Differences in State and Local Government Public Capital Expenditure Before, During, and After the Great Recession: Did the Federal Stimulus Matter?*

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Introduction

The United States Census Bureau defines capital expenditure as “[D]irect expenditure for construction of buildings, roads, and other improvements undertaken either on a contractual basis by private contractors or through a government’s own staff (i.e., force account); for purchases of equipment, land, and existing structures; and for payments on capital leases.”¹ This includes government dollars spent on additions, replacements, and major alterations to existing public capital. It does not include expenditure for maintenance and repairs to existing public capital.

An examination of recent state-local government capital expenditure in the United States yields some interesting facts. Annual subnational government expenditure on capital goods is substantial, representing just over two percent of the country’s GDP and about 12 percent of total state-local spending for the period 2000 through 2010. Although aggregate measures of state-local capital expenditure have been relatively stable over the previous decade, there is evidence that real per-capita public capital expenditure increased around both the mild recession of March-November 2001, and the Great Recession (December 2007 through June 2009). Furthermore, there are substantial differences in per capita public capital spending across the 50 states.

Given these observations, and the widely expressed concern about the declining quality of public infrastructure in the United States, we believe it is valuable to investigate the factors explaining capital expenditure differences across states and time during the last decade. In this paper, we first offer selected details about state and local government capital expenditure during the first decade of the 21st Century. We then briefly review the previous literature exploring the reasons for differences in subnational capital expenditure. Based on these previous

¹ See http://www.census.gov/govs/school/definitions.html.
investigations, we offer a regression-based examination of this issue. We conclude with lessons learned from this investigation that both confirm and contradict previous research.

**An Overview of Subnational Public Capital Expenditure Since 2000**

In Figure 1, we report the total amount of real per capita state-local capital spending for all 50 states (using a 2010 base year and deflating by the state and local government consumption expenditures/gross investment deflator) and state-local capital outlay as a percentage of GDP. At the bookends of the observed nine fiscal years, these measures of per person subnational capital investment in the United States were similar at $1,141 in fiscal year 2000 and $1,132 in fiscal year 2010. However, in between these two ends of observation, there was much variation. In fiscal year 2002, real per capita public expenditure was substantially higher at $1,213. Following this, the per capita value for subnational government capital investment in the United States fell to $1,115 in fiscal year 2005, and then rose to $1,173 in fiscal year 2007. In fiscal year 2008, the amount of aggregate per capita real public capital increased to $1,197 and remained essentially the same for fiscal year 2009 at $1,190. In 2010, this aggregate measure of subnational public capital expenditure in the United States decreased substantially. State-local capital outlay relative to GDP follows a similar pattern over time.
These highly aggregated data indicate fluctuation in total per capital real public capital expenditure that varies over time and seems, in some way, related to the occurrences of the decade’s two recessions. However, relating the pattern of state-local capital spending over time to the period of national recessions and related events is not straightforward because of inconsistent and overlapping periods. As shown in Table 1, the brief recession in the early part of the decade spanned fiscal years 2001 and 2002, and ended halfway through fiscal year 2002. The "Great Recession" started formally during fiscal year 2008 and ended at the end of fiscal year 2009. So, the recession was in force for all of FY 2009 and none of FY 2010.²

One complication is that state budget planning occurs ahead of actual spending. So

² Even this is a generalization because state fiscal years vary. The end of the fiscal year for 46 states occurs on June 30, but the other four use different dates.
planning for fiscal year 2010 (which came after the recession ended formally) happened during fiscal year 2009 (when the recession was in full force). Another complication is that the fiscal effects on state and local government budgets sometimes continue even after the recession ends formally. For instance, the Rockefeller Institute reports that the tax revenue of state governments continued to decline in the first and second quarters of CY 2002, even after the recession had formally ended. Similarly, state tax revenue declined in the third and fourth quarters of CY 2009, after the Great Recession had ended formally in June 2009. Finally, as shown in Table 1, the schedule for federal stimulus programs often does not correspond directly to state-local fiscal years. The Highway infrastructure investment funds per capita were available from March 2009 (FY 2009) through September 2010 (FY 2011), and Build America Bonds were an option from April 2009 (FY 2009) through December 2010 (FY 2011). Still, the timing and pattern of capital expenditure seems an important topic for examination.

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Period</th>
<th>Recession</th>
<th>Highway Investment Funds</th>
<th>Build America Bonds</th>
</tr>
</thead>
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<tr>
<td>2000</td>
<td>July 1999-June 2000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>July 2002-June 2003</td>
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<td>2005</td>
<td>July 2004-June 2005</td>
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<tr>
<td>2007</td>
<td>July 2006-June 2007</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>July 2009-June 2010</td>
<td></td>
<td>Ends September 2010</td>
<td>Ends December 2010</td>
</tr>
</tbody>
</table>
Figure 2: Average Annual Per Capita Real Public Capital Expenditure by State for Fiscal Years 2000-2010
Our initial intention was to analyze state and local government capital spending for the 50 states from fiscal year 2000 through fiscal year 2010 using Census data.³ Aggregate data for state and local government public capital expenditure, in total and by subcategories, are available for all of these years, but data for each state are not available for fiscal years 2001 and 2003. Capital spending data are available for 2001 and 2003 only for all state-local governments together, for all state governments, and for all local governments, including total capital spending and subcategories. From communication with Census staff, we found that that this is due to a designation in the data collection that only affected these years.⁴ Thus, for the state-by-state figures below, and for our later regression analysis, we must exclude these two fiscal years.

