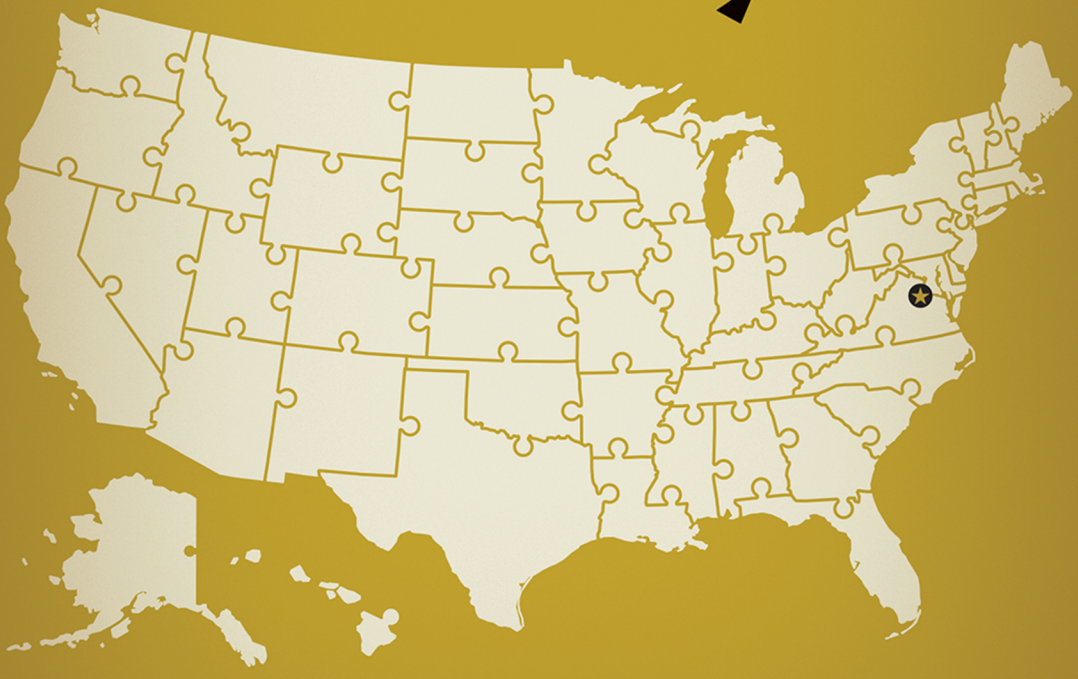
Perspectives on Political and Economic Governance

American Federalism Today



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Infrastructure in a Federal System

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The proper goal of restructuring the public sector cannot simply be decentralization. . . . The basic issue is one of aligning responsibilities and fiscal instruments with the proper levels of government.

—Wallace E. Oates, "An Essay on Fiscal Federalism,"
Journal of Economic Literature, 1999

The United States certainly has infrastructure needs. The American Society of Civil Engineers, serious if somewhat self-interested, rates the nation's infrastructure a C– in its 2021 report card (ASCE 2021). Some claim there is a multitrillion-dollar "infrastructure deficit," and others have blamed inadequate public investment in infrastructure for holding back US economic productivity (e.g., Aschauer 1991). In 2021, this point of view was used to justify the trillion-dollar Infrastructure Investment and Jobs Act (IIJA). Yet others argue that a closer analysis shows US infrastructure in much better shape and advocate for improving the allocation of funding over massive new expenditures (Duranton, Nagpal, and Turner 2020). In a similar vein, the World Economic Forum's 2019 Global Competitiveness Report rated the United States thirteenth out of 141 countries on infrastructure—behind top-rated Singapore and Hong Kong but ahead of countries like Sweden and Denmark. While there is clearly ample opportunity to do considerable productive long-run infrastructure investment, how much should be spent, which projects should be prioritized, and what role should government—at the federal, state, or local level—have in these investments remain contentious questions.

In seminal work originating in the 1970s, economist Wallace E. Oates laid out key principles for fiscal federalism (Oates 1972; Oates 2008).

His "decentralization theorem" emphasizes, under several assumptions, that unless there are cost advantages associated with the centralized provision of public goods, decentralized provision, with its ability to more closely align with local needs and preferences, will make more people better off. This argument also makes room for equity considerations, with Oates pointing out that intergovernmental grants to jurisdictions can be warranted if they have a relatively small tax base or relatively high costs of providing essential services. Further, he articulates what he calls a traditional theory of fiscal federalism, with the following policy prescription (Oates 2008): "Where there are spillover benefits associated with the provision of local public goods, the central government should introduce matching intergovernmental grants that serve to internalize the external benefits. The grants will provide the necessary inducement to local officials to extend provision of the local service to the socially efficient level." In other words, public good provision is optimally financed and delivered by local authorities, unless the central authority has cost advantages (i.e., economies of scale) or unless the local public goods also benefit other parts of the country.

Though this theory remains sound decades later, it crucially relies on good data, good research, and good faith assessments of the costs and benefits of public good provision. It says little about the practical realities of the "three C's": competence, capacity, and comparative advantage. While we do not address these here, they are discussed elsewhere in this volume. But surely the absolute or relative competence at different levels of government and the private sector; the capacity, and not just physical capacity and scale economies; and the comparative advantage of different jurisdictions at and within different levels of government should play an important role in the allocation of responsibilities and resources in a federal system in a free society. Current policy debates on infrastructure investment all too often either ignore the theory or work with cost-benefit estimates, explicitly or implicitly, that do not stand up to scrutiny. One such prominent argument, borne out of the Great Depression, is that infrastructure spending by the federal government is especially warranted during recessions, as it can dramatically spur growth and raise employment and incomes. When the Federal Reserve lowers interest rates and government borrowing rates are low, the argument goes, deficit finance becomes a cheap way to increase employment. Existing research, in fact, suggests that this is a misguided conclusion.

