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Can America Reduce Highway Spending?
Evidence from the States

Leah Brooks and Zachary Liscow

Infrastructure—capital investment in roads, water, schools, sewers, and many other facilities—is a key input into economic growth (Munnell 1992). Economic historians credit infrastructure investments with large increases in social welfare. For example, Beach et al. (2016) show that large-scale water purification in the US in the first part of the twentieth century decreased mortality and meaningfully increased human capital formation (see also Cutler and Miller 2005 and Ferrie and Troesken 2008). Duranton and Turner (2012) find that the large capital investment in the Interstate Highway System yielded broad-based increases in employment. And Allen and Arkolakis (2019) argue that large welfare gains are possible with improvements to selected segments of the Interstate System.

But these benefits are available only when we can build infrastructure at reasonable cost. Despite the importance of infrastructure, there is very lim-

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ited evidence about overall infrastructure cost patterns and what drives those costs. While there is contemporaneous coverage of specific instances of very high spending on infrastructure—New York City's new subways, Boston's Big Dig, and California's high-speed rail have all received substantial media coverage—without systematic evidence it is hard to evaluate whether these projects are well-publicized outliers or typical expenditures (Barro 2019b; Goldman 2012; Varghese 2019).

The limited evidence in the literature suggests that per-unit expenditures are rising. Looking at the construction sector as a whole over the past 70 years, Swei (2018) finds limited evidence of real growth in materials prices but substantial growth in labor costs. Brooks and Liscow (2020) find that states spent three times as much to build a mile of Interstate Highway in the 1980s as they did in the 1960s. Mehrotra, Turner, and Uribe (2019) find that this trend continued for both new Interstate construction and Interstate maintenance from 1980 onward.

This increase in per-unit expenditures may explain the much-decried state of US infrastructure. There is a general belief that the quality of US infrastructure is low. The American Society of Civil Engineers consistently gives US infrastructure a failing grade (American Society of Civil Engineers 2017). The US spent about the same in real per capita terms in 2016 as it did in 1956. If per-unit infrastructure expenditure increases, even an equivalent amount of spending translates into less physical capital to facilitate the movement of people and goods.

In this project, we focus on infrastructure for which we can consistently measure per-unit expenditure over time and space: the US Interstate Highway System. Our goal is to highlight variation in spending. If some of this expenditure variation is the result of policy choices in low-spending states that are replicable in high-spending states, policy provides one route to lowering the cost of new infrastructure. New Interstate construction is particularly useful for analysis because a new mile of Interstate is at least fairly uniformly defined over time and space. While all highway miles are certainly not exactly comparable, comparisons across different types of infrastructure, or even the same type of infrastructure at different levels of depreciation, are even more fraught. We focus on the period from 1956 to 1993, which saw the construction of more than 90 percent of today's Interstate System.

We analyze total spending per mile, which is determined by the cost to build a constant-quality highway mile and the quality of that mile. If the quality of an Interstate mile is roughly constant over time, then changes in spending come exclusively from changes in cost, such as changes in the prices of labor or concrete. However, changes in highway quality can also increase spending—if, for example, states build Interstate Highways with more exit ramps, or higher-quality concrete. Our work in this chapter and in a related paper (Brooks and Liscow 2020) is a first step to providing evidence on the drivers of spending changes.

In our related work, we analyze the temporal variation in Interstate spending from 1956 to 1993 (Brooks and Liscow 2020). We show that the US spent roughly $8.75 million 2016 dollars to build a new mile of Interstate for first decade and a half of the program, from 1956 to 1969. After this, however, Interstate spending per mile starts a steady increase. By the 1980s, states spent roughly $25 million 2016 dollars to build a new mile of Interstate—roughly a tripling in spending. As neither labor nor materials prices increase in any meaningful way over the period, they do not explain the temporal increase.

Our related work also marshals multiple pieces of evidence to suggest that the rise of "citizen voice" drives at least some of these increased expenditures. We define "citizen voice" as an amalgam of changes in statutes, changes in judicial doctrine, and the rise of social movements, dating to the late 1960s and early 1970s, all of which combined to give individual citizens a greater ability to modify government behavior (Altshuler and Luberoff 2003; Glaeser and Ponzetto 2018). For example, the passage of the National Environmental Policy Act of 1969 gave individual citizens a cause of action to sue the government if they thought that the regulatory agency was not faithfully implementing the act. In addition, we find that correlates of citizen demand for higher-quality Interstates, such as income or education, are associated with higher costs only after the "citizen voice" tools for challenging government behavior appear.

In this chapter we focus on whether there is economically meaningful cross-state variation in per-mile Interstate spending. We find that there is—the interquartile range in spending per mile is an astonishing $8.8 million, relative to the mean of $10 million. If states spending over the median had limited their expenditure per mile to that of the median state, the Interstate system would have cost about $260 billion to build, reducing the cost by 40 percent.

We then isolate Interstate spending subject to policy maker discretion, by conditioning on predetermined characteristics, such as changes in elevation along the route, that should drive costs.[1] When we restrict to spending subject to policy maker discretion, cross-state geographic variation falls but is far from eliminated. When we further limit analysis to the period after the rise of citizen voice, predetermined characteristics eliminate a smaller share of cross-state variation in spending.

We then look for clues as to the drivers of this cross-state variation by correlating Interstate spending and related private and public spending. We first show that the cross-state variation in Interstate spending is unusually large—considerably larger than any form of spending we study, other than highway maintenance—and this difference remains even conditional on predeter-

1. We deliberately use the phrase "policy maker" here to include both elected politicians and bureaucrats, both of whom have substantial power over spending decisions.

mined characteristics. We then test whether key types of spending covary with Interstate spending per mile. Of all the types of spending we analyze, including private construction and overall public spending, Medicare spending per enrollee is the most strongly statistically related with spending per new Interstate mile net of geographic covariates. Each additional $1,000 of Medicare spending per capita (mean $5,650) is associated with an additional $3.4 million dollars in Interstate spending, or about 20 percent of mean spending per mile. We do not think that senior citizen health care is driving greater expenditures on Interstate Highways. Rather, the same forces that yield high Medicare spending—possibly things like litigious citizens, or the social capital that allows people to pursue more medical care—may also yield more Interstate spending.

We then review the literature on the root causes of infrastructure costs. To help gain some insight, we examine the relationship between features of states and their Interstate spending per mile. In the period with more cross-state variation in the data (1970–1993), we find that states with a higher Democratic presidential vote share and (more tenuously) higher corruption have higher Interstate spending per mile. While these results are provocative, we interpret them with caution given that we do not limit to exogenous variation in spending.

Finally, we show that higher Interstate spending correlates both with higher subsequent maintenance expenditures and lower fatalities. The latter is possible evidence that higher initial spending yields higher-quality highways in the form of safer roads.

To undertake these analyses, we use novel data on the cost of the US Interstate Highway System from the Federal Highway Administration's *Highway Statistics* yearbooks that we assembled and cleaned in our related paper (Brooks and Liscow 2020). We combine these data with the date of mileage completion (Baum-Snow 2007) to calculate spending per mile. As in our related work (Brooks and Liscow 2020), we use multiple spatial data sources to calculate population density, slope, and wetlands and rivers by Interstate segment to control for the differential physical costs of constructing segments. Adding to our previous work, we also gather private spending on construction and health care, as well as public spending including Medicare, Medicaid, and state and local government general spending.

This chapter first presents background on the Interstate Highway System. We then discuss the data we use. We follow with an analysis of the variation in spending per mile and the variation in spending per mile subject to policy maker control, along with tests for the validity of this measure. We continue with the correlation between Interstate spending and other relevant private and public spending. We then review the literature on the root causes of infrastructure cost changes. In the final empirical section, we test whether some of these cost drivers are related to Interstate spending per mile. The final empirical section asks whether higher spending per mile is related to better Interstate outcomes; we then conclude.

2.1 Interstate Construction

Though planned since at least the 1940s, the Interstate System formally began with the Federal-Aid Highway Act of 1956. This act authorized a roughly 41,000-mile system with an estimated completion before 1970 at a projected cost of $25 billion 1946 dollars, or $192 billion 2016 dollars. In reality, Interstate construction was not proclaimed complete until the 1990s. The vast majority of miles were completed by 1993, the end of our study period. The total cost of the Interstate exceeded $504 billion 2016 dollars. (For details beyond this summary, see Brooks and Liscow 2020.) All states have at least some Interstate miles.

The Interstate construction program was a federal-state partnership. For each new mile of Interstate—our focus in this chapter—the federal government paid 90 percent of the cost; states bore the remaining 10 percent.[2] In return for federal funding, states were required to build roads up to "Interstate standards." These standards meant two lanes in each direction, full control of access, and a design that yielded a minimum speed of 50 miles per hour and that would support the projected traffic in 1975 (this requirement later changed to require support for projected traffic 20 years after completion). The government, although it mandated a minimum standard, would reimburse for quality above this minimum, subject to regulatory approval. The Interstate program was administered by state departments of transportation, which put projects out to bid. States varied in the bidding systems they used (Pietroforte and Miller 2002, 429).

In practice, states had broad latitude in ordering the segments they built and choosing how much to spend on each segment. However, the funding structure capped the amount states could spend in any one year. In each year of the program, the revenue available for highway spending came from the gas tax. The federal government split the gas tax revenue among states in proportion to the estimated cost of completion of remaining highway miles. Thus, states had to choose between constructing quickly at lower spending per mile or slowly at higher spending per mile.

In the years we study, the pace of construction slowed as the program aged. Most states built the bulk of their miles in the first two decades of the program; the 1950s and 1960s saw 60 percent of total miles constructed. States built another 30 percent of system mileage in the 1970s and the remaining 10 percent in the 1980s and early 1990s.

2. There were some exceptions to 90 percent reimbursement, as some states received modestly more reimbursement.

2.2 Data

To investigate the variation in Interstate spending per mile across states, we collect four types of data. These are Interstate spending per mile, measures of predetermined differences in construction costs, public and private spending by states, and key demographic covariates.

2.2.1 Spending per Mile

To construct Interstate spending per mile, we need both the numerator—spending—and the denominator—miles. For annual Interstate spending, we digitize state-level data from the US Department of Transportation's *Highway Statistics* yearbooks for years 1956 to 1993. These volumes report annual federal spending on new Interstate miles by state. The data appendix of our related paper (Brooks and Liscow 2020) details how we adjust these data to account for small anomalies and issues due to two special rules on apportionment. Here and throughout, we adjust all dollar figures to 2016 dollars using the Consumer Price Index for All Urban Consumers (CPI-U).

For the denominator of spending per mile, we measure miles constructed by year of completion from Baum-Snow (2007). For each roughly one-mile segment of Interstate, we observe the exact location of that segment and the year in which the segment was completed.

Because spending is counted when it occurs and miles are counted when completed, the timing of spending usually predates timing of completion of miles.[3] In this chapter, we focus on either the entire time period—in which case there is no temporal mismatch—or two long time periods, in which case this issue is substantially lessened.

2.2.2 Predetermined Features

To account for predetermined features that drive spending per mile and are outside of policy maker discretion, we rely on what researchers generally believe to be the three main drivers of physical construction costs (Alder 2019; Balboni 2019; Faber 2014). The first is population density, with data from the Decennial Census (specific files as noted in the data appendix). We measure population density for each one-mile segment as the population density of the census tract in which the largest part of the segment falls, when tract data are available, or the population density of the county, when tract data are not available.[4] We use population density from the census year

3. In addition, we adjust spending to be a weighted average of the year the segment opened and the two years prior. See details in Brooks and Liscow (2020). We omit Alaska, Hawaii, and the District of Columbia.

