Economic Mobility in Winston-Salem/Forsyth County, NC:

A Closer Look into Employed Bus Riders' Lives, Ambitions and Missed Opportunities to Climb the Economic Ladder

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This study was initiated by the Center for the Study of Economic Mobility (CSEM) located on the campus of Winston-Salem State University, in Winston-Salem, NC. CSEM is a research collaborative formed to understand and address the causes of low economic mobility in Forsyth County.

INTROUCTION AND MOTIVATION

Winston-Salem, NC is consistently rated one of the best places to live. Home to the city are many well-respected higher education institutions and prospering companies. Billions of dollars have been invested in the downtown area over the last decade. However, Forsyth County, NC, the county in which Winston-Salem is located, is one of the worst in the United States regarding economic mobility. It is the third worst county in the country, the first two being counties located on Indian reservations. This is easily seen while exploring Chetty, Friedman, Hendren, Jones, and Porter's (2018) interactive map named the Opportunity Atlas. According to a study by Harvard economists Chetty and Hendren (2018), children born to parents in the bottom income quantile in Forsyth County are unlikely to ever reach higher quantiles. Thus, from one generation to the next in Forsyth County, underprivileged families remain stuck in poverty. The United States takes great pride in being known as the "land of opportunity," where children can earn higher standards of living than their parents before them. In Winston-Salem, NC, however, the evidence suggests that this is not occurring.

There are many factors that affect economic mobility. Chetty, Hendren, Kline, and Saez (2014) identify 5 main factors that determine economic mobility, which are 1) residential segregation, 2) income inequality, 3) quality of education system, 4) social capital, 5) family structure. Segregation is measured in part by the distance commuters travel for work. This measurement will indicate whether opportunities lie elsewhere, far from the commuter's neighborhood. Residential segregation is one of the strongest correlates to economic mobility (Chetty et al., 2014). However, this factor may be capturing more than just physical segregation. It could also be that those who stand to gain the most from climbing the socioeconomic ladder, such as the poor and minorities, tend to lack personal vehicles and dedicate substantial amounts of their time to traveling on public buses to and from work without being compensated. Their commute times are higher than those with cars, even though the distance they travel is shorter (Gautier & Zenou, 2010; Hv & Young, 1999; Kawabata, & Shen, 2007). They spend many hours a week on public transportation systems, hours that could have been used for more productive activities like working or spending time with family, both of which can impact economic mobility (Chetty et al., 2014). Thus, it's not just being residentially segregated that can trap people on lower rungs of the socioeconomic ladder, but it is also the commute itself that takes valuable time away from them to do any *climbing* of that ladder.

Those without personal transportation and who rely on public systems, are not only losing time but are being restricted by the routes the systems are set on and the schedules in which they are operating (Gurley, & Bruce, 2005; Ong, 2002; Raphael, & Rice, 2002). Access to reliable and safe transportation is critical for success in the modern economy. Being physically mobile allows for the access of a wider variety of jobs and opportunities (Thakuriah, & Metaxatos, 2000). Without a personal vehicle, or at least a reliable public transportation system, the ability to access these opportunities is severely restricted (Tomer, Kneebone, Puentes, & Berube 2011). Public bus users are limited to jobs located near bus routes, or at least within reasonable walking distance. In Winston-Salem, the fifth largest city in North Carolina, located in the middle of Forsyth County, we believe the public transportation system is restricting the economic mobility of many of its residents, which is contributing to the county's poor economic mobility score.

It is crucial, from a public policy standpoint, to understand why economic mobility in Forsyth County is so low. The socioeconomic ladder sometimes takes a generation to climb, therefore, residents being affected are losing precious years. If the barriers to economic mobility can be identified, local governments can then work to remove them. It is our belief that a primary cause

of Winston-Salem/Forsyth County's economic mobility problem is the public transportation system. This report seeks to demonstrate how the transportation system is hindering the economic mobility of Winston-Salem and Forsyth County's residents, in the hopes that the system will be improved and the lives of the residents with it.

This report sheds light on the lives of Winston-Salem's employed bus riders by providing numerous detailed graphics to help visualize the survey data. For the analyses, we implemented correlation and regression analyses and found that the labor productivity of female bus riders is negatively impacted by long commutes on the bus. We also find that taking more buses to work negatively impacts labor productivity. Along with the productivity losses due to commuting on the bus, we find that employed riders face severe opportunity costs from their reliance on the bus system. We offer various policy solutions that could alleviate the barriers impeding economic mobility.

LITERATURE REVIEW

According to *The Pew Charitable Trusts* (2012), North Carolina (NC) has some of the lowest rates of economic mobility in the United States. Poor economic mobility is attributed to various factors, one being inefficient public transportation systems (Blumenberg and Pierce, 2014; Kaufman, Moss, Tyndall, and Hernandez, 2014; Bullard, 2003). Without proper transportation to and from jobs, events, and other beneficial economic activities, people can easily fall behind and become stuck in lower socioeconomic levels. This is especially relevant to Forsyth County, NC, which has some of the worst rates of economic mobility in the country, according to a study by Chetty and Hendren (2018). Since public transportation has been identified as an important determinant of economic mobility, it likely plays an important role in Forsyth County's predicament.

Local governments have recognized this trend in recent years and have actively worked to expand the access to higher quality public transportation (Pastor and Turner, 2010). However, "some regions of the United States persistently offer less mobility than most other developed countries," as demonstrated by many counties within North Carolina (Chetty et al., 2014). One area of focus has been understanding the link between high quality public transportation and the overall health of local economies. In a European report involving 45 nations, gross domestic product (GDP) was found to be positively linked to improvements in public transportation systems (Albalate, 2010). As GDP grows, demand for public transportation decreases due to increases in vehicle ownership, which further boosts GDP. However, if residents lack viable transportation, then GDP growth will likely be stunted because lacking transportation decreases the likelihood of participating in economic activities, such as working, shopping, and even networking (Kawabata, 2007). Local governments might hesitate to invest in public transportation systems when their economies are sluggish. This exacerbates the challenges surrounding their economy, since high quality public transportation has been shown to improve GDP. Thus, they become trapped with both low GDP growth and poor quality public transportation systems. Since the poor are those who stand to gain the most from high quality public transportation, they end up suffering from this stalemate and economic mobility remains low.

According to a study in 2000, while most jobs are accessible by a personal vehicle, only 60 percent are accessible by public transportation (Thakuriah and Metaxatos, 2000). With a personal vehicle, geographical barriers between a person's home and job opportunities are removed. If commuters had personal vehicles or if their public transit system expanded operational hours, they

would then be able to work non-standard work hours, which would increase income opportunities (Baum, 2009; Gurley and Bruce, 2005; Ong, 2002; Raphael and Rice, 2002). This would especially benefit those in lower income brackets. Thus, reliance on rigid public transportation schedules prevent low income commuters from pursuing extra income opportunities. This in turn precludes them from taking advantage of opportunities to get ahead. Overall, access to high quality public transits and personal automobiles has a powerful influence on commuters' ability to pursue, attain, and maintain employment (Cervero, Sandoval, and Landis, 2002). These are crucial determinants of economic mobility.

Public transportation systems have been found to increase the travel times of commuters, sometimes up to 90 minutes (Tomer, Kneebone, Puentes, and Berube, 2011). Long commute times, especially for those in poverty, are negatively correlated with workers' earning potential, which further decreases their ability to escape poverty and reach higher income levels (Chetty et al., 2014; Chetty and Hendren, 2018). This substantial time requirement, in combination with rigid public transit schedules, prevent individuals in low-income areas from accessing nearly 80 percent of jobs in low/middle-skilled metropolitan job sectors, thus, decreasing their ability to escape poverty, and undermining economic mobility (Tomer, 2011).

Incidents of crime and income tend to be negatively related (Hsieh and Pugh, 1993; Patterson, 1991). Hence, the poor tend to reside in more crime prone areas. Quality public transportation has often avoided extending into areas of violent tendencies, which tends to restrict the physical mobility of these residents. These areas often have large percentages of high school drop outs (Sharkey, 2017). Without the presence of public transportation in these areas, young adults with lower education achievements are unable to obtain proper employment and become trapped in these impoverished areas. According to Tyndall (2017), if better transportation options were extended to these individuals, to connect them to economic opportunities, unemployment and income gaps would decrease. Overall, studies show that there is a strong positive correlation between car ownership, educational attainment, and the likelihood of transitioning off welfare (Cervero et al., 2002). Likewise, individuals who live closer to bus stops have higher employment rates than those who live farther away (Sandoval, Cervero, and Landis, 2011). These factors are critical in understanding economic mobility (Chetty et al., 2014). Evidence supports the conclusion that physical mobility, whether it be with a personal vehicle or riding an efficient public bus, promotes all aspects of economic mobility.

While having transportation options is important for accessing jobs, maintaining and improving the quality of these sources of transportation is imperative for employment retention. A study conducted by Blumenberg and Pierce (2014) find that public transportation improvements increase the likelihood of maintaining employment. These improvements were made to the systems reliability, efficiency, and availability. Likewise, as work commutes shorten, commuters are more likely to experience job stability (Crane, 1996). Gurley and Bruce (2005) estimate reliable transportation's impact on the hourly wages of low income workers. They find that, for lower income workers provided with more efficient transportation options, their hourly wages could increase by $1.40 (Gurley and Bruce, 2005). Thus, there was a sizeable labor productivity gain. Along with productivity losses due to transportation, individuals who use inefficient transportation with longer commuters have an average daily opportunity cost of $14.59, compared to those with short commutes who face an average daily opportunity cost of $5.92 (Ciscel, 2001). The overall opportunity cost to commuters has been estimated to equal roughly ten percent of their annual incomes (Ciscel, 2001). This percentage is larger for those who use public transportation systems, since their commute lengths are much longer than those with personal vehicles. With such

significant opportunity costs, commuters earn less money, which could have otherwise promoted their economic mobility. Without high rates of job retention due to reliable transportation, economic mobility is less likely to occur.

As was previously discussed, a recurring issue with public transportation systems is the amount of time they require to use, compared to private transportation. Many public transportation users experience trips that take twice the time it would take in a personal vehicle (Hu and Young, 1999). An astonishing finding is that there is a correlation estimate of 0.605 between decreases in commute times and upward economic mobility for children (Chetty et al., 2014). This relationship stems from reduced residential segregation indicative of shorter commutes. Nevertheless, an additional explanation is that extra time to pursue economic activities boosts economic mobility. More time required for commuting with public transportation limits the "hours available for other productive activities, such as networking, professional development, continuing education, and personal care," thus, further limiting the potential for future job development (Majeski, 2015). For just a twenty-three-minute public transportation routine, a person is likely to lose potential earnings equivalent to 19 percent of their monthly salary, stemming from the opportunity cost of public transits (Stutzer and Frey, 2008). This is particularly burdensome to low income commuters, which disproportionately belong to minority communities.

Studies find it to be more difficult for minority groups, especially blacks and Hispanics, to experience economic mobility. According to Gautier and Zenou (2010), blacks on average spend more time traveling to work no matter the distance between their houses and their jobs. Their travel times are much higher when they use public transportation. As Gautier and Zenou (2010) argue, this sizeable time requirement reduces their ability to earn extra income and pursue other economically advantageous opportunities. Thus, black and Hispanic public transportation users have lower rates of economic mobility, which explains their disproportionate rates of intergenerational poverty. Corak (2013) argues that income inequality is the primary driver of poor economic mobility, which is evidenced by the severe income inequity in minority populations. Most researchers acknowledge that income inequality does play a role in low economic mobility. Nevertheless, it could be that income inequality, and in turn, poor economic mobility, are a result of economic isolation caused by inefficient public transportation systems. Along with the racial differences in transportation's impact on economic mobility, gender differences have been explored as well.

According to studies by Madden (1981) and Hanson and Johnston (1985), women tend to have shorter work commutes than men, and their longer commutes do not correspond to higher paying jobs, unlike for men. Roberts, Hodgson, and Dolan (2011) find similar evidence. They find that female commuters are more sensitive to longer commutes, which affects well-being and job satisfaction. Commuting generally has a negative effect on subjective well-being, resulting in a corresponding opportunity costs due to the health impact, regardless of gender (Stutzer and Frey, 2008). Nevertheless, the impact is worse for females. Their labor productivity takes a larger hit, which results in the female commuters earning less per hour (Thomas and Strauss, 1997; Glick and Sahn, 1998). Thus, female commuters that utilize public transportation face a greater burden since commute times are longer. Since their labor productivity is negatively affected, and they tend to earn less than male commuters, it stands to reason that economic mobility among females is worse than males, and even worse for minority females.

Public transportation is a key determinant of economic mobility, especially for vulnerable members of society who stand to gain the most from economic mobility. Chetty et al.'s (2014) 5 main factors that determine economic mobility, which are 1) residential segregation, 2) income

inequality, 3) quality of education system, 4) social capital, 5) family structure, are all impacted, directly or indirectly, by transportation. The research discussed above indicates that access to better transportation options, whether that be efficient public systems or personal vehicles, will lower the opportunity costs of commuting. The savings will stem from improved labor productivity and health, access to a wider range of employment opportunities, longer job retentions, and more time to pursue enriching activities.

DATA

Data used for this report are from the WSTA Employed Bus Rider Survey, which was designed by the Center for the Study of Economic Mobility at Winston-Salem State University. It is a representative survey involving *employed* bus riders in Winston-Salem, NC and was administered in August of 2018. Ten interviewers delivered the survey, which consists of 54 questions. All the riders that participated in the survey were employed. The survey has three main sections, which are Employment, Demographic, and Transportation.

The first section, Employment, contains questions regarding the number of jobs held, hourly wages earned, and the number of hours worked per week. There are questions measuring commute times involving the bus and how frequently the bus is used. There are also questions measuring foregone economic opportunities stemming from the public bus system.

The second section, Demographic, contains questions about education attainment, race, gender, and age. The section also contains questions regarding household size, household vehicles, and whether riders have cell phones, among other things.

The third and last section, Transportation, includes questions about the frequency of using public transportation and the purpose of using it. There are questions about the impact of public transportation on riders' diets and how it has affected other areas of the riders' lives. This section measures the perspectives surrounding the bus system, such as the bus riders' confidence in the bus's ability to get them to work on time. In addition, this section asks riders to rate the public bus system on its over quality. Thus, the survey gathers data on a rich set of variables covering many areas in the lives of employed bus riders in Winston-Salem, NC.

The sample includes 215 observations of 215 unique employed bus riders. Of those surveyed, around 58 percent are male, while the remaining 42 percent are female. The average rider is just under 42 years old. African Americans make up most of the employed bus riders in the Winston-Salem, consisting of around 78 percent. The next largest racial group are whites/Caucasians. Around 11 percent of the employed bus riders in the city are white. Eight percent identify as either Asian, American Indian, Pacific Islander, or biracial. These groups have been collapsed together into one category, named non-Hispanic other to improve the regression analyses later in the report. Two percent of employed riders identify as Hispanics/Latinos. Employed bus riders have completed an average of 12.4 years of formal schooling, which is slightly more than a high school education. Riders typically work more than one job. They work around 32 hours a week at their primary job, and for those with secondary jobs, there they work around 22 hours a week. The hourly wage they receive at their primary job is just over $10. The average annual income of employed riders is $20,636.15, which places the average rider close to the poverty line. They live in households with 2-3 people, and there is usually less than 1 working automobile available to the household. The amount of time employed riders in Winston-Salem dedicate to commuting to and from work is substantial. They spend over an hour getting to work and then another hour getting back home. They dedicate around 12 hours a week to commuting to and from work, involving the

bus. Riders in Winston-Salem take around 2 buses to get to work. The information discussed above is presented below in Table 1, along with other variables.

Table 1: Descriptive Statistics for the Continuous Variables

Results of 2018 WSTA Bus Transit Survey: Descriptive Statistics for the Continuous Variables	Mean	Stand. Dev.	N*
Commuting			
Total amount of time (minutes) it takes to get to work from home, when using the bus	66.79	34.53	
Total amount of time (minutes) it takes to get to home from work, when using the bus	68.60	33.89	
Days a week use the bus to commute to work	5.31	1.11	
Hours a week commuting to and from work, involving the bus	12.04	6.48	
Time (minutes) it takes to get to first bus stop	8.93	11.62	
Time (minutes) it takes to get from last bus stop to work	15.13	17.15	
Length of time (years) using public transportation reguarly	11.22	11.16	
Number of buses taken to get to work	1.96	0.73	
Education			
Years of education	12.40	1.21	
Work Information			
Number of jobs	1.15	0.36	
Hourly wage ($) of primary job	10.14	3.58	
Hourly wage ($) of non-primary job(s)	18.74	49.86	34
Annual income ($), involving all jobs	20636.15	20302.60	
Hours a week of work at primary job	32.59	12.38	
Hours a week of work at non-primary job(s)	22.02	11.18	34
Foregone Opportunities			
Hourly wage ($) of better job offer that was turned down, due to the bus	12.36	3.84	106
Hourly wage ($) of promotion that was turned down, due to the bus	13.12	4.63	29
Length of time (days) it took to find a new job	83.75	114.73	44
Hourly wage ($) of the lost job, compared to the new job	10.36	2.47	44
Hourly wage ($) of the new job, compared to the lost job	10.20	2.59	44
Non-Standard Transportation			
Cost ($) of taking a taxi to work	14.67	7.16	115
Household information			
People living in household	2.46	1.54	
Age	41.78	14.54	
Vehicle information			
Working automobiles owned by household	0.48	0.81	
Medical Access			
Length of time (minutes) to get to the doctor, by bus	47.94	27.75	
Length of time to get to the doctor, if driving a car	15.20	10.16	
Opinions of Bus System			
Satisfaction in the predictability of bus system to get riders to work on time (10 being Very Satisfied)	6.46	2.76	
Riders' rating of their public transportation system overall (5 being Excellent)	2.31	1.02	
Riders' belief that the bus system creates opportunities to achieve long term financial goals (10 being Most Likely)	6.66	2.77	
*N = 215, unless otherwise specified			

More than half of employed bus riders in Winston-Salem work full-time and are not students. Many of them have had to make the hard decision of passing on better opportunities because they did not align with the bus system's routes and/or schedules. For example, approximately 50 percent of employed bus riders have turned down better job offers from other companies because the current bus route did not take them close enough to the job. Twenty percent have lost jobs because a bus route changed. Nearly 74 percent have been late to work because of transportation issues. Most face penalties for being tardy, whether that be a dock in pay (20 percent face this), or disciplinary action (44 percent face this). Riding the bus also impacts other avenues of life beyond work, such as shopping for groceries. Forty-seven percent of employed riders buy less raw meat,

53 percent buy less canned foods, and 36 percent eat more fast food, like McDonalds, which they tribute to the bus system. The information discussed above is shown in Table 2 below.

Table 2: Percentages

Results of 2018 WSTA Bus Transit Survey: Percentages	
Education	
Bus riders with less than a high school education	10.69%
Bus riders with a high school education	47.44%
Bus riders with more than a high school education	41.86%
Work Information	
Bus riders that work full time and are not students	55.81%
Bus riders that work part time and are not students	42.32%
Bus riders that work and are full time students	1.86%
Foregone Opportunities	
Bus riders that have turned down a better job offer from another company because of current bus routes	49.30%
Bus riders that have turned down a promotion at their current job because of the bus schedule	13.48%
Bus riders that have lost a job because of a bus route change	20.46%
Bus riders that have used a taxi (includuing Uber, Lyft, etc.) to get to work	53.48%
Bus riders that use the night bus service to get to work	42.79%
Penalty for being late to work, if relevant (all that apply):	
Bus riders that are docked pay	20.30%
Bus riders that face a loss in promotion	5.58%
Bus riders that face disciplinary action	44.18%
Bus riders that face demotion	5.11%
Bus riders that don't face any penalties	38.60%
Race	
Black/African American	78.13%
White	11.16%
Hispanic/Latino	1.86%
Other (Asian, American Indian, Pacific Islander, etc.)	8.83%
Gender	
Male	58.13%
Female	41.86%
Vehicle information	
Bus riders with a valid drivers license	28.83%
Households that own the following vehicles:	
Car	29.30%
Truck	2.79%
Motorcycle	0.00%
Scooter	1.39%
Bicycle	1.39%
No vehicles owned	67.91%
Cell phone access	
Bus riders that own cellphones	88.37%
Bus riders with smart phones, like an Iphone or an Android	85.78%
Bus riders that report bus transportation interfering with:	
New employment opportunity	44.18%
Promotion at place of employment	17.20%
Arriving to work on time	73.95%
Receiving medical attention	20.93%
Everyday tasks (grocery shopping, going to the bank)	34.41%
School/classes	7.90%
Health and Nutrition	
Bus riders that say riding the bus contributes to a healthier diet	14.88%
Bus riders that say riding the bus has no impact on diet	64.65%
Bus riders that say riding the bus contributes to an unhealthier diet	20.46%
Bus riders that say riding the bus means purchasing:	
Less fresh vegetables	38.13%
Less cans of food	53.02%
Less raw meat	47.90%
More dried foods, like cereal and pasta	33.95%
More snack foods	39.06%
More fast food, like McDonald's and Bojangles	36.27%
N = 215	

DATA EXPLORATION AND ULLUSTRATIONS

This subsection contains many charts and graphs in the hopes that they will illuminate details about the lives of Winston-Salem's employed bus riders that may have otherwise been overlooked. Variables have been sliced in various ways to underscore areas of economic interest, such as differences across gender and race. Hopefully, this will shed even more light into the employed riders' lives. The more rigorous analyses and illustrations are saved for the Analyses section of the report.

Part I: Demographics, Labor, and Commutes

Around 58 percent of employed bus riders in Winston-Salem are male and 42 percent are female (see Figure 1). This differs from the national average. Most public transportation users in the United States are women, approximately 55 percent (American Public Transportation Association, 2017 Report). This is also true globally. Women are the primary users of public transportation around the world (The World Bank).

