Building Inequality: The Permanence of Infrastructure and the Limits of Democratic Representation

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Abstract

Past research has shown that improving democratic representation leads to more equal distribution of resources. However, we show that responsiveness to democratization depends substantially on public policies’ “stickiness.” While some policies such as social welfare spending are persistent primarily due to entrenched special interests, physical infrastructure is by nature unresponsive to changes at the ballot box. We test these claims using data on US highway construction, exploiting 1960s Supreme Court rulings that outlawed state legislative malapportionment. Drawing upon an original database of highways built between 1934 and 2011, we find that state governments invested more in highways in overrepresented counties between 1934 and 1960, and these investments persisted even after the Court-mandated equalization. States also continued to send more highway money to previously overrepresented counties, even as they balanced per capita spending in other categories. Infrastructures inherent durability prevents translation of improved representation into more equitable public spending.
1 Introduction

When does democratization yield more equal distribution of resources? The American constitutional revolution of the 1960s has been widely understood as a moment when voters’ voice at the ballot box promised a more egalitarian distribution of public spending. A series of Supreme Court decisions established the standard of “one person, one vote” in the apportionment of seats in state legislatures and Congress, beginning with the landmark *Baker v. Carr* (1962).\(^1\) Previous scholars have found great salutary effects associated with the equalization of Americans’ voting power at the ballot box (Ansolabehere, Gerber and Snyder, 2002; Ansolabehere and Snyder, 2008). In the words of the most important of these studies, “Apportionment of legislative seats determines the distribution of political power in legislatures and the resulting allocation of government resources” (Ansolabehere, Gerber and Snyder, 2002: 776).

Yet the American distributive politics literature has not fully addressed a critical obstacle to the translation of votes into legislative representation into more equitable distribution of resources: some distributive policies that were adopted under non-democratic regimes are persistent by nature, while others are more amenable to reform. Lumping diverse categories of spending together, the distributive politics literature has not addressed the extent to which the “irreversibility” (Diaz-Cayeros, Estévez and Magaloni, 2012) of public policies affects how effectively voters can use the ballot box to translate their preferences into the attainment of important local public goods. While some goods and policies delivered by reelection-seeking politicians (Mayhew, 1974) are short-lived, others are, by their very

\(^1\)The initial decision in *Baker v. Carr*, the Supreme Court’s first intervention into legislative districting, was the first of a series of cases establishing the one-person, one-vote standard. *Baker* established that the topic was justiciable, while *Reynolds v. Sims* (1964), a case filed by Birmingham, Alabama, was the first in which the Court laid out a national one-person, one-vote standard for all state legislative districts. *Wesberry v. Sanders* (1964) applied the one-person, one-vote standard to Congressional districts.
nature, difficult or impossible to change or reverse.

We focus on the problematic democratic consequences of a set of permanent or semi-permanent public policies that have previously figured primarily in the study of legislative distributive politics: investments in infrastructure. Bridges, dams, levees, subway lines, military bases, and highways are expected to last well beyond the political careers of the politicians who support them. Once built, such projects crowd out other opportunities for local public investment and limit the set of alternatives available to future policy makers. As a result, many of the dilemmas that face politicians looking to “credibly commit” or “lock in” policies are not present to the same degree (or sometimes at all) when it comes to the construction of infrastructure projects. Moreover, once built, they become a fixed asset of the state, often for decades to come. Yet their presence and persistence often owes more to the decisions of previous generations than the present-day needs and demands of constituents.

The case study that we use throughout the paper is the American federal-aid highway system. This network of roads, built and maintained by state governments with generous federal aid, is most often used by political scientists in quantitative case studies of Congressional pork-barreling (e.g., Lee 2003; Evans 1994). While this scholarship has yielded valuable findings about the internal distribution of benefits within Congress, it has devoted less attention to the overall policy implications and welfare gains among the public at large, particularly over the long term. Unsurprisingly, then, the literature has largely overlooked a key fact governing transportation policy: the existing stock of infrastructure, a physical manifestation of the status quo transportation policy, substantially eclipses the additional mileage (flow)

\(^2\)Such studies often capitalize on relatively small, but discretionary, line items such as so-called “demonstration” projects, that constitute only a small share of a total highway bill, even though formulas explain most of the variance in federal highway spending. Additionally, state bureaucracies have much more say in where highways are built than do members of Congress (Arnold, 1979: 79-80).
built in any given year.

We examine the persistence of American highway investments in the context of a historical “natural experiment” that has previously been leveraged to assess how changes in state legislation have shaped the geographic distribution of public goods: the Warren Court’s rulings, starting with *Baker v. Carr* (1962), that the Constitution requires one-person, one-vote apportionment of seats in legislative and Congressional elections. How much did prior state legislative malapportionment bias where states built highways? And have inequalities in highway-related outcomes—including the distribution of highway mileage, road surface quality, and road spending—changed meaningfully in the post-*Baker* era? To answer these questions, we draw upon an original database of US-numbered and Interstate highways built between 1934 and 2011, assembled from issues of the Rand McNally Road Atlas. Like previous scholars, we show that voter representation in legislatures influenced distribution of public benefits. Holding other important factors equal, counties with better representation got more highway mileage per capita than those with worse representation.

More significantly for our theory, we show that pre-*Baker* malapportionment continues to predict the distribution of highway mileage for decades after *Baker*. Counties that had better representation before *Baker* also continued to enjoy disproportionate state highway transfer spending post-*Baker*, even as these counties got a smaller share of state transfers in other, less permanent forms of social spending (for example, education and public welfare). These findings suggest a more pessimistic view of improved representation than appears in prior work on the topic: it is difficult to reverse biases in capital stock built during an undemocratic era.
2 Policy Irreversibility and the Politics of American Highway Spending

Two factors contribute to a set of expectations regarding the persistence of highways and the relative distribution of highway mileage and spending among US counties. The first is infrastructure’s physical nature and its implications. The second is the historical fact that most highway mileage occurred during a period of legislative malapportionment. We expect that these two facts should influence a host of outcomes, including the future distribution of highway mileage and expenditures.