Figure 2 contains data for subnational per capita real public capital expenditure by state averaged over the nine fiscal years observed. The results contained in Figure 2 are fascinating. For the nine available fiscal years of data, Maine on average spent the lowest amount per resident on real public capital investments at $718.56. If this was attributable to large variations in this investment that averaged out to this amount it would be less indicative of Maine’s propensity to invest being lower than the rest of the states, but it is not. The State of Maine real dollar amounts by fiscal year averaged to achieve this low figure were also consistently low ($707, $794, $873, $694, $720, $639, $560, $579, and $907). Over this same decade, Alaska led the states in real per capita public capital investment at nearly four times the amount of Maine ($2,784). This average was again the result of consistently high real dollar amounts spent over the nine observed years ($3,033, $3,240, $2,746, $2,673, $2,635, $2,817, $3,109, $3,351, and $3,345). Figure 2 offers clear evidence of the large variation in real public capital expenditure

³ See http://www.census.gov/govs.
per resident across the states that not only occurs in one fiscal year, but also occurred consistently on an annual basis over a decade.

The data contained illustrated in Figures 1 and 2 suggest the importance of examining explanations for both the time and state variations observed. We begin this investigation with a summary of the earlier empirical work that did the same. We use the results of this summary to formulate a regression-based inquiry and to look for consistency in findings from this most recent and quite economically tumultuous decade with previous findings drawn from previous decades. In doing this, we are also able to investigate the efficacy of the federal stimulus dollars offered in 2009 and 2010 through the American Recovery and Reinvestment Act, part of whose purpose was to increase state capital spending.\(^5\)

**Previous Research**

Given the relative importance of state and local capital spending, it is surprising to note that there has been relatively little academic inquiry about the topic since the 1990s. This nearly two-decade old research focused on three issues: (1) the factors that affect capital spending and thus that contribute to interstate differences, including differential use of debt to fund that spending; (2) the effect of fiscal rules and procedures on capital spending; and (3) the effect of public capital on economic growth. Temple (1994) provides an example of work on the first issue. Poterba (1995) offers an example of work about the first two issues together.

Temple (1994) models a median voter simultaneously making an annual choice regarding the state’s capital spending and the share of capital spending financed by debt. In this model, capital investment is a function of income, tax price, cost of borrowing, discount rate, and the

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\(^5\) For details about the American Recovery and Reinvestment Act that contained the public capital stimulus dollars labeled as Highway infrastructure investment funds per capita see [https://www.fhwa.dot.gov/economicrecovery](https://www.fhwa.dot.gov/economicrecovery).
existing capital stock. The variables used in a regression to explain annual capital spending in the 48 contiguous United States for 1983 and 1984 are median income, federal grants, tax price, capital stock, debt share of capital expenditure, population growth, population density, the percent elderly, and a control variable for “Sunbelt” states. Although she estimates capital spending and the debt share simultaneously, in the empirical results they seemed to be independent. Temple finds that residents of higher income states demand more capital spending than those in lower income states. Higher income states also finance a larger share of capital expenditure by borrowing compared to other means. Among other results, Temple finds that federal grants, population change, and the existing capital stock have positive effects on capital spending, whereas density and the percent elderly have negative effects.

Poterba (1995) analyzes differences in state and local government per capita capital spending (excluding highways) for the 48 contiguous states in 1962. The variables used in the empirical analysis include per capita income and income squared, federal grants per capita, population growth rate, population under 18, population over 65, percent homeowners, percent urban, outmigration in 1960, set of controls for the four Census Regions, whether a state has a capital budget dummy, whether there are pay-as-you-go requirements for capital financing; and how Republican the state legislature, governor, and electorate in the recent presidential election are. Regarding the economic, social, and political variables, Poterba reports federal grants have a strong positive effect, socio-economic measures show little significant effect, and the political measures have inconsistent results. The result for per capita income is unusual. The nonlinear

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6 “The estimated invariance of the level of state and local capital investment to the share of debt in the financing of the investment suggests that investment decisions are not greatly affected by factors influencing the willingness to issue bonds,” Temple (1994, p. 529).
result implies a negative marginal effect of income evaluated at the mean value (although income shows a positive effect on non-capital state spending).\(^7\)

On the issue of budgeting procedures, which is the primary focus of the Poterba paper, he reports that states with public capital budgets spend more on public capital than states with unified budgets and pay-as-you-go requirements reduce capital spending. The effect of a capital budget for state governments alone disappears if he aggregates state and local government capital spending, but the pay-as-you-go effects remain. One caveat is that Poterba used data from 1962 because of the availability of state-by-state information about budgeting procedures. However, in 1962, non-highway capital spending accounted for only about one-quarter of total state capital spending.

