MOBILITY ALONG THE RAIL LINE: HOW CHARLOTTE'S LIGHT RAIL PROJECT
IMPACTS ECONOMIC MOBILITY

by

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ABSTRACT

COURTNEY JAMES THOMAS BROWN. Mobility Along the Rail Line: How Charlotte's
Light Rail Project Impacts Economic Mobility
(Under the direction of DR. SCOTT FITZGERALD)

This paper adds to the existing literature on gentrification by exploring the impact of

newly developed light rail transportation systems on neighborhoods surrounding the rail stations.

Transportation costs place a disproportionate burden on people with low incomes, so expanding

access to public transportation should help relieve some of that burden. On the other hand, some

of the literature on gentrification suggests that new infrastructure that is attractive to the public,

such as a public transportation system, could encourage the inward migration of middle-income

people. This study explores that phenomenon by using difference-in-differences and binary logit

models. Findings show that the new LYNX Blue Line light rail in Charlotte, North Carolina may

have had an effect on the racial makeup of neighborhoods along the rail line which indicates

population changes related to the rail line. This study did see positive economic changes when

looking at average median household incomes and poverty rates; however, how the light rail

impacted existing residents along the line is unknown due to the population changes. This study

is an example of how public policy can lead to unintended consequences.

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I would like to thank Dr. Scott Fitzgerald for giving me the guidance I needed to shape my ideas in a way that would allow me to complete this thesis. Dr. Fitzgerald helped me significantly in narrowing down my ideas so they would be manageable for a two-year project. They also played a key role in my professional development as a researcher. I would like to thank Dr. Yang Cao for teaching me the statistical skills needed for this project and for their mentorship throughout my time as a graduate student at UNC Charlotte. I would also like to thank Dr. Candace Miller for introducing me to new ways of thinking around urban planning, and for recommending I use the difference-in-differences models used in the analysis of this research. I would like to thank Dr. Roslyn Mickelson for always being eager to talk with me through issues and lend their advice. Finally, I also appreciate my graduate assistantships which allowed me to dedicate all my time to school related projects. Without the financial help through the assistantships, I would have had more non-academic priorities that would have distracted me from my work.

DEDICATION

This study is dedicated to my mom who has helped me through my journey more than words can express. She never hesitates to console me during my darkest times and always wishes for the best for me and my brother. I can confidently say without a doubt that I would not be in this position without her undying love, patience, and commitment to my success. She has committed her life to serving others and has inspired me to do the same.

Honorable mentions include my late cat Durkey and my fellow graduate students. I got Durkey at the beginning of graduate school during the COVID-19 pandemic. Durkey was named after the famous sociologist Emile Durkheim. Ironically and unfortunately, Durkey died from FIP (a feline coronavirus) shortly after I got him. I will always remember my classmates laughing when they would see him run across my laptop during Zoom classes. Also, he was the only cat I have met that would beg for me to play fetch with him.

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LIST OF ABBREVIATIONS

LRT	light rail transit
LRTN	light rail transit neighborhood
2030 TCSP	2030 Transit Corridor System Plan

CHAPTER 1: INTRODUCTION

The impact of newly developed light rail stations on neighborhoods can vary from city to city. The development of light rail in some cities has resulted in increased access to affordable transportation for the existing residents (Kim 2021), while in other cities, light rail has displaced large segments of the population (Baker and Lee 2019). Access to reliable transportation is incredibly important for economic mobility (Fletcher et al. 2010). Public transportation can help people without cars get and maintain jobs, take their children to childcare, and meet their other obligations. Without a car or other means of transportation, individuals have fewer economic opportunities.

In theory, public transportation expansion should increase the existing population's access to transportation without increasing financial burdens in other areas. However, if new options for public transportation are implemented, but have unintended consequences, such as displacing residents, it may increase the burden for those who are displaced. Therefore, this research aims to address two questions: What economic impact does a light-rail station have on a neighborhood? If there is an economic impact, does this affect population change?

The importance of this research is twofold. Since a lack of access to transportation can be a significant barrier to economic mobility, drawing connections between public transportation expansions and how neighborhoods are affected by those expansions will provide city planners and other researchers a perspective to consider when planning future projects. Furthermore, this study contributes to the limited research on light rail and gentrification. There is inconclusive research on whether light rail causes gentrification, and this study may help to clarify some of the confusion around this issue. Population changes that are directly related to city-wide projects can be concerning and may counteract the benefits the projects aim to provide existing residents.

Identifying if Charlotte's light rail project is related to significant changes in population demographics is an important factor in understanding the effects of the light rail on existing residents.

This paper will begin by covering the role of cities in the lives of the working class. It will then briefly describe the deterioration of many cities in the United States and how city leaders are working to revitalize them. Next, this paper will form a definition of gentrification and describe its causes and impacts based on existing gentrification research. The next section will talk about the cost of personal vehicle ownership and how access to reliable transportation can make or break a person's ability to hold a steady job. After that, this paper describes Charlotte, North Carolina's relationship to transportation which will lead into the final section of the literature review on light rail transport (LRT).

The methodology applied in this analysis is a series of difference-in-differences analyses testing the effects of the LRT on neighborhoods close to LRT stations in Charlotte, North Carolina. This study uses Census data to test how various economic measures, such as median income, poverty rates, median home and rent values, have changed as a result of the light rail to explore whether economic mobility has been affected by the development of light rail. This study also assesses whether the light rail system in Charlotte has led to displacement of the surrounding neighborhood's long-term residents.

CHAPTER 2: HISTORY OF THE AMERICAN CITY AND NEIGHBORHOOD

American cities have traditionally been home to many blue-collar, working-class jobs (Preis et al. 2020, Billingham 2015). The changes in technology at the turn of the 20th century significantly transformed the way people work. Work that had been previously done by craftsmen in villages were now being done in factories in cities (Kim 2005). During this time people needed to live close to their jobs because there were no major forms of public transportation and the newly developed steam engines, used to transport goods, were slow and mainly used for long distance travel in and out of cities (Kim 2005).

Beginning in the mid-20th century, personal vehicles became more affordable and popular. At the same time, American cities shifted away from hubs of manufacturing, to centers for business services and the arts (Preis et al. 2020, Billingham 2015). A consequence of these changes was that suburbanization expanded tremendously, and the movement of people started shifting in the opposite direction, away from cities to the suburbs. Much of the retail business followed the people moving to the suburbs, taking the tax base with them. As globalization began to shift production to other countries, the people who have been left in many once thriving cities are those people who cannot afford to move out. Cities across the country were left with few jobs, poor schools, and high levels of poverty.

