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Approaches to Make Federal Highway Spending More Productive

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Summary

Federal spending on highways (or, synonymously, roads) totaled $46 billion in 2014, roughly a quarter of total public spending on highways. About 95 percent of that amount was spent for the construction of highways or for their improvement, expansion, and major repair, and the remainder was spent for operation and maintenance.

Recently, two factors have combined to highlight the importance of making each dollar spent on federal highway programs more productive economically. First, the federal government's main source of funds for highways—gasoline tax revenues dedicated to the Highway Trust Fund—has been insufficient to pay for federal spending on highways. Since 2008, lawmakers have transferred about $143 billion from other sources to maintain a positive balance in the trust fund. Second, adjusted for changes in construction costs, total federal spending on highways buys less now than at any time since the early 1990s.

Note: Numbers in the text and tables may not add up to totals because of rounding.

How Is Spending on Highways Related to Their Use and Performance?

Spending on highways does not correspond very well with how the roads are used and valued. Almost all federal spending for highways occurs through formula grants to state and local governments, and historically, less than half of the funding has been tied directly to the amount of travel on the roads. Although data from the past 20 years show that, on average, pavement quality is improving, fewer bridges have deficiencies, and highway fatalities occur less frequently, those averages mask differences between urban and rural areas and between Interstate highways and other roads, differences that sometimes are not reflected in spending. For example, even though highway travel is more concentrated on Interstates and in urban areas, and urban roads are typically in poorer condition than rural ones, the federal government and state governments typically have spent more per mile of travel for major repairs on rural roads.

Moreover, the extent to which new highways boost economic activity has generally declined over time, increasing the importance of maintaining existing capacity. Yet spending has not shifted much accordingly.

How Could Federal Spending Be More Productive?

Spending for highway infrastructure can increase economic productivity and well-being by providing benefits to businesses and households. It can increase the productivity of businesses when it reduces freight delivery costs, shortens travel times, or improves reliability. Spending for highway infrastructure can also provide benefits to households by lowering the costs for employees to commute to work; shortening commuting times and improving the reliability of commutes; improving households' access to health care, education, and other valued services; improving the safety of travel; and reducing some of the harmful byproducts of transportation, such as pollution.

Three approaches that the Congress could consider would make highway spending more productive:

- Have the federal government—or allow states or private businesses to—charge drivers directly for their use of roads more often, including charging them more for using roads when traffic is more congested;
- Allocate funds to states on the basis of the benefits and costs of specific programs and projects; and
- Link spending more closely to performance measures—such as ones for traffic congestion or road quality—by providing additional funds to states that meet standards or penalizing states that do not.

Lawmakers may also choose to fund highway projects to achieve various other objectives—including boosting economic activity in the short term, increasing employment, and increasing rural access to transportation networks. They may want to avoid too much of a mismatch between the gasoline taxes paid in each state and the federal funds allocated to each state. Or they may wish to direct less of the spending and, instead, provide money for states to pursue their own objectives, as long as the work is done, say, on the National Highway System or some other set of roads with national significance. Nevertheless, viewed in terms of the support provided to long-run economic growth, the way highway spending is allocated could be more productive.

Drivers Could Be Charged for Their Highway Use

Charging drivers specifically for using roads would increase economic output by allowing highly valued transportation to move more quickly and more reliably. Such pricing could take the form of per-mile charges (also known as vehicle-miles traveled, or VMT, charges), congestion charges, or tolls on Interstate highways. When faster travel and avoiding delays were a priority, drivers could opt to pay for the use of a less congested road, and when travel speed was less important, they could use a road with a lower fee or avoid paying a fee by using a road without one. Charges that varied by time of day or that differed by road would also affect economic activity by limiting congestion.

Besides affecting travel, such pricing would raise revenues, which could be used to make repairs, expand capacity, or substantially renovate the Interstate System or could be put to other purposes. It would also provide important information for spending decisions by showing how much drivers value the use of a road, helping to set priorities for future improvements. Over time, with more use of pricing, spending could shift from less productive to more productive uses of highways. Such shifts could boost economic growth—or they could allow spending to be reduced without affecting overall growth. According to the Federal Highway Administration (FHWA), widespread use of congestion pricing, for example, could reduce the amount of capital investment needed to meet a given set of goals for performance of the highway system by roughly 30 percent.

However, that approach would raise several concerns: Charging drivers to use roads could raise concerns about privacy, depending on the methods used. The approach could also place a proportionately greater burden on low-income households. Moreover, highway users could resent paying tolls if they believed that they had already paid for the roads through gasoline taxes over the years. And technological hurdles may exist: Although the costs of charging drivers are declining with improvements in technology, the costs remain higher than those for collecting revenues through the gasoline tax.

Spending Could Be Allocated on the Basis of Benefits and Costs

Policymakers could also boost the impact of highway spending on the economy by allocating more funding to programs or projects with economic benefits that were expected to outweigh the costs—rather than allocating funds on a geographic basis or providing fixed allocations to states. According to FHWA's analysis, capital spending would produce greater benefits relative to costs than it has recently if it was reoriented toward these purposes:

- Expanding urban Interstates,
- Making major repairs of urban highways (both Interstates and other roads), and
- Repairing bridges, particularly those in the Interstate System in rural areas and those not part of that system in urban areas.

Lawmakers could also provide more funding to programs that use benefit-cost analysis in selecting projects, including several existing programs, such as the Transportation Investment Generating Economic Recovery, or TIGER, grant program. According to FHWA, funding projects with the highest net economic benefits could realize most of the benefits of highway spending for about 25 percent less cost or allow the same amount of spending to have a greater economic payoff. Another approach would be to promote the use of benefit-cost analysis at the state and local levels, where most of the spending decisions are made.

But programs that assess the benefits and costs of highway spending will improve the economy's performance only to the extent that the calculations adequately capture the benefits to the economy, and benefit-cost analysis on a project-by-project basis may miss important ways in which distinct components of the highway network affect one another. Also, some such policies would reduce state and local governments' discretion in how they use their federal funds.

Spending Could Be Linked More Closely to Performance Measures

Using appropriately chosen performance measures (such as standards for traffic congestion or for the condition of pavement) could also make highway spending more productive. The cost, speed, and reliability of travel can largely be captured through measures of congestion, road quality, bridge quality, and safety. Formulas for federal highway spending in each state could be tied more closely to realizing set standards based on those measures.

Using performance measures to guide spending could be easier than using pricing or benefit-cost analysis because performance information can be readily obtained. However, using such measures would be less effective than using pricing or benefit-cost analysis. Performance measures alone do not provide any information about the relative costs of improving the performance of the system in different places or the

valuation of the benefits that would accrue from those improvements. As a result, using performance measures to guide spending does not always yield the same results as benefit-cost analyses. In some instances, benefit-cost analysis would suggest constraining spending for parts of the highway system with poorer performance, whereas needing to meet a performance measure could suggest the opposite—increasing spending for those parts of the highway system.

Chapter 1: The Current System

The United States has an extensive and heavily used system of highways, which consists of about 4 million miles of roads and, in 2015, was used to travel about 3 trillion vehicle-miles. Travel by car accounts for the bulk of personal travel within and between cities (even though the share of passenger-miles traveled between cities by air has risen over the past few decades). People benefit from the nation's highways not only as drivers and passengers but also as producers and consumers of shipped goods. In 2012, 2.5 trillion ton-miles of freight traveled on U.S. highways, constituting more than a third of the ton-miles of freight transported in the country and a much higher share of the value of goods shipped.

Public spending—that is, spending by federal, state, and local governments—on highways totaled $165 billion in 2014: $92 billion went to capital projects and $73 billion to operation and maintenance (see Table 1-1).[1] Spending for capital projects includes expenditures either for the initial construction of roads and associated structures (such as bridges, overpasses, and underpasses) or for the improvement, expansion, and major repair (that is, resurfacing, restoration, rehabilitation, and reconstruction) of existing highways. Spending for operation and maintenance includes expenditures for traffic control operations, snow removal, administrative and other expenses not related to capital spending, routine and minor repair (for example, filling potholes), and preventive maintenance.[2]

Most of the public spending came from state and local governments. The federal government supplied roughly a quarter of the total, including about half of all public spending for capital projects. Of the $46 billion in federal spending for highways, almost all, $44 billion, was for capital projects. Conversely, almost all of the operation

1. For more information on public spending on highways and other types of public infrastructure, see Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014* (March 2015), www.cbo.gov/publication/49910.

2. The definitions of capital spending and operation and maintenance spending come from the Federal Highway Administration, *A Guide to Reporting Highway Statistics* (accessed on March 6, 2015), pp. 8-10–8-12, www.fhwa.dot.gov/policyinformation/hss/guide/.

and maintenance spending for highway infrastructure came from state and local governments.

Notably, the various shares of spending have been consistent over the years. The split between capital projects and operation and maintenance has not changed much since 1980. The federal share of capital spending has typically ranged between about 40 percent and 50 percent since 1959 (shortly after construction began on the Interstate System). That percentage varies significantly among states, however. For example, in 2009, 12 states (primarily smaller ones) relied on federal funds for two-thirds or more of their capital spending for highways.[3]

Recently, two factors have combined to highlight the importance of making each dollar spent on federal highway programs more productive. First, the revenues from gasoline and diesel fuel taxes dedicated to the Highway Trust Fund—the federal government's main source of funds for highways—have been insufficient to pay for highway spending.[4] Since 2008, lawmakers have transferred about $143 billion (mostly from the Treasury's general fund) to the Highway Trust Fund, including $8 billion in 2015 and an additional $70 billion in 2016, in order to maintain positive balances in the fund (see Figure 1-1).[5] Second, the cost of goods and services that go into highway construction grew substantially over the past decade, much more rapidly than did prices in the economy as a whole. As a result, the amount of federal spending for highways, as well as the amount of spending by all levels of government, has declined since the early 2000s when adjusted for changes in the cost of those materials and other inputs (see Figure 1-2). In total, highway spending has bought less recently than at any time since 1993.

In addition, two considerations suggest that highway spending could be more productive:

- The allocation of federal highway funding is only loosely related to how much highways are used; and
- Research suggests that the increases in economic activity from spending for new highways in the United States have generally declined over time. As the highway system has matured and changes to it have become more incremental and localized, spending to repair existing capacity may have become relatively more productive.

3. Bipartisan Policy Center, *The Consequences of Reduced Federal Transportation Investment* (September 2012), http://tinyurl.com/muvebyy.

4. See the testimony of Joseph Kile, Assistant Director, Microeconomic Studies, Congressional Budget Office, before the House Committee on Ways and Means, *The Status of the Highway Trust Fund and Options for Paying for Highway Spending* (June 18, 2015), pp. 5–7, www.cbo.gov/publication/50297. See also Congressional Budget Office, *How Would Proposed Fuel Economy Standards Affect the Highway Trust Fund?* (May 2012), www.cbo.gov/publication/43198.

5. Congressional Budget Office, "Highway Trust Fund Accounts—Baseline Projections" (January 2016), www.cbo.gov/publication/43884.

The Allocation of Highway Funding

Almost all federal spending for highways takes the form of grants to state and local governments based on formulas set in federal law.[6] State and local governments own almost all highways; federal agencies own just 3 percent of the total (typically, those in national parks and forests, on Indian reservations, or on other federally owned land). Generally speaking, state and local governments decide which projects to pursue and then receive reimbursement from the federal government for projects that meet federal eligibility criteria under various programs. States' departments of transportation are ultimately responsible for planning and coordinating federal highway and transit investments, and each year they prepare both long-range (20-year) and short-range (four-year) plans to guide the use of funds. In urban areas, metropolitan planning organizations—made up of representatives from local governments and transportation agencies—coordinate to develop the plans.[7]

Like the previous authorization for highway programs, the Fixing America's Surface Transportation (FAST) Act, enacted in 2015, allocates funds to states and local governments in ways that are only partly linked to how the highway system is used.

Classifications of Roads for Funding Purposes

The Federal Highway Administration (FHWA) classifies roads according to their functionality in providing *access* and *mobility*, and those classifications serve as a basis for directing federal funds. Roads that primarily provide access usually serve smaller volumes of traffic traveling for shorter distances at lower speeds, whereas roads providing mobility typically serve larger volumes for longer distances at higher speeds, often allowing only limited access in order to maintain the speed of travel.[8]

For the purpose of distributing federal highway funding, the federal government identifies four categories of roads, which overlap to some extent (see Figure 1-3):

- Highways in the Interstate System;

6. For a further description of the different ways by which the federal government generates and directs the use of highway funds, see the testimony of Joseph Kile, Assistant Director, Microeconomic Studies, Congressional Budget Office, before the Senate Committee on Finance, *The Status of the Highway Trust Fund and Options for Paying for Highway Spending* (June 18, 2015), pp. 7–19, www.cbo.gov/publication/50297.

7. For more information on state and local transportation planning processes, see Federal Highway Administration and Federal Transit Administration, Transportation Capacity Building Program, *The Transportation Planning Process Briefing Book: Key Issues for Transportation Decision Makers, Officials, and Staff*, FHWA-HEP-15-048 (August 2015), www.fhwa.dot.gov/planning/publications/briefing_book/.

8. For more details, see Federal Highway Administration, *Highway Functional Classification Concepts, Criteria and Procedures* (2013), http://go.usa.gov/caV39.

- Roads in the National Highway System (composed of Interstates and other roads serving significant population centers, border crossings, transportation facilities, or travel destinations);

- Federal-aid highways (made up of Interstates and most other roads that are not local roads); and

- Non-federal-aid roads (mostly local roads and certain others that are typically not eligible for federal aid); in the federal classification system, local roads are two-lane roads that are usually owned by local governments and function almost entirely to provide access.

Current and Recent Highway Spending Programs

The FAST Act specifies a total amount of funding available for obligation in each year and directs that the amount be divided proportionally among the states, largely on the basis of the share each state received in fiscal year 2015, which in turn was based on the share that each state received in 2012. That share reflected the formulas specified in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), which was enacted in 2005 and subsequently extended. Many of the largest programs under SAFETEA-LU typically allocated 33 percent to 40 percent of their funding on the basis of the miles traveled by vehicles in the state and the rest on the basis of the number of miles of roads and their classification under federal guidelines as well as the amount of taxes credited to the Highway Trust Fund from users within the state.[9] In addition, in order to improve safety, the Highway Safety Improvement Program (HSIP) distributed funds partly on the basis of the number of fatalities in each state, and the Congestion Mitigation and Air Quality Improvement Program (CMAQ) provided funds to states to reduce pollution and congestion on the basis of their attainment of pollution standards.

The FAST Act also continues the consolidation of many of the smaller programs in SAFETEA-LU that targeted more specialized systems or purposes, such as the Denali Access System Program (to improve roads in Alaska) and the Safe Routes to School Program (to help children walk and bike to school more safely). That consolidation began with the enactment of the Moving Ahead for Progress in the 21st Century Act (MAP-21) in 2012 and entailed incorporating those smaller programs into new core programs or addressing them in other ways. The result has been greater flexibility for state and local governments in directing federal funds to their priorities.

9. Each state is assured certain relative rates of return on its contribution of revenues to the highway account of the Highway Trust Fund.