2.1 The Irreversibility of Infrastructure

The most obvious factor that sets infrastructure apart is its physical permanence: large, fixed infrastructure is costly to build, is difficult and costly to remove once built, and requires ongoing maintenance. Infrastructure is usually built with the expectation that it will depreciate slowly and will persist indefinitely (at least with respect to a politician’s electoral incentives) and be maintained and improved over time. Ferejohn (1974) notes, for example, that the Army Corps of Engineers “utilizes project lifetimes of one hundred years” when calculating the costs and benefits of its projects (28). Programs to remove highways prove controversial and costly, as evidenced by Boston’s Big Dig project, which replaced Boston’s elevated Central Artery expressway and other roads with new tunnels and bridges at a total cost of $14.6 billion, exceeding initial estimates by approximately 200% (Lewis and Murphy, 2003; Stern, 2003). Meanwhile, regardless of their own policy preferences, elected officials face pressure to be good stewards of existing infrastructure. Even if a politician preferred to remove or destroy infrastructure, the sunk-cost fallacy may dissuade him or her from doing so, and the feasibility of doing so may depend substantially on the concentration and organization of both supporters and opponents, as well as the geographic distribution of those who stand to gain or lose (Ferejohn, 1974: 53).
The second mechanism is *policy feedback*: infrastructure gives rise to new politics, which results in new policies (Pierson, 1993). When a policy is adopted, new interest groups, usually consisting of direct and indirect program beneficiaries, develop and influence policy. For example, road builders, truckers, and other “Road Gang” interests have had considerable influence over highway legislation, and also owe their existence and economic power to previous decisions to build an extensive highway network that undergirds their industries (Rose, 1990: 88). Moreover, mass motorization among most everyone except poor and urban Americans means that public support for highways and road improvements is nearly universal (Pucher and Renne, 2003).

Beyond the typical programmatic politics associated with highways as a government spending program, infrastructure can also reconfigure politics through *spatial policy feedback*, influencing where people live, and reconfiguring the political geography of interests (Nall, 2015). A similar phenomenon has been observed in railroads’ long-term effect on the geographic distribution of economic development (Jedwab and Moradi, 2015). Interstate highways not only facilitated suburbanization (Baum-Snow, 2007), but ensured that a growing, affluent population would live in sprawling areas dependent on Interstate highways. Building highways induces more traffic, which in turn induces greater use of roads (Duranton and Turner, 2009), as well as greater demands for road improvements. Such demands become geographically focused where roads were built to begin with.

Support for infrastructure stems from network externalities and dependencies, as well. As highways develop, driving becomes a more preferred means of travel, as people choose automobile transportation over walking, rail, and other forms of transportation. Infrastructure becomes the lattice-work upon which society organizes itself geographically. This is a strong source of persistence, and compounds the usual sources of program persistence resulting from beneficiary demands and interest-group influence.

To the extent that distributive politics scholarship has addressed the question of policy durability, the
question has commonly been framed in terms of the strategic behavior of politicians determining how to tie the hands of successors. Crain and Oakley (1995), for example, examine the choice between investment in public capital stocks and consumption-oriented goods, concluding that risk-averse politicians expecting future political volatility are more likely to devote resources to capital investment, knowing that such investments will be irreversible. More recently, Callander and Raiha (2014) have formalized the durability of infrastructure and its consequences for present decisions. They develop a formal model in which myopic politicians collectively make poor decisions, and note that the persistence of infrastructure introduces path dependencies and has long-range effects that have seldom been addressed in the literature. But while this literature commonly deals with the choices that politicians make over types of public spending and investment, it seldom examines empirically whether such investments do, in fact, tie the hands of successors.

2.2 Inequalities in the Design of the American Highway Program

A second set of factors, specific to highway politics in the United States, suggests which policies will persist in the American case: those that favored overrepresented, primarily rural areas at the expense of underrepresented urban areas. The foundation of the American highway system was laid pre-Baker under the influence of pro-rural biases in Congress and state legislatures. At least until the 1960s, longstanding debates over the proper role of the federal and state government spending on infrastructure (Larson, 2001) were typically settled in favor of rural interests and state oversight, circumventing both urban investment and federal centralization (Weingast and Wallis, 2005). A formula-based federal matching program, first adopted under the Federal-Aid Road Act of 1916 and maintained in modified form ever since, established a longstanding three-part formula for distribution of funds to states: one-third based on the state’s proportion of US land area, one-third based on the proportion of its postal “star” routes (i.e.,
contracted rural routes), and one-third based on its population (Federal-Aid Road Act of 1916). Thus, two criteria other than population, which favored rural areas, dictated most of the highway funding.\textsuperscript{3} Even as the American population urbanized in the first half of the century, Congress maintained the matching-formula system, modifying the formulas only slightly in ensuing decades.

In addition to the anti-urban bias inherent in the 1916 formula, early legislation contained stipulations that were explicitly hostile toward cities. Until the Federal Aid Highway Act of 1944, Congress prohibited states from using federal funds to build roads in incorporated municipalities with 2,500 residents or more. Not until the Federal-Aid Highway Act of 1956, under which the federal government covered 90\% of the cost of new Interstate highways, including those serving major cities, did the federal government seriously commit to a massive investment in both urban and rural transportation.

By delegating to the states, Congress accepted, and perhaps encouraged, malapportioned state legislatures’ influence over the distribution of federal-aid highway funds, deliberately inviting inequalities in the per capita distribution of infrastructure.\textsuperscript{4} State governments contributed to anti-urban bias in highway programs as well. As a result, even residents of states that were advantaged under the federal funding formulas nevertheless may have been disadvantaged in two other respects. While state highway departments had substantial discretion over roadbuilding, and adopted a technical approach when deciding where to locate highways, state legislators had both direct control (approving specific routes) and indirect control (power of the purse) over the highway officials’ actions. Thus, state legislative malapportionment would have compounded already biased federal policies that limited states’ freedom of action to develop their urban areas, while promoting the biases within state legislatures.

\textsuperscript{3}Because legislation goes through both houses of Congress, even now legislation may be expected to deliver benefits to a majority of states, or even a majority of US congressional districts, rather than to a majority of the US population (Lee, 1998).

\textsuperscript{4}This use of federalism to permit discriminatory policies has a long history in other settings, including in many New Deal programs (Mettler, 1998; Katznelson, 2013).
3 Hypotheses

The preceding facts give rise to two hypotheses, related to the stock of highway mileage and the flow of highway spending, respectively. First, we expect to find that pre-Baker malapportionment in state legislatures lead to an unequal distribution of highway mileage, and that such inequalities persisted even after equalization of state legislative districts. The first part of this hypothesis aligns with previous work that has found evidence of biased government allocations as a result of malapportionment (Ansolabehere, Gerber and Snyder, 2002). Yet this work also found that legislative equalization rectified such biases. We do not expect this to be the case for the American highway system and other types of infrastructure. Not only may areas where roads were initially built be the locus of construction and maintenance in the future (as suggested by path-dependence scholarship), but the US and Interstate systems were largely completed by 1970. Thus, we expect that the pre-Baker biases persisted for decades, even into the 21st century.

