Highway Site Selection and Race: Evidence from the US Interstate Highway System

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Abstract

This paper examines the causes and consequences of urban highway placements in the US. By exploiting cross-sectional variation in 1950, the last census before the Federal program that initiated highway construction, I find that tracts with a higher proportion of the city's Black population were more likely to have highways constructed through them. These effects do not stem from a deliberate Federal agenda to build highways in Black neighborhoods but rather from State officials utilizing highway construction for their own purposes. Turning to the consequences for treated neighborhoods, by employing a matched difference-in-difference model, I find that tracts where highways are constructed experience a decline in the White population over the long term while the number of Black households remains unaffected. Moreover, highway construction decreases the number of housing units but does not impact median land prices.

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1. Introduction

The Federal-Aid Highway Act of 1956, which triggered the construction of interstate highways, stands as one of the most important public policies implemented in the United States. Between 1956 and 1990, the US built a vast network of interstate highways, covering more than 43,000 miles, with approximately a quarter of them located in metropolitan areas. Recent scrutiny has shed light on the placement of highways through Black neighborhoods, prompting concerns from journalists, policymakers, urbanists, and community leaders about a deliberate effort to displace Black Americans from their longstanding communities (Lewis, 2013; Archer, 2020).[1]

A large body of qualitative evidence has raised concerns about highways being intentionally routed through neighborhoods with predominantly Black residents. Nevertheless, whether these accounts reflect a systematic racial bias in highway placement remains an open and pressing empirical question. This study addresses this integral question by examining the impact of a neighborhood's Black population share on the location of highways for the entire United States. These estimates allow me to shed light on the racial motives behind interstate highways' placement. One possibility is that highway construction was used as means to displace Black households from their historical neighborhoods in an effort to "clean urban blight" (Rothstein, 2017). If this were the case, the location of highways would depend on the location of Black communities. Alternatively, highway placement may have been based on factors unrelated to race, such as land prices, and these same factors could have influenced the distribution of Black households in a city. In such a scenario, there would be no relationship between highway construction and a city's racial composition once controlled for these factors. The main contribution of this study is to provide a

[1] In December 2020, Secretary of Transportation Pete Buttigieg voiced his criticism on Twitter, denouncing the disproportionate division of "Black and brown neighborhoods by highway projects" (Buttigieg, 2020).

quantitative analysis of the role historical Black population distribution played in future highway placement.

A second empirical question this paper tackles relates to the consequences for neighborhoods where highways are built. In particular, I examine how neighborhoods change following highway construction. There are two competing hypotheses regarding these changes. On the one hand, if planners intended to "whiten" these neighborhoods, we would anticipate a decline in the number of Black households and an increase in White households. On the other hand, the construction of highways generates negative externalities that diminish the amenities of these neighborhoods. During a period when Black households had limited choices when selecting their residential neighborhoods, low-income Black individuals may have relocated to these neighborhoods. Taken together, highways can significantly influence the long-term residential dynamics of neighborhoods.

The primary data source for this study is the US census from 1940 to 2010. To measure neighborhood characteristics before the 1956 Federal-Aid Highway Act, I use historical spatial census data from 1950 (Manson et al., 2021). I supplement this data with geographic information from the National Historical Geographic Information System (NHGIS) for each decade between 1940 and 2010. Additionally, I use the interstate highway network matched to the PR-511, which contains the opening date of each highway segment funded by the federal government (Baum-Snow, 2007). These datasets enable me to determine a neighborhood's proximity to highways and the opening date of the closest highway. I supplement this data with newly digitized and geocoded maps created by the Bureau of Public Roads in 1955, known informally as the Yellow Book. These maps were created specifically for the Highway Bill and allocated more than 2,000 miles of urban highways to 100 metropolitan areas.

I begin by addressing the central question of this analysis, which is whether highways are built through communities housing Black individuals. Exploiting the variation between census tracts, I estimate a specification that looks at highway construction on a tract and the tract's Black share, controlling for socioeconomic, physical, and political characteristics, as well as city fixed effects. The Black share corresponds to the proportion of the city's Black individuals living in the neighborhood. The coefficient of interest pertains to the Black share of the census tract. The estimate tells us whether the share of Black residents influences the construction of a highway in the tract.

I find that, consistent with qualitative accounts, neighborhoods with a higher proportion of the city's Black residents had a higher probability of having a highway constructed through them. These findings are robust to various sensitivity checks, including controlling for factors that influence highway construction, such as planned routes, land values, distance to the city center, the median income of residents, percentage of adults with a high school degree, the average slope of the neighborhood, proximity to rivers, among others. Furthermore, the results are stable under leave-one-city-out cross-validation. Additionally, I show that these findings are not a result of a racially biased federal plan. When examining the location of federally planned highways in the Yellow Book, I find no evidence that the distribution of Black households in a city predicted the placement of highways in these maps. In addition, I do not find evidence supporting the qualitative accounts denouncing highway construction to separate Black from White neighborhoods. Together, these results suggest that deliberate plans to construct highways through Black communities, rather than other unique aspects of highway construction, are the driving force behind the findings.

To assess the magnitude of the estimated effects, I calculate the equivalent variation in a neighborhood's land price, as measured by the median home value and rent, that would have the same impact on the likelihood of receiving a highway as a one standard deviation increase in the Black population. The baseline estimates suggest that such increase in the Black population is equivalent to a reduction in land price ranging from 18.8% to 25.7%. Moreover, in absolute terms, these estimated effects translate to a decrease from the mean median value of \$16,836 and \$106 in the median home value and rent, respectively. This comparison underscores the economic importance of the findings, quantifying the role played by the distribution of Black individuals in highway placement.

To the best of my knowledge, the only empirical article examining the determinants of highway location is Carter (2023). This article analyzes the case study of Detroit, Michigan, and investigates which neighborhood characteristics predict future highway construction. The author's results suggest that land value was the most robust predictor of highway location in the city, driven by local officials minimizing acquisition costs and future income losses from a lower property tax base. She finds no evidence that a neighborhood's Black share played a role in highway construction in Detroit. Furthermore, her findings indicate that neighborhoods where highways are constructed experienced a decline in their Black population over time. This paper expands on Carter's analysis by examining the impact of Black population distribution on highway construction throughout the entire continental United States.

The second part of the empirical analysis examines the long-term consequences of highway construction on neighborhoods. To do so, I estimate a dynamic differences-in-differences model that uses highway construction as treatment on a battery of outcomes. The dataset used in this analysis expands the one used in the cross-section analysis, incorporating information from 1940 to 2010. The dataset comprises a panel of consistent boundary tracts spanning seven decades. I compare treated neighborhoods that underwent highway construction to observationally similar untreated neighborhoods. To match each neighborhood to its control, I use nearest-neighbor propensity score matching, following the empirical strategy of Fenizia and Saggio (2022).

The findings indicate that highway construction significantly impacts the racial composition of neighborhoods. Compared to their matched counterfactual, treated tracts experienced a decline in total population over the subsequent three decades. This decline can be attributed entirely to the out-migration of White individuals from the neighborhood, while the Black population remained unchanged in the decades following highway construction. Additionally, the analysis reveals a decrease in the housing stock following highway construction. Moreover, the median home values and rents in the treated tracts remained unaffected after the construction of highways. These findings suggest a simultaneous decrease in housing demand and supply within the tract. Together, these results indicate that highway construction altered the racial composition of the receiving tracts without changing the land values.

The analysis complements existing literature that focuses on the history of discriminatory practices carried out by the US government by exploring the relationship between the Black population and future highway construction. Prior research has documented how the federal government imposed restrictions on loan access for properties located in historically Black neighborhoods, leading to long-lasting consequences for their residents (Aaronson et al., 2021; Hynsjö and Perdoni, 2022; Rothstein, 2017; Fishback et al., 2022, 2021). Additionally, other studies have examined the relationship between government policies such as zoning and slum clearance and their impact on traditionally Black communities (Lee, 2022; Sood et al., 2019; LaVoice, 2022). It has also been documented that racial and ethnic minorities face a higher property tax burden for the same level of public goods (Avenancio-León and Howard, 2022). By focusing on highway placement, this article contributes to the existing literature by providing novel insights into the discriminatory practices of the US government.

The findings also contribute to the existing literature on the economic determinants of the Interstate Highway System by providing new evidence regarding the role of race in the selection of sites for highway construction (Carter, 2023; Brooks and Liscow, 2023). Furthermore, the results add to the broader body of research on the consequences of highway construction, including studies that examine its effects on neighborhoods (Brinkman and Lin, 2022; Brinkman et al., 2023; Bagagli, 2023), segregation in cities (Baum-Snow, 2007; Mahajan, 2022; Weiwu, 2023), and economic factors such as productivity, employment, sector specialization, and travel distances (Duranton et al., 2014; Michaels, 2008; Herzog, 2021; Duranton and Turner, 2012; Chandra and Thompson, 2000; Redding and Turner, 2015; Duranton and Turner, 2011).

The paper is organized as follows. Section 2 discusses the history of the Federal-Aid Highway Act of 1956, which launched highway construction in the US, as well as presents qualitative accounts of the role Black individuals' residential distribution played on highway placement. I describe the data used in the analysis in Section 3. Section 4 presents the results for the relationship between the Black population share in 1950 and future highway construction. In Section 5, I discuss the dynamic implications for those neighborhoods where a highway was built. Finally, Section 6 provides the conclusion.

2. Background and Context

2.1 The Interstate Highway System

In the early 1940s, President Roosevelt initiated the first effort to establish an interstate network of highways in the US. In April 1941, the Interregional Highway Committee was established to develop a post-war road construction plan (Rose and Mohl, 2012). After years of discussions, the committee devised a plan that led to the Federal-Aid Highway Act of 1944, which proposed the creation of a "National System of Interstate Highways". The act called for the construction of over 40,000 miles of highways, which should be "located, as to connect by routes, direct as practical, the principal metropolitan areas, cities, and industrial centers, to serve the National Defense, and to connect at suitable points, routes of continental importance in the Dominion of Canada and the Republic of

Mexico" (National Interregional Highway Committee, 1944).[2] However, despite enacting the Federal-Aid Highway Act, the expected momentum in highway construction did not materialize due to the absence of a precise funding mechanism. It was not until a decade later, during the presidency of Dwight Eisenhower, that federal allocations for highway construction started.

President Eisenhower first attempted to pass highway construction legislation during the first session of the 84 Congress in 1955. The proposed bill included federal funding for 90% of the cost of highway construction for the next thirteen years. The legislation financed highway construction without increasing the government's debt. Instead, it proposed the creation of a highway trust fund, funded by an increase in the federal gasoline and diesel tax (Lewis, 2013, pp. 112-118). However, this funding mechanism faced fierce opposition from different interest groups. Lobbyists and truckers unions expressed their unalterable opposition to the bill, which increased the number of House members who disapproved of it (Rose and Mohl, 2012). As a result of the growing opposition, the bill was rejected in August 1955.

