Riding tandem:

Does cycling infrastructure investment mirror gentrification and privilege in Portland, OR and Chicago, IL?

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Abstract

Bicycles have the potential to provide an environmentally friendly, healthy, low cost, and enjoyable transportation option to people of all socio-economic backgrounds and demographics. Increasingly, however, the ways in which cycling culture is manifested in North American cities is being questioned on the grounds of transportation equity through concerns over gentrification and the cooption of cycling culture to promote the agendas of the privileged class. This research assesses the geographic distribution of cycling infrastructure with regard to community demographic characteristics to better understand claims that cycling investment arrives in tandem with gentrification and incoming populations of privilege. Using a mix of census data and municipal maps of cycling infrastructure in Chicago and Portland from 1990 to 2010, this study creates gentrification and cycling infrastructure investment indexes. Linear regression models determine the extent to which these two elements are related. The findings reveal that there is indeed a bias towards cycling infrastructure investment in areas of privilege, whether due to gentrification or pre-existing conditions. This paper does not attempt to analyze specific aspects of gentrification such as displacement; instead it shows concrete evidence that marginalized communities are unlikely to attract cycling infrastructure investment without the presence of the gentry. To alleviate the continuation of inequitable distributions of investment, it is proposed that planning processes both actively seek out diverse stakeholders and be sensitive to citywide community input in future active transit projects so that reinvestment is achieved through bottom-up processes of revitalization rather than the impositions of gentrification.

Résumé

Le vélo peut potentiellement être un mode de transport durable, sain, à faible coût et agréable pour les personnes de tout type de milieux socioéconomiques et démographiques. Cependant, la manière dont la culture cycliste se manifeste dans les villes d'Amérique du Nord est de plus en plus remise en question en raison d'enjeux d'équité en matière de distribution des infrastructures de transport. Le phénomène de l'embourgeoisement lié à l'ajout d'infrastructures cyclables inquiète ainsi que l'utilisation de la culture cycliste par les classes privilégiées pour subtilement promouvoir leur agenda politique. Cette recherche évalue empiriquement la répartition géographique des investissements en infrastructures cyclables en tenant compte des caractéristiques démographiques des collectivités afin de mieux comprendre les allégations supposant que ces investissements mènent à l'embourgeoisement, et à l'arrivée d'individus privilégiés. À l'aide de données de recensement et de cartes municipales montrant l'évolution des infrastructures cyclables à Chicago, IL et Portland, OR entre 1990 et 2010, cette étude développe un indice d'embourgeoisement et d'investissement en matière d'infrastructures cyclables. Une régression linéaire est utilisée pour déterminer dans quelle mesure ces deux éléments sont reliés. Les résultats révèlent qu'il y a effectivement un biais positif de l'investissement en matière d'infrastructures cyclables dans les zones privilégiées, que ce soit en raison de l'embourgeoisement ou de conditions préexistantes. Ce document ne cherche pas à analyser les aspects plus spécifiques de l'embourgeoisement comme le déplacement de population. Bien au contraire, cette étude démontre que les communautés marginalisées sont peu susceptibles d'attirer des investissements en infrastructures cyclables en l'absence d'individus aisés. Pour remédier à cette distribution inéquitable des investissements en infrastructures cyclables, il est proposé que les processus de planification et de détermination de l'emplacement des projets de transport actif impliquent un plus grand nombre d'acteurs et d'intervenants, tout en étant plus sensibles aux intérêts de la ville dans son ensemble. L'objectif étant que le processus de détermination des futurs investissements soit dirigé par un processus ascendant (*bottom-up*) de revitalisation plutôt que par l'embourgeoisement.

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Introduction

Bicycles have great potential to be an equitable and sustainable mode of transit. By reducing pollution and automobile dependence, cycling can help mitigate greenhouse gas emissions as well as local air pollutants that cause serious health risks. Bicycles have low initial and maintenance costs and there is evidence that encouraging cycling can boost local businesses (League of American Bicyclists, 2012). Cycling infrastructure, including lanes, parking or bicycle share programs, can go a long way towards generating a safe and inviting environment where users of all abilities have high access to opportunities and services.

Given these advantages, it is perhaps surprising that cycling advocacy is increasingly being questioned from an ethical perspective. Certainly, the act of cycling has many benefits and protected bicycle lanes have been identified by the 2015 Building Equity report as a catalyst for equitable transportation in North American cities that have been shaped by racial, ethnic and socioeconomic segregation (Andersen and Hall, 2015). Cycling infrastructure investment is an essential part of creating just active transportation networks in our cities. However, the seemingly progressive and inclusive culture of cycling is not immune to the historic disparities of North American social geography. Current patterns of investment and exclusionary decision-making processes perpetuate existing disparities along lines of class and race by catering disproportionately to the needs and desires of the privileged class.

A simple internet search reveals a slew of online newspaper and blog articles with titles such as: *Do Bike Lanes Gentrify Neighborhoods?* (Courtney, 2014); *Are Bike Lanes Expressways to Gentrification?* (Davis, 2011); *On Gentrification and Cycling* (Schmitt, 2011); and *The (re)gentrification of cycling* (Urban MythPrint, 2013). These articles repeatedly point to the predominance of mainstream cycling as a White activity, especially among affluent males, and the grievances of low-income and minority communities undergoing gentrification who see cycling culture as contributing to the processes of rising costs of living, displacement, and the undermining of established local cultures. The academic literature builds on these critiques by discussing underlying socio-political factors associated with gentrification, "white" cycling culture, and ongoing inequities in urban transportation networks and decision-making processes (Stehlin, 2015; Hoffman and Lugo, 2014; Lubitow and Miller, *Contesting Sustainability: Bikes, Race and Politics in Portlandia,* 2013).

To better understand claims that investment arrives in tandem with gentrification and incoming populations of privilege (and conversely, does *not* arrive in marginalized communities seeking safer active transit), this research empirically assesses the distribution of cycling infrastructure investment and community demographic characteristics in Chicago, IL and Portland, OR. Using geographic information systems (GIS) and a mix of census data and municipal maps of cycling infrastructure from 1990 to 2010, this study creates gentrification and cycling infrastructure investment indexes. Linear regression models assess the relationships between investment and

demographics, considering changes in community composition over time due to gentrification as well current levels of privilege.

The paper begins with a literature review outlining evidence of cycling infrastructure investment mirroring gentrification and privilege and explains why these patterns are problematic. Next, the methodology is explained, followed by the analysis results and a discussion of their significance. Finally, the paper concludes with a brief outline of policy lessons and strategies aimed at mitigating the continuation of investment disparities.

Literature review

Gentrification defined

Characterized by investment in historically disinvested urban areas, gentrification is often realized through an influx of young, educated, artistic or "creative class" individuals seeking low rent and exciting cultural environments in low-income and, often, minority communities. This first wave of community change is followed by further investment as the area is recognized as up-and-coming. An often-cited definition of gentrification comes from Smith (1998) as:

> *"the process by which central urban neighborhoods that have undergone disinvestments and economic decline experience a reversal, reinvestment, and the in-migration of a relatively well-off middle- and upper middle-class population" (p. 198).*

Rising living costs, displacement of long-term residents and the loss of established culture are very real concerns for gentrifying communities (Atkinson, 2000; Guerrieri et al., 2013; Hoffman and Lugo, 2014). This paper focuses on identifying changes in community composition associated with gentrification (an increase in the population with some college education, for instance) without attempting to discern the subtleties of displacement or voluntary mobility. The goal of focusing on who is coming *into* the community is to demonstrate how privileged populations shape our cities by attracting investment.

Displacement and discontent

Increasingly, cycling is being adopted by environmentally and socially conscious millennials but, as cycling becomes more and more popular, it is also viewed as a keystone activity of the demographic often present in the first waves of gentrification. In his 2013 paper *Regulating Inclusion: Spatial Form, Social Process, and the Normalization of Cycling Practice in the USA*, Stehlin describes how Valencia Street in San Francisco is a center for gentrification, cycling activity and investment in San Francisco. Following reinvestment efforts on Valencia Street, many businesses that had catered to the primarily working-class, Latino demographic of the neighborhood were replaced by trendier, primarily White-owned options. New traffic lights and bicycle corrals have been installed at a much higher rate than the rest of the city. A few blocks away, the remaining Latino population cycles without bicycle lanes on heavily trafficked streets.

Resentful communities perceive cycling as a harbinger of gentrification and its

associated hardships, and bicycle lanes have even been labeled the "white stripes of gentrification" (interview with Paige Coleman, director of the Northeast Coalition of Neighborhoods, Mirk, 2009). Active transit projects must be ready to address both real and perceived contexts of injustice voiced by marginalized communities.

Perceptions of cycling culture

Valencia Street is an overt example of investment following gentrification and, in this case, displacement. In other instances, cycling culture itself is used to shape public spaces to fit the agendas of the gentry, undermining marginalized groups who cycle. On the one hand, cycling is considered a sign of poverty and a last option for those without enough capital to invest in a private automobile. Conversely, cycling has also been deemed the pet of affluent, White, educated professionals.

Hoffman and Lugo (2014) describe the situation in Minneapolis where the Greenway system (a former railroad corridor converted to off-street bicycle lanes) was once a place for marginalized individuals to congregate, primarily the Native American population. The space was transformed by the city to attract the "creative class"-- young professionals associated with a growing economy-- and pursue an image as a global leader in sustainability. Through increased police presence, members of marginalized groups who used the public space in ways that did not fit the cultural experiences of the gentry, whether by congregating, sleeping, or even riding bicycles, were removed from the "blighted" area to make way for the more desirable, and notably White, cycling culture.

