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Robert Graham

The Process of Gentrification in New York City

*This thesis is submitted in partial fulfillment of the requirements for the course
Senior Seminar (EC 375), during the Spring semester of 2017*

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Abstract

This thesis examines the effects of increases in median property value and median rent on a neighborhood in New York City. Specific attention is paid to shifts in three variables: education outcomes of public school students, housing displacement, and fluctuations in crime rates. Data from the Census Bureau and American Community Survey are used to assess the impact of gentrification.

Introduction

In any setting the mere mention of the word gentrification is likely to start an interesting debate, due to the polarizing nature of this topic. People feel passionate about gentrification, often in a negative context. Freeman (2006) conducted a qualitative analysis of neighborhoods undergoing gentrification in New York City and some described the process as, “pushing poor people out of the city and in the process breaking up the power bases of their struggle”... “its gentrification, but you could also almost call it apartheid by both race and class” (Freeman). This topic is associated with controversy because the groups often thought to be effected negatively are lower income individuals who are left with no other choice but to move from their home where they may have been living for decades. The question this research is trying to answer is what are the changes a neighborhood experiences as it undergoes gentrification, specifically the impact on public education and changes in the demographics of both race and economics of the individuals living in the neighborhood. This paper will also investigate the impact of redlining on the shaping of neighborhoods, and how that may heavily impact how vulnerable neighborhoods are to swings in property value and or rent.

Although this topic is widely known, few have a succinct way of defining the topic. Authors such as Jackson (2014) summarize gentrification as the process when residents are forced from their homes because of increased rents, or private action from landlords attempting to repurpose/develop their property for higher profits. Other authors such as Freeman and Barconi (2004) focus on the mobility rate of “disadvantaged households.” The definition of gentrification plays a key role in the results and conclusions these studies find. Some authors discover widespread displacement of minorities that are inconsistent with regular mobility patterns, whereas others see little to no impact from what they define the process of gentrification.

The purpose of this paper is to examine the impact of gentrification in New York City, specifically analyzing the impact on local public school test scores, as well as a comprehensive analysis of the demographic change a neighborhood experiences as it is gentrified. I will also look at how the prejudicial lending policy known as redlining has impacted and shaped the neighborhoods in New York City. The timeframe for this analysis will be from 2009 to 2012, and will involve a time series panel regression analysis. The goal is to allow readers to grasp all aspects of gentrification, both positive and negative so they can develop an informed opinion on the topic.

The contributions of this work are twofold. First I replicate the work Keels et, al. (2013) which examined the effect of gentrification on public school test scores in Chicago. Although the methodology differs to select gentrifying neighborhoods, this research imitates the variables that Keels, et, al. (2013) implemented. Next I compare and contrast the research of Jackson (2014) and Freeman and Barconi (2004) which analyzes mobility patterns in Washington D.C and New York City respectively. These two studies

came to opposite conclusions: Jackson (2014) results showed widespread displacement of minorities in Washington D.C in gentrifying neighborhoods. Whereas Freeman and Barconi (2004) determined that in the 1990s there was no difference in the mobility patterns of minorities in gentrifying areas compared to non-gentrifying neighborhoods. I use the methodology of Jackson (2014) in New York City to discern if it was the difference in location that caused the conflicting results or if the difference was due purely to methodology. This result will also demonstrate the effect of gentrification, measured in percent change in rent, on the demographics as well as the economic class of the neighborhoods researched in this study.

The final part of this analysis will involve using GIS mapping to compare the redlining maps that were created in the 1930s to the mobility patterns that occurred between 2000 and 2010. Redlining was the process in which neighborhoods were rated A through D. This rating heavily determined the likelihood an individual could receive a home loan, as well as the rate they would pay. These maps however were heavily based on racial profiling which left predominately minority neighborhoods owning homes at a disproportionally lower rate than in other neighborhoods.

The goal of this research is to see if these prejudicial lending patterns impact how vulnerable these neighborhoods are to widespread displacement as economic conditions change. Currently there is little to no literature comparing gentrification to the redlining maps, possibly because these maps were only recently released. Although this is not the focus of this research, it is the main way this study extends the literature.

The results of this paper show that gentrification has no impact on public school test scores, which is consistent with previous research. However this study only

conducted an analysis between 2009 and 2012 that may have effected these outcomes. Public schools are funded through local property tax. As neighborhoods gentrified, property values increase which should lead to more funding for the local school (Keels, et, al.). However The Great Recession negatively impacted housing prices across the board, which may have mitigated the potential benefits one might assume come to education through the process of gentrification.

When analyzing how changes in rent impact the demographics of the neighborhood, there are some interesting results. First the only variable involving race that has a positive coefficient associated with an increase in median rent is white, as shown in figure 2. This suggests that as rents increase, as associated with gentrification, we do see displacement of minorities in relatively substantial figures. A 1% increase in rent corresponds to a .124% decrease in the population of African Americans and a .332% increase in the population of white individuals. Both of these results are statistically significant at the 1% level. These results do come with high VIF's due to the problem of simultaneous equations in my model.

This introduction will be followed by the analytical framework section, this will outline the general theory used in this analysis, then a comprehensive literature review that outlines both sides of debate over gentrification. Section four focuses on methodology and discusses the econometric model used to conduct this analysis. In the conclusion, I discuss the results as well as possible policy implications and extension of this model for future research.

