The state and local government sector owns nearly 90% of the nonmilitary capital structures and 70% of the nonmilitary equipment in the U.S. As such state and local governments are the key policymakers in determining levels of infrastructure investment. Yet as stewards of infrastructure, the states have had a rocky history. Current engineering studies examining the condition of U.S. capital stock suggest that much of it is disrepair and that investments of nearly $1.6 trillion would be needed over the next 5 years to restore full functionality to major types of infrastructure.

Recently states have shown renewed interest in using capital investment in infrastructure as an economic development tool. Popular economic development theories based on enhancing industry agglomeration often find the condition of key infrastructure as a factor in economic growth. While many states accept this conclusion, they are faced with a policy conundrum. Facing tight fiscal circumstances, states and localities are trying to determine which infrastructure investments matter in triggering economic growth. This paper will survey what is known about measuring the effect of infrastructure investment and discuss whether states are asking the right questions before spending infrastructure dollars.
In recent years, advocates for using infrastructure investments as a strategy to leverage state level economic development have become more vocal. In 2003, California placed an initiative (Proposition 53) on the ballot to establish a state infrastructure fund. Advocates suggested that basic infrastructure had been at the core of the California success story and that recent state policies had lead to an underinvestment in infrastructure that had damaged the state’s economic climate. Ultimately the initiative failed, but an infrastructure coalition (the California Rebuild America Coalition) continues to press the issue. In Illinois, Gov. George Ryan developed the $12 billion Illinois First program in response to a 1999 study of the states infrastructure that found that schools, roads and water systems were in disrepair. The state utilized bonds, federal matching funds and increases in vehicle and alcohol taxes to fund new infrastructure spending. Finally, the American Society of Civil Engineers issued its 2003 Report Card for America’s Infrastructure. The report estimated that the U.S. will need to spend $1.6 trillion dollars on infrastructure over the next 5 years to restore infrastructure to full functionality. The society gave the nation an overall infrastructure condition rating of D+. Infrastructure systems rated in the report included roads (D+), Bridges (C), transit (C-), Aviation (D), Schools (D-), Drinking water (D), Wastewater (D), Dams (D), Solid Waste (C+), Hazardous Waste (D+), Navigable Waterways (D+) and Energy (D+). 

Clearly such assessments suggest that the condition of infrastructure is less than optimal. However an engineering assessment of the condition of infrastructure is not the same thing as an economists assessment of the value of infrastructure. A bridge may be
in disrepair but if few people use the bridge its economic value is marginal. In an era when most states are faced with tight revenues, policymakers are interested in knowing what type of infrastructure provides the greatest return on the public investment. States are interested in using infrastructure to spur economic development. However, before they can invest in infrastructure they must ask the right questions and understand how to measure the value of the investment. This paper will discuss the tools that are available to help policymakers evaluate infrastructure decisions and some of the technical difficulties in calculating infrastructure benefits. In addition the paper will briefly discuss structural issues that might impede infrastructure decisions such as a lack of a regional governance structure for funding infrastructure investments that cross local boundaries.

**Asking the right question—what are the economic benefits of infrastructure?**

Few would argue whether infrastructure investments are important to the economy or that functioning infrastructure is clearly a necessary condition for economic activity. Eberts (2002) suggests that the key question is whether additional infrastructure investments on the margin contribute to economic growth. To policymakers, economic growth has several potential outcomes. It includes job and income growth, improvement in the quality of life, environmental preservation and even sustainable development. This multi-dimensional view of economic development leads to a need to make infrastructure investment analysis based on many factors. Eberts uses transportation infrastructure investment as an example. In a more traditional analysis of a road or transit project the value of the investment would be measured by the degree to
which the investment improved access and efficiency in mobility. This approach would focus on how the condition of the infrastructure has changed rather than how that improvement might effect the output of the economy. Using a broader method for determining the value of the investment would examine whether improved access and efficiency might influence jobs that would be maintained or generated, how improved mobility may increase workforce accessibility for employers and whether the investment may lead to potentially developable sites.

Other questions that can help define the economic value of the infrastructure investment include- will the investment:

- Improve productivity?
- Increase value added (personal income)?
- Create new jobs?
- Improve environmental quality?
- Enhance quality of life?
- Improve low-wage workers’ access to jobs?

Answering these questions provides a host of technical estimating difficulties but it also can provide a richer understanding of how to properly assess the economic value of the investment beyond engineering estimates.

In addition, Gordon (2002) suggests that infrastructure investments can spur organizational and management changes that go beyond the physical benefits of the
infrastructure. For example, the construction of the railway system lead to the introduction of time zones and standardized schedules that provided economic benefits beyond the rails themselves.

