"Rust Dust: Mounting Debt and Eroding Capital in the American Metropolis"

An Analysis of the Determinants of Municipal Public Capital Spending

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Table of Contents

Introduction

According to the World Economic Forum's Global Competitiveness Report 2012-13, the United States now ranks as 14th in the world in terms of the quality of its infrastructure. Further, alarm bells are going off at the local level based on the outlook of future financial requirements for the maintenance of existing infrastructure. With large levels of debt at the city level which constrain the ability of municipal governments to finance capital spending, it is becoming even more difficult to reverse the erosion of capital and consequently, economic competitiveness.

This study applies tested methods of researchers like Fisher (2013), Temple (1994) and Poterba (1995) in analyzing the determinants of capital spending. However, I break away from the norm of looking at spending at higher levels of government, and take a step down the lower level of the city government to see how capital spending might be determined. This is where the action is, and where there is a rising need to undertake research in the area of public finance.

More explicitly, the research question that I pose to myself is: "What are the major determinants of public capital spending at the city level?"

To answer this question, I employ a median voter demand model to analyze the factors that contribute to changes in the demand for municipal capital spending. The primary variables or factors of interest are median income and the tax price. However, also of critical importance especially for local governments are contributing factors such as existing debt levels, the revenue base of the city and the political ideology of its residents – who demand capital spending in the first place.

We find that tax price, total revenue per capita, political ideology and population levels have a direct, statistically significant impact on the demand for public capital spending at the city level. However, the study is constrained by a variety of limitations including but not limited to a low sample size and a weak analysis of the lagged effects of variables. Future studies should be cognizant of these constraints and aim to correct for these weaknesses in order to get to more reliable estimates for the impact of different independent variables on overall municipal public capital spending in the United States.

The first section of this study provides a brief review of existing literature in the field of capital spending, with a focus on its links with economic growth (which is why this study is relevant) and on its determinants (the focus of this study). I construct a median voter demand model in the second section, which lays down the foundations for further analysis of the determinants of public capital spending at the local level. In the third section, I discuss the universal set of variables in my dataset, together with their sources. Further, I use section three plus the appendix to provide my initial hypotheses on the independent variables for the analysis. The fourth section provides details on the methodology of my econometric analysis on my dataset. The three core models include simple ordinary least squares regression, two-way fixed effects estimation and first differencing. This section also includes information on the models and specifications used for the sensitivity analysis. I discuss the findings of my analysis in the fifth section. The last two sections provide a conclusion to the study and a way forward for future research.

Background

With more than half of the world's population living in urban areas which cover a little over 2% of the planet's land cover, managing urban infrastructure has emerged as one of the major challenges of the 21st century. A rapid inflow of individuals seeking a higher quality of life, higher incomes and more networked living, the strain on infrastructures in cities demands urgent attention. Within a city, infrastructure's significance to an economy is realized in multiple ways. First and foremost, it bolsters and maintains economic competitiveness, leading to a higher standard of living for a country's inhabitants and a better quality of life. While increased growth achieved through improved economic competitiveness leads to better payoffs for workers, infrastructure also upgrades the standard of life in and of itself.

The economic downturn of 2001 as well as the financial burden of the War on Terror and the 'Great Recession' of 2008 has financially destabilized the United States. This has happened at exactly at a time when robust economic growth was necessary to provide financial support to the deteriorating infrastructure in the urban centers. As a result, the USA is now ranked 14th in

the world in terms of infrastructure, as compared to 7th in 2008[1]. Furthermore, the American Society of Civil Engineers (ASCE) has downgraded the infrastructure status of the country to a D+, citing a lack of planned funding and inadequate maintenance[2].

The investments of the previous generation produced the highways, roads, railway tracks, neighborhoods and water and sewage lines that are utilized routinely. While it is clear that establishing this infrastructure required large investments, what is less understood is that the maintenance of this capital stock can be as expensive as creating it. The ASCE estimates that the country needs to inject US$ 3.6 trillion into the infrastructure sector by 2020 to maintain economic competitiveness. If the United States is unable to support its competitiveness, the current financial instability might turn out to be a telling blow to the country's trading position in the world, leading to a direct impact on its export sector on the one hand which affects job creation at home, as well as the quality of life at home for its citizens, both due to a lack of direct investment in infrastructure and through the deterioration of their net payoffs within the national economy. The existing capital stock is in urgent need of revitalization, and demands for new infrastructure have skyrocketed to meet the basic needs of growing populations.

The federal government certainly has a role to play, as signified as the crucial Stimulus package of 2009. However, Washington DC has been stuck in a perpetual state of gridlock in recent years. Combined with the financial constraints of the last decade, this political malaise at the federal level is forcing local governments to take matters into their own hands. The nation's top 100 metropolitan areas sit on only 12% of the country's land mass, but are home to two-thirds of the population and generate 75% of the GDP. Urban areas dominate because they embody "concentration and agglomeration – networks of innovative firms, talented workers, risk-taking entrepreneurs and supportive institutions and associations that cluster together in urban areas and coproduce economic progress"[3]. However, cities are where the debilitation of infrastructure will be the fastest, given the high population densities and rising, unprecedented demands on urban infrastructure. Further, capital spending by central cities dominates metropolitan spending every year. Evidence suggests that at least as far as local capital spending

[1] World Economic Forum, "Global Competitiveness Report 2012-13" , 2013, <http://www3.weforum.org/docs/WEF_GlobalCompetitivenessReport_2012-13.pdf>
[2] American Society of Civil Engineers, "Infrastructure Report Card", 2013, <http://www.infrastructurereportcard.org/>
[3] Katz, B., Jennifer, Bradley, "The Metropolitan Revolution", Brookings Institution, 2013.

is concerned, central city residents spend more than suburbanites in the metropolitan area. In line with this trend, a majority of the funds generated are spent in the central city as compared to the suburban areas of the metro[4].

This research is moving into uncharted territories. Almost all existing research deals with state, metropolitan or combined local government finance, without a specific focus on cities. The lowest unit of study that I have seen being used up until now in cross-sectional studies is the Metropolitan Statistical Area (MSA), which a city might or might not be exclusively bounded by. One of the reasons is that while comprehensive, annual data on city finances exists, it is found in every city's unique Comprehensive Annual Financial Reports (CAFR). Consolidating this data is both time consuming and costly. However, it could also be the case that the significance of cities specifically within state and local public finance is only now becoming obvious, in the context of urban growth and with a world reeling with the effects of the recession. Given the increased burden on city-level finances, more research might emerge on this topic.

Literature Review

One of the most important functions of local government is to construct and maintain public works infrastructure in their jurisdiction. These capital investments result in infrastructure which includes bridges, streets, sewer lines and water mains among others. It has been argued that residential and commercial actors depend on this infrastructure for their physical well-being and economic prosperity[5]. However, the debate about how much of an impact this infrastructure has on the economic growth of a particular community has raged on in the academia periodically.

