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1801 K Street NW
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109 McLaughlin Hall
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This report was written by Professors Robert Cervero, Karen Chapple, John Landis, and Martin Wachs with Dr. Michael Duncan and Ms. Patricia Lynn Scholl, all of the University of California, Berkeley. Professor Evelyn Blumenberg of the University of California, Los Angeles, served as a consultant to this project. Research assistance was ably provided by Mr. Guangyu Li of the University of California, Berkeley.

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1. INTRODUCTION

Prior and concurrent research commissioned by the Center for Housing Policy has demonstrated the degree to which America's working families must struggle with high transportation costs as well as excessive housing payments. According to the Center for Housing Policy's 2005 Report, *Something's Gotta Give: Working Families and the Cost of Housing*:

- Working families—those that earn between the minimum wage and 120% of area median income—that spend more than 50% of their income for housing, spend another 7.5% of their income to meet their daily transportation needs, including, critically, commuting to work.
- When the cost of transportation is considered together with the cost of housing, the percentage of working families paying more than half of their total income increases from 8.3% to 44.3% of all working families.
- For many working families, the tradeoff between housing and transportation costs is not a choice. Finding housing that working families can afford means commuting long distances to work.

These are national findings. In a more recent and detailed analysis of housing and transportation costs in 28 of the nation's largest metropolitan areas, a research team from the Center for Neighborhood Technology and Virginia Tech found that:

- High transportation costs dramatically reduce housing choice. Assuming that housing and transportation costs together should comprise no more than 50% of the income of working families (defined as those earning 80% or less of area median income), only 17% of housing units could be regarded as affordable. If transportation costs were not included, the share of housing units affordable to working families would rise to 40%.
- The degree of hardship varies widely by metropolitan area. Including transportation costs, the share of the metropolitan housing stock affordable to working families varied from a low of just 1% in the Tampa–St. Petersburg metropolitan area to a high of 30% in the Washington, D.C., region.
- In 20 of the 28 metropolitan areas studied, housing affordable to working families was far more distant from job opportunities than housing affordable to median-income families. The imbalance between affordable housing and job opportunities was particularly notable in "hot" ownership markets such as New York, Boston, Atlanta, and San Francisco.

Based on cross-tabulations of the Decennial Census and the Census Bureau's Consumer Expenditure Survey, these two research efforts tell a convincing story of the difficult housing and transportation choices facing America's working families. It is a story of family budgets stretched to the breaking point by expensive housing, a lack of affordable transportation alternatives, and federal and state housing policies that never seem to connect the two.

How are America's working families coping with their meager choices? Some are economizing by living in crowded or lower-quality housing. Many are driving long distances to work. Others are spending inordinate time commuting on local buses. Most are living paycheck to paycheck and foregoing other necessities.

These responses are not particularly surprising. In a market economy, choice is mostly a matter of income. We accept that less well-off families will have fewer choices than wealthier ones. Still, having *fewer* choices is not the same thing as having *few* choices or *no* choices. Similarly, at some point, there may be nothing more to tradeoff. In many American metropolitan areas, working family households are confronted with few housing choices *and* with few transportation choices. In such circumstances, the issue is not whether choices are limited, but whether choices are *so limited* as to be a matter of public policy concern.

This is an easy question to ask, but a hard one to answer. Census data allows analysts to identify national-scale household and consumer choices (through the annual Consumer Expenditure Survey) or geographically-specific patterns of housing and commute cost (through the decennial census), but not both. Understanding where and for whom housing and transportation choices are especially limited requires using Census data in some new ways and with different techniques.

This report explores how working families in seven major metropolitan regions (Atlanta, Chicago, Dallas–Ft. Worth, Los Angeles, New York City, the San Francisco Bay Area, and Baltimore–Washington) tradeoff housing and commuting costs, and how their tradeoffs differ from those of wealthier families. It is organized into five sections. Beyond this brief introduction, the report consists of five parts. Section 2 introduces the PUMS (Public Use Microdata Sample) database, upon which this analysis is based, and presents the procedures used to identify the seven case study metropolitan regions. Section 3 presents a series of descriptive statistics comparing the housing and transportation choices confronting different types of working families in each of the seven case study metropolitan regions. Section 4 develops a series of statistical "bid-rent" models to contrast the housing and transportation tradeoffs made by working families versus upper-income families. Section 5 looks at the tradeoff issue through the lens of residential location to examine the types of neighborhoods favored by working families. Section 6 summarizes the research results and explores their implications for public policy.

2. APPROACH

This report explores how working families in seven major metropolitan areas tradeoff housing and commuting costs, and how their tradeoffs differ from those of wealthier families. It makes use of a select set of individual and household observations from the 2000 Census known as the Public Use Microdata Sample (PUMS). Using PUMS data has both advantages and disadvantages. On the advantage side, PUMS data, which come from the 2000 Census long form, are as close as we can get to real people, real households, and real working families. On the disadvantage side, PUMS data provide a great deal of detailed information on individuals and their characteristics, but intentionally blur the details of where they live to protect confidentiality. Instead of identifying neighborhood-level geographic details (e.g., census tracts), PUMS data locate responding individuals and households in collections of urban neighborhoods and suburban communities known as PUMAs, Public Use Microdata Areas. Individual PUMA boundaries are drawn so as to contain 100,000 or more persons, and although generally contiguous, do not necessarily match existing municipal boundaries.

Identifying Working Families

The first step in our analysis is to identify the characteristics that describe working families and that distinguish them from other types of households. This was done in consultation with research staffs at the Center for Housing Policy and the Center for Neighborhood Technology. *Working families* (WFs) are distinguished from other non-poor households—henceforth, referred to as *upper-income households* (UIs)—by a combination of income and earnings: they include families with (i) total earnings from wages and salaries of at least the full-time minimum wage equivalent of $10,712 ($6,650 in 1990); (ii) wages and salaries representing at least half of household income; and (iii) total household income of less than or equal to 120 percent of HUD-adjusted area median family income. All three criteria must apply for a household to be considered a working family.

The Revealed Choices of Recent Movers

Metropolitan areas are constantly changing. Neighborhoods move in and out of fashion. New sizes and forms of housing and job centers supplement and replace older ones. Residents and businesses are constantly readjusting their locations in search of greater accessibility to jobs, other businesses, shopping, a nicer home or workplace, better public services, greater status, a preferred mix of neighbors and land uses, and better housing and real estate values. Moreover, many move, not by choice, but because of circumstances beyond their control, such as eviction.

The range of housing and travel choices is constantly changing as well. Inner-city neighborhoods, which fifty years ago were victims of middle-class white-flight, are today re-attracting new types of households and new generations of families. Because change is ongoing, we cannot reliably compare the choices and constraints faced by working

family households in the 1970s, 1980s, or early 1990s to the choices being made—or precluded from being made—today. This is the problem with looking at all neighborhood residents at one moment in time. Because some moved in decades ago, while others are recent arrivals, it conflates the decisions of earlier generations of movers with those of today's movers.

Fortunately, the Census Bureau provides a pathway out of this dilemma. One of the questions on the 2000 Census long form is whether respondents lived in their current residence prior to 1995. The answers to this question enable us to distinguish a subset of PUMS respondents known as *recent movers*. The choices facing recent movers and their decisions in response to those choices provide a lens on actual household location decision-making processes.

That's the good news. The bad news is that the Census Bureau does not ask recent movers *why* they moved. This means that it is difficult to know what combination of push-pull factors shape the housing and commute choices of recent movers. Did they move in response to dissatisfaction with their old home or neighborhood? Because they liked their new home and neighborhood better? Because they changed jobs and regions? To downsize or upsize their home? To be closer to their parents or children? Because their lease was up, or they were evicted? None of these motivation drivers are listed in the PUMS data. These data gaps present significant, but not insurmountable, difficulties for researchers trying to figure out how and why households make location and transportation choices.

Characterizing Neighborhoods and Communities

When it comes to deciding where to live and how to get around, we start from the presumption that working families have fewer and less advantageous choices than upper-income households. Compared to their upper-income counterparts, working families must choose from among older and smaller homes, often in neighborhoods with lower-quality public services, especially public schools. When their preferred bundle of housing and neighborhood characteristics is not available in the homeownership market, we would presume that working families are more likely to rent. On the transportation side, we hypothesize that working families would typically have less access to private vehicles than upper-income families and would tend to live in neighborhoods that, while perhaps centrally located, are more distant and therefore less accessible via public transit to the full range of regional employment, shopping, and cultural opportunities.

Because choosing a home also entails choosing a location and a set of commute mode alternatives, understanding the set of housing and transportation options available to working families requires being able to understand their locational choices. Unfortunately, as noted earlier, PUMS data cannot be used to identify precise locations. They can, however, be used to identify different PUMA types.

PUMA types are sets of Public Use Microdata Areas with comparable housing stocks, residential densities, and regional accessibility levels. In simple terms, they are sets of contiguous urban neighborhoods and suburban communities that offer a distinct set of

housing and public service choices. Based on extensive statistical comparisons among 30 of the largest metropolitan areas, we identified five distinct and robust PUMA types: (i) primary central city neighborhoods; (ii) secondary central city neighborhoods; (iii) inner suburbs; (iv) outer suburbs; and (v) fringe suburbs. Note that this list does not include rural, exurban, or non-metropolitan PUMAs.

The PUMA identification process proceeded in two steps. We first developed a statistical model for classifying individual PUMAs according to their housing density (calculated at the census tract level), their employment density (calculated at the zip code level), their average housing stock age (calculated by PUMA), and their distance to each metropolitan area's closest designated central city. The same model was used to classify 1990 PUMAs and 2000 PUMAs. Owing to changes in PUMA geography and housing–job characteristics, PUMAs were allowed to change type between 1990 and 2000, but only upward, as from a younger and less dense PUMA type in 1990 to an older and more dense PUMA type in 2000.

Figure 1 maps these four characteristics to the different PUMA types. The set of *primary central city PUMAs* consists of PUMAs with an average (2000) residential density of 12 dwelling units per acre; an average (2000) employment density of 14 jobs per acre; an average housing stock age of 51 years; and location within the MSA's primary central city.[1] *Secondary central city PUMAs* are similar to primary central city PUMAs in that they are surrounded by suburbs, but they tend to have lower densities and younger housing stock. *Inner suburban PUMAs* have lower housing and employment densities than central city PUMAs, a somewhat younger housing stock, and are more distant from the core city. The key distinction between inner suburban PUMAs and *outer suburban PUMAs* is in the age of their housing stock and their distance from the central city; in a few cases, housing and employment densities in outer suburban PUMAs were higher than in inner suburban PUMAs. *Suburban fringe PUMAs* have much lower densities, much younger housing stock, and are far more distant from the MSA central city than are inner and outer suburban PUMAs.

Having classified PUMAs statistically, we then applied a few common sense rules to deal with any remaining anomalies. We stipulated that there should be no "leapfrog" PUMAs. For example, central city PUMAs should not be seen outside suburban PUMAs. In a few cases, we readjusted our individual PUMA classifications to insure that each PUMA type included a sufficient number of individual PUMAs. Last, we ensured that all primary central city PUMAs and secondary central city PUMAs were predominantly located within each region's respective primary central city and/or secondary central city.

[1] Because PUMA boundaries do not correspond to central city, suburb, or metropolitan area boundaries, the PUMAs designated here as "primary central city" were not all located within the MSA's central city.

Figure 1: Characteristics of Different PUMA Types

2000 PUMA Characteristics	Primary Central City PUMAs	Secondary Central City PUMAs	Inner Suburban PUMAs	Outer Suburban PUMAs	Suburban Fringe PUMAs
Average Residential Density (dwelling units per acre)	**12.1 du/acre** (range is 1.0 - 104)	**2 du/acre** (range is .1 to 5.3)	**3.5 du/acre** (range is 0 to 17.9)	**1.1 du/acre** (range is 0 to 4.3)	**.4 du/acre** (range is 0 to 2.3)
Average Employment Density (jobs per acre)	**14.4 jobs/acre** (range is .7 - 456)	**2.1 jobs/acre** (range is .4 to 5.6)	**2.8 jobs/acre** (range is .1 to 13.2)	**1.1 jobs/acre** (range is 0 to 4.7	**.3 jobs/acre** (range is 0 to 3)
Median Housing Stock age (years)	51	44	41	33	28
Average Distance from Primary Central City (miles)	4.7	3.1	10.0	17.4	34.0

Choosing the Case Study Metropolitan Areas

PUMS data are a sample of a sample. The Census respondents included in the PUMS 2000 database are a small sample of the one in six U.S. households who responded to the 2000 Census long-form survey. Large enough for robust analysis at the national level, PUMS databases are much smaller when separated into metropolitan area subsets. When subdivided further—for example, into recent movers vs. non-movers and different types of working families living in different PUMAs—the number of PUMS observations per category starts to become uncomfortably small. Based on an initial survey of the number of PUMS observations in the 95 largest U.S. metropolitan areas, we selected a set of 30 MSAs and CMSAs (Consolidated Metropolitan Statistical Areas) to represent a broad cross-section of census regions, stratified as well by travel-time delay and housing elasticity. This initial set of MSAs—which included Atlanta, Baltimore–Washington, D.C., Boston, Buffalo, Chicago, Cleveland, Dallas, Denver, Detroit, Houston, Kansas City, Las Vegas, Los Angeles–Riverside–Orange County, Miami, Minneapolis–St. Paul, New York–Northern New Jersey–Connecticut, New Orleans, Norfolk, Oklahoma City, Orlando, Philadelphia, Phoenix, Pittsburgh, Portland, Providence, Salt Lake City, San Antonio, San Diego, San Francisco–San Jose–Oakland, and Seattle—was further culled by eliminating those metropolitan areas without the requisite number of observations to support a robust analysis of how different types of working families make different housing and transportation tradeoffs, and the need to add consistent data on school quality and transportation costs from sources external to the PUMS. This left a total of seven case study metropolitan regions: Atlanta, Baltimore–Washington, D.C., Chicago, Dallas–Ft. Worth, Greater Los Angeles, New York City, and the San Francisco Bay Area.

While necessary to guarantee statistical reliability, the net effect of this successive culling process was to eliminate certain MSAs with large populations of working families that would otherwise be of great interest. These include declining or stable MSAs such as

Detroit and St. Louis, as well as slower growing MSAs like Boston, Cleveland, and Minneapolis–St. Paul with lower rates of intra-metropolitan residential mobility.

This culling process also introduces certain issues of bias. In general, the number and range of residential and transportation choices increases with metropolitan area size. Bigger places offer more choices. In focusing only on large metropolitan areas, we will therefore tend to overstate the range of housing and transportation choices available to America's working families, and therefore understate the difficulties those families face, especially in smaller and shrinking metropolitan areas.

Figure 2 summarizes the number of PUMAs classified as primary central city, secondary central city, inner suburb, outer suburb, and suburban fringe in each of the seven case study metropolitan areas. It also includes the names of examples of each PUMA type. Appendix A presents the PUMA classifications in map form for each case study MSA.

Not surprisingly, the distribution of PUMA types differs markedly across the seven case study metropolitan areas. The majority of PUMAs in the Atlanta region, for example, are outer suburban and suburban fringe PUMAs. This reflects the fact that almost all of the Atlanta region's recent population growth has occurred in its outer areas while its central cities and inner suburbs have remained more or less stagnant.

PUMAs in the Chicago region, by contrast, are evenly distributed across the different PUMA types, with Gary (Indiana), Aurora, and Joliet each functioning as secondary central cities. Most of Chicago's inner suburban PUMAs are independent municipalities, as are all of its outer suburban PUMAs. Suburban fringe growth in the Chicago region slowed in the 1970s and 1980s but then picked up again in the 1990s.

Most residents of the Dallas–Ft. Worth MSA live outside the region's two central cities. This results in a PUMA distribution that is heavily weighted toward large inner and outer suburban communities. While older than its outer suburban PUMAs, Dallas's inner suburban PUMAs are still fairly young. Its suburban fringe PUMAs mostly consist of unincorporated county lands.

Whether measured in terms of land area or population, the Greater Los Angeles urban region is the country's largest. It is also the only one of the seven case study regions in which population growth continues to occur in all five PUMA types. The region's 20 central city PUMAs include most of the City of Los Angeles as well as several surrounding older suburbs and job centers. Its four secondary central cities are all much smaller and are located at the region's urban edge. The Greater Los Angeles region's inner suburbs are an extremely diverse lot, and include large and dense municipalities such as Anaheim, Burbank, Glendale, and Santa Ana; as well as somewhat smaller, newer, and wealthier low-density communities like Costa Mesa. Home to the L.A. region's affordable family housing in the 1980s and 1990s, outer suburban communities like Montclair, Rancho Cucamonga and Canoga Park are now beyond the financial reach of most of the region's family households. To find affordable housing in the Greater Los Angeles region, more and more households have to travel eastward 90 miles or more to newer edge cities like Apple Valley, Moreno Valley, and Lancaster.

Figure 2: Atlanta, Chicago, Dallas/Ft. Worth, Los Angeles, New York, San Francisco, and Washington DC/Baltimore: PUMA Types and Examples

Metropolitan Region	Number of PUMAs and Example Neighborhoods and Communities				
	Primary Central City PUMAs	Secondary Central City PUMAs	Inner Suburban PUMAs	Outer Suburban PUMAs	Suburban Fringe PUMAs
Atlanta	**5 PUMAs** Atlanta (4), East Point		**4 PUMAs** Atlanta (4)	**16 PUMAs** Alpharetta, Decatur, Lawrenceville, Marietta, Roswell, Sandy Springs	**8 PUMAs** Cummings, Douglasville, Stockbridge, Monroe
Chicago	**16 PUMAs** Chicago (15), Oakland Park	**4 PUMAs** Aurora, Carpentersville, Gary, Joliet	**13 PUMAs** Bedford Park, E. Chicago, Highland Park, Oak Lawn Skokie, Waukeegan	**15 PUMAs** Antioch, Batavia, Hoffman Estates, Lisle, Oak Forest, Waukeegan	**14 PUMAs** Beecher, DeKalb, Kanakee, Kenosha (WI)
Dallas-Fort Worth	**4 PUMAs** Dallas (4)	**1 PUMA** Central Ft. Worth	**12 PUMAs** Arlington, Garland, Irvington, Mesquite, University Park	**17 PUMAs** Aubrey, Crowley, Plano, Richardson	**4 PUMAs** McKinney, Eastern Dallas Metro, Western Ft. Worth
Greater Los Angeles	**20 PUMAs** Los Angeles (13), Burbank, Long Beach, Hawthorne, Huntington Park	**4 PUMAs** Oxnard, Riverside, San Bernardino, Ventura	**41 PUMAs** Anaheim, Burbank, Pasadena, Pomona, Costa Mesa, Fullerton, Glendale, Norwalk, Santa Ana	**22 PUMAs** Canoga Park, Corona, Montclair, Ontario, Rancho Cucamonga, Thousand Oaks	**23 PUMAs** Apple Valley, Banning, Camarillo, Lancaster, Moreno Valley, Palmdale, Riverside Hills
New York City	**44 PUMAs** Bronx (9), Brooklyn (16), Manhattan (1), Queens (5), Jersey City	**4 PUMAs** Bridgeport (CT), New Haven (CT), Stamford (CT)	**43 PUMAs** E. Newark (NJ), Elizabeth (NJ), Flushing (NY), Fort Lee (NJ), Port Chester (NY), Yonkers (NY)	**49 PUMAs** Asbury Park (NJ), Brewster (NY), Cliffwood (NJ), Edison (NJ), Meridan (CT), Paramus (NJ), Poughkeepsie (NY)	**15 PUMAs** Andover (NJ), Bayville (NJ), Brookville (NJ), Middletown (NY)
San Francisco Bay Area	**11 PUMAs** San Francisco (7), Oakland (2), San Jose	**2 PUMAs** Santa Cruz, Santa Rosa	**15 PUMAs** Alameda, Burlingame, Milpitas, Richmond, San Jose (3), Sunnyvale	**18 PUMAs** Benicia, Fremont, Lafayette, Pittsburg, Petaluma, San Jose (3)	**10 PUMAs** Antioch, Fairfield, Livermore, Napa County
Washington, D.C & Baltimore	**10 PUMAs** Arlington, Alexandria Baltimore (4) Washington (4)		**16 PUMAs** Bethesda (MD), College Park (MD), Kensington (MD), Silver Spring (MD)	**11 PUMAs** Columbia (MD), Frederick (MD), Gaithersberg (MD), Reston (VA), Tyson's Corner (VA)	**22 PUMAs** Anapolis (MD), Baldwin (MD), Hagerstown (MD), Leesburg (VA) Stafford (VA)

The New York City metropolitan region includes more PUMAs—155 in total—than any other U.S. urban region, including 44 central city PUMAs. Every New York City PUMA is a central city PUMA, as is Jersey City. The region's four secondary central city PUMAs are all in Connecticut, a 60–90 minute train trip from Manhattan. Having developed in the first half of the 20th century, most of New York's 43 inner suburban PUMAs are conveniently accessible by commuter rail, something that is true of no other American metropolitan area. New York's 49 outer suburban PUMAs are an extremely diverse and distant lot, united only by the rate of their post-War population growth and their location along one of the region's suburban commuter rail corridors. Like Chicago, suburban growth in the New York region took a break in the 1970s and 1980s, only to pick up with renewed energy in the 1990s.

The San Francisco Bay Area is unique among U.S. metropolitan areas in that it includes three central cities, only one of which (San Jose) is extremely large in terms of area and population. Even so, because San Jose is a fairly young city and its densities are low, six of its seven PUMAs are suburban. San Francisco's seven PUMAs and Oakland's two PUMAs, by contrast, are all central city PUMAs. Most of the San Francisco Bay Area's 15 inner suburban PUMAs ring the central San Francisco Bay, while most of its 18 outer suburban PUMAs are adjacent to the more northern San Pablo Bay. Except in a very few depressed and isolated central city and older suburban neighborhoods, all of the region's affordable housing—affordable being a very relative term in coastal California—is located in one of the Bay Area's 10 suburban fringe PUMAs, where, as the saying goes, "You drive until you qualify." Of the three case study urban regions with a commuter rail system built in the 1970s—Atlanta, San Francisco, and Washington, D.C.—the San Francisco Bay Area is the only one in which newer suburban PUMAs are well served by regional transit.

The two poles of the Washington, D.C.–Baltimore urban region are linked by Interstate 95, Civil War history, the Baltimore–Washington Airport, and almost nothing else. Almost all the region's population growth over the last fifty years has occurred around Washington, D.C., and mostly along its southern rim. The Washington, D.C.–Baltimore combined urban region includes 10 central city PUMAs, 16 inner suburban PUMAs (mostly in Maryland), 11 outer suburban PUMAs (evenly distributed between Maryland and Virginia), and 22 suburban fringe PUMAs, most of which are in Virginia. Much of the Washington, D.C.–Baltimore region's recent employment growth has occurred in its outer (Virginia) suburbs such as Tyson's Corner and Reston. This also has been true for the Atlanta and Dallas regions, making Washington, D.C., a bit of a triple with those other sunbelt MSAs.

Two Complementary Modeling Approaches

Housing and transportation choices can be analyzed two ways: either as a series of continuous tradeoffs subject to an income or budget constraint, or as a series of discrete neighborhood location decisions involving housing and transportation considerations. The first approach assumes that households can choose their housing bundles and transportation options from along a continuum, and that (for a given income) the decision

to spend more on housing requires spending less on transportation. The opposite is also true: spending more on transportation would mean spending less on housing. The continuous approach is consistent with the bid-rent model that lies at the core of contemporary urban economics. It is also easier to analyze statistically.

The second discrete choice approach, which is somewhat harder to model, does not assume that housing and transportation choices can be continuously varied. Instead, when deciding where to live, households must choose from among particular bundles of housing and transportation services that may or may not be advantageous.

Neither approach is inherently superior to the other. Both yield interesting and fresh insights, and we have elected to pursue both: the continuous tradeoff approach in Section 4, and the discrete tradeoff approach in Section 5.

3. A CLOSER LOOK AT THE DIFFERENCES BETWEEN WORKING FAMILIES AND UPPER-INCOME HOUSEHOLDS

Working families are notably different from upper-income families. In addition to—or perhaps because of—their lower incomes, working families make up different types of households. They live in different neighborhoods and communities. They are far more likely to rent their dwelling units than to own them. Even when they do own their own homes, they face much higher housing cost burdens. The one area in which working families and upper-income families seem indistinguishable, at least upon first look, is in their commuting behavior. Both groups commute by car in similar proportions, and both groups take about the same time to commute to work, although they typically work in different types of jobs and in different locations.

Before exploring these differences through the use of statistical models—which hold certain attributes constant in order to focus on others—we use this chapter to separately explore differences in household type, residential location, housing outcomes, and commuting behavior between working families and upper-income households. Note that these comparisons are limited to the seven case study metropolitan areas and apply solely to *recent movers*—those households who changed their residential location between 1996 and 2000. As a group, recent mover households are far more likely than non-movers to rent, slightly more likely to commute by public transit than car and, depending on the metropolitan area, somewhat more likely to live in a central city neighborhood than in the suburbs. The other big difference between recent movers and non-movers is how much more recent movers pay for housing. This is true even in affordable housing markets. Among working families in the Atlanta metropolitan area, for example, the median monthly housing cost (as of 2000) for recent mover homeowners was $2,066, versus just $1,318 for non-movers. Among Atlanta working family renters, the median rent for recent movers was $765 per month; for non-movers, it was only $664 per month. Similar differences between recent mover and non-mover housing costs are evident in the six other case study metropolitan areas.

In most other respects—where they choose to live, how they organize themselves into households, how much income they earn, and how far they commute—recent movers are virtually identical to non-movers. Appendix B compares the characteristics of recent movers and non-movers for each of the seven case study metropolitan areas.

Differences in Household Type

How do working families differ from upper-income ones? We first consider differences in household type (see Figure 3). Regardless of metropolitan area, working families (WF) are far more likely to include children than are upper-income (UI) households. In all seven case study regions, the largest WF household category by far was *married-couples with children*. Depending on the region, this group typically comprised 40% to 49% of WF households. The largest UI household group, by contrast, was *single-person*

households; depending on the region, they typically accounted for between 33% and 39% of UI households.

Children were the dividing line between WF and UI households in all seven of the case study metropolitan areas shown in Figure 3. If children were present, a household was two to four times more likely to be a WF household; if they were absent, the same household was three to five times more likely to be a UI household.

The New York region was typical in this respect. *Married-couples with children* comprised 46.5% of WF households in the New York region in 2000, but only 20.9% of UI households. *Single-parent households* in the New York Region accounted for 14.1% of WF households but only 3.1% of UI households. Among New York's *multiple-family households with children* household category, at 9.3% to 1.3%, the split between WF and UI households was even more extreme.

Among *households without children*, the split ran the other way, dramatically favoring UI households over WF households. Of the six household types profiled in Figure 3, the only one in which the presence of children did not form a hard dividing line between WF and UI households was *multiple-family households without children.*

Figure 3: Atlanta, Chicago, Dallas/Ft. Worth, Los Angeles, New York, San Francisco, and Washington, D.C./Baltimore: Working Family Household Types, 2000

Metropolitan Region	% Married-couples with children	% Married-couples without children	% Single-parent Family	% Single-person HHs	% Multiple families with children	% Multiple families without children	Total - All HHs
Atlanta							
Working Families	44.1%	8.9%	15.0%	10.2%	8.8%	13.0%	100%
Upper-Income Families	18.8%	28.3%	2.8%	34.8%	1.0%	14.2%	100%
Chicago							
Working Families	47.5%	8.6%	14.6%	10.2%	8.5%	10.6%	100%
Upper-Income Families	17.9%	26.2%	3.0%	38.6%	1.0%	13.2%	100%
Dallas/Ft. Worth							
Working Families	46.5%	9.5%	14.5%	10.7%	8.0%	10.9%	100%
Upper-Income Families	20.6%	27.9%	3.0%	36.8%	1.1%	10.5%	100%
Greater Los Angeles							
Working Families	48.9%	6.6%	14.4%	6.4%	13.5%	10.2%	100%
Upper-Income Families	21.1%	23.2%	4.8%	32.6%	2.4%	15.8%	100%
New York City							
Working Families	46.5%	9.1%	14.1%	9.7%	9.3%	11.3%	100%
Upper-Income Families	20.9%	25.4%	3.1%	35.1%	1.3%	14.2%	100%
San Francisco Bay Area							
Working Families	42.0%	9.8%	11.6%	10.5%	9.9%	16.2%	100%
Upper-Income Families	17.5%	26.0%	2.5%	33.3%	1.9%	18.8%	100%
Washington, D.C./Baltimore							
Working Families	40.9%	9.3%	15.3%	12.5%	8.9%	13.1%	100%
Upper-Income Families	16.4%	27.6%	2.8%	37.4%	1.4%	14.4%	100%

Source: 2000 PUMS data. Estimates are for recent movers only.

Differences in Residential Location

Differences in residential location between WF households and UI households are not as large as differences in household type. Indeed, they tend to be quite small. Depending on the region, suburban PUMAs were favored by 50%–65% of WF households, and by similar shares of UI households (see Figure 4).

Where residential location preference differed, it was more likely to be a matter of region than class. Regardless of whether they were members of WF or UI households, residents of New York City and Washington, D.C.–Baltimore were more likely to live in downtown PUMAs while residents of Dallas–Ft. Worth and Atlanta were less likely to live downtown. Chicago residents avoided inner suburban PUMAs while residents of Dallas and Washington, D.C.–Baltimore favored them. Compared to the other four metropolitan regions, fringe suburban PUMAs were most popular among residents of Chicago, New York City and Greater Los Angeles regions.

This is not to say that the residential location choices of working families exactly mirrored those of upper-income families. Among the places where they most differed:

- In Atlanta, WF households were more likely to live in outer suburban PUMAs than were UI households.
- In Chicago, WF households were far less likely to live in central city PUMAs and much more likely to live in inner suburban PUMAs than UI households.
- In Dallas–Ft. Worth, UI households were more likely than WF households to live in outer suburban PUMAs.
- In the Greater Los Angeles region, WF households were notably more likely than UI households to live in downtown PUMAs and less likely to live in outer suburban PUMAs.
- In New York City, WF households were far more likely to live in older, suburban communities than UI households and less likely to live in the outer ring.
- In Washington, D.C.–Baltimore, WF households were somewhat less likely to live in central city PUMAs than UI households, and somewhat more likely to live in fringe suburban PUMAs.

Housing Tenure, Costs, and Burdens

The housing cost, housing burden, and homeownership rate estimates reported in this section apply solely to recent movers, and not to non-movers. They thus provide a more accurate picture of contemporary housing choices and outcomes. Housing costs are for 2000, while income estimates are for 1999. Housing costs are reported on a monthly basis while incomes are reported annually. For homeowners, monthly housing costs include principal and interest payments, property taxes and insurance, and utilities. For renters, monthly housing costs (gross rents) include contract rent and utilities.

Working families are far less likely to own their homes than upper-income households (Figure 5). Among the seven case study metropolitan areas, homeownership rates averaged 16% lower for WF households than for UI households. Working family homeownership rates as of 2000 were highest in Atlanta (at 46.8%), and lowest in the Greater Los Angeles region (32.7%).

Measured in absolute terms, WF households paid considerably less for housing in 2000 than did UI households. This was true for both owners and renters. Among metropolitan regions, the typical monthly housing cost differential between WF and UI homeowners ranged from just $200 in Chicago (with WF homeowners paying $1,640 per month and UI homeowners paying $1,840 per month) to $592 in the San Francisco Bay Area. Among renters, the housing cost differential between WF and UI households ranged from $97 per month in Atlanta to $278 in Washington, D.C.–Baltimore.

Figure 4: Atlanta, Chicago, Dallas/Ft. Worth, Los Angeles, New York, San Francisco, and Washington, D.C./Baltimore: Where Working Families Reside, 2000, by PUMA Type

Metropolitan Region	% living in Central City PUMAs	% living in Secondary Central City PUMAs	% living in Inner Suburban PUMAs	% living in Outer Suburban PUMAs	% living in Suburban Fringe PUMAs	Total - All HHs
Atlanta						
Working Families	16.9%	na	29.5%	35.7%	17.9%	100%
Upper-Income Families	20.5%	na	28.7%	30.3%	20.5%	100%
Chicago						
Working Families	18.7%	5.6%	19.9%	27.7%	28.0%	100%
Upper-Income Families	26.3%	3.2%	12.2%	28.8%	29.5%	100%
Dallas/Ft. Worth						
Working Families	9.7%	2.0%	49.4%	30.6%	8.3%	100%
Upper-Income Families	10.2%	0.6%	46.7%	36.4%	6.1%	100%
Greater Los Angeles						
Working Families	23.8%	4.1%	22.8%	28.6%	20.7%	100%
Upper-Income Families	19.5%	2.6%	23.2%	32.5%	22.2%	100%
New York City						
Working Families	24.3%	3.3%	28.1%	22.4%	21.9%	100%
Upper-Income Families	27.5%	2.1%	17.1%	30.0%	23.3%	100%
San Francisco Bay Area						
Working Families	19.0%	5.6%	25.7%	32.8%	16.9%	100%
Upper-Income Families	21.2%	3.3%	29.5%	31.7%	14.3%	100%
Washington, D.C./Baltimore						
Working Families	20.9%	na	33.2%	33.5%	12.4%	100%
Upper-Income Families	25.4%	na	30.6%	35.0%	9.0%	100%

Source: 2000 PUMS data. Estimates are for recent movers only.

Figure 5: Atlanta, Chicago, Dallas/Ft. Worth, Los Angeles, New York, San Francisco, and Washington, D.C./Baltimore: Housing Tenure, Burdens, and Costs, 2000

Metropolitan Region	by Housing Tenure		Housing Costs and Burdens					
	% Owner-occupants	% renters	Owners: Average monthly housing cost	Renters: Average monthly rent	Owners: Average household income	Renters: Average household income	Owners: Average housing cost burden	Renters: Average housing cost burden
Atlanta								
Working Families	46.8%	53.2%	$1,472	$753	$55,500	$34,400	0.36	0.30
Upper-Income Families	65.4%	34.6%	$1,793	$850	$97,500	$61,000	0.25	0.18
Chicago								
Working Families	46.2%	53.8%	$1,640	$680	$60,000	$33,000	0.36	0.29
Upper-Income Families	60.6%	39.4%	$1,840	$830	$97,500	$62,000	0.25	0.18
Dallas/Ft. Worth								
Working Families	38.7%	61.3%	$1,650	$640	$52,000	$30,500	0.41	0.29
Upper-Income Families	54.3%	45.7%	$2,217	$750	$100,000	$56,000	0.29	0.18
Greater Los Angeles								
Working Families	32.7%	67.3%	$1,778	$733	$55,000	$31,600	0.42	0.33
Upper-Income Families	50.6%	45.4%	$2,267	$917	$103,500	$63,000	0.29	0.19
New York City								
Working Families	35.8%	64.2%	$2,073	$792	$65,500	$35,800	0.41	0.31
Upper-Income Families	51.3%	48.7%	$2,322	$982	$120,000	$75,000	0.25	0.18
San Francisco Bay Area								
Working Families	35.3%	64.7%	$2,218	$983	$72,000	$44,000	0.40	0.32
Upper-Income Families	50.7%	49.3%	$2,810	$1,261	$135,000	$89,200	0.28	0.18
Washington, D.C./Baltimore								
Working Families	44.7%	55.3%	$1,627	$758	$62,000	$35,900	0.35	0.28
Upper-Income Families	59.9%	40.1%	$1,970	$910	$107,000	$70,400	0.24	0.17

Source: 2000 PUMS data. Estimates are for recent movers only.
Note: Housing costs include utilities

Differences in housing costs between WF households and UI households pale before differences in household income. At the high end, in the San Francisco Bay Area, the average UI homeowner earned an income of $135,000 in 1999, versus $72,000 for the average WF homeowner—a difference of $63,000. Even in lower-cost Atlanta, where the average UI homeowner earned $97,500 in 1999, the income differential between WF and UI households was a fairly stiff $42,000.

Because renters typically earn less than homeowners, the income differentials between WF and UI renters were somewhat smaller. They ranged from $26,100 in Dallas to $45,200 in the San Francisco Bay Area.

Bringing together income and housing costs into a single measure, housing cost burden, reveals the true differences between WF and UI households. Among homeowners, WF households typically paid between 35% and 42% of their incomes toward mortgage payments, property taxes, and utilities. UI homeowners, by contrast, devoted just 24%–29% of their incomes toward housing costs. Among the case study metropolitan areas, the burden differential between WF and UI homeowners was relatively constant, but largest in New York City (+16%). This combination of very high housing cost burdens and a large WF–UI housing cost burden differential is indicative of housing markets that provide ready choices to upper-income homebuyers but is devoid of choice to working families seeking to become homeowners.

Among renters, WF households typically devoted 29%–33% of their monthly income toward housing costs. For UI households, rent burdens were a much lower 17%–19% of household income. Unlike the homeownership case, the gap between WF and UI rent burdens hardly varied across the different case study MSAs.

In sum, whereas upper-income households pay a lot for housing and get a lot relative to their incomes, working family households pay a lot but get somewhat less. This is true regardless of metropolitan area.

Commute Modes and Times

Americans rely heavily on cars. This is as true for working families as it is for upper-income families. Even in the case of daily commuting—which is the type of trip best served by public transit—an overwhelming majority of WF and UI households take their cars (see Figure 6). Among working families in the seven case study metropolitan areas, the drive-alone use of the private car comprises between 64% and 95% of commuting trips. Similar percentages apply for upper-income households. The New York City region, with its extensive subway and commuter rail service is at the bottom of this spread, while Dallas–Ft. Worth is at the top.

In Chicago, WF commuters are slightly more likely to drive to work than UI commuters. The opposite is true in the Greater Los Angeles region, where WF commuters are slightly less likely to drive. Elsewhere, the WF and UI commuters drive in almost exactly the same percentages.

