From Past to Present:

An Examination of the Effects of Historic Redlining on Net Worth Within Seattle

DeJai Alandra Mitchell

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Abstract

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The American government and its policies have a long history of racism. In particular, the historic policy of redlining is one legislation explicitly responsible for America's modern-day urban disparities. This study attempts to estimate the effect of redlining on urban disparities of wealth in Seattle. Using an ordinary least squares regression analysis of 2012 census tract-level net worth and socioeconomic data, I identify the long-run effects of redlining on net worth in Seattle. I found that net worth exponentially decreases when shifting from areas historically graded A to areas historically graded D. Additionally, my findings further confirm that homeownership significantly impacts wealth.

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ACKNOWLEDGEMENTS

I would like to acknowledge all those who helped me get to this point. It has been a long journey. Thank you for helping me to keep pushing forward.

DEDICATION

I would like to dedicate this thesis to all those who have encouraged me to never give up.

CHAPTER 1. INTRODUCTION

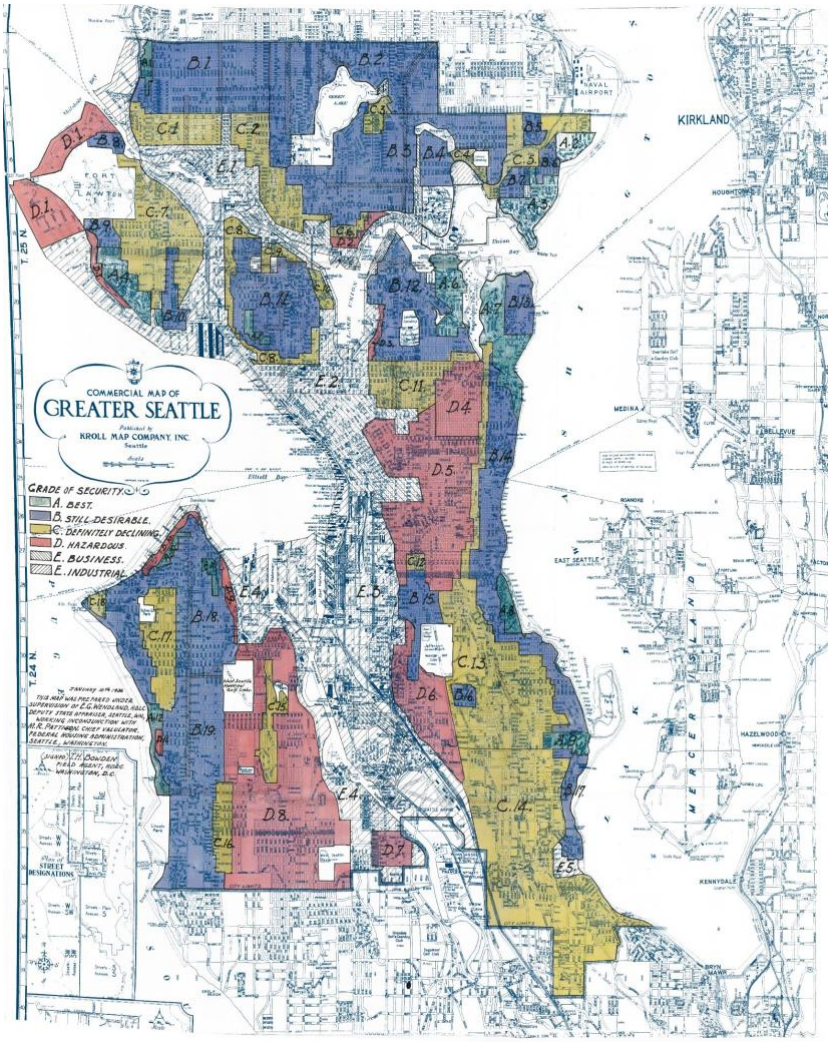
In times of social unrest, when movements such as Black Lives Matter are bringing equity issues to the forefront and sparking national conversations, it is time to reassess past and current policies that have perpetuated inequalities amongst minorities within the United States. The American government and its policies have a long history of racism. In particular, the historic policy of redlining is one legislation explicitly responsible for America's modern-day urban disparities. Though outlawed in 1968, it continues to be a significant factor in perpetuating wealth inequality in the United States, particularly between white and African Americans.

Before the New Deal, Jim Crow laws and Black codes had already initiated segregation by race. Chudacoff (2016) recalls Jim Crow laws and other discriminatory practices "increasingly confined African Americans to a city's most rundown areas"(pg. 109). What differentiated the New Deal and historic redlining was that these two created new homeownership avenues to segregate and divide African Americans from whites, diminishing the already low access to integrated and adequate homeownership options by denying access to loans and mortgage options. Michney et al. (2020) proclaim that “even though the Home Owners Loan Corporation did loan to African Americans, it did so in ways that reinforced racial segregation—and with the objective of replenishing the working capital of the overwhelmingly white-owned building and loans that held the mortgages on most Black-owned homes” (pg. 150). The New Deal’s exclusionary methods were not always de jure - De jure, meaning resulting from purposeful legal discrimination by the government. It is often compared to de facto segregation, which are practices that were the outcome of private activity, not law or explicit public policy. Despite not always being de jure, the New Deal's policies often happened undisguised and

without consequences. However, the introduction of redlining provided a method of enforced discrimination by American governmental systems and financial institutions, including the American planning system. Hillier (2003) states that "in the 1930s and 1940s, there were virtually no legal obstacles to lending discrimination. Redlining—not yet given a name—was simply considered to be good business" (pg. 395).

Initially created to stabilize the housing market after the Great Depression, the Home Owners' Loan Corporation (HOLC) was to renegotiate and amortize loans for all American citizens (at least on paper). To do this, the HOLC created and used an extremely discriminatory process to assess risk. This corporation used real estate agents to survey neighborhoods of a city, dividing the areas by security risk. Broken down into four categories (A-green, B-blue, C-yellow, D-red), real estate agents drew lines on a map, determining the best and worst areas to lend (as shown in Figure 1).

Figure 1.
Seattle's 1937 redline map



Source: University of Richmond

Areas with an A rating were the most desirable areas being homogeneously white with minimal risk. They were also where the highest loans were given. Areas with B ratings were still "desirable," being nice areas but not the best. Areas with C ratings were "definitely declining," infiltrated by races other than white. D ratings were deemed hazardous and characterized by undesirable populations or homogeneously Black (An et al, 2019). Hillier (2005) quotes the 1937

FHLBB (the Federal Home Loan Bank Board) appraisal manual as describing the difference in neighborhoods as:

- Grade A = Hot spots. These areas still had room for new residential growth, were "homogeneous," and were in demand during "good times or bad. Grade B = “completely developed but like a 1935 automobile-still good, but not what the people are buying today (in 1937) who can afford a new one."
- Grade C =” Older and becoming obsolete with expiring restrictions or lack of them” and infiltration of a lower grade population.” These areas had poorly maintained homes, had "jerry-built" areas, and often lacked homogeneity.
- Grade D = “Those neighborhoods in which the things that are now taking place in the C neighborhoods have already happened." They had lower homeownership rates, poor housing conditions, ‘‘detrimental influences in a pronounced degree,’’ and ‘‘undesirable population or an infiltration of it” (pg. 216-217)

These divisions were not created on previous tracts or any other census designations but instead based on the discretion and opinions of the real estate agents themselves. In the past, "HOLC surveyors assigned quality categories and accordingly classified neighborhoods on the basis of housing characteristics such as home value, home age, construction-type and rental values as well as demographic characteristics such as the occupation of residents and, most controversially, race and ethnicity" (Anders, 4). For African Americans and other minorities, historic redlining grades limited homeownership options, mortgage financing, and areas where they could buy homes. Nelson et al. (2016) further explains that "redlining directed both public and private capital to native-born white families and away from African American and

immigrant families because homeownership was arguably the most significant means of intergenerational wealth building in the United States in the twentieth century." Historic redlining inherently placed multiple racial groups in economically disadvantaged positions that simply continued from generation to generation.

However, this generational disparity is not by chance. Aaronson et al. (2021) suggest that "redlining ratings have a causal, and an economically meaningful, effect on outcomes like household income during adulthood, the probability of living in a high-poverty census tract, the probability of moving upward toward the top of the income distribution, and modern credit scores" (pg. 10). Historic redlining overtly denied investment and development, not only to neighborhoods but to people as well. By denying a group of people access to homeownership options, the United States denied these people the ability to accumulate wealth as "homeownership plays a crucial role compared with other types of assets in making the distribution of wealth in the United States more equitable" (Holloway, 43). Many Americans do not have stock portfolios that they pass down but rather have home equity as a means of generational wealth. The Congressional Records (2010) state that "homeowner equity remains the largest component of wealth for low-income and non-white households in the U.S."(pg. 110). Without even the option of equity, minorities are already at a considerable disadvantage.

Redlining continues to immobilize many Americans economically. When examining the wealth distribution in the United States today, one finds that the median wealth of many Black households is much lower than white households. Data from the 2019 Survey of Consumer Finances, a triennial cross-sectional survey of U.S. families, show that white families have a median wealth of $188,200 while Black families have a median wealth of $24,100. The Federal Reserve states that “long-standing and substantial wealth disparities between families in different

racial and ethnic groups were little changed since the last survey in 2016; the typical White family has eight times the wealth of the typical Black family and five times the wealth of the typical Hispanic family." The situation is even worse in Seattle, wherein 2019, white households had a net worth of $456,000 while Black households had a net worth of $23,000. When analyzing homeownership data for Seattle, only "28 percent of Black households in King and Snohomish counties own their home, compared with 64 percent of white households" (Balk, 2019). Per JPMorgan's Prosperity Now report, as of 2021, the wealth gap between white and Black households in Seattle continues to widen.

The wealth gap in Seattle and the continual wealth gap around the country suggest that wealth disparities are not the result of individual behaviors but rather "racial inequality in wealth is rooted in historic discrimination and perpetuated by policy" (Traub et al, 13). While literature asserts that multiple policies in housing, education, and labor markets all affect the current wealth gap issue, the purpose of this research is to explore the impact of the historic redlining policy on modern-day household wealth in Seattle. I explore this impact by statistically analyzing past historic redline grades on the current net worth within Seattle's tracts. Using a quantitative approach through an analysis of planning policy, census data, and redlining maps, this project aims to answer the following questions:

1. What are the effects of historic redlining grades on present-day family net worth in Seattle's?
2. How have historic redlining grades affected Black family net worth in Seattle?
3. How have historic redlining grades affected white family net worth in Seattle?