[4] Haughwoot, A. F. "Local capital spending in us metropolitan areas". Woodrow Wilson School of Public and International Affairs.
[5] Wendorf, Jill (2005) "Capital Budgeting from a Local Government Perspective," SPNA Review: Vol. 1: Iss. 1, Article 6. <http://scholarworks.gvsu.edu/spnareview/vol1/iss1/6>

Relationship between Public Capital Spending and Economic Growth

The work of Choate and Walter (1981) and Vaughan (1983) rang the alarm bells in the United States, in the perspective of deteriorating capital and insufficient levels of infrastructure financing in the country[6]. Following a brief lull, many prominent studies on the impact of capital spending on economic growth were undertaken in the early 1990s, including by Bartik (1991), Wasylenko (1991), Munnell (1992) and Fox and Murray (1993). While past researchers have used multiple measures for capital spending – aggregated as total state capital outlay, or disaggregated by sector – studies which have used spending on transportation and highway facilities produce the most significant results[7]. Even within this measure, those studies that use a physical measure of such facilities produce significant results more often, as compared to studies which use direct highway spending to assess the impact on economic growth. The only study which suggests that such spending has a negative and significant impact on development is Dalenberg and Patridge (1995).

Another way of looking at the impact of infrastructure on economic growth was to look at the potential relationship between infrastructure stock and national factor productivity and the resulting economic growth. Some of the critical works in this area include those by Aschauer (1989), Munnell (1990) and Garcia-Mila and McGuire (1992). Aschauer showed that public capital and private capital are complementary in improving economic growth. Alicia Munnell showed the complementarity between labor and public capital. Garcia-Mila and McGuire found that in addition to labor and private capital, highway as well as education spending also contribute to bolstering economic growth.

However, studies later in the decade tried to counter this earlier deluge of studies that suggested strong linkages between public capital and economic growth. One of the reasons for the consolidated response to these studies was their controversial nature, especially with regards to the methods used. Holtz-Eakin (1994), Evans and Karras (1994) and Garcia-Mila, McGuire and Porter (1996) suggested that results formulated early on in the decade were biased, since

[6] Hefner, F. L., & Burson, T. E. (1990, NOV). "The determinants of regional infrastructure spending". 37th Annual North American Regional science meetings, Boston, MA.
[7] Fisher, R. C. (1997). The Effects of State and local public services on economic development". New England Economic Review, 1997.

they did not control for time or area-specific effects which had a correlation with public capital – leading to endogeneity and as suggested, bias in the results. Once these effects were controlled for, smaller or zero returns to additional marginal investment in public capital were found[8].

Determinants of Public Capital Spending

While much has been said about the impact of public capital spending on economic growth, there is a real dearth of research – especially in recent years – on the issue. Poterba (1995)[9] dealt with the determinants of capital spending, which also affect interstate differentials, including those in the use of debts to fund that spending; as well as on the effect of fiscal rules and procedures on capital spending. Temple (1994)[10] also looked at the issue of public capital spending and the factors of this spending. I have to emphasize here that that most studies that were reviewed dealt with spending at the state level, while some dealt with the metropolitan area, or considered all local governments. No studies were found that specifically dealt with capital spending at the city level in a panel setting. Hefner and Burson dealt with the determinants of public capital spending at the regional level[11]. Fisher and Wassmer (2013) undertook a study the determinants of public capital spending at the state level, adapting the models of capital spending developed by Poterba (1995) and Temple (1994). I will also be using a variation of this model in the next section. It must be noted that there are studies which deal with trends in public capital spending in individual cities including Philadelphia, New York City and Boston, but again, none of these compares these trends with other cities to determine the causes of public capital spending. Thus, this research aims to continue research into the determinants of public capital spending and also, fill the gap in research at the city level. Given the rising importance of cities, this research provides important insights that might not have been provided by prior research into capital spending which dealt with higher subnational units of government.

[8] Fisher, R. C. (1997). "The effects of state and local public services on economic development". New England Economic Review, 1997.
[9] Poterba, James M., 1995. "Capital budgets, borrowing rules, and state capital spending," Journal of Public Economics, Elsevier, vol. 56(2), pages 165-187, February.
[10] Temple, Judy. 1994. "The debt/tax choice in the financing of state and local capital expenditures", Journal of Regional Science, vol. 34, pp. 529-547.
[11] Hefner, F. L., & Burson, T. E. (1990, NOV). "The determinants of regional infrastructure spending". 37th annual North American regional science meetings, Boston, MA.

The model in the following section has been adapted from multiple models found in the literature, including those by Temple (1994), Poterba (1995), Fisher (2007) and Fisher and Wassmer (2013). However, most of these models were constructed using covariates relevant for state level analyses. Therefore, major overhauling was required.

Median Voter Demand Model for Public Capital Spending

I borrowed from previous modeling done in the area of public spending, primarily by Fisher (2007, Chapter 4), Temple (1994) and Poterba (1995). Temple and Poterba specifically focused on capital spending. However, previous models have focused on the state level. The city level presents large variations from the state level: in tax structures (higher reliance on property taxes as compared to the state level); the structure of capital stock (concentrated capital at the city level as compared to the state level); and in political structures. Therefore, a one-to-one adaptation was not feasible. Therefore, I have retained the core components of the demand model for public spending, but made important variations that capture these differences between the city and the state level.

However, what are the characteristics of the voter that I base my consumer demand model on? In order to answer the question of this consumer is at the city level, I drew on existing literature and made the assumption that the median voter wins the vote in favor of his or her choice each time and is therefore, the decisive voter and consumer. Borrowing from Fisher (2007, chapter 3), the median-voter theorem states that:

"If voters' preferences are single-peaked, if the choice to be made by voting is represented along a single continuum, if all alternatives are voted on, and if voters act in their true preferences, then the choice selected by majority vote is the median of the desired outcomes."

By preferences being single-peaked, I mean that each voter in the city has a clearly preferred alternative and continually gets less satisfaction as he or she moves away from that alternative in either direction. Further, the choice to be made must be linear on a single continuum, implying that for example, there should be increase or decrease in capital spending in one direction, without varying chunks of capital spending put up to vote. This scenario can be illustrated by a simple example. Suppose that voter A has preference for capital spending level

Ea, voter B has preference for capital spending level Eb and voter C has preference for capital spending level Ec, where Ec>Eb>Ea. If the government wants to select between Ea and Eb, then voter A will vote for Ea and voter B will vote for Eb. Given that voter C desires the highest level of capital spending of Ec, he or she will prefer Eb or Ea, which will give it greater utility. The same logic applies if the government was choosing between Eb and Ec, where voter A would also vote for Eb since he or she prefers a lower level of capital spending. In either case, the median voter, voter B emerges with the winner and the highest level of utility.

However, does the median voter also have the median income? This question is important since the median voter demand model for capital spending takes into account the 'median income', with the assumption being made that the median income is earned by the median voter. Based on the work of Theodore Bergstrom and Robert Goodman, this will be true if the desired expenditure increases (decreases) with income, and this increase (decrease) in the desired expenditure is higher (lower) than the increase (decrease) in the tax price that a higher (lower) income leads to. If this condition fails and income elasticity of desired expenditure is U-shaped, than the median voter will not have the median income. However, following existing literature which employs this assumption generously, I will also assume that at the city level in the United States, the median income is earned by the median voter with slight – but negligible – variations. Therefore, the public sector demand model will use the median voter's preferences as its core characteristic.

