THE DETERMINANTS OF REGIONAL INFRASTRUCTURE SPENDING

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Introduction

Since Choate and Walter (1981) and Vaughan (1983) in the early 1980s, there has been a growing concern about the quality of infrastructure in America. This concern has been heightened by reports of bridges collapsing and pedestrians falling through sidewalks in New York City. Pagano (1989) notes that by 1980 over half the bridges in Buffalo, Charlotte, Independence, Miami Beach, New York City, Rochester, and Shreveport were either structurally deficient or obsolete. And in the area of solid waste disposal, an unwanted garbage barge from New York once roamed the seas looking for a willing recipient.

These observations on the decline in the quality of infrastructure and in the level of infrastructure spending have led to new studies to determine the effect of infrastructure on regional productivity. Fox and Smith (1990) note that in 1987 new infrastructure spending represented 1.7 percent of GNP, while in 1964 new infrastructure represented 2.3 percent of GNP. They further note that "there is little doubt roads, water, and sewerage systems, electricity, telecommunications, railroads, and airports generally support economic activity. Yet the degree to which such public infrastructure stimulates economic development in specific locations is less clear."

The importance of infrastructure in economic development long has been recognized. The provision of public capital may be viewed as productive government expenditure. The term *infrastructure* in its general use implies the recognition of the productive nature of this type of public expenditure. Unlike terms such as *civil works* or *public works*, infrastructure emphasizes the functional role of public capital in providing the framework for facilitating private sector production. Recognition of the relationship between infrastructure and output has led researchers to incorporate infrastructure in the production function for output. On the national level Aschauer (1989) uses an aggregate production function to determine the relationship between aggregate productivity and government spending variables and finds that infrastructure spending has explanatory power for productivity. Aschauer (1987) argues in an earlier

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paper that public investment induces an increase in the rate of return to private capital and thereby stimulates private investment.

In the framework of a regional economy, a major study of the role of public capital is by Hansen (1965). The issue addressed by Hansen and others is the difference in regional development attributable to difference in public capital. Eberts (1990) notes that interest in analyzing the question of whether public capital affects private sector productivity has increased with the apparent simultaneous occurrence of deterioration in the nation's public infrastructure and the dramatic slowdown in national productivity in the 1970s. Eberts concludes that public capital stock affects private sector productivity at the SMSA level.

Costa, Ellson, and Martin (1987) provide direct estimates of the association between public capital and regional output. They use cross-sectional data to estimate a production function for value added in state economies and find a significant positive relationship between public capital and economic activity. Garcia-Mila and McGuire (1989) and Mera (1973), who also use a production function framework, find infrastructure to have a positive effect on regional economic activity.

Infrastructure considerations often play a role in industrial site location, which affects regional development. In his survey of Fortune 500 firms, Schmener (1982) finds that the three top-ranking criteria for site selection are infrastructure considerations.

Bourque (1985) notes that the public pays for infrastructure deterioration in the form of higher prices, lost productivity, higher insurance premiums, and larger personal outlays for repairs and maintenance. He maintains that productivity losses caused by inadequate infrastructure have hindered U.S. competitiveness in the global market. In addition, there is an implicit cost in personal inconvenience.

The discussion remains an important one. The Federal Reserve Bank of Boston in 1990 held a conference on the topic "Is There a Shortfall in Public Capital Investment?" Further, there is some dispute whether there is a strong link between development and infrastructure spending. Munnell and Cook (1992) provide a survey of the recent debate on the issue.

Phares (1990) determines that the shortfall between articulated needs and available resources amounts to $100 billions. Bourque (1985) offers several hypotheses to explain the trends in spending on public capital.

Model, Trends, and Hypotheses

In his discussion of the causes of the infrastructure gap, Bourque (1985) notes that "the theory of the infrastructure gap addresses the central question: Why are government capital outlays failing to keep

pace with the growing needs of society?" He offers the following theories as possible explanations for this gap:

- Scarce resources and changing priorities. This hypothesis maintains that capital outlays have been crowded out by competing demands for public funds, particularly spending for expanding state and local government social service programs. The durability of public capital coupled with the pressing needs of, and demands from, voters potentially could encourage decision makers to change the expenditure mix in favor of social services. Public decision makers also may have a limited time horizon that extends to reelection which would encourage them to shift scarce revenues to those programs with more immediate pressing needs. We would expect that infrastructure spending is related inversely to public welfare spending;
- Tax gap theory. The sources of revenues for infrastructure spending have declined as taxpayers have resisted increased taxes in general. Tax revenues may not have kept pace with a growing economy with its increased needs for infrastructure. We would expect the tax rate to be related positively to infrastructure spending;
- The effects of inflation. Inflation may have a distortionary effect on infrastructure spending. Governments may spend the same nominal amount on infrastructure, but in an inflationary climate this amount purchases less real public capital. Although nominal tax revenues may increase, the share of the general revenue devoted to infrastructure may decline. Coupled with increasing demands for other public expenditures, inflation may reduce the actual share of government revenues devoted to infrastructure. Inflation, according to this hypothesis, should have a negative effect on public capital expenditures.
- Real interest rates increasing the cost of capital. Because public capital often is financed by municipal debt, high real interest rates increase the cost of borrowing which would reduce the amount of debt issued for infrastructure. High interest rates are also price signals to optimizing agents that present consumption is more valued than future consumption. Interest rates thus should be related negatively to infrastructure spending.

Bourque does not test these hypotheses. Further, he assumes that a gap exists without providing a measure of that gap. These four hypotheses offer an explanation of the pattern of infrastructure spending, however, regardless of whether this spending is deemed adequate or not. This section tests whether these four explanations explain the trends in infrastructure spending.

We investigate the change in public capital expenditure from FY1969 until FY1987. Data on public capital expenditures, public welfare expenditures, personal income, and total general revenue funds are from *Government Finances*. Public capital outlays are direct expenditures for the construction of buildings, roads, and other improvements and for the purchase of equipment, land, and existing

structures. Included in this category are amounts for additions, replacements, and major alterations to fixed works and structures. The drawback to using this variable to measure infrastructure spending is that expenditures for repairs and maintenance are classified as current operation expenditures. Because major alterations and replacements are included in this category, however, some degree of ongoing repair and improvement is captured. Public welfare expenditures include all expenditures in support of and assistance to persons contingent upon need. The Consumer Price Index is used to measure inflation. The real interest rate is an inflation-adjusted average of 20 municipal bonds.[1] These data are found in Citibase.

Total spending for both public welfare and public capital increased for many states over the observed time period. In order to test whether priorities in spending shifted, we investigate the proportions of total general revenue that are spent on public welfare and public capital.

First, in order to determine the trend effect of the percentage spending, we regress the percentage share of total general revenue spent on public capital and public welfare for each state between FY1969 and FY1987 on time. The results of the following three regressions are found in Table 1.

(1) $PCAP = \beta_0 + \beta_1 t$

(2) $PPW = \beta_0 + \beta_1 t$

(3) $TAX = \beta_0 + \beta_1 t$

where:

PCAP = Percentage of total general revenue funds spent on public capital;

PPW = Percentage of total general revenue funds spent on public welfare;

TAX = Average tax rate; i.e., the total general revenue divided by total personal income; and

t = Time trend.

[1] The real rate was calculated by subtracting the inflation rate from the nominal interest rate.

With the exception of Utah, a statistically negative trend in the percentage spending on public capital is found in every state. The results for public welfare are mixed. Eleven states have a statistically significant negative trend, three states have a positive trend, and the remaining states exhibit no statistically significant trend. The tax rate is positive for 46 states over the time period. Thus, the tax rate is increasing for the majority of the states while the share of spending devoted to public capital is declining.

To test the hypothesized determinants of infrastructure spending, we model the following equation:

$$(4)\ PCAP = \beta_0 + \beta_1\ TAX + \beta_2\ PPW + \beta_3\ REALRATE + \beta_4\ CPIU$$

where:

CPIU = Consumer Price Index; and

REALRATE = The real municipal bond interest rate.

The above equation is modeled as a pooled cross-sectional time series model. To account for possible heteroscedasticity, a weighted least squares estimation is used. The weights are determined from the ordinary lest squares estimates of the variances from regressing the model on each of the 50 states. The resulting estimates have the usual desirable characteristics; i.e., they are unbiased and consistent.