While these serve as the core research questions for this study, I will also address redlining's effect on the built environment. More specifically, I will later take the opportunity to discuss the question: How has historic redlining affected the design of the built environment in Seattle? Although this question is not the central thrust of this thesis, it aligns with my academic emphasis in urban design.

1.1 METHODS

I conducted an ordinary least squares regression analysis of 2012 net worth in Seattle on historic redline grades. Median household income, homeownership rate, home value, race, historic redline grade, unemployment rate, age, education, and household composition are all used as independent variables in this study. I ran these variables against net worth for each of the corresponding tracts (135 in total). Of the current 135 tracts, only 77 tracts had a historic redline grade encompassing 50% or more of its area; This is due to the growth of Seattle, which has expanded its city boundaries since the creation of the HOLC maps (Nelson et al, 2016).

My analysis will identify if there is a correlation between historic redline grades and net worth within Seattle's tracts. The analysis will also identify if historic redlining has affected net worth for Black and white families differently. If there is a correlation between these two races and net worth, the results will demonstrate the degree of this correlation.

1.2 OUTLINE OF THESIS

I divide this thesis into six different chapters. The organization is as follows:

Chapter 2 will cover the literature review related to historic redlining. This chapter will first overview the theoretical background of historic redlining, who the significant perpetrators were, and how historic redlining was implemented. The literature review will then discuss how

homeownership affects wealth accumulation and redlining's effects on homeownership and wealth accumulation. After that, I discuss the relevant literature on what wealth is and current wealth disparities. I conclude this section with a discussion on how historic redlining policy shaped the design of the built environment

In Chapter 3, I will focus on the methods of the thesis analysis. This chapter will discuss how the data was gathered and cleaned for use in the regression analysis. It will also provide the description of each variable and an associated research hypothesis. Lastly, I will explain the econometric model used in the study.

In Chapter 4, I will present the findings of the econometric analysis. Each of the resulting models regressed will be provided in a combined table for comparison.

Chapter 5 will offer an interpretation of the results. This chapter will explain possible reasons for results. In addition to the results, I will discuss the design implications of redlining.

Finally, Chapter 6 will present the conclusions of the thesis. This chapter will explain the limitations of the study, policy implications and provide recommendations for further study.

Chapter 2. LITERATURE REVIEW

Whether discussing slavery, Jim Crow laws, and even the current Black Lives Matter movement, America's historical timeline is riddled with the disenfranchisement of Black bodies. While discrimination based on race is currently illegal, there is still an increased need for understanding the generational effects of institutional racism throughout American governmental systems. There is a need to understand how discrimination has stunted wealth accumulation for Black Americans. The following review of the literature confirms a gap between white Americans and Black Americans as it pertains to wealth accumulation and asset ownership; One of the biggest hindrances is the inability to access homeownership options.

2.1 Background of Redlining

The process of redlining was multifaceted and encompassed multiple different actors within America's government and systems. Initially started by the Home Owners' Loan Corporation (HOLC) and partly the Federal Home Loan Bank Board (FHLBB), redlining was used to assess loan risk in areas throughout America. The organizations created a city survey program to adequately assess these risks, which produced detailed demographic and economic data. Freeman (2019) asserts, *"*The HOLC successfully developed methods that took account of a property's age, construction, neighboring sales trends, and the racial composition of the area. Black neighborhoods or those at risk of a Black influx were almost invariably assigned the lowest grade and deemed the highest risk. Even Black middle-class neighborhoods consisting of relatively new construction were given the lowest grade*"* (pg. 172). The HOLC eventually transcribed these insidious surveying methods and beliefs into the historic redlining maps. While

the data and maps produced were intended to stay internal between the two agencies, eventually the documents were used beyond just their employees. The HOLC and FHLBB "underwriting standards influenced practices in the private market. As part of the nascent federal banking system, the policies and practices adopted by the HOLC filtered into professional real estate organizations and other parts of the federal banking bureaucracy, including the Federal Housing Administration (FHA)" (Freeman, 173). Organizations such as the FHA, Federal Banking Bureaucracy, the American urban planning system, real estate companies, and private lenders all used these maps in tandem with and as influences on their processes.

This cross-agency use and integration of the HOLC security maps and data solidified the details of the map on the ground and institutionalized the discriminatory lending practices of historic redlining. One of the main contributors to institutionalizing redlining was the FHA (which later became a part of the Department of Housing and Urban Development office) and its underwriting manual. The FHA, whose role was to insure mortgages for qualifying properties, used HOLC maps to assist in appraising property. At the time of conception, the FHA lacked a systematic method for appraisals and used the HOLC security maps as a basis for its evaluations. After analyzing real property surveys, the FHA created its very own manual, transcribing the implementation of historic redlining and reasoning behind redlining. The manual provided instruction on underwriting risk, valuation, and cost procedures for commercial and residential properties. Freeman (2019) states that the FHA's underwriting manual detailed how "properties had to meet certain construction standards as well as to be located in areas that, among other criteria, were deemed economically stable and unduly burdened by adverse influences" (pg. 173). The manual even went as far as to explicitly explain its meaning of adverse influences, stating that "If a neighborhood is to retain stability, it is necessary that properties shall continue

to be occupied by the same social and racial classes" (FHA underwriting manual, section 937). In practice, this meant that most properties the FHA approved were not going to be in Black neighborhoods (and especially not in mixed neighborhoods) or Black-owned, as Blacks were adverse influences and Black neighborhoods were economically unstable. With historic redlining steps explicitly written down, the FHA Underwriting Manual soon became “the how-to guide for appraisers in the mortgage industry in this period” (Freeman, 178). The Federal Banking Bureaucracy, real estate companies, private lenders all followed the FHA, using its underwriting manual and the HOLC maps to deny or approve Black people of homeownership options. To further expand upon the FHA and HOLC influence, Freeman (2019) mentions a migration study conducted in Detroit during World War I that analyzes Detroit's neighborhood racial tension and property values. Within this study, realtors are asked their sentiments around Blacks and property values. Freeman notes that "interviews with ten white realtors showed six of them thinking that Blacks lowered property values and four of them qualifying their conclusions. Interviews with ten Black realtors showed six of them suggesting that the infiltration of Blacks would actually increase property value” (pg. 184). The racial bias that the FHA's manual permitted only further racialized field agents, who controlled a lot of the initial power in determining housing recourse for Blacks. However, field agents were not the only ones perpetuating the process of historic redlining. The racial bias perpetuated by real estate agents and finance companies continued to exist due, in part, to the American planning system. Kantor et al. (1982) affirm that "the operations of the redlining loop are, in turn, influenced by the larger loops involving government participation in setting the institutional environmental conditions. These include housing codes, zoning ordinances, regulations of local and national financial institutions, national monetary policy, civil rights laws applied to housing markets, regulations

related to housing developers, real estate transactions, and general civil law regulating business transactions" (pg. 313-314). While the HOLC created the historic redlining security maps, it took more than just the corporation itself to alter and implement the discriminatory lending and housing practices; it took the integration of most American governmental and financial systems, inclusive of the American urban planning system.

Some argue that the HOLC maps had little to no effect on institutionalizing the process of historic redlining. In particular, Hillier (2003) argues that the “HOLC's maps do not explain differences in lending patterns with the exception of interest rates, which were higher in areas colored red" (pg. 394). Hillier analyzes address-level mortgage data for the City of Philadelphia using geographic information systems and spatial statistical models. Her research concludes that the HOLC did not cause historic redlining as it was already widely accepted practice before the HOLC city survey program. She further goes on to say that " HOLC grades do help to explain difference in interest rates but do nothing to explain loan to value ratios” (pg. 412). However, higher interest rates in only red or predominantly Black areas do in itself affirm a difference in lending practices. Of course, HOLC and The FHA were not the sole perpetrators of historic redlining. However, the HOLC maps and FHA's underwriting manual created an institutionalized policy and a process of historic redlining that integrated the government, financial institutions, and real estate in the disenfranchisement of Black Americans.

2.2 Homeownership as A Means of Wealth Accumulation

The current racial wealth gap is the consequence of many decades of racial inequality that imposed barriers to wealth accumulation through explicit prohibition during slavery or unequal treatment after emancipation (The Federal Reserve Bank of Cleveland, 2019). While no action solely determines this inequitable distribution of wealth, income, or upward mobility, homeownership continues to be a highly influential factor. Homeownership has consistently been an "important contributor to the growth of aggregate household wealth in the United States," making it an important contributor to wealth equity (Holloway, 43).

While homeownership is supposed to be a path to wealth afforded to all, there is an extreme gap in homeownership rates between white and brown Americans. Using data from the Current Population Survey, American Housing Survey, and the decennial census, Herbert et al. (2005) concludes that "one implication of the similarity in broad homeownership trends among racial and ethnic groups is that while there have been large increases in homeownership rates for all minority groups, the white - minority homeownership gaps have remained stubbornly high" (pg. 85). Since the 1940 census, as homeownership rates increase, the gap between whites and minorities increases. This gap suggests that wealth accumulation for brown communities is also disproportionately affected. Comparing homeownership rates, income, and race, Herbert et al. (2005) assert that "one of the most salient characteristics of homeownership rates by race and income is that while homeownership rates increase significantly with income for all racial and ethnic groups, the impact of rising income on the probability of homeownership is more pronounced for minorities than for whites" (pg. 96). Thus, even as income rises for Black households, homeownership rates between Blacks of different income brackets are still low.

Their research states that even though there are differences in race and homeownership, many of those differences are correlated to household differences outside of just income.

Flippen (2001) further elaborates on this racial wealth gap, by including Hispanics in his study. Using multivariate models to answer the question, "what is the source of Hispanic housing inequality," Flippen's findings suggest that while Hispanics and Blacks have less wealth than white counterparts, white Hispanics tend to be wealthier than Blacks. Moreover, these differences encourage the idea of a more multiethnic perspective on wealth stratification.

Deng et al. (2003) attempt to better understand the homeownership gap between races by specifically studying citizens in Philadelphia. Using three tenure choice models and the 1985 metropolitan sample of the American Housing Survey for Philadelphia, they attempt to analyze the correlation between racial differences in homeownership and high levels of racial segregation observed in metropolitan areas. Their findings suggest there is “no evidence that existing racial differences in residential locations in Philadelphia decrease the homeownership rate among African Americans. But rather, the empirical evidence suggests that African American residential location outcomes are associated with lower than expected racial differences in homeownership” (Deng et al, 517). While African American homeownership rates are not affected by segregated residential location, the quality of housing obtained in these segregated residential locations are of lower quality with higher equity risk. As previously stated, homeownership is an important contributor to wealth accumulation. However, African Americans are severely limited in partaking in this form of wealth accumulation if the housing obtained is unlikely to appreciate over time.