The Relationship Between Spending on Highways and Their Use and Performance

Many of the costs travelers impose on the highway system —including traffic congestion, pavement damage, and accident costs—depend primarily on how many miles people drive.[10] Accordingly, in this study, the Congressional Budget Office examines spending on different kinds of roads relative to the vehicle-miles traveled on them. To make figures comparable across years, the agency has adjusted the amounts of spending for changes in construction costs over time.[11] (After such adjustments, a given lane-mile—one mile of one lane on a road—has the same construction cost in different years; however, the adjustments do not reflect cost differences in the types of lanes being built—as high-capacity roads such as Interstates are generally more expensive per lane-mile—or changes in the types of lanes being built over time.)

Primary goals of highway spending are to make transportation less expensive, faster, more reliable, and safer. The success of the highway system in meeting those goals depends, of course, on how the system is used. Highway use is concentrated on the Interstates and in urban areas, and highway performance—particularly in terms of traffic congestion, pavement quality, and bridge quality—is generally poorer on those roads (although they are often safer). However, spending per vehicle-mile traveled is typically greater for highways in rural areas.

Highway Use

Highway use has grown substantially over the past 30 years (see Figure 1-4). Vehicle-miles traveled have roughly doubled, whereas the number of lane-miles has increased only slightly.[12] In recent years, however, the growth of travel abated, at least in part because of the recent recession and slow recovery and perhaps because of the aging population and lower rates of driving among younger drivers. In terms of vehicle-miles traveled per person, highway use in 2015 was comparable with what it was in 2000. The shares of highway use for moving people and for moving goods have remained fairly constant over the past three decades, although truck traffic has grown slightly faster than total vehicle-miles traveled.

10. See Congressional Budget Office, *Alternative Approaches to Funding Highways* (March 2011), www.cbo.gov/publication/22059. Vehicle weight and the number of axles over which it is spread also play a role in the costs of pavement damage.

11. CBO used price indexes from the Bureau of Economic Analysis to convert current dollar (or nominal) spending into constant dollar (or real) values. CBO has modified those calendar year indexes to correspond to federal fiscal years. For further details about the adjustment for inflation, see Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure* (November 2010), p. 49, www.cbo.gov/publication/21902.

12. One mile of road with four lanes in each direction, for example, constitutes eight lane-miles. A mile of road regardless of the number of lanes in either direction is sometimes called a centerline mile of road. Adding a lane to one mile of existing road increases the number of lane-miles but does not increase the number of centerline miles.

Highway travel is not distributed evenly among the different kinds of roads. Although the Interstate system constituted only 3 percent of the lane-miles in 2013, it handled a quarter of vehicle-miles traveled (see Figure 1-5). Similarly, other federal-aid roads—such as numbered U.S. and state highways and other connector highways between those roads—made up 26 percent of highway capacity and accounted for 60 percent of the traffic. Local roads provided most of the capacity but accounted for 16 percent of the traffic.

In terms of geographical distribution, roads are identified by FHWA as being either rural or urban on the basis of the population density of the surrounding area.[13] As a result, rural roads can be located in low-density parts of counties in metropolitan areas. (For example, in the Washington, D.C., area, roads just west of Dulles Airport are considered rural.) More than two-thirds of highway capacity is found in rural areas, but those rural roads carry only about one-third of the traffic.

Freight traffic is concentrated on Interstates, with 40 percent of truck travel occurring there. Such traffic is split about evenly between urban and rural highways. In contrast, passenger travel occurs much more frequently in urban areas.

Thirty years ago, highway use was more rural and more concentrated on federal-aid roads other than Interstates. Now, urban Interstates and other urban federal-aid highways play a larger role. The share of passenger travel on rural federal-aid roads other than Interstates fell from 27 percent in 1980 to 18 percent in 2013.[14] Freight transportation has undergone a similar transition; traffic growth has been greater on urban roads than on rural roads outside of the Interstate system.

Congestion

One of the defining features of the highway system in the United States has been the extent to which more and more people have wanted to use its limited capacity. Unfortunately though, once traffic reaches a certain volume, congestion raises the cost of travel by reducing its speed and reliability; and with enough congestion, the volume of traffic served by a highway also begins to decline.

Delays in urban areas of all sizes have increased substantially since 1982, when such statistics began to be collected, although in recent years, they have moderated because of the decline in travel (see Figure 1-6). Drivers in very large urban areas (defined in terms of population size) experience more than twice as many hours of delay as do their counterparts in small urban areas. In percentage terms, however, delays in small

13. Rural areas typically, although not always, have a population density of less than 500 people per square mile, and urban areas, that amount or more. See Census Bureau, Economics and Statistics Administration, "Census 2000 Summary File 1 Technical Documentation" (2001), Appendix A, www.census.gov/census2000/sumfile1.html.

14. See Federal Highway Administration, *Highway Statistics 2013*, Table VM-2 (accessed on September 22, 2015), www.fhwa.dot.gov/policyinformation/statistics/2013/.

urban areas grew even more than those in very large urban areas. The Census Bureau projects that the United States will add about 100 million people to its population by 2060, suggesting that congestion may become more problematic in the future.[15]

The amount of congestion can indicate where savings in travel time might be greatest for highway expansion projects (or possibly transit projects). In general, more traffic on a road signals a greater need for more capacity (or other transportation options such as some types of mass transit, although the use of mass transit remains significantly less than the reliance on automobiles in most places outside of the largest cities). On urban Interstates, the amount of traffic is more than twice as high per lane-mile as it is on rural Interstates (see Figure 1-7). But spending that adds capacity to highways (by adding new lanes, for example) is not commensurate with the amount of travel on different kinds of highways.

A comparison of traffic levels and recent spending to expand highways shows that spending per vehicle-mile traveled on rural federal-aid highways (other than Interstates) was greater in recent years than spending on other kinds of highways.[16] Urban Interstates receive the most use by far, and capacity spending per mile of travel is higher for them than it is for some other types of road. However, for other rural federal-aid highways, which are used the least, the amount of capacity spending per mile of travel is even higher than it is for urban Interstates. Rural Interstates and other urban federal-aid highways are also more heavily traveled than rural federal-aid highways that are not Interstates, yet they have less capacity spending per mile traveled. Over the past 20 years, relative to travel, spending for expanded capacity (adjusted for inflation in highway capital costs) has fallen for all types of highways.

Those figures and observations are general. A higher traffic volume on a specific road does not always indicate that spending more on it than on a road with a lower traffic volume would be beneficial. The physical characteristics of specific roads, the cost of improving them, and the benefits that travelers receive vary in ways that can overcome general rules of thumb about highway spending. For example, some roads can carry more traffic than others without becoming heavily congested; some roads with less

15. Census Bureau, *2014 National Population Projections* (accessed on March 6, 2015), www.census.gov/population/projections/data/national/2014.html. For more on the sources of congestion and projections of future congestion, see Congressional Budget Office, *Using Pricing to Reduce Traffic Congestion* (March 2009), www.cbo.gov/publication/20241. In the future, automated driving technologies could play a role in alleviating traffic congestion, as could changes in demographics and developments in communications, transit, and other substitutes for driving.

16. Unless otherwise noted, spending as reported here and in the rest of this study is that by state highway agencies, which typically comes from both federal and state sources. It does not include spending by local governments. Although spending amounts per mile traveled may vary some from year to year for different categories, the share of total spending that goes to each category typically remains about the same.

traffic may be less expensive to expand than roads with more traffic; and on some roads with less traffic, travelers might particularly value even faster transit.

Pavement Quality

Transportation costs can also be affected by pavement quality, which FHWA classifies as very good, good, fair, poor, or very poor. Highways in good condition "give a first class ride and exhibit few, if any, visible signs of surface deterioration," and those in poor condition "have deteriorated to such an extent that they affect the speed of free-flow traffic" and "may have potholes and deep cracks … [as well as] [d]istress … over 50 percent or more of the surface."[17] Pavement in poor or very poor condition, besides slowing travel, may cause higher vehicle repair costs from wear and tear.

Although some observers have described the current state of the highway infrastructure as "crumbling," data suggest that, in general, pavement quality is improving.[18] The fraction of miles traveled on roads of good quality or better has actually improved from a third to nearly half since 1993, and the fraction of miles driven on roads of poor quality has remained unchanged at about 7 percent.[19] However, changes in quality have varied among different kinds of roads. From 1993 to 2008, for urban and rural Interstates and other rural federal-aid highways, the share of pavement in poor condition declined significantly, while for other urban federal-aid highways, that share increased by about half (see Figure 1-8). Because those other urban federal-aid highways carry about as much traffic as the other categories of roads combined, the percentage of miles driven on roads of poor quality has not declined. In 2008, those urban federal-aid highways were roughly seven times more likely to be in poor condition than were rural Interstates.

In 2013, less was spent for major repairs per mile of travel on roads with poorer pavement quality than on those with better pavement:

- Urban federal-aid highways that are not Interstates had the least spending relative to their use and had the worst pavement quality.

17. Federal Highway Administration, *Highway Economic Requirements System—State Version: Technical Report* (August 2005), p. 3–33, www.fhwa.dot.gov/asset/hersst/pubs/tech/tech00.cfm. For more details, see Federal Highway Administration and Federal Transit Administration, *2002 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (2002), www.fhwa.dot.gov/policy/2002cpr/.

18. See, for example, David T. Hartgen, M. Gregory Fields, and Elizabeth San José, "Are Highways Crumbling? State and U.S. Highway Performance Trends, 1989–2008," Policy Study 407 (Reason Foundation, February 2013), http://tinyurl.com/kgfskqb.

19. The fraction of miles traveled on roads of fair quality generally has declined. Federal measures of pavement quality changed in 1993, making comparisons with earlier periods difficult. Pavement quality measures are now changing again to a numerical roughness index, but data by that measure are available for a shorter historical period than the data used here.

- Both categories of urban highways had less capital spending per mile traveled and had worse pavement quality than their rural counterparts.
- Rural federal-aid highways other than Interstates had the highest amount of spending relative to their amount of use.

Average spending per mile of travel for major repairs (adjusted for inflation in highway capital costs) fell over the period for all four types of highway and location combinations examined.

Bridge Quality

Like pavement quality, bridge quality, which is measured in terms of structural deficiency and functional obsolescence, has also improved over time. Bridges with structural deficiencies have significant parts in a deteriorated condition and reduced load-carrying capacity. Bridges that are functionally obsolete do not meet current design standards; for example, a bridge built many years ago may have met design standards at the time in terms of the width of lanes and shoulders but may not meet current safety standards. Neither type of deficiency necessarily indicates that a bridge is unsafe.[20]

Deficiency and obsolescence rates vary for different classes of bridges. Combined, those rates have been consistently higher for urban bridges than for rural ones (see Figure 1-9). Interstate bridges have lower combined rates of deficiency and obsolescence, and other bridges in the Federal-Aid System have higher rates. When those rates are compared with spending based on the number of times bridges are crossed, other rural federal-aid bridges pose the largest mismatch, with lower rates of deficiency and obsolescence and higher rates of spending relative to the others.

Safety

Travel on U.S. highways is safer than it was 30 years ago. Since 1980, fatalities per 100 million vehicle-miles traveled have declined by about two-thirds. By that measure, travel on rural roads is less safe than it is on urban roads (see Figure 1-10). Roads with more limited access are safer, on average, than those with greater access, so Interstates are safer than other federal-aid highways. Other federal-aid highways in rural areas have much higher fatality rates than their urban counterparts.

Spending on safety per mile traveled in rural areas has increased significantly in recent years for other rural federal-aid highways; funds from the federal Highway Safety Improvement Program were allocated to states on the basis of fatalities starting after 2005. Conversely, such spending for urban roads (adjusted for inflation in highway

20. A bridge that is structurally deficient will not also be classified as functionally obsolete; the two categories are constructed to be mutually exclusive. See Federal Highway Administration, "Additional Guidance on 23 CFR 650 D" (September 1992), www.fhwa.dot.gov/bridge/0650dsup.cfm.

capital costs) has declined. At this point, though, changes in law have severed the direct link between safety outcomes and spending for the Highway Safety Improvement Program.

The Contributions of Highway Spending to Productivity

Investment in highways has made a significant positive contribution to economic growth. Studies of the economic returns from public investment in highways have found that the construction of the Interstate System was associated with sizable gains in productivity, especially for industries that use the road system relatively intensively. However, subsequent capital spending on roads has had a much smaller impact. As both the scope and age of the highway system in the United States have increased, greater attention has been given to the potential benefits from repairing and rehabilitating existing roads.

Attention has also turned to particular aspects of the contributions of highway investment. For example, projects focused on highways serving major airports and ports could increase the potential gains from international trade. Similarly, highway construction that facilitates the growth of urban (or metropolitan) economies might promote economic contributions from increased interactions among individuals and businesses (which are sometimes termed agglomeration effects).

Contributions to Overall Productivity and Well-Being

Spending for highway infrastructure can increase economic productivity and well-being by providing benefits to businesses and households. And a more productive economy results in more goods and services for citizens and more resources for further investment and continued growth. Other effects of highway infrastructure spending—such as the short-term economic boost from increased demand for materials and labor—are quite distinct from longer-term gains in productivity and are not addressed in this report.[21]

Highway infrastructure spending can increase the productivity of businesses—defined as the output produced from a given amount of capital, labor, and other inputs—when it reduces freight delivery costs, shortens travel times, or improves reliability. Reduced delivery costs increase the size of the market that businesses can cover profitably, allowing them to exploit economies of scale and reorganize production advantageously. Shortening travel times and improving reliability can enable delivery vehicles to convey raw materials and finished goods through the supply chain more quickly and cheaply, lowering logistics costs.

21. For an assessment of infrastructure spending and other policies as economic stimulus, see the testimony of Douglas W. Elmendorf, Director, Congressional Budget Office, before the Senate Committee on the Budget, *Policies for Increasing Economic Growth and Employment in 2012 and 2013* (November 15, 2011), www.cbo.gov/publication/42717.

Spending on highway infrastructure can also provide benefits to households. Some of those benefits will be reflected in measures of economic output; others may improve households' quality of living. Better infrastructure may lower the costs for employees to commute to work, thereby allowing households to realize a lower cost of living and effectively increasing real incomes. It may also shorten commuting times and improve the reliability of commutes, allowing households to devote more time to other activities, thereby improving the quality of life. Better infrastructure can also improve households' access to health care, education, and other valued services and may provide benefits to households by improving the safety of travel and reducing some of the harmful byproducts of transportation, such as pollution. (However, if better infrastructure results in more driving, society may also experience negative environmental effects.)

Just because highway infrastructure can have those positive economic effects does not necessarily mean that it will. Roads, bridges, or other forms of transportation to sparsely populated places or little used infrastructure may provide few of the benefits, let alone enough to offset the costs.

Estimates of Economic Returns

Researchers have found that highway investment in the United States since the 1950s has produced positive economic returns. Numerous studies have found construction of the Interstate System in the United States, which began in the mid1950s and lasted for several decades, to be strongly associated with productivity growth.[22] Productivity gains from capital spending on highways have been linked most strongly to industries that make more intensive use of highways. As the highway system grew and was able to convey more traffic to more destinations, businesses that used highways were able to produce and deliver their goods at a lower cost. As a result, they became more productive. Because some industries relied on highways more than others did, they stood to benefit more.