Analytical Framework

Solow Model

Conventional wisdom would not necessarily think that the Solow Growth model has any relation to gentrification, however the two do have a connection. This paper is in theory a development analysis just on the neighborhood level. The Solow model states that a country needs to reach a minimum level of investment in order for growth to begin, this relates directly to neighborhood development (Solow). Often neighborhoods are underfunded because they are located in an isolated parts of the city (Bryne). Lack of public transport makes areas unattractive to investors due to the inability for people to easily move to and from that area, but once public transportation is incorporated into an underinvested neighborhood the process of gentrification often begins (Bryne). Similar to the Solow model once a neighborhood reaches this minimum investment it will develop at a faster rate than other neighborhoods farther along on the curve. Instead of output being reflected in GDP it is reflected in the increased property values in the area. The gap between upper-class and lower class neighborhood, in major cities, will constantly shrink, similar to high and low income countries in the Solow model. The process of gentrification is the process of development. However in neighborhood analysis, unlike countries, the cost of living increases at an exponentially faster rate compared to developing countries.

Education Model

When looking at the determinants of educational outcomes Bowles (1970) developed an education production function, which evaluates all of the inputs, positive and negative, that impact education scores in an attempt to find the optimal resource

allocation in schools. Bowles argued that the educational environment plays a key role in the test score outcome. The logic he used was that that an educational environment explains more than 80% of the educational achievement between identical twins (Bowles). Bowles breaks up the environment of children's education into four sections, the quantity of verbal interaction with adults, the quality of verbal interaction with adults, their motivation for achievement, and the richness of the physical environment (Bowles). Due to the limitations associated with this definition the model in this study attempts to capture the physical environment by factoring in crime rates. As crime rates increase and there is more chaos in the neighborhood students are more likely to divert their attention away from school (Machin).

In order to capture the in school environment this study incorporates Keels et, al. assumption of positive peer effects on other students. Keels et, al assumes that students with better educational outcomes will rub off on their peers with will increase their educational outcomes. To capture this potential effect this model factors in median income of the neighborhood. Some may question this method however Keels et, al. concluded that children of higher income families are more likely to have higher educational outcomes. The data in this analysis is gathered on an aggregate school level, so there is no way to discern higher achieving students from lower. Thus median income of the neighborhood is a good proxy to capture these potential effects.

Median Rent Model

Sirmans (1991) analyzes the factors that influence rent prices. Some of the main factors that he looks at are property management, length of residency, vacancy rates, and crime rates. Due to the nature of a regression model factoring in the style of property

management and length of residency are near to impossible. However crime rates and can be easily incorporated through census data, as well as crime rates publish through DNA Info Crime and Safety Report (Sirmans). Controlling for median income in the neighborhood one can get a grasp of the rent rage of the neighborhood. In this model demographics of the neighborhood will also be factored in to analyze the effect changes of rent have on the mobility patterns by race of the neighborhood. Due to the fact that the neighborhoods being examined in this study were selected due to their percentage increase in rent, we can see how much this forces certain races out of the neighborhood.

Literature Review

Background

My thesis focuses on the effects of gentrification in New York City specifically how public school test scores and demographics of these neighborhoods are impacted from the changes that occur. For the purpose of this paper, the working definition on gentrification I will be using is, “the process by which central urban neighborhoods that have undergone disinvestments and economic decline experience a reversal, reinvestment, and the immigration of a relatively well-off middle- and upper middle-class population” (Hwang & Sampson). In the 1960s New York experienced “white flight”, the movement of affluent white families to the suburbs. In the past 20 years however, New York, along with most major cities across America, has seen a migration back to the cities, which causes drastic rise in gentrification (Hwang). I look to study the effect of gentrification on the demographics of the neighborhood and public school system grades 3-8 from 2009-2012. Public schools are funded through property tax, (Hwang & Sampson) so as a neighborhood becomes gentrified and property values increase, so

should the funding for local public schools. I expect to see an increase in test scores as a neighborhood becomes gentrified, but to what degree is unclear. The NYC Department of Education publishes test results annually. This will allow me to analyze who is receiving the benefit of these added school funds. Keels et al. conducted a similar study in Chicago which determined as a neighborhood becomes gentrified, public schools target middle-income families to attract donors (Keels et al.). If a similar phenomenon occurs in New York, you may see some students receiving more attention than other, which may result in a difference in educational results.

I also will incorporate variables such as property value, median income, total population by race, and crime rates. This will allow my results to give a total description of the changes that are associated with a neighborhood becoming gentrified.

Pre-Gentrification Literature

Considerable evidence demonstrates the powerful role of race and ethnicity in neighborhood selection, shaping residential patterns of segregation and neighborhood decline (Charles 2003). These pre-existing factors heavily determine what neighborhoods are likely to become gentrified, but “scholarship on gentrification has not systematically incorporated racial stratification in shaping the trajectory of gentrifying neighborhoods and their surrounding areas” (Hwang & Sampson). This is a key factor in how large sections in cities are developed due to the fact that “studies show that poor neighborhoods adjacent to gentrified or high-income neighborhoods are likely to upgrade” (Hackworth). The positive effect of gentrification has real benefits on their surrounding areas, as I will discuss later, which means that entire sections of cities can be

left underdeveloped as a result of “laissez faire” policies that heavily depend on private investment to developed neighborhoods (Hwang & Sampson).

Meltzer et, al (2010) further examine the gap of private amenities that lower income neighborhoods experience and how retail activity changes over time as the neighborhoods is in “economic transition” (Meltzer et, al). Meltzer et, al use New York City census data as well as two data sets on retail property and chain establishments to evaluate a neighborhoods retail access. They compare neighborhoods that have mean incomes above and below 80% of the city average. They conclude that higher income neighborhoods have higher densities of both establishments and employment and larger number of establishments on average for retail and food services (Meltzer et, al). The Herfindahl Index (HHI) for food services is also much lower for higher income neighborhoods suggesting that they have much more diversity in their food options. Thirty-five percent of chain restaurants were designated unhealthy in these low-income neighborhoods compared to 21% for high income showing that these disadvantaged communities have lower quality food services (Meltzer et, al). Furthermore there are lower densities in both “establishments and employment” in these low-income neighborhoods (Meltzer et, al). This research shows that the private sector does not support low-income neighborhoods with the quality that high-income neighborhoods receive. The process of gentrification could help mitigate some of these factors to have equal access to private amenities.

