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. Drawing on a new dataset on 20th century U.S. highway construction—the most extensive infrastructure project in modern history—we show that there are limits to this conclusion. Bias in highway construction that was established in an undemocratic era, before the Supreme Court outlawed legislative malapportionment, is still present today. It comes in the form of unequal distribution of highway mileage, biased highway funding, and uneven road quality. Thus, our results show that the *nature* of a given government resource explains whether improved representation will translate into more equitable distribution of it.

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 translated into 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 governments distribute other goods than those featured in past research. A focus on a subset of resources could bias conclusions about whether and to what extent democratization corrects past biases in resource distribution *in general*. For example, intergovernmental transfers—the resource under study in much previous work—differ from many other government resources in that they usually can be altered substantially from year to year. Furthermore, they may not be subject to the same type of policy feedback that can entrench biases in their distribution. By contrast, policy domains like infrastructure development is characterized by both physical permanence and policy feedback. Initial biases in the distribution of this type of good can persist and even spur additional biases in related policy domains. In short, the *nature*

[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.

of the government resources under study likely influences whether and to what extent biases established under non-democratic regimes are resistant to change.

To test this claim, we assemble a GIS panel dataset on the gradual evolution of US-numbered and Interstate highways (1934-2011). 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 often relies on line items that constitute only a small share of the total highway bill. Additionally, state bureaucracies have much more say in where highways are built than do members of Congress (Arnold, 1979: 79-80). Our new dataset allows us to study U.S. state actors' allocation of actual highway mileage.

We show that malapportionment led to substantial biases in the distribution of highway mileage in the pre-*Baker* era. This is consistent with prior work analyzing inter-governmental transfers. In contrast to this work, however, we show that biases in the geographic location of highways persisted after malapportionment was outlawed and are still evident today. But this is not enough: previously overrepresented communities also *spend* more on highways and have *higher quality* roads. One likely reason for this is that highway construction induces more traffic and greater demands for road improvements (Duranton and Turner, 2009). In other words, initial biases in highway construction give rise to new policies—in this case related to highway maintenance—characterized by the same type of bias. This conclusion suggests 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.[2] 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.[3] 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

[2]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).

[3]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).

have compounded already biased federal policies that limited states' freedom of action to develop their urban areas, while promoting the biases within state legislatures.

3 Hypotheses

The preceding discussion gives rise to four hypotheses, which we test in four separate sections after describing our data. First, we expect that malapportionment in state legislatures led to an unequal distribution of highway mileage in the pre-*Baker* era. In particular, we expect that overrepresented communities received a higher share of their state's highway mileage than their population share would otherwise justify. This hypothesis aligns with previous work that has found evidence of biased government allocations as a result of malapportionment (Ansolabehere, Gerber and Snyder, 2002).

Second, we expect that the biased distribution of highway mileage established in the pre-*Baker* era was *not* rectified after equalization of state legislative districts. In contrast to budgetary line-items that can easily be altered from year to year, infrastructure is by definition characterized by high degrees of permanence. In addition, the US and Interstate systems were largely completed by 1970, meaning that new construction could not make up for initial biases. Thus, it is likely that pre-*Baker* biases persisted for decades, even into the 21st century.

Our third and fourth hypotheses concern different aspects of highway maintenance. 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. Thus, previously overrepresented communities should have better local funding for highway maintenance (our third hypothesis) and should have better present-day road quality (our fourth hypothesis).

Note that these 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).[4]

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 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]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.

4 Data and Measurement

We rely on three data sources related to highway construction and maintenance to test our hypotheses. All measures we construct from these data are aggregated to the county level. This is standard in the U.S. distributive politics literature; 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). County boundaries were stable for most of the 20th century, allowing for longitudinal analyses without added assumptions.

Our most important source of data is an original GIS dataset on the evolution of the US highway system over the last 80 years.[5] To assemble these data, 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.[6] 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.[7]

Using this dataset, we construct a measure that indicates how much highway mileage a county received relative to its population size. For each county i in state $s[i]$ in year t we compute

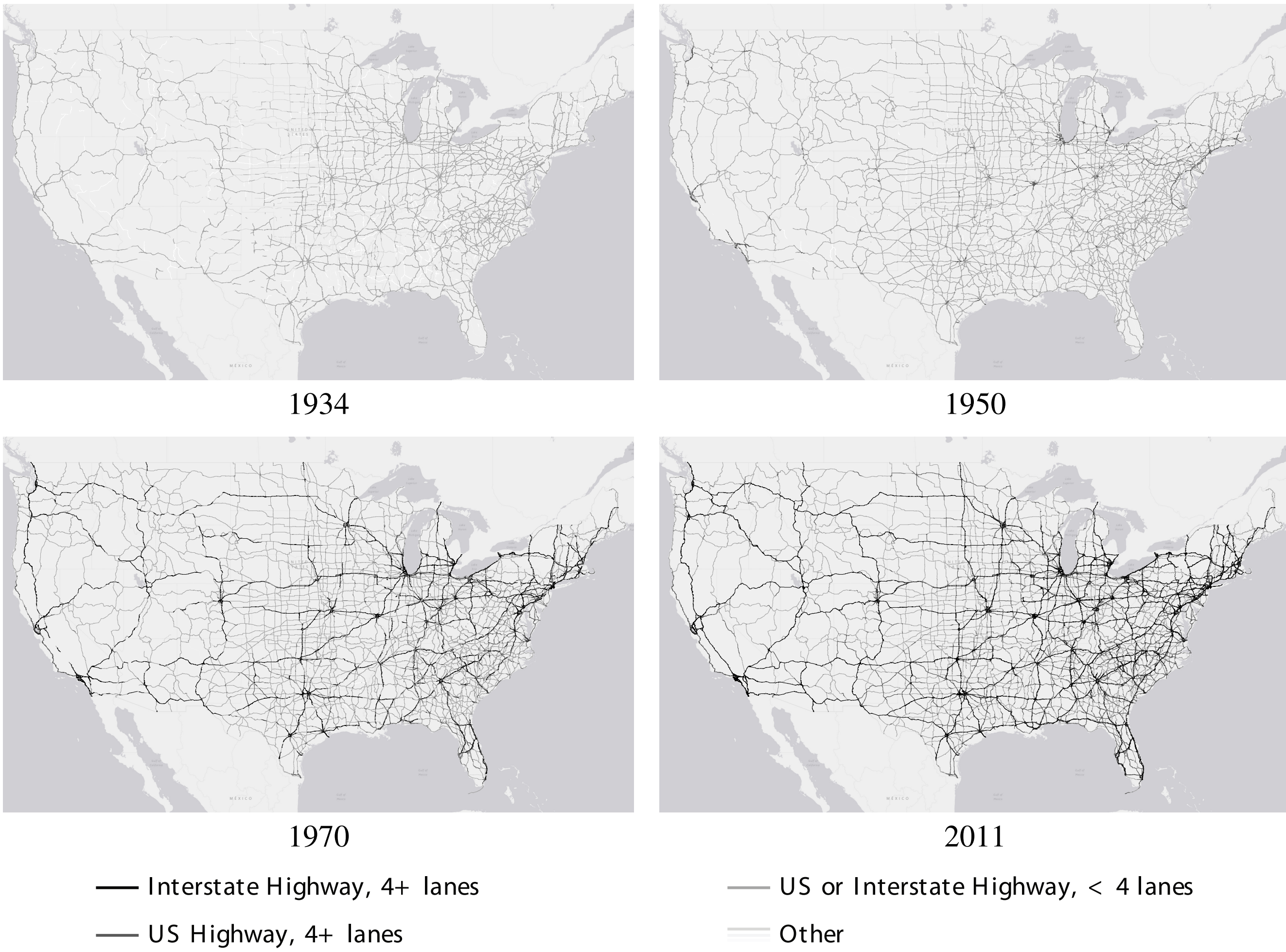
$$bias_{it} = \frac{highway_{it}/highway_{s[i]t}}{population_{it}/population_{s[i]t}} \tag{1}$$

[5]The years in our data are 1934, 1940, 1950, 1960, 1970, 1980, 1990, 2000, and 2011.