**Tools for answering these questions**

Two methods are widely applied to measure the value of infrastructure investments. Benefit-cost analysis favors a project specific assessment of the return on the project. In contrast macro production function estimates focus on the contribution of various types of investments to economic output. Both approaches have benefits and drawbacks. In either case the first hurdle is identifying the relationship between the infrastructure systems specific characteristics and output and outcomes. Essentially this requires relating the technical characteristics of the infrastructure investment to the nature of regional growth. This is a complex relationship and requires identifying the performance features of the infrastructure as well as estimating economic and environmental effects of the investment. It also requires a measurement of indirect effects. Finally, an Achilles heal of these approaches is establishing an accurate measure of capital stock. This too has been fraught with technical problems, as estimates of depreciation and economic value have been difficult to determine. Since public capital is rarely sold, its reported value is based on the cost at the time of installation less physical depreciation. Estimates of economic depreciation would be most useful, but they are unavailable. This failing means that public officials can assess the physical life of the infrastructure asset but not easily determine its economic value.
To date, the macroeconomic studies focusing on public infrastructures contribution to productivity have offered wide-ranging conclusions. Based on which study one selects, infrastructure either contributes virtually nothing to productivity or produces a rate of return that is significantly above the rate of return for private capital. Such a range of estimates does little to help policymakers determine how to spend limited public resources. Debate over capital stock measures, the time period of the study, functional form, controls and geographic level of agglomeration have lead to widely differing assessments of the value of infrastructure in various macroeconomic studies (see table 1). In addition there has always been concerns about the unintended consequence of public capital investment crowding out private capital investment. Finally, while macroeconomic studies can shed light on the value of past infrastructure investments, they provide little value in assessing future investments.

Table 1. U.S. macroeconomic studies estimating output elasticities from infrastructure

<table>
<thead>
<tr>
<th>Geographic Level</th>
<th>Elasticity Estimate</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>0.39</td>
<td>Aschauer (1989)</td>
</tr>
<tr>
<td>National</td>
<td>0.34</td>
<td>Munnell (1990)</td>
</tr>
<tr>
<td>National</td>
<td>0.04-0.08</td>
<td>Nadiri, Mamuneas (1999)</td>
</tr>
<tr>
<td>State</td>
<td>0.17</td>
<td>Eisner (1991)</td>
</tr>
<tr>
<td>State</td>
<td>0.15</td>
<td>Munnell (1990)</td>
</tr>
<tr>
<td>Metro areas</td>
<td>0.08</td>
<td>Duffy-Deno, Eberts (1991)</td>
</tr>
<tr>
<td>Metro areas</td>
<td>0.03</td>
<td>Eberts (1986)</td>
</tr>
</tbody>
</table>
Haughwout (1999) suggests an interesting alternative explanation for the mixed results from macro studies. Haughwout suggests that it is the effect of infrastructure investments on the intra-state pattern of economic growth that may be of greatest interest. Arguing that many infrastructure investments provide place specific benefits that decline with distance from the point of investment, infrastructure can change the spatial pattern of development. Interestingly, this may not always be for the good. Using the argument that the promotion of agglomeration can be a major factor in promoting economic growth, Haughwout suggest that infrastructure that redistributes growth from dense urban areas to other parts of the state may diminish the agglomeration benefits of cities.

For local policymakers the preferred approach is benefit cost analysis since they are principally interested in how a specific project will effect their local community. Basically any infrastructure investment can be justified if the effective real rate of return exceeds the going real interest rate or if the net present value of the projects benefits evaluated at the going rate of real interest rate is positive. However, like macro-econometric analysis, measurement issues become particularly tricky. A key issue is disaggregating the nature of the infrastructure investment. For example road construction includes both new facilities and maintenance expenditures. In addition the location of the spending matters. The Federal Highway Authority conducted studies in the early 1980s that estimated real rates of return on various road projects. Their work suggested that money spent to maintain current highway conditions provided a 35% real rate of return while new road projects provided only a 5% rate of return. While new urban construction
produced a 15% rate of return new rural road construction would produce a negligible rate of return.\textsuperscript{vi}

Also timing matters. If there has been a lag in road building, new construction is likely to have a higher rate of return than in an area where road construction has been maintained. The basic point is that the nature of the investment, the specific location and the timing all matter in assessing the value of the investment. This leads one to a conclusion that shortages or under-investment in particular types of infrastructure do occur at specific locations.

\textbf{Working toward a better understanding of infrastructure investments--Know your regional economy and industrial structure}