First, while infrastructure spending may have made for good short-run stimulus in the 1930s, that is no longer the case (Glaeser 2016; Ramey

2020). Only a small fraction of those unemployed today have the skills and experience for the kind of work required by today's infrastructure challenges, few of which require only a shovel. Tower crane operators, wind turbine technicians, and other skilled tradespeople cannot be trained overnight upon a sudden influx of infrastructure dollars. Additionally, planning and approval hurdles that were absent in the 1930s are omnipresent today, slowing the speed with which funds can be disbursed and infrastructure built. As a result, massive infrastructure spending within a short window of time may lead not to increases in employment but to backlogs that result in higher profits for a relatively small set of contractors and higher wages for the limited supply of skilled workers (Balat 2017). Higher costs in turn mean fewer highway miles repaved, bridges repaired, and electricity lines properly maintained. Worse yet, when federal funding is massive, local political incentives to spend all allocated funds exacerbate the tendency to fund too many low-return projects, along with boondoggles like California's high-speed rail project.

Second, large public infrastructure projects—highways, dams, and the like—are designed to last many decades, and aside from the recent rise in short-term interest rates driven by high inflation and the Federal Reserve's response to it, interest rates on long-term government debt will eventually rise to a more reasonable positive inflation-adjusted level.[1] Rolling over large amounts of debt accumulated in a low interest rate environment will eventually be much more expensive, making the infrastructure spending far from a cheap lunch.

If infrastructure investment policy should not be motivated primarily by short-run economic stimulus or by cheap debt, what guiding principles should policymakers use instead? We lay out and discuss these principles, rooting them in the fundamentals of fiscal federalism and applying them to today's infrastructure challenges, including the impending large influx of federal spending from the IIJA. We stress the importance of establishing capabilities and incentives for rigorous cost-benefit analysis at various levels of government; prioritizing the highest net benefit projects; financing work through user fees wherever possible; making infrastructure adaptive and planning for technological change; and focusing policy on creating the right incentives for the federal, state, local, and private actors. Throughout, we explain how the appropriate federal and local responsibilities are connected to each principle and make recommendations for sound infrastructure policies.

Overview

America's infrastructure, the conduit for our economic activity, is vast and varied by any measure. It connects us to the water and power we need in our homes, offices, factories, and schools. It brings our food to our grocers and products and mail to our doorstep. It enables us to use our computers and smartphones. And, of course, it enables us to travel to work, school, leisure, and tourism destinations. In short, it is an essential part of our lives and plays an important role in their quality. US infrastructure, in its physical nature, consists primarily of the wide-ranging inventory laid out in table 8.1. A more expansive definition would also include cloud data servers, airwave spectrum, IT and traditional infrastructure inside homes and businesses, and other technologies. Trains, cars, buses, trucks, airplanes, ships, cargo containers, and other items crucial to the transportation process could also be included.

Table 8.1 makes clear an often underappreciated fact: infrastructure ownership varies widely across and within types of infrastructure—sometimes ownership is public, sometimes it's private, and sometimes it's something in between. Cell towers and antennas are often owned by private companies, such as Crown Castle, American Tower, and AT&T Towers; bridges can be fully owned by a state, but also by quasi-independent interstate partnerships like the Port Authority of New York and New Jersey; and electricity lines can be owned by publicly regulated private utility companies. Though policy discussions often get simplified in their focus on government-owned and operated infrastructure, the US infrastructure landscape is much more varied and complex—a clear sign that focusing on government spending alone is inadequate infrastructure policy. As crises often reveal, the federal government often does have a crucial role to play in facilitating coordination and collaboration across infrastructure providers, especially across state lines, and in ensuring that responsible levels of safety and condition are maintained. Thus, the regulatory dimension of federal-state-local-private relationships—from standards to coordination practices to the strings attached to financial support—deserves considerable attention as well.

Adhering closely to the principles below has the potential to increase the return on public and private spending on infrastructure. With historic levels of funding recently allocated to infrastructure through Congress's IIJA of November 2021, adherence to the principles today has potential to be especially valuable and consequential.

Table 8.1 Inventory of US infrastructure

Infrastructure type	Quantity
Highways and roads	4.17 million miles
Railroad bridges	100,000
Bridges	More than 617,000
Heavy rail track	140,000 miles
Commuter and light rail track	10,049 miles
Commercial ports	926
Airports	19,853 airports
	14,784 are private use
	5,069 are public use
Dams and resevoirs	91,000
Oil and gas pipelines	3.3 million miles
Electricity lines	160,000 miles of high-voltage; millions of miles of low-voltage power lines
Cell sites (towers and antennas)	417,215
Fiber-optic cable	More than 4 million miles
Solar panels	More than 2 million
Wind turbines	73,352
Satellites	3,432 satellites
	31 civil
	2,992 commercial
	409 government and military

Sources: Data for highways and roads from US Bureau of Transportation Statistics 2023. Data for railroad bridges from ASCE 2017. Data for bridges, commercial ports, and dams and reservoirs from ASCE 2021. Data for heavy rail, commuter rail, and light rail track from US Bureau of Transportation Statistics 2023; in directional route-miles; light rail includes streetcar rail and hybrid rail. Data for airports from FAA 2022. Data for oil and gas pipelines from Pipeline and Hazardous Materials Safety Administration 2023. Data for electricity lines from EPA 2023. Data for cell sites from CTIA 2021. Data for fiber-optic cable from S&P Global Market Intelligence 2019. Data for solar panels from SEIA 2019. Data for wind turbines from USGS 2023. Data for satellites from Union of Concerned Scientists 2023; for comparison, of the satellites currently in space, 177 are Russian and 541 are Chinese; the vast majority of commercial satellites are owned by Starlink; see Witze 2023.

