

On the Performance of the U.S. Transportation System: Caution Ahead[†]

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Transportation is a vital sector of the U.S. economy based on consumers', firms', and government's enormous expenditures in money and time and on its effect on virtually all other sectors in the economy. I assess the performance of the transportation system and consider how it could be improved by analyzing whether the United States has the optimal mix of public and private provision. The empirical evidence indicates that our hugely important transportation system has been compromised by various government policies and the significant welfare costs motivate either vastly improving public provision or expanding the role of the private sector. (JEL H44, H54, H76, L91, L98, R41, R48)

1. Introduction

Transportation is a friction—a cost in both money and time—that must be incurred by individuals and firms to complete almost any market transaction. An efficient and extensive transportation system greatly enriches the standard of living in modern society by reducing the cost of nearly everything in the economy; expanding individuals' access to and choices of employers and employers' choices of workers; enabling firms and urban residents to benefit from the spatial concentration of economic activities, referred to as agglomeration economies; reducing

trade costs and allowing firms to realize efficiency gains from specialization, comparative advantage, and increasing returns; and limiting firms' ability to obtain market power by locating in geographically isolated markets with no competition. By increasing frictions, however, an inefficient transportation system, just like poorly functioning financial institutions (Hall 2010), can cause all sorts of economic activity to collapse.

Transportation is also important because it can be thought of as a merit good—that is, societies generally believe that citizens are entitled to accessible transportation to experience a decent quality of life no matter where they live, even if the cost of their service must be subsidized. To this end, both the public and private sector have provided and managed transportation throughout U.S. history and government policy has redistributed transportation resources across households

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with different incomes, between residents of urban and rural areas, across residents of different states, and between users of a specific service and general taxpayers.

Americans' annual expenditures in both money and time on transportation are enormous. As reported in 2007 dollars by Winston (2010), consumers spent \$1.1 trillion on gasoline and vehicles commuting to work, traveling to perform household chores and to access entertainment, and traveling for business and vacations, and spent an astronomical 175 billion hours in transit, which averages out to about 100 minutes per day for each and every American, valued at some \$760 billion. Firms spent \$1 trillion shipping products using their own and for-hire transportation, while the commodities that were shipped absorbed 25 billion ton-days in transit, valued at roughly \$2.2 trillion.¹ Local, state, and federal government spending on transportation infrastructure and services contributed an additional \$260 billion, bringing total pecuniary spending on transportation up to 2.4 trillion, or 17 percent of GDP in 2007, which is as much as Americans spent on health care, and total annual money and time expenditures to more than \$5 trillion! Finally, transportation looms large in American life because both the public and private sector have made huge investments in the transportation capital stock, which (after deducting depreciation) is valued by the U.S. Department of Commerce at nearly \$4 trillion (2009 dollars).²

¹Surveys of the value of time in transit indicate that a reasonable estimate is half the travelers' average hourly wage (Small and Verhoef 2007). The value of each day that a shipment spends in transit can be expressed as a fraction of the value of the shipment to reflect a daily discount rate. For example, Winston and Langer (2006) assumed shippers have a 7 percent daily discount rate, bounded by 15 percent for certain perishable commodities and 5 percent for bulk commodities.

²The value of the capital stock consists of the 4-million-mile road system, including roughly 46,000 miles of interstate highways, valued at some \$2.8 trillion; the

The fact that this sector is so large and simultaneously so intertwined with virtually all other sectors in the economy suggests it is vital to assess the performance of the transportation system and to consider how it could be improved. At first blush, this appears to be a daunting task given the system's size and complexity. However, because the government is so heavily involved in the system's performance through its management of public infrastructure and services, regulation of private sector competition and externalities, and subsidies for travelers and private carriers, my view is that a constructive assessment can be performed in this paper by analyzing whether the United States has the optimal mix of public and private provision of transportation. And while I focus on the U.S. transportation system, my discussion is relevant to all transportation systems that must consider this issue.