4. The entire country was tracted only in 1990; from 1950 to 1980, tract data are available only for selected areas.

closest to the opening of each segment.[5] We create a state or state-period measure by taking a segment-weighted average.

The second physical feature relevant to Interstate cost is the slope of terrain. We measure the average state slope by first finding the average slope of land within 50 meters of each segment using the US Geological Survey's National Elevation Map. We create a state or state-period measure of slope by taking the segment-length weighted average of all segment slopes for a state or state-period.

The final measure of predetermined features is based on the length of the segment, in miles, that intersects wetlands or rivers. We define wetlands as the any of water types in the Cowardin classification system from the US Fish and Wildlife Service (2018) National Wetlands Inventory. This definition includes rivers and any other large bodies of water. Our state or state-period measure is the average segment share in wetlands or rivers, weighted by segment length.

2.2.3 Public and Private Spending

We have several measures of private and public spending with which we correlate our Interstate spending measure. To compare Interstate spending to private spending, we use an index of private construction costs from R. S. Means, indexed to 100 in 1993, courtesy of Raven Molloy. Molloy collected these data for every five years from 1940 to 1980 and then annually 1981 to 2003. To measure construction wages, we use annual state-level construction payroll divided by number of construction employees from the County Business Patterns (available periodically in the 1950s and 1960s, then from 1971 to 1993) to measure average annual construction wages per state. We also include private health insurance expenditures per enrollee in 2001 (the earliest year available) from the Centers for Medicare and Medicaid Services' "Health Expenditures by State of Residence, 1991–2014" (see appendix for complete citation details). Private health insurance expenditures include expenditures by both the insurer and the insured.

We also compare Interstate spending to public spending. For Medicare and Medicaid, we use spending per enrollee from 1991, also from the Centers for Medicare and Medicaid Services' "Health Expenditures by State of Residence, 1991–2014."[6]

5. For example, we attribute the 1960 census characteristics to segments opening from 1956 to 1964, and the 1970 census characteristics to segments opening from 1965 to 1974.

6. In an appendix table we use a host of government spending measures from the Census of Governments (relying only on full censuses in 1967, 1972, 1977, 1982, 1987, and 1992). We use data on total statewide local government expenditures (the sum of state and all local expenditures) and rely on the time-consistent compilation from Willamette University (Pierson, Hand, and Thompson 2015). To avoid problems of differing state and local responsibilities, we aggregate all state and local government spending by state and year. These data do not include state-level accounts in 1967, so most of our data work relies on state-aggregate measures from 1972 onward.

2.2.4 Interstate Outcomes and Other Variables

To assess whether Interstate spending correlates with postconstruction outcomes, we collect the number of accidents and fatalities per mile from the oldest relevant *Highway Statistics*, which dates from 1995. We also collect 2015 state maintenance spending per mile, again from *Highway Statistics*. We use later measures of maintenance expenditures to assess the long-run quality of Interstate construction.

We also collect a variety of demographic and variables that measure other policies to see if they explain the cross-state variation. We describe these variables where we introduce them later.

See summary statistics for our main variables of interest in table 2.1.

2.3 Documenting Cross-State Differences

With these data in hand, we turn to documenting cross-state variation in Interstate spending per mile. We then create a measure of state spending per mile that reflects costs subject to policy maker discretion, omitting spending determined by preexisting features, such as the slope of the terrain. Finally, to look for clues about potential drivers of spending, we assess whether spending due to policy maker choice covaries with other relevant public and private spending.

2.3.1 Absolute Spending

We begin with absolute spending in figure 2.1, which shows how much states spend, on average, per new mile over the build-out of the Interstate system from 1956 to 1993. The average state spends $11.5 million per mile (all figures are in 2016 dollars). The bars in figure 2.1 present deviations from this average. Delaware spent the most per mile of any state, at just over $50 million dollars per mile; the top three spenders also include New Jersey at over $30 million per mile, and Connecticut at just under $25 million per mile. North Dakota spent the least of any state per mile, at roughly $3 million per mile. Even excluding the three top-spending states still leaves a difference of $30 million per mile between the highest- and lowest-spending states.

The figure demarcates the four census regions in shades of gray. Western states tend to spend the least per mile; northeastern states (and two states the Census denotes as part of the South but that may be more intuitively northeastern: Delaware and Maryland) are the highest-spending ones. There are no northeastern states in the bottom portion of the spending distribution.

This geographic variation is also visible in the top panel of figure 2.3, which maps spending per mile by state for the entire period of construction. Unconditional spending per mile is highest in the Northeast and on the West Coast; states in these regions are mostly in the top quartile of spending per mile (the darkest gray).

Table 2.1 **Geographic variation in Interstate and other local spending**

	Entire cross section			Period 1: 1956–1969			Period 2: 1970–1993		
	Mean (1)	Standard deviation (2)	Diff: p75–25 (3)	Mean (4)	Standard deviation (5)	Diff: p75–p25 (6)	Mean (7)	Standard deviation (8)	Diff: p75–p25 (9)
Spending/mile, $ millions	11.51	6.70	8.18	8.75	5.15	6.26	15.52	10.65	8.25
Private spending									
Residential construction cost index	31.53	4.93	5.83	19.83	1.70	2.12	48.55	5.66	5.84
Health insurance/enrollee, 2001, $1,000s	2.95	0.21	0.24	.	0.22	.	2.94	0.21	0.22
Public spending, all $1,000s									
Medicaid per enrollee, 1991	6.01	1.93	2.17	.	1.93	.	5.97	1.91	2.44
Medicare per enrollee, 1992	5.65	0.83	1.27	.	0.83	.	5.65	0.83	1.32
Local government expenditure per capita	6.50	1.31	1.80	.	1.30	.	6.94	1.34	1.58
Interstate outcomes									
Fatalities per VMT, 1995*	0.86	0.4	0.55	.	0.41	.	0.88	0.39	0.53
Accidents per VMT, 1995*	3.71	1.95	2.17	.	1.93	.	3.73	1.97	2.36
Maintenance per mile, millions, 1995	5.73	4.27	4.92	.	4.20	.	5.92	4.35	5.52
Potential root causes									
Share high school graduates	52.24	7.56	9.40	46.28	7.39	9.47	60.92	7.54	10.17
Median family income, $10,000s	5.49	0.80	1.29	5.17	0.86	1.31	5.96	0.76	1.23
Annual construction wages	43.22	7.53	10.44	42.04	7.73	12.14	44.93	7.85	12.87
Corruption index	0.05	0.66	0.68	0.03	0.67	0.67	0.07	0.66	0.61
Democratic presidential vote share	44.93	5.57	6.22	48.38	6.72	8.02	39.91	4.68	6.08

Note: *Fatalities are per 100 million vehicle miles traveled (VMT). Accidents are per 10,000 vehicle miles traveled. All rows contain 48 observations, with the exception of accidents, which has 47. We omit Alaska, Hawaii, and Washington, DC. We weight all summary statistics by Interstate miles constructed in that state. For this reason, summary statistics for time-invariant variables, such as Medicaid spending in 1991, may vary slightly across the two time periods. In the "residential construction cost index," 1993 is 100. "Local government spending" is the total of all state and local government spending in the Census of Governments for all census years after 1967 (1967 does not report state-level information). The corruption index is from Boylan and Long (2003).

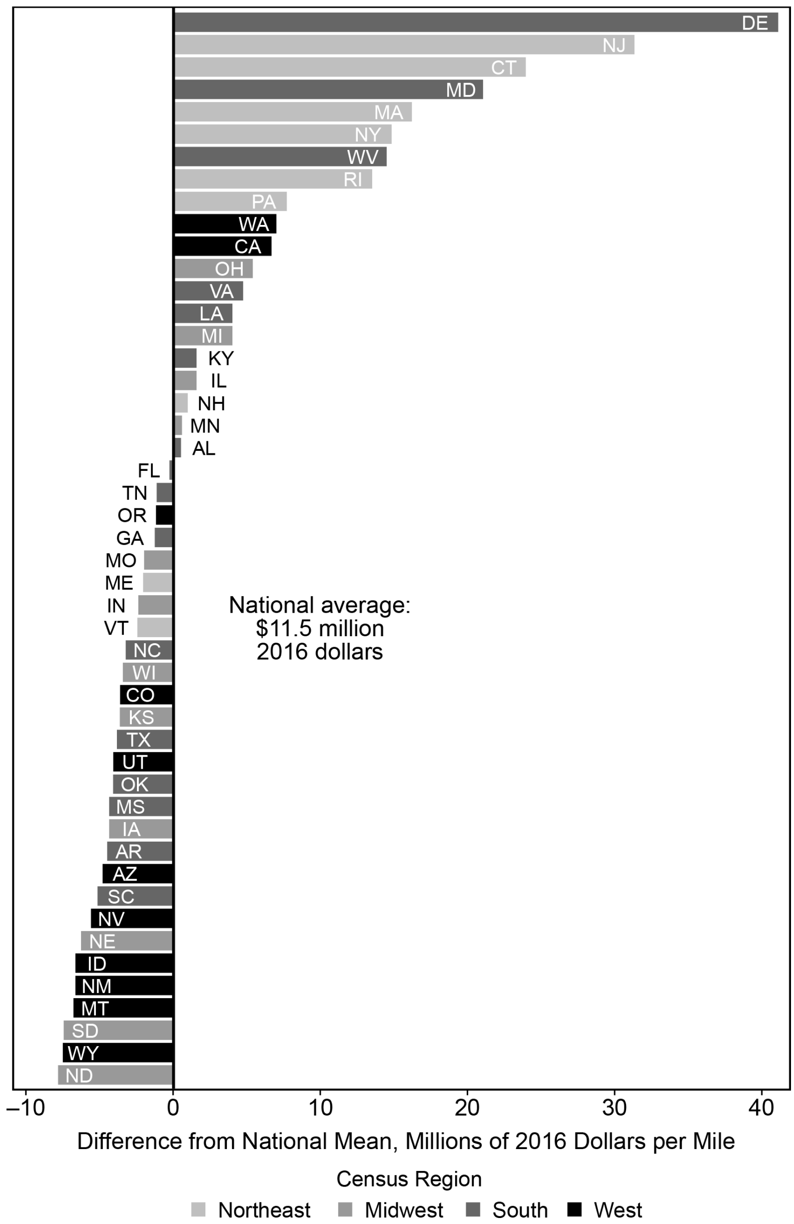


Fig. 2.1 Interstate spending per new mile, absolute difference from national average

Note: This figure presents deviations from national average Interstate construction spending per mile by state, 1956–1993. Here and everywhere else we omit Alaska, Hawaii, and Washington, DC.

2.3.2 Limiting to Spending Driven by Policy Maker Choices

Some of this spending variation is surely due to costs outside of state policy maker control. For example, construction costs in states with highways routed through more sloped land should be higher. Because we are interested in the scope of policy to potentially lower spending, our goal here is to isolate spending that is within the purview of state policy makers. In other words, for example, we cannot make Colorado less hilly, but we can suggest that Colorado change its procurement rules. Thus, we want to purge spending related to the former and keep only spending related to the latter.

To disentangle spending within policy maker choice from that determined by preexisting features, we regress spending per mile on three key covariates, denoted G_s: average population density, average slope, and share of miles in wetlands or rivers of segments constructed (see data section for more specifics on the calculation of these measures). Approximations of cost in the engineering literature rely on these three covariates (Alder 2019; Balboni 2019; Faber 2014). Recall that states were responsible for building highways on largely predetermined routes. Thus, the slope, the extent of wetlands and water, and the surrounding population density of segments were largely preexisting choices that constrained the actions of state policy makers.