We also expect that these effects will vary by region. Much of the attention to legislative malapportionment and its consequences has focused on its effects in two intersecting settings: urban areas and the South. Although state legislatures in the South were no more malapportioned than legislatures in the rest of the country, the region combined racial disfranchisement with pro-rural malapportionment in a way that favored white supremacist interests and led to the dominance of rural Southern whites in both congressional committees and state legislatures (Katzenelson, 2013; Farhang and Katzenelson, 2005). On these grounds alone, we would expect legislative malapportionment to have different effects in the South than elsewhere.\textsuperscript{5}

\textsuperscript{5}The variance in the county-level log Relative Representation Index across the years 1930 to 1960 was smaller in the South than elsewhere (0.33 versus 0.36), indicating that the average spread between overrepresented and underrepresented districts was no larger in the region, despite the region’s notoriety. At the same time, the overall lack of development in the
Our second hypothesis relates to the flow of new highway money after Baker. We expect that new highway funding will be distributed according to the preexisting distribution of highway mileage, thereby leading previously overrepresented places to continue to receive a disproportionate share of funding after legislative district equalization. By supporting new road traffic, highways lead to significant demands for new highways and ongoing highway maintenance, which politicians can only defer up to a point. By contrast, educational and social welfare programs are much more responsive to democratic reforms, as obstacles to changed policy are more likely to be rooted in political and social arrangements rather than physically permanent infrastructure stock.

Note that both of our hypotheses adopt population as a benchmark for biased distribution. That is, we expect that more equitable per capita distribution of legislative seats will lead to more equal per capita distribution of goods. In adopting population as our benchmark, we are implicitly accepting the normative standard that highway mileage or highway spending should be distributed accordingly. Population is the most readily available and easily comparable benchmark across time periods. While other, seemingly germane technical criteria such as gasoline consumption and motor vehicle registrations may be more plausible measures of demand for automobiles, they tend to be highly correlated with population, such that “the operational difference between these standards is minimal” (Burch, 1962: 112).6

Adopting population as a benchmark also comes with the assumption that the underlying preferences for highway spending are constant across different groups of voters. In our analyses, we address this by introducing covariates that capture such heterogeneous preferences and by running our analyses in post-war, pre-Baker period allowed infrastructure development to proceed at a different pace, and under different constraints, than in other regions.

There is a normative reason to rely on population, as well. Indicators of automobile-related consumption may capture affluence as much as they capture preferences for roads.
separate subsets (urban versus rural and Southern versus Non-Southern counties). Within each of these categories, we expect less heterogeneity in transportation-related preferences. However, the assumption of uniform support for highway spending is not all that extreme. In the widely used spending-preference measures on the General Social Survey, urban residents (who are commonly thought to dislike highways) are barely less likely to support highway construction than suburban and rural residents. Between 1984 and 2008, only 10% of urban residents, 10% of suburban residents, and 7% of rural residents said that “too much” money was being spent on “highways and bridges” (General Social Survey, 2008). Only in the boroughs of New York City does a majority of commuters use means other than driving to get to work (Census 2000).

4 Persistent Inequality in the Distribution of Highway Mileage

To examine the effects of malapportionment on the distribution of highway mileage (our first hypothesis), we carry out two sets of analyses. We first examine the contemporaneous effects of malapportionment in the pre-Baker era (1934-1960 in our data) using an approach similar to that in Ansolabehere, Gerber and Snyder (2002). We then examine the long-term effects of malapportionment (1970 to the present), demonstrating that the major legislative reforms of the 1960s did little to rectify the biases in highway construction that were established before Baker.

4.1 Data and Measurement

Following prior work on legislative malapportionment and public goods provision, we measure our two key variables—state legislative representation and highway bias—at the county level.\textsuperscript{7} A major ad-

\textsuperscript{7}Other works that adopt counties as the unit of analysis include Ansolabehere and Snyder (2008), Ansolabehere, Gerber and Snyder (2002), Reeves (2011), and Nall (2015).
The advantage of using counties is that county boundaries were stable for most of the 20th century, allowing for longitudinal analyses without added assumptions. We assemble our data as a panel, which ranges between years 1934 and 2011 for a total of 26,702 observations.\(^8\)

To construct our outcome variable (highway mileage bias), we assembled an original dataset on the evolution of the US highway system over the last 80 years. Specifically, we started with an electronic present-day GIS map of US-numbered and Interstate highways as a reference, and reconstructed the history of each segment of this map using decennial Rand McNally Road Atlases, physical highway maps that provide excellent national data on the location and quality of roads.\(^9\) This allows us to measure total highway mileage in all US counties. We also record the class of road (whether it was a state-signed, US-numbered, or Interstate highway) and the quality of the road (following Rand McNally classifications). Figure 1 displays the expansion of highways by class and quality over time in the United States.\(^10\)

Using this dataset, we code \textit{bias} in highway mileage. For each county \(i\) in state \(s[i]\) in year \(t\) we compute

\[
\text{bias}_{it} = \frac{\text{highway}_{it}/\text{highway}_{s[i]t}}{\text{population}_{it}/\text{population}_{s[i]t}}
\]

where \text{highway} denotes total highway mileage and \text{population} denotes population size. The numerator represents a county’s share of its state’s total highway mileage, while the denominator represents its share of the state’s total population. Counties with a greater share of highway mileage than their state population would justify receive a score above 1, while counties with a lower share of highway mileage would receive a score below 1.

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\(^9\)Our approach mirrors that taken by Burgess et al. (2015), who use historical Michelin maps of Kenya for the same purpose. This matching approach enables us to standardize a single route map over time and create a more extensive and less error-prone map than if we had attempted to exactly trace each of the line segments found on historical maps for each year.

\(^10\)See the Online Appendix for additional information about how we constructed the highway GIS database and the road categories used for each year.
than their share of population would justify receive a score below 1. For example, a county with half of its state’s highway mileage but only a quarter of its population would receive a score of 2, indicating that it has twice as much highway mileage as its population would justify. We log-transform this variable so that scores are centered at zero.

As our explanatory variable, we use the Relative Representation Index (RRI) reported in David and Eisenberg (1961), the most widely used indicator of legislative malapportionment covering the pre-Baker period (Ansolabehere, Gerber and Snyder, 2002; Ansolabehere and Snyder, 2008). This measure tells us
how over- or underrepresented a county is in the state legislature, relative to a baseline value of 1.\textsuperscript{11} A county with twice as much representation as its population justifies receives a score of 2, and a county with half as many people as its representation justifies receives a score of 0.5. This measure is available for each county in the United States for the years 1910, 1930, 1950, and 1960. For our analysis, we use only the scores for 1930, 1950, and 1960, years that coincide with those in our study. We again log-transform the variable so that scores are centered at zero, with larger positive scores indicating greater overrepresentation, and larger negative scores indicating greater underrepresentation.