Munnell (1992), Gramlich (1994), and Fisher (1997) all provide reviews of the literature regarding the third issue noted above (public capital investment and economic growth).\(^8\) Importantly, all note the ambiguity in the results based on the type of analysis performed, the period examined, and the method of measuring public capital. Gramlich (1994) provides a complete review of the research regarding public capital investment up to the early 1990s, especially regarding evidence about its productivity enhancing properties. The review includes (1) engineering needs assessments, (2) political voting outcomes, (3) measures of economic rates of return and, (4) economic estimates of productivity impact. Although rates of return measures show some shortages in public capital, the other approaches do not provide clear results, partly because of econometric issues that arise when using time series. Gramlich argues that it is less

\(^7\) The coefficient on per capita income is negative and significant, whereas the coefficient on per capita income squared is positive and significant.

important to examine the optimal public capital question, but rather what policies regarding infrastructure investment to alter to improve investment decisions. For instance, he argues that federal grant programs may delay state-local action as state-local officials wait for a federal program to subsidize capital investment and, in the opposite direction, that road tolls may provide direct measures of investment demand that encourage specific investments. Munnell (1992) concludes that the study of state and local government infrastructure investment is an area ripe for further research.

Fisher (1997) also notes the differential results found in the different studies of the effect of public capital on productivity and growth, including the debate about the appropriate econometric techniques to use for this type of analysis. Some argue that controlling for time- or area- fixed effects is crucial, which has the effect of reducing the impact of public capital on growth in the empirical studies. Others note that differencing over a short period may miss the longer-run effects from public capital investment. The area of impact also seems crucial, as some types of public capital may have little local effect, but a greater national effect. All of the research does suggest differences among types of public capital, with transportation infrastructure, communication facilities, and utility systems having the greatest relative effects.

Although we noted the seeming absence of recent academic empirical analyses of state-local capital spending, two recent survey articles suggest there may be a resurgence of interest in this topic. Marlowe (2012) focuses on the effect of the Great Recession on capital spending and on capital budgeting policies and procedures. Using National Income and Products data for spending on fixed assets through 2009, Marlowe concludes that state-local capital spending declined during the Great Recession, that the capital spending declines would likely have been even greater without the federal stimulus support, that the decrease in capital spending was more
intense than in past recessions, and that the federal stimulus brought about some changes to
capital budgeting practices. Based on surveys and NASBO data, Marlowe suggests that capital
spending would fall substantially in 2010 and beyond after the end of the federal stimulus, a
supposition now confirmed with the recent release of Census data for 2010 (see Figure 1).

Bivens (2012), writing as an Economic Policy Institute advocate for greater subnational
capital spending, offers a summary of the previous work on the effect of public capital on
productivity and economic growth. He selectively uses the earlier research findings to make the
case for greater public capital investment because of a belief that public capital improves private
productivity. However, as noted, the conclusion of past research about this issue is not
unambiguous. Nevertheless, this paper does raise a relevant concern that recent calls to balance
federal and state government budgets by reducing public capital spending may be misguided.

**A Model of Public Capital Expenditure**

Borrowing from a long history of analysis of public expenditure (see Fisher, 2007, Chapter 4), as
well as the work of Temple (1994) and Poterba (1995) regarding capital spending specifically,
we next offer a simple model of public sector choice to guide the understanding of a
government’s capital expenditure decision. We begin by representing a voter’s preferences by a
utility function encompassing private consumption, public services, and fiscal stability:

\[
U = U(X, G, S), \quad (1)
\]

where,

\[
X = \text{private consumption},
G = \text{public services},
S = \text{stabilization fund or account balances}.
\]

The level of public service provided to voters depends on current public sector spending, the
public capital stock, and population. So

\[
G = g(Ec, K, N), \quad (2)
\]
where,

\[ Ec = \text{current public expenditure,} \]
\[ K = \text{public capital stock} \]
\[ N = \text{population.} \]

Rewritten, the utility function becomes:

\[ U (X, Ec, K, N, S). \]  \hspace{1cm} (3)

If the public capital stock equals:

\[ K = K_{-1}*(1-d) + Ek, \]  \hspace{1cm} (4)

where,

\[ d = \text{public capital depreciation,} \]

then,

\[ U (X, Ec, K_{-1}*(1-d), Ek, N, S). \]  \hspace{1cm} (5)

The voter’s budget constraint is:

\[ X + h*T = Y, \]  \hspace{1cm} (6)

where,

\[ h = \text{decisive voter’s tax price or share,} \]
\[ T = \text{current tax collections,} \]
\[ Y = \text{income for the decisive voter.} \]

Similarly, the government budget constraint, assuming a balanced budget, requires that spending equal revenue, or:

\[ Ec + Ek + r*D_{-1} + Es = T + I + B, \]  \hspace{1cm} (7)

where,

\[ Ek = \text{capital expenditure,} \]
\[ r = \text{interest rate on outstanding debt,} \]
\[ D_{-1} = \text{outstanding debt,} \]
\[ Es = \text{allocation to the stabilization fund or balances,} \]
\[ I = \text{intergovernmental revenue,} \]
\[ B = \text{borrowing.} \]
Taxation or borrowing finances capital investment, thus:

\[ B = b \cdot E_k, \quad (8) \]

where,

\[ b = \text{debt share of current capital expenditure}. \]