While this is a useful exercise, these covariates may "overcontrol" for the amount of predetermined spending. For example, if areas with higher population density are more expensive places to build and also prefer more spending on Interstates, our method removes spending related to both of these causes. However, our goal is to remove only spending driven by population density itself. Thus, the covariates we use may contain elements of policy maker choice and may therefore yield residuals that understate the true variation in spending of interest. Alternatively, failure to control for omitted variables may yield residuals that are too big.

With these caveats in mind, we estimate

$$\text{spending per mile}_s = \beta_0 + \beta_1 G_s + \varepsilon_s, \quad (1)$$

where s indicates state. The dependent variable is spending per new Interstate mile in 2016 dollars. We use the estimated residual, $\hat{\varepsilon}_s$, as our measure of spending within policymaker discretion. We weight all regressions by the number of Interstate miles built in a state so that the results approximate the average mile, rather than the average state.

Figure 2.2 presents these $\hat{\varepsilon}_s$ residuals. By construction, they average to zero. A comparison of figures 2.1 and 2.2 shows that the magnitude of the variation shrinks substantially. Instead of an almost $50 million difference between the highest and lowest spending states (as in figure 2.1), the difference falls to about $25 million. Notably, Delaware—the highest-spending

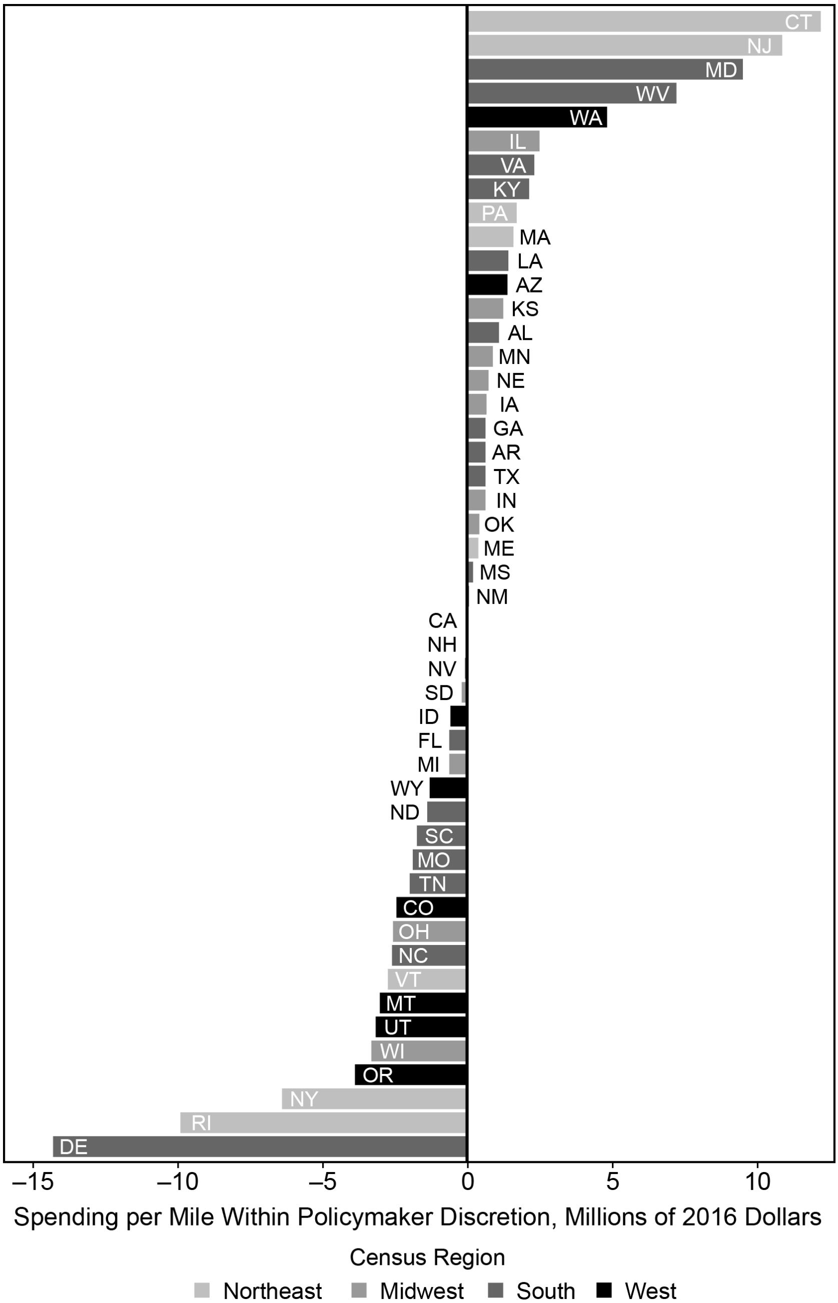


Fig. 2.2 Interstate spending per new mile, spending within policy maker discretion

Note: This figure reports residuals from a regression of Interstate spending per mile, 1956–1993, on population density, slope, and the extent of wetlands or rivers (see equation (1) and surrounding text for details).

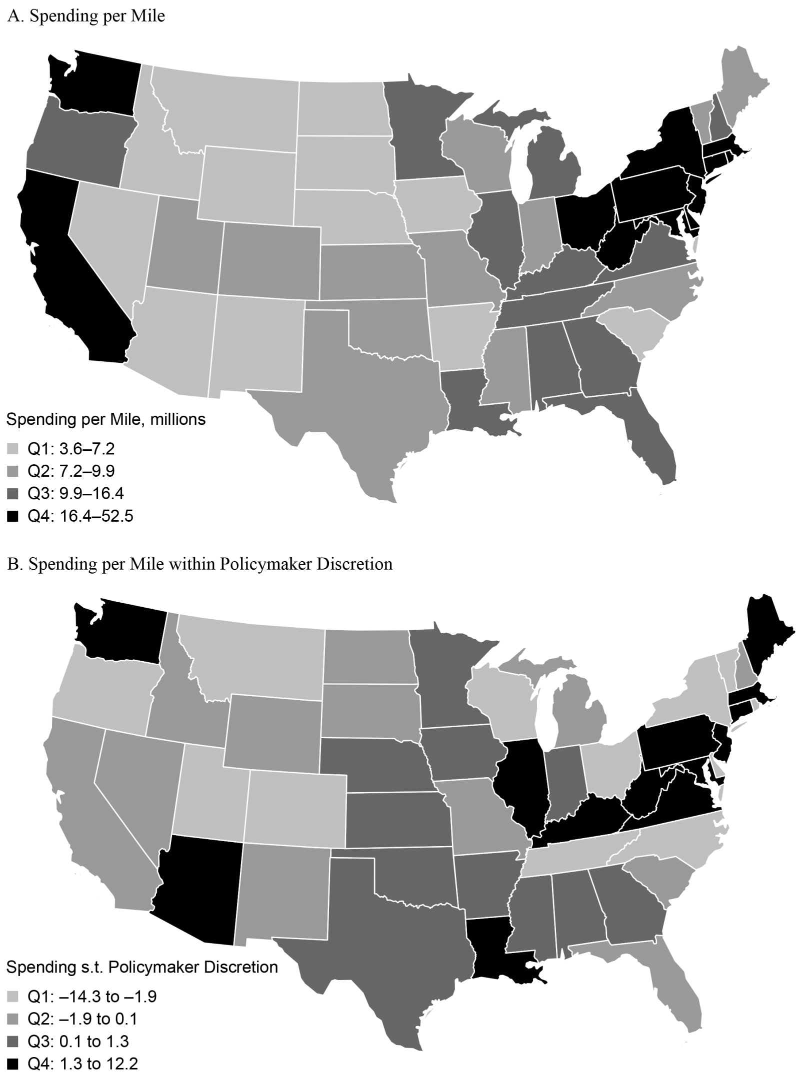


Fig. 2.3 Geographic pattern of spending per interstate mile

Note: Panel A maps quartiles of Interstate spending per mile from figure 2.1. Panel B maps quartiles of Interstate spending per mile subject to policy maker discretion as in figure 2.2.

state in the first figure—is now the lowest-spending state, spending almost $15 million fewer dollars per mile than the average state.[7]

The panel B of figure 2.3 shows this residual spending in a state map. While Washington State and parts of the mid-Atlantic region remain in the

7. Delaware has very few Interstate miles, and many of these miles are adjacent to or are over water.

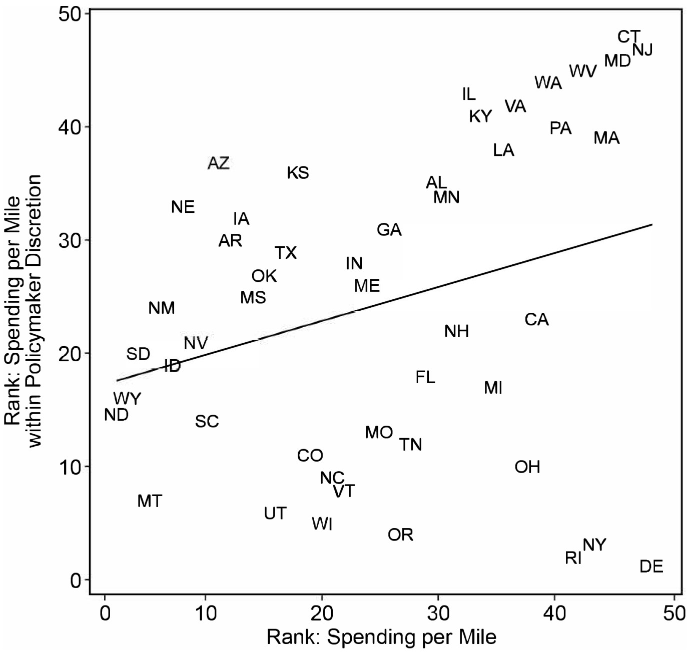


Fig. 2.4 Rank-rank correlation, raw spending and spending within policy maker discretion

Note: This figure shows each state's rank (from 1 to 48) in Interstate spending per mile on the horizontal axis versus the state's rank in Interstate spending per mile subject to policy maker discretion on the vertical axis.

top quartile of spending, much of New England and the Northeast moves out of the top quartile of spending. In addition, much of the South now falls into the second-highest quartile of spending per mile. The distribution also shows a fair amount of within-region heterogeneity in residual spending. For example, New York is in the bottom quartile, while most of its neighbors are in the top quartile. Louisiana is in the top quartile, while the rest of the South falls in lower quartiles.

We begin by considering the relationship between raw and residual spending. Figure 2.4 plots each state's rank in the raw spending per mile distribution on the horizontal axis and the rank of the residual from equation (1) on the vertical axis; points are the two-letter state abbreviation. The ranks are positively correlated, and the strength of the correlation is moderate ($\rho = 0.3$).

