Jobs–Housing Imbalance and Commuting in the Atlanta Metropolitan Area: Exploration of Causes of Longer Commuting

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Sultana, S. "Jobs–Housing Imbalance and Commuting in the Atlanta Metropolitan Area: Exploration of Causes of Longer Commuting," *Urban Geography*, Vol. 23 (8), pp. 728–749. https://doi.org/10.2747/0272-3638.23.8.728.

This is an Accepted Manuscript of an article published by Taylor & Francis in *Urban Geography* on 01 August 2002, available online: http://www.tandfonline.com/10.2747/0272-3638.23.8.728

Abstract:

Commuting is the major source of congestion and air pollution in the United States. For almost a decade, urban policy-makers have been concerned about the geographical balance between locations of jobs and housing as a strategy for reducing traffic congestion and air pollution in American cities. Despite the popularity and apparent acceptance of the job/housing (J/H) imbalance concept among public policy-makers, little empirical research has been done on the J/H imbalance and how it relates to commuting patterns. This research examines commuting patterns in the Atlanta metropolitan area to determine the extent to which commuting flow volume is the result of an imbalance between the location of home and workplace by using the most sophisticated and largest geographical scale data provided by the 1990 U.S. Census of Transportation Planning Package. This paper uses a Geographic Information System (GIS) to measure the job/housing imbalance within a commuting catchment area having a 7-mile radius from the centroid of each Transportation Analysis Zone. Analysis of variance, stepwise multiple regression and cartographic evidence all confirm the relationship between the imbalance of jobs and housing (J/H) and mean travel time to work. This investigation highlights the fact that the imbalance between the location of jobs and housing is the most important determinant for longer commuting and suggests that higher quality housing growth close to the job-rich communities may benefit the workers to economize the commuting time.

Keywords: job/housing imbalance | commuting time | GIS

Article:

This research examines commuting patterns in the Atlanta metropolitan area to determine the extent to which commuting flow volume is the result of an imbalance between the location of home and workplace by using the most sophisticated and largest geographical scale data provided by the 1990 U.S. Census of Transportation Planning Package (CTTP). The motivation

for addressing the concept of job/housing (J/H) imbalance and its relationship with mean travel time (MTT) to work is the fact that even though Atlanta is still a relatively low-density metropolitan area in population, several national reports indicate that Atlanta's traffic congestion is one of the worse, if not the worst, in the nation, and Atlantans are commuting farther than average American commuters (Monroe, 1991, 1994; Larson, 1998; Nasser and Overberg, 2001). However, none of these reports addressed the major specific reasons for these long commutes in the Atlanta metropolitan area, except for the issue of urban sprawl. Therefore, it is important to explore the basis of the long commutes in Atlanta. In this paper, I specifically argue that the J/H imbalance is the major cause of Atlanta's long commutes.

BACKGROUND AND RATIONALE

Commuting is the major source of congestion and air pollution in the United States. Cervero (1989a) proposed creating a balance between jobs and housing as a strategy for reducing traffic congestion and air pollution in American cities. Since then the J/H imbalance has been a major planning and public policy issue in environmental policy analysis. For more than a decade, researchers have been arguing that the reasons for the continued lengthening of commuting times and the marked deterioration of traffic conditions are results of the increasing J/H imbalance in many metropolitan areas across the country (Cervero, 1989a, 1996; Downs, 1992; Giuliano and Small, 1993; Clark and Kuijpers-Linde, 1994; Wang, 2000). A J/H imbalance occurs when the number of workers residing in an area differs substantially from the number of jobs there. A community is considered balanced when residential and employment distributions are approximately equal (Cervero, 1986, 1989a, 1996; Giuliano, 1991). The concept implicitly assumes that residents choose to work as close to home as possible (or that workers choose homes as close to their jobs as possible). If a given area has a much higher concentration of employment than employed residences, workers must be drawn from other areas; similarly, if employed residents greatly outnumber job opportunities, they must seek jobs in more distant areas, leading to longer commuting times. A J/H imbalance also occurs when the price or other characteristics of housing in an area are unsuitable for the workers who hold jobs there. Therefore, when the number of jobs and housing units are approximately equal, longer commutes may result if the mix of jobs and housing prices are not compatible. Thus, the more balanced the area, the shorter the commute (Frank and Pivot, 1994).

Despite the popularity and apparent acceptance of the J/H imbalance concept among public policy-makers, little empirical research has been done on the J/H imbalance and how it relates to commuting patterns. Cervero (1989a) pioneered the J/H imbalance concept to explain the reason for the continued lengthening of commuting times in metropolitan areas. Using case studies of Chicago and San Francisco, he found a J/H imbalance in suburban areas because suburbs often have restrictive land-use policies that prohibit industrial and commercial employment, resulting in longer commutes. Although he expected that the relocation of jobs to the suburbs would shorten the journey to work and improve overall traffic conditions, the evidence did not support this outcome. Instead, he argued, along with other researchers, that a primary cause of worsening traffic congestion in dispersed metropolitan areas is the growing imbalance between the locations of jobs and housing (Cervero, 1989a; Bourne, 1989; Guiliano and Small, 1993; Wachs et al., 1993; Wang, 2000). Work trips increase in length at least in part because new residential construction is concentrated in outlying suburbs far from the traditional urban core, and new

employment centers are clustered rather than dispersed in suburban areas. Some parts of metropolitan areas are job-rich and housing-poor (more jobs than housing) and vice versus. Only a few areas provide both residences and employment sites for roughly equal numbers of people. Similarly, Bourne (1989) argued, based on research in Canadian cities, that due to increasing residence-workplace separation there is a growing imbalance between labor supply and demand. Based on the National Personal Transportation Survey (NPTS), Bookout (1992) noted that in the United States there was an even worse relationship between the J/H ratio in 1990 compare to 1980, reflected in the increase in average commute from 9.2 miles to 10.6 miles. Rosetti and Eversole (1993), based on U.S. Census data, showed that mean commuting times increased in 35 of 39 metropolitan areas from 1980 to 1990. Wang's (2000) research, using 1990 CTTP data for Chicago, found that the J/H imbalance tends to correlate with longer commuting times.

When comparing residential locations to feasible employment locations, a few important analytical issues emerge. The simple ratio of total jobs to total residents is not an adequate indicator of an imbalanced neighborhood. Affordability of housing prices may be one of the most important determinants for the J/H imbalance, and thus this imbalanced condition may force the middle- and low-income workers to undertake longer commutes in order to find housing within their budgets (Cervero, 1996). In addition, the socioeconomic status and race of workers may have significant impacts on the number and types of jobs that a worker is qualified to hold. Researchers argued that low-status jobs with less educational requirements have relocated from inner cities to the suburbs (Cervero, 1989a; Kasarda, 1989, 1996; Zax and Kain, 1991, 1996; Wachs and Taylor, 1998). Affordable housing for poorly educated, low-status workers, however, is not generally available in the suburbs. As a result, J/H imbalances have resulted and reverse commuting has increased. More workers live farther from their workplace today than a decade or more ago, when the preponderance of jobs was confined to the inner city.

Other studies have questioned the J/H imbalance issue (Giulinano, 1991, 1993; Giuliano and Small, 1993; Downs, 1992; Wachs et al., 1993; Gober et al., 1993; Peng, 1997). Those studies found that the J/H imbalance has little impact on commuting times. Residential decisions are complex and may have little to do with jobs access. Rather, other factors such as school quality, road conditions, neighborhood characteristics and environmental amenities have important impacts on residential location decisions.