The weighted least squares results follow:[2]

$$(5)\ PCAP = 2.76 + .052\ TAX - .0268\ PPW + .0019\ REALRATE - .0017\ CPIU$$
$$(3.023)^* \quad (-2.479)^* \quad (1.435) \quad (-17.241)^*$$

In this model, we find that the tax rate is significant and positive, as expected. The percentage share spent on public capital, on average, is affected positively by increasing tax rates for the 50 states for the 19 years investigated. The crowding out effect hypothesized by Bourque also is confirmed. The share expended on public welfare has a significant and negative impact on infrastructure spending. Kamensky (1984)

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[2] The t-statistics are in parentheses. The asterisk denotes significance at the 5 percent level. Following the suggestion of one of the referees, we also ran a fixed effects model. The results are qualitatively equivalent; i.e., the coefficients of TAX, PPW, and CPIU are statistically significant with the same signs. The REALRATE remains insignificant.

notes that one effect of the federal role in intergovernmental relations is that state priorities shift from infrastructure spending to social expenditures. Much of the federal monies distributed to the states are in the form of seed grants that create vested interest groups that demand continued state and local funding after the federal grant ends. As a result, when budget choices have to be made, operating budgets to continue funding the vested groups win compared to capital budgets.

The real interest rate does not have a significant effect, contrary to what we hypothesized. This result may be explained by the reduced role bond financing plays in financing infrastructure expenditures. About 50 percent of state and local infrastructure expenditures traditionally was financed by bond issuance, but Kamensky (1984) notes that by 1981 bond financing accounted for only 29 percent of public capital expenditures.

Inflation, on the other hand, is highly significant and negative, which confirms our hypothesis about the possible distortionary effects of inflation. We speculate that inflation offers the appearance that sufficient amounts are being spent on infrastructure while the actual share of total revenue devoted to public capital is declining.

Conclusion

Bourque, in his discussion of the infrastructure spending gap, provides some explanations for this gap. This paper analyzes whether these hypotheses explain the changing proportion of public capital expenditures. The ratio of public capital expenditures to general revenue has declined for 49 of the 50 states over the time period studied. The pooled cross-sectional time series model reveals that public welfare expenditures have crowded out the share of total general revenues spent on public capital. The real interest rate is not significant, but inflation is significant and negative. This implies that higher levels of inflation have a distortionary effect on public spending patterns. Thus, we conclude from the above analysis that expenditures on public capital between 1969 and 1987 were influenced significantly by crowding out, by increasing expenditures on public welfare, and by the distortionary effects caused by inflation.

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Table 1—Trends in Public Capital Expenditures, Public Welfare Expenditures, and Tax Rates 1969-1987

State	Public Capital Expenditures	Public Welfare Expenditures	Tax Rate
Alabama	-0.0085 *(-8.819)	-0.0040 *(-10.503)	0.0041 *(6.470)
Alaska	-0.0219 *(-6.016)	-0.0018 *(-3.639)	0.0382 *(4.058)
Arizona	-0.0057 *(-4.755)	0.0009 (1.931)	0.0038 *(4.128)
Arkansas	-0.0064 *(-3.788)	-0.0017 *(-6.767)	0.0017 *(3.670)
California	-0.0049 *(-6.007)	-0.0038 *(-7.379)	0.0017 *(2.365)
Colorado	-0.0050 *(-6.009)	-0.0025 *(-6.716)	0.0022 *(3.678)
Connecticut	-0.0079 *(-5.200)	0.0001 (0.231)	0.0011 *(2.406)
Delaware	-0.0119 *(-5.878)	-0.0026 *(-7.574)	0.0046 *(7.990)
Florida	-0.0047 *(-4.294)	-0.0005 (-1.513)	0.0019 *(3.646)
Georgia	-0.0047 *(-6.646)	-0.0035 *(-6.694)	0.0031 *(4.606)
Hawaii	-0.0120 *(-7.618)	-0.0016 *(-3.323)	0.0012 (1.575)
Idaho	-0.0056 *(-4.961)	-0.0011 *(-3.933)	0.0014 *(2.597)
Illinois	-0.0055 *(-6.687)	-0.0016 *(-3.706)	0.0023 *(5.179)
Indiana	-0.0061 *(-6.705)	0.0015 *(7.816)	0.0025 *(8.461)
Iowa	-0.0059 *(-8.400)	0.0013 *(3.702)	0.0033 *(7.974)
Kansas	-0.0073 *(-4.820)	-0.0010 (-1.608)	0.0030 *(4.399)
Kentucky	-0.0092 *(-8.696)	-0.0002 (-0.617)	0.0022 *(6.517)

Table 1—Trends in Public Capital Expenditures, Public Welfare Expenditures, and Tax Rates 1969-1987 (cont.)