Interestingly, the controls G_s change the ranks of high-spending states more than the ranks of low-spending states. There are virtually no states in the top left quadrant (unconditionally low and conditionally high spending), but quite a few states in both the top right (high conditionally and

Table 2.2 **Estimates of spending conditional on predetermined characteristics robust to specification variation**

	Full period				Second period: 1970–1993			
Covariates	R^2 (1)	Standard deviation (2)	Diff: p75–p25 (3)	Diff: p90–p10 (4)	R^2 (5)	Standard deviation (6)	Diff: p75–p25 (7)	Diff: p90–p10 (8)
Raw data		10.51	9.41	23.00		16.08	14.32	35.43
+ Predetermined characteristics	0.84	4.37	3.25	8.16	0.67	10.23	8.00	16.40
+ Characteristics squared	0.87	3.62	2.77	8.58	0.71	9.81	7.51	15.94
+ Average number of lanes	0.87	3.63	2.78	8.58	0.71	9.76	7.53	15.97
+ Without two highest observations	0.88	2.98	2.66	4.91	0.79	5.66	6.98	14.04

Note: For variable definitions, please see note to table 2.1. Columns 1 to 4 report figures for 1956 to 1993 and columns 5 to 8 figures from 1970 to 1993 only. The first row of this table presents summary statistics for the residual from a regression of spending per mile on a constant. The second row reports summary statistics for the residuals from the estimation of equation 2.1. The third row reports summary statistics for the residuals from the previous estimation with the inclusion of a G_s^2 term. The fourth row reports summary statistics for residuals from an estimation that additionally includes the average number of lanes in a state. The final row has summary statistics from the same regression, but without the observations with the two highest values of spending per mile. All estimations have 48 observations except the last row, which has 46.

unconditionally) and bottom right (unconditionally high, conditionally low) quadrants.

2.3.3 Evaluating the Isolation of Spending from Policy Maker Discretion

These residual spending measures are of interest inasmuch as the variation we have isolated is truly just that spending within policy maker control. In this section, we stress-test the distribution of these residuals and assess their persistence over time.

If the residuals from figure 2.2 are spending within policy maker discretion, they should already omit predetermined spending variation. If this is the case, then changes in the specification should have little impact on the magnitude and distribution of their value. Table 2.2 tests this contention and reports the standard deviation, the interquartile range, and the difference between the 90th and 10th percentiles for the full period (first four columns) and the second half of our time period (1970–1993; last four columns). In the raw data (first row), the standard deviation in spending is 10.5 million 2016 dollars, or just slightly under mean spending over the entire period. The interquartile range and the 90-10 difference also reflect substantial variation.

These figures are even larger for the second period. The standard deviation of spending per mile across states from 1970 to 1993 is 16 million 2016 dollars, with an interquartile range of $14 million and 90-10 difference of $35 million.

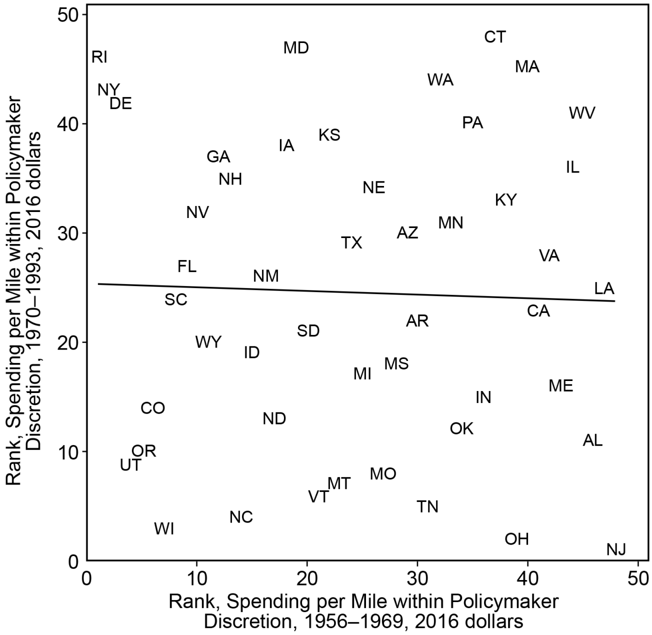
The second row of table 2.2 shows our preferred measure of spending within policy maker control, or residuals from a regression of spending per mile on slope, population density, and water and wetlands. As we saw in the comparison of figures 2.1 and 2.2, these predetermined features do explain a substantial amount of the variation in spending; the standard deviation for the full period falls from $10.5 to $4.4 million. Interestingly, when we consider just the 1970–1993 period, in which we hypothesize that a new policy regime has taken hold, the standard deviation of the residual is substantially closer to the unconditional standard deviation of raw spending ($10.2 million for the residual versus $16.1 million). Relative to the full period, the interquartile range and particularly the 90-10 difference are larger.

The following rows test whether the residuals estimated in the second row change substantially as we include additional covariates. In the third row, we add controls for all the predetermined characteristics squared and report results for the resulting residuals. Regardless of the time period, the variation in the residual changes very little, suggesting that the linear specification soaks up the bulk of the variation related to the predetermined characteristics. In the next row we evaluate whether variation in the residual could be driven by variation in the number of lanes per highway across states. Ideally, our dependent variable would be spending per lane mile, but data on the initial number of lanes constructed are not available for the first part of our analysis period. Instead, we add a control for the average number of lanes per highway in a state. This adds no explanatory power to the regression—the R^2 does not change—and the variation in the residuals is also virtually identical to the previous specification. This holds both for the full period and for the second half.

Alternatively, one might be concerned that these results are driven by a few high outliers, visible in both figures 2.1 and 2.2. To assess the role of outliers, we drop the states with the two highest values of spending per mile and reestimate equation (1) using the covariates from the previous row. While the standard deviation and the difference between the 90th and 10th percentiles both decline, the interquartile range is little changed, suggesting that the residuals for most observations are not driven by a particular relationship between the covariates and the very largest observations.

Another way to test whether these residuals are driven by underlying state features or by temporal vagaries is to assess whether states' residuals persist over time. As we discussed earlier, in other work we argue that there was a regime shift in spending that takes place around 1970. Because of this, the correlation between pre- and post-1970 residuals may be small. However, if state-specific factors such as procurement practices or industrial composition determine costs in the post-1970 regime, we should expect persistence in residuals within this latter period.

A. 1956 to 1969 versus 1970 to 1993



B. 1970 to 1981 versus 1982 to 1993

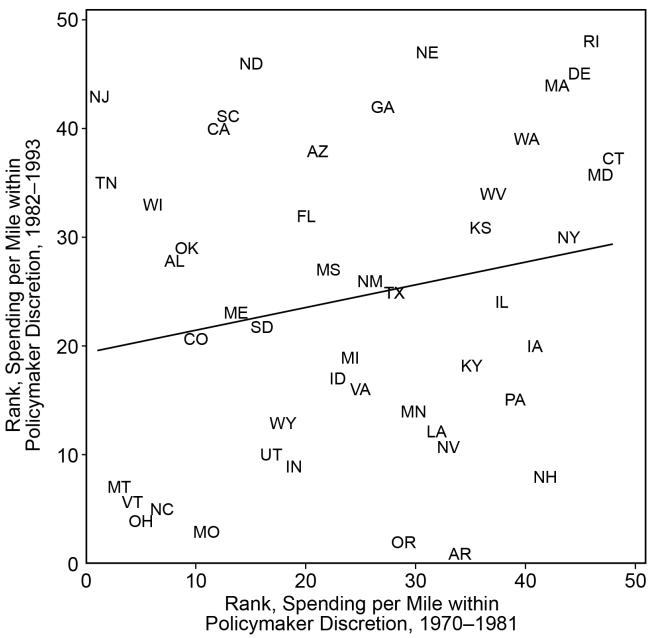


Fig. 2.5 Correlation state rank, spending per mile subject to policy maker discretion

Note: This figure presents state ranks in spending per mile, conditional on preexisting features. Panel A shows these ranks before 1970 (horizontal axis) and 1970 onward (vertical axis). Panel B shows these ranks between 1970 and 1981 (horizontal axis) and 1982 to 1993 (vertical axis).

Panel A of figure 2.5 plots each state's residual rank from 1956 to 1969; the vertical axis plots the residual rank from 1970 to 1993. We use ranks, rather than absolute magnitudes, to visually abstract from large outliers. As the figure shows, this correlation is small and actually negative ($\rho = -0.03$), consistent with a regime change in Interstate spending.

The pattern post-1970 is strikingly different. Panel B of figure 2.5 uses the same scheme but reports ranks from 1970 to 1981 on the horizontal axis and 1982 to 1993 on the vertical axis. Here the correlation is positive ($\rho = 0.2$), as we would anticipate if underlying state features drive spending.

2.3.4 Spending Due to Policy Maker Discretion and Related Private and Public Spending

Having created these residual measures of spending to reflect governance choices, we now turn to whether this residual variation is large or exceptional. We begin by comparing spending due to policy maker discretion with relevant private and public spending. The goal of this comparison is to illuminate possible common drivers of Interstate spending.

To make this comparison, we estimate regressions of the form

$$\text{spending per mile}_s = \beta_0 + \beta_1 G_s + \beta_2 C_s + \varepsilon_s. \quad (2.2)$$

The dependent variable is state Interstate spending per mile over either the entire 1956–1993 period or over the 1970–1993 period. As before, G_s is the vector of the three key predetermined features as defined for equation (1). We denote additional covariates as C_s. As in table 2.2, we measure this residual variation in three ways: the standard deviation of the residuals; the difference between the 75th and 25th percentiles of the residual distribution; and the difference between the 90th and 10th percentiles of the residual distribution.

The first row in the top panel of table 2.3 repeats the second row of table 2.2 for comparison with the other results. The inclusion of predetermined features explains 84 percent of the variation in spending for the full period, as shown by the R^2 in column 3. The standard deviation of the residuals falls by more than half to \$4.4 million (column 4; relative to a raw mean spending of \$11.5 million per mile in table 2.1). The other measures of residual variation shrink by even larger shares.

The first row in the bottom panel of this table shows analogous figures for the second half of the period. The raw cross-state variation in spending for this period is larger: the standard deviation of \$16.1 for the second period is larger than the standard deviation of \$10.5 for the entire period. The predetermined covariates explain less of the overall spending in this later period (R^2 of 0.67 versus 0.84). The first row in each panel serves as the baseline to which we compare whether other spending explains a meaningful portion of spending due to policy maker discretion.

Table 2.3 **Relationship between Interstate spending per new mile and public and private spending**

	Coefficient (1)	Standard error (2)	R^2 (3)	Residual variation: Standard deviation (4)	Residual variation: p75 – p25 (5)	Residual variation: p90 – p10 (6)
Interstate spending per mile: entire period, 1956–1993						
Predetermined characteristics			0.84	4.37	3.25	8.16
Predetermined characteristics and						
Private spending						
Construction spending, 1993 = 100	0.03	0.10	0.84	4.34	3.18	7.99
Health insurance per user, 2001, $1000s	−0.34	1.99	0.84	4.38	3.27	8.02
Public spending, all $1,000s						
Medicaid per enrollee, 1991	−0.23	0.22	0.84	4.42	3.67	8.17
Medicare per enrollee, 1991	1.29**	0.47	0.85	3.93	3.2	7.86
Local government expenditure per capita	−0.32	0.36	0.84	4.46	3.63	8.64
Interstate spending per mile: second period, 1970–1993						
Predetermined characteristics			0.67	10.23	8.00	16.40
Predetermined characteristics and						
Private spending						
Construction spending, 1993 = 100	0.51**	0.20	0.74	8.78	7.97	16.44
Health insurance per user, 2001, $1000s	8.66*	4.99	0.70	9.68	7.27	14.62
Public spending, all $1,000s						
Medicaid per enrollee, 1991	0.46	0.46	0.68	10.06	8.08	16.56
Medicare per enrollee, 1991	3.37**	1.00	0.72	9.69	7.06	15.59
Local government expenditure per capita	1.13**	0.57	0.69	10.06	7.67	14.13

Note: All rows contain 48 observations. ***Statistically significant at the 1 percent level. **Statistically significant at the 5 percent level. *Statistically significant at the 10 percent level. All regressions are weighted by Interstate miles constructed. The first row in each panel reports a regression of Interstate spending per mile on a constant and the three predetermined characteristics discussed in the text. All rows in each panel following "Geographic covariates and" report results from the estimation of Interstate spending per mile on geographic covariates and the named covariate (as in equation 2.2).