In the past, research on the J/H imbalance was tested based only on the J/H ratio (except for Cervero's work in 1989a). The concept of characteristics of worker and housing prices in the J/H imbalance research remain limited, bringing into question the empirical evidence of a correlation between the J/H imbalances and long commute times. There has also been considerable concern about the geographical scale of analysis. Geographic size of the area for measuring the J/H balance does matter. The larger the size of the area, the more likely the area is to be balanced (Cervero, 1996). Most previous studies have measured the J/H ratio at the macro-level based on predefined large administrative units such as cities, counties, or even entire metropolitan areas. There are substantial problems with those studies. First of all, the studies assumed that residents living and working in the same predefined subarea would have a balanced J/H ratio and have lower mean travel times (MTTs). Second, residents may work in different subareas and still having shorter commuting depending in which part of the areas they live and which part of area they work. Third, a subarea may be balanced but its residents may have longer commuting times

depending on the size of that subarea. Therefore, the use of larger area units obviously results in a more general interpretation.

At the micro-level, studies using census tracts or TAZ for analyzing the J/H ratio may have limited application to policy-oriented research. TAZs are even smaller than block groups (about 0.5-1.5 miles in width). It is inappropriate and even misleading to consider jobs and housing balanced only when the residents live and work in the same TAZ. This definition of the J/H balance deems residents working in neighboring TAZ as imbalanced, even though they may travel only a short time to their jobs.

Consequently, many previous studies suggest measuring the jobs/housing balance at the meso-level, within a reasonable commuting distance from a given employment or residential site. The definition of a "reasonable" commute range is arbitrary, however. Some suggest a 6- to 8-mile (9.7-12.9 km) driving distance as a suitable distance to a job site (Levington, 1989); others recommend a 3- to 10-mile (4.8–16.1 km) work-trip length as an appropriate distance (Deakin, 1989). Cervero (1989b) defined a 3-mile (4.8 km) radius as appropriate for a suburban employment center. Giuliano (1991) criticized the 3-mile radius because it implies a much shorter commuting range than Pisarsky's (1987) national estimate for the average suburb-to-suburb commute of 9 miles (14.5 km). Peng (1997) used a 5- to 7-mile radius of home-to-work-trip length as an appropriate measure of the J/H ratio, depending on the size of the metropolitan area.

Since the Atlanta metropolitan area is one of the fastest growing metropolitan areas in the United States, a 7-mile radius of home-to-work- trip length is assumed to be an appropriate distance to measure the J/H ratio. This paper, thus, measures the J/H ratio at meso-levels at a 7-mile buffer, an undefined jurisdiction level, for each TAZ. Here, I assume that every TAZ is a potential employment location.

Therefore, there are several ways my study differs from previous studies: (1) I redefined the J/H imbalance concept together with the J/H ratio, housing affordability of workers, and professional skill mismatches of local residents with local job opportunities; (2) a GIS technique is used to create new areal units for analysis instead of using predefined administrative units; and (3) each traffic zone is considered as a potential employment cluster by drawing a 7-mile buffer from each centroid of TAZs instead of drawing commuting catchment areas from each employment center to measure the J/H imbalance.

RESEARCH HYPOTHESES

The research hypotheses are based on two assumptions. The first assumption is that there may be a relationship between J/H imbalances and MTT. An area which is job-rich (imbalanced) will have a longer MTT compare to a balanced area for workers because such an area will draw more workers from outside that area, but employed residents will have shorter commuting times because they should be able to find jobs nearby. In a housing-rich area (imbalanced), workers employed there will have shorter MTTs because they will attract fewer workers from outside the area. However, the employed residents of these areas will have long MTTs because these residents will have access to fewer job opportunities and will be forced to seek jobs at more

distant locations. Individuals working or living in an area with proximity to ample housing and jobs (balanced) will have shorter MTTs because they will have greater opportunities to work and live nearby.

The second assumption is that there will be a negative effect on commuting times if housing affordability does not match the local housing price and if the occupational status of employed residents does not match local job opportunities. MTT will be greater if there is an imbalance between worker earnings and the cost of local housing, as well as the occupational levels of local residents and local job opportunities. In general, high-status professional workers (executive administrative, managerial and professional) will locate in higher-quality, more expensive housing, while moderate-status workers (technician, sales, administrative supportive jobs) and low-status workers (private household and other services) choose from among the remaining available housing stock. To reduce longer MTTs, housing availability, therefore, should match the earnings and the preferences of each of the occupational groups. Moreover, in the many previous studies race was found to be one of the fundamental determinants of commuting time or distance (Zax, 1990; Farley and Frey, 1994; McLafferty and Preston, 1997; Sultana, 2000; Chung et al., 2001; Johnston-Anumonwo, 2001). Thus, race of workers may independently play an important role in explaining commuting patterns in Atlanta.

I hypothesize that: (1) if an area is job-rich, the MTT will be longer for its workers compared to a balanced area, while the MTT will be shorter for the employed residents of that areas; (2) if an area is housing-rich, the MTT will be longer for its employed residents compared to a balanced area, while the MTT will be shorter for the workers of that areas; (3) the MTT will be higher for workers if the local housing price range does not match the affordability range of local workers; (4) the MTT will be higher for both workers and residents in an area if the locations of jobs for specific occupational groups do not match the location of houses suitable for members of those groups; and (5) the racial status of workers is independent of commuting time. The hypotheses are tested using Analysis of Variance and stepwise multiple regression, as well as cartographic evidence.

STUDY AREA, SOURCES OF DATA, AND DATA PROCESSING

The 13 counties of the Atlanta metropolitan region, known as one of the top-ten most congested metropolitan areas in the United States (Cervero, 1989a; Monroe, 1994; Larson, 1998; Nasser and Overberg, 2001), were selected for this study (Fig. 1), since CTPP data are not available for all 20 counties of the Census-defined Atlanta metropolitan statistical area. The Atlanta region, covering primarily the central urbanized area, contained 2.65 million people and 1.40 million jobs in 1990, an area that has also become well known for its sprawl and its suburban employment centers. The J/H ratio for the entire study area is 1, of course, indicating that the study area has a perfectly balanced in J/H ratio. The average travel times for the region is 27.27 minutes by workers and 24.39 minutes by employed residents, among the largest travel times of all U.S. metropolitan areas. Based on one-way place-of-work data (Fig. 2A), 4% of workers travel less than 20 minutes to reach their workplace, whereas 27% workers travel 20 to 25 minutes, 42% travel 25 to 30 minutes, and another 27% travel 30 to 60 minutes. Therefore, the majority of the workers (69%) travel more than 25 minutes one-way to work in the region.

From one-way place of residences data, 8% of the employed residents travel less than or equal to 20 minutes, 31% travel between 20 to 25 minutes, 43% commute 25 minutes to 30 minutes, and 18% exceed 30 minutes (Fig. 2B). Based on one-way place-of-residence data, the majority (61%) of workers travel more than 25 minutes. The Atlanta region has a significantly higher proportion of suburb-to-city and suburb-to-suburb commuting than the average American city (Mitchelson and Wheeler, 1995, p. 133). No previous research has been undertaken to determine the cause of these long commutes within the context of J/H imbalance. Therefore, to measure the extent and causes of longer commutes, Atlanta is an appropriate study area that deserves special consideration.

Figure 1. Counties of the Atlanta metropolitan statistical area (1990), with study area shaded.