The picture is slightly different for public transit commuters. In Atlanta, Dallas–Ft. Worth, and the Greater Los Angeles region, WF commuters are far more likely to take public transit to work than are UI commuters. (Both groups, however, are 15–40 times more likely to drive.) In Chicago and New York City, on the other hand, WF commuters are slightly less likely to take public transit than UI commuters. This is more a function of the types of communities served by commuter rail than of any underlying preference.

Regardless of the metropolitan area, WF commuters are more likely to walk or bicycle to work than are UI commuters, although as in the case of public transit, the overall mode share of walking and bicycling is far less than that of driving. Among WF households, walking and bicycling is most popular in the New York City and San Francisco Bay Area regions and least popular in Atlanta and Dallas–Ft. Worth.

Although they tend to work in somewhat different locations—UI breadwinners are more likely to work in downtown and suburban office buildings while their WF counterparts are more likely to work throughout the metropolitan area—both groups take about the same time to drive to work. In six of the seven case study MSAs, *driver* commuting times for WF and UI commuters average 28–31 minutes. Average commute times in Dallas–Ft. Worth are lower at 26 minutes.

Commuting by transit typically takes much longer, on the order of 15–20 minutes longer, depending on the region. In the New York City region, for example, the typical transit rider takes 48–50 minutes to get to work; the average driver takes only 29–31 minutes. Working family transit riders in Atlanta, Chicago, and Dallas–Ft. Worth take somewhat longer on average to get to work than their UI counterparts. In the Greater Los Angeles region, by contrast, WF transit users get to work an average of five minutes faster than their UI counterparts.

Except in Atlanta, pedestrian and bicycle commuters get to work much faster than their driver counterparts and much, much faster than transit commuters. Among pedestrian and bicycle commuters, the travel time differential between WF and UI travelers is small, and tends to slightly favor WF commuters.

In sum, the key differences in commute patterns are between drivers, transit users, and pedestrians, and not between working families and upper-income households. Both economic groups tend to favor driving over transit or walking in the same proportions—although these proportions differ slightly among metropolitan regions—and both groups take about the same time to travel to work.

Figure 6: Atlanta, Chicago, Dallas/Ft. Worth, Los Angeles, New York, San Francisco, and Washington, D.C./Baltimore: Commute Modes and Times, 2000

Metropolitan Region	Commute Modes and Times						
	% Commuting trips by car (drive-alone)	% Commuting trips by public transit	% Commuting trips by walking or bicycling	% Commuting trips by other modes	Average commuting time by car (minutes)	Average commuting time by public transit	Average commuting time by walking or bicycling
Atlanta							
Working Families	92.0%	5.2%	2.5%	0.3%	30	47	23
Upper-Income Families	93.0%	2.1%	1.4%	3.5%	29	42	36
Chicago							
Working Families	82.0%	13.0%	4.7%	0.3%	29	48	18
Upper-Income Families	76.0%	17.0%	4.0%	3.0%	30	45	20
Dallas/Ft. Worth							
Working Families	94.5%	2.5%	3.1%	0.0%	26	46	18
Upper-Income Families	95.0%	1.0%	1.5%	2.5%	26	44	30
Greater Los Angeles							
Working Families	87.0%	7.1%	5.0%	0.9%	28	46	19
Upper-Income Families	92.0%	1.9%	2.3%	3.8%	28	51	20
New York City							
Working Families	64.0%	28.0%	7.3%	0.7%	29	50	17
Upper-Income Families	61.0%	30.0%	6.2%	2.8%	31	48	17
San Francisco Bay Area							
Working Families	82.0%	10.0%	6.3%	1.7%	28	45	18
Upper-Income Families	81.0%	11.0%	4.4%	3.6%	29	44	21
Washington, D.C./Baltimore							
Working Families	83.0%	12.0%	4.6%	0.4%	30	45	19
Upper-Income Families	82.0%	11.0%	3.7%	3.3%	31	44	20

4. How Working Families Tradeoff Housing And Transportation Costs

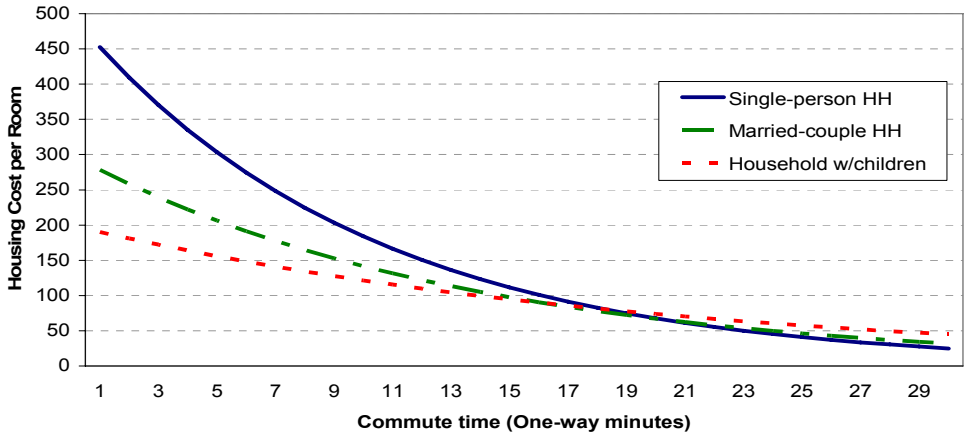
Approach

In this section, we explore how working family households continuously tradeoff housing and transportation costs.

For the past fifty years, William Alonso's theory of "bid rents," adapted from earlier theories of agricultural land prices, has framed our understanding of how the tradeoff between housing and transportation costs shapes metropolitan spatial structure. At its simplest, bid-rent theory holds that housing and commuting are bundled "goods," with households who face a fixed budget continuously trading off one for the other according to their incomes, demographic characteristics, and lifestyle preferences. Some households opt to live far out on the metropolitan fringes preferring bigger homes and lower housing costs, but at the expense of higher commuting costs and times. Stereotypically, these include young families with modest incomes and children. Other households choose to live closer to urban centers and, correspondingly, more job opportunities. The shorter commutes they enjoy also come at a price: higher housing costs per square foot of living space.

Figure 7 presents a series of archetypal bid-rent curves. Following long-standing conventions, transportation costs are measured in time as well as dollar terms. Different types of households will have different specific bid-rent curves, depending on their size, income and preferences, but all bid-rent curves have the same general shape, indicating that the trade-off between housing and transportation costs is a non-linear one.

Figure 7: Archetypal Bid-Rent Curves for Different Household Types



Initially put forth as a proposition, Alonso's "bid-rent" trade-off theory can be investigated empirically using PUMS data. Rather than lump all PUMS observations together, we identified separate bid-rent curves for different household types depending on their: (1) family type; (2) household income; (3) housing ownership status; and (4) recent mover status (whether or not they moved between 1995 and 2000. The tested models each took the following form:

Eq.[1] log (Housing Cost per Room) = *f* [log of (Commute Time of all workers by all modes, Family Type, Income Thirds, Age of household head, Education by household head, Homeowner status, Recent mover status, Neighborhood population density, Metropolitan Area fixed effect, Interactive terms)]

Expressing this equation in log-log form serves two purposes. First, it captures the already-noted tendency for bid-rent curves to follow a non-linear form. Second, it allows us to interpret the coefficient estimates as elasticities, through which we can observe the percentage change in the value of the dependent variable (housing cost) for a one percent change in the value of one or more independent variables—in this case, commute time—holding the other independent variables constant. Elasticities are a good, efficient way to summarize the results of tradeoff models. Specifically, the sensitivity of housing costs to changes in each of the independent variables can easily be compared in elasticity form (since log-log expressions standardize influences).

Housing Cost, the dependent variable, is expressed on a per-room basis to account for differences in dwelling size. Commute time was expressed as minutes per worker. While a full expression of generalized commuting costs (time as well as monetary expenditures for car usage, parking, bus fares, etc.) would have been preferred, the absence of all but commuting time data from PUMS precluded this. With the imputed value of commute times set at around one-half the prevailing hourly wage rate of large metropolitan areas, commute times are by far the largest component of any generalized cost expression.

Family type, household income, age and educational attainment of the head of household, and homeownership and recent mover status are each included as separate independent variables in order to investigate different combinations of household characteristics. Household income was represented through a three-category series of income thirds, with *working families indicated by the lowest income third*.[2] Neighborhood population density was also included to reflect the fact that different metropolitan locations come with different amenity and public service characteristics that, for the most part, vary with neighborhood age and density.

[2] Thirds break the sample of interest, sorted low-to-high, into three groups of equal size. When used to categorize income, thirds are less common than quartiles (4 groups) or quintiles (5 groups); however, in the current case, the use of single quartiles and quintiles would tend to undercount the number of working families.

Rather than test separate models for each of the case study metropolitan areas, a single model was tested with metropolitan fixed effect dummy variables included to account for inter-MSA differences. This was done for the sake of simplicity, as well as to maximize the number of observations per household type, income third, housing tenure, and mover status.

Of particular importance in estimating and mapping bid-rent curves were the set of interactive terms. These make it possible to capture the influences of changing commuting times on housing costs for each of the household types and income groups studied. Nine interactive terms were included in the model:

- Lowest Income Third * log (Commute Time)
- Middle Income Third * log (Commute Time)
- Single Parent Family * log (Commute Time)
- Married/Domestic Partners, with Children * log (Commute Time)
- Married/Domestic Partners, with no Children * log (Commute Time)
- Multiple Families, with Children * log (Commute Time)
- Multiple Families, with no Children * log (Commute Time)
- Homeowner * log (Commute Time)
- Non-mover * log (Commute Time)

The household type and income third variables were codes as 0/1 "dummy" variables. A value of 1 indicates that the surveyed PUMS household takes on a particular characteristic; a value of 0 indicates that they do not. Four interaction variables were purposely not included in the model in order to serve as the statistical referents. The excluded interaction variables combine commute time with, alternately, households in the highest income third, single-person households with no children, renters (non-homeowners), and recent movers.

The use of a bid-rent framework to analyze housing and transportation tradeoffs introduces a number of complications, one which is easy to deal with, and one which is not. The easy-to-deal-with complication concerns the spatial distribution of jobs. Alonso's bid-rent model was originally developed with reference to the *monocentric city* wherein jobs are concentrated downtown. Of course, the post-World War II era of job decentralization has given rise to *polycentric* and *edgeless* city forms. This posed little problem in our analyses since commute times were recorded by individual PUMS worker-respondents with reference to residences and job sites, regardless of location. Because the bid-rent curves estimated for this analysis are based on commute times independent of workplace location, they are hereafter referred to as *non-centric bid-rent curves*.

The second complication is more problematic. While we have chosen to explore housing costs as a function of commute times (e.g., housing cost is the dependent variable in Equation [1] and commute time is an independent variable), in fact, the two costs are more likely co-dependent, or what economists call "endogenous." Whereas demographic and lifecycle preferences regarding commute times might sway residential location choice, the opposite could also be true: housing and location preferences may affect the

willingness of households to tolerate different commute times. Under such conditions where housing costs and commute times have a two-way causal relationship, the use of standard model estimation approaches such as ordinary least squares can produce biased results. One way to cope with this problem is to create an instrument variable for the co-dependent predictor, which in our case was the "Commute Time" variable. Along with other non-endogenous variables in the equation, school test scores by PUMA were used in constructing the instrument. Besides being a variable outside of the equation, it was included as an instrument under the logic that some households (notably, those with children) would willingly accept longer commute times in return for living in areas with good schools.

Results

Equation [1] was estimated using ordinary least squares regression. As noted above, all seven case study metropolitan areas, all household types, and all household income thirds were combined to ensure that the results would be statistically robust, even in cases of very small sub-samples. Detailed model results and goodness-of-fit statistics are presented in Appendix C.

The estimated model parameters were then used along with a range of possible commute times (varying from 18 to 40 minutes) to simulate specific housing and transportation tradeoff curves (i.e., bid-rent curves) for each major household type, income level, tenure form, and mover group. Other independent variables were represented at their mean or modal values as appropriate.

Family Types**:** Figure 8 shows the constructed bid-rent curves for the three family types with children. Of the three family types in which children are present, *married-couple/domestic partner households with children* (married-with-children, for short) are most sensitive to changes in commute time, as revealed by the relatively steep slope. Married-with-children households living near work sites and averaging a relative short commute (18–20 minutes, one-way) pay a relatively high premium of $500 to $570 per room per month. Given that the mean commute time of surveyed households from the seven metropolitan areas was around 29 minutes, for these households, obtaining short commutes comes at a relatively high price for housing.

Compared to married-with-children households, the bid-rent curve for *multiple-family households with children* (multiple-with-children, for short) is flatter; and for *single-parent households*, it is flatter still. For longer distance commutes, these non-traditional families average higher housing cost outlays per room than the traditional nuclear family, an indication that they face more constraints and have fewer choices.

Figure 9 presents the bid-rent curves for the three family types without children. Compared to the households with children, all of these family types have relatively flat bid rent curves. For *single-person households*, the bid rent curve is essentially horizontal, suggesting factors other than proximity to workplace weigh in on residential choice for this group. *Married couples or domestic partners without children* appear to tradeoff housing outlays and commuting costs the most among these three categories. This may

be a legacy effect of having had children in the past, in anticipation of having children in the future, or just simply in recognition of the fact that home values tend to rise fastest in neighborhoods with good schools.

Figure 8: Estimated Non-centric Bid-Rent Curves for Households with Children

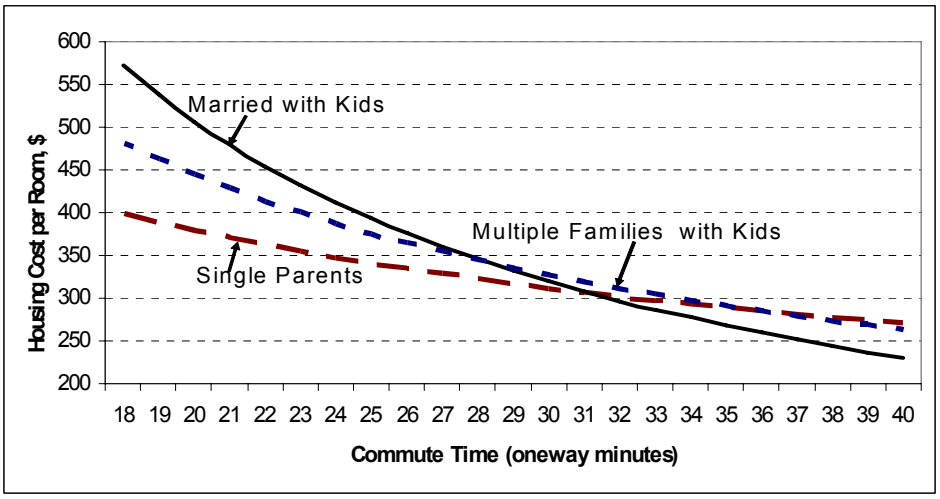
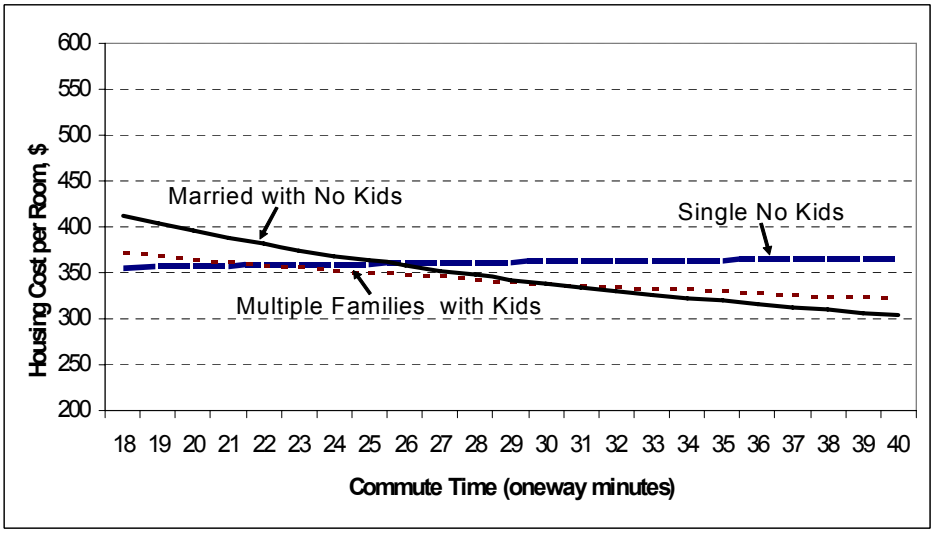
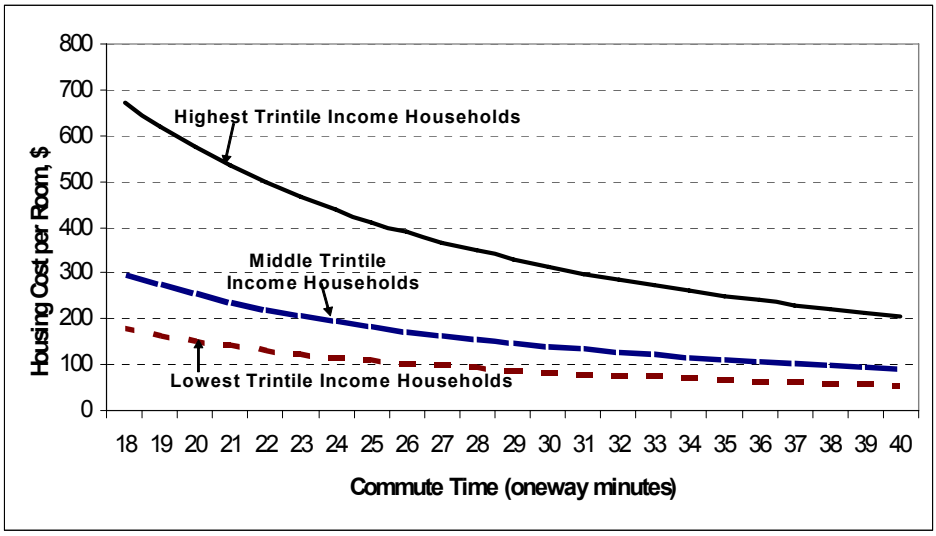


Figure 9: Estimated Non-centric Bid-Rent Curves for Households <u>without</u> Children



Household Income**:** A**s** Figure 10 shows, the estimated bid-rent curves were steepest for the highest income households (i.e., those in the highest income third), suggesting a greater sensitivity to commutes, and preference for minimizing commute times. This is consistent with prior research, including early work by Alonso, showing higher income households have the most residential location choices and their willingness to pay a rent premium erodes rapidly as commute distances rise. Working family households, on the other hand, who are mostly in the lowest-income third, face more location constraints and have fewer choices, yielding a flatter bid-rent curve.

Figure 10: Estimated Non-centric Bid-Rent Curves by Household Income Thirds



Tenure**:** There was little difference in commute sensitivity between owner-occupant and renter households. This is revealed by the similar slopes of the bid-rent curves in Figure 11. While there is a clear income effect, suggested by non-homeowners spending less for housing per room along the commute-time spectrum, the degree of sensitivity was similar regardless of ownership status.

Mover Status**:** PUMS respondents who had moved during the 1995–2000 period (i.e., *recent movers*) clearly viewed housing and transportation as a bundled good, more so than non-movers (Figure 12). Indeed, the fact that these households chose to move during the late 1990s could be an artifact of sensitivity to factors like commuting times. Mover-households who enjoyed short commutes of 18–20 minutes (particularly in light of the deteriorating traffic conditions in the seven large metropolitan areas studied) paid a high premium for this benefit—on average, between $700 and $800 per room per month.

Figure 11: Estimated Non-centric Bid-Rent Curve by Homeownership Status

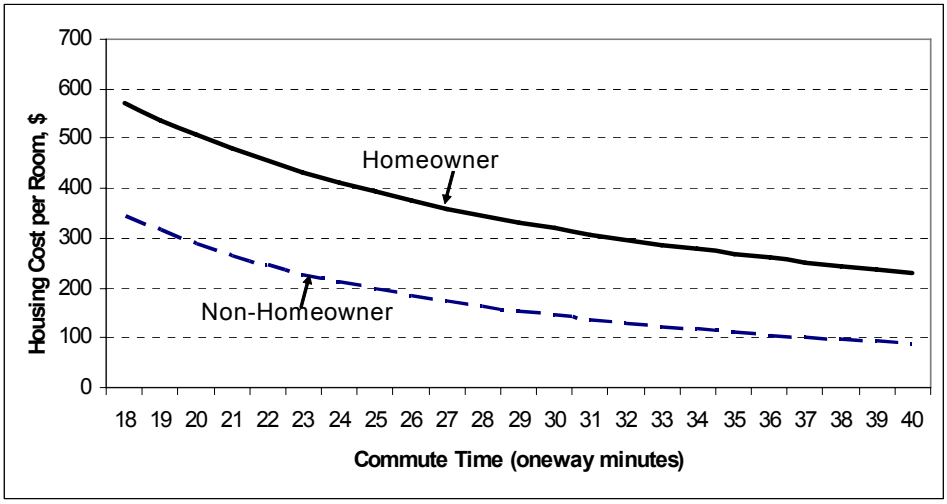
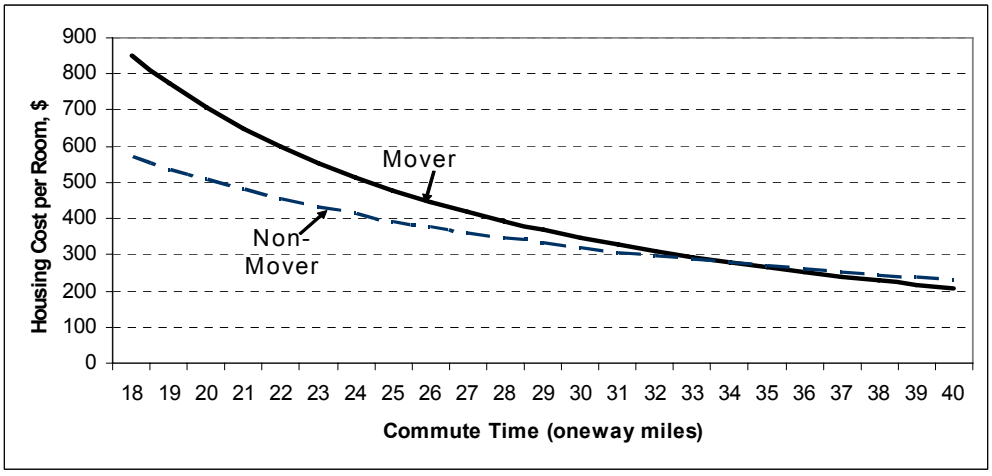


Figure 12: Estimated Non-centric Bid-Rent Curve by Recent Mover Status



Elasticities

One convenient way to condense and summarize these relationships is through the use of elasticities. As noted earlier, one of the principal advantages of using log-log equations such as Equation [1] is that the estimated coefficients can be directly interpreted as elasticities, or indices of sensitivity between housing costs and commute times.

We would expect all such elasticities to be negative, indicating that an increase in commuting costs or times will elicit a reduction in housing expenditures. Elastic relationships are those in which an elasticity value is less than -1.0. This means that a 1% increase in the cost of one item—in this case travel—will cause households to scale back their expenditures in another area, housing in this case, by more than 1%. Inelastic relationships are those in which an elasticity value is between 0 and -1. In the inelastic case, a 1% increase in the cost of the one item will cause households to scale back their expenditures on other goods by less than 1%. *Inelastic relationships are typically characterized by a lack of choice.*

Elasticities were calculated for each household group by summing estimated coefficients across the commute time variable and their respective commute time interaction terms (e.g., Married/Domestic Partners, with Children * log [Commute Time]). Building on these calculations, Figure 13 and discussions that follow explore how each household group would lower its housing bid given a 10% increase in commuting time.

Family Types: Consistent with the bid-rent curve results, the housing cost outlays of *married and domestic partner households with children* were most sensitive to commute time: all else being equal, a 10% increase in average commuting time led to a 2.6% decline in housing costs. Other household types, including multiple-family households with children and single-parent households were less sensitive to changes in commuting time. This indicates that they have fewer tradeoff options.

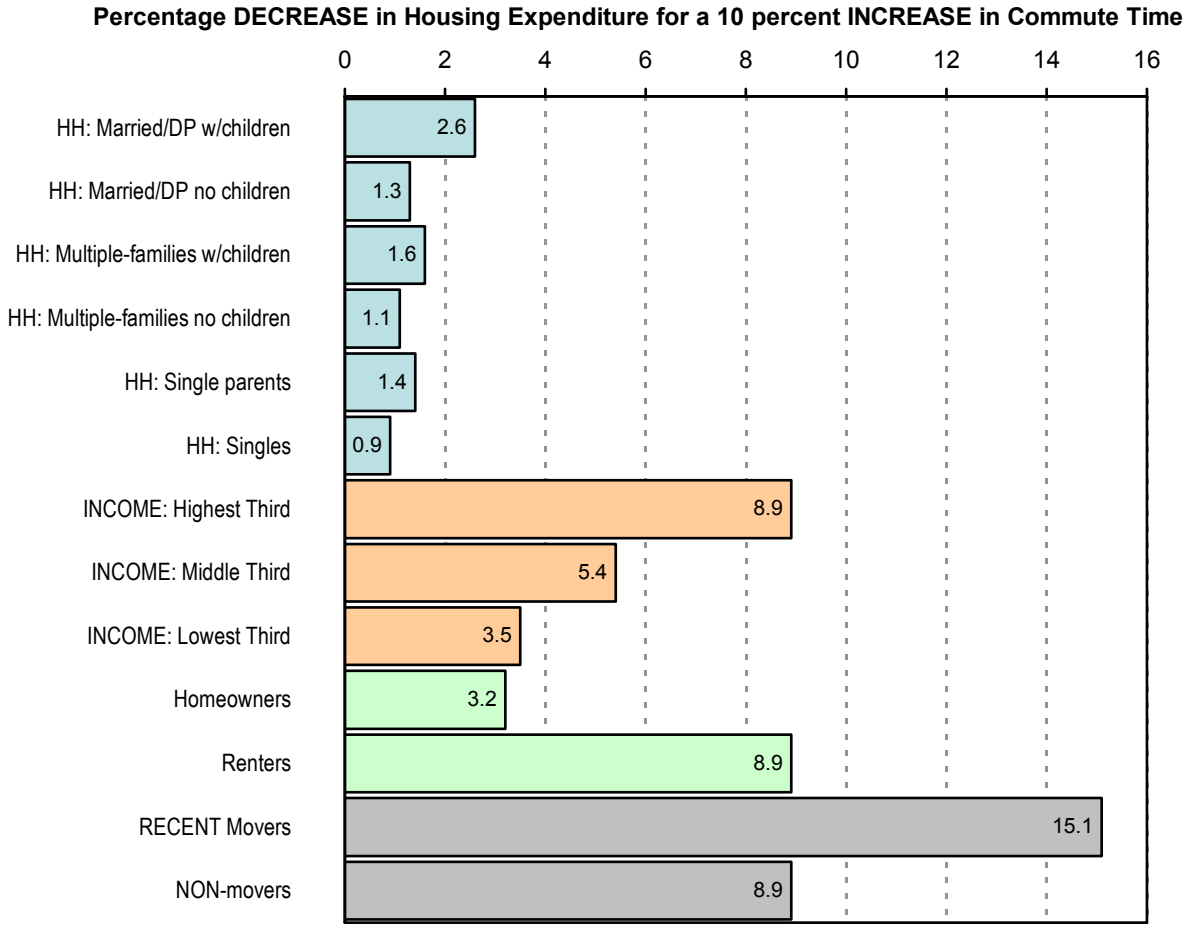
Household Income: Upper-income households were most inclined to tradeoff commute and housing expenditures, ostensibly because of wider choices. Among those in the highest income category, every 10% increase in average commute time was associated with an 8.9% decrease in housing expenditures, holding other factors constant. The housing preferences of *working families*—those in the lowest income third—were far more inelastic, an indication of a lack of choice. Confronted with a 10% increase in commuting time, working families were able to reduce their housing expenditures by only 3.5%.

Tenure: Renters move much more frequently than homeowners and are able to fine-tune their housing and transportation choices accordingly. Among renters, every 10% increase in commute time was associated with an 8.9% decrease in housing expenditures. Among homeowners, a 10% increase in commuting time was associated with a 3.2 percent cutback in housing expenditures.

Mover Status: Given their recent actions, it is not surprising that *recent movers* are much, much more sensitive to housing costs and commute times than non-movers, and in

a much better position to adjust their housing–commute tradeoffs. Among those households who moved between 1995 and 2000, all else being equal, a 10% increase in commute times was associated with a 15.1% decrease in housing expenditures. Among non-movers, by contrast, the same 10% increase in commuting time would lead them to reduce their housing expenditures by only 8.9%.

Figure 13: The Effects of a Ten Percent Increase in Commuting Times on Housing Expenditures



5. THE RESIDENTIAL LOCATION & COMMUTING CHOICES OF WORKING FAMILIES

Approach

Having previously explored how working families continuously tradeoff commute times with housing costs, we now turn to the related question of how and why they make actual residential location and commute choices; and how, if at all, their choices are different from those made by upper-income households. Whereas tradeoffs are continuous—like the bid-rent curves shown in the previous section—choices are mutually exclusive and discrete. Choosing to live in a suburban neighborhood precludes living in a central city neighborhood in much the same way the choosing to drive alone to work precludes taking public transit. Analyzing how and why families choose where to live and how to commute requires the use of a series of statistical techniques known as *discrete choice models.*

Most households choose their residential location and commute mode simultaneously. They may choose to buy an older single-family home in an inner suburban neighborhood that affords them good public transit service to work. Or they may choose to live in a new home in an outer suburb in which the only mode that provides convenient access to work is the private car. Or they may choose to live in an apartment tower in a central city neighborhood where they can walk to work. It is our hypothesis that working families have systematically fewer such choices available to them than upper-income families.

To test this hypothesis, we decompose the residential location–commute mode choice into two choices: the choice of residential neighborhood first as represented by a particular PUMA type, followed by the choice of commute mode. In statistics parlance, the choice of commute mode is said to be "nested" within the choice of residential location. This may not be a reasonable assumption, particularly for those households lacking access to a car. Car-less households may find their residential choices limited to communities in which they can walk, bike, or take public transit to work. Still, given that most American households, particularly family households, *do* have access to a car (if not own one outright), our assumption regarding the nested nature of commute and housing choices is probably quite reasonable.

The general structure of the nested PUMA type/commute mode model is as follows:

Eq. [2] Choice of PUMA Type$_i$ = f {Household income, Household size, Tenure preference, Condominium ownership preference, Gender and age of household head, Average high school test scores by PUMA, Auto accessibility to work by occupation}

Eq [3] Choice of Commute Mode$_j$ conditional on PUMA choice$_i$ = f {Household auto availability, Number of available vehicles per worker in the household, Auto accessibility to work by occupation, Tripmaker gender, Tripmaker age}.

The subscript *i* in the equation [2] indicates whether the household moved to a primary central city PUMA, a secondary central city PUMA, an inner suburban PUMA, an outer suburban PUMA, or a suburban fringe PUMA. The subscript *j* in equation [3] indicates whether the household commuted to work by driving alone, by carpooling, by taking transit, or by walking or bicycling. A central feature of the PUMA type model (equation [2]) is the inclusion of average high school test scores as summarized at the PUMA level. Particularly for families with children, the availability of a good public education is of paramount concern when deciding where to live; and although test scores are an imperfect measure of educational quality, they are the only such measure available for all seven MSAs.

The statistical procedure used to estimate these models is known as multinomial logistical regression, or multinomial *logit* for short. The term multinomial means that the household may choose from among more than two types of commute modes and two types of residential locations. Because logit is a more powerful statistical procedure than ordinary regression, we can test different models for different family types and MSAs, something we could not do in our previous tradeoff analysis. Separate logit models were tested for each case study MSA and for married-couple families with children, married-couple families without children, multiple-family households with and without children, single-parent households, and single-person households. As in the previous section, domestic partner households were coupled with married-couple families. The good part about testing more models is that we gain more detailed insights. The bad part is that there is a lot more output. Altogether, 84 different models were tested, one for each MSA and distinct family type. Because we are interested in understanding *contemporary revealed preferences*, the PUMS observations used to test the models were limited to recent movers. Estimated coefficients and goodness-of-fit statistics for each metropolitan area are presented in Appendix D-1 through D-7.

Once the various choice models have been estimated statistically, the results can be used with representative working family profiles to compare the housing location and commuting outcomes of working families with those of comparable families with higher incomes. To say that these outcomes are preferences or choices doesn't quite ring true. In many cases, working families choose to live where they do, or commute by a particular mode, only because they lack the range of choices available to wealthier families. To the extent that these outcomes represent household preferences, they are typically constrained preferences.

Residential Location Choices

Figure 14 compares the housing location choice outcomes of working families to those of similar upper-income families. These results are presented for each combination of case study metropolitan area and PUMA type. Because different types of working families have different housing and public service requirements, they are also presented by household type.

Figure 14: The Neighborhood Location Preference of Working Family vs.Upper Income Households

Metropolitan Region	Household Type	Working Family Outcome Probability / Comparable, Upper-income Household Outcome Probability				
		Central City PUMAs	Secondary Central City PUMAs	Inner Suburban PUMAs	Outer Suburban PUMAs	Suburban Fringe PUMAs
Atlanta	Married/domestic partners, children	0.14	na	0.42	1.49	3.98
	Married/domestic partners, no children	0.76	na	0.29	4.53	0.00
	Multiple families, children	3.15	na	sample too small	0.25	sample too small
	Multiple families, no children	0.30	na	0.84	1.73	0.00
	Single, children	2.66	na	0.94	0.97	0.00
	Single, no children	sample too small	na	sample too small	sample too small	0.00
Chicago	Married/domestic partners, children	0.34	1.36	0.95	0.93	1.08
	Married/domestic partners, no children	1.45	1.37	1.48	1.28	0.76
	Multiple families, children	9.15	19.60	1.62	0.66	0.44
	Multiple families, no children	0.52	0.83	0.87	1.03	1.74
	Single, children	1.37	5.35	2.74	0.78	0.31
	Single, no children	0.63	2.05	2.01	0.85	1.33
Dallas/Fort Worth	Married/domestic partners, children	0.50	0.54	0.95	0.95	1.66
	Married/domestic partners, no children	0.40	2.58	0.78	1.09	1.54
	Multiple families, children	sample too small	sample too small	0.98	0.37	0.27
	Multiple families, no children	1.18	2.75	1.22	0.49	0.30
	Single, children	1.63	sample too small	1.49	0.57	1.28
	Single, no children	0.67	3.92	0.89	1.27	1.48
Los Angeles	Married/domestic partners, children	1.93	1.17	1.39	0.93	0.78
	Married/domestic partners, no children	3.67	1.54	2.01	0.65	0.21
	Multiple families, children	3.89	10.35	2.62	0.79	0.32
	Multiple families, no children	1.54	2.22	1.01	0.62	0.83
	Single, children	2.63	2.36	1.13	0.74	0.55
	Single, no children	1.22	1.96	0.82	0.82	1.10
New York City	Married/domestic partners, children	1.11	2.08	1.29	0.64	1.39
	Married/domestic partners, no children	sample too small	0.69	2.35	0.42	0.53
	Multiple families, children	6.02	2.08	2.37	0.37	0.46
	Multiple families, no children	4.08	1.14	2.74	0.40	0.39
	Single, children	2.17	3.82	2.80	0.48	0.40
	Single, no children	0.49	1.45	1.22	0.86	1.36
San Francisco	Married/domestic partners, children	2.77	0.35	1.06	1.14	0.62
	Married/domestic partners, no children	2.34	1.20	1.44	1.28	0.49
	Multiple families, children	1.21	0.90	1.28	0.90	0.69
	Multiple families, no children	0.60	5.78	0.67	1.19	2.64
	Single, children	3.20	0.51	1.46	0.96	0.58
	Single, no children	0.74	4.08	0.81	0.92	2.43
Washington, D.C./Baltimore	Married/domestic partners, children	0.50	na	0.53	1.32	sample too small
	Married/domestic partners, no children	1.31	na	4.03	0.06	sample too small
	Multiple families, children	4.18	na	3.36	0.45	0.04
	Multiple families, no children	2.61	na	3.52	0.42	sample too small
	Single, children	0.96	na	1.55	0.60	sample too small
	Single, no children	na	na	na	na	na

The numbers presented in Figure 14 are *probability ratios*. They are calculated by dividing the estimated probability that a working family will "choose" to live in a particular PUMA type, divided by the probability that a similar, but wealthier, householdwill choose to live in that same PUMA type. Numerical values greater than one indicate that working families are more likely to reside in a PUMA type than wealthier families. Numerical values less than one indicate that working families are less likely than comparable wealthier families to reside in a PUMA type. Numerical values of one indicate there is no difference between the location choices of working and wealthy families.

Given that how varied housing and workplace opportunities are across the seven case study metropolitan areas, and the differing housing needs of different families, it is not all that surprising to find that the residential choices of working families also vary a great deal.

Let's begin by focusing on the choices made by married-couple working families with children. In the Atlanta region, married-couple working families with children are much less likely than similar upper-income families to live downtown or in older suburban locations, and more likely to live further out. Working family households consisting of married-couples with children, for example, are 86% less likely to live in one of Atlanta's central city PUMAs (based on a probability ratio of .14) and 49% more likely (based on a probability ratio of 1.49) to live in one of its outer suburban PUMAs than are wealthier married-couple-with-children families.

Dallas–Ft. Worth and Washington, D.C., are similar to Atlanta: working family households of married-couples with children are much less likely to live in downtown and older suburban neighborhoods, and much more likely to live in newer suburban areas and fringe communities.

In the Chicago region, by contrast, working family households of married-couple families with children are much less likely to live in or near downtown Chicago, but more likely to live in one of the region's other downtown cores. New York is similar to Chicago in the sense that married-couple working families tend to favor secondary downtown over newer suburban communities, but different in that they also favor living in New York City's downtown neighborhoods.

