What is the Effect of Commute Time on Employment?

An Analysis of Spatial Patterns in the New York Metropolitan Area

This study uses 1995 Nationwide Personal Transportation Survey (NPTS) data to determine the effect of commute time, a measure of accessibility, on employment for residents of the New York-Northern New Jersey-Long Island consolidated metropolitan statistical area (CMSA). The study uses two models to test the hypothesis that higher commute times are associated with lower employment probabilities, and considers both employed and non-employed individuals and private vehicle and public transit commute modes. In the first model, an ordinary least squares regression is used to predict commute time by auto and transit for all New York CMSA respondents (regardless of whether employed) on the basis of individual, household, neighborhood, and workplace characteristics. In the second model, a binary probit model estimates employment probability on the basis of individual, household, and neighborhood characteristics, as well as predicted commute time. The policy implications of the findings are discussed.

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Introduction

In many American cities, there is a spatial distinction within the metropolitan area between the locations of jobs (increasingly) in suburbs and edge cities and the residential location of low-income urban residents. Kain (1) first described this phenomenon when he articulated the spatial mismatch hypothesis. According to this theory, there is a mismatch between where residents of poor urban neighborhoods live and where potential jobs for these same individuals are located. A number of factors are believed to contribute to the creation and preservation of spatial mismatch, including segregation and discrimination in the housing market, job market discrimination, low levels of education, a lack of transit availability, and increasing decentralization of employment across metropolitan areas (1, 2). Two additional factors to which

the literature gives little attention are availability (or lack thereof) of childcare, and availability of government welfare benefits. Over the past three decades, a number of studies have attempted to quantify the incidence of spatial mismatch in American cities, often with conflicting findings.

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This study attempts to quantify the effect of various factors on commute time, a proxy for accessibility, and the effect of marginal change in commute time on the probability that an individual will choose to work. If increased commute time is indeed negatively related to employment probability, then enactment of prescriptive policies is warranted to increase individuals' employment probabilities by decreasing commute times of residents at risk of having low employment probabilities.

Nationwide Personal Transportation Survey (NPTS) data from 1995 were analyzed at a disaggregate (metropolitan) level of analysis, within one regional economy. Data from the New York-Northern New Jersey-Long Island consolidated metropolitan statistical area (CMSA), the metropolitan area for which the greatest quantity of NPTS metropolitan-level data was available, were used to conduct the study. Data from 12,217 total New York CMSA survey respondents were pared to 7,942 cases of study individuals of working age, and of those, 5,395 employed individuals had sufficient data for inclusion in the model. An ordinary least squares regression estimated the one-way commute times for these employed individuals based on a number of personal, household, and neighborhood characteristics. The results of this estimation were then fitted to predict commute times of all 7,942 cases of both employed and non-employed residents between the ages of 16 and 59. Then a binary probit regression model estimated the effect of various personal, household, and neighborhood characteristics, as well as commute time, on employment probability. An analysis of the marginal effect of change in commute time on individuals' employment probabilities is presented.

Literature Review

Spatial mismatch is a widely studied subject, with numerous investigations of the phenomenon. The question of whether or not spatial mismatch actually exists will probably never be answered definitively. While some studies conclude that spatial mismatch is a legitimate, quantifiable phenomenon, other research finds no evidence to support the spatial mismatch hypothesis. Studies with findings supporting the spatial mismatch

hypothesis generally have stronger methodologies, having adequately controlled for external factors (3, 4, 5, 6, 7). Explanation of these studies and their methodological strengths and weaknesses follows.

Kain (1) was the first to quantify the occurrence of spatial mismatch in a study in which he demonstrated that a statistically significant negative correlation exists between the percentage of blacks employed in a particular employment zone and the distance of the nearest ghetto. Kain's 1968 research is the seminal work on spatial mismatch; it would later be complimented by more complete studies of the subject.

Three early studies supported the spatial mismatch hypothesis, but had significant methodological shortcomings. Research by Alexis and DiTomaso (3) found that blacks in Chicago had longer commute times than whites, but the study did not control for modal choice. A study by Goodman and Berkman (4) used Panel Study of Income Dynamics data while research by O'Hare (5) used American Housing Survey and 1977 NPTS data to demonstrate longer commutes for blacks than whites, though both studies did not include key explanatory variables.