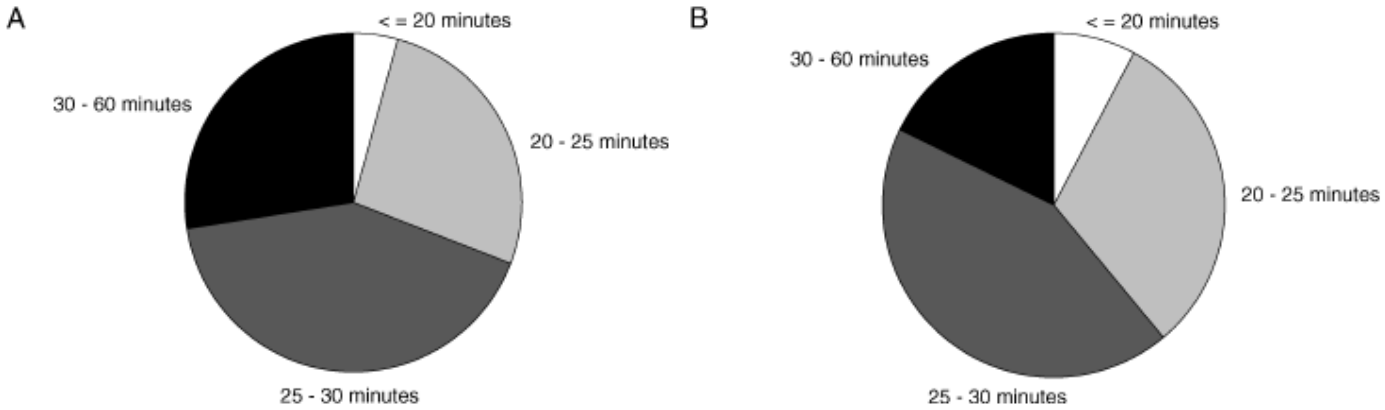

Figure 2. Percentage of workers (A) and residents (B) by mean travel time.

This study uses detailed journey-to-work data from the 1990 CTPP. The CTPP data are suitable for a micro-scale analysis and are provided at a high level of geographical resolution by Transportation Analysis Zones (TAZs), which are smaller than census tracts or block groups. For example, in 1990 there were 948 TAZs in the 13 counties of the Atlanta region compared to only

482 census tracts. CTPP data are organized in three ways by type of person surveyed. The first part of the CTPP data is by place of residence, the second part includes place-of-work data, and the third part provides trip interchange data (origin-destination data) and one-way mean travel time for each origin-destination pair (by mode). Data from the first and second parts of the CTPP databases are used in this study. The first part of the CTPP data provides employed residents' characteristics and commuting time by mode. The second part of the CTPP data provides information on workers such as location of employment and characteristics of workers. For each jurisdiction (TAZ), data are given on how many workers are employed in each jurisdiction and the average time spent commuting. The geographical coverage (Arc/Info coverage) of TAZs in this study was collected from the Atlanta Regional Commission (ARC), a 10-county planning agency. These two sources of data were aggregated for this research and a dynamic technique of buffering in geographical information systems is used to measure the J/H ratio and other socioeconomic characteristics of workers. This is accomplished by drawing a 7-mile buffer around the centroid of each TAZ and aggregating the number of jobs and housing units and as well as other socioeconomic characteristics of workers and residents within those buffered areas (Fig. 3). Data gathering and aggregation procedures are shown in Figure 4.

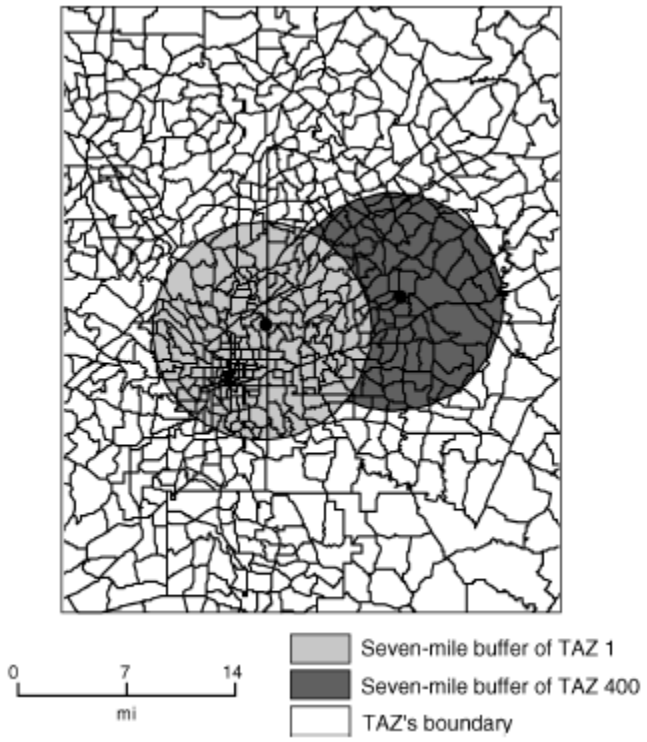

Figure 3. Example of a 7-mile buffer zone for the centroid of TAZ 1 and TAZ 400.

CRITERIA FOR IDENTIFYING J/H IMBALANCED AREAS

In order to determine whether an area has an imbalance in jobs or housing, I calculated the ratio of jobs-to-housing units (J/H ratio). A J/H ratio is the total number of jobs to total housing units (total employment/total housing units) in an area. I relied on Cervero's (1989a) approach that if the ratio for an area lies within the range of .75 to 1.50, the area is considered balanced for local employment. A J/H ratio above 1.50 suggests that there is an insufficient supply of available

housing to meet the needs of the local work force (job-rich), and a J/H ratio below .75 suggests that area has an insufficient supply of jobs for local employed residents (housing-rich).

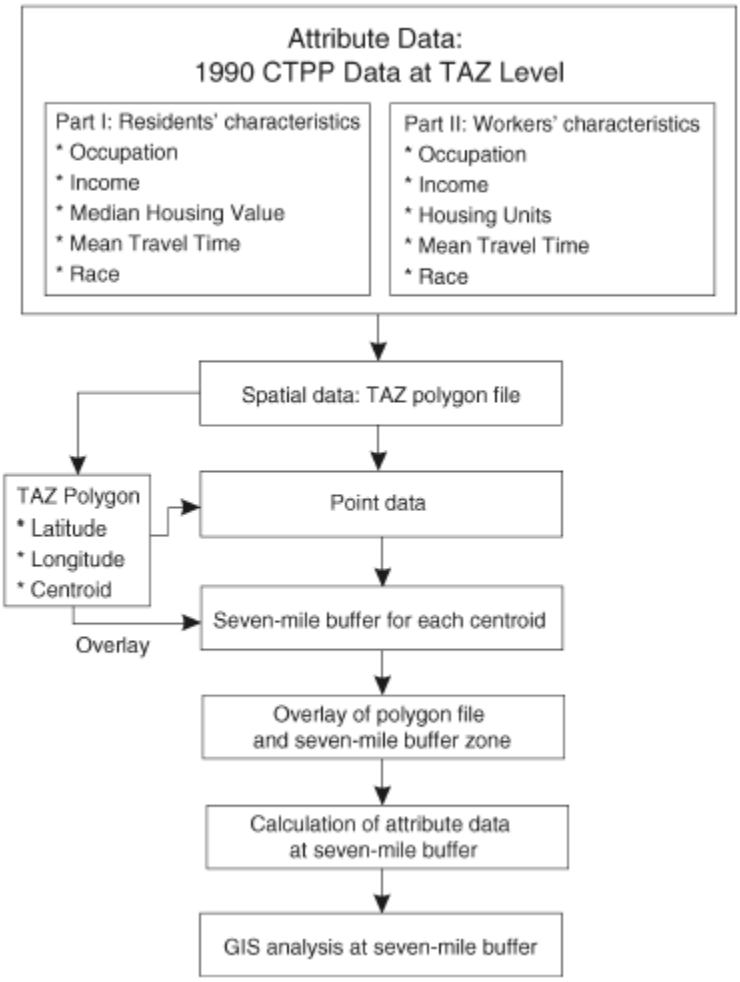

Figure 4. Data gathering and aggregation procedures.