Guiding Principles

Establish Capabilities and Incentives for Rigorous Cost-Benefit Analysis

As with any decision that requires the appropriation of scare resources, rigorous cost-benefit analysis should be at the core of government infrastructure spending. How rigorously policymakers are able to evaluate competing projects and proposals depends in part on the data they have at their disposal. Infrastructure projects are no exception.

Given how central infrastructure is to our daily lives, the data required for such cost-benefit analyses are wide-ranging. Accurate projections of the benefits of a new bridge require good data on past usage of comparable bridges and projections of future usage, along with elasticities of substitution across routes and modes of transportation. Sensible projections of population distributions, especially of the potential users of the infrastructure, along with user incomes and the availability of relevant technologies, all depend on high-quality data. Data on economic activity in the region are also important to understanding, among other things, the positive and negative externalities of the new construction. Is the benefit likely to be concentrated in the county where the bridge will be located, or will it be shared widely by others in the state or even the country?

Answers to these and other questions of the sort will only be as accurate as the data that go into the analyses, the competence of those conducting it, and the degree of professionalism and independence from political manipulation. In many jurisdictions, however, the data are often narrow, incomplete, and inaccurate. While over forty state departments of transportation (DOTs) use the same software (Bid Express) to run their infrastructure procurement bidding, there is no centralized database that allows for these data to be studied. How can states learn from one another's successes and mistakes, and how can the externalities of each state's procurement practices be understood without such data transparency? As prior work has shown (e.g., Bajari, Houghton, and Tadelis 2014; Bolotnyy and Vasserman 2023), how the procurement process is structured can have significant implications for project effectiveness and efficiency.

Project uncertainty can also drive up costs and may similarly arise from a lack of good data and from the unpredictability of timing, level, and regulatory requirements from own or "higher-level" government funding. The underground mess of infrastructure in New York is a striking example of the high costs of going into projects blind. In a process known colloquially as

"peek and shriek," contractors dig into New York roads knowing what they have to fix but having no idea what other infrastructure they will encounter along the way or how difficult their work will ultimately be (Rueb 2016). Poor coordination across utilities, city authorities, contractors, and other actors, along with poor recordkeeping on the location and condition of various infrastructure components, all snowball into painful delays and cost overruns. Investments in and maintenance of the infrastructure behind infrastructure projects—the data, the software, the sensors and robots that assess infrastructure conditions, etc.—can substantially reduce these problems (Vasserman 2020; Mims 2023). With accurate, up-to-date data and systems that allow for detailed cost-benefit analyses, state and federal authorities will be better positioned to take on the most productive projects.

The cost-benefit analysis process must also be well defined and based on assumptions that are both clearly shared with the public and defensible. It is all too easy to manipulate projections of costs and benefits for political or other purposes. Classic examples are assuming far greater population growth—and hence benefits to more people—and low discount rates, which raise the relative value of distant benefits compared to near-term capital costs. The cost-benefit analysis of California's high-speed rail assumed that California's population would grow to sixty million in coming decades—whereas it has been falling in recent years from a peak of forty million—growth that was supposed to lead to dramatically greater congestion that would have justified the huge cost of the project.

It's not just the funding levels but also the rules, restrictions, and requirements, i.e., the regulations that accompany the funding levels, that determine the costs and benefits of infrastructure projects. Cost-benefit analysis should not, for example, focus solely on the costs, as the Trump administration's "Two-for-One" rule—remove two regulations for every new regulation—effectively did, de-emphasizing the benefit side of the equation (Masur 2020). Nor should cost-benefit analysis wade deeply into unquantifiable territory, as in the Obama administration's inclusion of "equity, human dignity, fairness, and distributive impacts" in analyses or the Biden administration's effort to make sure that cost-benefit analysis "fully accounts for regulatory benefits that are difficult or impossible to quantify" (Masur 2020; Biden 2021). If approaches to cost-benefit analysis are politically driven and change with every administration, the federal and the state regulatory apparatus can experience swings in effectiveness that have little to do with actual costs and benefits and only increase regulatory uncertainty and overall costs.

While steps should be taken to ensure rigor and consistency in prospective cost-benefit analysis, retrospective cost-benefit analysis should also become institutionalized. Knowing that spending and regulation will eventually have to be reviewed for effectiveness will incentivize greater care in the budgeting and regulation-creation process, and this review will provide the government with an opportunity to make informed improvements to existing policies. Moreover, retrospective cost-benefit analysis will allow us to see how well our prospective cost-benefit analysis is doing and to improve data collection and forecasting practices. Finally, empowering politically independent analysis and review, perhaps by a separate, independent agency, might also limit the temptation to fund poor projects and to place unnecessary regulatory burdens on the economy. Such an agency could be modeled on the Congressional Budget Office (CBO) and could audit a random selection of infrastructure projects. By putting a spotlight on different project stages, the agency could limit fiscal cross-hauling across states and encourage stakeholders to take rigorous cost-benefit analysis more seriously when selling projects to their constituents.