Convinced about the positive effect a highway network would have on the US economy, President Eisenhower took the same legislation to the second session of Congress in September 1955. Initially lacking the votes needed to approve the legislation in a Democratic House and Senate, his presidency found a solution to avoid an almost inevitable rejection. Between congressional sessions, the Bureau of Public Roads allocated 2,175 miles of Interstate highways into metropolitan areas compiled in a report informally called the "Yellow Book" (Lewis, 2013, pp. 119-120).[3] Each Congress member received a copy of this report. The Yellow

[2]Under the Federal-Aid Highway Act of 1944, states submitted proposals for their portion of the network. The collection of these proposals resulted in the National System of Interstate Highways of 1947. This map has previously been used in economic research (Baum-Snow, 2007; Duranton and Turner, 2011; Herzog, 2021). This article, however, does not use this map because it focuses on interstate highways, not including urban segments.

[3]The original name of the report is the "General Location of National System of Interstate Highways, Including All Additional Routes at Urban Areas".

Book comprised maps illustrating the federal government's plans for a network of urban highways in 100 metropolitan areas (Rose and Mohl, 2012). In Figure 1 I present a sample of these maps for the cities of Atlanta, Detroit, Miami, and New Orleans. As a result, representatives could see how the Interstates would benefit voters in their districts, which helped secure the necessary votes for the bill to pass. In June 1956, President Eisenhower signed the Federal-Aid Highway Act of 1956 into law.

The Act aimed to improve the nation's transportation infrastructure by constructing a National System of Interstate and Defense Highways. The bill provided 25 billion dollars over twelve years to accelerate the construction of 41,000 miles of interstate highways. The legislation created the Highway Trust Fund to finance the construction, funded by an increase in the federal tax on gas and diesel. The bill ensured that the Federal Government paid 90% of the construction costs while leaving the routing of the future interstates into the hands of state and local officials (Rose and Mohl, 2012). The construction should be finished by 1972, and the built network should be able to handle 1972's traffic projections. The bill assured that the US would receive the modern, interconnected, transcontinental network of highways that the country was lacking (Murphy, 2009).

2.2 Highway Construction and Race

Urban routes proposed by the Federal Government were instrumental in securing the approval of the Federal-Aid Highway Act of 1956. However, these routes were not binding. As Rose and Mohl noted: "Congress and President Eisenhower reaffirmed the long-standing principle that the locus of authority in highway programming rested unambiguously in the hands of state highway officials" (Rose and Mohl, 2012, p. 161). This granted state and local officials the power to determine urban routes, which in turn allowed for the utilization of highways to serve racial and political agendas (Rose and Mohl, 2012, p. 97). Figure 2 provides evidence that the constructed highway network deviated from the federal plan. Although many highway segments aligned with the intended origin and destination points, there were variations in the specific locations where highways were ultimately built compared to the initial plan.

Scholars in the urban affairs literature frequently point to the relocation of Black households from their historical communities as the primary racial agenda played by highway construction. Highway builders envisioned these new highways as means of clearing "blighted" urban areas, often at the expense of Black neighborhoods. As Alfred Johnson, executive director of the American Association of State Highway Officials, recalled: "Some city officials expressed the view in the mid-1950s that the urban interstates would give them an opportunity to get rid of the local "n*****towns" [...]" (Rothstein, 2017, p. 128). In the mid-1960s, planning experts forecasted that the construction of the interstate network would result in the displacement of more than one million people from their homes, primarily African Americans (Rose and Mohl, 2012, p. 96). As shown in Figure 2, highways were built in nearly all neighborhoods with a significant Black population. In addition, Federal and local agencies provided little to no assistance to displaced Black households to find new living arrangements. As a result, highway construction forced relocated households to relocate to the fringe of cities (Rothstein, 2017).

One of the most well-documented cases of highway construction used for Black removal occurred in Miami, Florida. State planners chose to route Interstate 95 directly through the heart of Overtown, a community that was the center of economic and cultural life for the Black population in the city. State officials overlooked an alternative route that would have used an abandoned railway right-of-way and would have resulted in minimal population displacement (Rothstein, 2017). As a result, Interstate 95's construction displaced approximately ten thousand Black individuals from their homes and communities

(Archer, 2020). A similar situation unfolded in New Orleans, Louisiana, where highway constructors purposefully avoided the historic French Quarters and instead placed Interstate 10 through the traditionally Black community of Claiborne (Rose and Mohl, 2012). As depicted in the top two panels of Figure 3, the construction of the highway resulted in the destruction of century-old oak trees that characterized the neighborhood, changing the community irreversibly.

The use of highway construction to remove Black communities was not limited to the US South. For example, in Detroit, Michigan, the predominantly Black neighborhood of Black Bottom was wiped out by the construction of Interstate 75 (Avila, 2014, pp. 89-90). The bottom two panels of Figure 3 visually represent how Interstate 75 bisected the neighborhood. A similar pattern occurred in St. Paul, Minnesota, where Interstate 94 cut through the city's Black community, displacing one-seventh of St. Paul's African American population. One critic noted that "very few Black individuals lived in Minnesota, but the road builders found them" (Rose and Mohl, 2012, p. 108). In Camden, New Jersey, a State Attorney General Office report concluded that the highway plans "clearly aimed to eliminate the town's Black population" (Rothstein, 2017, p. 129).

Highways have been utilized not only to remove Black individuals but also to establish physical barriers between neighborhoods. In Birmingham, Alabama, state planners constructed Interstate 59 and Interstate 65 to create a buffer between Black and white communities. These divisions mirrored the historical racial zoning the city had implemented prior to the Supreme Court decision that made racial zoning unenforceable. Similarly, highway construction in Atlanta, Georgia, also resulted in the confinement of Black residents by serving as a barrier between them and other communities (Archer, 2020, pp. 1281-1285). Palo Alto, California, provides another example of this phenomenon where the construction of Interstate 101 separated the Black residents of East Palo Alto from the west side of the town (Schindler, 2015).

The construction of interstate highways played a significant role in shaping the spatial conditions prevalent in modern US cities. Highways razed entire neighborhoods, relocated households, and created physical barriers now perceived as natural, thereby changing the trajectory of urban segregation in subsequent decades (Trounstine, 2018). Furthermore, highways facilitated the migration of primarily white city dwellers to the suburbs. Consequently, urban segregation cannot be viewed as an independent issue from highway construction but rather as a direct result of their location and construction (Archer, 2020; Fotsch, 2007).

3. Data

The baseline set of historical neighborhood characteristics comes from the National Historical GIS census information for 1950 (Manson et al., 2021). The neighborhood sample consists of neighborhoods located inside 62 Metropolitan Statistical Areas (MSA) –henceforth, cities– that had spatial information in 1950. Appendix Table C.1 presents a list of the MSAs used. For the second part of the paper, I use a panel of time-consistent neighborhood definitions from 1940 to 2010 for 42 cities with spatial information in 1940.[4]

I complement this data with a variety of sources. I start by matching each tract to its geographic characteristics, which come from Lee and Lin (2017). These variables include the tract's average slope in degrees and distance to the closest river. Then, I estimate the distance from each tract to the Central Business District (CBD), a proxy for the city center, following the practices recom-

[4] A common challenge while working with neighborhoods over time is that geographic units rarely align across periods. This study addresses this problem by using the crosswalk provided by Lee and Lin (2017) and uses 2010 census tracts. For the census years 1940 to 1960, the crosswalk weighs by overlapping area. From 1970 onwards, it uses population weights. More detailed information about the crosswalk can be found on pages vii-viii of the online appendix of Lee and Lin (2017).

mended by Holian (2019).[5] I calculate the distance from each tract's centroid to the closet railroad network in 1921 (Sequeira et al., 2019).[6] Finally, I include the number of car registrations per 10,000 inhabitants in each state and the political party of the state governor.[7]

Data on planned and built highways are obtained from two distinct sources. The first source is a collection of maps found in the Yellow Book (Bureau of Public Roads, US, 1955), which I digitize and geocode manually. These maps provide information for 100 metropolitan areas, 46 of which have spatial data in the 1950 census. The last column of Appendix Table C.1 shows which cities in the sample are covered by the Yellow Book. The second data source is the interstate highway system network, segmented into 1-mile equal-length segments. Next, the network is matched with the PR-511 database to determine the opening date of each highway segment (Baum-Snow, 2007; Brinkman and Lin, 2022). I then compute the distance from each census tract to the planned and built highway network.

Summary statistics for the neighborhoods are reported in Table 1. Column 1 presents the average for the entire sample for a set of variables, whereas, in columns 2 and 3, I split the sample between neighborhoods where a highway was built and those that were not. Column 4 presents the p-value of the OLS estimate of the respective variable on a dummy that takes value one if a highway was built through the tract and zero otherwise. Neighborhoods where highways were constructed differ from those without highway construction. Highways were

[5]First, I use the centroid of the polygon designated as the CBD in the 1982 Trade Census as in Fee and Hartley (2013). If the census did not include the city, I used the location of the city hall. That data comes from Wilson (2012). Finally, if the city is not matched in either of the two previous steps, I used the location of the CBD given by Google Maps as in Holian and Kahn (2012).

[6]I use the network available 30 years before the planning to take into consideration that some railroads are not used anymore and were transformed into highways.

[7]I draw data on passenger car registrations by state and year from the Federal Highway Administration, table MV-201 (Eli et al., 2022). Data on Governors' political affiliation comes from Inter-University Consortium for Political and Social Research (1995).

constructed in neighborhoods that were, on average, more populous and housed a larger number of White and Black individuals. Moreover, they are located in areas with lower land values and incomes, closer to the city center, and with a larger number of housing stock.

4. Racial Distribution and Highway Location

I present cross-sectional evidence on the relationship between a census tract's Black share and the probability of a highway being built in later decades. To do this, I exploit variations among census tracts in 1950, the last recorded census before the 1956 Federal-Aid Highway Act that initiated highway construction. The sample size is limited to 62 cities with spatial information in the 1950 census. The main results use the 2010 census tract definition.

For each neighborhood, I identify whether a highway was built through it. Therefore, the dependent variable is an indicator that takes a value of one if a highway was constructed through the tract and zero otherwise. Figure 4 illustrates the construction of the dependent variable using an example from Miami, Florida. The neighborhoods in the north-south portion of the map are bisected by future highway developments, thus having a dependent variable equal to one. The same is true for the neighborhood in the northeastern part of the map. On the other hand, the neighborhoods in the western and southeastern parts of the map do not have highway developments, resulting in a dependent variable of zero.