The first thing that a median voter demand model for capital spending requires is an illustration of the median voter's preferences. These are captured by the following utility function:

$$U = U(X, G, S)$$

where,

X=private consumption
G=Public services
S=Stabilization fund or account balances
The level of public service provided to the median voter depends on current public spending, the public capital stock and population. Thus,

$$G=f(Ec, K, P),$$

where,

Ep=Current public expenditure

K=Public capital stock

P=Population

Thus, the utility function simplifies to:

$$U=U(X, Ep, K, P, S)$$

The public capital stock equals:

$$K=Kt\text{-}1*(1\text{-}d) + Ek$$

where,

d=public capital depreciation

Ek=capital expenditure

The utility function further simplifies to:

$$U=(X, Ep, Kt\text{-}1*(1\text{-}d), Ek, P, S)$$

Having defined the median voter's utility function, I would not define the median voter's budget constraint. His or her budget constraint is:

$$Y=X + t*T$$

where,

t=median voter's tax price or share,

T=current tax collections

Y=income for the median voter

The tax price or tax share of the median voter (t) can be defined in multiple ways. Given that I am dealing with city level finances where property taxes are the largest contributor to the city's tax base, the price that the median voter has to pay for the taxes can be measured using relevant statistics on property data at the city level. Therefore, our proxy for the overall price for tax for the median voter is his or her share of the overall property market valuation at the city level. This methodology is consistent with Fisher (2007, chapter 4). Fisher states:

$$t = Vm(1-S)/V$$

where,

t=tax price or tax share

Vi= taxable property value of the median voter

V=total taxable property value in the jurisdiction

However, I make two changes to this formulation. The first is that instead of taking the taxable property value which could be construed as the 'assessed' valuation of the taxable property, I take the market valuations of property at the city level. It is important to make this explicit, since a higher assessment rate might be cancelled out by a lower property tax rate and vice versa. Market valuations would therefore, give a fair idea of what the contribution of the median voter is to the total property tax base at the city level. Moreover, we make the strong assumption that tax deductions and credits for property taxes are consistent at the city level across the United States. Therefore, the tax price now becomes:

$$t=Vm/V$$

Thus, the median voter's budget constraint becomes:

$$Y=X+(Vm/V)*T$$

While it would be possible to attempt to maximize the median voter's utility (maxU) subject to this budget constraint ($X+(Vm/V)*T - Y=0$), it is important to understand what comprises the tax (T) or revenue for the government. Assuming a balanced budget, the government's budget constraint is:

$$Ep + Ek + r*Dt\text{-}1+Es = T + I + B$$

where,

Ep: Current public expenditure

Ek=capital expenditure

r=interest rate on outstanding debt

Dt-1=outstanding debt

Es=allocation to the stabilization fund or balances,

T=Tax revenues

I=intergovernmental revenue

B=borrowing

Since taxation and borrowing are the primary tools for financing capital expenditure, Ek is financed both by T and by B. Thus, part of the capital expenditure is financed by taxation and part of it is financed by borrowing. The share of capital expenditure financed by borrowing is:

$$B=b*Ek$$

where,

b=debt share of current capital expenditure

Building on the evidence provided by Temple (1994) and using the same assumption used by Fisher & Wassmer (2013), we assume that the debt share of capital spending (b) is independent of the level of capital spending (Ek). Therefore, the government's budget constraint simplifies to:

$$Ep + Ek + r*Dt\text{-}1+Es = T + I + b*Ek; \text{ or}$$

$$T=Ep + Ek + r*Dt\text{-}1 + Es – I – b*Ek$$

Going back to the median voter's budget constraint, I had:

$$X+(Vm/V)*T-Y=0$$

Combining the median voter's budget constraint and the government's budget constraint (substituting the expression for T in the individual's budget constraint), I arrive at:

$$X+(Vm/V)*(Ep + Ek + r*Dt-1 + Es – I – b*Ek) – Y=0$$

Remember that the median voter's utility function is defined as:

$$U=(X, Ep, Kt-1*(1-d), Ek, P, S)$$

Therefore, all that needs to be done is to maximize the median voter's utility function, subject to his or her budget constraint. Therefore,

$$\text{Maximize } U=(X, Ep, Kt-1*(1-d), Ek, P, S)$$

$$\text{subject to } X+(Vm/V)*(Ep + Ek + r*Dt-1 + Es – I – b*Ek) – Y=0$$

This implies that the median voter desires to consume whatever quantities of private consumption (X), public capital expenditure (Ek) and public current expenditure (Ep) that give the median voter the highest happiness – or utility – from the range that can be afforded, given his or her budget constraint. Therefore, the median voter's demand for public capital spending (Ek) depends on private income (Y), overall population in the city (P), stabilization funds (S), existing net public stock [Kt-1*(1-d)], the median voter's tax share (t), interest on debt (r), the outstanding city-level debts (Dt-1), intergovernmental revenue (I) and institutional fiscal constraints as well as the characteristics affecting preferences (nature of the utility function). These additional preferences and other institutional and environmental factors affecting the model are defined in the following section.

Dataset, Variables and Hypotheses

Sample Size

Data for this analysis covers three years: 2006, 2009 and 2012. There are two primary reasons for selecting these three years. Firstly, there was a risk that year to year changes in different variables might not be large enough to produce sufficient variation for obtaining statistically significant results from an econometric analysis on the data. Therefore, spacing out years allowed for larger potential changes to be observed. Secondly, given the impact of the recession in 2008-09, the year 2006 can be seen as the year containing observations prior to the recession, 2009 being affected directly by the recession and 2012 being the post-recession time

period. This makes our analysis richer, and controlling for appropriate covariates and time dummies, we can make inferences on the impact that the recession had on public capital spending at the local level. However, it must be noted that there is the possibility that the determinants of public capital spending between 2006 and 2009 were different as compared to the determinants of similar spending between 2009 and 12. However, analyzing this heterogeneity of determinants is beyond the scope of this study.

The selection of cities for the study was slightly more arbitrary. I selected 100 cities, based on 3 rounds of selection. I used total population size as the primary characteristic of selecting cities in the first round, when the 50 largest cities in the United States were selected. This provided a sample which represented 28 states of the total 50, as well as Washington DC, the federal district in the United States. The second round of selection was based on providing representation to the remaining 22 states. The biggest cities in each state were selected. The remaining 28 cities (100-50-22) were selected through randomization in round 3. However, it was ensured that all cities selected had populations greater than 60,000. Thus, the selection process aimed to strike a balance both in terms of city size as well as geographical representation. With three years of data (2006, 2009 and 2012) and 100 cities, my raw dataset included 300 observations. However, since the construction of the dataset relied on multiple sources, some of which provided insufficient data, a number of observations were lost in the cleaning of the dataset prior to analysis. Descriptive statistics are provided in Table 1 in the appendix to this paper. All data has been adjusted for inflation using GDP deflators with 2009 as the base year.