In gentrifying neighborhoods large numbers of minority citizens are displaced. This may be due to various factors such as, “long-standing inequalities in educational attainment, earnings, and net worth between whites and blacks.” These factors make it

more difficult for minorities to cope with rising living costs, which can disproportionately price them out. Also the actions of government agencies such as the Federal Housing Administration, “routinely refused to back home loans made in predominantly African American neighborhoods” (Massey & Denton, 1993). In a study of housing market lending in 23 cities in the United States, “they find that on average black home buyers are 2.33 times as likely to be denied a mortgage as identically qualified white applicants; Hispanics are 1.44 times as likely to be denied.” Even if minorities received a mortgage, they could pay above market interest rates, which make them disproportionately affected by changes in cost of living. It also prevents minorities from establishing concrete footholds in these cities in which gentrification would have a much more mitigated displacement effect.

Another factor that prevented minorities from building permanent residencies in major cities was the process of redlining which began at the end of the 1930’s (Domonoske). The Home Owners Loan Corporation graded neighborhoods based on four categories, best, still desirable, definitely declining, and hazardous. The problem with this process was the large impact the demographic of the neighborhood factored into their rating. A common descriptions of these lower ranked neighborhoods were, “an infiltration of negroes,” or, “Respectable people but homes are too near negro area”, and went as far as saying, “It is 100% poor class Negroes practically all on relief, but A high wall, however, prevents their spread” as an explanation to why an area was rated A grade that was adjacent to a D grade area (Domonoske). Lenders largely used these prejudicial classifications to determine if housing loans were approved and the rates they received, as recently as 1968 (Madrigal).

Ezeala-Harrison et, al (2008) examined loan patterns towards minorities in Mississippi between 1993 and 2002 to see if there are any discriminatory lending policies. Mississippi is an interesting research cite because 97.6% of its population identifyies as either African American or White. To contextualize the home ownership condition in Mississippi, in 2002, the overall homeownership rate in America was 68.6% compared to 50.6% for minorities. However, in Mississippi the overall homeownership rate was a record 73.4% but only 34.3% for minorities (Ezeala-Harrison et, al). Ezeala-Harrison et, al (2008) used a “probit analysis” by breaking down their data into three main regions of the State to observe the potential impacts of “redlining factors”, and the various loan decision variables, relative to the housing loans given to minority borrowers. (Ezeala-Harrison et, al). They discovered that loan denial rates were drastically reduced when minorities applied for loans in a predominantly minority neighborhood showing that these previous lending policies may be have a lingering impact today.

With minorities receiving higher rates or no loans at all in the explicit redlining period and still experiencing discrimination in the lending market, it disproportionately effects the homeownership rate of minorities. These household are then forced to become renters if they want to live in these communities, which makes them much more susceptible to volatility in the rental market, which is often experienced in gentrification (Jackson).

Empirical Models on Measuring Gentrification

Hwang and Sampson (2014) look at gentrification in Chicago by using “Google Street View to detect visible cues of neighborhood change,” because most economic studies rely heavily on census based data which, “neglect the distinctly visible changes to

the urban landscape produced by changes in the built environment that are inherent to gentrification” (Hwang and Sampson). This research is distinctly different from most of the literature on this topic because it takes more of a visual perspective rather than data based research, which Hwang and Sampson (2014) claim neglects changes such as, “large-scale private developers, city capital investments, and public housing policies, which increasingly play critical roles in facilitating or stalling gentrification” (Hwang & Sampson).

Hwang and Sampson argue that there must be a base level of demand from potential residents to “secure stability” to attract large scale development which can quickly advance the gentrification of the neighborhood. Looking further into the “taste for gentrification” Hwang and Sampson claim, “that gentrifying residents, especially in the early stages, are attracted to bohemian-like settings that tolerate diversity and thus are likely to have greater predilections toward racial integration and higher thresholds for out-group neighbors than would the general population” (Hwang & Sampson).

Hwang and Sampson concluded that, “black and Latino neighborhoods are least likely to continue to gentrify and are more likely to experience depressed trajectories among neighborhoods that showed signs of gentrification in 1995 or were adjacent to these neighborhoods and disinvested.” Areas that were more likely to be gentrified contained a, “substantial share of white residents, around 35 percent.” Although Whites do not constitute a majority, it is interesting to notice the drastic difference in rates of gentrification in Chicago based on the demographics of the neighborhood. Note Hwang and Sampson controlled for, “poverty, vacancy rates, ownership, and crime; proximity to institutions, jobs, and amenities; and state- driven policy external to the neighborhood.”

Hwang and Sampson do concede that this may not be solely due to “race based neighborhood selection.” Rather these neighborhoods that once showed signs of gentrification in 1995 may, “reflect gentrification by minority gentrifiers. If so, our results indicate that these neighborhoods had lower or slower degrees of reinvestment and upgrading relative to neighborhoods with larger white populations, which may be due to factors such as racial inequalities in wealth or biases by external sources of reinvestment.” Still it is shocking when statistics on a national level shows that, “only about 11 percent of metropolitan-area neighborhoods experiencing socioeconomic ascent from 1990 through 2009 were predominantly black.” These results highlight how big a role race places in the economic development in a neighborhood and the, “staying power of neighborhood stigma and collective negative appraisals, even for neighborhoods inclined to changing reputations”(Hwang &Sampson) These results show that Laissez-faire policies that depend on gentrification to improve impoverished neighborhoods may not have substantial effects on minority neighborhoods with concentrated poverty, which reduces the rate of reinvestment and intensifies urban inequality.