Using this data structure, I estimate the following equation:

$$y_n = \alpha + \lambda_{c(n)} + \beta BlackShare_n + \mathbf{X}_n'\gamma + \epsilon_n \tag{1}$$

In this equation, n indexes census tracts, and $c(n)$ indexes the metropolitan area in which the census tract was located in 1950. The dependent variable, y_n, takes a value of one if a highway was built through the census tract and zero otherwise. The equation includes a constant term, α, and a city fixed effect, $\lambda_{c(n)}$. The variable of interest is $BlackShare_n$ and corresponds to the share of Black individuals in the census tract. It is calculated as the ratio between the Black population in the tract and the total Black population in the city, i.e., $BlackPop_n/BlackPop_{c(n)}$. The variable mirrors the distribution of Black individuals in the city, following the qualitative evidence mentioned in Section 2.

The vector $\mathbf{X_n}$ comprises a set of neighborhood and state variables that may affect the location of a highway. Firstly, it includes the (log) median rent and (log) median home value of the tract to control land prices. It also controls for the (log) median income of the tract and the share of the adult population with a high school degree to account for the socioeconomic characteristics of the tract's inhabitants. Additionally, it includes the distance from the tract to the central business district to address the issue that highways are built to connect city centers and Black households sorted themselves into city centers (Boustan, 2010). Moreover, the vector contains an indicator that equals one when tract n was designated to host a highway in the Yellow Book and zero otherwise. The vector also controls for the tract's (log) average slope in degrees, the (log) area, and the distance to the nearest river and railroad network. Finally, it accounts for the political affiliation of the governor and the number of cars per 10,000 inhabitants in the state. The regression results are weighted by the total population of tract n in 1950, and standard errors are clustered at the city level.

The coefficient of interest is β, and the main hypothesis is that $\beta > 0$, or that highways were built where Black individuals lived in the city. I may find no effect, however, if highways were built to minimize acquisition costs, if they are located to connect city centers, or if they were built through places where their inhabitants had fewer ties to routing authorities. Any confounding force that could bias the estimate of β would need to vary across neighborhoods and be correlated with Black enclaves and future highway developments. Nevertheless, I document that the estimate of β is stable after including a broad range of controls.

4.1 Results: Black Share Predicts Future Highways

Estimates of Equation 1 are reported in Table 2. In all specifications, I find that neighborhoods that housed a larger share of Black individuals were associated with a larger probability of a highway bisecting the tract. The estimate is statistically significant even after controlling for a battery of tract and state characteristics that influence highway location. The estimate from column 4 implies that one standard deviation increase in the Black share of a tract increases the probability of a highway built through the neighborhood by 1.8 percentage points. A similar pattern arises when we use distance to future highway developments as the dependent variable. Appendix Table C.2 presents these results. Neighborhoods with a larger share of the city's Black population are closer to future highway developments.

The estimated effect is also economically significant. An increase of one standard deviation in the Black population share of a neighborhood is equivalent to a decrease in the mean median home value by 18.8% or by $16,836. Compared to median rents, the proposed increase is equivalent to a 25.7% decrease, or by $106, in the mean median rent.[8]

One possible explanation for these results is that state planners followed the Federal government's dictates. To test this hypothesis, I re-estimate Equation 1 using the Yellow Book maps as the dependent variable. In particular, I use an indicator that takes the value of one if a highway was planned in the neighbor-

[8]This estimates comes from $\Delta\%_x = 100 \times (exp\left(\frac{\sigma_{BS} \times \hat{\beta}_{BS}}{\hat{\beta}_x}\right) - 1)$ where x denotes median home value or rent and BS denotes Black share.

hood and zero otherwise. Table 3 presents the results. I find that the estimate is not different from zero after including proximity to the city center and the price of land. Similar results arise when using distance to the plan as the dependent variable, as seen in Appendix Table C.3. These results suggest that the racial composition of neighborhoods played a role in the decision of state planners to deviate from the federal plan.

These results refute part of the findings of Carter (2023). She suggests that the median home value was the most significant predictor of the highway location and that the share of Black individuals did not have a substantial effect. However, our papers differ in scope and in the way we model neighborhoods' Black share. While she uses the share of the tract's population that is Black, I use the share of the city's Black population residing in the tract. Although these two variables are highly correlated, they differ in spirit. Qualitative accounts indicate that highways were constructed "where Black individuals live" (Rose and Mohl, 2012). I argue that the definition used in this paper better reflects this motive. To illustrate, consider a city consisting of two neighborhoods: one with 1,000 Black residents and a total population of 2,000, and a second with a Black and total population of 100. If a highway is constructed through the first neighborhood, then Carter's definition of the Black share will not be picking statistically significant. However, the highway was built through the neighborhood that housed roughly 90% of the city's Black population.

4.1.1 Robustness and Sensitivity Checks

I now turn to the sensitivity of the estimates. A potential concern is the use of the 2010 census tract definition. Evidence suggests that state and city officials had detailed micro-data about neighborhood racial composition in 1950 (Caro, 1974, p.968), which is more disaggregated than any available census tract definition. In the previous analysis, I used the 2010 definition of census tracts because its geographic unit is smaller than the 1950 definition. However, it relies on area-weighted interpolation to convert the 1950 census tracts into the 2010 definition. To check the extent to which the results rely on this interpolation, I re-estimate Equation 1 using the 1950 definition. In Appendix Table C.4, I present the results for both the discrete and continuous dependent variables. The results, however, remain virtually unchanged. Therefore, for the rest of the paper, I will use the 2010 census tract definition, the standard in the urban economics literature (Brinkman and Lin, 2022; Brinkman et al., 2023; Lee and Lin, 2017; Couture et al., 2023).

A second potential concern is that controlling for proximity to the city center linearly may partially account for the city's racial distribution. In particular, including a linear term on proximity to the city center may not account for the fact that Black households tended to reside in city centers (Boustan, 2010), which were the main targets of urban highways. This is particularly important given the recent findings in Brinkman and Lin (2022), which show that highways in central parts of the city were most likely to deviate from the plan. Hence, a linear measure may not accurately capture the intended effect. To investigate this possibility, I include various specifications for distance to the city center, such as logarithmic, quadratic, cubic, quartic, and distance indicators, and an interaction term between the distance to the city center and the Black share of a tract. As displayed in Appendix Table C.5, the results remain robust to alternative definitions of proximity to the city center. Furthermore, the interaction term is not statistically significant and does not change the estimated effect for the Black share.

Another potential concern arises regarding the use of population as weights. In the 1950s, tracts closer to the city center had a larger population, which may have led to tracts that were more likely to receive an urban highway. To address this, I test the sensitivity of the estimates by excluding weights. As presented in Appendix Table C.6, the data does not support this critique. In fact, the estimated effect appears to be even larger without using weights.

It is possible that only a few cities constructed highways through Black communities, and the results may not reflect a widespread phenomenon throughout the US. To test this possibility, I re-estimated Equation 1 while leaving one city out of the sample each time. The estimated effects for the Black share are reported in Figure C.1. The estimates are similar in magnitude and remain highly significant.

Geographic projection introduces noise into the spatial calculations, which raises the possibility that some neighborhoods may not be treated as having a future highway constructed when they actually do. Although the use of distance to future highway construction as the dependent variable partially rules out this possibility, I address this concern by treating tracts close to future developments as receiving a highway. In Appendix Table C.7, I treat tracts within 25, 50, 75, and 100 meters of a future highway development as receiving a highway. The results are robust to these different specifications.

The final check examines the robustness of the results to various methods of calculating standard errors, including clustering by city, clustering by state, clustering for census tract in 1950, and allowing for spatial correlation within 2, 5, 10, and 100 kilometers of a tract.[9] As reported in Appendix Table C.8, the significance of the estimates is similar in each case.

4.2 Testing hypothesis: Highways as de-facto walls

The findings are consistent with the use of highway construction to advance local racial agendas. This result yields predictions regarding the motives behind local officials' decision to route and construct highways through Black communities. Urban researchers have identified one of these motives as the use of highways as a barrier between adjoining neighborhoods with dissimilar racial compositions.

[9] To calculate spatial standard errors, I use Colella et al.'s 2019 implementation of Conley (1999).

If this is the case, we should expect that neighboring tracts with highly different racial compositions are more likely to have a highway constructed between them.

To test this hypothesis, I investigate the relationship between the racial composition of neighboring tracts and the construction of highways. I estimate a modified version of Equation 1 that captures the impact of the White share in neighboring tracts on highway construction in a neighborhood. Figure 5 visually represents this relationship. First, I identify the neighboring tracts for each census tract, as shown in Panels 5a and 5b. Next, I select the highest value of the White share among the neighboring tracts as the relevant measure, as depicted in Panel 5c. As in the previous section, the dependent variable is an indicator that equals one if a highway was built through the tract. Panel 5d displays an example where the tract has a dependent variable of one.

The equation is given by:

$$\begin{aligned} y_n &= \alpha + \lambda_{c(n)} + \beta BlackShare_n + \beta_0^W WhiteShare_n^{\text{Neighbor}} \\ &\quad + \beta_1^W BlackShare_n \times WhiteShare_n^{\text{Neighbor}} + \mathbf{X'}_n\gamma + \epsilon_n \end{aligned} \tag{2}$$

In the equation, the indicator variable y_n takes the value of one if a highway is constructed in neighborhood n. The variable $BlackShare_n$ represents the proportion of the city's Black population residing in neighborhood n. The variable $WhiteShare_n^{\text{Neighbor}}$ denotes the White share in the neighboring tract of neighborhood n. The equation incorporates a constant term, α, and a city fixed effect, $\lambda_{c(n)}$. The vector $\mathbf{X_n}$ encompasses a range of neighborhood and state-level variables that determine highway location. These variables include the (log) median income, home value, and rent of the tract, the proportion of adults with a high school diploma, whether a highway was planned in the tract, the (log) average slope and area of the tract, the distance to the nearest river and railroad, as well as state-level factors such as the political affiliation of the governor and the number of cars per 10,000 inhabitants.

The results from the equation incorporating the racial composition of a tract's neighbors are presented in Table 4. The estimated effect for the tract's Black share remains virtually unchanged. The findings show that a higher proportion of White residents in a neighboring tract is associated with an increased likelihood of highway construction. However, while not statistically significant, the interaction term between these variables exhibits a negative coefficient. Appendix Table C.9 shows that similar effects are found when using the average racial composition between neighboring tracts. These findings suggest that, in contrast to the urban affairs literature findings, there is no evidence supporting the systematic construction of highways between racially dissimilar neighborhoods.

Similar findings are observed when examining the likelihood of a highway being constructed between two adjacent tracts. To do so, I transform the dataset and examine pairs of adjacent census tracts as the observation unit. This allows me to investigate whether highways are more likely to be constructed between two tracts with different racial compositions. Consistent with the findings presented in this section, the results presented in B.1 indicate that highways were not constructed between tracts that differed in terms of their racial composition. For a more comprehensive analysis and discussion of these findings, please refer to Appendix Section B.1.