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2.3 Redlining's Effect On Homeownership And Wealth Accumulation

Black Americans have often not been given an equal opportunity to attain homes throughout American history. Policies perpetuate "segregation, disparate access to credit and homeownership, and the consistent devaluation of homes in Black neighborhoods combine to constrict the ability of African Americans to build equity and accumulate wealth through homeownership" (Zonta, 2019). Many of these disruptive and restrictive policies originate within agencies of the American government.

Frequently past racial segregation in America is thought of as de facto, resulting from practices that were the outcome of private activity, not law or explicit public policy. Rothstein (2017) attempts to analyze this myth. He concludes that while, to some extent, segregation was de facto, it mainly was de jure segregation that only helped to perpetuate de facto segregation. His research suggests many laws and policy decisions passed by local, state, and federal governments helped sustain discriminatory practices. Main players in this de jure segregation included the American government and financial institutions through historic redlining.

Redlining has had long-term effects on the economic opportunity and socioeconomic success of African Americans. To understand the past, present, and future implications of historic redlining, Aaronson et al. (2021) analyze the long-term effects of the Home Owners Loan Corporation (HOLC) historic redlining maps on census tract level socioeconomic and economic opportunity data and using two different methods. The initial method compares cross-boundary differences between historic HOLC historic redlining boundaries and areas with similar pre-existing differences. The second method uses propensity scores “to identify a set of treated HOLC borders that do not exhibit pre-existing trends in observable outcomes” (pg. 86).

They found that historic redlining's ratings directly correlate with household income, living in a high poverty tract, upward mobility, and credit scores. They also concluded that "yellow-lining" may also have been more impactful than redlining. The impact of being raised in neighborhoods rated C instead of B (yellow-lining) appears to be greater than the impact of being raised in neighborhoods rated D instead of C. The synopsis demonstrates how government policy can impact disinvestment or investment in neighborhoods and their citizens for years to come.

Building off of the long-term effects of historic redlining, Hernandez (2009) claims that current contemporary lending practices in Sacramento mimic past historic redlining practices. He asserts that instead of denying mortgage lending in specific neighborhoods, agents now provide subprime lending with extremely high interest rates in the same historic redlined areas, causing increased rates of foreclosures. Using a case study approach, Hernandez (2009) analyzes Homeowners Loan Corporation (HOLC) residential security maps and appraisal data from 1938, Census data from 1950 to 2000, interviews with residents, and local government records to identify historically race-based market practices. He attempts to understand further how historic redlining has affected current lending practices and housing for non-whites. The analysis suggests that current "subprime lending is merely only reorganizing space created by previous redlining policies"(pg. 308); Subprime lending (like historic redlining) negatively impacts wealth accumulation, as home equity is one of the most significant contributors of wealth for low-income peoples. Hernandez goes on to suggest that "the combination of historical and contemporary housing policies created a set of structural conditions in neighborhoods that made them vulnerable to capital extraction and the resulting economic catastrophes brought on by the meltdown of the globally leveraged deregulated subprime loan industry" (pg. 308). Thus, it could

be argued that subprime lending is just a modern-day form of historic redlining, merely building off of the inequities already built into neighborhoods.

2.4 What Is Wealth and How Does It Affect Racial Disparities

Continually "research has demonstrated that Blacks, in particular, have not kept pace with whites" as it relates to differences in earnings (Keister, 477). When it comes to the complexity of indicators for financial status, the concept of wealth (not just income) is at the forefront of racial and social disparities. Keister (2000) states that " the control of wealth has been the key determinant of advantage, and the truly rich are still separated by net worth rather than income" (pg. 499). What differentiates the two is that income only measures an amount of money received over time, while wealth measures the difference between total assets and total debts or liabilities. This definition of wealth is also known as net worth. While Oliver et al. (1989) asserts that *net financial assets* (all assets minus liabilities excluding home and vehicle equity) are a better measure for wealth, "the use of net financial assets is controversial and still open to debate" (pg. 10). Thus, in my analysis, I will use net worth as a measure of wealth.

Additionally, while wealth encompasses income, wealth allows a deeper look into how much income is retained within the household. An excerpt from Keister (2000) explains that:

> Wealth can produce interest and dividend income that can be used to satisfy consumption needs. In addition to the income it produces, wealth generates more wealth because it appreciates and can be used as collateral for securing loans for further investment. Of course, interest and dividends can also be saved and reinvested. Wealth can be used to combine consumption with investment, as in the purchase of houses, land, vehicles, and jewels. Wealth can also be used to directly purchase such advantages as leisure, physical protection, a safe and pleasant living environment, and economic security. Moreover, wealth can be used to indirectly gain advantages such as political influence, social prestige, and improved educational and occupational advantages for oneself and one's children. (pg. 478)

Unlike income, wealth continues to provide opportunities when monetary streams fail. Wealth begets wealth, but income does not beget income. Wealth's ability to provide additional opportunities further correlates to more access to life chances and well-being.

Keister (2000) analyzes the relationship between family assets and racial inequalities in wealth ownership to expand upon wealth as an indicator for well-being between Black and whites. Using two methods, a standard regression method on survey data produced by the Survey of Consumer Finances (SCF), and a simulation model on the resulting asset patterns, she finds that racial differences in asset ownership lead to a dramatic difference in wealth inequities. More specifically, she finds that "whites were more likely than Blacks to buy high-risk, high-return assets and that the net worth of whites was, therefore, likely to increase faster than that of Blacks" (pg. 498-499). With the removal of this difference in asset ownership, racial wealth inequality decreased drastically over the three decades analyzed. The analysis further shows that while asset ownership is impactful, "racial differences in earnings, education, fertility, marriage behavior, etc. allowed quite substantial racial inequality in wealth ownership to persist despite the absence of direct racial differences in asset ownership" (Keister, 499). Thus, further proving that racial inequalities are more than just a difference in behavior; they are also a social problem.

To further analyze how this social problem affects different classes, races, and ethnic groups, Campbell et al. (2006) further expand upon the race-wealth issue, diving deeper into racial and ethnic groups. They analyze Survey of Income and Program Participation data using the ordinary least squares method on two sets of models. One model analyzed how independent variables mediate the effect of race and ethnicity on wealth. In contrast, the other model analyzed race and ethnicity differences on the effects of determinants of wealth. They again find that racial differences in wealth are correlated to asset accumulation.

Additionally, even when analyzing inequities among races and ethnicities, the divide between Blacks and whites in wealth is still the most extreme. Other races such as "Mexican-Americans and other Hispanics fall in the middle of the wealth continuum–between the Black and White extremes," while the wealth of Asian Americans aligns more with whites (Campbell et al, 149). They also note that “for Blacks particularly, but for Mexican-Americans, other Hispanics, and Asian-Americans as well, historical discrimination in schooling, occupational attainment, and homeownership (among other things) has hindered their ability to accumulate assets and pass wealth on to the next generation" (Campbell et al, 149).

Thus, while active racial discrimination has played a considerable role in wealth, the amount of time allotted for wealth accumulation (in tandem with other variables) adds to the wealth disparity. Using a quantile regression analysis on data from the 1989–2009 Panel Study of Income Dynamics, Thomas et al. (2019) find that race makes a significant difference and time plays a significant role in accumulating wealth across Black and white racial classes. Their findings suggest "that race is not only a significant determinant of wealth, but for African Americans, its negative impact increases over the life-course" (Thomas et al, 35). Unlike whites, Blacks have continually face discrimination that cumulatively impedes wealth as one gets older. In fact, "the African American-white wealth gap increases over the life course for each historical period (Thomas et al, 20). Because wealth compounds and accumulates over time, the racial wealth gap only continues to compound racial inequities: further expanding white wealth while negatively impacting Black wealth.

While each study differs in its purpose, all of them use similar variables in analyzing the concept of wealth disparity. I have chosen several of these shared variables for my research. I chose net worth, race, education, and household composition because they were consistent

throughout all three studies. The remaining variables (household income, homeownership rate, home value, historic redline grade, and unemployment rate) were chosen based on reviewed literature. They provide a robust regression model to analyze if there is a correlation between net worth, race, and historic redline grades within Seattle. Table 1. presents the variables across each reviewed study and my research.

Table 1.

Variables used to examine Wealth

Keister (2000)	Campbell et al. (2006)	Thomas et al. (2019)	This Study
Dependent variables • Home (primary residence) • Other real estate • Business • Stocks and mutual funds • Bonds • Cash (checking and savings account) Life insurance Explanatory variables • ***Race*** • ***Education*** o No high school o Some high school o High school graduate o Some college o College • Income • ***Married*** • ***Age*** • Number of children	Dependent Variable • ***Wealth (Net Worth)*** Independent Variables • ***Race-ethnicity*** o Black o Asian -American o Mexican - American o Other Hispanic • Residential location o Northeast o Midwest o West o South o Metro • ***Household composition*** o Not married male o Not married female o Inter-married • Number of children • Immigration and citizenship o Native-born citizen o Naturalized citizen o Not a citizen o Years living in U.S. (for o Immigrants only) o Years in U.S. missing • ***Age*** • ***Education*** o Some high school o High school o Some college o B.A. o Postgraduate • Employment o Number self-employed o Upper white collar o Lower white collar o Upper blue collar o Lower blue collar o Retired o Not in the labor force • Household income	Dependent Variable • ***Wealth (Net Worth)*** Independent variables • Percent Receiving Inheritance • ***Race*** • Period • ***Age*** • Cohort • ***Educational Attainment*** • Labor Market Tenure • ***Married*** • ***Divorced*** • Percent Female-Headed	Dependent Variable • ***Wealth (Net Worth)*** Independent variables • Household income • Homeownership rate • Home value • ***Race*** o Black o White • ***Age*** • ***Education*** o Bachelor's degree or higher • Redline grade. • Unemployment rate • ***Household composition*** o Married o Divorced

All variables bolded and italicized are shared amongst all three studies and my research

As shown in Table 1, each study uses some form of net worth as their dependent variable.

Two out of the three studies use a pre-calculated amount for net worth depicting assets minus

liabilities. However, while Keister (2000) also uses net worth, she further breaks down the indicator by including asset types as her dependent variables instead of a pre-calculated net worth amount. These studies all use race, age, education, and some form of household composition as independent variables across all three studies. Income and number of children are used only as variables with Keister (2000) and Campbell et al. (2006) studies.

