

THE EFFECT OF A CAPITAL BUDGET ON CAPITAL SPENDING IN THE U.S. STATES

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ABSTRACT

This thesis analyzes the impact of capital budget on capital spending in the U.S. states. The analysis is based on the James Poterba's 1995 study of the impact of a capital budget on capital spending using 1962 U.S. state-level data. I first replicate Poterba's model using the 1992-1996 data set that I had constructed for this study. I then extend Poterba's model to include a set of variables that allows exploration of the specific effects of the regulatory environment on spending outcomes in each state. These are mainly categorical variables that classify states in accordance with their definition of capital expenditure, organization of capital planning process, project selection and cost estimating techniques and capital financing practices. I constructed these variables using the data of the 1997 NASBO survey after reviewing the suggestions of practitioners and policy makers, as well as those engaged in research in this field. The introduction of a set of budget rule/budget composition variables into the analysis is an important contribution of this study. This study supports the claim that government spending is determined by a host of causal factors that can be grouped into four broad categories, (1) demographic-economic factors, representing both demand for public capital and source of its financing, (2) political decision-making factors that reflect electorate/party in power preferences for spending, (3) capital stock variables that relate to the age of infrastructure and control for spending culture in a state, and (4) budget composition/spending rules. The main finding of this study is the confirmation of Poterba (1995) finding with respect to the positive effect of capital budget on capital spending using a recent data set and longer time frame of analysis. Another major contribution of this study is a statistically significant effect of sixteen spending rule/ budget composition variables. The results support the basic premise found in the literature that budget process affects capital spending.

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THE EFFECT OF A CAPITAL BUDGET ON CAPITAL SPENDING IN THE U.S. STATES

Chapter 1: Introduction

This thesis analyzes a relationship between a capital budget and capital spending. Presently the impact of a capital budget remains an unanswered question. The literature on capital budgeting in the public sector includes a number of qualitative analyses and case studies, but there is a relative dearth of empirical work that would determine whether and how the existence of capital budget affects capital spending. Many studies (Hush and Peroff, 1988, Thomassen 1990, National Association of State Budget Officers, 1997) have noted that state governments vary significantly in their al practices of budgeting and their relative spending levels and therefore provide a natural laboratory for studying relationships between budgetary practices and policy outcomes.

This thesis addresses both of these issues: it incorporates the differences in capital budgeting practices into the analysis and it contributes to the quantitative literature on the effects of these practices. The thesis is based on a seminal study by Poterba (1995) that analyzed the relationship between the level of state capital expenditure and the use of capital versus operating budgets for the year 1962. Poterba's central hypothesis confirmed by his findings is that the very existence of capital budget positively affects non-highway capital spending by U.S. states.

This study first replicates Poterba's model and then offers a number of important extensions of that approach. The most obvious limitation of Poterba's model is his use of cross-sectional data for his study year. Capital expenditures may vary from year to year because of contingencies (one-time big expenditures, or natural disaster relief) or political factors such as a re-election campaign. This "noise" may distort the underlying relationship between the capital budget and capital spending.

My data set includes the period 1992-1996. Replicating the results of an earlier study using a recent data set provides a robustness check for the validity of the previous study's assertions. The panel data also allow me to verify whether Poterba's results are consistent when considered over several years, instead of just at a fixed point in time.

In addition to using panel as opposed to cross-sectional data, I extend Poterba's model to include a set of variables that allows exploration of the specific effects of the regulatory environment on spending outcomes in each state. These are mainly categorical variables that classify states in accordance with their definition of capital expenditure, organization of capital planning process, project selection and cost estimating techniques and capital financing practices. I also introduce additional control variables used in the studies described in the literature review.

The remainder of this study is organized as follows: Chapter 2 is devoted to a review of the relevant literature. Chapter 3 introduces the different variables that can affect capital spending and sets up the empirical regression models. The results of the regression are presented in Chapter 4, including a comparison with Poterba's 1962 results. I also indicate the limitations of this study and conclude with suggestions for further research.

Chapter 2: Literature Review

2.1 The Rationale for a Capital Budget

Separation of capital and operating budgets has been a contentious issue and dates back to the early work of Richard Musgrave (1939) who argued in favor of separation. The often-cited argument for instituting a capital budget (King, 1995, Darr, 1998, Poterba, 1996) is that instituting a separate budget provides for greater transparency in such spending allocations. This transparency in turn results in more efficient allocation of resources and greater effectiveness of capital spending.

Another argument espoused by proponents of a capital budget is that it leads to increased capital spending (Aschauer, 1989, 1990, Gramlich, 1990). Implicit in this argument is the assumption that more capital is better, which in turn is grounded in different theories of economic growth. The Keynesian School of economics suggests that public capital has a multiplier effect on private output. The Neo-Classical school of thought views capital - both public and private - as elements in the production function for economic output. In this view public capital is complementary to private capital.

Empirical work by Aschauer (1989) has demonstrated the positive link between aggregate productivity and infrastructure investment for the U.S. and several other countries. At the same time, as Button (1998) points out, the direction of causality in the relationship between economic performance and public infrastructure has not been sufficiently analyzed, i.e., it is not obvious whether infrastructure enhances output (neo-classical) or greater output leads to greater infrastructure provision (Keynesian) which then has a multiplier effect on the output. A related argument states that public capital can be seen as a strategic policy tool in the hands of the government to provide thrusts to different sectors of the economy. For example, construction of the interstate system gave a big boost to the automobile industry. Consequently, such growth theorists would view a capital budget as a necessity.

This argument is reinforced by claims that, being a public good and necessary for production of output, public capital may be underprovided if left to the private sector. Peterson (1990), among others, has argued that infrastructure is under-supplied. One of the arguments used to support this claim is a high (80%) rate of approval of capital investment bond referenda. In other words taxpayers/consumers are often willing to buy more infrastructure capital than has been provided by public authorities. Thus, contrary to the arguments given earlier, unmet consumer demand is posited as the cause of increased capital spending.

This has led researchers to examine whether public capital indeed is under-provided in comparison to its demand. Gramlich (1994) provides an account of methods to evaluate whether infrastructure is undersupplied (engineering assessments of infrastructure needs, political measures based on voting outcomes, economic measures of rates of return, econometric estimates of productivity impacts). The evidence with respect to under-provision is not conclusive. However, the author points out that "... at any given time there could well be, or have been, shortages of particular types of infrastructure capital" (Gramlich, 1994, pg. 1185).

However, a number of scholars have also argued against the posited relationship between the capital budget and capital spending. Critics of the capital budget contend that it is not an effective instrument. They argue that it does not lead to greater allocation of funds dedicated to capital spending, nor does it improve the efficiency of the budgetary allocation process. Consequently, a capital budget does not help in making better decisions. This (pessimistic) view has been expressed in the qualitative research of Henry Thomassen (1990): "States today use only capital listings; they have no bona fide capital budgets with revenues and costs that can be evaluated in a comprehensive framework to aid decision-making." Finally, still others contend that having a capital budget is bad because it shifts the emphasis in state spending from more important sectors like health and education.

Quite aside from normative arguments concerning the desirability of capital budgets, institutional economics suggests that institutions such as budget agencies have real effects on the economy. What are the venues through which a capital budget can have allocative effects on capital spending? Conybeare (1984) points out that adoption of a capital budget is generally accompanied by the creation of an organization or an administrative agency to oversee the

capital budget process. This agency becomes, in effect, a lobbying group for capital spending. A number of other such arguments have also been proposed. The capital budget can also become a facilitating venue for pro-capital interest groups at large (Poterba, 1995).

2.2 Understanding Capital Budgeting

In recent years a number of studies have specifically addressed the relationship between budgetary procedures and outcomes using quantitative tools. They did not specifically address capital spending; nevertheless, the models developed in these studies provided a contextual foundation for this research.

Holtz-Eakin, Rosen and Tilly (1994) provide a theoretical foundation and an important motivation for empirical studies such as this one. The authors tested the permanent income hypothesis for state and local governments. When applied to the U.S. states, this means that state spending patterns reflect total or long-term resources available to the state. They reject the permanent income hypothesis by finding that state and local spending is determined by current as opposed to long-term resources. This result suggests that current sources of income are a critical variable in explaining state spending.

Crain and Miller (1990) explored the relationship between state legislative budget agencies and state spending growth for the years 1979-86. They found that the line-item veto, budget bill format, and other legislative rules affected spending growth rates. Crain and Crain (1998) established that a current services budget baseline increased state spending for 1980-1990. In a similar vein, Crain and Oakley (1995) explored the effects of procedural and political factors such as biennial budget cycle, gubernatorial term limits, state bond rating, and separate capital budget on state government capital stock for 1978-88. They found that states with unlimited gubernatorial terms have lower stocks of public capital, separate capital budgets are negatively related to public capital stock and better bond ratings are positively related to public capital stocks.