Detroit, MI is an example of this. Detroit was the global leader in auto manufacturing in the aftermath of WWII and up until the early 60s. Globalization is one of the main factors that caused many of the automobile manufacturing plants that once employed most of the community to close or relocate. Deregulation of the auto industry, coupled with reduced union power, led to many factories shutting down or relocating (Shore 2016). Since the 1950s, Detroit has lost about

a million residents and countless jobs (Shore 2016, Sugrue 2005:3). Today, many parts of Detroit are run down and have been described as "eerily apocalyptic" (Sugrue 2005:3).

Over the past few decades, cities have begun seeking to attract young, healthy, educated individuals back into cities by focusing on improving the slums and other areas that were negatively impacted by the industry and individual abandonment of cities in the mid-20th century. The issues of poor infrastructure and lack of transportation, however, continue to be a major deterrent for inward migration. One way to attract people back into the city is through developing public goods and services that make living in cities more attractive, such as parks, apartment complexes with multiple amenities, or public transportation systems. These ideas have sparked new debates about urban renewal projects and to what extent they help cause gentrification related displacement.

CHAPTER 3: GENTRIFICATION

Defining Gentrification

Gentrification is typically associated with people who are affluent in wealth, cultural and social capital, and other resources (gentrifiers) replacing less affluent residents of an area. The general public typically associates gentrification with the influx of young, white, middle-class businesspeople displacing lower income minorities in central cities. When these upwardly mobile whites move in and improve on deteriorating houses and business locations, it increases the property values of those locations. These improvements also increase the property value of surrounding homes and business locations due to their proximity to the upgrades implemented by the gentrifiers. The general public assumes that gentrification causes rent increases and prices people out of their homes. In academic literature, however, the definition of gentrification is a bit more complicated. So, what is gentrification really and how do academics define it?

There is little academic consensus about what gentrification is and how to measure it (Billingham 2015, Brown-Saracino 2017). The literature on gentrification tends to fall under two different camps. First, qualitative researchers, who focus on the micro processes related to gentrification, tend to see it as an inevitable social problem that is resisted by long term residents (Brown-Saracino 2017). They see the state and corporations as the primary accelerators of the process, and they recognize that gentrification spreads to other underdeveloped communities like a virus that displaces the existing residents and erases the area's culture (Brown-Saracino 2017).

Quantitative researchers often take a slightly different approach to conceptualizing gentrification. Quantitative researchers examine gentrification on a macro scale and are less likely to agree with the characterization of gentrification as a social problem fueled by gentrifiers that always results in displacement of less affluent residents who were there before them

(Brown-Saracino 2017). They tend to be more aligned with the idea that gentrification is simply

a consequence of what people find attractive, including the types of places they want to live in

(Brown-Saracino 2017, Bader 2011). Displacement can occur when gentrifiers move into an

area; however, many quantitative scholars point out that low-income people, especially renters,

are likely to move more frequently anyways, and thus their movement as a result of

gentrification can be characterized as being replaced rather than displaced (Brown-Saracino

2017).

One of the points of consensus for most academics is that a key component of

gentrification is that it causes the cost of living to go up and squeezes lower income people out of

their neighborhoods (Brown-Saracino 2017, Baker and Lee 2017, Martin 2007). Considering that

the different approaches to studying gentrification leads to different conclusions on what the

exact causes and implications of it are, this paper simply acknowledges that some urban

development projects that are attractive to consumers have the potential to cause an influx of

middle-income residents.

Causes/Impact

Gentrification is not a type of urban renewal project; it is rather a result of those projects.

It has been widely established that projects that are intended to improve deteriorating

neighborhoods are often what attracts new residents to an area and displaces the old residents

(Billingham 2015, Hwang 2016). Quantitative studies on gentrification indicate that when

neighborhoods are close to cultural amenities, downtown, or public transportation then

gentrification is more likely to occur (Brown-Saracino 2017, Hwang and Sampson 2014). When

city projects attract gentrifiers to a neighborhood, the cost of living tends to increase (Billingham

2015). But what happens when the new infrastructure added through those projects have the potential to help the existing residents the most?

One key factor of gentrification is that it causes housing costs to rise, including the values of homes that are not updated. If there is not a plan in place to prevent the increase in living costs, the existing residents, who may benefit the most from the new developments, may have no choice but to move to another area where the cost of living is cheaper (Knaap et al. 2001; Billingham 2015). The increase in property values increases rents and taxes, pricing out longstanding and often low-income residents. In addition, the establishment of large corporate chains that may accompany the renewal project, such as Walmart and Starbucks, may make running a mom-and-pop store too costly for small business owners to survive (Haltiwanger et al. 2010). It is crucial that city planners take this possibility into account when planning renewal projects.

As lower income people are displaced, they are replaced with a different type of urban dweller. Stewart (2003) categorizes highly educated middle to high income earners as "knowledge workers". "Knowledge workers" who displace lower income residents, tend to have more economic freedom than the traditional working class and are said to be attracted more to appealing consumer amenities, rather than the utility of a particular location (Glaeser et al. 2000, Stewart 2003). In other words, an attractive environment with a variety of goods, services, and public amenities such as walking trails and dog parks are more likely to attract the higher wage earning "knowledge workers" than low wage-low skilled workers. While those attractive neighborhood characteristics previously mentioned are also important and attractive to low wage-low skilled workers, those who earn less are less likely to have the means to move into those types of areas.

Hypothesis 1: Newly developed and desirable infrastructure, such as a light-rail transit station, will attract an influx of middle to upper class residents to the area immediately surrounding the development.

Racial Themes in Gentrification

One key topic that is consistently debated in the gentrification literature is to what extent race plays a role in the process. This is understandable considering how segregated American neighborhoods are by race and the correlation between Black neighborhoods and poverty (Massey and Fischer 2000, Massey 2020). An idea that may be helpful to understand why the debate persists is that for a long time, white people have avoided living near racial minorities, especially Black people, due to racist ideologies and racist housing policies that at one time were socially acceptable and mainstream (Freeman and Cai 2015). For example, until the 1960s mortgage companies were allowed to redline neighborhoods. Redlined neighborhoods were considered high risk neighborhoods and risk was calculated racial composition. This made it almost impossible for people (mostly Black) living in those neighborhoods to get loans to move to more affluent neighborhoods. (Massey 2020). When Black people were able to move to mostly all-white suburbs, the white homeowners often feared that having Black neighbors would reduce property values and established restrictive covenants through homeowner associations as a response (Massey 2020, Gusoff 2020). Some other examples of past actions that have kept Black people impoverished and out of white spaces are the formation of sundown towns that banned minorities from the towns at night (Givel 2021), blockbusting by real estate agents (McGrew 2018), and by constructing sites, such as garbage dumps, that have a negative impact on the surrounding area either environmentally, socially, or both in predominantly minority areas (Molotch 2017).