In what follows, I outline the theory of efficient provision of transportation, describe how public-private provision in the United States has evolved historically, and summarize the salient features of the current system. I then survey the empirical literature on the public sector's performance, which indicates that our hugely important transportation system has been compromised by policies that have resulted in inefficient pricing, suboptimal investments, and inflated production costs that are manifested in congestion, delays, budget deficits, and excessive money and time costs to users and excessive government expenditures on transportation.

The hundreds of billions of dollars in welfare costs motivate either improving public provision or expanding the role of

rail freight network of 160,000 miles of track, valued at \$340 billion; pipelines valued at \$167 billion; and public airways, waterways, and transit structures valued at \$568 billion. The source of the estimates is the U.S. Department of Commerce, Bureau of Economic Analysis, Fixed Asset Tables, tables 3.1ES, 7.1B, 8.1, and Nonresidential Detailed Estimates, available at www.bea.gov.

the private sector. I point out that political forces and limitations of transportation agencies strongly contribute to inefficient policies and, in my view, constrain efficient improvements in public provision. Thus, for example, policymakers have called for a significant increase in spending on the nation's transportation infrastructure, but they have not considered how inefficient pricing policies have prevented travelers and shippers from making efficient use of existing infrastructure and how mispricing has distorted signals for investments in new capacity.

An alternative policy—privatization and deregulation—calls for fundamental institutional change to rid the system of its shortcomings that are attributable to current government policies and to rely on market competition to allocate transportation resources efficiently. Theoretical arguments and empirical evidence based on international experiences and simulations of the effects of privatizing certain parts of the U.S. system provide some support for this approach but they do not resolve all of the important uncertainties about its effects in practice. I therefore call for modest, localized experiments that would give economists and other analysts the opportunity to develop crucial empirical evidence based on actual U.S. experiences to help guide policymakers' decisions on what parts of the transportation system, if any, should be privatized and deregulated to improve its performance.

2. Public-Private Provision: Theory, Historical Evolution, and the Current System

Economic theory identifies conditions when social welfare will be enhanced if the private sector provides transportation, when it will be enhanced if the public sector provides it, and when the socially optimal choice of sector is not clear. The historical evolution of public-private provision in the United

States shows that policymakers are willing to change the mix of provision when certain parts of the system are performing poorly. Changes in the current system may therefore be justified because it has not been particularly responsive to users' travel preferences and to changing economic conditions.

Generally, public provision is justified if the private sector would fail to provide socially desirable services—that is, services whose social benefits exceed social costs. For example, infrastructure facilities such as highways, airports, and ports may be underprovided by the private sector because extremely large capital expenditures are required to purchase land and construct new facilities and because they share features with pure public goods, such as a user's marginal cost is zero when the facility is uncongested. Accordingly, the public provider should maximize social welfare by providing infrastructure that is socially desirable and by charging users efficient prices that take account of externalities like congestion and by making efficient investment decisions that balance marginal benefits and costs. The public sector may also be justified for acquiring a private transportation industry's assets and providing the service the industry used to provide if that service is socially desirable and if the industry experiences a serious financial crisis that causes all its firms to go into bankruptcy. Alternatively, the government could offer the industry financial assistance and give it a chance to solve its financial problems and to provide service in a competitive environment.

Public provision or economic regulation may be justified if a mode has elements of a natural monopoly, which means that social costs would be minimized if one firm provided service in a transportation market. Freight railroads, urban rail transit systems, and ocean vessels operate with economies of scale and high fixed costs. Urban buses and air carriers exhibit economies of scale

in waiting time because an increase in service frequency reduces travelers' waiting times and increases demand, which reduces average costs. In theory, the firm providing service under those technological conditions could be a public authority that receives a subsidy because prices are set at marginal cost or it could be a private firm that is subject to price and entry regulation. It is also desirable for the government to introduce social regulations that maximize the difference between the benefits and costs of reducing externalities created by vehicle emissions and collisions.

Finally, public provision can be justified to pursue social goals such as ensuring that the elderly and disabled have access to basic transportation in their community (for example, van service) even if such service requires taxpayer subsidies. The government should ensure that those services are provided at minimum social cost either by providing them directly or contracting with a private firm to provide them.