[6]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.

[7]See the Online Appendix for additional information about how we constructed the highway GIS database and the road categories used for each year.

Figure 1: Expansion of the US highway system, 1934-present



where $highway$ denotes total highway mileage and $population$ denotes population size. 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 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.

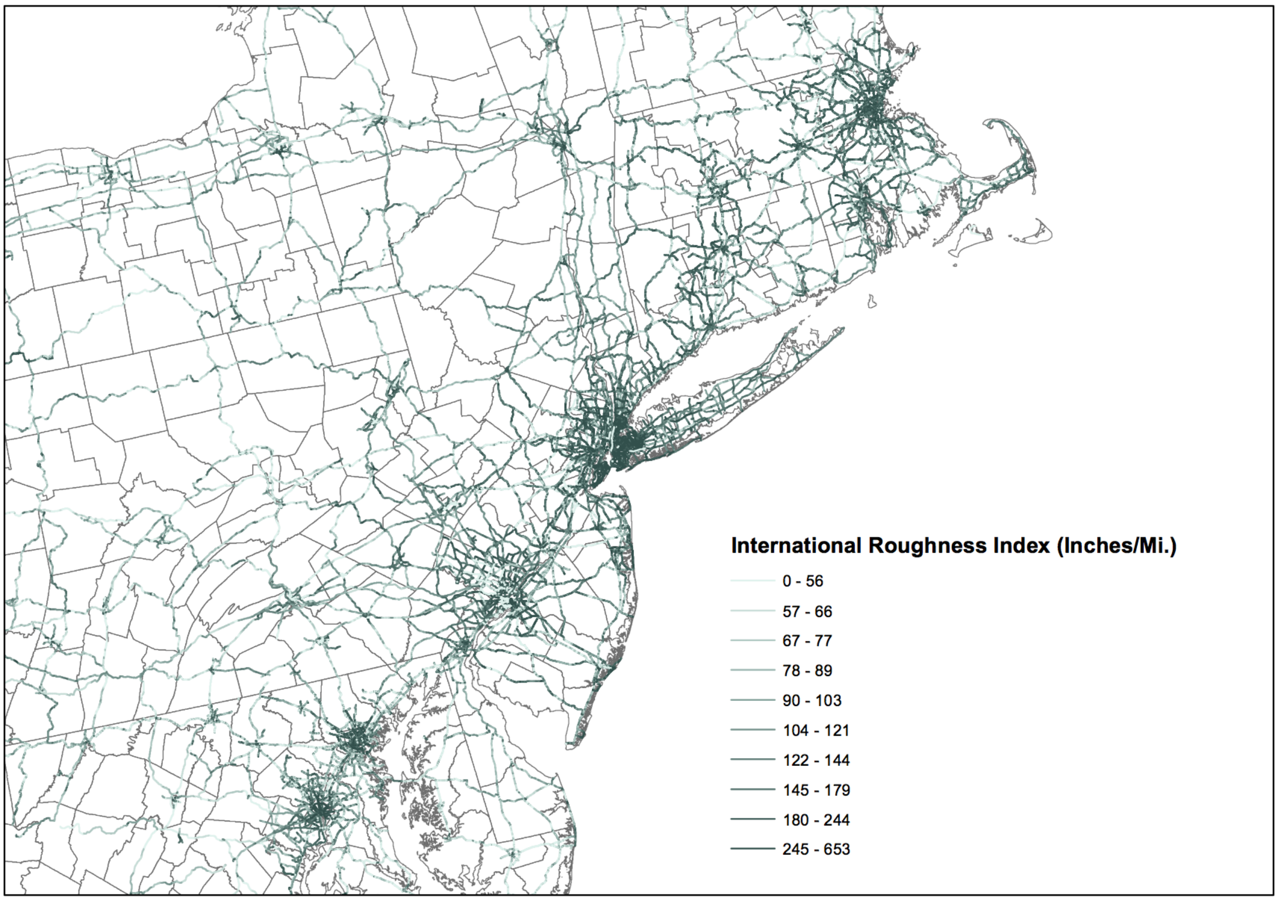
We rely on two additional data sources to test the third and fourth hypotheses related to highway funding and road quality. First, we examine the distribution of intergovernmental transfers of highway funds (including local road repair and maintenance) from state governments to county areas between 1972 and 2002.[8] While it would be ideal to also examine the distribution of such highway funds in the pre-*Baker* era, itemized numbers are not available prior to 1972. Regardless of this limitation, the available data do allow us to test whether previously overrepresented counties have higher spending on highways today (relative to their population size). We re-construct the variable in Equation 1, replacing total highway mileage with total highway funds.

Second, to analyze present-day road quality, we use the Federal Highway Administration's record of the International Roughness Index (IRI) of major U.S. roads. The IRI was developed to evaluate the quality of roads in developing countries before and after World Bank investment projects (Sayers, Gillespie and Queiroz, 1986; Office of Highway Policy Information, 2012), and measures the "longitudinal profile" (or bumpiness) of roads using lasers or other instruments. The result is a measure of the average deflection in the road for every linear unit of distance traveled (inches per mile in the United States). The best-paved surfaces have IRI values of less than 50 inches per mile, while rough, unpaved roads have values of 200 inches per mile or higher (Sayers, Gillespie and Queiroz, 1986). Values at the upper end of this range are commonly associated with developing-world roads, and yet appear widely in measurements of road quality in US Rust Belt cities. Figure 2 displays a map of IRI data for the Northeastern United States in 2012.

As our explanatory variable, we construct a county-level measure of state legislative malapportionment. 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,

[8]These data come from the Census of Governments (U.S. Department of Commerce, Bureau of the Census, 2008). "County aeras" include county governments, corporative municipalities, and special-purpose governments such as school districts.

Figure 2: Inequalities in road quality in Northeastern United States, 2012



Note: The international roughness index, here displayed for major roads in Northeastern United States, measures the average deflection in the road for every linear unit of distance traveled (in inches per mile). The best paved surfaces have IRI values of less than 50 inches per mile, while rough, unpaved roads have values of 200 inches per mile or higher.

Gerber and Snyder, 2002; Ansolabehere and Snyder, 2008). This measure tells us how over- or under-represented a county is in the state legislature, relative to a baseline value of 1.[9] 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.[10] Coefficient estimates and their standard errors are first generated separately for each of the five multiply imputed datasets and then combined using the method recommended by Rubin (1987).

5 Pre-*Baker* Inequality in the Distribution of Highway Mileage

We test the contemporaneous effect of malapportionment on the distribution of highways in the pre-*Baker* era (our first hypothesis) using a panel OLS setup with county and decade fixed effects:

$$bias_{it} = \beta(RRI_{it}) + \gamma_i + \delta_t + X'_{it}\theta + \epsilon_{it} \tag{2}$$

[9] David and Eisenberg (1961) use a baseline value of 100, which we rescale.