Alt and Lowry (1994) have analyzed a related question. They examined the relationship between state spending and a host of variables reflecting the structure of the government. They

found that various forms of divided government, such as party-split branch and party-split legislature affect state spending. While unified governments are quick to adjust spending to (revenue) changes, divided governments tend to make smaller adjustments, and to do so more slowly. Bohn and Inman (1996) investigated the effect of state Constitutional imitations on state deficits. Constitutional limitations include balanced budget rules, the line item veto and debt-issue restrictions. They found that balanced budget rules, when applied to an end-of-year General Fund balance, reduced the extent of deficits. They also found that long-term restrictions discourage capital spending and public debt. Finally, their study is unique with respect to its scope as it looked at a comparatively large number of agency structure and procedural variables.

A number of studies (Clingermayer and Wood, 1995, Kiewert and Szakaly, 1996) have analyzed the effect of political instruments and budget structure on state debt. A primary rationale for incurring debt is that when benefits from a project extend far into the future, the future beneficiaries of the project should also help to pay for those benefits. Hence it is justifiable to borrow funds that future beneficiaries can help to repay. Moreover, current taxpayers may be unwilling to pay for future benefits that they will not enjoy. Since benefits of capital projects extend into the future, capital items are often purchased with debt. Hence the findings of studies of state debt are especially important for this research.

Using time series data, Clingermayer and Wood (1995) have analyzed the patterns in state indebtedness used to finance the provision of long-lasting infrastructure. They found that tax, expenditure and debt limitations do not significantly alter the growth of debt, and suggested that state governments were not immune to the so-called "debt-culture" prevailing at the national level. Kiewert and Szakaly (1996) analyzed the effect of constitutional limitations on state borrowing. They found that a number of limitations such as public referendum approval requirements are effective in constraining state debt.

Two studies have directly analyzed capital spending: Holtz-Eakin (1988), and Poterba (1995). Holtz-Eakin, (1988) examined the effects of the gubernatorial line item veto on several categories of state revenues and expenditures including capital expenditures. The results of his study indicate that the line item veto does not limit the average level of state expenditures. In the short run, however, the line item veto may affect spending contingent upon the political setting,

i.e. when governors face a legislature controlled by the rival political party. In such situations capital outlays tend to be reduced under Republican governors.

Poterba (1995) analyzed the relationship between the level of state capital expenditures and the use of capital versus operating budgets in 1962. Since the model used in this study first replicates and then extends Poterba's (1995) model, his study is described in some detail below.

2.2.1 The Poterba (1995) Model

Poterba's central hypothesis is that a capital budget has a positive effect on capital spending. Poterba also hypothesized that the practice of borrowing is associated with a higher level of investment, and the no-borrowing rule with a lower level of investment.

Poterba's model is a cross-section regression of non-highway per-capita capital expenditure on a dichotomous variable for capital budget, a dichotomous variable indicating borrowing funds to finance capital projects, and a set of control variables reflecting state-specific demographic and economic characteristics. Poterba also included dichotomous control variables for a Republican-controlled Congress, Senate and gubernatorial incumbent, as well as the percent of the popular vote for presidential candidate Barry Goldwater, who was the Republican Party Presidential nominee in 1964. These variables were aimed at capturing differences in spending preferences along party lines.

Poterba suggested that the very existence of a capital budget positively affects capital spending. He defined a capital budget as an investment plan that specifies investment amounts and targets. The higher the level of investment, the greater the need for a capital budget in order to coordinate and simplify the investment process. He also suggested that these variables are possibly endogenously determined. This endogeneity is corrected for by using an instrumental variable for whether the capital budget existed in 1940.

The capital budget and borrowing rules data used in Poterba's study was taken from a survey of capital budgeting practices in 1962 conducted by Hillhouse and Howard in 1963. The 1962 capital outlay data used in Poterba's study came from the Compendium of State

Government Finances produced by the U.S. Department of Commerce. Demographic data for 1962 was taken from the annual Statistical Abstract of the United States.

Poterba found a statistically significant positive effect of a capital budget on capital spending, and a significant negative effect of a no-borrowing rule. Other statistically significant findings include a negative effect of per-capita income, and a positive effect of federal grants per capita on state capital spending.

Chapter 3: Methodology

This chapter describes the dependent variable and all the different explanatory variables used in the study. I start with the economic and demographic variables, and utilize a large number of indicator variables to capture the political culture as well as budgetary agencies and procedures in the states. This is followed by a brief discussion of the data set and the different regression models used in the study. While, as noted, I begin with the basic model suggested by Poterba (1995), I augment it by including variables accounting for budget composition and practices to postulate more detailed models than that offered by Poterba. Chapter 4 begins with the results of the five different regression models, followed by a comparison with Poterba's findings.

3.1 Study Variables

This section introduces the variables and the data used in the analysis. I construct a data set similar to that of Poterba (1995). The demographic and per-capita income data and data on capital outlay and intergovernmental revenue for 1992-1996 are from the U.S. Statistical Abstract and the Bureau of the Census. Per-capita income was adjusted for inflation by multiplying each annual figure by the respective Consumer Price Indices. Data for each of the years 1992-1995 was adjusted to the level of 1996. Similar adjustments were performed for the capital outlay and the intergovernmental revenue annual figures. Capital outlay was adjusted using the government index for capital goods and intergovernmental revenue was adjusted using the general Government Purchases Index. Similar to other studies of U.S. states, the variables used in the analysis are in per-capita terms.

The budget composition variables and variables accounting for spending practices were constructed using data from the survey of state budgetary practices conducted by the National Association of State Budget Officers (NASBO) and published in 1997. The aim of the survey was to compile information about each state's capital budgeting practices and contribute towards establishing a set of recommended practices in capital budgeting. The binary (yes/no) responses of the survey are coded as dichotomous variables.

Table 1 lists the variables and their expected effects. Each is described in greater detail in the sections below.

Table 1. Variables Used in the Analysis and their Expected Effects (Dependent Variable: Per-Capita Capital Spending)			
Independent Variable	Expected Effect	Description/type of variable	Source/other studies using the variable
Capital Budget	+ or -	Dichotomous variable: capital budget=1	Poterba 1995, Crain and Oakley 1995
Net in-migration	+	Continuous: % of population	Poterba 1995
Metropolitan area	-	Continuous: % of area	Poterba 1995
Population under 18	+	Continuous: % of population	Poterba 1995; Crain & Crain 1998
Population over 65	+	Continuous: % of population	Poterba 1995
Personal income	+ or -	Continuous: \$ per capita	Poterba 1995, Holtz-Eakin 1988, Clingenmayer and Wood 1995, Alt and Lowry 1994
Homeowners	+	Continuous: % of households	Poterba 1995
Intergovernmental revenue	+	Continuous: \$ per capita	Poterba 1995, Holtz-Eakin 1988, Clingenmayer and Wood 1995, Alt and Lowry 1994
Population Density	+ or -	Continuous: persons/sq. mile	Poterba 1995
Control for annual effects	-	Dichotomous variable for 1993, 1994, 1995	
Control for regional effects	+ or -	Dichotomous variable for West, North-East, South	Poterba 1995
Government Capital Stock	+ or -	Continuous: \$ per capita	Crain and Oakley 1995

Table 1. Variables Used in the Analysis and their Expected Effects
(Dependent Variable: Per-Capita Capital Spending)

Independent Variable	Expected Effect	Description/type of variable	Source/other studies using the variable
Ratio of public to private capital stock	+ or -	Continuous: \$ per capita	Crain and Oakley 1995
Government Debt Stock 1984 – 1987	+	Continuous: \$ per capita	Holtz-Eakin, 1988
% vote for democratic president in 1996	+ or -	Continuous	Poterba 1995
% of democrats in the House	+ or -	Continuous	Poterba 1995
% democrats in the Senate	+ or -	Continuous	Poterba 1995
Governor party affiliation	+ or -	Dichotomous: 1=Democrat	Holtz-Eakin 1988, Alt and Lowry 1994
System to prioritize investment projects	-	Dichotomous	NASBO survey, 1997
Existence of mechanism for setting aside funds to preserve facilities	-	Dichotomous	NASBO survey, 1997
Exclusion of maintenance from the capital budget	-	Dichotomous	NASBO survey, 1997
Availability of other mechanisms for allocating maintenance.	-	Dichotomous	NASBO survey, 1997
Treatment of long-term leases as operating versus capital expense	-	Dichotomous	NASBO survey, 1997
Existence of lease versus own policy	+ or -	Dichotomous	NASBO survey, 1997
Inclusion of education and hospitals in the capital budget	+	Dichotomous	NASBO survey, 1997
Minimum expenditure requirement for inclusion in the capital budget	-	Dichotomous	NASBO survey, 1997
Joint boards for capital review	-	Dichotomous	NASBO survey, 1997
Single state agency to oversee and manage projects	+	Dichotomous	NASBO survey, 1997
Multiple versus single entity requests for funding	-	Dichotomous	NASBO survey, 1997
Existence of written guidelines for use of bonds versus cash	-	Dichotomous	NASBO survey, 1997