After the Fair Housing Act was passed in 1968 redlining became illegal, but much of the segregation of the past continued. Realtors contributed to segregation by blockbusting neighborhoods. Realtors would scare white residents into thinking that their housing values would decline if Black residents moved in (McGrew 2018). They would convince white residents to sell their homes for less than they were worth and then turn around and sell those same homes to Blacks at inflated values. Blockbusting and the continuing fear of Blacks by whites, contributed to the phenomena of "white flight." (Freeman and Cai 2015). This historical pattern of white people not wanting to live in mixed race neighborhoods, and making the neighborhoods undesirable for investment, may explain why the racial implications of gentrification are not always clear in the data.

Recent studies question the prevalence of the racialized aspect of gentrification (Hwang and Sampson 2014, Brown-Saracino 2017, Yonto and Thrill 2020, Freeman and Cai 2015). There is some evidence that gentrification is less likely to occur in neighborhoods that already consists of predominately one race (Hwang and Sampson 2014, Yonto and Trill 2020). This is likely due to racist ideologies and the resulting negative stigma that associates Black neighborhoods with crime, violence, poverty, etc. (Freeman and Cai 2015). However, if racism declines, we may expect that these trends in gentrification should change.

The Black Lives Matter movement, which began in 2014, has been said to be comparable, if not bigger, than the Civil Rights Movement in the mid-20th century (Gallagher 2021, Sugrue 2021). The significance of the movement could be a sign that racist ideologies may be declining, or at least that there is continued societal pressure to address existing racial inequalities. If so, the neighborhood preferences of whites may be changing as well. White people may be less apprehensive of living in inner city (stereotypically "Black") neighborhoods,

taking public transportation, or walking around cities at night, than they have been in the past. Since white people in the United States on average have higher SES than other races (Shapiro et al. 2013), they are more likely to have the resources required to move into neighborhoods they deem desirable. One way to make those inner-city neighborhoods more desirable is by reducing the burden of transportation related costs.

Hypothesis 2: Racially homogeneous areas are less susceptible to gentrification.

CHAPTER 4: COST OF PERSONAL VEHICLE OWNERSHIP

Economic stratification and inequality can be made worse when there are inequalities in access to transportation, as access to a reliable form of transportation is an important type of economic capital (Fletcher et al. 2010). Instead of access to transportation being considered a human right, one could argue that access transportation is seen as a luxury in the United States. In the United States cars are treated like other arguably necessary goods such as dish washers or refrigerators. Unlike with housing and food, there have never been any federal welfare programs for people who are struggling to secure a vehicle, or dishwasher. It is assumed people own cars or that they can figure out other ways to get around, like it is assumed that people without dishwashers can just clean their dishes by hand. Personal automobile ownership is extremely costly so people who live in low-income communities are less likely to own a personal vehicle (Holzer 1991). When they do own a vehicle, they are overburdened by the costs of ownership when compared to middle- or high-income people.

Not only is the cost of the actual vehicle often a large portion of many of American's monthly expenses (Moody et al. 2021), but paying for gas, maintenance, inspections, registration fees, etc. can all add up to be a heavy burden on people in poverty. People without a lot of money usually resort to paying cash for a vehicle that is often older and has high mileage. The types of cars people resort to buying with cash are often unreliable, and can break down easily, which drives up maintenance costs. Many individuals experiencing poverty end up in a cycle where every few years they find themselves having to come up with a few thousand dollars in cash to buy a new vehicle that will likely break down. When a lower-income person is able to secure a loan for a newer vehicle, they often have to pay a higher interest rate simply because they live in a low-income area (Sugata 2019).

In most parts of the country, having access to reliable transportation is necessary for people's survival. Without reliable transportation it is difficult to get and maintain employment. Without a vehicle, people are forced to find another way to get to work and other places they must get to. People get stuck walking everywhere they need to go if there is no efficient form of public transportation. Finding a job is extremely difficult if someone tells an employer they have no reliable form of transportation to depend on. It is also difficult to maintain a job if it requires someone to walk hours in the heat, rain, or cold before arriving to their shift. Public transportation can expand opportunities to low-income areas by connecting them to more affluent ones and by reducing transportation related costs for residents.

Hypothesis 3: Areas with an increase in access to public transportation will see positive economic growth.

CHAPTER 5: CHARLOTTE TRANSPORTATION

Like many other cities across the country, Charlotte's streets were developed mainly around the automobile. Charlotte did have a streetcar system to transport people from the suburbs into the city from 1887 to 1938 when the city was much smaller (Morrill 2018), but by the end of the 1930s, Charlotte's population had increased from 10,000 to 130,000, while at the same time personal vehicles became more affordable and desirable by the public. Therefore, the streetcar projects were disbanded, or converted into buses (Mahoney 2021), in favor of the automobile (Morrill 2018).

Over the past 20 years the Charlotte area has expanded tremendously. Areas on the outskirts of the city that were mostly farmland in the 1990s are now filled with suburban neighborhoods. The suburbs the street cars once connected to are barely on the outside of the city if you compare them to the suburbs that surround Charlotte today. For example, Myers Park, one of the old streetcar suburbs, is roughly four miles from the city center where the town of Ballantyne is roughly seventeen miles away. Realistically, it is unlikely that someone will walk seventeen miles from Ballantyne to Charlotte and back each day to get to work; therefore, if someone who lives in one of the areas surrounding Charlotte does not own a vehicle, they must find a public transportation option to go that distance or find employment closer to home.

The downside of a city being developed under the assumption that people own personal vehicles is that many opportunities for employment and housing are spread out beyond walking distance (Delmelle et al. 2021). Furthermore, people are expected to own and maintain their own vehicle which, as already established, can be extremely costly. This puts a strain on people's economic mobility. The further someone needs to travel for work, and the harder it gets to afford

the costs of transportation, the harder it is to pursue opportunities that could positively impact a person's economic situation (Delmelle et al. 2021).

Charlotte has an economic mobility problem. Charlotte was recently ranked the lowest out of the 50 largest cities in the United States in terms of economic mobility (Chetty et al. 2014). The 2014 study found that, in Charlotte, for children born to parents whose income falls in the lowest quintile, only 4.4% of them make it to the top quintile (Chetty et al. 2014). A conclusion someone can make based on the outcome of the Chetty study is that Charlotte needs to do more to eliminate barriers that make it difficult for workers to access better opportunities.