However, those returns have diminished over time.[23] Since the early 1970s, when the Interstate System was largely completed, investment in highways has displayed a much

22. Sizable public investment in the nation's highways actually began in the 1920s and continued up to World War II. Some economic historians suggest that spending on highways and other infrastructure contributed to the growth in productivity during the 1930s. See Alexander J. Field, "The Most Technologically Progressive Decade of the Century," *American Economic Review* (September 2003), http://dx.doi.org/10.1257/000282803769206377.

23. In CBO's macroeconomic models, the central estimate of the average return on new federal investment—which includes spending for physical capital such as highways as well as spending for education and for research and development—is about one-half as large as the return on private investment in the economy.

weaker link to productivity, which suggests a decline in the economic returns from that spending.[24]

A recent analysis of 68 studies conducted from 1983 to 2008—addressing not only highway spending but also investment in other kinds of infrastructure—also supports estimates of a decline in economic returns over time.[25]

There are several reasons why the economic returns from highway spending in the United States—both overall and for specific industries—might be expected to decline over time. First, the availability of fast and reliable road transportation nationally, which was provided by the construction of the Interstate System and thousands of miles of other roads, enabled some businesses to become more productive to an extent that could not be replicated by subsequent, and more incremental, additions to the highway system.[26]

Second, research suggests that when new capacity is added to existing roads, the benefits—in terms of reduced congestion and, hence, travel times—diminish over time as the roads become more fully used again. As more traffic uses the new lanes, travel speeds decline toward those that existed before the improvement. A recent study finds that the addition of new lanes is likely to have little effect on congestion within 10 years.[27] Instead, businesses use more trucking, residents drive more, new people move to the area, and traffic is diverted from other roads to the new lanes. Some of the "induced traffic" may represent additional economic activity, and some may represent

24. See M. Ishaq Nadiri and Theofanis P. Mamuneas, "Contribution of Highway Capital to Industry and National Productivity Growth" (prepared by Apogee Research, Inc., for the Federal Highway Administration, Office of Policy Development, September 1996), ntl.bts.gov/lib/5000/5800/5807/growth.pdf (1.0 MB); John G. Fernald, "Roads to Prosperity? Assessing the Link Between Public Capital and Productivity," *American Economic Review*, vol. 89, no. 3 (June 1999), pp. 619–638, http://tinyurl.com/pzg9qtt; and Chad Shirley and Clifford Winston, "Firm Inventory Behavior and the Returns From Highway Infrastructure Investments," *Journal of Urban Economics*, vol. 55, no. 2 (May 2004), pp. 398–415, http://tinyurl.com/o8ommmu.

25. Pedro R.D. Bom and Jenny E. Ligthart, "What Have We Learned From Three Decades of Research on the Productivity of Public Caputal?" *Journal of Economic Surveys*, vol. 28, no. 5 (2014), pp. 889–916, http://dx.doi.org/doi:10.1111/joes.12037.

26. The usefulness of the Interstate System as a means of conveying goods throughout the United States is probably one reason why economic returns from highway investment that are estimated at the national level (which are described in this chapter) exceed the returns estimated on a state-by-state basis. State-level estimates may not fully account for the benefits of interconnectivity nationally. See Charles R. Hulten and Robert M. Schwab, "Public Capital Formation and the Growth of Regional Manufacturing Industries," *National Tax Journal*, vol. 44, no. 4 (December 1991), pp. 121–134, http://tinyurl.com/nlc77wk; and Douglas Holtz-Eakin, "Public Sector Capital and the Productivity Puzzle," *The Review of Economics and Statistics*, vol. 76, no. 1 (February 1994), pp. 12–21, http://tinyurl.com/m6ve5ko.

27. Gilles Duranton and Matthew A. Turner, "The Fundamental Law of Road Congestion: Evidence from U.S. Cities," *American Economic Review,* vol. 101, no. 6 (October 2011), pp. 2616–2652, http://tinyurl.com/khquj8x.

economic activity redistributed from other areas. Indeed, in some cases, investments in state and local roads have simply led to the redistribution of existing economic activity from adjoining regions.[28]

Third, highway spending now serves a number of different goals besides economic productivity, and those other goals tend to lower the economic impact of that spending. For example, highway projects increasingly take into consideration environmental concerns (about air and water pollution and habitat preservation), and more is spent to address those issues. Also, highway construction projects take place in the context of a federally required (and funded) planning process that can increase costs. The Davis-Bacon Act requires federally funded highway projects to comply with prevailing wage standards, although states may have their own relevant wage standards. Similarly, purchases of steel and other building materials are subject to Buy America provisions unless a waiver is granted.[29]

Although the economic returns from highway investment may, on average, be lower today than they were in the past, economically advantageous highway projects are not lacking. FHWA periodically examines some of the benefits (as well as the costs) of different possible improvements to the highway system. In its most recent analysis, FHWA estimated that if only the economically advantageous projects were funded, future spending on highways in an amount at least 25 percent greater than what it was in 2010 (in inflation-adjusted terms) could yield benefits that outweighed its costs.[30]

Recent research into the economic returns from highway spending distinguishes between capital spending to add capacity and spending to restore the performance of existing highways—in other words, to keep the stock of highway capital stable rather than increase it. One study has found that capital depreciation can drag down the growth of output, so in theory, spending to preserve the stock of public capital could be as important as expenditures on new capital.[31] Other research has found differences in

28. See Howard J. Shatz and others, *Highway Infrastructure and the Economy: Implications for Federal Policy* (RAND Corporation, May 2011), www.rand.org/pubs/monographs/MG1049.html.

29. One measure of the cost of such national goals is the rate of exchange that several states offer to local governments for federal transportation grant funds in place of a discounted amount of state funds; that rate is typically 80 to 90 cents on the dollar. Local agencies that participate in the Kansas Department of Transportation's federal funds exchange, for example, can choose from a broader set of projects than the use of federal funds would permit, and they need to comply only with state regulations and not federal ones. See Kansas Department of Transportation, "Federal Fund Exchange Program Guidelines" (November 22, 2010), http://tinyurl.com/oh6j2o9 (PDF, 193 KB). Some states, though, have regulations just as stringent as the federal ones.

30. Federal Highway Administration and Federal Transit Administration, *2013 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*, (2013), www.fhwa.dot.gov/policy/2013cpr.

31. See Pantelis Kalaitzidakis and Sarantis Kalyvitis, "On the Macroeconomic Implications of Maintenance in Public Capital," *Journal of Public Economics*, vol. 88, no. 3-4 (2004), pp. 695–712, http://tinyurl.com/kdac6de.

economic performance among countries depending on how well they maintain their infrastructure, which includes the condition of their highways.[32]

Contributions to International Trade

One noteworthy aspect of the contribution of highways to productivity is their link to international trade. As trade continues to become a larger part of the U.S. economy, the freight capacity of the nation's transportation networks increases in importance—especially their ability to convey freight to and from airports and ports in a timely way. Over the past decade, the real value of goods exported from the United States has grown by 60 percent, while imports have risen by 22 percent; in contrast, real gross domestic product has increased by 16 percent. Much of that international trade crosses the U.S. border at only a handful of points. For example, more than three-quarters of the value of the exported and imported freight that is shipped in containers flows through 10 ports in the United States.[33]

But points that serve as major gateways for the United States' trade with other countries are among the most congested areas in the nation—both currently and, according to forecasts, for the next 25 years.[34] Hence, spending to expand the capacity of the highways that serve the major airports and ports and provide a link to the rail networks that transport the heaviest freight could help the United States take better advantage of the potential gains from the increasingly globalized nature of the production of goods and services.

Contributions From Increased Interactions Among Individuals and Businesses

Although much of the benefit that comes from highway spending accrues to those who use the highway system, some effects are distributed more broadly. For example, highway spending can encourage people or businesses to locate close together in a given area or within an area with low transportation costs. The benefits from that clustering, which go beyond transportation cost savings, depend on whether the proximity involves employees and employers, suppliers and customers, or businesses and people more generally.

Reduced transportation costs for employees may allow better matches between the skills of employees and the needs of employers by lowering the costs for job searches and commuting. For suppliers and customers, the lower costs can allow businesses to

32. See Charles R. Hulten, *Infrastructure Effectiveness as a Determinant of Economic Growth: How Well You Use It May Be More Important Than How Much You Have*, Working Paper 5847 (National Bureau of Economic Research, December 1996, revised December 2005), http://tinyurl.com/pbnqjxg (PDF, 136 KB).

33. See Department of Transportation, *Beyond Traffic: Trends and Choices 2045* (draft, 2015), accessed February 8, 2016, p. 67, www.transportation.gov/BeyondTraffic.

34. See Department of Transportation, *Beyond Traffic: Trends and Choices 2045* (draft, 2015), accessed February 8, 2016, p. 57, www.transportation.gov/BeyondTraffic.

specialize more in terms of the products and services they produce and the materials they use. And for businesses and people otherwise, the exchange of ideas may become easier. In each of those ways, productivity may increase.

Assessing the magnitude of such effects is difficult. Estimates from the United Kingdom suggest that productivity is greater in cities with higher population density.[35] Recent research on the United States suggests that such effects are similar but offsetting between small and large places as well as between places with greater density and ones with lesser density.[36] So increasing such agglomeration effects in one location as a result of transportation improvements may comparably decrease such effects in another location. Further research would aid in understanding the net effects.[37]

Chapter 2: Alternative Approaches

To make federal highway spending more productive for the economy, policymakers could adopt different approaches to managing highways and determining how to allocate funds, including these:

- Charge Drivers: Have the federal government—or allow states or private businesses to—charge drivers directly for their use of more roads than they are currently charged for using.
- Use Benefit-Cost Analysis: Estimate the economic benefits and the costs of spending for particular programs or highways and reallocate spending to programs or projects with benefits for the economy greater than their costs.
- Link Spending to Performance: Link spending more closely to measures of the performance of the highway system that have implications for the economy, such as ones for traffic congestion or road quality—by providing additional funds to states that meet certain standards or penalizing states that do not.

35. U.K. Department for Transport, "Transport, Wider Economic Benefits, and Impacts on GDP" (discussion paper, July 2005), http://tinyurl.com/qasgtkn (PDF, 446 KB).

36. Edward L. Glaeser and Joshua D. Gottlieb, "The Economics of Place-Making Policies," *Brookings Papers on Economic Activity* (Spring 2008), pp. 155–239, http://tinyurl.com/ccu2sgb.

37. To add to the complexity of identifying the impact of highway spending on economic activity through agglomeration effects, over recent decades U.S. population densities changed *within* metropolitan areas, and residential densities changed differently from job densities. The expansion of the highway network between 1960 and 2000 is thought to have reduced the density of city center urban populations while increasing that of suburban populations. The number of jobs in central cities, though, increased while the number of residents there declined. See Nathaniel Baum-Snow, "Changes in Transportation Infrastructure and Commuting Patterns in U.S. Metropolitan Areas, 1960–2000," *American Economic Review,* vol. 100, no. 2 (May 2010), pp. 378–382, http://dx.doi.org/10.1257/aer.100.2.378, and "Did Highways Cause Suburbanization?" *Quarterly Journal of Economics*, vol. 122, no. 2 (May 2007), pp. 775–805, http://dx.doi.org/10.1162/qjec.122.2.775.

The Congress may also choose to allocate highway funds to achieve other objectives, such as boosting economic activity in the short term, increasing employment, and increasing rural access to transportation networks. It may want to avoid too much of a mismatch between the gasoline taxes paid in each state and the federal funds allocated to each state. Or it may wish to direct less of the spending and provide money for the states to pursue their own objectives, perhaps as long as projects are for roads in the National Highway System or others with national significance.

Charging Drivers for Their Use of Highways

For the vast majority of roads in America today, drivers are not specifically charged to use them. Governments instead use a variety of other sources to pay for highways, including taxes on gasoline and general tax revenues. But more widespread charging for the use of roads could increase economic output by allowing highly valued transportation to move more quickly and reliably and could reduce the demand for additional capacity, allowing funding to be spent for other purposes. Pricing could take the form of charges for vehicle-miles traveled, or VMT, congestion charges, or tolls on Interstate highways. For example, to more closely capture the costs of drivers' use of the roads than a fuel tax does, drivers could be charged for each mile that they drive. Drivers could also be charged for using roads when traffic is greatest, or the federal government could allow some of the most heavily used roads—older Interstates, where charges are generally not imposed now—to be converted into toll roads.

Rationale

The method used to pay for highway spending—whether it is charging user fees, assessing taxes that provide general revenues, or using some combination of both—may affect economic growth. Charging user fees such as per-mile charges, congestion charges, or tolls that were structured to substantially reduce traffic congestion could increase growth in the long term—although CBO has not estimated or compared the specific effects (per dollar of revenues raised) that different approaches could have on growth. In contrast, current taxes on motor fuels and diesel provide little incentive related to growth, though they provide some incentive for efficient use of highways. And many taxes that provide general revenues discourage growth.

More widespread charging for the use of roads could increase economic output by giving drivers a financial incentive to switch to other roads and discouraging some travel and reducing congestion. Highly valued freight would thus move more quickly and more reliably, reducing delivery costs for producers as well as inventory costs for retailers, thereby freeing up resources to accommodate additional demand by consumers or allow for additional investment by businesses. Similarly, shorter commutes could translate to a boost in the supply of labor in the economy by allowing workers to spend more time on the job or encouraging some people to take a job at a more distant location. Charging for the use of roads could allow for more travel overall by reducing congestion, which occurs in many urban areas during peak periods. That

counterintuitive effect occurs because user fees, by diverting even a relatively small number of users to other roads or to another time of day on the same road, can cause speeds to rise sharply, increasing the total number of vehicles that can pass through a bottleneck during peak periods.[38]

In addition, charging drivers would raise revenues, which could be used to make repairs, expand capacity, substantially renovate the Interstate System, or pursue other purposes. Those revenues would also indicate how much drivers valued using a highway at the places and times where the tolls were collected. The extent to which people continued to use a highway for trips for which the benefits to them exceeded the charges would help identify the economic value of investments in highways in those locations and help set priorities for future improvements.

Despite its economic advantages, the use of pricing for highways faces technological hurdles. Although the costs of charging drivers on roads are declining with improvements in technology, they remain higher than those for collecting revenues via the gasoline tax. In the past, the costs of implementing a system of charges for drivers—particularly the costs of users' time for slowing and queuing at tollbooths—would clearly have outweighed the potential benefits from more efficient use of highways. Now, new technologies for electronic metering (determining what users owe) and billing are bringing costs down to a level at which per-mile charges might soon be a practical option. Still, the operational costs of metering, the collection of payments, and enforcement are higher than are the costs associated with the current gasoline tax, and metering can have high start-up costs to get equipment in place.