Figure 1

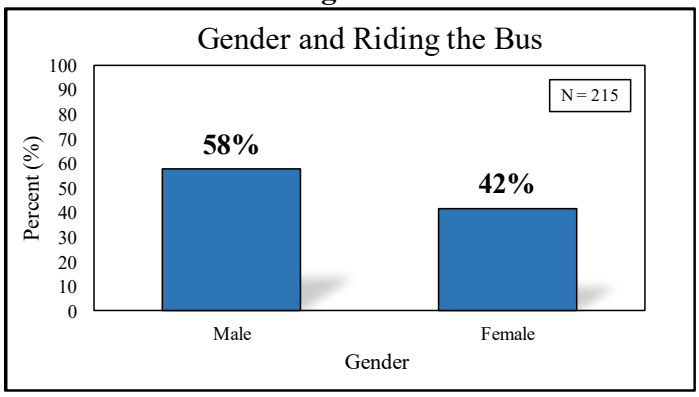
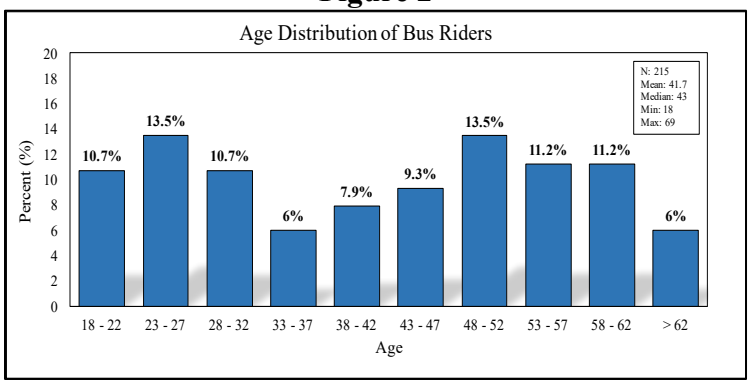


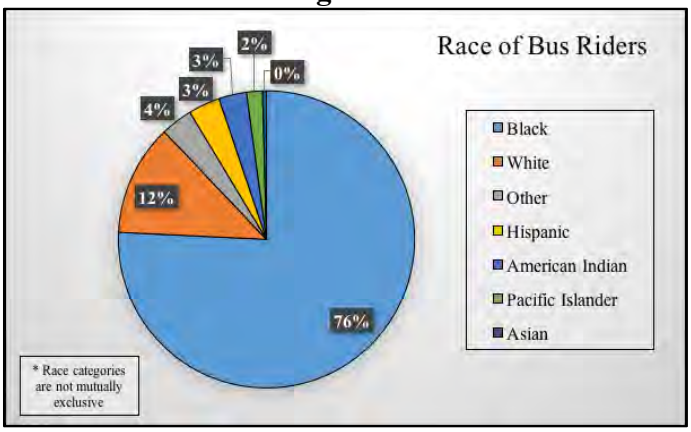
Figure 2 shows that employed bus riders in Winston-Salem, on average, are in their early 40s. There are many riders less than 30 or older than 50. Thus, there is a noticeable age divide. In the US, the age distribution of bus riders is more heavily weighted in the age range of highest economic activity (25 – 54) (*American Public Transportation Association, 2017 Report)*. The age of employed bus riders in Winston-Salem, however, does not follow this pattern.

Figure 2



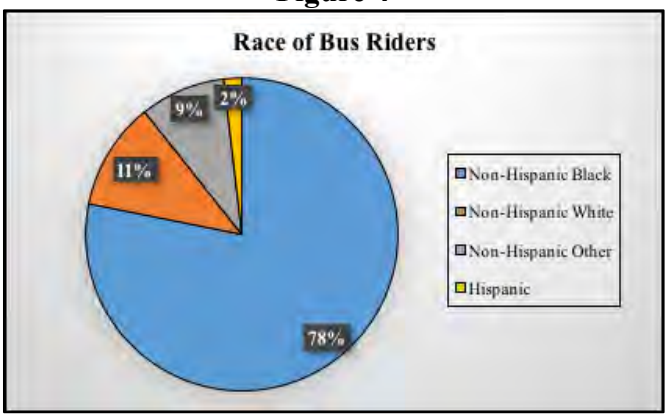
African Americans make up the largest employed group to use the public bus, with the next largest group being white (see Figure 3). In the US, African-Americans and whites nearly tie when it comes to which group more often uses public buses (American Public Transportation Association, 2017 Report).

Figure 3



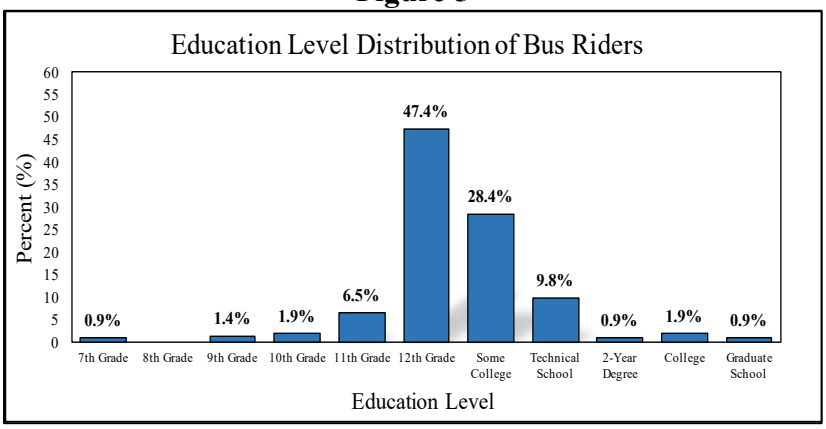
The four race categories shown in Figure 4 establish mutual exclusivity and help with the regression analyses shown later in the report. Some of the original race categories were either empty or very sparse, so these were collapsed into the group labeled Non-Hispanic Other. As is still the case, most employed riders in Winston-Salem qualify as non-Hispanic black.

Figure 4



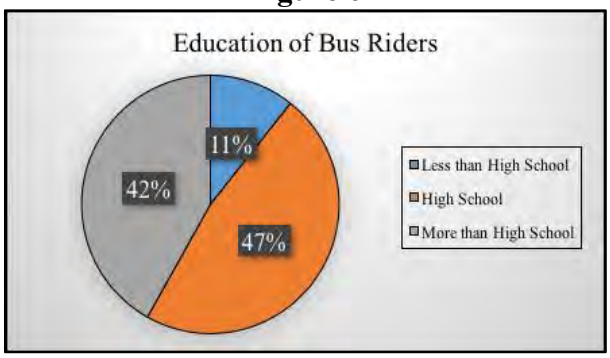
Most employed bus riders in Winston-Salem report having only a high school diploma, with nearly 11 percent having less than a high school education (see Figure 5). Around 42 percent report having an education level higher than high school. Less than 2 percent report having a 4-year degree and less than 1 percent report having a graduate degree. These differ from the national averages. In the US, for example, more than half of all bus riders report having at least an undergraduate college degree (American Public Transportation Association, 2017 Report). Thus, employed bus riders in Winston-Salem tend to be less educated.

Figure 5



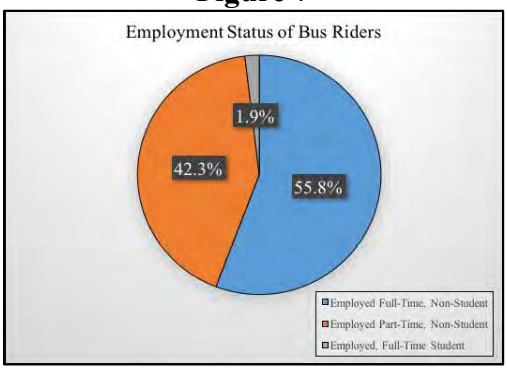
When education achievement is examined in relation to completing high school, it reinforces the conclusion that most employed bus riders in Winston-Salem have only a high school education (see Figure 6). The next largest group reports having completed more than just a high school education. Most riders in this group report having some college.

Figure 6



Nearly 56 percent of employed bus riders are employed full-time and are not students, while the second largest group are employed part-time and not students. Only 1.9 percent are employed and full-time students. To give this some context, in the US, 62 percent of bus riders are employed either full or part time, 12 percent are students, 8 percent are retired, and 9 percent are unemployed (American Public Transportation Association, 2017 Report).

Figure 7



The distribution shown in Figure 8 below is that of weekly hours of work. This includes both primary and secondary jobs, thus, it is the distribution of total hours of labor a week. Most employed riders, nearly 30 percent, work between 40 – 45 hours a week. The distribution is heavily weighted in the 20 – 40 hours a week range. Some riders work the equivalence of two full-time jobs, in terms of total number of hours. For example, over 3 percent of employed bus riders in Winston-Salem work more than 80 hours a week.

Figure 8

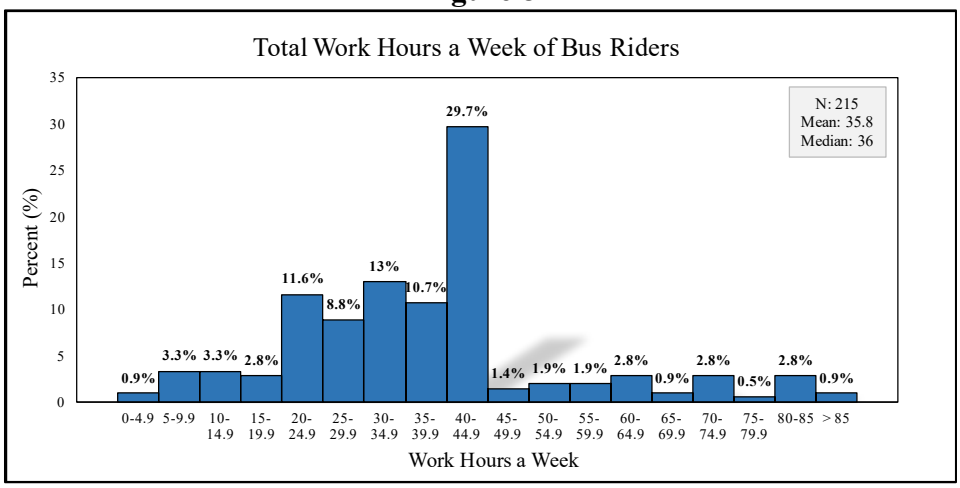
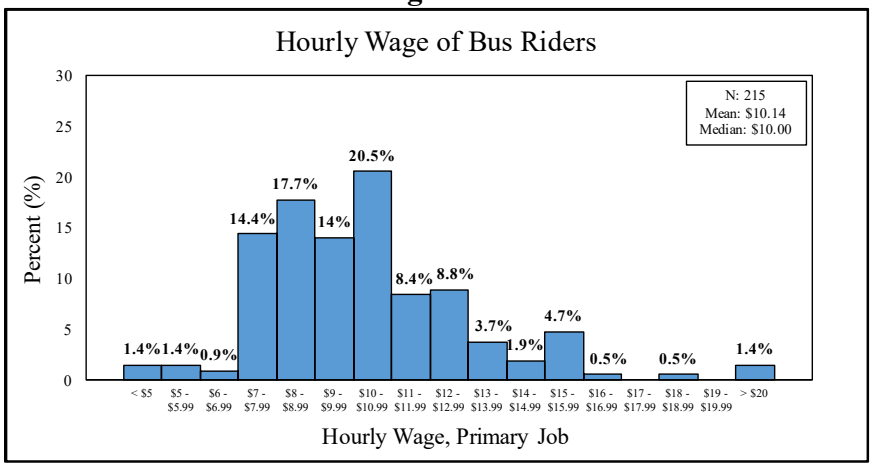


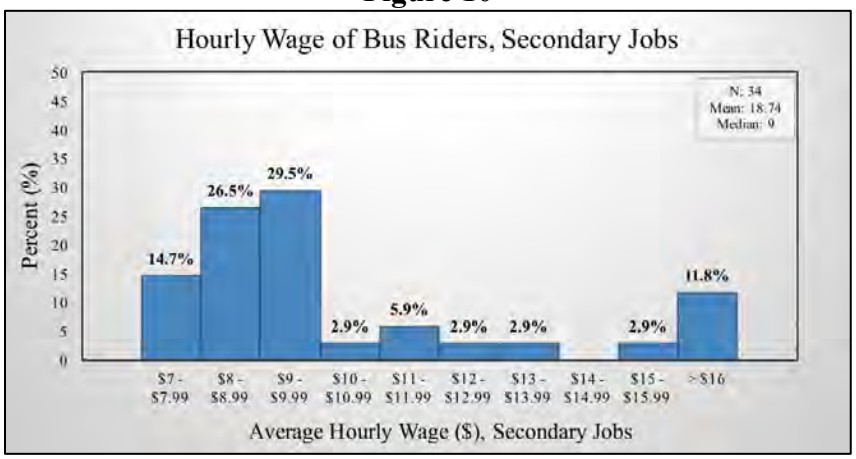
Figure 9 shows the distribution of hourly wages. The mean wage is $10.14 per hour. Most riders earn wages between $7 – $14 an hour. The distribution is skewed to the right because some riders earn over $20 an hour, though they only comprise around 1.4 percent of employed riders.

Figure 9



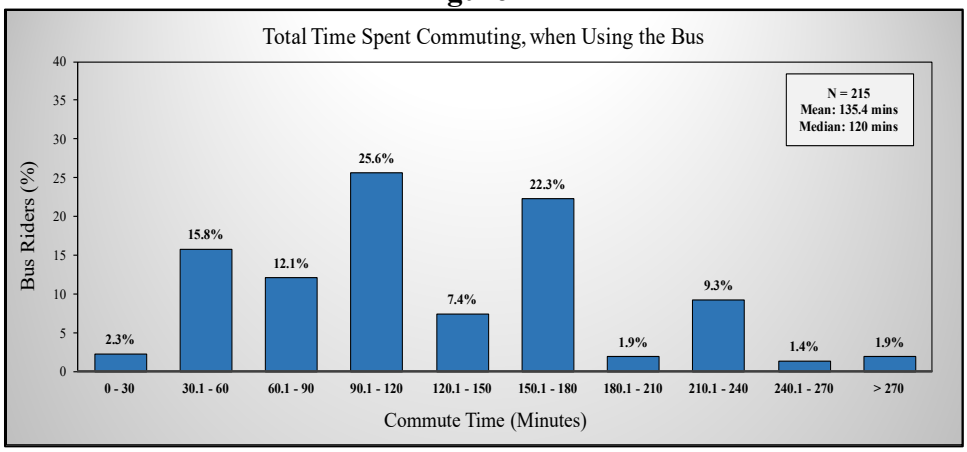
Many riders have more than one job. Figure 10 shows the distribution of hourly wage earned at these non-primary jobs. Around 70 percent of employed riders earn between $7 - $10 an hour. The mean is larger than the median because one rider reports earning $300 an hour, which is suspect, but not impossible.

Figure 10



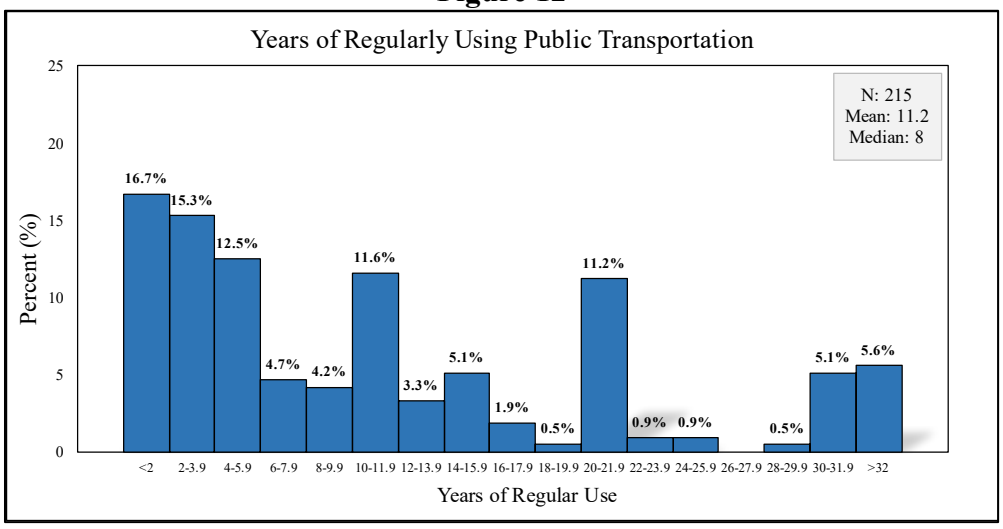
Bus riders in Winston-Salem spend a sizeable number of hours commuting to and from work each day (see Figure 11). This is time they could otherwise be spending with family or earning a wage. The average amount of time an employed bus rider spends commuting from home to work, then back, is approximately 134 minutes. This is almost twice that of commuters in large metro areas, such as NYC and Washington DC (*United States Census Bureau)*. This includes the time spent walking to bus stops, waiting at bus stops, and changing buses. In a way, it measures non-compensated labor hours, because it is time dedicated to work (physically getting to work and back) that is not being directly compensated.

Figure 11



Variability exists in the lengths of time employed riders have been using public transportation. Most in Winston-Salem have been using public transportation for 0 to 6 years. Around 24 percent of employed riders have been using public transportation for over 20 years. More than 10 percent have been using public transportation for over 30 years. The average employed bus rider has been using public transportation for more than a decade (see Figure 12 below).

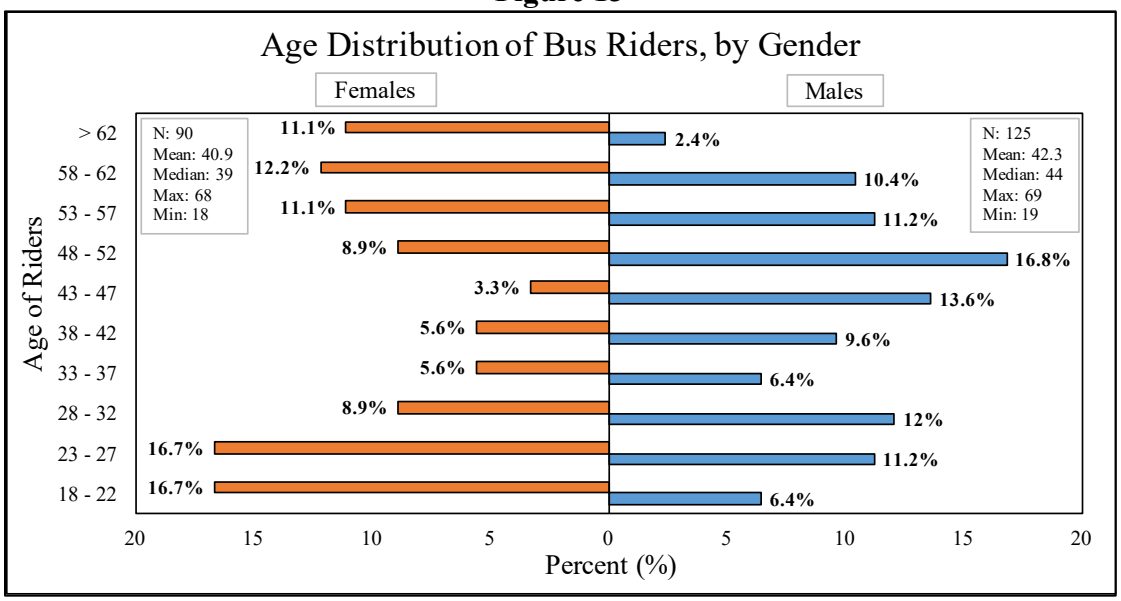
Figure 12



Part II: Gender Differences in Demographics, Labor, and Commutes

In this part of the data exploration, gender differences among the employed bus riders in Winston-Salem are investigated.

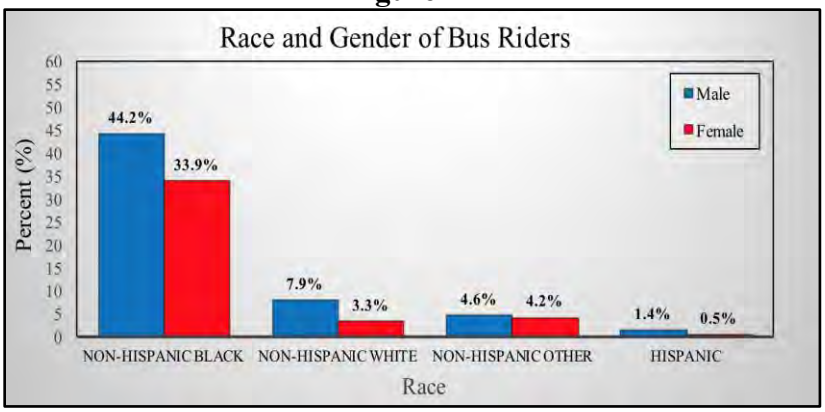
Figure 13



There are age differences between males and females. The male riders tend to be older and are more often middle-aged, while the female riders tend to be younger and less often middle-aged. The age distribution of male riders resembles more of a normal distribution than that of the females. There are many female riders who are quite young (< 27 years old) and quite old (> 62 years old), compared to male riders. Regarding age, male riders more often fall within the prime economic age range, while female riders more often fall outside of this range.

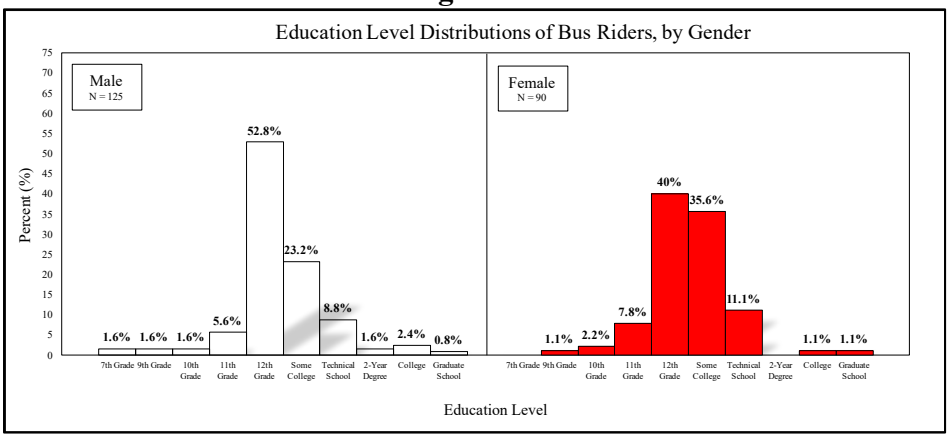
Figure 14 shows the percentage break-down of the race and gender of employed bus riders in Winston-Salem. The clear majority are black and male, with the next largest segment being black and female. Again, this stands in stark contrast to the national average.

Figure 14



The split histogram in Figure 15 shows how the education distribution varies by gender for the employed bus riders in Winston-Salem. Male riders more often have only a high school education, while females more often report having some college education. Thus, the females tend to be more educated than the males. In the United States overall, females, on average, tend to be more educated than males (*United States Census Bureau*).

Figure 15



The split histogram in Figure 16 uses collapsed education variables centered around high school. It is more obvious here that employed female bus riders have higher rates of college education achievements than males. Males more often have only high school educations.

Figure 16

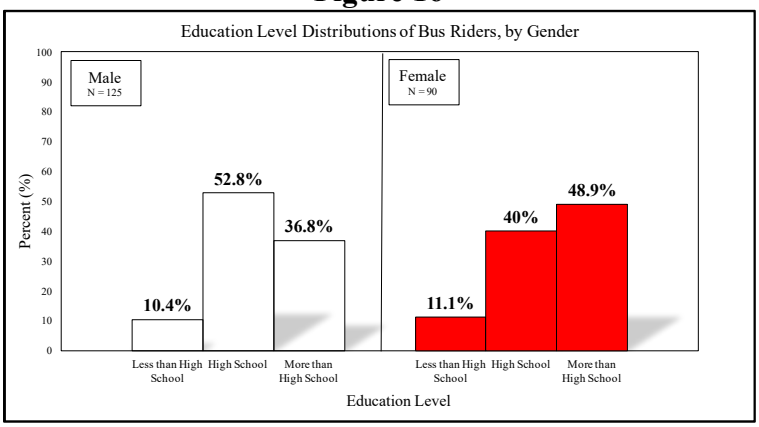
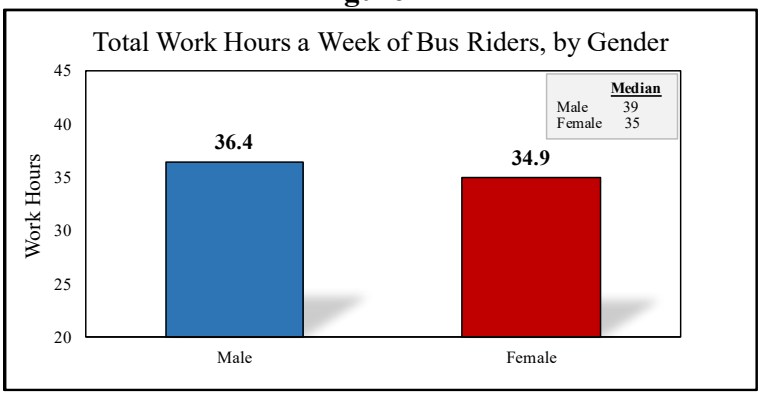


Figure 17 below shows how employed male and female bus riders compare regarding the number of hours they work per week. The average male rider works around 2 hours more than the average female bus rider each week.