One recent study on the Charlotte area examined the location of employment opportunities in different areas using longitudinal data from 2010 and 2017. The authors examined income levels by neighborhood and how neighborhood incomes have changed over time and found that the increased job accessibility does lead to a higher median income for low-income areas (Delmelle et al. 2021). One of the variables the authors used to measure accessibility included the time it takes people to commute to work by car since more than 80% of workers commuted by car in 2018; however, one of the limitations of this study was failing to account for commutes by public transportation (Delmelle et al. 2021).

Today, the city of Charlotte has an expansive bus system that connects the suburbs to the city. However, the long commute times on the bus can make this method of transportation inconvenient. If the public transportation system was more convenient, it could be assumed that more people would consider using it to get to and from work. Charlotte has already begun laying the groundwork for expanding their transportation options by developing a single light rail line, bringing back one of the old streetcar lines, and making the bus system more efficient. Furthermore, the city's "2030 Transit Corridor System Plan" (2030 TCSP) and their "Charlotte

Future 2040 plan" includes plans for increasing public transportation options and creating more economically diverse neighborhoods (Charlotte Future 2040 2022; 2030 Transit Corridor System Plan 2019). Ideally this would increase economic mobility because first, it would increase people's access to more economically diverse work options, and it has the potential to reduce the cost of owning a personal vehicle if people chose not to own one due to having an efficient public transportation system at their disposal. On the other hand, if a better form of transportation is too attractive, it could cause an influx of property developers and more affluent people to the areas with the most access to public transportation, which raises concerns about gentrification.

CHAPTER 6: LIGHT RAIL TRANSIT: APPEALING QUALITIES AND GENTRIFICATION

Over the last few decades Charlotte has been looking at alternative forms of public transportation outside of a bus system. Recently, Charlotte's most notable project has been the LYNX Blue Line that extends 18.9 miles from University of North Carolina at Charlotte to the north of the city, through a transportation hub in the center of the city, and then to the I-485 south of the city (City of Charlotte Government 2021). Plans for the LYNX Blue Line were included in the 2030 TCSP and is part of Charlotte's light rail transit (LRT) system that is currently expanding. The first section of the LYNX Blue Line was opened in 2007 and the second half was finished in 2018 (2030 Transit Corridor System Plan 2019).

LRT systems have many appealing qualities. One of these qualities is that they are an environmentally friendly form of transportation (Bartłomiejczyk and Połom 2016), especially when the rider can rely on LRT as their primary source of transportation. In the first year of the LYNX Blue Line's operation, 72% of riders previously commuted alone by car (2030 Transit Corridor System Plan 2019). Reducing the number of cars on the road can improve the air quality by reducing vehicle emissions and, considering the public's increasing concerns about climate change over the past couple of decades (Ballew et al. 2019), it is easy to see how having a strong public transportation system easily accessible by the community, can be appealing to many.

Aside from the benefits LRT has on the environment, there are economic benefits that come with LRT. The 2030 TCSP claims that the LYNX Blue line is expected to increase people's access to employment by 72% (2030 Transit Corridor System Plan 2019). LRT may connect people from areas that get little attention from members of the community to more affluent areas with more economic opportunities. Many people in low-income neighborhoods

have businesses they could work for within walking distance, however the availability of high paying jobs is limited. Many of the jobs available in low-income neighborhoods tend to be low paying service industry jobs (Wang 2003). So, while somebody may have the option to walk to work, their options tend to be limited to gas stations, fast food, and grocery stores. Development of LRT can expand opportunities to those low-income areas by connecting them to more employment locations.

The downside of LRT being so appealing are the concerns surrounding gentrification. Light-rail and other public transportation projects are often paired with development that makes low-income areas surrounding LRT stations more pleasant to live in. Private developers may be more likely to purchase properties in those areas as they anticipate economic growth. The problem with this is that it has the potential to raise the cost of living. Taking the responsibility off of developers to create the infrastructure needed for their projects can increase their likelihood of investing in areas they otherwise would not. The LYNX Blue line has already attracted $2.8 billion in private development projects including 12,000 housing units, 3.8 million square feet of new office space, and over 1.3 million square feet of retail space to be completed 2035 (2030 Transit Corridor System Plan 2019). This is concerning because, for example, in Washington County, Oregon, LRT development plans were directly related to rising property values prior to any LRT construction (Knaap et al. 2001).

There is some evidence that suggests that simply developing an LRT system may not be enough to cause gentrification (Baker and Lee 2017, Knaap et al. 2001). Through a study examining 14 urbanized areas in the United States, Baker and Lee (2017) found mixed results when looking at how neighborhood characteristics change after LRT development. They find little evidence of gentrification occurring because of new LRT stations. They conclude that most

neighborhood changes depend on the context in which the LRT is built in. In other words, the

overall economic changes for the area, and how local planers prepare for the LRT stations, are

more influential in causing or preventing neighborhood changes rather than the implementation

of LRT on its own.

CHAPTER 7: METHODS

Data

Four years of data are used in this study. Decennial Census data were used for the years 1990 and 2000. American Community Survey (ACS) 5-year estimates are used for 2010 and 2019 with estimates from the years 2008-2012 and 2015-2019 respectively. The unit of analysis for this study is U.S. Census tracts in Mecklenburg County, NC. Census tracts for each year are adjusted to 2010 boundaries. There are a total of 234 Census tracts in Mecklenburg County using 2010 boundaries. Four of those tracts were removed due to them containing populations of less than four for one or more years. The removed Census tracts also contain mostly businesses, thus not providing much, if any, data on households. The total count of Census tracts included in this study is 229. There was also missing data for the median rent cost in 2010 (four missing) and 2019 (two missing). Those cases were automatically dropped in the models including median rent cost.

Variables for median household income, median rent value, median home value, percentage of white households, percent of Black households, and percent of adults with more than four years of college education are included in this study. Median rent and home values are used as cost-of-living indicators. All dollar values are adjusted for inflation to 2010 values. Fixed effects are used for household income, median rent value, and median home value to control for wide variations between different Census tracts. Medians are used instead of averages for income, rent, and home values to give a more accurate representation of the population due to the issues averages can have with outliers skewing the values.

The percentage of people with four or more years of college education and the percentage of white and Black households are used to measure population changes. The racial household

variables are the best measure of population change since race is an unchangeable characteristic; however, since there is a debate about how racialized of a process gentrification is (Hwang and Sampson 2014, Brown-Saracino 2017, Yonto and Thrill 2020, Freeman and Cai 2015), percent of white and Black households may not be enough to identify population change. Introducing a measurement for college educated residents can help indicate if people with higher socioeconomic status are moving into areas with LRT stations.