In a different study, Jackson (2014) looks at the consequences of gentrification in relation to the racial change in neighborhoods in Washington D.C. between 1990-2010. Literature on this topic is mixed partially due to the different methods used to evaluate displacement. Some researchers define displacement as a, “process of aggregate population changes involving racial replacement and turnover,” where others define it as a, “force whereby residents must leave against their will because of circumstances beyond their control” (Jackson). Along with the difference in definition, there are two distinctly difference ways to evaluate displacement. The first method looks at mobility

patterns and the, “degree to which moving patterns in gentrifying neighborhoods are indicative of displacement” (Jackson). The main drawback from this method is that it is impossible to know why someone left the neighborhood. High rates of out-migration could be a cause of gentrification pricing out lower income residents, but it is impossible to know for sure. The second approach attempts to, “ameliorate the disadvantages of migration studies by using data-sets that have information on the motives of out-movers.” They consider displacement due to gentrification if the resident moved due to, “housing costs or landlord harassment or were displaced by private action” (Jackson 2014). The main drawback of this approach is that it is difficult to locate where the resident move from.

Washington D.C. has experienced large amounts of gentrification over the past 30 years. It has seen its African American population decline from 70% to just above 50% in 2010 (Jackson 2014). This makes it a great area to investigate the consequences of mass outward migration of often low-income households. Part of the reason for such a drastic change was public policy that was implemented. Washington D.C. heavily invested in its subway system in the 1970s and again in the 1990s. This made areas of the city that were once neglected much more attractive to investment and development. This resulted in the redevelopment of low-income housing projects into “mixed income developments” using funds from the HOPE VI program (Jackson). At the start of the 1990s, Washington D.C. was on the verge of bankruptcy. Restructuring and strong economic progress allowed the city to regain economic stability (Swope). The economic growth of the late 1990s brought, “newfound prosperity to the area and continued in the 2000s” (Jackson 2014). Backed by ambitious mayors, new housing and commercial construction boomed,

“leading to a dizzying array of new apartments, office buildings and mixed-use projects” (Swope, 2004). All of this investment was deemed a success leading to a net population increase from 2000 to 2010 making the first time the population had not decreased over a decade since 1950 (Jackson).

Jackson uses data from decennial census from 1990-2010 along with the American Community Survey to analyze the changes D.C. experienced over those two decades. He defines gentrification as an, “influx of affluent residents.” This definition is more vague than those used in other studies, but it uses a similar premise to evaluate gentrification. Jackson uses a three step technique developed by Wyly and Hammel (1999) to identify neighborhoods on “gentrifying tracts” using census reports from 1960 to 1970 to determine neighborhoods with median incomes below city-wide medians. Jackson then reviewed, “scholarly research, city planning documents, and local media reports to create a list of gentrifying neighborhoods and conducting block-by-block field surveys from the tracts found in their review.” Out of these neighborhoods, he defines them as gentrifying or not based on, “socioeconomic benchmarks that provide evidence of housing reinvestment and class turnover.” (Jackson 2014) This method is rooted in quantitative statistics, which drastically different from Hwang and Sampson’s approach, but they both focus on housing development and changes in the demographic of the neighborhood.

Jackson’s analysis of the neighborhoods on “gentrifying tracts” is profound. From 1990 to 2010 the demographic of individuals who were 18-34 living in this neighborhood changed from 59.9% African American to 36%. In this same age range, the white population increased from 36.4% to 53.7% (Jackson 2014). This method does not

account for why so many African Americans left these communities, but such a drastic change cannot be the result of voluntary desires to live somewhere else. Along with this displacement Jackson also discovered that between 2000 and 2009 the percentage of people living below the poverty line in these gentrifying areas decreased from 15.67% to 10.08%, and the median household income increased from \$72,080 to \$ 96,626. In addition, between 1990 and 2009, neighborhoods where whites were the majority increased from 18.99% to 76.67% and areas where African Americans were the majority decreased from 23.33% to 3.33% (Jackson 2014). Overall Jackson clearly proves that as gentrification occurs, there is wide spread displacement of minorities associated with it. What Jackson's research does not prove is the state of the neighborhood post gentrification. For those residents who were able to stay in these neighborhoods, what public benefits did they receive? Jackson starts the conversation about how gentrification impacts these areas demographically but does not incorporate the quality of life change for the residents still in these areas. Nevertheless his results show the drastic changes in neighborhoods being gentrified from purely a race basis.

Freeman and Braconi (2004) looked at New York City in the 1990s and the displacement rates associated with it. They examine the mobility rate of "disadvantaged households" in gentrifying neighborhoods. They define neighborhoods as the sub-borough area according to the NYCCHVS data and selected seven neighborhoods for examination based on their "familiarity with recent trends" (Freeman & Barconi). They concluded that, "mobility rates in gentrifying neighborhoods are inconsistent with a process dependent on the massive displacement of disadvantaged residents", specifically that a "disadvantaged households" that resided in one of the selected gentrifying

neighborhoods was 19% less likely to move than a poor household residing elsewhere. (Freeman & Barconi). They also claim that when controlling for rent controlled apartments, residents who resided in those apartments would also exit the neighborhood at higher rates than residents of unregulated units (Freeman & Barconi). This surprising conclusion was explained by the fact that rent control is only in place in the apartments of individuals who have resided there since 1972 and elderly tenants are more likely to relocate once they retire (Freeman & Barconi). In a second model to check the impact on rent inflation on displacement they found that a 1% increase in rent inflation is associated with a 1% decrease in the probability of displacement. They also say that gentrifying neighborhoods get more public goods such as better retail stores, safer streets, public transportation, and job opportunities. Although this was not a definitive conclusion due to the fact that these residents could have been displaced out of their homes but moved within the same neighborhood. They also see a great deal of secondary displacement, due to higher rents.