2.5 Redlining's Effect on Urban Design and The Built Environment.

Redlining policy combined with discriminatory private sector activities has been instrumental in compounding problems for poor black residents. These problems persist not just in wealth accumulation but also in the design of the built environment. Eisenhauer (2002) states that "erosion of real estate values and declining tax bases [caused by redlining] have reduced resources for public education, while in the private sector, these changes have translated into the departure of both opportunities and amenities, including jobs, recreation, and retail businesses" (pg. 126). The disinvestment caused by the historic policy of redlining ensured communities obtained less infrastructure to support a healthy and vibrant community. Despite outlawing historic redlining, the lack of investment within these previously redlined communities has only sustained a built environment of lower quality today.

Many black and brown communities still lack single-family homes, green space, and transit infrastructure at present. However, this is not by chance. An excerpt from An et al. (2019) states that:

> Redlining changed the built environment because residents could not access mortgages, they could not buy single-family houses, and therefore the real estate industry did not build as many single-family houses in those neighborhoods. They built multi-family apartment buildings instead. These large, fixed investments were costly to reverse. Therefore, the built environment was sticky. Residents moved, banks, changed their lending practices, laws and policies were overturned, but the physical structures were rarely demolished or converted to single-family uses. (pg. 7)

Because historic redlining legally created spaces for white suburban life while limiting Blacks in dense urban areas, many historically redlined areas had low investments in single-family homes. Instead, real estate and development companies built an abundance of multi-family housing, which would later solidify the lack of single-family homes in black communities today. To explore the relationship between poorly graded neighborhoods and housing stock, An et al. (2019) uses a two-step research design comparing the distribution and size of the housing stock to historic redline grades across ten different U.S. cities. The results of their study indicated that "HOLC grades are a statistically significant predictor of where multi-family housing is located, with more multi-family in lower graded neighborhoods" (pg. 20). Thus, despite the abolishment of redlining, the effects of its discriminatory practices are cemented in the built environment.

Similarly, historic redlining has dictated where and to what degree areas implemented green spaces. Nardone states that "A lack of greenspace is associated with racial residential segregation" (pg. 1). The lack of investment in redline communities, as an effect, promoted disinvestment in neighborhood amenities. Thus, historic redline areas had limited green space and urban greenery. Today many minority communities still lack green spaces. Nardone et al. (2021) conducted a nationwide geospatial analysis using 2010 normalized difference vegetation index (NDVI) across previous HOLC neighborhood grades. They found a direct correlation between a lack of green spaces and historic redline grades. Frequently, historically redlined

neighborhoods had a dearth of parks and trees, with impervious surfaces like asphalt and concrete often covering most of the land. (Nardone, 2021, as cited in Lewis, 2021). Additionally, the limitations on greenspace do not stop at tree coverage. They found that historically redlined areas lack all greenery, from grass to trees to shrubs.

To further expand on redlining's effect on transportation infrastructure, Weiss (2020) uses various regression models to determine the relationship between transit access and concentrated disadvantage within Chicago's previously redlined areas. Weiss (2020) explains that "while the policy of redlining has had a pervasive impact on the overall spatial layout of segregation and concentrated disadvantage throughout various American cities, redlining has had a direct impact on transportation policy" (pg. 14). He finds a negative relationship between distance to rail stations and social well-being for employment access. In particular, his research suggests that the areas closest to rail stations are whiter, while the areas with less transit coverage are majority-minority. Though previously redlined areas lack adequate public transit, they often possess most of the highway infrastructure. Hoffman et al. (2020) state that "many redlined neighborhoods were transformed and divided by road and highway infrastructure projects" (pg. 10). Ironically, Hoffman further asserts this results from "the privileging of the suburban highway system at the expense of the cities' public transportation "(pg. 3). Thus, while cities failed to design redline areas in a transit-oriented manner, they further used redlined communities to benefit affluent, white, suburban areas and their transit needs. This inequitable design of transit infrastructure is still prominent in cities today.

Chapter 3. METHODS

3.1 DATA

The purpose of this research is to investigate wealth, defined in this case as household net worth in Seattle, and what impact historic redline grades and other variables such as income, homeownership rate, home value, race, age, education, and the unemployment rate have on current wealth within Seattle's neighborhoods.

The literature revealed that median household income, homeownership rate, home value, race, historic redline grade, unemployment rate, age, education, and household composition were consistently used throughout past research on predictors of net worth (a proxy for wealth). Thus, I chose them as my preliminary and obtainable independent variables. I compared these independent variables to Seattle's 2012 median household net worth.

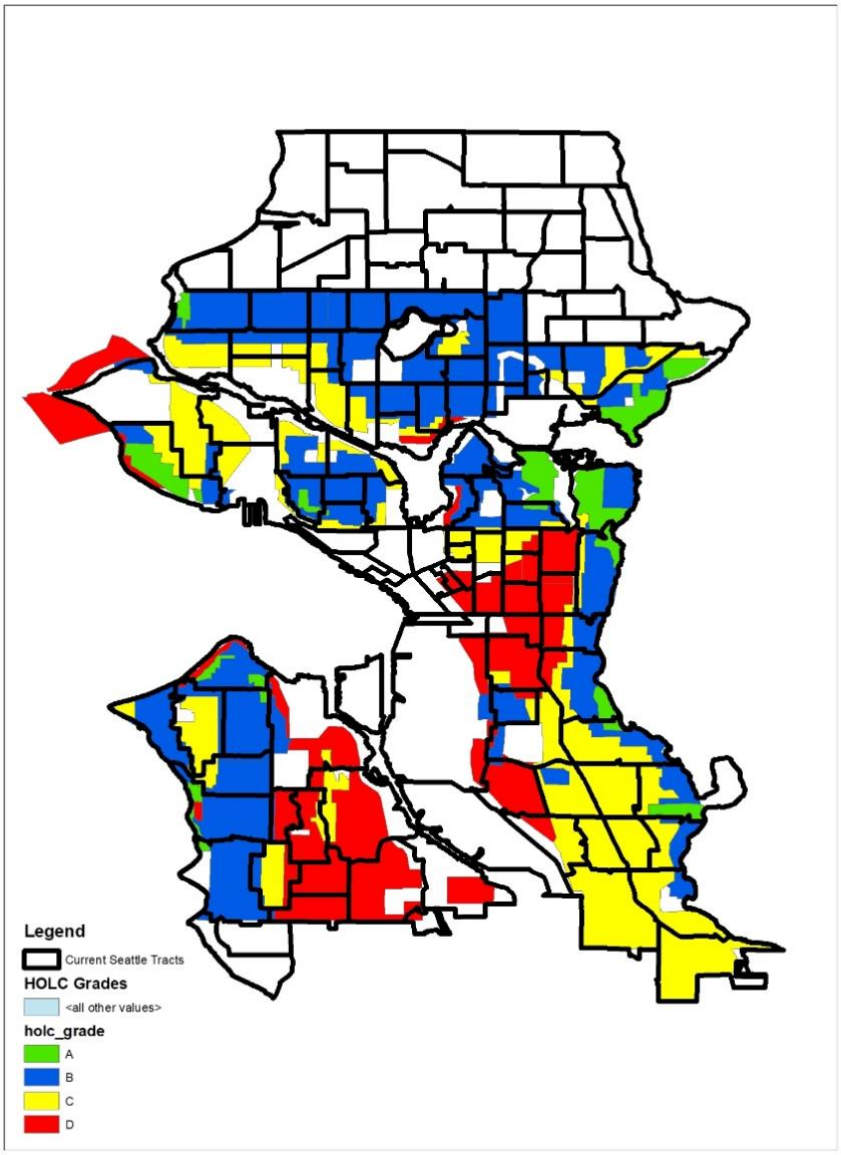
While this study incorporates a literature review to understand the historical context, the analysis is quantitative. I use cross-sectional data for all tracts in the City of Seattle during 2012 for the analysis. Because net worth requires a calculation of all assets and liabilities for each household, there are very minimal academic sites that provide net worth at the tract level for all of Seattle. However, the geographic information company ESRI provides available net worth data for Seattle only for 2012. Due to this, my study uses 2012 as the year of analysis.

Data for this study were retrieved from the United States Census, ArcGIS (the geographic information company ESRI), the City of Seattle, and the University of Richmond's mapping equity project. I gathered and cleaned the American Community Survey five-year estimates of household income, homeownership rate, home value, race, age, education, unemployment rate, and household composition for the year 2012. After gathering the selected socioeconomic data, I

retrieved a GIS shapefile of Seattle's historic redline map from the University of Richmond and the shapefile of Seattle's census tracts from the US Census and imported all of these into GIS for analysis. I joined the census tracts and the historic redline map using a spatial join feature in ArcGIS. This feature joins map layers based on their spatial characteristics rather than variables in their respective attribute tables. For this research, the spatial join merged contemporary census tract layers (which have associated census data) with the overlapping historic redline grades, as shown in figure 2.

I determined current tract historic redline grades in the following manner: if a tract's centroid was covered by a particular historic redline designation, that tract was given that redline grade. However, because not all tracts are centered in a single historic redline grade, I had to assign some grades manually. For every tract that was less than 50% covered by a historic redline grade, the tract received no grade. If a tract had more than one grade covering its area, then the tract received whichever grade covered greater than 50% of the tract.

Figure 2.
My spatial join of historic redline grades with current Seattle tracts



There are places in the city that were not graded when the historic redline maps were produced; those were parks, military bases, business areas, and industrial lands. In present-day Seattle, the majority of these places continue to have the same use. There are also places in Seattle today that were not graded then because they were not in the boundaries of the city at that

time, but now are. Of the current 135 tracts within Seattle, 77 received a historic redline grade based on the coverage of the historic redline map, as shown in Figure 2 above. Five tracts that were covered by less than 50% of a redline grade I manually assigned with no redline grade. In total, 58 tracts (inclusive of the former mentioned five) had no redline grades. I assigned these 58 tracts the letter "E " for their redline designation.

Once the census data and historic redline grades matched their respective tracts, I manually added net worth data from ESRI to the data composition. Because net worth is defined as the difference of all household assets and liabilities, and this data is not regularly collected by a single entity, finding this data for all households on the tract level is difficult. However, ESRI forecasts median household net worth based on the Survey of Consumer Finances, by the Federal Reserve Board. Like previous literature, ESRI calculates net worth as total household wealth minus secured and unsecured debt. These forecasts were done for all block groups, tracts, counties, and states within the United States for the year 2012. For this study, I used tract-level net worth data and manually associated it with the respective tract-level census and historic redline data.

3.2 VARIABLES

The independent variable in this study is net worth, which I used as a proxy for wealth. The study's preliminary independent variables are median household income, homeownership rate, home value, race, historic redline grade, and unemployment rate, age, and household composition. I hypothesize that some redline grades, and the presence of Black people will have a negative effect on net worth. However, I hypothesize that the presence of white people will

have a positive effect on net worth. The detailed hypotheses, per variable, and how I operationalized each variable are presented below.