Figure 17



The average hourly wage for male riders is almost one dollar more than that of female riders, even though female riders tend to be more educated. This could be because employed male riders are older and perhaps have more work experience. Regardless, males tend to earn higher wages than females at a national level.

Figure 18

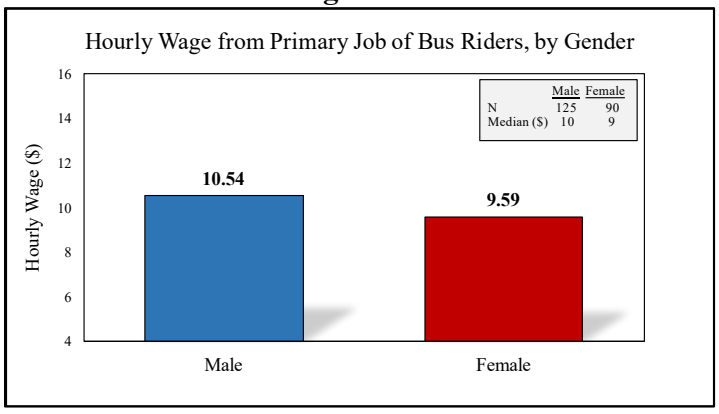
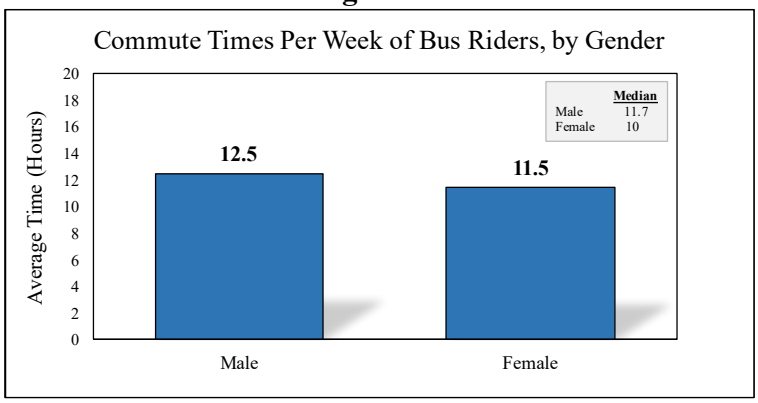


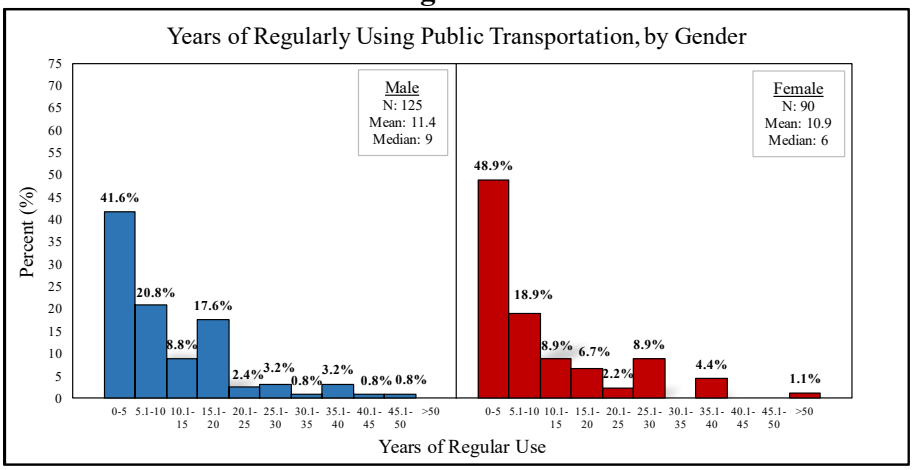
Figure 19 shows the average number of hours, per week, dedicated to commuting to and from work for both male and female bus riders in Winston-Salem. Males spend an extra hour a week commuting, compared to females. Both, however, dedicate a sizeable number of hours per week commuting to and from work.

Figure 19



The figure below shows the distribution of years of using public transportation, for the employed male and female bus riders. Female and male riders have similar distributions for the time in which they have been regularly using public transportation. Female riders, however, tend to be more recent users of public transportation than males. This undoubtedly corresponds with age, because the employed female riders in Winston-Salem tend to be younger than their male counterparts.

Figure 20



Male and female riders have slightly different opinions about the impact that riding the bus has on their diets. Around 70 percent of employed male riders believe that riding the bus has no effect on their diet, while only 57 percent of the females share this view. Employed female riders more often believe the bus negatively impacts their diet, compared to males. Females, though, more often believe the bus positively impacts their diet. Thus, females more often believe the bus does have an impact on their diet, whether it is positive or negative.

Figure 21

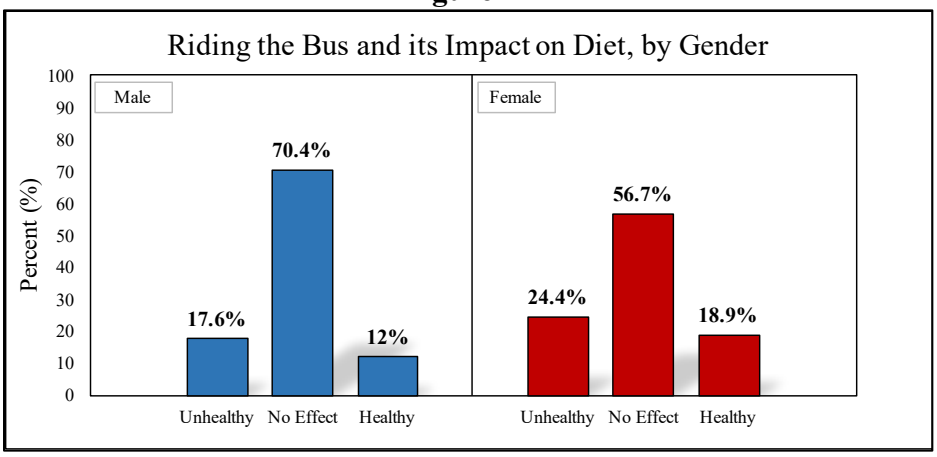
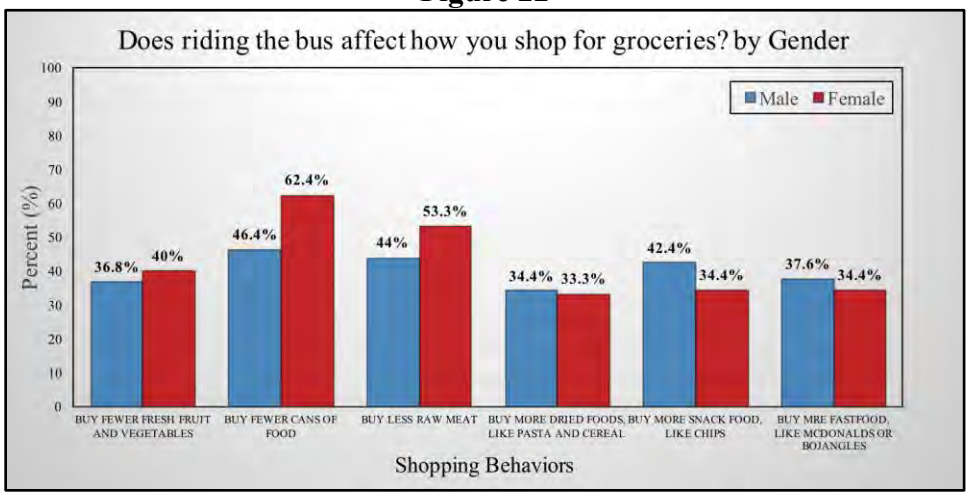


Figure 22 above shows response differences between employed male and female riders for questions about grocery shopping. Around 62 percent of females and 46 percent of males buy less canned foods. This undoubtedly stems from the fact that canned foods are heavy to carry, even for short distances. Forty-four percent of males and 53 percent of females buy less raw meat. Raw meat cannot be transported easily without a portable cooler, without risking spoilage. Obviously, a cooler is difficult to haul on and off a public bus.

Figure 22



Part III: Racial Differences in Demographics, Labor, and Commutes

In this part of the data exploration, racial differences among the employed bus riders in Winston-Salem are investigated.

There are noticeable age differences across races (see Figure 23 below). The largest group of employed bus riders, African Americans, are also the oldest, being nearly 43 years old on average. The youngest group of employed bus riders are Asian, though only one respondent identified as Asian in the survey. In the US, most public transportation users are in their late 30s – the range of highest economic activity. The white, American Indian, and Hispanic riders in Winston-Salem fall within this range, while the largest group, blacks, are older than this expected age range.

Figure 23

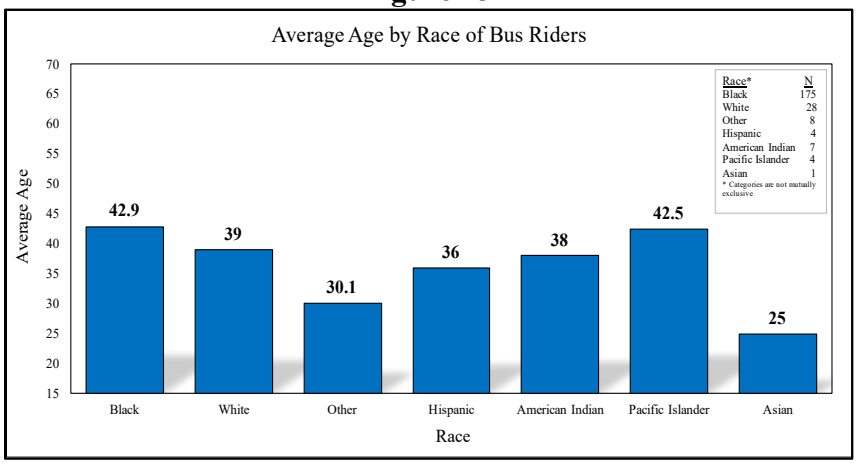
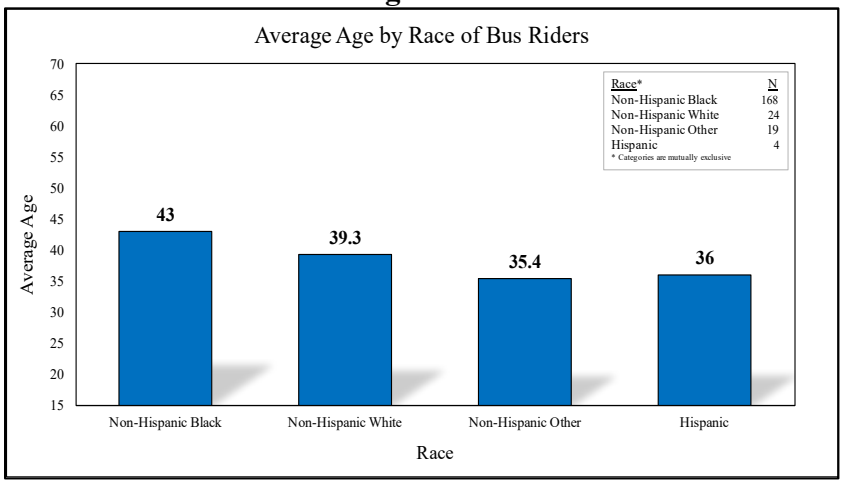


Figure 24 below shows the race categories used in the regression analyses presented later. The average non-Hispanic black bus rider is 43 years old. The average non-Hispanic white rider is around 39 years old. Thus, the largest group of employed riders is also the oldest.

Figure 24



When the education of employed bus riders is examined by race, interesting differences emerge (see Figure 25). The largest group, African-Americans, more often have only a high school education compared to other groups. They are also less likely to have any college education. The next largest group, whites, tend to have more education than black bus riders. Riders who fall in the Non-Hispanic Other category, such as Asians, American Indians, and Pacific Islanders, have similar education levels to the white riders.

Figure 25

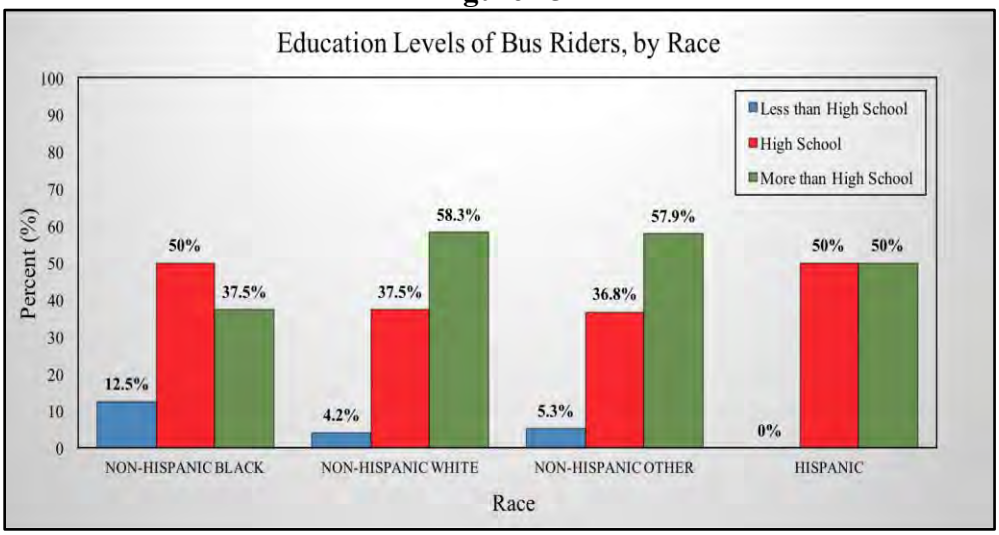
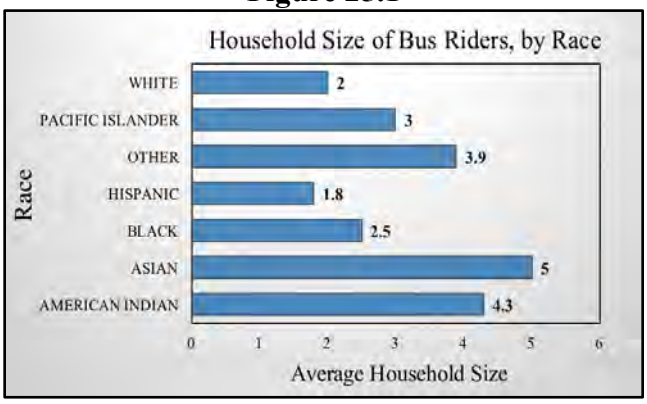


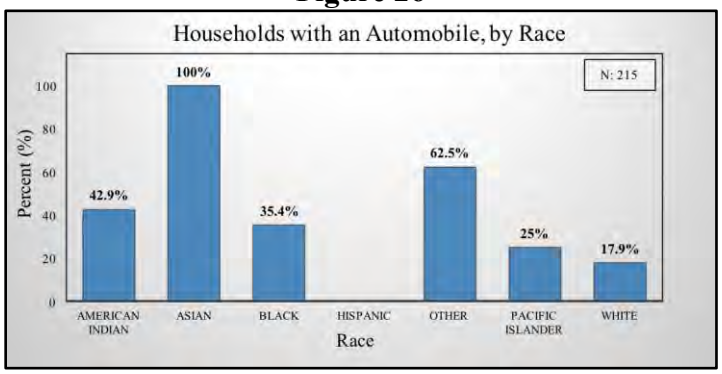
Figure 25.1 below shows the average household size, by race, of the employed bus riders in Winston-Salem. The best estimates are for the black and white riders, since they comprise the largest groups. Blacks, on average, come from households with around 2.5 residents, while whites come from households with around 2 residents. Riders who identify as American Indian come from the largest households, approximately 4.3 residents. Since only one employed bus rider identified as Asian, and they happen to come from a household of 5, this is unlikely to be representative. The table displays the median and the standard deviation of household size, by race. White riders and Hispanic riders tend to have the lowest variability in their household sizes, while American Indians have the largest variability.

Figure 25.1



More than half of public transportation users in the US have access to a working vehicle (*American Public Transportation Association, 2017 Report).* Figure 26 below shows the automobile access by race, of employed bus riders in Winston-Salem. All groups, except for Asians and those who identify as Other, have low rates of automobile access. For example, around 35.4 percent of employed black bus riders live in households with an automobile. Therefore, the public bus system is a critical mode of transportation for many of Winston-Salem's working residents.

Figure 26



The figure below shows the average work hours, by race, of employed bus riders. The American Indian and Asian riders work over 40 hours a week. The white bus riders only work an average of 33 hours a week. While Hispanic and black bus riders average around 34-35 hours of work per week.

Figure 27

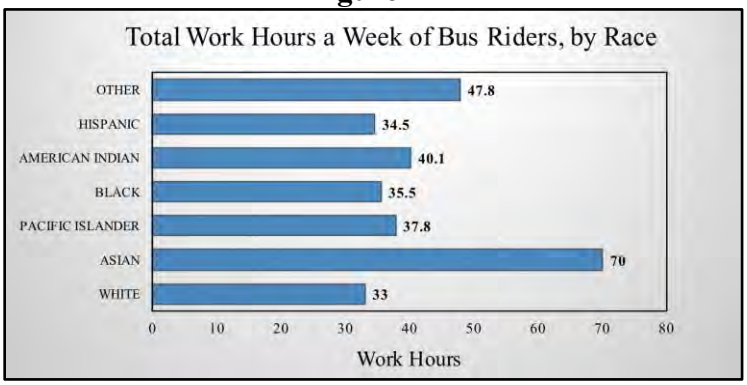


Figure 28 and Table 4 below show the hourly wage information, by race, of the employed bus riders in Winston-Salem. The figure shows mean hourly wages by group, while the table shows the median hourly wages by group. The race categories are the original survey categories. These categories are not mutually exclusive, so it is difficult to draw firm wage-by-race conclusions. Nevertheless, notice the median wages. Whites and Hispanics are tied for the highest median hourly wage, while Pacific Islanders have the lowest median hourly wage. Blacks, the largest group of employed bus riders, receive nearly an entire dollar less, per hour, than the white bus riders. Thus, black riders earn an average of $1,664 less per year than white bus riders. It is an interesting fact that most employed bus riders in Winston-Salem are black and that black bus riders

tend to earn less per hour than the other groups. The median hourly wage of black workers in the US is around $17, while in Winston-Salem their median hourly wage is $9.50 (*Bureau of Labor Statistics*).

Figure 28

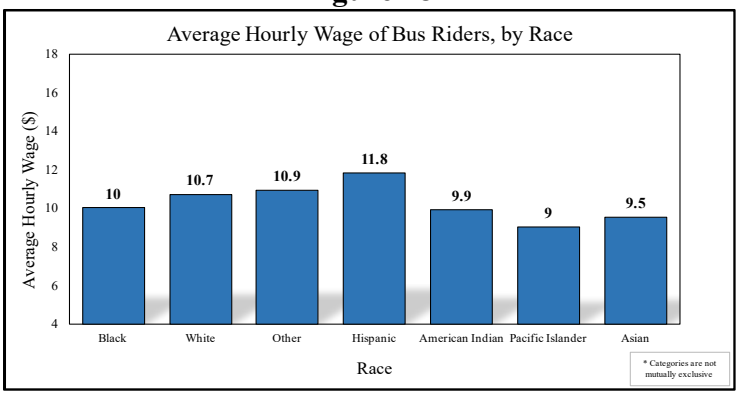
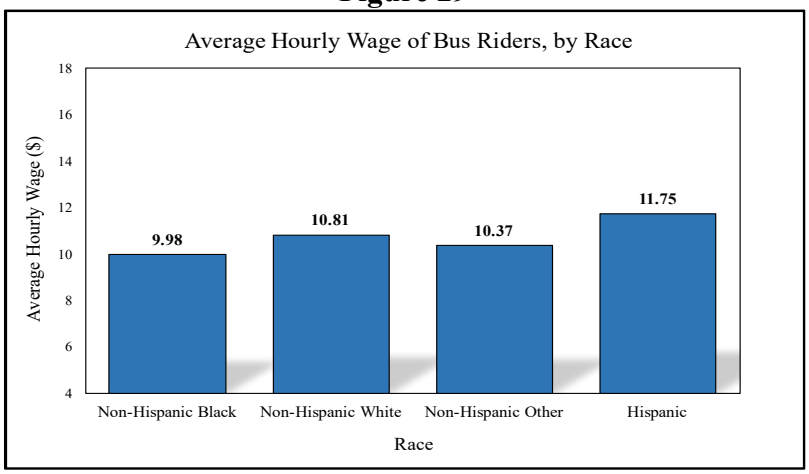


Table 4

Race	N	Median
American Indian	7	10.0
Asian	1	9.5
Black	175	9.5
Hispanic	4	10.3
Other	8	9.6
Pacific Islander	4	9.0
White	28	10.3

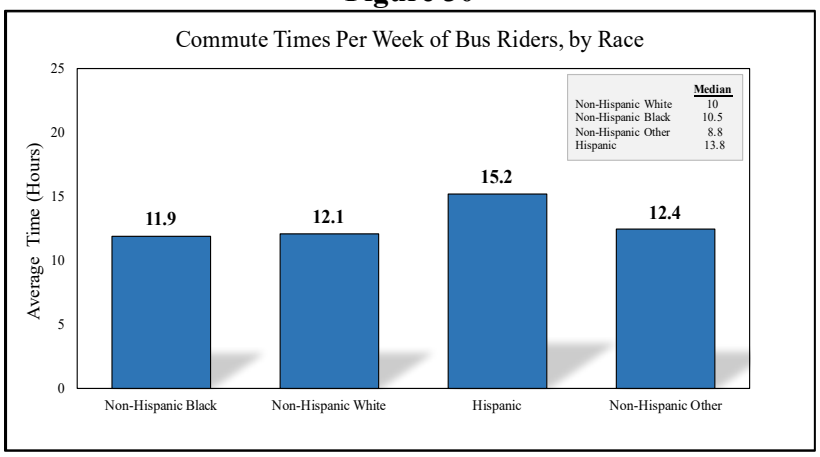
Figure 29 below shows the average hourly wage for employed bus riders in Winston-Salem, by the collapsed race categories. Hispanics earn the highest hourly wage and blacks earn the lowest.

Figure 29



The figure below shows the average number of hours spent commuting to and from work every week, by race. Hispanics spend the most time on the bus. They spend around 15 hours a week commuting to and from work on the bus. Whites and blacks spend around 12 hours a week on the bus. This is a large amount of time to dedicate to a job without being compensated.