Our first additional covariate is private construction spending. This comparison to private costs tests whether Interstate spending per mile is higher in, for example, New Jersey or Connecticut because costs are generally higher in these states or because of other factors specific to the Interstates. If construction labor costs are generally higher in New Jersey, Interstate spending per mile should be related to private construction costs, as they both include these higher labor costs. Said differently, if construction costs matter to both, a control for private construction costs in equation (2) should substantially decrease the variation in the residual.

We measure construction costs via a constant quality index (see data section and appendix for more details). The second row of the top part of the table shows that there is virtually no relationship between the variation in private construction costs and Interstate spending per mile for the 1956–1993 period—despite the fact that both operate in similar markets. This is consistent with the result in Brooks and Liscow (2020) that cross-state variation in labor costs explains none of the temporal increase in Interstate spending per mile. The coefficient on residential private construction costs is small and very imprecisely estimated; the measures of residual variance are barely changed by the addition of this additional covariate.

This finding is somewhat different in the 1970–1993 period; here private construction costs are significantly and positively related to Interstate spending. A two-unit increase in the private residential construction index (about one-third of the interquartile range for this variable) is associated with $1 million additional Interstate spending per mile.

We can get at this same issue by evaluating whether, if highway spending varied across states in the same pattern as private construction costs, there would be any cross-state variation in Interstate spending left. We use a constrained regression to ask this question. We specify both the Interstate spending per mile and the construction cost index in logs so that no variation in excess of construction cost implies a coefficient of one. Estimating this log-log regression with the coefficient on private construction costs fixed at one, we find results very similar to the conclusions from table 2.3. This restriction has very little impact on the remaining variance in spending subject to policy maker discretion. Thus, the cross-state pattern of Interstate spending differs from that of residential private construction.

Another private cost that varies substantially across space is health care. If the regulatory environment that drives health spending also drives Interstate spending, we would expect to see a large drop in the residual with the inclusion of private health care costs. These private health care costs are expenditures by individuals and insurance companies for health care, including premiums and health care expenses, as well as administrative expenses by health insurers. For the full period, we find an imprecise correlation between private health insurance expenditures per user from 2001 (the earliest available year) and spending due to policy maker discretion. Costliness of private care may speak to the regulatory environment in the state. However, we see no strong relationship between highway spending and private health insurance expenses, as standard errors are large.

However, in the 1970–1993 period, this relationship strengthens substantially. An additional $250 in private insurance spending—the magnitude of the interquartile range—is associated with slightly more than $2 million more in Interstate spending per mile. This is about 14 percent of mean Interstate spending per mile. This is suggestive evidence that there may be common factors driving up both types of spending. However, the residuals change only modestly. For example, the standard deviation of the residuals falls from $10.3 to $9.68. Thus, there seem unlikely to be critical common drivers for these two types of spending.

With these mixed findings in hand, we now turn to public spending, which has different drivers than private spending does and which may therefore suggest different drivers in Interstate spending. We start with spending on Medicare per enrollee. Medicare funding decisions are almost exclusively federal. States have no control over what or how much the system covers, nor do they bear any fiscal liability for the program. Yet there is local variation: federal decisions manifest locally through the choices of patients, hospitals, and health care providers. In addition, Medicare reimbursement rates vary regionally.

Although there is a near vacuum in work on the geographic variation in highway costs, the geographic variation in Medicare has been studied intensely (see Cutler and Sheiner 1999; Martin et al. 2007; Wennberg and Gittelsohn 1973). The most prominent strand of the literature, led largely by researchers at Dartmouth, argues that there is substantial unexplained variation in Medicare costs. In implementing these studies, researchers usually adjust spending for Medicare prices, so that the effects are driven by the quantity of procedures, rather than the price of procedures (Skinner and Fisher 2010). Variation in prices is mechanical, because the federal government sets Medicare reimbursement rates. Quantity differences in health care, however, could be driven by, for example, different physician practice styles across the country.

The overview in Congressional Budget Office (2008) divides the drivers of Medicare spending into four main categories: prices; health and illness status; regional preferences about the use of healthcare services; and residual variation. The summary of the literature suggests unsurprisingly that price is not a major driver. While this literature argues that regional variation in individual preferences for care is generally not a large driver, the report acknowledges that it is very difficult to measure regional preferences and that demographics' ability to explain preferences may be limited. This literature points out that the unexplained variation is large and that addressing factors that cause the variation, such as physician practices, could yield large savings in the program.

A host of more recent work builds on these findings. For example, Gottlieb and colleagues (2010) analyze Medicare spending after adjusting for local price differences and find that utilization—not prices—drives Medicare spending. Finkelstein, Gentzkow, and Williams (2016) also find an important role for place-based variation. They use patient migration to show that "40 to 50 percent of geographic variation in utilization is attributable to demand-side factors, including health and preferences, with the remainder due to place-specific supply factors." Similarly, Molitor (2018) shows that physicians change practice styles after moving and estimates that place can explain between 60 to 80 percent of physician practice differences.

In contrast, Sheiner (2014) argues that using state-level Medicare spending data—like the data we use in this chapter—and a very limited set of state health status controls can explain a large amount of the cross-sectional variation in Medicare spending. She takes this as evidence that differing practice styles do not explain a large amount of variation in spending. Further, she is skeptical of the ability of geographic variation in Medicare spending to illuminate "inefficiencies in our healthcare system" (1). Our work addresses part of this concern. If spending of multiple types is consistently high in some states, it may suggest which factors are at work.

We correlate Interstate spending per mile with Medicare spending per enrollee in 1991, the earliest year with digitized costs. Interestingly, Medicare spending is statistically significantly related to Interstate spending; it is also the only variable in the table that yields a notable decrease in Interstate spending residuals. For each additional $1,000 of Medicare spending—an amount slightly smaller than the interquartile range for this variable—a state spends an additional $1.3 million dollars to build an Interstate mile. This $1.3 million is roughly 10 percent of the average state expenditure per mile. Comparing the final two columns of the table, it is clear that this stems from the explanatory power at the tails of the state spending distribution.

This relationship only strengthens in the second period. An additional $1,000 of Medicare spending—four-fifths of the interquartile range—is associated with an additional $3.4 million dollars in spending per mile, compared with an average of $15.2 million per mile. An additional $1,000 of local government spending—roughly three-fifths of the interquartile range—is associated with $1.1 million additional spending per mile. Medicare spending reduces the residual variation in the middle of the distribution (columns 4 and 5, standard deviation and interquartile range), whereas local government spending is more tied to reductions in residual variation at the tails of the distribution (column 6, 90-10 percentile difference).

Of all the variables we consider in this section, Medicare is the most strongly and significantly related to Interstate spending. To better understand the relationship with Medicare, figure 2.6 shows the raw correlation between Interstate spending per mile from 1970 to 1993 on the horizontal axis and Medicare spending per enrollee on the vertical axis. The two series are clearly related, particularly at the high end of spending. The distribu-

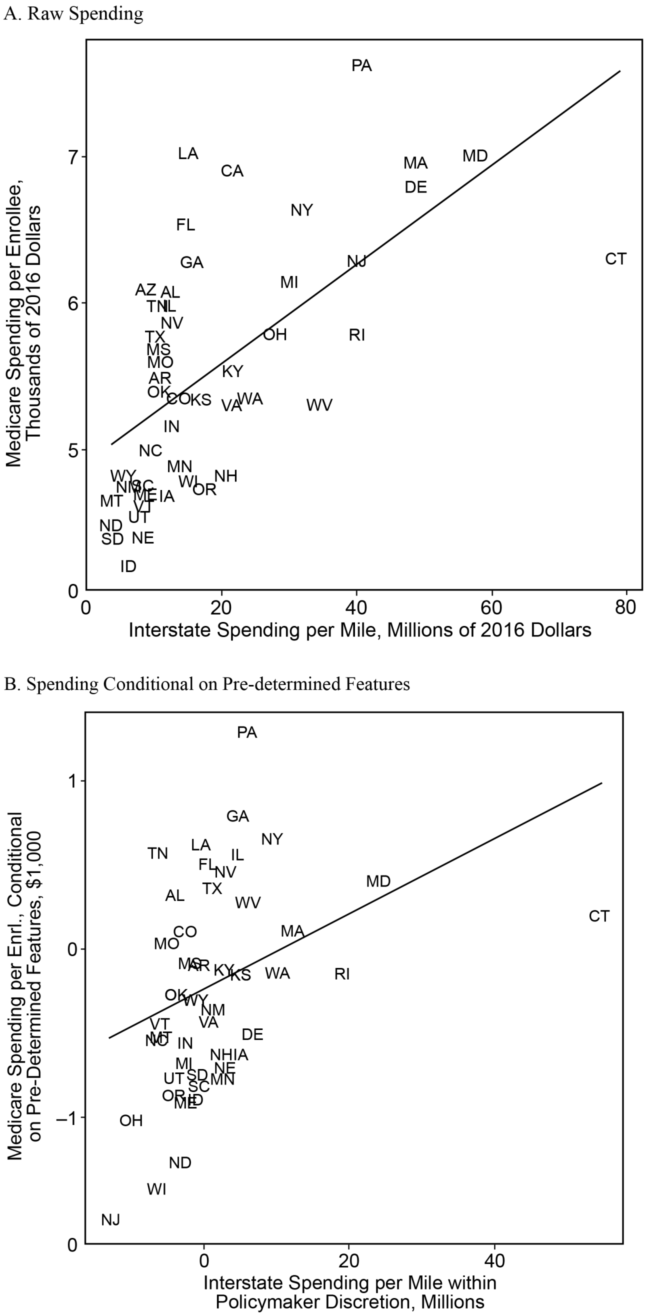


Fig. 2.6 Correlation, Interstate spending per mile and Medicare spending per enrollee

Note: Panel A shows the relationship between Interstate spending per mile after 1970 (horizontal axis) and Medicare spending per enrollee in 1991 (vertical axis; both in 2016 dollars). Panel B shows these two measures conditional on the three geographic covariates that we use throughout.

tion of Medicare spending is substantially less skewed than the distribution of Interstate spending. Panel B shows this relationship conditional on the geographic covariates; both axes present residuals.[8] The positive correlation remains, as does the much less symmetric distribution of Interstate spending.

We do not believe that Medicare spending drives Interstate spending. However, the correlation does suggest some common cost drivers. For example, the same institutional features that lead some states to consume large quantities of health services, such as second opinions, may also lead them to use more features, such as noise walls, on Interstates.

In contrast to Medicare, Medicaid decisions include substantial state discretion, subject to federal rules. States have some ability to choose who is covered, above certain minimum limits, and to expand the type of coverage. In form, the Interstate program is probably closer to Medicare, in the sense that states cannot limit coverage—if we analogize coverage to Interstate miles that the state must construct. However, states can provide Interstate quality above the minimum bar, as states can provide health care above a required minimum for Medicaid.

However, the Medicaid program, with substantially more state discretion, has virtually no relationship with Interstate spending and makes no meaningful change to the residual variance. This lack of a meaningful relationship holds for the second period as well.

We also evaluate whether general patterns of state fiscal behavior can explain Interstate spending. Perhaps states are high spending in all dimensions, and Interstate spending is a reflection of this general pattern. To test this hypothesis, we condition on overall state and local spending. To abstract from institutional differences in government organization across states, we use state aggregate spending.[9] This measure of total expenditure per capita is not statistically related to per mile Interstate spending; its inclusion actually slightly increases variation in the residuals. Therefore, if there is a common component that drives Interstate spending per mile and local government expenditure per capita, this component has little impact on local spending.