5. Highway Construction and Neighborhoods

I now turn my attention to the consequences for those neighborhoods where a highway was built. Specifically, I study what happens to their demographic composition, housing stock, and housing values after the event of receiving a highway. To do this, I use a matched differences-in-differences design in which the treatment is the construction of a highway through the tract. Due to data limitations, I narrowed the sample to the 42 cities with available spatial information in 1940. The analysis focuses on highway openings that occurred between 1950 and 1980.

5.1 Matching Algorithm

I utilize nearest-neighbor propensity score matching to pair each census tract where a highway was constructed between 1950 and 1980 with a control census tract. To do so, I first group census tracts based on their city and the decade in which a highway was constructed. Then, I select as potential controls all census tracts that were never treated and were not intended to receive a highway on the Yellow Book maps. Tracts that were planned to receive a highway in the Yellow Book are excluded as there is evidence that the expectation of highway construction can affect neighborhood dynamics (Brinkman et al., 2023). The control group must be located in a different city than the treatment to avoid contamination from spillover effects (Fenizia and Saggio, 2022).

Next, I estimate a separate probit model on a cross-sectional sample of tracts consisting of the treated and potential control groups. The probit regressions relate the construction of a highway in the decade of treatment to the proximity of the tract's centroid to the city center, the (log) Black population in the decade before opening, and one- and two-decade lagged log rent and total population. Finally, using the estimated predicted values as the treatment propensity, each treated tract is matched with the untreated tract having the closest propensity score. The matching procedure matches 83% (2,023/2,414) of the events. The algorithm creates a relatively well-balanced sample. A broader discussion of the matched sample can be found in Appendix Section B.2.

5.2 Dynamic Effect of Highway Construction

To study the effect of highway construction on neighborhood characteristics, I estimate the following model:

$$
\begin{aligned}
y_{nt} \;&=\; \alpha_n + \lambda_{c(n)t} + \sum_{k=-1}^{4} \tilde{\theta}_k 1\{t = t_n^* + k\} \\
&\quad + \sum_{k=-1}^{4} \theta_k 1\{t = t_n^* + k\} \times HWY_n + u_{nt}
\end{aligned} \tag{3}
$$

where y_{nt} is an outcome variable (such as Black population) for neighborhood n in decade t. HWY_n is an indicator equal to one if neighborhood n received a highway –the definition of event– and zero otherwise. I select those highway segments that, once open, remain open until the end of my sample.[10] Thus, highway construction is an absorbing treatment, and the dummy variable takes the value of one for all periods. The variable $1\{t = t_n^* + k\}$ are event time dummies, where t_n^* is the last decade prior a highway opening for neighborhood n.[11] I control for neighborhood fixed effects, α_n, and city-by-decade fixed effects, $\lambda_{c(n),t}$, where $c(n)$ denotes the city associated with neighborhood n. In this specification, I omit the dummy for two decades before the highway event so that θ_k identifies the changes in outcome y_{nt} between treated and counterfactual neighborhoods relative to the same difference at $k = -2$. I normalize for two decades before the event because I only observe segment openings, but the effect could start showing up when construction begins. u_{nt} is the error term. The regression results are weighted by the tract population in the decade before highway construction. Standard errors are clustered at the census tract level.

[10]Although the movement to tear down highways has gained momentum lately (Lee, 2022), the number of segments that close during the time period is low.

[11]Time units will be decades. When I'm using matched neighborhoods, I assign the event time of each treated neighborhood to its matched control. Therefore, the event time dummies are defined for treated and control neighborhoods.

5.3 Validity of the Design

The specification builds on the dynamic matched difference-in-differences design used in recent papers (Fenizia and Saggio, 2022). The effect of highway construction thus comes from comparing treated neighborhoods to matched counterfactual neighborhoods that are never treated. Using a matched control group circumvents challenges scrutinized in recent research that arise in event-study models that rely solely on the variation in the timing of treatment (Borusyak et al., 2023). The key identifying assumption is that the outcomes in treated and control neighborhoods would have followed parallel trends in the absence of highway construction. Although this assumption is not directly testable, I look for violations of parallel pre-trends in the decades leading up to the event by evaluating the event-study coefficients for $k < 0$.

5.4 Results: Neighborhood Dynamics

In this section, I present the results of the effect over time of highway construction in a tract. By comparing treated neighborhoods to observationally similar tracts, I present the causal effect of highway construction on a battery of outcomes, including total, Black, and White population, median home value and rent, and housing stock. Figure 6 reports the event-study coefficients $\hat{\theta}_k$ from Equation 3. For the six outcomes we have that, previous to highway construction, the evolution of control and treated groups was similar, supporting the validity of the research design. The estimated effects are also presented in Table 5.

Figure 6a shows that the total population of a tract decreases after a highway opening. Two decades after a highway opening, the tract lost around 500 inhabitants and never recovered from the population loss. The decline corresponds to a 12% decrease in the tract's population compared to the last decade before highway construction. Figures 6b and 6c suggest that population loss comes entirely from White individuals leaving the neighborhood. In contrast, the Black population remains unchanged after the highway construction, thus increasing the Black share of the tract. This result is similar to what Bagagli (2023) finds for the city of Chicago. Together, these results suggest that highway construction accelerated the process of "White flight" (Boustan, 2010).

I now measure highway construction's effect on a neighborhood's housing stock. Compared to control neighborhoods, the number of housing in treated tracts decreased, as seen in Figure 6d. Part of the result is mechanical due to the physical destruction of properties needed to build highways. However, even four decades after the highway construction, the housing stock is considerably lower in treated neighborhoods. These effects suggest that highways permanently change the neighborhood structure, reducing housing stock and investments.

Finally, I turn my attention to property prices and rent. Figures 6e and 6f suggest that treated neighborhoods do not have different trends in prices after highway construction. A reduction in the demand and supply for housing in the tract can partially explain these results. As discussed, the total number of households living in treated neighborhoods declines, contracting the demand. Also, the housing stock decreased after highway construction. As a result, these effects combined explain why the median rent and median home value remain unaltered after a highway is opened.

6. Conclusion

This paper studies whether the racial distribution of a city played a role in the location of highways built after the 1956 Federal-Aid Highway Act of 1956 using data from 62 cities in the US. Recent scrutiny from journalists, policy-makers, urbanists, and community leaders has drawn attention to the deliberate efforts of state planners to use highway projects to displace Black Americans from their traditional neighborhoods. The findings provide empirical support for these anecdotal accounts, showing that the proportion of Black residents in a neighborhood is a significant predictor of the location of future highway developments.

The core of the analysis documents a relationship between the share of Black individuals residing in a tract and the occurrence of highway construction. The estimated effects are robust to a battery of sensitivity and robustness checks. Furthermore, these results are economically significant, as a one standard deviation increase in the Black share corresponds to an approximate 20% reduction in the mean median land value. Importantly, these results indicate that the placement of highways through Black tracts is not primarily driven by federal initiatives, but rather by deliberate actions taken by state and local officials. However, contrary to some accounts, the evidence suggests that highways were not consistently located between neighborhoods with different racial compositions.

The second set of results shed light on the consequences of highway construction for the affected tracts. Employing matched difference-in-difference model, the analysis reveals that the construction of highways is associated with a subsequent decline in the White population, while no significant effect is observed for the Black population. As a result, the proportion of Black residents in the tract tends to increase following highway construction. Additionally, the findings indicate that the construction of highways leads to a reduction in housing stock, although housing prices remain unaffected.

This paper contributes to the growing literature studying the Interstate Highway System, one of humankind's largest public works. By uncovering the role race played in the location of highways, this paper makes a small step towards understanding how public works, in general, and highways, in particular, impact city dwellers. Collecting and analyzing micro-level data on those relocated by highway developments would be extremely helpful for future research, especially now that the US is in the process of re-thinking its infrastructure.

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7. Tables

Table 1: Summary Statistics

	All	Built	Never built	p-val
	(1)	(2)	(3)	(4)
Total population	2,801.42	3,000.87	2,746.87	0.00
	(2,708.06)	(3,189.87)	(2,557.97)	
Total white population	2,493.48	2,581.57	2,469.38	0.01
	(2,332.05)	(2,567.84)	(2,262.79)	
Total Black population	295.54	405.00	265.60	0.00
	(1,228.63)	(1,496.33)	(1,142.80)	
Distance to city center	15.32	14.52	15.54	0.00
	(11.97)	(11.31)	(12.13)	
% of adults with a high school degree	0.72	0.71	0.72	0.00
	(0.10)	(0.11)	(0.10)	
Total housing units	854.77	888.07	845.66	0.00
	(823.26)	(938.81)	(788.51)	
Median home value	89,954.79	83,824.95	91,652.67	0.00
	(29,690.90)	(29,195.16)	(29,604.15)	
Median rent	414.51	382.48	423.30	0.00
	(148.52)	(138.32)	(150.01)	
Median income	29,221.14	28,244.30	29,488.30	0.00
	(12,522.95)	(10,904.91)	(12,917.73)	
Highway planned in the tract	0.18	0.43	0.11	0.00
	(0.38)	(0.50)	(0.32)	
Observations	19,011	4,075	14,936	

Note: Each observation is a census tract in 1950. The sample includes 62 cities in the US. Column 4 corresponds to the p-value of an OLS regression between the variable of interest and a dummy equal to one if a highway was built through the tract and zero otherwise.

Table 2: Black Share Predicts Future Highway Construction

	Dependent Variable: Indicator for a highway built in the tract				
	(1)	(2)	(3)	(4)	(5)
Black share	1.585[a]	1.609[a]	1.012[a]	0.949[a]	0.902[a]
	(0.310)	(0.311)	(0.308)	(0.271)	(0.271)
Distance to city center		0.001	0.002[c]	0.002[b]	-0.006[a]
		(0.001)	(0.001)	(0.001)	(0.001)
(log) Median income			-0.015	-0.012	-0.012
			(0.010)	(0.008)	(0.010)
(log) Median rent			-0.078[a]	-0.068[a]	-0.060[a]
			(0.024)	(0.022)	(0.018)
(log) Median home value			-0.097[a]	-0.073[a]	-0.085[a]
			(0.028)	(0.026)	(0.022)
% with a high school degree			-0.159	-0.059	0.019
			(0.096)	(0.076)	(0.075)
Highway planned				0.335[a]	0.290[a]
				(0.040)	(0.042)
Mean dependent var.	0.215	0.215	0.217	0.217	0.218
Std. dev. Black share	0.019	0.019	0.019	0.019	0.020
City Fixed Effect	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	Yes
Obs.	18,691	18,691	17,210	17,210	16,944
R^2 (Adj.)	0.078	0.078	0.096	0.194	0.239

Note: Each column corresponds to a different regression. The unit of observation is a census tract. The dependent variable is an indicator if a highway was built through the tract in the decades to come. The vector of controls includes the (log) area and slope of the tract, distance to the nearest river, an indicator if the governor of the state was part of the Republican party, the state (log) number of car registrations per 10k inhabitants, and the distance to the 1921 railroad network. Coefficients are reported with standard errors clustered at the city level. [a] indicates the coef. is significant at the 1%, [b] at the 5%, and [c] at the 10%. Regressions are weighted by the census tract's population.