The two west coast urban regions are very different in this regard. Married-couple working families with children who live in the Los Angeles and San Francisco regions are much, much more likely to choose to live in older central city neighborhoods, and less likely to choose to live in a newer suburban community.

What of single-parent working families? How do their housing and location outcomes differ? Compared to similar upper-income families, and regardless of the metropolitan region, single-parent families are much more likely than their wealthier counterparts to live in a central city neighborhood, a secondary central city neighborhood, or an older suburban community. This is especially true on the West Coast where single-parent working families are 163% more likely to live in a downtown Los Angeles PUMA (based

on a probability ratio of 2.63), and 220% more likely to live in a San Francisco central city PUMA (based on a probability ratio of 3.20), than are single-parent families with higher incomes. Conversely, single-parent working families are slightly less likely to live in newer suburban communities and unlikely to live at the urban fringe. The degree to which these outcomes are the result of unconstrained preferences or are reflective of the high cost of suburban housing and the limited availability of suburban jobs is hard to say. The fact that single-parent working families so consistently choose to live in or near regional centers is probably due to the greater availability of public services and the proximity of family members and other supportive institutions in those locations. Racial discrimination is also likely to play some role.

Multiple-family households are America's fastest growing household type. Where are working family households of multiple-families most likely to live? Mostly in the same types of central city and inner suburban neighborhoods as single-parent working families. Indeed, of all the different types of working families, multiple-household working families are most consistently drawn to central city and older suburban neighborhoods; and least attracted to newer suburban communities. In New York, for example, working families of multi-family households (with children) are 500% more likely to live in a central city PUMA, 108% more likely to live in a secondary central city PUMA, 137% more likely to live in an inner suburban neighborhood, but 63% less likely to live in an outer suburban neighborhood and 54% less likely to live on the suburban edge. This outcome pattern is consistent with the observation that many multiple-family households are also immigrant households who tend to cluster in neighborhoods with other immigrant households of similar background and origin.

Finally, we come to working family households without children. Where are they choosing to live? Except in Los Angeles, where they are also living downtown, working-class singles are mostly choosing to live in secondary city and older suburban neighborhoods, leaving downtown locations and newer suburban communities to wealthier singles. Likewise, married-couple working families without children (many of whom are "empty nesters") are eschewing newer suburban communities for more established suburban and downtown neighborhoods. This is especially true in the more cosmopolitan downtowns of New York City, San Francisco, and Los Angeles.

Commute Choices

There are so many possible combinations of region, household type, PUMA type, and commute mode that it is impossible to represent, let alone understand, the complete pattern of residential and commute choices. So, instead of focusing on the typical commute mode choice, which is almost always the use of a private car to drive alone, we focus on *atypical choices*: those circumstances in which working families choose different commute modes compared to their wealthier counterparts. (A complete listing of commute probability ratios is included as Appendix D-8). As with location choice, above, all of these results are based on the revealed preferences of households who moved between 1995 and 2000.

Among households who moved to central city PUMAs, working family commuters, especially those with children, were more likely than upper-income commuters to carpool to work. Carpooling was especially popular among working family commuters in the Dallas and Los Angeles metropolitan regions, both of which are characterized by multiple and dispersed job centers. Of the seven case study MSAs, Los Angeles is the only one in which working family commuters were consistently more likely to take public transit to work. By contrast, up the California coast in San Francisco, working family commuters were less likely to take public transit to work. Working family commuters living in central city PUMAs were neither more nor less likely to walk or bicycle to work than wealthier commuters. The exception to this is Dallas–Ft.Worth, where working family commuters were much, much less likely to walk to work.

Among households who moved to secondary central city PUMAs, working family commuters in the New York, Los Angeles, and San Francisco regions were much more likely to carpool to work than wealthier families. In Chicago, working family commuters who lived in secondary central cities, such as Gary or Joliet, were less likely to commute via public transit. In other respects and locations, the commute mode choices of working family commuters living in secondary city PUMAs were the same as those of their upper-income counterparts.

Among households who moved to inner suburban PUMAs, working family commuters in five of the case study regions (Atlanta, Chicago, Dallas–Ft.Worth, Los Angeles, and New York) were much more likely to carpool to work than similar wealthier commuters. Except in Los Angeles and New York City, working family residents of older suburban neighborhoods were neither more nor less likely to commute to work by walking or public transit. In Los Angeles, working family commuters were much more likely to take the bus to work. In New York, they were much more likely to walk.

Owing to its sparser availability and lower quality of service, public transit was generally much less popular among working family residents of outer suburban PUMAs. Compared to their wealthier cohorts, working family residents of outer suburban PUMAs in New York and San Francisco were somewhat more likely to walk to work.

Last, among households who moved to newer and more distant suburban fringe PUMAs, working family commuters were consistently more likely to carpool to work than wealthier families. The one exception to this finding was in Washington, D.C.–Baltimore, where carpooling was no more popular among working families than among other families.

In sum, regardless of where they choose to reside, working families tend to favor the private automobile as a commute mode in roughly the same proportions as wealthier families. Where working family commuters most differ from their wealthier counterparts is in their greater preference for carpooling; in their greater indifference to public transit (except in far-flung Los Angeles, where bus service is the only feasible alternative to the private car for many low-income households); and in the New York region where they are more likely to walk.

Do Working Families Have Fewer and Inferior Choices?

Having used PUMS data to uncover the housing location and commuting choices made by working families, we now turn to the question of whether those choices are more limited or inferior to the choices made by comparable upper-income families. Certainly they are more expensive, if only by virtue of the fact that working families have lower incomes. But are they also more disadvantageous?

To find out, we sorted the different MSAs and PUMA-types in reverse housing cost order, from highest to lowest (Figure 15). Generally speaking, we would expect most households to prefer to pay less for housing than to pay more. Those who *must* pay more have fewer choices.

As a further indication of housing choice, we also calculated the average housing cost burdens faced by recent movers in each of the PUMA types. Housing cost burden is the ratio of housing cost to household income. Most U.S. households pay less than 25% of their income on housing costs. A housing cost burden of 35% or more is indicative, not only of extreme financial hardship, but also of a profound lack of housing choice; were more housing choices available households would not have to pay as dearly for housing, and housing cost burdens would presumably fall.

In the transportation domain, having a choice means being able to select from among multiple modes with comparable levels of service. To identify those PUMAs where working families had fewer commute choices, we sorted the different MSAs and PUMA types according to the ratio of *average commute time via public transit* to *average commute time by private car* (Figure 16). In PUMAs where this ratio is particularly high—on the order of 1.5 or greater, commuters must spend an average of 50% longer traveling to their work place destination by public transit than by car. The only reason for most commuters to endure such a hardship, we would presume, is because they do not have access to a private car or carpool opportunities. We also estimated the average cost of commuting. As with housing, we would expect most households to want to minimize this cost.

A few clarifications and qualifications are in order before reviewing the results of these comparisons. All estimates and ratios were drawn from the 2000 Census PUMS recent mover subset. Average housing costs were estimated by computing the tenure-weighted average of monthly rents and monthly mortgage costs. These costs, drawn from the responses of recent movers to insure their currency, were multiplied by 12 to yield an annual housing cost estimate.

When used to compare housing costs and burdens across different locations, this method assumes an "apples-to-apples comparison," or as it is more commonly known, a "constant-quality" comparison. This means we would assume the housing quality bundles in central city PUMAs to be identical to the housing quality bundles in suburban PUMAs. In the real world, this is decidedly not the case. Whether in terms of house size, lot size, or the quality of local public services, suburban residents generally get far more for their housing dollar than do central city residents. While this assumption does

not affect the calculation of housing cost burdens, it does point to the fact that the set of housing choices in central city PUMAs are fundamentally different than the set of housing choices in suburban or fringe PUMAs.

On the commuting choice side of the ledger, we use *average commute times based on transit and auto trips made by working families*, and not by all commuters. This was done in recognition that working family commuters are more likely to work at different jobs in different locations than are upper-income commuters. Fifty years ago, most blue-collar and low-skilled job opportunities were in manufacturing industries located in central cities. Today, most low-skilled jobs are in the retail and service sectors in suburban locations. Because most urban highway and public transit systems were designed and built to move workers from suburban subdivisions to downtown workplaces—and not from central city neighborhoods to suburban job centers—blue-collar and low-wage workers have faced a widening "spatial mismatch" between their commuting needs and the ability of urban transportation system to meet those needs. Using generalized commute times rather than commute times keyed to working families would gloss over the spatial mismatch issue, and give the false impression than working families have more commute options than they really do.

Figure 15 lists the different metropolitan area-PUMA combinations in reverse order of annual housing cost (as of 2000); average housing cost burdens are also listed. To make the connection to working families, the last set of columns in Figure 16 lists the types of working family households which, based on the results of our prior discrete choice models, are most likely to live in the different PUMA types. A single "X" means that working families are 30%–49% more likely to live in a particular PUMA type than are comparable wealthier families; a "XX" means they are 50%–99% more likely, and a "XXX" means they are 100% more likely to live in that PUMA type.

- Average housing costs are much higher in Atlanta's fringe and outer suburban PUMAs than they are in its central city and inner suburban PUMAs—by as much as 50%. Housing cost burdens are higher as well. The working family households most likely to live in these high-housing-cost/high-housing-burden PUMAs are married-couple families with children, married-couple families without children and multiple-family households without children. Single-parent families and multiple-family households with children are more likely to live in Atlanta's central city neighborhoods where, despite lower average housing costs, housing is only slightly more affordable.

- Housing costs in the Chicago region rise with distance from the city center. Among recent movers, average housing costs ranged from a low of $14,000 in Chicago's central city PUMAs to a high of $22,590 in its extent suburban PUMAs. Despite this difference in housing costs, housing cost burdens were similar throughout the Chicago region, except in central city PUMAs where they were somewhat lower. Chicago's working families are much more likely to live in its central city, secondary central city, and inner suburban PUMAs where they face lower absolute housing costs than in the rest of the region but comparable housing cost burdens.

- Average annual housing costs in the Dallas–Ft. Worth region in 2000 ranged from a low of $11,131 in the Ft. Worth area to $21,110 in the region's toniest suburbs. Because incomes followed a somewhat different pattern, households living in suburban fringe communities faced the highest cost burdens (41%), while central city residents faced the lowest (29%). Working families *without* children are more likely to live in and around Ft. Worth, where absolute housing costs were fairly low, but housing cost burdens are not. Working families of married-couples *with* children are much more likely to live in fringe suburban communities where housing is least affordable.

- Regardless of their composition, working families in the Greater Los Angeles region are much more likely to live in or near downtown Los Angeles; in a secondary central city neighborhood such as Anaheim or Riverside; or in an older suburban community. As of 2000, average housing costs were lower in these older communities. Except in secondary central city PUMAs, housing was also more affordable.

- Housing in the New York City region is least expensive in central city neighborhoods (due largely to the concentration of public housing units within the five boroughs) and more expensive further out. Affordability trends run the opposite way. Relative to incomes, housing is most affordable in central city and older suburban PUMAs, and least affordable in new communities near the suburban fringe. In New York, as in Los Angeles, working families are consistently more likely to live in lower-cost and more affordable locations.

- The San Francisco Bay Area is unique among the seven case study metropolitan areas in that its most expensive (and least affordable) housing is in its inner suburban communities. Its least expensive housing is in certain central city neighborhoods, most notably those in Oakland. Among recent movers, housing cost burdens were typically highest in central city and inner suburban PUMAs. These two PUMA types were favored by all types of working families except married-couples without children and single-person households.

- Housing costs and housing cost burdens in the Washington, D.C.–Baltimore metropolitan area are the highest of any of the seven case study regions. Housing costs are especially high among the region's outer suburban and suburban fringe PUMAs. Except for married-couples with children who bear the brunt of these high costs, working families in the Washington, D.C.–Baltimore region are more likely to live in central city and inner suburban neighborhoods where housing costs and cost burdens are somewhat lower.

The results of these comparisons indicate that working families disproportionately locate wherever they can find affordable housing—"affordable" being a relative term—and that there are fewer affordable choices available to working families with children (especially single-parent and multiple-family households) than those without.

Figure 15: Metro Areas and PUMA Types where Working Families Face Disadvantageous Housing Choices

Metropolitan Region	PUMA Type (sorted from high to low average yearly housing cost)	Average Yearly Housing Cost	Average Housing Cost Burden	"X" indicates whether working family HHs are present in much greater proportions than comparable upper-income households					
				Married-couple WITH Children	Multiple-families WITH Children	Single-parent families	Married-couple W/O Children	Multiple Families W/O Children	Single persons
Atlanta	Suburban fringe	$23,107	36%	XXX					
Atlanta	Outer suburb	$19,314	31%	X			XXX	XX	
Atlanta	Inner suburb	$15,462	28%						
Atlanta	Central city	$14,563	30%		XXX	XXX			
Chicago	Suburban fringe	$22,589	32%					XX	X
Chicago	Outer suburb	$20,853	32%						
Chicago	Secondary central city	$16,824	32%	X	XXX	XXX	X		XXX
Chicago	Inner suburb	$16,753	32%		XXX	XXX	X		XXX
Chicago	Central city	$14,001	29%		XXX	X	X		
Dallas/Ft. Worth	Outer suburb	$21,110	35%						
Dallas/Ft. Worth	Suburban fringe	$19,641	41%	XXX			XX		X
Dallas/Ft. Worth	Inner suburb	$15,461	30%						
Dallas/Ft. Worth	Central city	$12,077	29%			X			
Dallas/Ft. Worth	Secondary central city	$11,131	33%				XXX	XXX	XXX
Los Angeles	Suburban fringe	$19,721	33%						
Los Angeles	Outer suburb	$19,338	31%						
Los Angeles	Secondary central city	$16,287	32%		XXX	XXX	XXX	XXX	XX
Los Angeles	Inner suburb	$15,939	29%	X	XXX		XX		
Los Angeles	Central city	$10,526	26%	XX	XXX	XXX	XXX	XX	
New York City	Outer suburb	$24,456	31%						
New York City	Suburban fringe	$23,533	32%	X					X
New York City	Inner suburb	$15,877	28%		XXX	XXX	XXX	XXX	
New York City	Secondary central city	$14,455	29%	XXX	XXX	XXX			X
New York City	Central city	$10,091	20%		XXX	XXX	XXX	XXX	
San Francisco	Inner suburb	$23,731	32%			X	X		
San Francisco	Secondary central city	$23,323	30%					XXX	XXX
San Francisco	Outer suburb	$21,273	28%						
San Francisco	Suburban fringe	$17,418	29%					XXX	XXX
San Francisco	Central city	$13,535	23%	XXX		XXX	XXX		
Washington, D.C./Baltimore	Outer suburb	$26,082	35%	X					
Washington, D.C./Baltimore	Suburban fringe	$25,033	41%						
Washington, D.C./Baltimore	Inner suburb	$20,876	32%		XXX	XX	XXX	XXX	
Washington, D.C./Baltimore	Central city	$15,070	30%		XXX		X	XXX	

Key: X indicates working families are likely to be present at 30-49% greater concentration than wealthier families
XX indicates working families are likely to be present at 50-99% greater concentration than wealthier families
XXX indicates working families are likely to be present at 100%+ greater concentration than wealthier families

Figure 16, which focuses on transportation choice and burden, has a similar format to Figure 15. It lists the different metropolitan area-PUMA type combinations in reverse order of the ratio of *average commute time via transit* to *average commute time via private automobile*. Average commute costs are also listed. To make the connection to working families, the last set of columns in Figure 16 lists the types of working family households which, based on the results of our prior discrete choice models, are most likely to live in the different PUMA types. A single "X" means that working families are 30%–49% more likely to live in a particular PUMA type than are comparable wealthier families; a "XX" means they are 50%–99% more likely, and a "XXX" means they are 100% more likely to live in that PUMA type.

- With most of Atlanta's jobs near or beyond the region's Perimeter Freeway, working families who live in downtown neighborhoods take almost twice as long to commute to their jobs by public transit as by private car. Working family commuters who live in inner and outer suburban areas must also contend with infrequent public transit service. The types of working families most likely to suffer from a lack of timely public transit service are multiple-family households with children, and single-parent households in central city PUMAs; and married-couple and multiple-family households without children in outer suburban PUMAs.

- Chicago's extensive rail and bus public transit system provides good corridor service from suburbia to downtown Chicago, but poor service to suburban job centers and employment opportunities in secondary central city neighborhoods. For Chicago's working families, excess public transit commute times vary from a high of 147% in suburban fringe PUMAs, to a low of 33% in central city PUMAs. The types of working families most likely to face excessively lengthy transit commutes are multiple-family households without children, single-parent and single person households, and multiple-family households with children.

- In no part of the Dallas–Ft. Worth metropolitan area does public transit offer commuter service that is competitive with private vehicles. For working families, excess public transit commute times vary from a high of 100% in suburban fringe PUMAs, to a low of just 70% in central city locations. Dallas's infrequent transit service reduces travel choices for everyone, not just working families. Those working families who are most disadvantaged are married-couple and single-parent family households living in suburban fringe communities.

- Among working families, public transit commute times exceed auto commute times by 70–75% just about everywhere in the Greater Los Angeles area. The types of working family households most consistently disadvantaged by the comparatively poor quality of public transit service in Los Angeles are married-couple households without children, multiple-family households with and without children, and single-parent households.

Figure 16: Metro Areas and PUMA Types where Working Families Face Disadvantageous Commuting Choices

Metropolitan Region	PUMA Type (sorted by the ratio of transit-to-auto commute time)	Average transit commute time/ Average auto commute time	Average Annual Commute Cost	"X" indicates whether working family HHs are present in much greater proportions than comparable upper-income households					
				Married-couple WITH Children	Multiple-families WITH Children	Single-parent families	Married-couple W/O Children	Multiple Families W/O Children	Single persons
Atlanta	Central city	182%	$764		XXX	XXX			
Atlanta	Inner suburb	165%	$948						
Atlanta	Outer suburb	156%	$1,092	X			XXX	XX	
Atlanta	Suburban fringe	111%	$1,149	XXX					
Chicago	Suburban fringe	247%	$1,094					XX	X
Chicago	Secondary central city	220%	$947	X	XXX	XXX	X		XXX
Chicago	Outer suburb	210%	$927						
Chicago	Inner suburb	159%	$698		XXX	XXX	X		XXX
Chicago	Central city	133%	$487		XXX	X	X		
Dallas/Ft. Worth	Suburban fringe	199%	$1,136	XXX			XX		X
Dallas/Ft. Worth	Inner suburb	182%	$885						
Dallas/Ft. Worth	Outer suburb	172%	$1,059						
Dallas/Ft. Worth	Secondary central city	170%	$807				XXX	XXX	XXX
Dallas/Ft. Worth	Central city	169%	$740			X			
Los Angeles	Inner suburb	177%	$748	X	XXX		XX		
Los Angeles	Outer suburb	175%	$880						
Los Angeles	Secondary central city	173%	$870		XXX	XXX	XXX	XXX	XX
Los Angeles	Suburban fringe	172%	$994						
Los Angeles	Central city	169%	$597	XX	XXX	XXX	XXX	XX	
New York City	Outer suburb	240%	$987						
New York City	Suburban fringe	237%	$1,087	X					X
New York City	Secondary central city	186%	$790	XXX	XXX	XXX			X
New York City	Inner suburb	182%	$642		XXX	XXX	XXX	XXX	
New York City	Central city	138%	$348		XXX	XXX	XXX	XXX	
San Francisco	Suburban fringe	201%	$1,069					XXX	XXX
San Francisco	Outer suburb	184%	$940						
San Francisco	Inner suburb	184%	$837			X	X		
San Francisco	Secondary central city	161%	$951					XXX	XXX
San Francisco	Central city	148%	$576	XXX		XXX	XXX		
Washington, D.C./Baltimore	Suburban fringe	200%	$1,150						
Washington, D.C./Baltimore	Outer suburb	177%	$1,065	X					
Washington, D.C./Baltimore	Inner suburb	168%	$904		XXX	XX	XXX	XXX	
Washington, D.C./Baltimore	Central city	150%	$668		XXX		X	XXX	

Key: X indicates working families are likely to be present at 30-49% greater concentration than wealthier families
XX indicates working families are likely to be present at 50-99% greater concentration than wealthier families
XXX indicates working families are likely to be present at 100%+ greater concentration than wealthier families

- New York City has the best public transit service in the nation, at least in four of the five boroughs. Beyond the city proper, the quality of public transit service to working family commuters vis-à-vis the private car falls off considerably. Among New York's fringe and outer suburbs, for example, working family commute times by public transit exceed auto commute times by 140%. Among the New York region's older and closer-in neighborhoods, public transit commute times exceed auto commute times by 80% or more. These excess public transit commute times adversely impact almost all of New York's working family households, many of whom live in secondary central city and inner suburban PUMAs.

- The transit situation for working families in the San Francisco Bay Area parallels that of New York: only those working family commuters who live in central city neighborhoods enjoy public transit service that offers comparable travel times to the private car. The types of working family households most disadvantaged by the comparatively poor quality of suburban transit service in the San Francisco region are typically multiple-family households without children and single-person households.

- The private car has a difficult time competing with public transit within Washington, D.C.'s Metro corridors. Everywhere else in the Washington, D.C.–Baltimore region transit consistently loses out among working family commuters. This is as true in central city neighborhoods as it is on the suburban fringe. The types of working families in the Washington, D.C.–Baltimore area most likely to face excessively lengthy transit commutes are multiple-family households with and without children, and married-couple families without children living in the region's inner suburban communities.

Summary

Which working families in which locations suffer most from a *combined* lack of affordable housing and quality public transit service*?* As with housing and transportation separately, the answer differs by region. In Atlanta, it's an either-or thing: working families living in fringe communities suffer from high housing cost burdens and working families living downtown suffer from inferior public transit service, but no group suffers from both. Whereas working family housing burdens are fairly consistent across the Chicago region, all working families, except those living in Chicago's central neighborhoods, suffer from adverse transportation choices. In the Dallas–Ft. Worth region, working families of married-couples (with and without children) living in suburban fringe neighborhoods are most disadvantaged. A similar result holds in the Washington, D.C.–Baltimore region. All working families living in or near central Los Angeles have more housing and more transportation choices. Those who live further out suffer from higher housing payment burdens and longer commutes. The same is true in the New York metropolitan area. In the San Francisco Bay Area, working families who live in central city neighborhoods have greater access to affordable housing and quality transportation service, but those who live in nearby inner suburban neighborhoods face some of the region's least affordable housing.

6. SUMMARY AND POLICY OPTIONS

Summary

Poor Americans pay an extraordinary share of their incomes for housing. According to the Census Bureau's most current American Community Survey, an astonishing 75% of renters and 65% of homeowners with incomes less than $20,000 spent more than 30% of their income for housing in 2004. The situation for near-poor and moderate-income households was not much better. Among renter households with incomes between $20,000 and $35,000, half spent more than 30% of their incomes for housing in 2004; among homeowners of similar income, 38% spent more than 30% of their incomes on housing.

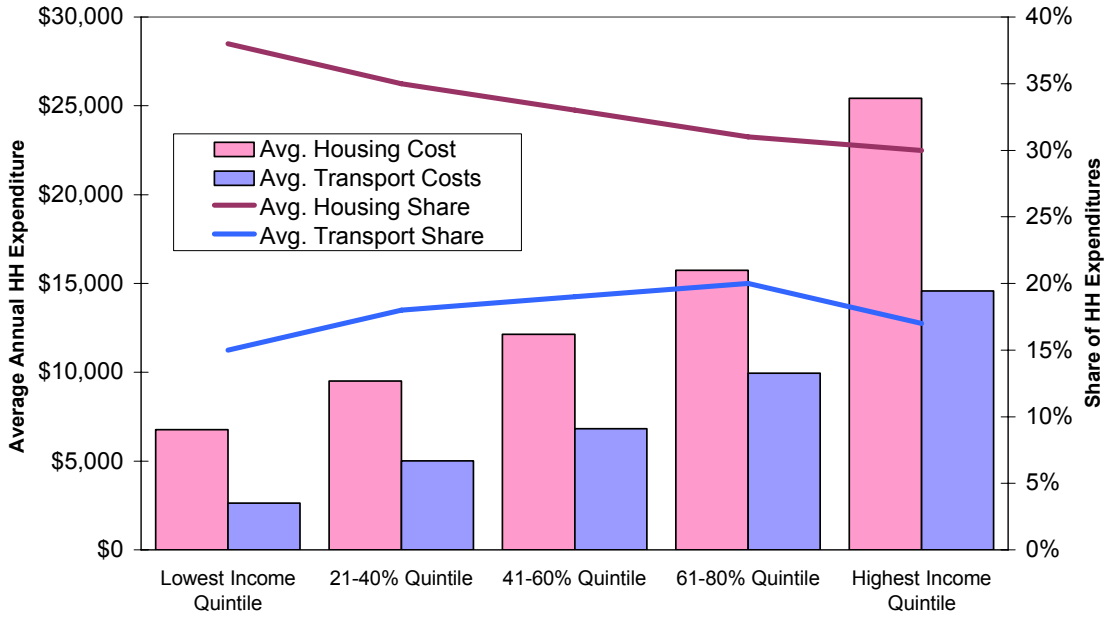
When added to the high cost of getting around—according to the Bureau of Labor Statistic's Consumer Expenditure Survey, in 2004, American households spent an average of $7,800, or 18% of their income, on transportation—housing expenditures accounted for exactly one-half of the pre-tax income of American households. Among the poorest one-fifth of American households, housing and transportation accounted for 52.6% of the family budget in 2004.

As Figure 17 shows, nationally, this excess burden problem is principally one of high housing costs. Among the poorest 20% of American households, housing costs comprise 38% of household budgets while transportation costs comprise 15%. Among the wealthiest 20%, housing costs account for 30% of household budgets and transportation costs account for 17%. As their incomes increase, American households devote a lesser share of their earnings to housing but a greater share to transportation.

Why do American households devote such large percentages of their incomes to housing and transportation costs? The answer to this question, as with much in American society, is a matter of income. On the housing side, wealthy households value privacy, exclusivity, high-quality public services (and low taxes), amenities such as views, and the opportunity to live near other wealthy people. Poorer households value these same attributes, but lack the incomes to compete with their wealthier counterparts. On the transportation side, the principal difference between poor and wealthy households is in the number, age, and value of their cars. Wealthy households own more cars, newer cars, and more expensive cars than poorer households.

But, whereas poorer households have many fewer housing choices than wealthy households, their vehicle and commuting mode choices aren't quite so limited. Thanks to the size and vitality of the used car market and the low price of gasoline in America (at least by world standards, in the year 2000), only a small fraction of American households cannot afford to own a car. Nationwide, according to the 2004 Consumer Expenditure Survey, 88% of American households own or have access to at least one vehicle. (Some car-less households could afford to own a car, but prefer not to.) Among income quintiles, only the poorest fifth of American households have an auto-accessibility level that is less than this average.

Figure 17: Average Yearly Housing and Transportation Costs and Burdens by Income Quintile
(Source: Bureau of Labor Statistics, 2004 Consumer Expenditure Survey)



Nor is transit accessibility necessarily a matter of income. Among working families, average commute times and distances by public transit are only slightly longer than for upper-income families. And when it comes to walking, working families generally live in neighborhoods that are more pedestrian friendly than do upper-income households.

This is not say to say that poor households have the same richness of transportation choices as wealthier ones. They clearly do not. The quality and degree of transportation choices, just like the quality and degree of housing choices, are much greater for wealthier households than for poorer ones. *This enables wealthier households to achieve a more advantageous tradeoff between housing quality and affordability and transportation mobility.* And because the supply of housing locations is fixed—at least in the short run—to the degree that wealthy households are able to choose the most advantageous neighborhoods, they consign poorer households to less advantageous locations.

Income is not the only important dimension to choice. Household type, residential location, and metropolitan area also matter a great deal. According to the tradeoff analysis presented in Section 4, of *households with children*, single-parent families and multiple-family households have significantly fewer housing–transportation tradeoff options than married-couple families. The same is also true for *households without children*: married-couple households have more housing–transportation tradeoff options than single-person households, and multiple-family households have fewer tradeoff options than married-couple households. Section 4 also affirms the critical importance of household income in determining housing–transportation tradeoff options.

Location also matters—both inter-metropolitan and intra-metropolitan location. Inter-metropolitan locations matter because different metropolitan areas are characterized by different housing market conditions, different work locations, and different levels of roadway and public transit service. Intra-metropolitan location matters due to neighborhood-based differences in house size, age, school quality, and transit service.

Consider the inter- and intra-metropolitan revealed choice differences identified in Section 5. In the Atlanta metropolitan area, working family households with children are most likely to live in outer suburban and suburban fringe communities, where housing is more expensive and local transit service is poor. The same pattern is evident in the Dallas–Ft. Worth region: working families have been pushed to the outer suburbs where they face high housing costs and lengthy and expensive commutes. In Chicago, working families are more likely to live in central city and older suburban neighborhoods, where housing is generally more affordable and where public transit service is better. In the Greater Los Angeles region, working families are far more likely to live downtown or in the region's close-in, older suburbs where housing is more affordable and transit service is better (if overcrowded). Working families are also more likely to live in inner suburban communities in the San Francisco Bay Area where they can enjoy reasonably good-quality bus service. This comes at a price, however, as the Bay Area's inner suburban communities are generally its least affordable. In the New York City region, working-family households are more likely to live close to New York City where they can best take advantage of that region's most affordable housing and superior public transit service. A similar pattern is evident in the Washington, D.C.–Baltimore region.

In short, working families—especially those with children—usually locate to take advantage of affordable housing opportunities. Sometimes, as in the cases of New York, Chicago, Los Angeles, and Washington, D.C.–Baltimore, the more affordable neighborhoods also have good-quality transit service. In Atlanta and Dallas–Ft. Worth, by contrast, working families have been pushed to the outer suburbs where housing is dear and transit service is essentially non-existent. And then there are the outliers like San Francisco where working families disproportionately live in neighborhoods with good transit service but must pay, by national standards, exorbitant housing prices and rents.

Policy Options—A Quick Survey

What does this research tell us about what might be done to relieve the ultra-high housing and transportation costs confronting so many of America's working families? Because the nature and severity of the problem varies so widely by metropolitan area and family type, it is difficult to conceive of a one-size-fits-all (or even a one-size-fits-a-few) policy approach.

Conceptually at least, one can differentiate alternate policy approaches according to whether they come at the issue from a housing cost, housing choice, transportation cost, transportation choice, or income perspective. Let us consider each approach in turn.

From a *housing cost* perspective, the easiest, most direct, and most effective way to relieve the excessive housing and transportation cost burdens faced by so many working-families would be to subsidize them using a means-tested gap-subsidy program like the Section 8 housing program. Given the size of the federal budget deficit, the tremendous cost of such a program, Congress's long-standing opposition to housing subsidies and political opposition to housing programs for poor households, this approach is a clear non-starter.

From a *housing choice* perspective, the preferred approach would be to encourage the increased production of new infill housing in locations with good transit accessibility. Increasing the supply of housing would put downward pressure on housing prices and rents and potentially, at least, add to the ridership base for public transit. Given the difficulties of planning, siting, and financing new infill housing—particularly for moderate-income households—and the potential for gentrification, it is not immediately obvious that this type of strategy would be successful. Nonetheless, to the degree that many cities and metropolitan areas are already pursuing infill strategies as part of locally-initiated urban regeneration and smart growth efforts, this strategy is certainly worth pursuing at the federal, state, metropolitan, and municipal levels.

From a *transportation cost* perspective, it is difficult to see how any level of government could structure an administratively workable transportation subsidy program for working families other than through the tax code. Aside from issues of fairness, subsidizing drivers would have the perverse effect of increasing the demand for travel and therefore traffic congestion. Subsidizing transit users (other than by reducing fares) would be an administrative nightmare. Besides, almost all empirical studies reveal public transit use to be price inelastic, suggesting that the ridership benefits of such a program are likely to be small. Worthwhile initiatives like the Locationally Efficient Mortgage (LEM) program may help provide working families access to a wider variety of housing choices, but they do little to reduce total burdens.

There is somewhat greater potential on the *transportation choice* side. To the extent that public transit service quality and the convenience of walking can be meaningfully enhanced, there is some evidence suggesting that some travelers will shift modes. However it is done, boosting the coverage and frequency of local public transit service is likely to be extremely expensive and therefore require a dedicated revenue source, with at least some of the funds coming from transit users themselves. Nonetheless, by European and Asian standards, transit service in America is not particularly expensive. As recent experiences in London indicate, transit fare increases that result in visible and substantial improvements in service may be quickly accepted by the transit-riding public. Given that the annual user costs of public transit are generally far less than the capital and operating cost of owning a late-model car, this approach may make a fair amount of sense in those locations where activity patterns and densities can support increased transit use. And as we have seen, many of these same locations and neighborhoods are already home to working families.

Promoting walking is a longer-term project. It will require re-engineering public rights-of-way in old and new suburban communities, and a patient and careful attention to

linking trip origins and destinations. Given the right models and incentives, it can be done; however, the pay-offs will likely take long to materialize and are unlikely to principally benefit working families.

It is on the *income-side* that the greatest potential lies. Through a mechanism similar to the Earned Income Tax Credit (EITC), it should be possible to institute a targeted, means-tested and sliding-scale program to increase the effective incomes of those working family households who face the greatest housing and transportation cost burdens. Such a program might work as follows: households earning less than 80% of area-adjusted median income (AMI) and spending more than 50% of their annual income on a combination of housing and transportation costs would be eligible for a tax credit which would bring their combined housing and transportation payment burden down to a 40% level. This approach would have several advantages. It goes directly to the problem of inadequate income. Through the use of AMI, it could be structured to account for local variations in housing and transportation costs. The amount of the credit could be capped to limit over-allocation to high-income/high-cost markets. And, it could be targeted toward those particular working family household types (e.g., those with children and at least one full-time wage-earner) whose housing and transportation choices are most limited. As with its model, the EITC, the negative effect of such a program on federal tax revenues would likely be small. The positive effect on over-burdened working family households, on the other hand, could be huge.

