Determining Travel Time to Work: The Effects of Race and Wage on Commuting in Large Cities

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Abstract

This paper seeks to study the effects of wage on travel time to work for hourly workers in populous cities. While scholars have extensively studied the effect of income on job placement, there is little consensus in the academic community on the Spatial Mismatch Hypothesis which posits low-income/Black workers face a disparity between where they live and work. Utilizing responses from the American Time Use Survey and multivariate OLS regression, this study measures the effect of hourly wage on travel time to work. I find that the effect of wage on travel time to work differs for Black and non-Black workers. The study concludes that lower-income Black workers face higher travel times than their counterparts. Furthermore, for every 10 percent increase in wage for Black workers, I find a decrease in travel time by 2 percent. For non-Black workers, I find an insignificant effect on travel time to work when wage increases. This analysis and future studies have important implications for transit policy as it can help inform how to better fund public transit to serve low-income and Black workers who often face unique job placement challenges.

Introduction

As the effects of the Great Recession fade and unemployment decreases, the Federal Reserve is able to focus on one of its lesser known responsibilities — community development and

urbanization. Patrick Harker of the Philadelphia Fed recently highlighted one of these issues of urban development. "Many individuals don't have cars. Public-transport options are limited. We absolutely have to work hard to bring people from the sidelines into the workforce. Not only for those communities and individuals, but for the economy as a whole" (Costa 2018). The Federal Reserve's statement represents a larger question of how policymakers can best address issues like transportation and employment in a rapidly-changing metropolitan environment. Transportation and commuting times can be a defining factor in conversations regarding policy solutions to help alleviate the burdens that accompany low-incomes and unemployment. Two questions arise when considering this problem: does income have any affect on the placement of jobs, and if so, are there policy solutions to aid those facing larger commuting times?

Over the past two decades, scholars have examined commuting times and methods in order to help achieve better labor market outcomes for those in need of a job, or to help increase economic mobility (Ong 2002, Ong 2002, Sanchez, Shen and Peng 2004, Sanchez 1999, Cervero, Sandoval and Landis 2002, Baum 2009). One prominent explanation for the variance in transportation access and its relationship with employment is the Spatial Mismatch Hypothesis (SMH). The SMH contends that there is an increasing difference in where low-skilled jobs and low-skilled employees are located. John Kain's seminal (1968) paper, "Housing Segregation, Negro Employment, and Metropolitan Decentralization" posits and develops this idea by emphasizing structural disadvantages for Black employment due to location. Because of housing discrimination and dispersal of employment opportunities, Kain explains that Black people living in segregated areas face higher costs to employment and fewer resources regarding possible jobs.

Since the publishing of Kain's paper, notable studies contributed to this body of literature (Harrison 1972, Shen 2001, Taylor and Ong 1995). While some studies find little evidence for the SMH, the majority of evidence supports Kain's original findings (Blackley 1990, Cervero, Sandoval and Landis 2002, Easley 2018, Gobillon, Selod and Zenou 2007, Holzer 1991, Ihlanfeldt and Sjoquist 1998). The SMH provides a backdrop to understand why a policy solution regarding transportation could help alleviate unemployment and reduce inequality. If poorer residents are located in cities and are unable to access jobs that are increasingly outsourced to suburbs, reverse commute patterns and public transit policy will affect large numbers of

low-skilled workers. Longer and more expensive commutes can only be accepted by workers if the benefits offset the costs of the job's location, and low-skill and low-paying jobs often do not meet that condition.

More recent studies find similar evidence for other racial groups. Utilizing 2010 Census and Business Pattern data, Easley finds that the average Vietnamese or Cuban worker experiences SMH at a higher rate than their Black counterparts (2018). Additionally, this theory has been extended beyond race and shown to affect all low-income individuals or welfare recipients (Blackley 1990, Cervero, Sandoval and Landis 2002, Sanchez, Shen and Peng 2004, Taylor and Ong 1995). For the purposes of this study, I examine the effects on Black workers and low-income workers specifically.