Prioritize Highest Net Benefit Projects

Rigorous and transparent cost-benefit analysis will be helpful not only in project planning but also in project prioritization and implementation. A clearly articulated and publicly available analysis can make it harder for political actors, at all levels, to prioritize projects that might have low social net benefit but high short-term political net benefit for their favored constituents. Such projects often involve new, salient, and customized construction, with California's high-speed rail project being a prime, misbegotten example. The highest net benefit projects are often regular maintenance projects, because they not only improve infrastructure quality contemporaneously but also prevent exponential, snowballing deterioration. Maintenance that would have prevented the 2007 rush-hour collapse of the I-35W Mississippi River bridge in Minneapolis would have had a high net benefit. Ditto California's Oroville Dam Causeway maintenance, for which an investment of millions of dollars would have prevented the need to evacuate a quarter million people and to spend billions on repairs. Of course, there is the political reality that shiny new projects and ribbon-cutting ceremonies provide better publicity for elected officials than do repairs and maintenance.

Also likely of high net benefit are projects that enable the use of targeted pricing mechanisms that in turn reduce negative externalities like congestion

and pollution. License plate–scanning tollbooths and cameras that make congestion pricing possible are some examples of this kind of infrastructure. Integrating these technologies near our seaports and airports, where the confluence of cargo traffic and rush-hour traffic generates large congestion costs and economic losses, deserves especially high prioritization. These projects and others that have high net benefits (due to potentially high "positive externalities"—benefits to society beyond the local area) are the kinds of things that the federal government should prioritize, working actively with the states. For example, with twenty-five US port complexes accepting 85 percent of internationally traded goods and only 4 percent of these goods staying in the local market where they enter the United States, the benefit of having our major ports function effectively is widely diffused across the country and even among our trading partners (Tomer and Kane 2015). While the construction and upkeep of locally used infrastructure should be financed and prioritized locally, infrastructure with large implications for economic activity across the country should be prioritized and partly financed appropriately at the federal level.

Finance through User Fees Wherever Possible

While there are substantial positive social externalities to everyone drinking clean water, driving on smoothly paved roads, and being connected to the internet, the most direct benefits of improved infrastructure are obtained by those who use it. It makes sense, therefore, that we have systems through which we pay individually for the electricity, water, gas, broadband, and other infrastructure that we use. These payment systems, however, could still be more widely deployed across our roads and bridges. Just as utility companies raise electricity pricing when demand would otherwise exceed supply to balance the grid and prevent blackouts, cities should employ the so-called dynamic pricing (fees or tolls varying with congestion) used on some highways and tollbooths to decrease congestion and pollution.[2] In some cases, where the likely benefits of these systems are large and diffuse, it makes sense for the federal government to partner with states to finance these systems.

Once in place, however, the fees collected would both support optimal infrastructure usage and serve as a reliable source of maintenance financing.[3] If usage were to decrease over time as individuals switched to alternative modes or routes of transportation, the piece of infrastructure would take itself out of commission by popular demand instead of by decree. The path of

funding maintenance with user fees is not without its pitfalls, however. The case of the Pennsylvania Turnpike has shown that politics has a tendency to distort how money is actually spent. Taking advantage of the fact that the turnpike could take on debt, the state required it to send more money than it had to the Pennsylvania Department of Transportation for a wide range of infrastructure projects, putting the turnpike into a major debt crisis and forcing it to raise user fees to levels that dramatically reduced demand (Hoffman 2022). Policymakers should thus take extra care to make sure that the revenue collected is devoted first and foremost to cover expected maintenance costs, and only then allocate any surplus revenues to other needs.

User fees are a particularly appealing source of financing for new construction, with contractors due to receive the user fees incentivized to build quickly and provide maintenance efficiently. They can also serve as a way to temper the power of interest groups to disrupt construction plans with add-ons and modifications (Brooks and Liscow 2019), since such requests can be saliently tied to an increase in user fees and help future users push back on such lobbying. Relatedly, infrastructure for which demand is low is unlikely to be built if user fees are the main source of financing. The Detroit People Mover monorail and Alaska's Gravina Island Bridge, commonly referred to as the "bridge to nowhere," for example, would likely not exist under a user fee system (Glaeser 2016). In addition to offering up-front savings to taxpayers, preventing the construction of unproductive infrastructure will save our cities and towns decades of urban planning headaches, burdensome maintenance costs, and even environmental damage.

User fee systems can also be adjusted to subsidize usage where necessary. As Ashraf, Glaeser, and Ponzetto (2016) show, for example, subsidizing individual usage of infrastructure such as water and sewage pipes in areas where people are too poor to cover those costs could be desirable due to large and widespread positive benefits. The authors also caution, however, that the optimal usage of subsidies depends not just on the type of infrastructure in question but also on the government's institutional capacity and ability to prevent waste and corruption.

However, introducing user fees for existing, previously zero-fee infrastructure is much harder to achieve politically than having user fees from the get-go. It is hard to sell a new bridge toll, for example, to finance that bridge's maintenance, in part because maintenance is less salient to the public than new construction. It is also difficult to predict maintenance costs, due to uncertainty around the condition of an old bridge, so contractors would

likely demand high tolls for commitments to long-term contracts. State and federal officials could, however, work together on transition plans that involve a phased-in user fee approach for existing infrastructure, accompanied by budget-neutral reductions in fees that are less well targeted at the usage of specific infrastructure (e.g., vehicle registration fees, electricity delivery fees, etc.). Major federal infrastructure bills could come with incentives tying the disbursement of additional dollars to a state's commitment to establish stable and adequate sources of maintenance funding. Funding for maintenance is plagued by political wrangling, leading to years of deferred maintenance. A proper division of commitments between federal and local authorities can enable the long-term health of US infrastructure (Fitzsimmons 2017).