Figure 30



The employed bus riders in Winston-Salem have been using public transportation for a long time. When examined by race, there is noticeable variability in the lengths of time that employed riders have been using the bus system in Winston-Salem. Employed black and Hispanic riders have been using public transportation for 12 years, compared to whites who have been using public transportation for around 7 years.

Figure 31

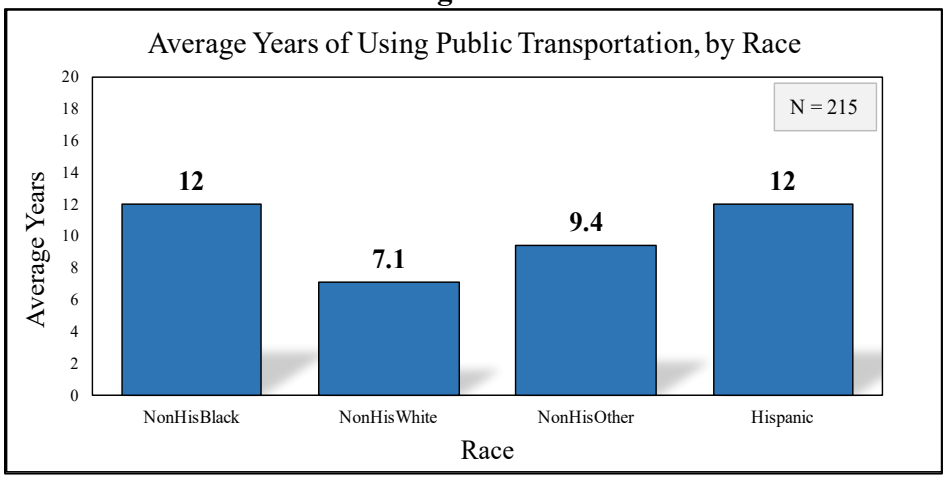
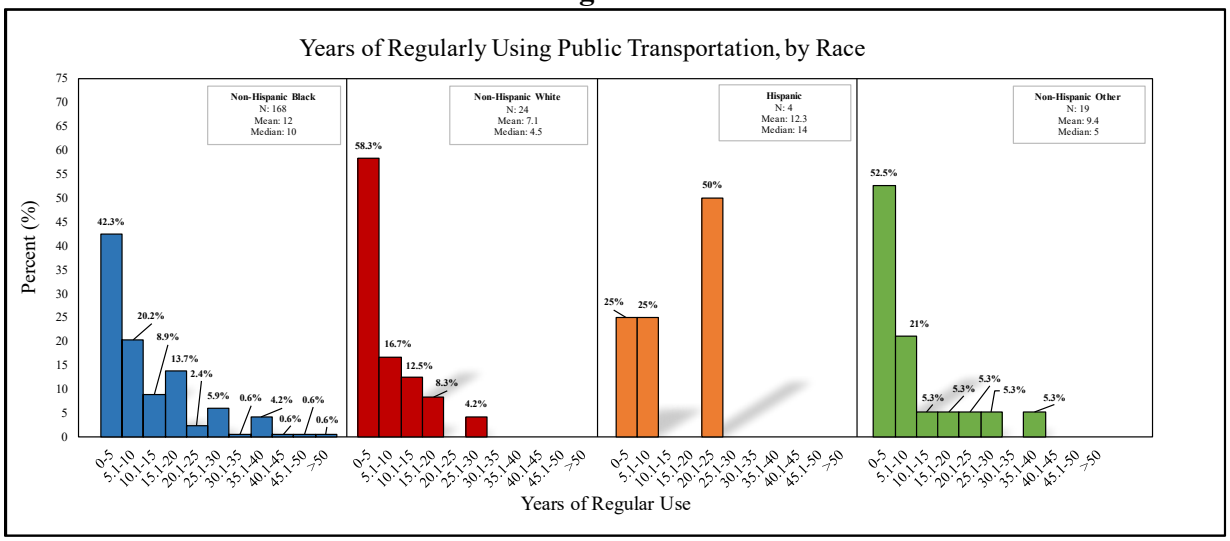


Figure 32 below shows how the years of public transportation use varies by race. Employed black bus riders have been using public transportation longer than the other groups. They also have the largest range, which corresponds with the fact that their ages have the largest range as well. Employed white bus riders are the newest users of public transportation. Almost 60 percent have been using public transportation for less than 5 years. Following closely behind are the riders who identify as Asian, American Indian, etc. Over half have been using public transportation for less

than 5 years. Thus, employed African-Americans in Winston-Salem use the bus more often and have been using the bus longer than any other group.

Figure 32



Part IV: Racial/Gender Differences in Demographics, Labor, and Commutes

In this part of the data exploration, gender *and* racial differences among employed bus riders in Winston-Salem are investigated together and in combination.

The figure below shows the average age of employed bus riders by both race and gender, using the collapsed race categories. Black males are slightly older than black females. White males, however, are an average of 5 years older than white females. For the riders who qualify as Non-Hispanic Other (Asian, American Indian), females are older than males.

Figure 33

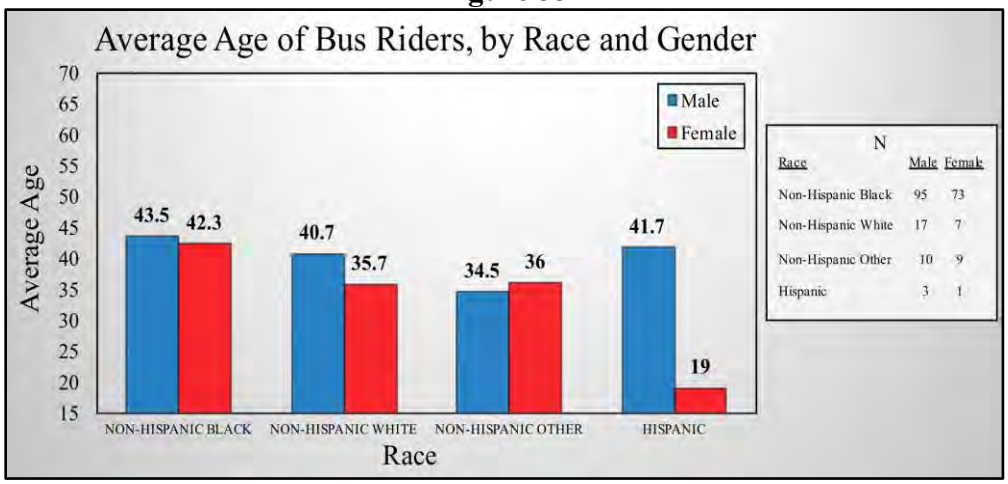
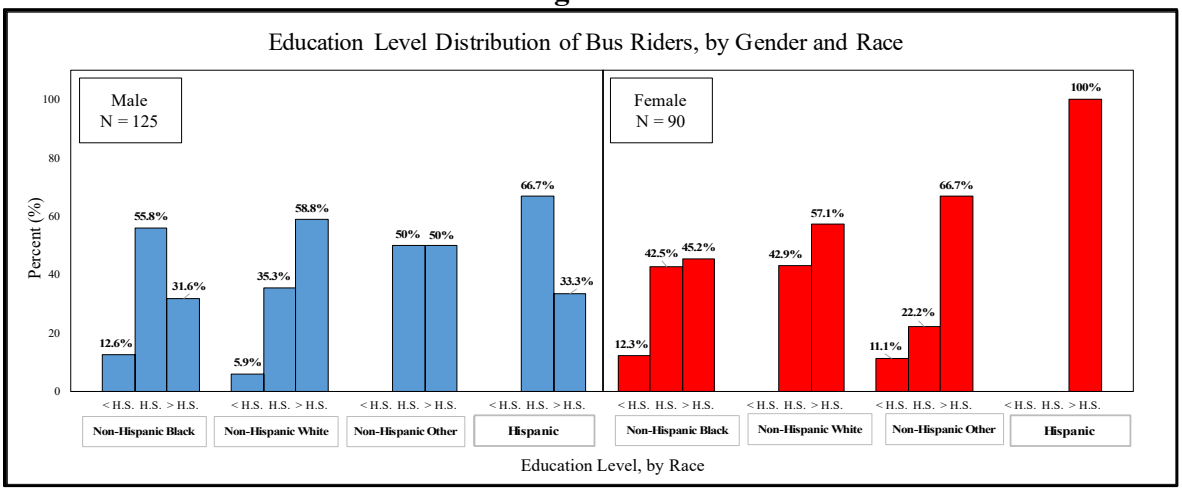


Figure 34 below shows education differences, by race and gender, of employed bus riders in Winston-Salem. Black females tend to be more educated than black males, but less so than white males and females. This aligns with national averages. Whites tend to have more years of education

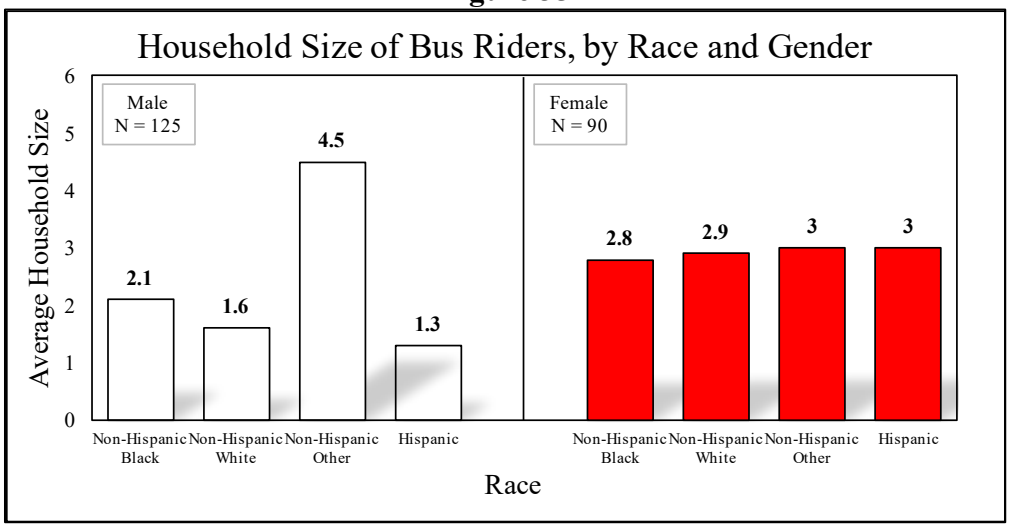
than blacks, while females tend to have more years of education than males (*United States Census Bureau*).

Figure 34



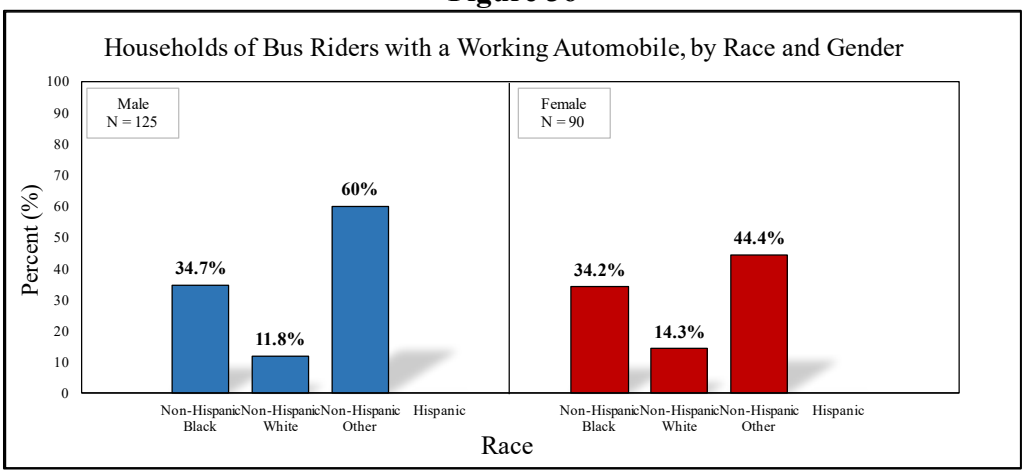
The figure below shows the average household sizes of employed bus riders in Winston-Salem, broken out by race and gender. There is more variability across the various races for males, compared to females. Females, regardless of race, tend to come from households with 3 members. For males, whites and Hispanics live in the smallest households. Bus riders qualifying as Non-Hispanic Other (Asian, American Indian, etc.) live in the largest households.

Figure 35



The households of employed white male and female bus riders have the lowest access to automobiles. Black males and females are equally likely to live in households with an automobile. Those who qualify as Non-Hispanic Other, regardless of gender, have the highest access to working automobiles. Around 12 percent of employed white male bus riders live in households with a working automobile. Nearly 40 percent of employed black male bus riders live in households with a working automobile.

Figure 36



The figure below shows how weekly work hours vary by the race and gender of bus riders in Winston-Salem, using the collapsed race categories. The female riders that qualify as Non-Hispanic Other average the highest number of work hours per week at 47.1. White females work the least number of hours per week. Black males work around 36 hours a week, while white males work approximately 35 hours a week. Hispanic females work nearly 6 hours more every week than Hispanic males.

Figure 37

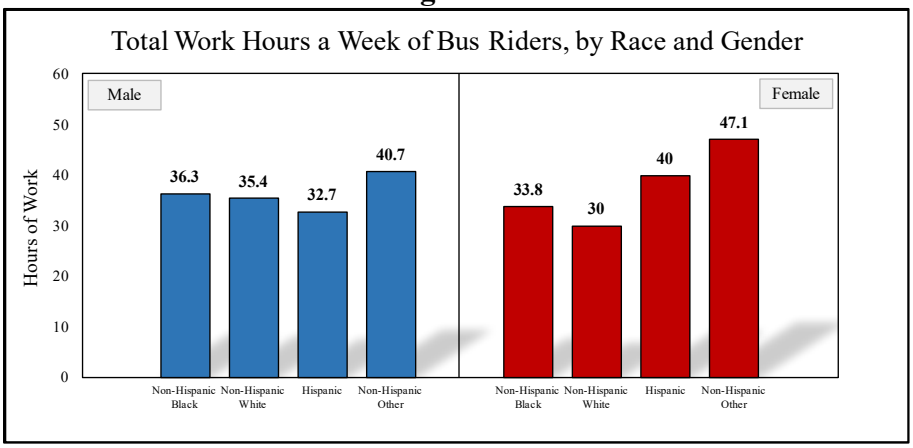


Figure 38 shows the hourly wage differences, by race and gender, of bus riders in Winston-Salem, using the original race categories. To summarize a few interesting differences: black females make $3,744 less per year than white males. Black males earn $2,288 less per year than white males.

Figure 38

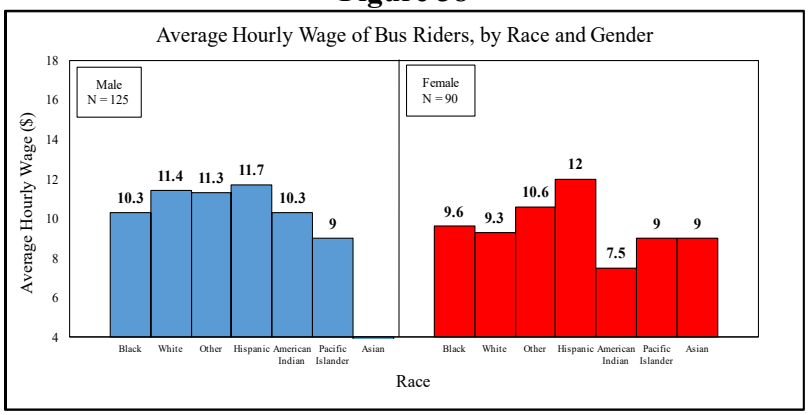


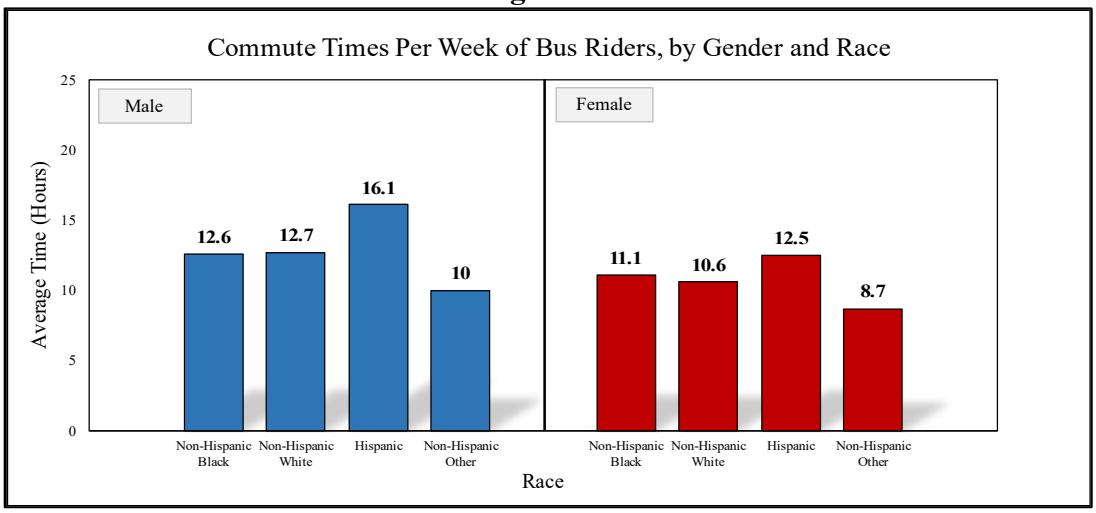
Figure 38 above, which shows the average hourly wage of employed bus riders by race and gender, reveals more variability for females than males. Black females make almost an entire dollar less per hour than black males and almost two dollars less per hour than white males. White females make an entire dollar less per hour than black males and almost two dollars less per hour than white males. Black males have a higher median hourly wage than black females (see Table 5 below). This is the same for whites, American Indians, and those who identify as Other. Hispanic females have a higher median wage than males.

Table 5

	Median Hourly Wage ($)	
Race	Male	Female
American Indian	10.30	7.50
Asian	.	9.00
Black	10.00	9.00
Hispanic	8.50	12.00
Other	10.00	9.50
Pacific Islander	9.00	9.00
White	11.00	8.50

Figure 39 below shows the total hours a week spent commuting to and from work, by the race and gender of employed bus riders in Winston-Salem (using the collapsed race categories). Hispanic males spend the most time commuting to and from work, and females qualifying as Non-Hispanic Other spend the least amount of time commuting on the bus. Black males spend around the same amount of time on the bus commuting to and from work as white males. The average black female spends half an hour longer commuting every week than the average white female.

Figure 39



The figure below shows the average number of years that employed bus riders in Winston-Salem have been using public transportation, broken out by their race and gender. The average employed black male has been a regular user for 12.4 years, which is one year longer than the average black female. The average employed white female rider has been regularly using the bus for 7 years, which is slightly longer than the average white male. The average employed Hispanic bus rider has been using the public system for 16 years, while the average employed Hispanic female has only been riding the bus for one year.

Figure 40

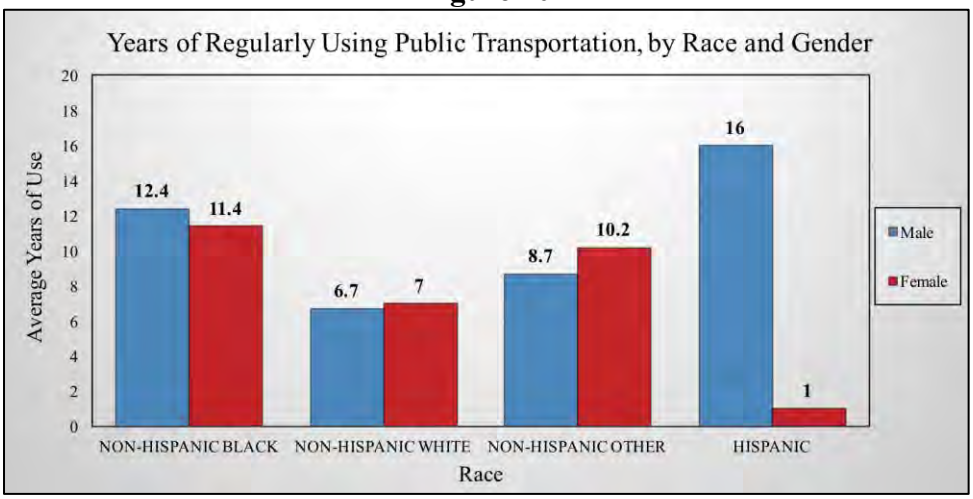
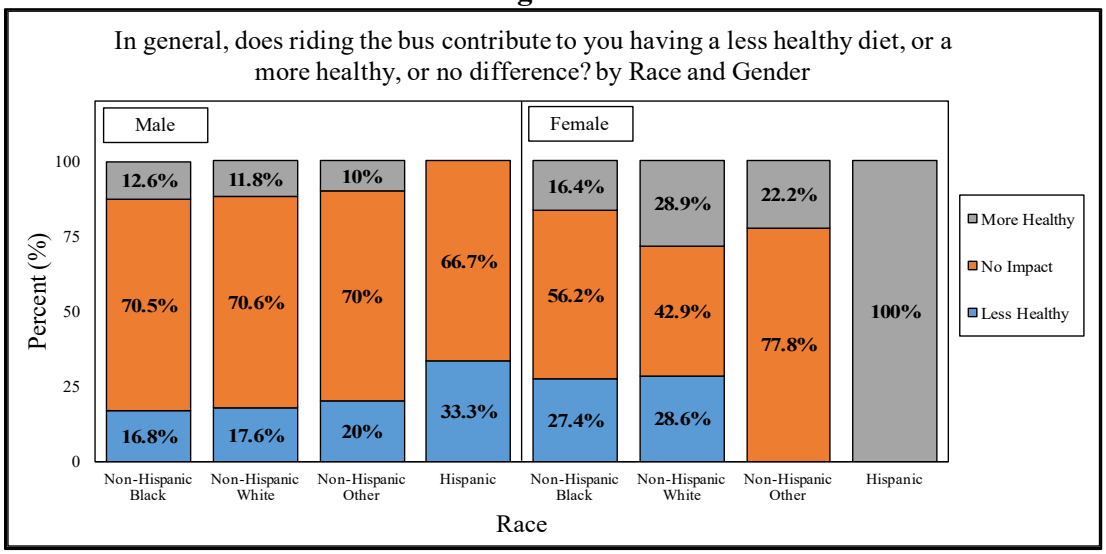


Figure 41 below shows how employed bus riders rate the bus's contribution to their diets, broken out by their race and gender. Males tend to think the bus has no impact on their diet and are less likely than females to think it has contributed to them having a healthier diet, regardless of their race. Around 29 percent of white females think the bus has contributed to them having healthier diets, however, the same percentage thinks the system has contributed to them having unhealthier diets. Nearly 78 percent of employed female riders qualifying as Non-Hispanic Other

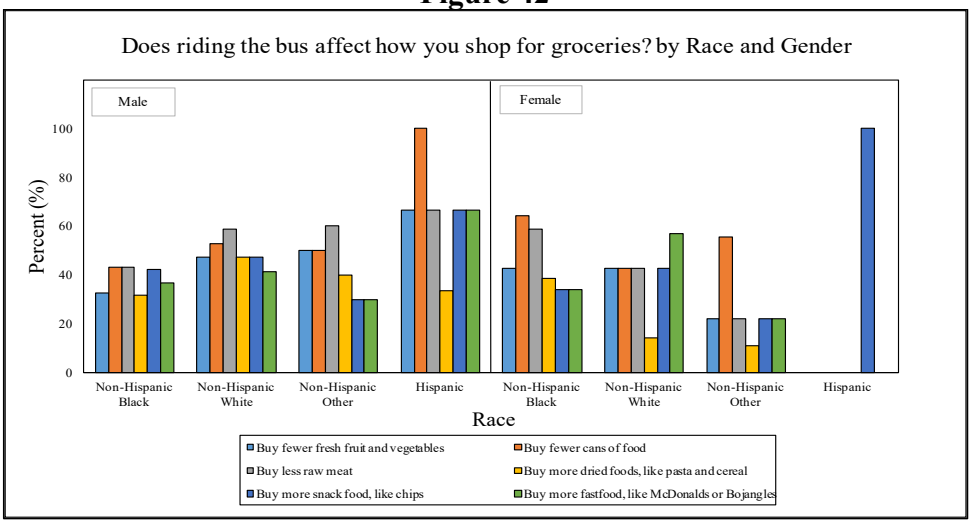
believe the bus has no impact on their diet, while the remainder believe it has contributed to them having a healthier diet.