Byrne (2003) argues that this increased rent may however be justified due to the increased job opportunity and increased public goods. Also as gentrification occurs, according to Byrne, it gives a political voice to low income individuals who would not have had such power previously due to the added attention these communities receive. This causes low-income families to have their demands heard, and more likely to be acted upon because their community votes have become much more valuable. Byrne also argues that gentrification creates access to capital that was previously unavailable through real-estate lending. He argues that previously the increase in housing prices due to gentrification would not stimulate lenders lending to lower income neighborhoods.

Policies such as redlining are real: “the practice of purposely denying or charging more for loans in certain areas, especially those containing a large number of minorities.”

(Byrne) This literature focuses on the “positive” outcomes associated with increased property values. His research shows interesting results, but the increase of minimum wage jobs may not outweigh, in some people’s minds, the large displacement that Jackson depicted that happens when a neighborhood becomes gentrified.

The drastic differences between Jackson’s research and Freeman and Braconi’s may be due to the method in which they evaluated gentrification. Freeman and Braconi look solely at the mobility of “disadvantaged households” in New York City rather than the entire population of the area. Also the laws on restricting public housing in New York City and Washington D.C may be drastically different. These two factors may have been the reason for the different conclusions. Part of the reason the topic of gentrification is so controversial is due to the ambiguity of the results. One would not expect that two major cities such as New York and Washington D.C during the same timeframe would have such different conclusions on the effect of gentrification in regards to displacement risk.

The literature closest to my thesis is Keels, et al. They use, “system-wide administrative data from the Chicago Public School (CPS) district to explore what happens to the achievement levels of low-performing, high-poverty, neighborhood public schools when the neighborhood undergoes revitalization.” They anticipated an increase in the proportion of students from “higher income families, who are more likely to have higher test score” which would increase the average achievement level of the student population. As well as indirect effects that would affect children through improved, “neighborhood institutional resources, increased collective socialization, and contagion

effects” (Ellen and Jargowsky et al. 2005; Keels et al.). Keels et al. uses a, “categorical and a linear method of measuring gentrification” that uses percent change in census indicators of Social Economic Status (SES) to approximate the extent of gentrification (Keel et al.). Keels et al. look at data from 1992 to 2004 and uses a one mile radius surrounding the school as the definition of the “neighborhood.” The area is considered gentrified if it undergoes at least two of the following: “a 9 percent increase in the percent of residents with a college education, 29 percent consumer price index (CPI)-adjusted increase in average household income, 65 percent CPI- adjusted increase in average home value, or 11 percent increase in CPI-adjusted median rent.” This is the most defined criteria for a neighborhood becoming gentrified. This method best controls for potential errors in other techniques that mainly use one or two variables to define gentrification.

They concluded that for a, “1 percent increase in the fraction of residents with a bachelor’s degree is associated with an annual increase in reading scores that was 0.002 points higher than the CPS average.” This is an extremely small coefficient, however. What is more interesting is that for every 1% increase in initial percent of population with a bachelors degree (in year 1990) you see an effect eight times larger effect on children’s educational scores. Thus the initial starting education level of the population has a much greater effect on the educational outcomes of the students. Furthermore the effect of median household income was negative, but not significant on reading scores and only slightly positive on math. If two schools that began the period with the same neighborhood income level, but with one experiencing an “increase in neighborhood income of two standard deviations, would only be expected to differ at the end of the 12-

year period by 3 points, or approximately one-quarter of a standard deviation in the distribution of math test scores.”

These are unexpected results given the preexisting literature on income and test results. One explanation for this would be that as a neighborhood becomes gentrified, the population of children in that area may be reduced. Keels et. al. noticed a 3% reduction in the population of children over a 10 year period as a neighborhood becomes gentrified. Also the population of students going to private schools may drastically increase. These negative effects on enrollment in public school would decrease the budget they receive even if the neighborhood is being rapidly gentrified.

When looking at positive peer effects, Keels et. al. concluded that there were, “no effects on the growth trajectory of low-income students’ reading and math scores” (Keel et al.). This could be explained by the high mobility noticed among these low-income students in gentrifying neighborhoods. Any positive peer effects could be mitigated by the negative academic effects of school mobility (Mehana & Reynolds 2004). Overall there was no conclusive evidence that gentrification has significant effects on children’s education in Chicago public schools.

Clearly the literature on gentrification is very mixed. Studies fundamentally differ on their conclusions due to the different definitions of gentrification used in each study. I hope to combine some of the techniques discussed previously to give a quantitative and qualitative definition of the changes that occur to neighborhoods as they become gentrified in New York City.

Methodology:

Before elaborating the regressions being run in this model, it is important to clearly define gentrification and the process through which areas were selected. In this study, gentrification is defined as neighborhood experiences wide spread displacement of members of the community due to the change in the economic conditions in the neighborhood. This definition is derived from Jackson's method of measuring displacement in Washington D.C. This analysis will focus on New York City--- specifically on gentrifying neighborhoods. The neighborhoods were selected using the model of Hwang and Sampson (2014) research on the "racial inequality and the social order of renewal in Chicago neighborhoods." Hwang and Sampson attempted to identify neighborhoods that were likely to become gentrified by looking at 1960 census tracts and finding neighborhoods that fell below the citywide median income. Although I did not use this method directly, it inspired me to use rent as a variable that could anticipate neighborhoods experiencing the changes we see in gentrifying neighborhoods.

The areas being evaluated in this study are Williamsburg, Bushwick, Central Harlem, East Harlem, Lower East Side, China Town, Bedford Stuyvesant, North Crown Heights/ Prospect Heights, Washington Heights/ Inwood, Astoria, Sunset Park and Greenpoint. These neighborhoods were selected because they experienced the largest average rent increase between 1990 and 2010.