The next sub-section lists both the dependent variables and the independent variables considered in this analysis. Not all of these variables were part of every model specification. All monetary data besides median income is in per capita, inflation-adjusted terms

Dependent Variable:

1. Capital outlay per capita (referred to, interchangeably, as capital spending per capita)

Independent Variables:

1. Median income

2. Tax price
3. Real GDP per capita
4. Total revenue per capita
5. Tax per capita
6. Median age of structure
7. Net capital assets per capita
8. Outstanding debt per capita
9. Credit ratings
10. Population
11. Median age
12. Unemployment rate
13. Political ideology
14. ARRA
15. Time dummies
16. City dummies
17. No debt limit dummy

Detailed information on the description of this data, their sources, the hypotheses for all the impact of all the independent variables on capital spending per capita and the explanation of these hypotheses are provided in Table 2 in the appendix

Methodology

For analyzing my dataset, I had a range of options to pick from. The basic model that I use is an ordinary least squares regression, controlling for different sets of covariates. However, given that there might be time invariant heterogeneity and common unobserved effects across cities, I also use a two-way fixed effects estimator. It would also be interesting to see how much the rate of change in capital expenditure is altered across time, controlling for different covariates, for which I utilized a first differenced model.

Pooled OLS regression

The basic Pooled Ordinary Least Squares (POLS) model provides us with a foundational understanding of the impact of different covariates including tax price and the income of the median voter on the demand for capital spending at the city level. It is specified as follows:

$$CapitalSpending_{it} = \beta_0 + \beta_1 MedianIncome_{ij} + \beta_2 Tax\ Price_{ij} + \sum \beta X_{it} + \mu_{it}$$

The assumption that I make for the POLS model is that there are no common unobserved trends across cities (nothing structurally different happens in all cities at the same time for a particular year) and that there is no unobserved heterogeneity across cities (cities do not have unique unobserved characteristics that might affect their demand for capital spending). These assumptions are hard to defend, since there must have been a time-specific change in the demand for capital spending during the recession of 2008-09, reflected in our data for 2009. Further, cities might have had unique unobserved heterogeneity which affected the demand for capital spending by median voters in these cities. These could range from the belief of individuals in the role of government (which I have tried to partially capture with the political ideology variable), to general belief in the importance of capital spending in advancing the socioeconomic condition of a city.

If the time-invariant or common trends error term is correlated with the covariates in my model, then omitted variable bias would be introduced into the analysis. Therefore, the POLS will have to make the strong assumption that even if these effects exist, they are not correlated with the covariates in the analysis. However, this might not be true since a median voter's beliefs about the role of government might affect both the demand for public capital spending, as well as the desire for more or less public debt to be incurred.

While these two factors can bias our estimates for the POLS model, it gives us a good foundation to start off with, especially in noting the direction of the impact of different variables on the demand for capital spending at the city level. Further, and more importantly, it enriches our understanding of these two effects, since by utilizing a model that controls for them, we can compare this new model and the POLS model and see how the impact of different variables on demand for capital spending changed.

Two-way fixed effects estimator

The two-way fixed effects estimator does not make the assumption of unobserved common trends or unobserved heterogeneity across cities. Instead, it takes into account the possibility that these two effects exist and are captured by the error term in my model, and that

these effects (and thus, the error term) are correlated with the observable variables in my model. Thus, it controls for these effects by generating dummies for cities and time periods (one dummy is of course omitted, in order to avoid the 'dummy variable trap' or the issue of perfect multicollinearity). These dummies allow us to control for the effect of common, time-specific trends as well as time-invariant unobserved characteristics of cities. However, I do assume strict exogeneity in my analysis. Otherwise, even a two-way fixed effects model might not be tenable. What this implies is that the present error term has a mean of zero, conditional on past, present and future values of the regressors. Thus, we assume that the two unobserved effects are not related to independent variables such as income, tax price or outstanding debt. In fact, this assumption must hold for our entire analysis if it is to produce consistent results.

The fixed effects estimator, also known as the within estimator is specified for my model as follows:

$$CapitalSpending_{it} = \beta_0 + \beta_1 MedianIncome_{it} + \beta_2 Tax\ Price_{it} + \sum \beta X_{it} + \alpha_i + \gamma_t + \nu_{it}$$

Where $\mu_{it} = \alpha_i + \gamma_t + \nu_{it}$ (ν_{it} is independent and identically distributed)

The time-invariant unobserved heterogeneity is captured by α_i, while the common unobserved trends are captured by γ_t. The within estimator demeans the data, that is, it subtracts the respective mean values from the dependent variables, the independent variables and the error term. Thus, this sweeps away the effects of time-invariant unobserved heterogeneity. Further, the common unobserved effects are captured by time dummies in this model. Under the assumptions made in this section, the two-way fixed effects estimator should give us unbiased estimates of the parameters on our independent variables.

Between Estimator

The model is as follows:

$$\overline{CapitalSpending}_i = \beta_0 + \beta_1 \overline{Median\ Income}_i + \beta_2 \overline{Tax\ Price}_i + \sum \beta X_i + \alpha_i + u_t$$

Where μ_{it} is independent and identically distributed)

While two-way fixed effects estimation provides us with key insights into variation within cities across time, we would also like to analyze the differentials in variation across cities. For this, the between estimator is used. The between estimator averages out variables across times and runs a pooled OLS on the cross-section of averages across cities, allowing us to see the how the impact of different variables affect public capital spending at the municipal level across cities.

Sensitivity Analysis

While my core models are intended to provide key insights into the determinants of public capital spending at the municipal level, I want to run a sensitivity analysis to see how variations in my models would alter these impacts. One reason would be to see the robustness of my results across different models, but also to tease out why – if any – changes are emerging from the use of different models. Another reason is to see if anything new could be learnt from analyzing the dataset.

First-difference estimator

While level changes give us critical information about the impact of different covariates on capital spending at the city level, I wanted to see the impact of these variables on the rate of change of capital spending over the period of our study. Essentially, I wanted to see how much of a change the change in one variable had, on the rate of change on capital spending. Therefore, a first-differences estimator was also used. The same assumptions of strict exogeneity and the assumption that the error term is independent and identically distributed are made in this model.

The first-differences estimator exploits the special features of panel data to measure the association between time-invariant one-period changes in regressors and time-invariant one-period changes in the dependent variable[12]. I start with the fixed effects model and lag it by one year:

$$CapitalSpending_{i,t-1} = \beta_0 + \beta_1 MedianIncome_{i,t-1} + \beta_2 Tax\ Price_{i,t-1} + \sum \beta X_{i,t-1} + \alpha_i + \gamma_{t-1} + \nu_{i,t-1}$$

[12] Cameron A. C. & Trivedi P. K., "Microeconometrics: Methods and Applications," Chapter 21, Cambridge University Press, New York, 2005.