3.3 Dependent Variable

“NW” is the dependent variable representing median net worth for tracts within Seattle during the year 2012.

3.4 Independent Variables

Grade

“Grade" is a dummy variable representing the historic HOLC redline grades. It is dichotomous for grades A- E; Where A-D equates to historic HOLC redline grades and E are current Seattle tracts with no redline grades. I expect tracts with grades superior to D (i.e., A, B, C) will have a higher net worth than tracts graded as D. There is no hypothesis for grade E, as it did not experience historic redlining.

"MedHHI" is an independent variable representing the median household income for each Seattle census tract in 2012. I expect this variable to have a positive relationship with net worth. Thus, as median household income increases, I expect that net worth will increase.

"OwnershipR" is an independent variable representing the homeownership rate for each tract within Seattle in the year 2012. I expect this variable to have a positive relationship with net worth. Thus, as the homeownership rate increases, I expect that net worth will increase.

" MedHomeVal " is an independent variable that represents the median home value for each tract within Seattle in the year 2012. I expect this variable to have a positive relationship with net worth. Thus, as the median home value increases, I expect that net worth will increase.

"MedianAge" is an independent variable representing the median age of the population for each tract within Seattle in the year 2012. I expect this variable to have a positive relationship with net worth. Thus, as median age increases, I expect that net worth will increase.

" Pct_BachDeg " is an independent variable representing the percent of the population 25 years or older with a bachelor's degree or higher for each tract within Seattle in the year 2012. I expect this variable to have a positive relationship with net worth. Thus, as the percent of the population 25 years or older with a bachelor's degree or higher increases, I expect that net worth will increase.

" UnemployRate " is an independent variable representing the unemployment rate for each tract within Seattle in the year 2012. I expect this variable to have a negative relationship with net worth. Thus, as the unemployment rate increases, I expect that net worth will decrease.

Household composition

“Pct_Married” is an independent variable representing the percent of the population 15 years or older and married for each tract within Seattle in the year 2012. I expect this variable to have a positive relationship with the net worth. Thus, as the percent of the population 15 years or older and married increases, I expect that net worth will increase

“Pct_Divorced” is an independent variable representing the percent of the population 15 years or older and divorced for each tract within Seattle in the year 2012. I expect this variable to have a negative relationship with net worth. Thus, as the percent of the population 15 years or older and divorced increases, I expected that net worth will decrease.

Race

“Pct_Black" is an independent variable that represents the percent of the population that is Black for each tract within Seattle in the year 2012. I expect this variable to have a negative relationship with the net worth. Thus, as the percent of the population who are Black increases, I expect that net worth will decrease.

“Pct_White" is an independent variable that represents the percent of the population that is white for each tract within Seattle in the year 2012. I expect this variable to have a positive relationship with the net worth. Thus, as the percent of the population who are white increases, I expect that net worth will increase.

3.5 Research Design

This study seeks to answer the questions: What are the effects of historic redlining grades on present-day family net worth (wealth) in Seattle? How have historic redlining grades affected Black family net worth (wealth) in Seattle? How have historic redlining grades affected white family net worth (wealth) in Seattle? I used a multivariate linear regression analysis to answer the research questions, which allows for estimating net worth with historic redline grade, median

household income, race, home value, homeownership rate, unemployment rate, age, household composition, and education.

The ordinary least squares method is used for estimating unknown parameters in a linear regression model. These unknown parameters are validated by the use of p-values to indicate significance. I used Stata, a statistical software, to perform the analysis in this study.

For the variables depicted in the regression model below, I used a p-value of less than .05. This means that if the regression analysis provides p-values below .05, then that estimator is accepted as statistically significant. To test multicollinearity—a potentially disruptive level of relationship between my independent variables, and one I had serious issues with—and further validate my p-values, I use VIF scores. A VIF score greater than 5 represents high levels of multicollinearity. A score greater than 5 assumes that the coefficients are poorly estimated, and the p-values are unreliable. In tandem with p-values, I examined the R-squared and adjusted R-squared of the model. The R-squared measures the variance in the dependent variable that can be accounted for from the combined influence of the independent variables. Thus, the higher the R-squared, the more the independent variables predict the variance in the dependent variable. Additionally, in comparing my models, as I remove or add variables, I also examine my adjusted R-squared to determine which combination of variables yields the best outcome. Models, along with their resulting values, were compared against each other to determine the model of best fit.

The functional equation for the research is:

NW=f (RG, MHI, R, HV, HR, UR, A, HC, E)

Where:

NW= Wealth

RG = Redline grade

MHI = Median household income

R = Race

HV = Home value

HR = Homeownership rate

UR = Unemployment Rate

A = Age

HC = Household Composition

E = Education

The resulting regression equation is thus as follows:

$NW=bo+ b1(Grade_A)+ b2(Grade_B) + b2(Grade_C)+b2(Grade_E)+b3(MedHHI)+b4(Pet\_Black)+ b5(Pet\_White)+b6(MedHomeVal)+b10(OwnershipR)+b10(UnemployRate)+b11(MedianAge)+b 12(Pet\_Divorced)+b13(Pet\_Married)+b14(Pet\_BachDeg) +e$

The above equation serves as a preliminary equation for the analysis. After solving for multicollinearity within the model, several variables were removed. The resulting outcomes are presented in Chapter 4.

Chapter 4. RESULTS

As explained in the previous chapter, ten different independent variables were run against the dependent variable, net worth. Table 2 illustrates the main results of each regression. After running the original regression and analyzing the VIF scores, variables for median household income, percent married, and percent white were affected by multicollinearity.

After running the first model, five variables had high multicollinearity, as depicted in the VIF scores in the original equation. I then individually dropped variables (starting with the variable with the highest VIF score) replacing each one when dropping the next collinear variable. I repeated these steps for each of the 5 collinear variables. Unfortunately, this process did not solve for the multicollinearity but rather gave me VIF scores over 5 for other variables. Because this method failed to solve for the multicollinearity in the model, I chose to eliminate variables without replacing them. Once I eliminated median household income, percent married, and percent white together, the remaining variables had VIF scores under 5. Using this process of elimination, I solved the multicollinearity within the models after running three additional regressions. I chose the best regression based on the highest adjusted R-squared combined with low VIF scores.

Of the four regressions, regression 4 was the model of best fit. This regression excluded the variables for median household income, percent married, and percent white. The resulting formula, as represented in the final analysis, is as follows:

NW=bo+b1(GradeA)+b2(GradeB)+b2(GradeC)+b2(GradeE)+b3(Pet_Black)+b4(MedHomeVal)+b5(OwnershipR)+b6(UnemployRate)+b7(MedianAge)+b8(Pet_Divorced)+b9(Pet_BachDeg)+e

With the absence of median household income, percent married, and percent white, the R-squared changed from (.76) in the original equation to (.75) in the final regression. This suggests 75% of the variance in net worth can be accounted for in the independent variables within the final model. I expected this decrease in R-squared as it usually accompanies the removal of variables. The Adj R-squared changed from (.73) in the original equation to (.72) in the final regression. Though smaller than the original equation, the adjusted R-squared in this model was the highest out of the additional three regressions run, affirming this was the highest performing model out of the three.

	Original regression R-squared = 0.7625	Regression 2	Regression 3 R-squared = 0.7455	Regression 4 R-squared = 0.7454

	Adj R-squared = 0.7348				R-squared = 0.7458 Adj R-squared =0.7185				Adj R-squared = 0.7204				Adj R-squared = 0.7227			
MedHHI	(usc)	1.703815	(pv)	0.004												
Pet_White	(usc)	-278.4537	(pv)	0.642	(usc)	-54.8991	(pv)	0.928	(usc)	-38.6746	(pv)	0.949				
Pet_Black	(usc)	-675.5287	(pv)	0.536	(usc)	-368.416	(pv)	0.742	(usc)	-350.246	(pv)	0.753	(usc)	-300.248	(pv)	0.703
MedHomeVal	(usc)	.0598787	(pv)	0.353	(usc)	.0832167	(pv)	0.207	(usc)	0.085616	(pv)	0.191	(usc)	0.085934	(pv)	0.186
OwnershipR	(usc)	958.6523	(pv)	0.116	(usc)	1875.022	(pv)	0.001	(usc)	2045.945	(pv)	0.000	(usc)	2043.245	(pv)	0.000
UnemployRate	(usc)	5941.741	(pv)	0.012	(usc)	4408.485	(pv)	0.063	(usc)	4207.171	(pv)	0.069	(usc)	4210.666	(pv)	0.067
MedianAge	(usc)	7523.698	(pv)	0.000	(usc)	7147.608	(pv)	0.000	(usc)	7370.846	(pv)	0.000	(usc)	7368.249	(pv)	0.000
Pet_BachDeg	(usc)	350.1821	(pv)	0.625	(usc)	1126.981	(pv)	0.102	(usc)	1049.041	(pv)	0.113	(usc)	1027.879	(pv)	0.071
Pet_Divorced	(usc)	-7513.011	(pv)	0.001	(usc)	-6682.155	(pv)	0.003	(usc)	-6854.34	(pv)	0.002	(usc)	-6889.39	(pv)	0.001
Pet_Married	(usc)	-372.4011	(pv)	0.706	(usc)	412.4078	(pv)	0.673	(usc)							
GradeA	(usc)	150408.5	(pv)	0.001	(usc)	166642.8	(pv)	0.000	(usc)	170561.7	(pv)	0.000	(usc)	170709.9	(pv)	0.000
GradeB	(usc)	-14082.85	(pv)	0.526	(usc)	-14669.77	(pv)	0.521	(usc)	-12473.7	(pv)	0.574	(usc)	-12353.9	(pv)	0.575
GradeC	(usc)	-21064.6	(pv)	0.297	(usc)	-27335.56	(pv)	0.187	(usc)	-25856.5	(pv)	0.204	(usc)	-25765.6	(pv)	0.202
GradeE	(usc)	10402.2	(pv)	0.588	(usc)	3531.032	(pv)	0.857	(usc)	5090.648	(pv)	0.791	(usc)	5259.791	(pv)	0.781

Variable	VIF
MedHHI	8.44
OwnershipR	6.84
Pet_Married	6.61
Pet_BachDeg	5.94
Pet_White	5.51

Variable	VIF
Pet_Married	6.12
Pet_White	5.42
Pet_BachDeg	5.11

Variable	VIF
Pet_White	5.40

Variable	Standardized Coefficient
OwnershipR	0.392876
MedianAge	0.353514
GradeA	0.25182

Table 2.