Education

To understand the impact of gentrification on public school education and displacement in New York City, this study will use a regression analysis of 3 population regression functions. Each regression will evaluate time series panel data, the first two regressions examining education are represented by:

$$TM = B_0 + B_1MHP + B_2MI + B_3CR + B_4TPW + B_5TPAA + B_6TPH + B_7PA + B_8P_0 + B_9P_2 + E_i$$

$$TELA = B_0 + B_1MHP + B_2MI + B_3CR + B_4TPW + B_5TPAA + B_6TPH + B_7PA + B_8P_0 + B_9P_2 + E_i$$

The dependent variable in both regressions are average public school tests score grade 3-8 from 2009-2012. TM represents average math test score where TELA denotes English language arts. Data for both tests scores is sourced from New York City's Department of Education. Scores are averaged by school district to control for the different educational and economic conditions in each neighborhood. Both models use the same variables to evaluate changes in test scores. Public schools received funding based on the local property tax so in order to control for the level of financial support each school receives the variable median housing price represented by MHP is implemented. This data is collected from the American Community Survey from 2009 to 2014 and a linear model is used to estimate the years in which data is not available. Median housing price is expected to have a positive sign due to the connection between increased funding and increased test results (Keels et, al.) The variable median income is represented by MI to capture the economic state of the district being analyzed. Although this is the median income of the total population of the district not the median income of the households attending public schools, it still captures the economics of the households in the area, which are likely to be reflected in the public schools. Median income is also expected to have a positive sign due to the fact that upper class families are more likely to have higher educated children (Keels et, al.). An inflow of more educated students has positive peer effects associated on lower achieving students (Keelst et al.). This variable

is not expected to be strongly positive because upper income families may rather opt for private school rather than send their children to public school, which would negate any of these positive peer effects (Keels et, al). According to Keels et, al. research in Chicago public school low income student migration is not widely noticed. In his research schools only experienced a 4% decrease in the amount of poor students, identified by receiving free school lunches, over the 12 year analysis. Therefore, if low-income children attending public schools in gentrifying neighborhoods are to benefit academically from the socioeconomic changes occurring, the educational changes that occur at the school will be largely due to the students that were enrolled before gentrification received increased funding. New York does rank 12th nationally in terms of quality of public school education which may cause New York to have a higher percentage of students enrolled in public schools compared to Chicago (Morse 2017).

The variable crime rates, as shown by CR, are instituted to control for the disruption in the area, which has negative impacts on education (Keels et, al). Data on crime rates was gathered from DNAinfo's crime and safety report. This source does not have data for all the years between 2006-2012. Due to the Great Recession in 2008, a linear model would not be appropriate to evaluate crime statics. To calculate the years without complete crime reports, I use an estimation based on employment rates. Crime rates often fluctuate in response to unemployment. As Fallahi et. al (2002) conclude, in the short run employment volatility has a positive effect on burglary. I expect crime rate to have a negative effect on educational outcomes as research from Machin et. al. and Meghir (2007) explain that higher educational achievement are associated with longer hours spent in school which heavily reduces juvenile crime rates. The added human

capital that one gains through education is similar to the income effect which also decreases the probability of crime. Although these studies looked at the inverse relationship that I am testing, it is a fair assumption to make that as crime rates increase, it will have a negative impact on educational outcomes. Finally I expect a negative sign for displacement of all races. Residential instability of low-income families increases children's susceptibility to the negative academic effects of school mobility (Mehana and Reynolds 2004). Any movement of families either in or out of the neighborhood should be associated with decreased test results.

The variable total population of whites (TPW), African Americans (TPAA), Asian (TPA), other(TPO), two or more races (TP2), and Hispanics (TPH) all will be gathered from census data between 2000 and 2010. Again a linear model will be used to estimate the variable between dates that the census reports are published. This same logic applies to the second regression because the only difference between the two is the dependent variable of ELA test scores.

Median Rent

The population regression function for my second regression will be represented by:

$$MR = B_0 + B_1MI + B_2IS + B_3CR + B_4TPW + B_5TPAA + B_6TPH + B_7PA + B_8P0 + B_9P2 + E_i$$

Median rent (MR) data set will be generated from the 2005-2009 and 2010-2004 American Community Survey. I will use a liner model to estimate the years where data is not available. This regression has the same independent variables as the education regressions. This model is constructed based off of Freeman and Braconi (2004) model

that examines rent inflation on displacement in New York City in the 1990s. Their method distinguished between disadvantaged households and normal residents to examine the effects of changes in rent on lower income families rather than the whole community.

Crime rates should have negative associations with median rent (Thorsby 2016). Finally, I expect total population for African American and Hispanics to have negative effects on median rent and total population of whites to have positive effects. As African Americans and Hispanics migrate from these neighborhoods in drastic number, it is likely due to the changing economics conditions, which will be reflected in the price of median rent. These outflows are connected with the inflows of Caucasian residents who take their places at an increased cost (Jackson 2014).

Redlining

The final analysis that I am going to conduct will be examining the redlining maps from 1938 in relation to the displacement statistics of New York City between 2000 and 2010. Redlining maps have only recently been released so there is little existing literature on this topic today. Thus the method I will use will be based on Jackson's (2014) and Wyly and Hammel's (1999) method of identifying and evaluating neighborhoods on gentrifying tracts. The theory these authors used was to examine census reports from 1960 to 1970 to find neighborhoods with median incomes below the city wide average. Based on these results, they designated areas as gentrifying or non-gentrifying. The redlining maps will be used in this manner as well. As detailed previously, redlining grades heavily factored in the race of the neighborhood and economic circumstances of the neighborhood. Based on the grade neighborhoods

received, I will investigate to see if lower graded areas are now experiencing the same effects as neighborhoods designated to be on gentrifying tracts by Jacksons (2014) and Wyly and Hammel (1999). Instead of having only two categories, there will be four based on the A through D grade neighborhoods received and assess how much of an impact the deprivation of housing loans shape these neighborhoods as well as how susceptible these areas are to changing rent and economic conditions.