I hope to contribute to this body of literature by examining the SMH through the lens of commuting times. Confirming or advancing this body of literature will better motivate policy solutions in the coming years.

Data

American Time Use Survey

The American Time Use Survey is collected through the United States Census Bureau and released annually.[1] The purpose of the study is to measure the amount of time people are doing various activities such as exercising, eating, practicing religion, socializing, taking care of children, working, or traveling. It is asked after certain respondents complete their 8 month Current Population Survey via telephone interviews. It is a crosssectional dataset which asks its respondents to answer a 24-hour diary detailing their activities from 4 a.m. of the previous day to 4 a.m. of the interview day. Surveyors also ask the duration of each of the respondent's activities, in addition to who else was partaking in the activity and where/how the activity took place.

[1]The census data was accessed through IPUMS, which can be found here: https://timeuse.ipums.org/

Description of Sample

For the purposes of this study, I pull from the 2006-2018 ATUS microdata files. For each year, I choose respondents based on three qualifiers. First, the respondent must live in what the census considers to be a "Metropolitan, central city." Second, the respondent is in a Metropolitan Statistical Area (MSA) of 5,000,000 or more people. The census describes MSAs as a "geographical region with a relatively high population density at its core and close economic ties throughout the area." Third, in order to have a continuous variable as my main independent variable, I use hourly wage. This limits the sample to respondents who are not salaried workers. Higher-income individuals make up the most of this group, so the sample I collect is naturally skewed toward those with lower income. The sample size is 2,560.

This sample is helpful in describing and isolating the effects of the Spatial Mismatch Hypothesis. Although the SMH explains both movement from high-income earners from where they live (suburban areas) to where they work (downtown areas) and low-income earners from where they live (downtown areas) to where they work (suburban areas), I focus on attempting to quantify the latter relationship. If there is a negative effect of wage on travel time to work for this specific sample, it could indicate that lower-income people must travel further outside their cities for jobs near the suburbs, and would confirm the SMH.

There are obvious limitations to this data. First, despite my efforts to subset the data to only include those in large cities, metropolitan areas are not homogeneous and can vary. I attempt to control for this using location fixed-effects, but obviously a person living closer to the outside of the city is going to have a different situation relating to travel time than someone who is directly in a core downtown area. Second, people are forgetful and not precise. They often round their travel time to the nearest 15 or 30 minute mark and this can cause inconsistencies and bunching within the data. Finally, travel time to work is a complex and oftentimes random aspect of a worker's life. Attempting to find a relationship between the variables I hypothesize will have an effect is difficult due to the nature of how travel time to work is often assigned by job placement and the market.

Hypothesis

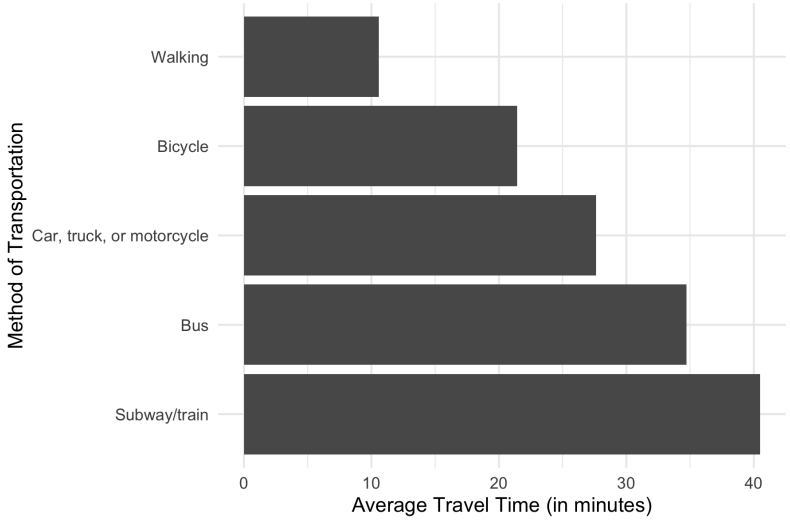

Figure 1: Mean Travel Time by Method of Transportation

Based on the literature surrounding this issue, I hypothesize that wage will have a negative effect on travel time to work. I also think that being Black will have a positive effect on travel time. In other works, any increase in wage will decrease travel time to work for those in my sample area and Black respondents will have a larger travel time overall.