Then, I subtract this lagged equation from the original fixed effects model to get:

$$CapitalSpending_{it} - CapitalSpending_{i,t-1} = \beta_1 MedianIncome_{it} - \beta_1 MedianIncome_{i,t-1} + \beta_2 Tax\ Price_{it} - \beta_2 Tax\ Price_{i,t-1} + \sum \beta X_{it} - \sum \beta X_{i,t-1} + \gamma_t - \gamma_{t-1} + \nu_{it} - \nu_{i,t-1}$$

Or

$$\Delta CapitalSpending_{i,t} = \beta_0 + \beta_1 \Delta MedianIncome_{i,t} + \beta_2 \Delta Tax\ Price_{i,t} + \sum \beta \Delta X_{i,t} + \gamma_t + \nu_{i,t}$$

Where $\mu_{it} = \gamma_t + \nu_{it}$ (ν_{it} is independent and identically distributed)

Like the fixed effects estimator, the first-differences estimator yields consistent estimates of the parameters. This is because time-invariant unobserved heterogeneity is subtracted out, while the common unobserved trends are controlled with the use of time dummies. However, the major weakness of this model is that the parameters on time-invariant covariates are not identified. Further, it is less efficient than the fixed effects model if T>2, which is true in our case where T=3 (2006, 2009, 2012), where T is the number of time periods considered. Furthermore, the lagged effect of variables is much more difficult to gauge with the first-differences estimator. For example, while I might be looking at the rate of change of capital spending between 2006-09 while controlling for the rate of change of outstanding debt at the same time, it can be argued that the rate of change in outstanding debt in prior periods is what defines the rate of change of capital spending in the time period 2006-09. However, while the core model just looks for rates of change in the same period, I try to minimize this weakness in the model in the sensitivity analysis, where level variables are also considered. This implies that the rate of change in capital spending is estimated, controlling for the *initial* or *base* values of different covariates at the beginning of the time period

First-differenced dependent variables with level independent variables

As discussed in the analysis of the first-difference estimator, there are issues with determining causality while looking at the impact of a change in one variable on the change in another variable. This may be because the change in the dependent variable might actually have been determined by the level of the independent variable at the start of the period during which the change is being assessed, or by changes in the prior period. While not discounting the fact that changes in the independent variable might also have an effect on changes in the dependent

variable in a common time period, base values of independent variables can provide useful information the determinants of the rate of change of the dependent variable – public capital spending at the municipal level. Therefore, for this sensitivity analysis, I constructed a model which has first differenced data for the dependent variable and independent variables, but also level (or base) values for the independent variable. So for example, if I am looking at the rate of change in public capital spending between 2006 and 2009, I used base values for 2006 for all independent variables. The model is illustrated below:

$$\Delta CapitalSpending_{i,t} = \beta_0 + \beta_1 \Delta MedianIncome_{i,t} + \beta_2 MedianIncome_{i,t-1} + \beta_3 \Delta Tax\ Price_{i,t} + \beta_4 Tax\ Price_{i,t-1} + \sum \beta \Delta X_{i,t} + \sum \beta X_{i,t-1} + \gamma_t + \nu_{i,t}$$

Where $\mu_{it} = \gamma_t + \nu_{it}$ (ν_{it} is independent and identically distributed)

The intuition here is that both changes in independent variables in a period, as well as base values of the independent variable at the beginning of the time period will have an impact on the change in capital spending during the same time period.

Discussion of Results

Pooled OLS

The pooled OLS (POLS) provided interesting results. While the coefficient on median income was positive as hypothesized, it was not statistically significant. at the 95% confidence level. Similarly, the estimates on tax price are not statistically significant but are negative, as hypothesized. This regression suggests that median income and tax price do not have a statistically significant impact on public capital spending.

Out of the range of environmental covariates included in the model, only outstanding debt per capita was statistically significant at the 99% confidence level. It suggests that a $1 increase in debt increases capital spending by $0.08. This might be a reflection of cities taking debt to partially finance capital spending at the municipal level. However, what is significant is the magnitude which is low.

Local share of capital spending as a share of state-local capital spending also has a statistically significant impact on capital spending at the 90% confidence level. A one percentage

point increase in this share increases capital spending at the local level by approximately $4, on average, ceteris paribus. Since we control for a host of other factors, this is not simply a reflection of greater spending at the local level. What this suggests that holding even total capital spending and total capital stock constant, cities which are more active in the public economy spend more on average on capital spending. Thus, our hypothesis is validated. This might be a reflection of the fact that cities which take more of a leadership role in a particular state also focus more on the capital needs of their economy.

A one dollar increase in total net capital stock per capita increases public capital spending by $0.013, on average, ceteris paribus. This suggests that cities which have larger existing infrastructure also spend more on that infrastructure. This is an interesting finding, since we would expect infrastructure spending to increase with *lower* existing capital stock because of the catch up effect. However, I would conjecture that it might be the case that a higher level of capital stock is indicative of momentum in capital spending and a higher prioritization of such spending at the city level.

Fixed Effects Estimator

While the POLS produced interesting results, I wanted to make sure that my estimates are not biased by unobserved heterogeneity across cities, or by unobserved common trends in the form of shocks generalizable across cities in a particular time period (such as the recession). The fixed effects estimator helped me sweep away these unobserved effects. However, the fixed effects estimator did not produce significant estimates for the impact of median income on capital spending. Conversely however, estimates for the tax price variable are significant at the 99% confidence level for the two-way fixed effects estimator. For every percentage point increase in the share of the median voter in the total tax base of the city (the tax price), capital spending decreases by $6178.5 per capita. This is the hypothesized change. However, bear in mind that the tax price variable is essentially the fraction of total tax supported by the median voter: one individual. One would not expect an individual with the median income in a community to support more than a few thousands of the tax base, unless the population is extremely low. Since this is not the case, it must be kept in mind that the right scale will have to

be used for interpreting results on tax price. It might be better to say that for every 0.001 percentage point increase in tax price, public capital spending per capita increases by $6.2 on average, ceteris paribus.

Of the environmental variables in the model, an increase in outstanding debt per capita of one dollar increases capital spending by $0.0891. This result is significant at the 99% confidence level. This goes counter to my hypothesis that increasing debt hampers the ability of city governments to borrow for capital spending, leading to lower capital spending. The case might be that this is simply a reflection of governments borrowing to finance capital spending, with a simple correlation between the two variables. The effect of constrained borrowing on capital spending can better be captured by including a lagged debt variable to see the effect of past borrowing on current capital spending. However, this can also be captured by the dummy for low credit rating. However, this model suggests that the estimate for the impact of low credit rating on capital spending is not statistically significant.

If the local share of capital spending as a share of state-local capital spending increases by one percentage point, public capital spending per capita increases by $2.2, on average, ceteris paribus. This result is statistically significant at the 90% confidence level. The explanation for this result remains the same as for POLS. However, this estimate is almost half of what I got for POLS, indicating that unobserved heterogeneity might have been producing an upward bias in the estimate for POLS. The other variables show statistically insignificant impacts when we use the two-way fixed effects estimator.

Between Estimator

The between estimator produced interesting results. Firstly, while the hypothesized signs seem to be correct in the case of median income (positive) and tax price (negative), these estimates appear to be statistically insignificant. However, stimulus funding appears to have played a significant role in impacting public capital spending levels at the city level when we compare cities. For every one dollar increase in stimulus funding (solely for infrastructure), there is an increase of $1.067 in public capital spending per capita at the city level, on average, ceteris paribus. This result is statistically significant at the 90% confidence level. This indicates that if a city got one dollar more than another – controlling for other variables – it increased public

capital spending by *more* than one dollar: public capital spending was stimulated. Thus, the between estimator suggests that the stimulus had the desired effect on capital spending at the city level.