One might also hypothesize that particular categories of local spending, rather than public spending overall, might be related to Interstate spending and illuminate common cost drivers. In table 2A.3 we also consider the two key discretionary categories of local government: education spending and capital spending. Neither of these is statistically related to Interstate spending per mile, nor does either have any appreciable impact on the residual variation.

8. Because these regressions are weighted by miles constructed, the average of the points in the figures may not average to zero when not weighted.

9. Because the digital Census of Governments does not have state governments in 1967, we make an additional measure that uses data from Census years (ending in 2 and 7) from 1967 to 1992, but excludes state governments; this is "Local (no state) expenditure per capita, $1,000s." Results with this measure are in table 2A.3.

While we have considered each spending covariate independently, this may mask some interesting covariation across spending types and with Interstate spending. Table 2A.2 shows specifications with covariates standardized, so readers can compare their relative influence and specifications with all spending covariates entered jointly, both for the full period and the latter half. Regardless, Medicare per enrollee remains the category with the strongest and most precisely estimated relationship to Interstate spending per mile.

Finally, Interstate spending per mile has high cross-state variation. Table 2A.1 shows the coefficients of variation for all relevant variables. The only spending variable we analyze that has a higher coefficient of variation than Interstate spending per new mile is Interstate maintenance spending per mile. In particular, the coefficient of variation in Interstate spending is 0.58—about four times that of Medicare per enrollee and twice that of Medicaid per enrollee. This pattern remains even after controlling for predetermined features; dividing the residual standard deviation by the mean spending per mile produces 0.38,[10] considerably higher than forms of spending other than highway maintenance. This difference is even larger for the higher-variance 1970–1993 period.

In sum, there is substantial cross-state variation in Interstate spending per mile. When we restrict to the variation within policy maker control, the variation is somewhat diminished but still economically meaningful. The geographic pattern of spending subject to policy maker discretion is most related to Medicare spending per enrollee, potentially highlighting a common mechanism.

2.4 Root Causes of Variation in Interstate Spending

In this section, we review evidence on root cause drivers of infrastructure spending. Unlike the attention given to health spending, outside of some popular press profiles, there has been very limited work on the geographic variation in infrastructure spending. *New York* magazine profiled New York City's new transport infrastructure and found that for the same amount of money, New York gets "four new miles of tunneled LIRR (Long Island Rail Road) route and one new terminal station" while "London will get 14 miles serving seven stations" (Barro 2019b).[11] The article provides examples of high labor costs—many hours worked, if not necessarily high hourly wages—and high costs of coordination across governments.

In an equally eye-popping result, Gordon and Schleicher (2015) find that the US leads the world in the cost of building new rail. These authors rule

10. Recall that the coefficient of variation is simply the standard deviation of a distribution divided by its mean.

11. Rosenthal (2019) presents a similar example in the *New York Times*.

out a number of obvious suspects for these high costs: land, labor costs, and a decentralized system of infrastructure creation. The Reason Foundation also provides a state-level ranking of road spending, which highlights the declining quality of US road infrastructure, along with its increasing costs (see, for example, Feigenbaum, Fields, and Purnell 2019).

The General Accountability Office was recently tasked by Congress to undertake an assessment of what makes US infrastructure costly relative to other advanced economies. Taken as a whole, the report punts, suggesting that no comparisons are possible until agencies do a better job collecting cost information (Barro 2019a; General Accountability Office 2019). Indeed, at a November 2019 Transportation Review Board convening that Brooks attended, a top Federal Highway Administration (FHWA) official acknowledged that while FHWA monitors spending, it does not track costs on a per-project basis.

Broadly, there are many potential drivers of infrastructure spending. McKinsey Global Institute (2013) divides these drivers into seven categories. The first is technical explanations, including design standards, the type and location of projects, materials costs, and economies of scale. We choose the Interstate system in part to abstract from some of these technical concerns: design standards are set nationally and, to the extent that materials are a national market, our comparison is net of these costs. In Brooks and Liscow (2020) we find very little temporal variation in materials costs.

As the Interstate project drew to a close, fixed costs may have grown relative to variable costs. While this is an issue for a temporal analysis, it matters for cross-state variation only if these fixed costs were relatively larger in some states. This seems possible, but none of our data can speak to this question.

More generally, Flyvbjerg, Holm, and Buhl (2004) examined 258 rail, bridge, tunnel, and road projects from around the world, finding that projects have grown larger over time. For bridges and tunnels, they find that larger projects are associated with higher cost overruns, so a trend toward larger projects could be one reason that costs have grown. However, this only seems to hold true for bridges and tunnels. In their dataset, larger road projects (without bridges and tunnels) were not associated with higher cost overruns. In a study of cost overruns for Norwegian roads, Odeck (2004) found that overruns occur more frequently with smaller road projects. He attributes this finding to reduced economies of scale.

A second potentially important driver, also not relevant for our cross-state Interstate comparison, consists of the restrictions implicit in a funding source. Since the Interstate system follows a similar funding scheme across states, funding restrictions are unlikely to be a major driver of cross-state variation. In other types of projects, however, funding limitations or restrictions may limit some states' ability or incentive to make the long-term commitments that lead to low-cost projects. In addition, funding restrictions could increase costs across the board, without increasing cross-state variation.

A third potential driver is the market structure of the construction industry and the government's bidding and procurement practices. If the construction industry is more concentrated in some states, this could yield higher bids and therefore higher costs. For the state of Indiana, Kishore and Abraham (2009, 2) note a decline in the average number of bids on road projects, from 4.2 in 2001 to 3.6 in 2005. They attribute the decline in bids to consolidation among contractors, increased work with repeat contractors, and frequent delays that discourage contractors from bidding on state projects in the future. Many other bidding and procurement practices—such as the mandatory choice of the low-cost bid or Buy American provisions—are unique to US projects but constant across states, so they cannot explain the variation we document here (Davis 2017; Intueor Consulting 2016).

Fourth, labor costs are a potential driver of spending. Over the past 20 years, construction productivity has been flat as overall productivity has increased (McKinsey Global Institute 2013, 31). In the cross-state context, this could drive results if the change in productivity varies across state, which seems possible. Brooks and Liscow (2020) show that construction wages are roughly flat over time, so the price of labor does not explain the temporal increase in infrastructure cost. Further, labor's share of Interstate spending actually declines somewhat, suggesting that labor quantities are not a disproportionate cost driver.

All US states are subject to the Davis-Bacon Act of 1931, which requires the payment of "prevailing wages" on public projects. Findings on the role of Davis-Bacon in raising overall costs are mixed. In an early and influential study, Fraundorf, Norby, and Farrell (1984) found that Davis-Bacon adds about 26 percent to overall construction costs for new, non-residential buildings. Dunn, Quigley, and Rosenthal (2005) found that the California prevailing wage law led to an increase of between 9 and 37 percent in the cost of building subsidized housing.

However, this overall finding is not unanimous in the literature. Azari-Rad, Philips, and Prus (2003) criticized the early findings of Fraundorf, Norby, and Farrell (1984), pointing out that labor accounts for only a third of overall construction costs, making the 26 percent estimate seem implausible. The study of school construction costs by Azari-Rad, Philips, and Prus (2003) found no statistically significant difference between the cost of constructing schools across states with and without labor agreements.

Examining 10 years of Colorado road maintenance contracts, Duncan (2015) made similar findings. Duncan compared projects built with federal money, which are subject to both Davis-Bacon and Disadvantaged Business Enterprise (DBE) requirements, to locally funded projects. He found no difference in repaving costs, despite the different prevailing wage law and DBE requirements. He points out, however, that Colorado as a state has low rates of unionization in the construction industry, and thus Davis-Bacon may not substantially alter labor costs for highway contracts.

A fifth, oft-cited potential cause of high costs is the regulatory environment for large construction projects, including, but not limited to, environmental regulation, litigation threat, and eminent domain costs. While all Interstate projects are subject to review under the National Environmental Policy Act of 1969 (NEPA), regional variation in enforcement—or enforcement via threat of litigation—is likely.

More generally, Brooks and Liscow (2020) show that the rise of "citizen voice," which dramatically shifted the regulatory environment by allowing affected citizens more direct sway over government decision-making because of new statutes, judicial doctrine, and social movements, is consistent in timing and magnitude with the increase in infrastructure spending. In particular, proxies for economic and political power—income and housing prices—statistically explain much of the increase in Interstate spending, but only after 1970. Consistent with this, we see a pronounced rise, after the 1970s, in ancillary structures that reduce local impacts (for example, noise walls). We also see a notable increase post-1970 in politicians' joint discussion of environment and the Interstate, as measured by text from the Congressional Record.

By construction, environmental regulation is designed to raise project costs by forcing builders to internalize the negative externalities from their construction. The policy question is then whether these regulations increase costs above and beyond this internalizing of externalities. Hecht and Niemeier (2002) made use of the fact that many projects in California receive categorical exemptions from NEPA requirements to estimate the costs of completing an environmental impact statement. They found that the cost of completing an environmental impact statement can come close to matching the rest of the costs associated with the initial project design phase. In addition to the direct costs of litigation, Todorovich and Schned (2012) state that threat of litigation leads to expensive environmental impact statements that are overly technical.[12]

It is also possible that eminent domain costs could vary across states. Gordon and Schleicher (2015) identify the US, UK, Australia, and New Zealand as common-law countries with high infrastructure costs. They suggest that common-law countries may provide property owners with particularly strong protections that drive up the cost of eminent domain. However, the combination is not necessarily decisive. The authors note that countries such as Germany have strong property rights protections and per-unit infrastructure spending that is lower than in the US. Brooks and Liscow (2020) argue

12. Cordes and Weisbrod (1979) show that a requirement to better compensate those harmed by Interstate construction led to meaningful changes in program implementation.

that common law alone is insufficient to explain the rise in US per-unit infrastructure spending. During the period that per-unit infrastructure spending is rising, the US was (and is) a common-law country. Thus, common law alone, absent an interaction with some additional institutional feature, cannot be a sufficient explanation. Brooks and Liscow (2020) also suggest that land costs do not drive the increase in Interstate spending, since the share spent by states on land and planning declines over time.

In addition to these regulatory costs, other political institutions are a sixth potential driver of increased Interstate spending. Broadly, economists believe that institutions play a crucial role in determining state spending levels (see review in Besley and Case 2003). Ideology also plays a role in spending decisions, and empirical work suggests that ideology plays a greater role as income increases (Pickering and Rockey 2013). Brooks and Liscow (2020) find no relationship between changes in the specific institution of governmental fragmentation and increases in Interstate spending per mile.

Finally, project management is the seventh factor that could drive cost variation. There is a suggestion in the literature that management is very important, but work on quantitative classification is very limited. Many articles cite mismanagement as a major factor in delays and overruns. For example, Todorovich and Schned (2012, 5) attributes many delays in the NEPA process to "administrative process bottlenecks, project management failings, or a lack of capacity among the agencies involved in the process."

A large number of factors influence project management, including staff experience, institutional culture, and political will. Hecht and Niemeier (2002, 352) surveyed employees of the California Department of Transportation and found that fewer than 2 percent of employees felt that their agency would reward them for reducing the time or cost of a project—even with simple rewards like recognition.

And these are merely the major drivers in a retrospective sense. Looking prospectively, Winston (2013) highlights a number of technological innovations—most important among them the driverless car—that have the potential to decrease cost.