A dummy variable was created to indicate neighborhoods near LRT stations. Previous research on LRT has used the half-mile radius because it tends to work best to capture who utilizes LRT and other impacts from LRT stations (Baker and Lee 2019). To identify which Census tracts fall within a half mile radius around a light rail station, a map of 2010 Census tracts was overlayed onto Mecklenburg County, NC in Google Earth Pro and half-mile radius circles were drawn around the LRT stations.

Other dummy variables that were created from the existing data are a variable representing mixed-race Census tracts before 2010, one that represents Census tracts with high rates of college educated residents before 2010, and one that represents Census tracts with high poverty rates before 2010. The mixed-race dummy variable indicates Census tracts that had less than 70% white and Black households before 2010. Since racial residential segregation is prevalent in Charlotte, and whites and Blacks are the two dominant races in Charlotte, identifying Census tracts with less than 70 percent of the population being white or Black can be a good measurement for tracts that contain a diverse racial population. The variable representing Census tracts with high rates of college educated residents uses 29% or less as the cutoff. The variable representing Census tracts with high poverty rates uses 24% or less as the cutoff.

Descriptive Statistics

<div align="center">Table 1. – Descriptive Statistics by Year and Neighborhood Type</div>

			Descriptive Statistics				
			Non-LRTN			LRTN	
		N	Mean	Std. Deviation	N	Mean	Std. Deviation
Year	Variable						
1990	Households	193	845.429	619.415	36	1023.025	483.784
	Median Household	193	205.302255	13663.295	36	-1095.45749	15345.09
	% HH white	193	0.809	0.225	36	0.563	0.328
	% HH Black	193	0.174	0.227	36	0.413	0.328
	% Col. Edu.	193	0.186	0.107	36	0.135	0.104
	Poverty Rate*	193	-2.80993	0.052	36	-2.47614	9.698
	Median Rent Cost*	193	-384.233968	120.324	36	-340.00869	106.048
	Median Home Value*	193	-98611.7433	69234.957	36	-86462.1237	60660.979
	Total N = 229						
2000	Households	193	1199.778	575.185	36	1162.934	493.398
	Median Household	193	7726.69301	8992.783	36	85.8767698	8514.45
	% HH white	193	0.692	0.254	36	0.44	0.305
	% HH Black	193	0.237	0.238	36	0.443	0.3
	% Col. Edu.	193	0.256	0.129	36	0.171	0.142
	Poverty Rate*	193	-2.52799	3.836	36	-1.00249	5.471
	Median Rent Cost*	193	-129.355116	104.056	36	-146.039388	113.325
	Median Home Value*	193	-36362.8865	41818.758	36	-38834.9658	36534.192
	Total N = 193						
2010	Households	193	1612.301	603.274	36	1406.694	643.478
	Median Household	193	-5788.36591	9122.409	36	-3259.84046	11154.843
	% HH white	193	0.564	0.28	36	0.412	0.269
	% HH Black	193	0.305	0.252	36	0.422	0.265
	% Col. Edu.	193	0.396	0.209	36	0.32	0.224
	Poverty Rate*	193	3.8003	5.463	36	4.62103	9.644
	Median Rent Cost*	189	238.63559	131.217	36	173.976437	112.375
	Median Home Value*	193	66193.9112	52049.575	36	54473.7735	44185.3
	Total N = 189						
2019	Households	193	1812.29	686.331	36	1668.861	758.798
	Median Household	193	-2143.62936	11989.96	36	4269.42119	13936.794
	% HH white	193	0.53	0.279	36	0.431	0.26
	% HH Black	193	0.322	0.251	36	0.37	0.218
	% Col. Edu.	193	0.443	0.207	36	0.422	0.231
	Poverty Rate*	193	1.53762	4.923	36	-1.1424	7.871
	Median Rent Cost*	191	274.953494	120.746	36	312.071641	162.957
	Median Home Value*	193	68780.7186	59838.269	35	70823.316	62840.96
	Total N = 191						
	*These variables use fixed effects. Variables with dollar values are also adjusted for inflation						

Table 1 displays descriptive statistics for non-light rail and future light rail neighborhoods in 1990, 2000, 2010, and 2019. This table shows that the future light rail neighborhoods in 1990 have more Black residents and fewer white residents than neighborhoods that are not future light rail neighborhoods. Non-light rail neighborhoods had an average of 81% white residents and 17.43% Black residents in 1990, while future light rail neighborhoods averaged 56% white residents and 41.3% Black residents. Future light rail neighborhoods in 1990 also have fewer college educated residents (mean=13.47%) than neighborhoods that do not become light rail

neighborhoods in the future (Mean=18.59%). In 1990 future light rail neighborhoods have higher

poverty rates than non-light rail neighborhoods. The mean poverty rate for future light rail

neighborhoods is 17.96%, which is much more than the mean of 7.43% in non-light rail

neighborhoods. These poverty rates correspond to the average income in these areas. Future light

rail neighborhoods had average incomes of $26,095, while non-light rail neighborhoods' average

income was much higher at about $38,712.

Similar to the descriptives for the 1990 data, the 2000 descriptives show that the future

light rail neighborhoods have more Black residents and fewer white residents than

neighborhoods that are not future light rail neighborhoods. Non-light rail neighborhoods had an

average of 69.14% white residents and 23.68% Black residents in 2000. Future light rail

neighborhoods now contain about the same proportion of Black and white residents (44%). The

proportion of white residents in Mecklenburg County seems to have declined overall between

1990 and 2000. Future light rail neighborhoods continue to have fewer college educated

residents (mean=17.13%) than neighborhoods that do not become light rail neighborhoods in the

future (Mean=25.63%). The mean future non-light rail poverty increased slightly (From 7.43%

to 7.74%) whereas future light rail poverty rates increased by almost two percent (17.96% to

19.43%).

The descriptive statistics for 2010 show that the light rail neighborhoods continue to have

more Black residents and fewer white residents than neighborhoods that are not future light rail

neighborhoods, although the gap between the two different types of neighborhoods is closing.

Non-light rail neighborhoods had an average of 56.35% white residents and 30.47% Black

residents in 2010. Light rail neighborhoods continue to have about the same proportion of Black

and white residents (42.16% and 41.24% respectively) as in previous years. Light rail

neighborhoods continue to have fewer college educated residents (mean=32%) than neighborhoods that do not become light rail neighborhoods in the future (mean=21%). The mean non-light rail poverty almost doubled from 2000 to 2010 (from 7.74% to 14.07%), whereas light rail poverty rates increased from 17.96% to 25.06%.