Figure 41



The figure below shows how the bus impacts grocery shopping behavior, by race and gender. Black females report buying less canned foods and fresh fruit and vegetables than black males. White males buy more dried foods than white females. White females eat more fast-food than white males. Male riders qualifying as Non-Hispanic Other eat less fruits and vegetables, less raw meat, more dried foods, more snack foods, and more fast food than females.

Figure 42



Part V: Bus Riders and their Viewpoints on the Bus System

In this part of the data exploration, the opinions held by employed bus riders regarding Winston-Salem's public transportation system are investigated.

Employed bus riders in Winston-Salem were asked the question shown in the title of Figure 43 below. It seems that they are, for the most part, satisfied with the predictability of the bus system to get them to work on time. The average rating is a 6.5, which suggests moderate satisfaction.

Figure 43

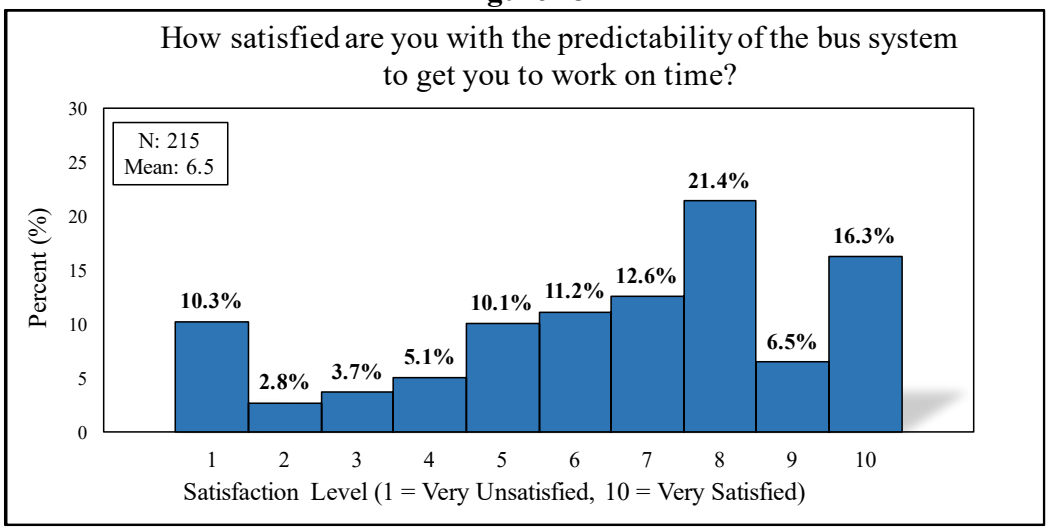


Figure 44 below shows what employed riders *think* about the public transportation system in Winston-Salem. Most rate the system as being either Fair or Good. Eighteen percent think the system is less than Fair (Awful and Poor), while 55 percent rate the system as being more than Fair (Good and Excellent).

Figure 44

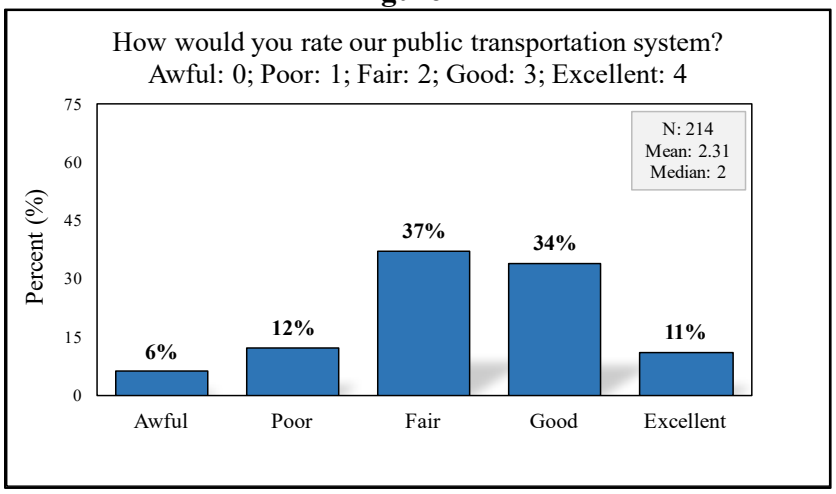
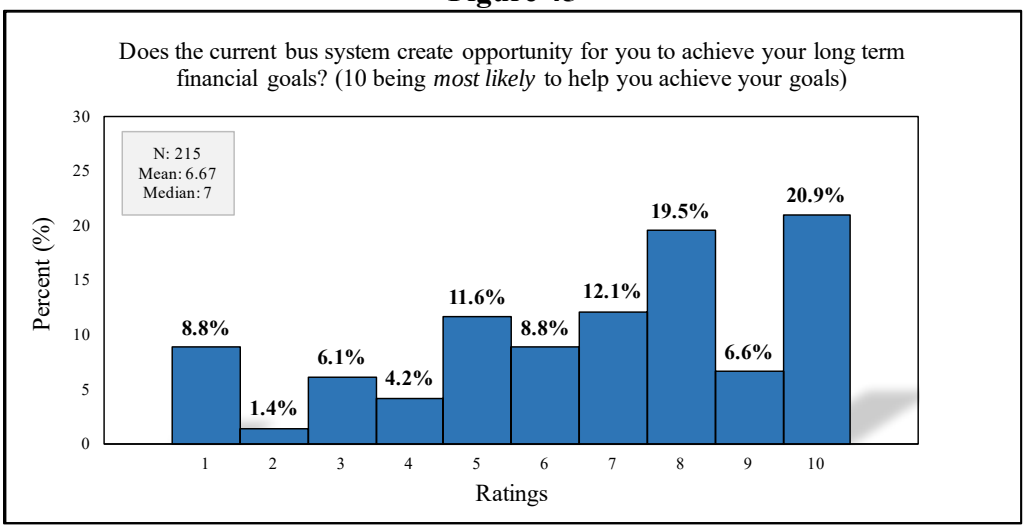


Figure 45 below shows the distribution of employed bus riders' ratings on whether the bus system will create opportunities for them to reach their financial goals. They were asked to rate the question shown in the title of the figure. The average rating is 6.67, which suggests moderate confidence in the bus system to create financial opportunities.

Figure 45

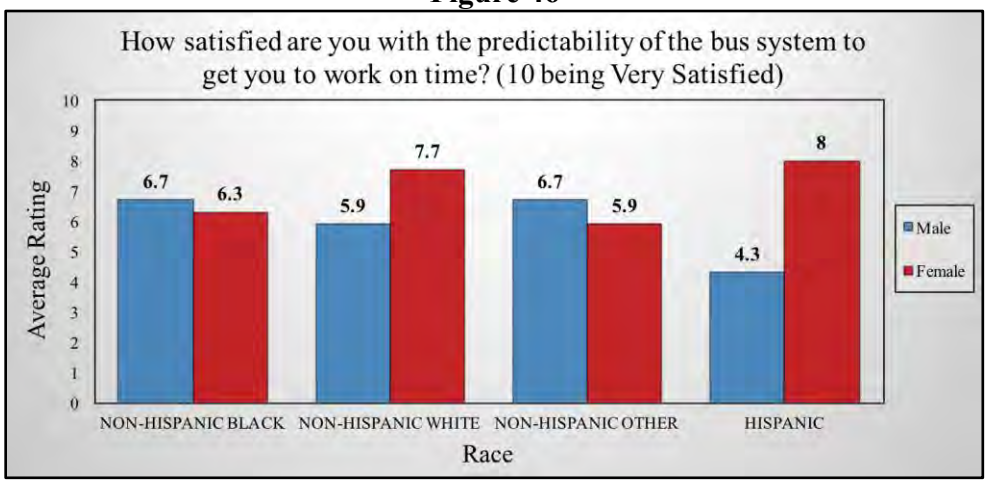


Part VI: Bus Riders and their Viewpoints on the Bus System, by Race and Gender

In this part of the data exploration, the opinions held by employed bus riders about Winston-Salem's public transportation system are investigated, broken out by their race and gender.

Employed bus riders in Winston-Salem were asked the question shown in the title of Figure 46 below. The figure shows the average ratings by race and gender. Black males and females rate the predictability of the bus similarly, 6.7 and 6.3 respectively. White females rate the predictability of the bus much higher than white males, at 7.7 compared to 5.9. Hispanic males rate the predictability of the bus the lowest. They give an average rating of 4.3.

Figure 46



The figure below shows what employed riders *think* about the public transportation system. The average ratings are presented by race and gender. All groups, across gender and race, give the public bus system a rating between 2.2 – 2.7, except for Hispanic riders. Hispanic males give the bus system an average rating of 1.7, while Hispanic females give the bus system an average rating of 3.

Figure 47

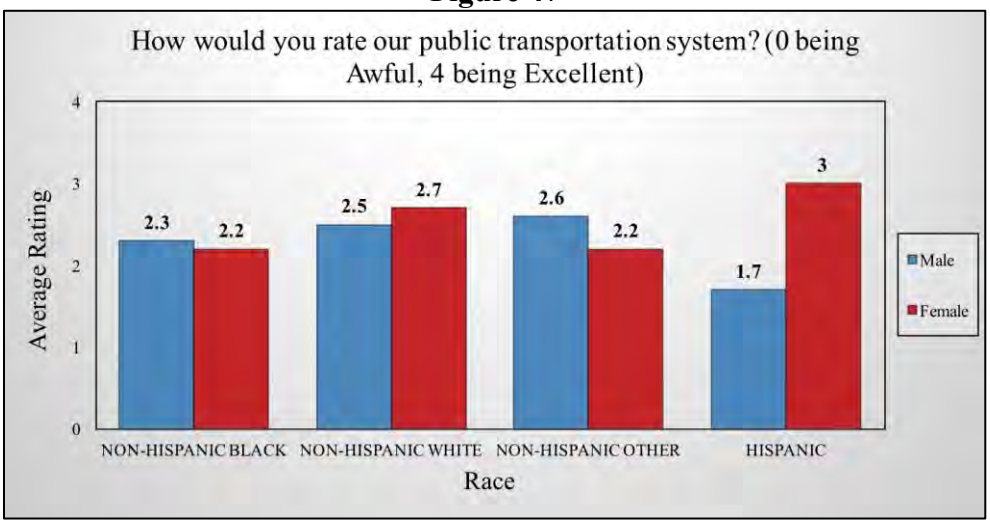
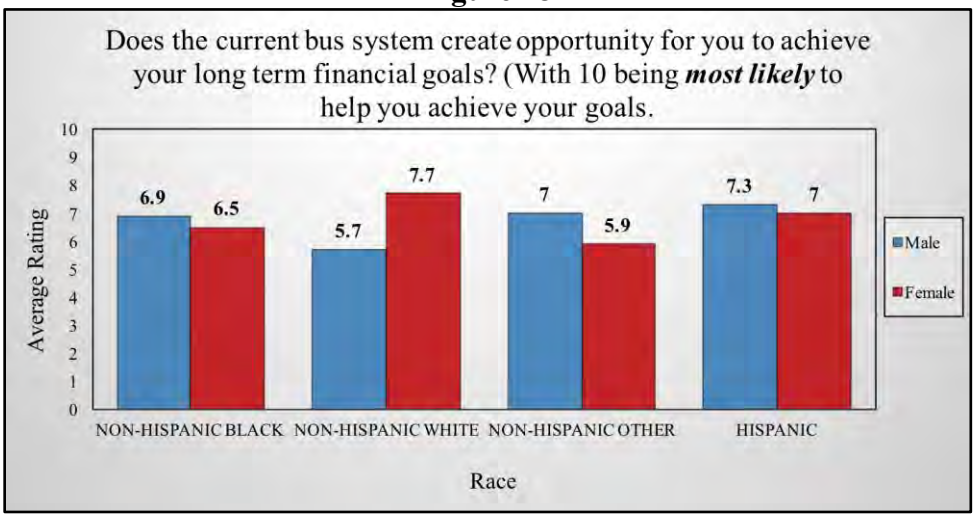


Figure 48 below shows how employed bus riders in Winston-Salem rate the question shown in the title, broken out by race and gender. White females rate the bus system the highest, with an average rating of 7.7. White males, on the other hand, rate the bus system the lowest, with an average rating of 5.7. Black males and females rate the bus system similarly, with average ratings of 6.9 and 6.5 respectively. Male and female riders qualifying as Non-Hispanic Other (Asians, American Indians, etc.) give noticeably different ratings. Males in this group rate the bus system, on average, with a 7, while females rate the system with a 5.9.

Figure 48



ANALYSIS

There are many viable ways to analyze how the public bus system influences economic mobility. The indirect consequences of a person's transportation situation can affect more than one of Chetty et al.'s (2014) five factors, which in turn affect economic mobility. Dedicating time to riding the bus necessarily means there is less time available to earn a wage, thus, there are opportunity costs associated with riding the bus. Riding the bus for long periods of time, prior to

arriving at work, can lower labor productivity, which means lower hourly wages. More time spent on the bus also means less time to spend with family, friends, or pursuing other invigorating leisure activities. Without personal transportation, a worker is less able to handle sudden changes that a bus system might produce, like a route change or late arrival. These scenarios can lead to lost jobs or the inability to accept new and better paying opportunities. Without personal transportation, a person's diet may be affected. Healthy meats, like chicken or fish, need to be kept cool while in route to a person's freezer at home. Carrying a cooler on and off a bus, for long periods of time, is difficult, therefore, bus riders may be less inclined to buy healthy meats. Less canned foods will be purchased because they tend to be heavy and hauling them long distances can be exhausting. Thus, there are many ways that economic mobility and transportation can be studied, both their direct and indirect relationships.

To handle this complexity and the broadness of the topic, three main areas of analyses are pursued. The first area is simple correlational analyses, to see how, if at all, using the bus impacts earnings and productivity. The second area involves more rigorous regression analyses to measure the magnitude and significance of the impact of riding the bus on earnings and labor productivity. The last area involves estimations of opportunity costs associated with riding the bus.

Part I: Correlation Analyses

If labor productivity is negatively affected, and, consequently, a lower hourly wage is earned, then economic mobility will also suffer. Studies find that commuting time is negatively related to well-being and health, both of which are determinants of labor productivity (Stutzer and Frey, 2008; Roberts, Hodgson and Dolan, 2011). Less healthy people tend to earn lower wages, which is a recipe for reduced economic mobility (Thomas and Strauss, 1997; Glick and Sahn, 1998). Thus, we would expect to see a negative relationship between commute times involving the public bus and hourly wages. To study this phenomenon, several bivariate relationships are estimated. The correlation between hourly wage and variables such as daily commute time to work, total hours spent commuting to and from work a week, and the number of buses taken to get to work are estimated. It should be noted, however, that some studies have shown that a positive relationship exists between wages and commuting, due to laborers' willingness to commute further for higher paying jobs. However, these studies usually involve workers that are commuting with personal vehicles, are not at lower income levels, and are commuting long distances. The sample of commuters in our study use the public bus system, and they tend to belong to lower income levels. Long distances and long commutes do not always correspond. Studies regularly show commute times for public bus users are longer than those commuting in personal vehicles, even though the distance is shorter (Gautier and Zenou, 2008; Hu and Young, 1999). This is the case for employed bus riders in Winston-Salem. Their commutes would be much shorter if they had personal vehicles. This is further discussed later in the report.

Table 6 below presents the correlation between hourly wage (and annual income) and daily commute, weekly hours spent commuting, and number of buses taken to work. The correlation between hourly wage and daily commute is positive. The correlation between hourly wage and weekly time spent commuting to and from work is positive and statistically significant at the 10 percent level. Hourly wage and the number of buses taken to work are negatively correlated, but the correlation coefficient is insignificant. Annual income is positively related to both daily commute time and total hours spent commuting to and from work per week, the former estimate being significant at the 5 percent level and the latter at the 1 percent level. Unlike hourly wage,

annual income is positively related to the number of buses taken to work and the correlation coefficient is significant at the 1 percent level.

Table 6

	Correlation Coefficients [Standard Deviations]		
	Daily Commute to Work (minutes)	Weekly Time Spent Commuting, to and from Work (hours)	Number of Buses Taken to Work
Hourly Wage ($)	0.0893 [0.1922]	0.1119* [0.1027]	-0.0498 [0.4674]
Annual Income ($)	0.1348** [0.0484]	0.1946*** [0.0043]	0.1755*** [0.0099]
	N = 215		
	Statistical Significance: *10% level, **5% level, ***1% level		

The table below presents the same correlations but only for the employed female riders in the sample. The correlation between hourly wage and daily commute is negative, though the coefficient is statistically insignificant. The correlation between hourly wage and weekly time spent commuting to and from work is also negative and statistically insignificant. Hourly wage and the number of buses taken to work is negatively correlated. The estimate of the correlation coefficient is highly insignificant. Annual income is negatively related to daily commute time and positively related to total weekly hours spent commuting to and from work. For both, the estimates are highly insignificant. Annual income is positively related to the number of buses taken to work but is also highly insignificant. These findings suggest a possible gender difference in commuting's impact on labor productivity and earnings.

Table 7

	Correlation Coefficients [Standard Deviations], Females		
	Daily Commute to Work (minutes)	Weekly Time Spent Commuting, to and from Work (hours)	Number of Buses Taken to Work
Hourly Wage ($)	-0.1118 [0.2942]	-0.1176 [0.2696]	-0.0810 [0.4477]
Annual Income ($)	-0.0066 [0.9509]	0.0470 [0.6597]	0.0187 [0.8614]
	N = 90		
	Statistical Significance: *10% level, **5% level, ***1% level		

Table 8 below shows the same correlations, but only for employed African-American female bus riders. There are some noticeable differences in the correlation estimates. The correlation between hourly wage and daily commute is highly negative, but statistically insignificant. Still,

this suggests that the labor productivity of black females is negatively affected by their commute to work, even more so than other females. The correlation between hourly wage and weekly time spent commuting to and from work is highly negative and statistically significant at the 10 percent level. Hourly wage and the number of buses taken to work are negatively correlated but highly insignificant. Annual income is negatively correlated with daily commute time and positively correlated with total weekly hours spent commuting to and from work. Both estimates are highly insignificant. Annual income is positively correlated with the number of buses taken to work. The estimate is also highly insignificant.

Table 8

	Correlation Coefficients [Standard Deviations], Black Females		
	Daily Commute to Work (minutes)	Weekly Time Spent Commuting, to and from Work (hours)	Number of Buses Taken to Work
Hourly Wage ($)	-0.1735 [0.1420]	-0.1919* [0.1039]	-0.0320 [0.7879]
Annual Income ($)	-0.0748 [0.5291]	-0.0429 [0.7186]	0.0285 [0.8109]
	N = 73		
	Statistical Significance: *10% level, **5% level, ***1% level		

Figure 49 below shows hourly wage plotted against daily commute time to work for both female and male bus riders. The blue circles represent males, and the orange triangles represent females. No discernable relationship is apparent between the two variables across either gender. If anything, the plot debunks the idea that commuters travel farther for higher paying jobs, at least for commuters that depend on public transportation. As commute time increases, hourly wage remains relatively flat for both males and females.

Figure 49

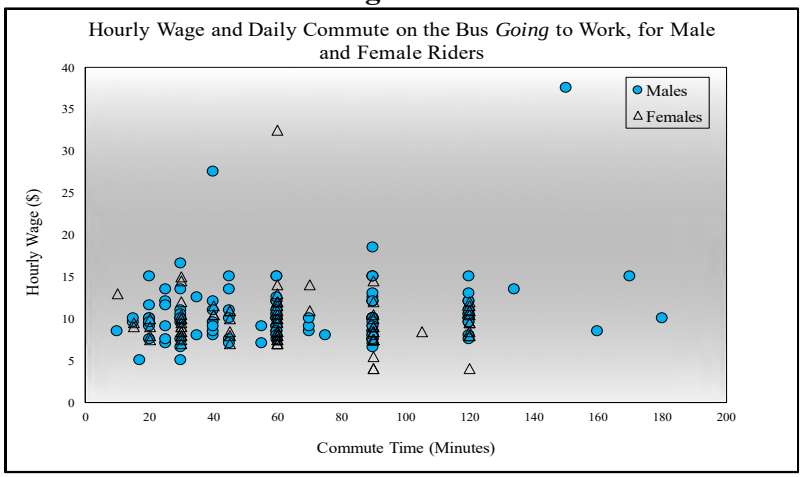
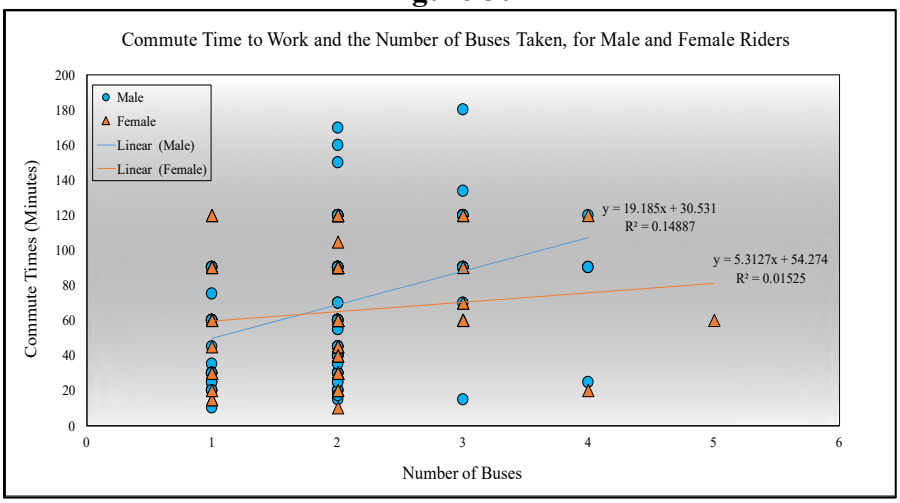


Figure 50 above shows daily work commute plotted against number of buses taken, for employed male and female riders. Blue circles represent males and orange triangles represent

females. The more buses taken during a commute to work tends to increase the duration of the commute. This is the case for both male and female riders. However, the relationship is much stronger for males than females.