Beyond the technical considerations, one concern is about privacy, because the process of assessing charges that vary by time and place could give the government access to specific information about how individual vehicles are used. In addition, charging drivers could place a proportionately greater burden on low-income households than the current gasoline tax does.[39] Another concern is that highway users could resent paying tolls if they believed that they had already paid for roads through gasoline taxes over the years. And another is that pricing authority spread across too many jurisdictions could impede interstate commerce: If multiple jurisdictions charged high prices to maximize their profitability, the result could be inefficiently low use of

38. See Federal Highway Administration, *Congestion Pricing—A Primer: Overview* (October 2008), p. 9, http://go.usa.gov/37EmA.

39. See Government Accountability Office, *Traffic Congestion: Road Pricing Can Help Reduce Congestion, but Equity Concerns May Grow*, GAO-12-119 (January 2012), www.gao.gov/products/GAO-12-119. Some analysts have suggested that the burden to low-income households could be addressed in different ways, such as by periodically offering them a rebate of a portion of the fees collected.

roads.[40] Indeed, establishing—and maintaining—charges leading to efficient use may well involve a considerable amount of trial and error, during which traffic may be either too low or too high. Eventually, however, setting prices for the use of highly trafficked and congested roads should result in a more efficient outcome than if those roads remained freely accessible.

Steps That Policymakers Could Take

The Congress could incorporate more direct pricing of the use of roads in a number of ways, including the following:

- Implementing VMT charges;
- Facilitating more congestion pricing; and
- Allowing tolling on additional existing Interstates.

Implementing VMT Charges. Estimates from several sources indicate that most highway users currently pay much less than the full external cost of their travel.[41] Most of the costs of using a highway, including pavement damage, congestion, accidents, and noise, are tied more closely to the number of miles traveled than to the amount of fuel consumed. Therefore, fuel taxes do not provide a strong incentive for people to avoid overusing highways—that is, to forgo trips for which the costs to themselves and others exceed the benefits. VMT charges that varied for different types of passenger and freight vehicles and by time and place of travel would better align with the costs imposed by driving. Such charges would also provide much more information about how drivers valued their use of those roads, which could inform spending decisions, though charges that varied in more ways would tend to be more costly to administer and more likely to raise concerns about privacy.

Facilitating More Congestion Pricing. If highway users were charged fees that specifically reflected the costs of congestion, leaving aside the other external costs of

40. For a historical example of that effect, see Edi Karni and Subir K. Chakrabarti, "Political Structure, Taxes, and Trade," *Journal of Public Economics*, vol. 64, no. 2 (May 1997), pp. 241–258, http://tinyurl.com/lq3a4cc.

41. External costs are costs that affect people other than the highway user. Even in places where states or private operators charge tolls, drivers are typically charged only part of the costs that their driving entails for society. Efficient pricing would include not only congestion pricing but also charges to cover other external costs such as pollution and noise. If drivers paid for the full cost of their driving, the demand for highway capacity would be even less than it would be with congestion pricing. See Congressional Budget Office, *Alternative Approaches to Funding Highways* (March 2011), www.cbo.gov/publication/22059; and David Austin, *Pricing Freight Transport to Account for External Costs*, Working Paper 2015-03 (Congressional Budget Office, March 2015), www.cbo.gov/publication/50049.

driving, the demand for future capacity would be substantially lower.[42] According to the Federal Highway Administration, widespread use of congestion pricing would reduce the amount of capital investment needed to fully meet demand by about 30 percent.[43] Under the Moving Ahead for Progress in the 21st Century Act, the Section 129 General Toll Program was changed to allow states to charge for the use of newly constructed federal-aid highways, bridges, and tunnels or reconstructed facilities (as long as reconstruction of an Interstate does not reduce the number of toll-free lanes). Lawmakers could facilitate congestion pricing further by allowing pricing on more existing toll-free lanes without substantial reconstruction of those facilities.

Allowing States or Private Businesses to Charge Drivers on Additional Existing Interstates. One way that lawmakers could reduce federal barriers to greater implementation of pricing is to reduce restrictions on tolling on existing Interstate highways. Current law permits federal aid to be used to build or maintain toll roads, add toll lanes to existing roads, or convert existing roads into toll roads. However, with some exceptions, federal aid cannot be used to convert existing Interstate highways into toll roads. Currently, only about 7 percent of the Interstate System is composed of highways with tolls.[44] Interstates, which are typically the most heavily used roads, would yield the greatest benefits from such pricing. The revenues gained from tolling on Interstates could be used to make repairs, expand capacity, or substantially renovate the Interstate System.[45] Or, of course, lawmakers could allow those revenues to be used for other purposes. An alternative approach would be to encourage private companies to own or operate Interstate highways, which would allow them to charge tolls or set prices that corresponded with the amount of congestion at a given time (see Box 2-1).

Allocating Spending on the Basis of Benefits and Costs

An alternative to using pricing to inform highway spending decisions is to directly analyze the benefits and costs of those decisions. Although performing such analysis can be costly, a number of recent studies have called for more rigorous selection of

42. For a comprehensive discussion of the benefits and challenges of congestion pricing, including options for its design and implementation for highways, see Congressional Budget Office, *Using Pricing to Reduce Traffic Congestion* (March 2009), www.cbo.gov/publication/20241.

43. Federal Highway Administration and Federal Transit Administration, *2010 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (2010), Chapter 9, www.fhwa.dot.gov/policy/2010cpr. For a complementary study, which argues that the need to expand capacity could be met with better management of highways through pricing and other schemes, see Richard Dobbs and others, *Infrastructure Productivity: How to Save $1 Trillion a Year* (McKinsey Global Institute, January 2013), http://tinyurl.com/bx5ztn5.

44. Federal Highway Administration, "Toll Facilities in the United States" (accessed on March 6, 2015), www.fhwa.dot.gov/policyinformation/tollpage/.

45. For a detailed proposal to renovate the Interstate System using toll revenues, see Robert W. Poole, Jr., *Interstate 2.0: Modernizing the Interstate Highway System via Toll Finance* (Reason Foundation, September 2013), http://tinyurl.com/klw54eq.

transportation projects.[46] If the benefits and costs of a wide range of projects were examined and spending was prioritized accordingly, the projects with the highest net economic benefits could yield most of the possible benefits for a fraction of the cost.

Every two years, the Federal Highway Administration assesses the conditions and performance of the nation's highways, bridges, and transit systems.[47] As part of that process, FHWA examines the benefits and costs of different improvements and estimates the spending that would be necessary to meet various goals for the system (see Box 2-2). The agency uses a representative sample of more than 100,000 sections of highways. For various kinds of projects on those sections, it then estimates benefit-cost ratios—which can vary widely.

FHWA broadly characterizes the spending for projects as being either for expansion or for major repairs, depending, respectively, on whether the spending adds new capacity to the system (by adding a new lane, for instance) or extends the useful life of existing highways or bridges (by reconstructing or resurfacing, for instance). Although FHWA includes accident costs in its benefit-cost analysis, it does not separately analyze spending for safety improvements.

FHWA uses the results of its benefit-cost analyses to construct scenarios for spending. One of the key features of the scenarios is that improvements are ranked on the basis of their benefit-cost ratios, so that projects with the highest ratios are selected first and projects with lower ratios are selected thereafter. The scenarios then involve selecting projects until spending equals a specific dollar amount (such as the current level), selecting projects in order to maintain the system's performance, or selecting all projects with benefit-cost ratios exceeding a certain level. Thus, each scenario arrays

46. Statements such as these are representative: "Transportation infrastructure investment programs are not all equally effective at creating jobs or economic growth," and "[The] net effect on workers and the economy as a whole will be positive . . . only if government transportation investments are rigorously selected to meet productivity criteria" (Douglas Holtz-Eakin and Martin Wachs, *Strengthening Connections Between Transportation Investments and Economic Growth*" [Bipartisan Policy Center, January 2011], pp. 1, 10, http://tinyurl.com/za8lap9; "Assessing benefits and costs is critical in determining whether certain transportation investments will grow the economy, improve productivity, and support national goals" (Bill Bradley, Tom Ridge, and David Walker, *Road to Recovery: Transforming America's Transportation* [Carnegie Endowment for International Peace, 2011], p. 60, http://tinyurl.com/nk2waje; "Transportation needs to be evaluated according to its impact on travel costs" (Edward L. Glaeser and Joshua D. Gottlieb, "The Economics of Place-Making Policies," *Brookings Papers on Economic Activity* [Spring 2008], p. 196, http://tinyurl.com/ccu2sgb; and "Federal funds should be directed to projects where there is a clear demonstration that they will return value for money …" (Robert Puentes, *A Bridge to Somewhere: Rethinking American Transportation for the 21st Century* [Brookings Institution Press, 2008], p. 8, http://tinyurl.com/kp8ff7x.

47. The most recent assessment published, from which the results reported here are drawn, is Federal Highway Administration and Federal Transit Administration, *2013 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (2013), www.fhwa.dot.gov/policy/2013cpr.

projects with significant benefits relative to their costs but results in different amounts of spending.

Under a scenario using the amount of spending in 2010 (the most recent year for which the necessary detailed data are available) but allocating it to projects with benefits exceeding costs by the greatest percentages, broad spending patterns would, on the basis of FHWA's estimates, change little in terms of purpose but substantially by location. That scenario would suggest decreasing spending on expansion by 2 percent and increasing spending on major repairs by 1 percent. However, by that scenario, spending substantially more in urban areas (43 percent more for Interstates and 22 percent more for other federal-aid roads) and less in rural areas (46 percent less for Interstates and 43 percent less for other federal-aid roads) would improve the system's performance.

In particular, public spending on highways would generate greater benefits relative to its costs if:

- A larger share went to expanding roads in urban areas, particularly Interstates;
- A somewhat larger share was allocated to performing major repairs of urban highways—in particular, rehabilitating roads other than Interstates in urban areas; and
- A larger share went to improving bridges in rural areas in the Interstate System.

Of the spending for expansion under that scenario, more of it would go toward Interstates in urban areas (a 140 percent increase) and less to rural roads (an 86 percent decrease for other federal-aid roads in rural areas) (see Figure 2-1). Of the spending for major repairs, more would occur in urban areas (51 percent more for other federal-aid roads) and less in rural areas (65 percent less for Interstates). Of the spending for major repairs of bridges, more would occur for those in the Interstate System in rural areas (30 percent more) and less for those in the Interstate System in urban areas (13 percent less). More would also be spent for bridges in urban areas that are not in the Interstate System, which have higher rates of deficiency and obsolescence than other categories of bridges.

Results of the benefit-cost analysis that suggest a slight shift in spending away from expansion and toward repairs are reinforced by two further considerations. The results reflect a projected 1.4 percent average annual increase in the amount of driving based on a 15-year historical average of growth in vehicle-miles traveled. But vehicle-miles traveled in 2015 for the first time surpassed what they were in 2007, before the recession. To the extent that economic conditions, demographic trends, or other societal changes cause the demand for highway travel to be lower in the future than the

15-year historical growth rate would suggest, FHWA's analysis would suggest a larger proportion of spending for projects devoted to major repairs.[48]

The results also reflect federal spending authorized under the American Recovery and Reinvestment Act of 2009. That spending was required to be obligated in a shorter period of time than usual to meet the purposes of the legislation. As a result, a greater proportion was devoted to repair projects than was the case in prior years, because those kinds of projects tend to require less planning and can be completed sooner. If spending returns to a higher, more typical share of spending for highway expansion, FHWA's analysis would suggest that a larger proportion of current spending be reallocated to projects involving major repairs.

Rationale

Establishing priorities on the basis of benefit-cost analysis could allow the same amount of spending to be more productive, with a larger impact on the economy, or could allow less spending to bring about a degree of economic activity that is similar to what currently occurs.

Indeed, if the federal government and states set priorities to favor the projects with the highest benefits relative to their costs, most of the current benefits from improvements to the highway system could be achieved with less spending. For example, on the basis of data provided by FHWA, pursuing a series of projects with a benefit-cost ratio of at least 2.4 would deliver 84 percent of the estimated benefits for only 52 percent of the costs when compared with implementing all projects with benefits that exceed costs (see Figure 2-2). Spending on projects with a lower benefit-cost threshold of 1.5 would deliver 94 percent of the estimated benefits for only 76 percent of the total costs.

An econometric analysis of spending and congestion costs provides another measure of the kinds of benefits that could result from elevating the role of benefit-cost analysis in selecting highway programs and projects.[49] According to that 2006 study, costs arising from traffic congestion would be reduced by $8.6 billion (in 2014 dollars) if highway spending was distributed among states in order to minimize such costs. Beyond those savings, reductions in highway users' operating and accident costs would represent additional benefits. If spending was prioritized both among and within states to minimize congestion, the reductions in congestion costs would be almost twice as

48. FHWA's estimates that use a higher average growth rate based on state forecasts would instead suggest shifting spending toward expansion and away from major repairs. However, such estimates in the past several FHWA reports have proved to be too high. See Eric Sundquist, "U.S. DOT Highway Travel Demand Estimates Continue to Overshoot Reality" (State Smart Transportation Initiative, March 10, 2014), http://tinyurl.com/ntpnv83.

49. Clifford Winston and Ashley Langer, "The Effect of Government Highway Spending on Road Users' Congestion Costs," *Journal of Urban Economics*, vol. 60, no. 3 (November 2006), pp. 463–483, http://tinyurl.com/mysxnmo.

large, at $16.1 billion, or roughly a third of the value of federal capital spending on highways.

Steps That Policymakers Could Take

The Congress could change the way that it allocates highway spending to states and guides them in its use. Policies that could increase economic returns on that spending include these:

- Allocating more funding to programs that explicitly consider the net economic effects of their spending;
- Allocating more funding to programs that support the parts of the highway system yielding greater net economic benefits; and
- Promoting the use of benefit-cost analysis at the state and local levels.

Such changes would generally entail a greater degree of federal involvement in state and local decisions, reducing state and local governments' discretion in selecting highway projects.

Allocating More Funding to Programs That Consider Economic Effects. Shifting funds to programs that provide incentives for projects with greater economic returns—rather than continuing the current allocation among states or allocating funds on a geographic or modal basis—could make those funds more economically productive. Some efforts have already been made to implement that approach:

- The Transportation Investment Generating Economic Recovery (TIGER) program, established in 2009 under the American Recovery and Reinvestment Act to provide competitive grants to fund infrastructure projects, has received about $5 billion to date. The program includes benefit-cost analysis as a basis for evaluating grant applications, although some observers have raised concerns that many of the analyses submitted are of little use in the evaluation process and that in some instances the results of those analyses do not appear to bear on the final project selection decisions.[50]
- For the loan and loan guarantee program established by the Transportation Infrastructure Finance and Innovation Act, economic benefits were included as one of a number of evaluation criteria for projects, but MAP-21 eliminated that criterion (as well as some others).

50. See Government Accountability Office, *Surface Transportation: Department of Transportation Should Measure the Overall Performance and Outcomes of the TIGER Discretionary Grant Program*, GAO-14-766 (September 2014), www.gao.gov/products/GAO-14-766.

- The Nationally Significant Freight and Highway Projects program under the FAST Act is meant to generate national economic benefits as part of a discretionary competitive grant program. However, selection criteria for the program will ultimately be decided by the Secretary of Transportation.