Lastly, while our two key measures have no missing values, some of our covariates (discussed below) do. These missing values would result in 10-15\% of our rows being deleted depending on the analysis. To mitigate potential biases associated with values that are conditionally missing at random, we multiply impute five datasets using Amelia II software, allowing for time trends in the data to improve the imputations (Honaker and King, 2010; Honaker, King and Blackwell, 2011). We use these data for all of our analyses.\textsuperscript{12}

\section*{4.2 Methods}

We estimate relative representation’s effect on our data using two sets of regression models. First, we test the contemporaneous effect of malapportionment on the distribution of highways in the pre-\textit{Baker} era using a panel OLS setup with county and decade fixed effects:

\[ bias_{it} = \beta (RRI_{it}) + \gamma_i + \delta_t + X'_{it}\theta + \epsilon_{it} \]  

(1)

where \( bias_{it} \) is our highway-mileage bias measure in county \( i \) in year \( t \), \( \gamma_i \) captures county-level fixed effects, \( \delta_t \) represents decade-specific fixed effects, and \( RRI_{it} \) is the Relative Representation Index de-

\textsuperscript{11}David and Eisenberg (1961) use a baseline value of 100, which we rescale.

\textsuperscript{12}The results are similar if we do not multiply impute missing values.
scribed above for county \( i \) at time \( t \). Including county-level fixed effects allows us to estimate the over-time effect of legislative representation within each county. Among the factors accounted for in the county-level fixed effects is the county’s land area. Year fixed effects account for differences in the atlases’ coding of different types of highways in each year, as well as any other decade-to-decade uniform shocks in the distribution or labeling of highways in the atlases. We include in \( X \) a set of time-varying covariates: median income, population size, the percentage Democrat (based on results of the most proximate presidential elections), percentage black, percentage above age 65, percentage living in poverty, percentage in school, and percentage unemployed. For all analyses, we employ clustered standard errors (Arellano, 1987; Hothorn et al., 2014).

Our second modeling approach estimates the long-term effects of malapportionment using a cross-sectional OLS setup with state fixed effects:

\[
\text{bias}_{i}^{\text{post-Baker}} = \alpha_{s[i]} + \beta (\text{RRI}_{i}^{\text{pre-Baker}}) + X'_{i} \theta + \epsilon_{i}
\]

where \( i \) indexes counties and \( s \) indexes states. In this set of models, we average our measure of malapportionment (represented by \( \text{RRI}_{i}^{\text{pre-Baker}} \)) over the pre-Baker decades in our data (1930, 1950, and 1960). The highway bias measure (represented by \( \text{bias}_{i}^{\text{post-Baker}} \)) is measured for one of the post-Baker decades in our data (1970, 1980, 1990, 2000, or 2011). We include in \( X \) a set of county-specific covariates. These include, to begin, two variables that address concerns about demand for highways: the percentage driving to work and the percentage working outside the county (both measured in 1970). We also control for the county’s land area. Lastly, we include a set of demographic covariates: median income, the percentage in manufacturing, percentage black, and percentage urban (all measured in 1950) (Fitch and

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13 We tested several different methods for calculating clustered standard errors. Findings are not sensitive to choice of method.

14 The year 1940 is omitted because it is not reported in David and Eisenberg (1961).
Ruggles, 2003; Leip, 2012). The demographic variables indirectly account for population and overall development levels, two major factors considered when dispersing highway funds, while the race and partisanship variables account for potential racial discrimination or political favoritism in highway placement. Others are included to make these analyses comparable with subsequent analyses that compare state transfer spending on highways versus other goods.

In both sets of analyses, we allow for heterogeneous effects in two ways. First, we run the equations in three different subgroups: for all counties, and for Southern and non-Southern counties. Prior research indicates that the consequences of malapportionment, combined with ongoing black disenfranchisement, were particularly pronounced in Southern states, and in major Southern cities such as Nashville, which acted as an intervening plaintiff in *Baker* (Ansolabehere, Gerber and Snyder, 2002: 767). Second, we run the models separately for each region according to whether or not the county was rural or urban in 1950. We do this because, as Ansolabehere and Snyder (2008) note, increased intergovernmental transfers to previously underrepresented counties benefited urban (and increasingly, growing suburban) areas. Similarly, differences in urban/rural bias may have varied by region.16

Finally, because we are using five multiply imputed datasets (see above), we estimate the coefficients of interest and their standard errors by first generating these estimates for each of the five datasets. We

15We use Census and electoral data from 1950, when feasible, because it offers the richest set of Census covariates from the pre-*Baker* years. For example, to researchers’ chagrin, the Census Bureau never produced a public-use file containing county-level income data for 1960. Using 1950 data also limits the potential for post-treatment bias (Rosenbaum, 1984). In the Online Appendix, we run the same analyses with contemporaneous versions of the same covariates and with more restricted models.

16We define the “South” as states in the South Census region. We define a county as “urban” if its proportion urban under the 1950 Census was in the top quintile nationally, and “rural” if its proportion urban was below the national median (Fitch and Ruggles, 2003).
then combine them using the method recommended by Rubin (1987).

4.3 Results

We begin by examining whether counties with better representation received more highway mileage in the pre-\textit{Baker} era. We find that legislative representation had approximately the same effect on a county’s share of state highway construction, regardless of region and urbanism. Second, and more importantly, we find that pre-\textit{Baker} malapportionment had a persistently significant effect on highway-mileage bias in the decades after \textit{Baker}. We find that representation mattered, but that it was the \textit{timing} of the representation—prior to the construction of most of the American highway network—that dictated the distribution of highway infrastructure for decades to come.

4.3.1 Malapportionment’s Effect on the Distribution of Highways before \textit{Baker}

Figure 2 shows that counties with greater relative representation during the pre-\textit{Baker} period had more highway mileage than their populations would otherwise justify, even after accounting for land area and other time-invariant characteristics (captured by the county fixed effects) as well as a set of time-varying covariates. According to the figure, for every within-county standard-deviation increase in relative representation, highway-mileage bias increased by 0.3 standard deviations in the years 1934-1960 (95% CI: [0.18, 0.42]), and legislative representation’s effects did not vary substantially by region. In the South, a one standard-deviation (within counties in the region) increased highway bias by 0.2 standard deviations (95% CI: [0.03, 0.34]). Outside the South, a similar within-county shift increased highway bias by 0.38 standard deviations (95% CI: [0.19, 0.57]). Similarly large effects were observed within urban and rural subgroups. Representation in state legislatures is a robust positive predictor of highway construction in the pre-\textit{Baker} era, regardless of region and urbanism.
Figure 2: Representation vs. bias in highway mileage by region and urbanization, 1934-1960

Note: The figure shows that legislative representation is a strong positive predictor of highway bias. Each coefficient (with 95% confidence intervals) shows how much of a within-county standard-deviation change in highway bias is expected given a within-county standard-deviation increase in relative representation. Within-county standard deviations were calculated by averaging over the standard deviation changes in each county over the time period.