I then examine whether or not the imbalance between characteristics of workers and prices of housing in an area is an appropriate measure to explain long commutes in the Atlanta region. First, I calculated the housing price index (HPI) as an indicator of balance. The index is the comparison of the quantity of housing units demanded at an affordable price compared to the quantity of housing units available at the same price level. The index compares prices for which households can afford (or are willing to pay) with the available supply of housing units at an affordable price. The HPI thus includes workers' income and housing price in the analysis of residential location in the job and housing markets. Ideally, household affordability and housing availability for each housing price would match for workers. An affordability factor is usually a "rule of thumb," e.g., a home purchase should not exceed 3.5 times a worker's annual income.[1] Although specific housing prices and individual incomes are needed to calculate HPI, those data are not available. Thus, median housing price and median income of workers were used.

[1] The Department of Housing and Urban Development (HUD) utilizes such rules to determine poverty level and "overpayments" for Housing.

In addition, I use occupation as proxy for a worker's income to compare housing affordability and local job opportunities. The occupational status of workers is classified into three groups: high-status professionals (executive administrative, managerial and professional), moderate-status workers (technician, sales, administrative supportive jobs), and low-status workers (private household and other services). These three groups are used to examine whether MTTs are longer if there is an imbalance between the location of jobs for specific groups and the location of houses suitable for members of those groups.

In this study, actual commuting time is used since the Census gives only mean travel time data. Measuring commuting in terms of distance may be misleading too because travel time would be much greater to a central area for the same distance in the suburbs. Besides, time spent on commuting is considered a better measure of the cost of commuting than distance (Dubin, 1991). Empirical studies suggest that time cost of travel is more important than the money cost since a worker's time is more scarce than money.

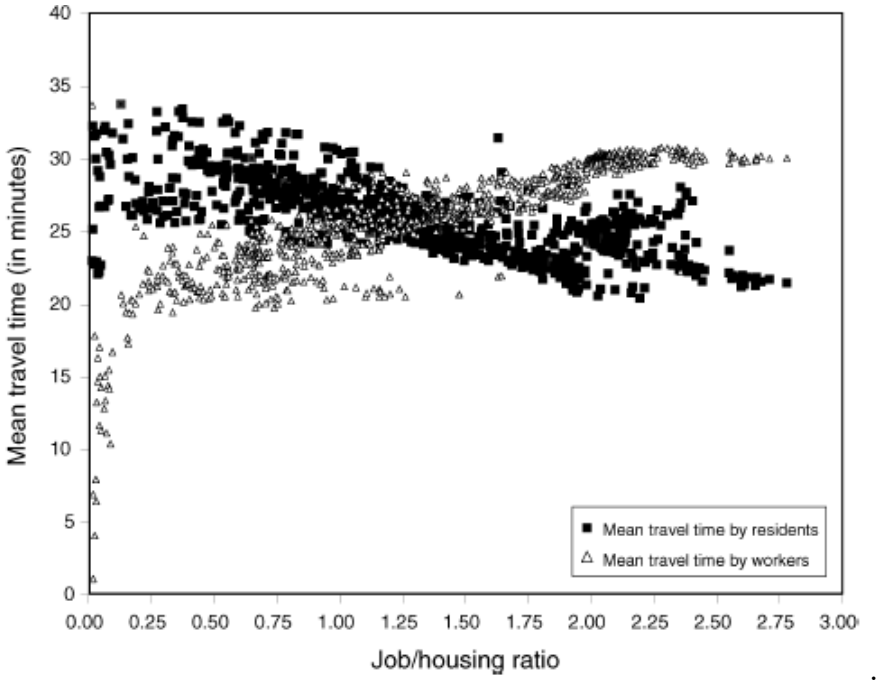

Figure 5. Job/housing ratio and mean travel time.

VISUALIZING REGIONAL VARIATION OF J/H IMBALANCE AND COMMUTING

J/H Ratio and Commuting Times:

When the J/H relationship was examine for the 7-mile buffer zones of each TAZs, it was found that the 38% (358 TAZs) of the buffers were balanced (J/H ratio is .75 to 1.50), 22% (204 TAZs) were housing-rich (J/H ratio is below .75), and 40% (386) were job-rich (J/H ratio is above 1.50). Therefore, 62% of the buffer areas are imbalanced for the J/H ratio in the 13-county of metropolitan area. Figure 5 shows the relationship between MTTs and the J/H ratio by place of residence and by place of work. The figure gives clear evidence that the MTT is related to the

J/H ratio. As the J/H ratio increases, the MTT of workers increased by place of work, but decreased by place of residence. In other words, the job-rich buffer areas had longer MTTs for workers employed there and shorter MTTs for residents living there. Housing-rich areas had longer MTT for residents, whereas the MTT was shorter for workers employed there, which is consistent with the hypotheses.

To determine if this trend can be observed for the entire Atlanta metropolitan area, I mapped the spatial variation of the J/H ratio and mean commuting times. Figures 6A, 6B, and 6C were drawn by 7-mile buffer zone for each TAZ. The figures reveal a clear pattern showing that the central part of the metropolitan Atlanta is predominantly job-rich and has higher MTTs for workers than the areas of balanced J/H ratio. Employed residents in the central part of the Atlanta metropolitan have significantly shorter MTTs (less than 25.5 minutes) to work. In contrast, suburban areas in Atlanta are predominantly residential (housing-rich) in which employed residents have longer MTTs compared to areas of balanced J/H ratios. However, it is interesting to note that the relationship between balanced J/H ratios and commuting time does not exactly coincide in all the buffers. For example, around the I-285 perimeter the buffer areas (Sandy Springs, Roswell, Norcross) are mostly balanced in the J/H ratio, even though travel times exceed 26.5 minutes. Similarly, many residents employed in balanced areas such as East Henry, East Gwinnett, and NW Cobb have long commuting time.

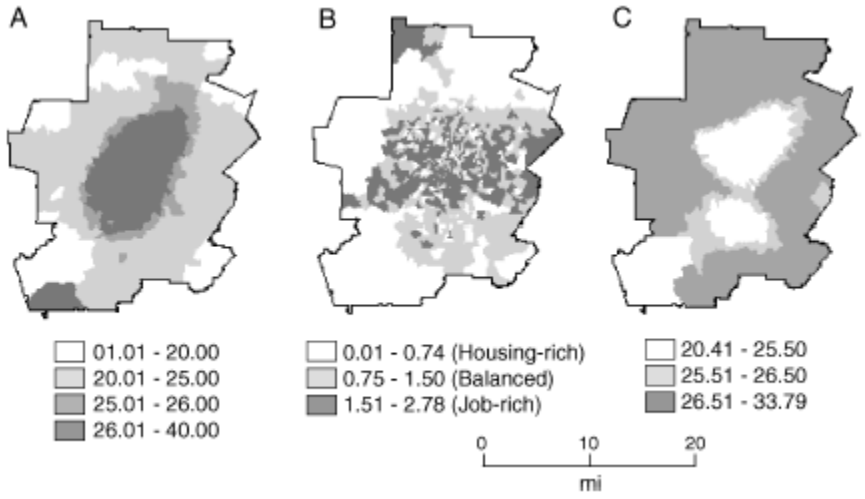

Figure 6. Mean travel time by workers (A), job/housing ratio (B), and mean travel time by residents (C) in the 13-county study area.

The pattern is consistent with the assumption that an area either with more jobs relative to housing (job-rich) or more housing relative to jobs (housing-rich) tends to have a comparatively longer MTT for their workers and employed residents, respectively, compared to a balanced area. However, these regional variations in commuting times and in J/H ratios reveal the fact that many balanced areas have longer MTTs than imbalanced areas for their workers and employed residents, raising the question as to why some of the major areas have longer MTTs for workers employed there.