**Table 1. Variables Used in the Analysis and their Expected Effects
(Dependent Variable: Per-Capita Capital Spending)**

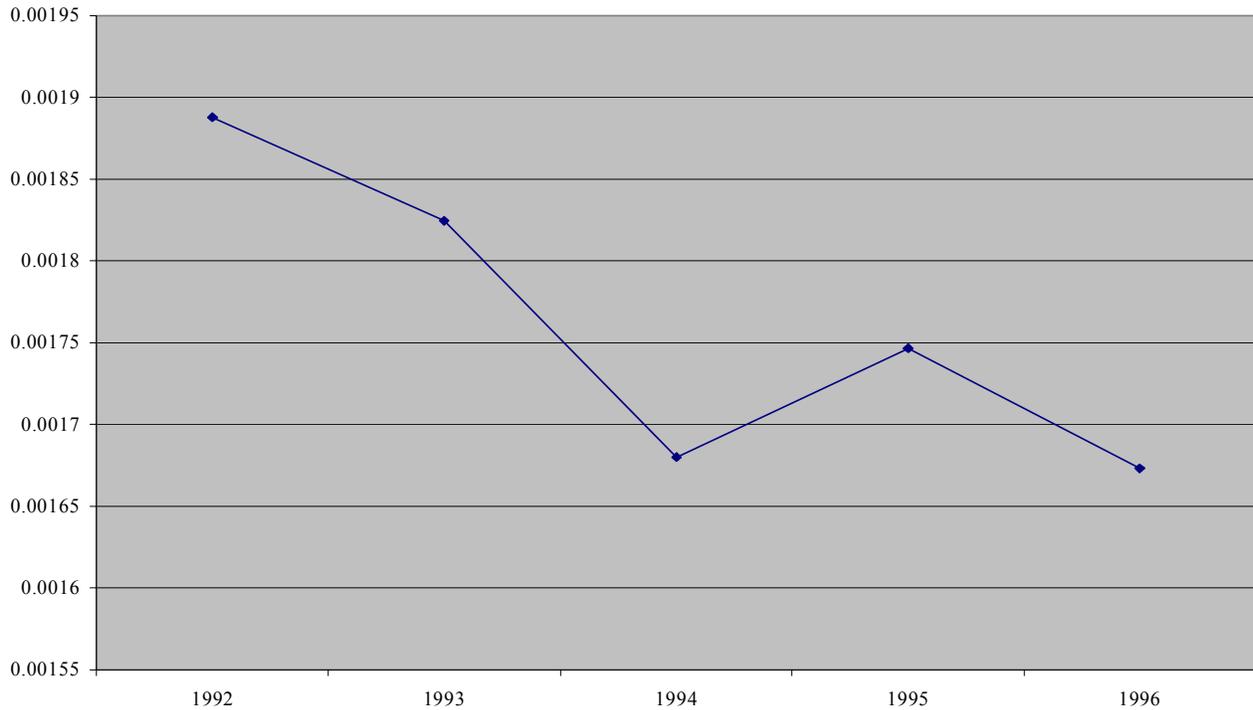
Independent Variable	Expected Effect	Description/type of variable	Source/other studies using the variable
Legislative approval as primary determinant to using bonds versus cash	-	Dichotomous	NASBO survey, 1997
Comparison of debt service to revenues and expenditures	+	Dichotomous	NASBO survey, 1997
Existence of inventory data base	+ or -	Dichotomous	NASBO survey, 1997
Number of cost-estimating methods for capital expenditure	-	Categorical	NASBO survey, 1997
Existence of policy to limit debt service, such as balanced budget rules	-	Dichotomous	NASBO survey 1997; Clingenmayer and Wood 1995
Bond ratings	+ or -	Categorical	NASBO survey 1997, Crain and Oakley 1995, Clingenmayer and Wood 1995
Use of Treasury loans for project financing	+	Dichotomous	NASBO survey, 1997
Determinants of the extent of general fund use for project financing	+	Dichotomous	NASBO survey, 1997
Private sector participation	-	Dichotomous	NASBO survey, 1997
Availability of alternative financing	-	Dichotomous	NASBO survey, 1997
User fee financing	-	Dichotomous	NASBO survey, 1997
User-paid debt service	-	Dichotomous	NASBO survey, 1997
Provision for interim project financing	+	Dichotomous	NASBO survey, 1997

3.2 Dependent Variable - Capital Spending

A starting point for this analysis is a closer look at the dependent variable. I will begin by describing the capital spending trends that are common to all states. Capital spending comprised a larger portion of the GNP in the 1960s, the time analyzed in Poterba's study, than at present. The National Council on Public Works Improvement (1988) reported a drop in public works capital outlays by all levels of government from 2.5% of GNP in 1963 to 1 % in 1984. The calculation for the 1992-1996 state data used in this research appears to confirm the decreasing trend.¹ The ratio of state capital spending to gross state product has been steadily decreasing from 0.19% in 1992 to 0.17% in 1996 (see Graph 1 in the Appendix). Rubin (1990), who describes fiscal trends in state and local governments, suggests that lower capital spending can be partly explained by lower revenues - lower tax collections in late 1980s and early 1990s and federal cutbacks throughout the 1980s. She also notes that when states experience revenue shortfalls, they may divert resources from capital to current operations (for example, reacting to lower world oil prices in the late 1980s, the oil-producing U.S. states of Colorado, Louisiana, Oklahoma and Wyoming curtailed their construction spending). To sum up, capital spending seems to have two features: variability from year to year, while exhibiting an overall declining trend. Both of these facts illustrate the need for using data for several years rather than a single year in the analysis.

¹ Although one could argue that five years is not a sufficiently long time frame to assert this with certainty.

Figure 1. Ratio of Capital Spending to GSP, 1992-1996, Continental U.S. States



With respect to the composition of the dependent variable, capital spending, this analysis uses values that were (self) reported by the states for the years 1992-1996. Many authors (e.g., Poterba, 1995, Thomassen, 1990) report differences in how states define capital, which results in differences in the composition of the capital spending variable. While all states include expenditure on buildings and construction, some states include transportation expenditure as capital, while the majority of the states exclude it. According to a survey by Hush and Peroff (1986), "25 out of 42 states exclude transportation programs financed by state current revenues such as gasoline tax ... even though the function by itself accounts for more than half of capital spending at the state level on a national basis." It is important to note that states do not include transportation expenditure financed by federal grants in the capital budget.

Other differences in the composition of the capital-spending variable across states are due to the inclusion versus exclusion of maintenance, equipment, long-term leases of structures, and capital expenditures on education and hospitals. A number of states include only "major" repairs, while others include all repairs or provide a specific dollar benchmark. While two states may be spending similar amounts on maintenance, they may be reporting it differently. In some states maintenance expenditure is allocated primarily to the capital budget and in others to the operating budget. The differences with respect to inclusion of items in the capital budget introduce a bias in the form of a measurement error. Another source of measurement error is any temporary reallocation from capital to operating budgets, for example, in order to balance the budget without altering the actual amount of spending. This is the problem of "relabeling" emphasized by Poterba (1995). Depending on prevailing constituent preferences, a portion of capital spending may be passed on as operating costs or vice versa (Shepsle and Weingast, 1984). Re-labeling would present the same problems for research design as measurement error. This discussion underscores the need to control for differences in defining capital expenditures. This study tackles the problem by grouping the states according to categories - using dichotomous variables reflecting differences in how each state defines capital expenditure and budget composition.

3.3 Explanatory Variables

Explanatory variables include the main variable of interest, capital versus operating budget, and a number of control variables. Bohn and Inman (1995) suggest that a comprehensive set of control variables is needed to analyze state spending. Failure to do this will lead to the omitted variable bias problem giving imprecise or incorrect estimates. In order to obtain better estimates three sets of variables are used. These are 1) economic and demographic variables that control for inter-state differences, 2) variables that control for party affiliation to account for variation in state political structures and 3) past value of debt to control for spending preferences. In addition, a fourth set of explanatory variables accounting for budget composition and spending rules is included. Inclusion of these variables in the analysis is one of the original contributions of this study as these variables are more comprehensive than those used in other studies.

3.3.1 The Capital Budget

The use of a capital budget is the main variable of interest. According to a National Association of State Budget Officers' 1997 survey of state capital budgeting practices, out of forty-eight contiguous states, thirty-two have separate capital budgets and sixteen do not. It is interesting to note that there has been little temporal variation in the number of states with capital budgets. Hush and Peroff (1986) conducted a comprehensive survey of capital budgeting practices among the U.S. states. They found that in 1985 the same thirty-two states had capital budgets. A survey by Hillhouse and Howard (1963) cited in Poterba, 1995, reports twenty-nine states as having a capital budget in 1963.

Poterba hypothesized that capital budget is conducive to capital spending. His hypothesis was confirmed by his empirical findings of statistically significant effect on capital spending of a dichotomous variable for existence of capital budget. One can also argue that the transparency induced by a separate capital budget results in greater efficiency and therefore that the relationship between spending and a capital budget will be negative.² Moreover, many authors, in particular Hush and Peroff (1986) point to the difficulty of precisely defining the capital budget because the degree of separation between capital and operating budget differs across the states. The degree of separation between capital and operating budget is the potential source of difference in allocating expenditure between capital and operating budgets. The dichotomous formulation (capital budget/no capital budget) may miss what in actuality is "capital budget for a narrow definition of capital" or "capital budget integrated in the operating budget" for some states. To address this problem this study uses a more detailed framework, which takes into account the structure of the capital budget. The intent is also to delineate further research venues to address questions relating to the quality of a capital budget and its effects on capital spending by the states. This will be accomplished by expanding the set of budget-rule variables described later in the chapter. The function of the many control variables and especially budget- rule control variables is to explicate the relationship between the capital budget and capital spending.