Allocating More Funding to Programs That Support Parts of the Highway System Yielding Greater Net Benefits. As one approach, policymakers could use the results of FHWA's benefit-cost analyses to more explicitly guide spending for different programs, allocating more funding to programs that support the parts of the highway system that would be expected to produce greater net benefits. To the extent that such a change shifted spending among different projects in different locations, it would involve trade-offs. Doing so might increase the total benefits from highway spending but would reduce state and local governments' discretion or increase their responsibility for providing highway funding.

Another strategy would be to adjust federal matching rates to emphasize programs that provide greater economic returns. MAP-21 adopted that approach to some extent by increasing the federal share of spending on Interstates to 90 percent. However, a drawback to such an approach is that many states spend more on highways than is required for matching funds, so increasing the federal contribution to a particular project could just free up (or displace) funds the state had already dedicated to it and enable the state to spend that money on other projects. Analyses of highway spending by different levels of government over time suggest that federal spending on highways displaced some funding that states would have provided in the absence of federal involvement.[51] Thus, changing the federal matching rate might not alter either the total amount of states' spending or the likelihood that they would undertake federally desired programs.

Promoting the Use of Benefit-Cost Analysis at the State and Local Levels. Economic considerations appear to play a limited role in state and local governments' selection of projects, and the type of formal analysis undertaken can vary greatly. State governments may themselves allocate their spending of federal highway grants for a variety of purposes. A survey by the Government Accountability Office (GAO) in 2010 found that economic analysis of projects was of "great or very great importance" for only about 20 percent of states' departments of transportation.[52] An earlier GAO survey, in 2004, of states' departments of transportation and transit agencies found that fewer than half used economic analysis on a regular basis and that when they did,

51. See Government Accountability Office, *Federal-Aid Highways: Trends, Effects on State Spending, and Options for Future Program Design*, GAO-04-802 (August 2004), www.gao.gov/products/GAO-04-802.

52. Government Accountability Office, *Statewide Transportation Planning: Opportunities Exist to Transition to Performance-Based Planning and Federal Oversight*, GAO-11-77 (December 2010), p. 18, www.gao.gov/products/GAO-11-77.

they had considerable flexibility to use different models without being subject to minimum standards. Furthermore, that survey found that "although the costs and benefits of projects were almost always considered in some way, formal analyses such as benefit-cost analysis were not usually conducted when considering project alternatives, and they were completed less frequently for proposed highway projects than transit projects."[53] Other studies have also found that measuring the impact of transportation spending on jobs and economic activity is done infrequently.[54] Roughly 60 percent of states' departments of transportation indicated that political support and public opinion were factors of "great or very great importance" in decisions about highway projects. In fact, research suggests that building more roads is sometimes the approach used to benefit areas with low population densities or poor or worsening economic conditions, instead of maximizing long-term economic growth.[55]

Reviewers of grant requests under the TIGER program have found common errors and considerable variance in the quality of applicants' benefit-cost analyses.[56] In the past few years, the U.S. Department of Transportation has provided significant guidance to states and localities performing benefit-cost analysis for the TIGER program.[57] Although the quality of submissions has improved somewhat, as further assistance the federal government could offer staff expertise to states and localities desiring to perform benefit-cost analysis. (One question that would arise in such benefit-cost analysis is whether states should capture only state-level effects or national ones as well.) Or the federal government could establish standards for the use of benefit-cost analysis, although any such standards would come at the expense of state and local control.

53. Government Accountability Office, *Highway and Transit Investments: Options for Improving Information on Projects' Benefits and Costs and Increasing Accountability for Results*, GAO-05-172 (June 2005), p. 23, www.gao.gov/products/GAO-05-172.

54. Pew Center on the States and the Rockefeller Foundation, *Measuring Transportation Investments: The Road to Results* (May 2011), http://tinyurl.com/hme3zha.

55. See Gilles Duranton and Matthew A. Turner, "Urban Growth and Transportation," *The Review of Economic Studies* vol. 79, no. 4 (October 2012), pp. 1407–1440, http://dx.doi.org/10.1093/restud/rds010; and Edward L. Glaeser and Joshua D. Gottlieb, "The Economics of Place-Making Policies," *Brookings Papers on Economic Activity* (Spring 2008), pp. 155–239, http://tinyurl.com/ccu2sgb.

56. Michael J. Markow, *Engineering Economic Analysis Practices for Highway Investment*, NCHRP Synthesis Report 424 (Transportation Research Board, 2012), p. 22, www.trb.org/Publications/Blurbs/167096.aspx.

57. Notice of Funding Availability for the Department of Transportation's National Infrastructure Investments Under the Transportation, Housing and Urban Development, and Related Agencies Appropriations Act for 2010, 75 Fed. Reg. 30460 (June 1, 2010). See also Department of Transportation, *TIGER Benefit-Cost Analysis (BCA) Resource Guide* (accessed on March 6, 2015), http://go.usa.gov/DYtm.

Linking Spending More Closely to Performance Measures

Highway spending contributes to economic growth by improving access to desired destinations and improving the cost, speed, and reliability of travel. Those factors are affected by important features of highways' performance such as congestion, the quality of roads and bridges, and safety. Taking those aspects of performance into account more and considering how spending would affect them could improve funding decisions.

Rationale

Using performance measures to help allocate highway spending would provide incentives for states to increase the effect that their spending has on those measures. So far, the use of such measures has been limited, although states are now required to develop performance-based asset management plans and ultimately achieve performance measure targets (discussed below). GAO examined states' use of performance measures before they were required and their importance for the planning process at states' departments of transportation. According to GAO, "Only a select few states have made significant attempts to integrate performance measures into their statewide planning process to inform investment decisions."[58]

States have reported some such measures playing more of a role than others. About half of all states' departments of transportation identified traffic congestion as a measure that was very important for the planning process, but it was judged to be important less often than other measures of performance. Perhaps as a result, the difference between actual spending per vehicle-mile traveled and spending as identified by FHWA's benefit-cost analysis has been greatest in percentage terms for the category of spending to expand capacity. According to GAO's survey results, about 80 percent of states' departments of transportation found performance metrics gauging the condition of pavement to be important. About 85 percent found such metrics gauging the condition of bridges to be important, and bridge spending in different areas matched the results of FHWA's benefit-cost analysis most closely. Once states and the federal government agree on state-specific targets to address deficiencies in bridges, states must spend a set amount of funds on bridge rehabilitation if structurally deficient bridges exceed a certain threshold for three years in a row.

On the basis of its reviews, GAO has recommended greater use of performance measures, and an FHWA report reviewing international practices suggested linking high-level transportation goals to performance measures and targets at the state and local levels.[59]

58. Government Accountability Office, *Statewide Transportation Planning: Opportunities Exist to Transition to Performance-Based Planning and Federal Oversight*, GAO-11-77 (December 2010), pp. 40-41, www.gao.gov/products/GAO-11-77.

59. Federal Highway Administration, *Linking Transportation Performance and Accountability,* FHWA-PL-10-011 (April 2010), www.international.fhwa.dot.gov/pubs/pl10011/.

However, relying on performance measures may lead to less economically productive spending than using pricing or benefit-cost analysis. Although benefit-cost analysis also uses performance measures, it attributes an economic value to the benefits that result from improving them and compares the benefits to the costs. Performance measures do not carry information about the relative costs required to improve the performance of the highway system or the valuation of the benefits that accrue from those improvements. Nor do they indicate how much funding should be directed toward projects to add capacity versus projects making major repairs or how much should be spent on particular types of projects within each of those broad categories. Focusing on performance measures thus does not consider the value of projects' benefits and costs.

As a result, using performance measures to guide spending can be simpler than performing a series of benefit-cost analyses, but it does not always yield the same results. In some instances, benefit-cost analysis would suggest constraining spending for parts of the highway system with poorer performance, whereas needing to meet a performance measure could suggest the opposite—increasing spending for those parts of the highway system.

To help assess some of the potential for differences between how spending could be directed using different approaches, CBO calculated amounts using some simple performance measures and compared them with the amounts from FHWA's benefit-cost analysis. To determine the comparable performance-based amounts, CBO began by taking the amount that was spent on major repairs for highways in 2010 and calculating average spending per vehicle-mile traveled, which was 1.5 cents (in 2014 dollars). CBO then calculated spending for the different types of highways on the basis of the share of roads with poor pavement quality. Among federal-aid highways in urban areas other than Interstates, for instance, 14 percent have poor pavement quality, and highways with poor pavement quality account for 9 percent of all highways. So, by that simple measure, spending per vehicle-mile traveled on federal-aid highways in urban areas other than Interstates—based on pavement quality—would be about 2.4 cents (1.5 cents multiplied by 0.14 divided by 0.09, using round numbers) (see the top panel of Figure 2-3). According to that measure, more spending would be directed toward such roads than the amount suggested by FHWA's benefit-cost analysis, which is 1.7 cents. The reverse would occur for other categories of roads with lower percentages of poor quality pavement: The performance-based measure would suggest less spending than the benefit-cost analysis.

CBO did the same calculations on the basis of the number of bridge crossings and rates of bridge deficiencies and reached similar conclusions about spending to repair bridges: Bridges in categories with higher percentages of deficiency (in this case, both urban Interstate bridges and other federal-aid bridges in urban areas) would be allotted more spending than the amount suggested by FHWA's benefit-cost analysis, and those with lower percentages of deficiency, less spending.

The relationships between spending amounts based on those simple performance-based measures and actual amounts of spending are comparable to the relationships between spending amounts based on the performance-based measures and the amounts from FHWA's benefit-cost analysis: The performance measures typically suggest spending more than what has been spent for the types of roads and bridges with poorer performance and less for the types of roads and bridges with better performance. For example, the 2.4 cents per vehicle-mile traveled in 2010 suggested by the performance measure for the type of road with the poorest pavement performance—federal-aid highways in urban areas other than Interstates—is higher than the actual amount spent that year, which was 0.8 cents.

In practice, using more standardized performance measures across states and areas would be simpler to administer. Alternatively, allowing for more differences among states in the measures used and the performance needed to meet standards would allow greater consideration of the differences in the benefits and costs of improvements or other considerations, but at the expense of added complexity.

Steps That Policymakers Could Take

Performance measures and target levels for those measures will be determined individually by the states in conjunction with the Department of Transportation. If a state fails to meet one of its designated performance measures within a specified number of years of the measure's implementation (a period of two years or more, depending on the performance measure), the state will be required to spend a certain minimum amount to improve its performance in that area.

A challenge for designing and implementing programs that use performance measures is to create incentives for states to achieve their targets without penalizing those states whose roads are already performing at high levels. If the current approach results in targets that are controversial or ineffective, one alternative would be to use the results from FHWA's benefit-cost analysis to inform the target levels for performance measures. If the financial ramifications of failing to meet a performance target do not appear to adequately motivate states or threaten to impose undue burdens on states, incentives to attain performance targets could take the form of additional funds or additional flexibility in using existing funds.[60]

60. For a discussion of an incentive bonus program based on state highway system performance, see Bipartisan Policy Center, National Transportation Policy Project, *Performance Driven: Achieving Wiser Investment in Transportation* (June 2011), http://tinyurl.com/l9ozd3x.

About This Document

This report was prepared in response to a request by the former Chairman of the Senate Finance Committee, Senator Baucus. In keeping with the Congressional Budget Office's mandate to provide objective, impartial analysis, the report makes no recommendations.

Chad Shirley and Nathan Musick prepared the study with guidance from Joseph Kile. Perry Beider, T.J. McGrath, Sarah Puro, and Robert Shackleton—all of CBO—provided helpful comments on the report. Sujit CanagaRetna of the Council of State Governments, Kevin DeGood of the Center for American Progress, Rocky Moretti of The Road Information Program, Martin Wachs of the RAND Corporation, and Clifford Winston of the Brookings Institution did the same. The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.

Jeffrey Kling and Robert Sunshine reviewed the report. John Skeen edited it, and Maureen Costantino and Jeanine Rees prepared it for publication. An electronic version is available on CBO's website (www.cbo.gov/publication/50150).

Keith Hall Director

February 2016

Table 1-1. Return to Reference

Public Spending on Highways, by Level of Government and Purpose, 2014

Billions of Dollars

	Capital	Operation and Maintenance	Total
Federal	44	3	46
State and Local	48	70	118
Total	**92**	**73**	**165**

Source: Congressional Budget Office based on data from the Census Bureau and the Office of Management and Budget.

Note: For further details, see Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014* (March 2015), www.cbo.gov/publication/49910.

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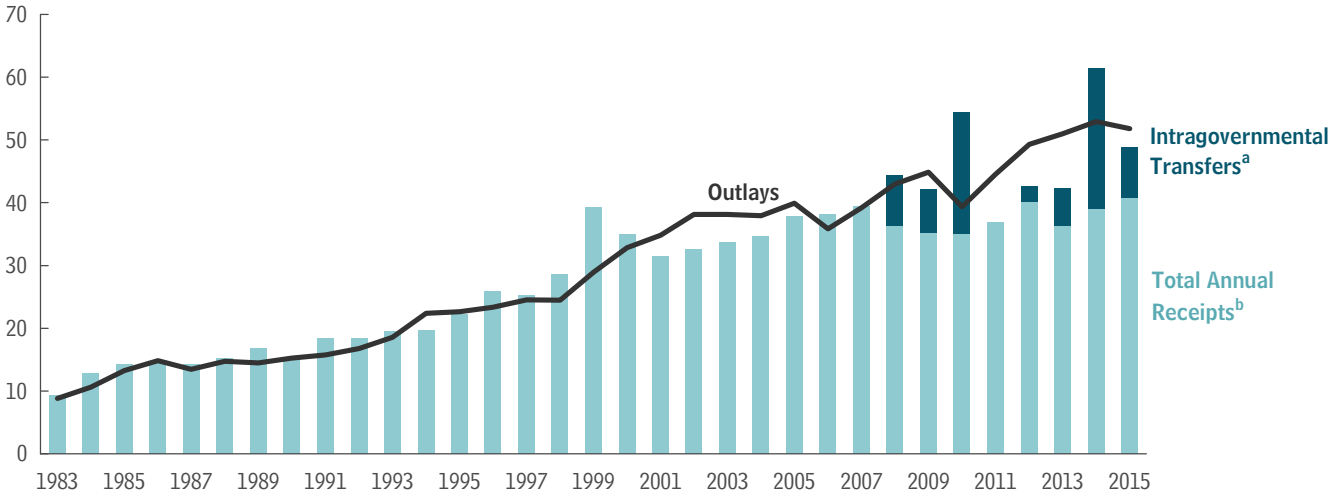
Figure 1-1. Return to Reference

The Highway Trust Fund's Outlays, Receipts, and Transfers



Source: Congressional Budget Office based on data from the Federal Highway Administration.

Notes: Beginning in 2006, annual outlays reflect a change in accounting treatment for certain outlays from the Highway Trust Fund's mass transit account. That change slowed the rate of spending from that account and thus reduced the amounts recorded for outlays from the trust fund relative to amounts in earlier years; certain outlays that had been recorded in a single year are now spread across several years.