Temple (1994) provides evidence that the debt share of capital expenditure (b) is independent of the level of capital spending. If we assume this to be fixed, the government budget constraint becomes:

\[ E_c + E_k + r \cdot D_{-1} + E_s = T + I + b \cdot E_k \quad (9) \]

Combining the individual and government budget constraints, the choice problem for a voter then is:

maximize \[ U( X, E_c, K_{-1}^*, (1-d), N, S), \] \( (10) \)

subject to,

\[ X + h \cdot (E_c + E_k^* + s + r \cdot D_{-1} - I - b \cdot E_k) - Y = 0. \quad (11) \]

The model could be further complicated by adding institutional constraints on the choice of current expenditure (\( E_c + E_k \)), on taxation (T), or on debt and borrowing (D, B). It follows that capital expenditure in the current period (E_k) is a function of income (Y), intergovernmental revenue (I), the decisive voter’s tax price (h), population (N), the past public capital stock (K_{-1}), the depreciation of public capital (d), the interest rate on government borrowing (r), outstanding debt (D_{-1}), stabilization balances (S), and institutional fiscal constraints as well as the characteristics affecting preferences (nature of the utility function).

Note that the interest rate on government borrowing (r) is not expected to be independent of other variables in the fiscal system, including fiscal balances (S), the level of taxation (T), the amount of government expenditure (E_c + E_k) as well as the institutional limits on fiscal
decisions and the underlying economic conditions in that jurisdiction. In addition, outstanding debt ($D_{-1}$) and the capital stock coming into the period ($K_{-1}$) were determined in the past and influenced by the same factors affecting current decisions, including such things as income, tax price, intergovernmental revenue, population and so on. Therefore, the model captures the effect of these two variables on current capital expenditure by the other variables in the system, except to the degree that these other factors (income, intergovernmental revenue, tax structure, population) have changed substantially. Without specifying a complete multi-period or fully dynamic model, changes in economic characteristics might capture this dynamic nature. Finally, the effect of fiscal balances ($S$) essentially depends on how that factor enters the utility function, that is how voters perceive or value fiscal stability.

Based on this model, ideally one might analyze capital spending simultaneously as part of a complete system of fiscal choices for current spending, capital spending, fiscal balances, tax structure, and perhaps even institutional constraints. Such a possibility is limited both by the conceptual difficulty of noting identifying characteristics for each choice and by data availability. However, this simple theoretical model also suggests a format for a reduced-form regression analysis of annual capital expenditure. Per capita capital expenditure is a function of:

- **per capita resources** (per capita income, per capita intergovernmental revenue),
- **tax structure characteristics affecting tax prices** (progressivity, federal deductibility),
- **changes in economic characteristics** (population change, major structural tax changes),
- **public capital depreciation** (measures of public capital quality, weather),
- **borrowing costs** (bond rating, economic conditions, deficits),
- **institutional** fiscal constraints (tax, spending, or debt limits),
- **voter preference characteristics** (age, race or ethnicity, education).

This theoretical perspective also clarifies the difficulty of interpreting coefficients from the empirical analysis. For example, income influences capital spending through its effect on the
demand for government service directly. However, income also can affect the government borrowing cost \((r)\), as the bond rating agencies rely heavily on economic conditions in a jurisdiction in setting ratings. In addition, correlation might occur between income and fiscal stability \((S)\). Therefore, the coefficient on income in a single reduced-form regression about capital expenditure is likely to capture more than the traditional income effect of demand for public service.

**Interstate Differences in Annual Subnational Capital Expenditure**

Using all of the annual state data available from fiscal year 2000 (the fiscal year before the early 2000s mild recession which officially began in March 2001) and fiscal year 2010 (the first full fiscal year after the Great Recession which officially ended in June 2009), we next offer an empirical analysis of what determines differences in the amount of general (excluding utility) capital spending per capita in a state. We derive the explanatory variables included in the regression model from the theoretical model just described and those previously included in both Temple (1994) and Poterba (1995), with a few new relevant explanatory variables included.

\[
\text{State and local general capital spending}_{i,t} = \text{f (Set of fiscal year dummies [2008 excluded] }_{t}, \text{ Set of state dummies [CA excluded] }_{i}, \text{ Population}_{i,t}, \text{ Previous decade % population growth}_{i,t}, \text{ Population % attending K-12 public schools}_{i,t}, \text{ Population % > age 65}_{i,t}, \text{ Population % homeowners}_{i,t}, \text{ Per capita state GSP}_{i,t}, \text{ Federal grants per capita}_{i,t}, \text{ State expenditure % state-local expenditure}_{i,t}, \text{ Liberal citizen political ideology}_{i,t}, \text{ Poor road %}_{i,t}, \text{ No limit debt dummy}_{i,t}, \text{ Highway infrastructure investment funds per capita}_{i,t})
\]

Like Temple, we chose as our dependent variable the real per capita amount of state and local general capital spending, excluding capital investment by utilities.\(^9\)