Additionally, a initial view of the data supports this view. As seen in Figure 1, mean travel time is highest at public transportation options like buses, rail lines, or trains. As it is less individualized and usually less convenient for commuters than a car, this makes sense.

In addition to this relationship, it is apparent through Figure 2 that income has a relationship with public transportation usage. This figure represents family income rather than the hourly wage used in this study, and demonstrates the drastic drop in public transportation commuters for those earning $50,000 and above yearly. Not only is usage smaller, but Spatial Mismatch posits that public transportation will not be as effective for lower income workers. Because they are often commuting in the opposite direction of their high-income counterparts, they face increase times and fewer options to travel where job opportunities exist.

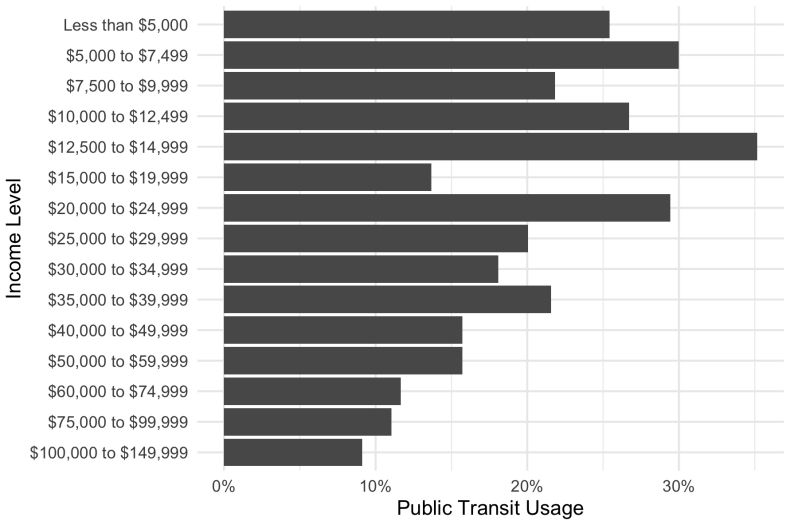

Figure 2: Proportion of Travel Entries with Subway or Bus Ridership by Total Household Income

Methodology

I use weighted multivariate Ordinary Least Squares (OLS) regression to analyze the relationship between wage and travel time. Because the survey is nationally representative, each observation has a different level of influence in the model. The probability weights were provided by the Census "ensures that the sums of the respondent weights add up to the appropriate number of weekday person-days and weekend person-days over the quarter, both for the population as a whole and for selected." subpopulations.[2] The model is as follows:

$$\text{LOG(TRAVELTIME)} = \beta_0 + \beta_1 * LOG(WAGE) + \beta_2 * BLACK + \beta_3 * FEMALE + \beta_4 * EDUCATION + \beta_5 * AGE + \beta_6 * MULTIPLEJOBS + \beta_7 * HOURSWORKED + \beta_8 * PARTTIME + \beta_9 * NUMBEROFCHILDREN + \beta_{10} * MARRIED + \beta_{11} * METHOD + \beta_{12} * (WAGE * BLACK) + \beta_{13} * COUNTY + \beta_{14} * STARTINGHOUROFCOMMUTE + \beta_{15} * DAYOFCOMMUTE + \beta_{16} * YEAROFSURVEY$$

[2]Usually, calculating standard errors for surveys like these require replicate weights. For the purposes of this study and the time constraints of the assignment, I use person weights in the regression which should not significantly change my results.