Gordon et al. (6) used 1977 and 1983-84 Nationwide Personal Transportation Study data to measure the aggregate incidence of spatial mismatch across similarly sized metropolitan areas. They find that blacks and other minorities have commuting patterns (including commute time and distance) that are similar to other workers in these metropolitan areas, which indicates that spatial mismatch is non-existent. But their study does not control for such factors as density or mode.

Another study, by Taylor and Ong (7) also found no incidence of spatial mismatch. This investigation compares the difference between commute time and commute distance for individuals of various races by controlling for such factors as age, income, education, urban area type, transit availability, and sex. The study uses 1977-78 and 1985 American Housing Survey data to track changes over time. Taylor and Ong calculate stable

and declining commute times and distances by minority workers between 1977-78 and 1985, contradicting the spatial mismatch hypothesis. They do find, however, that "slow public transit" may contribute to longer average commute times for residents of poor urban neighborhoods. The study does not account for the employment probability of non-employed individuals, however, which can bias coefficients.

Holzer (2) examined the wealth of empirical evidence generated around the topic of spatial mismatch in his survey of various models. These studies attempt to calculate such dependent variables as employment probability, unemployment rates, earnings and income, and income ratios. Holzer concludes, "after more than 20 years of empirical research on the spatial mismatch hypothesis, considerable disagreement and uncertainty remain on many issues" (2, 117). He lists some conclusions which can be "safely drawn" from existing research, including continuing decentralization and employment in the United States, suburbanization and declining residential segregation of blacks, decreased access to employment by blacks in central cities compared to suburban residents (typically white and black), and higher wages for blacks in the suburbs than in the central city.

Workplace Accessibility and Employment

McLafferty and Preston (8) examined Public Use Microdata Sample data for Northern New Jersey to examine the effect of spatial mismatch on African-American and Latina women. The researchers found that spatial access to jobs was poorer for minority women than for white women, but was better for minority women than for minority men. While this study affirms that spatial mismatch indeed exists, it does not consider non-employed individuals in its methodology, as ours does.

Green and James (9) find no evidence of spatial mismatch in greater Washington, D.C., as their computed accessibility index finds no significant difference between the results for blacks and whites. The study uses an aggregate gravity model instead of disaggregate level commute time data

to determine access.

A study by Holloway (10) employs a methodology similar to our study to determine the effect of job accessibility on male teenage employment between 1980 and 1990. The author concludes that accessibility became less of a factor in the employment of inner-city teenagers over the course of the 1980s as black male teens lost the "advantage of accessibility" rather than overcame the "disadvantage of inaccessibility" [Holloway's emphasis]. The study does not control for mode, however.

Cervero (11) attempts to characterize trends in job accessibility in various San Francisco Bay area neighborhoods between 1980 and 1990. The study found that disparities in job accessibility between high and low access neighborhoods widened during the period of study, and that wealthy neighborhoods were often more accessible to jobs for which residents were qualified than poorer neighborhoods.

Sanchez (12) indicates that access to public transit is a significant factor in determining average rates of labor participation within the cities of Atlanta and Portland. He showed that residents living in census block groups with timely, proximate transit service—including bus and rail—were likely to be employed a greater number of weeks per year, on average, than residents of census block groups with lesser transit service.

Khattak et al. (13) are the first to correct for sample selection bias in commute time and distance research by estimating employment probability before estimating time and distance. Their study, which utilized a two-step modeling methodology, found that in aggregate residents of poor urban neighborhoods have greater commute times and distances than suburban and more affluent urban residents, although the additional distance was only 1.5 miles and the additional time was only 3 minutes for poor urban residents. Data from over 95,000 individual respondents to the 1995 Nationwide Personal Transportation Study were analyzed using a variety of regression models normalized to account for such factors as income, race, commute

mode, and various residential neighborhood characteristics. These findings are significant, but further study of the incidence of spatial mismatch at the metropolitan level is warranted.