The 4 regressions I ran to find the model of best fit

*usc= unstandardized coefficients *pv = p-value

Of the variables used, only homeownership rate, median age, percent divorced, and grade A had significant unstandardized coefficients, with p-values significant at all levels. All other variables were statistically insignificant. The unstandardized coefficients for these variables are interpreted as follows:

- For every one percentage point increase in the homeownership rate, median net worth increases by $2,043, holding all other variables constant.
- For every additional year increase in the median age, median net worth increases by $7,368, holding all other variables constant.
- For every one percentage point increase in the population 15 years or older that is divorced, median net worth decreases by $6,889, holding all other variables constant.

As for the results on historic redline grades, the only grade with a statistically significant unstandardized coefficient was grade A. The coefficient for historic redline grade A is interpreted as: the median net worth for Seattle tracts labeled A is approximately $170,709 more than tracts with a historic redline grade of D, holding all other variables constant.

Of all significant variables that affect net worth, homeownership rate, median age, and redline grade A were the top three most impactful variables, based on their standardized coefficients. Their standardized coefficients are as follows: homeownership rate (.39), median age (.35), and grade A (.25), with homeownership rate being the most impactful of the 3. That is, net worth at the tract level is most impacted by the residents being older, whiter, and homeowners. These findings are consistent with the expectations of the theoretical framework.

Chapter 5. DISCUSSION

5.1 Major Findings

I designed this research to determine the impact of historic redline grades on the net worth within Seattle's tracts. After specifying an appropriate regression equation, the independent variables included were grade, percent black, home value, homeownership rate, unemployment rate, age, and education. I excluded median household income, percent married, and percent white from the final regression model because they were highly correlated with many other variables.

The results showed that net worth is statistically significantly correlated to homeownership rate, median age, percent divorced, and redline grade A. The remaining variables percent black, median home value, unemployment rate, education, and historic redline grades B and C were all statistically insignificant. Additionally, though I had no hypothesis for grade D, it was also statistically insignificant. Based on my results, I can accept my hypotheses for homeownership rate, median age, percent divorced, and grade A. I can reject my hypotheses for historic redline grades B and C. However, because the coefficients for percent Black, median home value, unemployment rate, education, and historic redline grades B and C were all statistically insignificant, there is insufficient data to accept or reject the hypothesis.

Of the correlated variables, net worth was positively correlated with all four. By examining the standardized coefficients of the regression, I can determine which of the variables were the most impactful. The three most impactful variables found by examining the standardized coefficients were homeownership rate (.39), median age (.35), and grade A (.25).

5.2 Why Were Race and Historic Redline Grades Insignificant in The Model?

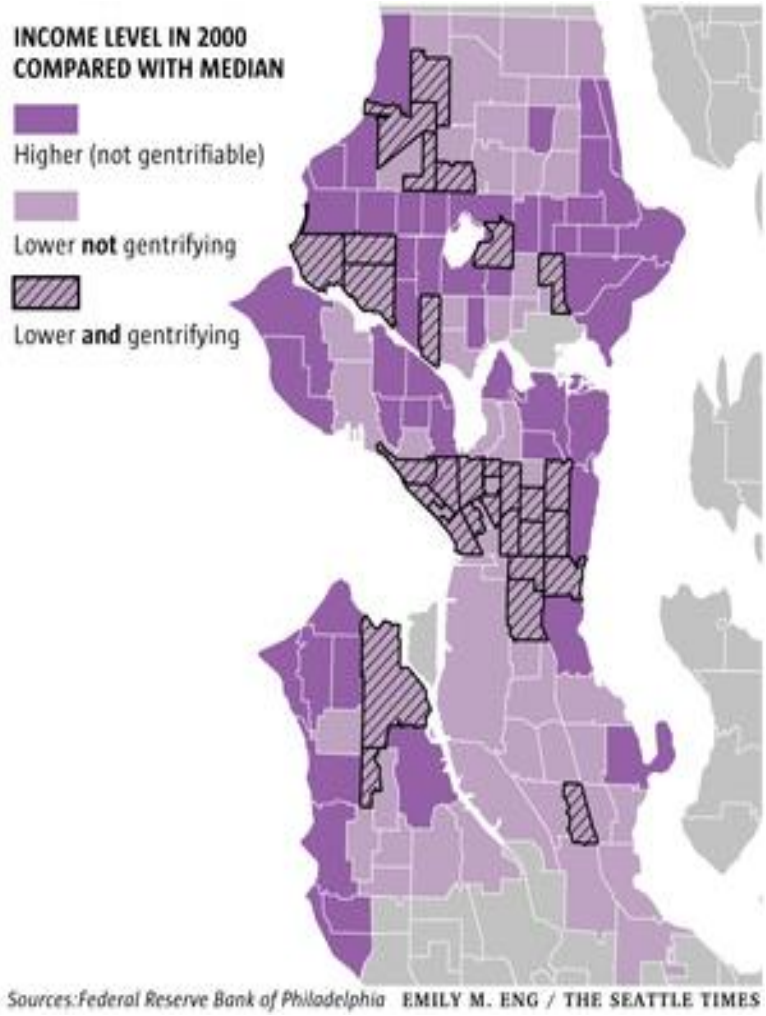
While I expected most of my results, the lack of significance for race and the lack of correlation with historic redlined grades B and C to the referent variable was surprising. Though my model demonstrates no data to support this, as it was not my research question, I speculate that this may be a result of gentrification, displacement, and a rapidly changing urban environment.

Gentrification and displacement are common urban issues that stem from historic redlining. Fogal (2020) states that "gentrification is often the outcome of decades of segregation, redlining, and urban renewal policies that exploit the large gap between existing and potential property values, which in turn encourages an influx of wealthier residents. Young professionals and more affluent people move back into the urban core, often into neighborhoods that have historically been home to people of color; this new wealth quickly changes the look and feel of the neighborhood, increases the cost of living, and displaces the original residents." The very act of historic redlining facilitated disinvestment in historically redlined D and C areas. Thus, these areas would have the most potential for redevelopment or gentrification in the late 20th and early 21st century.

When analyzing socioeconomic data for Seattle, the increase in tech (which resulted in the increase of tech workers and higher incomes) bolstered the city's median household income as more people moved into the city center. The Silicon Valley Competitiveness and Innovation Project report shows that Seattle's tech employment doubled between 2004 and 2014. Additionally, per the Federal Reserve Bank, median household income in Seattle increased by $19,769 during this same period.

A study done by the Seattle Times that examined past historic redline maps showed that many areas once labeled D and C were "lower and gentrifying" by the 2000-2014 period (Figure 3). Even the occasional B tracts were considered "lower and gentrifying" during this period as well. This Study further asserts that of the 82 gentrifiable low-income tracts in Seattle during 2000, 37% of those tracts were undergoing gentrification by 2014. Fogal (2020) provides supplementary data on these same gentrifiable tracts for the year 2015.

Figure 3.
Gentrification map of Seattle



Source: Seattle Times

She further explains that:

> 50% of eligible census tracts have gentrified since 2000, including five tracts in Georgetown and South Park, one near Belltown, and one near Lake City. The median home values in each gentrified census tract increased by an average of 47% between 2000 and 2013. While racial demographics changed across the board between 2000 and 2010. In neighborhoods like the Central District and Capitol Hill, highly educated and predominantly white professionals are moving into previously affordable areas, drawn to the city's growing tech industry, and pricing lower-income homeowners and renters out. In both of these rapidly changing neighborhoods, gentrification not only pushes lower-income people and communities of color out but shifts the character of an area until it feels like a place for more affluent white people.

The parts of Georgetown, South Park, Belltown, and Lake City mentioned were all once graded D and C, with the occasional B Grades.

Wealthy residents are moving into the city core, taking advantage of not just the ideal locations and property values of historically redlined African American neighborhoods but of all properties. The city center is and has become home to an influx of new people who have the means to live and develop as they please. Thus, as an effect, socioeconomic data for all areas previously graded B-D have shifted, while previously redlined A areas remain affluent and continue to grow. Although this data provides a plausible explanation of why race and historic redline grades B and C were statistically insignificant, it does not exclude the redlining ranking system from inequities created based on race.

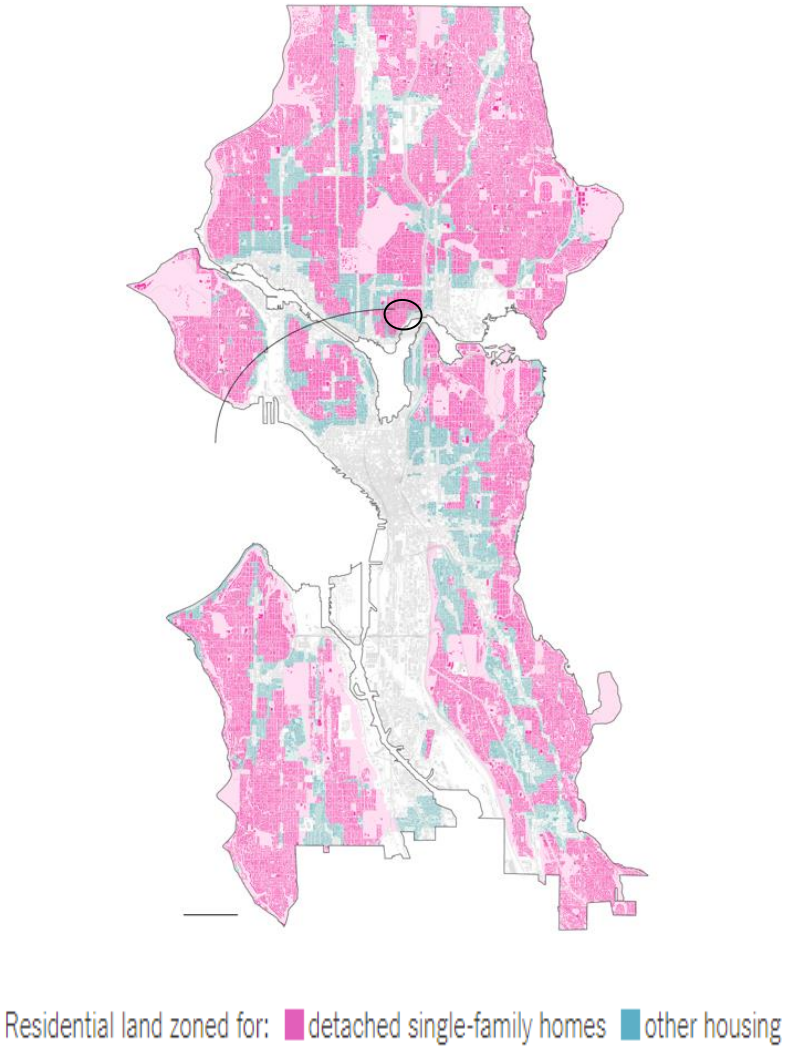
5.3 Redlining's Effect on Urban Design and The Built Environment.