Make Infrastructure Adaptive and Plan for Technological Change

Accurate data and infrastructure that allow for the widespread use of user fees will provide authorities with the tools to finance and prioritize the highest net benefit infrastructure projects across the country. The power of these tools is their ability to provide up-to-date information and to allow for more dynamic use of the infrastructure. New technologies develop and both add to the nation's infrastructure and sometimes displace existing modes. Fiber-optic replaces coaxial cable. Cellular telephony decreases the need for additional landline infrastructure. Solar and wind power create a need for connectivity upgrades but may eventually decrease the need to expand traditional transmission lines, when large-scale affordable battery storage that nets out to environmental improvement, accounting for manufacture and disposal, eventually becomes available. Demand also changes as the population both grows and ages, and the shock of the COVID-19 pandemic makes working from home more common (Aksoy et al. 2022; Aksoy et al. 2023).

While so much of the future is hard to forecast, we know, as the Greek philosopher Heraclitus wisely noted, that the only thing that remains constant is change, whether in technology or in population patterns. Infrastructure by its very nature is inclined to be fixed, serving as the foundation and conduit for economic activity. However, knowing what we know now, for example, about the negative unintended consequences of lead, asbestos, and fossil fuel usage, along with a range of threats facing American infrastructure, we would do well to have systems in place that allow us to adapt our infrastructure to new knowledge and evolving challenges.

Winter Storm Uri, which took out power across Texas for days in February 2021, is a prime example. Though the frequency of such storms had been

forecasted to grow, the state and its energy producers failed to adapt and properly insulate and winterize their systems (Norton 2021). While other states were hit similarly hard by the storm, their infrastructure and their ability to tap into energy sources across state lines kept them from experiencing the kind of humanitarian crisis that unfolded in Texas. Similar episodes abound, from Hurricane Katrina in New Orleans and lead contamination in Flint, Michigan, to the Oroville Dam crisis in California and the Colonial Pipeline ransomware attack that shut down fuel delivery to the East Coast (Plumer 2017; Sanger and Perlroth 2021).

Local authorities know their needs and vulnerabilities best, but coordination across jurisdictions is often crucial to crisis preparedness and response. This is where federal authorities can play an important role in setting sensible standards for safety and maintenance, incentivizing timely monitoring and reporting of issues, and facilitating collaboration and coordination across authorities. To ensure the resilience and long-term productivity of infrastructure across the country, we need to make sure that our investments in construction and maintenance are forward looking and have the entire country's social welfare in mind.

Focus Federal Policy on Incentives

An important role of the federal government should be to put in place the right incentives for the state, local, and private actors so that returns on taxpayer investments are maximized. In practice, this means incentivizing uniform data collection and rigorous cost-benefit analysis; helping localities move to user fee–based financing systems; encouraging investments in adaptive infrastructure through long-run rather than short-run planning; and realigning cost-sharing and matching grants to reflect local, state, and national benefits far more closely. In cases where infrastructure crosses state lines, has substantial spillovers, or where (reasonably set minimum) uniform standards across the country allow net benefits to be increased, the federal government should serve a coordinating role. While federal financing can serve as a powerful carrot and regulation as a powerful stick, rigorous cost-benefit analysis should be guiding the federal government's use of these tools, as it should at the state and local level (California's high-speed rail boondoggle is a classic example of poor ex ante cost-benefit analysis).

And that analysis must include accurate information on the distribution of (potential) benefits among local, state, and national jurisdictions. To cite a core potential problem, if the federal government is paying for 80 percent

of an infrastructure project and the state (or local) government 20 percent, that means the elected representatives at the lower level have an incentive to promote projects with pretty low local benefits, in theory anything over 20 percent of the cost, since their voters will only pay 20 percent. But all have that incentive, so in total there can be lots of poor-return projects unless the spillovers are the large majority of benefits. Since we are all residents of a locality, a state, and the nation, inattention to this issue can result in massive wasteful fiscal cross-hauling. In theory, the reverse could also be true if the federal share is far smaller than the spillover percentage. But in practice, most federal funding comes with large federal shares that likely exceed spillovers, in some cases substantially.

Careful consideration should be given to the incentive structures built into fund disbursements to prevent moral hazard at the local level and a kind of tragedy of the fiscal commons. Increasing competition and transparency in the procurement process (e.g., Lewis-Faupel et al. 2016; Liscow, Nober, and Slattery 2023); encouraging experimentation with auction designs that limit bureaucratic disruptions and take into account time to completion (e.g., Summers and Lipson 2016; Gupta et al. 2015), as was successfully done in California in response to the freeways collapsing from the Northridge earthquake; allowing allocated budgets to roll over instead of expiring at the end of a fiscal year (e.g., Liebman and Mahoney 2017); and discouraging excessive customization in project design (e.g., Goldwyn, Levy, and Ensari 2020) are all areas where federal action can play an important role. Random audits of the use of federal funding for effectiveness, coupled with enhanced transparency, could also help increase accountability and success while decreasing corruption (e.g., Ferraz and Finan 2008; Campos et al. 2021). Finally, incentivizing crisis prevention, in the same way that health insurance companies incentivize healthy behaviors to decrease the probability of expensive future procedures, should help states invest in maintenance and adaptation to emerging threats. In effect, the more the federal government serves as a catalyst rather than a micromanager, the better.

Short-Run Stimulus, Long-Run Investment, or Both?

Many policymakers, interest groups, and constituents alike still view infrastructure spending as shovel-ready work that is both desperately needed and great at creating new jobs. Recent academic evidence on the matter, however, suggests that better allocation of infrastructure spending versus increased spending is more important for long-run productivity (Duranton, Nagpal,

and Turner 2020) and casts doubt on whether a large allocation of federal funds for infrastructure will work to effectively reduce unemployment (e.g., Balat 2017; Gallen and Winston 2019; Ramey 2020).