In 2010, the trust fund saw a significant decrease in outlays because states spent funds from the general fund of the Treasury that were appropriated in the American Recovery and Reinvestment Act of 2009 (ARRA). Under that law, projects that were otherwise eligible for funding from the Highway Trust Fund were eligible for federal funding provided in ARRA that did not require state or local governments to contribute their own funds.

a. Intragovernmental transfers represent transfers of funds to the Highway Trust Fund from other governmental budgetary accounts, mostly from the Treasury's general fund.

b. Total annual receipts include excise tax revenues (primarily taxes on motor fuels) and interest earned on balances.

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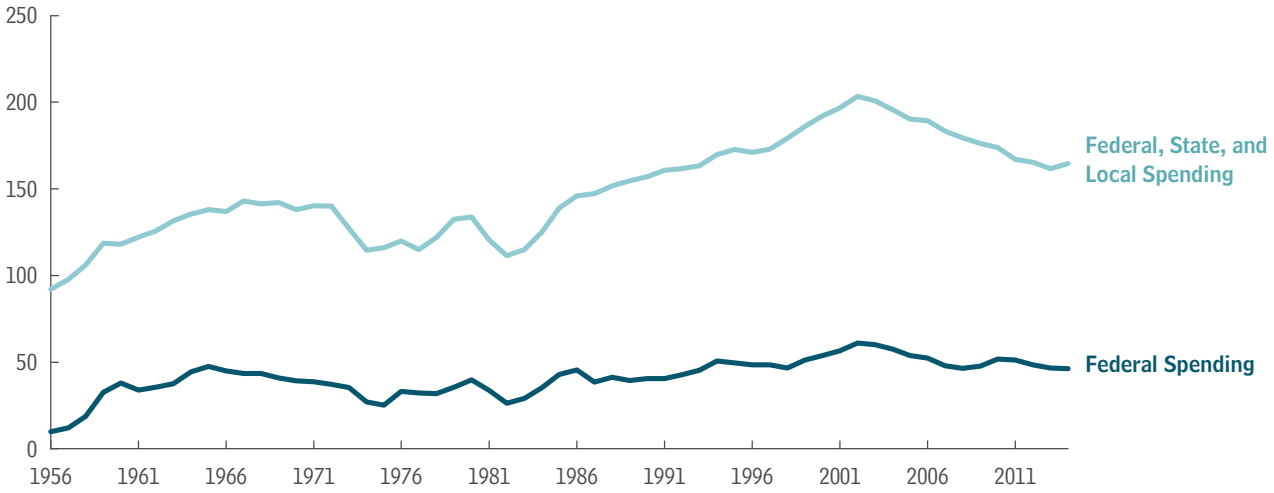
Figure 1-2. Return to Reference

Spending for Highways



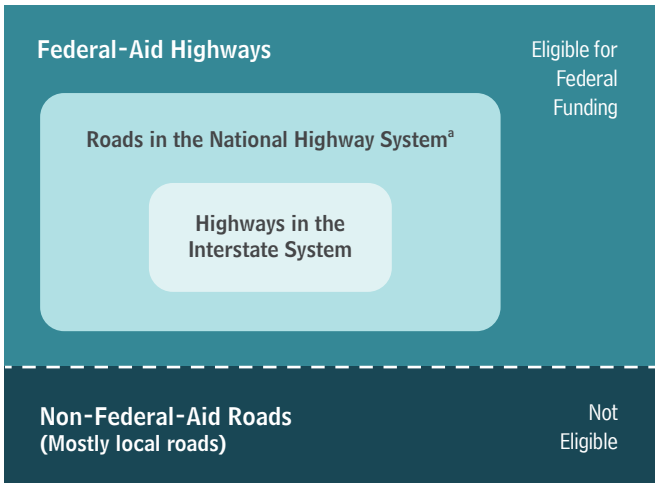
Source: Congressional Budget Office based on data from the Office of Management and Budget, the Census Bureau, and the Bureau of Economic Analysis.

Notes: For 2013 and 2014, state and local spending was estimated by relying on changes in spending as reported in monthly surveys of highway construction projects. For further details, see Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014* (March 2015), www.cbo.gov/publication/49910.

Dollar amounts are adjusted to remove the effects of inflation using price indexes for government spending that measure the prices of materials and other inputs used to build and repair highways.

Figure 1-3. Return to Reference

Highways' Eligibility for Federal Funding



Source: Congressional Budget Office.

a. The National Highway System is composed of Interstates and other roads serving significant population centers, border crossings, transportation facilities, or travel destinations.

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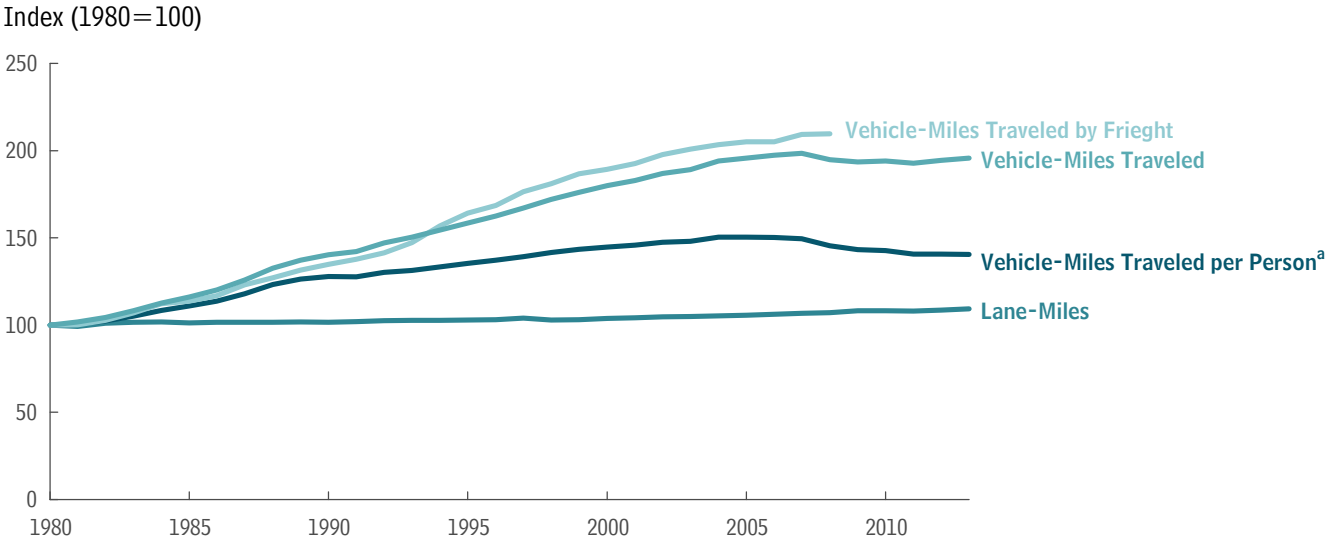
Figure 1-4. Return to Reference

Changes in Highway Use and Lane-Miles



Source: Congressional Budget Office based on data from the Federal Highway Administration, the Bureau of Transportation Statistics, and the Census Bureau.

Note: Because of a change in the Federal Highway Administration's methodology, data for freight vehicle-miles traveled after 2008 are not comparable with the information from earlier periods, so they are not separately reported in this figure. Data for vehicle-miles traveled and vehicle-miles traveled per person include both passenger and freight vehicles.

a. The amounts shown are based on the population residing in the United States.

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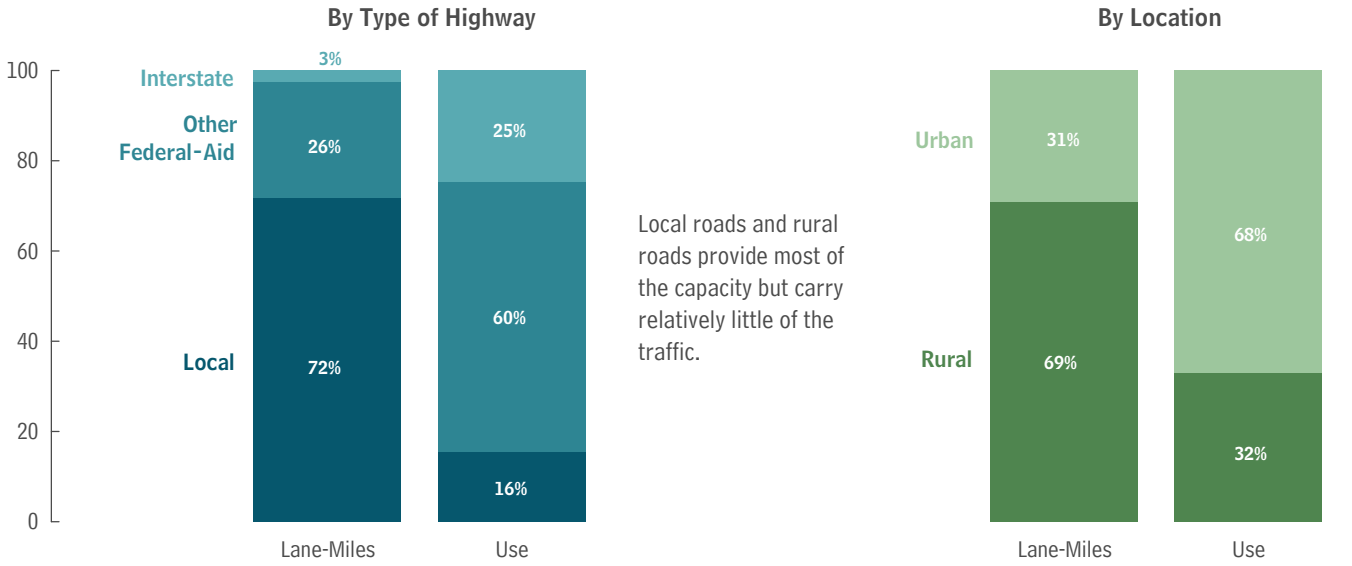
Figure 1-5. Return to Reference

Highway Use and Lane-Miles, by Type of Highway and Location, 2013



Source: Congressional Budget Office based on data from the Federal Highway Administration.

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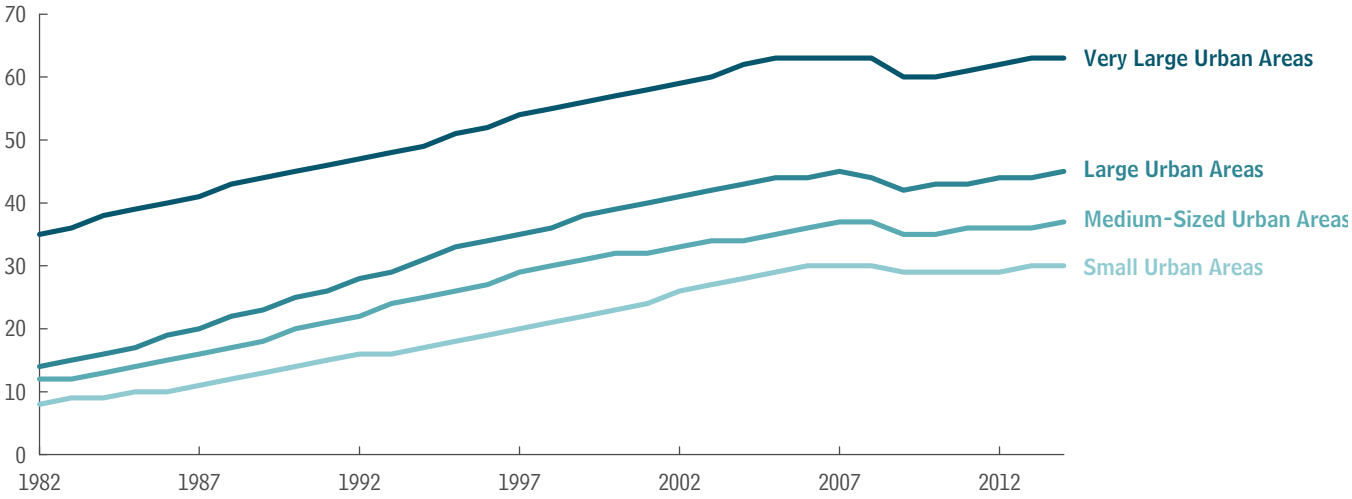
Figure 1-6. Return to Reference

Annual Hours of Delay per Auto Commuter in Urban Areas, by Size of Area



Source: Congressional Budget Office based on data from the Texas Transportation Institute.

Note: Among urban areas, ones that are very large have a population of more than 3 million people; large, between 1 million and 3 million; medium-sized, between 500,000 and 1 million; and small, fewer than 500,000.

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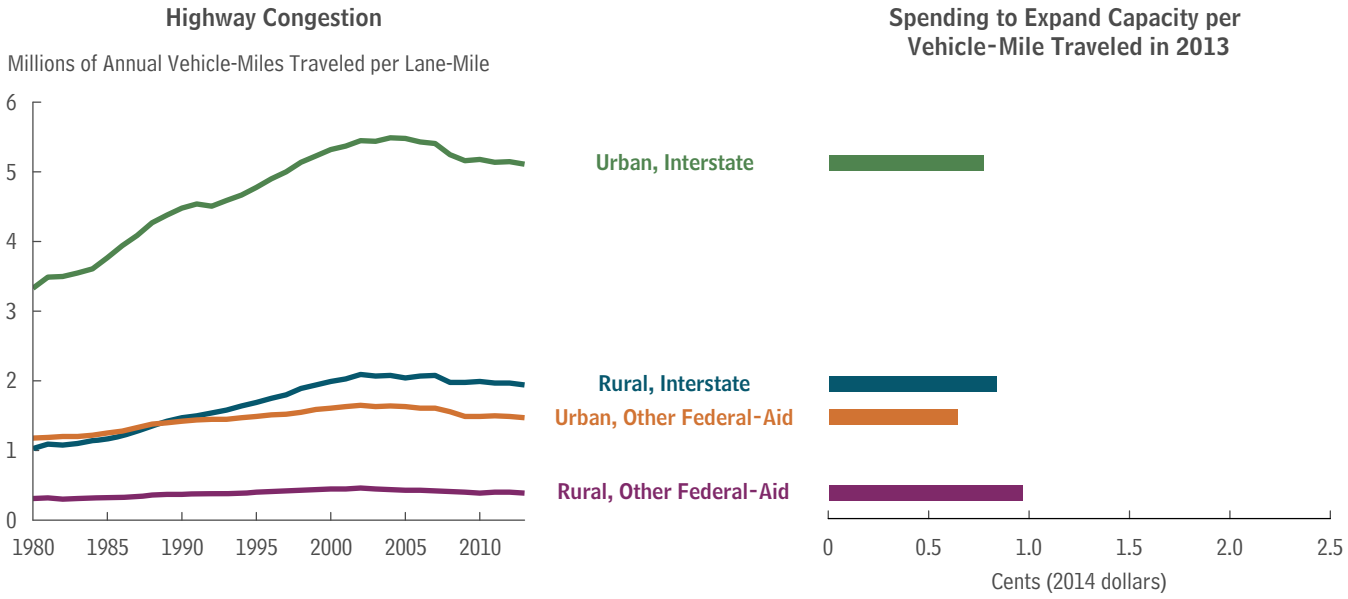
Figure 1-7. Return to Reference

Traffic Congestion and Spending, by Type of Highway

Traffic per lane-mile has been greater on urban Interstates than on other classes of highways . . .

