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Highway Infrastructure and the Economy

Implications for Federal Policy

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RAND INVESTMENT IN PEOPLE AND IDEAS

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Summary

This monograph reviews the literature on the effects of highway infrastructure on economic outcomes to inform the current debate about federal transportation policy reform in the United States. The U.S. government has at times premised investment in highway infrastructure in part on the belief that it contributes to economic growth. However, the economic effects of highway infrastructure remain a matter of debate. We focus on highway infrastructure because it constitutes the largest share of federal spending on transportation infrastructure and because there exists a rich literature assessing the economic effects of highways.

We start by highlighting connections the federal government has drawn between highways and the economy, noting the recent calls for reconsideration of national transportation policy, and providing a brief description of current issues in federal highway policy. We then turn to an analysis of the quantitative literature tracing the effects of highway infrastructure on such economic outcomes as productivity, output, and employment. We conduct this analysis in two ways. First, we present a qualitative discussion of the literature. Second, we conduct a formal quantitative meta-analysis to discern more clearly why the literature has produced its current findings about infrastructure and the economy. After discussing these findings, we consider their implications for federal highway policy and for future research.

Current Federal Policy

In recent decades, promoting economic growth has occupied an important place in federal statements about transportation infrastructure. This is particularly so in the major transportation program reauthorization bills that Congress considers approximately every six years. Transportation programs also reflect a variety of other important national goals, including increasing traffic safety, reducing environmental pollution, and supporting national defense, yet the long and deep current economic downturn has focused attention on the role of infrastructure in economic growth and that connection is in need of more study.

Such an analysis fits well within the idea of a reconsideration of federal transportation policy, something that has been brewing for much of the last decade. Calls for the reform of U.S. transportation policy have been mounting since Congress approved a law in 2005 reauthorizing transportation funding for the nation's surface transportation network from 2005 to 2009. The law itself mandated the creation of two study commissions to consider the future of the U.S. transportation system. But Congress did not provide the only impetus for reconsidering U.S. transportation policy. Voices both inside and outside the government also made such calls, including the independent Government Accountability Office (GAO), inside the government, and the Bipartisan Policy Center, outside the government.

U.S. transportation programs are in many ways the quintessential embodiment of federalism. Although a partnership between different levels of government is well established in practical terms, it has never been carefully described in federal legislation nor formally designated as a "national transportation policy." What we understand to be U.S. policy has evolved through a long series of disconnected federal and state legislative actions, most of which were accommodations at specific times to particular problems. This evolution has resulted in more than 100 federal surface transportation funding programs, many of which appear to embody limited concern about the economic effects of infrastructure investment.

The intellectual model of highway programs in particular is that the states own and operate the major roads—even the interstates. The

federal government “aids” the states through grants or loan subsidies, but in principle, as a matter of state sovereignty, the states plan and decide where the highways will go and then operate and manage them. The result is that the federal government recognizes the overall highway program as a state program and gives the states money if they meet design or safety standards and follow certain planning procedures.

States and localities have always provided the majority of money for highways and roads in the United States. Federal funding grew dramatically in the early years of the interstate highway system, starting with the passage of the Federal Aid Highway Act of 1956, but state and local financing has grown somewhat more rapidly since the early 1980s. For most of the years since 1956, the federal share of total government spending on highways and roads in the United States has hovered between 25 percent and 30 percent. Federal funds are typically disbursed to states according to formulas. The creation of these formulas often results from a great deal of political bargaining, because slightly different formulas can have large effects on the amount of money a state receives.

The processes by which federal funds are disbursed suggest one of the main weaknesses of national transportation policy and are symptomatic of how federal highway investments may be only loosely linked to ensuring large economic benefits. Programs and formulas have become complex and change substantially from one transportation bill to the next. Although programs proliferated to create balanced attention to many competing interests, the current mix of programs constitutes “stovepipes” that stymie innovation and prevent rational, integrated, comprehensive planning. That is, although a region may need a mix of maintenance, public transit, and highway investments, these federal programs are funded separately using different formulas, and decisionmaking is dominated by cleverly navigating the funding structures rather than by adhering to logical regional or metropolitan plans. The proliferation of programs and the stovepiping make it difficult to fashion investments that clearly meet any federal transportation goals, let alone increasing national economic performance.