Garin (2019) studies how funding allocated by the federal government for road construction projects through the 2009 American Recovery and Reinvestment Act (ARRA) affected local employment. He finds that every dollar of ARRA spending increased local construction payrolls by thirty cents but had virtually no effect on employment.[4] Balat (2017) analyzes the effect of ARRA spending on highway-related procurement in California, finding that the sudden infusion of cash into an industry that was already working near capacity did not grow the number of construction firms or construction employment but resulted in higher procurement prices. This capacity constraint is directly at odds with a 1930s vision of what infrastructure spending can accomplish. The highly specialized and technologically advanced nature of the work now requires skills, experience, and certifications that make it difficult to quickly expand the number of firms and workers. In California, Balat (2017) finds that the government not only paid 6.2 percent more on ARRA projects, it also paid 4.8 percent more on other projects as a result of ARRA, thereby increasing construction company revenues but forgoing about $335 million that could have been spent on other roadwork.

Additional studies, such as Ramey (2020), demonstrate that infrastructure spending is usually slow to move from appropriation to implementation to actual use, making even the most productive and most shovel-ready projects poor candidates for short-run economic stimulus. In fact, as Gallen and Winston (2019) argue, disruptions that come from a slew of highway infrastructure projects can even result in negative short-run effects on total employment. Studies of the ARRA also provide cautionary tales on the ability of infrastructure spending to create jobs in the short run and on the cost of doing so. Leduc and Wilson (2017), for example, find a "flypaper" effect, whereby federal highway grants under ARRA induce states to spend more of their own funds on highway infrastructure as well. The explanation for this apparent—it may just be spending that would have occurred anyway but was delayed in anticipation of the federal funds—complementary state spending, however, is rent seeking: states with the largest volume of political contributions from public works contractors are the ones that see the largest flypaper effects. Moreover, the study measures the direct effects of federal spending on highway construction-sector employment and finds

a cost of $500,000 per job in 2010. This is considerably more costly than the roughly $125,000–$200,000 per job that other papers have attributed to ARRA spending overall (Wilson 2012; Conley and Dupor 2013), and about ten times higher than typical construction worker earnings at that time.

Long-run productivity is a different story, but the devil is in the details. As discussed above, the research literature generally stresses that quality and rigor behind fund allocation is key to large long-run returns, much more so than the sheer volume of spending. Other research also makes clear that infrastructure spending can generate long-run winners and losers. Analyzing the effects of new regional highway construction in China, Baum-Snow et al. (2020) show that such construction can increase population and economic output in major cities at the expense of the hinterlands. Highways that improve connections to major ports, however, appear to make all areas better off. Careful consideration of spillovers and path-dependency during cost-benefit analyses is thus crucial for project selection and prioritization, as well as for state and federal financing decisions.

Reflecting on Past Experiences and Looking Ahead

What can we learn from recent infrastructure policies as we look ahead to future legislation and reforms that define local, state, and federal responsibilities for infrastructure? An abundance of recent experiences has highlighted how crucial effective, reliable, and safe infrastructure is to the well-being of citizens across the country. Whether it's lead contamination in Flint, Michigan, erosion at the Oroville Dam in California, a sewage line failure in Jackson, Mississippi, or the collapse of the I-35W bridge in Minneapolis, Minnesota, communities take a huge human and economic hit when the infrastructure they rely on fails. The May 2021 closure of the I-40 bridge linking Arkansas and Memphis, Tennessee—home to FedEx and the largest cargo airport in the world—also illustrated that infrastructure failures can cause disruptions that reverberate far beyond the immediately affected community. The flip side of these notable failures is the simple, yet often neglected, fact that when the infrastructure we take for granted is working well, it is generating benefits that make our quality of life possible.

Infrastructure failures and successes are often determined by policy, with high stakes for getting it right. Failure by authorities to arrange for adequate incentives and resources for maintenance can result in disruptions or worse, consequences that are possibly costlier than the maintenance would have

been in the first place. Negligent cost estimates, unmoored from responsible cost-benefit analysis, can lead to wasteful spending with low returns on investment. Thinking of infrastructure spending as effective short-run economic stimulus and trying to rush spending risks backlogs, higher prices, and hundreds of thousands of taxpayer dollars spent for each job created. On the other hand, setting incentives right after a major disaster, like the $200,000-a-day bonus for contractors to speed up Santa Monica Freeway repairs after the 1994 Northridge earthquake, can spur cost-effective infrastructure repairs and get the economy moving again. Partnerships between states and the federal government to improve forest management on federal lands can reduce wildfire risk and the associated destruction. And having federal authorities serve as arbiters when neighboring states cannot resolve water usage disputes, as the government did in the spring of 2023 with Arizona, California, and Nevada around usage of the Colorado River, can ensure that communities have access to fresh water for the long run. As these and many other past experiences have shown, the relationship between the federal and local governments can either generate pitfalls or prevent them.

The 2021 Infrastructure Investment and Jobs Act (IIJA) is a valuable case study of policy, both good and bad. By allocating $550 billion over five years in *additional* federal funding for roads, bridges, transit, ports, airports, the electric grid, water systems, and broadband—increasing federal funding on infrastructure over this period to $1.2 trillion—the law makes a historically large investment in the nation's infrastructure (Tomer et al. 2021). Table 8.2 breaks down the allocation of *additional* funds by type of infrastructure, in the context of several other recent infrastructure bills. Federal spending on ports, waterways, airports, cybersecurity, and environmental monitoring infrastructure has especial potential to generate positive externalities across the country and appears to follow the principle that projects with positive externalities should be subsidized. Federal spending on broadband in low-income and rural areas also has the potential to be appropriate under the same principle. Some education scholars estimate the social return on such investment for public K–12 education alone to be above 200 percent in states such as Alabama (Goulas, Han, and Raymond 2021); if even a quarter of that return was realizable, these would be outstanding investments. In contrast, it is not clear why the federal government, rather than states and localities, should be paying for school buses and ferries.