In this example, both perceptions of cycling culture are at work, transforming public space into exclusive space. The desired demographic who cycles is encouraged to use the Greenway through municipal investment. To further promote an atmosphere suitable for creative class cyclists, other users who do no adhere to the privileged class's experiences and perceived appropriate uses of the public space are removed. Even members of the undesired demographic who cycle are perceived as contributing to the "blighted" characteristics of the Greenway.

Common good projects and capturing the creative class

Cycling and other sustainable initiatives are touted as altruistic endeavors for the common good but must still be approached with caution. "Common good" projects allow advocates to avoid hard discussions of justice by pushing forward with projects that are intended to improve sustainability, livability or safety without acknowledging the desires of original community members or the historic contexts of racial and class tensions (Hoffman, 2013). Additionally, Checker (2011) asserts that environmental gentrification can appear politically neutral, consensus-based and ecologically and socially sensitive, while in practice being profit-driven (p. 210).

Active transit projects are used by cities to boost the local image and create an environment attractive to the "creative class" (Lubitow and Miller, *Contesting Sustainability: Bikes, Race and Politics in Portlandia,* 2013). Cycling culture and the ubiquitous promise of livable, green, vibrant communities and robust commercial sectors are an attractive goal for local government but are not deemed achievable in

disinvested communities who have not undergone at least the first waves of gentrification. Some disinvested communities are reshaped to fit a "sellable" image at the expense of at-risk populations, while non-gentrifying disinvested communities, with already weak political agency, face huge hurdles when trying to capture limited active transportation funding.

Supply and demand

It is tempting to think that demand-based decision-making, as a function of cyclist density and culture, can provide an unbiased guide for where cycling investments should be made. Relying purely this type of model ignores the historical context of how and why social geography in North American cities has been shaped. Marginalized communities are often pushed out to the low-density urban fringe or undesirable locations (such as alongside highways), manifesting in riding conditions that dissuade riders and create latent demand.

In a striking set of statistics, the 2015 Building Equity report (Andersen and Hall, 2015) states that 20 percent of bicycle commuting in the United States is conducted by the richest income quartile while 39 percent is conducted by the poorest quartile. Pucher and Buehler (2011) also found that the lowest quartile of household incomes in the United States have the highest share of cycling trips and the share of Black, Latino and Asian riders have all increased from 2001 to 2009. The American Community Survey, which only reports commuters, and cycling count studies that focus on major cyclist

routes do not accurately reflect latent demand and those who have been referred to as subaltern cyclists (Stehlin, 2013; Lugo, 2015).

Finally, Hispanic cyclists, followed by Black, are most likely to die in a bicycle accident (1999-2011) (Centers for Disease Control and Prevention, 2014 referenced in Andersen and Hall, 2015). Although little research was found specifically addressing the issue of race or ethnicity and cycling safety, the high rate of fatalities among Hispanic and Black riders is likely due to the fact that infrastructure and safety measures are concentrated in predominantly White areas.

With such high rates of cycling among low-income neighborhoods and communities of color, there is a clear disconnect between demand and supply of cycling infrastructure. The Portland Bureau of Transportation North Williams Traffic Operations Safety Project has become a poster child for the type of racial tensions and grievances that can arise when inequitable distribution is followed by investment only once there is an influx of the privileged population. North Williams Portland was the site of aggressive redlining and disinvestment where processes of marginalization and exclusionary planning created an environment ripe, half a century later, for gentrification. Incoming gentry, typically White, well educated and affluent, to the North William's area have been accompanied by an increase in active transit investment (Lubitow and Miller, *Contesting Sustainability: Bikes, Race and Politics in Portlandia,* 2013).

The North Williams Traffic Operations Safety Project is a bicycle lane improvement effort to increase safety along a major cycling commuter route. Advocates believed that

the "common good" project would move ahead easily. However, at public meetings regarding the project in 2011, community frustration about the planning process came to light. At one meeting, Sharon Maxwell-Henricks demanded to know why, "You say you want it 'safe' for everybody, how come it wasn't safe 10 years ago? That's part of the whole racism thing…we wanted safe streets back then; but now that the bicyclists want to have safe streets then it's all about the bicyclists getting safe streets" (Maus, 2011, para 22).

Lubitow and Miller (*Contesting Sustainability: Bikes, Race and Politics in Portlandia,* 2013) conclude,

> *"On the one hand, decision makers working for the city of Portland developed a narrative around bicycle lane expansion that highlighted the importance of improving safety on the street, reducing accidents and promoting ease of movement for cyclists and commuters. On the other, long-time African American residents responded to the city's framing of the project by articulating a competing narrative that acknowledged an extensive history of exclusionary development, displacement, and gentrification in the area" (p. 124).*

Safety improvements have been universally desired in North Williams- unfortunately, the difference between inaction and action seems to have come down to *who* was requesting the improvements.

In Chicago, a different supply and demand controversy has arisen around the

distribution of the docking stations for Divvy Bicycles. The bicycle share program, which launched in June 2013, was initially questioned when West and South Side Chicagoans realized that the vast majority of stations would be located near the lake shore or in the more affluent North Side region. In fact, there are so few stations in the South Side that the average trip length of rides originating or terminating in the South Side is over half an hour (calculated from Divvy 2013 ridership data) (Divvy Bikes, 2015). The bicycle share pricing scheme is such that a rider can take as many rides per day as desired using a yearly membership or a $7 per day pass, so long as the trip is less than half an hour in length. After the 30-minute mark, the rider begins to incur additional costs at a rapid pace; a high density of stations is essential for successful bicycle share usage. The burden of limited station availability and the resulting additional costs for bicycle share users is particularly disturbing given that South and West Side Chicago are predominantly low-income, non-White areas.

Following critique from community organizations such as Bronzeville Bikes, a South Side cycling advocacy group, the city and Divvy have made efforts to increase citywide access to the program, but much work remains to be done. Divvy is set to expand throughout the summer of 2015, growing from 300 to 476 stations, but still will only serve about 56% percent of the city's population, according to Sean Wiedel, assistant commissioner of the Chicago Department of Transportation (Vivanco, 2015).

Current decision-making processes seemingly continue to ignore the demands of marginalized communities. Marven Norman from Inland Empire, California, stated in an

interview for the 2015 Building Equity report that cycling infrastructure goes "perpetually to those who have the time and the resources to ask for and demand the goods from the government" (Andersen and Hall, 2015, p. 9), leaving disinvested communities behind once again.

Bicycle ridership and proximity to amenities

Proximity to amenities and destinations, such as employment locations, services, or transit stations, can lead to increased walking and cycling. Moudon et al. (2005) performed a cross-sectional study of randomly sampled respondents in Washington and found that proximity to desirable destinations (offices, clinics, and restaurants) is a significant factor for ridership, and that transit riders are more likely to also be cyclists. Tools used to help bike share programs optimize locations for stations focus on population and job density (Gregerson et al., 2010). Looking at monthly bicycle share station usage, Rixey (2013) found that population and job density are significant factors affecting ridership. In Montreal, Faghih-Imani et al. (2014) assessed BIXI bicycle share ridership, using minute-by-minute data of each station. The authors considered weather, time of travel (hour and day), and the distance from each station to the central business district (CBD) and points of interest throughout the city.

The convergence of active transit infrastructure investment around high destination and population densities would imply a more unbiased, although not necessarily equitable, geography of cycling infrastructure and is an important factor to be considered in this study. As discussed earlier, models relying purely on density ignore historic factors that

have created current urban social geographies and as such, an equitable distribution of cycling facilities and infrastructure must go beyond density and actively seek to benefit marginalized communities.

Justification

The literature review for this study has attempted to give an overview of the many complex factors that create disparities in the geography of cycling investment and how those investments are implemented to disproportionately benefit privileged groups. Many references to the relationships between cycling culture, gentrification and marginalized communities were found, however, little attempt appears to have been made to quantify these relationships to better understand patterns and characteristics of areas of investment. This study hopes to address this angle of the research by assessing claims that cycling investment is disproportionately implemented in privileged or gentrifying areas.

Hypothesis

It is hypothesized that cycling infrastructure investment is not equitably distributed throughout the two study cities and is concentrated in areas that are currently privileged or experiencing an in-migration of privileged “gentry”.

Methodology

Study Areas

Due to the presence of both a strong cycling culture and a history of socioeconomic segregation in each location, the two study areas analyzed were Portland, OR and Chicago, IL, as defined by their respective city boundaries and assessed at the census tract level. Portland is an interesting case study because of its reputation as a cyclist's haven and rapid gentrification. The city has been listed as the most gentrified in the country according to the 2009-2013 American Community Survey and US2010 Longitudinal Tract Data Base data (Maciag, 2015). Chicago, on the other hand, has a robust bicycle share program and a much larger and more racially and ethnically diverse population. Analyzing the circumstances in each city allowed for some generalizations to be made while also capturing area-specific attributes.

Cycling infrastructure index

This research relied on a mix of methodologies to provide a comprehensive empirical look at cycling infrastructure investment and gentrification at the census tract level. The cycling infrastructure investment variable was calculated as a gradient measure of bicycle lanes, bicycle parking, and bicycle share stations (Chicago only). Bicycle lane data matching census years as closely as possible were obtained: 1991, 2001 and 2012 for Chicago (City of Chicago, 2015) and 1990, 2000 (Geller, 2012) and 2010 (CivicApps, 2015) for Portland. The Chicago 1991 and 2001 maps and Portland 1990 and 2000 maps

were unavailable in usable formats and had to be digitized by hand for analysis in ESRI ArcGIS. While the maps all included some level of identification between off-street trails, bicycle lanes, or recommended routes, some assumptions were made in the creation of the bicycle lane shapefiles. Only off-street trails and bicycle lanes (including buffered bicycle lanes, cycle tracks, and boulevards) were included in the final models, while routes classified as "recommended" were excluded.