\(^9\) We exclude utility investment because utility provision by the public and private sector varies widely across the states and therefore would make the inclusion of this form of capital spending inconsistent.
A set of fiscal year dummies, with the 2008 fiscal year excluded as the base year, are included as explanatory variable to assess how capital spending differed in the other fiscal years in comparison to this base year (the fiscal year during which the recession began). A set of state dummies is included to test whether the state-specific differences previously documented in Figure 2 persist after controlling for standard explanatory variables thought to determine differences in capital spending across the states. We include Population to see if independent changes in this measure of size (and hence population density because state area is held constant through the inclusion of state dummies) influences capital spending. Like Temple and Poterba we include Previous decade % population growth to see if current capital spending is a response to catching up to the needs of previous growth. Similar to Temple and Poterba, who include percentage population less than age 18, we include the Population % attending K-12 public schools as a likely more direct measure of greater demand for public capital needs in this sector. As the previous authors do, we include the Population % > age 65 and Population % homeowners as a measures of differences in citizen taste and tax price for public capital expenditure and Per capita state GSP and Federal grants per capita as measures of own-state affluence and federal help that should both exert a positive influence on a state’s capital expenditure.  

Unique to this study, we include State expenditure % state-local expenditure as a control for the wide variation among the states in the divisions of subnational activity between these sectors. This variable suggests whether a greater concentration of subnational activity at the state government level influences aggregate state and local capital expenditure in a given year. 

\[^{10}\text{Federal grants per capita exclude the value of Highway infrastructure investment funds per capita.}\]
Instead of relying on measures of Republican party affiliation in a state to account for possible political influences on the amount of public capital investment in a year (as in Poterba), we instead use a citizen political ideology measure widely favored by political scientists and developed by Berry, Ringquist, Fording, and Hanson (1998). Liberal citizen political ideology takes on a value from zero to 100 with the upper-end representing the most politically liberal states. Furthermore, we thought it would be informative to include values from the *Annual Report*[s] on the Performance of State Highway Systems*11 on the Poor road % as measured by the percentage of major multi-lane interstates in and near urban areas judged in poor condition. Thus, we are able to estimate whether state-local capital spending responded to greater perceived deficiency in this type of public infrastructure.

Unlike Poterba (1995), we do not include measures of states that used a separate capital budget or pay-as-you-go financing because we found no evidence of variation in these measures across a state in the period observed. Instead, the state fixed effects dummies capture these influences. We were also able to account for the absence of any restrictions in a state on the issuance of general obligation debt through a *No limit debt dummy* expected to exert a positive influence on a state’s capital spending.12 Finally, we wish to measure the influence that the issuance of Highway infrastructure investment funds per capita to states, as part of the American Recovery and Reinvestment Act (ARRA) of 2009, may have had on the state’s public capital spending. The amount of these issues per state are available, but it is not clear if a state spent their funds in fiscal year 2009 or 2010. The allocation of federal dollars for this public capital stimulus program occurred in March 2009 with a September 2010 requirement for spending.

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Thus, *Highway infrastructure investment funds per capita* divides a state’s total allocation under this program in half and assumes this amount spent in each of these fiscal years.

Table 2 includes sources and descriptive statistics for all variables used in the regression analysis. Table 3 contains the regression results. We report the 50 state results for three separate regression models.\(^{13}\) Model I includes all explanatory variables with the values for federal grants per capita excluding Highway infrastructure investment funds per capita for fiscal years 2009 and 2010. Model II is the same as Model I, but it excludes Highway infrastructure investment funds per capita to measure the change in the fiscal years 2009 and 2010 regression coefficients from doing this. Alternatively, Model III excludes federal grants per capita due to the concern that it may be endogenously determined.