Outstanding debt per capita is once again estimated to produce a statistically significant impact on capital spending at the 99% confidence level. However, across cities, this impact is marginally lower than within cities across time. For a one dollar increase in outstanding debt per capita, public capital spending per capita increases by $0.06 (as compared to approximately $0.08-$0.09 within cities across time) on average, ceteris paribus. Thus, cities which took more debt spent more on capital spending.

Net capital stock per capita appears to generate a positive impact on public capital spending at the 90% confidence level. Interestingly, the coefficient is the same as the pooled OLS: $0.0129. Thus, a one dollar increase in net capital stock per capita produces an increase in public capital spending per capita of $0.0129, on average, ceteris paribus. Thus, cities which have more capital stock also appear to have the momentum in public spending as well as the willingness to spend more. In a way, this raises a red flag for state and local governments. In the long run it might be the case that the disparity between infrastructure standings across cities will increase over time, with cities with better infrastructure now will have an even larger advantage against cities which do not have quality infrastructure currently, leading to further erosion of economic competitiveness of these cities.

The results for the POLS, two-way fixed effects estimator and the between estimator are presented in Table 3:

Table 3: Results for Pooled OLS, Two-Way Fixed Effects Estimator and Between Estimator

Variable Name/Estimator	Pooled OLS	Two-way Fixed Effects	Between Estimator
Primary Variables of Interest			
Median Income	0.0008	0.003	0.0004
Tax Price (%)	-1723.7	-6178.5***	-1605.7
Environmental Covariates			
Stimulus Funding Per Capita	0.2	-0.03	1.06*
Median Age	0.9	-5.9	1.1
Population Density	-0.005	-0.03	-0.0005
Local Share of State-Local Expenditure	4.03*	2.2*	2.9
Net Capital Stock Per Capita	0.01*	0.02	0.01*
Median Age of Structures	1.0	5.6	0.4
Political Ideology	0.2	0.3	-0.3
Outstanding Debt Per Capita	0.08***	0.09***	0.06***
Low Credit Cities	-18.3	30.4	-41.0
2009	-11.2	8.7	
2012	-23.1	-52.2	
Constant	-258.4	-122.3	-166.3
Model Details			
R-squared	0.3	0.6	0.3
# of observations	232	232	232

Sensitivity Analysis: First Difference Estimator

The simple first-difference estimator confirmed my primary estimates from the two-way fixed effects model. While median income again appears to have a statistically insignificant impact on capital spending, an increase in the increase the tax share of the median voter (tax price) by 0.001 percentage point produces a large decrease in the rate of change of capital spending per capita of $6.8. This result is statistically significant at the 95% confidence level. This suggests as the rate of change tax price increases within a city across time, the rate of change of capital spending also increases.

Local share of state-local capital expenditure again appears to produce statistically significant impacts on capital spending at the city level – even when we compare changes across time. As the *change* in local share of capital expenditure increases by one percentage point, the

change in capital spending per capita at the city level increases by approximately $4 on average, ceteris paribus. This estimate is statistically significant at the 99% confidence level. Thus, not only does the activeness of a particular city affect its prioritization of capital spending across time, changes in these also affect the level of change in capital spending.

While the estimates for the impact of a majority of the other environment variables on capital spending per capita were not statistically significant, political ideology did seem to have an impact on capital spending per capita when we consider changes across time. As a city leans more towards Democrat presidential candidates, it also starts increasing its capital spending per capita. More specifically, the estimates suggest that an increase of one percentage point in the increase in a city's Democrat leanings increases the rate of change of capital spending by $4.04. This result is statistically significant at the 90% confidence level. Further, a change in the increase in net capital stock per capita of $1 appears to lead to an increase of $0.04 in public capital spending per capita at the city level, on average, ceteris paribus. These results validate our results from the two-way fixed effects model, and are presented in table 4 in the appendix.

Sensitivity Analysis: First-differenced with level independent variables

The first-difference estimator with initial base values for dependent variables produced interesting results on a number of independent variables. The coefficient on tax price remains consistent with the one that I estimated earlier using the regular first-difference estimator. Same is the case for the differences local share of state-local capital expenditure and the differenced net capital stock per capita. However, I added an unemployment variable in this model to see how it reacts. While the other results remain robust, I found that unemployment also has a statistically significant impact on public capital spending at the 90% confidence level. For a 1 percentage point increase in the change of the unemployment rate across time, the change in public capital spending per capita decreases by approximately $9. This is as was hypothesized, since we expect a city with higher levels of unemployment to have a lower ability to afford more capital and therefore, to spend less on infrastructure.

Amongst the initial (level) variables, only initial levels of net capital stock per capita appears to have a statistically significant impact on the *change* in public capital spending per capita at the city level. If a city's initial net capital stock per capita was higher by $1, the change

in public capital spending per capita in that city over time was negative and of the magnitude $0.02. Thus, higher infrastructure levels at the beginning of a period do appear to have a marginally negative impact on the rate of change of capital spending over time in a particular city. These results are illustrated in Table 5 of the appendix.

Conclusion

In this study, I analyzed a unique dataset using established econometric techniques in order to understand the determinants of capital spending at the municipal level. While there is a significant corpus of studies available on the links between infrastructure and economic growth, and on the determinants of capital spending at the state level, there are no significant studies in the public domain that look at the latter at the municipal level. Metropolitan areas are engines of economic growth in the United States. The rising importance of cities in the country as an arena for policymaking and public resource-creation and management is increasing the need for studies to focus on the heart of the metropolitan area. However, the challenge of undertaking such research is exacerbated by the dearth of consolidated data. Municipal level finances remain siloed at the city level, buried in the depths of individual annual financial reports. One of the most important lessons emerging from this study is that there is a dire need for all levels of government to fund the consolidation of this information. Without such a database, city level analyses will remain anecdotal, and any attempt at evidence-based policymaking at the state or federal level will be futile.

While the results of this study are limited by a relatively low number of degrees of freedom and potential problems with lagged effects in the impact of certain variables on capital spending, some interesting findings emerge from it. Firstly, changes in median income do not seem to have a statistically significant impact on capital spending per capita. This runs counter to the intuition that as the income of the median voter increases, then so does the affordability of more capital spending and higher the demand for it. This could be the result of: a) a failure of the median voter demand model to hold in this case, since capital spending might not be a normal good or the median voter might not be the one winning the vote; b) the data might have insufficient variation with respect to median income; or c) other factors are the cause for changes in capital spending at the city level. However, while it is understandable that the demand for

capital spending would decrease due to a rise in the price of such spending (due to a rise in tax price), it is surprising to see how large of an impact this has on the demand for capital spending. Thus, city level financial managers should be wary of movements in the tax price when planning future capital spending decisions.