2.5 Interstate Spending: Evidence on Root Causes and Consequences

While our data do not afford relevant variation to identify causal effects, in this section we present correlations between some of the root causes from the previous section and Interstate spending per mile. We conclude by evaluating whether Interstate spending per mile is correlated with outcomes, such as accidents or maintenance spending.

2.5.1 Highway Spending and Potential Drivers

As our literature review covers more cost drivers than we have degrees of freedom—we have evidence from 48 states—we now turn to assessing the relationship between Interstate spending per mile and a few salient or well-measured potential cost drivers. As before, the dependent variable is spending per mile (in millions of 2016 dollars), and we condition on our three predetermined characteristics (slope, population density, and water and wetlands).

We focus here on the second period, 1970–1993, when Interstate spending variation is larger (the analogous table for the full period is table 2A.4). We focus on demand for Interstate quality and on wages and politics. In table 2.4 we report regressions where each variable enters individually (columns 1 and 3) and where all variables enter jointly (columns 2 and 4). To ease interpretation of levels, columns 1 and 2 show results for unstandardized variables; to ease relative comparisons, columns 3 and 4 report coefficients for standardized variables. In addition to the coefficient and standard error, we also report the standard deviation of the residuals and the interquartile range for the residuals, since we wish to understand how much cross-state variation remains.

The first two rows test the root cause that wealthier citizens prefer "more" highway, in the sense of having a safer, less physically disruptive, or less noisy main artery. We proxy for these demand factors with the share of people age 26 and above with at least a high school education and real median family income. While both variables have positive coefficients, indicating more spending in places with more educated populaces and higher income populations, neither of these factors is related in any sharp way with Interstate spending per mile.[13]

The evidence presented in Brooks and Liscow (2020) suggests that wages do not drive cross-state variation, consistent with our finding here in the third set of rows of the table. We use annual wages from the County Business Patterns data (see data appendix for details) and see a small, positive, and imprecisely related relationship between wages and cross-state spending.

As discussed later, management could play a significant role in cost containment. The second-to-last set of rows in this table use a measure of the most pathological form of mismanagement: corruption. We measure corruption via an index from Boylan and Long (2003), who surveyed statehouse reporters to generate a cross-state measure of corruption. This measure is a normalized average of reporter responses and ranges between −2 and 2. While this measure of corruption is not individually related to highway spending per mile, in the joint estimation, we do find that states where reporters perceive more corruption have higher spending. A change in corruption equal to the interquartile range (0.68) yields an additional $1.7 million dollars of spending per mile.

Political taste in willingness to spend public funds is another possibility. The final row in table 2.4 looks at the impact of the Democratic presidential

13. Some findings from the cross section here differ from results in Brooks and Liscow (2020). Here we rely on purely cross-sectional variation. Our related paper relies on within state changes, using a specification with state and period fixed effects. These two different sources of variation yield different conclusions.

Table 2.4 Spending per mile and potential explanations, 1970– 1993

	Unstandardized variables		Standardized variables	
	Variables enter		Variables enter	
	Individually (1)	Jointly (2)	Individually (3)	Jointly (4)
Share high school graduates	0.10	0.16	0.79	1.24
	(0.12)	(0.18)	(0.97)	(1.40)
Residuals: standard dev.	10.10		10.10	
Residuals: Q75 – Q25	7.57		7.57	
Real median family income, $10,000s	1.74	1.25	1.46	1.05
	(1.30)	(2.18)	(1.09)	(1.83)
	9.89		9.89	
	8.85		8.85	
Real construction wage	0.21	–0.07	1.55	–0.55
	(0.13)	(0.20)	(0.96)	(1.48)
	10.09		10.09	
	8.25		8.25	
Corruption index	1.79	2.51*	1.27	1.79*
	(1.47)	(1.49)	(1.05)	(1.06)
	9.96		9.96	
	6.42		6.42	
Democratic presidential vote share	0.44**	0.55**	2.39**	2.95**
	(0.20)	(0.24)	(1.09)	(1.28)
	9.82		9.82	
	15.49		15.49	
Overall				
Standard deviation of residuals		8.93		8.93
Diff: p75–p25		6.62		6.62

Note: All specifications contain 48 observations and condition on the three predetermined characteristics we discuss in the text. ***Statistically significant at the 1 percent level. **Statistically significant at the 5 percent level. *Statistically significant at the 10 percent level. All regressions are weighted by Interstate miles constructed and use data from the period from 1970 to 1993. The first column in the table reports results for separate estimations of equation 2.2. Below the standard error, we report the standard deviation of residuals and then interquartile range of the residual. The second column report results from a regression when we include all covariates together. The final two rows report summary statistics for the residual from this regression. Columns 3 and 4 have a parallel organization but report results for variables standardized to mean zero standard deviation one to ease cross-variable comparisons.

vote share from 1970 to 1993 (see appendix for construction details). Note that most of this period has a somewhat different political alignment than the present: the South was largely Democratic, and the Northeast substantially more Republican. With this caveat in mind, we see that a 5.6 percentage point increase in the Democratic presidential vote share, a change of one standard deviation, is related to a $3.1 million dollar increase in spending per Interstate mile (column 2).

Overall, most of these covariates have no substantive impact on the residual variation, measured as either the standard deviation of the residuals or the interquartile range of the residuals (the two rows below the coefficient and the standard error for each variable). Nevertheless, states that have a higher Democratic presidential vote share and (more tenuously) states that are rated as more corrupt seem to spend more on Interstates per mile. While we are cautious in our interpretation, given the lack of exogenous variation, these correlations may point the way for future research.

2.5.2 How Does Spending Relate to Outcomes?

If states are spending more on Interstate Highways but are in some sense "getting more"—safer or longer-lasting roads—the cross-state variation in governance choices may have fewer lessons for cost containment. In table 2.5 we assess whether state spending is correlated with measurable highway outcomes. As in the previous table, the top panel covers the entire period and the bottom panel the higher variance second period. The first two rows of each panel of the table repeat the first two rows of each panel of table 2.3 for reference. Over the entire period, controlling for fatalities per hundreds of millions of vehicle miles traveled (VMT) has no additional explanatory power for the variance in state spending—doing so in fact raises the residual variation at the tails of the distribution. Accidents per 100,000 of VMT have similarly no relationship with Interstate spending per mile.

States that spend more money to build a new Interstate mile also spend more to maintain those miles, as measured by per-mile maintenance costs per state in 2015. Over the entire period, each additional million dollars of maintenance per mile is associated with an additional $200,000 dollars of initial highway construction. Although this is a statistically significant relationship, the relationship accounts for very little of the residual variation in spending, either as measured by R^2 (84 to 85), or by the change in the standard deviation of the residuals (4.4 versus 4.5).

This pattern is similar when we limit the analysis to the second period, 1970–1993. States with higher highway maintenance expenditures are those that initially spent more per mile. This variation now does seem to explain some portion of the variation in the residual at the tails. However, unlike for the overall period, there is a negative and significant relationship between fatalities per vehicle mile traveled on Interstates and construction spending per mile. Reducing fatalities by the amount of the interquartile range—0.55 per 100 million vehicle miles traveled—is associated with $2.5 million dollars of additional Interstate spending per mile, or about 15 percent of the mean. This is some of the first statistical evidence of a positive outcome associated with increased highway spending.

2.6 Discussion and Conclusion

In this chapter, we show that the geographic variation in Interstate spending per mile is large. If states in the top half of the spending distribution had

Table 2.5 Relationship between spending per mile and highway outcomes

	Coefficient (1)	Standard error (2)	R^2 (3)	Residual variation: Standard deviation (4)	Residual variation: p75 – p25 (5)	Residual variation: p90 – p10 (6)
Interstate spending per mile: entire period, 1956–1993						
Predetermined characteristics			0.84	4.37	3.25	8.16
Predetermined characteristics and highway outcome						
Fatalities per 100m miles of VMT	−1.39	1.04	0.84	4.23	3.64	8.38
Accidents per 1m miles of VMT	−0.05	0.22	0.83	4.41	3.18	8.28
Highway maintenance per mile, millions	0.21**	0.08	0.85	4.50	3.02	7.41
Interstate spending per mile: second period, 1970−1993						
Predetermined characteristics			0.67	10.23	8.00	16.40
Predetermined characteristics and highway outcome						
Fatalities per 100m miles of VMT	−4.51**	2.20	0.69	10.29	7.64	16.81
Accidents per 100,000 miles of VMT	0.26	0.46	0.66	10.23	7.85	15.13
Highway maintenance per mile, millions	0.44**	0.20	0.7	10.06	7.56	13.80

Note: All rows contain 48 observations, except for accidents, which has 47. ***Statistically significant at the 1 percent level. **Statistically significant at the 5 percent level. *Statistically significant at the 10 percent level. All regressions are weighted by Interstate miles constructed. The first row in each panel reports results from a regression of Interstate spending per mile on a constant and the three geographic covariates discussed in the text. All rows in each panel following "Predetermined characteristics and" report results from the estimation of Interstate spending per mile on predetermined characteristics and the named covariate (as in equation 2.2).

capped their spending at the median, the Interstate system would have cost 40 percent less to build. Furthermore, the coefficient of variation in Interstate spending is unusually large—considerably larger than for other forms of government spending. The high relative variance in Interstate spending per new mile remains even when we limit the analysis to spending within policy maker discretion—that is, spending net of predetermined route features. While we have done our best to control for features that determine spending and are outside of policy maker control, it is still possible that we have failed to control for all such determinants. However, the variation in Interstate spending per mile net of policy maker discretion we estimate is very large. It is at least as economically meaningful as the variation in other categories of spending, such as Medicare, to which economists have devoted reams of papers.

In addition, we show that the geographic pattern in spending per Interstate mile is related, surprisingly, to spending per Medicare enrollee. An additional $1,000 dollars of Medicare spending is associated with an additional $1.3 million dollars of Interstate spending per mile, or about 10 percent of the mean.

In Brooks and Liscow (2020), we show that temporal increases in the cost of constructing a new Interstate mile are driven by input quantities rather than prices. Our primary evidence for this conclusion is twofold: nationally, real prices for labor and materials change little from 1956 to 1993, and cross-state variation in labor prices is not correlated with Interstate spending. Our finding is very similar to the argument in the Medicare spending literature that it is quantities, rather than prices that drive variation in spending (see Finkelstein, Gentzkow, and Williams 2016; Gottlieb et al. 2010; and others). These results suggest that some common feature or features may drive "more" provision—both higher Medicare spending and higher infrastructure spending.

While we have no direct evidence on what these features are, we offer two speculative and related hypotheses. First, higher average incomes in a state, by increasing demand, could drive the provision of "more." This hypothesis is consistent with Brooks and Liscow (2020), in which we show that increases in incomes and housing values statistically explain the entire increase in Interstate spending per mile over the period. We also show that costly features that mitigate the local costs of the Interstate, such as noise walls, are substantially more common in the citizen voice period. In health care, "more" could be more additional health care screenings, more appointments with specialists, or more luxurious hospital surroundings.

Second, and relatedly, states may differ in culture, which could consist of the underlying preferences of state citizens, the institutions that aggregate those preferences, or both. This hypothesis is consistent with some of the Medicare spending literature, which argues that higher spending is driven by a "culture of practice" (Gottlieb et al. 2010; Molitor 2018). In the Interstate realm, this would be a "culture of production," where higher production costs could be due to state procurement practices, underlying preferences of state voters, or the state-specific market concentration of construction firms.