To expand upon the idea that historic redlining inherently changed the built environment, I want to take the opportunity to discuss how historic redlining has affected the design of the built environment outside of the implications of gentrification. Because my research questions

were not specifically guided towards urban design, I did not do an empirical assessment at the street level. However, I would like to demonstrate the correlation between redlining and the design of the built environment through additional sources that specifically address Seattle's built environment.

The impact of redlining on the design of Seattle's built environment is no different than any other major city. Similar to the former mentioned literature, redlining has greatly influenced the form and configuration of the built environment in Seattle's previously redlined communities. When analyzing previous historic redline grades on the design of Seattle's current built environment, previously historic redlined areas D and C are continually at a disadvantage. As shown below, the majority of Seattle is zoned for single-family zoning. Badger et al. (2019) state that as of 2019, "81% of residential land [in Seattle] is zoned for detached single-family homes. Interestingly enough, 19% of the residential land that Seattle zoned for other housing is located in previously historic redlined D and C areas. Badger further finds that "Neighborhoods like Wallingford were downzoned to single-family but still contain many multi-family buildings built in the early 20th century." The described area in Wallingford was once too an area redlined D and C.

Figure 4.
Residential zoning in Seattle



Source: The New York Times

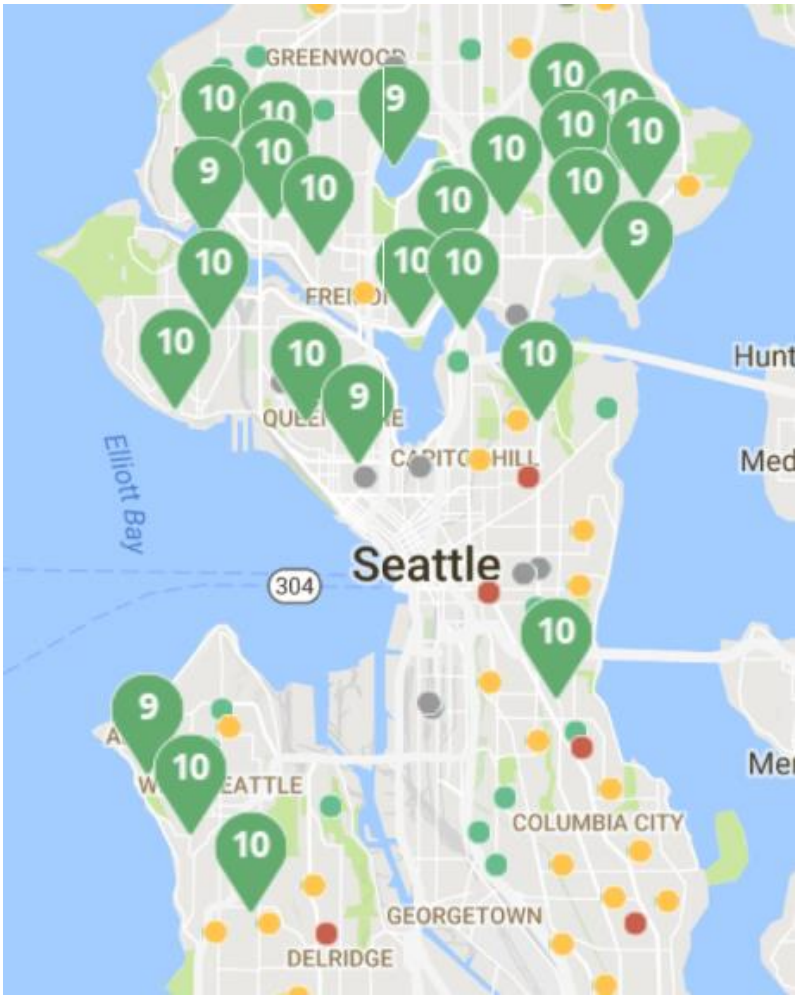
Figure 5.
Tree grove locations in Seattle

Source: The City of Seattle

Similar results are depicted when analyzing tree coverage in Seattle. Based on the 2016 Seattle Tree Canopy Assessment, previously graded A and B areas have more access to trees and tree groves, while C and D areas have minimal tree groves. The City of Seattle even recognizes that “large trees and tree groves are largely absent from the most urbanized areas.” This absence is especially present in the Duwamish and Delridge areas, which were once rated D and C as well.

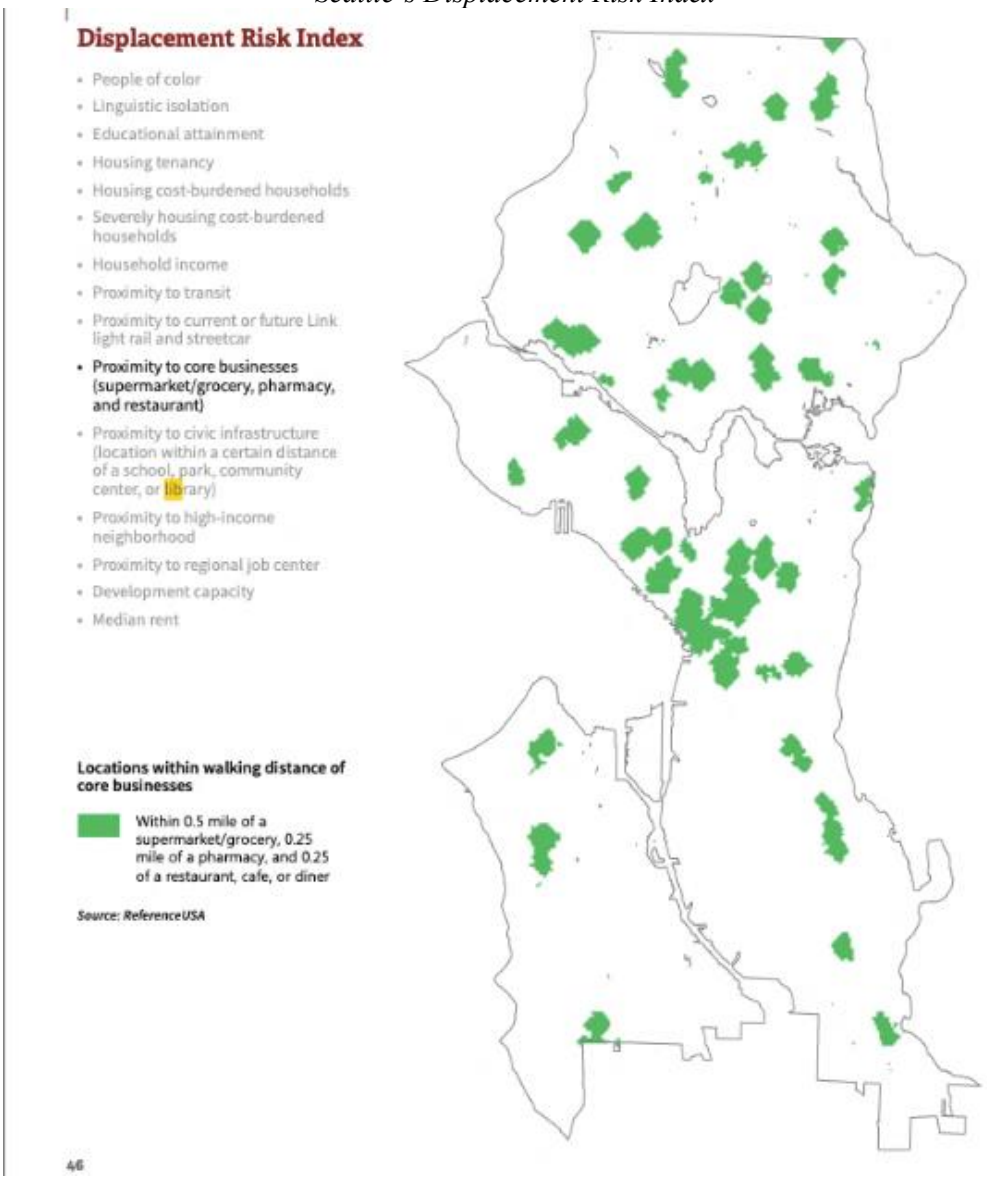
There are parallel patterns relating to the locations of Seattle's best schools, core businesses and public transit. Per GreatSchools, the best elementary schools are often located in areas that once had higher historic redline grades (Figure 6). Seattle's 2035 growth and equity analysis puts these same areas outside of the .05-mile range of a supermarket grocery store and outside the .25 miles radius of a pharmacy (Figure 7).

Figure 6.
Best elementary schools in Seattle



Source: GreatSchools

Figure 7.
Seattle's Displacement Risk Index

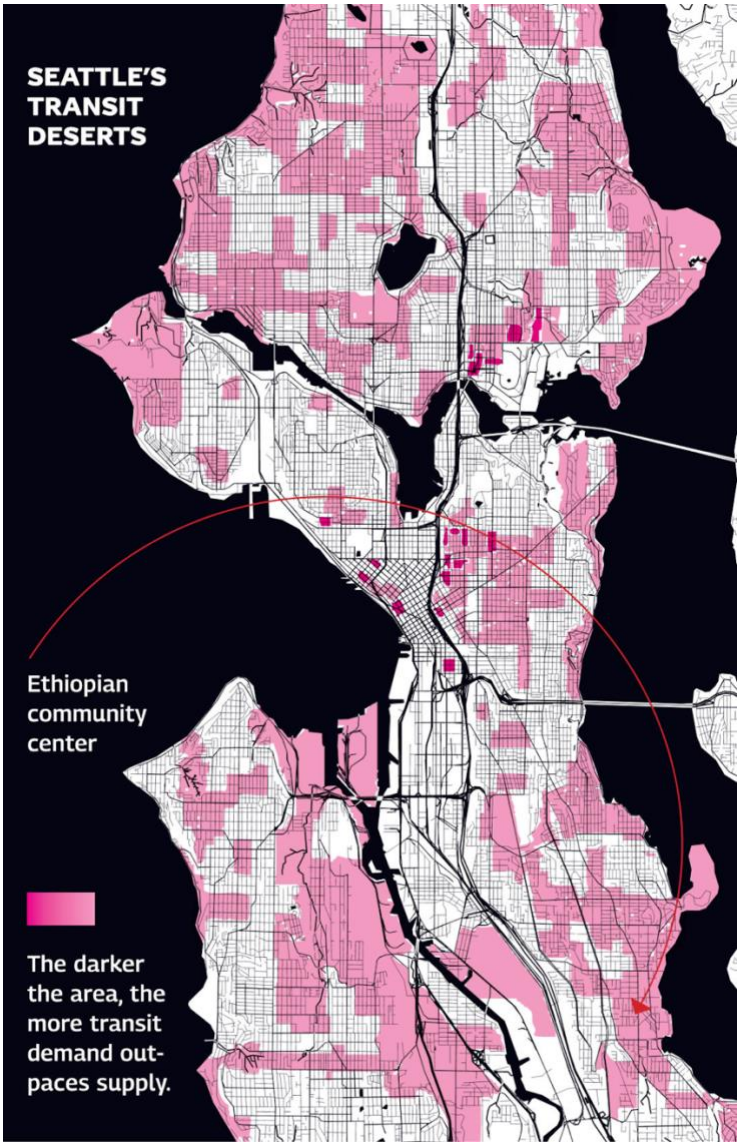


Source: The City of Seattle

When examining Seattle's transit desert (Figure 8), the same pattern emerges. One can see that areas that are predominantly minority, or areas once redlined D and C, are at an extreme