It appears that the federal stimulus worked, in the sense that it stimulated capital spending at the city level across cities. This is an important finding and invalidates concerns over the fungibility of public capital spending at the local level in the context of the recession and the ensuing stimulus package. Further, I found that higher debt levels are highly correlated with higher spending levels. This might be a reflection of the prioritization of capital spending within cities, whereby, financial managers are ready to incur more debt with the hope that higher capital spending will leave to future economic gains and financial stability. Given that the local share of state-local capital spending appears to play a positive role in increasing public capital spending per capita and is robust across different models, I conclude that cities which are playing a more active role within their states, also demand more capital spending and are also willing to spend more on their infrastructure needs.

Based on the analysis, I also show how the rate of change of municipal capital spending per capita changes when a city begins to lean more towards Democrat ideals. While this makes intuitive sense, given the respective stances of the Democrat Party and the GOP on the size and role of government (with the GOP preferring government contraction), it goes to show that politics have a major role to play in the financing decisions of the future and consequently, the economic health of the country.

Way Forward

While this study attempted to tackle some of the challenges of doing research on municipal finance from a cross-sectional, national perspective, it was limited by data and time constraints. Future studies should look at expanding the number of years in the dataset; improving model specifications by delving deeper into the lagged impacts of independent variables on capital spending per capita; analyzing potential differences between even the determinants of capital spending before and after the recession, not just the estimates of a common set of determinants; undertaking regional analyses to see if there is heterogeneity in

capital spending patterns across different regions in the United States; looking at the impact of varying demographics on capital spending at the local level; understanding the differential impact of the multiple varieties of capital spending; and undertaking case studies on municipal capital spending patterns.

Precisely like the study, this list is not exhaustive. It is only meant to open up municipal capital spending to a more rigorous line of inquiry

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Appendix

Table 1: Descriptive Statistics

Variable	Units	# of Observations	Mean	Std. Dev.	Min	Max
Median Income	USD ($)	259	45813.37	13738.11	24061.14	117606.7
Tax Price	Percentage (%)	260	0.0021808	0.0048816	0.0000631	0.0403547
Median Age	Years	260	34.08885	3.033365	24.5	47.6
Real GDP Per Capita	USD ($)	260	45908.4	11886.24	24561	97200.82
Unemployment Rate	Percentage (%)	243	7.126502	3.099898	2.2	24.8
Local Share of State-Local Expenditure	Percentage (%)	260	63.23554	12.27838	33.62	100
Population	Units	260	4882.98	4718.877	171.2161	27486.64
Outstanding Debt Per Capita	USD ($)	260	908.509	1455.644	0	15034.93
Total Revenue Per Capita	USD ($)	239	2666.614	2696.216	1.807686	30856
Capital Outlay Per Capita	USD ($)	237	239.8922	259.9269	10.08616	2119.338
Net Capital Stock Per Capita	USD ($)	236	6559.325	3901.711	1225.974	28801.09
Tax Per Capita	USD ($)	237	1137.093	1627.54	154.7511	19788.82
Political Ideology	Percentage (%)	257	13.14214	27.1034	-45.07	85.93
Stimulus Funding Per Capita	USD ($)	260	24.74175	83.49131	0	873.4563
Median Age of Structures	Years	260	46.06538	14.83525	13	75
Low Credit Cities	Units	260	0.1884615	0.3918345	0	1
Medium Credit Cities	Units	260	0.1923077	0.3948736	0	1
High Credit Cities	Units	260	0.6192308	0.4865125	0	1

Table 2: Details on Variables

Dependent Variable				
Variable Name	**Description**	**Data Source**		
Capital outlay per capita	The primary dependent variable that I used was capital outlay per capita at the city level. The capital outlay includes expenditure made through the general fund, the major fund as well as the non-major capital projects fund at the city level. The capital outlay is the primary budget item that identifies the overall expenditure made on public infrastructure in a given year.	CAFRs		
Independent Variables				
Variable Name	**Description**	**Data Source**	**Expected Impact**	**Explanation**
Median income	The median income represents the income earned by the median voter, as discussed earlier. The median income is given in dollars.	United States Census Bureau		As the median income increases, I expect public capital spending to increase, since the public's purchasing power increases, increasing demand for desired public capital expenditure.
Real GDP per capita	This represents the real Gross Domestic Product (GDP) per capita at the Metropolitan Statistical Area (MSA). The idea here is that while this is not a city level variable, it captures the economic externalities produced by a central city in a metropolitan area, which might not be captured by just controlling for GDP per capita for the city's residents. This makes intuitive sense given that suburbs and smaller towns depend on the primary city in the metro area for numerous economic functions, such as insurance, banking, finance and export. Further, many earners in the city prefer to live in the suburbs and in exurban areas, who remain unaccounted for with covariates such as city level income per capita data.	Bureau of Economic Analysis		As real GDP per capita increases, the metro area gains in wealth, creating new potential that the city attempts to tap into by laying down more infrastructure through greater capital spending.
Median age of structure	This is a weak proxy for the quality of the infrastructure. The intuition here is that the older the infrastructure (median) the lower its current quality	United States Census Bureau		The older (and lower quality) the infrastructure, the greater the capital spending per capita required to furnish and maintain it.
Outstanding debt per capita	This represents the city government's general obligation (GO) bonds position. The city funds much of its capital spending using	CAFRs		The higher the outstanding debt per capita, the lower capital

	funds generated through the issuance of GO bonds. These are part of what are commonly known as municipal bonds and are part of a vibrant muni-bond market in the United States. The GO bond is secured by a city government's pledge to use legally available resources, including tax revenues (many times property taxes) to repay bondholders. A city's outstanding debt per capita represents its credit position, especially in the context of capital spending.			spending, since higher indebtedness negatively affects a city's availability to fund capital spending. However, this current increase in debt might fund current increase in capital spending. Past debt levels might affect capital spending negatively, however.
Local Share of State-Local Capital Spending	This variable holds data on the capital expenditures made at the local level as a percentage of capital spending across an entire state. Since data is not available at the city level, local shares are used for city shares. Further, because there is at times more than one city for a particular state, the local share in one city in a state remains the same for another city in the same state. However, this is a good proxy for the city's share of state-city finances, since local shares do not have large movements across cities in a particular state.	Census of Govts.		As the local share of state-local capital spending increases, I would expect public capital spending to increase as well, as cities play a larger role in infrastructure financing and in laying down the terms of their future economic growth.
Credit ratings	Standard & Poor's (S&P) ratings of each city's general obligation bonds. The variable ranges from a high of AAA to a low of BBB- for this particular dataset. No city had a credit rating worse than BBB-. The change in interest rates from moving up or down this scale is non-linear, implying that moving from say, AA+ to AAA does not lead to the same decrease in interest rate owed on GO bonds as does a movement from BBB- to BBB. Therefore, linear, discrete ranking on a numerical scale was not possible. Therefore, the nonlinear variations in interest rates were used to construct a new index. This is an environmental variable, providing insights into the broader financial health of the city. A higher credit rating provides a city to acquire GO bonds at lower interest rates. Further, a higher credit rating is also an indication of stability in the financial indicators of the city.	CAFRs		A higher credit rating should lead to higher capital spending
Population density	Population density for a city in a particular year. This is an environmental covariate which controls for demographic characteristics of a city.	United States Census Bureau and CAFRs		As population density increases, the pressure for spending on infrastructure for a city would also be expected to increase.