I log both travel time to work and wage for both ease of interpretation and to normalize the distribution of the dependent variable to satisfy the assumptions of OLS (See Figure 4 and Figure 5 for distributions in Appendix B).

Each of these variables represent confounding factors that may effect travel time to work for individuals. By controlling for these variables, the parameter estimate becomes less biased by omitted variables and the endogeneity problem. I also use robust standard error reporting to account for possible heteroskedasticity.

The results of the regression are reported below in Table 1.[3]

Results and Discussion

As reported in Table 1, there was an effect of wage on travel time to work, but only for Black workers. The coefficient of Log of Hourly wage is statistically significant for the first model with just race and wage, but is found to insignificant once more variables are added. This represents the effect of hourly wage on travel time for non-Black workers as the interaction term below account for the difference between non-Black and Black workers.

When wage is controlled at 0 and all other variables are held constant, Black workers travel on average 46 percent longer than their non-Black counterparts. This is represented by the statistically significant coefficient on Black (=1) in the regression table.

The interaction term at the bottom of the regression table represents the difference in simple slopes for the reference group (non-Black workers) and those included in the interaction (Black workers). Because the result for non-Black workers is insignificant, this can be interpreted that for every 10 percent increase in wage, Black workers' travel time decreases by 1.7 percent while any increase in wage for non-Black workers has no effect on their travel time to work.

This has interesting implications in regard to policy and the SMH. More recent literature on

[3]Note that the commuting time fixed effects variables are included in the model and regression but not reported in the table itself.

Table 1: Model Results and Robustness Checks

	Dependent variable:		
	Log Travel Time		
	(1)	(2)	(3)
Log of Hourly Wage	0.061*	0.009	0.007
	(0.035)	(0.034)	(0.038)
Black (=1)	−0.015	0.028	0.468**
	(0.040)	(0.036)	(0.209)
Female (=1)		−0.191***	−0.170***
		(0.032)	(0.033)
Years of education		−0.008	−0.008
		(0.006)	(0.006)
Age		0.003***	0.002*
		(0.001)	(0.001)
Holds multiple jobs (=1)		−0.154***	−0.100*
		(0.055)	(0.057)
Hours worked in a week		−0.001	−0.001
		(0.002)	(0.002)
Part time (=1)		−0.092*	−0.068
		(0.054)	(0.055)
Number of Children		0.031**	0.014
		(0.014)	(0.014)
Not Married (=1)		−0.048	−0.103***
		(0.037)	(0.038)
Driving (Reference Group)			
Walking		−0.988***	−1.048***
		(0.042)	(0.049)
Bus		0.188***	0.125**
		(0.056)	(0.058)
Subway/Train		0.474***	0.383***
		(0.054)	(0.062)
Bicycle		−0.307**	−0.332**
		(0.153)	(0.155)
Wage * Black (=1)			−0.175**
			(0.079)
Constant	2.779***	3.177***	2.879***
	(0.095)	(0.142)	(0.224)
Observations	2,560	2,560	2,560
R^2	0.001	0.267	0.340
Adjusted R^2	0.001	0.263	0.320

Note: Model 3 includes fixed effects. *p<0.1; **p<0.05; ***p<0.01

the subject has extended Kain's original argument of Black mismatch to low-income individuals in general. These findings are in contrast with the previously cited studies, but supports Kain's findings specifically.

This may be explained partially by Figure 3. This is the same chart as Figure 2 but broken out by race. The blue bars represent Black usage of public transportation options to travel to work by income while the red bars represent non-Black usage. Overall, Black workers use public transit at a higher rate than their counterparts at every income level. However, the discrepancy between Black and non-Black usage is much smaller at higher income levels. This would indicate that Black workers are more responsive to wage effects on transportation options as shown in the regression.