. . . but in 2013, spending to expand capacity per vehicle-mile traveled was greater for lightly traveled rural federal-aid highways (other than Interstates) than for other classes of highways that were much more heavily used, including urban Interstates.



Source: Congressional Budget Office based on data from the Federal Highway Administration and the Bureau of Economic Analysis.

Note: Spending is adjusted to remove the effects of inflation using price indexes for government spending that measure the prices of materials and other inputs used to build and repair highways.

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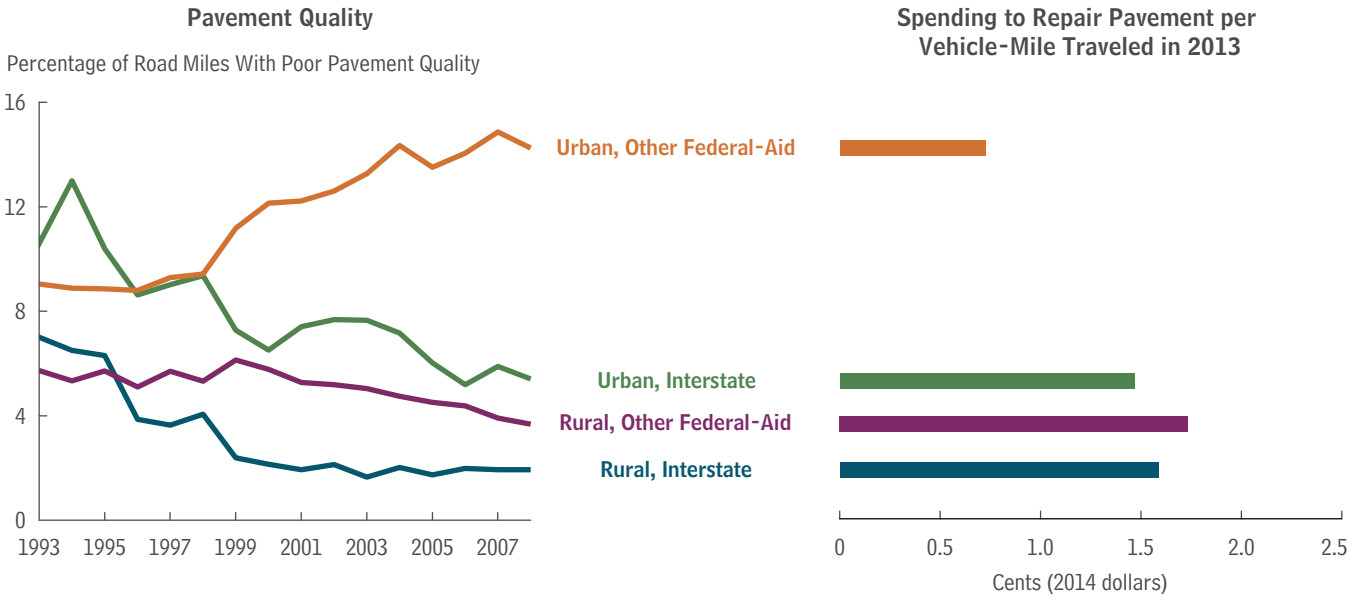
Figure 1-8. Return to Reference

Pavement Condition and Spending, by Type of Highway

Urban federal-aid highways (other than Interstates) have poorer pavement quality than other classes of highways . . .

. . . but spending per vehicle-mile traveled to repair those urban federal-aid highways has been less than that for other classes of highways in much better condition.



Source: Congressional Budget Office based on data from the Bureau of Transportation Statistics, the Bureau of Economic Analysis, and the Federal Highway Administration.

Notes: Spending is adjusted to remove the effects of inflation using price indexes for government spending that measure the prices of materials and other inputs used to build and repair highways.

Federal measures of pavement quality changed in 1993, making comparisons with earlier periods difficult. Those quality measures are now changing again so comparisons will again be challenging.

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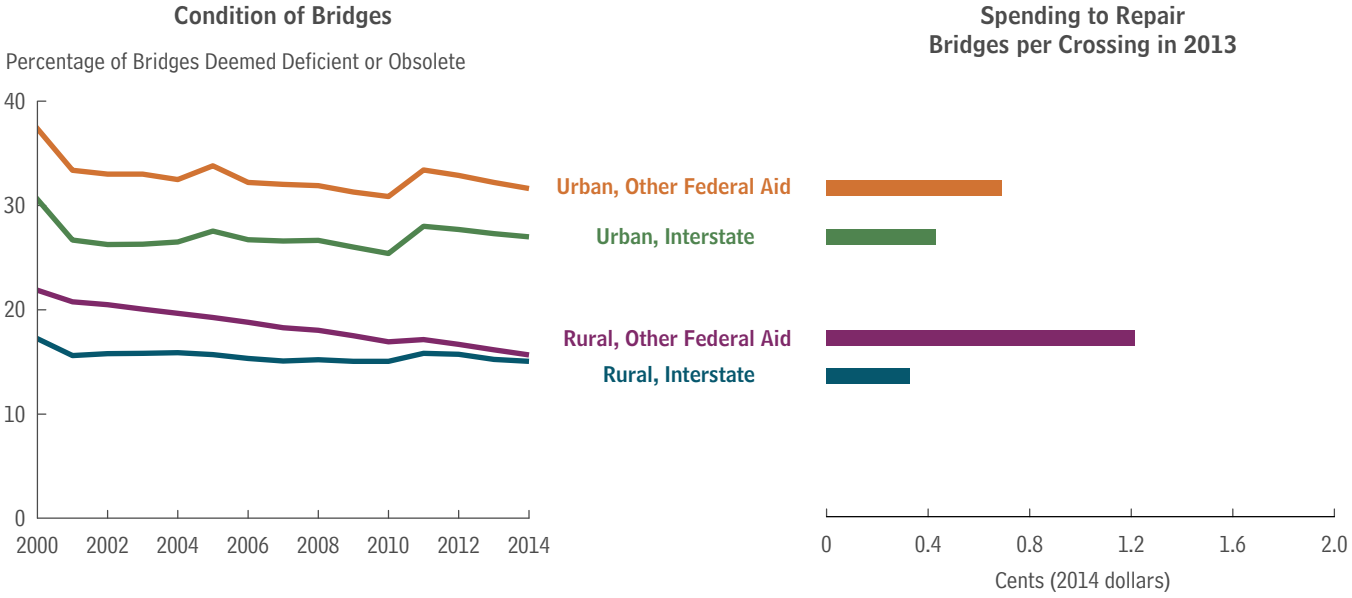
Figure 1-9. Return to Reference

Condition of Bridges and Spending, by Location and Bridge Class

Bridges in rural areas are less frequently structurally deficient or functionally obsolete than those in urban areas . . .

. . . but the most spending per crossing has been devoted to rehabilitating bridges on rural federal-aid roads other than Interstates.



Sources: Congressional Budget Office based on data from the Bureau of Transportation Statistics, the Bureau of Economic Analysis, and the Federal Highway Administration.

Notes: Bridges are typically considered structurally deficient if significant load-carrying elements are found to be in poor or worse condition because of deterioration or damage. However, the classification of a bridge as structurally deficient does not imply that it is likely to collapse or that it is unsafe. Functional obsolescence is a function of the geometrics of the bridge (such as the width of lanes and the shoulder area and vertical clearances) in relation to current design standards. Whereas structural deficiencies are generally the result of the deterioration of a bridge's components, functional obsolescence generally results from changing traffic demands.

Spending is adjusted to remove the effects of inflation using price indexes for government spending that measure the prices of materials and other inputs used to build and repair highways.

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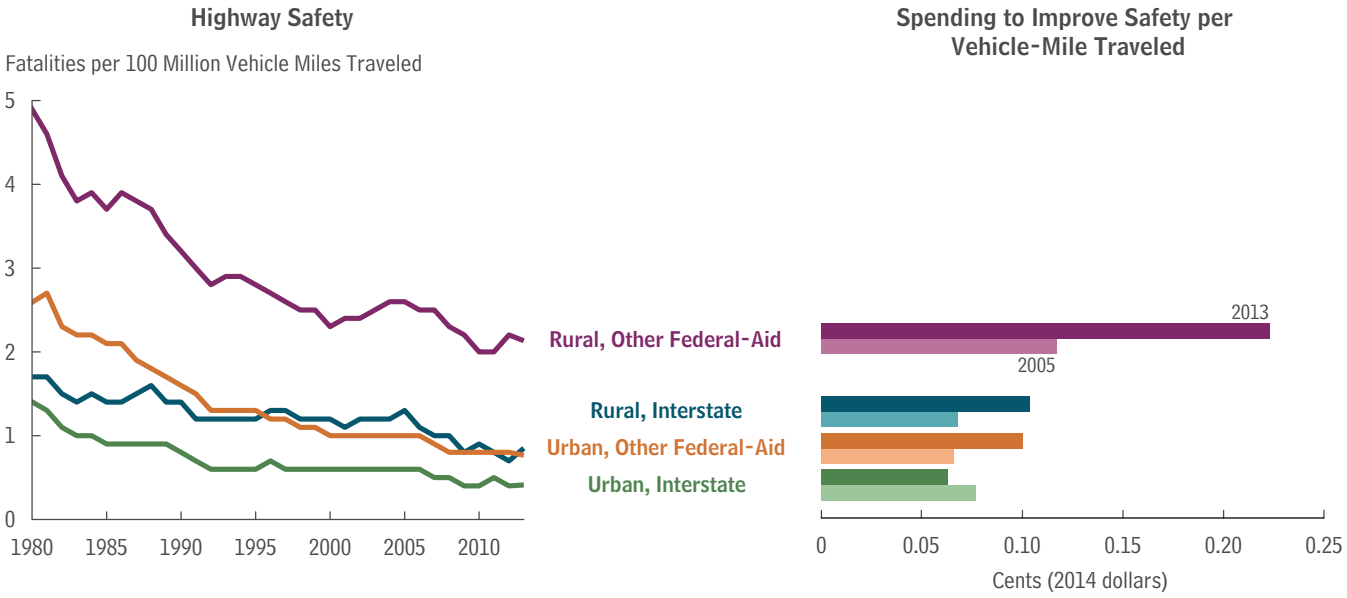
Figure 1-10. Return to Reference

Highway Safety and Spending, by Type of Highway

Safety has improved on all classes of highways over the past 30 years, but rural roads have higher fatality rates than comparable (that is, Interstate or other federal-aid) urban roads.

Funds from the federal Highway Safety Improvement Program were allocated to states on the basis of fatalities starting in 2005. Since then, spending per mile traveled to improve safety on rural roads has increased significantly, whereas such spending for urban Interstates has declined.



Source: Congressional Budget Office based on data from the Federal Highway Administration and the Bureau of Economic Analysis.

Note: Spending is adjusted to remove the effects of inflation using price indexes for government spending that measure the prices of materials and other inputs used to build and repair highways.

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Box 2-1. Return to Reference

Privatizing Highways

Advocates of greater involvement by the private sector argue that private builders and operators of highways would spend in a more economically efficient manner than the government does—in particular, by completing projects more quickly and by operating and maintaining highways at lower cost—and would be able as well to recoup reconstruction and maintenance costs by charging prices that reflected the demand for highways' use. The government could facilitate privatization through various mechanisms already in place—increasing funding provided under the Transportation Infrastructure Finance and Innovation Act, increasing the cap on the amount of tax-exempt private activity bonds that can be issued to finance highways, and authorizing tax-preferred bonds for public-private partnerships that have a larger subsidy than current private activity bonds.

Assessments of the experience with private financing of highways in the United States suggest that turning to a private partner does not typically yield additional financing, although doing so may speed the financing and make new roads available sooner than they would have been otherwise.[61] Private financing can provide the capital necessary to build a new road, but it comes with the expectation of repayment and a future return, the ultimate source of which is either tax revenues collected by a government or fees from road users, like tolls—the same sources that are available to governments. All told, the total cost of the capital for a highway project, whether that capital is obtained through a government or through a public-private partnership, tends to be similar once all relevant costs are taken into account.

Moreover, the results from recent projects in which private companies have leased and operated highways have not conclusively answered whether a public- or private-sector role is generally more advantageous for managing infrastructure. So decisions must be made carefully case by case. Some advocates of a larger private role have called for states to experiment.[62]

Almost all highways in the United States are currently provided by the public sector. Such infrastructure displays, at least to some degree, important characteristics of a "public good." To wit, charging everyone who benefits from the service provided can be difficult if not impossible; as a result, the private sector would supply less infrastructure than would be optimal for society to have. Government can remedy that shortfall by collecting taxes to pay for such a good. Moreover, some of the benefits of highways—promoting commerce, for instance—may extend beyond the places where they are built and beyond the people who use them directly. If a private company could

61. See Congressional Budget Office, *Using Public-Private Partnerships to Carry Out Highway Projects* (January 2012), www.cbo.gov/publication/42685.

62. See, for example, Clifford Winston, *Last Exit: Privatization and Deregulation of the U.S. Transportation System* (Brookings Institution Press, 2010), www.brookings.edu/research/books/2010/lastexit.

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recoup its costs by charging the users of a highway, it might still be unable to charge all those who eventually benefit from it and, again, would probably provide less highway infrastructure than is socially beneficial.

In addition, because infrastructure is costly to build, though less expensive to operate and maintain, having competing highway networks is not practical. The success of privatized or privately operated roads depends in part on the degree of competition from other local roads or alternative forms of transportation. Roads that face effective competition from alternatives for which tolls are not charged may not be able to generate enough revenues to cover their costs, so finding a private owner or operator willing to pay for such a road could be difficult. Roads that face too little competition, though, may encourage charges that are higher than socially optimal. Such "natural monopolies" are often either provided directly by the government or regulated by it.

When an existing highway is privatized, the tax revenues received by the federal government can be reduced, providing a benefit in the form of a higher transaction price for the state or local government that owns the highway—as exemplified in this scenario: When a private entity takes effective ownership of a highway through a long-term lease (of 50 or 99 years, for example), the duration of the lease allows the private entity to expense the costs implied by depreciation of the highway—even though that road was built by the public sector and had already been in service for some time. Because expensed depreciation reduces the tax liability of the private owner while leaving its cash flow unchanged, long-term leases lead to higher bids.[63] Thus, the public owner has a short-term incentive to offer long leases when privatizing highways, even though such leases may not be in the best interest of highway users or the public more broadly. Similarly, if tax-exempt bonds were used to finance the construction of the highway that is being privatized, then a portion of the revenues that the federal government would forgo because of the tax exemption would accrue to the state or local government that is leasing the road; that state or local government could then use the revenues from leasing the road for purposes other than those for which the tax exemption was offered.

Privatizing highways might impose other types of costs, which the federal government (as well as state and local governments) would eventually have to bear. For example, tolls or user fees on a newly privatized highway could push motorists onto other roads, increasing traffic congestion there at the same time that it was reduced on the private road. Thus, public spending to maintain roads that serve as alternatives to privatized highways might increase. In cases where some toll-setting authority is turned over to the private sector, higher tolls are likely to result. That outcome may conflict with other

63. Testimony of Edward D. Kleinbard, Chief of Staff, Joint Committee on Taxation, before the Subcommittee on Energy, Natural Resources, and Infrastructure of the Committee on Finance, *Tax and Financing Aspects of Highway Public-Private Partnerships* (July 24, 2008), JCX-62-08, www.finance.senate.gov/imo/media/doc/072408ektest.pdf (81 KB).

public-sector goals, since the private sector may not take those goals into account when setting tolls.