Median age	The median age in a particular city for a specific year. This is an environmental covariate which controls for demographic characteristics of a city.	United States Census Bureau		No clear hypothesis on median age, since it has both pulls and push factors on capital spending. As people age, their spending peaks. However, as people age further, they might be get more economically conservative, leading to a resistance to higher capital spending
Unemployment rate	The unemployment rate at the city level. This is an socioeconomic covariate, reflecting the state of the city's economic wellbeing, level of inequality and distribution of jobs in the city's economy.	United States Census Bureau		As the unemployment rate increases, capital spending will decrease, controlling for stimulus funding that might be correlated with it. Higher unemployment makes public capital spending less affordable for the public.
Political ideology	This variable contains information on the gap between votes cast for Democrat presidential candidates as compared to Republican presidential candidates in the elections of 2004, 2008 and 2012. Thus, it aims to show how 'Democrat' a particular city is. Given the gradual polarization between the positions of the two political parties, apart from limited variation, it is argued that a city which votes for a Democrat member will be more amenable to a greater role of government. Data for 2004 is used for 2006, data for 2008 is used for 2009 and data for 2012 is used for 2012. Since political allegiance shows a certain amount of inertia, the flexible use of years should not be a major problem. Further, the data was collected at the county level.	Dave Leip's Atlas of US Presidential Elections (http://uselectionatlas.org/)		The more 'Democrat' a city, the higher the acceptability for the role of government and therefore, high the level of capital spending.
Net capital assets per capita	This variable provides data on public capital stock less depreciation. Net capital assets represent the overall capital stock that a city has at a particular point in time. The methodology for measuring capital stock is provided by the Governmental Accounting Standards Board (GASB) and is thus, standardized across cities. The capital stock however, is historically priced. This creates the problem of potential understatement of the capital stock for older cities as compared to newer ones. The same street would	CAFRs		A larger level of net capital assets per capita would imply that the city would need lower levels of capital spending.

	have cost less (in nominal terms) in the 1940s than it does in 2012. However, this threat to this variable does not create major hurdles for the analysis. The intuition here being that while older infrastructure has a lower price associated with it because of the lower nominal price, the lower level of the price also encapsulates the age of the infrastructure. However, it had to be assumed that local inflation is consistent across cities.			
ARRA	Variable for incorporating stimulus, infrastructure data into the analysis. The American Recovery and Reinvestment Act (ARRA) of 2009, also referred to as the Stimulus or the Recovery Act was an economic stimulus package enacted by the 111th United States Congress in February 2009 and signed into law on February 17, 2009, by President Barack Obama. ARRA was introduced in response to the recession of 2008-09 in order to get the economy going again. This variable was controlled for because it had an impact on local level capital spending, by definition. The variable was created by extracting only data on stimulus infrastructure spending at the city level.	Recovery.gov		An increase in the federal stimulus spending on infrastructure should definitionally lead to higher capital spending
Time dummies	I used two time dummies (2009 and 2012) in OLS regressions and fixed effects models (explained later) and one time dummy (2009-12) in the first differencing model. This allows us to see the impact that a particular year has on capital spending. Essentially, we control for time invariant common trends using time dummies. This also allows us to quantify the impact of a specific year, based on the generation of a new intercept for our regression estimate.	Not Applicable		The year 2009 should have a statistically significant decrease on capital spending, controlling for ARRA
City dummies	Introduction of city dummies controls for time invariant unobserved heterogeneity across cities. We introduce 99 dummy variables in certain sensitivity analysis to see how capital spending varied across particular cities, controlling for other variables.	Not Applicable		Not Applicable

Table 4: Results for First-Difference Estimator

FD_capitalo~y	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
FD_medianin~e	.0006176	.00325	0.19	0.850	-.0058188	.007054
FD_taxprice~t	-6755.283	2863.202	-2.36	0.020	-12425.7	-1084.862
FD_arra	.0446147	.0908035	0.49	0.624	-.1352169	.2244462
FD_medianage	-2.828531	7.031555	-0.40	0.688	-16.75416	11.0971
FD_populati~y	.032064	.0371719	0.86	0.390	-.041553	.105681
FD_localshare	4.056754	1.526159	2.66	0.009	1.034277	7.079232
FD_ncspc	.0373524	.0198374	1.88	0.062	-.0019345	.0766393
FD_medstruc~e	4.677825	6.361316	0.74	0.464	-7.920428	17.27608
FD_political	3.631654	2.014106	1.80	0.074	-.3571768	7.620485
FD_debt	.0516946	.0438212	1.18	0.241	-.0350909	.1384801
FD_unemprate	-4.744725	5.085968	-0.93	0.353	-14.81722	5.327768
_cons	-53.26002	36.23138	-1.47	0.144	-125.0144	18.49433

Table 5: Results for First-Difference Estimator with Level Variables

_cons	-50.66602	34.55011	-1.47	0.145	-119.0907	17.75867

Linear regression

Number of obs	129
F(22, 106)	2.20
Prob > F	0.0042
R-squared	0.2420
Root MSE	174.02

FD_capitaloutlay	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
FD_medianincome	.0022061	.0041886	0.53	0.600	-.0060982	.0105104
FD_taxpricepercent	-6853.58	3774.614	-1.82	0.072	-14337.12	629.96
FD_arra	-.0298311	.1200905	-0.25	0.804	-.2679222	.2082599
FD_medianage	2.153562	8.754025	0.25	0.806	-15.20214	19.50927
FD_populationdensity	.0545729	.0603147	0.90	0.368	-.0650069	.1741527
FD_localshare	3.558748	1.418189	2.51	0.014	.7470497	6.370446
FD_ncspc	.0739203	.0349406	2.12	0.037	.0046471	.1431935
FD_medstructage	8.564791	6.870064	1.25	0.215	-5.055778	22.18536
FD_political	2.435644	2.002755	1.22	0.227	-1.535014	6.406301
FD_debt	.0489927	.0466843	1.05	0.296	-.0435635	.1415488
FD_unemprate	-9.067783	5.374413	-1.69	0.095	-19.72308	1.587514
ini_medianincome	-.0012155	.0012946	-0.94	0.350	-.0037822	.0013511
ini_taxpricepercent	-1206.499	1174.279	-1.03	0.307	-3534.621	1121.623
ini_arra	-.0053949	.1662621	-0.03	0.974	-.3350256	.3242359
ini_medianage	-.6842231	5.610332	-0.12	0.903	-11.80725	10.43881
ini_populationdensity	-.0030481	.0071401	-0.43	0.670	-.0172041	.0111079
ini_localshare	.3548841	1.49573	0.24	0.813	-2.610546	3.320314
ini_ncspc	-.0174765	.0096901	-1.80	0.074	-.036688	.0017351
ini_medstructage	1.465926	1.29076	1.14	0.259	-1.093132	4.024984
ini_political	.4293025	.9894578	0.43	0.665	-1.532394	2.390999
ini_debt	.0021451	.0130241	0.16	0.869	-.0236764	.0279667
ini_unemprate	-7.439956	5.551009	-1.34	0.183	-18.44537	3.565459
_cons	59.02049	188.5402	0.31	0.755	-314.7788	432.8198

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