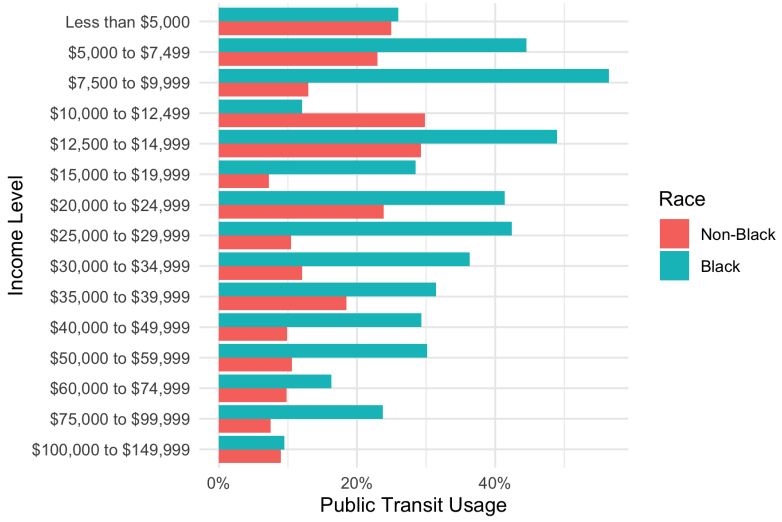

Figure 3: Public Transit Usage and Income, Separated by Race

There may be other reasons that the relationship does not hold for non-Black workers. First, there Kain's explanation which describes the history of discrimination and redlining. Because of this, white power structures required that Black individuals lived in disadvantageous communities away from adequate job opportunities. The US has perpetuated this marginalization and is most likely the reason for these results. Additionally, due to the skewed nature of the sample toward lower-income, hourly workers, there may be a wage effect at higher incomes for non-Black workers that is not captured by the model.

There were several other significant results in the final model. First, the female dummy variable indicates that being female decreases travel time by 17 percent on average. This may be due to to the fact this population may be mothers and want to be closer to home. Additionally, job placement may function differently for females, even controlling for other factors like age or education. Additional research may field more insightful results.

Age had a relatively small but positive effect on travel time. For every 10 year increase in age, travel time to work increased by .02 percent, which is insignificant in magnitude.

Those who hold multiple jobs on average have a 10 percent smaller travel time then those with only one job. This is a puzzling finding. It may be that those who work in larger cities and do not travel as far have job opportunities that are lesser in quality. People with multiple jobs are usually low wage and what economists would describe as low-skilled, so these jobs may be present in part-time work in the city but not so for full-time, better quality jobs that exist in the suburbs for this population.

Being married increases travel time by about 10 percent, but the number of children a person has does not have any statistically significant effect. This relationship is also difficult to explain. It may be that married individuals have to balance the jobs of both individuals, so even if they have mobility in their living situation it may be a compromise in location preference between the two, increasing the travel time of each. Once again, more research may shed light on this topic.

The method of travel also has definite effects on travel time to work. Compared to a person commuting either as a driver or passenger in a car, those walking have 104 percent less travel time to work. Those taking the bus take 12.5 percent more time to get to work than those who drive, on average. Commuters on the train/subway around 38 percent more time to get to work than those in cars. Those traveling by bike have a 38 percent smaller travel time than drivers. These results make intuitive sense and are substantiated by Figure 1.

Conclusion

Travel time to work is an often overlooked aspect of labor markets and worker behavior. It's implications and relationships with job market outcomes, however, provide insight into new

policy that lawmakers can enact to boost employment mobility and reduce inefficiencies in the way commuters function. This study finds that Black, and more specifically low-income Black, workers face higher commuting times that their similarly situated counterparts. This furthers the argument that SMH holds, but only for Black individuals. Additionally, the results suggest that the SMH is a problem that Black individuals can overcome with an increase in hourly wage. For non-Black workers, however, the study finds that Spatial Mismatch is not applicable.

There are several solutions to the SMH problem for low-income Black workers. First lies in transit engineers who decide where bus/rail lines are constructed and how often they run. Taking into account the voices of low-income communities that are predominately Black is essential to understanding how their travel and commuting behaviors differ.