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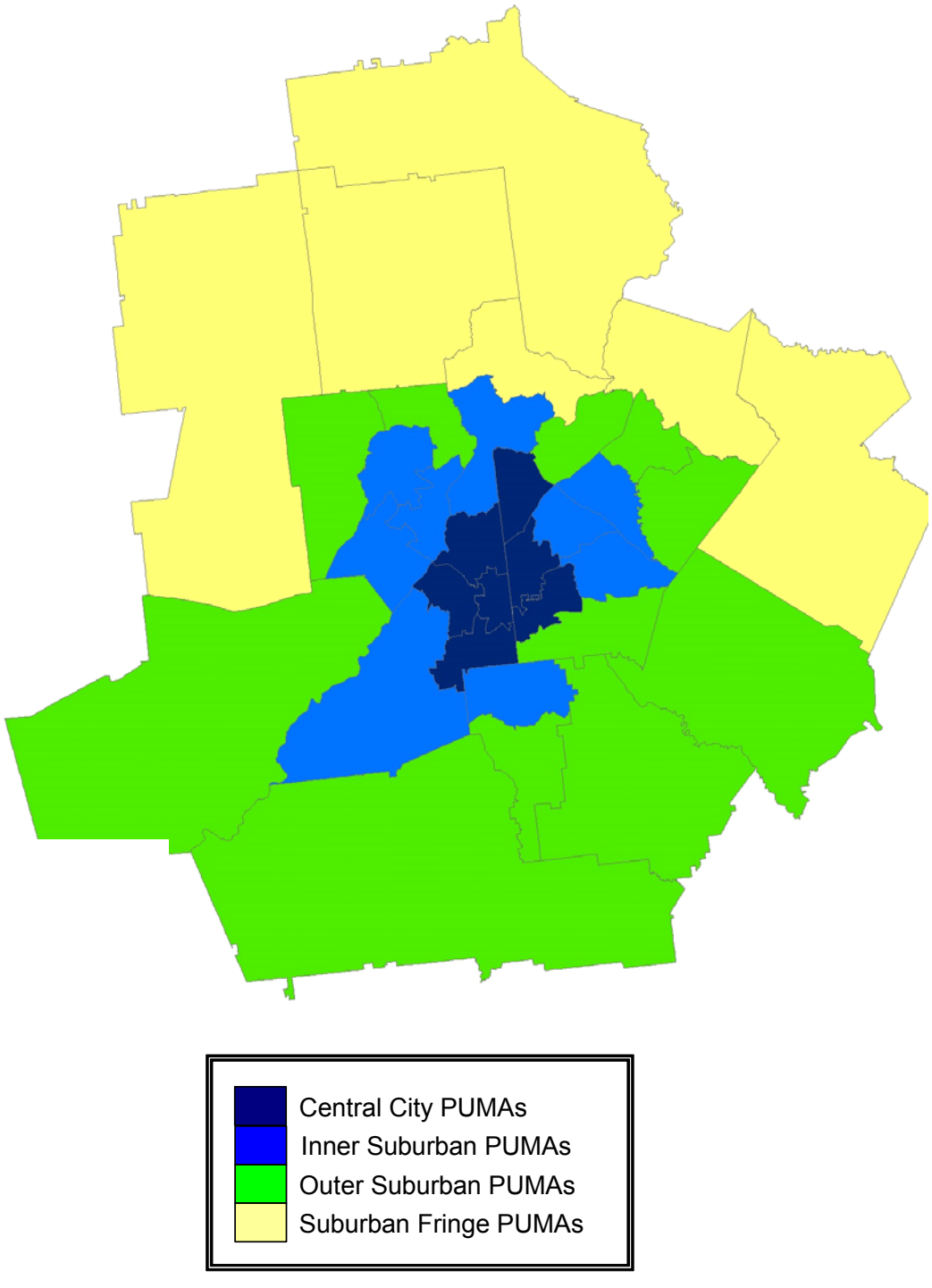
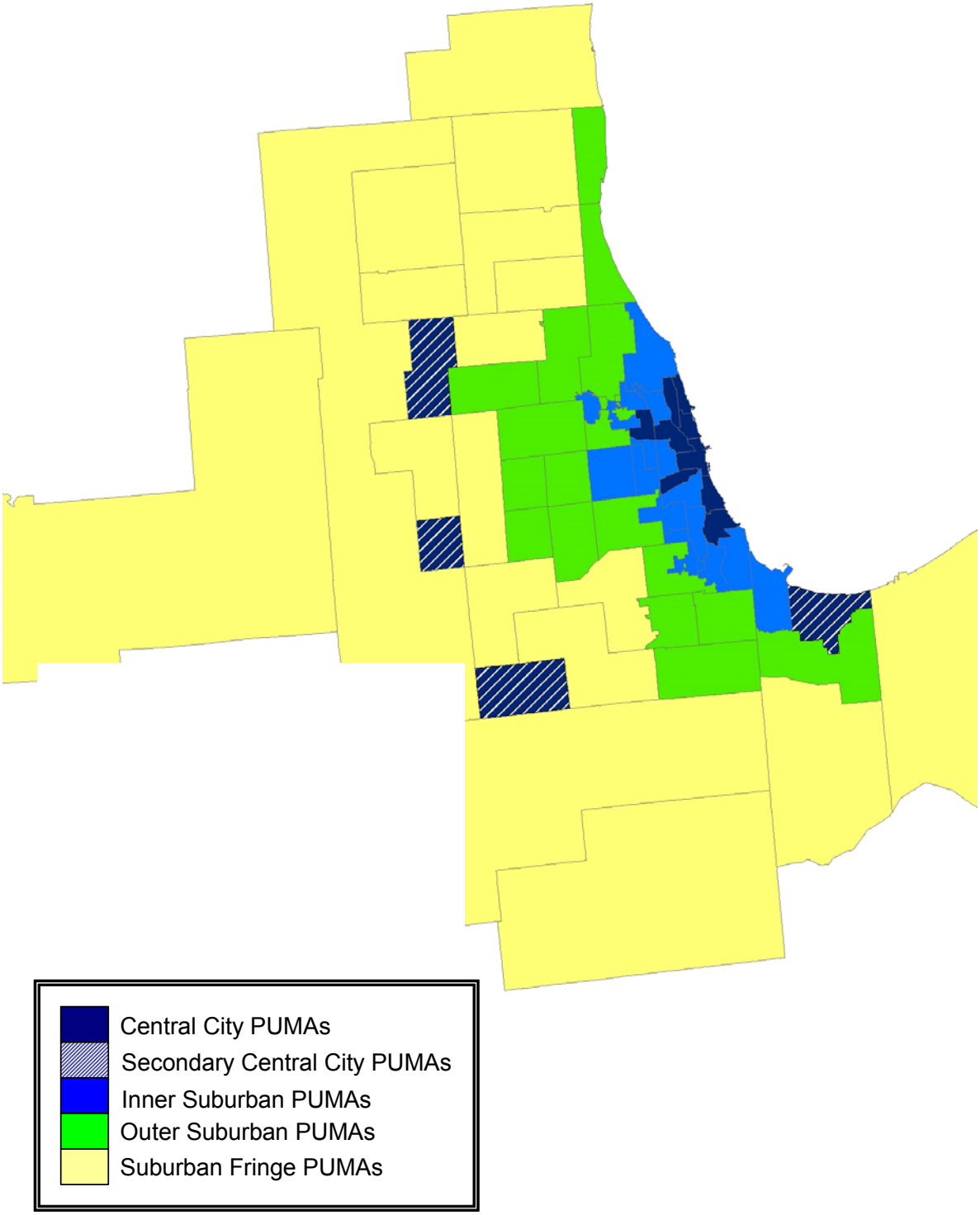
U.S. Census Bureau. Public Use Micro-data Samples. (data and documentation are available at www.census.gov/main/www/pums.html)

APPENDIX A

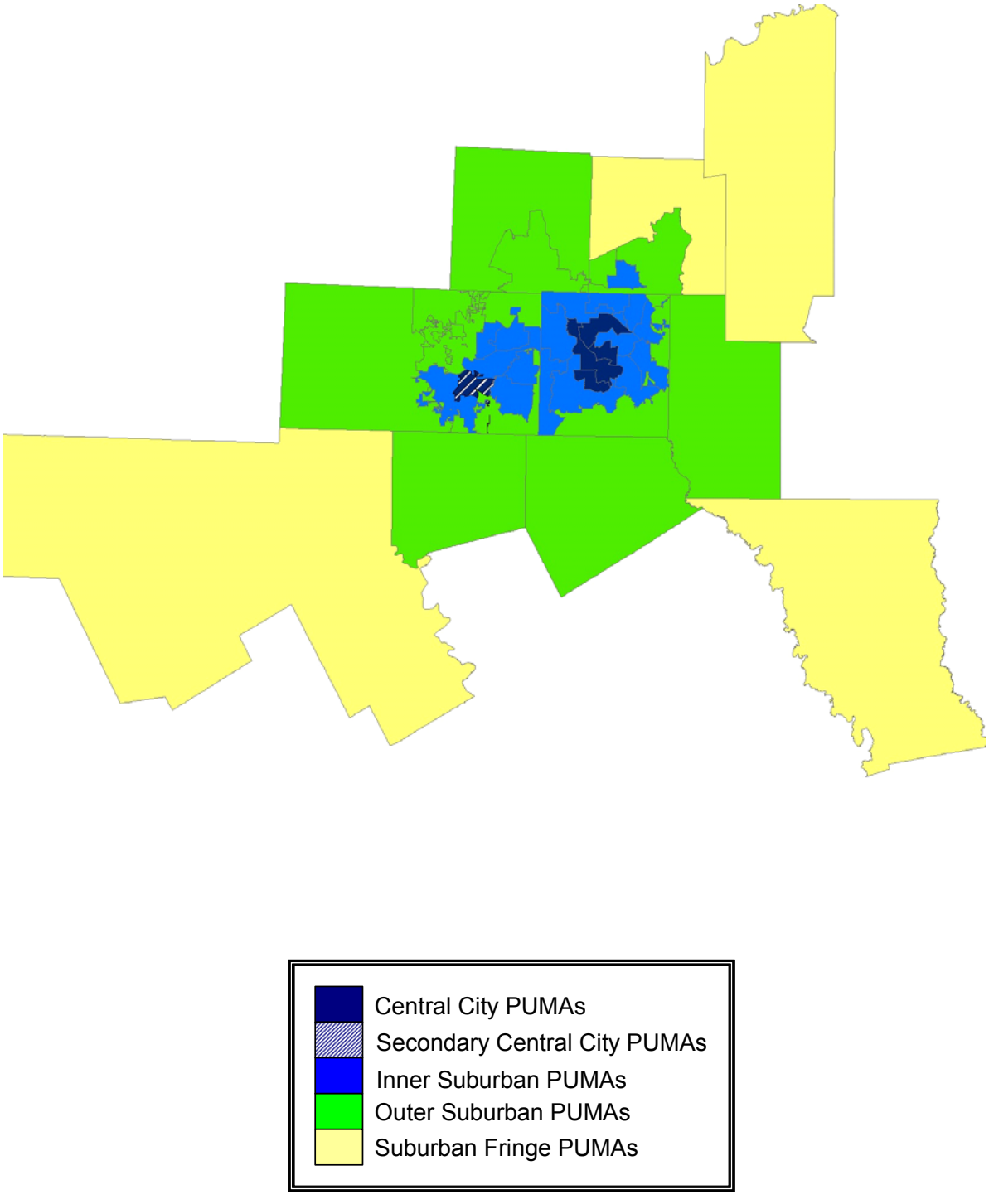
Appendix A-1:
Atlanta Metropolitan Area PUMA Types, 2000



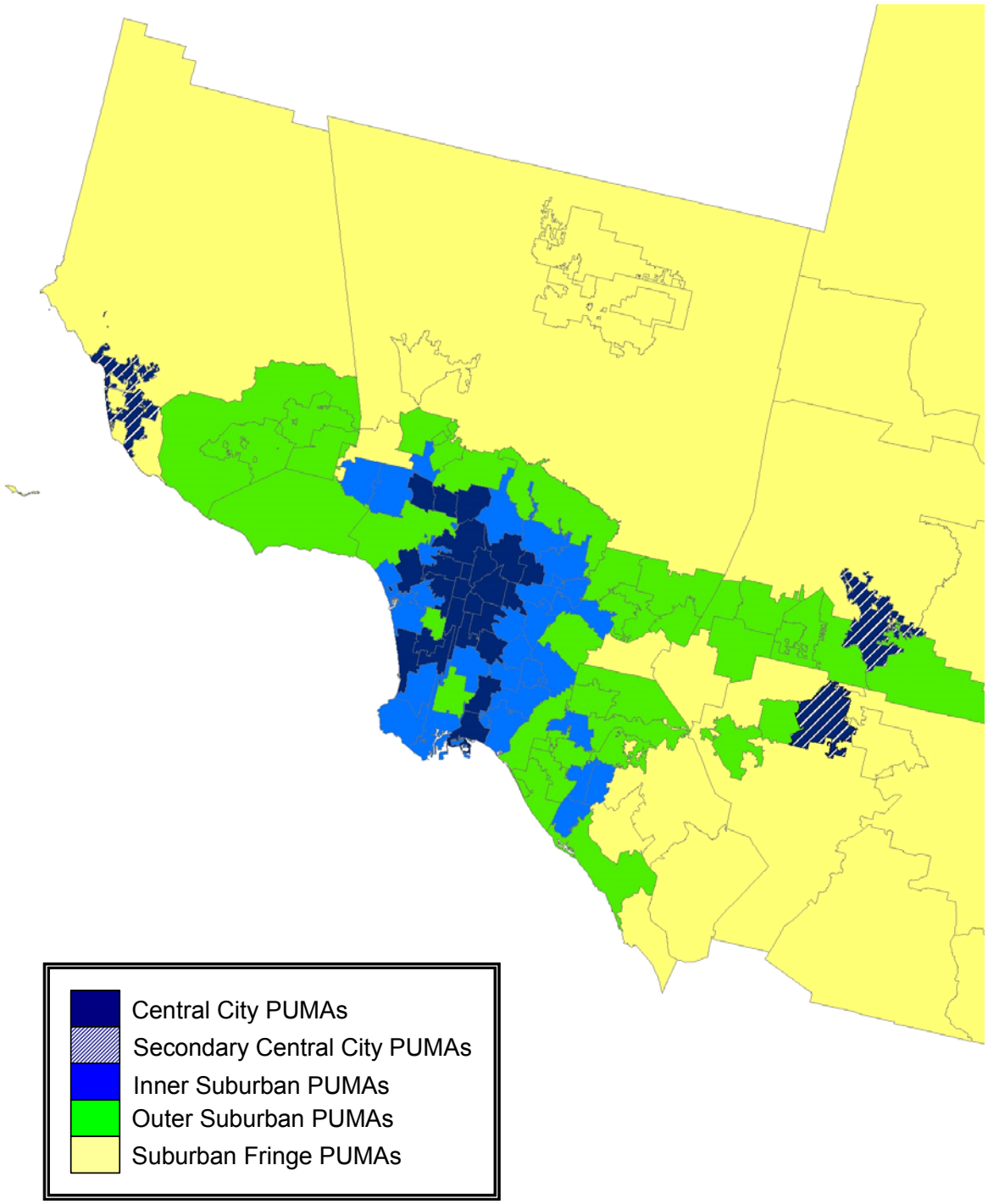
Appendix A-2:
Chicago Metropolitan Area PUMA Types, 2000



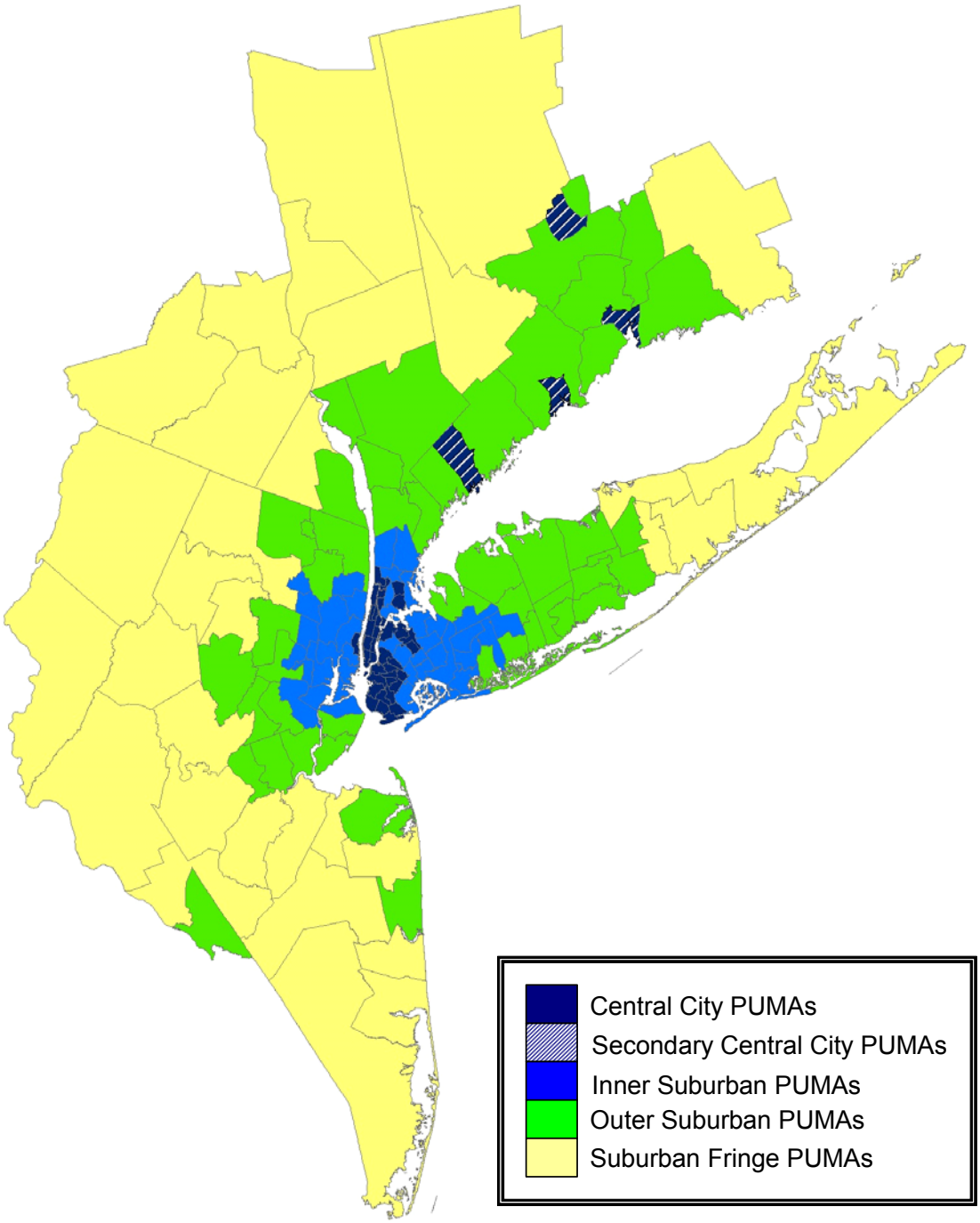
Appendix A-3:
Dallas Ft. Worth Metropolitan Area PUMA Types, 2000



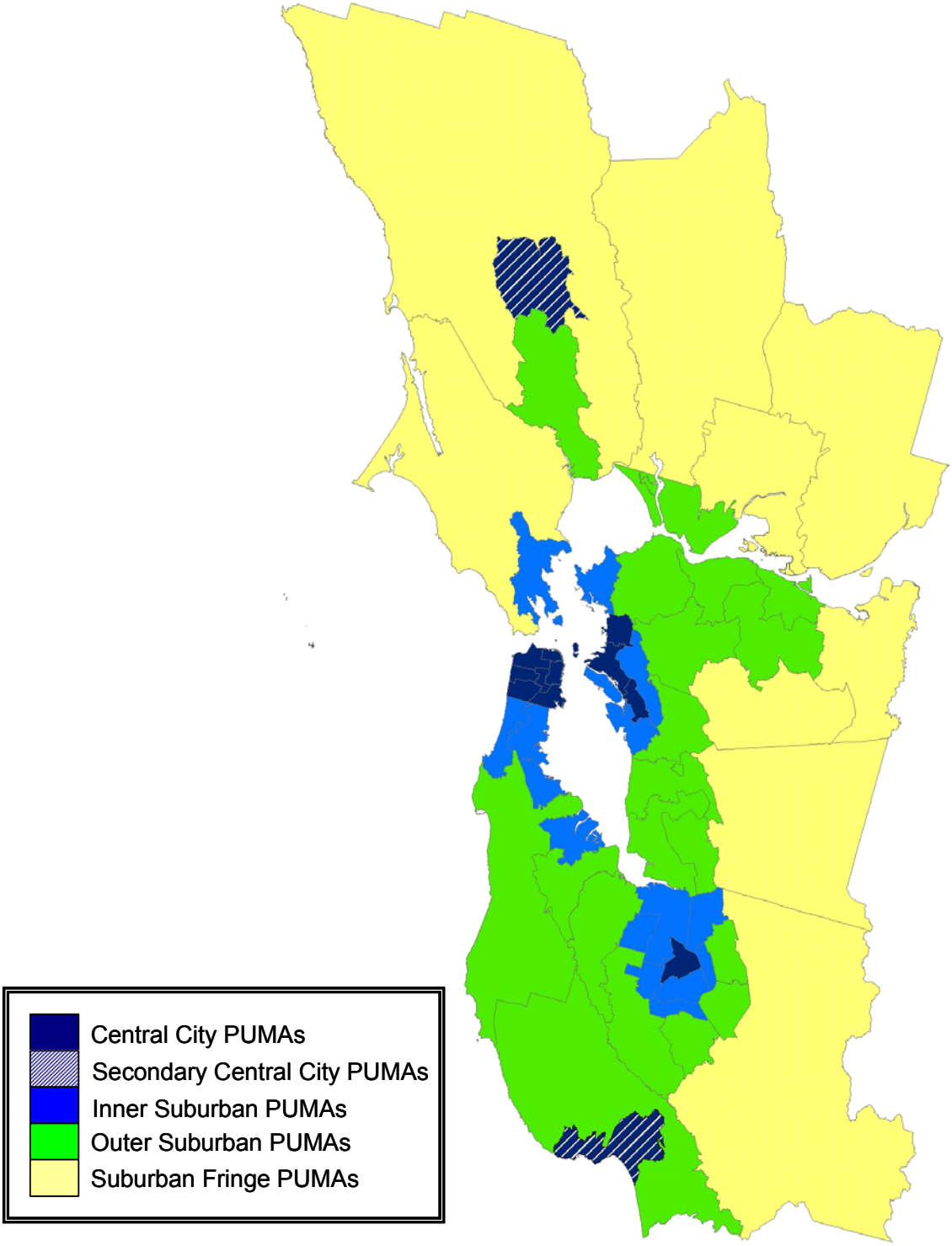
Appendix A-4:
Greater Los Angeles Metropolitan Area PUMA Types, 2000



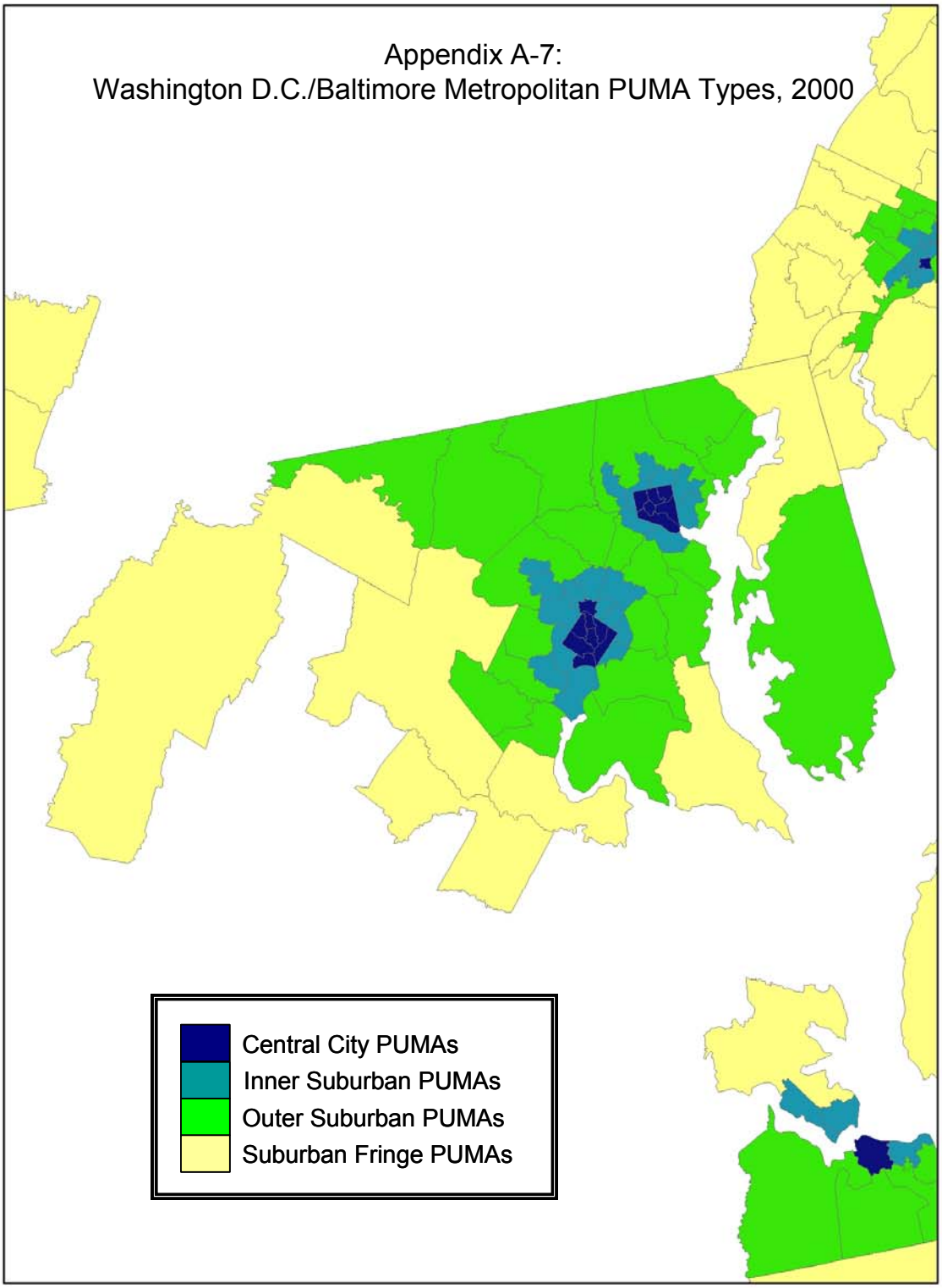
Appendix A-5:
Metropolitan New York PUMA Types, 2000



Appendix A-6:
San Francisco Bay Area Metropolitan PUMA Types, 2000



Appendix A-7:
Washington D.C./Baltimore Metropolitan PUMA Types, 2000



APPENDIX B

Appendix B-1: Working Family Profile: Metropolitan Atlanta

Component Counties:	Working Family Households		Upper-Income Households	
	Recent Mover HHs	Nonmover HHs	Recent Mover HHs	Nonmover HHs
By Location				
% living in central city PUMAs	17%	16%	21%	18%
% living in inner suburban PUMAs	30%	23%	29%	28%
% living in outer suburban PUMAs	35%	40%	30%	37%
% living in suburban fringe PUMAs	18%	21%	21%	16%
By Household Composition				
% married-couple with children	44%	55%	19%	29%
% married couple without children	9%	12%	28%	35%
% single-parent family	15%	16%	3%	5%
% single person households	11%	6%	35%	24%
% multiple families with children	9%	5%	1%	1%
% multiple families without children	13%	6%	14%	6%
By Housing Tenure				
% owner-occupants	47%	81%	65%	91%
% renters	53%	19%	35%	9%
Housing Costs and Burdens				
Owners: Median monthly housing cost	$2,066	$1,318	$2,408	$1,575
Renters: Median monthly rent	$765	$664	$896	$745
Owners: Median household income	$58,905	$55,000	$122,922	$101,000
Renters: Median household income	$38,159	$33,600	$73,141	$57,000
Owners: Median housing cost burden	0.51	0.32	0.31	0.21
Renters: Median housing cost burden	0.31	0.26	0.18	0.17
Commute Modes and Times				
% Commuting trips by car (drive-alone)	92%	94%	93%	93%
% Commuting trips by public transit	5%	4%	2%	2%
% Commuting trips by walking or bicycling	3%	2%	1%	2%
% Commuting trips by other modes	0%	0%	4%	4%
Average commuting time by car (minutes)	30	30	29	30
Average commuting time by public transit	47	49	42	43
Average commuting time by walking or bicycling	23	23	36	32

Source: 2000 PUMS data

Note: Housing costs and burdens include utilities.

Appendix B-2: Working Family Profile: Metropolitan Chicago

Component Counties:	Working Family Households		Upper-Income Households	
	Recent Mover HHs	Nonmover HHs	Recent Mover HHs	Nonmover HHs
By Location				
% living in central city PUMAs	19%	13%	26%	**13%**
% living in secondary central city PUMAs	6%	5%	3%	4%
% living in inner suburban PUMAs	20%	25%	12%	17%
% living in outer suburban PUMAs	28%	30%	29%	36%
% living in suburban fringe PUMAs	28%	27%	30%	30%
By Household Composition				
% married-couple with children	47%	59%	18%	28%
% married couple without children	9%	9%	26%	33%
% single-parent family	15%	17%	3%	6%
% single person households	10%	6%	39%	26%
% multiple families with children	9%	6%	1%	1%
% multiple families without children	11%	4%	13%	6%
By Housing Tenure				
% owner-occupants	47%	77%	61%	88%
% renters	54%	23%	39%	12%
Housing Costs and Burdens				
Owners: Median monthly housing cost	$2,233	$1,467	$2,652	$1,552
Renters: Median monthly rent	$717	$610	$912	$682
Owners: Median household income	$62,289	$61,800	$126,732	$102,300
Renters: Median household income	$37,342	$35,000	$76,237	$59,100
Owners: Median housing cost burden	0.52	0.32	0.35	0.20
Renters: Median housing cost burden	0.30	0.25	0.18	0.15
Commute Modes and Times				
% Commuting trips by car (drive-alone)	82%	87%	76%	84%
% Commuting trips by public transit	13%	10%	17%	11%
% Commuting trips by walking or bicycling	5%	3%	4%	3%
% Commuting trips by other modes	0%	0%	3%	2%
Average commuting time by car (minutes)	29	28	30	28
Average commuting time by public transit	48	51	45	52
Average commuting time by walking or bicycling	18	17	20	19

Source: 2000 PUMS data

Note: Housing costs and burdens include utilities.

Appendix B-3: Working Family Profile: Metropolitan Dallas-Ft. Worth

Component Counties:	Working Family Households		Upper-Income Households	
	Recent Mover HHs	Nonmover HHs	Recent Mover HHs	Nonmover HHs
By Location				
% living in central city PUMAs	10%	10%	10%	8%
% living in secondary central city PUMAs	2%	3%	1%	1%
% living in inner suburban PUMAs	49%	45%	47%	50%
% living in outer suburban PUMAs	31%	31%	36%	34%
% living in suburban fringe PUMAs	8%	11%	6%	7%
By Household Composition				
% married-couple with children	46%	56%	21%	28%
% married couple without children	10%	12%	28%	38%
% single-parent family	15%	15%	3%	5%
% single person households	11%	6%	37%	24%
% multiple families with children	8%	6%	1%	1%
% multiple families without children	11%	5%	11%	5%
By Housing Tenure				
% owner-occupants	39%	77%	54%	88%
% renters	61%	23%	46%	12%
Housing Costs and Burdens				
Owners: Median monthly housing cost	$2,159	$1,440	$2,508	$1,895
Renters: Median monthly rent	$672	$582	$814	$655
Owners: Median household income	$54,951	$50,600	$126,273	$97,000
Renters: Median household income	$34,581	$31,400	$68,997	$54,000
Owners: Median housing cost burden	0.57	0.37	0.32	0.26
Renters: Median housing cost burden	0.30	0.25	0.18	0.16
Commute Modes and Times				
% Commuting trips by car (drive-alone)	94.5%	97%	95%	94%
% Commuting trips by public transit	2.5%	2%	1%	1%
% Commuting trips by walking or bicycling	3.1%	1%	2%	1%
% Commuting trips by other modes	0.0%	0%	3%	4%
Average commuting time by car (minutes)	26	27	26	27
Average commuting time by public transit	46	45	44	45
Average commuting time by walking or bicycling	18	19	30	30

Source: 2000 PUMS data

Note: Housing costs and burdens include utilities.

Appendix B-4: Working Family Profile: Greater Los Angeles

Component Counties:	Working Family Households		Upper-Income Households	
	Recent Mover HHs	Nonmover HHs	Recent Mover HHs	Nonmover HHs
By Location				
% living in central city PUMAs	24%	24%	20%	16%
% living in secondary central city PUMAs	4%	4%	3%	3%
% living in inner suburban PUMAs	23%	25%	23%	24%
% living in outer suburban PUMAs	29%	29%	33%	36%
% living in suburban fringe PUMAs	21%	18%	22%	21%
By Household Composition				
% married-couple with children	49%	58%	21%	30%
% married couple without children	7%	7%	23%	29%
% single-parent family	14%	15%	5%	8%
% single person households	7%	4%	33%	23%
% multiple families with children	13%	11%	2%	2%
% multiple families without children	10%	5%	16%	8%
By Housing Tenure				
% owner-occupants	34%	61%	51%	82%
% renters	67%	39%	49%	18%
Housing Costs and Burdens				
Owners: Median monthly housing cost	$2,202	$1,662	$2,772	$2,002
Renters: Median monthly rent	$790	$700	$1,009	$800
Owners: Median household income	$56,535	$57,600	$132,483	$103,100
Renters: Median household income	$35,371	$33,300	$80,419	$60,000
Owners: Median housing cost burden	0.57	0.39	0.34	0.26
Renters: Median housing cost burden	0.35	0.29	0.19	0.18
Commute Modes and Times				
% Commuting trips by car (drive-alone)	87%	90%	92%	92%
% Commuting trips by public transit	7%	5%	2%	2%
% Commuting trips by walking or bicycling	5%	4%	2%	2%
% Commuting trips by other modes	1%	1%	4%	4%
Average commuting time by car (minutes)	28	27	28	28
Average commuting time by public transit	46	47	51	53
Average commuting time by walking or bicycling	19	17	20	20

Source: 2000 PUMS data

Note: Housing costs and burdens include utilities.

Appendix B-5: Working Family Profile: Metropolitan New York

Component Counties:	Working Family Households		Upper-Income Households	
	Recent Mover HHs	Nonmover HHs	Recent Mover HHs	Nonmover HHs
By Location				
% living in central city PUMAs	24%	24%	28%	21%
% living in secondary central city PUMAs	3%	2%	2%	2%
% living in inner suburban PUMAs	28%	28%	17%	20%
% living in outer suburban PUMAs	22%	25%	30%	35%
% living in suburban fringe PUMAs	22%	21%	23%	23%
By Household Composition				
% married-couple with children	47%	55%	21%	30%
% married couple without children	9%	9%	25%	30%
% single-parent family	14%	18%	3%	7%
% single person households	10%	6%	35%	25%
% multiple families with children	9%	6%	1%	2%
% multiple families without children	11%	6%	14%	7%
By Housing Tenure				
% owner-occupants	37%	58%	52%	77%
% renters	63%	42%	49%	23%
Housing Costs and Burdens				
Owners: Median monthly housing cost	$2,485	$1,860	$2,957	$1,967
Renters: Median monthly rent	$851	$700	$1,168	$800
Owners: Median household income	$67,271	$67,900	$158,432	$122,100
Renters: Median household income	$40,521	$37,600	$100,179	$71,000
Owners: Median housing cost burden	0.54	0.36	0.31	0.21
Renters: Median housing cost burden	0.33	0.26	0.18	0.15
Commute Modes and Times				
% Commuting trips by car (drive-alone)	64%	67%	61%	70%
% Commuting trips by public transit	28%	26%	30%	22%
% Commuting trips by walking or bicycling	7%	7%	6%	5%
% Commuting trips by other modes	1%	0%	3%	3%
Average commuting time by car (minutes)	29	28	31	29
Average commuting time by public transit	50	51	48	53
Average commuting time by walking or bicycling	17	17	17	18

Source: 2000 PUMS data

Note: Housing costs and burdens include utilities.

Appendix B-6: Working Family Profile: San Francisco Bay Area

Component Counties:	Working Family Households		Upper-Income Households	
	Recent Mover HHs	Nonmover HHs	Recent Mover HHs	Nonmover HHs
By Location				
% living in central city PUMAs	19%	19%	21%	18%
% living in secondary central city PUMAs	6%	4%	3%	3%
% living in inner suburban PUMAs	26%	26%	30%	27%
% living in outer suburban PUMAs	33%	34%	32%	36%
% living in suburban fringe PUMAs	17%	16%	14%	16%
By Household Composition				
% married-couple with children	42%	53%	18%	25%
% married couple without children	10%	10%	26%	32%
% single-parent family	12%	14%	3%	5%
% single person households	11%	7%	33%	26%
% multiple families with children	10%	9%	2%	2%
% multiple families without children	16%	7%	19%	10%
By Housing Tenure				
% owner-occupants	36%	66%	51%	82%
% renters	64%	34%	49%	18%
Housing Costs and Burdens				
Owners: Median monthly housing cost	$2,610	$1,982	$3,191	$2,343
Renters: Median monthly rent	$1,060	$883	$1,343	$983
Owners: Median household income	$75,447	$73,300	$168,209	$131,000
Renters: Median household income	$48,075	$44,300	$111,524	$80,000
Owners: Median housing cost burden	0.50	0.36	0.30	0.24
Renters: Median housing cost burden	0.34	0.27	0.18	0.16
Commute Modes and Times				
% Commuting trips by car (drive-alone)	82%	85%	81%	83%
% Commuting trips by public transit	10%	9%	11%	8%
% Commuting trips by walking or bicycling	6%	5%	4%	3%
% Commuting trips by other modes	2%	1%	4%	6%
Average commuting time by car (minutes)	28	27	29	28
Average commuting time by public transit	45	45	44	47
Average commuting time by walking or bicycling	18	19	21	23

Source: 2000 PUMS data

Note: Housing costs and burdens include utilities.

Appendix B-7: Working Family Profile: Metropolitan Washington, D.C./Baltimore

Component Counties:	Working Family Households		Upper-Income Households	
	Recent Mover HHs	Nonmover HHs	Recent Mover HHs	Nonmover HHs
By Location of Residence				
% living in primary or secondary central city PUMAs	21%	20%	25%	18%
% living in inner suburban PUMAs	33%	30%	31%	35%
% living in outer suburban PUMAs	34%	37%	35%	39%
% living in suburban fringe PUMAs	12%	13%	9%	8%
By Household Composition				
% married-couple with children	41%	53%	16%	25%
% married couple without children	9%	11%	28%	35%
% single-parent family	15%	16%	3%	5%
% single person households	13%	7%	37%	27%
% multiple families with children	9%	6%	1%	1%
% multiple families without children	13%	6%	14%	7%
By Housing Tenure				
% owner-occupants	45%	79%	60%	90%
% renters	55%	21%	40%	10%
Housing Costs and Burdens				
Owners: Median monthly housing cost	$2,533	$1,462	$2,947	$1,725
Renters: Median monthly rent	$797	$642	$1,000	$760
Owners: Median household income	$66,338	$63,200	$133,214	$111,200
Renters: Median household income	$41,045	$35,400	$86,042	$66,100
Owners: Median housing cost burden	0.55	0.31	0.35	0.20
Renters: Median housing cost burden	0.30	0.24	0.17	0.15
Commute Modes and Times				
% Commuting trips by car (drive-alone)	83%	88%	82%	86%
% Commuting trips by public transit	12%	9%	11%	8%
% Commuting trips by walking or bicycling	5%	3%	4%	2%
% Commuting trips by other modes	0%	1%	3%	4%
Average commuting time by car (minutes)	30	29	31	30
Average commuting time by public transit	45	46	44	48
Average commuting time by walking or bicycling	19	17	20	20

Source: 2000 PUMS data

Note: Housing costs and burdens include utilities.