Findings on the Relationship Between Highway Infrastructure and the Economy

Highway infrastructure can affect the economy in a number of ways, nearly all of them related to increasing mobility. It can enable producers to reach markets more cheaply, to increase the size of their market area, and to have a broader choice of input suppliers. It can increase the speed with which producers can reach markets or inputs, allowing them to hold lower inventories and carry out just-in-time production. Highway infrastructure can enable workers to choose among a wider array of employment opportunities and to live farther from their workplaces. It can enable consumers to have a more varied choice of goods, services, and prices.

Not all highway infrastructure produces these outcomes in the same way. Some transportation infrastructure serves purely local needs, whereas other infrastructure enables connections to national and international markets. Besides the longer-run effects, highway infrastructure also can boost economic activity through immediate construction activity that results from new highway infrastructure investment.

We focused the literature review on studies that used statistical methods to seek relationships between existing highway investment, highway capital, or some other measure of highways, and economic outcomes. We conducted this review two ways. First, we carried out a qualitative review describing key findings in the literature. Second, we conducted a formal meta-analysis using statistical methods to help us gain a better understanding of how study characteristics influenced study results.

In our review, we concentrated on three broad classes of economic outcomes: changes in productivity, meaning the ability to produce greater levels of output than previously from a specific level of inputs; changes in economic output, measured as changes in total output, value added, or per capita measures of either; and changes in employment. Analysts have also considered a number of other economic and demographic outcomes, such as earnings growth and population shifts, and we discuss these outcomes as well where appropriate. We excluded

the immediate employment and income effects of highway construction and maintenance.

The Qualitative Literature Review

We separately reviewed papers that studied highway infrastructure at the national level, the state level, and the substate level and in other countries. Studies of highway infrastructure at the national level tended to find high rates of return and strong productivity effects, at least in the initial building phase of the national highway system. One way this was manifested was through lower costs to industries, especially those that most heavily used the highway network. Likewise, some of the research at the state level found positive effects of highways, or broader measures of public capital, on a variety of economic outcomes. However, these effects tended to be lower than those of private capital investment when the two were compared. In addition, some papers found no effect. Although some research identified positive effects of infrastructure in one state on the economy of neighboring states, more identified zero or even negative effects. Taken together, this evidence is consistent with the idea that *some* highway infrastructure investment can lead to positive productivity or output outcomes. However, there is a possibility that such investment can have negative effects on neighboring states.

Research at the substate level confirms that the economic effects of highway infrastructure are far from straightforward. Highway infrastructure in a county can boost the economic performance of that county but can also cause economic declines in other counties. Such positive and negative effects can even be found within a county or metropolitan area and could result in a zero or even negative overall economic effect for a metropolitan area or a multicounty region.

There are solid reasons why the effects of highway infrastructure vary. County characteristics, such as existing levels of income, have a strong influence on whether highway infrastructure will change economic outcomes. In addition, even among highways, the type of highway matters. Finally, the value or quantity of highway infrastructure is only one factor to be considered when measuring the effects of highways on economic outcomes. Congestion—which might not be solved

by building more infrastructure but by managing highway use in an efficient way—can have negative effects on economic performance. International research further confirms that quantity and value are not the only important variables and provides the intriguing finding that the condition of highway infrastructure can have large effects on economic outcomes.

The Meta-Analysis

The studies we reviewed used a variety of methods, analyzed different types of infrastructure, covered different time periods, focused on different geographic areas, and investigated different types of economic outcomes. To find out how the variation in study design affected the results, we conducted a formal meta-analysis. In such an analysis, results from a broad range of studies are analyzed statistically against the characteristics of those studies.

The meta-analysis cannot answer definitively whether highway infrastructure has positive effects on the economy. Rather, it can explain the general tendencies present in the set of papers analyzed. If the papers were representative of the broader literature, the meta-analysis would also indicate what researchers in general would tend to find.

The meta-analysis indicated that research that analyzed the relationship between infrastructure and productivity tended to find a positive and statistically significant result. Statistical significance means that there is only a low probability that this relationship occurred by chance. Secondarily, research that analyzed the relationship between infrastructure and output tended also to find a positive and statistically significant result. These results extended to highway infrastructure, specifically. We found that highway infrastructure had the same effect on productivity and output as broader measures of public investment and that this effect was positive and significant. It appears that highway investment and broader public investment had different effects on employment and population, but we were unable to test this for the technical reason that certain variables in our data set were too highly correlated to allow us to calculate results.