Overall, these aggregate as well as disaggregate studies indicate that evidence for spatial mismatch in the employment-accessibility context is mixed. This study builds on the research of previous accessibility and employment studies to investigate the link between commute time and employment within one metropolitan area by considering both employed and non-employed segments of the population and controlling for mode.

Is accessibility still an issue?

In recent years, the United States economy has been expanding quickly, with rising average incomes and low unemployment (the national rate of which hovers around 4.0 percent). The 2000 Economic Report of the President (14) indicates that median family income for whites, blacks, and all races was higher in 1998 than any other year in the previous 18 years. Poverty was also lower for blacks, whites, and all races in 1998 than any other year during the previous 18 years. Despite economic expansion, 12.7 percent of Americans of all races and 26.1 of blacks lived in poverty in 1998, and the 1999 unemployment rate for blacks stood at 8.0 percent, 3.8 percentage points higher

than the nationwide unemployment rate for all civilian workers (14). Given the persistence of pockets of poverty and unemployment in America, concerns associated with spatial mismatch and the employment patterns of urban residents remain relevant despite high economic times.

Study Methodology

A number of variables factor into the probability of whether an individual will be employed, including the individual characteristics of mode, household characteristics of race, and neighborhood characteristics of area type of neighborhood of residence (urban, suburban, etc.), median household income of block group, and job density in household census tract. Some person-specific external factors may also affect one's likelihood of employment, including segregation and discrimination in the housing market and job market discrimination. These person-specific external factors are represented by the household characteristics and neighborhood characteristics. In addition, external factors common across individuals could also be expected to contribute to one's employment decision, including the job market, macroeconomy, and government programs. Figure 1 maps this relationship.

Using indicators of these individual and person-specific external influencing characteristics and assuming that external influencing characteristics

Figure 1: Relation between characteristics influencing individuals' work decision.

Figure 2: Study methodology schematic diagram.

are constant at any one time in any one metropolitan area, it is possible to estimate the likelihood that one would choose to work. Unfortunately, while indicators of individuals' personal, neighborhood, and household characteristics are readily available, commute characteristics are only possible for working individuals, as non-working individuals have no job to which they commute. Using 1995 Nationwide Personal Transportation Survey data, however, it is possible to use individual characteristics to predict commute characteristics. These predicted commute characteristics may then be regressed with individual, household, and neighborhood characteristics to estimate the likelihood of working. Figure 2 maps this relationship, which is the conceptual framework for this study.

As spatial mismatch is a localized phenomenon, this study considers the effect of accessibility at the metropolitan level. The unit of analysis is the individual person level. The data analyzed is a subset of 1995 Nationwide Personal Transportation Survey personal and household data files, a national survey of intra-city travel characteristics collected every five to seven years by the Bureau of Transportation Statistics. All residents of sampled households were surveyed regarding such personal travel characteristics as auto ownership and (if a worker) commute mode,

time, and distance, as well as demographic, household, and neighborhood characteristics.

This scope of this study is limited to the New York-Northern New Jersey-Long Island consolidated metropolitan statistical area. With 12,217 cases of surveyed individuals, the New York CMSA has the largest sample size of all NPTS metropolitan areas, providing the quantity of data necessary to predict commute time and estimate employment probability with a high level of confidence. The survey sample is restricted to individuals of working age (16 to 59), creating a study sample of 7,942 cases.

The reported commute time serves as the measure of accessibility, which is one of the best measures of spatial mismatch according to Holzer (2). Commute time was ascertained from NPTS survey respondents through the question "How many minutes does it usually take to get from home to work, not including time it takes to drop off children or make other stops?" While commute distance is often used as a measure of accessibility, commute time better accounts for perceived quality-of-life and residential location issues that become a factor in individual's employment choices, especially for individuals who would rely on public transportation to commute to work. Theoretically, there may be some simultaneity

between commute time and mode choice, as one's mode choice would be affected by the projected commute time via various modes. Yet one's commute mode affects the length of one's commute nonetheless, so our model uses commute mode as predictor of commute time. This is consistent with the methodology employed by a number of other researchers (4, 5, 7, 8, 13).

A key set of variables that explains commute time is the area type of the place of residence. The NPTS data groups place of residence cells (or neighborhoods) into five area types: urban; second city; suburban; town; and rural. Population density decreases along the spectrum between urban and rural. Urban and second city area types are population centers or locations in which the population density is greater or as great as the eight neighboring cells.