APPENDIX C

Appendix C: Detailed Model Results for Non-centric Bid-Rent Models of Housing Cost vs. Travel Time

MODEL 1: Two-stage-least squares Regression: Dependent Variable is TOTAL COMMUTE TIME (per Household)			
Independent Variables (Instrumented)	Coefficient	Standard Error	t-statistic
Housing cost per room	-0.0652688	0.0013447	-48.54
Per room housing cost * Lowest income third (0/1)	-0.0274545	0.0015252	-18
Per room housing cost * Middle income Third (0/1)	-0.0269927	0.0015949	-16.92
Independent Variables (Instrumental Variables)			
Number of drive-alone commuters in household	23.54835	0.022839	1031.06
Recent mover (0/1)	5.293998	0.0486444	108.83
Number of children in household	0.1904699	0.008033	23.71
Householder years of education	-0.0865218	0.0047546	-18.2
Householder age	-0.2099004	0.0024668	-85.09
Lowest income third (0/1)	5.040007	0.4901271	10.28
Middle income third (0/1)	7.671784	0.5343276	14.36
Single-parent household	-2.014429	0.0749231	-26.89
Married-couple/domestic partner family (0/1)	1.52048	0.0588865	25.82
Married-couple/domestic partner family with children (0/1)	1.547237	0.0640187	24.17
Multiple-family household without children (0/1)	0.55619	0.068039	8.17
Multiple-family household with children (0/1)	2.095318	0.0775692	27.01
PUMA population density	0.0002213	2.54E-06	87.11
Homeowner (0/1)	27.92657	0.2133903	130.87
Atlanta MSA location (0/1)		(dropped)	
Chicago MSA location (0/1)	-1.578733	0.0564666	-27.96
Dallas-Ft. Worth MSA location (0/1)	-1.475148	0.0652271	-22.62
Greater Los Angeles MSA location (0/1)	8.578741	0.1307146	65.63
Greater New York City MSA location (0/1)	1.695945	0.0724465	23.41
San Francisco Bay Area MSA location (0/1)	12.75768	0.1705577	74.8
Constant	30.37471	0.5131635	59.19
R-squared		0.03	
F-statistic		93,877	
Observations		8,870,834	

Appendix C: Detailed Model Results for Non-centric Bid-Rent Models of Housing Cost vs. Travel Time

MODEL II: Two-stage-least squares Regression: Dependent Variable is TOTAL AUTO-BASED COMMUTE TIME			
Independent Variables (Instrumented)	Coefficient	Standard Error	t-statistic
Housing cost per room	-0.0652688	0.0013447	-48.54
Per room housing cost * Lowest income third (0/1)	-0.0274545	0.0015252	-18
Per room housing cost * Middle income Third (0/1)	-0.0269927	0.0015949	-16.92
Independent Variables (Instrumental Variables)			
Number of drive-alone commuters in household	23.54835	0.022839	1031.06
Recent mover (0/1)	5.293998	0.0486444	108.83
Number of children in household	0.1904699	0.008033	23.71
Householder years of education	-0.0865218	0.0047546	-18.2
Householder age	-0.2099004	0.0024668	-85.09
Lowest income third (0/1)	5.040007	0.4901271	10.28
Middle income third (0/1)	7.671784	0.5343276	14.36
Single-parent household	-2.014429	0.0749231	-26.89
Married-couple/domestic partner family (0/1)	1.52048	0.0588865	25.82
Married-couple/domestic partner family with children (0/1)	1.547237	0.0640187	24.17
Multiple-family household without children (0/1)	0.55619	0.068039	8.17
Multiple-family household with children (0/1)	2.095318	0.0775692	27.01
PUMA population density	0.0003756	2.54E-06	147.61
Homeowner (0/1)	18.74434	0.192391	97.43
Atlanta MSA location (0/1)	-7.00488	0.1586158	-44.16
Chicago MSA location (0/1)	-10.0254	0.1407387	-71.23
Dallas-Ft. Worth MSA location (0/1)	-10.13717	0.1305382	-77.66
Greater Los Angeles MSA location (0/1)	-3.499303	0.0591283	-59.18
Greater New York City MSA location (0/1)	-9.66515	0.1145628	-84.37
San Francisco Bay Area MSA location (0/1)		(dropped)	
Constant	27.97988	0.5147328	54.36
R-squared		0.126	
F-statistic		72,308	
Observations		7,522,860	

Appendix C: Detailed Model Results for Non-centric Bid-Rent Models of Housing Cost vs. Travel Time

MODEL III: Two-stage-least square Regression: Dependent Variable is TOTAL TRANSIT COMMUTE TIME			
Independent Variables (Instrumented)	Coefficient	Standard Error	t-statistic
Housing cost per room	-0.0652688	0.0013447	-48.54
Per room housing cost * Lowest income third (0/1)	-0.0274545	0.0015252	-18
Per room housing cost * Middle income Third (0/1)	-0.0269927	0.0015949	-16.92
Independent Variables (Instrumental Variables)			
Number of drive-alone commuters in household	23.54835	0.022839	1031.06
Recent mover (0/1)	5.293998	0.0486444	108.83
Number of children in household	0.1904699	0.008033	23.71
Householder years of education	-0.0865218	0.0047546	-18.2
Householder age	-0.2099004	0.0024668	-85.09
Lowest income third (0/1)	5.040007	0.4901271	10.28
Middle income third (0/1)	7.671784	0.5343276	14.36
Single-parent household	-2.014429	0.0749231	-26.89
Married-couple/domestic partner family (0/1)	1.52048	0.0588865	25.82
Married-couple/domestic partner family with children (0/1)	1.547237	0.0640187	24.17
Multiple-family household without children (0/1)	0.55619	0.068039	8.17
PUMA population density	-0.0001733	2.56E-06	-67.73
Homeowner (0/1)	12.6064	0.3269066	38.56
Atlanta MSA location (0/1)	2.55023	0.2578928	9.89
Chicago MSA location (0/1)	4.97899	0.2091876	23.8
Dallas-Ft. Worth MSA location (0/1)		(dropped)	
Greater Los Angeles MSA location (0/1)	8.050011	0.2627537	30.64
Greater New York City MSA location (0/1)	13.18028	0.2124138	62.05
San Francisco Bay Area MSA location (0/1)	2.996632	0.2752819	10.89
Constant	-23.46649	0.6595619	-35.58
R-squared		0.43	
F-statistic		20,875	
Observations		1,593,250	

APPENDIX D

Appendix D-1: Atlanta Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Observations	924,080	268,832	238,336	464,208	423,808	381,296
Log-likelihood Ratio	-92308.0	-29818.9	-28048.0	-54960.9	-46387.9	-40129.2
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
DRIVE ALONE/No vehicles owned/Central City PUMA	-0.3455266	0.6796916	0.2969138	-0.308259	1.87102	2.433477
CARPOOL/No vehicles owned/Central City PUMA	-3.299009	-0.0635144	0.4779275	-0.3179365	2.252152	0.1502818
PUBLIC TRANSIT/No vehicles owned/Central City PUMA	-1.523046	1.196959	1.180063	0.9147454	2.842303	4.180843
BIKE-PEDESTRIAN/No vehicles owned/Central City PUMA	-0.9183026	1.526989	-0.3246735	-0.2884683	2.920702	25.04987
DRIVE ALONE/No vehicles owned/Inner Suburb PUMA	-0.8792925	0.0472483	0.285194	0.327152	2.964328	2.09808
CARPOOL/No vehicles owned/Inner Suburb PUMA	-2.542075	-0.7106501	-0.0146995	0.0659507	1.397342	0.6730142
PUBLIC TRANSIT/No vehicles owned/Inner Suburb PUMA	-3.614131	-1.111536	-0.9598469	-1.636096	0.9200607	2.492461
BIKE-PEDESTRIAN/No vehicles owned/Inner Suburb PUMA	-0.0261733	-0.4189207	-1.966378	0.1782178	2.073283	23.89916
DRIVE ALONE/No vehicles owned/Outer Suburb PUMA	-0.903019	0.8340519	0.4422996	0.2598274	2.776413	2.025278
CARPOOL/No vehicles owned/Outer Suburb PUMA	-7.96E+14	0.0363811	-1.81199	-2.491553	1.56913	-0.1117387
PUBLIC TRANSIT/No vehicles owned/Outer Suburb PUMA	-1.38E+15	-1.267656	-1.924793	-0.4157995	0.5378768	0.384077
BIKE-PEDESTRIAN/No vehicles owned/Outer Suburb PUMA	-0.9717818	-46.66231	-0.1886477	-0.4902531	1.59139	23.72576
DRIVE ALONE/No vehicles owned/Fringe Suburb PUMA	-1.32336	-36.30131	-1.232061	-7.24E+16	2.91042	
CARPOOL/No vehicles owned/Fringe Suburb PUMA	-1.08E+15	-48.92185	-4489.951	-7.10E+16	1.026159	
PUBLIC TRANSIT/No vehicles owned/Fringe Suburb PUMA	-1.92E+15	-1.277694	-4086.859	-1.245025	-0.2534722	
BIKE-PEDESTRIAN/No vehicles owned/Fringe Suburb PUMA	17.08809	19.99061	21.71031	7.375862	-0.2412363	
DRIVE ALONE/1 vehicle owned/Central City PUMA	17.36107	19.85723	22.34887	7.287601	3.059296	
CARPOOL/1 vehicle owned/Central City PUMA	17.06233	19.14379	20.35577	6.733805	2.326857	
PUBLIC TRANSIT/1 vehicle owned/Central City PUMA	15.15438	19.72192	19.74634	5.895328	-2.99E+16	
BIKE-PEDESTRIAN/1 vehicle owned/Central City PUMA	17.92866	21.30509	21.91734	7.38067	3.002339	
DRIVE ALONE/1 vehicle owned/Inner Suburb PUMA	17.92295	20.36207	22.08527	7.772397	2.36724	
CARPOOL/1 vehicle owned/Inner Suburb PUMA	15.25834	17.92307	19.79648	5.820304	-0.6806733	
PUBLIC TRANSIT/1 vehicle owned/Inner Suburb PUMA	15.29155	-26.8342	19.32291	4.811884	-6.13E+16	
BIKE-PEDESTRIAN/1 vehicle owned/Inner Suburb PUMA	18.71886	20.92686	22.54659	7.558948	2.91146	
DRIVE ALONE/1 vehicle owned/Outer Suburb PUMA	18.25186	20.83605	22.11478	7.204402	1.612387	
CARPOOL/1 vehicle owned/Outer Suburb PUMA	15.9245	-26.98918	-1442.949	3.994917	-0.9035794	
PUBLIC TRANSIT/1 vehicle owned/Outer Suburb PUMA	14.34609	-97.25105	19.09218	4.69483	-4.79E+16	
BIKE-PEDESTRIAN/1 vehicle owned/Outer Suburb PUMA	17.98578	19.68533	22.37001	5.898182	2.416049	
DRIVE ALONE/1 vehicle owned/Fringe Suburb PUMA	17.54671	19.96564	21.43896	6.885796	0.6446417	
CARPOOL/1 vehicle owned/Fringe Suburb PUMA	-2.30E+15	-26.62658	-2461.97	4.386449	-1.54E+17	
PUBLIC TRANSIT/1 vehicle owned/Fringe Suburb PUMA	-2.68E+15	-659.1511	18.68942	-2.62E+16	-1.12E+17	
BIKE-PEDESTRIAN/1 vehicle owned/Fringe Suburb PUMA	4.883852	37.37775	17.00264	23.28464	16.19729	
DRIVE ALONE/2 vehicles owned/Central City PUMA	3.798297	34.9649	16.21317	21.02119	13.97746	26.9809
CARPOOL/2 vehicles owned/Central City PUMA	1.782964	34.90531	15.63535	20.91218	12.54319	29.33983
PUBLIC TRANSIT/2 vehicles owned/Central City PUMA	0.7309962	34.88075	15.36675	20.39681	-4.90E+17	50.86958
BIKE-PEDESTRIAN/2 vehicles owned/Central City PUMA	6.24683	38.52322	18.35301	23.54341	17.0199	31.45672
DRIVE ALONE/2 vehicles owned/Inner Suburb PUMA	4.842229	36.50366	17.30819	21.83644	14.25556	27.80791
CARPOOL/2 vehicles owned/Inner Suburb PUMA	2.89619	34.15616	12.98407	19.63883	11.92498	28.51182
PUBLIC TRANSIT/2 vehicles owned/Inner Suburb PUMA	-9.08E+15	33.68547	15.30899	18.99543	-4.81E+17	49.10975
BIKE-PEDESTRIAN/2 vehicles owned/Inner Suburb PUMA	6.920373	38.85593	18.21422	23.2154	17.03893	31.31247

Appendix D-1: Atlanta Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
DRIVE ALONE/2 vehicles owned/Outer Suburb PUMA	5.117389	37.11196	16.71466	21.41178	14.51442	26.94732
CARPOOL/2 vehicles owned/Outer Suburb PUMA	2.108428	33.52027	-5027.178	-3.22E+16	9.584179	26.45759
PUBLIC TRANSIT/2 vehicles owned/Outer Suburb PUMA	0.6491804	-6.016336	-3790.901	-2.30E+16	12.23049	47.95293
BIKE-PEDESTRIAN/2 vehicles owned/Outer Suburb PUMA	6.332283	38.44106	17.70061	21.60368	15.98222	30.21313
DRIVE ALONE/2 vehicles owned/Fringe Suburb PUMA	4.532631	36.62396	16.16769	19.26216	12.8775	26.52478
CARPOOL/2 vehicles owned/Fringe Suburb PUMA	1.641602	-4.610338	-9315.219	-5.16E+16	10.34778	-4.94E+17
PUBLIC TRANSIT/2 vehicles owned/Fringe Suburb PUMA	1.209211	-8.543485	14.42981	-3.97E+16	11.07877	-3.85E+17
DRIVE ALONE/Occupation-specific auto accessibility	8.86E-10	9.98E-10	4.80E-10	1.77E-10	-6.25E-10	6.16E-11
CARPOOL/Occupation-specific auto accessibility	5.59E-12	1.24E-09	2.05E-10	-1.03E-10	-6.90E-10	-6.53E-10
PUBLIC TRANSIT/Occupation-specific transit accessibility	-8.39E-09	1.02E-08	-5.68E-09	1.36E-09	-5.96E-09	-8.17E-09
BIKE-PED/Occupation-specific transit accessibility	-1.27E-08	-2.79E-08	-3.33E-08	-4.94E-09	-3.58E-08	-2.10E-08
DRIVE ALONE/Female trip-maker	-0.9272016	-5.455478	-0.4498204	0.6185452	-0.6715936	0.5864845
CARPOOL/Female trip-maker	-0.6024337	-5.774974	-0.5530405	-0.0093444	-0.0990499	0.0053537
PUBLIC TRANSIT/Female trip-maker	-0.6043362	-5.020709	-0.0327647	0.3584782	0.7704335	-0.2316979
BIKE-PED/Female trip-maker	0.0129749	-38.63801	-0.343895	-0.0089899	-1.037049	-0.5331555
DRIVE ALONE/45-64 year-old trip-maker	32.01336	15.47154	-2901.603	22.25642	31.20226	26.44761
CARPOOL/45-64 year-old trip-maker	-7.22E+14	15.45953	361.0967	22.957	-1.21E+16	-5.24E+16
PUBLIC TRANSIT/45-64 year-old trip-maker	-7.59E+14	-41.96595	-693.8873	-1.77E+15	-3.93E+15	29.62961
BIKE-PED/45-64 year-old trip-maker	-1.35E+15	-31.93267	-949.7977	-9.62E+15	-1.79E+16	-1.63E+15
DRIVE ALONE/45-64 year-old trip-maker	-0.3004013	0.5527745	-0.6912927	0.6141427	0.3429088	0.0295973
CARPOOL/45-64 year-old trip-maker	-0.6063138	0.8918972	-0.6941529	0.5823575	0.209153	0.089293
PUBLIC TRANSIT/45-64 year-old trip-maker	-0.5337111	-0.0333797	0.5775272	0.1090933	0.4673501	0.1832096
BIKE-PED/45-64 year-old trip-maker	0.1672357	0.0626332	-0.8384588	-0.0948069	-0.462351	0.164096
DRIVE ALONE/Single-worker households trip-maker						
CARPOOL/Single-worker households trip-maker						
PUBLIC TRANSIT/Single-worker households trip-maker						
BIKE-PED/Single-worker households trip-maker						
DRIVE ALONE/Disabled trip-maker	-0.3004013	0.5527745	-0.6912927	0.6141427	0.3429088	0.0295973
CARPOOL/Disabled trip-maker	-0.6063138	0.8918972	-0.6941529	0.5823575	0.209153	0.089293
PUBLIC TRANSIT/Disabled trip-maker	-0.5337111	-0.0333797	0.5775272	0.1090933	0.4673501	0.1832096
BIKE-PED/Disabled trip-maker	0.1672357	0.0626332	-0.8384588	-0.0948069	-0.462351	0.164096
Constants						
Central City PUMA Type (Level 2 model only)	0.9992829	1	0.6980905	2.11064	1.016348	1.000696
Inner Suburb PUMA Type (Level 2 model only)	1.000962	1	0.7046941	2.103053	0.9917828	0.9964206
Outer Suburb PUMA Type (Level 2 model only)	0.9975665	0.9999998	0.7039164	2.123766	0.9970638	1.003652
Fringe Suburb PUMA Type (Level 2 model only)	1.00672	1	0.7041555	2.218983	1.002258	0.9982256

Appendix D-1: Atlanta Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Level 1: Choice of PUMA Type						
INNER SUBURB PUMA choice	0.1060001	0.2461574	-0.0949301	-0.6804201	-0.5517775	
CENTRAL CITY PUMA choice * Household Income	1.80E-06	-8.20E-06	4.74E-06	-4.71E-06	-4.17E-06	-0.0000235
INNER SUBURB PUMA choice * Household Income	2.80E-06	-2.27E-06	9.46E-06	9.65E-06	0.0000119	0.0000282
OUTER SUBURB PUMA choice * Household Income	2.29E-06	4.47E-06	3.47E-06	-6.56E-06	7.73E-06	2.51E-07
FRINGE SUBURB PUMA choice * Household Income	1.54E-06	4.68E-06	1.91E-06	9.47E-06	-5.47E-06	0.0000282
CENTRAL CITY PUMA choice * Renter Dummy Variable	0.9824728	0.8003217	0.4010921	0.7481622	0.5877467	0.9634055
INNER SUBURB PUMA choice * Renter Dummy Variable	0.4868607	0.3319439	0.1626589	0.5456992	0.5488547	0.5110962
OUTER SUBURB PUMA choice * Renter Dummy Variable	-0.5632057	-0.2200846	-0.9686372	-0.6453258	-0.6167187	-0.4424794
FRINGE SUBURB PUMA choice * Renter Dummy Variable	-0.8718363	-0.4658819	-0.6166343	-0.9304099	-0.7282426	-1.442735
CENTRAL CITY PUMA choice * Condo Owner Dummy Variable	-5458219	9.350497	-4137.44	0.9742543	5.890121	3.210202
INNER SUBURB PUMA choice * Condo Owner Dummy Variable	4.005047	8.993443	8.941578	0.6998349	5.296993	2.860362
OUTER SUBURB PUMA choice * Condo Owner Dummy Variable	1.809797	-8.889485	9.583898	0.0444752	3.339965	0.3864976
FRINGE SUBURB PUMA choice * Condo Owner Dummy Variable	2.786953	-8.685264	9.852124	-0.0646271	-4.22E+07	-6.45E+07
CENTRAL CITY PUMA choice * Persons in Household	-0.014856	-0.0204579	0.1153035	-0.0147116	-0.0046539	
INNER SUBURB PUMA choice * Persons in Household	0.014686	-0.0066537	0.0000585	-0.0768057	-0.148043	
OUTER SUBURB PUMA choice * Persons in Household	-0.0165688	0.0118203	-0.0251652	-0.0334255	0.0295369	
FRINGE SUBURB PUMA choice * Persons in Household	-0.017863	-0.0097451	-0.0277772	0.0555534	0.1060441	
CENTRAL CITY PUMA choice * White HH Head Dummy Variable	-0.4739263	-0.2922404	-0.0161755	-0.6489961	-0.8476171	-0.8007834
INNER SUBURB PUMA choice * White HH Head Dummy Variable	-0.4292515	-0.270689	0.9201466	-1.082997	-0.134084	-1.134024
OUTER SUBURB PUMA choice * White HH Head Dummy Variable	0.648761	0.2982544	2.012082	-0.0683128	1.029337	-0.4002056
FRINGE SUBURB PUMA choice * White HH Head Dummy Variable	1.688268	0.5213578	3.43272	0.8136628	2.461054	1.50988
CENTRAL CITY PUMA choice * Female HH Head Dummy Variable	0.2904802	0.0776725	0.0247571	0.1285003	-0.3151829	0.1639874
INNER SUBURB PUMA choice * Female HH Head Dummy Variable	0.2522155	-0.1030375	-0.6526122	0.4305806	0.3070145	0.3491202
OUTER SUBURB PUMA choice * Female HH Head Dummy Variable	-0.146268	-0.094029	-0.6704126	-0.2239058	-0.1452261	-0.1167068
FRINGE SUBURB PUMA choice * Female HH Head Dummy Variable	-0.4498398	-0.0817747	-1.268279	0.0414662	-0.0795557	-0.2859436
CENTRAL CITY PUMA choice * Senior HH Head Dummy Variable	5.882594	0.9288109	44.60744	8.383957	2.636204	10.73543
INNER SUBURB PUMA choice * Senior HH Head Dummy Variable	-2920787	-0.3010008	-3271954	7.934958	3.338841	10.2054
OUTER SUBURB PUMA choice * Senior HH Head Dummy Variable	4.526064	0.1974086	-4040538	-1964673	2.227645	-7.97E+07
FRINGE SUBURB PUMA choice * Senior HH Head Dummy Variable	4.76032	-0.0833725	-8834032	-5054445	-2.82E+07	-1.64E+08
CENTRAL CITY PUMA choice * Age 45-64 HH Head Dummy Variable	0.2685831	0.1381966	-0.1508834	-0.4614857	-0.2278175	-0.2393973
INNER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.3193209	-0.0424905	0.2240744	-0.2817663	-0.0942403	-0.1948516
OUTER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.5936269	0.1231773	0.5426065	-0.0961728	0.0018381	0.1359956
FRINGE SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.6667919	0.3095333	-0.5441877	0.255574	0.3198694	0.2786366
CENTRAL CITY PUMA choice * Single-worker HH Dummy Variable	0.4409435	-0.0605344	0.2468623	0.1328086	-0.1207552	
INNER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.042782	-0.016567	-0.3691045	-0.2163105	0.1407354	-0.6109777
OUTER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.1134499	-0.167011	0.3792782	0.0942751	-0.1620186	
FRINGE SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.0727612	0.0154679	0.0022608	0.2900867	0.2717128	
PUMA Average High School Test Score	-0.069033	-0.0202888	-0.1202675	-0.1028013	-0.0980579	-0.0794589
PUMA Average Occupation-specific Auto Accessibility	-8.73E-10	-1.08E-09	-9.69E-10	-1.42E-09	-3.80E-10	-7.69E-10
PUMA Average Auto Accessibility	-5.73E-10	-6.03E-11	-9.63E-10	-6.46E-10	-4.71E-10	-4.19E-10

Appendix D-2: Chicago Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Observations	1863060	462960	421760	712200	740500	742640
Log-likelihood Ratio	-182656	-48656	-46470	-78485	-75074	-73047
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
DRIVE ALONE/No vehicles owned/Central City PUMA	0.4678265	-0.4467158	0.0160527	-0.1503506	1.897521	0.461511
PUBLIC TRANSIT/No vehicles owned/Central City PUMA	1.796498	1.452408	-0.3841385	-0.7770593	1.874922	0.4647701
BIKE-PEDESTRIAN/No vehicles owned/Central City PUMA	0.170017	0.3586513	-0.5442937	1.029481	3.15999	3.093739
DRIVE ALONE/No vehicles owned/Secondary City PUMA	-1.087059	-0.6311873	-1.26685	-1.514609	2.163475	-0.4315255
CARPOOL/No vehicles owned/Secondary City PUMA	0.6141601	-0.3878857	-2.416232	-1.790038	-1.625228	0.9520282
PUBLIC TRANSIT/No vehicles owned/Secondary City PUMA	-1.44E+14	-4.87E+16	-2.275167	-1.12E+23	-0.9631912	-1.198731
BIKE-PEDESTRIAN/No vehicles owned/Secondary City PUMA	-0.3703182	-0.1720904	-2.05E+50	-1.01E+21	-1.800078	
DRIVE ALONE/No vehicles owned/Inner Suburb PUMA	0.7085181	0.4196155	0.197511	-0.7414935	-2.094759	-0.2575559
CARPOOL/No vehicles owned/Inner Suburb PUMA	0.0713783	-0.3139544	-0.2543429	-1.011682	2.278406	0.0568343
PUBLIC TRANSIT/No vehicles owned/Inner Suburb PUMA	1.515796	0.2356881	0.6180602	-0.1224722	2.107855	1.660162
BIKE-PEDESTRIAN/No vehicles owned/Inner Suburb PUMA	0.3621381	-2.56E+16	-2.826616	-0.9302403	3.166873	-1.569324
DRIVE ALONE/No vehicles owned/Outer Suburb PUMA	0.7881751	-0.1885964	-0.8947943	-1.033818	1.513516	0.2330169
CARPOOL/No vehicles owned/Outer Suburb PUMA	-0.0448018	-1.525055	-0.9863342	-1.086596	1.448427	-0.293035
PUBLIC TRANSIT/No vehicles owned/Outer Suburb PUMA	-0.0372023	-0.1050399	-1.901357	-2.170487	0.4557919	0.7854326
BIKE-PEDESTRIAN/No vehicles owned/Outer Suburb PUMA	-0.2998077	-0.5507635	-1.71E+21	-1.81307	0.4781953	-1.383153
DRIVE ALONE/No vehicles owned/Fringe Suburb PUMA	1.288783	0.6133391	0.1399617	-0.9759527	-0.8223683	
CARPOOL/No vehicles owned/Fringe Suburb PUMA	0.1545243	-2.70E+16	-0.3945035	-2.714928	-1.703022	
PUBLIC TRANSIT/No vehicles owned/Fringe Suburb PUMA	-9.37E+13	-2.30E+16	-5.05E+20	-2.435745	-1.165901	0.6632344
BIKE-PEDESTRIAN/No vehicles owned/Fringe Suburb PUMA	-0.210697	-2.03E+16	-2.17E+20	-1.399878	-2.321493	-1.307804
DRIVE ALONE/1 vehicle owned/Central City PUMA	9.544308	20.31327	16.20027	22.35968	-2.323157	1.52632
CARPOOL/1 vehicle owned/Central City PUMA	8.96112	19.8963	15.44225	21.71976	1.481708	0.3298168
PUBLIC TRANSIT/1 vehicle owned/Central City PUMA	9.048103	20.11803	15.00018	21.73662	1.481461	1.253903
BIKE-PEDESTRIAN/1 vehicle owned/Central City PUMA	7.543477	18.8662	14.95914	20.60775	-0.1147172	-1.865547
DRIVE ALONE/1 vehicle owned/Secondary City PUMA	6.462727	14.08182	15.88978	21.7968	0.0124156	0.6919706
CARPOOL/1 vehicle owned/Secondary City PUMA	6.244979	13.11983	16.60742	21.52443	-0.4322927	-0.4336525
PUBLIC TRANSIT/1 vehicle owned/Secondary City PUMA	5.533545	-1.59E+16	14.44083	-4.04E+17	-3.12E+17	-2.230473
BIKE-PEDESTRIAN/1 vehicle owned/Secondary City PUMA	-1.31E+14	-1.43E+16	-798.1293	-3.37E+17	-3.67E+17	-3.006014
DRIVE ALONE/1 vehicle owned/Inner Suburb PUMA	8.802188	17.3076	15.62206	22.15346	1.83135	0.8116952
CARPOOL/1 vehicle owned/Inner Suburb PUMA	8.307717	16.43114	14.76942	21.82917	1.036902	-1.242022
PUBLIC TRANSIT/1 vehicle owned/Inner Suburb PUMA	7.327305	16.61183	14.69303	21.01471	0.5243486	-0.395196
BIKE-PEDESTRIAN/1 vehicle owned/Inner Suburb PUMA	4.972872	15.66012	14.28864	20.86584	-0.4000086	-4.192003
DRIVE ALONE/1 vehicle owned/Outer Suburb PUMA	7.666018	16.00668	16.32244	20.70837	1.886884	1.077269
CARPOOL/1 vehicle owned/Outer Suburb PUMA	7.188902	15.33106	15.81655	20.60377	1.514508	-1.100152
PUBLIC TRANSIT/1 vehicle owned/Outer Suburb PUMA	5.725011	14.87876	14.07512	18.29936	0.4204093	-1.579029
BIKE-PEDESTRIAN/1 vehicle owned/Outer Suburb PUMA	5.666168	13.59577	13.59389	18.92775	0.6642114	-3.612293
DRIVE ALONE/1 vehicle owned/Fringe Suburb PUMA	7.974752	16.17135	16.23155	17.72455	1.784526	0.9485588
CARPOOL/1 vehicle owned/Fringe Suburb PUMA	7.448394	15.91963	15.53472	17.72844	0.6324204	-0.8102798
PUBLIC TRANSIT/1 vehicle owned/Fringe Suburb PUMA	5.161065	14.35323	13.25929	14.41417	-1.529199	-1.735095
BIKE-PEDESTRIAN/1 vehicle owned/Fringe Suburb PUMA	6.015367	14.62309	-1.93E+22	16.59033	-2.48E+17	-4.719383
DRIVE ALONE/2 vehicles owned/Central City PUMA	4.550647	5.211995	3.804851	9.387627	26.81218	
CARPOOL/2 vehicles owned/Central City PUMA	3.754383	3.529826	2.7445	7.608326	26.00087	
PUBLIC TRANSIT/2 vehicles owned/Central City PUMA	2.681665	3.975974	1.993769	8.179068	24.71177	
BIKE-PEDESTRIAN/2 vehicles owned/Central City PUMA	2.20297	2.766636	1.282525	7.335137	24.19803	

Appendix D-2: Chicago Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
DRIVE ALONE/2 vehicles owned/Secondary City PUMA	3.603437	3.942532	3.95383	10.07859	26.64497	
CARPOOL/2 vehicles owned/Secondary City PUMA	2.294531	1.845176	2.510183	8.47752	24.90145	
PUBLIC TRANSIT/2 vehicles owned/Secondary City PUMA	0.1618862	0.6676567	0.7019126	-4.69E+18	-3.36E+17	
BIKE-PEDESTRIAN/2 vehicles owned/Secondary City PUMA	0.4931875	-5.36E+16	0.0906704	6.907362	-1.54E+15	
DRIVE ALONE/2 vehicles owned/Inner Suburb City PUMA	4.876452	4.565082	4.257845	9.817187	27.76108	
CARPOOL/2 vehicles owned/Inner Suburb City PUMA	3.595204	2.635713	3.038597	8.417262	26.57909	
PUBLIC TRANSIT/2 vehicles owned/Inner Suburb City PUMA	2.341577	2.796263	2.384009	7.936472	25.86098	
BIKE-PEDESTRIAN/2 vehicles owned/Inner Suburb City PUMA	0.6139394	0.457586	-2.23E+16	6.505468	24.94352	
DRIVE ALONE/2 vehicles owned/Outer Suburb City PUMA	4.850944	4.664696	4.527783	10.2546	28.19078	
CARPOOL/2 vehicles owned/Outer Suburb City PUMA	2.783643	2.21579	3.111504	7.948034	26.08124	
PUBLIC TRANSIT/2 vehicles owned/Outer Suburb City PUMA	2.472467	1.98676	1.644384	7.456013	25.67336	
BIKE-PEDESTRIAN/2 vehicles owned/Outer Suburb City PUMA	0.6019754	0.9448828	0.3779717	6.054479	24.50289	
DRIVE ALONE/2 vehicles owned/Fringe Suburb City PUMA	5.276822	4.754959	4.985069	9.465766	28.41447	
CARPOOL/2 vehicles owned/Fringe Suburb City PUMA	2.805955	2.993622	3.572098	7.754289	26.19494	
PUBLIC TRANSIT/2 vehicles owned/Fringe Suburb City PUMA	2.349075	1.499161	0.2224941	5.704811	24.10558	
BIKE-PEDESTRIAN/2 vehicles owned/Fringe Suburb City PUMA	0.8957034	1.060806	0.7048789	6.679795	25.1073	
DRIVE ALONE/Occupation-specific auto accessibility	0.0000191	0.0000165	0.0000159	9.92E-06	8.28E-06	0.000011
CARPOOL/Occupation-specific auto accessibility	0.0000179	0.0000173	0.000015	8.54E-06	5.10E-06	0.0000125
PUBLIC TRANSIT/Occupation-specific transit accessibility	0.0002257	0.0001645	0.0001939	0.0001432	0.0001462	0.0001257
BIKE-PED/Occupation-specific transit accessibility	0.0001429	0.0001669	-0.0000261	0.000109	0.0000863	0.0000172
DRIVE ALONE/Female trip-maker	-0.6703375	-0.029077	0.0660503	0.1936465	-0.1744595	0.3940482
CARPOOL/Female trip-maker	-0.4834463	0.0472275	-0.0542406	0.0210239	0.086635	-0.0297133
PUBLIC TRANSIT/Female trip-maker	0.1992744	-0.0000959	0.6561145	0.6074701	0.1050598	0.4480086
BIKE-PED/Female trip-maker	-0.2293848	0.0514046	0.5870551	0.1436087	-0.7723755	0.3808674
DRIVE ALONE/45-64 year-old trip-maker	29.8252	-0.1076735	17.14739	14.18439	16.18868	21.58823
CARPOOL/45-64 year-old trip-maker	-2.50E+13	-1.134579	18.25568	-2.10E+16	16.21919	-7.61E+15
PUBLIC TRANSIT/45-64 year-old trip-maker	-2.94E+13	-1.574368	-1.63E+21	16.57842	-3.56E+16	22.15679
BIKE-PED/45-64 year-old trip-maker	-4.14E+13	0.8568785	-2.85E+12	-1.72E+16	-3.60E+16	-1.57E+15
DRIVE ALONE/45-64 year-old trip-maker	-0.3316224	0.5228071	0.1944746	0.7193769	0.4267409	-0.3725659
CARPOOL/45-64 year-old trip-maker	-0.1203283	0.2849376	-0.2872484	0.3224451	0.0721677	0.0571557
PUBLIC TRANSIT/45-64 year-old trip-maker	-0.2710259	0.4673403	-0.2234483	0.0364067	0.3119076	-0.5656765
BIKE-PED/45-64 year-old trip-maker	0.1021823	-0.2362048	0.9787328	0.0383407	0.2512992	0.0586138
DRIVE ALONE/Single-worker households trip-maker	0.0670583	-0.9233959	-0.0336126	0.6109578	0.1398995	1.053035
CARPOOL/Single-worker households trip-maker	-0.2001644	-0.9434379	0.0555449	0.5027991	-0.2341325	
PUBLIC TRANSIT/Single-worker households trip-maker	0.2132319	-0.9765405	-0.1832877	0.7511472	0.0989455	0.5056166
BIKE-PED/Single-worker households trip-maker	0.389555	-0.2445503	0.8505269	0.9294709	0.0406167	2.670666
DRIVE ALONE/Disabled trip-maker	-0.3417288	-0.4066774	-0.4507885	-0.5239087	-0.1363955	0.022518
CARPOOL/Disabled trip-maker	-0.0486589	-0.5789998	-0.2436723	-0.1953954	-0.1373629	0.5856575
PUBLIC TRANSIT/Disabled trip-maker	-0.7262548	-0.0955319	-0.1731665	-1.77641	-0.0132691	0.396552
BIKE-PED/Disabled trip-maker	-0.6687154	-1.577434	-0.759744	0.1680608	-0.5748785	0.3701778
Constants						
Central City PUMA Type (Level 2 model only)	0.8328022	1.783251	0.616107	0.7395462	0.4208075	2.778024
Secondary City PUMA Type (Level 2 model only)	1.072441	2.498885	0.6132218	0.7432085	0.4209471	4.000065
Inner Suburb PUMA Type (Level 2 model only)	0.9389743	2.080546	0.684182	0.7172291	0.4269529	3.611635
Outer Suburb PUMA Type (Level 2 model only)	1.032932	2.223938	0.6477254	0.7704036	0.4397789	3.486442
Fringe Suburb PUMA Type (Level 2 model only)	1.015744	2.188725	0.6611938	0.9064185	0.4353387	3.71523
Level 1: Choice of PUMA Type						
INNER SUBURB PUMA choice	1.090986	0.8354346	0.5261959	0.8542434	0.2027301	0.3436669
FRINGE SUBURB PUMA choice	-0.441862	-0.3213828	-0.0758073	-1.929305	0.075174	