² Though Poterba finds a positive relationship, a third possibility is that the existence of a capital budget may have no effect on capital spending cannot be ruled out.

3.3.2 Control Variables

I begin by assessing the impact of different population and economic parameters on capital spending.

3.3.2.1 Demographic and Economic Variables

(i) Per-capita income -- Income is an important explanatory variable because it represents both the demand for services and is the source of financing government expenditure. State capital spending and state per-capita income may be inversely or directly related. The direct relationship may be explained by government spending on infrastructure being a "luxury" good so that increases in per-capita income induce increases in the share of spending devoted to infrastructure uses as argued in Aschauer (1990). Or, simply stated, higher spending may be due to higher tax revenues in the affluent state. Also, if infrastructure is under-supplied, the state government may channel higher income per-capita tax revenue to capital spending.

On the other hand, the state may take on a more interventionist role and spend more in poorer states in areas that in richer states may remain in purview of the private sector (hence an inverse relationship). That is a possible explanation for the inverse relationship between capital spending and income found by Poterba for his 1962 data.

(ii) Fraction of population below 18 and Fraction of population above 65 -- In states with a higher fraction of population below 18 years spending on schools may be higher in response to higher population projections. States might also spend more on state hospitals, or on nursing homes when they have a higher proportion of their population over 65. These variables have been used by Poterba (1995), and Crain and Crain (1998).

(iii) Fraction of home-owners in total households -- The anticipated effect of the home-ownership variable is expected to be positive because of the homeowners' demand for infrastructure and income level (source of funding for supply of infrastructure). Home-ownership may require more infrastructure, such as roads and utility lines because of lower population density of settlements with greater single home ownership than with apartment-type dwellings. The supply of infrastructure is determined by government policy and availability of funds.

(iv) Percent of population living in metropolitan area -- The reason for this variable is the supposition that capital spending in metropolitan areas is different from that in non-metropolitan areas. For example, more concentrated infrastructure needs may account for less capital spending. Also, states with large cities can have lower per-capita state spending because the city authorities do capital spending in the cities. The percentage of metropolitan population is used in this study instead of Poterba's "percent urbanized" variable. The "Percent living in metropolitan area" variable allows for greater variation of data than the "percent urbanized" variable and is therefore preferred from a statistical point of view.

(v) Population density -- Population density may affect capital spending in a number of different ways. On the one hand, more concentrated infrastructure needs may account for less capital spending per capita due to economies of scale in the delivery of government services including capital outlays. On the other hand, a more concentrated population may be indicative of agglomeration economies with higher levels of per-capita income (Aschauer, 1990) and possibly higher demand for government services. One can also postulate that a threshold population density level may be required to justify public spending. Poterba (1995) finds no effect of population density.

(vi) Net migration -- Poterba includes net migration as a control variable because it accounts for "constituents' unwillingness to vote for capital projects that bring future benefits but have to be paid for by current tax revenues" (Poterba, 1995). It also controls for the overall economic climate of the state: if there is significant in-migration, the state is doing well economically and capital spending is correlated with good economic performance.

(viii) Indicator variables for Census geographic regions: northeast, south, west, mid-west -- Regional indicator variables are necessary to isolate trends that are common to geographical regions. They are used in all econometric models in the literature in the form of dummy variables. Wheat and Crown, who undertook a longitudinal study of U.S. state income changes argue that "per-capita income variation is essentially a regional phenomenon" (1995, pg.2). States within regions tend to be similar in terms of agriculture, urbanization, manufacturing, employment and transportation costs. In addition, there may be unobserved region-specific factors that can be captured by controlling for the regions. For example, South

has been growing at a relatively faster rate and catching up with other regions of the nation in recent decades.

Munnell (1990) notes that the South had the highest rate of public investment during the 1970s and was the only region to increase its public capital stock in the 1980s. Bohn and Inman (1995), who explore the relationship between public deficits and state budget composition, include regional variable for the South because they expect southern states to be more fiscally conservative. Their expectations are confirmed by their results.

(ix) Intergovernmental revenue per capita -- Intergovernmental revenue is a direct source of revenue to the state and it consists of federal and local transfers. In contrast to Poterba, who includes only federal aid, inclusion of this variable enables accounting for revenues received from the local government, as well as non-governmentally funded gifts and donations. However, the proportion of revenue coming from the local governments for capital expenditure is relatively small, being around 10-20%, with federal support being the main source of intergovernmental revenue for state governments. A certain portion of state intergovernmental revenue gets distributed to capital spending. States do not have the freedom to use intergovernmental revenue as they please, as funds are in many instances allocated for specific uses. Because of this, intergovernmental revenue is an imperfect variable - part of it reflects the composition of the dependent variable. There is an additional caveat that also applies to federal funding: while federal aid is a significant component of capital spending, it may be to a certain extent endogenously determined with capital spending because some grants are matching and federal aid is a function of state spending (Oates, 1968). Hence a similar criticism can also be applied to Poterba's analysis. On a related note, Clingenmayer and Wood (1995) suggest that besides being a mere component of spending, intergovernmental aid also directly impacts spending because the federal matching grant system propels more spending initiatives from state governments. For all these reasons intergovernmental revenue is still a better explanatory variable than pure federal aid.

Table 2 shows the mean values for this set of economic and demographic variables.

Table 2. Demographic and Economic Variables: Means for 48 U.S. states, 1994		
Variable	Mean	Standard deviation
Net in-migration, % of population	3.42729	8.177443
Population growth, %	1.21875	0.9040468
Capital Spending, \$ per capita	228.7262	81.50745
Metropolitan area, %	67.36667	21.67012
Population under 18, %	26.67292	2.255439
Population over 65, %	12.90417	1.784085
Personal income, \$	23735.52	3841.503
Homeowners, % of households	66.41042	4.737054
Intergovernmental revenue per capita, \$	760.4319	192.286
Population Density, persons/sq. mile	174.0625	240.8676

3.3.2.2 Past values of Debt and Capital Stock

Contemporaneous explanatory variables capture the effect of current differences across the states. Current spending is also the result of long-run adjustments to changes in the economy. Hence there is a need to control for past decision-making using variables such as capital and debt stock which represent the total value of state capital and debt.

(i) Debt stocks -- There are several ways debt stock may affect spending on capital. For example states with higher debt stock spend more on debt service thus raising spending on capital in these states. What then is the rationale for incurring debt? Taxpayers-voters inherently prefer borrowing since they favor current benefits and dislike current taxes (Buchanan, 1962). Debt stocks differ widely across states and the variation is greater than that of capital spending levels. The coefficient of variation (standard deviation divided by the mean) for the 48 states in 1993 is 0.36 for capital spending and 0.68 for the stock of debt. A higher value of the coefficient of variation indicates greater variation in magnitudes across the data. The variation may be due to differences in "debt culture", or readiness to incur debt. Some states may dislike incurring debt and set-up various debt-limitation measures to guard against the incentive to incur debt. (These spending rules are addressed later in this chapter). To isolate the effect of the capital budget and

various other budget structures, including enacted debt-limitations, it is necessary to control for the "debt culture". So the debt stock variable is included to control for the debt culture and for differences in debt service across the states. The relationship should however, be interpreted with caution because of endogeneity between capital spending and debt stock: not only does debt influence spending on capital but spending on capital contributes to the stock of debt as well. To avoid the latter, the 1984 stock of debt value is used.

(ii) Public capital stock -- The public capital stock variable controls for capital spending preferences: states that used to spend more on capital may carry on spending more in the future. On the other hand, the states that have already accumulated capital may be spending less than states that are still in the process of capital accumulation. Because of these two conflicting tendencies the expected effect of the public capital stock variable on capital spending is uncertain. This variable may be correlated with the debt stock variable because capital is partly debt-financed.

(iii) Private Capital stock -- Private capital may be a substitute or a complement for public capital. If they are substitutes, then states with greater private capital may have lower capital spending. Substitutability is related to the notion of "crowding out". Some authors suggested that public capital might be crowding out private capital: successive increases in public capital result in private capital being replaced by public capital. If private and public capital are complements, then higher private capital may be associated with greater public capital spending. Munnell (1990) suggests that certain public capital, such as roads, water and sewer facilities are complements to private capital, while others, such as hospitals, are substitutes. It is very difficult to precisely measure private capital and this study relies on estimates provided by Munnell (1990). The ratio of private capital stock to public capital stock is used because only the ratio was available from the Munnell study.

3.3.2.3 Variables controlling for Political Preferences of the State Population

Poterba (1995) points out the possibility of endogeneity between budget agencies, spending procedures and constituents' preferences. This implies that states with greater capital spending have different capital budget processes from other states but these differences in spending and budget processes may be a reflection of constituents' preferences implying that

capital budget exerts no independent effect on capital spending. Here I follow Poterba (1995) by including variables for the party composition of the legislature (Democratic/Republican Senate and Democratic/Republican House), Governor party affiliation and State percentage vote for the elected president in 1996.