Description of New York Metropolitan Area

The New York-Northern New Jersey-Long Island, NY-NJ-CT-PA consolidated metropolitan statistical area (CMSA) includes a population of over 19.8 million people spread over 10,166 square miles (15). The CMSA includes 11 primary metropolitan statistical areas in parts of four states, New York; New Jersey; Connecticut, and Pennsylvania.

According to the U.S. Census Bureau State and Metropolitan Area Data Book (15), the New York-Northern New Jersey-Long Island CMSA was 74.2 percent white, 19.3 percent black, 6.2 percent Asian or Pacific islander, with 16.8 percent Hispanic origin as of June 1, 1996. In 1993, the date for which most recent data are available, 14.7 percent of persons in the CMSA were living below the poverty level. As of June 30, 1996, Per capita personal income averaged \$29,021, while annual pay averaged \$40,089. The civilian labor force included nearly 9.7 million persons, or 49.0 percent of the total CMSA population. In both 1995 and 1996, the unemployment rate stood at 6.5 percent.

Description of the Sample

Commute time is the reported time to travel

from home to work at whatever time of the day one starts working, not including the time it takes to wait for public transit. About 76 percent of the sample is employed. Commutes of longer than 180 minutes were recoded as 180 minutes. The average reported commute time was 32.4 minutes. Descriptive statistics of all key variables are presented in Table 1.

Explanatory variables of commute time

Table 1 shows the descriptive statistics of individual, household, neighborhood, and commute characteristics used as variables to predict commute time. Just over 70 percent of surveyed New York CMSA residents were white and 13.3 percent were black. (Note that Hispanic origin is not included as a race because the U.S. Census Bureau considers it an ethnicity. Persons of Hispanic origin may be expected to fall within any of the four categories of race.)

The majority of residents (42 percent) lived in an urban neighborhood while 26.5 percent resided in suburbs. Of employed workers surveyed, 62.5 percent commute by private vehicle, 21.8 percent use public transit, and around five percent walk or bike to work. (Mode was not reported for approximately 10 percent of employed survey respondents.) About 58 percent of employed respondents commute to work during morning rush hours between 6:00 and 8:30 a.m.

Table 2 (omitted) illustrates various descriptive statistics for survey respondents disaggregated by area type. Suburban neighborhoods have the highest rate of employment at 80.5 percent. Urban neighborhoods have the lowest employment rate at 71.4 percent. Average one-way commute times average 35.4 minutes for urban residents and 31.2 minutes for suburban residents. Blacks are more likely to live in urban areas, comprising 25.1 percent of the urban population.

Regression Analysis

This study uses a two-step process to estimate the effect of commute time on employment probability. An ordinary least squares model

Variable	Type	Mean	Standard Deviation	Minimum	Maximum
Commute Characteristics (N=5,395)					
Commute Time	Scale	32.37	25.88	0	180*
Private automobile	Binary	0.478	0.5	0	1
Public transit use	Binary	0.167	0.373	0	1
Walk or bike	Binary	0.0379	0.191	0	1
Other mode of transportation	Binary	0.0108	0.104	0	1
Leave during morning rush hours (between 6:00 and 8:30 a.m.)	Binary	0.443	0.497	0	1
Demographics (N=7,942)					
Single	Binary	0.136	0.343	0	1
Age Scale		37.49	11.39	16	59
Employed	Binary	0.764	0.424	0	1
Household characteristics (N=7,942)					
White	Binary	0.702	0.457	0	1
Black	Binary	0.133	0.34	0	1
Asian	Binary	0.0398	0.195	0	1
Other race	Binary	0.102	0.303	0	1
Number of adults	Scale	2.32	0.91	1	7
Number of drivers	Scale	1.92	1.01	0	7
Homeowner	Binary	0.624	0.484	0	1
Household family income	Scale	\$54,313	30,974	\$2,500	\$110,000*
Residential neighborhood characteristics (N=7,942)					
Urban	Binary	0.421	0.494	0	1
Suburb	Binary	0.265	0.441	0	1
Second city	Binary	0.135	0.341	0	1
Town	Binary	0.161	0.367	0	1
Rural	Binary	0.0179	0.133	0	1
Population density (persons/sq. mile)	Scale	13,175.18	11,852.12	50	30,000
Median household income in census block group (in \$10,000s)	Scale	4.9495 (49,495)	1.845	1.5	8
Ninety or more percent black in census group	Binary	0.0583	0.234	0	1
Job density in household census tract (in 1,000s of worker/sq. mi.)	Scale	2.302 (2,302)	1.98	0.025	5
Workplace characteristics (N=5,395)					
Job density in workplace census tract (in 10,000s of workers/sq. mi.)	Scale	1.45 (14,500)	1.914	0.0025	6