Table 3: Black Share Does Not Predict Planned Highways

	Dependent Variable: Highway planned in the tract			
	(1)	(2)	(3)	(4)
Black share	0.765^a	0.723^a	0.189	0.137
	(0.236)	(0.237)	(0.253)	(0.239)
Distance to city center		-0.002	-0.001	-0.008^a
		(0.001)	(0.001)	(0.002)
(log) Median income			-0.009	-0.007
			(0.010)	(0.011)
(log) Median rent			-0.029	-0.005
			(0.035)	(0.035)
(log) Median home value			-0.071^b	-0.093^a
			(0.027)	(0.021)
% with a high school degree			-0.299^c	-0.185
			(0.159)	(0.153)
Mean dependent var.	0.182	0.182	0.185	0.184
Std. dev. Black share	0.019	0.019	0.019	0.020
City Fixed Effect	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes
Obs.	18,691	18,691	17,210	16,944
R^2 (Adj.)	0.060	0.061	0.075	0.115

Note: Each column corresponds to a different regression. The unit of observation is a census tract. The dependent variable is an indicator if a highway was planned through the tract in the decades to come. The vector of controls includes the (log) area and slope of the tract, distance to the nearest river, an indicator if the governor of the state was part of the Republican party, the state (log) number of car registrations per 10k inhabitants, and the distance to the 1921 railroad network. Coefficients are reported with standard errors clustered at the city level. ^{a} indicates the coef. is significant at the 1%, ^{b} at the 5%, and ^{c} at the 10%. Regressions are weighted by the census tract's population.

Table 4: Neighboring White Share

	Dependent variable:		
	𝕀(Highway built in the tract)		
	(1)	(2)	(3)
Black share	0.902[a]	0.788[a]	1.435[b]
	(0.271)	(0.268)	(0.545)
Neighboring White share		3.471[a]	3.880[a]
		(1.103)	(1.204)
Black share ×			-18.842
Neighboring White share			(11.574)
Mean Dep. Var.	0.218	0.218	0.218
Std. Dev. Black share	0.020	0.020	0.020
Std. Dev. White share	0.007	0.007	0.007
Observations	16,944	16,935	16,935
R^2 (Adj.d)	0.242	0.244	0.245

Note: Each column corresponds to a different regression. The unit of observation is a census tract. The dependent variable is an indicator variable that equals one if a highway was built through the tract. The neighboring White share corresponds to the maximum value of White share among neighboring tracts. Each column controls for the (log) median rent, home value, and income of the tract, the share of adults with a high school diploma, if a highway was planned in the tract, the (log) average slope and area of the tract, the distance to the nearest river and railroad, and state variables such as political affiliation of the governor and number of cars per 10k inhabitants. Each observation is weighted by the tract's total population. Standard errors are clustered at the city level.

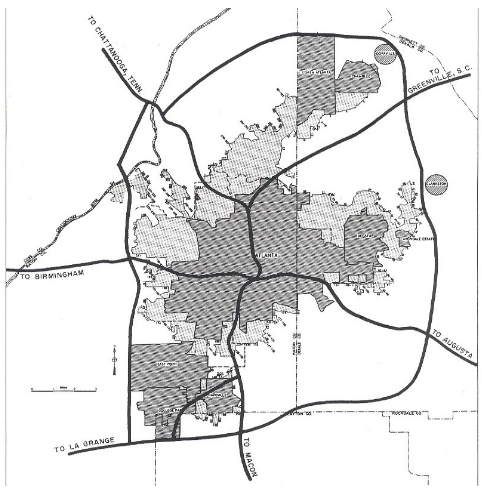
Table 5: Effects of Highway Construction

	# Total	# Black	# White	# Housing	Median Rent	Median Home
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\theta}_{-1}$ (t = -1)	-41.981	18.505	-54.129	-35.271	-5.219	-1,220.379
	(112.033)	(63.659)	(111.516)	(30.512)	(5.272)	(1,392.715)
$\hat{\theta}_0$ (t = 0)	-161.443	137.062	-313.171[c]	-36.756	-1.381	-1,341.647
	(162.658)	(97.947)	(170.275)	(42.570)	(6.449)	(1,443.385)
$\hat{\theta}_1$ (t = 1)	-461.225[b]	-15.943	-439.457[b]	-139.683[a]	-3.194	1,462.113
	(192.128)	(115.765)	(185.038)	(51.441)	(7.223)	(2,060.659)
$\hat{\theta}_2$ (t = 2)	-521.240[b]	-10.410	-516.056[a]	-158.838[a]	0.053	-4,857.507
	(212.532)	(120.860)	(186.743)	(61.621)	(7.838)	(3,194.890)
$\hat{\theta}_3$ (t = 3)	-553.598[b]	-0.822	-608.848[a]	-173.819[a]	2.056	-9,343.438[b]
	(222.560)	(126.505)	(186.617)	(66.284)	(9.870)	(4,468.908)
Mean dep. var.	3,905.60	917.75	2,789.02	1,395.74	551.31	122,779.00
Obs.	24,024	24,024	24,024	24,024	23,713	23,108
R^2	0.625	0.718	0.617	0.690	0.778	0.781

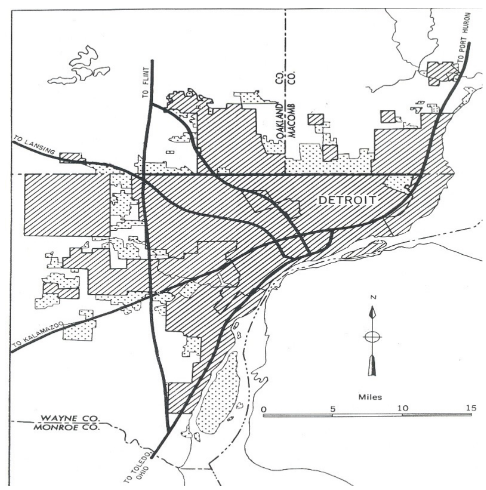
Note: Matched neighborhood sample. Treated tracts are matched to out-of-city potential controls. This table the estimated θ_k of Equation 3. Each observation is weighted by the tract's total population in 1950. Standard errors are reported in parentheses and are clustered at the census tract level. The visual results are reported in Figure 6.

8. Figures

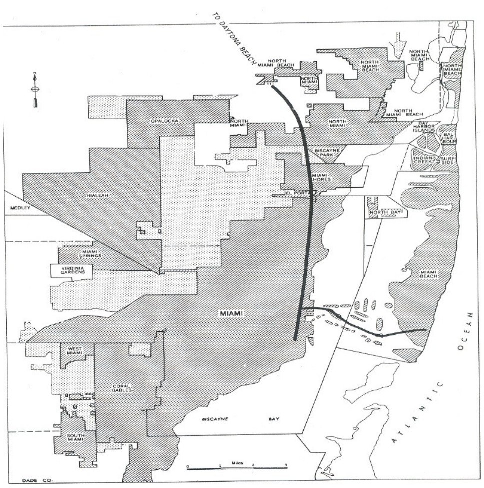
Figure 1: Yellow Book Maps



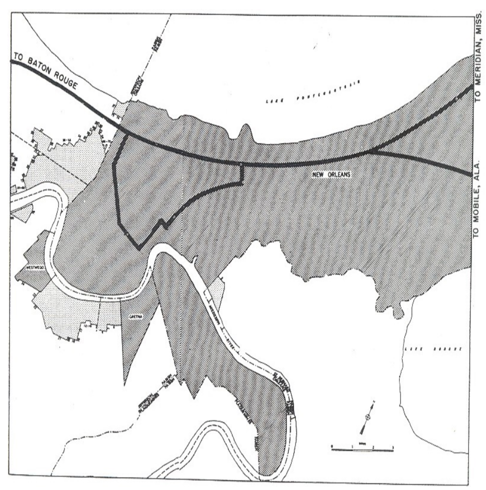
(a) Atlanta



(b) Detroit



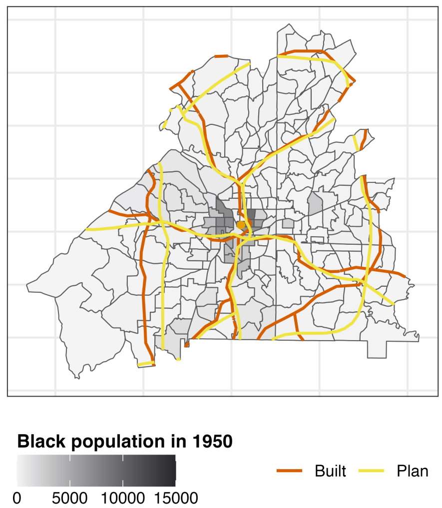
(c) Miami



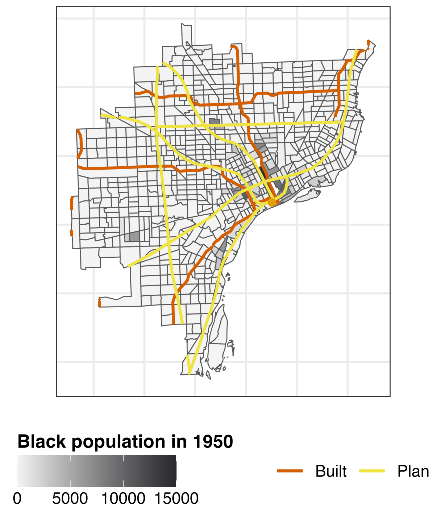
(d) New Orleans

Note: The figure includes the maps in the Yellow Book for the cities of Atlanta, Detroit, Miami, and New Orleans.