4.3.2 Malapportionment’s Long-Term Effect on the Distribution of Highways

The first indication of malapportionment’s effects in the post-\textit{Baker} period appears in Figure 3, a visual cross-tabulation of the relationship between pre- and post-\textit{Baker} highway-mileage bias. Across all areas, counties with high relative representation (above the median) received a disproportionate share of highway mileage. This was especially the case in the urban South, where high-RRI counties gained a steadily growing and disproportionate share of highway mileage from 1970-2011, while previously low-RRI counties languished. Urban areas outside the South do not appear to have derived nearly as much long-term benefit from greater representation. Unsurprisingly given what we know about federal highway policy, rural areas enjoyed large malapportionment-driven advantages in both the South and non-South, regardless of their representation levels. Even in rural areas, however, higher pre-\textit{Baker} relative representation was still associated with more mileage per capita across all time periods. Thus, the
differences do not appear to have been driven only by the urban-rural gap.

Figure 3: Pre-Baker representation and highway-mileage bias, 1934-2011

Note: We plot the mean of the (unlogged) highway bias measure, by region, urbanization, year, and high vs. low representation. We define high representation counties (solid line) as those that had an above-median score on the Relative Representation Index (RRI) in the pre-Baker era (relative to other counties in the same region and with the same level of urbanization). Low representation counties (dashed line) had a below-median RRI score. The graph excludes a few outliers (counties with a land area or highway bias above the 99th percentile). 95% confidence intervals are in transparent gray.

Figure 4 shows that these differences are a result of counties’ pre-Baker state legislative representa-
tion. In the regressions, which are based on Equation 2, we compare the effect of a one-SD increase in RRI on the standard deviations of the log of highway bias. We do so both for the country at large and for different regions and at different levels of urbanization.

**Figure 4: Post-Baker highway-mileage bias vs. pre-Baker relative representation**

Note: The coefficients (with 95% CIs) represent the implied effect of a one standard deviation increase in pre-Baker RRI (averaged between 1930 and 1960) on the standard deviation of the log of highway bias for each post-Baker decade in our data. The regression model includes all the controls in Equation 2 as described in the text.

The figure demonstrates a substantively meaningful initial effect of RRI, which decays only slightly over the ensuing 50 years. After accounting for a county’s land area, the percentage of the population driving to work, the percentage working outside the county, and a host of demographic covariates, a one-SD increase in pre-Baker malapportionment led to a 0.15 standard deviation increase in highway mileage bias in the post-Baker period (on average across all counties). Effects of similar magnitude were observed in both regions, and they were higher among urban areas. While the effects of representation on highway-mileage bias are not statistically significant in all four strata of counties, we find no evidence that highway bias has faded meaningfully over time.

Our results would seem to affirm what is widely known: that stocks of infrastructure, once built, are persistent, and as road systems are completed, there are few changes in mileage. An alternative approach
is to measure the effects of prior representation only on the flow of new highway mileage into counties. To compensate for prior inequalities in highway provision, the distribution of new mileage would need to offset prior bias, a challenging proposition from the standpoint of public policy.

Unsurprisingly, new highway mileage built after *Baker* was not distributed in accordance with pre-*Baker* malapportionment. Much of the new highway mileage built during the post-Baker period consisted of new four-lane roads and Interstate highways. These differed in key respects from previous road projects, the most important difference being that the overall plan for the Interstate system was developed jointly by the federal Bureau of Public Roads working in consultation with state highway officials. The entire network was planned in advance, and routes were justified in terms of their technical benefits. Despite this, bias remained in the overall provision of Interstate and four-lane roads post-Baker. Low-RRI counties received a disproportionately small share of Interstate mileage, and this held true across urban and rural, Southern and non-Southern counties (see Online Appendix).

5 Persistent Inequality in State Highway Spending

We now turn to an analysis of the flow of transportation spending to counties. Because ongoing transportation spending will focus on maintenance and expansion of preexisting infrastructure, we expect new spending to also be biased in favor of counties that originally enjoyed advantages under malapportionment. By contrast, we do not expect such persistent bias in fiscal transfer categories such as education and public welfare, which should be more responsive to changes in representation than investments in highway infrastructure.

State formulas determining highway transfer funds have advantaged rural areas over urban areas, with varying severity. In some states, highway funds have been assigned equally among counties, which has no real basis in local road needs. States have also distributed funding to counties on the basis of
area, even though it “has little or no value as an index for the equal apportionment of highway funds,” since land area is only weakly related to traffic and mileage (Burch, 1962: 119). Finally, some states appropriate funds on the basis of existing road mileage. While this may seem to be a fair indicator of road needs, it ensures that rural areas with lightly traveled roads get funding at the expense of more populated areas (Burch, 1962: 119). In 1959, for example, half of state highway aid to Tennessee counties was distributed on an equal basis, 25% by area, and only 25% by population, guaranteeing that rural counties would receive excess funding (Federal Highway Administration, 1960), while limited aid to city governments was distributed among them on a population basis, a fact that Nashville Mayor Ben West lamented in his public campaign for legislative reapportionment (Ansolabehere and Snyder, 2008: 127). Yet Tennessee’s funding formulas remained on the books in 1973, some 11 years after Baker (Federal Highway Administration, 1973).

5.1 Data and Measurement

We examine the distribution of intergovernmental transfers from state governments to local governments. Such transfers have been the basis of prior studies on the distribution of public spending, including Ansolabehere, Gerber and Snyder (2002), who use total intergovernmental transfers to study the effects of improved representation.

Our measures of spending on infrastructure and social policy come from the Census of Governments itemized data on intergovernmental transfers to all governments within county areas between 1972 and 2002 (U.S. Department of Commerce, Bureau of the Census, 2008).17 The most important item is the

---

17This includes county governments, corporative municipalities, and special-purpose governments such as school districts. While the Census of Governments has been used in distributive politics research on state transfers to local governments, itemized numbers are not available prior to 1972.
amount that states transfer to county areas for highways. This spending encompassed local road repair, new road construction, and road maintenance. We compare these data against expenditures in two other categories: public welfare and education. These other funding categories typically take the form of transfers to local institutions proportional to the number of program beneficiaries, such as the number of students in a school district with subsidized meals. With data itemized in this manner, we can test our claims that policy type matters to the distribution of goods.

5.2 Methods

As our outcome variable, we apply the same logged bias measure that we generated for highway mileage (Equation 4.1) to state transfer spending. Centered at zero, this measure captures the extent to which a county received more or fewer per capita transfers than its population share would justify. As before, our explanatory variable is logged average pre-Baker RRI. Because our data are available exclusively from the post-Baker period, we average the pre-Baker RRI from 1930, 1950, and 1960.