[10] The results are similar if we do not multiply impute missing values.

where $bias_{it}$ is our highway-mileage bias measure in county i in year t, γ_i captures county-level fixed effects, δ_t represents decade-specific fixed effects, and RRI_{it} is the Relative Representation Index described 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, proportion Democrat (based on results of the most proximate presidential elections), proportion black, proportion above age 65, proportion living in poverty, proportion in school, and proportion unemployed. For all analyses, we employ clustered standard errors (Arellano, 1987; Hothorn et al., 2014).[11]

Table 1 presents the results, and shows that better state legislative representation is associated with receiving more highway mileage than expected. The coefficient estimates on the Relative Representation Index are substantively large and statistically significant at conventional levels. Model 1, which includes all counties, suggests that a county whose RRI increased by 22% (the median change in the pre-*Baker* period) got 9% more of the state's highway mileage than predicted given its population size. For example, a typical state distributed 650 miles of highway between 1934 and 1960. For a county with 200,000 people in a state with 1 million people, the 9% increase implies that the county received 11 highway miles more than expected, a large number given that a typical county received 14 highway miles between 1934 and 1960.

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

Table 1: Malappotionment and Highway Bias in the Pre-*Baker* Era

	Dependent variable:				
	Ln highway bias (higher score = more highway than pop. would justify)				
	All	South	Non-South	Rural	Urban
	(1)	(2)	(3)	(4)	(5)
Relative Representation Index (ln)	0.45***	0.33**	0.47***	0.50***	0.48***
	(0.10)	(0.14)	(0.14)	(0.15)	(0.16)
Population (ln)	0.02	−0.11	0.08*	0.19**	−0.26***
	(0.04)	(0.07)	(0.05)	(0.08)	(0.05)
Proportion Vote for Democrats	0.10	0.22	−0.63**	0.37	−0.65*
	(0.18)	(0.27)	(0.32)	(0.26)	(0.35)
Proportion African-Americans	−0.10	−0.11	−0.29	−0.22	0.10
	(0.14)	(0.17)	(0.29)	(0.21)	(0.28)
Proportion Age 65 or Older	3.81***	4.62***	4.00***	4.44**	3.28*
	(1.11)	(1.63)	(1.48)	(1.78)	(1.75)
Proportion in School	0.74	1.07	0.82	0.47	1.02
	(0.73)	(0.74)	(1.20)	(0.96)	(0.81)
Proportion Unemployed	−0.17	−1.33	1.22	−0.68	−0.01
	(0.73)	(1.10)	(1.03)	(1.19)	(1.18)
Median Family Income (10,000s)	−0.04***	−0.06***	−0.04***	0.39*	−0.02***
	(0.01)	(0.02)	(0.01)	(0.21)	(0.01)
Proportion in Poverty	0.34**	0.18	0.48*	0.35	0.22
	(0.17)	(0.25)	(0.29)	(0.28)	(0.29)
County Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	11,852	4,580	7,272	5,924	2,368

*p<0.1; **p<0.05; ***p<0.01

Table 1 also presents results from running Equation 2 in four subsets of our data. The first two subsets divide the data into Southern and Non-Southern counties.[12] We do this because malapportionment and post-*Baker* redistricting followed an entirely different process in the South due to the Democratic party's total dominance and the role of the Justice Department (rather than courts) in arbitrating redistricting plans in this region (Cox and Katz, 2002). Malapportionment's effect was somewhat weaker in the South than elsewhere (see Models 2-3). The third and fourth subsets divide the data into rural and urban counties.[13] We do this to account for heterogeneous preferences for highway construction in these different communities. While the county fixed effects ensure that time-*un*varying factors do not bias our main results, the effect of malapportionment may be weaker in urban areas if urban residents demanded other government resources than highways in response to better representation.[14] We do not find strong evidence for this, however: malapportionment had a strong effect on highway distribution in the pre-*Baker* era regardless of region and urbanism.

6 Malapportionment's Long-Term Effect on the Distribution of Highways

To test whether the biases introduced under malapportionment persisted, we use a cross-sectional OLS setup with state fixed effects:

$$bias_i^{\text{post-Baker}} = \alpha_{s[i]} + \beta(RRI_i^{\text{pre-Baker}}) + X_i'\theta + \epsilon_i \tag{3}$$

[12]We define the "South" as states in the South Census region.

[13]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).

[14]Even so, we show above that present-day preferences for highways, as expressed in surveys, actually do not differ meaningfully across urban and rural areas.

where i indexes counties and s indexes states. In this set of models, we average our measure of malapportionment (represented by $RRI_i^{\text{pre-Baker}}$) over the pre-*Baker* decades in our data (1930, 1950, and 1960).[15] The highway bias measure (represented by $bias_i^{\text{post-Baker}}$) 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, proportion in manufacturing, proportion black, and proportion urban (all measured in 1950) (Fitch and Ruggles, 2003; Leip, 2012).[16] 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 of state transfer spending on highways.[17]

[15]The year 1940 is omitted because it is not reported in David and Eisenberg (1961).

[16]We 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. Unfortunately, data on workers' means of transportation to work and whether workers worked outside their county of residence are not available prior to 1970.

[17]We also ran models that included a variable measuring the number of state legislative districts per county in 2000 and 2011. (State legislative boundaries are not available prior to 2000.) The reason for including such a variable is that overrepresentation as measured by the relative representation index may be associated with a greater absolute number of representatives, which may impact collective action capacity (**?**). The results are not sensitive to including this variable.

Table 2: Malappotionment and Highway Bias in 2011

	Dependent variable:				
	Ln bias in 2011 (higher score = more highway than pop. would justify)				
	All	South	Non-South	Rural	Urban
	(1)	(2)	(3)	(4)	(5)
Relative Representation, avg. 1930-60 (ln)	0.59***	0.48***	0.67***	0.58***	0.97***
	(0.10)	(0.15)	(0.13)	(0.20)	(0.16)
Land Area (1000s of km)	0.25***	0.68***	0.23***	0.31***	0.16***
	(0.03)	(0.13)	(0.04)	(0.07)	(0.04)
Proportion Employed Outside County	−1.56***	−1.49***	−1.54***	−1.41***	−1.28***
	(0.27)	(0.38)	(0.38)	(0.48)	(0.41)
Proportion Commuting by Car	−2.16***	−3.18***	−1.23*	−2.18***	−1.04
	(0.48)	(0.71)	(0.65)	(0.76)	(0.77)
Median Income (10,000s)	−0.05***	−0.13***	−0.04***	0.12	−0.03***
	(0.01)	(0.04)	(0.01)	(0.37)	(0.01)
Proportion in Manufacturing	0.08	−0.14	0.81	0.79	0.32
	(1.47)	(1.91)	(2.25)	(2.81)	(2.25)
Proportion Vote for Democrats	0.72**	0.61*	0.71	0.31	0.84
	(0.31)	(0.36)	(0.56)	(0.48)	(0.62)
Proportion African-Americans	0.14	0.01	1.38	0.55	−1.66**
	(0.36)	(0.39)	(0.90)	(0.55)	(0.84)
Proportion Urban	−0.25	−0.42	−0.13	0.70	−1.69***
	(0.18)	(0.28)	(0.25)	(0.77)	(0.54)
Intercept†	1.66***	2.41***	−0.43	1.65**	2.02**
	(0.50)	(0.71)	(0.84)	(0.78)	(1.00)
State Fixed Effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Observations	2,963	1,145	1,818	1,481	592

*p<0.1; **p<0.05; ***p<0.01
†Intercept for Alabama (Arizona for Non-South) displayed

Table 2 shows that malapportionment's effect on the distribution of highway mileage is still evident today, 50 years after it was outlawed. The coefficient estimate on the Relative Representation Index is substantively very large: a county with an RRI 10% higher than a similar county in the same state on average had 6% more highway mileage in 2011 than expected given its population size. Effects of similar magnitude were observed in both the South and Non-South, and they were higher among urban areas.[18] Moreover, as shown in Figure 3—which presents standardized coefficient estimates for each post-*Baker* year in our data (also based on Equation 3)—the bias observed right after the end of malapportionment did not decline throughout the 20th century.[19]