Figure 50



The figure below shows hourly wage plotted against length of daily bus commute for employed female riders. The fitted regression line shows a negative relationship between the two variables. The downward slope is not steep, and the R-squared is small. Nevertheless, for the female riders, hourly wages tend to fall as commute times rise.

Figure 51

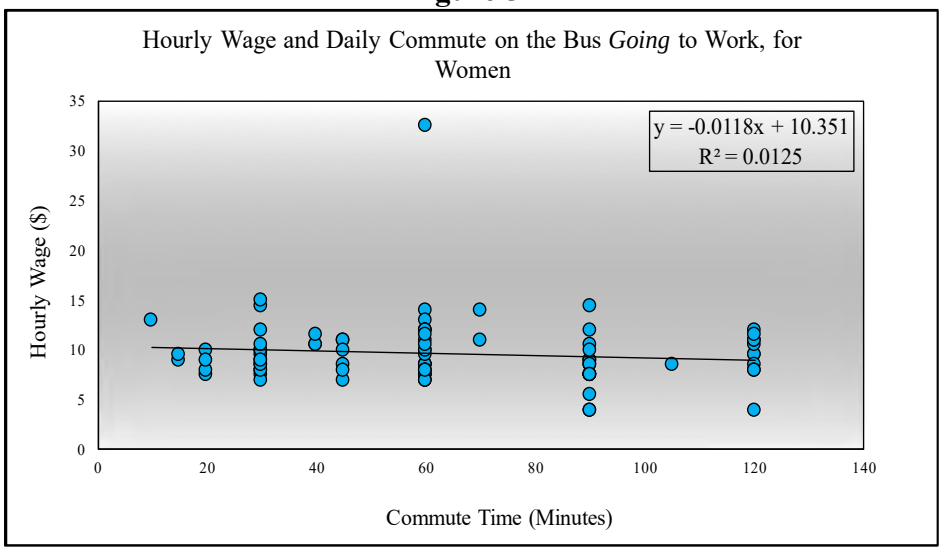


Figure 52 below shows hourly wage plotted against the number of buses taken to work, for employed female riders. The fitted regression line shows a steep negative relationship between the two variables. This suggests that, for female riders, hourly wages tend to fall as the number of buses taken during a commute increases. According to the regression line, a female commuter that rides 4 buses to work can expect to earn around one dollar less per hour than a female commuter that rides only 1 bus.

Figure 52

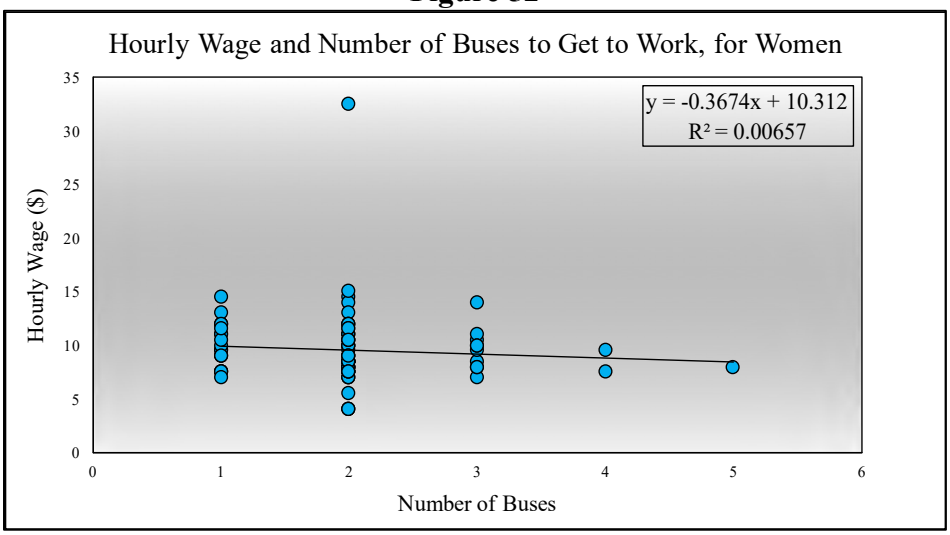
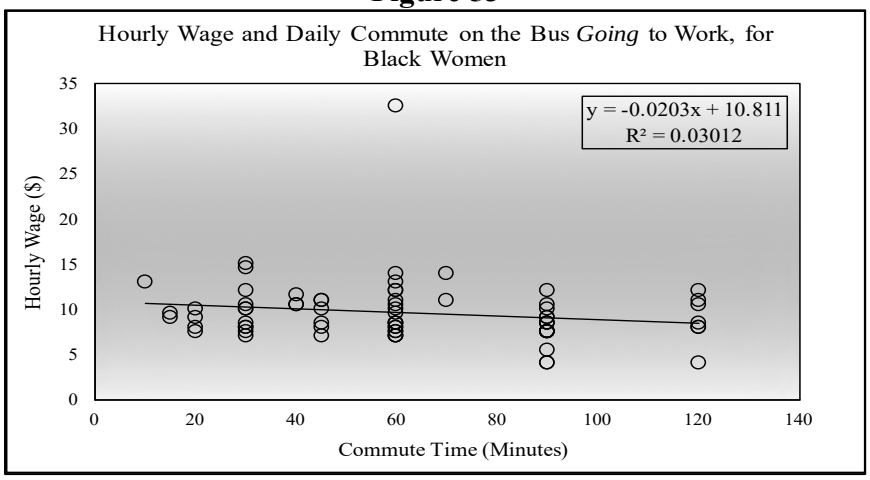


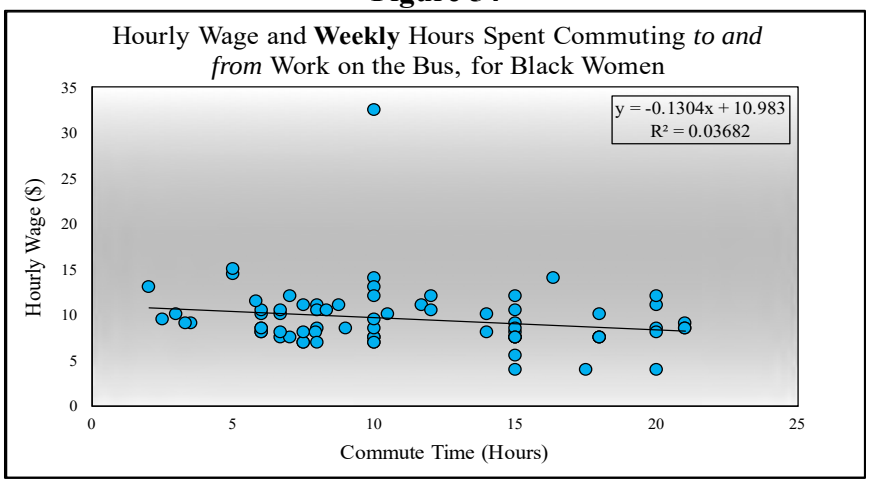
Figure 53 below shows hourly wage plotted against daily commute time, for employed black female bus riders. The fitted regression line shows a negative relationship between the two variables. The slope of the fitted line is steeper than that for female riders in general, suggesting that the labor productivity of black females suffers more from longer commutes than other groups. According to the regression line, a black female can expect to earn 2 cents less per hour for every additional minute she spends on the bus commuting to work.

Figure 53



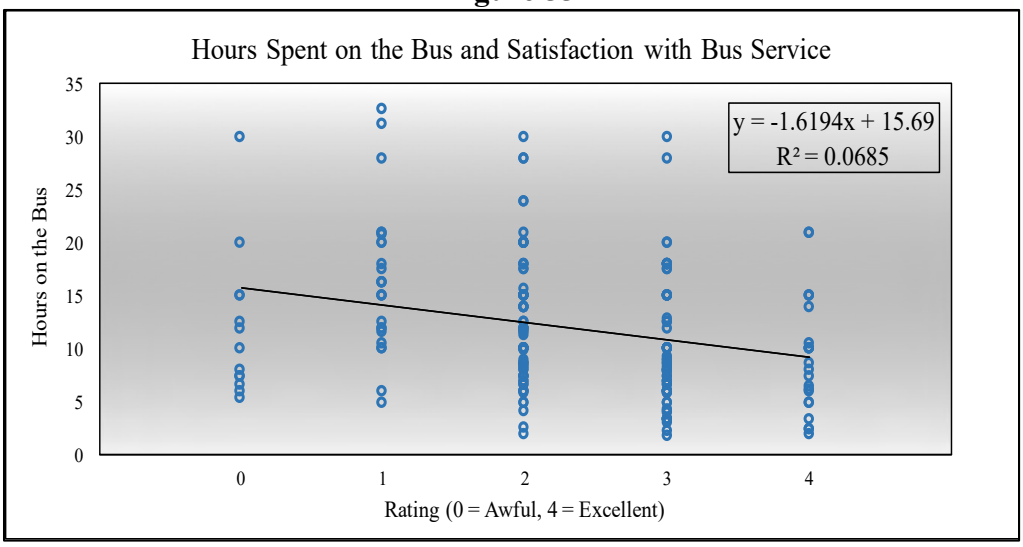
The figure below shows hourly wage plotted against weekly time commuting to and from work on the bus, for black female riders. The fitted regression line shows a steep negative relationship between the two variables. This suggests that the more time dedicated per week to commuting to and from work on the bus, the less commuters earn per hour. According to the regression line, a black female can expect to earn 13 cents less for every additional hour she spends a week commuting on the bus to and from work. Thus, the labor productivity of black females is seriously harmed by their weekly experience using the public bus system.

Figure 54



Unsurprisingly, employed bus riders tend to rate the bus system poorly when they spend more time per week commuting to and from work (see Figure 55). This suggests that spending large amounts of time on the bus is burdensome to riders.

Figure 55



Part II: Regression Analyses

Informed by the findings in Part I, various regression models are estimated. Each of the estimated models contain some or all the following regressors: a gender dummy variable (whether male or female is the base depends on the model specification and context), years of education, a series of mutually exclusive race dummy variables, and commute time to work (in minutes). This last variable, commute time, is a primary variable of interest. The more complex models contain additional regressors: age, a dummy variable for whether the bus rider has a car, and number of buses taken to get to work. It is important to control for age because riders with ages outside of the prime economic range may be less productive than those within it, which would result in lower hourly wages. A dummy variable indicating whether a person has a car is informative because a bus rider with a car has greater liberty in choosing how to get to work. Commuters with cars, who

also ride the bus, are potentially more physically mobile and are less restricted by the public transportation system. This could result in higher earnings. Number of buses taken to work is a primary variable of interest because commutes involving multiple bus changeovers can be arduous and tiresome. For example, once commuters arrive to work after a trip involving 3 bus changes, their labor may be less productive, which could result in lower hourly wages.

The last two models estimated include an interaction term between commute time and gender. Findings from the correlation analyses in Part I suggest that long commutes may impact the hourly wages of males and females differently. Previous studies have found that gender differences exist regarding the relationship between commute lengths and economic mobility (Chetty et al. 2018).

The dependent variable in all models is either annual income, or the natural log of hourly wage. The natural log is used for a few reasons. First, it allows for the coefficients to be interpreted as semi-elasticities. Second, taking the natural log mitigates the impact of any heteroscedasticity present in the data.

The first regression model has the following specification:

$$\textit{Log of Hourly Wage} = ß_0 + ß_1(\textit{male}) + ß_2(\textit{length of commute}) + ß_3(\textit{years of education}) + ß_4(\textit{lost a job}) + \varepsilon,$$

where *male* is a dummy variable equal to one if the bus rider is male and zero if female. *Length of commute* is the total time (minutes) it takes for a commuter to arrive at work, when the bus is involved. *Years of education* is self-explanatory. *Lost a job* is a dummy variable equal to one if a rider has lost a job due to a bus route change and zero otherwise. The table below presents the estimation results.

The F-statistic is significant at 1 percent level, suggesting the model explains a significant amount of the variation in hourly wage. The R-squared is 0.067, and the adjusted R-squared is 0.049. Only the coefficients on the gender dummy variable and *years of education* are significant, both at the 1 percent level. The coefficient estimates for *length of commute* and *lost a job* are highly insignificant. According to the coefficient on *length of commute*, a rider with a 61-minute commute can expect to earn 1.8 percent more per hour that a rider with a 1 minute commute, all else constant. Again, it should be emphasized, the coefficient estimate is highly insignificant, so there's no evidence that commute length has any impact on hourly wage.

Table 9: Regression Results for Specification 1

N	215
F(4, 210)	3.79
Prob > F	0.0053
R - squared	0.0673
Adjusted R - squared	0.0496
Root MSE	0.2756

	Dependent variable: Natural log of hourly wage of primary job					
Explanatory Variables	Coeff.	Std. Err.	t	P> |t|	[95% Conf. Interval]	
Male	0.0994***	0.0382	2.6	0.01	0.0241	0.1748
Length of Commute to Work (minutes)	0.0003	0.0006	0.47	0.638	-0.0008	0.0014
Years of Education	0.0446***	0.0154	2.89	0.004	0.0142	0.075
Ever lost a job due to a schedule change	0.0075	0.0472	0.16	0.873	-0.0855	0.1001
Intercept	1.9531***	0.0939	20.8	< 0.001	1.768	2.1382
	*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level					

The second regression model has the following specification:

$$\textit{Log of Hourly Wage} = ß_0 + ß_1(\textit{male}) + ß_2(\textit{years of education}) + ß_3(\textit{non-Hispanic white}) + ß_4(\textit{non-Hispanic other}) + ß_5(\textit{Hispanic}) + ß_6(\textit{length of commute to work}) + ß_7(\textit{number of buses}) + \varepsilon,$$

where a few additional variables have been added as regressors. Dummy variables for race have been included to control for any wage differences due to race. *Non-Hispanic white*, *non-Hispanic other*, and *Hispanic* have been included, while *non-Hispanic black* has been omitted to avoid perfect multicollinearity. A new primary variable of interest has been included, *number of buses*. It measures the number of buses a commuter takes to get to work. The estimation results for this model are shown in Table 10 below.

The F-statistic is significant at the 5 percent level, suggesting the model is explaining a significant amount of the variation in hourly wage. The R-squared is 0.08, and the adjusted R-squared is 0.049. Only the coefficients on *male* and *years of education* are significant, both at the 5 percent level. The coefficients of interest, those on *length of commute* and *number of buses*, are insignificant. The coefficient estimate on *number of buses* is almost significant at the 10 percent level. According to the coefficient on *length of commute*, hourly wage will increase by 0.05 percent for an additional minute spent commuting to work, all else constant. The coefficient on *number of buses* is -0.0371, suggesting that taking an additional bus during a commute will result in hourly wage falling by 3.7 percent, all else constant. Theoretically, since wage is a measure of labor

productivity, commuters who ride multiple buses to work may have a more toilsome commute, which undermines their productivity once they finally arrive at work.

Table 10: Regression Results for Specification 2

N	215
F(4, 210)	2.6
Prob > F	0.0135
R - squared	0.0809
Adjusted R - squared	0.0498
Root MSE	0.2755

	Dependent variable: Natural log of hourly wage of primary job					
Explanatory Variables	Coeff.	Std. Err.	t	P> |t|	[95% Conf. Interval]	
Male	0.0959**	0.0385	2.49	0.014	0.0199	0.1719
Years of Education	0.0411***	0.0158	2.59	0.01	0.0098	0.0724
Non-Hispanic White	0.0772	0.0611	1.26	0.208	-0.0433	0.1978
Non-Hispanic Other	0.0435	0.0676	0.64	0.52	-0.0897	0.1768
Hispanic	0.1118	0.1409	0.79	0.428	-0.1659	0.3896
Length of Commute to Work (minutes)	0.0005	0.0006	0.8	0.425	-0.0007	0.0016
Number of Buses to Get to Work	-0.0371	0.0274	-1.35	0.177	-0.0912	0.0169
Intercept	1.7348***	0.2011	8.63	< 0.001	1.3384	2.1312
	*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level					

The third regression model has the following specification:

$$\textit{Log of Hourly Wage} = ß_0 + ß_1(\textit{female}) + ß_2(\textit{years of education}) + ß_3(\textit{non-Hispanic white}) + ß_4(\textit{non-Hispanic other}) + ß_5(\textit{Hispanic}) + ß_6(\textit{length of commute to work}) + ß_7(\textit{has a car}) + ß_8(\textit{age}) + ß_9(\textit{length of commute to work*female}) + \varepsilon,$$

where *female* is a dummy variable equal to one if the commuter is female and zero if male. The variable *has a car* is a dummy variable indicating whether the bus rider has a car. The last term is an interaction term between *commute length* and *female*. It will measure whether commutes have

a different effect on females versus males. The results can be seen in Table 11 below. Robust standard errors are used to help correct for the heteroscedasticity in the data.

The F-statistic is significant at the 1 percent level, suggesting the model explains a significant amount of the variation in hourly wage. The coefficient estimates on *years of education*, *non-Hispanic white*, *have a car*, and the interaction term are statistically significant. The coefficient on *length of commute* is almost significant at the 10 percent level. *Have a car* is a variable of interest because having a personal car may increase hourly wage because more jobs across a wider geographic area are accessible. The coefficient estimate suggests that having a car increases a bus rider's hourly wage by 8.7 percent compared to riders without cars, all else equal. A car enables an occasional bus rider to reach a wider range of work opportunities, perhaps that pay more per hour. The coefficient estimate on the interaction term is -0.0031. It is almost significant at the 1 percent level. This suggests that longer commutes on the bus affect female riders differently than male riders. For female riders, as commutes increase their labor productivity tends to fall, relative to male riders, all else constant. For every additional minute spent commuting to work, female riders' wages will fall by 0.3 percent, relative to male riders. Interpreting this in another way, female riders that have a 60-minute bus commute to work will earn an hourly wage that is 7.5 percent less than that of male riders, all else constant.

Table 11: Regression Results for Specification 3

N	215
F(4, 210)	2.68
Prob > F	0.0058
R - squared	0.1243
Root MSE	0.2703

	Dependent variable: Natural log of hourly wage of primary job					
Explanatory Variables	Coeff.	Robust Std. Err.	t	P> |t|	[95% Conf. Interval]	
Female	0.1103	0.0833	1.33	0.187	-0.0538	0.2745
Years of Education	0.0348**	0.0175	1.99	0.048	0.0003	0.0692
Non-Hispanic White	0.0974*	0.0496	1.96	0.051	-0.0004	0.1952
Non-Hispanic Other	0.0772	0.0607	1.27	0.205	-0.0425	0.1969
Hispanic	0.1127	0.2033	0.55	0.58	-0.2881	0.5136
Length of Commute to Work (minutes)	0.0013	0.0008	1.57	0.117	-0.0003	0.0029
Have a car	0.0878*	0.0486	1.8	0.073	-0.0081	0.1837
Age	0.0014	0.0012	1.22	0.235	-0.0009	0.0037
(Length of Commute to Work (minutes))*Female	-0.0031**	0.0012	-2.52	0.013	-0.0055	-0.0007
Intercept	1.6872***	0.2144	7.87	<0.001	1.2646	2.1099
	*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level					

Thus, there is evidence suggesting that the more time spent on the bus commuting to work, the less productive the workers become and, in turn, they earn lower hourly wages.

The fourth and final regression model has the following specification:

$$\textit{Annual Income, Primary Job} = ß_0 + ß_1(\textit{female}) + ß_2(\textit{years of education}) + ß_3(\textit{non-Hispanic white}) + ß_4(\textit{non-Hispanic other}) + ß_5(\textit{Hispanic}) + ß_6(\textit{length of commute to work}) + ß_7(\textit{has a car}) + ß_8(\textit{age}) + ß_9(\textit{length of commute to work*female}) + \varepsilon,$$

where the explanatory variables are the same as for those in the third regression specification. Robust standard errors are used to correct for the heteroscedasticity present in the data. The results of the estimation can be found in the table below.

The F-statistic is significant at the 5 percent level, suggesting the model explains a significant amount of the variation in annual income. *Length of commute*, *have a car*, and the interaction term are statistically significant. The coefficient estimate on *length of commute* is positive, suggesting longer bus rides are associated with higher annual incomes. The coefficient estimate on *have a car* is positive. Having a car increases a bus rider's income by nearly $5,000, relative to those who do not have cars, all else equal. This suggests a car enables an occasional bus rider to reach a wider

range of work opportunities and higher paying jobs. The coefficient estimate on the interaction term is -85.51 and is almost statistically significant at the 1 percent level, suggesting that longer commutes on the bus affect female riders differently than male riders. For female riders, longer commutes result in less income, all else constant. For every additional minute spent commuting to work, a female rider's annual income will fall by $85.51 relative to a male rider's income, all else constant. A female rider that has one hour-long commute to work can expect to earn $1,703 less a year, compared her male counterparts, all else constant.

Table 12: Regression Results for Specification 4

N	215
F(4, 210)	2.03
Prob > F	0.032
R - squared	0.1052
Root MSE	10091

	Dependent variable: Annual Income from Primary Job					
Explanatory Variables	Coeff.	Robust Std. Err.	t	P > |t|	[95% Conf. Interval]	
Female	3426.74	3132.57	1.09	0.275	-2749.62	9603.11
Years of Education	655.49	689.88	0.95	0.343	-704.73	2015.7
Non-Hispanic White	2190.04	2070.64	1.06	0.291	-1892.55	6272.63
Non-Hispanic Other	1473.24	1988.49	0.74	0.46	-2447.39	5393.87
Hispanic	-1020.33	4262.52	-0.24	0.811	-9424.58	7383.91
Length of Commute to Work (minutes)	61.82*	35.59	1.74	0.084	-8.36	132
Have a car	4888.99**	1992.14	2.45	0.015	961.16	8816.82
Age	-30.64	45.97	-0.67	0.506	-121.27	60
(Length of Commute to Work (minutes))*Female	-85.51**	44.18	-1.94	0.015	-172.62	8816.82
Intercept	7339.96	8255.31	0.89	0.375	-8936.72	23616.64
	*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level					

Thus, there is evidence that the more time riders spend on the bus commuting to work, the less annual income they tend to earn.

The key findings from the regression results are the following:

- Having a car increases a bus rider's hourly wage by 8.7 percent compared to those without cars, all else equal. The estimate is statistically significant.
- Having a car increases a bus rider's annual income by nearly $5,000, relative to those without cars, all else equal. The estimate is statistically significant.
- Taking an additional bus to work decreases the labor productivity of bus riders by nearly 3.7 percent, all else equal. The estimate is nearly statistically significant at the 10 percent level.
- Longer commutes on the bus negatively affect the labor productivity of female riders compared to male riders. For every additional minute spent commuting to work, female riders' wages will fall by 0.3 percent, relative to male riders. The estimate is statistically significant.
- Longer commutes on the bus negatively affect the annual incomes of female riders compared to male riders. For every additional minute spent commuting to work, female riders' incomes will fall by $85.51 relative to a male riders' incomes, all else constant. The estimate is statistically significant.