* data points above this maximum were recoded at this value

Table 1: Descriptive statistics for key variables.

Figure 3: Predicted average one-way commute times of New York CMSA residents (N=7,942).

predicts the commute time on both working and non-working individuals, and a binary probit model estimates employment probability. Two sets of analysis are performed: one in which private vehicle is the base mode, and one in which public transit is the base mode. These models permit estimation of employment probability with both private automobile and public transit as assumed modes for non-workers.

Ordinary least squares models predicting travel time

Two ordinary least squares regression (OLS) models use personal, household, neighborhood, and workplace characteristics to explain commute time of the basis of 5,395 resident respondents of working age who reported to be employed full or part time, and for whom commute time was reported. This study builds on previous research by Khattak, et al. (2000) by using two different OLS models. The first (OLS Model A) predicts commute time when public transit is assumed to be the commute mode of non-workers. The second (OLS Model B) predicts commute time when non-workers are assumed to commute via private vehicle. These models are presented in Table 3.

According to OLS Model A (in which the base mode is private vehicle), use of public transit has the largest influence on commute time. All else equal, average commute via public transit is 37.4 minutes longer than the average commute via private vehicle. Commuters living in urban neighborhoods experience average commutes roughly two minutes longer than suburbanites, all else equal. A commute during the morning rush is, on average, 3.5 minutes longer.

When compound effects of mode, neighborhood area type, and the interaction variables of mode and neighborhood area type are considered together, the average commute of a suburbanite via transit is 60 minutes while the average commute of a suburbanite via private vehicle is 23 minutes. The average commute of an urbanite via transit is 40 minutes, while an urbanite's average commute via private vehicle is 25 minutes. The predicted average commute times for Model A and Model B are illustrated in Figure 3. As expected, the predicted average commute times of Model B (in which public transit is the modal base) do not differ significantly from Model A. Slight differences between models are due to variations in the parameters of mode and area type interaction variables.

	OLS Model A: <i>Private vehicle as base mode</i>		OLS Model B: <i>Public transit as base mode</i>	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Constant	23.512***	1.521	59.145***	2.152
<i>Individual characteristics</i>				
Public transit use	37.354***	1.795	Base	Base
Private Vehicle	Base	Base	-36.051***	1.691
Walk or bike	-15.656***	2.498	-51.828***	2.855
Other mode of transportation	9.664***	2.492	-11.887***	2.49
Mode missing	21.559**	9.745	-3.96	9.777
Leave during morning rush hours (6:30 to 8:00 a.m.)	3.447***	0.625	3.516***	0.626
<i>Household characteristics</i>				
Black	4.083***	1.125	3.964***	1.126
Asian	1.432	1.586	1.287	1.588
Other	3.176**	1.094	3.360**	1.095
Race missing	3.704	2.105	3.818	2.108
<i>Residential neighborhood characteristics</i>				
Urban	1.906	1.078	-19.048***	1.746
Second city	0.277	1.026	-3.957**	2.649
Town	1.867	1.013	11.331**	3.339
Rural	0.577	2.345	45.541**	21.843
Median household income in census block group (in \$10,000s)	0.0458	0.2	0.0819	0.2
Ninety or more percent black in census group	0.514	1.574	0.671	1.576
Job density in household census tract (in 1,000s of worker/sq. mi.)	-1.826***	0.232	-1.791***	0.233
<i>Workplace characteristics</i>				
Job density in workplace census tract (in 10,000s of workers/sq. mi.)**	2.442***	0.172	2.516***	0.172
<i>Interaction variables</i>				
Urban & public transit	-23.370***	1.99	N/A	N/A
Second & public transit	-6.067	3.298	N/A	N/A
Town & public transit	13.563***	4.165	N/A	N/A
Rural & public transit	43.808**	21.919	N/A	N/A
Urban & private vehicle	N/A	N/A	20.977***	1.891
Second & private vehicle	N/A	N/A	4.408	2.843
Town & private vehicle	N/A	N/A	-9.420**	3.458
Rural & private vehicle	N/A	N/A	-44.776**	21.947
Urban & walk or bike	0.576	2.991	21.469***	3.273
<i>Summary statistics</i>				
	R ² = 0.298		R ² = 0.296	
	Adj. R ² = 0.295		Adj. R ² = 0.293	
	F-stat = 103.57		F-stat = 102.47	
	N = 5,395		N = 5,395	