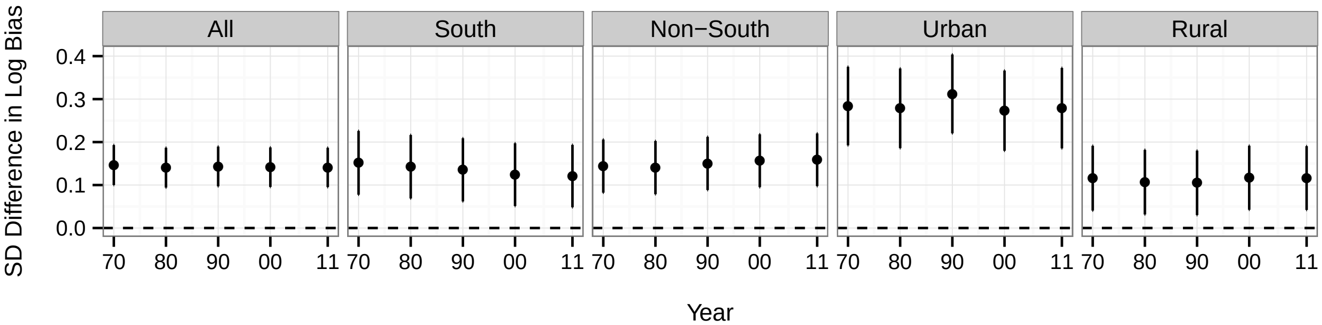
7 Persistent Inequality in State Highway Spending

We also expect new spending to be biased in favor of counties that originally enjoyed advantages under malapportionment. Such bias should not be as persistent in fiscal transfer categories such as education

[18]As before, it is important to re-run the model in these subsets to ensure that the results are not sensitive to different redistricting practices in the South (Cox and Katz, 2002) or heterogeneous preferences for highways across urban and rural areas.

[19]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 (see Online Appendix).

Figure 3: Initial biases in the distribution of highway mileage have not declined after *Baker*



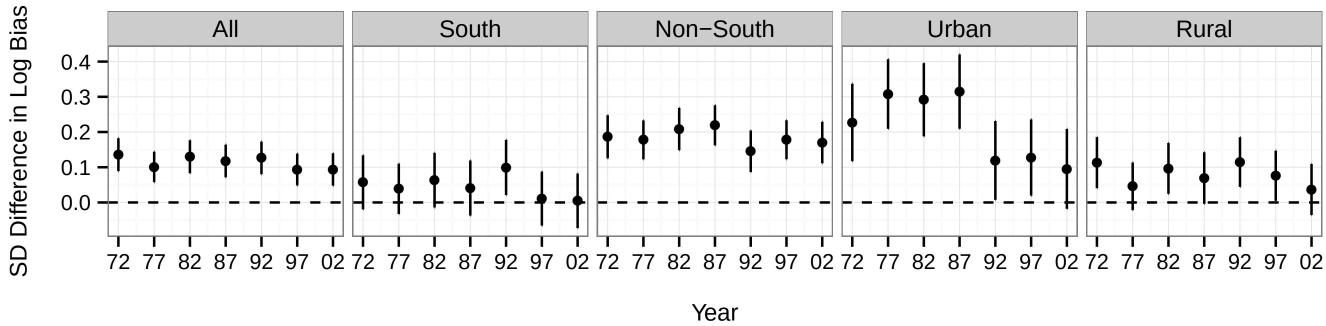
Note: The coefficients (with 95% CIs) have been standardized and represent the implied effect of a one standard deviation increase in pre-*Baker* RRI (averaged between 1930 and 1960) on the standard deviation of logged highway-mileage bias for each post-*Baker* decade in our data. Higher values of logged highway-mileage bias indicate that counties received more highway mileage than their population would justify. Each coefficient comes from a regression model that includes the same covariates as in Table 2.

and public welfare, which are more responsive to changes in representation than investments in infrastructure.[20]

To carry out these analyses, we rely on Census of Governments data on intergovernmental transfers to all governments within county areas (see Data and Measurement section). As our outcome variable, we apply the same logged bias measure that we generated for highway mileage (Equation 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

[20]While we focus on highway funding here, in the Online Appendix we present evidence consistent with the idea that spending on education and public welfare was much more amenable to legislative equalization.

Figure 4: Previously overrepresented counties spent more on highways after *Baker*



Note: As in the previous figure, the coefficients (with 95% CIs) have been standardized. The dependent variable is logged funding bias for highways; higher values indicate that counties received more funding than their population would justify. Each coefficient comes from a regression model that includes the same covariates as in Table 3.

logged average pre-*Baker* RRI, and we again conduct regressions following Equation 3, a least-squares regression with state fixed effects.[21]

Table 3 presents the full results for 2002, and Figure 4 summarizes the results for all years in our data. Again the historical legacy of malapportionment is evident: still in 2002, a county with an RRI 10% higher than a similar county in the same state on average received 5% more state highway funds than expected given its population size (Table 3, Model 1). Malapportionment's legacy is stronger outside the South and in urban areas, though the estimates are consistently positive in all subsets. And while in some cases the effect of malapportionment appears to have declined during the 30 years in our data, its impact was still quite sizable in 2002 across all counties.

[21]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).

Table 3: Malapportionment and Bias in Highway Funding in 2002

	Dependent variable:				
	Ln bias in 2002 (higher score = more funding than pop. would justify)				
	All	South	Non-South	Rural	Urban
	(1)	(2)	(3)	(4)	(5)
Relative Representation, avg. 1930-60 (ln)	0.47^{***}	0.08	0.80^{***}	0.25	0.44^{**}
	(0.12)	(0.21)	(0.14)	(0.23)	(0.20)
Land Area (1000s of km)	0.03	0.64^{***}	0.01	-0.04	0.02
	(0.04)	(0.18)	(0.04)	(0.09)	(0.05)
Proportion Employed Outside County	-1.43^{***}	-1.19^{**}	-1.21^{***}	-2.30^{***}	-0.34
	(0.32)	(0.51)	(0.41)	(0.57)	(0.52)
Proportion Commuting by Car	-4.81^{***}	-2.96^{***}	-5.18^{***}	-5.05^{***}	-2.22^{**}
	(0.58)	(0.97)	(0.72)	(0.90)	(1.01)
Median Income (10,000s)	-0.01	-0.01	-0.02	-0.68^{*}	-0.01
	(0.01)	(0.05)	(0.01)	(0.38)	(0.01)
Proportion in Manufacturing	1.42	-2.69	4.56^{*}	3.85	-4.40
	(1.73)	(2.61)	(2.38)	(3.29)	(2.75)
Proportion Vote for Democrats	0.48	0.84^{*}	0.51	0.18	2.20^{***}
	(0.36)	(0.49)	(0.59)	(0.57)	(0.76)
Proportion African-Americans	-0.27	-1.02^{**}	5.04^{***}	0.59	-0.78
	(0.38)	(0.45)	(0.96)	(0.58)	(0.94)
Proportion Urban	-1.27^{***}	-1.43^{***}	-1.20^{***}	-1.96^{**}	0.17
	(0.22)	(0.38)	(0.26)	(0.89)	(0.67)
Intercept†	6.02^{***}	4.18^{***}	5.05^{***}	6.95^{***}	1.87
	(0.60)	(0.96)	(0.90)	(0.92)	(1.26)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	2,959	1,145	1,814	1,481	588

*p<0.1; **p<0.05; ***p<0.01

†Intercept for Alabama (Arizona for Non-South) displayed

8 Persistent Inequality in Road Surface Quality

Do previously overrepresented counties also enjoy better quality roads? Using cross-sectional data collected from state transportation departments in 2012 (see Data and Measurement section), we calculate the average per-mile international roughness index for each county in the United States for 2011. Again, we use as our explanatory variable the log of the average pre-*Baker* RRI, pooling the years 1930, 1950, and 1960, and include the same covariates as above.