By overlaying the redlining map with the census tract map, I was able to identify 23 neighborhoods that were received only 1 grade for the total area. There were some neighborhoods I was forced to exclude due to the fact that sections of those areas received different grades. Out of the 23 neighborhoods I examined, 11 were rated D, 4 rated C, 6 rated B, and only 2 were given an A grade. Through Census and American Community survey data, these neighborhoods will be examined to see if there are any discernable differences today from decisions made decades ago.

Results

When looking to figure 1 the results of the double log regression function for math test scores had some interesting outcomes. First median property value has a negative, and insignificant impact on test results. Similarly property value has a negative impact for ELA tests results, but it is significant at the 1% level.

The results in figure 2 which depict the double log function with median rent as the dependent variable confirms that New York City has experienced displacement similar to other cities discussed in the previous literature review. This model does not look at the aggregate displacement statistics, however it tells a similar story. As median rent increases by 1% there is a .124% decrease in the

population of African Americans a .12% decrease in the population of Asians, and a .162% decrease in individuals who identify as an other race. All of these variables are statically significant at the 1% level. Similarly, the populations of Hispanics and those who belong to two or more races also have negative coefficients however they are not statistically significant at any level. The only positive coefficient regarding race, as expected, is White, which has the highest coefficient value with .332 and is spastically significant at the 1% level.

When looking at figure 3, which analyzes displacement in neighborhoods according to the 1938 redlining maps rating of these neighborhoods, we get an interesting perspective of how these previous policies impacted how neighborhoods change today. In neighborhoods designated A or B, we noticed a decrease in the percentage of white population within the community by 3.12% and 4.45% respectively. On the other hand, in neighborhoods designated C and D, there was an increase in white population by 11.23% and 15.07%. In these lower rated neighborhoods, we also notice a decrease in the African American community by 6.49% and 6.51%. The most drastic change in the demographics occurred in neighborhoods rated C of those who identified as other with a decrease of 52.95% in the community and two or more races with a decline of 46.21% in the population.

Discussion/ Concussion

Median Rent

Looking at the results from the education model, they are consistent with Keels et, al. research which found that there was no difference between the growth rate of students' third through eight grade reading or math scores based on neighborhood schools located in gentrifying neighborhoods compared to starting in ones located in nongentrifying neighborhoods (Keels et, al.). One explanation for this may be that gentrifiers may reduce the local public school population of children by opting for private school, negatively affect enrollment at local public schools, thus negatively affects school budgets. This logic also applies to the very slightly positive and insignificant results of median income. As wealthier families enter the neighborhood, low-income families experience residential instability that increases children's vulnerability to the negative academic effects of school mobility (Keels et, al). Even if a family chooses to keep their child enrolled in the same school even though that have relocated to a near by neighborhood, this disruption still has a large negative impacts on the educational outcome of students (Keels et, al.). One exogenous factor that could have impacted these results was The Great Recession. Due to the economic crash that followed, specifically in the housing market, housing values may now have increased at the appropriate rate. In these gentrifying neighborhoods median property value only increased 3%. This could have drastically shifted the funding schools would have received, if it were not for this crash.

When looking at the median rent regression model, it appears it is also consistent with the literature, specifically Jackson (2014) displacement research in

Washington D.C. between 1990 and 2009. Jackson (2014) concluded that in neighborhoods undergoing the process of gentrification, the population that was 18-34 and African American changed from 59.9% to 36% and the White population changed from 36.4% to 53.7%. The largest neighborhood percent rent change in my dataset between 1990 and 2010 was 78.7% with the majority hovering around 30%-50%. Simple arithmetic shows a 9.75% decline in African Americans living in these gentrifying neighborhoods. Jackson (2014) research concluded that 18-34 were most susceptible to either enter or leave the neighborhood so the 9.75% total decline in African American population in gentrifying is similar to the 23.9% decline of 18-34 year old African Americans in Washington D.C.

My results do however somewhat contradict the findings of Freeman & Barconi (2004) whose analysis of mobility rates in gentrifying neighborhoods in New York City in the 1990s concluded that there was no evidence of, “massive displacement of disadvantaged residents.” My analysis does not factor in the income of the residents that are moving out of the neighborhood, however as rent increases and this displacement occurs, one could make the assumption that the inability to pay this increased rent could be the leading factor for the migration from the neighborhood. One possible explanation for this is that the definition of gentrification used in my model is more in line with the definition Jackson (2014) used when analyzing Washington D.C. This shows that the definition of gentrification, which is wide ranging, directly impacts the results and conclusions.

The preliminary results of the redlining analysis indicate that these previous lending policies have impacted how demographics are changing today. The large

outflow of minorities in neighborhoods that received a disproportionately low amount of loans per capita, C and D neighborhoods, could be due to designation by The Home Owners Loan Corporation that suggested these neighborhoods were bad investments. With a lower homeownership rate, families were forced to enter the rental market. Thus when rents drastically increase, it could cause mass displacement. Furthermore, it seems that rents in major cities may not be directly correlated to housing value. Housing value from 2008 to 2012 increased by 3.4% in the gentrifying neighborhoods examined in this regression analysis where rents increase an average of 26%. These results may indicate that the rental market may be a more stable increasing market due to the fact leases are often signed for years at a time, where housing value may fluctuate more in line with market movements. Also the time of this analysis was set in The Great Recession, which may have caused a shift on individuals from the housing market to the rental market, further inflating prices. At the moment there is little literature examining the relationship between housing value and rents, but these initial results may indicate that in developing neighborhoods rent increases may not be directly correlated with housing values. This could cause a disproportional negative effect on minorities due to the lower percentage of homeownership.