*** $p < 0.001$, ** $0.001 < p < 0.05$; Mean travel time for workers = 32.4 minutes

Note: The base for race is white; the base for area type is suburb. When an individual is not employed, the job density in workplace census tract = 0.7535, the mean New York CMSA workplace job density.

Table 3: OLS regression model with one-way commute time as dependent variable.

Examining other coefficients of interest in OLS Model A, one finds that black residents on average face a commute that is four minutes longer than whites. When the average commuter's job density in the census tract of their workplace increases by 10,000 persons, their commute time increases by 2.4 minutes, all else equal.

OLS Model A and OLS Model B both predict the commute time of all survey respondents, regardless of whether they work. Model A, using private vehicle as its base, assumes that non-working individuals would commute via private vehicle; Model B assumes non-workers would use public transit. Descriptive statistics of the predicted commute times of both models, as well as the reported commute times and the residuals between reported and predicted times, are shown in Table 4 (omitted).

When private vehicle is the base mode (OLS Model A), average predicted commute time for all commuters is 36.3 minutes, 12.1 percent higher than the 32.4 minute average reported commute times for working individuals. When public transit is the base mode (OLS Model B), average predicted commute time is 39 minutes, 14.2 percent higher than the average reported commute times for workers. Predicted commute times range between -0.3 and 120 minutes in OLS Model A, and -1.7 and 120 minutes in OLS Model B. (Note that only one case of predicted commute time A and five cases of predicted commute time B out of 7,942 total predicted cases had negative predicted commute times. In each instance, the negative predicted commute times were for employed individuals residing in urban areas and commuting to work by walking or bicycling.) The residuals, of course, average 0, with a standard deviation of 12.5 for OLS Model A and 15.9 for OLS Model B. The range of residuals indicates that the models' predicted commute times at the extremes were approximately 81 minutes shorter and 160 minutes longer than actual reported for OLS Model A, and 76 minutes shorter and 161 minutes longer for OLS Model B. These predicted commute times for each survey individual, regardless of whether the individual is employed or not, serve as independent variables in the binary probit regressions.

Binary probit models estimating employment probability

Two binary probit regressions are used to estimate employment probability. The binary probit regression model is more appropriate than a least squares linear probability model because the dependent variable is restricted between 0 (=not employed) and 1 (=employed). The models were estimated with the 7,942 New York CMSA cases of individuals of working age for which adequate data to run the model was available. Probit Model A uses commute times predicted by OLS Model A to estimate employment probabilities when private vehicle is assumed to be the mode of non-workers. Probit Model B uses the commute times predicted by OLS Model B to estimate employment probabilities of respondents when public transit is assumed to be the mode of non-workers. The model is shown in Table 5. Note that while sex, age, education level, race, neighborhood area type, and single-parent status are included as variables, personal income is excluded, as reliable personal income data is not available for non-working individuals.