We again conduct regressions following Equation 2, a least-squares regression with state fixed effects. As controls, we include in all models several variables that account for demand for particular types of goods and services, or that may otherwise predict biases in state transfers. These include land area and the percentage working outside the county, the percentage of commuters who drive to work, median income, the percentage employed in manufacturing, the percentage Democrat (based on results of the most proximate presidential elections), the percentage urban, percentage in school, and percentage in poverty. Data on land area, the percentage working outside the county, and the percentage who drive to work all account for factors other than population that may increase demand for highway spending. The other variables account for factors that may lead to demand for education and social welfare services. While the latter are not directly applicable to highway spending, and the former do not apply directly to social
welfare spending, we include all variables in the models. When possible, we used variables measured before 1960 to avoid post-treatment bias that could result from using contemporaneous controls.\textsuperscript{18} We run this model separately for each spending category and each post-\textit{Baker} year in our data, 1972-2002 at five-year intervals.\textsuperscript{19}

5.3 Results

Figure 5 contrasts transfer spending for highways versus education and public welfare, two major spending categories that may be more responsive to changes in representation. After \textit{Baker}, previously overrepresented counties continued to receive a larger share of highway transfers from state governments than their population share would justify, even after accounting for a number of confounding factors. By contrast, previously overrepresented counties received less state funding for education and public welfare, other factors being equal. Across all counties, an increase in relative representation of one standard deviation coincided with approximately a 0.1 standard deviation increase in a state’s highway transfer funding across the entire post-\textit{Baker} period.

These results imply that state governments did not actively attempt to make up for the biases in highway construction established before \textit{Baker} by transferring a larger share of highway funds to previously underrepresented counties. Meanwhile, transfers for education and public welfare have not been predicted by pre-\textit{Baker} representation. While we do not have data on pre-\textit{Baker} itemized transfers, this result is consistent with our hypothesis, as social policies are more reversible by nature and therefore should be more responsive to changes in representation. It also explains why previous scholars have

\textsuperscript{18}We report the results of additional models in the Online Appendix. Unfortunately, data on workers’ means of transportation to work and whether workers worked outside their county of residence are not available prior to 1970.

\textsuperscript{19}We again use five multiply imputed datasets to account for missing values. We first estimate coefficients and standard errors separately for each dataset. We then combine these estimates using the methods recommended in Rubin (1987).
Figure 5: Pre-\textit{Baker} representation vs. post-\textit{Baker} bias in state transfers to county areas

Note: The coefficients (with 95\% CIs) represent the implied effect of a one standard deviation increase in pre-\textit{Baker} RRI on the standard deviation of the logged bias measure for each post-\textit{Baker} year in our data. The regression model includes all controls discussed in the text.

found improved equality in transfer spending before and after \textit{Baker}, even as highway spending has not yet equalized (Ansolabehere, Gerber and Snyder, 2002). Some spending categories are amenable to changes in representation. Others, including those associated with fixed infrastructure, are not.
6 Discussion and Conclusion

Our results empirically confirm a long held, but rarely tested, proposition: some forms of public policy are substantially more durable than others. While scholarship on policy durability has focused primarily on social welfare policies, investments in transportation infrastructure (or a lack thereof) have major consequences for the economic performance of localities and the mobility of their residents. Thus, among the various sources of inequality of social welfare provision in the United States, transportation is a crucial component.

Our results also affirm one of the key findings of the literature on representation and its consequences for policy outcomes: that representation matters, and malapportionment contributes to inequality in the distribution of public goods (Ansolabehere, Gerber and Snyder, 2002). Malapportionment in state legislatures led to lower provision of a vital public good—highway transportation infrastructure—during the primary construction years of the United States federal-aid highway system.

To be sure, by devoting attention to the persistence of infrastructure stock, we may seem to be favoring our claim that changing legislative representation has a minimal effect on the distribution of transportation infrastructure and spending. Indeed, our purpose here is not to show that democratic representation is irrelevant, but to show that the timing of the representation matters dramatically. We affirm the motivating insights in Crain and Oakley (1995): politicians who choose to invest in persistent policies are, in fact, anchoring future policy outcomes, and there appear to be meaningful differences across different classes of spending. American legislators between the 1930s and 1960s had great influence over future American transportation policy. And while subsequent policy makers have gradually adjusted policy to distribute new infrastructure programs more equally on a per capita basis, this has done little to overcome inequalities in the stock of transportation infrastructure.
These findings have implications for work on distributive politics in the US. Highway and transportation infrastructure appears frequently in this literature, precisely because it appears to be easily manipulable by members of Congress and legislatures. Yet this search for sources of variation conceals the substantial stability of infrastructure: the transportation benefits that Americans enjoy in any given year has little to do with year-on-year transportation spending or earmarks. Although annual spending matters for the internal politics of legislatures and Congress, long-term and persistent factors govern “who gets what, when, how” (Lasswell, 1936) in the realm of transportation infrastructure.

A potential source of skepticism of our findings is that there may be substantial heterogeneity in preferences for infrastructure spending, with urban areas opposing new road construction. Of course, people do not always favor construction of valuable public goods, and a subset of constituents may bear great costs from infrastructure projects, seeing them as “public bads” (Aldrich, 2008). We address this concern in two ways. First, we break down our analysis by subgroup, thereby establishing that our findings are not limited to urban areas that reacted negatively to large-highway construction. We also include, where feasible, variables associated with automobile-related demand for highways, such as the proportion of residents working outside the county and the proportion commuting by automobile. Second, by using both highway stock measures and highway transfer data, we account for different measures of highway investment. Even metro areas that oppose additional highway expansion will prefer funding to maintain existing roads and road-related infrastructure. Yet previously underrepresented areas continued to be disadvantaged in this category of spending.

Finally, an important substantive and policy implication of our work is that the current plight of American infrastructure—widely described as a “national infrastructure deficit”—is not a universal phenomenon but represents a long-term legacy of legislative malapportionment and decisions about infrastructure made before cities had equal representation in state legislatures. The poor state of American
infrastructure is not merely a result of overall underinvestment, but stems from a historical legacy of unequal treatment that left some areas (notably cities) with a host of social and economic problems, including underfunded road infrastructure. The inherent irreversibility of some goods can make inequalities in their distribution long-lived and resistant to remedy.
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Online Appendix

A  Summary of the Highway Coding Method

To assemble our historical GIS database of the American highway system, we used the 2013 National Highway Planning Network (NHPN) shapefile of all roads in the United States as a reference (Federal Highway Administration, 2013). The map consists of highway line segments containing information on road type, number of lanes, inclusion on the Strategic Highway Network, and other indicators.\(^\text{20}\) We selected from this shapefile all roads currently marked as US and Interstate highways, the two types of roads that have consistently been identified over time by AASHO and in commercial atlases as the most important highway routes. We then superimposed the NHPN Interstate/US layer on scans of historical road atlas for the years 1934-1935, 1940, 1950, 1960, 1970, 1980, and 1990.