The costs of ensuring that a privatized highway remains in service might not be fully transferred to the private sector. If revenues from tolls or other pricing schemes turned out to be insufficient to cover construction or operating costs and the private owner went bankrupt, continued use of the road could require a government entity to step in to find a new private owner or absorb the responsibility of ownership on its own. Some of the projects that have been financed through tolls by public-private partnerships have failed financially because the private-sector partners initially overestimated the volume of traffic and their revenues and, as a result, were unable to fully repay the projects' debts.[64]

64. Testimony of Joseph Kile, Assistant Director, Microeconomic Studies, Congressional Budget Office, before the Panel on Public-Private Partnerships, House Committee on Transportation and Infrastructure, *Public-Private Partnerships for Highway Projects* (March 5, 2014), pp. 5–7, www.cbo.gov/publication/45157.

Box 2-2. Return to Reference

The Federal Highway Administration's Benefit-Cost Analysis

The Federal Highway Administration (FHWA) has devoted substantial time and effort over a number of years to develop the data and models necessary to perform benefit-cost analysis of highways on a national basis. The agency typically has measured benefits in terms of reductions in the costs of travel: the cost of operating a vehicle, the cost of time spent in travel, and the cost of accidents. The cost of time spent in travel is typically assumed to be a fraction of the hourly wage rate, depending on whether the trip is for business or a personal reason. Other measured benefits include reductions in the cost of highway maintenance and reductions in vehicle emissions.

In its analysis, FHWA estimates benefits that accrue from improvements over a 20-year period, and projects are evaluated every 5 years. The value of benefits received in future years is adjusted to be comparable with that of benefits received today; benefits in the future are assumed to be worth less than those today, reflecting uncertainty about the future and the fact that money in hand now is worth more than the same amount received in the future.

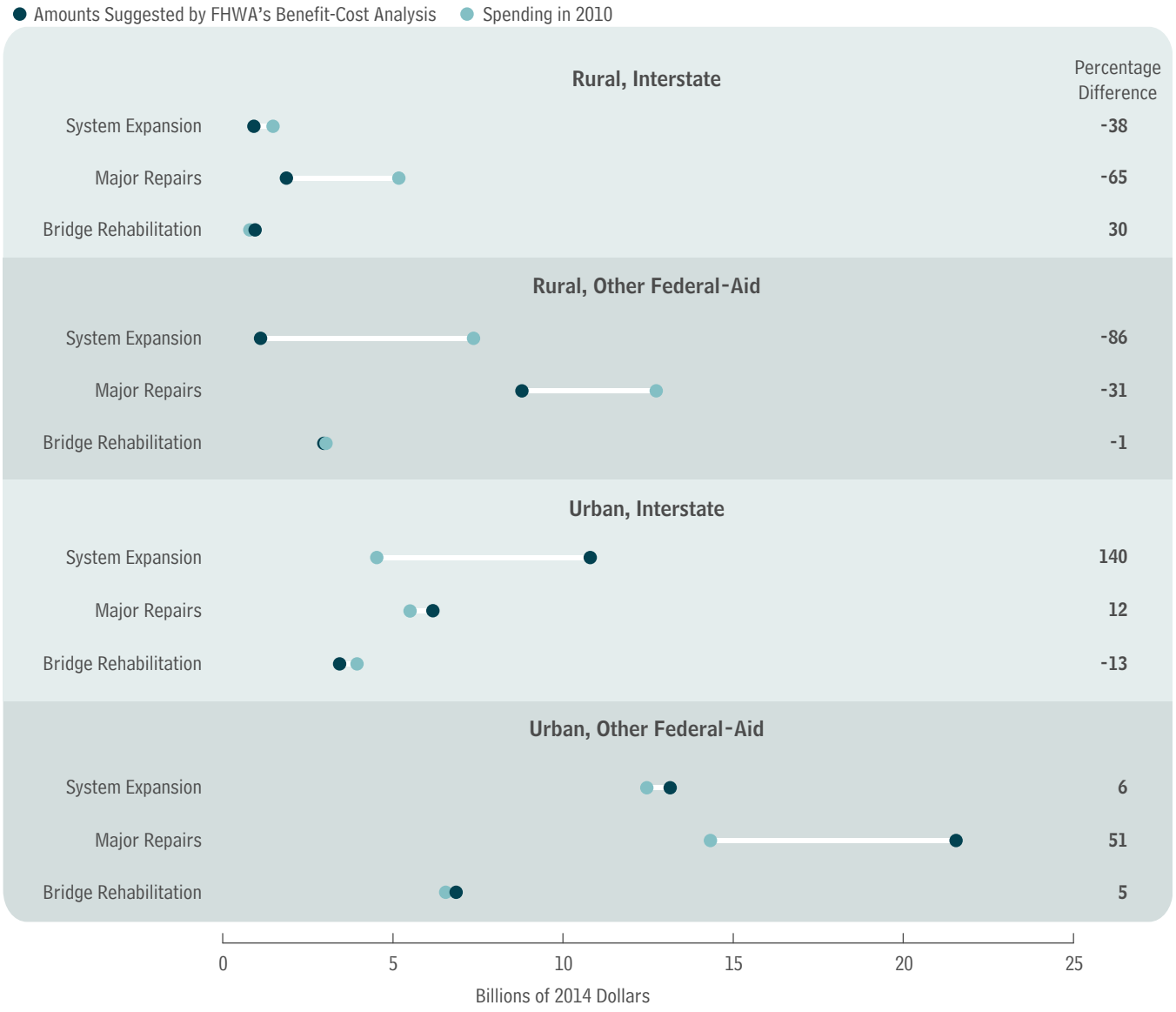
Costs vary for different kinds of projects in different areas. Improvements to Interstates typically cost more than those to other federal-aid highways. In rural areas, costs vary with the type of terrain. In urban areas, costs can be affected by the size of the population. For example, costs may be 40 percent to 75 percent higher in a small urban area than in a flat rural area.[65] To add a lane where conventional approaches are not feasible (for example, where there are limitations on the ability to widen lanes), the costs in a small urban area may be several times higher than those in a flat rural area. Costs in more heavily populated urban areas tend to be even higher, as do costs in rural areas with more rolling or mountainous terrain. A report issued by the Washington State Department of Transportation in 2002 found average construction costs for a lane-mile of highway in 25 states varied from $1 million to more than $8 million.[66]

65. Federal Highway Administration and Federal Transit Administration, *2013 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* (2013), Appendix A, www.fhwa.dot.gov/policy/2013cpr/.

66. Washington State Department of Transportation, *Highway Construction Cost Comparison Survey: Final Report* (April 2002), http://tinyurl.com/mcr8r3l (PDF, 517 KB).

Figure 2-1. Return to Reference

Changes in Spending Suggested by the Federal Highway Administration's Benefit-Cost Analysis If Total Spending Was Held Constant



Source: Congressional Budget Office based on data from the Federal Highway Administration.

Notes: Comparisons are for 2010, the year of FHWA's benefit-cost analysis.

Dollar amounts are adjusted to remove the effects of inflation using price indexes for government spending that measure the prices of materials and other inputs used to build and repair highways.

FHWA = Federal Highway Administration.

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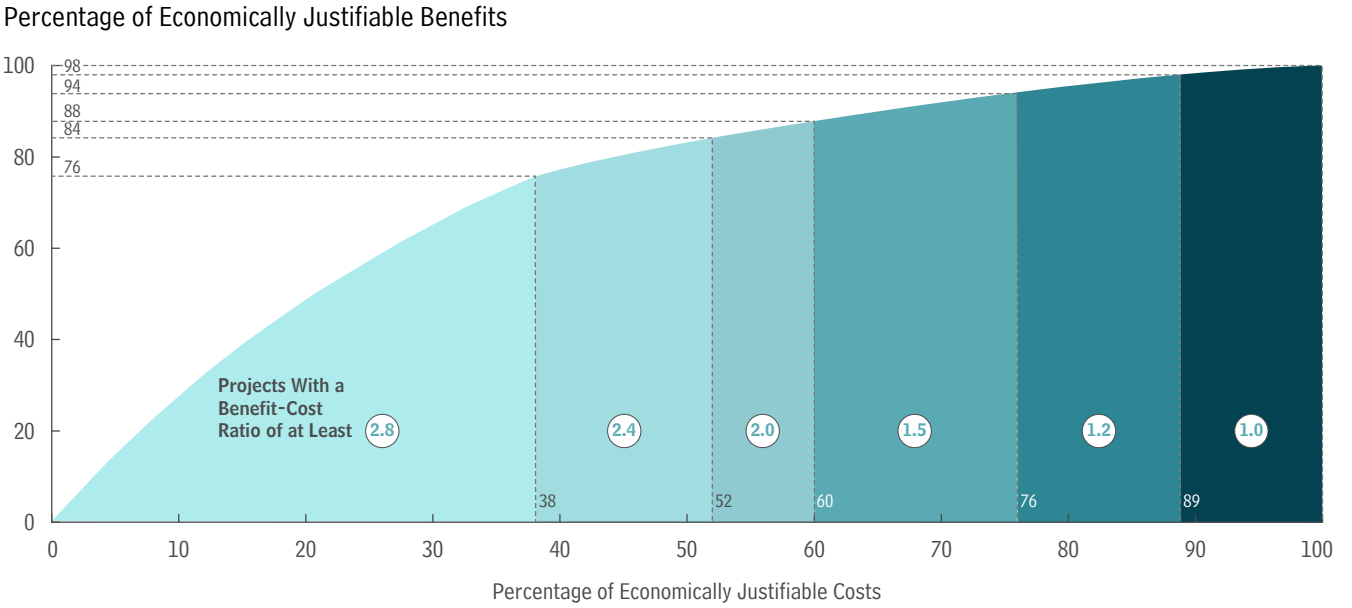
Figure 2-2. Return to Reference

Cumulative Shares of Benefits and Costs From the Federal Highway Administration's Benefit-Cost Analysis of Economically Justifiable Highway Projects



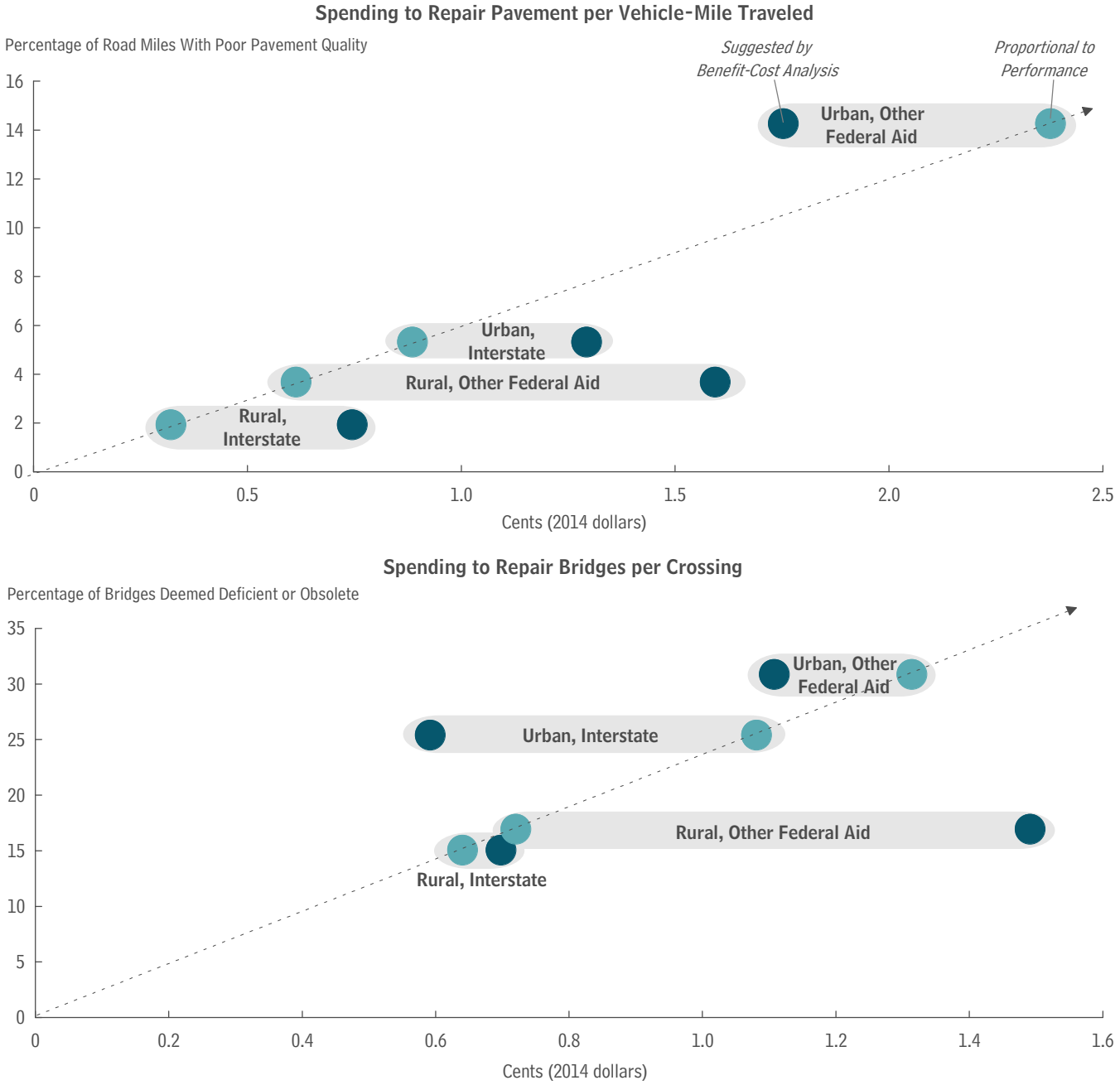
Source: Congressional Budget Office based on data from the Federal Highway Administration.

Note: Economically justifiable projects are those projects that have a benefit-cost ratio of greater than 1.0 in the Federal Highway Administration's analysis, meaning that the estimated value today of the benefits of such a project in the future is greater than the estimated cost of that project.

CBO

Figure 2-3. Return to Reference

Comparison of Spending in Proportion to Performance With Spending as Suggested by the Federal Highway Administration's Benefit-Cost Analysis



Source: Congressional Budget Office based on data from the Federal Highway Administration and the Bureau of Transportation Statistics.

Notes: Spending proportional to performance was estimated by calculating the average spending given the average level of performance and then adjusting that amount proportionally to performance so as to keep the total amount of spending constant. In the top panel, performance is measured as the percentage of road miles with poor pavement quality. In the bottom panel, performance is measured as the percentage of bridges deemed deficient or obsolete.

Comparisons are for 2010, the year of the Federal Highway Administration's benefit-cost analysis. Pavement quality data, however, are for 2008.

Dollar amounts are adjusted to remove the effects of inflation using price indexes for government spending that measure the prices of materials and other inputs used to build and repair highways.

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