Residential Location by the Type of Work and Occupational Groups

Why do certain areas with a balanced in J/H ratio have longer MTTs either for their workers or for residents compared to other balanced areas? I hypothesize that high housing prices have negative effects on the locational choices depending on a worker's income. High housing prices often displace lower-income workers, limiting their residential choices to locations outside their subregion of employment. In contrast, higher salaried workers will be attracted by high housing prices and may live near their work. First, I compared the imbalances between medium income of workers and housing prices (Fig. 7). Second, I compared the occupational status of workers (an indirect measure of income) with employed residents' occupational status using the 7-mile buffer areas (Fig. 8).

Figure 7. Housing affordability for workers in the 13-county study area, by workers.

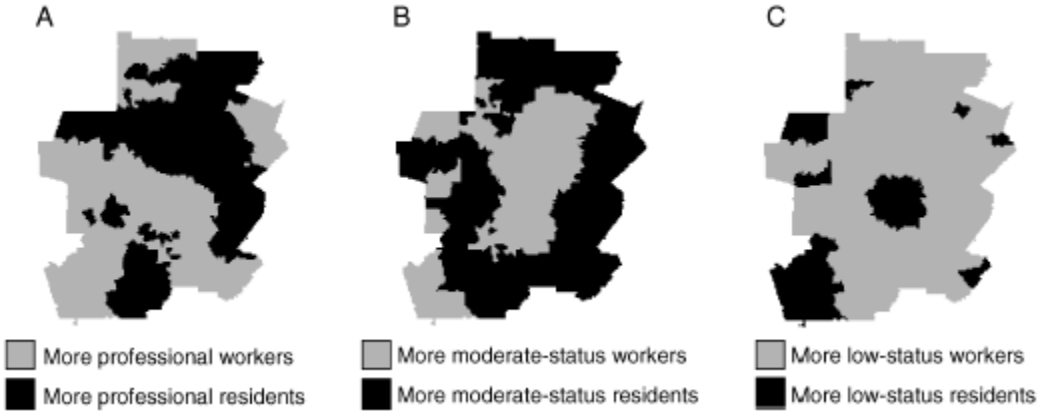

Figure 8. Differences between employed residence and workplace by occupational status in the 13-county study area: professional (A), moderate-status (B), and low-status (C).

Figure 7 depicts housing affordability, the housing price index (HPI) (median housing value/workers medium income) for 7-mile buffer areas. The higher the housing price range, the more expensive is the housing price compared to a worker's median income. The medium

housing price is lowest near the CBD and in the south central part of the City of Atlanta compared to a worker's median income. Figure 7 also shows that North Atlanta (Sandy Springs, Roswell, North Fulton, NE Cobb), East Fayette, and the part of East Henry have the highest HPI (7.01–8.52). The HPI for the rest of Atlanta varies between 3.51 and 7.00. The visual evidence suggests that, though many areas in Atlanta are balanced in the J/H ratio, commuting time is longer because of imbalances of between affordability level for workers and housing prices. For example, Sandy Springs is balanced in its J/H ratio, but has longer than average MTTs for workers. Sandy Springs has an unusually high median housing price ($242,000), while approximately 48% of the workers in Sandy Springs earn less than $25,000; 34% make between $25,000 and $50,000; and 18% earn more than $50,000. In terms of professional status, Sandy Springs has approximately 39% high-status professional workers compared to 45% high-status professionally employed residents (Fig. 8A). As a rule of thumb, because of high median housing prices, Sandy Springs is a more attractive place for high-status occupational residents (Fig. 8A), reflected by MTTs of less than 25 minutes to work for employed residents there (Fig. 6C). Indeed, a 1998 report in the *Atlanta Journal-Constitution* found that residents in Sandy Springs think of their location as something of a suburb, but close to the city; it has everything that a resident prefers—good schools, large lots, and an easy commute to work (Cauley, 1998). However, workers in moderate-ranking and low-ranking occupations cannot afford to live close by because of the extremely high housing values in these and surrounding areas (Figs. 8B and 8C). Buckhead, Roswell, NE Cobb, and Cumberland all have median housing values above the affordability level for these workers, thus forcing them to live farther from their workplaces and, therefore, they may have longer commuting times.

In contrast, SW Atlanta has a high MTTs for its workers and as well as for its residents (Fig. 6A and 6C), though it has a low median housing price ($67,000) (Fig. 7). In reality, a poorly laid out transportation network may cause residents of this area (with a balanced J/H ratio) to experience longer commuting times, although there may be other interpretations as well. Because of its relatively low housing prices, SW Atlanta is more attractive to lower-status residents (Fig. 8C), as reflected by comparing the occupational status of residents and workers. There are more high-status professional workers compared to high-status professional residents in this area (Fig. 8A). A similar pattern is found in other areas of balanced J/H ratios in the central city of Atlanta such as NW Atlanta and SE Atlanta. Housing prices are relatively inexpensive in those areas, attracting substantially more moderate-to-low-status workers to live close by (Fig. 8C). At the same time, many of the high-status and moderate-status workers are excluded from the areas because those workers cannot find suitable housing in those areas (Figs. 8A and 8B). Another example is East Henry, a portion of a southern suburban area in Atlanta. It has a balanced J/H ratio and also has median housing values of less than $100,000. Since, medium housing price is not all that high in this area, residents in more moderate-to-low-status occupations reside there and have longer than the average commuting times (Fig. 6C).

Are there other factors contributing to longer MTTs besides imbalances between occupational status, income and housing prices for workers in perfectly balanced in J/H ratio areas? To answer this question, I next look at the influence of race on commuting. A high percentage of Blacks live in the central city of Atlanta (Fig. 9A). Discrimination and exclusionary housing practices partly explain why many Blacks and low-wage earners live in the central city, even though there are far more job opportunities for low-status occupations in suburban Atlanta (Fig. 8C). As

expected, the longer commuting times for NW, SE, and SW Atlanta, though they are balanced in J/H ratios, may be associated with low-to-medium housing prices and a high percentage of Black residents (80%, 80%, and 98%, respectively). For example, in NW Atlanta only 20% of the employed Whites reside there, but 59% of the workers are White. In SE Atlanta only 20% of the employed residents are White, but 48% of the workers are White. This scenario is even more marked in SW Atlanta, where only 2% of the employed residents are White, but 57% of the workers are White. It is apparent that race contributes to longer commuting time to these workplaces. Though there is an imbalance between job location and housing affordability, racial issues have led to more Whites leaving the central city for suburban areas or moving into the suburban rather than the central city from outside the region. In contrast, minority employed residents may experience discrimination in the housing market and become entrapped in central-city locations, being forced into long reverse commutes to low-status jobs in suburban areas (Fig. 9B).

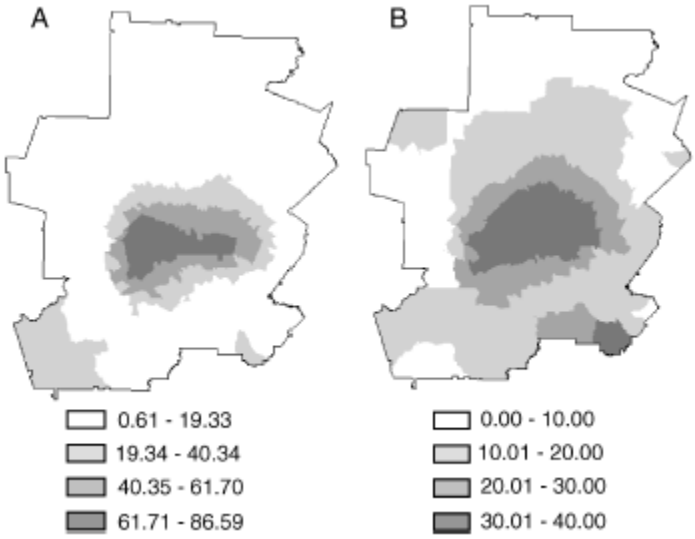

Figure 9. Percentage of Black residents (A) and percentage of Black workers (B) in the 13-county study area.