3.3.2.4 Budget Composition variables

After economic and political variables have been accounted for, the supposition of this study is that the rest of the variation in the dependent variable can be explained by differences in budget composition. The budget composition variables are grouped by their functions, in particular what kind of spending is included in the capital budget in each state, use of analysis for project selection, centralized versus decentralized features of spending decision-making, debt-finance and alternative finance.

(i) Capital expenditure items included in the capital budget

I used a number of indicator variables to capture the inclusion of capital expenditure items in the capital budget: *Inclusion of education and hospitals in the capital budget; minimum expenditure requirement for inclusion in the capital budget; inclusion versus exclusion of maintenance from the capital budget; availability of other mechanisms for allocating maintenance; treatment of long-term leases as operating versus capital expense; existence of a lease versus own policy.*

Hush and Peroff, 1988 as well as other authors report that what is included as capital varies across the states. For example, according to Hush and Peroff, only three states include vehicle purchases, while thirty-six states include major maintenance. Since inclusion of education and hospitals in the capital budget will reflect higher level of spending, it is necessary to control for it. Another important capital budget composition indicator variable *Minimum expenditure requirement for inclusion in the capital budget* (Expenditures below the requirement amount are included in the operating budget). States without such a requirement should have higher capital spending than states with such a requirement, which is the rationale for controlling for minimum expenditure requirements. Since inclusion of maintenance in the capital budget will reflect higher spending, it is necessary to account for the inclusion of maintenance in the

regression. If *other mechanisms* for allocating maintenance (that is not through the capital budget) are used, the link between the capital budget and capital spending will be weaker and we would expect to have a negative effect for this variable.

Treating long-term leases as operating expenses will decrease the level of capital spending, which is why it is necessary to control for it. Existence of lease versus own policy specifies what items are for lease and which ones have to be purchased so while the direction of the effect on spending is not obvious, we would expect there to be a more systematic relationship between capital budget and capital spending, i.e. less noise. Bunch (1996) notes that allocation of long-term leases is a source of significant differences in budget allocations across states.

(ii) Use of analytic techniques and mechanisms for priority project selection

The following is a list of indicator variables that reflect the states' effort to provide information for capital decision-making: *System to rank investment projects; existence of mechanism for setting aside funds to preserve facilities; existence of inventory data base; number of cost-estimating methods for capital expenditures; comparison of debt service to revenues and expenditures.*

The objective of a system to rank order investment projects is to commit resources to the most important investments. Lee (1991) notes that priority ranking is one of the newer practices in the budgetary process that became common after 1970.

The rationale behind having a mechanism for setting aside funds to preserve facilities is to avoid sharp increases in spending that may entail unanticipated debt service. Setting aside funds is a form of precautionary saving that is more likely to take place in states with more stringent budget constraints (Bohn and Inman, 1995).

The existence of the inventory data base (for capital assets) may be indicative of a more judicious decision-making that is based on better information than in the states without inventory data base. This variable may exert either positive or negative influence on capital spending.

While use of analysis in budgetary decision-making has become standard practice (Lee, 1991), the greater number of cost-estimating methods for capital expenditure analysis reflects greater use of analysis or use of more sophisticated analysis. It is likely to be an indicator of greater precision in decision-making and the expected effect is negative or indeterminate.

Comparison of debt service to revenues and expenditures is another practice that may be indicative of judicious decision-making. A closer look at the NASBO survey reveals that states that compare debt service to revenues and expenditures do so for both their capital and operating budgets. The direction of the anticipated effect is suggested in Rubin (1990) who notes that the practice of comparison of revenues and expenditures tends to allocate spending outside of the operating budget, specifically to the capital budget; therefore this should have a positive effect on capital spending.

(iii) Centralized versus decentralized decision-making

The issue of centralized versus decentralized decision-making with respect to budgeting in the states has been raised by Darr (1999) and Lee (1981). The indicator variables used for this purpose include: *joint boards for capital review; multiple versus single entity requests for funding; and, a single state agency to oversee and manage projects.*

With respect to the variables above, joint boards for capital review and multiple entity requests for funding can be interpreted as lesser centralization, as both imply multiplicity of decision-makers. Single state agency to oversee and manage projects can be interpreted as greater centralization. Clingenmayer and Wood (1995) hypothesize that centralized policy responsibilities could result in higher state debt which is used to finance capital expenditures. According to their hypothesis, single state agency to manage projects would result in greater spending on capital. Conversely, joint boards for capital review and multiple versus single entity request for funding indicator variables should have a negative effect on capital spending

(iv) Debt financing and Bonds

There is a large body of literature on Pay-As-You-Use (debt) versus Pay-As-You-Go (no debt) financing of capital and other expenditures. Constitutional or statutory debt limitations are frequently imposed in the states to constrain the growth of debt. If these constraints are effective,

they may result in lower capital spending. The following variables reflect debt-containment efforts by the states: *existence of written guidelines for use of bonds versus cash; legislative approval as primary determinant to using bonds versus cash; existence of policy to limit debt service* (for example, balanced budget rules).

These variables reflect dissimilar efforts across the states to limit debt service. While a balanced budget rule does not specifically apply to the capital expenditures, (but to the whole budget or operating budget) it is nevertheless included because it produced a robust effect in a number of studies (Crain and Crain, (1998), Bohn and Inman (1995), etc. While Kiewert and Szakaly (1996) found that the existence of debt limitation reduces debt, they nevertheless argued that "such (debt) limitations are too high to place any binding constraints on debt issuance" and the constraining factor is the credit market. For this reason this analysis includes bond ratings as well.

A state's bond rating is an indicator of its borrowing costs with a higher rating indicating lower costs. Bond ratings may exert counteracting effects on capital spending. A bad rating is awarded for greater debt/deficit spending and hence a low rating can possibly be associated with greater spending. At the same time bad rating or especially downgrading of a rating may make debt service prohibitively expensive and hence the opposite relationship (low rating leading to low spending) is possible. Moreover, both of these developments may be present at the same time in a state. For example, Crain and Oakley (1995) find that a low rating is associated with greater spending for a single year (1988), while they also find that a higher rating helped states in the long run - they were able to afford greater spending compare to states with lower ratings between 1978-1988.

(v) Other financing methods

The set of indicator variables for describing this include: *availability of alternative financing; user fee financing; user-paid debt service; use of treasury loans for project financing, private sector participation in financing, provision for interim project financing, and, determinants of the extent of general fund use for project financing.*

These variables need to be included in the analysis because they reflect the effort to provide flexibility in financing. One of the ways that flexibility in financing can affect capital spending is if it will result in increased off-budget allocations.

Alternative financing means that spending is not necessarily allocated to the capital budget which may affect the amount of spending on capital hence availability of alternative financing is a necessary control variable. User fee financing and User-paid debt service are introduced for greater accountability and efficient use of resources. The expected effect of these spending rules on capital spending is negative.

Use of Treasury loans for project financing provides a cheaper source of financing and is therefore expected to increase capital spending. Provision for interim project financing methods is expected to have a positive effect on capital spending as it allows for more frequent issuance of new funding.

Determinants of the extent of general fund use for project financing imposes a limit on using general funds for large outlay so this budget rule may affect capital spending as it implies that infrastructure projects will have to be allocated to capital budget or off-budget. Private sector investment may be a substitute for public sector investment and so I would expect a negative effect on public capital spending.

3.4 Regression Analysis

My analysis is based on a multiple regression model of capital expenditure on the budget-rule and demographic and political preference variables with the state being the unit of analysis. Regression analysis describes "the nature and significance of the pattern of values taken on by interally measured variables" (Giventer, 1996). Regression analysis is the most widely used tool when the objective is to describe the nature of the relationship between a dependent and a set of independent variables for given data, as regression statistics calculated from the data are the best estimates of the true population parameters.

In contrast to Poterba, who used a single year cross-section, I pool the 1992-1996 annual cross-sections into a panel combining both cross-sectional and time-series data. This increases the size of the data set and allows me to employ a much larger set of control variables in this study. In addition, panel data possess several major advantages over cross-sectional and time series data. Panel data contain a larger number of data points which yields more precise regression estimates. By utilizing information on both the inter-temporal dimension and the individuality of the entities being investigated, I am better able to control for the effects of unobserved variables (Hsiao, 1986). Panel data is also used in this study because a cross-sectional study does not control for the potential annual variability of capital expenditure due to contingencies or political factors.

3.4.1 Models Employed in the Analysis

Five models were employed in the analysis. Each represents an extension of the basic Poterba (1995) model. The models have a nested structure, so that successive models add another set of control variables to the previous model. The reason for having five models with a nested structure is to determine whether all models are giving the same answers in terms of the direction and magnitude of the estimated coefficients. This procedure can be thought of as model selection, as the final model has variables that were significant in all previous (and less detailed) versions of the model. As the number of variables in the estimated model increases, some of the variables lose their statistical significance, that being a known consequence of multi-collinearity. In such cases, the Akaike and Schwartz Information Criterion were applied and variables that were not statistically significant variables were dropped if the value of either Information Criterion was reduced as a result of excluding the variable in question.

1. The basic model: The basic model is similar to that of Poterba's model. It postulates that capital spending is a function of current-year state-specific variables and a capital budget.³

³ Note that β_1 , the first term in the basic model represents the constant term. This representation is followed in all the subsequent models as well.