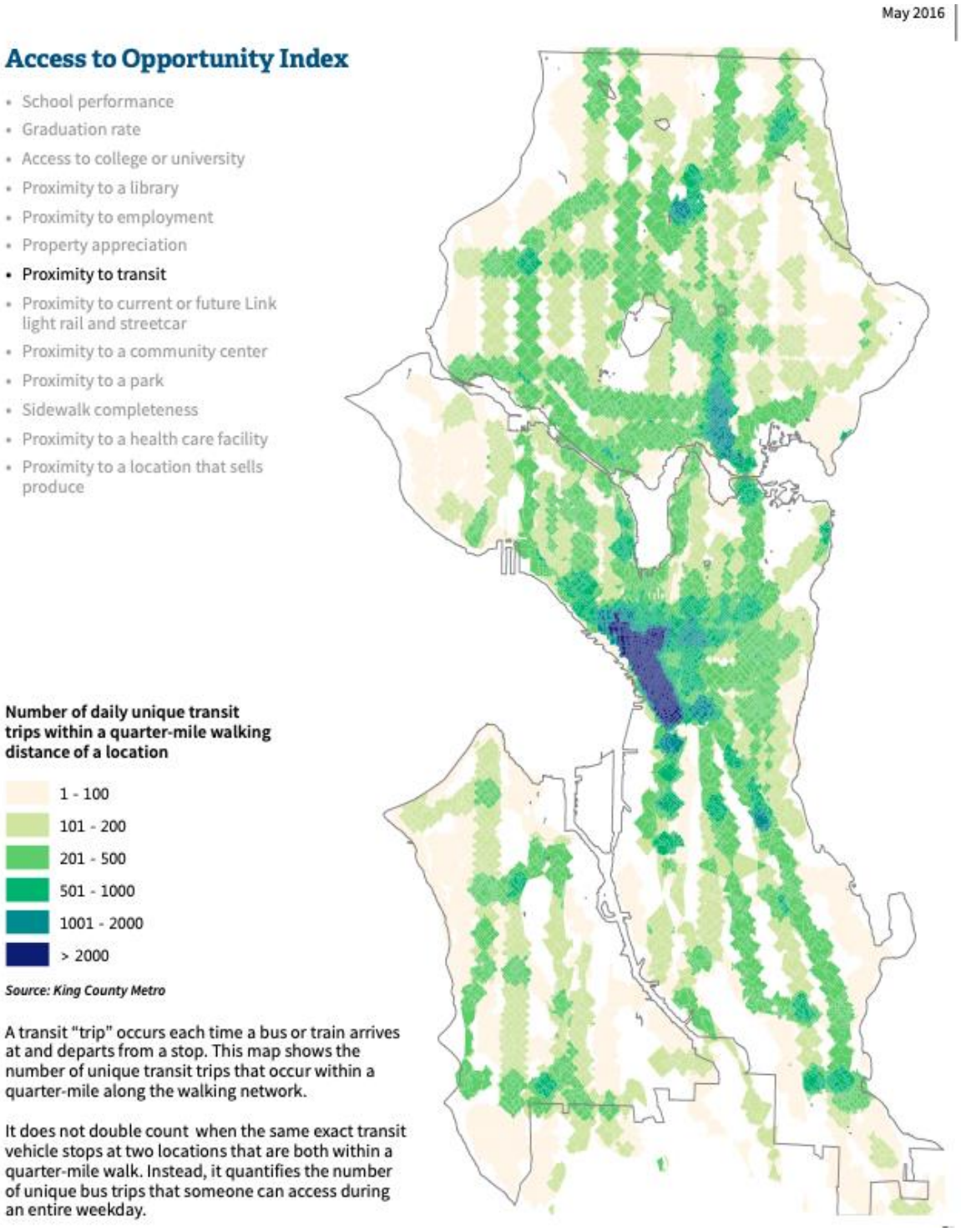
disadvantage when it comes to transit. Historically redlined area's transit demand is far more than the supply in these areas. The City of Seattle further expands upon this issue in their 2035 growth and equity analysis, where they map the access to opportunity within Seattle. In Figure 9, redlined areas (especially those in south Seattle) have fewer daily unique transit trips within a quarter mile of walking distance from a location. Both maps present inequitable transit design in previously redlined areas within Seattle.

Figure 8.
Seattle's Transit Dessert



Source: SeattleMet

Figure 9.
Seattle's Access to Opportunity Index



Source: The City of Seattle

These inequalities are not by chance. Redlining's ability to induce disinvestment in areas has transformed the design of Seattle's built environment to benefit areas that were once graded A and B. However, it is important to note that because gentrification is often an outcome of past historic redlining, some of these areas, like the Central District, are again transforming and gaining access to the same amenities that historic redlining once restricted them from. Thus, while historic redlining has since been long gone, it continues to transform the design of the built environment through a cycle of disinvestment and investment.

Chapter 6. CONCLUSION

6.1 LIMITATIONS

One of the main limitations of this study was my use of current city boundaries to identify tracts. I did not consider that since the conception of the historic redlining maps, Seattle's borders have since changed and expanded. While a good portion of Seattle tracts once had historic redline grades, 58 of the current tracts did not. As a result, a little over 1/3 of the tracts within this study never experienced being redlined.

Additionally, because the HOLC maps were not based on tract designation but rather where races settled, tracts often encompassed two or more grades. As a limitation of the methodology, I only accounted for one grade (the grade encompassing more than 50% of the tract) to accurately analyze redline grades against net worth. It should be noted that, even if I were to have used only the tracts from 1940, redline grades still do not perfectly align.

Furthermore, my data was limited to the year 2012, and thus misses significant urban growth and change since then. This 2012 data does not consider the change in the environment or change in people since that time; and there have been significant changes (though the change probably just intensified the disparate impacts).

6.2 POLICY IMPLICATIONS

Historic HOLC grades B and C were not statistically correlated with net worth, nor was there any statistical significance to race in my study. Instead, net worth is strongly correlated with homeownership rate, median age, percent divorced, and grade A. Thus, this modeling of race's impact on net worth based on historic redline grading has not been effective.

Despite this failure, my research is still very relevant for local-level planning policy. Although race was insignificant, the model demonstrates the impact of historic redline grades on overall tract wealth. Additionally, this study shows that homeownership rate, median age, percent divorced significantly affect net worth. Based on this study, future policies must consider these variables when creating equitable policies in a city with a vast wealth gap.

American systems used historic redlining to exclude areas from different benefits. In this case, areas given the redline grade D were excluded from a vast wealth factor, homeownership, which has affected the net worth of these areas to this day. Thus, policymakers and newly created policies should be intentional in their implementation to not exacerbate this problem. areas graded D and areas graded A do not have the same issues nor design. Thus, policy should not be the same in both areas. In addition, future policies should explore place-based strategies and people-based strategies, as they often go hand and hand.

A good way of addressing both people and place solutions would be analyzing policy issues at a smaller scale. As mentioned in the limitations, redlining was not based on any census designations but rather where people settled. Thus, many tracts encompass more than one HOLC grade. Using tract-level data or even block-level data does not accurately account for redlined areas on the cusp of or inside more affluent areas. Moreover, gentrification and displacement have substantially changed many of the previously redlined areas. While not all redlined areas are entirely different, areas such as Central District are no longer poor or majority black. Thus, implementing equitable policies or solutions in every area once graded D would not entirely benefit residents affected by redlining. Future policies must analyze at micro-levels. Analyzing at a micro-scale would ensure that place-based strategies are focused on the people who were

affected rather than just the places as a whole. The same sentiments apply to legislation that influences the design of areas.

Lastly, the results of this study have the potential to inform zoning. As presented in the discussion, 81% of Seattle is zoned for single-family housing. The remaining 19 % of Seattle zoned for other housing uses are mostly areas once graded D and C. Up zoning vast areas of Seattle, without considering the continued depravities in homeownership and wealth in historically graded D areas, would only continue to hinder the access to homeownership options. Instead, in tandem with other legislation, zoning policy should encourage high-risk asset ownership that is likely to increase net worth specifically in these areas. Policymakers must make an intentional effort to fix exclusionary development provisions instead of just up zoning. Without deeper reforms for the underlying failures of zoning, up zoning merely exacerbates and reinforces the problem of homeownership and wealth within redlined areas.

6.3 Conclusion

This study analyzed the impact of historic redline grades on family net worth in Seattle, Washington. In particular, I focused on whether there was a difference in the net worth of Black families and white families inside and outside these graded areas. Based on the previous literature regarding historic redlining's effect on wealth, I chose net worth as my dependent variable; While median household income, homeownership rate, home value, race, historic redline grade, unemployment rate, age, education, and household composition served as my independent variables.

I expected historic redline grades better than grade D to have higher net worth. I also expected Black families to have lower net worth, while white families would have a higher net worth. The results showed that race, in general, shows no statistical relationship to net worth

within Seattle's tracts. However, homeownership rate, median age, percent divorced, and grade A were statistically correlated to net worth and were statistically significant at all levels. Homeownership rate had the strongest correlation to net worth out of all correlated variables.

My findings provide further significant evidence that the disinvestment and housing restrictions caused by historic redlining impact wealth and place. More specifically, my findings suggest that net worth exponentially decreases when shifting from areas historically graded A to areas historically graded D. Moreover, my findings further confirm that homeownership significantly impacts wealth.

Further work on the subject matter should analyze the impact of historic redlining on net worth based on block levels within Seattle. In addition, it would be appropriate for future work to analyze the impact of historic redlining on gentrification/displacement within Seattle's neighborhoods. The public's response to social unrest and racial inequalities demonstrates that equity within American systems must be addressed. New policies must be just as precise in implementing solutions as inequitable policies were in their mistreatment and exclusion of minorities.

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