ANALYSIS OF VARIANCE: RELATIONSHIPS BETWEEN J/H IMBALANCE AND COMMUTING TIME

This section examines the statistical relationships between the J/H imbalance and characteristics of commuting times by using Analysis of Variance (ANOVA). ANOVA is used to compare the mean commuting time between balanced and unbalanced areas and to test their statistical validity. Since the main objective of this paper is to determine the extent to which commuting flow volume is the result of an imbalance between the location of home and workplaces, J/H imbalance concepts are carefully considered in selecting independent variables. The dependent and independent variables are listed and described in Table 1. Table 2 shows the commuting time of areas with a J/H imbalance compared to balanced J/H areas. All the mean comparisons are statistically significant at .05 levels. Analyses are presented for (1) characteristics of the employed residents by place of residence and (2) characteristics of workers by place of employment.

Table 1. Dependent and Independent Variable Names, Definitions, and Descriptions Identifying the J/H Imbalance and MTT Relationship

Variable name	Definition and description
MTT_PR	One-way mean commuting time by employed residents for each seven-mile buffer zone
MTT_PW	One-way mean commuting time by workers for each seven-mile buffer zone
JHR_DM1 (dummy)	More housing than jobs (housing-rich); if J/H ration is .75–1.50 = 0 and if J/H ration is <.75 = 1
JHU_DM2 (dummy)	More jobs than housing (job-rich); if J/H ration is .75–1.50 = 0 and if J/H ration is >1.50
HPI_DM1 (dummy)	Housing affordability of workers higher than median housing price (median housing price divided by workers' median incomes); if HPI = 3.5–5.5 = 0 and if HPI is <3.5 = 1
HPI_DM2 (dummy)	Housing affordability of workers lower than housing price (median housing price divided by workers' median incomes); if HPI = 3.5–5.5 = 0 and if HPI is >5.5 = 1
RK1_DM1 (dummy)	More professional-status employed residents than professional status occupations; if RK1 ratio is .90–1.10 = 0 and if RK1 ratio is <.90 = 1
RK2_DM2 (dummy)	More professional-status occupations than professional status employed residents; if RK1 ratio is .90–1.10 = 0 and if RK1 ratio is >1.10 = 1
RK2_MD1 (dummy)	More moderate-status employed residents than moderate-status occupations; if RK2 ratio is .90–1.10 and if RK2 ratio is <.90 = 1
RK2_DM2 (dummy)	More moderate-status occupations than moderate-status employed residents; if RK2 ratio is .90–1.10 = 0 and if RK2 ratio is >1.10 = 1
RK3_DM1 (dummy)	More low-status employed residents than low-status employed residents; if RK3 ratio is .90–1.10 = 0 and if RK3 ratio is <.90 = 1
RK3_DM2 (dummy)	More low-status occupations than low-status employed residents; if RK3 ratio is .90–1.10 = 0 and if RK3 ratio is >1.10 = 1
BLACK_DM1 (dummy)	More Black employed residents than Black workers; if Black workers ratio is .90–1.10 = 0 and if Black workers ratio is <.90 = 1
BLACK_DM2 (dummy)	More Black workers than Black employed residents; if Black workers ratio is .90–1.10 = 0 and if Black workers ratio is >1.10 = 1
PTM50K	Percentage of workers who earn than $50,000 per year

JHR is a measure of the J/H ratio (number of jobs/number of workers), and JHR_DM1 and JHR_DM2 are dummy variables that are used to compare the MTT between areas that have an unbalanced J/H ratio and a balanced J/H ratio. The MTT is highest for the workers who are employed in job-rich areas and lowest for workers employed in housing-rich areas. The MTT for workers employed in job-rich area is 29.05 minutes and the MTT for workers employed in housing-rich areas is 21.23 minutes. In contrast, the MTT is higher for employed residents that live in housing-rich areas (28.46 minutes) and lowest (24.04 minutes) for those employed residents who are live in job-rich areas. ANOVA (Table 2) clearly supports the argument that job-rich areas in Atlanta tend to have longer commuting times (3.78 minutes longer) than balanced J/H ratio areas for workers because these areas draw workers from outside of that area due to unavailability of adequate housing stock. Similarly, employed residents living in housing-rich areas in Atlanta have longer commuting times (2.06 minutes longer) than balanced J/H ratio areas since these residents have to go farther to find jobs. In contrast, employed residents who live in job-rich areas and workers who are working in housing-rich areas tend to have the shortest commuting times. In the first case, employed residents do not have to travel farther to find jobs, and in the second situation workers have many housing choices and reside close to their workplaces.

The variable HPI is a measure of housing affordability for workers (median housing price/workers median income), and HPI_DM1 and HPI_DM2 are dummy variables that are used to compare the mean commuting time between areas where housing affordability is balanced and areas in which housing affordability is below or above average. Though a HPI of 3.5 is indicative

of a balanced housing affordability level, I assume that many workers may be dual-earner households; therefore, HPI 3.5–5.5 is used to indicate a balanced housing affordability level. Table 2 shows that lower housing prices compared to the affordability range for workers is associated with an increase in commuting times. This findings supports the argument that if the housing price index does not match the housing affordability range, most workers will reside outside the area, thus incurring relatively longer MTTs. However, higher housing prices compared to affordability level does not seem to have a negative effect on commuting times; instead higher housing prices decrease commuting times.

Table 2. Analysis of Variance (ANOVA): Comparison of Commuting Characteristics among Variables

	Comparison	Number of TAZs	MTT_PR[a]	MTT_PW[b]
1	JHR_DM1: Housing-rich	206	28.46	21.23
	Balanced in job/housing ratio	354	26.41	25.27
	F-value		144.217*	271.374*
2	JHR_DM2: Job-rich	388	24.04	29.05
	Balanced in job/housing ratio	354	26.41	25.27
	F-value		392.061**	924.33**
3	HPI_DM1: Lower housing price range	102	25.76	27.41
	Balanced housing price range	355	26.11	26.17
	F-value		3.26*	9.23**
4	HPI_DM2: Higher housing price range	491	25.75	25.47
	Balanced housing price range	355	26.11	26.17
	F-value		3.92**	7.14**
5	RK1_DM1: More professional employed residents	634	26.85	24.14
	Balanced professional jobs and professional employed residents	49	22.74	28.18
	F-value		155.56**	69.96**
6	RK1_DM2: More professional jobs	265	24.18	29.84
	Balanced professional jobs and professional employed residents	49	22.74	28.18
	F-value		40.04**	262.52**
7	RK2_DM1: More moderate-status employed residents	400	27.91	22.64
	Balanced moderate-status jobs and moderate-status employed residents	96	25.67	26.31
	F-value		106.16**	110.71**
8	RK2_DM2: More moderate-status jobs	452	24.14	28.78
	Balanced moderate-status jobs and moderate-status employed residents	96	25.67	26.31
	F-value		93.92**	224.90**
9	RK3_DM1: More low-status employed residents	324	28.02	22.29
	Balanced low-status jobs and low-status employed residents	95	26.89	25.04
	F-value		21.87**	51.87**
10	RK3_DM2: More low-status jobs	529	24.40	28.34
	Balanced low-status jobs and low-status employed residents	95	26.89	25.04
	F-value		201.94**	255.18**
11	BLACK_DM1: More Black residents than workers	368	27.29	23.42
	Balanced Black employed residents and workers	100	26.77	25.07
	F-value		4.502*	15.87**
12	BLACK_DM2: More Black workers than residents	480	24.63	28.06
	Balanced Black employed residents and workers	100	26.77	25.07
	F-value		88.292**	127.20**

[a]One-way mean commuting time by employed residents.
[b]One-way mean commuting time by workers.
*Significant at .01 level.
**Significant at .05 level.