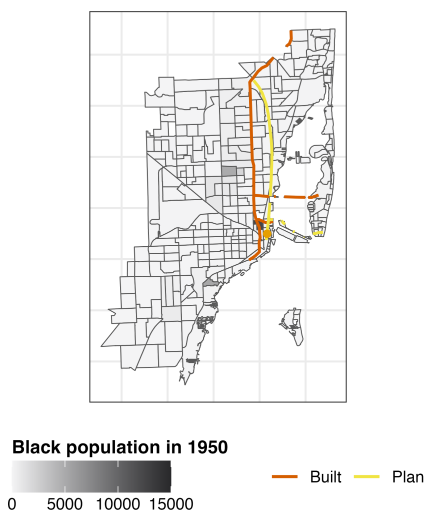
Figure 2: Racial Distribution, Highways, and Planned Routes



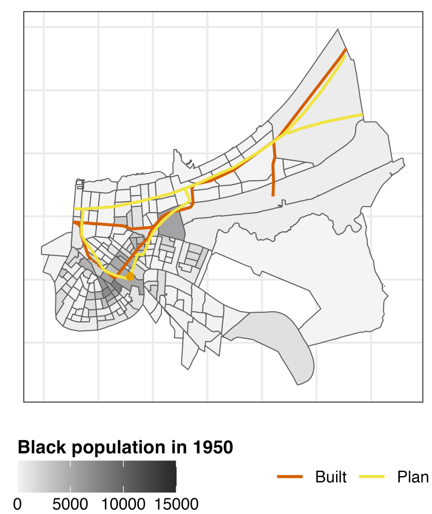
(a) Atlanta



(b) Detroit



(c) Miami



(d) New Orleans

Note: The figure includes maps for Atlanta, Detroit, Miami, and New Orleans. Each observation is a census tract, and its filling corresponds to the number of Black residents in the tract. Depicted in red is the built highway network. The network planned in the Yellow Book is presented in yellow. Finally, the city center is plotted in orange.

Figure 3: Disruptive Effects of Highway Construction

(a) Claiborne before Interstate 10 **(b)** Claiborne after Interstate 10

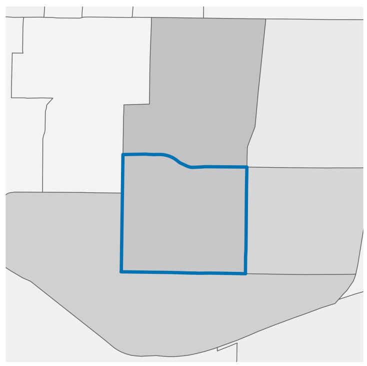
(c) Black Bottom before Interstate 75 **(d)** Black Bottom after Interstate 75

Note: The figure presents a visual representation of two neighborhoods, Claiborne in New Orleans and Black Bottom in Detroit, before and after highway construction.

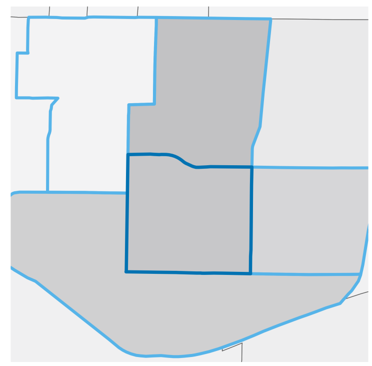
Figure 4: Structure of Data Analysis

Note: The figure depicts a subset of neighborhoods in Miami, Florida, shaded according to the number of Black individuals living in the tract. The Interstate Highway built subsequently is presented in red.

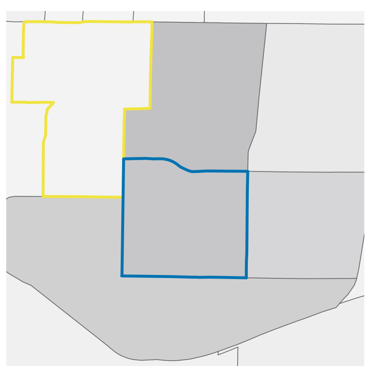
Figure 5: Structure of the Neighboring Analysis



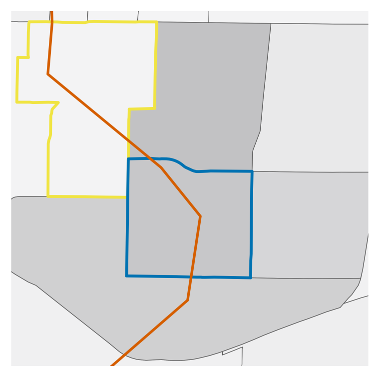
(a) Observational unit



(b) Identifying all neighbors



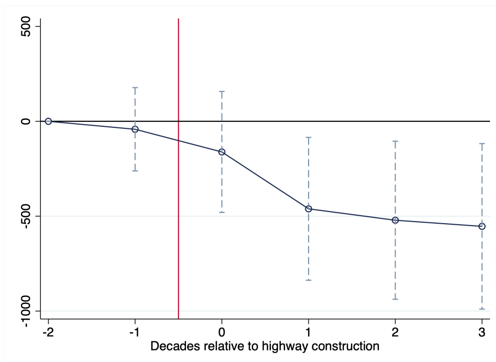
(c) Neighbor with the highest White share



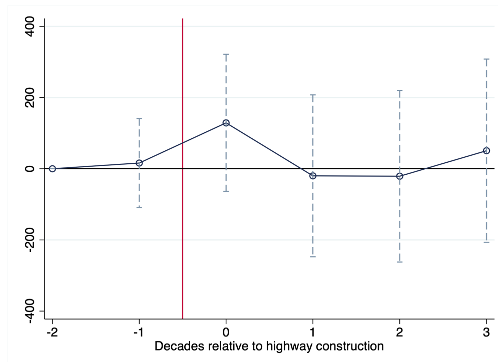
(d) Highway construction

Note: The figure depicts a subset of neighborhoods in Atlanta, Georgia, shaded according to the number of Black individuals living in the tract. The Interstate Highway built subsequently is presented in red.

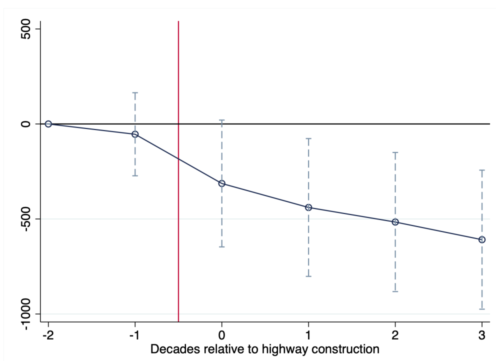
Figure 6: Event-Study Results



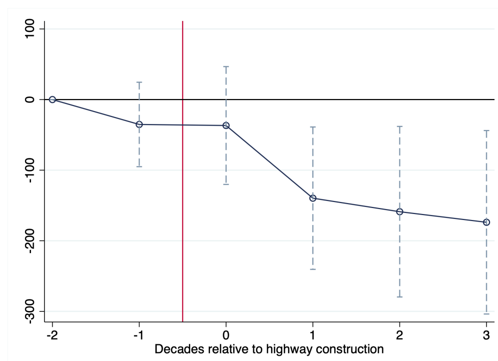
(a) Total population



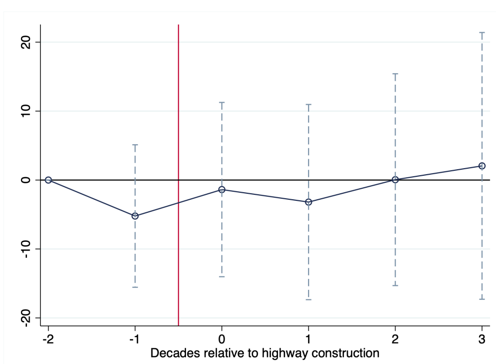
(b) Black population



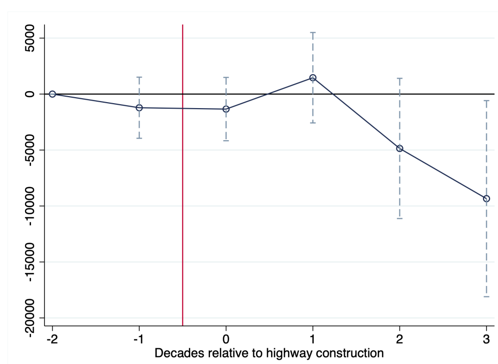
(c) White population



(d) Total housing



(e) Median rent



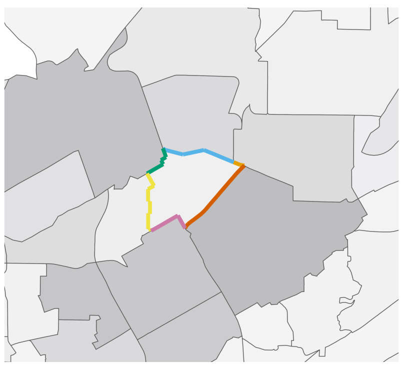
(f) Median home value

A. Data Appendix

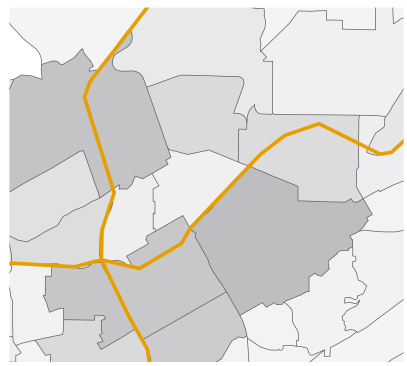
TBD

A.1 Separation

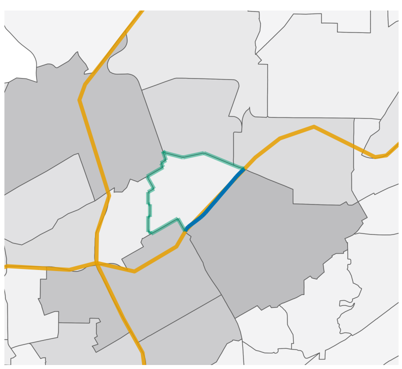
Figure A.1: Structure of the Separation Analysis



(a) Observational unit



(b) Highways built



(c) Dependent variable

(d) Dependent variable for the city

Note: The figure depicts a subset of neighborhoods in Birmingham, Alabama, shaded according to the number of Black individuals living in the tract. The Interstate Highway built subsequently is presented in red. Pairs of tracts divided by highway construction are presented in blue.

B. Additional Empirical Analysis

B.1 Highways as barriers

The results in Section 4 suggest that highways were constructed in neighborhoods that housed a larger number of Black residents. In this section I focus on the motives behind the racial bias in highway location. Highways act as a barrier to adjacent neighborhoods, increasing the time of trips between neighborhoods (Brinkman and Lin, 2022). I look if highways were built between adjacent neighborhoods that differ in their racial composition.

To do so, I modify Equation 1 by transforming the observational unit into pairs of adjacent census tracts. Figure A.1 illustrates the data structure. Panel A.1a presents all the census tract pairs for one census tract in Birmingham, Alabama. For example, the central census tract has six adjacent tracts, each mapped with a different color.

To study which tracts are separated, I overlay the highways built afterward, as depicted in panel A.1b. The dependent variable is an indicator that equals one if a highway is constructed between two adjacent tracts and zero otherwise. Panel A.1c illustrates how the dependent variable is constructed for the central tract. The blue line depicts the tract's boundary that received a highway, resulting in a dependent variable of one. In contrast, the remaining green boundaries are non-treated and have a dependent variable equal to zero. Finally, panel A.1d highlights all boundary pairs with highways separating them from their pair.