Having a car enables occasional bus riders to reach a wider range of work opportunities, perhaps that pay more per hour. This is an explanation for our finding that having a car increases a bus rider's hourly wage by 8.7 percent compared to those without cars, all else equal. In addition, it explains our finding that having a car increases a bus rider's annual income by nearly $5,000, relative to those without cars, all else equal. Having a car allows bus riders to cover a greater geographic area, attaining jobs that would otherwise be unreachable if riders were dependent on the fixed routes of public bus systems. These fixed routes and inflexible schedules often require that commuters take more than one bus to get to work. Getting on and off multiple buses prior to starting a work day is tiring. This explains our finding that taking an additional bus to work decreases the labor productivity of employed bus riders by nearly 3.7 percent, all else equal.
The labor productivity of female bus riders is negatively impacted by their bus commute to work, relative to male riders. For every additional minute spent commuting to work, female riders' wages will fall by 0.3 percent, relative to male riders. In addition, longer commutes on the bus negatively affect the annual incomes of female riders compared to male riders. For every additional minute spent commuting to work, female riders' incomes will fall by $85.51 relative to male riders' incomes, all else constant. These estimates are statistically significant, suggesting that female bus riders are harmed by their experiences using the public bus system to commute to work. Not only are female bus riders restricted in the jobs they can access, but their labor productivity is negatively affected.

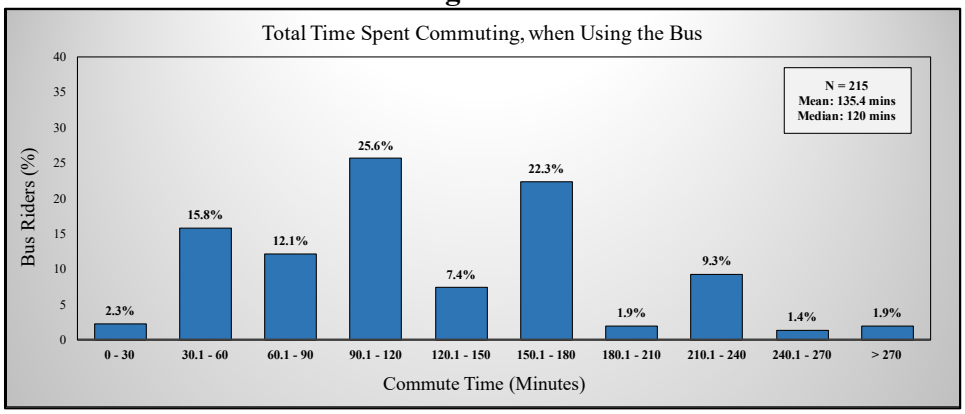
Part III: Opportunity/Economic Costs

In this part of the analyses, the economic/opportunity costs associated with riding the bus are estimated. The weekly and annual costs of commuting on the bus, along with the costs of missing out on opportunities, like new jobs and promotions, are estimated. Several assumptions are made to carry out these calculations and are noted in the appropriate areas.

Opportunity Costs: Taking the Bus to and from Work

The opportunity costs associated with riding the bus to get to and from work are estimated. Total time (per week) spent riding the bus to work and then back home not only includes the time spent physically riding the bus but also the time spent walking to and from bus stops, etc. This time is used to calculate the income that bus riders *could be* earning if they were able to use that time to work (and earn a wage), instead of commuting. This, in addition to the bus fare, is the opportunity cost of riding the bus to and from work. If riders could use this time to work, how much would they earn?

Figure 56

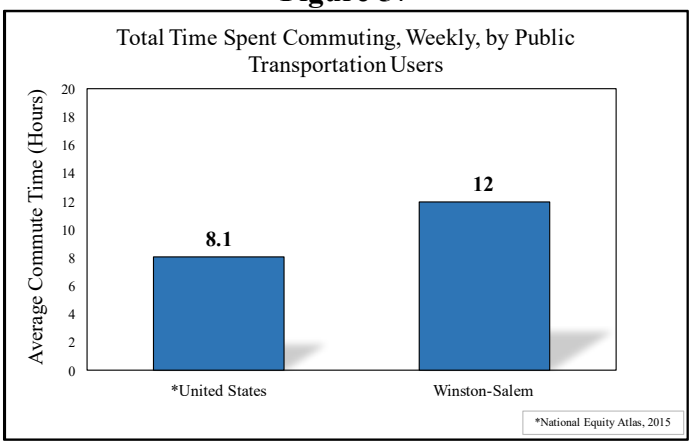


The daily commute to and from work for the average employed bus rider in Winston-Salem is around 135.40 minutes. Assuming a 5-day work week, this adds up to 677 total minutes, which is equivalent to 11.28 hours a week. If these bus riders were to commute in a personal vehicle, their daily commutes would only be around 32.07 minutes. Assuming a 5-day work week, this adds up to 160.35 total minutes, which is equivalent to 2.67 hours a week. Therefore, if the average bus rider in Winston-Salem used a personal vehicle instead of the bus, they could save 103.33 minutes per day. Across a 5-day work week, they would save a total of 516.65 total minutes, which is equivalent to saving 8.61 hours per week (see Table 13 below).

Table 13

Commuting to and from Work			
Time	By Bus	By Vehicle	Difference
Daily (minutes)	135.40	32.07	103.33
Weekly (minutes)	677.00	160.35	516.65
Weekly (hours)	11.28	2.67	8.61

Figure 57



Bus riders in Winston-Salem spend approximately 12 hours a week commuting to and from work (whether walking to the bus stop, riding the bus, getting home from the bus), as shown in Figure 56 and Figure 57 above. This is slightly different from the results shown in Table 13, which are calculated assuming all bus riders work 5 days a week. In Table 13.1 below, the calculations account for the fact that not all bus riders work 5 days a week. Some riders work less than 5 days a week and others work more. In fact, employed bus riders in Winston-Salem tend to work more than 5 days a week. Bus riders in Winston-Salem commute to work an average of 5.31 days each week (see Table 1). On each day commuters take the bus to work *and* then back home, they spend $2 (bus fare is $1 per trip). From these commutes, they lose an average of $124.68 in lost labor time and $10.62 from bus fares every week, or an average of $7,035.60 a year (see Table 13.1 and Figure 58) in foregone wages and bus fares. This is equal to the average of the products of their hourly wage and the hours spent commuting to and from work on the bus, plus the fares they pay for using the bus. If the time they spend commuting was saved, by having a quicker commute, and used, instead, to earn wages, then they would earn approximately the same amount in additional income that they lose from the foregone labor time.

Table 13.1

Opportunity Cost of Commuting to and from Work on the Bus	
Average time (hours) commuting per week	12
Average hourly wage	$10.14
Average weekly opportunity cost from bus fares	$10.62
Average weekly opportunity cost from lost labor time	$124.68
Average *total* weekly opportunity cost	$135.30
Average *total* annual opportunity cost	**$7,035.60**

Figure 58

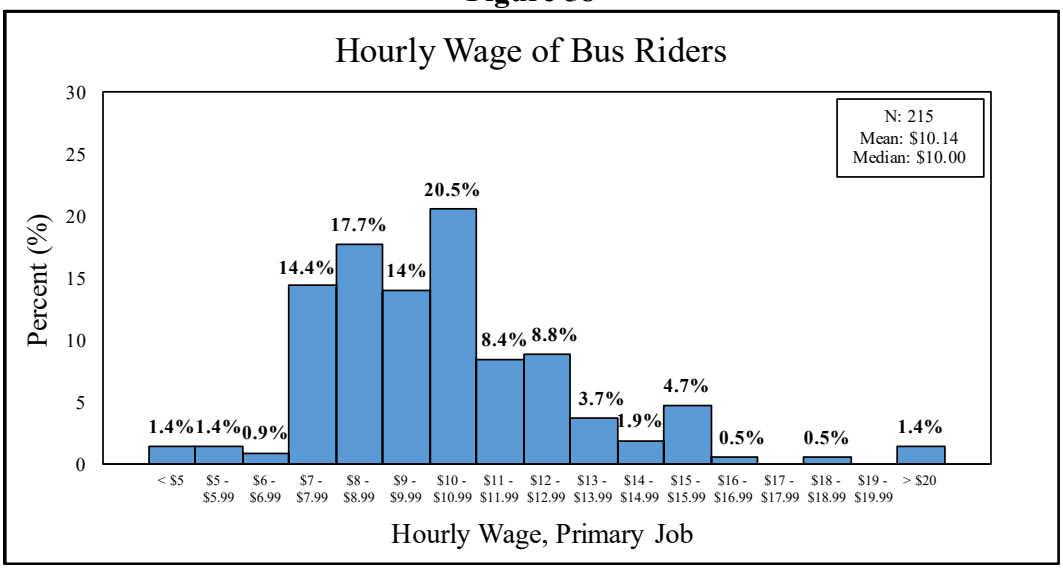


Table 14 below shows the opportunity cost per decade of commuting to and from work using the public bus system. Thus, this is a measurement of the total income a bus rider loses from a decade of riding the bus to and from work, from lost labor time and bus fares. A decade of riding the bus to and from work costs the average commuter in Winston-Salem approximately $70,356.00. This estimate does not incorporate the many other hours lost from long trips to complete simple tasks, such as grocery shopping or visiting the doctor.

Table 14

Total Average Opportunity Cost Per Decade of Using the Public Bus System to Commute to and from Work	
Average years of regularly using the bus system	11.22
Average annual income from primary job	$17,721.60
Average annual opportunity cost of riding the bus	$7,035.60
Total average opportunity cost per decade of riding the bus	**$70,356.00**

What if bus riders used a taxi, instead of the bus, to commute to and from work?

What would the opportunity cost be of using a taxi (or Uber or Lyft) to get to and from work, instead of the bus? Could this be cheaper? The opportunity cost of using a taxi equals the foregone wages from time spent in the taxi plus the actual monetary cost of paying the taxi fare.

Figure 59

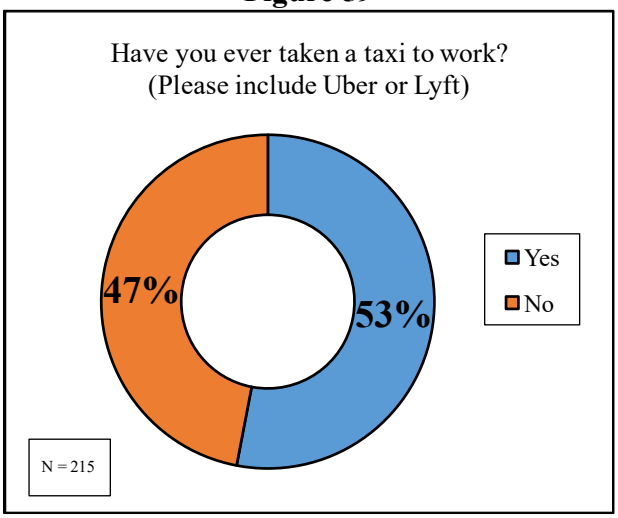
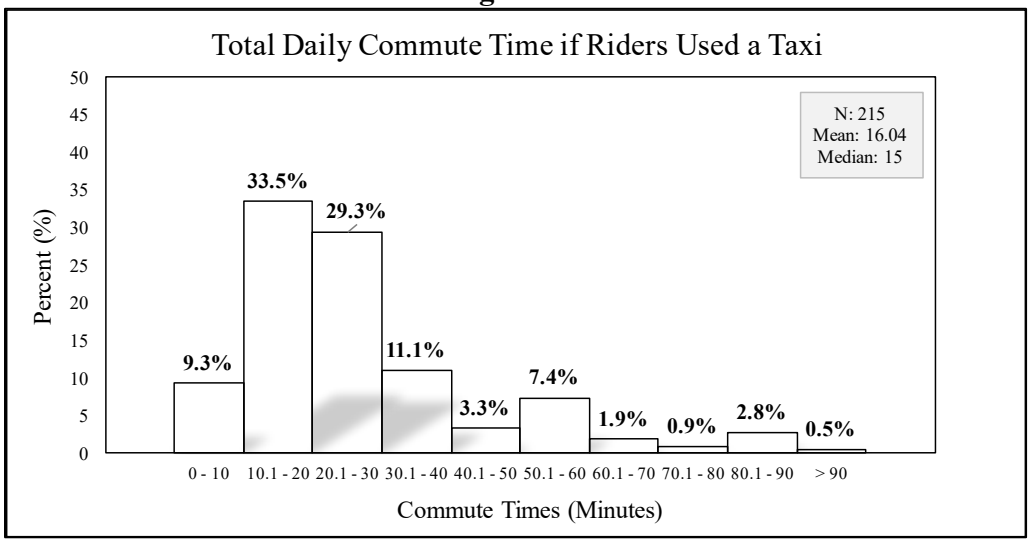
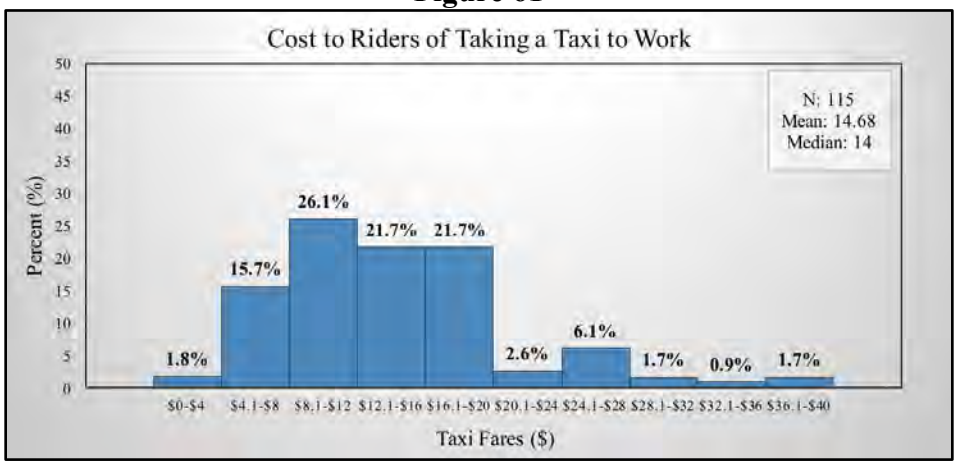


Figure 60



A taxi ride to work would take employed bus riders around 16.04 minutes (see Figure 60 above). Around 53 percent of employed bus riders in Winston-Salem have taken a taxi to work (see Figure 59 above). If they used a taxi to commute to and from work each week, they would spend an average of 2.57 hours a week sitting in the taxi (see Table 16 below). This would be equal to $27.69 of forgone wages each week. This assumes a 5-day work week, that the taxi ride to work is equal in length to the taxi ride back home, and that the time it takes to drive a personal vehicle to work is a good approximation for the length of a taxi ride to work. In addition to lost wages from lost time, taxi riders would spend around $146.78 a week in taxi fares (see Figure 61 below). This assumes a 5-day work week, and that the taxi fare to work is equal to the taxi fare back home. Per rider, the weekly opportunity cost of using a taxi for commuting to and from work is approximately $174.47. This is equivalent to $9,072.44 a year.

Figure 61



By taking a taxi, instead of a bus, commuters would save 9.08 hours a week from the quicker commutes. This is time they could use to earn additional wages. If these time savings were used to earn income, riders would earn an additional $97.70 more per week or $5,080.40 more per year.

By taking the difference between the weekly opportunity cost of using a taxi and the weekly additional income a rider could earn, the net opportunity cost of using a taxi is calculated. For the 53 percent of commuters that have taken a taxi to work, the net weekly opportunity cost of using a taxi is $76.77 (see Table 16 below). When extrapolating this out to an entire year, the net annual opportunity cost of using a taxi to commute to and from work is $3,992.04. For these same commuters, the annual opportunity cost of using the bus to commute to and from work is $7,038.20 (see Table 15 below).

Table 15

Opportunity Cost of Commuting to and from Work on the Bus (for those who have used a taxi)	
Time (minutes) commuting per day	139.85
Time (hours) commuting per week	11.65
Hourly wage	$10.76
Weekly opportunity cost from bus fares	$10.00
Weekly opportunity cost from lost labor time	$125.35
Total weekly opportunity cost	$135.35
Total annual opportunity cost	**$7,038.20**
N = 115	

The difference between the annual opportunity costs of using a bus and using a taxi for commuting to and from work is equal to the annual opportunity cost savings of using a taxi instead of a bus. Each commuter could earn an additional $3,046.16 by using a taxi instead of the bus and by using the time savings to work (see Table 16 below).

The value of the saved time from using a taxi far outweighs the cost of the taxi fares. If the saved time is used to work and earn additional wages, riders could minimize the opportunity cost of their commutes. Thus, it makes more economic sense for a commuter to use a taxi to get to and from work, than use a bus service that costs only $1 per trip. This shows that riding the public bus

in Winston-Salem is extremely burdensome to those who rely on it. In terms of lost time, they are foregoing a sizeable amount of potential income. This is income that they could use to *get ahead* and perhaps, over time, reach higher income levels.

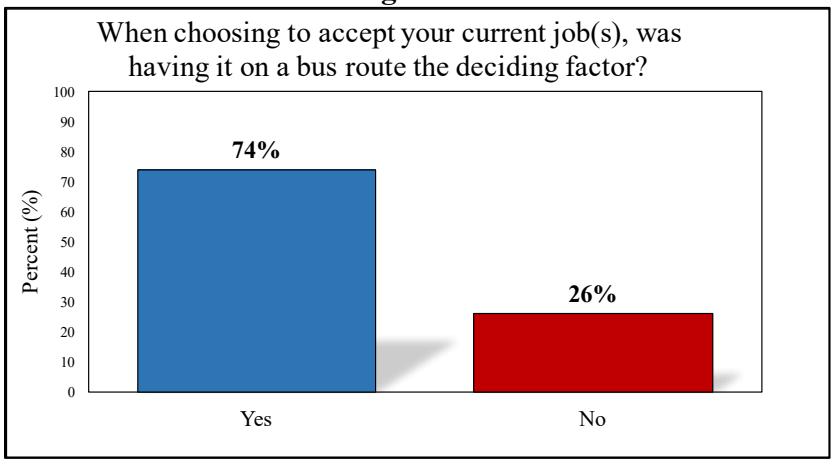
Table 16

Opportunity Cost of Commuting *to and from* Work: Bus vs. Taxi*		
	Bus	Taxi
Time (hours) commuting per week	11.65	2.57
Hourly wage	$10.76	$10.76
Lost wages from commute per week	$125.35	$27.69
Cost of transportation per week	$10	$146.78
Time saved (hours), *relative to using the bus* per week	0	9.08
Income gain (if time saved is used to earn wages) per week	$0	$97.70
Net weekly opportunity cost of transport option	$135.35	$76.77
Net annual opportunity cost of transport option	$7,038.20	$3,992.04
Potential income gain from using a taxi, instead of the bus = $3,046.16		
*N = 115, estimates correspond to those who have used a taxi		

Opportunity Cost: Turning down better job offers because the job is too far from any bus routes

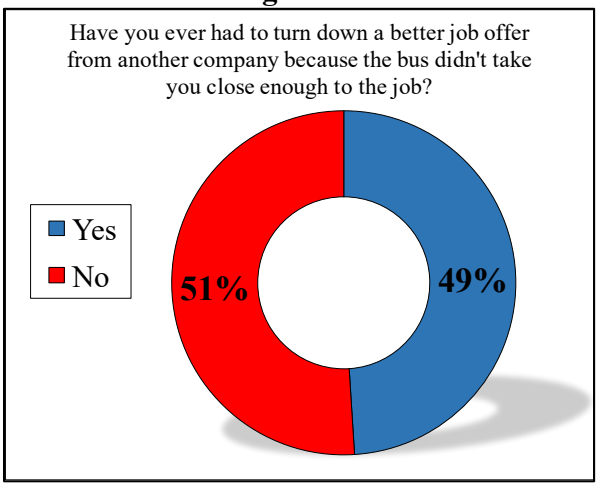
It is not uncommon for public transportation users to have jobs located along established bus routes. In fact, this is often the primary reason that they have these jobs, as can be seen in Figure 62 below. Job opportunities at companies that are not located close to bus routes tend to be inaccessible. Thus, labor opportunities are severely restricted for those that rely on public bus systems.

Figure 62



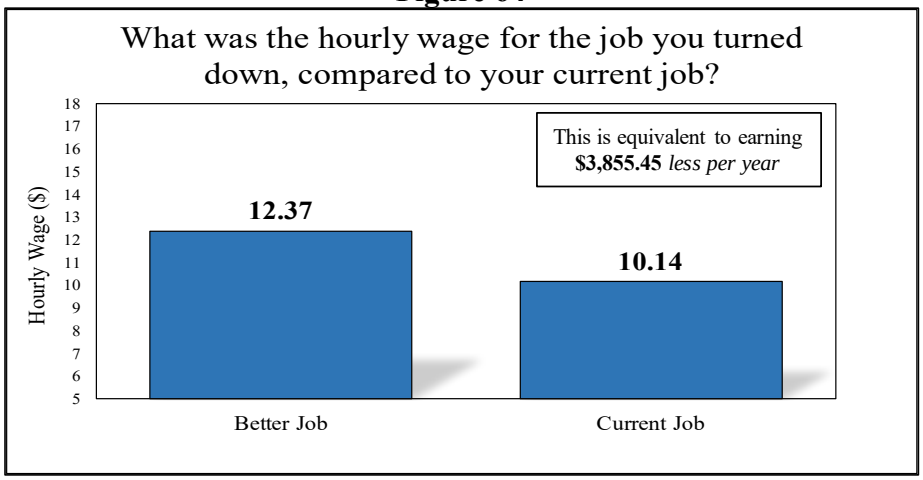
Many employed bus riders in Winston-Salem have had better job offers from other companies, but they turned them down because no bus route was close enough to the job. Consequently, reliance on inflexible and limited public transportation leads to many riders losing out on better economic opportunities.

Figure 63



As can be seen in Figure 63 above, nearly half of bus riders in Winston-Salem have turned down better job offers because the bus did not take them close enough to the job. These better jobs paid higher hourly wages, therefore, there are opportunity costs with riding the bus stemming from lost prospects.

Figure 64



The average wage of the better jobs was around $12.37, compared to riders' current jobs, which pay an average of $10.14 an hour (see Figure 64 above). This is equal to a $2.23 difference. This may seem small, but across an entire year this wage difference adds up. If bus riders could have accepted the better offers, they each would have earned *$3,855.45 more a year*. This is calculated by first finding the annual income of those riders who turned down better opportunities, which is equal to their hourly wage multiplied by the number of hours they work each, which is then multiplied by 52 (assuming 5-day work weeks, 52 weeks out of the year to simplify the

calculation). Then, the same calculation is carried out again but using the hourly wage of the rejected job. For this calculation, it is assumed that the better job would have required the same hours of work as the rider's current job. The difference between these two amounts is equal to the annual opportunity cost. The opportunity cost per rider is $3,855 (see Table 17 below).

Table 17

Opportunity Cost of Turning Down Better Jobs not on Bus Routes	
Annual income from current primary job	$18,417.08
Annual income from better job	$22,272.53
Annual opportunity cost	**$3,855.45**

Thus, many riders lose out on better opportunities because of their reliance on a public bus system that restricts their ability to access them. When bus riders must pass on these higher paying jobs, they are missing key opportunities to climb the socioeconomic latter. Considering how common this is, it is no surprise that Winston-Salem/Forsyth County's economic mobility is so abysmal.