Model I:

$$Cap_spend_i = \beta_1 + \beta_2 Cap_budget_i + \beta_3 West + \beta_4 NorthEast + \beta_5 South + \beta_6 1993 + \beta_7 1994 + \beta_8 1995 + \beta_9 \%homeowners_i + \beta_{10} \%metro_i + \beta_{11} popdens_i + \beta_{12} \%pop < 18_i + \beta_{13} pop > 65_i + \beta_{14} migr_i + \beta_{15} intergov_i + \beta_{16} income_i + error_i$$

2. The Basic model augmented by lag capital variables: This variant of the model postulates that capital spending is related to current-year state-specific variables as well as past values of capital stock, debt and relative proportions of private and public stocks of capital.

Model II:

$$Cap_spend_i = \beta_1 + \beta_2 Cap_budget_i + \beta_3 West + \beta_4 NorthEast + \beta_5 South + \beta_6 1993 + \beta_7 1994 + \beta_8 1995 + \beta_9 \%homeowners_i + \beta_{10} \%metro_i + \beta_{11} popdens_i + \beta_{12} \%pop < 18_i + \beta_{13} pop > 65_i + \beta_{14} migr_i + \beta_{15} intergov_i + \beta_{16} income_i + \beta_{17} gov_capstock_i + \beta_{18} pub/priv_i + error_i$$

3. The Basic model augmented by political preference variables: This variant of the model postulates that capital spending depends on current-year state-specific variables controlling, in addition, for political preference of the constituents.

Model III:

$$Cap_spend_i = \beta_1 + \beta_2 Cap_budget_i + \beta_3 West + \beta_4 NorthEast + \beta_5 South + \beta_6 1993 + \beta_7 1994 + \beta_8 1995 + \beta_9 \%homeowners_i + \beta_{10} \%metro_i + \beta_{11} popdens_i + \beta_{12} pop > 65_i + \beta_{13} migr_i + \beta_{14} intergov_i + \beta_{15} income_i + \beta_{16} dempres_vote_i + \beta_{17} demhouse_i + error_i$$

4. The Basic model augmented by past capital variables and political preference variables:

The hypothesis is that capital spending depends on current-year state-specific variables, controlling for political preferences of the population and past values of capital stock variables.

Model IV:

$$Cap_spend_i = \beta_1 + \beta_2 Cap_budget_i + \beta_3 West + \beta_4 NorthEast + \beta_5 South + \beta_6 1993 + \beta_7 1994 + \beta_8 1995 + \beta_9 \%homeowners_i + \beta_{10} \%metro_i + \beta_{11} popdens_i + \beta_{12} pop > 65_i + \beta_{13} migr_i + \beta_{14} intergov_i + \beta_{15} income_i + \beta_{16} dempres_vote_i + \beta_{17} demhouse_i + \beta_{18} gov_capstock_i + \beta_{19} pub / priv_i + \beta_{20} gov_debt + error_i$$

Finally, I consider a model that includes a large number of budget composition and spending rule variables discussed in Chapter 2 as well as all of the listed economic/demographic variables.

The next chapter outlines the results of these regression models.

Chapter 4: Study Results

This chapter reports the regression results of the five models. I then interpret these findings, compare them with Poterba (1995) and suggest policy implications based on these results.

4.1 Regression Results

Statistically significant variables affecting the level of capital spending for the five models are presented in the tables below. Interestingly, all explanatory variables retained their signs (direction of the effect: positive or negative) across the five models. The magnitudes are not always the same because additional variables have been added in consecutive models. The reported results are at the 5 percent level of significance, and have been obtained through the OLS technique, which is also the technique Poterba uses. Note that beta has been standardized here.

Table 3. The Basic Model (Dependent variable: per-capita state capital spending)			
<i>Variables</i>	<i>Standardized β</i>	<i>T-statistic</i>	<i>Significance</i>
Constant		-2.022	0.045
Capital budget	0.116	2.157	0.032
Regional Indicator: West	0.16	1.930	0.055
Regional Indicator: North-East	-0.375	-4.78	0.000
Regional Indicator: South	0.146	2.031	0.044
Annual Indicator: 1993	-0.203	-3.091	0.002
Annual Indicator: 1994	-0.341	-4.936	0.000
Annual Indicator: 1995	0.011	0.195	0.846
Home-owners as fraction of total households	0.145	2.783	0.006
Percent of population living in metropolitan area	-0.613	-7.828	0.000
Population density	0.639	6.767	0.000
Population share >65	0.184	2.627	0.009
Population share <18	0.137	1.715	0.088
Net migration	0.181	2.348	0.02
Intergovernmental revenue	0.414	6.037	0.000
Per-capita income	0.522	6.417	0.000
Adjusted R-square 0.596			

Table 4. The Model with Capital Stock Variables (Dependent variable: per-capita state capital spending)			
<i>Variables</i>	<i>Standardized β</i>	<i>T-statistic</i>	<i>Significance</i>
Constant		-1.821	0.07
Capital budget	0.13	2.794	0.006
Regional Indicator: West	0.005	0.074	0.941
Regional Indicator: North-East	-0.144	-1.951	0.053
Regional Indicator: South	0.121	1.866	0.064
Annual Indicator: 1993	-0.186	-3.275	0.001
Annual Indicator: 1994	-0.261	-4.285	0.000
Annual Indicator: 1995	-0.003	-0.057	-.955
Home-owners as fraction of total households	0.081	1.765	0.079
Percent of population living in Metropolitan area	-0.202	-2.297	0.023
Population density	0.451	5.327	0.000
Population share >65	0.119	1.947	0.053
Population share <18	0.176	2.449	0.015
Net migration	0.163	2.444	0.016
Intergovernmental revenue	0.142	2.044	0.042
Per-capita income	0.257	3.245	0.001
Government Capital Stock	0.531	7.057	0.000
Ratio of public to private capital stock	-0.147	-3.167	0.002
Adjusted R-square = 0.7			

Table 5. The Model with Political Preference Variables (Dependent variable: per-capita state capital spending)			
<i>Variables</i>	<i>Standardized β</i>	<i>T-statistic</i>	<i>Significance</i>
Constant			
Capital budget	0.16	3.088	0.002
Regional Indicator: West	0.142	1.798	0.074
Regional Indicator: North-East	-3.11	-4.213	0.000
Regional Indicator: South	0.114	1.637	0.103
Annual Indicator: 1993	-0.182	-2.867	0.005
Annual Indicator: 1994	-0.331	-4.818	0.000
Annual Indicator: 1995	0.014	0.271	0.787
Home-owners as fraction of total households	0.124	2.573	0.011
Percent of population living in metropolitan area	-0.486	-6.029	0.000
Population density	0.638	7.142	0.000
Population share >65	0.157	2.792	0.006
Net migration	0.137	1.866	0.064
Intergovernmental revenue	0.479	7.210	0.000
Per-capita income	0.506	6.331	0.000
% vote for democratic president in 96	-0.369	-4.652	0.000
% of democrats in the House	0.081	1.145	0.254
Adjusted R-square 0.637			

Table 6. The Model with Political Preferences and Capital Stock Variables
(Dependent variable: per-capita state capital spending)

<i>Variables</i>	<i>Standardized β</i>	<i>T-statistic</i>	<i>Significance</i>
Constant		2.321	0.021
Capital budget	0.158	3.458	0.001
Regional Indicator: West	-0.004	-0.051	0.959
Regional Indicator: North-East	-0.143	-2.011	0.046
Regional Indicator: South	0.069	1.097	0.274
Annual Indicator: 1993	-0.139	-2.349	-.02
Annual Indicator: 1994	-0.238	-3.813	0.000
Annual Indicator: 1995	0.013	0.266	0.791
Home-owners as fraction of total households	0.066	1.517	0.131
Percent of population living in metropolitan area	-0.193	-1.951	0.053
Population density	0.491	5.902	0.000
Population share >65	0.074	1.452	0.148
Net migration	0.117	1.844	0.067
Intergovernmental revenue	0.220	3.172	0.002
Per-capita income	0.261	3.415	0.001
% vote for democratic president in 96	-0.334	-4.776	0.000
% of democrats in the House	0.095	1.535	0.127
Government Capital Stock	0.433	5.076	0.000
Government Debt Stock 1984 – 1987	0.075	1.182	0.239
Ratio of public to private capital stock	-0.141	-3.228	0.001
Adjusted R-square = 0.728			

Table 7. The Model with Political Preferences, Capital Stock and Budget variables
(Dependent variable: per-capita state capital spending)