For bicycle parking, 2010 data for Portland (CivicApps, 2015) and 2012 data for Chicago (City of Chicago, 2015) were found, but no historic data. Chicago's Divvy bicycle share program rolled out in 2013 (Divvy Bikes, 2015); Portland does not currently have a bicycle share program, although one is expected to launch in 2016. For analysis, the bicycle share stations and bicycle parking locations are included in the infrastructure index as a measure of "current conditions".

To account for census tract size, a measure of change in relative bicycle lane coverage [(km bicycle lanes 2010 – km bicycle lanes 1990)/km^2 census tract area] was calculated. Similarly, bicycle parking and bicycle share stations are normalized by census tract area for consistency ([bicycle parking count/km^2 census tract area] and [bicycle share station count/km^2 census tract area]). The sum of the z-scores of each indicator (change in relative bicycle lane coverage, current bicycle parking availability, and current bicycle share stations) created a census tract level bicycle infrastructure index used as the dependent variable in the regression models.

Gentrification Index

Gentrification is a difficult phenomenon to quantify and other research has attempted to assess the presence and impact of gentrification in a number of ways. For instance, a recent Harvard study considers municipal structural reinvestment in previously disinvested areas by looking at Google Street View (Hwang and Sampson, 2014), while other studies look at the presence coffee shops (Papachristos et al., 2011) or art festivals (Shaw et al., 2011), seemingly ubiquitous signs of gentrification.

In order to better understand the relationships between privilege and cycling infrastructure, this study assesses gentrification as a gradient of community change over time. By using a liner regression model, the likelihood of cycling infrastructure investment can be understood with respect to different gentrification indicators (1990-2010) and current community demographics (2010).

The 1990 and 2010 data were transposed using census tract relationship files to 2000 census tract geographic boundaries for ease of comparison between years. Census tracts with no household incomes or population (e.g. industrial regions such as airports) were removed and all monetary values adjusted to 2010 dollars (Bureau of Labor Statistics).

Similar to the bicycle infrastructure index, a gentrification index was created using United States Census data from 1990, 2000 and 2010. Gentrification indicators were based on previous research (Bates, 2013; Freeman, 2005; Atkinson, 2000; McKinnish et al., 2010) and measured the change from 1990-2010 for each of the following

attributes: percent White population; percent homeownership; percent population with some college education or higher; median household income; and median home value.

The z-scores of the gentrification variables were calculated and summed to identify areas undergoing the greatest changes associated with gentrification. Figure 1 and Figure 2 show the distribution of bicycle infrastructure and change in community composition based on the gentrification index. Here, the index is referred to as "change in community composition" because it also reflects census tracts that were, for instance, already affluent and experienced a significant increase in income. These areas cannot be considered "gentrifying" because the assumption of initial disinvestment is not met. The maps do, however, give a clear image of bicycle infrastructure distribution and increasing privilege.

Figure 3 and Figure 4 include only census tracts that fall in the lowest income quartile in 1990; this limitation serves as a proxy for initial disinvestment conditions and only these census tracts are eligible for gentrification. Supporting the gentrification index methodology, areas of positive change (gentrification) reflect other findings (Maciag, 2015) while those with the greatest change in the opposite direction reflect "landing zones", potentially due to the relocation of displaced individuals (Friesen, 2015).

Mapping the gentrification index is useful to test whether the methodology for assessing gentrification is justified and to present the relationships between community change and infrastructure visually. The regression models include all census tracts (regardless of initial income in 1990) as well as conditions in 2010 to separate out each

variable and evaluate the characteristics of non-gentrifying marginalized or privileged neighborhoods. Descriptions of all variables used are listed in Table 1.

Table 1: Linear regression model variables

	Independent Variables		
	2010 Conditions	**Change in community composition 1990-2010**	**Description and expected associations**
Distance (constant 1990-2010)	**Distance to downtown****	**N/A**	Distance (km) from the centroid of each census tract to the centroid of the downtown area
	Distance to transit	N/A	Distance (km) from the centroid of each census tract to the nearest CTA station (Chicago) or TriMet MAX light rail or Portland Streetcar station (Portland).
Population density	**Population density****	**Change in population density***	M^2 are used rather than km^2 so the model coefficients better capture the slope of the relationship with the dependent variable. A positive change in population density is expected to reflect an increase in cyclists and, by extension, cycling infrastructure supply.
Gentrification indicators	**% non-White[1]***	**Change in % White population***	An increase in White population concentrations is associated with gentrification.
	% renter occupied units*	**Change in % homeownership***	High rentership rates often are an indicator that gentrification may occur, followed by a switch from renting to homeownership.
	% with some college or higher*	**Change in % with some college or higher***	Higher educational attainment is associated with gentrification.
	%new resident since 2009*	**N/A**	High mobility, whether through displacement or in-migration, is associated with gentrification and changing community composition
	Median home value (per $1000)*	**Change in median home value (per $1000)***	An increase in housing costs is associated with gentrification.
	% unemployed (civilian labor force)*	**not available 1990**	A decrease in unemployment is associated with gentrification.
	Median household income (per $1000)	Change in median household income (per $1000)	Increased affluence is associated with gentrification
	Median age	not available 1990	Lower median age is associated with gentrification.
	Median age^2	N/A	Median age squared is used to reflect the non linear relationship with the dependent variable in the linear model

***indicates the variable is significant in one model**
****indicates the variable is significant in both models**

[1] It is perhaps simplistic to lump all individuals into White and non-White. However, the discussions around cycling culture, gentrification and privilege in North America have largely converged specifically around the dominance of White privilege and norms. As such, the grouping in this instance is seen as justified.

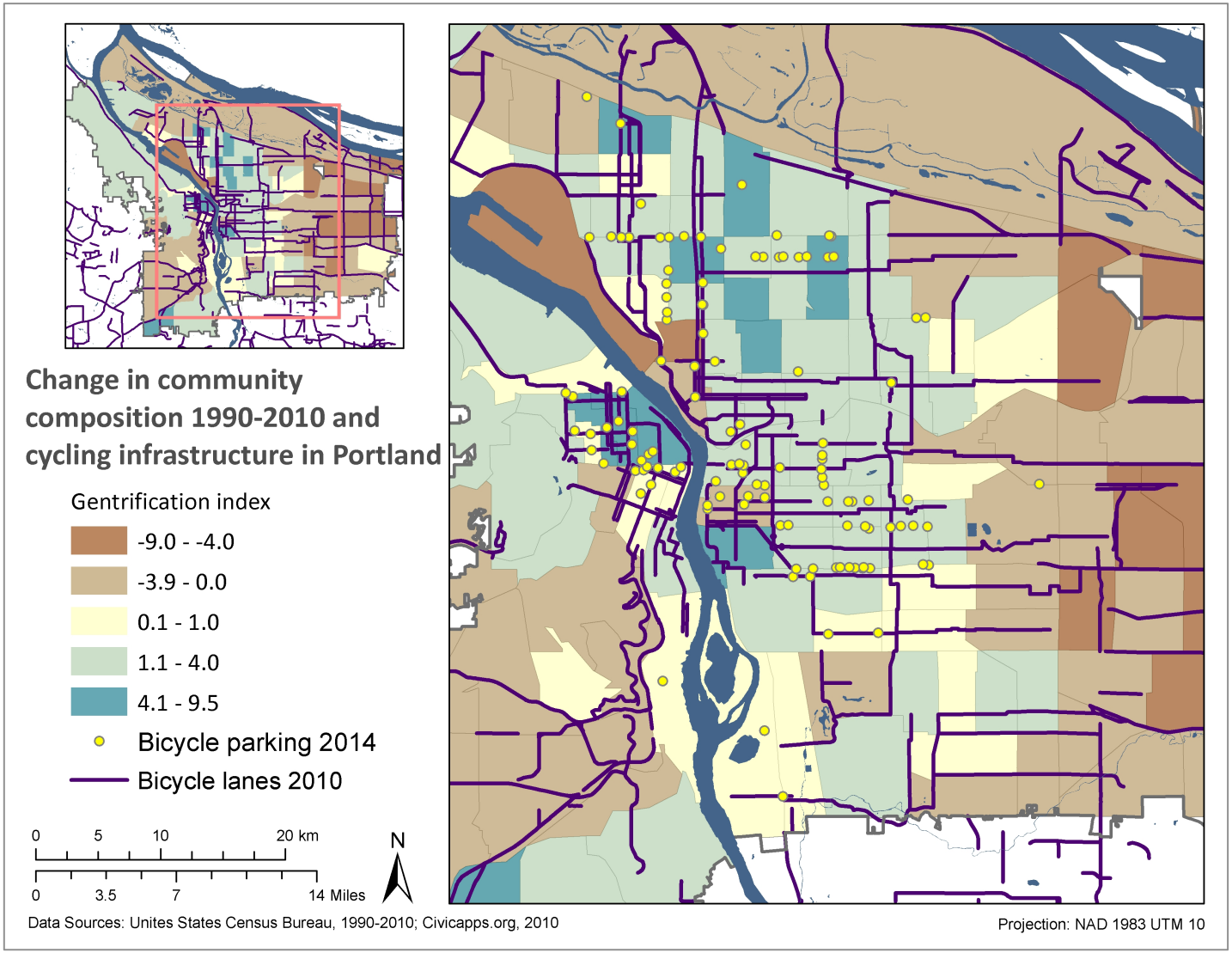

Figure 1: Change in community composition 1990-2010 and bicycle infrastructure in Portland