Using ArcGIS, research assistants manually assigned attributes for road quality and type to each of the segments in the NHPN shapefile according to the symbology of the corresponding road in the Rand McNally Road Atlases. We coded for two factors: the class of road (whether it was a state-signed, US, or Interstate highway), and the quality of the road, as reported in the Rand McNally atlases. This approach therefore depends on Rand McNally’s coding scheme for road quality, which varied over time and reflected contemporaneous road-quality standards.\(^\text{21}\)

By 1960, after passage of the Federal-Aid Highway Act of 1956 (which established the Interstates) and expansion of the American freeway systems, the Rand McNally Atlases reported the full present-day hierarchy of road systems, including limited-access toll roads (i.e., turnpikes) and limited-access free

\(^{20}\)Documentation accompanying the file indicates that these data, while released in 2013, were up-to-date as of 2011.

\(^{21}\)In 1934, for example, most American roads had yet to be paved using modern techniques, and many roads were simply “improved” using gravel or other durable non-pavement surfaces.
roads (i.e., freeways). Through 1990, we produced a complete manual coding of these road segments.\textsuperscript{22} In addition to using the data from 2000 and 2011, we primarily relied on the road attribute information provided in NHPN data (Institute, 2001; Federal Highway Administration, 2013), but checked their accuracy by comparing them against national-level Rand McNally maps. The road-quality indicators used in our data for each year appear in Table A-1.

\footnote{Road coding occasionally depended on subjective judgments, so each coder’s work was checked independently multiple times: once by a separate research assistant and at least once by one of the coauthors.}
Table A-1: Summary of road quality indicators used in coding scheme, by year.

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Source</th>
<th>Road-Quality Indicators Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1934-35</td>
<td>Rand McNally Road Atlas</td>
<td>US Highway (Paved)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US Highway (Improved)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>State Highway (Paved)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>State Highway (Improved)</td>
</tr>
<tr>
<td>1940, 1950</td>
<td>Rand McNally Road Atlas</td>
<td>US Highway (Paved, 4+ Lanes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US Highway (Paved, &lt;4 Lanes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>State Highway (Paved, &lt;4 Lanes)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US Highways (Divided)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US Highways (Two-Lane)</td>
</tr>
<tr>
<td>2000</td>
<td>ESRI Database based on 2000 NHPN</td>
<td>Interstate Highways</td>
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<tr>
<td></td>
<td></td>
<td>US Highways (Divided)</td>
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<td></td>
<td></td>
<td>US Highways (Two-Lane)</td>
</tr>
<tr>
<td>2011</td>
<td>NHPN Database</td>
<td>Interstate Highways</td>
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<td>US Highways (Two-Lane)</td>
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B Supplementary Information for Highway Mileage Analyses
Table A-2: Summary Statistics for County Highway-Mileage Panel Data, 1934–2011

<table>
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<tr>
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<th>q₁</th>
<th>̄x</th>
<th>̄x</th>
<th>q₃</th>
<th>Max</th>
<th>s</th>
<th>IQR</th>
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<td>0.0</td>
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<td>3.0</td>
<td>0.3</td>
<td>0.2</td>
<td>0</td>
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<tr>
<td>Log Average RRI, 1930, 1950, 1960</td>
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<td>2.6</td>
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<td>Urban, 1950 (Coarsened)</td>
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<td>1.0</td>
<td>5.9</td>
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<td>20131.0</td>
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<td>30588.6</td>
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<td>38320.1</td>
<td>46072.2</td>
<td>112400.0</td>
<td>12957.1</td>
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<td>Proportion in Mfg.</td>
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<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
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<td>3346197.0</td>
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<td>26666</td>
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<td>10663.0</td>
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<td>33327.0</td>
<td>4063342.0</td>
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<td>10032.0</td>
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<td>9417.0</td>
<td>18497.0</td>
<td>58288.7</td>
<td>39567.0</td>
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<td>30150.0</td>
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<td>Pop., 1970</td>
<td>26666</td>
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<td>6877717.0</td>
<td>227389.9</td>
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<td>22387.0</td>
<td>80368.7</td>
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<td>26026.0</td>
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<td>67810.0</td>
<td>9818605.0</td>
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<td>1.0</td>
<td>0.5</td>
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</tr>
</tbody>
</table>
C Additional Analyses: Bias in Added Highway Mileage

Figure A-1: Post-\textit{Baker} bias in added highway mileage vs. pre-\textit{Baker} relative representation

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figureA1}
\caption{Post-\textit{Baker} bias in added highway mileage vs. pre-\textit{Baker} relative representation}
\end{figure}

\textit{Note:} The coefficients (with 95\% CIs) represent the implied effect of a one standard deviation increase in pre-\textit{Baker} RRI (averaged between 1930 and 1960) on the standard deviation of the log of highway bias for each post-\textit{Baker} decade in our data. The regression model accounts for state fixed effects, land area, per capita income in 1949, the proportion of workers employed in manufacturing jobs, and the percentage of voters casting ballots for the Democratic presidential candidate in 1948.
D Additional Analyses: Bias in Total County Highway Mileage Using Multiply Imputed Covariates

In all of the following figures, the coefficients represent the implied effect of a one standard deviation increase in a county’s log-transformed pre-Baker relative representation index (RRI) on either the pre or post-Baker log-transformed highway mileage bias in standard deviations. The lines above and below the point estimates indicate 95% confidence intervals. The RRI is calculated by dividing the ratio of a county’s seats in the legislature to its population by the ratio of state legislative seats to state population. Highway bias is defined as the fraction of state mileage that existed in the county, divided by the percentage of the state population who resided in the county. In addition to the full sample, some figures present results for counties in the following subgroups: South vs. non-South and urban vs. rural. The US Census definition of “South” is used. Counties are defined as urban if the proportion of residents living in urban areas (according to the Census) is in the top quintile nationally; counties are rural if the proportion urban is below the national median. All analyses with pre-Baker highway mileage as the outcome variable pool county-level data for the years 1934, 1950, and 1960, and include decade and county fixed effects. All analyses with post-Baker highway mileage bias as the outcome variable are cross-sectional for the years 1970, 1980, 1990, 2000, and 2011, and include state fixed effects. Missing covariates were estimated using multiple imputation.