State	Public Capital Expenditures	Public Welfare Expenditures	Tax Rate
Louisiana	-0.0076 *(-6.035)	-0.0017 *(-4.189)	0.0023 *(4.832)
Maine	-0.0064 *(-7.316)	0.0009 *(2.664)	0.0016 *(2.669)
Maryland	-0.0079 *(-8.240)	0.0170 (1.483)	0.0015 *(2.279)
Massachusetts	-0.0053 *(-5.048)	0.0051 (0.549)	0.0005 (0.538)
Michigan	-0.0068 *(-7.645)	0.0073 (0.775)	0.0044 *(6.918)
Minnesota	-0.0069 *(-6.848)	0.0086 (0.909)	0.0039 *(8.345)
Mississippi	-0.0086 *(-8.164)	0.0064 (0.647)	0.0023 *(3.880)
Missouri	-0.0066 *(-5.711)	0.0073 (0.737)	0.0015 *(4.288)
Montana	-0.0085 *(-7.324)	0.0092 (0.926)	0.0047 *(6.144)
Nebraska	-0.0183 *(-10.260)	0.0077 (0.764)	0.0066 *(6.253)
Nevada	-0.0058 *(-5.410)	0.0078 (0.761)	0.0020 *(2.410)
New Hampshire	-0.0105 *(-6.560)	0.0070 (0.726)	0.00005 (0.088)
New Jersey	-0.0054 *(-5.365)	0.0063 (0.653)	0.0027 *(6.815)
New Mexico	-0.0018 *(-2.503)	0.0070 (0.692)	0.0051 *(4.982)
New York	-0.0072 *(-5.668)	0.0061 (0.650)	0.0051 *(6.387)
North Carolina	-0.0064 *(-5.343)	0.0074 (0.736)	0.0040 *(8.921)
North Dakota	-0.0057 *(-7.862)	0.0105 (1.057)	0.0019 (2.045)

Table 1—Trends in Public Capital Expenditures, Public Welfare Expenditures, and Tax Rates 1969-1987 (cont.)

State	Public Capital Expenditures	Public Welfare Expenditures	Tax Rate
Ohio	-0.0081 *(-9.413)	0.0088 (0.915)	0.0066 *(13.069)
Oklahoma	-0.0033 *(-4.580)	0.0040 (0.408)	0.0020 *(5.049)
Oregon	-0.0090 *(-9.340)	0.0141 (1.284)	0.0047 *(5.649)
Pennsylvania	-0.0090 *(-7.066)	0.0065 (0.686)	0.0031 *(5.767)
Rhode Island	-0.0035 *(-4.187)	0.0058 (0.635)	0.0038 *(5.556)
South Carolina	-0.0075 *(-5.262)	0.0085 (0.847)	0.0046 *(9.351)
South Dakota	-0.0046 *(-3.287)	0.0083 (0.837)	0.0012 *(2.503)
Tennessee	-0.0121 *(-7.636)	0.0072 (0.720)	0.0055 *(5.948)
Texas	-0.0048 *(-5.958)	0.0056 (0.553)	0.0028 *(9.223)
Utah	-0.0002 (-0.071)	0.0084 (0.837)	0.0065 *(9.510)
Vermont	-0.0074 *(-5.072)	0.0077 (0.799)	-0.0005 (-0.673)
Virginia	-0.0083 *(-6.926)	0.0074 (0.738)	0.0015 *(3.350)
Washington	-0.0088 *(-4.548)	0.0064 (0.641)	0.0051 *(6.279)
West Virginia	-0.0133 *(-14.685)	0.0087 (0.876)	0.0030 *(5.777)
Wisconsin	-0.0050 *(-6.024)	0.0092 (0.976)	0.0029 *(5.672)
Wyoming	-0.0050 *(-3.816)	0.0084 (0.801)	0.0130 *(8.812)

t-statistics are in parentheses
*Significant at the 5 percent level
Expenditures are measured as a percent of total general revenues