Additionally, the study shows that access to a car, controlling for all other factors, decreases travel time compared to public transportation. While this may seem like an obvious relationship, policymakers could choose to address this in two ways. First, increase funding for public transportation overall. An interconnected and efficient public transportation system will alleviate burdens associated with commuting greatly. Second, several states have experimented with policies to help low-income people get cars in the meantime. Subsidies for low-income car ownership may help alleviate the job search that is already burdensome.

Finally, this study shows the need for further research into why and how travel behaviors are affected by socioeconomic characteristics. Job markets and placements are an essential part of the economy and deserve more attention in the literature.

Appendix A: Summary Statistics

Table 2: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
AGE	2,560	40.666	13.548	16	29	51	80
RACE	2,560	106.488	12.800	100	100	110	300
EDUCYRS	2,560	173.864	69.954	101	112	216	321
HOURWAGE	2,560	16.348	10.373	2	10	19.8	95
UHRSWORKT	2,560	38.746	11.248	6	35	40	87
NCHILD	2,560	0.825	1.174	0	0	1	7
FAMINCOME	2,560	9.807	3.739	1	7	13	16
TRAVELTIME	2,560	25.498	20.913	1	10	30	140
BLACK_dummy	2,560	0.309	0.462	0	0	1	1
EDUCYEARS	2,560	12.980	3.219	1	12	16	21
HOUR_num	2,560	11.872	5.573	0	7	16	23
peak_dummy	2,560	0.329	0.470	0	0	1	1
LOGHOURWAGE	2,560	2.644	0.526	0.756	2.303	2.986	4.554
LOGTRAVELTIME	2,560	2.898	0.881	0.000	2.303	3.401	4.942

Appendix B: Log Versions of Variables

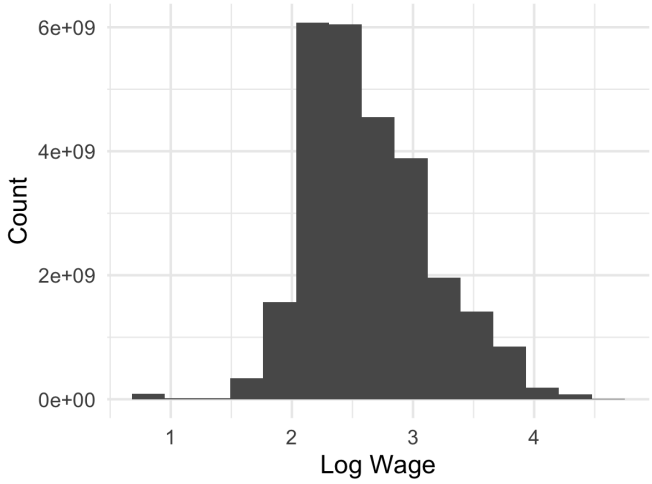

Figure 4: Histogram of Log Wage

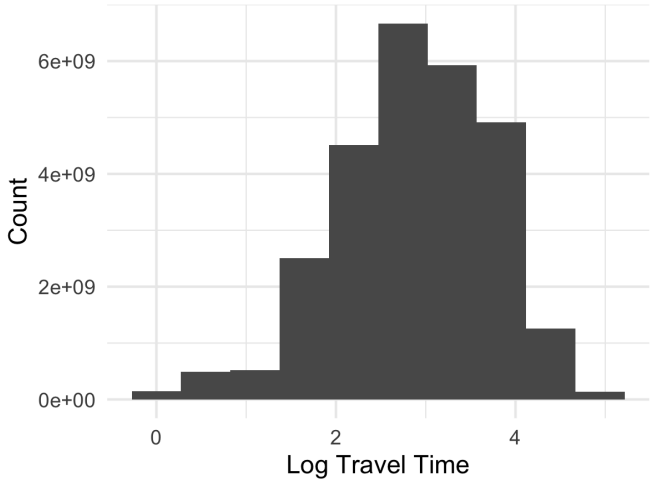

Figure 5: Histogram of Log Travel Time

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