The traditional theory is that high occupational status workers commute longer because they can afford to live farther from their work because of a lack of suitable housing available nearby, reflected by the strong negative correlation (–.508) between job-rich area and professional employed residents. Thus income may not to be the best indicator of housing affordability for workers, as salary may not reflect the total income of workers having other sources of income.

The variables RK1_DM1, RK1_DM2, RK2_DM1, RK2_DM2, RK3_DM1, and RK3_DM2 are used as the second measure of a worker's housing affordability, comparing occupational status and local job opportunities. The ratios of jobs to employed residents by occupational status are calculated, and .90 to 1.10 is selected as representing a balanced area. Table 2 indicates that workers tend to have longer travel times in areas in which the occupation status of workers and employed residents are not balanced compared to balanced areas. These results reflect the fact that if an area has a great diversity of occupational groups but where there is a limited supply of affordable housing for these groups in surrounding areas, most workers will reside outside the area, thus incurring relatively longer MTTs. Similarly, when occupational skills of employed residents are not balanced with local job opportunities, workers are forced to travel to more distant jobs. In other words, in areas where the housing stock within the employment zone does not match the characteristics of the occupation of workers in the zone, more interzonal commuting was found to occur.

The dummy variables BLACK_DM1 and BLACK_DM2 are used to test the imbalance between the location of the Black workers' residents and their workplaces. Workers have longer commuting times in areas where there are more Black workers or more Black residents compared to areas in which Black workers and residents are not balanced (Table 2). This finding is consistent with the expectation that imbalances between the workplaces for Blacks and Black residents increase workers mean commuting times compared to a balanced area.

REGRESSION ANALYSIS: DETERMINANTS OF CAUSES OF LONGER COMMUTING

A stepwise regression model is used to determine the influence of each independent variable on the dependent variable, while controlling for the influence of other variables as well as the influence of all independent variables combined. The dependent variable is one-way mean commuting time by workers for each 7-mile buffer zone (MTT_PW). The independent variables are imbalanced J/H ratio, imbalances between housing affordability of workers and local housing prices, imbalances between employed residents' skills and local jobs opportunities, and imbalances between the location of the workplaces for Blacks and their residents. All are dichotomous variables except for the percentage of workers who make more than $50,000 per year, which is a continuous variable (Table 1). Since ANOVA results indicate that the MTTs decrease in areas in which housing prices are above the affordability level of workers, I added the PTM50K variable (percentage of workers who make more than $50,000 per year) to measure the effect of high-income on commuting time. Other variables such as housing characteristics, school quality, and environmental amenities, which influence workers' location decision are not available for this study.

The regression equation is:

$$MTT\_PW = a + b_1 (JHR\_DM1) + b_2 (JHR\_DM2) + b_3 (HPI\_DM1) + b_4 (HPI\_DM2) + b_5 (RK1\_DM1) + b_6 (RK1\_DM2) + b_7 (RK2\_DM1) + b_8 (RK2\_DM2) + b_9 (RK3\_DM1) + b_{10} (RK3\_DM2) + b_{11} (BLACK\_DM1) + b_{12} (BLACK\_DM2) + b_{13} (PTM50K)$$

The model has 948 observations. Multicolinearity was tested and the variables were eliminated if there was evidence of multicolinearity among the independent variables. Given the large sample size (948), the model is statistically significant (Table 3). The imbalances between occupational status of residents and the location of job opportunities are not entered in the model due to their strong correlation with JHR. All the variables are statistically significant at the .01 level. The results confirm our earlier observation of a positive relationship between job-rich areas (more jobs than housing) and the workers MTT, as indicated by the standardized coefficient (.612). The model predicts that the average commuting time of workers will be 3.5 minutes longer in buffer areas where the J/H ratio is above 1.5 (more jobs than housing) than that of the areas where the J/H ratio is balanced, while controlling for the other variables.

Table 3. Regression Results for Longer Commutes[a]

	By place of work	
Variable	**Unstandardized coefficient**	**Standardized coefficient**
Constant	18.385*	
JHR_DM1		
JHR_DM2	3.500*	0.612*
HPR_DM1	1.063*	0.113*
HPR_DM2		
BLACK_DM1		
BLACK_DM2	–0.481*	–0.066*
PTM50K	0.694*	0.408*

Similarly, HPI_DM1 (lower housing prices compared to a balanced housing affordability for workers) has a statistically significant relationship with mean commuting time. The model predicts that MTT is expected to be 1.06 minutes longer in buffer areas where median housing price is below the affordability level of workers compared to areas where housing prices are balanced with workers' affordability levels, controlling for other variables in the model. As expected, the model predicts that as the percentage of workers earning more than $50,000 increases by 1%, there will be a corresponding increase of .69% in MTT, while controlling for other variables. This model also predicts, in contrast to my expectation, that workplaces subtract .48 minutes in commuting times if there are more Black workers than Black residents in an area compared to an area in which the location of Black workers and Black residents are balanced, while controlling for other variables in the model.

The regression model implies that the J/H imbalance is the most influential determinant for explaining longer commuting for workers. In addition, the model also predicts that the less expensive housing in an area compared to the affordability level of workers, the more likely those employees will not be able to reside close to their workplace. They have to live farther from their workplaces to find better housing, adding to greater commuting times. The regression model indicates that high-income workers have longer MTTs. Thus, these findings partially support the argument that housing affordability is an important factor in increased MTTs. The results also show that the J/H imbalance between the residential location of Blacks and their

workplace does not add extra commuting time, which is contradiction to much past research. However, this is not a positive outcome for Black workers. Rather, I argue that in the Atlanta metropolitan area—where Blacks still are heavily concentrated in the central city and only recently a small percentage has moved to the innercity peripheral suburbs—have less opportunity to find jobs and residences in the more distant suburbs (Fig. 9), and, therefore, their presence does not add extra commuting time to the workplaces.

CONCLUSIONS

The outcome of this research supports the argument that an area with an imbalanced J/H ratio is associated with long commutes. The location of jobs and housing has a statistically significant association with MTT and is the most important influence on MTT as calculated both for employed residence of an area or by workers in an area for the Atlanta metropolitan area. These results are similar to some past studies that indicate that the J/H imbalance is the most significant factor explaining long commuting times. The job-rich areas in Atlanta tend to have average of 3.5 minutes longer commuting times than areas of balanced J/H ratios because these areas draw workers from outside of that area due to unavailability of adequate housing stock. Similarly, employed residents living in housingrich areas in Atlanta have longer commuting times than areas with balanced J/H ratios since these residents have to commute farther to find jobs. In contrast, employed residents who live in job-rich areas and workers who are employed in housing-rich areas tend to have the shortest commuting times in the Atlanta region. In the first case, employed residents do not have to travel farther to find jobs and in the second situation workers have many housing choices and may elect to reside close to their workplaces.