These results are somewhat speculative and there is much room for improvement. There were large areas of New York City that could not fit into this analysis due to some neighborhoods composing of multiple ratings. Future research could look at the block-by-block census reports to capture all of the areas rated in the redlining maps. Secondly, a more complex regression could be run that could factor in values that further capture

displacement. This model was not the central focus of my thesis, but definitely warrants further research.

There were a few problems in my regression analysis, mainly the multicollinearity that was found. If you look at Figure 4 which displays the VIF results for my models that evaluated education test scores the variables crime, population white, population African American, population Asian, population other, and population two or more races, all had VIF's greater than 5, demonstrating multicollinearity exists. After attempting to manipulate variables such as change the evaluation the demographics by race to percentages instead of gross numbers, squaring variables, and discarding population variables with no success, I concluded there was a deeper issue with my variables than the method I was evaluating them. It appears that in my education and crime models, whose VIF's can be seen in Figure 5, there is the problem of simultaneous equations. This means that my model has a two-way casual relationship between variables, specifically my demographics and crime variables. This violates the third classical assumption, which states that, the error term of each variable must be uncorrelated with one another (Studenmund 2011). There is, in a sense, a "feedback loop" which causes variables to continuously influence each other. To solve this problem, you must look at the entire system that each variable belongs to. In the case of these models, demographics of the neighborhoods are highly correlated with the crime rates of those areas. The solutions would be to use reduced form equations that my variables such as income and median housing value solely in their an error terms and all the variables that are highly correlated in the simultaneous system (Studenmund 2011). Unfortunately this problem

was discovered too late for me to use this technique. Thus there is high multicollinearity in these models, which reduces the significance of the results.

There were also some data limitations in this analysis, mostly the gap of years between Census and American Community Survey data, along with education results. Public school test scores just recently became widely available in 2006, where the most detailed American Community Survey data, which was used for median rent, median income, and property values, were reported in 2009 and 2014. The Census data however was only reported in 2000 and 2010. This led to a plethora of data that only overlapped for a select number of years. Also with the Great Recession taking place during this time frame, it was impossible to forecast these numbers for years in which data was not reported due to the large fluctuations in economic variables in general. This reduced the amount of years that I could completely analyze, which may have impacted my education results the most. Test score improvement may be heavily lagged from the time a neighborhood starts to gentrify, and receive more funding. An analysis that captured a larger time frame may have yielded different results, which could have contradicted the existing literature.

Even with these limitations there are still some policy implications from this research. It seems that rent is the main factor in displacement rather than property values. This could lead to public action such as rent control, but that may not lead to favorable outcomes. Often rent control in major cities is associated with crowding out individuals willing to pay market rent and gives benefits randomly to those fortunate enough to land a rent control apartment or house (Lindbeck, 1967). Thus the policy recommendation based on this research would be to provide affordable loans, through subsidies, to

minorities in major cities. These policies could be justified for the inexcusable results from redlining with unjustly denied minorities loans for decades. This would allow minorities in major cities to have a home ownership rate comparable with Caucasians on a national level. This would allow individuals to make decisions to remain in the area or sell their home and reap the profits rather than being forced to move due to the drastic increases in rent.

Moving forward there is room for a variety of research on this topic. In my research alone, I discovered a wide array of definitions that lead to contradictory results, specifically Jackson (2014) and Freeman & Barconi (2004). A summary of the existing definitions, and the results attached to the definitions could shed light on how much of an impact the classification of gentrification makes.

The most interesting analysis moving forward, from my perspective, would be connecting redlining to homeownership rates in neighborhoods, and then extending those results to the impact of changing rents and changing property values on the displacement that occurs. It seems that everyone is looking for a solution to solving the widespread displacement that often occurs in areas of cities that contain a predominantly minority population. A connection between these variables could lead to policy changes that could remedy, or at least slow down, the displacement that is happening as we speak.

Tables

Figure 1

All logged	Math Results	ELA Results
Crime	-.006	-.011***
Population White	.012***	.007***
Population African American	-.003***	-.002***
Population Asian	.0004	-.001
Population Other	-.009***	-.007***
Population Two or More	-.001	.001
Population Hispanic	-.001*	-.004***
Median Housing Value	-.00007	-.006***
Income	.0001	.003*
Constant	6.562***	6.6***
R ²	.95	.967
N	40	40

Figure 2

All Variables Logged	Rent Model
Income	.435***
Median Housing Value	-.366
Population Hispanic	-.105
Population Two or more Races	-.111
Population Other	-.162***
Population Asian	-.120***
Population African American	-.124***
Population white	.332***
Crime Rate	10.069***
Crime ²	-.646***
Constant	-29.88**
R ²	.8637
N	40

Figure 3

Grade	A	B	C	D
White	-3.12%	-4.45%	11.23%	15.07%
African American	-14.97%	-12.59%	-6.51%	-6.49%
Asian	24.13%	31.26%	37.71%	4.03%
Other	-20.65%	-12.33%	-52.95%	-15.13%
Two or More Races	2.26%	-48.31%	-46.21%	-18.17%
Hispanic	-9.12%	15.28%	1.98%	3.48%

Figure 4

All logged	Math VIF results	ELA VIF Results
Crime	25.95	25.95
Population White	16.58	16.58
Population African American	9.78	9.78
Population Asian	9.78	9.78
Population other	16.30	16.30
Population Two or more	9.87	9.87
Population Hispanic	4.08	4.08
Median Housing Value	4.81	4.81
Income	2.57	2.57

Figure 4

All logged	Median Rent VIF results
Crime	17.16
Population White	11.45
Population African American	17.40
Population Asian	6.48
Population other	17.02
Population Two or more	20.74
Population Hispanic	15.26
Median Housing Value	4.85
Income	2.56

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