Appendix D-2: Chicago Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
CENTRAL CITY PUMA choice * Household Income	-5.22E-06	-1.45E-06	-4.63E-06	1.23E-06	-2.82E-06	-3.93E-06
SECONDARY CITY PUMA choice * Household Income	2.34E-06	3.53E-06	-8.14E-06	-3.88E-06	-6.37E-06	3.26E-06
INNER SUBURB PUMA choice * Household Income	-6.54E-06	0.0000123	-8.37E-06	4.97E-06	1.87E-06	0.000018
OUTER SUBURB PUMA choice * Household Income	5.55E-06	0.0000101	4.60E-06	8.09E-06	9.85E-06	0.0000264
FRINGE SUBURB PUMA choice * Household Income	6.20E-06	0.0000103	5.87E-06	-2.73E-06	-3.39E-06	5.65E-06
CENTRAL CITY PUMA choice * Renter Dummy Variable	0.9823315	1.276051	0.3841214	1.345167	0.229968	1.010676
SECONDARY CITY PUMA choice * Renter Dummy Variable	-0.1021292	-0.4193524	-0.6593286	-0.5073759	0.2108781	-0.7557199
INNER SUBURB PUMA choice * Renter Dummy Variable	-0.3378536	-0.4393809	-0.2002283	0.3997799	-0.5108063	0.120233
OUTER SUBURB PUMA choice * Renter Dummy Variable	-0.0835811	-0.268698	-0.0194901	-0.3748867	-0.1659141	-0.3463975
FRINGE SUBURB PUMA choice * Renter Dummy Variable	-0.4138227	-0.8123554	-0.0672366	-0.3671815	-0.5132255	-0.6566837
CENTRAL CITY PUMA choice * Condo Owner Dummy Variable	0.0346859	1.452377	6.045775	-0.1019986	0.2970763	0.5378115
SECONDARY CITY PUMA choice * Condo Owner Dummy Variable	0.2380173	-0.7959219	4.863225	0.1829977	-0.1460306	-0.2853516
INNER SUBURB PUMA choice * Condo Owner Dummy Variable	-0.2310924	-0.4820356	-6400369	-0.4812321	-2.280217	-0.2553924
OUTER SUBURB PUMA choice * Condo Owner Dummy Variable	-0.3226533	0.2077155	4.485764	0.0453423	0.4292462	0.2456245
FRINGE SUBURB PUMA choice * Condo Owner Dummy Variable	-0.7396718	-0.9231157	2.676489	-1.184063	0.2966779	-0.7341128
CENTRAL CITY PUMA choice * Persons in Household	0.0219131	0.093541	0.0501527	0.0647331	-0.0311299	
SECONDARY CITY PUMA choice * Persons in Household	0.0394376	0.0262202	0.1567249	0.1376163	0.0711357	
INNER SUBURB PUMA choice * Persons in Household	0.0230592	0.1161852	0.0114371	-0.0164667	0.0684867	
OUTER SUBURB PUMA choice * Persons in Household	-0.044924	-0.0876415	-0.0002216	-0.1150493	-0.1585291	
FRINGE SUBURB PUMA choice * Persons in Household	-0.0188745	-0.0108764	-0.0605586	0.2171336	-0.2296983	-0.126931
CENTRAL CITY PUMA choice * White HH Head Dummy Variable	-0.5756257	-0.0186998	-0.8315472	0.5947163	-0.7738144	0.190062
SECONDARY CITY PUMA choice * White HH Head Dummy Variable	0.0620414	0.4875343	0.0376269	-0.1654977	-0.2314923	-0.1632311
INNER SUBURB PUMA choice * White HH Head Dummy Variable	-0.4868944	-0.3929684	-0.6461792	-0.2048394	-0.8624201	-0.1081969
OUTER SUBURB PUMA choice * White HH Head Dummy Variable	0.3900804	0.2704859	0.5629676	0.2994295	0.4560271	0.6532018
FRINGE SUBURB PUMA choice * White HH Head Dummy Variable	1.346548	1.087316	1.613631	1.170445	2.098748	1.433229
CENTRAL CITY PUMA choice * Female HH Head Dummy Variable	-0.0894256	0.3025161	0.0790594	0.2917593	-0.1751772	0.3500079
SECONDARY CITY PUMA choice * Female HH Head Dummy Variable	0.1944395	-0.0141544	0.1198483	-0.2438246	0.3777875	-0.0200265
INNER SUBURB PUMA choice * Female HH Head Dummy Variable	0.0633362	0.3375573	0.2385975	0.0503129	0.1430115	0.0755608
OUTER SUBURB PUMA choice * Female HH Head Dummy Variable	-0.0700524	-0.201458	-0.1393422	-0.100684	0.3213711	-0.0844328
FRINGE SUBURB PUMA choice * Female HH Head Dummy Variable	-0.2367411	-0.12715	-0.4175917	0.0541915	0.3820158	0.0247173
CENTRAL CITY PUMA choice * Senior HH Head Dummy Variable	10.28361	0.6681984	-1.19E+07	8.994706	0.5388333	14.62186
SECONDARY CITY PUMA choice * Senior HH Head Dummy Variable	2.994077	-0.2545513	10.00053	-1.49E+08	1.19238	-4.39E+08
INNER SUBURB PUMA choice * Senior HH Head Dummy Variable	5.031368	-0.2331161	-5361565	-1.41E+07	0.1211626	-1.05E+08
OUTER SUBURB PUMA choice * Senior HH Head Dummy Variable	2.174761	0.2724174	8.3368	10.49224	-2.01545	1.30101
FRINGE SUBURB PUMA choice * Senior HH Head Dummy Variable	-1503125	-0.6692607	-4994994	-1.76E+07	-1.94482	-3.621848
CENTRAL CITY PUMA choice * Age 45-64 HH Head Dummy Variable	0.672041	0.3737858	-0.0430785	-0.428948	0.4240194	-0.4313165
SECONDARY CITY PUMA choice * Age 45-64 HH Head Dummy Variable	-0.6688297	-0.3724909	-0.1480339	0.129748	-0.040404	0.3405731
INNER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	0.1205953	-0.2061251	-0.2323123	0.2877459	0.2216159	0.5419556
OUTER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	0.0246361	-0.0988989	-0.1201956	-0.4753237	-0.1602438	0.1593288
FRINGE SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.1098262	0.0833194	-0.8464911	-0.5522282	-0.3917757	0.1428326
CENTRAL CITY PUMA choice * Single-worker HH Dummy Variable	0.0429834	0.0847976	-0.2089077	-0.1216365	0.1080182	
SECONDARY CITY PUMA choice * Single-worker HH Dummy Variable	0.2330642	-0.1075694	0.1707238	-0.0464297	-0.1739973	
INNER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.0263838	0.3295639	0.4491154	0.2633218	0.1070525	
OUTER SUBURB PUMA choice * Single-worker HH Dummy Variable	0.0392274	-0.2493016	-0.2365884	-0.4711307	-0.0163102	
FRINGE SUBURB PUMA choice * Single-worker HH Dummy Variable	0.061009	-0.5872539	-0.4574489	-0.774071	0.1253695	
PUMA Average High School Test Score	0.0234618	0.0565555	-0.0052792	0.0617778	0.0033703	0.0313942
PUMA Average Occupation-specific Auto Accessibility	-6.25E-06	-5.24E-06	0.0000183	-0.0000122	0.0000129	-0.0000119
PUMA Average Auto Accessibility	5.40E-06	2.87E-06	-1.43E-08	-1.02E-06	7.57E-06	1.64E-07

Appendix D-3: Dallas-Ft. Worth Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Observations	10803500	484700	385020	630540	724600	711740
Log-likelihood Ratio	-1423958	-40480	-34318	-57559	-59654	-56111
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
DRIVE ALONE/No vehicles owned/Central City PUMA	-14.80512	0.3741942	0.6243302	-0.1463024	21.92711	-0.1923567
CARPOOL/No vehicles owned/Central City PUMA	23.21281	1.445146	1.71477	1.176835	23.16016	24.71128
PUBLIC TRANSIT/No vehicles owned/Central City PUMA	21.38423	-0.3712926	1.106155	0.3544855	22.99215	1.059104
DRIVE ALONE/No vehicles owned/Secondary City PUMA	-14.66494	0.77172	0.7318941	-5.10E+17	-5.60E+13	-0.4983149
CARPOOL/No vehicles owned/Secondary City PUMA	-14.44254	-7.56E+17	-17.39281	0.8846688	20.50984	0.3157456
PUBLIC TRANSIT/No vehicles owned/Secondary City PUMA	-15.2577	-6.36E+17	-17.90124	0.4344414	21.28887	23.05382
BIKE-PEDESTRIAN/No vehicles owned/Secondary City PUMA	-13.88086	-4.25E+17	-17.27418	0.5207028	19.56971	0.1606249
DRIVE ALONE/No vehicles owned/Inner Suburb PUMA	23.49427	1.627279	1.463884	0.5235669	-1.90E+14	0.611301
CARPOOL/No vehicles owned/Inner Suburb PUMA	23.43601	1.063556	1.991102	1.264178	24.11201	1.116934
PUBLIC TRANSIT/No vehicles owned/Inner Suburb PUMA	21.54704	0.8233934	1.139263	0.1137046	24.53267	24.09613
BIKE-PEDESTRIAN/No vehicles owned/Inner Suburb PUMA	-13.93742	-0.5513871	1.842578	0.0823871	23.44909	1.335518
DRIVE ALONE/No vehicles owned/Outer Suburb PUMA	23.55714	1.051145	-17.4452	0.7853076	22.37933	0.5956625
CARPOOL/No vehicles owned/Outer Suburb PUMA	22.31582	0.3948279	1.354001	0.8183429	23.31509	0.2238393
PUBLIC TRANSIT/No vehicles owned/Outer Suburb PUMA	-15.182	0.1012311	0.383244	-0.4808823	23.548	23.41615
BIKE-PEDESTRIAN/No vehicles owned/Outer Suburb PUMA	22.11214	-1.108675	0.8905013	-0.487064	21.78024	0.8382739
DRIVE ALONE/No vehicles owned/Fringe Suburb PUMA	22.31732	0.0491967	0.7977452	0.7000205	20.79319	-2.212134
CARPOOL/No vehicles owned/Fringe Suburb PUMA	21.86025	0.8268973	1.143919	0.9132219	21.90871	
PUBLIC TRANSIT/No vehicles owned/Fringe Suburb PUMA	-15.15837	-4.31E+17	-17.86133	-3.72E+17	22.13539	
BIKE-PEDESTRIAN/No vehicles owned/Fringe Suburb PUMA	-14.20535	0.0752233	-17.401	-2.32777	-1.83E+14	
DRIVE ALONE/1 vehicle owned/Central City PUMA	17.29676	17.28167	11.95644	17.94552	21.23717	3.477992
CARPOOL/1 vehicle owned/Central City PUMA	18.74914	17.51745	12.14341	19.17947	24.82997	2.155779
PUBLIC TRANSIT/1 vehicle owned/Central City PUMA	15.67847	15.46737	10.72267	16.67212	25.32712	24.03735
BIKE-PEDESTRIAN/1 vehicle owned/Central City PUMA	17.83818	-7.55E+24	11.13972	-6.06E+16	21.36136	2.203521
DRIVE ALONE/1 vehicle owned/Secondary City PUMA	15.54367	14.78698	10.65329	17.68629	22.30703	1.099562
CARPOOL/1 vehicle owned/Secondary City PUMA	17.35329	15.43858	11.37501	18.27655	23.16363	-0.5285795
PUBLIC TRANSIT/1 vehicle owned/Secondary City PUMA	-18.86841	-1.77E+30	-7.510833	-7.60E+16	21.29364	-1.57E+17
BIKE-PEDESTRIAN/1 vehicle owned/Secondary City PUMA	-18.22978	-5.91E+28	10.95027	-1.26E+17	-1.09E+15	-0.134012
DRIVE ALONE/1 vehicle owned/Inner Suburb PUMA	19.79107	18.2233	12.75628	19.22325	26.75368	4.233076
CARPOOL/1 vehicle owned/Inner Suburb PUMA	19.67723	18.06864	12.86402	19.34218	26.35088	2.348053
PUBLIC TRANSIT/1 vehicle owned/Inner Suburb PUMA	16.31092	14.6004	10.24485	17.29471	23.65087	24.6645
BIKE-PEDESTRIAN/1 vehicle owned/Inner Suburb PUMA	17.29819	15.00473	11.24774	17.34792	-5.53E+13	1.940534
DRIVE ALONE/1 vehicle owned/Outer Suburb PUMA	19.52527	17.61211	12.53374	18.91475	25.9426	3.823005
CARPOOL/1 vehicle owned/Outer Suburb PUMA	19.04063	17.28925	12.5811	18.81819	22.76623	2.224251
PUBLIC TRANSIT/1 vehicle owned/Outer Suburb PUMA	-18.85516	-1.12E+29	-7.387017	-5.59E+16	22.56512	23.45482
BIKE-PEDESTRIAN/1 vehicle owned/Outer Suburb PUMA	-18.48914	13.84622	10.85622	17.42776	-5.28E+14	1.525273
DRIVE ALONE/1 vehicle owned/Fringe Suburb PUMA	18.66925	16.93944	12.08434	18.43991	24.24921	2.299407
CARPOOL/1 vehicle owned/Fringe Suburb PUMA	18.34765	16.20393	11.85726	18.48533	22.8959	0.8611336
PUBLIC TRANSIT/1 vehicle owned/Fringe Suburb PUMA	-18.83263	-4.82E+51	-7.39696	-8.16E+16	-8.53E+14	-1.05E+17
BIKE-PEDESTRIAN/1 vehicle owned/Fringe Suburb PUMA	-18.5574	-3.03E+91	-6.966719	16.33499	-6.93E+13	-0.3546101
DRIVE ALONE/2 vehicles owned/Central City PUMA	18.64777	18.38542	11.49321	37.66173	9.738368	
CARPOOL/2 vehicles owned/Central City PUMA	17.79344	17.06918	11.13488	36.84174	8.850277	
PUBLIC TRANSIT/2 vehicles owned/Central City PUMA	14.61772	-3.98E+77	-8.700669	34.7614	7.488202	
BIKE-PEDESTRIAN/2 vehicles owned/Central City PUMA	15.92857	13.36768	-7.391006	35.79212	3.845508	

Appendix D-3: Dallas-Ft. Worth Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
DRIVE ALONE/2 vehicles owned/Secondary City PUMA	17.32729	16.7989	11.03007	36.16642	8.382962	
CARPOOL/2 vehicles owned/Secondary City PUMA	15.91476	15.76089	10.3582	35.26975	6.512645	
PUBLIC TRANSIT/2 vehicles owned/Secondary City PUMA	-19.63362	-3.20E+153	-8.395069	-6.38E+73	5.680326	
BIKE-PEDESTRIAN/2 vehicles owned/Secondary City PUMA	-18.53038	13.51318	-7.571619	-8.46E+50	5.161193	
DRIVE ALONE/2 vehicles owned/Inner Suburb City PUMA	20.85238	19.65576	12.54561	39.09707	10.70974	
CARPOOL/2 vehicles owned/Inner Suburb City PUMA	19.52172	18.0817	11.66435	37.38792	9.687587	
PUBLIC TRANSIT/2 vehicles owned/Inner Suburb City PUMA	14.85024	14.56288	9.440878	33.79396	6.447065	
BIKE-PEDESTRIAN/2 vehicles owned/Inner Suburb City PUMA	16.22474	14.11835	-7.696988	35.69148	5.961973	
DRIVE ALONE/2 vehicles owned/Outer Suburb City PUMA	20.97288	19.55113	12.31137	38.54883	10.24696	
CARPOOL/2 vehicles owned/Outer Suburb City PUMA	19.13532	17.27254	11.47731	36.63849	8.727458	
PUBLIC TRANSIT/2 vehicles owned/Outer Suburb City PUMA	14.90125	-3.98E+34	-8.386329	-2.16E+16	5.473263	
BIKE-PEDESTRIAN/2 vehicles owned/Outer Suburb City PUMA	16.82415	12.95848	10.2029	35.57589	5.608549	
DRIVE ALONE/2 vehicles owned/Fringe Suburb City PUMA	20.00638	18.29875	11.92957	37.62057	9.506684	
CARPOOL/2 vehicles owned/Fringe Suburb City PUMA	18.58662	16.72367	11.04929	35.79288	8.331238	
PUBLIC TRANSIT/2 vehicles owned/Fringe Suburb City PUMA	-19.55338	-2.23E+29	-8.360285	-2.70E+15	-1.09E+16	
BIKE-PEDESTRIAN/2 vehicles owned/Fringe Suburb City PUMA	14.79748	12.13468	-7.774833	33.85104	4.487321	
DRIVE ALONE/Occupation-specific auto accessibility	0.0008089	-0.0003736	0.0023745	0.0002648	0.0001284	0.0007631
CARPOOL/Occupation-specific auto accessibility	-0.0002369	-0.0004611	0.0015939	-0.0004041	-0.0002234	0.0001177
PUBLIC TRANSIT/Occupation-specific transit accessibility	0.0113355	-0.0094782	0.0325843	0.001868	-0.0119956	0.0097522
BIKE-PED/Occupation-specific transit accessibility	-0.0634041	-0.0322198	-0.0341275	-0.0333987	0.0243979	-0.0177198
DRIVE ALONE/Female trip-maker	-1.218118	-1.86906	-0.1568026	0.242225	-0.6517019	-0.0438801
CARPOOL/Female trip-maker	-0.7423384	-1.954618	-0.30877	0.0094954	-0.9515568	-0.3213483
PUBLIC TRANSIT/Female trip-maker	0.2558848	-0.8917727	0.0364097	0.0973281	0.0438238	0.2425808
BIKE-PED/Female trip-maker	-0.2866574	0.1826559	-0.4980079	-0.1419529	-1.264123	-0.8780449
DRIVE ALONE/45-64 year-old trip-maker	1.016066	19.23023	14.85605	7.705808	17.21175	15.45724
CARPOOL/45-64 year-old trip-maker	1.609685	-1.51E+16	-4.530704	-8.15E+15	-1.26E+14	-3.19E+16
PUBLIC TRANSIT/45-64 year-old trip-maker	-30.91869	-8.01E+11	-0.6896228	-1.01E+13	-5.17E+14	-1.67E+16
BIKE-PED/45-64 year-old trip-maker	4.554755	-7.04E+26	-3.011545	-5.82E+14	19.42957	18.91518
DRIVE ALONE/45-64 year-old trip-maker	0.8530291	-0.0336503	-0.7607307	-0.5425007	0.281342	-0.063708
CARPOOL/45-64 year-old trip-maker	0.5987367	-0.4321429	-1.20532	-1.070994	-0.0528082	-0.2257811
PUBLIC TRANSIT/45-64 year-old trip-maker	-0.1621849	-0.1631478	0.0954728	-0.0656916	-0.0342906	0.1798062
BIKE-PED/45-64 year-old trip-maker	1.260757	0.1941942	-0.9905957	-0.7617985	0.5174659	-0.8410343
DRIVE ALONE/Single-worker households trip-maker	-0.2914036	-0.3172922	-0.3696129	-0.2804972	0.3502301	0.7643031
CARPOOL/Single-worker households trip-maker	-0.258978	-0.6403386	-0.3384806	-0.0872855	0.0456266	
PUBLIC TRANSIT/Single-worker households trip-maker	0.3442725	0.3393642	0.0930297	0.0014717	0.0678521	-23.668
BIKE-PED/Single-worker households trip-maker	-0.8135004	0.6592918	-0.424655	0.1878323	1.195706	-0.0672755
DRIVE ALONE/Disabled trip-maker	-0.6703529	-1.726668	0.069582	-0.6765794	-0.5635004	-2.076429
CARPOOL/Disabled trip-maker	-0.3696538	-1.464981	0.1793909	-0.4155204	-0.2604506	-1.938307
PUBLIC TRANSIT/Disabled trip-maker	0.6682821	-0.5007785	-0.0558872	0.7200468	-0.2707265	-2.132469
BIKE-PED/Disabled trip-maker	-34.64357	-0.0580622	0.0416899	-1.156608	-0.6309892	-2.405246
Constants						
Central City PUMA Type (Level 2 model only)	0.9640683	1.003696	0.9350803	3.632078	4.1658	0.7150188
Secondary City PUMA Type (Level 2 model only)	1.035901	1.027704	1.026032	3.787448	4.433387	1.827738
Inner Suburb PUMA Type (Level 2 model only)	0.9539292	0.9986	0.9557471	3.549405	3.94736	1.019706
Outer Suburb PUMA Type (Level 2 model only)	0.959608	0.9934355	1.002128	3.588084	4.10661	1.078078
Fringe Suburb PUMA Type (Level 2 model only)	0.9962771	1.015889	1.014501	3.64538	4.311041	1.141425
Level 1: Choice of PUMA Type						
INNER SUBURB PUMA choice	0.5860963	0.1691155	1.312691	0.690693	-0.1560986	0.1141984
FRINGE SUBURB PUMA choice	-0.0495506	0.2740907	0.5879362	-1.214374	0.7268058	0.4760674

Appendix D-3: Dallas-Ft. Worth Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
CENTRAL CITY PUMA choice * Household Income	-6.85E-06	-0.0000245	0.0000177	6.64E-06	-6.92E-06	0.0000351
SECONDARY CITY PUMA choice * Household Income	-1.63E-06	3.56E-06	0.0000114	-7.17E-06	-0.000016	-0.000084
INNER SUBURB PUMA choice * Household Income	0.0000155	0.0000125	0.0000225	0.0000112	7.44E-06	0.0000182
OUTER SUBURB PUMA choice * Household Income	0.0000212	1.64E-06	0.0000166	3.07E-06	7.40E-06	7.53E-07
FRINGE SUBURB PUMA choice * Household Income	5.96E-06	-0.000013	3.07E-06	-0.0000152	-0.0000166	-0.0000336
CENTRAL CITY PUMA choice * Renter Dummy Variable	0.2806574	0.2692841	0.0810271	1.488023	0.0752392	1.051882
SECONDARY CITY PUMA choice * Renter Dummy Variable	-0.1150016	0.244736	-1.312922	0.4231391	0.6612976	-0.0410492
INNER SUBURB PUMA choice * Renter Dummy Variable	0.0673102	-0.1965647	-0.4428079	0.6648142	0.1083373	0.2829607
OUTER SUBURB PUMA choice * Renter Dummy Variable	-0.7069169	-0.7639359	-0.9976444	0.0164955	-0.7583074	-0.7786835
FRINGE SUBURB PUMA choice * Renter Dummy Variable	-0.5105557	-1.561332	-1.638748	-0.7137596	-0.8687145	-0.8458831
CENTRAL CITY PUMA choice * Condo Owner Dummy Variable	-7.496498	9.869914	0.4536858	-1736.56	6.950994	6.177383
SECONDARY CITY PUMA choice * Condo Owner Dummy Variable	-6.944103	-2.82E+08	1.032744	-13049.48	-197990.7	-344082.2
INNER SUBURB PUMA choice * Condo Owner Dummy Variable	7.642776	9.383502	32.3026	381.5681	5.948627	3.748301
OUTER SUBURB PUMA choice * Condo Owner Dummy Variable	6.472267	7.233846	-0.2726896	-607.4642	4.570642	2.115366
FRINGE SUBURB PUMA choice * Condo Owner Dummy Variable	-8.748496	-5.61E+07	0.3484227	-2104.874	5.544001	-116932
CENTRAL CITY PUMA choice * Persons in Household	0.1150796	0.0092076	-0.0265218	0.1352798	-0.0690797	
SECONDARY CITY PUMA choice * Persons in Household	0.0146755	0.245248	0.0205497	-0.2713699	0.2681263	
INNER SUBURB PUMA choice * Persons in Household	-0.0730126	-0.20213	-0.2659815	-0.1410103	-0.1006316	
OUTER SUBURB PUMA choice * Persons in Household	-0.0494685	-0.0717175	-0.1709799	-0.0598567	-0.182748	
FRINGE SUBURB PUMA choice * Persons in Household	0.0045076	0.3371045	-0.0920466	0.2792749	0.0620833	
CENTRAL CITY PUMA choice * White HH Head Dummy Variable	-0.3018584	-0.3278194	-1.772861	-0.5041352	-1.352786	-0.6195415
SECONDARY CITY PUMA choice * White HH Head Dummy Variable	-0.1827298	-0.3096256	-1.41376	-1.023561	-1.697055	-0.4390196
INNER SUBURB PUMA choice * White HH Head Dummy Variable	0.1164906	-0.183303	-0.3350851	0.1303487	-0.1604515	-0.4860959
OUTER SUBURB PUMA choice * White HH Head Dummy Variable	1.091104	0.7425611	0.6683005	0.9686443	0.9014935	0.3043865
FRINGE SUBURB PUMA choice * White HH Head Dummy Variable	1.448841	1.067024	1.365719	1.866431	1.765354	0.7770695
CENTRAL CITY PUMA choice * Female HH Head Dummy Variable	-0.1899614	-0.0832078	-0.4339561	-0.1939333	-0.8148156	-0.0088535
SECONDARY CITY PUMA choice * Female HH Head Dummy Variable	0.0612821	0.3515315	0.2601038	-0.3376314	0.8951512	-0.0304883
INNER SUBURB PUMA choice * Female HH Head Dummy Variable	-0.1722	-0.1771862	-0.2184568	0.0336011	-0.3832004	-0.016474
OUTER SUBURB PUMA choice * Female HH Head Dummy Variable	-0.3458949	-0.2298995	0.0474039	0.2431788	-0.3250247	0.3445875
FRINGE SUBURB PUMA choice * Female HH Head Dummy Variable	-0.074235	-0.2196017	-0.2151639	-0.3286189	-0.238021	-0.0438424
CENTRAL CITY PUMA choice * Senior HH Head Dummy Variable	-9.005427	-1.02E+08	-0.6694657	-3511.836	1.042938	6.467351
SECONDARY CITY PUMA choice * Senior HH Head Dummy Variable	-8.239301	-4.09E+08	0.4887591	-18680.87	-152705	-297322.5
INNER SUBURB PUMA choice * Senior HH Head Dummy Variable	5.833737	9.135926	30.67299	534.9612	2.635587	0.8973545
OUTER SUBURB PUMA choice * Senior HH Head Dummy Variable	6.701442	7.992235	-1.473489	-835.2327	-10785.36	-1.83494
FRINGE SUBURB PUMA choice * Senior HH Head Dummy Variable	-9.388899	9.195673	-0.1930942	-2736.575	-2.901751	-1.856226
CENTRAL CITY PUMA choice * Age 45-64 HH Head Dummy Variable	-0.1880678	-0.2691209	-0.2941165	0.435728	-0.1796308	-0.2614402
SECONDARY CITY PUMA choice * Age 45-64 HH Head Dummy Variable	0.0572174	0.3409289	0.7737619	1.209457	0.0940588	0.3622003
INNER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.278707	-0.2320073	-0.2787411	-0.1399295	0.0712986	0.1707805
OUTER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.4496276	0.1088072	-0.2449308	-1.092294	-0.0179495	-0.0512005
FRINGE SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.229635	0.2300819	-0.120236	0.5824189	-0.1722977	0.4928922
CENTRAL CITY PUMA choice * Single-worker HH Dummy Variable	0.0498049	0.2225258	-0.1239966	0.2630243	0.0828987	
SECONDARY CITY PUMA choice * Single-worker HH Dummy Variable	0.0759819	-0.3135179	0.6973821	-0.1056946	0.8456245	
INNER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.1350166	0.1687916	-0.1386221	0.0499364	-0.1696036	
OUTER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.0312194	-0.1645698	-0.5287685	0.1779171	-0.1797162	
FRINGE SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.18064	0.0634138	-0.4022212	0.8629608	-0.701127	
PUMA Average High School Test Score	0.0332389	0.0838164	0.0794738	0.0138977	0.059935	0.0261019
PUMA Average Occupation-specific Auto Accessibility	0.0001927	0.0011877	-0.0003469	0.0002527	0.0006988	-0.0005122
PUMA Average Auto Accessibility	0.000279	0.0003522	0.0002944	-0.0003193	0.000323	7.18E-06

Appendix D-4: Greater Los Angeles Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Observations	3372660	602180	1014720	1063940	1139740	785020
Log-likelihood Ratio	-349697	-631340	-112595	-120340	-121128	-80720
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
DRIVE ALONE/No vehicles owned/Central City PUMA	-1.060977	-0.0731848	0.4240087	-1.157577	0.6260547	
CARPOOL/No vehicles owned/Central City PUMA	-0.5914119	-0.8147521	0.2502772	-1.679939	0.3771153	
BIKE-PEDESTRIAN/No vehicles owned/Central City PUMA	-0.3074024	1.092368	1.365939	-1.194629	2.307102	
DRIVE ALONE/No vehicles owned/Secondary City PUMA	-0.6496916	-1.619441	-0.4927458	-1.801436	-0.5298457	-0.4673291
CARPOOL/No vehicles owned/Secondary City PUMA	-0.9681886	-4.28E+17	-0.7658957	-1.990957	-0.6177621	-0.7616208
PUBLIC TRANSIT/No vehicles owned/Secondary City PUMA	-1.33E+15	-3.46E+17	-0.8734132	-5.26E+18	-0.222146	-1.498241
BIKE-PEDESTRIAN/No vehicles owned/Secondary City PUMA	-1.07E+15	-2.241771	-1.94E+15	-0.8138896	-2.269848	-2.094474
DRIVE ALONE/No vehicles owned/Inner Suburb PUMA	-0.3250347	-0.6336996	0.1045478	-1.709569	0.7707755	-0.292786
CARPOOL/No vehicles owned/Inner Suburb PUMA	-0.3591891	-1.924579	-0.1994685	-1.57877	0.2127786	-0.2836273
PUBLIC TRANSIT/No vehicles owned/Inner Suburb PUMA	-0.7724587	-1.130643	-0.3991694	-0.9534646	0.4880457	-0.9171716
BIKE-PEDESTRIAN/No vehicles owned/Inner Suburb PUMA	-0.8737125	-1.770118	0.1821243	-1.262881	-1.166329	0.3408995
DRIVE ALONE/No vehicles owned/Outer Suburb PUMA	-0.4137289	-1.045301	0.4824412	-1.278842	-1.303578	0.2130535
CARPOOL/No vehicles owned/Outer Suburb PUMA	-0.6784311	-1.101999	0.2085395	-1.768967	-1.184763	0.1564374
PUBLIC TRANSIT/No vehicles owned/Outer Suburb PUMA	-2.14977	-2.303574	-0.2202425	-1.222087	-0.9809523	-1.390728
BIKE-PEDESTRIAN/No vehicles owned/Outer Suburb PUMA	-0.1389065	-2.909737	-0.418521	-1.57993	-3.041235	0.1871081
DRIVE ALONE/No vehicles owned/Fringe Suburb PUMA	-0.2937283	-1.461207	0.2754777	-1.474392	0.1434107	-0.2375619
CARPOOL/No vehicles owned/Fringe Suburb PUMA	-2.232258	-1.323978	0.5923163	-1.583105	-0.7034698	-0.5127753
PUBLIC TRANSIT/No vehicles owned/Fringe Suburb PUMA	-2.704	-2.116714	-0.3064714	-2.282666	-0.8532903	-1.616709
BIKE-PEDESTRIAN/No vehicles owned/Fringe Suburb PUMA	0.048285	-1.259113	-0.2471972	-0.9378346	-2.176651	0.3088755
DRIVE ALONE/1 vehicle owned/Central City PUMA	16.70188	-10.57916	1.516918	8.193071	13.27526	14.87419
CARPOOL/1 vehicle owned/Central City PUMA	16.40599	-10.73839	1.612097	7.670674	12.48193	12.82061
PUBLIC TRANSIT/1 vehicle owned/Central City PUMA	15.11103	-12.09813	0.424675	6.776665	12.22379	10.88691
BIKE-PEDESTRIAN/1 vehicle owned/Central City PUMA	15.11887	-12.31055	-0.7341457	6.956721	11.10562	12.02841
DRIVE ALONE/1 vehicle owned/Secondary City PUMA	12.64928	-7.621611	0.1026921	5.907068	11.55255	12.03664
CARPOOL/1 vehicle owned/Secondary City PUMA	13.24551	-7.69428	-0.3600444	5.837606	11.73056	10.26665
PUBLIC TRANSIT/1 vehicle owned/Secondary City PUMA	-6.79E+14	-1.04E+17	-2.383272	-9.23E+16	-7.66E+14	-1.01E+15
BIKE-PEDESTRIAN/1 vehicle owned/Secondary City PUMA	11.95732	-9.247153	-1.377378	4.04941	9.10279	9.175868
DRIVE ALONE/1 vehicle owned/Inner Suburb PUMA	15.55633	-9.403193	1.188819	7.545129	12.53465	14.35913
CARPOOL/1 vehicle owned/Inner Suburb PUMA	15.08226	-9.478685	0.6828204	7.265197	11.6861	12.01404
PUBLIC TRANSIT/1 vehicle owned/Inner Suburb PUMA	12.79449	-10.56129	-1.31439	6.302456	11.12292	8.919746
BIKE-PEDESTRIAN/1 vehicle owned/Inner Suburb PUMA	14.40464	-10.76095	-0.7439581	6.123466	10.31215	11.76241
DRIVE ALONE/1 vehicle owned/Outer Suburb PUMA	14.94103	-8.99644	1.375082	7.350061	12.93464	14.47419
CARPOOL/1 vehicle owned/Outer Suburb PUMA	14.55197	-9.318554	0.5789362	6.83658	12.79052	12.32679
PUBLIC TRANSIT/1 vehicle owned/Outer Suburb PUMA	12.47823	-13.04897	-2.016744	5.579341	10.45987	9.021944
BIKE-PEDESTRIAN/1 vehicle owned/Outer Suburb PUMA	12.39442	-10.27553	-0.9271003	6.038872	11.31069	11.23716
DRIVE ALONE/1 vehicle owned/Fringe Suburb PUMA	15.36946	-9.688747	1.44185	7.204855	12.51402	13.66984
CARPOOL/1 vehicle owned/Fringe Suburb PUMA	14.20543	-9.544925	1.089427	7.173266	12.04428	12.05945
PUBLIC TRANSIT/1 vehicle owned/Fringe Suburb PUMA	-3.95E+14	-12.8899	-4.87E+14	5.242242	9.205614	7.21967
BIKE-PEDESTRIAN/1 vehicle owned/Fringe Suburb PUMA	12.27519	-10.24631	-1.973289	5.966895	9.709246	11.0368
DRIVE ALONE/2 vehicles owned/Central City PUMA	11.52383	-16.22651	5.666376	12.88771	9.122593	
CARPOOL/2 vehicles owned/Central City PUMA	10.23274	-17.83349	4.432263	11.17956	8.004692	
PUBLIC TRANSIT/2 vehicles owned/Central City PUMA	8.478784	-19.18838	2.29349	9.934801	6.602982	
BIKE-PEDESTRIAN/2 vehicles owned/Central City PUMA	9.225164	-19.56114	2.792397	10.17092	4.372641	

Appendix D-4: Greater Los Angeles Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
DRIVE ALONE/2 vehicles owned/Secondary City PUMA	9.087498	-9.753792	1.912851	9.898421	7.831605	
CARPOOL/2 vehicles owned/Secondary City PUMA	8.042618	-11.13818	1.028937	8.374103	6.604901	
PUBLIC TRANSIT/2 vehicles owned/Secondary City PUMA	5.08518	-2.78E+17	-2.05379	6.61151	-2.96E+15	
BIKE-PEDESTRIAN/2 vehicles owned/Secondary City PUMA	6.691168	-13.64215	-2.02E+15	-1.50E+17	3.772185	
DRIVE ALONE/2 vehicles owned/Inner Suburb City PUMA	10.86797	-13.24373	4.254166	12.21884	9.801613	
CARPOOL/2 vehicles owned/Inner Suburb City PUMA	9.33926	-15.18191	3.093491	10.4471	8.632892	
PUBLIC TRANSIT/2 vehicles owned/Inner Suburb City PUMA	7.186577	-19.41836	-0.0387522	8.529193	6.32876	
BIKE-PEDESTRIAN/2 vehicles owned/Inner Suburb City PUMA	8.307411	-16.64054	0.9914799	8.577535	5.613484	
DRIVE ALONE/2 vehicles owned/Outer Suburb City PUMA	11.05178	-12.49527	4.501013	11.82619	10.38963	
CARPOOL/2 vehicles owned/Outer Suburb City PUMA	9.40191	-14.16443	3.194856	10.13576	9.049398	
PUBLIC TRANSIT/2 vehicles owned/Outer Suburb City PUMA	7.075309	-16.2289	0.0276694	8.040085	5.696106	
BIKE-PEDESTRIAN/2 vehicles owned/Outer Suburb City PUMA	5.847237	-18.07361	0.1917185	8.96905	5.061673	
DRIVE ALONE/2 vehicles owned/Fringe Suburb City PUMA	11.19557	-13.25817	4.731476	11.97876	9.865867	
CARPOOL/2 vehicles owned/Fringe Suburb City PUMA	9.54038	-14.90404	3.545802	9.868133	8.418165	
PUBLIC TRANSIT/2 vehicles owned/Fringe Suburb City PUMA	-1.13E+15	-18.34245	-0.4064937	6.228012	5.789465	
BIKE-PEDESTRIAN/2 vehicles owned/Fringe Suburb City PUMA	7.656422	-16.16974	-0.7560442	9.183461	5.232761	
DRIVE ALONE/Occupation-specific auto accessibility	2.05E-09	2.07E-09	1.57E-09	1.08E-09	1.21E-09	-2.71E-10
CARPOOL/Occupation-specific auto accessibility	1.68E-09	1.60E-09	1.51E-09	8.85E-10	9.00E-10	-1.95E-10
PUBLIC TRANSIT/Occupation-specific transit accessibility	4.01E-08	5.36E-08	3.85E-08	3.75E-08	1.34E-08	-1.09E-08
BIKE-PED/Occupation-specific transit accessibility	-2.15E-08	4.27E-08	2.13E-08	1.69E-08	6.27E-09	-1.60E-08
DRIVE ALONE/Female trip-maker	-1.392604	0.0892447	-0.4734175	0.1198849	-0.3880365	**0.002422**
CARPOOL/Female trip-maker	-0.8655643	0.2451409	-0.4505971	-0.1838119	-0.1455262	-0.1478584
PUBLIC TRANSIT/Female trip-maker	-0.0161127	0.7766251	0.0373141	0.0896059	0.2454465	-0.1481
BIKE-PED/Female trip-maker	-1.052581	0.0168754	-0.3576723	0.2634138	0.2132232	0.0742981
DRIVE ALONE/45-64 year-old trip-maker	16.41625	-0.783811	23.94477	22.81577	15.74598	20.14248
CARPOOL/45-64 year-old trip-maker	16.90226	0.2917932	-6.58E+14	22.39808	16.37352	-3.45E+14
PUBLIC TRANSIT/45-64 year-old trip-maker	-4.45E+13	0.477498	24.79324	-2.83E+15	-1.07E+14	19.999
BIKE-PED/45-64 year-old trip-maker	-4.12E+14	-0.5877627	-5.77E+14	-1.85E+16	-1.82E+14	-2.49E+14
DRIVE ALONE/45-64 year-old trip-maker	0.7258932	-0.0505904	-0.4865782	0.2478898	-0.0287649	0.0716219
CARPOOL/45-64 year-old trip-maker	0.8261487	-0.2409398	-0.6876972	-0.2047017	-0.2597516	-0.1095685
PUBLIC TRANSIT/45-64 year-old trip-maker	1.215849	0.2386516	-0.0614381	-0.1560637	0.2720575	0.3437813
BIKE-PED/45-64 year-old trip-maker	-0.2086789	-0.216165	0.1489968	-1.245968	-0.0489083	-0.2094853
DRIVE ALONE/Single-worker households trip-maker	-0.8045624	0.0741362	-0.5989757	-0.5180677	0.0671666	
CARPOOL/Single-worker households trip-maker	-0.9635309	0.0226916	-0.6224542	-0.2584816	-0.3261506	-0.3840886
PUBLIC TRANSIT/Single-worker households trip-maker	-0.1007426	0.1283421	-0.1897833	-0.2443885	-0.1528444	1.177871
BIKE-PED/Single-worker households trip-maker	-1.29402	0.5203226	-0.3048363	-0.1119699	0.6513037	-0.0918705
DRIVE ALONE/Disabled trip-maker	-0.7358023	-1.664567	-0.4572799	-0.9788871	0.1564603	-1.010511
CARPOOL/Disabled trip-maker	-0.5392261	-1.393813	-0.2319031	-0.4480873	-0.0619726	-0.4290471
PUBLIC TRANSIT/Disabled trip-maker	-0.5645954	-1.919113	0.0103595	-0.6900829	-0.574754	-0.3387508
BIKE-PED/Disabled trip-maker	-1.47694	-1.658604	0.2277038	-1.021684	-0.0656208	-0.777414
Constants						
Central City PUMA Type (Level 2 model only)	0.9554999	0.7411018	1.424984	1.862569	0.3378825	3.307275
Secondary City PUMA Type (Level 2 model only)	1.186472	1.430092	3.565189	2.361286	0.3256325	3.831019
Inner Suburb PUMA Type (Level 2 model only)	1.042807	0.9455638	1.889423	1.94146	0.2983903	3.384659
Outer Suburb PUMA Type (Level 2 model only)	1.079388	0.9928993	1.900308	1.998761	0.3159386	3.367774
Fringe Suburb PUMA Type (Level 2 model only)	1.078961	0.9289837	1.842547	2.00853	0.3072135	3.502546
Level 1: Choice of PUMA Type						
INNER SUBURB PUMA choice	-0.2081838	-0.7042871	-1.002962	0.0897084	-1.019838	
FRINGE SUBURB PUMA choice	0.092994	-0.7190548	0.450504	0.0939719	0.2972525	-0.8607553