Figures A-7 and A-8 include the same covariates, except that in Figure A-7, the controls are from pre-Baker years (so as to minimize post-treatment bias) or whatever the earliest year is for which data were available; in Figure A-8, the covariates (aside from land area) are from the year closest to the year of interest for which data are available. The covariates are: state fixed effects, land area in 1950, median income in 1949 (the previous year ending in 9), the proportion of workers employed in manu-
Figure A-2: Pre-Baker representation bias vs. pre-Baker (1934-1960) county highway mileage bias controlling for county fixed effects, by region and urban-rural status

facturing jobs in 1950 (the nearest decennial Census year), the percentage of voters casting ballots for the Democratic presidential candidate in 1948 (the previous presidential election, the percentage of residents in who were black and the proportion who lived in urban areas (using the US Census definition of “urban”) in reported in 1950 (the nearest Census), the percentage of workers who worked outside their county reported in 1970 (the nearest Census), and the percentage of commuters who traveled to work in automobiles reported in 1970 (the nearest Census).
Figure A-3: Pre-\textit{Baker} representation bias vs. pre-\textit{Baker} (1934-1960) county highway mileage bias controlling for county fixed effects, population, and \% Democratic vote, by region and urban-rural status

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure_a3}
\caption{Pre-\textit{Baker} representation bias vs. pre-\textit{Baker} (1934-1960) county highway mileage bias controlling for county fixed effects, population, and \% Democratic vote, by region and urban-rural status.}
\end{figure}

\textit{Note:} Additional controls include: county population at the time of the nearest Census, and the percentage of voters who cast ballots for the Democratic candidate in the previous presidential election.

Figure A-4: Pre-\textit{Baker} representation bias vs. pre-\textit{Baker} (1934-1960) county highway mileage bias controlling for county fixed effects, population, and \% Democratic vote, \% black, \% aged 65 and over, \% in school, and \% unemployed, by region and urban-rural status

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure_a4}
\caption{Pre-\textit{Baker} representation bias vs. pre-\textit{Baker} (1934-1960) county highway mileage bias controlling for county fixed effects, population, and \% Democratic vote, \% black, \% aged 65 and over, \% in school, and \% unemployed, by region and urban-rural status.}
\end{figure}

\textit{Note:} Additional controls include: county population at the time of the nearest Census, the percentage of voters who cast ballots for the Democratic candidate in the previous presidential election, and the percentage of the population as of the nearest Census who were black, aged 65 and over, in school, and unemployed.
Figure A-5: Pre-\textit{Baker} representation bias vs. pre-\textit{Baker} (1934-1960) county highway mileage bias controlling for county fixed effects, population, and \% Democratic vote, \% black, \% aged 65 and over, \% in school, \% unemployed, and median income, by region and urban-rural status

\textit{Note:} Additional controls include: county median income in the previous year ending in 9, county population at the time of the nearest Census, the percentage of voters who cast ballots for the Democratic candidate in the previous presidential election, and the percentage of the population as of the nearest Census who were black, aged 65 and over, in school, and unemployed.
Figure A-6: Pre-\textit{Baker} representation bias vs. pre-\textit{Baker} (1934-1960) county highway mileage bias controlling for county fixed effects, population, and \% Democratic vote, \% black, \% aged 65 and over, \% in school, \% unemployed, median income, and \% in poverty, by region and urban-rural status

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure6.png}
\caption{Pre-\textit{Baker} representation bias vs. pre-\textit{Baker} (1934-1960) county highway mileage bias controlling for county fixed effects, population, and \% Democratic vote, \% black, \% aged 65 and over, \% in school, \% unemployed, median income, and \% in poverty, by region and urban-rural status.}
\end{figure}

\textit{Note:} The poverty measure was only available for 1950 and 1960. In 1950, it is defined as the percentage of families whose total 1949 income was below $2,000. In 1960, it is defined as the percentage of families whose total 1959 income was below $3,000.

Figure A-7: Pre-\textit{Baker} representation bias vs. post-\textit{Baker} (1970-2011) county highway mileage bias using pre-\textit{Baker} controls (when possible), by region and urban-rural status

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure7.png}
\caption{Pre-\textit{Baker} representation bias vs. post-\textit{Baker} (1970-2011) county highway mileage bias using pre-\textit{Baker} controls (when possible), by region and urban-rural status.}
\end{figure}
Figure A-8: Pre-Baker representation vs. post-Baker (1970-2011) bias in county highway mileage bias using contemporaneous controls, by region and urban-rural status.
E  Additional Analyses: State Transfers to Counties Using Multiply Imputed Covariates

In Figures A-9 and A-10, coefficients represent the implied effect of a one standard deviation increase in a county’s log-transformed averaged pre-Baker relative representation index (RRI) on post-Baker log-transformed state intergovernmental cash transfer bias in standard deviations. The lines above and below the point estimates indicate 95% confidence intervals. The RRI is calculated by dividing the ratio of a county’s seats in the legislature to its population by the ratio of state legislative seats to state population. We take the average of a county’s RRI for the years 1930, 1950, and 1960. State intergovernmental transfers are moneys given to county governments from the state government. These data come from the Census of Governments, which occur every year ending in 2 and 7. Bias is defined as the amount of money the county receives for the particular item (highways, education, or public welfare), divided by the total amount of state transfers for the item to all counties. Highway bias is defined as the fraction of state mileage that existed in the county, divided by the percentage of the state population who resided in the county. In addition to results for the full sample, results are broken down by South vs. non-South and urban vs. rural status. The US Census definition of “South” is used. Counties are defined as urban if the proportion of residents living in urban areas (according to the Census) is in the top quintile nationally; counties are rural if the proportion urban is below the national median. The analyses include the same covariates, except that in Figure A-9, the controls are from pre-Baker years (so as to minimize post-treatment bias) or whatever the earliest year is for which data were available; in Figure A-10, the covariates (aside from land area) are from the year closest to the year of interest for which data are available. The covariates are: state fixed effects, land area in 1950, median income in 1949 (the previous year ending in 9), the proportion of workers employed in manufacturing jobs in 1950 (the
nearest decennial Census year), the percentage of voters casting ballots for the Democratic presidential
candidate in 1948 (the previous presidential election, the percentage of residents in who were black and
the proportion who lived in urban areas (using the US Census definition of “urban”) in reported in 1950
(the nearest Census), the percentage of workers who worked outside their county reported in 1970 (the
nearest Census), and the percentage of commuters who traveled to work in automobiles reported in 1970
(the nearest Census). Missing covariates were estimated using multiple imputation.

Figure A-9: Pre-Baker representation bias vs. post-Baker (1972-2002) bias in State intergovernmental
revenue transfers to counties for highways, education, and public welfare using pre-Baker controls (when
possible), by region and urban-rural status
Figure A-10: Pre-\textit{Baker} representation vs. post-\textit{Baker} (1970-2011) bias in State intergovernmental revenue transfers to counties for highways, education, and public welfare using contemporaneous controls, by region and urban-rural status.