With that structure in mind, I estimate the following equation:

$$y_i = \alpha + \lambda_{c(i)} + \beta^1 \Delta BlackShare_i + \mathbf{X}_i' \gamma + \epsilon_i \qquad \text{(B.1)}$$

where y_i is an indicator for the construction of a highway across the census tract pair i. The estimation includes a constant α and a city fixed effect $\lambda_{c(i)}$.

$\Delta BlackShare_i$ is the variable of interest and measures the difference in the racial composition between the two census tracts that make up the census tract pair i. In particular, $\Delta BlackShare_i$ corresponds to the absolute value of the difference between the Black share of each tract. The vector $\mathbf{X}_i$ includes average characteristics for census tract pair i. These variables include (log) average median income, home value, and rent, the average share of adults with a high school diploma, distance to the city center, an indicator if any of the tracts received a highway in the yellow book, and geographic controls such as the (log) average slope, area, and length of the segment, and the distance to the nearest railroad and river. Finally, it includes state variables such as the political affiliation of the state governor and the number of car registrations per 10,000 inhabitants.

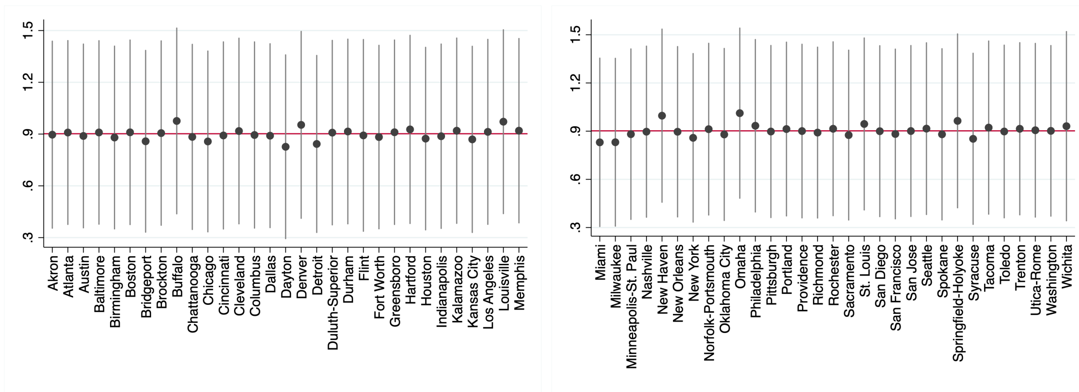
The estimates of Equation B.1 are reported in Appendix Table B.1. I find that the coefficient for racial dissimilarity is positive but not statistically different from zero in the preferred specification (column 5). This result suggests that highways were not systematically built between adjacent neighborhoods with dissimilar racial composition.

B.2 Event Study

Appendix Table C.10 reports the summary statistics in the last decade before the highway opening for the matched census tracts sample in column 1. Columns 2 and 3 display the statistics for treated and control census tracts, respectively. Finally, column 4 presents the p-value of an OLS regression between the variable and an indicator that takes the value one if a highway was built through the tract and zero otherwise.

The average census tract has a total population of 4,270 inhabitants, and its population is mostly White. Differences in White population and median home value notwithstanding, covariates are relatively well balanced as a whole

Figure C.1: Leave-out Estimation



Note: These figures present the results of Equation 1 ommiting one city at a time. All regressions include the controls specified in column 5 of Table 2. Standard errors are clustered at the city level and weighted by the tract's total population.

between treated and control groups. The algorithm matches well variables that were not used in the procedure, such as housing units, median rent, and median income.

C. Supplementary Figures and Tables

C.1 Figures

C.2 Tables

Table C.1: List of MSAs Used in the Analysis

Metropolitan Area Name	State	Code	# tracts	Yellow Book
Akron	OH	80	95	No

Continues on next page

Table C.1 – *Continued from previous page*

Metropolitan Area Name	State	Code	# tracts	Yellow Book
Atlanta	GA	520	228	Yes
Austin	TX	640	71	No
Baltimore	MD	720	476	Yes
Birmingham	AL	1000	70	Yes
Boston	MA	1120	596	Yes
Bridgeport	CT	1160	70	No
Brockton	MA	1200	57	No
Buffalo	NY	1280	188	Yes
Chattanooga	TN-GA	1560	50	Yes
Chicago	IL-IN	1600	1547	Yes
Cincinnati	OH-KY	1640	233	Yes
Cleveland	OH	1680	473	Yes
Columbus	OH	1840	284	Yes
Dallas	TX	1920	205	Yes
Dayton	OH	2000	126	No
Denver	CO	2080	126	Yes
Detroit	MI	2160	748	Yes
Duluth-Superior	MN-WI	2240	36	No
Durham	NC	2280	60	No
Flint	MI	2640	113	Yes
Fort Worth	TX	2800	131	Yes

Continues on next page

Table C.1 – *Continued from previous page*

Metropolitan Area Name	State	Code	# tracts	Yellow Book
Greensboro-High Point	NC	3120	119	No
Hartford	CT	3280	108	Yes
Houston	TX	3360	785	Yes
Indianapolis	IN	3480	186	Yes
Kalamazoo	MI	3720	46	No
Kansas City	MO-KS	3760	136	Yes
Los Angeles	CA	4480	2348	Yes
Louisville	KY-IN	4520	85	Yes
Memphis	TN	4920	93	Yes
Miami	FL	5000	286	Yes
Milwaukee	WI	5080	297	Yes
Minneapolis-St. Paul	MN	5120	329	Yes
Nashville	TN	5360	86	Yes
New Haven	CT	5480	41	No
New Orleans	LA	5560	183	Yes
New York-Northeastern NJ	NY-NJ	5600	2491	Yes
Norfolk-Portsmouth	VA	5720	85	Yes
Oklahoma City	OK	5880	144	Yes
Omaha	NE-IA	5920	73	Yes
Philadelphia	PA-NJ	6160	1300	Yes
Pittsburgh	PA	6280	420	Yes

Continues on next page

Table C.1 – *Continued from previous page*

Metropolitan Area Name	State	Code	# tracts	Yellow Book
Portland	OR-WA	6440	117	Yes
Providence	RI	6480	53	Yes
Richmond	VA	6760	71	Yes
Rochester	NY	6840	106	Yes
Sacramento	CA	6920	318	No
St. Louis	MO-IL	7040	348	Yes
San Diego	CA	7320	406	No
San Francisco-Oakland	CA	7360	421	Yes
San Jose	CA	7400	47	No
Seattle	WA	7600	283	Yes
Spokane	WA	7840	50	No
Springfield-Holyoke	MA-CT	8000	86	Yes
Syracuse	NY	8160	140	Yes
Tacoma	WA	8200	149	No
Toledo	OH-MI	8400	77	Yes
Trenton	NJ	8480	35	No
Utica-Rome	NY	8680	34	Yes
Washington	DC-MD-VA	8840	266	Yes
Wichita	KS	9040	56	Yes
Total				18,687

C.3 Summary Statistics

Table B.1: Highways as barriers

	Dependent Variable: Indicator for a highway built between the tracts				
	(1)	(2)	(3)	(4)	(5)
Δ Black share	0.261^{a}	0.242^{a}	0.157^{c}	0.118^{c}	0.107
	(0.082)	(0.081)	(0.083)	(0.069)	(0.070)
Distance to city center		-0.001^{b}	-0.001^{b}	-0.000^{c}	-0.001^{a}
		(0.000)	(0.000)	(0.000)	(0.000)
(log) Median income			-0.006^{c}	-0.006^{b}	-0.006^{b}
			(0.003)	(0.003)	(0.003)
(log) Median rent			-0.013	-0.009	-0.007
			(0.010)	(0.009)	(0.008)
(log) Median home value			-0.027^{b}	-0.026^{b}	-0.029^{a}
			(0.012)	(0.011)	(0.010)
% with a high school degree			0.016	0.043^{c}	0.058^{b}
			(0.029)	(0.022)	(0.025)
Highway planned				0.095^{a}	0.090^{a}
				(0.011)	(0.012)
Mean dep. var.	0.055	0.055	0.056	0.056	0.056
Std. dev. Δ Black share	0.024	0.024	0.024	0.024	0.024
City Fixed effect	Yes	Yes	Yes	Yes	Yes
Observations	48,143	48,143	44,207	44,207	43,546
R^2	0.013	0.013	0.016	0.048	0.054

Note: Each column corresponds to a different regression. The unit of observation is a census tract pair. The dependent variable is an indicator if a highway was built between the tracts that make up for the pair. The vector of controls includes the (log) average area and slope of the tracts, (log) distance of the segment, average distance to the nearest river, an indicator if the governor of the state was part of the Republican party, the state (log) number of car registrations per 10k inhabitants, and the distance to the 1921 railroad network. Coefficients are reported with standard errors clustered at the city level. ^{a} indicates the coef. is significant at the 1%, ^{b} at the 5%, and ^{c} at the 10%.

Table C.2: Black Individuals are Closer to Future Highway Construction

	Dependent Variable: Distance to the closest highway built				
	(1)	(2)	(3)	(4)	(5)
Black share	-6.835^a	-3.310^a	-2.460^a	-2.231^a	-2.490^a
	(1.089)	(0.956)	(0.888)	(0.835)	(0.907)
Distance to city center		0.135^a	0.135^a	0.134^a	0.118^a
		(0.028)	(0.028)	(0.027)	(0.024)
(log) Median income			-0.130	-0.140	-0.116
			(0.118)	(0.110)	(0.112)
(log) Median rent			-0.043	-0.079	-0.106
			(0.165)	(0.156)	(0.157)
(log) Median home value			0.510^b	0.424^c	0.317^c
			(0.242)	(0.248)	(0.175)
% with a high school degree			0.009	-0.354	-0.602
			(0.663)	(0.572)	(0.577)
Highway planned				-1.215^a	-1.206^a
				(0.155)	(0.169)
Mean dependent var.	3.230	3.230	3.100	3.100	3.104
Std. dev. Black share	0.019	0.019	0.019	0.019	0.020
City Fixed Effect	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	Yes
Obs.	18,691	18,691	17,210	17,210	16,944
R^2 (Adj.)	0.103	0.277	0.282	0.318	0.353

Note: Each column corresponds to a different regression. The unit of observation is a census tract. The dependent variable is the distance from the tract to interstate highways built in the decades to come. The vector of controls includes the (log) area and slope of the tract, distance to the nearest river, an indicator if the governor of the state was part of the Republican party, the state (log) number of car registrations per 10k inhabitants, and the distance to the 1921 railroad network. Coefficients are reported with standard errors clustered at the city level. ^{a} indicates the coef. is significant at the 1%, ^{b} at the 5%, and ^{c} at the 10%. Regressions are weighted by the census tract's population.