\(^{13}\) Although Temple and Poterba used data from only the 48 contiguous states, our results were not significantly different with 48 or 50 states.
<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Source</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Maximum</th>
<th>Minimum</th>
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<tbody>
<tr>
<td>State and local general capital spending</td>
<td>United States Census Bureau, State and Local Government Finances, various years, <a href="http://www.census.gov/govs/local">http://www.census.gov/govs/local</a></td>
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<td>$423.61</td>
<td>$3,351.01</td>
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<tr>
<td>Explanatory Variables</td>
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<tr>
<td>Previous decade % population growth rate</td>
<td>United States Census Bureau, Population Estimates, various years, <a href="http://www.census.gov/popest/data/historical/index.html">http://www.census.gov/popest/data/historical/index.html</a></td>
<td>12.39%</td>
<td>9.81%</td>
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<td>65.66%</td>
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<td>Population % &gt; age 65</td>
<td>United States Census Bureau, Age and Sex, various years, <a href="http://www.census.gov/population/age/data/cps.html">http://www.census.gov/population/age/data/cps.html</a></td>
<td>12.76%</td>
<td>1.71%</td>
<td>17.53%</td>
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<td>Population % homeowners</td>
<td>United States Census Bureau, Statistical Abstract, <a href="http://www.census.gov/compendia/statab/cats/construction_housing/homeownership_and_housing_costs.html">http://www.census.gov/compendia/statab/cats/construction_housing/homeownership_and_housing_costs.html</a></td>
<td>70.06%</td>
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<td>Per capita GSP</td>
<td>United States Department of Commerce, Bureau of Economic Analysis, Gross Domestic Product by State, <a href="http://www.bea.gov/iTable/ITable.cfm?reqid=70&amp;step=1&amp;isuri=1&amp;acrdn=1#reqid=70&amp;step=1&amp;isuri=1">http://www.bea.gov/iTable/ITable.cfm?reqid=70&amp;step=1&amp;isuri=1&amp;acrdn=1#reqid=70&amp;step=1&amp;isuri=1</a></td>
<td>$49,748.22</td>
<td>$9,126.21</td>
<td>$81,354</td>
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<td>Federal grants per capita</td>
<td>United States Census Bureau, <a href="http://www.census.gov/govs/local">http://www.census.gov/govs/local</a></td>
<td>$1,934.06</td>
<td>$627.85</td>
<td>$4,839.19</td>
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<td>State expenditure % state-local expenditure</td>
<td>United States Census Bureau, State and Local Government Finances, various years, <a href="http://www.census.gov/govs/local">http://www.census.gov/govs/local</a></td>
<td>50.48%</td>
<td>8.98%</td>
<td>79.49%</td>
<td>32.56%</td>
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<tr>
<td>Poor road %</td>
<td>Reason Foundation, Annual Report on the Performance of State Highway Systems, various years, <a href="http://reason.org/areas/topic/annual-highway-report">http://reason.org/areas/topic/annual-highway-report</a></td>
<td>5.46%</td>
<td>6.28%</td>
<td>38.78%</td>
<td>0.0%</td>
</tr>
<tr>
<td>No limit debt dummy</td>
<td>National Association of State Budget Officers, Budget Processes in the States, various years, <a href="http://www.nasbo.org/publications-data/budget-processes-in-the-states">http://www.nasbo.org/publications-data/budget-processes-in-the-states</a></td>
<td>0.13</td>
<td>0.34</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Highway infrastructure investment funds per capita</td>
<td>United States Department of Transportation, Apportionment of Highway infrastructure investment funds per capita Pursuant …, <a href="http://www.fhwa.dot.gov/legsregs/directives/notices/4510705.htm">http://www.fhwa.dot.gov/legsregs/directives/notices/4510705.htm</a></td>
<td>$12.89</td>
<td>$27.25</td>
<td>$149.87</td>
<td>$0.00</td>
</tr>
</tbody>
</table>
Table 3: Regression Analysis of State and Local Capital Spending Per Capita  
(450 Observations, State Dummies Included But Not Reported)