Table 4 presents the results. Again, we see a strong and long-lasting effect of malapportionment. In 2011, a one point log increase in logged pre-*Baker* RRI is associated with a six inches per mile drop in road roughness across counties within the same state (Model 1). This 6 point drop represents about one quarter of a standard deviation in the road roughness measure. As in the highway funding analyses, the effect is stronger outside the South and in urban areas.

9 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 legis-

Table 4: Pre-Baker Malappotionment and Road Quality in 2011

	Dependent variable:				
	Roughness index (higher score = worse quality)				
	All	South	Non-South	Rural	Urban
	(1)	(2)	(3)	(4)	(5)
Relative Representation, avg. 1930-60 (ln)	-6.21^{***}	-3.45	-7.14^{***}	2.63	-10.89^{**}
	(1.67)	(2.59)	(2.21)	(3.12)	(4.39)
Land Area (1000s of km)	-1.49^{**}	-1.14	-1.44^{**}	0.20	-4.22^{***}
	(0.58)	(1.97)	(0.59)	(1.14)	(1.50)
Proportion Employed Outside County	0.22^{***}	0.07	0.29^{***}	0.07	0.22^{**}
	(0.04)	(0.06)	(0.05)	(0.07)	(0.09)
Proportion Commuting by Car	-0.66^{***}	-0.21^{*}	-0.90^{***}	-0.04	-1.66^{***}
	(0.07)	(0.12)	(0.08)	(0.13)	(0.14)
Median Income (10,000s)	5.92^{***}	5.38^{***}	7.39^{***}	3.29^{*}	8.80^{***}
	(1.11)	(1.70)	(1.48)	(1.97)	(2.83)
Proportion in Manufacturing	-7.38	-39.42	-1.77	-48.28	29.54
	(21.33)	(30.03)	(31.27)	(43.94)	(50.38)
Proportion Vote for Democrats	8.02^{*}	-0.92	15.91^{**}	9.59	-20.98
	(4.20)	(5.54)	(6.90)	(6.66)	(14.20)
Proportion African-Americans	0.03	-0.01	0.15	-0.09	0.76^{***}
	(0.05)	(0.06)	(0.11)	(0.07)	(0.22)
Proportion Urban	2.29^{***}	1.46^{***}	2.51^{***}	5.30^{**}	6.45^{***}
	(0.27)	(0.46)	(0.35)	(2.21)	(1.39)
Intercept	134.76^{***}	76.13^{***}	144.51^{***}	78.89^{***}	186.04^{***}
	(14.01)	(11.91)	(14.91)	(26.48)	(27.59)
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	2,436	902	1,534	933	378

*p<0.1; **p<0.05; ***p<0.01

latures 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.[22] 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.[23]

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

[22]Documentation accompanying the file indicates that these data, while released in 2013, were up-to-date as of 2011.

[23]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.[24] 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.

[24]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.

Year(s)	Source	Road-Quality Indicators Used
1934-35	Rand McNally Road Atlas	US Highway (Paved)
		US Highway (Improved)
		State Highway (Paved)
		State Highway (Improved)
1940, 1950	Rand McNally Road Atlas	US Highway (Paved, 4+ Lanes)
		US Highway (Paved, <4 Lanes)
		State Highway (Paved, <4 Lanes)
1960, 1970, 1980, 1990	Rand McNally Road Atlas	Interstate Highways
		US Highways (Divided)
		US Highways (Two-Lane)
2000	ESRI Database based on 2000 NHPN	Interstate Highways
		US Highways (Divided)
		US Highways (Two-Lane)
2011	NHPN Database	Interstate Highways
		US Highways (Divided)
		US Highways (Two-Lane)

B Supplementary Information for Highway Mileage Analyses

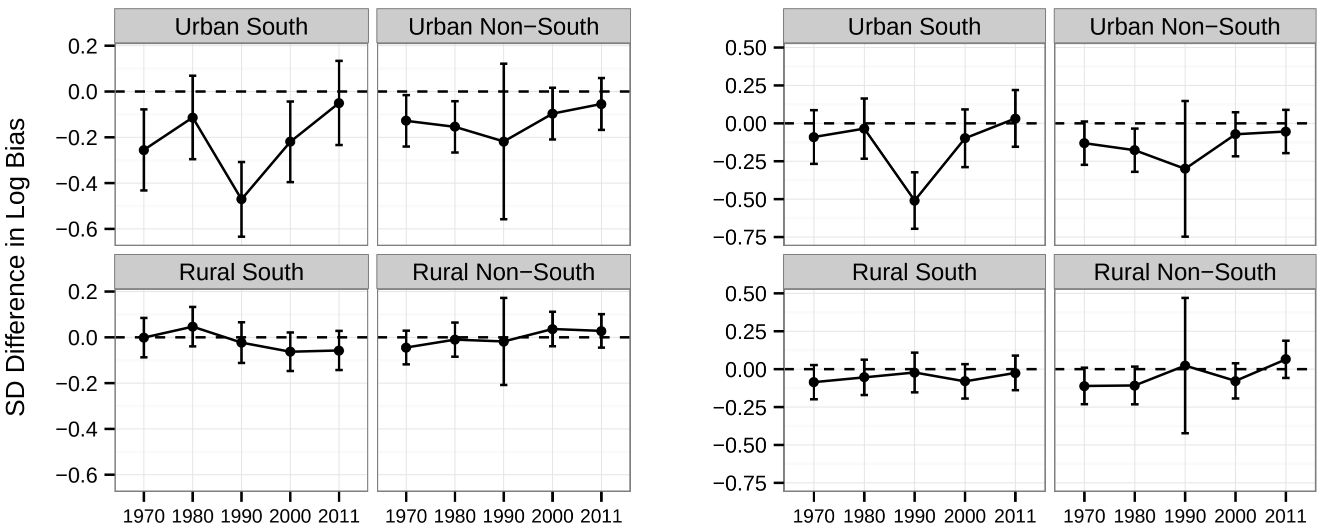
Table A-2: Summary Statistics for County Highway-Mileage Panel Data, 1934–2011

Variable	**n**	**Min**	q_1	$\widetilde{x}$	$\bar{x}$	q_3	**Max**	**s**	**IQR**	**#NA**
Log RRI	26666	-2.4	0.0	0.0	0.1	0.2	3.0	0.3	0.2	0
Log Average RRI, 1930, 1950, 1960	26270	-1.8	0.0	0.1	0.2	0.4	2.6	0.4	0.4	396
Urban, 1950 (Coarsened)	26666	0.0	0.0	2.0	2.5	4.0	9.0	2.5	4.0	0
Highway Mileage Bias	26666	0.0	0.7	1.5	2.7	2.8	351.1	6.3	2.1	0
Log Highway Mileage Bias	26666	-4.6	-0.3	0.4	0.1	1.0	5.9	1.7	1.3	0
Land Area, 1940	26666	22.0	446.0	637.0	987.5	940.0	20131.0	1331.8	494.0	0
Median Income	17720	4072.5	30588.6	38028.2	38320.1	46072.2	112400.0	12957.1	15483.5	8946
Proportion in Mfg.	17777	0.0	0.0	0.1	0.1	0.1	0.3	0.0	0.1	8889
Dem. Proportion of Pres. Vote	26598	0.0	0.3	0.4	0.5	0.5	1.0	0.2	0.2	68
Pop., 1930	26666	153.0	7992.0	13995.0	32482.0	24197.0	3346197.0	115114.4	16205.0	0
Pop., 1940	26666	285.0	10663.0	18758.0	43195.7	33327.0	4063342.0	146387.9	22664.0	0
Pop., 1950	26666	227.0	10032.0	18824.0	49273.8	35900.0	4508792.0	171991.3	25868.0	0
Pop., 1960	26666	208.0	9417.0	18497.0	58288.7	39567.0	6038771.0	207695.5	30150.0	0
Pop., 1970	26666	65.0	8904.0	18124.0	63987.8	41805.0	6877717.0	227389.9	32901.0	0
Pop., 1980	26666	91.0	10489.0	21840.0	73385.8	51699.0	7477503.0	240136.1	41210.0	0
Pop., 1990	26666	107.0	10371.0	22387.0	80368.7	56240.0	8863164.0	268038.8	45869.0	0
Pop., 2000	26666	67.0	11236.0	25224.0	90940.7	62899.0	9519338.0	296927.9	51663.0	0
Pop., 2010	26666	82.0	11096.0	26026.0	99658.4	67810.0	9818605.0	317440.0	56714.0	0