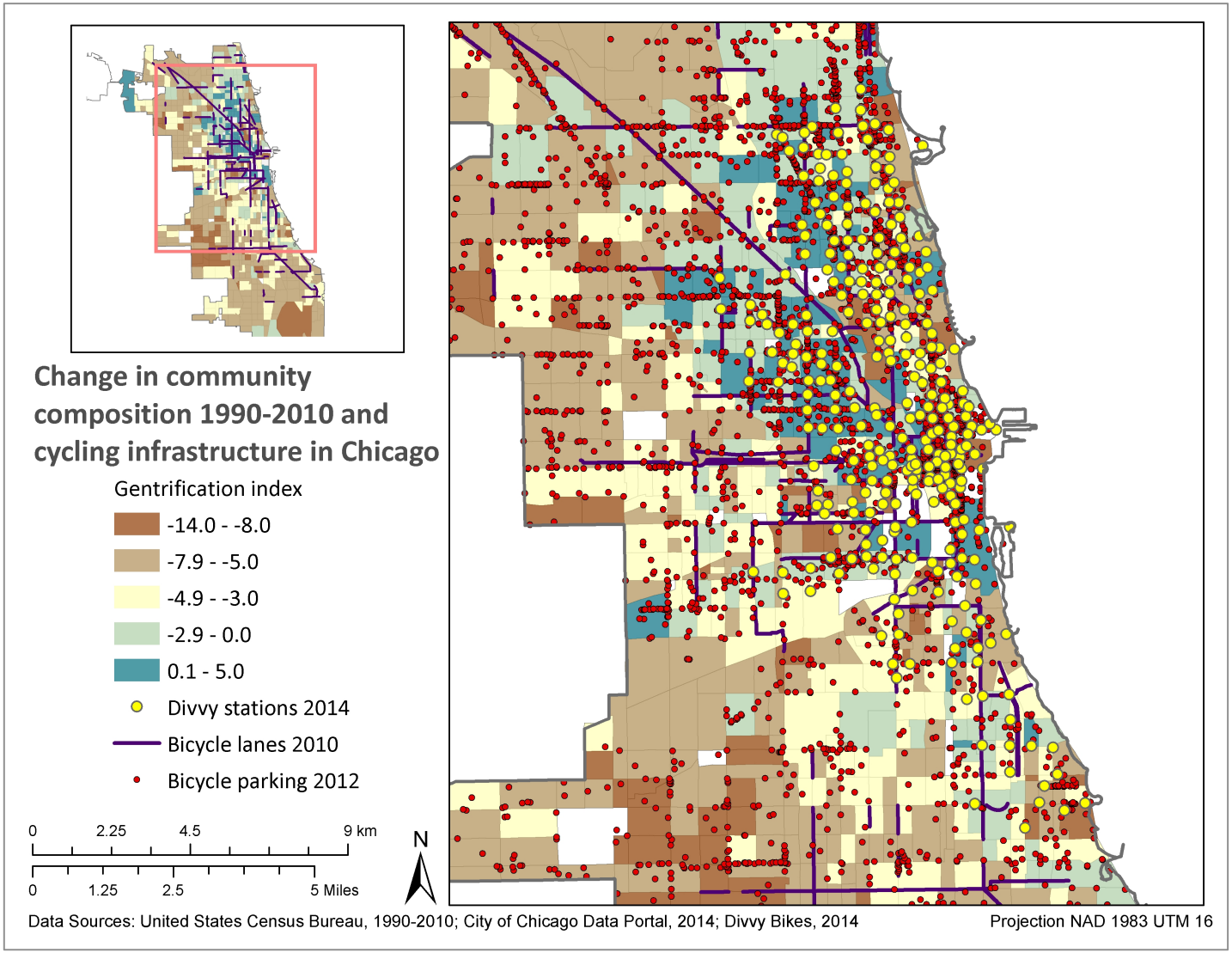

Figure 2: Change in community composition 1990-2010 and bicycle infrastructure in Chicago

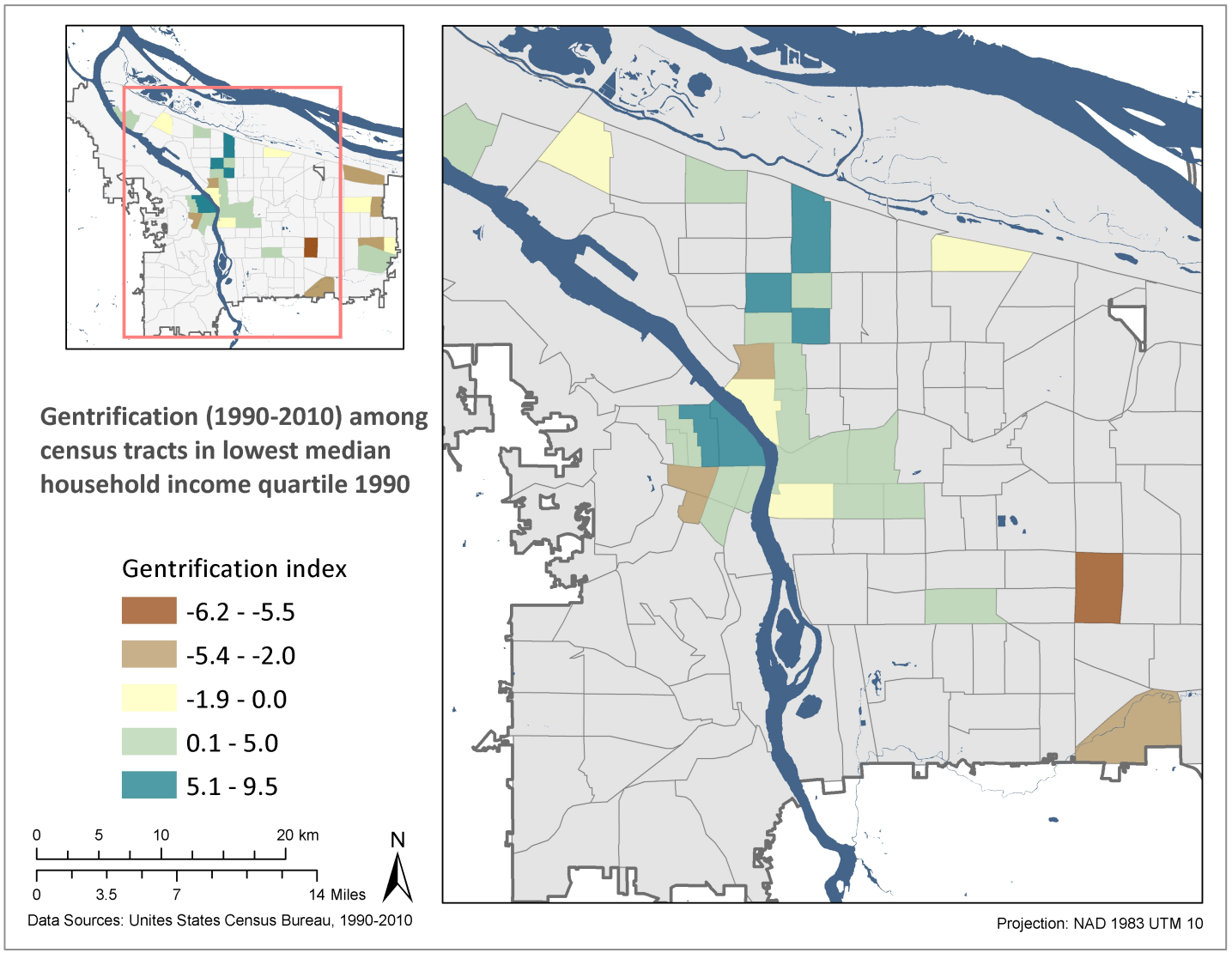

Figure 3: Gentrification (1990-2010) among census tracts in lowest median household income quartile 1990 in Portland