Most significantly, both models indicate a negative correlation between commute time and employment probability. The models also show that males are more likely than females to be employed. In addition, higher levels of education are correlated with increased employment probabilities (with a negligible decline in employment probability in both probit models between individuals with bachelors' degrees and graduate or professional degrees). Single parents of children aged zero to five years are less likely to be employed. Interestingly, both models indicate that blacks are more likely to be employed than whites controlling for other factors including predicted commute time, a result that contradicts suppositions that discrimination and segregation would have a negative effect on the employment probability of blacks vis-à-vis whites. Residents of urban and second city neighborhoods are less likely to be employed than suburban residents. The commute time coefficients in both models are very close (-0.046 in Probit Model A and -0.038 in Probit Model B), an indication that travel time effects on

Variable	Probit Model A: <i>Private vehicle as base mode</i>			Probit Model B: <i>Public transit as base mode</i>		
	Coefficient	Standard Error	Marginal Effect	Coefficient	Standard Error	Marginal Effect
Constant	1.930***	0.09	0.487	1.789***	0.089	0.45
<i>Individual characteristics</i>						
Male	0.639***	0.037	0.161	0.599***	0.037	0.151
Youth (16-18)	-1.296***	0.083	-0.327	-1.282***	0.083	-0.322
College-aged (18-24)	-0.489***	0.052	-0.123	-0.494***	0.052	-0.124
High school education	0.447***	0.066	0.113	0.458***	0.065	0.115
Some college or associates degree	0.566***	0.068	0.143	0.581***	0.068	0.146
Bachelor's degree	0.840***	0.071	0.212	0.863***	0.071	0.217
Graduate or professional degree	0.835***	0.079	0.211	0.861***	0.079	0.216
Education data missing	0.282***	0.084	0.071	0.288***	0.083	0.072
Single parent of a child between 0 and 5	-0.449***	0.118	-0.113	-0.523***	0.115	-0.132
Single parent of a child between 6 and 18	-0.00098	0.101	0.00025	-0.036	0.099	-0.009
<i>Household characteristics</i>						
Black	0.157**	0.055	0.04	0.112**	0.054	0.028
Asian	-0.085	0.088	-0.021	-0.11	0.087	-0.0277
Other	0.0634	0.06	0.016	0.04	0.058	0.01
Race missing	0.0027	0.113	0.0007	-0.038	0.112	-0.01
<i>Residential neighborhood characteristics</i>						
Urban	-0.177***	0.048	-0.045	-0.513***	0.05	-0.129
Second city	-0.095	0.063	-0.024	-0.133**	0.064	-0.033
Town	-0.015	0.059	0.0039	0.214***	0.063	0.539
Rural	-0.029	0.148	-0.0072	10.117***	0.207	0.281
<i>Commute Time</i>						
Commute Time (minutes)	-0.0457***	0.0014	-0.011	-0.038***	0.0012	-0.956
<i>Summary statistics</i>						
	Log likelihood function = -3,294.653 Restricted log likelihood = -4,336.991 Chi-squared = 2.084.676 N = 7,942			Log likelihood function = -3,323.674 Restricted log likelihood = -4,336.991 Chi-squared = 2,026.633 N = 7,942		

*** p=<0.001, ** 0.001<p=<0.05

Note: The base gender is female; the base age group is adult (age 25 to 59); the base education is no high school degree; the base family situation is 'not a single parent'; the base race is white; the base area type is suburb

Table 5: Probit equations estimating the likelihood of being employed

Notes

1. Computation of employment probability based on race, sex, education level, and residential area type parameters predicted by Probit Model A and Probit Model B.
2. All four series are black males with a high school level of education or higher.
3. Average commute time varies with mode and residential area type based on average commute time predicted by OLS Model A and OLS Model B.
4. Average predicted commute time of black suburban private vehicle commuter = 28.9 minutes; black urban private vehicle commuter = 26.9 minutes; black suburban public transit commuter = 66.5; black urban public transit commuter = 43.7 minutes.

Figure 4: Employment probabilities of urban and suburban black males.

employment are not significantly different between the two models.