The descriptive statistics for 2019 show that the light rail neighborhoods continue to have more Black residents and fewer white residents than neighborhoods that are not-light rail neighborhoods, although the gap between the two different types of neighborhoods is closing. Non-light rail neighborhoods had an average of 52.84% white residents and 32.28% Black residents in 2019. The gap between the proportion of Black and white residents in light rail neighborhoods widened between 2010 and 2019. The proportion of white residents in light rail neighborhoods was 43.13% and the proportion of Black residents was 37.04% in 2019. Light rail neighborhoods continue to have fewer college educated residents (mean=42.15%) than neighborhoods that did not become light rail neighborhoods (mean=44.4%). The mean non-light rail poverty decreased from 14.07% to 11.76% and the mean light rail poverty rate also fell from 25.06% to 19.29%.

Tables 1 shows that the proportion of white residents compared to Black residents declined in Mecklenburg County between 1990 and 2019. While the data from 2000 and 2010 show the proportions of Black and white residents narrowing in light rail neighborhoods, white residents maintained their majority in 2019. While white residents also maintained their majority in non-light rail neighborhoods, their proportion shrunk more between 1990 and 2019 than in light rail neighborhoods (81% to 52.84% in non-light rail neighborhoods vs. 56.32% to 43.13% in LRTNs). Moreover, the proportion of people with more than 4 years of college education also increased overall between future light rail neighborhoods and non-light rail neighborhoods. The

rise and drop of poverty rates from 2000-2019 are likely due to the economic recession of 2008 which caused poverty rates around the country to rise. When the recession was over, poverty rates fell to a more normal rate.

Analysis

The two questions this study aims to address are: What economic impact does a light-rail transit (shortened to LRT) station have on a neighborhood? If there is an economic impact, does this affect population change?

This study uses a mix of demographic and economic Census data to test these three hypotheses as stated earlier in the paper:

> *Hypothesis 1: Newly developed and desirable infrastructure, such*
> *as a light-rail transit station, will attract an influx of middle to*
> *upper class residents to the area immediately surrounding the*
> *development.*
> *Hypothesis 2: Racially homogeneous areas are less susceptible to*
> *gentrification.*
> *Hypothesis 3: Areas with an increase in access to public*
> *transportation will see positive economic growth.*

To measure the economic impact of LRT, neighborhoods within a half mile of a light rail station (which will be referred to as "LRT neighborhoods" going forward) are compared with other neighborhoods in Mecklenburg County, Charlotte, NC. This study uses Difference-in-Differences (DD) models and a binary logistical regression model to test the hypotheses stated above. DD models are useful when testing the effects of new policies, interventions, etc.,

because the model identifies trends over time and compares those trends between treatment and control groups.

 The main assumption of DD models is that the change in the dependent variable would be similar between treatment and control groups if the intervention had not happened. This study's treatment group would be the LRT neighborhoods and the intervention is the opening of an LRT station. While the 2008 recession impacted many of the dependent variables used in this study, the bias is not much of an issue. First because the recession affected all parts of the county, but also because this study primarily looks at the time period after the recession to compare trends. The recovery from the recession is captured in the 2010 and 2019 data. Since the first section of the LYNX Blue line opened in 2007, and this study uses the trends between 2010 and 2019 to capture how LRT affected the surrounding area, if the non-LRT and LRT neighborhoods recovered from the recession differently the LRT station could be given some credit for the disproportionate recovery. Including data from 1990 and 2000 allows enough time for pre-LRT trends to be established by the model to be compared to post-LRT trends from 2010 to 2019.

Once the models were created, the residuals of the DD models were plotted on line plots and histograms to check for heteroskedasticity and autocorrelations. In each plot the residuals were centered around zero and there were not many outliers. The errors are normally distributed. Therefore, the assumptions of this model are met.

The first step in understanding how economic mobility has been impacted by LRT is through Models 1-4a, which are DD models testing how LRT stations have affected the surrounding area's median income, poverty rate, median rent value, and median home value. These models do not control for any population changes and are more of an indication on how

the neighborhood economics have changed after the light-rail was installed, regardless of any individual resident's changes in economic mobility or movement in or out of the neighborhood.

Models 1-4b address the possibility of population changes affecting economic indicators by adding control variables. To understand if changes in median incomes, poverty rates, median rent values, and median home values are related to displacement caused by LRT, controls for the percentage of Black households and adults with more than four years of college education are added to Models 1-4a. Significant coefficients for percent Black households and percent of adults with a bachelor's degree will indicate whether changes in those demographic variables contribute to the change in the dependent variables.

To address the first hypothesis, that newly developed and desirable infrastructure will attract an influx of middle to upper class residents to the surrounding area, changes in the percent of adults with four or more years of college education in Census tracts containing LRT stations are compared to changes in Census tracts without LRT stations in Model 5. College degrees are commonly used to indicate a person's socio-economic status because it is a strong measurement of cultural and human capital. On average, having a college degree also tends to lead to higher incomes (Department of Labor 2021). Therefore, changes in educational attainment in Census tracts with LRT stations that differ from Census tracts without LRT stations can be an indication of how influential the LRT station is in changing educational outcomes.

One issue with looking at the change in the proportion of college educated people is that over time people can earn degrees; therefore, the models testing population changes over time should also be used with dependent variables that are unchangeable over time. Models 6 and 7 further test population changes with DD models using the percent of Black households and percent of white households as the dependent variables. These models test if there is a

relationship between LRT neighborhoods and changes to the percent of white and Black

households in those neighborhoods prior to LRT implementation.

A binary logit model is used for Models 8a-c to get an understanding of how LRT might

have affected majority-minority neighborhoods, since research has shown that gentrification is

less likely in neighborhoods that are racially homogeneous (Yonto and Trill 2020). Using the

dummy variable indicating LRT neighborhoods as the dependent variable, Model 5 tests if there

is a relationship between the racial composition of Census tracts, and the likelihood of those

tracts acquiring an LRT station. This model addresses Hypothesis 2.