Table 8.2 Infrastructure allocations over time, by act (2009–2022)

ARRA (2009)		MAP-21 (2013-2015)		FAST Act (2016-2021)		IIJA (2022-2026)	
Infrastructure	**Spending allocated**	**Infrastructure**	**Spending allocated**	**Infrastructure**	**Spending allocated**	**Infrastructure**	**Additional spending allocated**
Transportation infrastructure	**48.1**	Highways	77.2	Highways	225	Roads and bridges	110
Highways and bridges	27.5	Transit	21.6	Transit	61	Passenger and freight rail	66
Transit	8.4	Safety	2.2	Rail	20.5	Safety	11
Rail	8	Other	4.1	Safety	16	Public transit	39.2
Airports	1.3	**Total**	**$105.1 billion**	Research	4	Broadband	65
Ports	1.5			**Total**	**$326.5 billion**	Ports and waterways	16.6
Other transportation	1.4					Airports	25
						Water infrastructure	55
Energy infrastructure	**39.3**					Power and grid	65
Smart grid and transmission	11					Resiliency	47.2
Renewable energy	9.4					Clean school buses and ferries	7.5
Energy efficiency	6.3					Electric vehicle charging	7.5
Fossil energy research	4.6					Reconnecting communities	1
Carbon capture	3.4					Addressing legacy pollution	21
Nuclear energy	2.4					Western water infrastructure	8.3
Other energy	2.2					**Total**	**$545.3 billion**
Water and environmental	**18.2**						
Clean/drinking water	6						
Superfund, brownfields cleanup	1.2						
Environmental restoration, preservation	3.4						
Other	7.6						
Broadband	7.2						
Other infrastructure	11.2						
Total	**$124 billion**						

Note: (1) MAP-21 was extended through 2015 by the Highway and Transportation Funding Act of 2015. (2) The ARRA was a single-tranche investment in 2009. The infrastructure bill in place was SAFETEA-LU (2005–2009, extended through 2012 until MAP-21 augmented it).

Laudably, the law allocates a significant amount of funding, across infrastructure categories, through a competitive grant process that has the potential to ensure the money goes to projects with high benefit-cost ratios—if and only if the politics that usually seeps into the decision can be kept at bay. Two sections of the legislation also place a commendable, if still limited, emphasis on user fees. Section 13001, titled "Strategic Innovation for Revenue Collection," extends $75 million over five years to municipalities and state-level DOTs in support of pilot programs that explore "user-based alternative revenue mechanisms . . . to maintain the long-term solvency of the Highway Trust Fund." Section 13002 in turn dedicates $50 million over five years toward a nationwide motor vehicle per-mile (VMT) user fee pilot, with the same objective. While these pilots do not commit Congress to implementing user fees in future legislation, they will result in a report and should provide a basis for a more informed nationwide conversation on sustainable infrastructure financing, one that does not require Highway Trust Fund bailouts with general taxpayer dollars. Moreover, with Utah, Oregon, Virginia, and Hawaii now voluntarily running their own VMT programs, we should soon have additional evidence on the pains and benefits of user fees straight from these laboratories of democracy.

As table 8.2 demonstrates, federal infrastructure spending has come in waves that are heavily influenced by the political process. ARRA directed about $124 billion toward a wide range of infrastructure categories, in response to infrastructure needs but also to an economic and financial crisis. In a similar vein, the IIJA of 2021 was motivated as much by need as by the misguided view that the spending would create many new jobs. The law, as a result, does not fundamentally address pitfalls in the existing structure of federal infrastructure spending. One-off spikes in federal appropriations risk not only backlogs and higher prices but also an unsustainable "build-it-and-forget-it" mindset that perpetuates unfunded and deferred maintenance.

User fees and the creation of sustainable funding mechanisms that support the infrastructure over the long term are notably missing from the law, leaving us with significant incentives for localities to shirk on spending their own dollars on infrastructure, waiting until the infrastructure is in bad shape, and hoping for another windfall from the federal government. Indeed, a study of federal spending through the ARRA found states decreasing their own spending on highways by 81 percent in response to the influx of federal funds (Dupor 2017). A 2021 CBO report of various federal infrastructure spending scenarios projected that states would decrease spending on physical

infrastructure by fifteen cents for every federal dollar allocated; the report's 2016 analysis, looking more broadly at federal allocations, projected state and local spending would decrease by thirty-three cents for every federal dollar (CBO 2021).

The IIJA sections that invest in user fee pilots and move us toward more sustainable income streams for the Highway Trust Fund capture the spirit of what is necessary. The roller-coaster nature of the balance of the Highway Trust Fund, shown in figure 8.1, captures well the current unsustainability and inconsistency of federal infrastructure spending. Future legislation should build on the IIJA and do what the IIJA, ARRA, Moving Ahead for Progress in the 21st Century Act (MAP-21), Fixing America's Surface Transportation Act (FAST Act), and other infrastructure legislation have failed to do: combine federal infrastructure spending, especially capital spending, with requirements for minimum maintenance funds for the new infrastructure and incentives for complementary financing through user fees.