Finally, we also found that papers that analyzed national-level data were more likely than studies that analyzed state-level or substate-level data to find a positive and significant relationship between infrastructure and economic outcomes. We believe that this reflects the findings of much of the analysis at the state level and below that highway infrastructure has a tendency to reallocate economic activity and not just to increase it. Furthermore, national-level studies may be more likely to capture geographically distant spillovers that could be quite important but might not be found in a study concentrating on more constrained geographic areas.

Summing Up the Qualitative and Quantitative Reviews

The qualitative and quantitative reviews suggest the following patterns in the literature:

- Research has identified positive effects of highway infrastructure on economic outcomes, in particular productivity and output. However, studies often do not take the next step of calculating whether the benefits stemming from the infrastructure outweigh the costs of building it.
- The meta-analysis confirms that broad measures of public infrastructure have a positive and significant effect on economic outcomes, and that highways have such an effect on productivity and output specifically.
- Private capital investment tends to have larger effects on economic outcomes than public capital investment or highway investment, although the public investment can serve as a complement to the private investment.
- In the absence of a complete network, construction of transportation infrastructure can have large, positive effects on economic outcomes. As the network becomes more complete, effects of network expansion tend to diminish.
- These effects appear to be both direct—with transportation infrastructure serving as an input in production processes—and indirect—with transportation infrastructure making other types of inputs more productive.

- Not just the quantity but the condition of infrastructure and its level of congestion may be important for inducing positive economic benefits.
- Transportation infrastructure has effects beyond the geographic area in which it is located. These can be positive or negative, and so the net economic effect could be positive, zero, or even negative. However, the meta-analysis results regarding national-level studies versus those at the state-level and below suggest that geographically distant effects may be hard to measure when a study focuses only on smaller geographic areas.

Implications for Federal Policy Reform and Future Research

Many transportation specialists agree that federal transportation policy is in need of fundamental change. At the same time, they hold a wide range of opinions about how to effect that change and craft future programs. The most recent national transportation bill expired in October 2009; since then, Congress has supported federal transportation programs through a series of continuing resolutions and temporary extensions.

In this study, we explored one principle of federal involvement—the extent to which highway investments contribute to improvement in economic outcomes. When alternative expenditures of federal funds for highway improvements are considered, those that enhance the economy should be favored over those that do not, all else equal.

We intend the findings from the literature review to suggest alternative ways to view key policy issues and inform public debates over the content of the next federal surface transportation legislation. Although the findings do not suggest specific programs that can be implemented, they may present underlying principles for the reform of federal policy and programs. The findings also lead us to suggest avenues for future research.

Underlying Principles for the Reform of Federal Policy

Highway infrastructure varies greatly in its economic effects, depending on a wide variety of system and geographic factors at the local and regional levels. Although highways on average appear to have positive economic effects, these effects can be highly context-specific. Better targeting of federal highway investments could lead to better economic outcomes.

The economic benefits and costs of highway investments can and often do spill over into jurisdictions different from those in which the infrastructure is located. Where benefits are dispersed or costs are concentrated, this can make it politically difficult to achieve support for projects that allocate differential benefits and costs over multiple political jurisdictions.

Currently, federal spending goes to a large variety of highway projects, including those that may have only local effects or even net negative effects. With the United States facing fiscal constraints, federal highway spending can fulfill the policy aim of supporting better economic performance by focusing on projects that have positive net benefits dispersed over large geographic areas. We refer to these as projects of national significance, and we suggest that they are the most likely to be in the national interest and worthy of national funding.

Avenues for Future Research

The review also suggests a number of avenues for future research. A great deal of statistical research on the economic consequences of highway infrastructure focuses on how highways have influenced productivity, output, or employment. A minority of that literature has then taken the next step of placing a value on those economic changes and comparing that value with the cost of the infrastructure. Taking that next step can make a valuable contribution to the policy debate and should be a priority of future highway research.

Furthermore, research should be broadened from considering not just the value or quantity of highway infrastructure but also its condition. In addition, even where studies have been done in the past, researchers should revisit these studies using the most recent available data. It is possible that long-term economic changes such as increased

globalization have affected relationships between transportation infrastructure and the economy. Finally, there was relatively less literature of the type we considered—studies that used statistical methods to analyze existing infrastructure—on public transit and intercity freight railway than on highway infrastructure, suggesting a further knowledge gap.