Appendix D-4: Greater Los Angeles Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
CENTRAL CITY PUMA choice * Household Income	1.72E-06	-0.0000208	-9.83E-06	-1.84E-06	-3.45E-06	-4.94E-06
SECONDARY CITY PUMA choice * Household Income	-5.98E-06	0.0000128	-2.41E-06	-8.89E-06	6.86E-06	4.87E-06
INNER SUBURB PUMA choice * Household Income	6.38E-06	-6.24E-06	4.50E-06	6.36E-06	0.0000182	4.34E-06
OUTER SUBURB PUMA choice * Household Income	9.56E-06	3.75E-06	7.09E-06	0.0000151	0.0000152	-0.0000297
FRINGE SUBURB PUMA choice * Household Income	8.78E-06	1.42E-06	4.00E-06	-6.14E-07	3.77E-06	9.33E-06
CENTRAL CITY PUMA choice * Renter Dummy Variable	0.5141989	1.037676	0.0330366	0.9414862	0.3067109	0.8021884
SECONDARY CITY PUMA choice * Renter Dummy Variable	-0.0432567	0.4555208	-0.6148197	-0.9319121	-0.1300716	-0.4044312
INNER SUBURB PUMA choice * Renter Dummy Variable	0.1502105	0.6479057	0.1888874	0.27279	0.4133891	0.3654926
OUTER SUBURB PUMA choice * Renter Dummy Variable	-0.384801	-0.1560371	-0.3617314	-0.1464822	-0.0788784	-0.7442478
FRINGE SUBURB PUMA choice * Renter Dummy Variable	-0.5688173	-0.4688337	-0.4903787	-0.6880818	-0.2933608	-1.042462
CENTRAL CITY PUMA choice * Condo Owner Dummy Variable	-0.5127676	3.349226	1.450351	0.4962164	-0.4055696	-1.54714
SECONDARY CITY PUMA choice * Condo Owner Dummy Variable	0.224473	-2.07E+07	-3.23E+07	0.425605	-0.5479986	-0.2101429
INNER SUBURB PUMA choice * Condo Owner Dummy Variable	0.4106676	3.911165	2.074081	0.3963102	0.7415357	1.239998
OUTER SUBURB PUMA choice * Condo Owner Dummy Variable	0.2643938	2.981414	2.169046	0.3029558	0.5464964	-0.5275667
FRINGE SUBURB PUMA choice * Condo Owner Dummy Variable	-0.1400268	3.033574	2.015969	-0.1790261	-0.3932254	-1.19383
CENTRAL CITY PUMA choice * Persons in Household	0.0016843	0.1569586	-0.029446	0.0184339	-0.0296083	
SECONDARY CITY PUMA choice * Persons in Household	0.0317597	-0.012309	0.0807988	0.1437879	-0.0350422	
INNER SUBURB PUMA choice * Persons in Household	-0.0343217	0.2156234	0.0278989	0.0188251	0.0782174	
OUTER SUBURB PUMA choice * Persons in Household	-0.0400214	-0.0191259	-0.0480933	-0.0392034	0.0497828	
FRINGE SUBURB PUMA choice * Persons in Household	-0.0681589	0.0160923	-0.0419502	0.0990487	0.1069827	
CENTRAL CITY PUMA choice * White HH Head Dummy Variable	-0.4648324	-1.008276	-1.146566	-0.2931102	-1.123885	-0.596711
SECONDARY CITY PUMA choice * White HH Head Dummy Variable	0.9172121	0.0674033	0.1693052	0.1169805	0.3453138	0.2181382
INNER SUBURB PUMA choice * White HH Head Dummy Variable	0.1784019	-0.575331	-0.537336	-0.2562722	-0.1646444	-0.0995964
OUTER SUBURB PUMA choice * White HH Head Dummy Variable	0.6443109	-0.3075097	0.0685354	0.3708216	0.1472856	-0.1137145
FRINGE SUBURB PUMA choice * White HH Head Dummy Variable	1.012607	0.7498341	0.9220262	0.2590207	0.8495802	0.1708106
CENTRAL CITY PUMA choice * Female HH Head Dummy Variable	-0.129684	0.4472518	-0.1665977	0.2157832	-0.0610941	0.1484762
SECONDARY CITY PUMA choice * Female HH Head Dummy Variable	0.4325899	-0.4343891	1.18204	0.1732265	-0.0499141	0.2413009
INNER SUBURB PUMA choice * Female HH Head Dummy Variable	-0.2358108	0.0675074	-0.1159857	0.1723316	0.1231155	0.3181025
OUTER SUBURB PUMA choice * Female HH Head Dummy Variable	0.0519249	0.2064277	0.0136313	0.3158233	0.1847906	0.2479054
FRINGE SUBURB PUMA choice * Female HH Head Dummy Variable	0.0084739	0.2157362	-0.0204594	0.028649	0.1334998	0.2289261
CENTRAL CITY PUMA choice * Senior HH Head Dummy Variable	11.13063	2.909035	5.055508	0.1604623	9.780764	2.604001
SECONDARY CITY PUMA choice * Senior HH Head Dummy Variable	-1.63E+08	-1.79E+07	-2.95E+07	-10.32073	10.05088	-7.182746
INNER SUBURB PUMA choice * Senior HH Head Dummy Variable	10.9162	4.455279	-5.52119	-0.8265498	10.37442	1.435477
OUTER SUBURB PUMA choice * Senior HH Head Dummy Variable	9.558313	3.935412	-6.586729	-2.116116	-1.22E+08	2.957311
FRINGE SUBURB PUMA choice * Senior HH Head Dummy Variable	-2.82E+07	4.153044	-4.259708	-4.834438	-2.31E+08	0.4847934
CENTRAL CITY PUMA choice * Age 45-64 HH Head Dummy Variable	0.1684162	0.002333	0.0086267	-0.3384926	-0.0288021	-0.1996171
SECONDARY CITY PUMA choice * Age 45-64 HH Head Dummy Variable	0.1375102	-0.1352573	0.4828737	-0.3215356	-0.5168141	0.1320818
INNER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	0.2584609	-0.0542385	0.0319013	0.0350059	0.1838583	0.1895381
OUTER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.1486486	-0.1337236	-0.2569256	-0.267968	0.2654223	0.1715398
FRINGE SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.2688517	0.2149538	0.380467	0.3033347	-0.0462172	0.3651205
CENTRAL CITY PUMA choice * Single-worker HH Dummy Variable	0.253515	0.1226208	0.0450144	0.1474594	0.1583134	-0.8950168
SECONDARY CITY PUMA choice * Single-worker HH Dummy Variable	-0.2162781	-0.5352651	1.10572	-0.2346458	-0.2447561	
INNER SUBURB PUMA choice * Single-worker HH Dummy Variable	0.1158518	0.2909192	-0.1033031	0.3672448	0.1853804	
OUTER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.1258057	-0.0078189	-0.0742816	0.1009949	0.1186807	
FRINGE SUBURB PUMA choice * Single-worker HH Dummy Variable	0.0692295	0.1639483	-0.0021403	-0.0113826	0.3446947	
PUMA Average High School Test Score	0.060345	0.0918183	0.0544886	0.0179083	-0.0169259	0.0729653
PUMA Average Occupation-specific Auto Accessibility	-5.71E-10	4.17E-10	-8.56E-10	-1.59E-09	-7.70E-12	2.96E-10
PUMA Average Auto Accessibility	1.58E-10	-1.03E-10	5.24E-10	-1.40E-10	2.44E-10	-2.75E-10

Appendix D-5: Greater New York City Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Observations	3333120	854500	764480	1252260	1175800	
Log-likelihood Ratio	-348392	-91824	-85279	-127713	-123344	
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
CARPOOL/No vehicles owned/Central City PUMA	-0.8823149	2.21808	-0.0278956	18.23977	1.136033	0.2603324
PUBLIC TRANSIT/No vehicles owned/Central City PUMA	1.358313	1.773893	1.961309	18.31108	1.41084	
BIKE-PEDESTRIAN/No vehicles owned/Central City PUMA	-0.6313887	3.948161	-0.4428662	20.9078	4.303066	
DRIVE ALONE/No vehicles owned/Secondary City PUMA	-5.802946	2.51661	-2.573663	19.59112	2.458135	-0.8880515
CARPOOL/No vehicles owned/Secondary City PUMA	-1.24E+18	2.233833	-0.6750601	16.85248	2.550321	-0.7336784
PUBLIC TRANSIT/No vehicles owned/Secondary City PUMA	-4.91418	2.194563	-1.176845	18.13608	0.8001236	-2.049975
BIKE-PEDESTRIAN/No vehicles owned/Secondary City PUMA	-5.336194	2.618205	-1.761708	17.74891	2.966274	-1.846965
DRIVE ALONE/No vehicles owned/Inner Suburb PUMA	-0.2807279	0.9969704	0.2243564	-2.36E+16	1.315887	-1.091699
CARPOOL/No vehicles owned/Inner Suburb PUMA	-0.3446231	2.287668	0.6788701	17.62651	1.588683	-0.7273373
PUBLIC TRANSIT/No vehicles owned/Inner Suburb PUMA	1.003811	2.202096	1.462117	18.51012	1.397995	-1.506318
BIKE-PEDESTRIAN/No vehicles owned/Inner Suburb PUMA	-1.450943	3.791106	-0.8585961	19.58231	3.550266	-1.456079
DRIVE ALONE/No vehicles owned/Outer Suburb PUMA	-2.517217	1.950105	-0.0949064	18.10787	2.191897	-0.2423078
CARPOOL/No vehicles owned/Outer Suburb PUMA	-2.671953	2.983119	0.0993791	17.38748	1.418557	-0.0526405
PUBLIC TRANSIT/No vehicles owned/Outer Suburb PUMA	-3.817611	2.63831	-0.6373318	18.3195	1.745124	-1.886803
BIKE-PEDESTRIAN/No vehicles owned/Outer Suburb PUMA	-4.921322	3.241841	-1.016964	18.2567	2.877642	-2.244531
DRIVE ALONE/No vehicles owned/Fringe Suburb PUMA	-2.671225	2.29706	-0.6365715	18.86052	1.64616	-3.207607
CARPOOL/No vehicles owned/Fringe Suburb PUMA	-2.815558	3.657071	-0.7889296	17.73662	2.535218	-1.120917
PUBLIC TRANSIT/No vehicles owned/Fringe Suburb PUMA	-5.57E+17	1.424427	-0.879782	19.30436	2.021784	
BIKE-PEDESTRIAN/No vehicles owned/Fringe Suburb PUMA	-4.334324	1.591937	-2.796998	17.71288	1.711681	
DRIVE ALONE/1 vehicle owned/Central City PUMA	20.64918	3.196356	3.120444	18.27878	1.394258	7.601546
CARPOOL/1 vehicle owned/Central City PUMA	19.25905	0.8875112	2.720756	-0.0209596	-1.658912	6.191457
PUBLIC TRANSIT/1 vehicle owned/Central City PUMA	20.69672	1.162818	3.218487	0.9451298	0.2664082	4.829214
BIKE-PEDESTRIAN/1 vehicle owned/Central City PUMA	17.79859	-0.1950224	1.204669	-0.7978925	-0.7456069	5.091182
DRIVE ALONE/1 vehicle owned/Secondary City PUMA	16.16654	1.101172	2.934159	0.7574112	0.8638851	10.46254
CARPOOL/1 vehicle owned/Secondary City PUMA	15.70343	0.8567959	2.707902	0.5646414	-3.14E+14	9.057132
PUBLIC TRANSIT/1 vehicle owned/Secondary City PUMA	-3.43E+17	-5.38E+14	0.7968231	-1.843069	-3.10E+14	-1.21E+15
BIKE-PEDESTRIAN/1 vehicle owned/Secondary City PUMA	-3.58E+17	-5.14E+14	-0.982927	-0.4471382	-0.0510834	7.667447
DRIVE ALONE/1 vehicle owned/Inner Suburb PUMA	19.50695	1.354884	3.985304	0.6457836	0.4667608	3.821797
CARPOOL/1 vehicle owned/Inner Suburb PUMA	18.87829	0.2677185	3.428273	0.6122488	0.114951	1.993442
PUBLIC TRANSIT/1 vehicle owned/Inner Suburb PUMA	18.53204	0.7060907	3.013607	0.6104644	0.1147429	0.7080568
BIKE-PEDESTRIAN/1 vehicle owned/Inner Suburb PUMA	17.21648	-0.846454	0.7184649	-0.8101669	-1.288398	0.4457589
DRIVE ALONE/1 vehicle owned/Outer Suburb PUMA	17.15057	1.580423	3.613961	0.8645549	0.6509267	7.219767
CARPOOL/1 vehicle owned/Outer Suburb PUMA	16.81558	0.3543481	2.660495	0.7908756	0.4008109	5.537018
PUBLIC TRANSIT/1 vehicle owned/Outer Suburb PUMA	15.58793	0.0264705	1.405737	-0.3732931	-0.5672028	2.214903
BIKE-PEDESTRIAN/1 vehicle owned/Outer Suburb PUMA	13.47873	-0.6573044	0.9046105	-0.9241656	-1.298204	3.088779
DRIVE ALONE/1 vehicle owned/Fringe Suburb PUMA	16.95248	1.711218	3.590941	1.156801	0.9156072	8.10423
CARPOOL/1 vehicle owned/Fringe Suburb PUMA	16.14628	0.5273819	3.030896	0.6833872	-0.806753	6.156944
PUBLIC TRANSIT/1 vehicle owned/Fringe Suburb PUMA	14.81442	-1.10729	0.4565974	-1.357329	-2.54765	1.702509
BIKE-PEDESTRIAN/1 vehicle owned/Fringe Suburb PUMA	14.27863	-0.4791136	0.2219394	-0.6766707	-1.383998	3.682853
DRIVE ALONE/2 vehicles owned/Central City PUMA	18.40156	12.09645	2.805933	21.94524	9.925911	
CARPOOL/2 vehicles owned/Central City PUMA	17.52672	**10.48682**	**1.780128**	**21.49375**	**9.14824**	
PUBLIC TRANSIT/2 vehicles owned/Central City PUMA	17.55579	11.61185	2.09547	21.78975	10.24004	
BIKE-PEDESTRIAN/2 vehicles owned/Central City PUMA	16.11353	9.134401	0.7467785	19.16629	8.512777	

Appendix D-5: Greater New York City Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
DRIVE ALONE/2 vehicles owned/Secondary City PUMA	17.73715	10.54541	2.967079	21.57342	10.3912	
CARPOOL/2 vehicles owned/Secondary City PUMA	16.37708	8.575916	1.908334	19.00804	8.983828	
PUBLIC TRANSIT/2 vehicles owned/Secondary City PUMA	-3.17E+17	-2.01E+15	0.2304323	19.25334	8.155872	
BIKE-PEDESTRIAN/2 vehicles owned/Secondary City PUMA	-3.71E+17	6.43006	-0.1481926	-7.36E+17	-6.30E+14	
DRIVE ALONE/2 vehicles owned/Inner Suburb City PUMA	21.48293	12.39847	4.023594	22.06077	9.717744	
CARPOOL/2 vehicles owned/Inner Suburb City PUMA	19.90107	9.776922	2.75387	20.48509	8.095061	
PUBLIC TRANSIT/2 vehicles owned/Inner Suburb City PUMA	19.69669	10.66955	2.282509	20.70021	8.362857	
BIKE-PEDESTRIAN/2 vehicles owned/Inner Suburb City PUMA	17.38844	8.766254	-0.4533784	19.09275	6.423598	
DRIVE ALONE/2 vehicles owned/Outer Suburb City PUMA	21.96245	12.62524	4.073716	22.59503	9.731716	
CARPOOL/2 vehicles owned/Outer Suburb City PUMA	19.602	9.785752	2.56484	20.32567	7.839409	
PUBLIC TRANSIT/2 vehicles owned/Outer Suburb City PUMA	19.85332	9.47796	0.9022421	18.8184	6.874056	
BIKE-PEDESTRIAN/2 vehicles owned/Outer Suburb City PUMA	17.60361	8.678702	-1.37081	19.67682	6.22938	
DRIVE ALONE/2 vehicles owned/Fringe Suburb City PUMA	22.11862	12.92528	4.375516	23.01468	9.550086	
CARPOOL/2 vehicles owned/Fringe Suburb City PUMA	19.8955	10.1473	2.880959	20.79373	6.770413	
PUBLIC TRANSIT/2 vehicles owned/Fringe Suburb City PUMA	19.34662	8.699633	0.4704767	19.23737	6.441566	
BIKE-PEDESTRIAN/2 vehicles owned/Fringe Suburb City PUMA	17.24506	8.852312	0.9149254	19.6546	5.258974	
DRIVE ALONE/Occupation-specific auto accessibility	1.32E-10	-3.78E-11	-3.06E-10	5.48E-10	5.60E-10	1.26E-09
CARPOOL/Occupation-specific auto accessibility	-4.31E-10	1.19E-10	-3.04E-10	-1.58E-10	2.06E-10	2.11E-09
PUBLIC TRANSIT/Occupation-specific transit accessibility	5.41E-09	-5.66E-10	1.12E-09	6.53E-09	2.03E-09	3.27E-08
BIKE-PED/Occupation-specific transit accessibility	1.01E-08	-8.28E-10	6.05E-10	4.62E-09	1.21E-10	2.74E-08
DRIVE ALONE/Female trip-maker	-0.1568262	-0.289149	0.0782172	0.0808276	0.1664583	**-0.6053731**
CARPOOL/Female trip-maker	0.1431552	-0.1864035	0.1122374	-0.088791	0.3839183	-0.6753218
PUBLIC TRANSIT/Female trip-maker	0.2090868	-0.1627333	0.5239743	0.4131195	0.4728259	-0.2859176
BIKE-PED/Female trip-maker	0.0332568	-0.1040949	0.5600913	-0.0273967	-0.0560666	-0.3217598
DRIVE ALONE/45-64 year-old trip-maker	7.248593	1.083259	32.86246	5.340441	0.5924487	1.408401
CARPOOL/45-64 year-old trip-maker	8.545079	0.1516412	-5.19E+14	-2.97E+15	0.1812295	-0.0089856
PUBLIC TRANSIT/45-64 year-old trip-maker	7.555782	1.175288	-3.77E+14	4.672653	-0.7311705	1.158301
BIKE-PED/45-64 year-old trip-maker	-3.18E+16	-1.677384	-9.78E+14	5.214914	-0.6303375	1.32616
DRIVE ALONE/45-64 year-old trip-maker	-0.5214383	-0.078909	0.5043365	0.3816075	0.3172598	0.1263619
CARPOOL/45-64 year-old trip-maker	-0.3493505	0.1164905	0.3130042	-0.0266867	-0.0919863	0.1742211
PUBLIC TRANSIT/45-64 year-old trip-maker	-0.3113168	-0.0511453	0.2537562	-0.1115171	0.1562447	0.3663585
BIKE-PED/45-64 year-old trip-maker	0.1585486	-0.0996264	0.0912555	0.0044084	0.3907635	-0.1627707
DRIVE ALONE/Single-worker households trip-maker	-0.4427525	-1.161877	-0.3044647	-1.156907	0.009515	
CARPOOL/Single-worker households trip-maker	-0.4343224	-0.6342492	-0.4600202	-0.5274938	-0.0226937	-0.95644
PUBLIC TRANSIT/Single-worker households trip-maker	-0.0110085	-0.4694931	-0.3137183	-0.4498391	-0.0701121	1.778074
BIKE-PED/Single-worker households trip-maker	-0.1460328	0.0407422	-0.1398444	-0.3869269	0.1673305	0.8822722
DRIVE ALONE/Disabled trip-maker	-0.2098174	-0.0312038	-0.8315062	-0.0099523	-0.9551064	0.0044714
CARPOOL/Disabled trip-maker	-0.2037369	0.0409941	-0.4026225	0.381354	-1.2768	0.0989478
PUBLIC TRANSIT/Disabled trip-maker	-0.6167228	0.1743993	-0.6388567	0.1215897	-1.006394	0.3819136
BIKE-PED/Disabled trip-maker	0.1872339	-0.2209733	-0.2277893	-0.2371327	-0.4329339	-0.8244801
Constants						
Central City PUMA Type (Level 2 model only)	0.3002619	14.52173	0.9153898	2.608837	2.76359	0.6902647
Secondary City PUMA Type (Level 2 model only)	0.3663764	17.64349	0.969494	2.846015	2.907921	0.6260202
Inner Suburb PUMA Type (Level 2 model only)	0.341469	14.88347	1.002242	2.736269	3.148021	1.791393
Outer Suburb PUMA Type (Level 2 model only)	0.3501256	14.8572	1.035697	2.740901	3.24365	1.056925
Fringe Suburb PUMA Type (Level 2 model only)	0.3564301	14.54792	0.99576	2.702751	3.34175	0.9960945
Level 1: Choice of PUMA Type						
INNER SUBURB PUMA choice	0.8052478	0.4044151	0.5473003	0.9832458	0.9918416	
FRINGE SUBURB PUMA choice	0.1365292	0.0367053	0.0864992	-0.0419756	0.5290112	

Appendix D-5: Greater New York City Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
CENTRAL CITY PUMA choice * Household Income	3.43E-06	-3.16E-06	3.32E-06	0.0000116	7.91E-06	0.0000352
SECONDARY CITY PUMA choice * Household Income	-1.90E-06	-4.93E-06	-8.59E-07	-0.0000103	-9.89E-06	4.05E-06
INNER SUBURB PUMA choice * Household Income	6.70E-07	4.07E-08	4.48E-06	6.04E-06	3.88E-07	0.0000185
OUTER SUBURB PUMA choice * Household Income	5.82E-06	8.44E-07	2.22E-06	-3.19E-06	-7.06E-06	0.0000363
FRINGE SUBURB PUMA choice * Household Income	6.21E-06	-2.93E-06	-4.91E-06	-3.68E-06	-0.0000144	0.0000299
CENTRAL CITY PUMA choice * Renter Dummy Variable	0.382957	0.2779951	-0.0829959	0.272253	0.0986631	0.6052078
SECONDARY CITY PUMA choice * Renter Dummy Variable	0.254697	-0.0350587	0.7512946	-0.4372084	0.1844087	0.5287729
INNER SUBURB PUMA choice * Renter Dummy Variable	-0.2936191	0.0612641	-0.443	-0.3192229	-0.3090528	1.007863
OUTER SUBURB PUMA choice * Renter Dummy Variable	-0.3103298	-0.3638213	-0.7528411	-0.6294289	-0.3542026	0.5399624
FRINGE SUBURB PUMA choice * Renter Dummy Variable	-0.4298011	-0.5675696	-0.3786751	-0.4249942	-0.3122315	0.3231169
CENTRAL CITY PUMA choice * Condo Owner Dummy Variable	-0.0882454	0.2083464	-0.9068007	-0.364984	-0.3790147	0.5691524
SECONDARY CITY PUMA choice * Condo Owner Dummy Variable	1.204915	-0.3695097	1.000366	0.6177865	1.074036	-0.0664296
INNER SUBURB PUMA choice * Condo Owner Dummy Variable	-0.8275333	0.0483562	-1.042681	0.0262659	-0.693344	0.8620487
OUTER SUBURB PUMA choice * Condo Owner Dummy Variable	-0.5992542	-0.1247525	-2.090089	-0.4873115	0.0564501	0.433637
FRINGE SUBURB PUMA choice * Condo Owner Dummy Variable	-0.1501497	0.0488823	-0.1937621	0.5053229	0.7351631	0.8933973
CENTRAL CITY PUMA choice * Persons in Household	-0.0029505	0.1062938	0.0325613	-0.1981895	-0.1326752	
SECONDARY CITY PUMA choice * Persons in Household	-0.0849473	-0.0532489	-0.0285702	0.1645518	0.1271228	
INNER SUBURB PUMA choice * Persons in Household	0.0572349	0.1114972	-0.0102961	-0.114542	-0.081022	-0.3440833
OUTER SUBURB PUMA choice * Persons in Household	0.1401884	0.1314019	0.0622342	0.2701928	0.0110146	
FRINGE SUBURB PUMA choice * Persons in Household	0.0898864	0.0908655	0.0795291	0.0973532	0.0191314	
CENTRAL CITY PUMA choice * White HH Head Dummy Variable	0.1576951	0.1516724	-0.8144107	0.0528387	-0.3832319	-0.1865089
SECONDARY CITY PUMA choice * White HH Head Dummy Variable	-0.2739988	-0.2591349	0.1825628	-0.4934854	-0.1223997	-0.1755118
INNER SUBURB PUMA choice * White HH Head Dummy Variable	-0.5611392	-0.7393675	-0.5168104	-0.970466	-0.272515	-0.7211013
OUTER SUBURB PUMA choice * White HH Head Dummy Variable	0.5950044	0.15549	1.077905	0.0462439	0.9133639	0.3142675
FRINGE SUBURB PUMA choice * White HH Head Dummy Variable	0.9998024	0.8703879	1.639768	0.515125	1.71883	0.8367926
CENTRAL CITY PUMA choice * Female HH Head Dummy Variable	-0.0211375	-0.9022527	-0.1708919	0.0878153	-0.4037869	0.1514807
SECONDARY CITY PUMA choice * Female HH Head Dummy Variable	0.4415612	0.4197305	0.1467698	0.3920746	0.4965511	0.1262633
INNER SUBURB PUMA choice * Female HH Head Dummy Variable	0.1596075	-0.6416116	-0.0543871	0.0649204	-0.1724426	0.6241246
OUTER SUBURB PUMA choice * Female HH Head Dummy Variable	-0.0746883	-0.2572185	-0.1124328	0.0601273	0.0116146	0.4758261
FRINGE SUBURB PUMA choice * Female HH Head Dummy Variable	-0.4168155	-0.4289293	-0.4381388	0.2103789	-0.0471582	0.4016011
CENTRAL CITY PUMA choice * Senior HH Head Dummy Variable	0.9472219	2.127372	10.38618	3.722833	1.475538	-0.0173962
SECONDARY CITY PUMA choice * Senior HH Head Dummy Variable	-1.99E+07	-4.55E+07	-1.58E+07	-3.26E+08	2.069255	0.1840263
INNER SUBURB PUMA choice * Senior HH Head Dummy Variable	2.121216	2.034049	6.31056	4.001062	-0.7966149	-0.4343117
OUTER SUBURB PUMA choice * Senior HH Head Dummy Variable	1.254564	2.657043	-4415813	3.527369	1.215834	0.9330101
FRINGE SUBURB PUMA choice * Senior HH Head Dummy Variable	1.659626	2.796597	6.553333	3.744825	0.4694638	0.3292305
CENTRAL CITY PUMA choice * Age 45-64 HH Head Dummy Variable	0.3806362	0.1887357	0.1185803	-0.1104648	0.2456955	-0.4146667
SECONDARY CITY PUMA choice * Age 45-64 HH Head Dummy Variable	-0.2507533	-0.4086682	0.1157726	0.1919217	-0.4499013	0.0215197
INNER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	0.3788002	0.173351	0.1547652	0.272884	0.0207911	0.1198435
OUTER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.0430398	-0.0458216	-0.2299808	0.3429596	0.0823879	0.1796283
FRINGE SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	0.0496281	0.0505108	-0.0077447	0.3677386	-0.3679051	0.2958735
CENTRAL CITY PUMA choice * Single-worker HH Dummy Variable	0.6132551	-1.241876	0.4355911	0.4802623	-0.0517111	
SECONDARY CITY PUMA choice * Single-worker HH Dummy Variable	-0.2791233	2.971404	0.0555787	-0.2349833	0.1473731	
INNER SUBURB PUMA choice * Single-worker HH Dummy Variable	0.231631	-0.2245985	0.2532313	0.3036198	-0.2932098	
OUTER SUBURB PUMA choice * Single-worker HH Dummy Variable	0.0077795	0.6441056	-0.4105431	-0.143701	-0.1930974	
FRINGE SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.2723603	0.732705	-0.6414389	-0.5133439	-0.7007703	-0.2947163
PUMA Average High School Test Score	-0.0045403	-0.0009444	0.0203618	0.0095368	0.0287084	-0.0205274
PUMA Average Occupation-specific Auto Accessibility	2.47E-10	1.04E-09	1.79E-10	-1.13E-09	-3.59E-10	-1.57E-09
PUMA Average Auto Accessibility	4.84E-11	1.06E-10	5.69E-11	9.32E-11	1.83E-10	1.66E-10

Appendix D-6: San Francisco Bay Area Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Observations	1425300	442060	361040	815520	450700	579140
Log-likelihood Ratio	-143850.63	-47545.364	-38600.01	-94796.356	-47776.001	61716.077
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
DRIVE ALONE/No vehicles owned/Central City PUMA	0.0341846	-0.9755764	-0.441034	0.2356811	-1.037085	
PUBLIC TRANSIT/No vehicles owned/Central City PUMA	0.8411307	0.7536101	-0.293187	2.255953	0.5285844	
BIKE-PEDESTRIAN/No vehicles owned/Central City PUMA	1.737618	0.6304954	-1.026193	1.948003	0.381358	
DRIVE ALONE/No vehicles owned/Secondary City PUMA	0.8781712	0.0698167	-1.246151	0.3040184	-40.15017	-2.8058
CARPOOL/No vehicles owned/Secondary City PUMA	-1.42E+21	-3.03E+23	-3.70E+15	-0.3819416	-39.91121	-5.22E+15
PUBLIC TRANSIT/No vehicles owned/Secondary City PUMA	-1.27E+17	-1.89E+26	-2.347501	0.4302235	-41.20083	-5.62E+15
BIKE-PEDESTRIAN/No vehicles owned/Secondary City PUMA	-1.25E+14	0.6044647	-1.476774	-0.051435	-1.420965	-4.075785
DRIVE ALONE/No vehicles owned/Inner Suburb PUMA	1.182039	0.8791753	-0.2577057	1.512014	-0.288679	0.8537185
CARPOOL/No vehicles owned/Inner Suburb PUMA	-1.52E+20	-1.521963	-0.641535	0.0407248	0.3519457	-0.9210705
PUBLIC TRANSIT/No vehicles owned/Inner Suburb PUMA	-1.225991	-0.1479641	-0.8868238	1.220535	-0.3866193	-0.883114
BIKE-PEDESTRIAN/No vehicles owned/Inner Suburb PUMA	-0.8890748	-0.6393131	-1.468233	0.3691791	-0.2363205	-1.602104
DRIVE ALONE/No vehicles owned/Outer Suburb PUMA	1.179231	0.6362663	0.3864926	1.357778	0.2539816	0.0045296
CARPOOL/No vehicles owned/Outer Suburb PUMA	1.272244	-0.425241	-1.142379	0.5414346	0.048856	-0.6846056
PUBLIC TRANSIT/No vehicles owned/Outer Suburb PUMA	0.027967	-0.2879514	-1.34125	1.261452	-0.5611139	-0.8121449
BIKE-PEDESTRIAN/No vehicles owned/Outer Suburb PUMA	-1.00E+17	-0.6245093	-0.3257014	1.328936	-0.7082354	-1.87437
DRIVE ALONE/No vehicles owned/Fringe Suburb PUMA	1.329248	-0.2649904	-3.400211	0.8119275	-0.324991	-0.3440746
CARPOOL/No vehicles owned/Fringe Suburb PUMA	-0.3085675	-5.23E+40	-3.40E+15	-0.6954207	-1.523236	-4.25E+15
PUBLIC TRANSIT/No vehicles owned/Fringe Suburb PUMA	-0.5140693	-1.60E+145	-3.20E+15	-2.386576	-2.533791	-3.628711
BIKE-PEDESTRIAN/No vehicles owned/Fringe Suburb PUMA	-7.59E+16	-0.1197302	-3.51E+15	-0.2704149	-40.34811	-2.974407
DRIVE ALONE/1 vehicle owned/Central City PUMA	15.25073	19.80102	9.647294	6.049024	22.15256	1.266731
CARPOOL/1 vehicle owned/Central City PUMA	15.38293	19.91064	9.069474	5.278483	20.68269	-0.5199619
PUBLIC TRANSIT/1 vehicle owned/Central City PUMA	14.98167	19.61412	7.725942	6.341414	20.69572	-1.420085
BIKE-PEDESTRIAN/1 vehicle owned/Central City PUMA	14.01245	19.75427	6.339363	5.25207	20.77369	-1.604224
DRIVE ALONE/1 vehicle owned/Secondary City PUMA	15.73528	28.02072	8.98643	5.441762	20.88694	2.875114
CARPOOL/1 vehicle owned/Secondary City PUMA	14.78472	-8.38E+23	8.024307	3.94521	20.17246	1.377696
PUBLIC TRANSIT/1 vehicle owned/Secondary City PUMA	-1.57E+17	26.35986	7.139211	4.110369	-16.84038	-2.224688
BIKE-PEDESTRIAN/1 vehicle owned/Secondary City PUMA	14.20915	-1.54E+23	-5.04E+15	4.335696	-14.93413	-0.2484614
DRIVE ALONE/1 vehicle owned/Inner Suburb PUMA	16.44807	22.82976	10.36204	5.844084	22.75036	3.256282
CARPOOL/1 vehicle owned/Inner Suburb PUMA	15.71065	22.89734	10.15415	5.352363	21.49751	0.7172583
PUBLIC TRANSIT/1 vehicle owned/Inner Suburb PUMA	14.60013	20.7854	8.053688	4.575061	21.08447	-0.2569827
BIKE-PEDESTRIAN/1 vehicle owned/Inner Suburb PUMA	13.4601	20.75602	7.225827	3.549304	20.46479	-1.149123
DRIVE ALONE/1 vehicle owned/Outer Suburb PUMA	16.58111	21.21972	10.26372	6.41325	22.6509	3.375278
CARPOOL/1 vehicle owned/Outer Suburb PUMA	16.00077	20.40638	10.06076	5.809284	21.242	1.138303
PUBLIC TRANSIT/1 vehicle owned/Outer Suburb PUMA	14.58852	19.89117	7.550283	4.627207	19.54152	-0.5460809
BIKE-PEDESTRIAN/1 vehicle owned/Outer Suburb PUMA	13.68184	18.65571	7.437551	5.257819	20.80558	-0.9715687
DRIVE ALONE/1 vehicle owned/Fringe Suburb PUMA	16.04218	23.21918	9.408025	3.941533	21.57628	1.529663
CARPOOL/1 vehicle owned/Fringe Suburb PUMA	15.44082	22.29081	8.771536	3.265547	21.09614	-0.9133057
PUBLIC TRANSIT/1 vehicle owned/Fringe Suburb PUMA	-3.01E+16	-9.56E+14	6.810543	-1.38E+14	-16.00082	-3.097866
BIKE-PEDESTRIAN/1 vehicle owned/Fringe Suburb PUMA	11.58273	21.67919	7.46845	2.206006	-15.05374	-2.401035
DRIVE ALONE/2 vehicles owned/Central City PUMA	19.97143	5.024384	8.179667	3.609464	6.436809	
CARPOOL/2 vehicles owned/Central City PUMA	18.67327	3.1215	7.436329	1.612814	5.006354	
PUBLIC TRANSIT/2 vehicles owned/Central City PUMA	17.82555	2.9077	5.116848	2.350405	3.500387	
BIKE-PEDESTRIAN/2 vehicles owned/Central City PUMA	17.6926	2.453769	-1.45E+16	1.773947	4.096054	
DRIVE ALONE/2 vehicles owned/Secondary City PUMA	20.25931	6.732518	9.113058	3.547165	5.836407	
CARPOOL/2 vehicles owned/Secondary City PUMA	18.36426	4.71438	8.179941	1.78919	4.012513	
PUBLIC TRANSIT/2 vehicles owned/Secondary City PUMA	-3.68E+17	-2.22E+17	6.317301	0.5097941	-32.65158	
BIKE-PEDESTRIAN/2 vehicles owned/Secondary City PUMA	-3.43E+17	3.296073	6.358295	0.9741529	3.331771	