CHAPTER 8: RESULTS

Table 2. – Difference-in-Differences Models Testing Economic Change Over Time

	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b
DV:	Median HH Income	Median HH Income	Poverty Rate	Poverty Rate	Median Rent	Median Rent	Median Home Value	Median Home Value
Intercept	3966***	-3254**	-0.0267***	0.0035	-256.8***	-392.2***	-67487***	-109045***
	(595.1)	(1129)	(0.0029)	(0.0056)	(7.8)	(14.41)	(3047)	(5787)
LRTN	-4471**	-4128**	0.0093	0.0082	13.8	-1.7	4839	4491
	(1501)	(1468)	(0.0073)	(0.0072)	(13.3)	(18.57)	(7777)	(7559)
Time	-7932***	-13906***	0.0534***	0.0782***	513.6***	408.1***	134975***	101246***
	(842)	(1092)	(0.0041)	(0.0054)	(11)	(13.9)	(4309)	(5591)
DID	8942***	9354***	-0.0186 .	-0.0205*	-27.5	-8.6	-9678	-5792
	(2123)	(2032)	(0.0103)	(0.01)	(27.3)	(25.7)	(10998)	(10500)
% HH Black		6594**		-0.0288**		200.1***		46600
		(2030)		(0.01)		(25.8)		(10455)
% Col. Edu.		26505***		-0.1096***		426.7***		144551
		(2904)		(0.0143)		(37)		(14875)

. p < .1. * p < .05. ** p < .01. *** p < .001.

Household Income

Model 1a tests how the LRT station impacts household income overall where the dependent variable measures household income in 2010 dollars and is centered around zero, *LRTN* is the LRT neighborhood indicator with 1 indicating an LRT neighborhood, *Time* is a dummy variable with 1 indicating the years 2010 and 2019 (after the light rail implementation), and *DID* is an interaction between *LRTN* and *Time*.

Model 1a indicates through the negative coefficient for *LRTN* that household income is lower in LRT neighborhoods than others overall. Model 1a shows that about 9 percent of the variance in household income can be attributed to LRT with an adjusted R squared of 0.0867. The significant coefficient for *DID* is indicative of a positive relationship between household income and introducing an LRT transit station to a neighborhood. In other words, income in LRT neighborhoods have increased at a greater rate than non-LRT neighborhoods. This result gives support to both Hypothesis 1 and 3. The increased income in LRT neighborhoods could be a sign that upward economic mobility is increasing, however it could also be a sign that people with higher incomes are moving into LRT neighborhoods. The next step is to test for displacement.

Model 1b adds covariates for the percentage of Black households and the percentage of people with 4 or more years of college education to Model 1a. The significance of the DD indicator increases after controlling for these variables. Furthermore, the adjusted R squared increased in this model to 0.175, which signals that the controls added to this model help explain some of the variance in household income.

Poverty Rate

Models 1a and 1b were calculated using the poverty rate for each Census tract as the dependent variable in models 2a and 2b. Model 2a accounts for 16 percent of the variance in poverty rates (Adjusted R-Squared=0.1654). Model 2a shows that overall, the poverty rate increased slightly over time in Mecklenburg County. However, the coefficient for *DID* is negative although it is not statistically significant at the 0.05 alpha level (p-value=0.0719). There is a chance that the poverty rate increased at a slightly lower rate in LRT neighborhoods than in non-LRT neighborhoods. Although the coefficient for poverty rate in Model 2a is not significant enough to conclude that the effect from the light rail was strong.

The variable *DID* does become statistically significant at the 0.05 alpha level when controls are added to the model. A greater proportion of variance in the poverty rate is also captured in Model 2b compared to Model 2a (Adjusted R-Squared=0.2218). The statistically significant positive coefficient for *Time* once again confirms that the overall poverty rate for Mecklenburg County has increased over time. When changes in the percent of Black households and the percent of people with 4 or more years of college education are controlled for, the negative relationship between poverty rate and LRT neighborhoods becomes more statistically significant. Despite the idea that development can increase the cost of living, thus, also increasing the rate of poverty, it appears that LRT has played a role in decreasing poverty rates in

LRT neighborhoods. The next step is to repeat these tests to see how LRT impacted housing and rent costs in Models 1c-d and Models 2c-d.

Cost of Living – Median Home Values & Median Rent

Surprisingly, Models 3a-b and Models 4a-b do not find statistically significant relationships between median home values or median rents and LRT neighborhoods. Models 3a-4a and 3b-4b both show statistically significant and positive relationships between *Time* and the median cost of rents and home values; however, the DD indicator is not significant in either set of models. Charlotte has had a number of luxury condos built in recent years. Some of the developments are along the light-rail line, while other developments are in other parts of the city. The overall cost of housing has also been rapidly increasing in the city. It is possible that the overall trends for increasing home and rent values in the Charlotte area are strong enough that the location's proximity to an LRT station had no effect on housing costs. In other words, the cost of living measured by rent and home values has increased so dramatically that there are no statistically significant differences in those costs between LRT neighborhoods and non-LRT neighborhoods.

Population Changes

Table 3. – DID Models Testing for Displacement

	Model 5	Model 6	Model 7
DV:	% Col. Edu.	% HH Black	% HH White
Intercept	0.2212***	0.2053***	0.7506***
	(0.0088)	(0.0127)	(0.0137)
LRTN	-0.0683**	0.2226***	-0.2490***
	(0.0223)	(0.0319)	(0.0345)
Time	0.1986***	0.1078***	-0.2036***
	(0.0125)	(0.0179)	(0.0193)
DID	0.0192	-0.1397**	0.1238*
	(0.0316)	(0.0452)	(0.0488)
. $p < .1$. * $p < .05$. ** $p < .01$. *** $p < .001$.			

Models 5, 6, and 7 test for population changes before and after LRT development. Coefficients and standard errors for models 5 through 7 are shown above. The coefficient for *LRTN* in Model 5 is negative and significant. This shows that there were significantly fewer people with four or more years of college education pre 2010 in Census tracts near light rail stations, however it does not appear that there were significant changes as a result of the LRT station's implementation, despite the idea that college educated "knowledge workers" are more likely to be attracted to new public amenities (Glaeser et al. 2000, Stewart 2003).

Model 6 yielded a positive coefficient for *LRTN* and Model 7 produced a negative coefficient for *LRTN.* According to these models, the proportion of Black households in LRT neighborhoods appears to have decreased while the proportion of white households has increased. Models 6 and 7 signal that there were significant changes in the percentage of Black and white households after the LRT stations opened. These findings are an indication that the displacement of residents did occur in LRT neighborhoods. These results give support to Hypothesis 1, that newly developed infrastructure will attract higher income residents, while at the same time reduces support for Hypothesis 3, that access to transportation will increase upward mobility. This is likely because population changes might be accounting for some of the increased income in LRT stations, rather than the rail line aiding the existing resident's income growth. Although the median income in LRT neighborhoods rose over time, it is difficult to say if the original residents of these areas experienced upward economic mobility when displacement is a concern.