<i>Variables</i>	<i>Standardized β</i>	<i>T-statistic</i>	<i>Significance</i>
Constant		3.857	0.00
Capital budget	0.222	4.663	0.00
Regional Indicator: West	0.103	2.186	0.03
Regional Indicator: North-East	-0.242	-3.307	0.001
Regional Indicator: South	-0.013	-0.190	0.849
Annual Indicator: 1993	-0.08	-1.794	0.075
Annual Indicator: 1994	-0.131	-3.103	0.002
Annual Indicator: 1995	0.021	0.553	0.581
Home-owners as fraction of total households	0.054	1.453	0.148
Percent of population living in metropolitan area	-0.26	-2.979	0.003
Population density	0.542	6.936	0.00
Per-capita income	0.091	3.213	0.01
Government Capital Stock	0.541	6.910	0.00
Government Debt Stock 1984 – 1987	0.203	3.387	0.001
Ratio of public to private capital stock	-0.166	-3.897	0.00
Democratic/Republican House	0.232	3.563	0.00
System to prioritize investment projects	-0.126	-2.053	0.042
Mechanism to set aside funds to preserve	0.28	4.664	0.00
Maintenance excluded from the capital budget	-0.126	-1.9	0.059
Other mechanisms for allocating maintenance	0.103	2.194	0.03
Long-term leases as operating vs. capital expense	-0.191	-4.134	0.00
Existence of lease versus own policy	0.097	2.013	0.046
Joint boards for capital review	-0.244	-4.764	0.00
Multiple versus single entity requests for funding	-0.415	-6.397	0.00
Written guidelines for use of bonds vs. cash	0.154	3.165	0.002
Legislative approval as main determinant of	-0.172	-3.849	0.00
Comparison of debt service to revenues and	0.17	3.224	0.002
Existence of policy to limit debt service	-0.071	-1.609	0.11
Bond ratings	-0.085	-1.658	0.099
Use of Treasury loans for project financing	0.264	4.73	0.00
Procedures for extent of general fund use for	-0.158	-3.109	0.002
Private sector participation	-0.205	-4.525	0.00
Adjusted R-square=0.818			

4.2. The Effect of Capital Budget

The existence of a capital budget has a statistically significant positive effect on the amount of state capital spending in all the variants of the model. The effect ranged from 0.12 (basic model) to 0.22 (full model with budget composition variables), which means that holding other variables constant, having a capital budget increased annual state spending by 12 to 22 percentage points. It is interesting to note that the greater the number of control variables in the model, the greater the impact of capital budget on capital spending.

4.3 Effects of the Control Variables

4.3.1 Effect of Demographic and Economic Variables

(i) Regional Indicators: In comparison to the Midwestern region, the West and South Census regions tend to spend about ten percentage points more on capital, while the North-Eastern region tends to spend 14 to 37 percentage points less. The largest effects on spending are observed for the basic regional-characteristics model while the smallest regional effects are observed for the model with budget related variables. This suggests that regional indicator captures some of the effect of the budget related variables when these latter are not included in the model.

(ii) Annual Indicators: Although annual figures were adjusted for inflation, the results show that spending tended to be lower in 1993 and 1994 compared to 1995 and 1996. This is consistent with Rubin's (1990) discussion of lower spending in the late 1980s and early 1990s due to macro-level economic conditions.

(iii) Home-ownership: Home ownership has a small positive effect on capital spending. It increases capital spending by 0.14-0.05 percentage points. This may reflect higher property taxes collected by the state and used for capital spending.

(iv) Population Density: Population density has a strong positive effect on capital spending. It is interesting to note that greater population density increases per-capita spending, so there is a nonlinear relationship between total spending and population density. It may be that areas with

higher population density demand require government services (demand argument) and/or greater spending simply reflects greater tax collections (supply argument).

(v) Metropolitan area: Metropolitan areas have a negative effect on capital spending, ranging from 0.2 to 0.6 percentage points. The likely explanation for the negative effect is that a greater proportion of capital spending is borne by the city authorities.

(vi) Income: Income has a positive effect on capital spending, i.e., wealthier states spend more on capital. The relationship between capital spending and income is related to larger issues of whether capital spending is demand or supply-driven. Capital (spending) is demanded by constituents and provided by governments while being ultimately supplied by constituents through tax revenue. The positive effect of the income variable could be indicative of under-provision of capital and pent-up demand in states that would spend more on capital if they were richer.

(vii) Intergovernmental Revenue: As expected, receiving Intergovernmental revenue increases capital spending by 15 to 40 percentage points. As discussed in Section 3.2.3 the intergovernmental revenue is included to account for the composition of capital spending variable. In many cases the value of capital spending is directly related to the amount of intergovernmental revenue because the latter includes federal transportation grants.

4.3.2 Effect of Capital Stock Variables

Government capital stock has a large positive effect of 0.43 - 0.54. As suggested in Section 3.2.2, higher spending may be due to maintenance of the higher stock of capital. The variable *ratio of public to private capital* has a negative effect of 14-16 percentage points. This finding supports the idea that public and private capital are substitutes. Stock of government debt has a positive effect of 7 to 20 percentage points on capital spending. Unless this positive effect is due only to greater debt service expenditure, this result would support the "debt culture" argument that some states have a higher preference for incurring debt.

4.3.3 Effect of Political Control Variables

Percent Vote for Democratic President in 1996 has a negative effect on spending (ranging from 33-36 percentage points). It is difficult to interpret this result other than that states with greater presidential Democratic vote tend to have lower capital spending. This variable may be correlated with some unobserved variable(s) that have a negative effect on capital spending. Also, the variable Percent Democrats in the State House of Representatives is positively related to capital spending (9-20 percentage points). This suggests that Democratic majority tends to spend more (on capital).

4.3.4 Effect of Capital Budget Composition and Spending Rules Variables

For ease of exposition I first describe the negative effects and discuss the positive effects of the budget composition and spending rule variables.

4.3.4.1 Budget-rule variables exerting a negative effect on capital spending

(i) *Exclusion of maintenance from the capital budget and treatment of long-term leases as operating versus capital expense* -- The effects of the two capital budget composition variables are negative as expected: since maintenance is excluded and long-term leases are allocated to the operating budget, states with these budget arrangements tend to spend less on capital.

(ii) *System to rank investment projects* -- Ordering expenditures is aimed at more efficient decision-making (Lee, 1991). The negative effect of ranking investment projects is an interesting result that can be interpreted as more efficient decision-making resulting in less spending.

(iii) *Joint boards for capital review and Multiple versus single entity requests for funding* -- As discussed in Section 2.4, these two variables can be linked to the notions of centralized versus decentralized decision-making (Lee, 1981) and represent more decentralized decision-making. These two negative effects support the Alt and Lowry (1995) argument that centralization could result in more state debt-financed spending. Both decentralized and multiple levels of decision-making led to less capital spending.

(iv) *Legislative approval as primary determinant to using bonds versus cash and Existence of policy to limit debt service* (such as balanced budget rules) -- Kiewiert and Szakaly (1996) suggest that several variables should be used to capture the effect of debt limitations since in reality there are several types of limitations in use by state governments. Several variables were used here and all were significant. The negative effect of *legislative approval as primary determinant to using bonds* variable supports the argument of Bohn and Inman (1995) that legislature-imposed constraints on spending are effective.

(v) *Determinants of the extent of general fund use for project financing* -- The negative effect of this variable suggests that limiting the extent of general fund allocations and hence greater use of non-general fund allocations is associated with less capital spending.

(vi) *Bond ratings* -- The negative effect of bond ratings means that states with higher bond ratings tend to spend less. As discussed before, the direction of causality may run both ways because of endogeneity between debt stock and bond ratings: lower debt stock is associated with higher ratings, but higher ratings make borrowing easier.

(vii) *Private sector participation* -- The negative effect of private sector participation is an expected result since private sector financing of capital spending is a substitute for government financing and hence results in reduction of public spending on capital. The extent and type of private participation in financing is not recorded in the survey, and more research on private sector involvement is needed.

4.3.4.2 Budget-rule variables exerting a positive effect on capital spending

(i) *Existence of mechanisms for setting aside funds to preserve facilities* -- The explanation for this effect could be that the states that care more about maintenance and repair adopt a systematic approach by creating maintenance funds and spend more (on maintenance or on capital in general).

(ii) *Availability of other mechanisms for allocating maintenance* -- The positive effect of this indicator variable is just as expected - the existence of more options for paying for maintenance allows states to spend more on maintenance of capital stock.

(iii) *Existence of lease versus own policy* -- The interpretation of this result could be that the existence of lease versus own policy encourages leasing capital assets and this is associated with greater capital spending. Because leasing is cheaper in the short run but more expensive in the long run than owning, leasing states tend to spend more.

(iv) *Existence of written guidelines for use of bonds versus cash* -- This positive result indicates that the guidelines make it easier to use debt financing by clearly specifying the terms of use. The positive result may also reflect the endogeneity between spending preferences and the structure of the budget. In other words the guidelines are there because bonds are used a lot. Finally, note that this variable is different from legislative approval as a primary determinant to using bonds versus cash indicator, which has a negative effect.

(v) *Comparison of debt service to revenues and expenditures* -- The positive effect of this indicator variable on capital spending is consistent with the observation made by Rubin, 1990 that the practice of comparison of revenues and expenditures tends to allocate spending to the capital as opposed to operating budget.

(vi) *Use of Treasury loans for project financing.*-- This positive effect can be attributed to the fact that it is cheaper to finance capital projects with treasury loans rather than private market loans.