<table>
<thead>
<tr>
<th>Explanatory variable</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1967.09</td>
<td>-1520.83</td>
<td>-2207.80</td>
</tr>
<tr>
<td></td>
<td>(1216.25)</td>
<td>(1327.32)</td>
<td>(1279.39)</td>
</tr>
<tr>
<td>2000 dummy</td>
<td>-58.47**</td>
<td>-70.01**</td>
<td>-74.09***</td>
</tr>
<tr>
<td></td>
<td>(22.72)</td>
<td>(26.35)</td>
<td>(21.59)</td>
</tr>
<tr>
<td>2002 dummy</td>
<td>1.638</td>
<td>-4.516</td>
<td>5.026</td>
</tr>
<tr>
<td></td>
<td>(17.259)</td>
<td>(19.030)</td>
<td>(18.054)</td>
</tr>
<tr>
<td>2004 dummy</td>
<td>-110.37***</td>
<td>-117.06***</td>
<td>-95.96***</td>
</tr>
<tr>
<td></td>
<td>(13.19)</td>
<td>(14.84)</td>
<td>(14.52)</td>
</tr>
<tr>
<td>2005 dummy</td>
<td>-124.02***</td>
<td>-129.18***</td>
<td>-113.45***</td>
</tr>
<tr>
<td></td>
<td>(10.65)</td>
<td>(11.98)</td>
<td>(11.67)</td>
</tr>
<tr>
<td>2006 dummy</td>
<td>-107.22**</td>
<td>-112.76**</td>
<td>-100.86***</td>
</tr>
<tr>
<td></td>
<td>10.37</td>
<td>11.50</td>
<td>10.83</td>
</tr>
<tr>
<td>2007 dummy</td>
<td>-67.03***</td>
<td>-71.53***</td>
<td>-62.68***</td>
</tr>
<tr>
<td></td>
<td>(7.11)</td>
<td>(8.59)</td>
<td>(7.40)</td>
</tr>
<tr>
<td>2009 dummy</td>
<td>-85.13**</td>
<td>75.60***</td>
<td>-65.25***</td>
</tr>
<tr>
<td></td>
<td>(29.54)</td>
<td>(17.80)</td>
<td>(34.77)</td>
</tr>
<tr>
<td>2010 dummy</td>
<td>-68.99</td>
<td>102.54**</td>
<td>-28.97</td>
</tr>
<tr>
<td></td>
<td>(45.25)</td>
<td>(39.16)</td>
<td>(54.37)</td>
</tr>
<tr>
<td>Population</td>
<td>0.00004*</td>
<td>0.00002</td>
<td>0.00004*</td>
</tr>
<tr>
<td></td>
<td>(0.0002)</td>
<td>(0.0002)</td>
<td>(0.0002)</td>
</tr>
<tr>
<td>Previous decade % population</td>
<td>14.45***</td>
<td>18.64***</td>
<td>13.85***</td>
</tr>
<tr>
<td>growth rate</td>
<td>(4.15)</td>
<td>(4.37)</td>
<td>(4.03)</td>
</tr>
<tr>
<td>Population % attending K-12</td>
<td>31.48</td>
<td>26.64</td>
<td>35.35*</td>
</tr>
<tr>
<td>public schools</td>
<td>(18.81)</td>
<td>(20.78)</td>
<td>(17.00)</td>
</tr>
<tr>
<td>Population % &gt; age 65</td>
<td>-18.37</td>
<td>-10.98</td>
<td>-9.60</td>
</tr>
<tr>
<td></td>
<td>(23.48)</td>
<td>(21.63)</td>
<td>(22.84)</td>
</tr>
<tr>
<td>Population % homeowners</td>
<td>2.62</td>
<td>4.04</td>
<td>3.18</td>
</tr>
<tr>
<td></td>
<td>(5.45)</td>
<td>(4.79)</td>
<td>(6.31)</td>
</tr>
<tr>
<td>Per capita GSP</td>
<td>0.018***</td>
<td>0.021***</td>
<td>0.021***</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Federal grants per capita</td>
<td>0.104***</td>
<td>0.105**</td>
<td>Not Included</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.036)</td>
<td></td>
</tr>
<tr>
<td>State expenditure % state-local expenditure</td>
<td>-11.08**</td>
<td>-13.83***</td>
<td>-6.37</td>
</tr>
<tr>
<td></td>
<td>(4.30)</td>
<td>(4.14)</td>
<td>(5.17)</td>
</tr>
<tr>
<td>Liberal citizen ideology</td>
<td>2.107</td>
<td>2.118</td>
<td>2.175</td>
</tr>
<tr>
<td>(0 - 100 most Liberal)</td>
<td>(1.270)</td>
<td>(1.338)</td>
<td>(1.359)</td>
</tr>
<tr>
<td>Poor road %</td>
<td>4.533***</td>
<td>4.955***</td>
<td>4.802***</td>
</tr>
<tr>
<td></td>
<td>(1.200)</td>
<td>(1.144)</td>
<td>(1.188)</td>
</tr>
<tr>
<td>No limit debt dummy</td>
<td>125.24***</td>
<td>125.27***</td>
<td>128.33***</td>
</tr>
<tr>
<td></td>
<td>(20.01)</td>
<td>(18.66)</td>
<td>(20.69)</td>
</tr>
<tr>
<td>Highway infrastructure investment funds per capita</td>
<td>2.81***</td>
<td>Not Included</td>
<td>2.72***</td>
</tr>
<tr>
<td></td>
<td>(0.44)</td>
<td></td>
<td>(0.46)</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.939</td>
<td>0.935</td>
<td>0.938</td>
</tr>
</tbody>
</table>

Statistical significance in two-tailed test: *** = 99% or greater, ** = 95 - 99%, * = 90 - 95%.
All standard errors robust based on nine clusters by fiscal year.
We use fixed effects ordinary least squares regression methodology with both time and state dummies included. An issue in such estimation is the robustness of the regression coefficient’s standard errors to heteroskedasticity concerns. We use STATA that allows for the preferred estimation of such standard errors that could cluster by state, time, or both. Based on the recommendation of Thompson (2011, p. 5) who finds if the time element (of nine) is unbalanced from the state element (of 50), it is best not to double cluster by both time and state and instead to cluster on the element (time) with fewer observations. We use this estimation technique for all three models.

Because Model I is the fully specified model, its results are the basis of discussion. Both a state’s current population and the percentage growth in its population over the previous ten years exert a positive influence on public capital spending in a state. For every 100,000 more residents in a state, the state spends about $4 more per capita on public capital annually. For every one-percentage point more increase in the previous decade’s population growth, the state spends annually about $14.50 more per resident on public capital. Interestingly we found no evidence that the young or old age characteristics of a state’s population or differences in the percentage of homeowners in a state (tax price) influence its public capital spending. Consistent with theory and the findings of previous regression studies, a state’s affluence and its receipt of federal revenue sharing both increase public capital spending per capita. The regression shows that a thousand dollar increase in state income per resident yields about $18 greater public capital spending per resident. A dollar increase in federal grants per capita to the state and its local governments results in a little more than a ten-cent increase in government capital spending per capita. Importantly, an equivalent dollar increase in federal Highway infrastructure investment
funds per capita in 2009 and 2010 yielded the much larger $2.81 increase in this capital spending.

The regression results in Model I also indicate the influence of institutional, political, and existing capital characteristics on a state’s public capital spending. A state that has absolutely no restrictions in place regarding the issuance of general obligation debt spends about $125 more annually per resident on public capital. Given the observed mean of about $1,185 for this expenditure, this is more than a ten percent increase. At just slightly below the 90 percent confidence level (87 percent) that the influence is not zero, there is evidence also that a state with a more Liberal political ideology is inclined to invest more each year in its public capital. Perhaps also not surprising, a state with one percentage more of its major multi-lane interstate highways in and near urban areas judged to be in poor condition spends about $4.50 more per year in capital expenditure. This is the likely result of trying to correct this, and other deficient public infrastructure that this may proxy for, in the state. There is also evidence that if a state government is more dominant in the total expenditure of all state and local spending in a state, capital expenditure by all subnational governments in the state falls. Specifically, the regression results from Model I indicate a one-percentage point increase in this dominance yielding about an annual $11 per capita decrease. Thus, decentralization of fiscal authority is associated with greater capital spending.