Light-Rail Likelihood for Mixed Race Neighborhoods

Table 4. – Binary Logit Models Testing Neighborhood Type Vulnerability

	Model 8a	Model 8b	Model 8c
DV:	LRTN	LRTN	LRTN
Intercept	-2.1041***	-1.9677***	-2.2615***
	(0.2735)	(0.2961)	(0.3342)
Mixed Race Dummy[a]	0.8582*	0.7217 .	0.8850*
	(0.3689)	(0.386)	(0.4079)
High Col. Edu. Dummy[b]		-0.7404	-0.4466
		(0.788)	(0.8031)
High Poverty Dummy[c]			1.8313**
			(0.5823)

a <70% wht. & blk households in 1990 & 2000
b >= 30% Col. Edu. People in 1990 and 2000
c >= 25% Poverty Rate in 1990 and 2000
. p < .1. * p < .05. ** p < .01. *** p < .001.

Model 8a tests if there is a relationship between LRT neighborhoods, and neighborhoods that consisted of less than 70 percent white or Black households before 2010. The coefficient for *Mixed Race Dummy* is positive and significant in Model 8a. Therefore, according to this model, neighborhoods that were mixed race before 2010 were likely to turn into LRT neighborhoods. This finding is consistent with the work of Hwang and Sampson (2014) who find that gentrification is less likely to occur in single race neighborhoods, and more likely to occur in mixed race neighborhoods.

Model 8b adds an independent variable identifying areas that consisted of more than 30% of the population with four or more years of college education before 2010. The coefficient for the variable representing areas where more than 30% of the population has four or more years of college education is not significant. Including this variable in the model also reduces the significance of the variable representing mixed race areas before 2010.

Including the control for poverty rate in Model 8c increases the significance of the mixed-race variable, showing that there is a relationship between areas with less than 70 percent white or Black households before 2010, and where LRT stations opened. The significance of the

variable indicating areas with high rates of college educated people is unchanged from Model 8b

in Model 8c.

CHAPTER 9: DISCUSSION

Overall, the LYNX Blue Line light rail in Charlotte, NC did have some effects on the economy and population. The median household income adjusted for inflation showed disproportionate increases in LRT neighborhoods even though the income had decreased over time for the entire county. Poverty rates also declined in LRT neighborhoods while increasing over time for the entire county. The light rail had no effect on median rent and home values. There was a strong relationship between time and the costs of rents and home values. As mentioned earlier, it is likely housing costs rose so dramatically throughout the Charlotte area over time that any effects from the light rail were negligible.

When testing for population changes in LRT neighborhoods, findings show that the percentage of white residents decreased overall in Mecklenburg County from 1990 to 2019 while the percentage of Black residents increased throughout the county; however, the opposite was true in LRT neighborhoods after the light rail was implemented. LRT neighborhoods saw a 13% decrease in the Black population and a 12% increase in the white population after the year 2000. The light rail had no effect on the amount of people with 4 or more years of college education in LRT neighborhoods.

Since there were significant population changes in LRT neighborhoods, incomes rose, and poverty rate declined, these findings indicate that the light rail attracted people with higher incomes to the areas immediately surrounding light rail stations. Since white people tend to have higher incomes on average than other races in the United States (Shapiro et al. 2013), the increases in the proportion of white residents and decreases in the proportion of Black residents give support to Hypothesis 1 that states new desirable infrastructure attracts middle to upper class residents to the area immediately surrounding the development.

Models 6-8 give support to Hypothesis 2 that racially homogeneous areas are less susceptible to gentrification. LRT neighborhoods were corelated with census tracts that contained less than 70% white and Black households. This is consistent with Hwang and Sampson's (2014) research stating that gentrification is most likely to occur in racially diverse neighborhoods. While the two dominant races in Charlotte are white and Black, Charlotte has more diversity that goes beyond the white-Black dichotomy It is possible that these results may differ when including other racial data into the model.

Support for Hypothesis 3, that areas with an increase in access to public transportation will see positive economic growth, is mixed. While LRT neighborhoods did see positive economic gains in terms of median incomes increasing and poverty rates decreasing, that does not necessarily mean that the light rail improved the quality of life and decreased transportation related costs for residents of the area. Without the population changes, it could have been assumed that the existing residents are who experienced the increases in income. However, the significant population changes in LRT neighborhoods make it hard to tell if the light rail has improved the existing resident's economic conditions.

CHAPTER 10: CONCLUSION

This study shines a light on how Charlotte's efforts to transform the city and address transportation and economic mobility issues have impacted the areas surrounding LRT stations. Studying the effects of LRT development and how it can affect neighborhood demographics and individual economic measures can lead to an important conversation about who benefits most from these types of infrastructure projects. Theoretically, increasing an areas access to transportation should increase access to employment opportunities for low-income people. This study found that the median household income in areas surrounding LRT stations increased even after controlling for the percentage of Black households and people with 4 or more years of college education.

This study is really a story of the unintended consequences of public policy. It is important to understand whether or not LRT has helped the long-term residents living along the rail line, or if something else, such as gentrification, has offset the benefits LRT provides. This study did identify population changes among different racial groups, although the possibility that the change is a temporary issue is there. Future research should replicate the models used in this study to see if the relationships identified in this study remain after a longer period of time.

CHAPTER 11: LIMITATIONS

The main limitation of this study is not being able to account for the various types of LRT stations that were built along the LYNX Blue Line. The LYNX Blue Line spans the length of the city and crosses many different types of neighborhoods. It also uses a mix of park-and-ride stations and walk-and-ride stations. It is conceivable that different areas would respond differently to the LRT stations, and those responses could vary depending on what kind of station it is. Furthermore, different sections of the LYNX Blue Line were opened at different points in time. The first section of the rail line was opened in 2007, but the final station was not completed until 2018. It is likely that the announcement of the light rail plans catalyzed other development plans and gentrification prior to any LRT construction; however, the full effect of the light rail may not be captured by the models used in this study because of some of the station's recent openings.

Another limitation of this research is the way heterogeneity of neighborhoods is accounted for. The parallel trends assumption for difference-in-differences models states that the treatment group (neighborhoods that light-rail stations were opened near in this case) would progress similarly to non-treatment groups absent of treatment. It could be the case that something else going on in Charlotte over the past 3 decades could have changed the trajectory of some areas and not others. This study attempted to control for those differences to isolate the effects of the light rail by using fixed effects models.

The final limitation present in this study are the cutoff thresholds chosen for the independent variables in the binary logit models. These thresholds were not chosen based on standard practices. For example, the mixed-race variable created for these models identified census tracts with less than 70 percent white and Black population. A more accurate measure of

mixed-race neighborhoods could use different percentages for different races based on theories on how many minorities it takes before real-world impacts (ex. White flight, culture change, etc.) begin to occur in a neighborhood.

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