4.4 Comparison with Poterba's (1995) Results

Overall, this study supports Poterba's (1995) main conclusion the capital budget exerts a positive effect on capital spending. Nonetheless, several other results in my analysis for the 1992-96 period differ from Poterba's results. They differ with respect to the magnitude and direction of the effects. Overall there are more significant variables for the 1992-95 data (see Tables 3-7 of regression results) than in the original 1962 Poterba's cross-sectional regression. This can definitely be attributed to the fact that I consider five years of (1992-95) pooled data, rather than analyzing a single year. Running a single cross-section for 1995 gives the same direction of the effects as in the 4-year average. However, all variables in a single year cross-section have lesser statistical significance.

Some similarities between Poterba's results and the 1992-96 results are the absence of a relationship between the level of capital spending and the following demographic controls: share of younger or older population and homeownership. Also, federal grants (1962 data) and intergovernmental revenue (1992-96 data) both have a positive effect indicating that a proportion of federal funds and intergovernmental revenue is being consistently spent on capital.

With respect to regional differences in capital spending, after controlling for other variables, the North-East has the lowest level of per-capita capital spending, while the South has the highest. According to the results, outmigration is associated with lower levels of capital spending, and hence, in-migration with higher spending. The South is the principal destination of domestic migration. It is likely then that the outmigration and regional indicator variables are not independent (as they are required to be according to the econometric theory) and so this result might have a problem of spurious correlation.

While in Poterba's single-year model population density and urbanization rate exert no effect on capital spending, in my analysis population density has a positive effect on capital spending, while the percent of population living in metropolitan area has a negative effect on capital spending. The two variables are closely related: the higher the percentage of population in a metropolitan area - the higher the population density and vice versa - the higher the population density - the higher the possibility of here being a metropolitan area. The opposite effects of these two variables are interesting and warrant additional interpretation. While the negative effect of percent metropolitan could simply mean that city spending is substituted for state spending, it could also reflect the effects of urban sprawl, and perhaps more concentrated infrastructure needs. Since people are concentrated in one place, they travel shorter distances, so need shorter roads. Also they can build bigger hospitals and schools, where economies of scale lead to smaller per-capita spending. One would expect that similar reasoning could be applied to population density. The data analysis suggests the opposite: a state invests less per capita if there are fewer people. The explanation may be that states with sparse population do not generate enough revenue and hence cannot afford much above operating expenses. Comparing the amount of total revenue and operating expenses for states with different population densities can resolve this issue.

An interesting policy implication emerges from comparing the effect of per-capita income in Poterba's analysis for 1962 to the effect of per-capita income in this study. The reversion of the effect of per-capita income on the level of capital spending from negative to positive between 1962 and the 1990s, indicates that while the state governments used to spend more on capital in poorer states in 1962, now they tend to spend more on capital in richer states. The result suggests that in the past state governments tended to be more active in generating growth and development in poorer areas and redistributing resources from richer to poorer states.

To sum up, since the data and the regression equation used in this study are very similar to those used by Poterba, the differences in results of the 1962 and the 1990s regressions point to the fact that the relationship between capital spending and key economic variables, such as income, has changed and/or the role of the government in the economy has changed in the last thirty years.

Chapter 5: Conclusion and Recommendations for Future Research

I begin by summarizing the main findings and contributions of this study. Some policy implications of these findings are also suggested. After indicating some of the limitations of this research, I conclude by suggesting directions for further research.

This study supports the claim that government spending is determined by a host of causal factors that can be grouped into four broad categories, (1) demographic-economic factors, representing both demand for public capital and source of its financing, (2) political decision-making factors that reflect electorate/party in power preferences for spending, (3) capital stock variables that relate to the age of infrastructure and control for the spending culture in a state, and (4) budget composition/spending rules.

This study is an extension of James Poterba's 1995 study of the impact of a capital budget on capital spending using 1962 U.S. state-level data from the US. My study used a relatively recent data set (which I constructed from a number of sources) spanning the years 1992-96. Construction of this data is a contribution of this analysis since it can be used to study other public finance related issues. A major drawback of Poterba's study was the use of data for one year only, which may be insufficient to draw conclusions about capital spending behavior. Using a five-year data set yields more credible results. I also incorporate changes to Poterba's approach. I have redefined some of the variables to better reflect the prevailing economic environment in the 1990s. These include the variables *use of intergovernmental revenues* instead of *Federal aid*, and *Percent living in metropolitan area* instead of *Percent urbanized*. Finally, I analyze five different OLS models. While each begins from the basic Poterba model, each model is augmented by a larger set of control variables. A major contribution of this study is the confirmation of Poterba's finding with respect to the positive effect of capital budget on capital spending using a recent data set and longer time frame of analysis.

The most important contribution of the study, however, is the introduction of a set of budget rule/budget composition variables into the analysis. These were constructed using the data of the 1997 NASBO survey after reviewing the suggestions of practitioners and policy makers, as well as those engaged in research in this field. The main finding of this study is a statistically significant effect of sixteen spending rule/budget composition variables. The results of this study support the basic premise found in the literature that budget process affects capital spending.

These findings also have some policy implications. The results support the idea that the states that spend more on capital adopt a capital budget, because it presumably allows better planning and utilization of funds. The more interesting policy implications arise from the use of the budget variables. The analysis shows, for instance, that Treasury loans are a better way to finance capital spending. However the main impact of the budgetary variables is that they serve as pre-commitment devices for capital spending and hence promote better use of funds. This study suggests that appropriate choice of budgetary makeup will enable the states to have better control over capital spending. For example, the existence of written guidelines and mechanisms for maintenance spending will lead to higher capital spending. On the other hand, priorities, multiple reviews, legislative constraints and budgetary debt constraints, all of which are possible ways to improve decision-making, curtail capital spending. One of the more interesting findings is that the existence of a leasing policy leads to more capital spending. This is possibly due to the fact that current governments are myopic and prefer to accomplish more with their existing budgets by leasing, leaving the task of dealing with the debt burden to future governments. Hence leasing is more expensive in the long run which translates in higher spending on capital in the long run.

This is one of the first studies to examine a large number of budget rule variables simultaneously. As discussed in Chapter 2, the dependent variable is composed of different parts and dichotomous variables were used to control for composition of the variable. Given the general nature of this study, the fact that results are statistically significant provides justification for further research on the allocative effects of budgetary makeup. This analysis may be viewed as an exploratory study. The fact that

such a large number of variables has a statistically significant effect on capital spending, warrants further research into both the nature of capital spending decision-making and model selection issues. Further inquiry into what constitutes capital spending in each state will improve the analysis. If more detailed information on what constitutes capital in each state were available, a uniform capital outlay variable composed of same expenditure items for each state could be constructed.

An extension of the model would be to better control for the phenomena of divided government that has received a lot of attention in the political science literature. For example, Holtz-Eakin (1988) finds that the gubernatorial line-item veto is effective under such divided governments. Alt and Lowry (1994) suggest that governments characterized by divided control of the legislature have difficulties in adjusting to exogenous shocks by returning the fiscal balance to its previous path within a relatively short time. Parties have different goals and react differently to changes in permanent expected levels of income, changes in federal aid and business cycle. The parties find budget agreements more difficult and thus deficit financing more attractive.

Another simple extension would be to increase the size of the data set to cover more years that will also allow for more variability in the data.

This study has some limitations. Perhaps the most significant is the potential endogeneity between capital budget and the level of capital spending. Poterba controls for this problem by using the presence or absence of a capital budget in 1940 as an instrumental variable. It is arguable whether this approach is an improvement over OLS because for an instrumental variable to be effective, it has to differ from the variable for which it is an instrument. It is likely that many states that had the capital budget in 1962 also had it in 1940 so there would be little difference between the two variables. An alternative approach would be to develop a simultaneous equation model for capital budget and the level of capital spending. This would entail a formulation of an equation determining the existence of capital budget for a state. Related to this is the issue of searching for additional or alternative explanatory variables and their operationalization.

Future research should incorporate new or updated control variables reflecting state spending rules such as a restriction on debt service in form of a certain percentage of gross state product. These new variables can be drawn from the updates of the NASBO survey. In fact this entire study could be continuously updated as the new data on capital budgeting and economic variables becomes available. Explanatory variables should also capture increasing importance of private funds in financing state expenditures. This study used a dichotomous variable for private sector financing of capital spending while a continuous variable reflecting the amount of spending would give a more precise estimate.

Accounting for intergovernmental revenue could be improved by a more detailed spending function classification becoming available. Use of federal money for purposes other than capital spending could free state funds to be used for capital spending and therefore need to be accounted for in the analysis. Moreover, federal funds that directly contribute to capital spending could be subtracted from capital spending levels thus allowing only capital spending originating within the state to be functionally related to state-specific variables.

Another important issue to consider is equity and stakeholder involvement. Future research on the determinants of the capital spending should incorporate a measure of inclusiveness of various stakeholders in the capital planning process.

Following Munnell (1990) one can separate capital stock into use-categories and analyze the effect of each category and/or interaction of public and private capital stock within each category on public capital spending. Further research could also develop alternative formulations for models of relationship between capital spending and budgetary makeup. This line of inquiry suggests another very relevant and important question that has not been discussed directly by Poterba or in the present analysis - the issue of efficient capital spending. Instead of asking whether capital budgets lead to increase in capital spending, future research should also examine if this allows states to engage in more judicious capital spending.

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