South	26666	0.0	0.0	0.0	0.4	1.0	1.0	0.5	1.0	0

C Additional Analyses: Bias in Added Highway Mileage

Figure A-1: Post-*Baker* bias in added highway mileage vs. pre-*Baker* relative representation



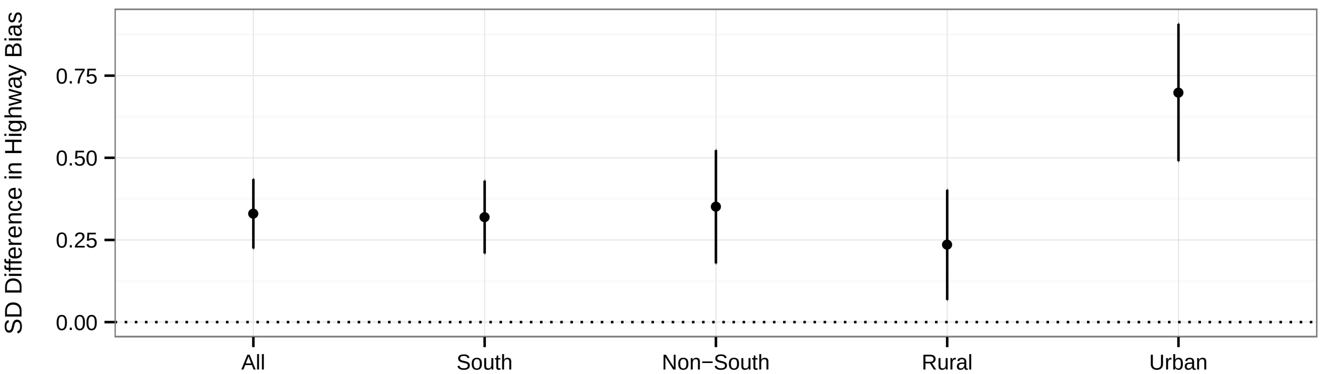
Note: The coefficients (with 95% CIs) represent the implied effect of a one standard deviation increase in pre-*Baker* RRI (averaged between 1930 and 1960) on the standard deviation of the log of highway bias for each post-*Baker* decade in our data. The regression model accounts for state fixed effects, 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.

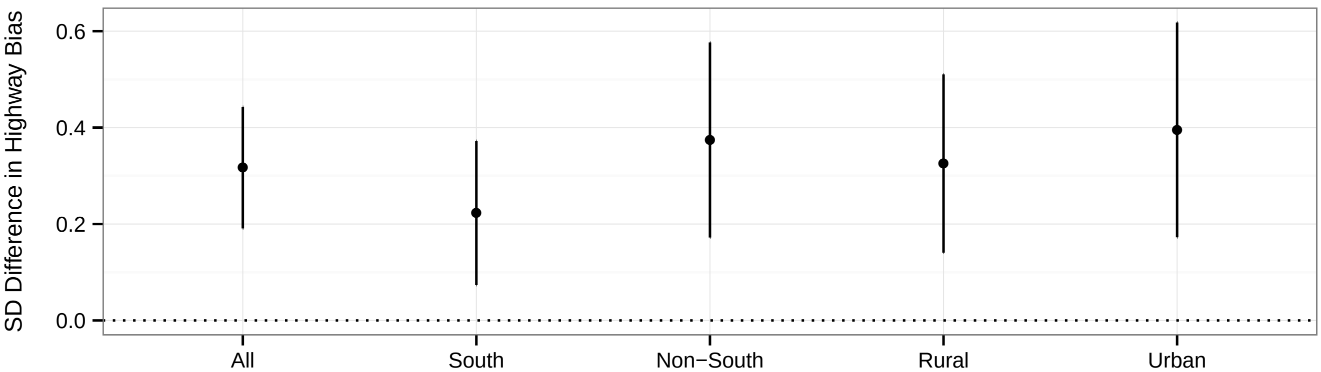
Figures A-7 and A-8 include the same covariates, except that in Figure A-7, the controls are from pre-*Baker* years (so as to minimize post-treatment bias) or whatever the earliest year is for which data were available; in Figure A-8, the covariates (aside from land area) are from the year closest to 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



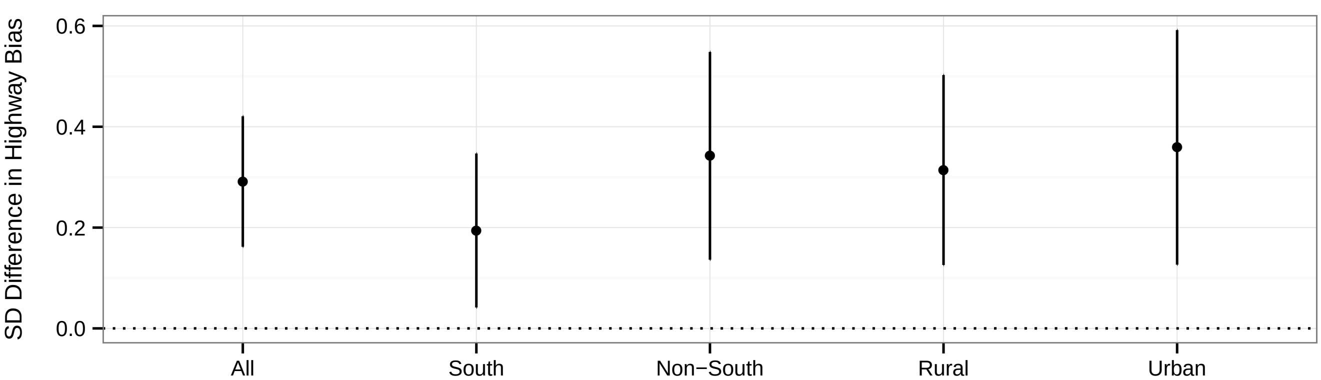
facturing jobs in 1950 (the nearest decennial Census year), the percentage of voters casting ballots for the Democratic presidential candidate in 1948 (the previous presidential election, the percentage of residents in who were black and the proportion who lived in urban areas (using the US Census definition 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-*Baker* representation bias vs. pre-*Baker* (1934-1960) county highway mileage bias controlling for county fixed effects, population, and % Democratic vote, by region and urban-rural status