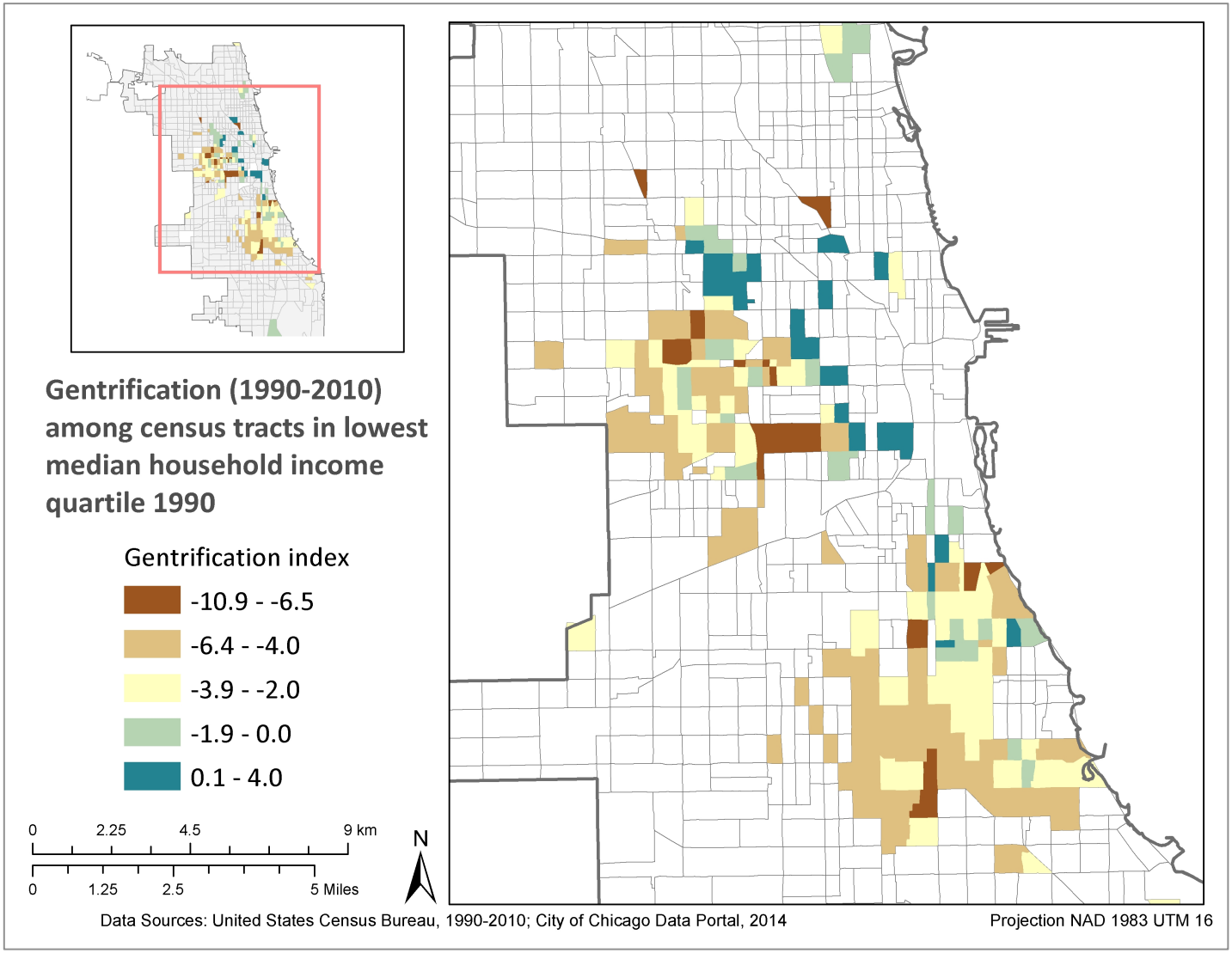

Figure 4: Gentrification (1990-2010) among census tracts in lowest median household income quartile 1990 in Chicago

Distance to amenities and population density

To account for proximity to amenities as a possible influencer of cycling infrastructure investment, the distance from each census tract centroid to downtown and the nearest transit facility was calculated. "Downtown" was defined as the centroid of census tracts that encompass what is generally considered the downtown area (Appendix A). Transit includes subway and light rail but excludes bus stops due to the possibility of stop relocations. 2010 population density and the change in population density (1990-2010) were also included in the regression models with the assumption that higher population densities will correlate to higher densities of cyclists.

Modeling

The linear regression models measure the degree of association between cycling infrastructure as a function of population density, distance to downtown and transit, gentrification variables (1990-2010) and 2010 conditions. All variables were initially included to test the general strength of the model. The model was then built stepwise to include only significant variables for each city (Table 1). A test of collinearity ensures that none of the variables are overly associated. An unbiased (although, again, not necessarily equitable) distribution of infrastructure based on demand would be most affected by distance to amenities (downtown and transit) and population density. Inequitable patterns of investment, on the other hand, may be identified through the strength of demographic factors in the models.

Analysis

Results

Portland

The Portland model (Table 2) reveals a relatively strong correlation between the independent variables and cycling infrastructure investment with 58.8% of the variance explained. All model relationships are expressed in standard deviations relative change in infrastructure per square kilometer. Distance to downtown is the most significant variable (sig.=0.000) where 1km further from downtown is associated with a 0.228 standard deviations relative decrease in cycling infrastructure. Population density is also a significant variable in the Portland model, with a one percent increase in density resulting in .074 standard deviations relative increase in infrastructure. The influence of distance to downtown and population density on investment follows what would be expected of an unbiased distribution. However, variables associated with gentrification and privilege are also very strong predictors of investment in the model.

Two gentrification variables (change from 1990 to 2010) are significant: an increase in home ownership and an increase in the population with some college education or higher. Change in college education has the greatest impact, with a one percent increase associated with a relative increase of 3.080 standard deviations of cycling infrastructure. A percent increase in homeownership is associated with 2.920 standard

deviations relative greater investment.

Finally, two variables reflecting 2010 conditions are significant in the step-wise model: percent renter occupied units and percent unemployed. A one percent increase in rentership is associated with 1.582 standard deviations relative increase in infrastructure. At first glance, this may seem contradictory with respect to the change in home ownership variable. However, high rates of renting are a factor thought to provide a platform that attracts gentrification, while an increase in homeownership is associated with gentrification in later phases. Unemployment was the least significant variable in the model (sig.=0.036) but also had the strongest relationship with a one percent increase in unemployment associated with 3.996 standard deviations relative increase in infrastructure. As with rentership, neighborhoods with high levels of unemployment are often primed for gentrification. Despite the significance in the model of proximity to downtown and population density, the strong presence variables reflecting changes in community composition associated with gentrification and privilege indicate that there are disparities in Portland's infrastructure distribution.

Table 2: Portland cycling infrastructure investment regression model

	Unstandardized Coefficients		Standardized Coefficients		
	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	-.163	.408		-.400	.690
Population density 2010	.074	.027	.154	2.762	.007
Distance to downtown (km)	-.228	.030	-.511	-7.539	.000
Change in % homeowner 1990-2010	2.920	1.108	.156	2.636	.009
Change in % with some college or higher 1990-2010	3.080	.954	.193	3.227	.002
% renter occupied units 2010	1.582	.601	.186	2.633	.009
% unemployed	3.996	1.887	.133	2.117	.036

Summary	**N**	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
	149	0.767	.588	.571	1.064

Chicago

Initially, the regression model for Chicago was much weaker than the Portland model (R^2=0.466) (Appendix B-Table 1). Hwang and Sampson (2014) recently found that, in Chicago, there is a threshold of greater than 40 percent Black community concentration at which gentrification does not occur. Excluding census tracts with greater than 40 percent non-White population from the model (Appendix B-Figure 1) revealed a much stronger regression relationship, reflected in the final model below (R^2=0.634) (Table 3).

The coefficients of the variables of each model are similar except for Change in percent White population (1990-2010). In the first model (Appendix B-Table 1), which includes all census tracts, a one percent increase in the White population is associated with .545 standard deviations relative increase in infrastructure. When census tracts with greater

than 40 percent non-White population are removed from the analysis, a percent increase in White population is associated with a 2.624 standard deviations relative decrease in infrastructure. In both models, a higher concentration of non-White population (2010) is associated with lower investment. The two models suggest that within gentrifying census tracts, there is perhaps some increase of racial mixing, but it is very important to remember that regions with largely non-White populations are likely excluded from both this mixing and gentrification. Among all Chicago census tracts, areas with higher White populations or those experiencing an influx of white residents are more likely to receive cycling infrastructure investment.

Performing the same adjustment to the Portland model resulted in a slight decrease in model strength (from R^2=0.588 to R^2= 0.574) (Appendix B-Figure 2 and Appendix B-Table 2), which is not surprising given that Chicago has a much larger and more geographically segregated non-White population than Portland.

The model improvement after excluding census tracts with large non-White population concentrations is very telling; there is clearly a relationship between the concentration of minority residents and the likelihood of attracting cycling infrastructure investment. To further test the relationship between race and infrastructure in Chicago, a Pearson correlation test for all census tracts reveals that there is a significant positive correlation at the 0.01 level between change in White population (1990-2010) and more cycling infrastructure (significance=0.000 and Pearson Correlation value=0.262). There is also a significant negative correlation between percent non-White population in 2010 and

cycling infrastructure (significance=0.000 and Pearson Correlation value = -0.340). As shown in Figure 5, there is some extension of bicycle lanes into areas of high non-White concentrations, but the distribution of Divvy stations illustrates the disparity of cycling investment in non-White neighborhoods versus those that are primarily White.