Private provision is justified in the absence of market failures. But even if market failures occur, private provision may be justified if the cost of government failure exceeds the cost of market failure. That is, the situations where public provision is justified in theory, call for the government in practice to implement efficient policies and to operate efficiently. Government failure arises when public provision of infrastructure results in inefficient prices, investments, and operations. Interest groups are a potent source of such failure because they can appeal to various layers of government to support socially undesirable infrastructure projects or to kill desirable policy reforms like congestion pricing. The cost of government failure may exceed the cost of market failure because the nation's transportation infrastructure is highly developed; thus, the private sector no longer faces the prohibitive capital requirements of building a new system of

roads and airports, it may be able to manage and operate the current infrastructure more efficiently than the public sector can, and if sufficient competition exists, it would not set excessive prices.

Government failure may also arise from economic regulations that are no longer justified but create the appearance of excess capacity and scale economies by, for example, preventing transit companies from abandoning routes with little patronage or preventing them from adjusting vehicle sizes to respond to fluctuating demand throughout the day. Constraints like those could impede technological change and more efficient operations that could enable private firms to exhaust scale economies and operate in a competitive deregulated market close to constant returns.

Finally, government's distributional goals could be exploited by interest groups who seek to share in the available subsidies. Thus government could offer transportation vouchers to targeted individuals whom society wishes to help and allow unsubsidized private firms to compete to provide the service. Private profit-maximizing firms make it more difficult for well-organized interest groups to obtain cross-subsidies (Peltzman 1976).

2.1 *Transportation Provision in Historical Perspective*

The United States has grappled with determining the optimal mix of public and private provision of transportation since its founding. All modes and infrastructure were initially developed and operated by the private sector. Starting with the Ohio Statehood Enabling Act in 1802, states provided limited funds for road building and in the 1820s, state governments subsidized and owned some canals and railways. But even by the 1860s, cumulative private capital investment in bridges, canals, ferries, railroads, and roads amounted to roughly \$3 billion (in 1860 dollars), a significant share of the nation's GDP (Wright and Murphy 2009).

It has been hotly contested whether government effectively responded or contributed to various financial crises that transportation firms experienced in subsequent decades. In any case, those crises resulted in all levels of government becoming increasingly involved in regulating, and in some cases operating and owning, the transportation modes and infrastructure. In 1887, the Interstate Commerce Commission (ICC) began regulating the railroads, ostensibly to prevent "destructive competition." And with the onset of the Great Depression, the ICC began regulating motor carriers in 1935 and the Civil Aeronautics Board began regulating the airline industry in 1938. Local and state governments took over private commercial airports during that period. States also became more involved in roads as private turnpikes failed financially during the depression. The federal government's involvement in the road sector, which began with grants in 1916 to help pay for constructing rural roads used to deliver the mail, peaked in the 1950s and 1960s with the construction of the interstate highway system.³

By the 1950s, city governments began to take over private, urban bus and rail systems as intense competition from the automobile accelerated the decline in transit ridership. Federal legislation in the 1960s gave cities money to buy most of the remaining private transit companies and convert them into publicly operated services.

The significant extent of public sector involvement in transportation may be attributable to market failures. Engerman and

Sokoloff (2006) argue that the investment required to build the Erie Canal was beyond what a private firm could manage during the early nineteenth century, and that on the whole, the canal's construction was well conceived and executed, and its operations were well managed. Goodrich (1960) credits the government for playing an expedient role in promoting the development of canals and railroads. Fishlow (1965) concluded that rail's contribution to U.S. economic growth in the antebellum period was substantial, underscoring the importance of government's role.

But this view is debatable. For instance, Fogel (1964), in his classic debate with Fishlow, questioned the importance of rail by arguing that rail's contribution to growth was relatively small compared with a hypothetical system of improved roads and canals that nineteenth-century Americans might have built in the absence of railroads.