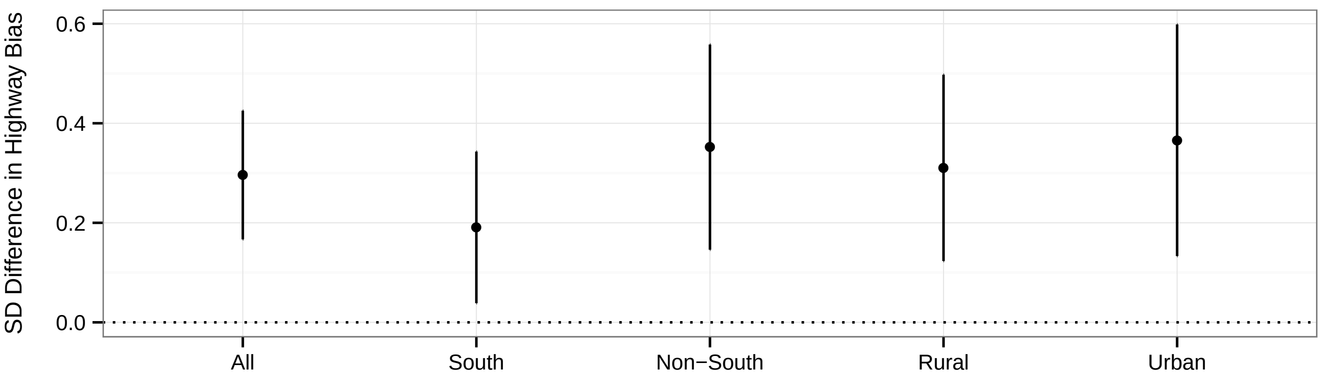
Note: Additional controls include: county population at the time of the nearest Census, and the percentage of voters who cast ballots for the Democratic candidate in the previous presidential election.

Figure A-4: Pre-*Baker* representation bias vs. pre-*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



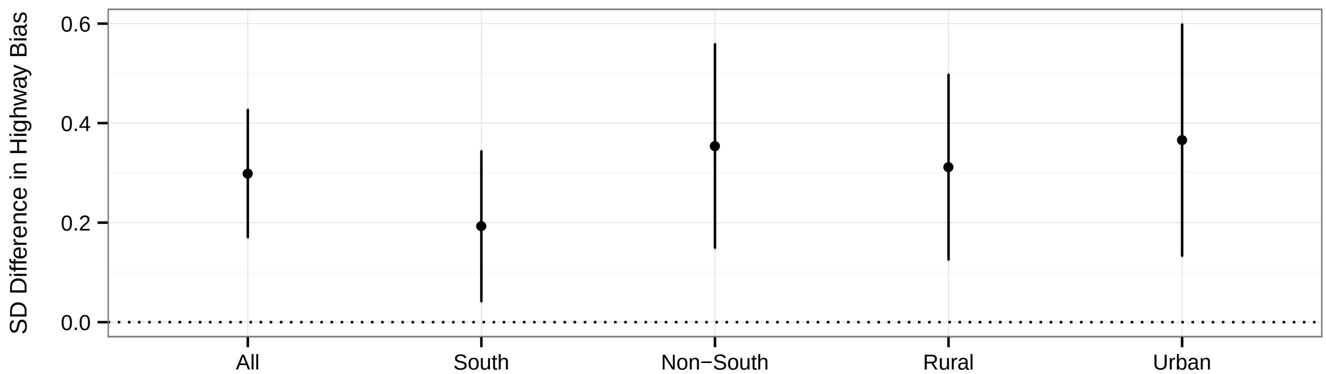
Note: Additional controls include: county population at the time of the nearest Census, the percentage of voters who cast ballots for the Democratic candidate in the previous presidential election, and the percentage of the population as of the nearest Census who were black, aged 65 and over, in school, and unemployed.

Figure A-5: Pre-*Baker* representation bias vs. pre-*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



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-*Baker* representation bias vs. pre-*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



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-*Baker* representation bias vs. post-*Baker* (1970-2011) county highway mileage bias using pre-*Baker* controls (when possible), by region and urban-rural status

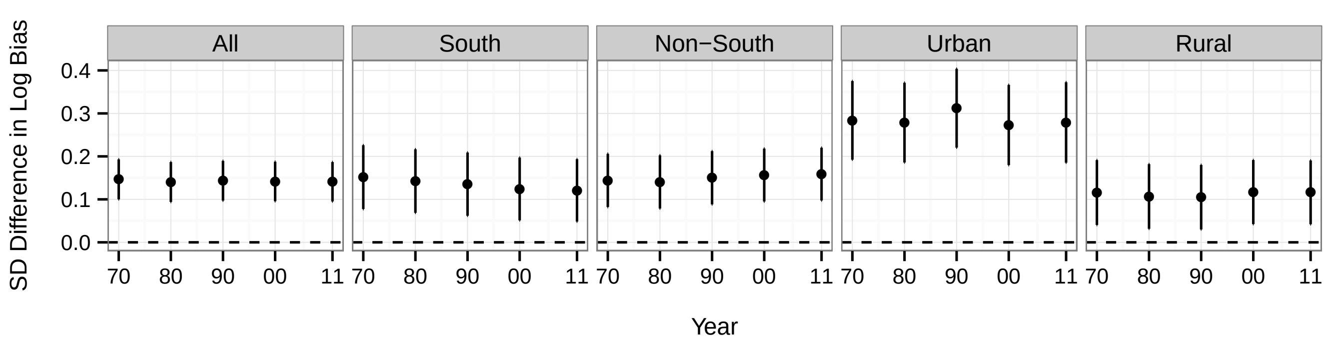
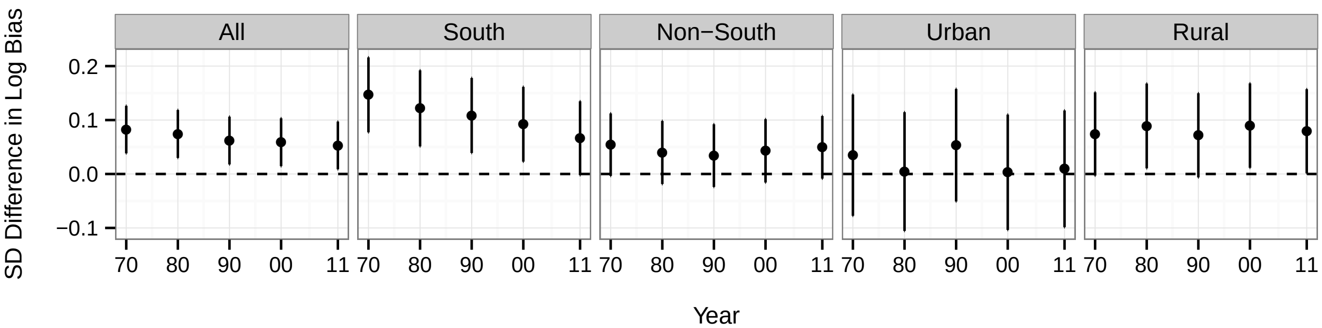


Figure A-8: Pre-*Baker* representation vs. post-*Baker* (1970-2011) bias in county highway mileage bias using contemporaneous controls, by region and urban-rural status