Appendix D-6: San Francisco Bay Area Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
DRIVE ALONE/2 vehicles owned/Inner Suburb City PUMA	21.24902	5.99815	9.846638	3.928147	7.363875	
CARPOOL/2 vehicles owned/Inner Suburb City PUMA	19.88234	3.748881	8.486699	1.689613	5.647262	
PUBLIC TRANSIT/2 vehicles owned/Inner Suburb City PUMA	17.7939	2.659743	5.984861	1.395208	4.009804	
BIKE-PEDESTRIAN/2 vehicles owned/Inner Suburb City PUMA	17.59871	2.186778	6.715341	0.2725681	2.336879	
DRIVE ALONE/2 vehicles owned/Outer Suburb City PUMA	21.60682	5.510219	10.08807	4.389445	7.630549	
CARPOOL/2 vehicles owned/Outer Suburb City PUMA	19.95343	3.574978	8.818771	2.324422	6.099258	
PUBLIC TRANSIT/2 vehicles owned/Outer Suburb City PUMA	18.54842	2.634806	6.21218	1.332638	4.198131	
BIKE-PEDESTRIAN/2 vehicles owned/Outer Suburb City PUMA	17.598	1.483625	7.533774	1.089336	3.35835	
DRIVE ALONE/2 vehicles owned/Fringe Suburb City PUMA	21.05071	5.746018	9.907103	2.542614	6.967583	
CARPOOL/2 vehicles owned/Fringe Suburb City PUMA	19.74831	3.876877	8.652665	0.7160739	5.66208	
PUBLIC TRANSIT/2 vehicles owned/Fringe Suburb City PUMA	17.73077	2.656027	5.083485	-1.90887	1.917923	
BIKE-PEDESTRIAN/2 vehicles owned/Fringe Suburb City PUMA	16.94924	2.456468	5.797384	-0.6534752	2.213293	
DRIVE ALONE/Occupation-specific auto accessibility	8.00E-10	-9.93E-10	9.79E-10	8.71E-10	-4.76E-10	6.20E-11
CARPOOL/Occupation-specific auto accessibility	7.10E-10	-6.48E-10	-3.75E-11	9.01E-10	1.36E-10	-1.54E-10
PUBLIC TRANSIT/Occupation-specific transit accessibility	1.65E-08	-2.31E-10	1.19E-08	1.19E-08	-1.34E-08	1.14E-08
BIKE-PED/Occupation-specific transit accessibility	-1.73E-08	-1.56E-08	2.48E-08	1.27E-08	-1.58E-08	5.30E-09
DRIVE ALONE/Female trip-maker	-0.7086977	0.1319022	0.6222351	-0.0363718	0.1695612	0.494193
CARPOOL/Female trip-maker	-0.0937368	0.3118517	0.6449626	-0.2280777	0.2781046	0.522048
PUBLIC TRANSIT/Female trip-maker	0.1206654	0.4186968	1.179596	0.115348	0.7340868	0.1950278
BIKE-PED/Female trip-maker	0.2005987	0.1672905	-0.483203	-0.1299308	-0.1896275	0.1404879
DRIVE ALONE/45-64 year-old trip-maker	17.00823	6.600493	18.29978	21.95804	17.37608	13.82941
CARPOOL/45-64 year-old trip-maker	-2.33E+16	7.495954	17.98533	22.0149	-18.83954	-1.03E+15
PUBLIC TRANSIT/45-64 year-old trip-maker	-5.74E+13	6.743476	-2.42E+15	-1.81E+13	19.8205	14.41112
BIKE-PED/45-64 year-old trip-maker	-1.12E+16	-1.12E+16	-1.56E+15	-4.36E+13	-16.39606	-2.41E+14
DRIVE ALONE/45-64 year-old trip-maker	0.2894366	-0.2024769	-0.9215335	0.0281958	-0.0941725	0.6561111
CARPOOL/45-64 year-old trip-maker	0.1721772	-0.206304	-1.6883	0.0959224	-0.44628	-0.1416443
PUBLIC TRANSIT/45-64 year-old trip-maker	-0.0111721	0.0438554	-0.0887847	-0.1615172	0.2606014	0.1440674
BIKE-PED/45-64 year-old trip-maker	0.0129842	-0.076093	-1.188426	-0.3335716	0.1783001	0.0532307
DRIVE ALONE/Single-worker households trip-maker	-0.0471058	0.1648239	-0.1281784	-0.3894455	0.0934848	
CARPOOL/Single-worker households trip-maker	-0.7154781	0.1855802	-0.0087447	-0.1824719	-0.2795385	-0.3560624
PUBLIC TRANSIT/Single-worker households trip-maker	0.328576	0.6744878	0.0892131	0.0498832	0.2972969	1.339062
BIKE-PED/Single-worker households trip-maker	0.3764422	0.8761237	-0.6253322	-0.0815068	0.1899493	1.364299
DRIVE ALONE/Disabled trip-maker	-0.4691802	2.452526	0.4166008	0.7526184	4.333355	-2.591693
CARPOOL/Disabled trip-maker	-0.3967025	2.974024	-0.0873333	1.105419	4.434968	-2.228674
PUBLIC TRANSIT/Disabled trip-maker	0.1356862	2.020673	0.8999072	0.2474455	5.012616	-2.689412
BIKE-PED/Disabled trip-maker	-1.035256	1.151047	-0.2738155	0.9880573	-32.19999	-1.844977
Constants						
Central City PUMA Type (Level 2 model only)	0.9986887	2.572961	0.6473312	1.810743	0.0138335	1.136219
Secondary City PUMA Type (Level 2 model only)	1.034307	1.854626	0.6293425	1.955541	0.0156484	0.3779633
Inner Suburb PUMA Type (Level 2 model only)	1.000276	2.309254	0.6738988	1.961907	0.0132925	0.6560567
Outer Suburb PUMA Type (Level 2 model only)	0.9953909	2.487684	0.6784362	1.867548	0.0130052	0.5719231
Fringe Suburb PUMA Type (Level 2 model only)	0.9988791	2.223044	0.6479981	2.651135	0.0140174	1.014999
Level 1: Choice of PUMA Type						
OUTER SUBURB PUMA choice * Household Income	5.40E-06	3.04E-06	5.56E-07	1.75E-06	1.31E-06	0.0000167
FRINGE SUBURB PUMA choice * Household Income	-1.78E-06	4.45E-06	-1.59E-06	2.08E-06	5.16E-06	-0.0000104

Appendix D-6: San Francisco Bay Area Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
CENTRAL CITY PUMA choice * Renter Dummy Variable	0.3100213	0.5906287	0.1619989	0.3290563	0.149047	0.7578699
SECONDARY CITY PUMA choice * Renter Dummy Variable	-0.5880849	-0.5375142	0.0681824	-0.2784847	-0.0032168	-0.2055425
INNER SUBURB PUMA choice * Renter Dummy Variable	0.356207	0.625762	0.1853756	0.0613385	0.05435	0.3004586
OUTER SUBURB PUMA choice * Renter Dummy Variable	-0.168869	-0.0778822	-0.1814033	-0.3461405	-0.0210525	-0.1148762
FRINGE SUBURB PUMA choice * Renter Dummy Variable	-0.5388424	-0.1732564	-0.4463587	-0.5665787	0.0551321	-0.5935399
CENTRAL CITY PUMA choice * Condo Owner Dummy Variable	-0.8439211	0.6651755	-1601.482	-0.9199419	-8.071613	-0.7760957
SECONDARY CITY PUMA choice * Condo Owner Dummy Variable	-0.4990606	-0.8956573	-5818.913	-0.6897162	0.97308	-0.3402703
INNER SUBURB PUMA choice * Condo Owner Dummy Variable	0.3968099	1.059696	5.094714	-0.2693806	1.036798	0.4633165
OUTER SUBURB PUMA choice * Condo Owner Dummy Variable	0.3917794	0.583508	4.439701	0.6133047	1.138533	0.0827071
FRINGE SUBURB PUMA choice * Condo Owner Dummy Variable	-0.2872401	-0.5215999	3.251853	-0.1240157	1.041246	-1.37082
CENTRAL CITY PUMA choice * Persons in Household	0.0339882	0.010363	0.0193313	-0.0720178	0.0037354	
SECONDARY CITY PUMA choice * Persons in Household	-0.1877945	-0.0535155	0.071316	0.1447269	0.0431206	
INNER SUBURB PUMA choice * Persons in Household	-0.0731802	0.0555169	-0.0278555	-0.0064614	-0.0354486	0.595656
OUTER SUBURB PUMA choice * Persons in Household	0.02308	0.0635419	0.0210934	-0.0429115	-0.0179542	
FRINGE SUBURB PUMA choice * Persons in Household	0.1024004	0.1464988	-0.0812674	-0.1533133	-0.0092914	
CENTRAL CITY PUMA choice * White HH Head Dummy Variable	-0.8370022	-0.4737635	-0.7610527	-0.0867767	-0.1339107	-0.4456001
SECONDARY CITY PUMA choice * White HH Head Dummy Variable	1.16344	1.086444	0.771517	0.6274291	0.5470125	0.638558
INNER SUBURB PUMA choice * White HH Head Dummy Variable	-0.9404442	-0.743085	-0.0217073	-0.5165789	0.0101398	-0.3605124
OUTER SUBURB PUMA choice * White HH Head Dummy Variable	-0.5876864	-0.3296618	0.2847987	-0.4132704	0.1354671	-0.0535699
FRINGE SUBURB PUMA choice * White HH Head Dummy Variable	0.6620977	0.4114916	0.7475299	0.2235881	0.374999	0.4549806
CENTRAL CITY PUMA choice * Female HH Head Dummy Variable	-0.2560137	0.2465223	-0.4620137	0.246927	0.0616417	0.1116035
SECONDARY CITY PUMA choice * Female HH Head Dummy Variable	-0.3389207	-0.3240229	-0.0735327	0.157869	-0.076044	0.0532103
INNER SUBURB PUMA choice * Female HH Head Dummy Variable	0.3525829	-0.2861872	0.1836135	0.171747	0.1159107	0.0865023
OUTER SUBURB PUMA choice * Female HH Head Dummy Variable	0.2103723	-0.4218095	-0.0664365	0.1540152	0.0619795	0.25566
FRINGE SUBURB PUMA choice * Female HH Head Dummy Variable	-0.072887	0.0799646	0.214091	0.0342834	0.0193285	0.1805233
CENTRAL CITY PUMA choice * Senior HH Head Dummy Variable	5.505138	0.7562212	5.419224	2.321131	5.408826	-4.276973
SECONDARY CITY PUMA choice * Senior HH Head Dummy Variable	-6762.445	5.451639	-4325.644	-516.115	-7.97806	7.735412
INNER SUBURB PUMA choice * Senior HH Head Dummy Variable	3.437144	2.054718	-877.9779	-2.360004	4.95035	3.800976
OUTER SUBURB PUMA choice * Senior HH Head Dummy Variable	3.200176	0.6147004	3.197623	-3.38E+99	5.059948	5.586672
FRINGE SUBURB PUMA choice * Senior HH Head Dummy Variable	-2111.701	-2258.548	-1496.688	-454.1378	-5.911131	-0.3030742
CENTRAL CITY PUMA choice * Age 45-64 HH Head Dummy Variable	0.1552446	-0.0256428	0.2645694	-0.1542234	0.0456754	-0.3026682
SECONDARY CITY PUMA choice * Age 45-64 HH Head Dummy Variable	-0.0805877	0.1543808	-0.3342957	-0.3390725	0.044214	0.1204387
INNER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.0327074	-0.2054717	-0.1067692	0.3392714	0.0267737	0.0061539
OUTER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.1345208	0.1549395	0.0136809	0.0990424	-0.0155652	0.3643154
FRINGE SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.1662622	0.5279159	0.0234817	0.3307274	-0.0350971	-0.0025112
CENTRAL CITY PUMA choice * Single-worker HH Dummy Variable	0.1919189	-0.4054793	0.0101204	0.2963359	0.0554643	
SECONDARY CITY PUMA choice * Single-worker HH Dummy Variable	-0.0808583	-0.3090994	0.4152381	-0.0788554	-0.008452	
INNER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.0309016	0.3360822	-0.0154678	-0.1488576	0.089366	
OUTER SUBURB PUMA choice * Single-worker HH Dummy Variable	0.0790429	0.0876796	0.1190271	0.066495	0.153851	
FRINGE SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.1505605	-0.0018895	-0.1971243	0.0896872	0.0810153	0.451329
PUMA Average High School Test Score	0.1132409	0.1539751	0.1382693	0.1700832	0.1888727	0.1282609
PUMA Average Occupation-specific Auto Accessibility	7.80E-10	2.57E-09	1.14E-09	-8.23E-10	8.43E-10	-3.35E-10
PUMA Average Auto Accessibility	3.35E-10	3.86E-10	4.71E-10	4.81E-10	6.89E-10	3.56E-10

Appendix D-7: Washington, D.C.-Baltimore Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
Observations	1252208	421504	353712	723680	624944	703616
Log-likelihood Ratio	-140744.63	-50507.215	-43122.931	-94619.406	-73186.254	-83935.625
Level 2: Choice of Commute Mode Contingent on Choice of PUMA Type						
DRIVE ALONE/No vehicles owned/Central City PUMA	-0.6678112	0.741063	0.2081552	-1.19521	20.58252	0.417429
PUBLIC TRANSIT/No vehicles owned/Central City PUMA	0.5447768	1.900155	1.279565	-1.842735	20.5388	4.524205
BIKE-PEDESTRIAN/No vehicles owned/Central City PUMA	-1.773614	0.0140552	-0.1271101	-0.465207	21.84783	25.4986
DRIVE ALONE/No vehicles owned/Inner Suburb PUMA	0.9657455	0.2878732	0.6056772	-1.436067	21.28452	-0.3270385
CARPOOL/No vehicles owned/Inner Suburb PUMA	-0.0642228	-0.1390041	0.6293187	-1.685375	20.65702	-0.6276677
PUBLIC TRANSIT/No vehicles owned/Inner Suburb PUMA	0.187573	0.1191233	-0.6320436	-0.9533053	20.23088	3.274631
BIKE-PEDESTRIAN/No vehicles owned/Inner Suburb PUMA	-1.418197	-0.6270477	-0.6875141	-1.889644	21.19741	22.84471
DRIVE ALONE/No vehicles owned/Outer Suburb PUMA	-0.025943	0.5737517	0.4956818	-1.729234	20.19633	-0.5093328
CARPOOL/No vehicles owned/Outer Suburb PUMA	-1.865905	1.249725	-0.0449774	-2.308408	20.24185	-1.203431
PUBLIC TRANSIT/No vehicles owned/Outer Suburb PUMA	-2.044699	-0.5831744	-1.248291	-2.916219	19.58713	2.32509
BIKE-PEDESTRIAN/No vehicles owned/Outer Suburb PUMA	-1.388583	-0.0219173	-0.6771376	-2.396723	18.94642	23.99207
DRIVE ALONE/No vehicles owned/Fringe Suburb PUMA	0.7710246	-1.209069	-0.1332913	-3.138276	18.82684	-1.121558
CARPOOL/No vehicles owned/Fringe Suburb PUMA	-1.88E+17	-0.8682949	-4.91E+16	-2.861972	19.91498	
PUBLIC TRANSIT/No vehicles owned/Fringe Suburb PUMA	-2.17E+17	-2.64E+17	-4.72E+16	-1.20E+15	19.75789	
BIKE-PEDESTRIAN/No vehicles owned/Fringe Suburb PUMA	-2.719195	-1.68E+17	-4.79E+16	-4.076113	-1.82E+15	
DRIVE ALONE/1 vehicle owned/Central City PUMA	2.683362	18.46855	18.00309	5.550518	-1.43E+15	
CARPOOL/1 vehicle owned/Central City PUMA	2.026927	18.01169	17.83462	4.687055	2.295192	
PUBLIC TRANSIT/1 vehicle owned/Central City PUMA	0.8431778	17.51125	16.90728	4.908737	1.779183	
BIKE-PEDESTRIAN/1 vehicle owned/Central City PUMA	0.4606712	16.20304	15.05406	4.468717	1.140737	
DRIVE ALONE/1 vehicle owned/Inner Suburb PUMA	3.294548	15.94076	19.14068	4.921753	2.703971	
CARPOOL/1 vehicle owned/Inner Suburb PUMA	2.763345	15.86039	18.9213	4.063284	1.390728	
PUBLIC TRANSIT/1 vehicle owned/Inner Suburb PUMA	1.963443	15.18936	17.37378	3.746529	1.435724	
BIKE-PEDESTRIAN/1 vehicle owned/Inner Suburb PUMA	-0.4803114	13.27624	16.24044	2.732152	-1.53E+14	
DRIVE ALONE/1 vehicle owned/Outer Suburb PUMA	3.734166	11.96849	18.92783	4.251453	1.819902	
CARPOOL/1 vehicle owned/Outer Suburb PUMA	2.611585	12.03687	18.54094	3.719643	0.9086831	
PUBLIC TRANSIT/1 vehicle owned/Outer Suburb PUMA	-0.2238377	10.0435	-8.26E+14	1.697311	-0.8595711	
BIKE-PEDESTRIAN/1 vehicle owned/Outer Suburb PUMA	0.3616165	10.12662	14.41367	2.316638	-1.63E+14	
DRIVE ALONE/1 vehicle owned/Fringe Suburb PUMA	2.415812	18.03334	17.94668	4.539475	1.10116	
CARPOOL/1 vehicle owned/Fringe Suburb PUMA	1.162487	17.58197	17.30134	3.625685	0.5301496	
PUBLIC TRANSIT/1 vehicle owned/Fringe Suburb PUMA	-0.3384651	-5.24E+16	-1.40E+15	-4.58E+14	-3.97E+14	
BIKE-PEDESTRIAN/1 vehicle owned/Fringe Suburb PUMA	0.1479835	-5.30E+16	14.74236	2.686398	-0.0362225	
DRIVE ALONE/2 vehicles owned/Central City PUMA	3.643521	5.20387	9.81023	3.84901	6.013209	-14.75021
CARPOOL/2 vehicles owned/Central City PUMA	2.204189	3.864893	8.803113	1.870707	4.680607	-16.74151
PUBLIC TRANSIT/2 vehicles owned/Central City PUMA	0.8143498	2.776725	7.089288	1.936059	3.883191	-12.80529
BIKE-PEDESTRIAN/2 vehicles owned/Central City PUMA	0.7447014	2.125159	-2.39E+15	1.454351	4.038214	8.11205
DRIVE ALONE/2 vehicles owned/Inner Suburb City PUMA	5.142565	7.801764	11.04845	4.29178	7.851066	-13.67719
CARPOOL/2 vehicles owned/Inner Suburb City PUMA	3.174832	5.480823	9.643399	1.70295	6.263833	-15.9729
PUBLIC TRANSIT/2 vehicles owned/Inner Suburb City PUMA	2.36517	5.943494	8.031581	2.086306	4.934149	-12.76881
BIKE-PEDESTRIAN/2 vehicles owned/Inner Suburb City PUMA	0.1435211	4.41645	7.520448	0.6375414	3.991049	7.518235
DRIVE ALONE/2 vehicles owned/Outer Suburb City PUMA	6.038032	7.254652	11.09115	4.461328	7.562188	-14.01053
CARPOOL/2 vehicles owned/Outer Suburb City PUMA	3.913101	5.473895	9.538056	2.540434	5.850691	-15.87344
PUBLIC TRANSIT/2 vehicles owned/Outer Suburb City PUMA	2.115456	4.389605	6.732029	1.063165	3.827379	-14.75471
BIKE-PEDESTRIAN/2 vehicles owned/Outer Suburb City PUMA	0.7197884	3.018751	7.599219	1.067268	2.938115	7.593089

Appendix D-7: Washington, D.C.-Baltimore Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
DRIVE ALONE/2 vehicles owned/Fringe Suburb City PUMA	4.691387	7.890491	9.982915	3.65746	6.578984	-14.43293
CARPOOL/2 vehicles owned/Fringe Suburb City PUMA	2.808869	6.133741	8.411668	1.765691	4.721105	-15.89253
PUBLIC TRANSIT/2 vehicles owned/Fringe Suburb City PUMA	-0.7486312	-1.66E+17	-3.00E+15	-1.00472	2.617875	-16.54837
BIKE-PEDESTRIAN/2 vehicles owned/Fringe Suburb City PUMA	-0.8543125	2.655553	3.89537	0.3657067	-9.57E+14	7.07942
DRIVE ALONE/Occupation-specific auto accessibility	1.11E-10	4.88E-10	-5.35E-11	2.77E-10	-5.72E-11	2.04E-10
CARPOOL/Occupation-specific auto accessibility	1.24E-10	4.83E-10	-1.12E-10	3.08E-10	-6.73E-11	1.43E-10
PUBLIC TRANSIT/Occupation-specific transit accessibility	1.87E-09	4.85E-09	-3.25E-10	2.65E-09	-4.39E-10	2.02E-09
BIKE-PED/Occupation-specific transit accessibility	-8.13E-11	4.95E-09	4.22E-10	2.43E-09	-1.90E-09	1.82E-09
DRIVE ALONE/Female trip-maker	-0.346772	-0.1287858	0.3476731	-0.0599014	0.2272277	0.123706
CARPOOL/Female trip-maker	0.0069729	-0.5797674	0.6469457	-0.1484852	0.2909586	-0.0812499
PUBLIC TRANSIT/Female trip-maker	-0.0209701	0.4207301	1.080888	0.4744597	0.6325546	0.4999503
BIKE-PED/Female trip-maker	-1.540112	0.2286788	-0.2478344	0.1319718	-0.1151822	-0.0327633
DRIVE ALONE/45-64 year-old trip-maker	16.90074	8.039949	2.09181	4.132399	19.79035	17.21347
CARPOOL/45-64 year-old trip-maker	18.07381	8.127025	-3.92E+14	4.608302	20.28586	-1.09E+15
PUBLIC TRANSIT/45-64 year-old trip-maker	-2.36E+96	6.454115	3.177776	-1.52E+14	-1.20E+14	16.80105
BIKE-PED/45-64 year-old trip-maker	-2.96E+20	-9.53E+15	4.066341	5.327884	-7.72E+13	-2.97E+14
DRIVE ALONE/45-64 year-old trip-maker	-0.2411905	-0.6196663	0.224879	0.0077696	0.2971913	-0.0128491
CARPOOL/45-64 year-old trip-maker	-0.1850142	-0.6656602	0.0126365	0.0261388	0.0636868	0.1134363
PUBLIC TRANSIT/45-64 year-old trip-maker	0.0614359	-1.208221	0.0617896	-0.1690981	0.5744808	-0.0512755
BIKE-PED/45-64 year-old trip-maker	-0.2817022	-0.3054635	0.3862285	-0.4718325	-0.7250346	-0.0642672
DRIVE ALONE/Single-worker households trip-maker	0.0694647	-1.026223	-0.4456694	-0.638166	0.2218204	
CARPOOL/Single-worker households trip-maker	0.2755165	-1.418531	-0.0475767	-0.0026168	0.1956655	-0.5310854
PUBLIC TRANSIT/Single-worker households trip-maker	0.7438068	-0.2457194	-0.0020001	-0.2504761	0.4312795	-3.301591
BIKE-PED/Single-worker households trip-maker	1.582884	-0.3147449	-0.110557	-0.2313386	-0.3901523	-24.57396
DRIVE ALONE/Disabled trip-maker	10.7251	-1.12016	0.0695689	1.547986	0.1339656	0.9319195
CARPOOL/Disabled trip-maker	10.58997	-0.6029957	0.2405475	1.700334	0.189252	0.8991518
PUBLIC TRANSIT/Disabled trip-maker	10.73566	-1.933847	0.5105958	0.7217635	-0.1752021	0.8887933
BIKE-PED/Disabled trip-maker	-1.89E+16	-1.098492	-0.4594596	-1.708699	-0.3995012	0.0067633
Constants						
Central City PUMA Type (Level 2 model only)	0.7255883	0.2973889	1.434672	0.5627202	0.5521499	0.968113
Inner Suburb PUMA Type (Level 2 model only)	0.7401754	0.3726106	1.375637	0.6716587	0.5460336	1.020033
Outer Suburb PUMA Type (Level 2 model only)	0.6978819	0.5446277	1.376059	0.6703785	0.542048	0.9987143
Fringe Suburb PUMA Type (Level 2 model only)	0.7266937	0.2807613	1.416141	0.6143407	0.5061222	0.9966277
Level 1: Choice of PUMA Type						
INNER SUBURB PUMA choice	0.400627	-0.5060406	-0.2951818	-0.3662899	-0.470169	
OUTER SUBURB PUMA choice	0.2527171	-2.104178	-0.2105268	-0.182923	-0.0166666	
CENTRAL CITY PUMA choice * Household Income	-9.76E-06	-5.67E-06	-2.65E-06	1.30E-06	6.71E-07	9.37E-07
INNER SUBURB PUMA choice * Household Income	3.23E-06	0.0000137	5.37E-06	5.62E-06	0.0000149	0.0000205
OUTER SUBURB PUMA choice * Household Income	6.25E-06	0.0000143	-1.41E-06	0.0000107	0.0000137	0.0000231
FRINGE SUBURB PUMA choice * Household Income	-3.03E-06	8.86E-06	4.31E-06	-0.0000104	-9.77E-06	-8.12E-06
CENTRAL CITY PUMA choice * Renter Dummy Variable	0.1977127	0.3587568	-0.1310232	0.5402832	0.1296027	0.8533177
INNER SUBURB PUMA choice * Renter Dummy Variable	0.1278622	0.0986923	0.1268574	0.3017512	0.3705841	0.4292827
OUTER SUBURB PUMA choice * Renter Dummy Variable	-0.1793974	-0.2812767	-0.5197239	-0.1549186	-0.0407013	-0.0849761
FRINGE SUBURB PUMA choice * Renter Dummy Variable	-0.4484039	-0.5520981	-0.2712256	-0.3282772	-0.1981739	-0.3072237
CENTRAL CITY PUMA choice * Condo Owner Dummy Variable	0.5377845	-0.0342741	-1.07324	-0.0232413	-0.1921272	4.117784
INNER SUBURB PUMA choice * Condo Owner Dummy Variable	0.4953735	0.1782337	0.5237878	0.6495298	0.6674269	3.568435
OUTER SUBURB PUMA choice * Condo Owner Dummy Variable	0.0224969	-0.6044064	0.5320169	0.2209936	0.1777953	3.302773
FRINGE SUBURB PUMA choice * Condo Owner Dummy Variable	-2.050017	-1.245988	0.3544326	-3.082185	-0.2231137	-1.49E+07

Appendix D-7: Washington, D.C.-Baltimore Metropolitan Area, Working Families: Choice of Commute Mode Contingent on Choice of PUMA Type

Choice Outcome and Independent Variable (Estimated parameters are statistically significant at the .05 level unless indicated in red)	Married/DP w/children	Married/DP no children	Multiple families w/children	Multiple Families no children	Single Parent HH	Single Person HH
CENTRAL CITY PUMA choice * Persons in Household	-0.0046401	-0.2196909	-0.0706446	-0.0013895	0.0473634	
INNER SUBURB PUMA choice * Persons in Household	-0.0812805	-0.0693155	-0.0452298	0.1000204	-0.0596159	0.2546196
OUTER SUBURB PUMA choice * Persons in Household	-0.0750015	0.3206982	0.1016062	-0.0704352	-0.0986337	0.0906789
FRINGE SUBURB PUMA choice * Persons in Household	-0.0214983	0.0749513	-0.025412	0.0159687	0.0770147	
CENTRAL CITY PUMA choice * White HH Head Dummy Variable	-1.05602	-0.8321627	-2.279748	-0.091496	-2.068824	-0.6615932
INNER SUBURB PUMA choice * White HH Head Dummy Variable	-0.8027818	-0.8803319	-1.245508	-0.3177628	-1.16272	-0.8223959
OUTER SUBURB PUMA choice * White HH Head Dummy Variable	0.109028	0.19993	0.1187987	0.4126804	0.0605484	0.1325813
FRINGE SUBURB PUMA choice * White HH Head Dummy Variable	1.402514	0.8031672	0.7898769	0.8509996	0.8999799	1.313412
CENTRAL CITY PUMA choice * Female HH Head Dummy Variable	0.1885685	0.0131326	-0.103065	0.3048859	-0.1604237	0.0336718
INNER SUBURB PUMA choice * Female HH Head Dummy Variable	0.1197441	0.0695308	-0.1089211	0.3519442	0.0735724	0.3518074
OUTER SUBURB PUMA choice * Female HH Head Dummy Variable	0.0302838	0.1321625	-0.0577158	-0.0798396	0.1668614	0.2007493
FRINGE SUBURB PUMA choice * Female HH Head Dummy Variable	0.042003	-0.433374	-0.5094644	0.0352687	0.0708841	0.1176736
CENTRAL CITY PUMA choice * Senior HH Head Dummy Variable	4.992843	0.4488575	9.153755	-2794.466	6.90343	0.2339803
INNER SUBURB PUMA choice * Senior HH Head Dummy Variable	3.849266	1.058568	-1211675	0.2137209	5.285301	-0.0243994
OUTER SUBURB PUMA choice * Senior HH Head Dummy Variable	4.27884	-0.9987615	9.720228	0.8318248	-1078264	0.4226565
FRINGE SUBURB PUMA choice * Senior HH Head Dummy Variable	-1614985	0.9341152	-7130624	1.538388	7.608545	-0.103396
CENTRAL CITY PUMA choice * Age 45-64 HH Head Dummy Variable	-0.0155338	0.1173745	0.4237369	0.03419	0.0807065	-0.2916621
INNER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	0.1312653	0.0533293	0.2235375	-0.3595588	0.3065313	-0.1830941
OUTER SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.1118453	0.3354628	-0.349369	0.4384576	0.0132889	0.1507921
FRINGE SUBURB PUMA choice * Age 45-64 HH Head Dummy Variable	-0.25559	0.3024256	-0.4663079	0.6363629	-0.0309198	0.3453861
CENTRAL CITY PUMA choice * Single-worker HH Dummy Variable	0.2559947	-0.113921	0.0661753	0.2353708	0.428052	
INNER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.2940485	-0.1010391	-0.0599377	0.0347073	0.3809792	
OUTER SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.1547437	0.2060308	-0.2357562	-0.1762377	-0.0936159	
FRINGE SUBURB PUMA choice * Single-worker HH Dummy Variable	-0.2039085	-0.0782464	0.0554461	-0.3630623	-0.3778367	
PUMA Average High School Test Score	-6.87E-11	-8.83E-11	9.21E-11	-1.02E-10	7.29E-11	-1.36E-10
PUMA Average Occupation-specific Auto Accessibility	2.45E-11	4.71E-11	2.32E-11	2.88E-12	9.90E-13	1.63E-11
PUMA Average Auto Accessibility						

Appendix D-8: Commute Mode Preference of Working Family Households Compared to Similar Upper-income Households

Metropolitan Region	Family Type	Central City PUMAs				2ndary Central City PUMAs				Inner Suburban PUMAs				Outer Suburban PUMAs			
		Drive alone	Carpool	Transit	Walk-bike	Drive alone	Carpool	Transit	Walk-bike	Drive alone	Carpool	Transit	Walk-bike	Drive alone	Carpool	Transit	Walk-bike
Atlanta	Married/domestic partners, children	0.95	1.57	0.59	2.25	na	na	na	na	0.95	1.44	1.95	sss	0.97	1.40	0.62	0.80
	Married/domestic partners, no children	0.94	1.57	1.39	0.64	na	na	na	na	0.89	2.92	0.27	0.28	0.87	2.44	0.17	sss
	Multiple families, children	1.88	0.37	sss	sss	na	na	na	na	2.04	0.34	sss	sss	1.09	0.69	sss	sss
	Multiple families, no children	0.92	1.22	4.72	1.65	na	na	na	na	0.98	1.45	0.74	0.38	0.96	1.66	sss	sss
	Single, children	1.16	sss	sss	sss	na	na	na	na	0.85	11.60	sss	sss	0.86	3.81	sss	sss
	Single, no children	1.02	0.94	0.83	0.43	na	na	na	na	1.01	0.82	1.03	0.82	1.02	0.75	0.45	0.57
Chicago	Married/domestic partners, children	1.02	16.31	0.13	0.65	0.84	sss	0.11	sss	1.03	5.42	0.10	1.10	1.06	1.95	0.20	1.46
	Married/domestic partners, no children	0.99	1.12	0.93	1.17	0.99	1.54	0.26	sss	0.95	2.18	0.97	0.56	0.98	2.22	0.54	2.42
	Multiple families, children	1.73	6.11	0.35	0.60	0.82	sss	sss	sss	1.45	2.04	0.27	0.00	1.16	2.11	0.13	0.05
	Multiple families, no children	0.94	0.81	0.99	2.31	0.99	0.94	sss	sss	0.94	3.03	0.70	1.68	1.04	1.11	0.57	0.89
	Single, children	1.37	0.43	1.91	0.22	3.10	0.14	sss	0.00	0.78	sss	1.37	sss	0.96	1.30	1.64	0.27
	Single, no children	0.91	1.22	1.35	0.33	0.96	1.17	sss	1.83	1.02	0.73	1.28	0.19	1.06	0.71	0.45	0.65
Dallas-Fort Worth	Married/domestic partners, children	0.79	6.57	sss	sss	1.16	0.58	sss	sss	0.92	1.81	0.17	sss	0.93	2.06	0.31	sss
	Married/domestic partners, no children	0.89	8.65	sss	0.06	0.92	1.36	sss	sss	0.96	1.68	3.51	0.19	1.02	0.78	0.00	0.34
	Multiple families, children	0.80	sss	sss	sss	1.47	0.58	sss	sss	0.88	2.49	sss	sss	0.80	3.40	sss	sss
	Multiple families, no children	0.83	6.81	sss	sss	0.79	sss	sss	sss	1.01	4.48	0.04	sss	0.89	3.59	sss	sss
	Single, children	1.29	0.32	sss	sss	0.82	sss	sss	sss	0.95	1.21	sss	sss	0.93	1.88	sss	sss
	Single, no children	1.05	1.17	0.81	0.10	0.94	sss	sss	sss	1.02	0.61	1.12	0.78	1.00	0.99	1.57	1.12
Baltimore & Washington, D.C	Married/domestic partners, children	1.01	1.30	0.66	1.63	na	na	na	na	1.01	0.98	0.89	0.64	1.05	0.83	0.40	1.08
	Married/domestic partners, no children	0.98	1.35	0.56	1.43	na	na	na	na	1.12	0.50	0.46	sss	1.02	1.02	0.24	1.14
	Multiple families, children	0.78	sss	sss	0.00	na	na	na	na	0.90	1.00	sss	sss	0.95	0.98	sss	sss
	Multiple families, no children	0.92	1.37	0.91	2.13	na	na	na	na	1.11	0.60	0.66	0.60	0.96	1.42	0.36	sss
	Single, children	0.87	13.12	0.71	sss	na	na	na	na	1.01	1.01	0.87	sss	0.97	1.97	0.48	sss
	Single, no children	1.01	0.40	1.05	1.17	na	na	na	na	1.01	0.71	0.89	1.95	1.00	0.85	0.57	6.23
Los Angeles	Married/domestic partners, children	0.98	1.16	1.77	0.49	0.86	1.38	sss	sss	0.92	1.45	sss	2.18	0.96	1.40	1.02	0.31
	Married/domestic partners, no children	0.95	1.46	sss	0.56	0.89	1.94	sss	sss	0.99	1.21	1.09	0.70	0.97	1.45	1.31	0.18
	Multiple families, children	0.79	3.56	sss	sss	0.78	2.99	sss	sss	0.90	1.80	sss	0.42	0.88	1.78	sss	sss
	Multiple families, no children	0.88	1.99	6.20	1.98	0.95	1.50	sss	sss	0.94	1.41	6.86	1.27	0.91	1.87	7.42	1.73
	Single, children	0.88	1.43	sss	sss	1.12	1.06	sss	sss	0.99	1.61	0.20	sss	0.94	1.84	0.20	sss
	Single, no children	0.91	2.66	3.02	1.18	0.98	1.55	sss	0.70	0.95	1.78	2.34	1.21	0.95	1.68	0.95	1.86
New York City	Married/domestic partners, children	0.96	0.95	1.09	1.01	1.01	sss	sss	sss	0.97	1.26	0.96	2.15	1.04	1.07	0.70	1.67
	Married/domestic partners, no children	0.97	sss	1.37	0.16	0.76	sss	sss	sss	0.76	2.18	2.00	1.96	0.90	1.81	1.00	4.45
	Multiple families, children	0.94	sss	0.75	1.59	0.51	sss	sss	sss	1.11	2.70	0.51	2.05	0.90	sss	0.27	sss
	Multiple families, no children	1.17	0.61	0.98	1.38	0.57	11.37	0.66	2.11	0.56	2.99	1.68	7.70	0.56	6.36	1.17	5.14
	Single, children	1.01	sss	0.78	0.61	0.90	0.96	sss	sss	1.14	2.01	0.52	0.64	0.98	3.11	0.35	sss
	Single, no children	0.65	3.81	0.93	2.16	0.85	4.81	sss	2.82	1.08	3.53	0.58	2.11	1.00	3.72	0.35	1.97
San Francisco	Married/domestic partners, children	0.85	4.49	0.87	1.59	0.97	1.21	sss	sss	0.92	2.24	0.38	1.30	0.94	1.70	0.72	2.65
	Married/domestic partners, no children	1.07	1.58	1.47	0.26	1.15	0.83	0.00	0.31	0.99	1.18	1.19	0.72	0.98	1.10	1.91	0.43
	Multiple families, children	2.08	0.29	0.23	0.00	1.81	0.72	0.33	0.13	2.69	0.30	0.09	0.14	2.02	0.47	0.11	0.19
	Multiple families, no children	1.02	0.86	0.82	1.63	0.87	2.76	sss	0.95	0.99	1.13	1.27	0.62	1.02	0.98	0.58	1.55
	Single, children	1.74	1.45	0.10	sss	0.83	sss	1.36	sss	0.92	1.34	2.00	0.91	0.89	2.03	1.14	sss
	Single, no children	1.04	0.87	1.12	0.76	0.84	5.45	1.10	2.17	0.93	0.90	2.43	1.80	0.94	1.56	1.49	1.65

Key:

Indicates working-family commute mode probability is 50% or more greater than for working families

Indicates working-family commute mode probability is 50% or more greater than for wealthier families

sss Indicates recent mover sample size is too small for a reliable estimate