $<.0005$ it is likely that at least one of the variables significantly explains the change in the dependent variable and that the relationship is not due to chance. The following table specifies the coefficients of the standardized Beta weights and the corresponding t test values:

Table 4: Regression Coefficients for Total Block Groups in Tucson, AZ.

| Variable Aliases | B | Std. Error | Beta | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 30.214 | 1.560 | | 19.372 | 0 000 |
| ACCESS | 9.822E-06 | 0 000 | 0 022 | 0 743 | 0.458 |
| COMM | -0 008 | 0 037 | -0.006 | -0.215 | 0.830 |
| DIST | -0 423 | 1.001 | -0 012 | -0.423 | 0.673 |
| FREQ | 0.003 | 0.018 | 0.004 | 0 152 | 0.879 |
| VEHIC | 5.178 | 1 244 | 0.156 | 4.164 | 0.000 |
| CORE | -0.121 | 0 082 | -0 054 | -1 480 | 0 140 |
| FEMHH | 4.532 | 2.684 | 0 050 | 1.688 | 0.092 |
| NLFAGE | -39 019 | 1.486 | -0 728 | -26 256 | 0.000 |
| POV | -13.876 | 1.445 | -0 394 | -9 603 | 0.000 |
| WHITE | 6 197 | 0 747 | 0.291 | 8 294 | 0.000 |

The table above illustrates the strong relationship between nearly all the same control variables to the dependent variable as in the regression of all block groups in Austin, TX. Again, the variable "Persons Associated with Non-Labor Force" reveals the strongest relationship between an independent variable and labor participation rates. In fact the relationship between this variable and the dependent variable shows an even stronger correlation with a standardized Beta of -0.728. The poverty variable at 0.394, also suggests a strong correlation that corresponds with the relationship revealed in the regression on all block groups in Austin, TX. On the other hand, "Vehicles Per Capita" variable is statistically significant but its Beta score of 0.156 illustrates a relationship that markedly weaker than in the Austin analysis. The model diverges from the Austin analysis in two other ways. First, the control variable "Persons Non-Hispanic White" emerges as a significant predictor and strong correlation to the dependent variable. Second, neither the commute variable nor the "Distance to the Nearest Bus Routes" variable appears significant in determining "Average Number of Weeks Worked." It seems that the dominant racial make-up of either Whites or Non-Whites is a more important factor for determining the dependent variable than commute times (See Table 4). Perhaps, as suggested although not definitively implied, people in Tucson, Arizona live closer to employment thereby discounting the effect of the commute variable and elevating the effect of race. Indeed, the less uniform distribution of the commute variable seems to suggest that people do not need more time to commute to employment thus there is less variance in the data to influence the dependent variable (See Fig. 5).

In the regression performed on the bottom quartile of median income groups in Tucson, AZ, the adjusted $R^2$ value is 0.584, meaning, 58% of the variance is explained by relationships between independent variables with the dependent variable. Again, just as in the regressions in Austin the score reveals a great decrease in the explanatory power of the independent variables on the dependent variable from the regression in all block groups of Tucson, AZ. The $R^2$, however, is larger for this regression than in the Austin bottom quartile regression suggesting again the greater capability of the independent variables to explain "Average Number of Weeks Worked." The degrees of freedom in the test, is 104 which produces an F test score of the whole analysis at 15.628. The F test score is significant at <.0005 level. The following table specifies the coefficients of the Beta weights and the corresponding t test values:

Table 5: Regression Coefficients for Analysis on the Bottom Quartile of Median Income Groups in Tucson, AZ.

| Variable Aliases | B | Std. Error | Beta | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 24.384 | 3 872 | | 6.297 | 0 000 |
| ACCESS | 1 37374E-05 | 0 000 | 0 050 | 0.597 | 0 552 |
| COMM | -0.014 | 0 090 | -0.011 | -0 159 | 0 874 |
| DIST | 1.712 | 5 149 | 0 024 | 0.333 | 0 740 |
| FREQ | 0.117 | 0 065 | 0.135 | 1.799 | 0.075 |
| VEHIC | 11 248 | 3.004 | 0.316 | 3.745 | 0.000 |
| CORE | -0 618 | 0.355 | -0 165 | -1.739 | 0.085 |
| FEMHH | 0 622 | 5.578 | 0 009 | 0 111 | 0.911 |
| NLFAGE | -33 215 | 5 091 | -0.468 | -6.524 | 0 000 |
| POV | -13.289 | 3 369 | -0 323 | -3.944 | 0.000 |
| WHITE | 4 174 | 1.937 | 0.205 | 2.155 | 0.034 |

The same variables in the table above appear significant as variables that appeared significant in the regression of all block groups in Tucson, AZ. In fact, the "Persons Associated with Non-Labor Force" variable is still strongly correlated to "Average Weeks Worked" however the standardized Beta score at -0.468 is not as dominant as it was in the regression of all block groups. Instead, the "Vehicles Per Capita" variable, at a standardized Beta weight of -0.316, shows a stronger correlation in this regression than in the Tucson all blocks regression. As expected both the poverty and race variable appear to have the same relationship to the dependent variable.

CHAPTER VI

SUMMARY

**Conclusions and Suggestions for Future Research**

In this study, I attempted to evaluate the effect of public bus transit on labor participation rates in Austin, Texas and Tucson, Arizona. To test the influence of public bus transit on employment levels, a multiple regression model closely resembling a model developed by Thomas Sanchez (1999) was applied to a collection of variables in all census block in each city. As well, a second regression was performed to block groups in the bottom quartile of median income in each city. More specifically, the regressions tested the significance of four variables indicating mobility and job access by public transit to predict the magnitude of the dependent variable that described labor participation rates (average annual weeks worked, as reported by the 1990 Census). Controlling for vehicle ownership and demographic characteristics, I expected higher labor participation rates in block groups that indicated higher levels of accessibility by public transit. Contrary to the basic tenets of the hypothesis, although a high percentage of variance in the dependent variable was explained in the regressions, only the control variables emerged as significant predictors of labor participation rates in all four regressions. In the regressions performed on the bottom quartile of median income block groups, less of the variance of the dependent variable was explained.

Future research could further incorporate travel-time in the model of access to jobs by public transit. In my study, the network created to account for access to job by public transit, minimized the length of routes measured in miles to input values into a distance-decay formula. There is the potential to enhance the model by devising a network that accounts for actual travel times as indicated by departure and arrival times in the schedule booklets. As well, the enhanced model could assign weights at connecting bus transfer stops to impede the travel times according to the "wait time" for the arrival of the connecting bus on that route, as also illustrated in the schedule booklets. Indeed, since the Census Transportation Planning Package will soon release data from the 2000 Census about employment locations, future studies would not be restricted to representations of bus routes from 1990 in the analysis. Because the use of Geographic Information Systems is increasing, transit agencies may already possess, in GIS format, current models of transit networks that incorporate travel time, readily available for researchers.

Additionally, future research that investigates areas containing denser residential populations might provide evidence that access to public transit increases employment levels. Because population density dictates the size of the block groups, larger densities allow for greater variation in the values of the data. Expected results are more likely to appear significant in the analyses if greater proportions of the level of access to public transit are detected.

Furthermore, a model that incorporates data from survey information could possibly garner results that illustrate access to public transit as a significant factor for determining labor participation rates. Data that is less aggregated could highlight specific factors related to access that contribute to increased employment rates. As data becomes increasingly available in a wide array of formats, the opportunities for more informative research also increases.

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