Opportunity Cost: Losing a Job Due to a Bus Route Change

Bus route changes can be devastating to commuters that depend on the bus to get to and from work in a timely fashion. If a bus route is significantly altered, it can lead to commuters losing their jobs because they can no longer reach them. Thus, there are opportunity costs associated with bus route changes. The opportunity cost of a route change consists of two parts.

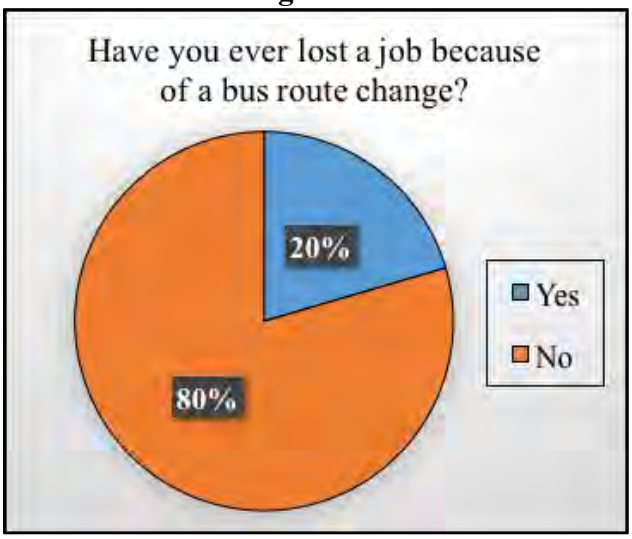
1. The lost wage due to the unemployed time, or, in other words, what *could have been* earned if the rider had not lost the job
2. The difference between the hourly wage of the lost job and the replacement job. Often, riders find new jobs that pay less per hour.

The opportunity cost calculation is restricted to one year and is equal to the cost incurred within a year of losing a job due to a route change. Opportunity cost component 1 is computed by taking the number of days that a rider is unemployed, finding the total workdays (assuming 5-day work weeks) lost within that time frame, and then calculating the number of lost work hours (assuming 40-hour work weeks. This final number is then multiplied by the hourly wage of the lost job. The result is the lost income, caused by the bus route change, from being unemployed (opportunity cost component 1).

For the riders who found jobs within 365 days of losing their job, the number of days between finding the new job and 365 is computed along with the hourly wage difference between the original and new job. The calculated days is converted into total work hours, which is then multiplied by the wage difference. The product of these two numbers equals the income difference, associated with the new wage, due to the change in bus route (opportunity cost component 2). The components are summed together. The result is the total opportunity cost, within a year of losing the job, of the bus route change.

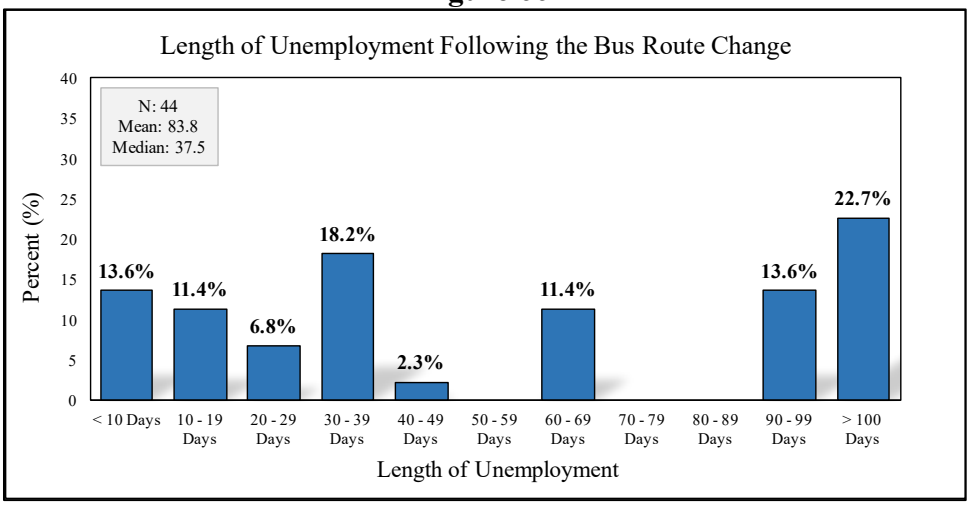
Twenty percent of employed bus riders in Winston-Salem have lost jobs due to bus route changes (see Figure 65).

Figure 65



The average length of time spent looking for a new job is 83.8 days (see Figure 66 below). The minimum number is 4 days, and the maximum is 650 days (1.78 years). The average length of time spent looking for a new job, with an upper bound of 365 days, is 77.27 days.

Figure 66



The average hourly wage of the lost jobs is $10.36, and the average hourly wage of the new jobs is $10.20 (see Figure 67 and Figure 68 below).

Figure 67

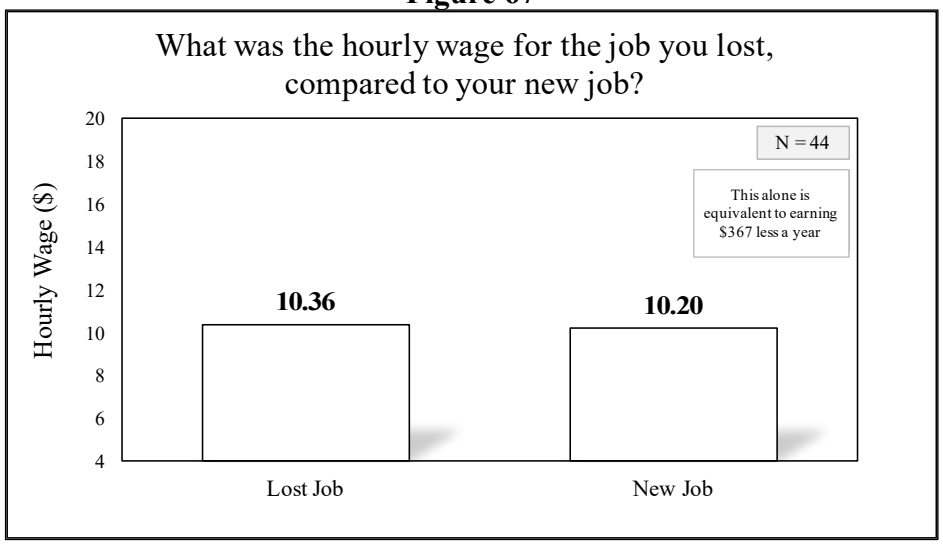
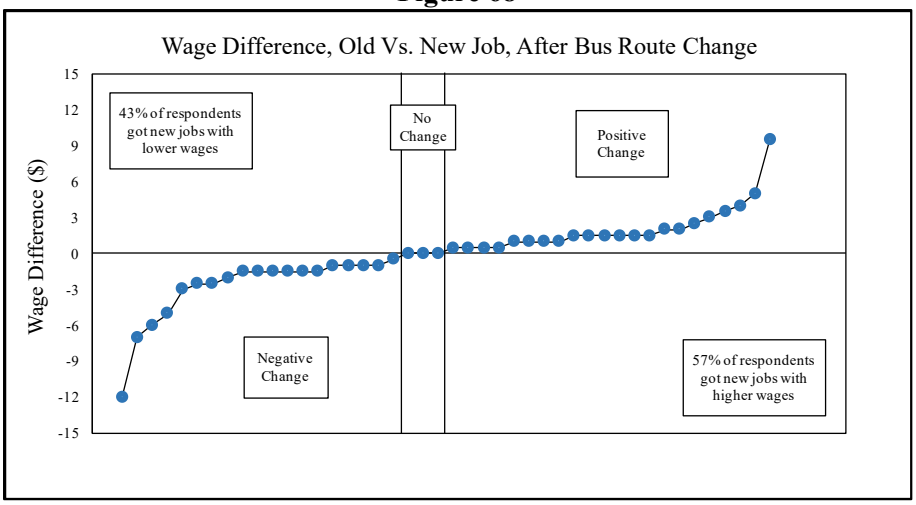


Figure 68



The first component of the overall opportunity cost is equal to $4,699.74 per rider. The unemployed time cost each rider an average of $4,699.74 in lost income. This is calculated by multiplying the number of lost work hours (40 hour weeks, 5 days a week), within the unemployed time frame, by the hourly wage of the lost job.

The second component of the overall opportunity cost is equal to $367.14 per rider. In many cases, riders take new jobs that pay less per hour than the job they lost. Therefore, for each hour they work in this new job, there is a cost stemming from the bus route change that led to them losing their original, higher paying, job. Each rider lost an average of $367.14 because of this hourly wage difference.

The total opportunity cost to each rider, within a year of initially losing a job due to a bus route change is equal to $5,066.88. Thus, each rider could have earned an additional $5,066.88 if the route change had not occurred (see Table 18 below).

Table 18

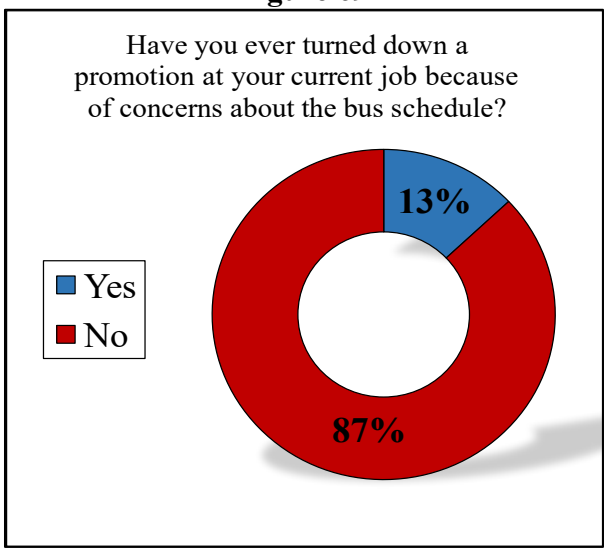
Opportunity Cost Associated with Losing a Job Due to a Bus Route Change	
Lost wage while seeking a new job (being unemployed)	$4,699.74
Lost wages due to wage difference between the lost job and the new job	$367.14
Total Opportunity Cost, per Rider	**$5,066.88**

Commuters that rely on the public bus system to get to and from work are vulnerable to events completely out of their control. They may be hardworking and dependable employees that would otherwise never lose their jobs. Nevertheless, a sudden bus route change may prevent them from reaching their workplace, eventually costing them their jobs. Hence, their employment status is always vulnerable due to their strict reliance on a public transportation system that is inflexible and inherently restrictive. Considering that relying on public buses has cost many commuters their jobs, it is no wonder that economic mobility in Winston-Salem is so poor. Getting ahead is difficult in a city where falling behind is as easy as a simple bus route change.

Opportunity cost: Turning down promotions because of concerns about the bus schedule

Some riders have had promotion opportunities but turned them down because of their concerns about the bus schedule. In Winston-Salem, 13 percent of employed riders have turned down promotions for this very reason (see Figure 69 below). Naturally, promotions lead to greater responsibility, which in turn often demands a more flexible work schedule. This can be problematic for someone without personal transportation, such as a car. Riding the public bus usually restricts a rider to a firm schedule. Thus, it is unsurprising that some bus riders have had to turn down promotion opportunities.

Figure 69



These promotions would have paid $2.81 more per hour compared to the riders' current jobs, which can be seen in Figure 70 below. This is equivalent to earning an additional $3,612.20 more

per year, assuming the promotion requires that riders work the same number of hours as their original job. Thus, this estimate is probably conservative. The riders, therefore, could have earned an additional $3,612.20 a year, if they had not been restricted by the bus system (see Table 19 below).

Figure 70

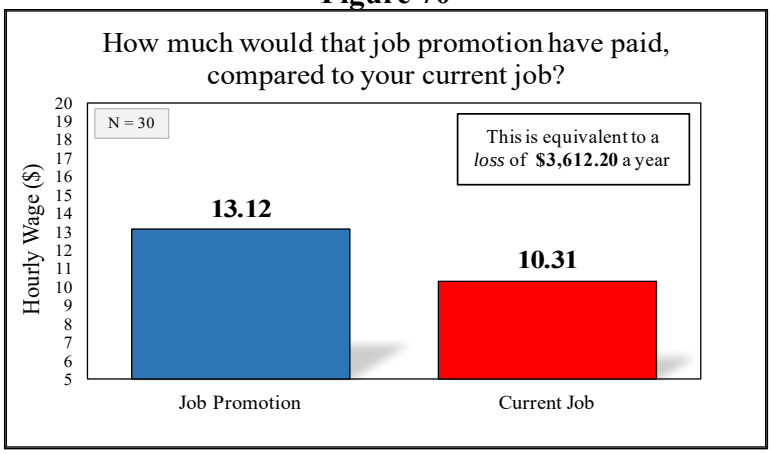


Table 19

Opportunity Cost of Turning Down Promotion Due to Concerns About Bus Schedule	
Annual income from better job	$20,777.59
Annual income from current job	$17,165.38
Annual opportunity cost	**$3,612.20**

Relying on the public bus system in Winston-Salem can trap commuters in their current jobs, without being able to advance in their current place of employment. This, in turn, prevents them from further climbing to higher income levels and restricts their economic mobility.

DISCUSSION

Winston-Salem, NC is consistently rated as one of the best places to live in the United States. Home to the city are many prosperous companies and well-respected higher education institutions. The city has received billions of dollars in investments over the last decade resulting in significant growth in the downtown area. Nevertheless, it is one of the worst places in the United States for the poor. Economic mobility in Winston-Salem/Forsyth County is abysmal (Chetty et al., 2018). Children born to poor parents are unlikely to ever escape poverty. Many factors undoubtedly contribute to this, such as racial and income inequality, along with ailing social and community networks (Chetty et al., 2014). However, physical immobility may be the prime factor that is undermining the economic mobility of residents living in the city of Winston-Salem and Forsyth County overall.

Research has shown that long commutes decrease the probability of children escaping poverty (Chetty et al., 2018; Chetty et al., 2014). Long commutes are strong indicators of residential segregation (Chetty et al., 2014). Commuters that use public transportation, however, are not only

effected by residential segregation but also severe opportunity costs. Bus users spend a considerable amount of their time commuting to and from work. The correlation analyses presented in this report suggest that commuting time negatively impacts labor productivity. Along with the impact on productivity, the foregone wages add up to a sizeable loss. The more time stuck on a bus means less time during the week to earn a wage. In addition, relying on the bus makes riders vulnerable to unexpected events (late bus arrivals, route changes) and holds them firm to rigid schedules. These factors have caused employed riders in Winston-Salem to lose out on many economically beneficial opportunities, such as promotions and new jobs. All riders face these opportunity costs, though certain groups of riders endure more negative effects compared to other groups.

The labor productivity of female riders, compared to male riders, is negatively correlated with commute time. An explanation for this finding is that long trips on the bus, involving many stops and bus changes, can be an arduous experience. Once riders finally arrive at work, they may be more tired than when they began their commute, which is an explanation for the decrease in their productivity (lower hourly wages). An added explanation is offered by Roberts, Hodgson, and Dolan (2011). They argue that "women's greater sensitivity to commuting time seems to be a result of their larger responsibility for day-to-day household tasks, including childcare and housework." For male riders, hourly wage is not negatively correlated with commute length. Male riders are commuting longer to reach jobs that pay more per hour. In general, it is a standard finding that males have longer commutes than females (Madden, 1981; Hanson and Johnston, 1985). Moreover, female bus riders are less likely to have personal automobiles, compared to males. Thus, male bus rides can occasionally commute to work in an automobile and are not totally reliant on the public bus system. We find that female labor productivity in general is highly sensitive to commute lengths and that for black females it is even more so. This could be because they have even more family and household responsibilities than other groups of females. It could also be that, due to racial segregation in neighborhood occupancy and the labor market, they must travel farther for employment that tends to pay less per hour. This explanation is supported by a myriad of studies that find ethnic differences in the relationships between commuting and labor (Thomas, 1998; Gautier and Zenou, 2008). Along with the findings from the correlation analyses, the regression results tell a similar story.

In the third regression specification, an interaction term between commute time and gender is included. The estimated coefficient on the interaction term is negative and statistically significant, suggesting that female riders' labor productivity is negatively affected by longer bus commutes, relative to male bus riders. As commutes lengthen, riders' hourly wages tend to decrease. This finding aligns nicely with previous literature (Roberts et al., 2011). Along with the loss to productivity, riders face considerable opportunity costs from riding the bus.

All commuters, regardless of mode, face opportunity costs because the time spent commuting is time that could have been used to earn wages. It is time dedicated to a job that is uncompensated. Unlike workers that commute with personal vehicles, it is unlikely that public transportation users are being compensated for their commutes, especially since they tend to occupy lower income brackets (Leigh, 1986). Commuters that use public transportation face greater opportunity costs because they spend more time commuting, causing them to lose out on better opportunities. Viable jobs for bus riders must be closely located to a bus route or else they are unreachable. Promotions, too, cannot be accepted if they require working hours that do not conform to the established bus schedule. These factors are just a few examples of the ways bus riders miss out on much needed

economic opportunities, which undoubtedly undermines their ability to climb the socioeconomic ladder.

The average employed bus rider in Winston-Salem foregoes thousands of dollars each year from lost time spent on the bus, which is substantial considering the average rider earns around $20 thousand a year. A particularly striking possibility is that the opportunity cost of commuting to and from work in a taxi is less than that of using a public bus service that charges only $1 per trip. The time saved by using a taxi could be used to earn extra income. Since commuters would save around 9 hours per week by using a taxi, the extra annual income they could earn would exceed the cost of using the taxi and the foregone income from using the bus. The opportunity costs of riding the bus go beyond just foregone wages. Riding the bus impacts other areas of life that often get overlooked but are equally critical for understanding the opportunity cost of commuting on the bus.

Nearly 80 percent of employed bus riders in Winston-Salem have been late to work due to the bus. Most of them face penalties for being tardy. They can be fired, docked pay, or disqualified from promotion opportunities. These facts have implications for researchers who argue that having an automobile promotes employment and job retention, relative to using public transportation (Blumenberg and Pierce, 2014; Cervero, Scandoval, and Landis 2002; Gurley and Bruce, 2005; Sandoval, Cervero, and Landis, 2011). Due to the inconsistencies of public transportation systems and the amount of time required to use them, a supplementary explanation could be that bus riders become discouraged by the time required to commute to their jobs that tend to pay low wages. This frustration and discouragement could be causing many bus riders to eventually quit their jobs. Bus systems could be causing many commuters to arrive late to work, eventually leading some to be fired. It should be emphasized that the commuters' tardiness is completely out of their control but due, instead, to the inconsistencies of the bus system. This explanation is indirectly supported by Crane (1994), who finds that stable jobs are associated with shorter commutes. No wonder that public transportation users face more job volatility and unemployment. These facts could be explanations for the findings suggesting that automobile access promotes job retention relative to using public transportation. A resume of job volatility and unemployment, stemming from reliance on inconsistent transportation systems, undoubtedly makes it difficult to have higher paying jobs and to succeed in workplaces. This in turn undermines economic mobility.

Most jobs are accessible with a car, but only around 60 percent are accessible when using public transit (Thakuriah, 2000). Since job accessibility is highly correlated with employment, and employment is correlated with economic mobility, then it stands to reason that public bus users are less likely to be economically mobile than those with cars. Access to flexible transportation, like a personal automobile, and access to a wider range of job opportunities, gives people bargaining power over wages, which explains why those with personal vehicles earn more than transit users (Thakuriah, 2000). This also explains why public bus users are less likely to experience economic mobility than car users. Thus, relying on public transportation, with its long commutes, unreliable arrival times, and limited ranges inhibit economic mobility. This is especially so for employed bus riders in Winston-Salem, many of which report being late to work because of the bus, facing penalties for their tardiness, and losing jobs due to simple bus route changes.

In addition to public bus systems' impact on work life, the diets of bus riders are affected. Grocery shopping and hauling food on and off a public bus is no easy task. Employed riders in Winston-Salem report eating less fruits, vegetables, and healthy meats. An explanation for this is that healthy foods are difficult to transport without a personal vehicle, especially when the foods

must be placed in a cooler while being transported. Male riders tend to eat more fast food and snacks, while female riders report buying less canned foods. Winston-Salem is not unique in this regard. Studies show that using public transportation affects grocery shopping behavior in other urban areas (Sherman and Brittan, 1973; Wiig and Smith, 2009; Walker, Block, and Kawachi, 2012). In addition to affecting diets, medical access is also made more difficult. Trips to hospitals and medical appointments are three times longer using a public bus compared to using a personal vehicle. In the case of a medical emergency, this extra time could be life threatening. Hence, the public transportation system in Winston-Salem affects more than just work and income but impacts all areas of the life of a rider.

The public transportation system in Winston-Salem impacts many factors important to economic mobility. The system, overall, seems to negatively affect these factors, and, in turn, hinders the ability of those who use it to reach higher income levels. Those who depend on the city's public bus system tend to occupy lower income levels and have the lowest rates of economic mobility. They also have the most to gain. Our study has examined what we believe to be the primary cause of Winston-Salem/Forsyth County's poor economic/income mobility. Considering our findings, local leaders and officials have an obligation to alleviate these barriers, which will allow public transportation users to reach their full economic potential. Without addressing the public transportation issues, the city's most vulnerable residents will continue to suffer and economic mobility will remain stagnant. It is no coincidence that those who depend on public transportation the most in Winston-Salem, like African-Americans, have the lowest economic mobility (Bhattacharya and Mazumder, 2011). Nevertheless, there are viable options available to address these issues.

Bus routes can be redesigned to be more efficient. Major gains can be made by abandoning the spokes and wheel design. This out dated design makes it extremely difficult for riders who want to travel laterally across town. Short distances become unnecessarily long commutes. More buses could be added to the system, which could decrease wait times at bus stops. Nevertheless, some researchers find that employment outcomes would improve more by making automobiles more accessible, compared to improving public transportation systems (Cervero, Sandoval, and Landis, 2002). Thus, the city should consider offering bus riders discounts on taxi services. Perhaps they could subsidize Uber and Lyft drivers so that their fares are cheaper for riders that qualify, like a food stamp except for transportation. Riders that utilize this could be further incentivized or encouraged to use the time they save to work more hours. City and other local government agencies could even offer to pay a portion of bus riders' purchase of their own personal vehicles. This would incentivize bus riders to buy a vehicle, which could then be used to commute. These changes could positively impact economic mobility in the long run, which in turn would benefit the city and county overall.

Limitations

There are limitations with this study. First, many of the correlations are statistically insignificant, making firm conclusions difficult. Second, the regression models undoubtedly suffer from endogeneity and omitted variable bias. Third, we rely on self-reported information, which is problematic when analyzing wages. Fourth and finally, many assumptions had to be made for the opportunity cost estimations, some of which may not be valid.

CONCLUSION

Employed bus riders in Winston-Salem/Forsyth County are at a severe economic disadvantage. Their labor productivity suffers from long commutes to work, and they face sizeable opportunity costs from lost time commuting to and from work. These effects are disproportionately felt by African Americans and those in lower income brackets, making it difficult for them to escape poverty or climb the socioeconomic ladder. Many employed bus riders in the city are severely restricted regarding their ability to find higher paying jobs and many lose out on opportunities for advancement in the work place due to their reliance on the public bus system. Considering these facts, it is no wonder that Winston-Salem/Forsyth County's economic mobility is one of the worst in the entire United States.

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