Figure 4 illustrates the effect of five- and ten-minute changes in commute time on the employment probability of both urban and suburban blacks using private vehicles and public transit to commute to work. In this graph, only a comparison of blacks is shown, as the spatial mismatch hypothesis focuses on the accessibility of urban blacks to employment. The trend lines of urban and suburban whites appear quite similar, however. In this figure, employment probability is computed based on race, sex, education level, and residential area type parameters predicted by Probit Model A and Probit Model B. All four series are black males

with a high school education or higher. The average predicted commute time is predicted by OLS Model A and OLS Model B and varies with mode and residential area type. Average predicted commute time of black suburban private vehicle commuters equals 28.9 minutes; for black urban private vehicle commuters equals 26.9 minutes; for black suburban public transit commuters equals 66.5 minutes, for black urban public transit commuters equals 43.7 minutes.

The graph shows that the employment probability of black urbanites and suburbanites using private vehicles to commute to work does not differ significantly. But the predicted employment probabilities of urban and suburban commuters

using public transit is significantly lower than the employment probability of commuters using automobiles. According to this estimation, the employment probability of black urbanites reliant upon transit is at best 0.76 when the commute time is ten minutes shorter than average, and drops to 0.60 when the commute time is ten minutes longer than average, a range of 16.2 percentage points. This trend is even more pronounced for black suburban transit users, whose employment probability ranges from 0.69 when the commute is ten minutes shorter than average to 0.51 when the commuter is ten minutes longer than average, a range of 18 percentage points. These results show that urban and suburban residents reliant on public transit are most at risk of non-employment due to poor workplace accessibility. This finding may indicate that it is not employment discrimination but residential segregation and/or decentralization of workplaces across the metropolitan area that may have the greatest effect on employment probability.

Conclusion

This paper investigates the link between commute time and employment probability, focusing on urban and suburban residents in the New York-Northern New Jersey-Long Island consolidated metropolitan statistical area. The hypothesis was that an increase in an individual's commute time, all else equal, would result in a decrease in that person's employment probability. The study shows that predicted commute time is indeed negatively correlated with employment probability, findings which support the spatial mismatch hypothesis. Notably, the employment probability of urban and suburban residents assumed to be reliant upon transit to commute to work is lower than residents of any other area type. The results, however, do not indicate a demonstrable difference in employment probabilities between blacks and whites.

Given the demonstrated effect on individuals' employment probabilities when non-workers are assumed to commute via transit, efforts to reduce commute time (a proxy for accessibility) may result in somewhat increased employment probabilities. Commute times may be reduced through a number

of prescriptive policies, including increased availability and reliability of transit; provision of alternative means of transportation to work; and increased proximity of new low-skilled work opportunities to at-risk areas.

Study limitations and further study

This study focuses exclusively on the New York-Northern New Jersey-Long Island CMSA. The New York area arguably has a higher degree of transit availability and reliability, especially in urban neighborhoods, than any other metropolitan area in the United States. Study of a more typical American metropolitan area, such as Chicago, Philadelphia, or Washington, might better represent the extent of the effect of spatial mismatch on employment probabilities in large metropolitan areas. Additionally, study of smaller metropolitan areas without fixed-guideway transit systems would indicate the effect in areas in which the only practical transit option is the bus.

This study uses 1995 NPTS data. One limitation of NPTS data is the survey question used to ascertain respondents' commute times: "How many minutes does it usually take you to get from home to work." The question asks respondents to make an estimation based on perception, which may or may not be correct. In addition, the question does not explicitly instruct respondents to exclude transit wait time from their reported commute time.

There are a number of other limitations within this dataset. This survey asks ordinary citizens to report their travel behaviors. Responses may be skewed as memory loss affects individuals' ability to correctly recall facts and figures. Additionally, travel time perceptions may result in rounding-off errors or incremental perceptions of delay that circumstantially vary.

Furthermore, while economic numbers indicate that the poverty and unemployment still exists among blacks and in urban areas, more current data (such as 2000 NPTS data, released in 2001) might indicate whether the effect of spatial mismatch on employment is more or less pronounced today compared to 1995.

This study also considers only personal, neighborhood, household, and commute characteristics in estimating employment probabilities. Key determinants of whether individuals will choose to work are attributes of the job to which individuals would commute, especially income and fringe benefits. A more precise model to estimate employment probability might use predicted income and other workplace factors as independent variables to correct for this. In absence of further research at this time, however, this study provides evidence that commute time indeed has an effect on employment probability, and that measures to increase accessibility could improve the employment probability of residents of urban neighborhoods.

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