In addition to user fees, future legislation should work on reforms that set better incentives in other respects as well. It should revise the 90-10 rule for federal-state spending shares on the Interstate Highway System. As a 2018

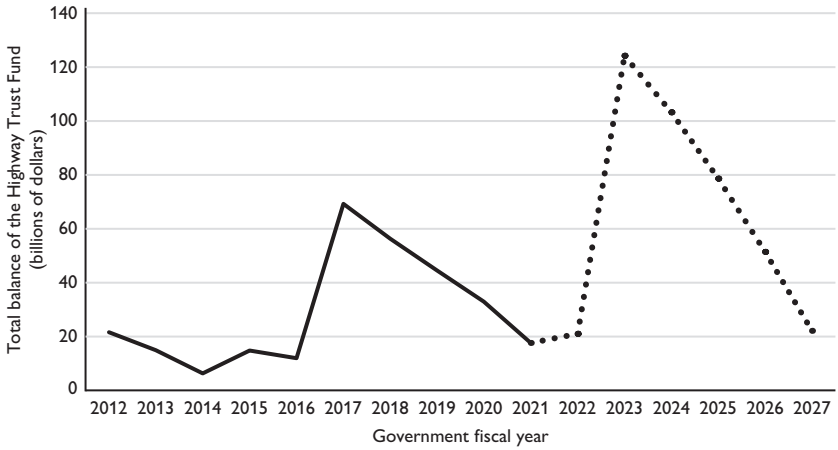

Figure 8.1 Total balance of the Highway Trust Fund (2012–2027)

Note: Highway Trust Fund start-of-year balances from 2012–2021 reflect the actual account balance at the beginning of the year. For the years 2022–2027, the projections are taken from the FY2023 budget. Prior to FY2017, the Highway Trust Fund was referred to as the Transportation Trust Fund in the Income, Outgo, and Balance tables of the Budget.

Source: Analytical Perspectives, Budget of the United States Government, FY2014–23.

CBO analysis showed, in 2017 the federal government covered 41 percent of all capital spending on transportation and water infrastructure and 10 percent of the operation and maintenance costs for that infrastructure, a strong contrast to its coverage of 90 percent of spending on interstate highways (CBO 2018). An improved approach, to interstate highway funding and to funding of other forms of infrastructure, would anchor the spending shares to clear and systematic calculations of national and local costs and benefits. For a start, an update to Ned Gramlich's analyses from the 1990s that found 67 percent of spending on interstate highways benefits the local area and that most interstate highway drivers are from within the same state (Gramlich 1990; Gramlich 1994), would be a helpful foundation for revisions of the 90-10 rule. Indeed, Duranton, Nagpal, and Turner note in a similar spirit that "like public transit, the Interstate system is largely organized around the provision of short trips in urban areas" (2020, 166).

Future legislation should also ground itself in firmer assumptions on returns to investment. The IIJA assumes, for example, a 33 percent return on investment from some of the spending, expecting $56 billion in additional tax revenue to cover over 10 percent of the additional federal spending. Such a return is wildly unrealistic and considerably exceeds CBO estimates (ranging from 6 percent to 9.2 percent) and academic estimates (5 to 12 percent) for returns on infrastructure spending (CBO 2021; Ramey 2020). Although spread out over five years, the law comes at a time of large supply-chain disruptions from the COVID-19 pandemic, worker shortages, backlogs for contractors, and rising inflation—all of which do not bode well for getting a lot of bang for the taxpayers' buck. Further raising alarms are members of the Society for Benefit-Cost Analysis who have recently warned that the Office of Management and Budget is being politicized and building value judgments into calculations of economic efficiency that are distorting decision making (Dudley and Viscusi 2023).

Finally, observers have noted that the allocation of funding through competitive grants, with a cumbersome submission process and the absence of adequate data infrastructure in many localities, can result in winning localities where the returns on investment are not as high as they can be (Tomer et al. 2021). Helping states and localities build out data systems that allow them to run pilots, monitor their infrastructure, and compete for competitive grants on relevant outcomes could thus have also been a valuable feature of the law and should be considered in future legislation.

Conclusion

The Infrastructure Investment and Jobs Act of 2021, historic in its size and scope, will likely not be the last historic federal infrastructure spending bill to wind up being debated in Congress. Leaning, however, on existing research and on the work that will likely come out of evaluations of the IIJA, policymakers would do well to move on from views that large infrastructure spending bills are a good short-run stimulus and a cost-effective way of addressing our country's infrastructure needs. Instead, this chapter encourages work toward a world where our infrastructure is consistently and sustainably funded with incentives for both overall quality and usefulness, and where the allocation of responsibilities among different levels of government avoids wasteful fiscal cross-hauling. The principles we present here—establishing capabilities and incentives for rigorous cost-benefit analysis; prioritizing highest net benefit projects; financing with user fees wherever possible; making infrastructure adaptive and planning for technological change; and making federalism about incentives—are meant to guide policymakers who embark on this task. Using these principles, we believe policymakers at each and all levels of government can better leverage our federal system—making the most of our cities and states as laboratories of democracy—to avoid boondoggles and waste, while increasing the country's long-run growth and productivity.

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Notes

1. Indeed, as they have done as of this writing.

2. London's Congestion Charge has so far been an example of significant success, reducing congestion and increasing property values in affected areas (Leape 2006; Tang 2021).

3. David Pearce is credited with being the first to note the fact that user fees both increase efficiency and generate revenues, calling this the "double dividend" (Pearce 1991).

4. At a June 13, 2011 press conference with the President's Jobs Council, President Obama himself acknowledged that "shovel-ready was not as shovel-ready as we expected."

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