Table C.3: Black Individuals are Not Closer to the Plan

	Dependent Variable: Distance to planned network			
	(1)	(2)	(3)	(4)
Black share	-7.293^a	-0.903	-1.287	-1.537
	(1.440)	(1.597)	(1.001)	(1.113)
Distance to city center		0.216^a	0.217^a	0.217^a
		(0.055)	(0.053)	(0.056)
(log) Median income			-0.371^c	-0.330
			(0.220)	(0.227)
(log) Median rent			-0.572	-0.648^b
			(0.349)	(0.295)
(log) Median home value			0.542^a	0.457^c
			(0.161)	(0.241)
% with a high school degree			0.746	0.299
			(1.228)	(1.237)
Mean dependent var.	3.796	3.796	3.606	3.628
Std. dev. Black share	0.017	0.017	0.017	0.018
City Fixed Effect	Yes	Yes	Yes	Yes
Controls	No	No	No	Yes
Obs.	16,965	16,965	15,682	15,416
R^2 (Adj.)	0.086	0.366	0.371	0.389

Note: Each column corresponds to a different regression. The unit of observation is a census tract. The dependent variable is an indicator if a highway was planned through the tract in the decades to come. The vector of controls includes the (log) area and slope of the tract, distance to the nearest river, an indicator if the governor of the state was part of the Republican party, the state (log) number of car registrations per 10k inhabitants, and the distance to the 1921 railroad network. Coefficients are reported with standard errors clustered at the city level. ^{a} indicates the coef. is significant at the 1%, ^{b} at the 5%, and ^{c} at the 10%. Regressions are weighted by the census tract's population.

Table C.4: Results Unchanged Under Different Census Tracts Units

	2010 CT definition		1950 CT definition	
	$\mathbb{I}$(Built)	Distance	$\mathbb{I}$(Built)	Distance
	(1)	(2)	(3)	(4)
Black share	0.902[a]	-2.490[a]	0.374[c]	-2.411[b]
	(0.271)	(0.907)	(0.220)	(0.957)
Distance to city center	-0.006[a]	0.118[a]	-0.005[a]	0.114[a]
	(0.001)	(0.024)	(0.001)	(0.022)
(log) Median income	-0.012	-0.116	-0.055[c]	-0.215
	(0.010)	(0.112)	(0.029)	(0.317)
(log) Median rent	-0.060[a]	-0.106	-0.073[a]	-0.098
	(0.018)	(0.157)	(0.023)	(0.148)
(log) Median home value	-0.085[a]	0.317[c]	-0.062[b]	0.393[b]
	(0.022)	(0.175)	(0.027)	(0.158)
% with a high school degree	0.019	-0.602	0.034	-0.332
	(0.075)	(0.577)	(0.073)	(0.669)
Highway planned	0.290[a]	-1.206[a]	0.317[a]	-1.442[a]
	(0.042)	(0.169)	(0.054)	(0.227)
Mean dependent variable	0.218	3.104	0.238	2.439
Std. dev. Black Share	0.020	0.020	0.026	0.026
Observations	16,944	16,944	9,439	9,439
R^2 (Adj.d)	0.242	0.356	0.256	0.328

Note: Each column corresponds to a different regression. The unit of observation is a census tract. Column 2 replicates column 5 in Table 2. Column 2 replicates column 5 in Table C.2. All regressions include the controls specified in column 5 of Table 2. Standard errors are clustered at the city level and weighted by the tract's total population.

Table C.5: Robustness to Non-linear Distance to the City Center

	Dep. var.: Indicator for a highway built in the tract						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black share	0.902[a]	0.954[a]	0.735[a]	0.898[a]	0.855[a]	0.789[a]	0.793[a]
	(0.271)	(0.296)	(0.262)	(0.270)	(0.267)	(0.264)	(0.261)
Black share ×		-0.014					
Distance to CBD		(0.027)					
Distance to CBD	Linear	Linear	Logarithmic	Quadratic	Cubic	Quartic	Indicator
Observations	16,944	16,944	16,944	16,944	16,944	16,944	16,944
R^2 (Adj.d)	0.242	0.242	0.247	0.242	0.244	0.246	0.241

Note: Each column corresponds to a different regression. The unit of observation is a census tract. Each column controls for the (log) median rent, home value, and income of the tract, the share of adults with a high school diploma, if a highway was planned in the tract, the (log) average slope and area of the tract, the distance to the nearest river and railroad, and state variables such as political affiliation of the governor and number of cars per 10k inhabitants. Column (7) includes dummies for distance within 0 and 4 kms, 4 and 8, 8 and 16, and larger than 16 kms. Each observation is weighted by the tract's total population. Standard errors are clustered at the city level.

Table C.6: Robustness to Unweighted Observations

	Dependent Variable: Indicator for a highway built in the tract				
	(1)	(2)	(3)	(4)	(5)
Black share	1.453^a	1.479^a	1.152^a	1.009^a	1.118^a
	(0.285)	(0.284)	(0.302)	(0.261)	(0.263)
Distance to city center		0.001	0.000	0.001	-0.005^a
		(0.001)	(0.001)	(0.001)	(0.001)
(log) Median income			-0.004	-0.003	-0.002
			(0.006)	(0.005)	(0.005)
(log) Median rent			-0.071^a	-0.059^a	-0.038^b
			(0.022)	(0.021)	(0.015)
(log) Median home value			-0.050^c	-0.047^c	-0.064^a
			(0.028)	(0.025)	(0.021)
% with a high school degree			-0.021	0.034	0.099
			(0.069)	(0.066)	(0.069)
Highway planned				0.354^a	0.321^a
				(0.037)	(0.040)
Mean dependent var.	0.215	0.215	0.217	0.217	0.218
Std. dev. Black share	0.019	0.019	0.019	0.019	0.020
City Fixed Effect	Yes	Yes	Yes	Yes	Yes
Controls	No	No	No	No	Yes
Obs.	18,691	18,691	17,210	17,210	16,944
R^2 (Adj.)	0.046	0.046	0.052	0.156	0.194

Note: Each column corresponds to a different regression. The unit of observation is a census tract. The dependent variable is an indicator if a highway was built through the tracts in the decades to come. The vector of controls includes the (log) area and slope of the tract, distance to the nearest river, an indicator if the governor of the state was part of the Republican party, the state (log) number of car registrations per 10k inhabitants, and the distance to the 1921 railroad network. Coefficients are reported with standard errors clustered at the city level. ^{a} indicates the coef. is significant at the 1%, ^{b} at the 5%, and ^{c} at the 10%.

Table C.7: Robustness to Noise in the Dependent Variable

	Dep. var.: Indicator for a highway built in the tract				
	(1)	(2)	(3)	(4)	(5)
Black share	0.902[a]	0.753[a]	0.707[a]	0.701[b]	0.669[b]
	(0.271)	(0.264)	(0.264)	(0.273)	(0.273)
Buffer	0 mts.	25 mts.	50 mts.	75 mts.	100 mts.
Mean dep. var.	0.218	0.244	0.254	0.260	0.264
Observations	16,944	16,944	16,944	16,944	16,944
R^2 (Adj.d)	0.242	0.246	0.245	0.244	0.244

Note: Each column corresponds to a different regression. The unit of observation is a census tract. Column (1) is the main estimate. Columns (2) - (5) treat as receiving a highway those tracts within 25, 50, 75, and 100 meters of a future development. Each column controls for the (log) median rent, home value, and income of the tract, the share of adults with a high school diploma, if a highway was planned in the tract, the (log) average slope and area of the tract, the distance to the nearest river and railroad, and state variables such as political affiliation of the governor and number of cars per 10k inhabitants. Each observation is weighted by the tract's total population. Standard errors are clustered at the city level.

Table C.8: Robustness to Different Standard Errors

	Dep. var.: Indicator for a highway built in the tract						
	Clustering			Spatial correlation			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Black share	0.902[a]	0.902[a]	0.902[a]	0.902[a]	0.902[a]	0.902[a]	0.902[a]
	(0.271)	(0.245)	(0.212)	(0.240)	(0.247)	(0.261)	(0.288)
Standard errors	1950 MSA	State	1950 CTs	2 km	5 km	10 km	100 km

Note: Each column corresponds to a different regression. The unit of observation is a census tract. Each column controls for the (log) median rent, home value, and income of the tract, the share of adults with a high school diploma, if a highway was planned in the tract, the (log) average slope and area of the tract, the distance to the nearest river and railroad, and state variables such as political affiliation of the governor and number of cars per 10k inhabitants. Each observation is weighted by the tract's total population.

Table C.9: Neighboring White Share

	Dependent variable:		
	$\mathbb{I}$(Highway built in the tract)		
	(1)	(2)	(3)
Black share	0.902[a]	0.827[a]	1.582[a]
	(0.271)	(0.268)	(0.553)
Neighboring White share		5.970[a]	6.878[a]
		(1.872)	(1.953)
Black share ×			-40.979[c]
Neighboring White share			(21.798)
Mean Dep. Var.	0.218	0.218	0.218
Std. Dev. Black share	0.020	0.020	0.020
Std. Dev. White share	0.007	0.007	0.007
Observations	16,944	16,935	16,935
R^2 (Adj.d)	0.242	0.244	0.245

Note: Each column corresponds to a different regression. The unit of observation is a census tract. The dependent variable is an indicator variable that equals one if a highway was built through the tract. The neighboring White share corresponds to the mean value of White share among neighboring tracts. Each column controls for the (log) median rent, home value, and income of the tract, the share of adults with a high school diploma, if a highway was planned in the tract, the (log) average slope and area of the tract, the distance to the nearest river and railroad, and state variables such as political affiliation of the governor and number of cars per 10k inhabitants. Each observation is weighted by the tract's total population. Standard errors are clustered at the city level.

Table C.10: Event Study: Summary Statistics Matched Sample

	All	Treated	Control	p-val
Total population	4,270.98	4,336.06	4,205.90	0.178
	(3,060.03)	(3,200.57)	(2,912.06)	
Total white population	3,476.21	3,568.91	3,383.51	0.019
	(2,499.01)	(2,523.72)	(2,471.20)	
Total Black population	767.26	744.05	790.48	0.459
	(1,985.47)	(1,977.09)	(1,994.04)	
Distance to city center	10.62	10.63	10.62	0.979
	(8.49)	(8.27)	(8.70)	
Total housing units	1,378.38	1,388.63	1,368.13	0.517
	(999.91)	(1,035.92)	(962.70)	
Median home value	88,352.20	85,655.18	90,997.48	0.000
	(33,588.46)	(30,996.69)	(35,760.63)	
Median rent	469.41	473.81	465.01	0.139
	(188.55)	(185.15)	(191.84)	
Median income	36,795.86	36,650.32	36,941.39	0.576
	(16,454.76)	(16,350.57)	(16,561.10)	
Observations	4,006	2,003	2,003	

Note: Each observation is a census tract in the year before the event. The sample includes 42 cities in the US. Column 4 corresponds to the p-value of a mean comparison test with unequal variances.