A central concern is whether additional spending delivers additional value. The Medicare spending literature generally finds that higher treatment spending is not associated with better health outcomes; see Chandra, Sabik, and Skinner (2011) and Fisher and colleagues (2003), among many others. The picture for Interstate Highways is more nuanced. We find that more Interstate spending per mile is associated with fewer fatalities, a finding that is consistent with more spending delivering higher quality. However, more initial Interstate spending is not associated with lower future highway maintenance. The reason could be that more initially expensive highway miles are also more expensive to maintain. Alternatively, the reason could be that states that initially choose high spending also spend more on maintenance. Of course, a full analysis of quality requires a more holistic analysis that extends beyond the three factors we consider here.[14]

Any increase in the quality of US infrastructure depends crucially on managing the amount we spend per unit. Understanding what drives Interstate spending and the extent to which costs justify benefits is crucial if we seek to spend more to improve the state of US infrastructure. What precisely drives infrastructure spending remains fertile ground for future research.

Data Appendix

1. Interstate spending per mile
   See Data Appendix in Brooks and Liscow (2020).
2. Geographic features
   a. Population density
      We use tract population density, or county density when tract data are not available. See Brooks and Liscow (2020) for specific files.
   b. Slope
      We measure the average slope within 50 meters of a segment using the Digital Elevation Map from USGS, purchased in 2018.

14. While we find a correlation between Interstate spending per mile and Medicare spending per enrollee, we find no such relationship with Medicaid spending. This is consistent with an important role for income in generating spending. If higher income yields greater demand for spending, this means that it is the relatively wealthy who drive at least some of the spending increases. These relatively wealthy people are in the Medicare population. They are, however, by definition, not in the Medicaid population. This bolsters the case that part of the common driver of higher spending is higher income, or some institutional features that develop in the presence of higher-income people.

c. Wetlands

We use the length, in miles, that the segment touches wetlands, defined as any of the types of wetlands classified by the Cowardin system, from US Fish and Wildlife Service (2018) National Wetlands Inventory data set.

3. Public and private spending

a. Health care spending

We measure Medicare spending per enrollee, Medicare spending per enrollee, and private health insurance spending per enrollee from the Centers for Medicare and Medicaid Services' "Health Expenditures by State of Residence, 1991–2014." We specifically use tables 23 ("Medicare Per Enrollee State Estimates by State of Residence"), 26 ("Medicaid Per Enrollee State Estimates by State of Residence"), and 29 ("Private Health Insurance Per Enrollee State Estimates by State of Residence").

We download data from https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsStateHealthAccountsResidence.html.

The Centers for Medicare and Medicaid Services define private health insurance in the National Health Expenditure Accounts as follows: "Includes premiums paid to traditional managed care, self-insured health plans and indemnity plans. This category also includes the net cost of private health insurance which is the difference between health premiums earned and benefits incurred. The net cost consists of insurers' costs of paying bills, advertising, sales commissions, and other administrative costs; net additions to reserves; rate credits and dividends; premium taxes; and profits or losses." See https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/quickref.pdf.

b. State and local expenditures

We use the 1967, 1972, 1977, 1982, 1987, and 1992 Censuses of Governments, as compiled by Willamette University researchers Pierson, Hand, and Thompson (2015).

These data do not contain state expenditures in 1967. Thus, to be time-consistent, we create a panel of spending per census year. Specifically, we include data on total local (nonstate) spending per capita per year, parks and recreation spending per capita per year, elementary and secondary education spending both per capita and per enrollee per year, and total education spending (which includes higher education and other small categories) per capita per year.

4. Other Interstate measures

a. Highway maintenance

We rely on the 2015 *Highway Statistics* data. We create highway spending per mile using maintenance spending from table SF-4 and maintenance mileage from table HM-10.

b. Fatalities per Interstate vehicle miles traveled, 1994

We use the oldest available digital data on highway fatalities from section 5 of *Highway Statistics, 1995*. Specifically, we use "Total Rural Interstate System Fatalities and Injuries," table FI-6, and "Total Urban Interstate System Fatalities and Injuries," table FI-7.

Both tables also include vehicles traveled and are available at https://www.fhwa.dot.gov/ohim/1995/section5.htm. Fatalities are expressed per 100 million miles of vehicle travel.

c. Lanes

Calculated from the Federal Highway Administration, Highway Performance Monitoring System, 2016.

5. Private construction spending

a. Private residential construction costs

These data were assembled by Raven Molloy, who has generously shared them. Molloy used city-level historical cost indexes from R. S. Means Company (2003). She matched the city names to Census place IDs, merged with city-level housing unit counts, and created statewide averages. We use these statewide averages. Costs are indexed and not in nominal dollars. Molloy uses these data in Saks (2008).

b. Private health insurance spending

We measure private health insurance spending per enrollee from the Centers for Medicare and Medicaid Services' "Health Expenditures by State of Residence, 1991–2014." We use table 29 ("Private Health Insurance Per Enrollee State Estimates by State of Residence").

We download data from https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsStateHealthAccountsResidence.html.

6. Demographics

We use data on population from the Decennial Census. Specifically, we rely on the Census of Population and Housing for 1950–2000. We use state median family income,[15] percentage of adults over the age of 25 who have graduated high school, and median home values. All final variables are state-period averages weighted by miles. We use data on population from the Decennial Census.

7. Inflation adjustment

We use the CPI-U from the Federal Reserve Bank of Minneapolis, downloaded from https://www.minneapolisfed.org/community/financial

15. Note that because of issues of data availability, we use mean family income for 1970.

-and-economic-education/cpi-calculator-information/consumer-price-index-and-inflation-rates-1913.

8. Democratic presidential vote share

We use data from 1956 to 1993. See Brooks and Liscow (2020) for full citation.

Table 2A.1 Coefficient of variation: Interstate and other local spending

	Entire cross section			Second period: 1970–1993		
	Mean (1)	CV: standard deviation/ mean (2)	Residual standard deviation/ mean (3)	Mean (4)	CV: standard deviation/ mean (5)	Residual standard deviation/ mean (6)
Spending/mile, $ millions	11.51	0.582	0.379	15.52	0.686	0.659
Private spending						
Construction cost index	31.53	0.156	0.145	48.55	0.117	0.153
Health insurance/enrollee, 2001, $1,000s	2.95	0.072	0.072	2.94	0.070	0.078
Public spending, all $1,000s						
Medicaid per enrollee, 1991	6.01	0.320	0.311	5.97	0.321	0.320
Medicare per enrollee, 1992	5.65	0.146	0.152	5.65	0.146	0.117
Local government expenditure per capita	6.50	0.201	0.208	6.94	0.193	0.187
Interstate outcomes						
Fatalities per VMT, 1995*	0.86	0.469	0.543	0.88	0.445	0.408
Accidents per VMT, 1995*	3.71	0.525	0.478	3.73	0.529	0.403
Maintenance per mile, $ millions, 1995	5.73	0.745	0.661	5.92	0.735	0.899

Note: For variables, please see note to table 2.1. This table presents coefficients of variation (standard deviation divided by mean, weighted by Interstate miles constructed) for Interstate spending per mile and other related or major public spending categories. The first set of three columns shows results for the entire period; the second set show results just for 1970 to 1993.

Table 2A.2 Relative relationship of other spending to Interstate spending using standardized variables

	Full period		Years 1970–1993	
	Covariates enter		Covariates enter	
	Individually (1)	Jointly (2)	Individually (3)	Jointly (4)
Construction spending, 1993 = 100	0.16	0.51	2.88**	2.40**
	(0.47)	(0.53)	(0.86)	(0.86)
Health insurance per user, 2001, $1000s	−0.07	0.09	1.78*	1.19
	(0.50)	(0.51)	(1.00)	(0.90)
Medicare per enrollee, 1991	1.06**	1.34**	2.78**	4.13**
	(0.49)	(0.64)	(1.07)	(1.27)
Medicaid per enrollee, 1991	−0.44	0.29	0.88	2.19**
	(0.43)	(0.54)	(0.95)	(1.06)
Local government expenditure per capita	−0.47	−0.81	1.39	−1.14
	(0.46)	(0.51)	(0.92)	(0.90)

Note: All regressions contain 48 observations. ***Statistically significant at the 1 percent level. **Statistically significant at the 5 percent level. *Statistically significant at the 10 percent level. All regressions are weighted by Interstate miles constructed. All variables in this table are standardized to mean zero, standard deviation one. The first column reports results for the full period. Each row in the first column is the coefficient from a separate regression of spending per mile on the named covariate and the three predetermined characteristics. In the second column, covariates enter jointly. Columns 3 and 4 repeat this pattern, but for the period from 1970 to 1993.

Table 2A.3 Correlation between spending per mile and additional measures of public spending

				Residual variation		
	Coefficient (1)	Standard error (2)	R^2 (3)	Standard deviation (4)	p75 − p25 (5)	p90 − p10 (6)
Entire period: 1956–1993						
Predetermined characteristics			0.84	4.37	3.25	8.16
Predetermined characteristics and public spending						
Local (no state) expenditure per capita, $1000s	−0.57	0.58	0.84	4.53	3.51	8.71
Primary and secondary education per capita	−1.11	1.44	0.84	4.39	3.51	8.51
Capital outlays per capita, $1000s	0.07	1.88	0.84	4.37	3.23	8.11
Second period: 1970–1993						
Predetermined characteristics			0.67	10.23	8.00	16.40
Predetermined characteristics and public spending						
Local (no state) expenditure per capita, $1000s	1.61*	0.82	0.69	10.22	8.01	14.92
Primary and secondary education per capita	2.79	3.36	0.68	10.06	8.19	15.68
Capital outlays per capita, $1000s	5.36	3.51	0.69	10.18	7.99	14.97

Note: All rows contain 48 observations. ***Statistically significant at the 1 percent level. **Statistically significant at the 5 percent level. *Statistically significant at the 10 percent level. All regressions are weighted by Interstate miles constructed. The first row in each panel reports a regression of Interstate spending per mile on a constant and the three pre-determined characteristics discussed in the text. All rows in each panel following "Predetermined characteristics and" report results from the estimation of Interstate spending per mile on geographic covariates and the named covariate (as in equation 2.2).

Table 2A.4 Spending per mile and potential explanations, 1956– 1993

	Unstandardized variables		Standardized variables	
	Variables enter		Variables enter	
	Individually (1)	Jointly (2)	Individually (3)	Jointly (4)
Share high school graduates	−0.04	−0.10	−0.28	−0.77
	(0.05)	(0.09)	(0.41)	(0.69)
Residuals: standard deviation	4.37		4.37	
Residuals: Q75 − Q25	3.48		3.48	
Real median family income, $10,000s	0.14	1.00	0.12	0.87
	(0.57)	(1.04)	(0.49)	(0.91)
	4.34		4.34	
	3.19		3.19	
Real construction wage	0.02	0.01	0.13	0.06
	(0.06)	(0.10)	(0.46)	(0.73)
	4.32		4.32	
	3.17		3.17	
Corruption index	1.00	1.05	0.71	0.75
	(0.64)	(0.70)	(0.46)	(0.50)
	4.29		4.29	
	3.04		3.04	
Democratic presidential vote share	0.03	0.03	0.18	0.17
	(0.09)	(0.11)	(0.61)	(0.70)
	4.34		4.34	
	8.26		8.26	
Overall				
Standard deviation of residuals		4.05		4.05
Diff: p75–p25		3.50		3.50

Note: This table follows the same format as table 2.4 but uses data for the full 1956–1993 period.

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Comment

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Introduction

For several decades, a familiar refrain to motivate policy discussions about how to improve the performance of the nation's largest civilian public investment has been "America's road system is deteriorating, and urban traffic congestion is worsening." As early as Pigou (1920), economists have argued that efficient transportation infrastructure policy maximizes the difference between the social benefits and cost of its provision and use, including the

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