Model II shows what happens to the 2009 and 2010 state dummy findings when we do not use a specific accounting of the 2009 and 2010 expenditure of federal stimulus Highway infrastructure investment funds per capita. In this model, these funds are lumped into the overall federal grants per capita measure. Note that this results in the 2009 and 2010 year dummies changing to positive and statistically significant; compared to being negative and statistically
significant when highway infrastructure funds in these years were separately accounted for in Model I. This is strong evidence that the greater spending by subnational governments on public capital in these years driven partly by these federal stimulus highway grants.

We offer Model III results to account for the fact that federal grants per capita may be an endogenous variable whose value in a state is in part determined by other explanatory variables in the regression (population, growth, age distribution, income, etc.). After dropping federal grants per capita from the original Model I specification, the findings change in a rather predictable way for Model III. The positive regression coefficient on population percentage attending public schools now becomes statistically significant. This reduced-form result is because more public school kids per resident results in greater federal grants per resident (now not included), and hence greater (public school) capital spending per resident.

Figure 3 is a visual representation of the state specific effects included in Model I, but not specifically reported. All of the state specific dummy variables included in regression Model 1, except for Nevada, are statistically significant from zero with at least a 90 percent confidence level in a two-tailed test. The values in Figure 3 is are the estimated amounts in 2008 (the excluded year dummy) that each state’s real public capital expenditure per person is expected to be above California’s, if California and the state under consideration exhibited the same values for other explanatory variables included in the regression. Thus, the state fixed effects offer a relative comparison over this first decade as to which states made a relatively greater effort (holding other factors expected to drive their capital spending) at increasing their public infrastructure per resident. In other words, states such as Alaska, Wyoming, North Dakota, and Nebraska spent substantially more on capital expenditure during the 2000 to 2010 period than
Figure 3: State Fixed Effects
one would expect based on the economic characteristics of those states and the estimated average marginal effects.

**Conclusion and Suggested Further Research**

Two aspects of state-local capital spending seem clear: (1) interstate differences in state and local government capital spending over the last decade are substantial (varying by a factor of five from the highest state to the lowest for per capita spending) and (2) capital spending was substantially higher in fiscal years 2002, 2008, and 2009 than in other years of the decade. Our empirical analysis helps clarify both observations.

We also find a positive relationship between the level of state-local capital expenditure (and thus the difference among states) and income, population, population growth, the magnitude of federal grants, and the amount of depreciation of assets. Such results imply that public capital is normal and subject to congestion. These fundamental economic factors influencing state-local capital spending between 2000 and 2010 are quite similar to those found in analyses for capital spending in the 1960s and 1980s.

In addition, our regression results confirm the timing of state-local capital spending between 2000 and 2010 we also found in the aggregate data. After controlling for the economic factors expected to influence state-local capital expenditure, we find that spending was substantially higher in the years during or immediately after this decade’s national economic recessions (2002 and 2008 and after). This seemingly counterintuitive finding may reflect the effect of federal government countercyclical assistance to states and local governments during those periods. Indeed, the results in this paper show an explicit positive effect from one component of ARRA support, the Highway infrastructure investment funds per capita. It seems
clear that state and local government spending would have been lower in these years with the increased federal assistance.\textsuperscript{14}

Subsequent research will explore other issues about state-local capital spending. Three topics seem worthy of particularly close attention. First, it seems important to test whether there are differences in the factors affecting capital spending for different types of capital investment. The model in this paper can be applied to subcategories of capital spending, especially the larger categories of highways, K-12 education, and higher education. One might expect, for instance, that federal grants could be an especially important factor for highway spending. Second, the interstate differences in the composition of capital spending (rather than level) are also of separate, but related, interest. For instance, in 2009 highway spending by state governments varied from 20 percent of total state capital spending (in South Carolina) to 84 percent (in Illinois). Third, the relationship between capital spending and borrowing, which also varies substantially among the states, deserves further inquiry. Perhaps, as hypothesized by Temple (1994), capital investment and borrowing are determined jointly. Even if that is not the case, the interstate differences in the degree of debt finance of capital spending needs better understanding, clarifying the process of fiscal decision making among the states. In 2009, for instance, a number of states had negative net long-term borrowing (debt retired greater than debt issued) but positive capital spending. At the other end of the spectrum, Indiana’s net long-term borrowing that year was 70 percent of capital spending.

In view of the relative importance of state and local capital expenditure, relative to both the magnitude of state-local budgets and national GDP, as well as its potential impact on

\textsuperscript{14} This result is consistent with findings in other research we have conducted (Wassmer and Fisher, 2012b) showing a positive effect from the availability of Build America Bonds in 2009 and 2010 on overall state-local borrowing.
productivity and economic growth, careful examination of this component of state-local fiscal behavior seems valuable and important.

References