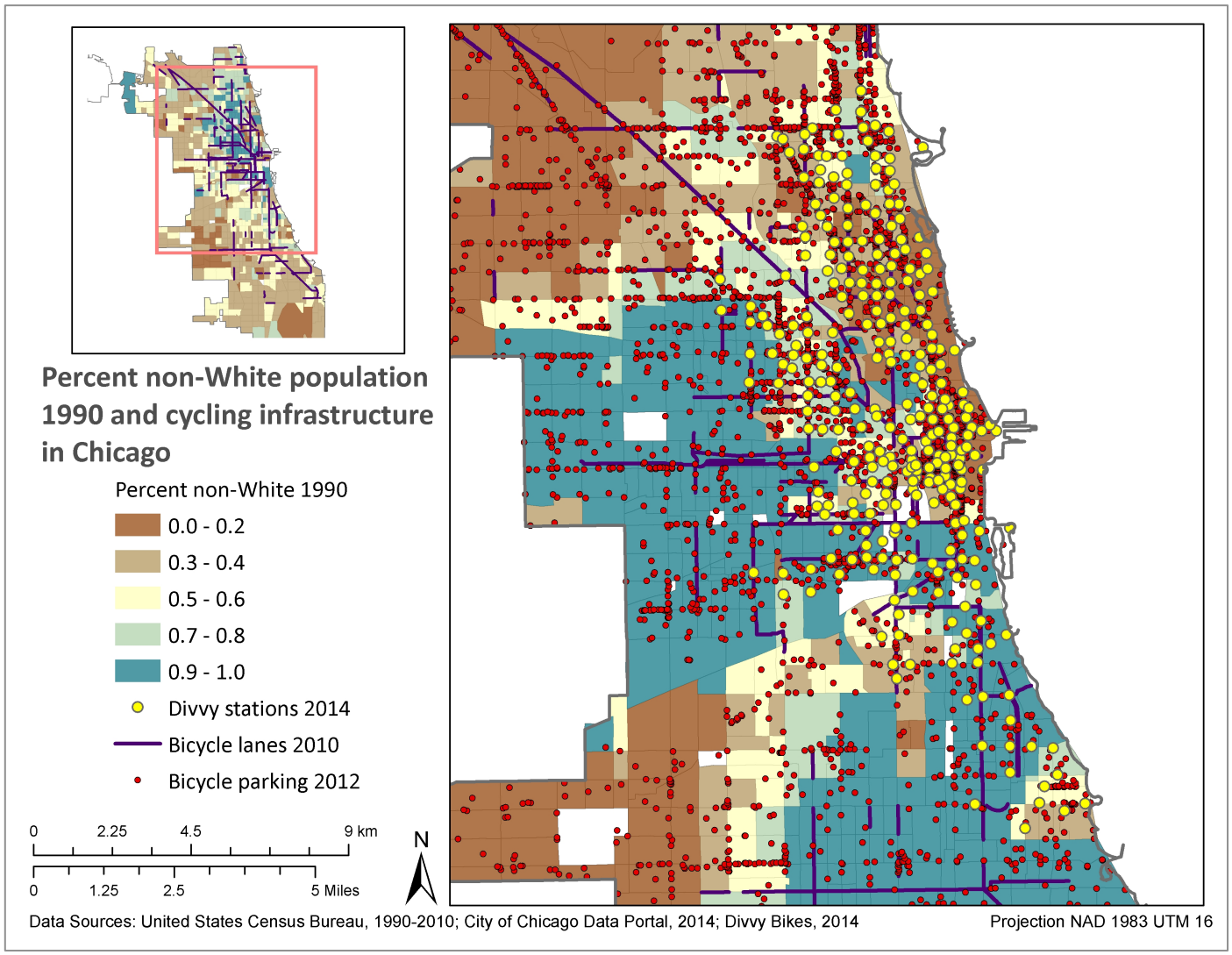

Figure 5: Chicago percent non-White and cycling infrastructure

This paper has largely painted gentrification in a negative light with regard to the unethical way in which marginalized communities lack decision making-power and the needs of an incoming elite are prioritized. However, gentrification can manifest positive investments to otherwise disinvested communities. In Chicago, communities with over 40 percent non-White population concentrations are unlikely to be able to attract investment on their own and are also unlikely to experience investment through gentrification.

The role of race has already been discussed; the other significant demographic variables for Chicago are percent with some college education or higher (2010), percent new residents since 2009, median home value (2010), and change in median home value (1990-2010). A one percent higher concentration of population with some college education or higher is associated with a relative increase of 3.914 standard deviations infrastructure investment. Additionally, greater infrastructure investment is associated with an interesting combination of increasing density (1990-2010), high rates of new residents since 2009, lower median home values (2010) and increasing median home values (1990-2010). Neighborhoods with low value housing stock are primed for gentrification, resulting in an influx of new residents and rising housing costs.

The regression model's B coefficients suggest that higher density areas and those experiencing population growth are more likely to gain additional cycling infrastructure. Each kilometer further from downtown is associated with .114 standard deviations relative decrease in infrastructure. As with Portland, there is a positive correlation

between population density and proximity to downtown, as would be expected in an unbiased distribution of investment, but the strength of demographic characteristics in the models point to disparities in investment distributions throughout both cities. Predominantly White areas undergoing many of the markers of gentrification receive a disproportionate amount of cycling infrastructure investment.

Table 3: Chicago cycling infrastructure investment regression model

	Unstandardized Coefficients		Standardized Coefficients		
	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	-1.748	.694		-2.519	.012
Change in population density 1990-2010	206.889	54.936	.156	3.766	.000
Population density 2010	73.858	24.575	.151	3.005	.003
Distance to downtown (km)	-.114	.023	-.269	-4.921	.000
Change in % White 1990-2010	-2.624	.928	-.225	-2.826	.005
% non-White 2010	-2.747	.927	-.237	-2.962	.003
% with some college or higher 2010	3.914	.696	.391	5.619	.000
% new resident since 2009	6.219	1.227	.289	5.068	.000
Change in median home value (per $1000) 1990-2010	.002	.001	.18	3.164	.002
Median home value (per $1000) 2010	-.003	.001	-.215	-3.217	.001

Summary	**N**	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
	261	.797	.634	.621	1.424

Validation

To test whether there is a difference between the distribution patterns of the different bicycle infrastructure elements (change in relative bicycle lane coverage, relative bicycle

parking, and relative bicycle share stations), the Chicago regression was run with the dependent variable set to just the change in relative bicycle lane coverage and then again with the dependent variable set to include only relative bicycle parking and relative bicycle share stations. A t-test shows that there is no significant difference between the two model coefficients, revealing that different types of cycling infrastructure investment generally follow the same investment patterns (Table 4).

Table 4: T-test showing no significant difference between coefficients of Chicago model where dependent variable is set to change in relative bicycle lane coverage and where dependent variable is set to bicycle parking and bicycle share stations

	Variable 1	*Variable 2*
N=10		
Mean	20.194	4.460
Variance	2952.478	6176.175
Observations	9	9
Pearson Correlation	.758	
Hypothesized Mean Difference	0	
df	8	
t Stat	0.916	
P(T<=t) one-tail	0.193	
t Critical one-tail	1.860	
P(T<=t) two-tail	0.387	
t Critical two-tail	2.306	

Discussion

Although the significant variables in each city's model are not identical, they do reflect similar attributes. Population density and distance to downtown are clearly an important factor in the processes determining where infrastructure investments are made. In the Portland model, the change in homeownership between 1990-2010 and renter occupancy in 2010 are significant, while in the Chicago model, the percent of new

residents since 2009 is a significant variable. Each of these variables reflects to some degree the amount of housing turnover and mobility potential, suggesting that communities undergoing changing residential composition are correlated to higher rates of cycling infrastructure investment. College education is also a common element between both models. Surprisingly, however, race was only a significant variable in Chicago. This could be due to the relatively small number of census tracts in Portland that are predominantly non-White (only 4 out of 149 have a non-White population concentration greater than 40 percent).

Neither change in median household income (1990-2010) nor median household income (2010) is a major influencing variable in either model. In a 2005 study, Freeman found that income between 1980 and 1990 for gentrifying neighborhoods throughout the United States had an upswing in income but the trend reversed between 1990 and 2000. He suggests that this could be due to decreasing household size or an influx of first-wave gentrifiers who are relatively poor (artists, entrepreneurs, students, etc.). If this reasoning is accurate, it could contribute to the lack of significance of income for the two models.

The findings from this study reveal a disconcerting continuation of the disparities in investment that are systemic throughout North American cities. Claims that investment follows gentrification are supported in both cases. Perhaps most striking, though, is the role of race in the Chicago model and the dramatic improvement of the model once census tracts with greater than 40% non-White population concentrations were

removed. This clear segregation between race and investment should be a red alert.

It should be noted that the home value variable from the census only considers owner occupied units. Therefore, neither model is able to capture changes in rental prices. Low-income neighborhoods often have high rental rates and rising living costs are a major issue in gentrifying neighborhoods. The addition of rental unit pricing changes would be a valuable addition to this research.

One aspect to be considered and improved in future studies is that areas with the highest rates of cycling infrastructure investment may not mirror those with the highest increase in gentrification indicators if cycling projects need to follow major roads and commuter routes, taking them outside key neighborhoods serving as catalysis for investment. Proximity to gentrifying and privileged census tracts or the areas that are connected by cycling projects could be considered in future analysis.

Another area for further research revolves around the role and effectiveness of community advocacy groups. This study has attempted to quantify and reveal patterns of investment with respect to community composition attributes. It does not, however, take into account the role of community organizations and active transit specific advocacy groups. These organizations have the potential to either contribute to or mitigate inequitable network distributions. Privileged cycling advocates may push for self-serving projects under the impression that the projects serve the common good, as discussed in the literature review. Alternatively, advocacy groups led by members of marginalized communities or that cater to a diverse group of members can promote

inclusive dialogues and reveal strategies for promoting equitable active transit networks. Further research is required to determine the effectiveness of current and past advocacy efforts in implementing just active transit network improvements.

Policy Lessons

This study reveals disparities in cycling infrastructure investments in the cases of Portland and Chicago. Mitigating these disparities moving forward will be challenging and require rethinking assumptions about cycling culture and planning processes.

Efforts to implement cycling infrastructure in areas with the highest ridership rates are problematic because of pre-existing circumstances, which create more visible and amenable cycling environments for privileged groups. For instance, if community members living along a heavily trafficked road with no shoulder are unable to bicycle to work, cycling counts will never reflect high demand although the desire to ride may easily be present. Because cycling counts or other "demand" based measures do not capture latent demand, concerted efforts to partner with and listen to the narratives of community members from different demographic and geographic groups and developing methods for assessing latent demand and the presence of subaltern cyclists can help develop a better picture of where projects are needed.

Recognition of implied privileges of common decision-making processes is also essential- for instance, are community meetings held at a variety of times to accommodate non-traditional work schedules? Is there a feedback option for those who

cannot attend meetings in person? Is information disseminated in all local languages or only English? Importantly, are meetings and discussions welcoming, open, and respectful, acknowledging and working to address past and current grievances?

Partnering with local community groups, faith organizations, non-profits and community leaders city-wide is an essential step in ensuring that communities who are not normally a part of policy and planning processes or who do not expect to be listened to are made aware of opportunities and plans for change. "I think there's a need to bring the African-American leadership forward to make sure that that voice is there in the outcome," was a sentiment raised by a speaker during the community meetings regarding the North Williams Traffic Operations Safety Project. "It's sad to think that we have to protest to have our voices heard. We should be at the table making decisions about the outcomes" (Maus, 2011, papa. 19).