However, these findings do not support the hypothesis that a balanced J/H ratio will always result in reduced commuting times. Rather, they suggest that in many cases the imbalance between the cost of housing and housing affordability of workers is also an important factor in shaping the residential location choices of workers in an employment area, even though the area has a balanced J/H ratio. This research suggests that workers have less incentive to economize on commuting time when housing price is lower than the affordability levels of workers. A higher housing price decreases workers' MTTs. Thus, I argue that some workers' income may be "hidden" since these data give only a worker's median salary and do not consider other sources of income. Workers take their entire income into their consideration when they choose a residence. Therefore, when they do not find suitable housing near their workplace, they are forced to commute more minutes on average to find suitable housing in more distant areas. Notably, many job-rich communities have restrictive, high-quality housing close to employment locations and this may displace high-income workers from their workplace as reflected by the fact is that higher income workers experience greater MTTs.

The results also find that the J/H imbalance between the residential location of Blacks and their workplace do not add extra commuting time, which is contradiction to many past studies. However, this outcome may not have a positive interpretation. Atlanta is known as a racially segregated metropolis, the exodus of Whites to the suburbs, looking for better living conditions and greater distances from Black neighbors. Whites moving into Atlanta also tend to prefer suburban residential areas. Blacks are still heavily concentrated in the central city and have recently moved only to the inner city peripheral suburbs, such as western and southern DeKalb

County. As a result, racial discrimination may limit a Black's ability to freely select both their job and residential location. Therefore, Blacks workers may live and work in central areas and as well as in near-suburban areas close to their central city residences.

REFERENCES

Bourne, L. S., 1989, Are new urban forms emerging? Empirical test for Canadian urban areas. *The Canadian Geographer*, Vol. 33, 312–328.

Bookout, L., 1992, Neotraditional town planning: Cars, pedestrians, and transit. *Urban Land*, Vol. 51, 10–15.

Cauley, H. M., 1998, Annual Home Report. *The Atlanta Journal-Constitution,* August 13, p. JH5.

Cervero, R., 1986, *Job-Housing Imbalance as a Transportation Problem*. Berkeley, CA: Institute of Transportation Studies, University of California, Research Report 86-9.

Cervero, R., 1989a, Jobs housing balancing and regional mobility. *Journal of the American Planning Association,* Vol. 55, 136–150.

Cervero, R., 1989b, *America's Suburban Centers: The Land Use Transportation Link*. Boston, MA: Unwin-Hayman.

Cervero, R., 1996, Jobs-Housing balance revisited: Trends and impacts in the San Francisco bay area. *Journal of American Planning Association*, Vol. 62, 492–511.

Chung, C., Myers, Jr., S. L., and Saunders, L., 2001, Racial differences in transportation access to employment in Chicago and Los Angeles, 1980 and 1990. *American Economic Review*, Vol. 91, 174–177.

Clark, W. A. V. and Kuijpers-Linde, M., 1994, Commuting in restructuring urban regions. *Urban Studies*, Vol. 31, 465–483.

Deakin, E., 1989, Land use and transportation planning in response to congestion problems: A review and critique. *Transportation Research Record*, Vol. 1237, 77–88.

Downs, A., 1992*, Stuck In Traffic: Coping With Peak Hour Traffic Congestion*. Washington, DC: The Brookings Institution.

Dubin, R., 1991, Commuting patterns and firm decentralization. *Land Economics,* Vol. 67, 12–29.

Farley, R. and Frey, W. H., 1994, Changes in the segregation of whites from blacks during the 1980s: Small steps towards a more integrated society. *American Sociological Review*, Vol. 59, 23–45.

Frank, L. and Pivo, G., 1994, *Relationships between Land Use and Travel Behavior in the Puget Sound Region*. Seattle, WA: Washington State Transportation Center.

Giuliano, G., 1989, New directions for understanding transportation and land use. *Environment and Planning A*, Vol. 21, 145–159.

Giuliano, G., 1991, Is job housing balance a transportation issue? *Transportation Research Record*, Vol. 1305, 305–312.

Giuliano, G. and Small, K. A., 1991, Subcenters in the Los Angeles region. *Regional Science and Urban Economics*, Vol. 21, 163–182.

Giuliano, G., 1993, Is journey to work explained by urban structure? *Urban Studies*, Vol. 30, 1485–1500.

Gober, P., Kevin, E. M. and Leclerc, D., 1993, Job-rich but housing-poor: The dilemma of a western amenity town. *The Professional Geographer*, Vol. 45, 12–20.

Johnston-Anumonwo, I., 2001, Persistent racial differences in the commutes of Kansas City workers. *Journal of Black Studies,* Vol. 31, 651–670.

Kasarda, J. D., 1989, Urban industrial transition and the underclass. *Annals of the American Association of Political and Social Science*, Vol. 501, 26–47.

Kasarda, J. D., 1996, Joblessness and poverty in American's central cities: Causes and policy prescriptions. *Housing Policy Debate*, Vol. 7, 387–419.

Larson, J., 1998, Surviving commuting. *American Demographics,* July, 51.

Levington, B. L., 1989, *Using Jobs/Housing Balance Indicators for Air Pollution Controls*. Berkeley, CA: Institute of Transportation Studies, University of California.

McLafferty, S. and Preston, V., 1997, Gender, race, and the determinants of commuting: New York in 1990. *Urban Geography,* Vol. 18, 192–212.

Mitchelson, R. L. and Wheeler, J. O., 1995, Analysis of aggregate flows: The Atlanta case. In S. Hanson, editor, *The Geography of Urban Transportation*. New York, NY: Guilford.

Monroe, D., 1991, The traffic report: Atlantans commute farther and faster than average. *The Atlanta Journal-Constitution*, August 16, p. C2.

Monroe, D., 1994. Commuting Atlanta. *The Atlanta Journal-Constitution*, August 31, p. B2.

Muth, R. F., 1969, *Cities and Housing: The Spatial Pattern of Urban Residential Land Use*. Chicago, IL: University of Chicago Press.

Nasser, E. H. and Overberg, P., 2001, The cost of moving up census: Bigger homes, longer commutes, and higher mortgage. *USA Today*, August 6, p. A01.

Peng, Z. 1997. The jobs-housing balance and urban commuting. *Urban Studies*, Vol. 34, 1215–1235.

Pisarky, A., 1987*, Commuting in America.* Westport, CT: Eno Foundation for Transportation.

Punpuing, S., 1993, Correlates of commuting patterns: A case study of Bangkok, Thailand. *Urban Studies*, Vol. 30, 527–546.

Rosetti, M. and Eversol, B., 1993, *Journey to Work Trends in the United States and Its Major Metropolitan Areas, 1960–1990: Final report.* Washington DC: Federal Highway Administration.

Sultana, S., 2000, Some effects of employment centers on commuting times in the Atlanta metropolitan area, 1990. *Southeastern Geographer*, Vol. 41, 225–233.

U.S. Bureau of the Census, 1990, *Census of Transportation and Planning Package.* Washington, DC: U.S. Department of Commerce.

Wachs, M., Taylor, B. D., Levin, N., and Ong, P., 1993, The changing commute: A case study of the jobs-housing relationship over time. *Urban Studies*, Vol. 30, 1711–1729.

Wachs, M. and Taylor, B. D., 1998, Can transportation strategies help meet the welfare challenge? *Journal of the American Planning Association*, Vol. 64, 15–19.

Wang, F., 2000, Modeling commuting patterns in Chicago in a GIS environment: a job accessibility perspective. *The Professional Geographer*, Vol. 52, 120–133.

Wheeler, J. O., 1969, Some effects of occupational status on work trips. *Journal of Regional Science*, Vol. 9, 69–77.

Zax, J. S., 1990, Race and commutes. *Journal of Urban Economics,* Vol. 28, 336–348.

Zax, J. S. and Kain, J. F., 1991, Commutes, quits, and moves. *Journal of Urban Economics*, Vol. 29, 153–165.

Zax, J. S., 1996, Moving to the suburbs: Do relocating companies leave their black employees behind? *Journal of Labor Economics*, Vol. 14, 472–504.