Work by Fernald (1999)\textsuperscript{vii} and Hewings (2002)\textsuperscript{viii} suggest the missing link in much of the measurement issue. Fernald estimated the benefits of the road system to transportation reliant industries and found that benefits were significantly higher than that for other industries. Hewings takes this a step further by measuring intra-regional trade in the Midwest. In this manufacturing dominated region, Hewings finds that truck shipments within the region vastly surpass any foreign trade measures. Essentially intra regional trade between Midwest states is critical to the health of the local economy and efforts to support that trade are critical. What these studies suggest is that it is critical to consider the effects of infrastructure on agglomeration and regional industry structure to properly assess its full benefit.
For example, Hewings work finds that the production process in the Midwest has become increasingly fragmented as the spatial organization of production has aligned itself to more efficiently serve customers. This fragmentation increases the importance of highway infrastructure for connecting the phases of the production process. Increasingly raw materials are produced in one state, initial transformation in another, secondary transformation in yet another and final product in yet another. In this context, Hewings believes that infrastructure should be viewed as a substitutable input in competition with raw materials, labor and capital. For the Midwest, it is this recognition of trade (both international and inter-regional) that is so important to understanding the input value of infrastructure. Hewings estimates that the value of interstate trade in the Midwest is 4 to 5 times that total international trade. For example in Illinois 1997 international commodity trade was estimated at $34 billion while interstate trade was estimated at $224 billion. In Hewings work a regional input-output model is employed to understand inter- and intra- industry linkages across midwestern states.

A word of caution—if you build it will they really come?

Some communities will use infrastructure investments to build excess capacity in a hope that it will attract new private investment. Investments in airports and public tech parks, fiber optic connections and new roads are often seen as offering congestion free alternatives that will attract investment from congested urban areas. While this works for some communities, it is hardly a replicable strategy for any distressed town. For example, Hewings (2001) examined the economic benefits of rural airports and found
that the expected connectivity benefits are less than expected. Because of schedule constraints and higher airfares, rural residents are often more than willing to drive to a major metro for flights. When Hewings measured economic growth in terms of employment levels in rural communities with airports and without, he found little difference in their performance. ix

Is there a need for regional governance?

A final issue with infrastructure investment is political. In many cases, infrastructure investments such as a park have benefits that diminish with distance from the location. In these cases, local government is best able to assess the value of the investment to the people who will receive the greatest benefit. However, when the infrastructure represents a regional asset or is part of a regional network, there is often not a regional structure to properly assess the value of the investment. Gordon (2002)x suggests a structure for defining regional governance to optimize infrastructure decisionmaking. In order to effectively manage infrastructure, four factors need to be considered. These are:

- Scale (size of the operation)
- Scope (range of activities)
- Structure (internal pattern of authority and communication)
- Strategy (long-range objectives)

These factors next need to be applied to the appropriate definition of an infrastructure region. As Gordon suggests infrastructure regions can be by economic linkages (shared patterns of consumption, production and distribution); fiscal boundaries (who pays and benefits from infrastructure) or administrative boundaries (who governs). In an ideal system, the overlapping territory between these three regions would define the
infrastructure region. The problem for the U.S. is that regional structures have tended to evolve from coalitions and multi-state compacts to regional authorities but often fail to have the tools or resources to optimize decision making.

Conclusion

Assessing the contribution of infrastructure to economic growth is inherently a messy and often unsatisfying exercise. The analysis defies the use of a single statistical technique and relies heavily on good judgement and knowledge of the local economy. Proper assessment requires understanding how the infrastructure will interact with key sectors of the economy and recognizing that there is a spatial component to the analysis. Infrastructure that benefits one jurisdiction may well hurt another locality.

References


http://www.chicagofed.org/news_and_conferences/conferences_and_events/maintaining_and_financing_public_infrastructure_agenda.cfm


http://www.library.unt.edu/amcouncil/chicagofedpaper3.pdf


Appendix 1—Can accounting standards help improve infrastructure measurement?

One tool available to communities in the U.S. to help better maintain the quality of their existing infrastructure is GASB Standard 34. GASB is the Government Accounting Standards Board and Standard 34 is an attempt to require municipalities to report the value of capital assets. In the past, the lack of standards led to irregularities in how communities maintained infrastructure assets. Many communities lacked capital budgets and operating and capital funds often became intermingled. Reporting capital assets has several benefits. As enumerated by Harris (1999) they include:

• Heightened awareness of the size of public investment in infrastructure for which the reporting entity is responsible;
• Enhanced perspective about the on-going costs to maintain and replace infrastructure relative to total costs of infrastructure;
• Improved knowledge of infrastructure from locating and inventorying assets and from assessing the condition of assets; and
• Increased accountability for infrastructure management from examining trends in asset values over time.xii

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xi For more on Proposition 53 see [http://www.calrac.org/involve/prop53.html](http://www.calrac.org/involve/prop53.html)

xii More information on the California Rebuild America Coalition can be found at [http://www.calrac.org/](http://www.calrac.org/)

xiii The complete report provides state by state assessments of infrastructure conditions and can be found at [http://www.asce.org/reportcard/](http://www.asce.org/reportcard/)


x Cameron Gordon, “S…S…S…S Marks the “Spot”: Who should do what, when and why in the provision of regional infrastructure”, American Council on Intergovernmental Relations, Discussion draft prepared for Maintaining and Financing Infrastructure in Tough Budgetary Times, Federal Reserve Bank of Chicago
and National Association of State Budget Officers, September 25, 2002.
http://www.library.unt.edu/amcouncil/chicagofedpaper3.pdf


xii Harris, p. 39.