Trying to move forward without acknowledging and addressing past inequities and social tensions will only undermine, once again, the valid frustrations and grievances of marginalized groups. Following community outcry in the case of North Williams Avenue, efforts were made to create a more diverse stakeholder committee and discussion sessions were held around gentrification and racial discrimination (Lubitow and Miller, *Contesting the North Williams Traffic Operations and Safety Project,* 2013).

The 2013 Gentrification and Displacement Study (Bates), commissioned by the City of Portland Bureau of Planning and Sustainability, focuses on the housing market but presents key principles that should be considered more broadly for all forms of planning,

investment and development:

1. An inclusive development paradigm with a racial/ethnic equity lens,
2. A recognition of how public investments affect the market,
3. Ways to utilize the opportunities of the role of the public sector in the housing market by anticipating change, regulating appropriately, and engaging networks of development and community actors (p. 4).

It is encouraging that the City of Portland has acknowledged and is seeking to address the harmful effects of gentrification and displacement but it is important to remember that housing values and new businesses are not the only forms of development that have significant impacts on communities. Even small changes, such as installing bicycle parking, changing a stop sign configuration for increased safety, or adding streetlights, are improvements often bypassed in disadvantaged neighborhoods. No similar municipal report or study of the impacts of gentrification, displacement or equity and alternative development strategies was found for Chicago.

This paper does not presume to outline a full approach to planning that will address gentrification and uneven community investment, but rather attempts to quantify the relationships between factors associated with gentrification and privilege and investment in cycling infrastructure, both private and municipal. As the models show, there is a clear link between gentrification, privilege and cycling infrastructure. Low-income and communities of color, who would benefit most from increased cycling infrastructure for the economic, health and safety benefits, are least likely to receive municipal or private investment.

The 2015 Building Equity report (Andersen and Hall, 2015) and Portland Gentrification and Displacement report (Bates, 2013) are attempts to recognize existing disparities and address the needs of diverse and varied communities. One of the concluding statements of the Building Equity report is that "disinvested neighborhoods all have unique needs, but all share the same problem: political processes that unintentionally but consistently ignore their residents" (Andersen and Hall, 2015, p. 31).

As a concluding remark, concerted efforts must be made so that investment is equitably distributed, but not imposed. Forcing frustrated communities to accept changes that may seemingly (or actually) disproportionately benefit affluent, White residents will not build trust or a safe environment for cycling among all socio-economic groups. Rather, planners should seek to support "revitalization" efforts- bottom-up economic reinvestment- instead of the top-down impositions of economic development through gentrification.

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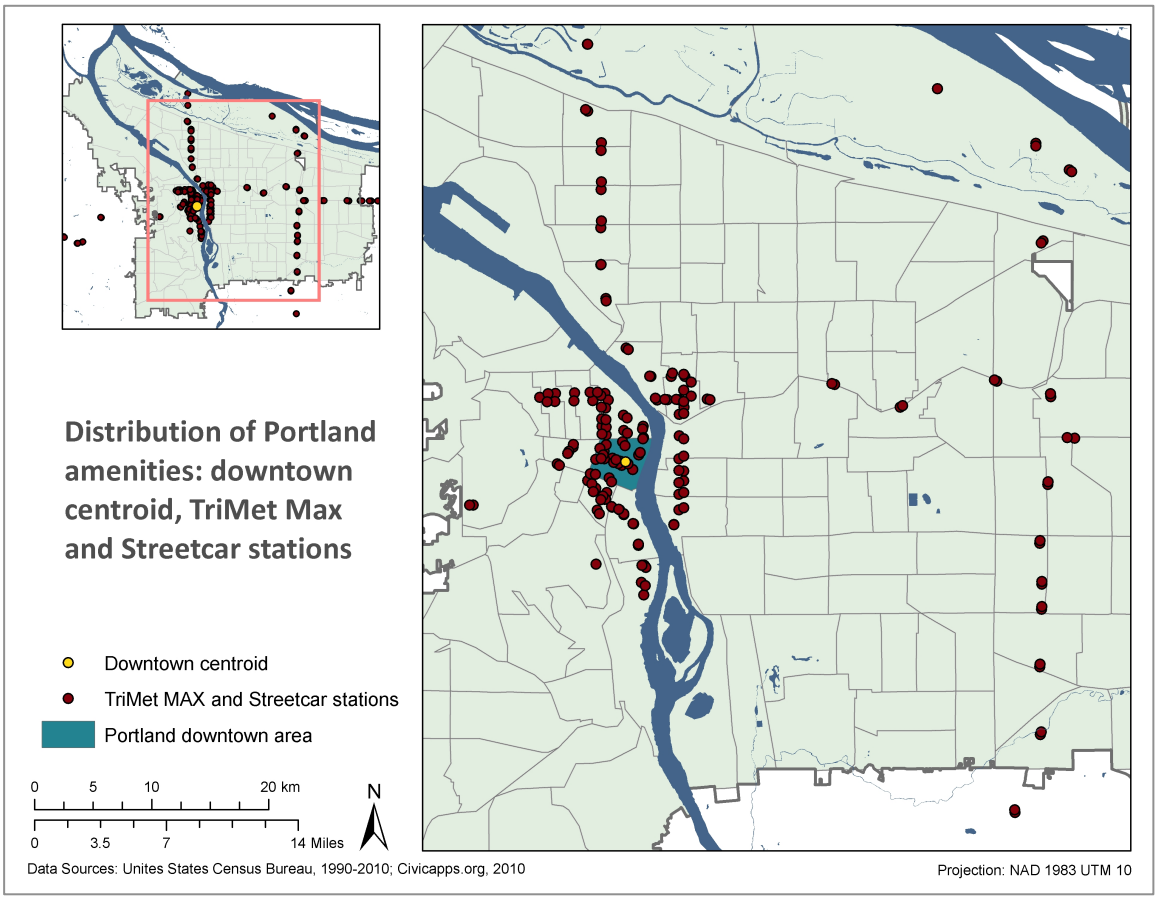
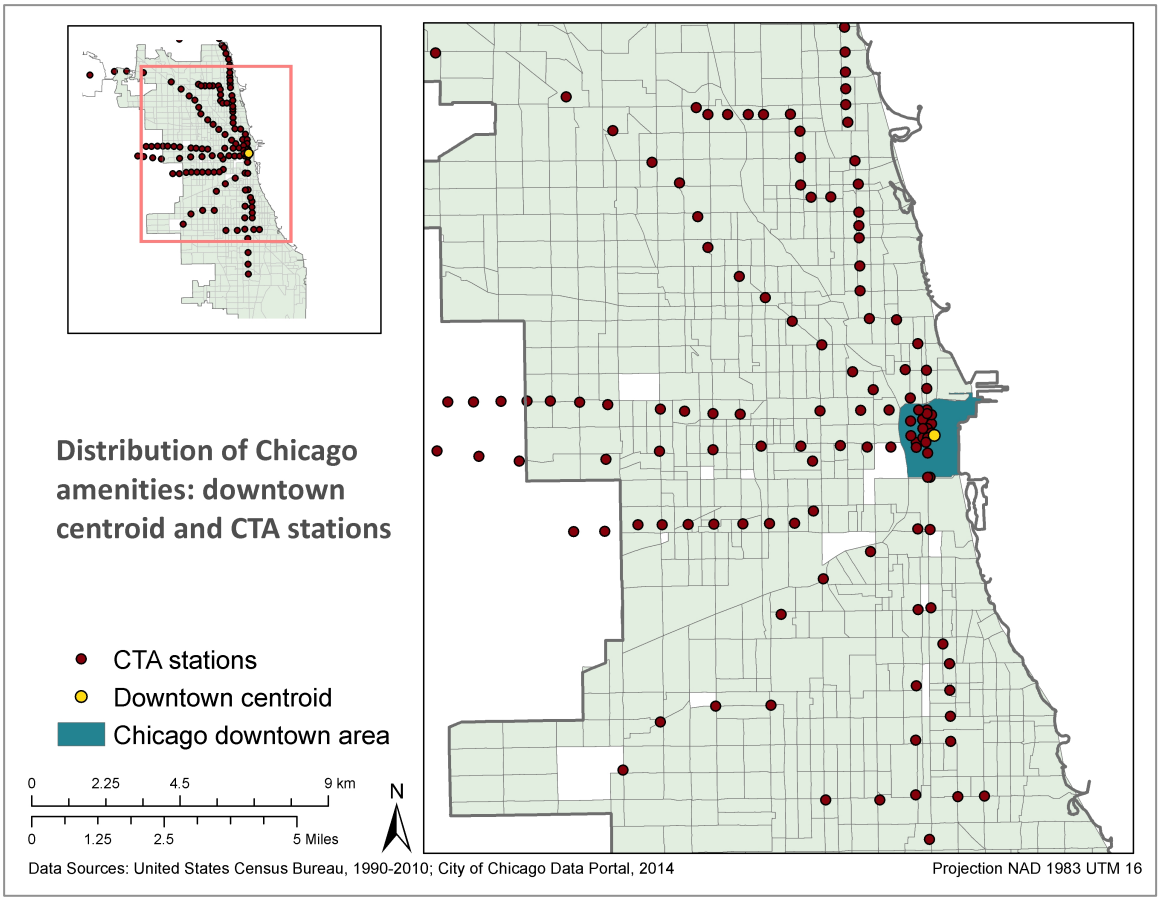
Appendices

Appendix A- Distance to amenities



Appendix A-Figure 1: Portland distance to amenities (downtown centroid and TriMet MAX light rail and Streetcar station)