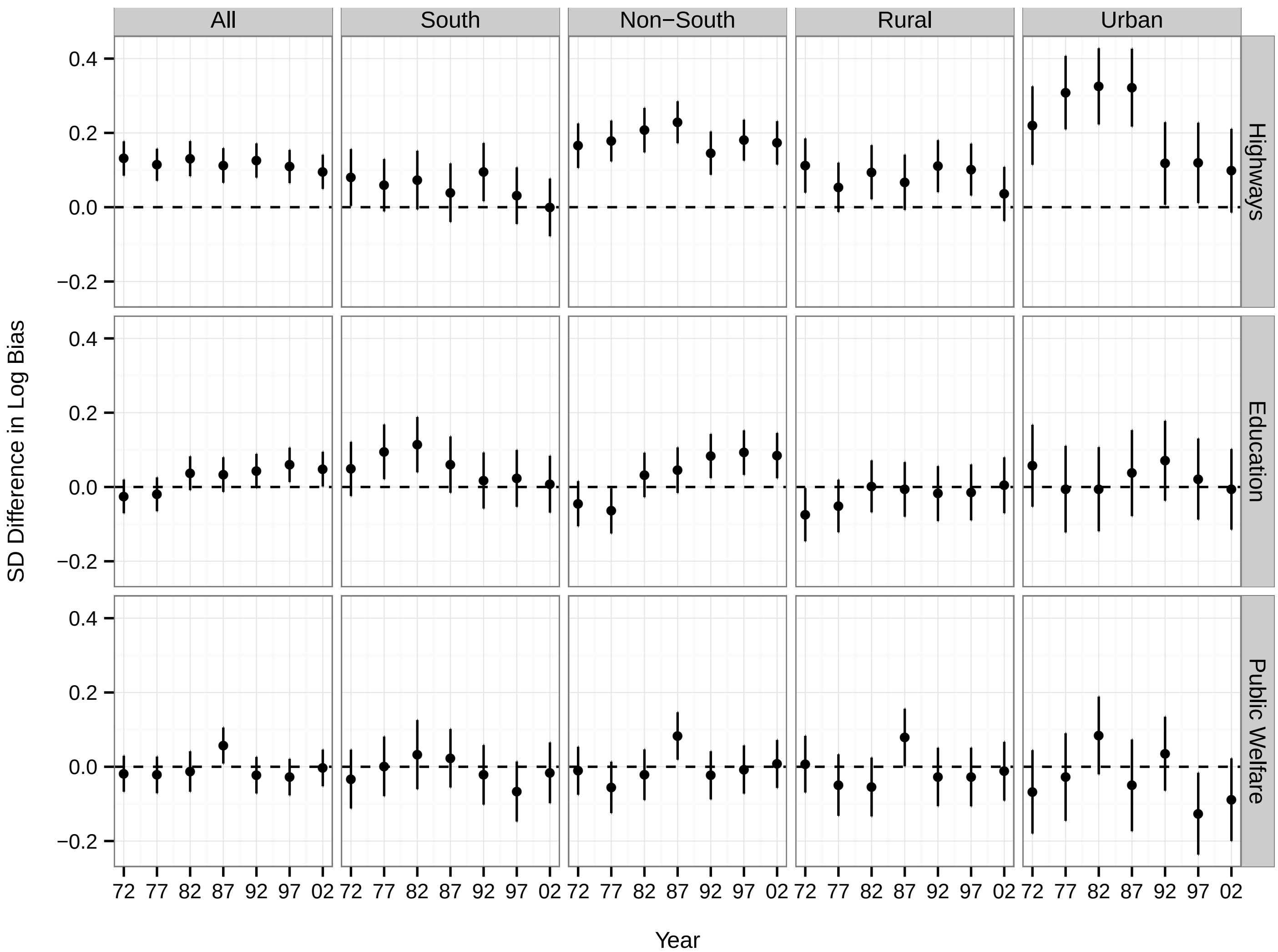


E Additional Analyses: State Transfers to Counties Using Multiply Imputed Covariates

In Figures A-10 and A-11, coefficients represent the implied effect of a one standard deviation increase in a county's log-transformed averaged pre-*Baker* relative representation index (RRI) ave 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-10, 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-11, 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 vs. post-*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-*Baker* RRI on the standard deviation of the logged bias measure for each post-*Baker* year in our data. The regression model includes all controls discussed in the text.

Figure A-10: 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

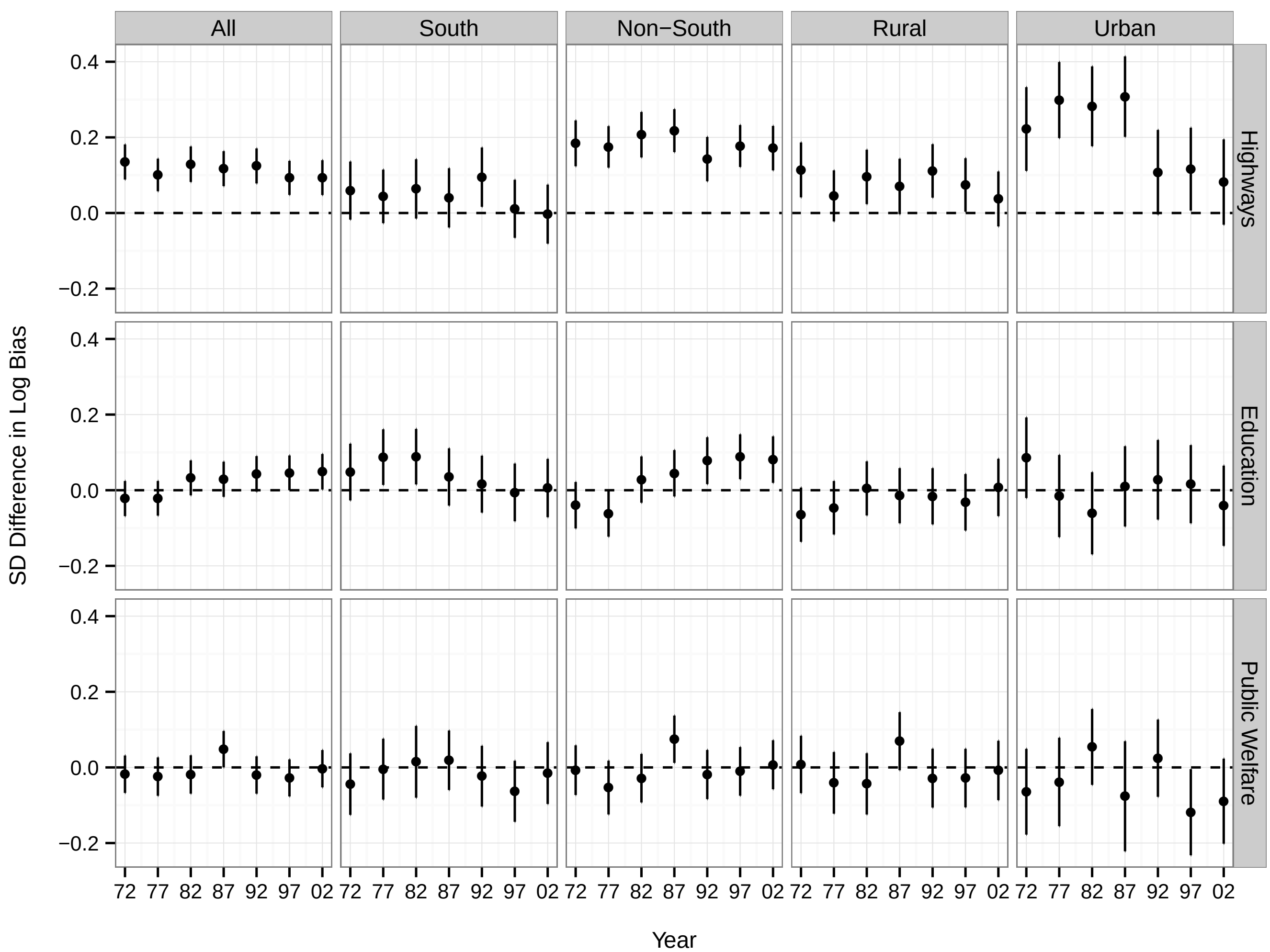


Figure A-11: Pre-*Baker* representation vs. post-*Baker* (1970-2011) bias in State intergovernmental revenue transfers to counties for highways, education, and public welfare using contemporaneous controls, by region and urban-rural status