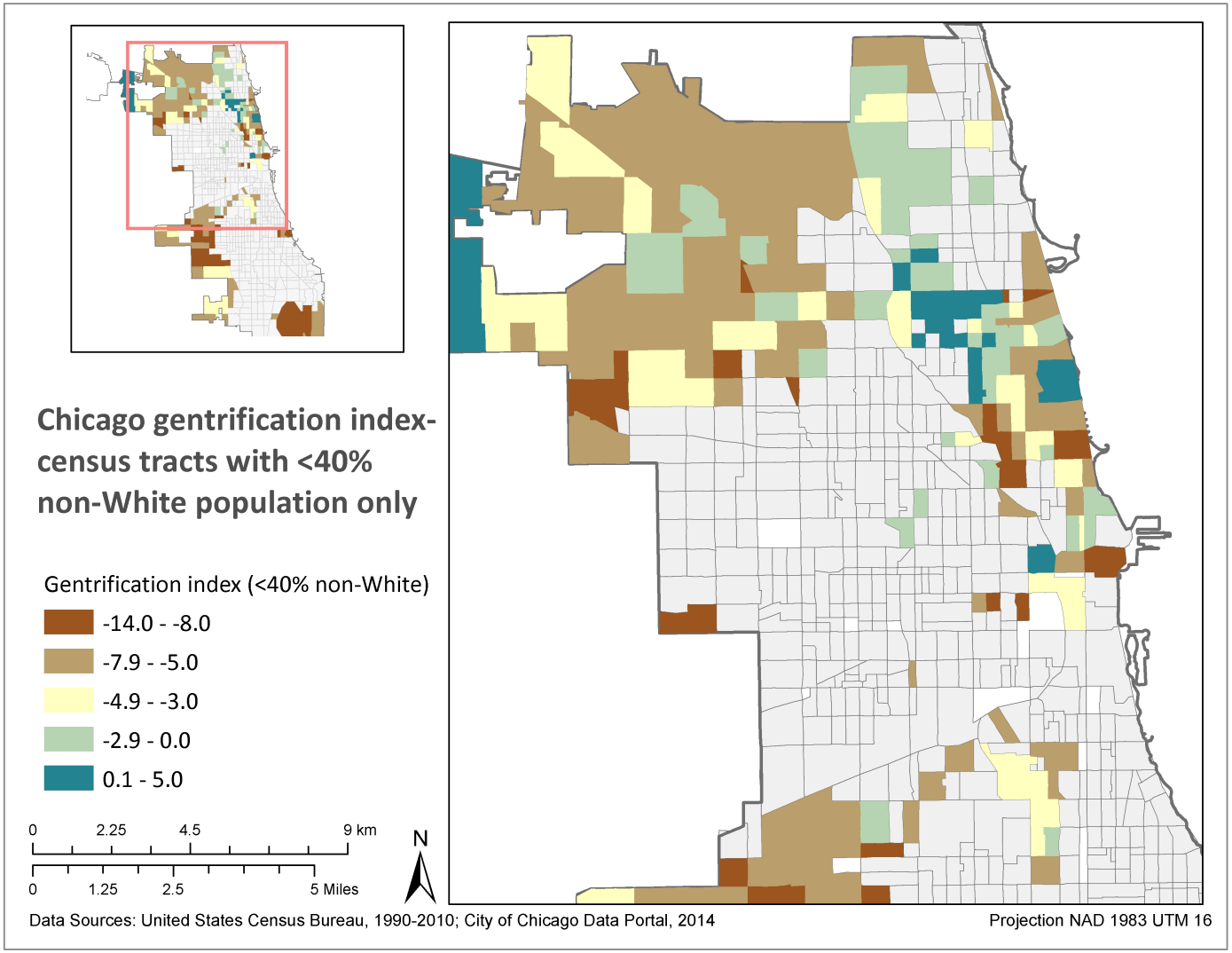
Appendix A-Figure 2: Chicago distance to amenities (downtown centroid and CTA stations)

Appendix B- Adjusting for percent non-White population concentration

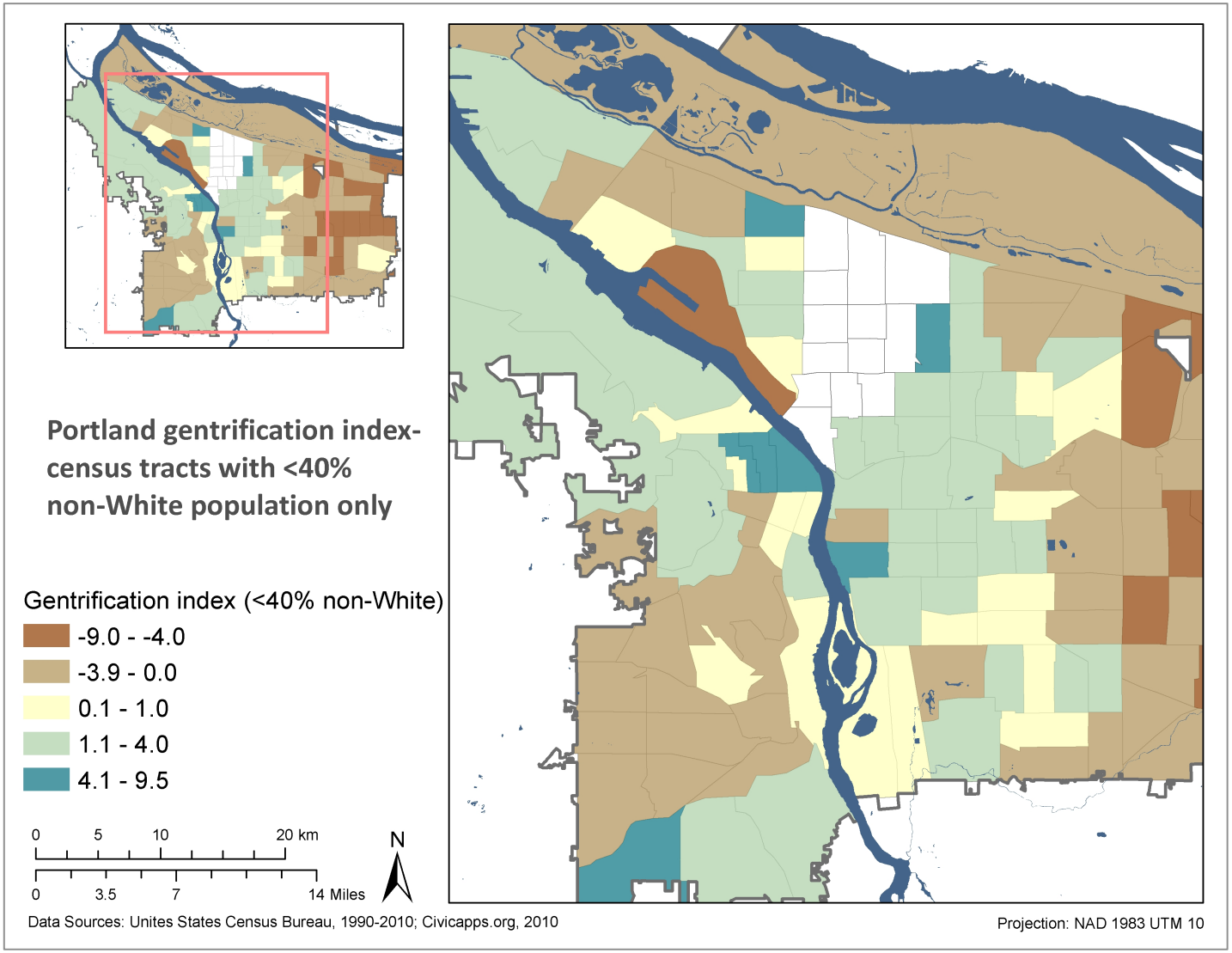
Appendix B-Table 1: Chicago cycling infrastructure investment regression model, all census tracts

	Unstandardized Coefficients		Standardized Coefficients		
	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	-.593	.343		-1.731	.084
Change in population density 1990-2010	63.270	24.032	.073	2.633	.009
Population density 2010	96.397	17.453	.178	5.523	.000
Distance to downtown (km)	-.154	.014	-.337	-11.261	.000
Change in % white 1990-2010	.545	.331	.053	1.646	.100
% non-White 2010	-.801	.237	-.117	-3.377	.001
Change in % with some college or higher 1990-2010	-1.997	.509	-.140	-3.926	.000
% with some college or higher 2010	4.430	.417	.435	10.633	.000
% new resident since 2009	2.646	.709	.112	3.731	.000
Change in median home value (per $1000) 1990-2010	.002	.001	.173	3.983	.000
Median home value (per $1000) 2010	-.003	.001	-.226	-4.075	.000

Summary	**N**	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
	844	.683	.466	.460	1.642



Appendix B-Figure 1: Chicago gentrification index for only census tracts with less than 40% non-White population



Appendix B-Figure 2: Portland gentrification index for only census tracts with less than 40% non-White population

Appendix B-Table 2: Portland cycling infrastructure investment regression model, only census tracts less than 40% on-White population

	Unstandardized Coefficients		Standardized Coefficients		
	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	-.210	.417		-.504	.615
Distance to downtown (km)	-.225	.031	-.502	-7.260	.000
Population density 2010	.075	.027	.157	2.747	.007
Change in % homeowner 1990-2010	3.013	1.135	.160	2.655	.009
Change in % with some college or higher 1990-2010	3.208	1.002	.196	3.203	.002
% renter occupied units 2010	1.543	.612	.181	2.523	.013
% unemployed 2010	4.031	1.918	.134	2.012	.037

Summary	**N**	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
	145	0.764	.584	.566	1.076