The government has also been roundly criticized for contributing to and missing opportunities to reduce the cost of market failures. Klein and Fielding (1992) argued that government regulations of highway tolls during the nineteenth century greatly contributed to the failure of private highway companies. Pashigian (1976) and Hilton (1985) provided evidence that private bus operations failed because they were weakened by government regulations, and Meyer and Gomez-Ibanez (1981) pointed out that federal policy made it almost mandatory for cities to acquire their private transit companies instead of allowing them to raise fares to become profitable. White (2011) takes a dim view of government subsidies of the transcontinental railroads by arguing that farmlands would have been settled without the railroads and that the contractors and the financiers were the primary beneficiaries of the subsidies while the railroads continued to experience financial problems. Hilton (1966) disagreed with the subsequent economic regulation

³Congress decided in 1956 to authorize the Bureau of Public Roads to incorporate toll facilities in the Interstate system to ensure connectivity without added expense. The inclusion of this mileage, which today is 2900 miles of turnpikes included in the 46,730 mile interstate system, meant that Interstate construction funds that would have been used for construction of toll free interstate highways in those corridors could be used elsewhere to build interstate highways sooner than would otherwise have been possible.

of the industry that began in the late 1880s, although Bogart (2009) indicated that industry efficiency would have been worse if railroads were nationalized as they were in many other countries. Finally, the government takeover of private airports during the Great Depression has been questioned because a better course of action in the long run may have been to allow private airport competition to develop by offering struggling airports financial assistance so they could stay in business and eventually compete.

In the late 1970s, as part of a broader movement away from government intervention in the economy and a concern that economic regulation was preventing competition that could reduce prices during an inflationary period, Congress partially deregulated most intercity transportation services. Still, the presence of government in the transportation sector is immense. Currently, the government regulates private transportation to various degrees, including federal regulations of international passenger and air cargo service, international ocean shipping and inland water carriers, freight railroads, and pipelines, and state and local government regulations of taxis in most U.S. cities. Domestic airline service, motor carriers, and intercity buses are no longer subject to economic regulations, but government intervenes in those modes' operations by subsidizing bus and air service in certain markets and by providing and regulating aviation and highway infrastructure. Local governments, with state and federal financial backing, are quasi-monopolistic providers of intracity bus and rail transit. Amtrak, a federal government corporation, is a monopoly provider of intercity passenger rail transport nationwide and the federal government is subsidizing exploration of building a high-speed national passenger railroad network. Most U.S. roads, bridges, airports, and ports are owned and operated by federal, state, or local governments. And the federal

government owns and operates the air traffic control system. Finally, the government sets speed limits and promulgates vehicle safety and emissions regulations.

2.2 *Salient Features of the Current System*

The postwar evolution of the transportation system can be summarized by the major modes' amounts and shares of passenger and freight traffic. Concerns with public provision of transportation service and infrastructure have recently arisen because several modes have been experiencing serious financial and service-related problems as they have tried to adjust to changes in users' preferences and economic conditions.

At the end of World War II, rail transported nearly 70 percent of the nation's intercity freight, and transit—buses and subways—accounted for some 15 percent of the nation's commutes. Those modes experienced significant declines in traffic as truck and automobile transportation became more widespread.

By the 1960s the growth of the intercity trucking industry, spurred by the development of the interstate highway system that started in the previous decade, and the growing importance of specialized forms of transportation (e.g., water and pipeline) had put an end to the nation's heavy dependence on rail. Rail's decline was also exacerbated by economic regulation; however, following deregulation in 1980, rail significantly improved its operating efficiency and eventually began to regain market share that it had lost before deregulation. Today, rail, truck, inland water transport, and pipelines are all vital components of the intercity freight system (table 1).⁴

Despite the public sector's full takeover of urban bus and rail transit by the 1960s, their

⁴Air freight has a tiny share of traffic, but its value, especially international shipments, amounts to hundreds of billions of dollars.

TABLE 1
U.S. INTERCITY REVENUE FREIGHT TON-MILE DISTRIBUTION BY MODE: 1960–2007

Year	(Amounts shown in billions)				
	Rail	Truck	Water	Pipelines	Air
1960	579	285	220	229	1
1970	771	412	319	431	3
1980	932	555	407	588	5
1990	1,091	735	475	584	10
2000	1,546	1,193	646	928	16
2007	1,820	1,317	553	904	15

Percent of Total					
1960	44.1	21.7	16.9	17.4	0.0
1970	39.8	21.3	16.4	22.3	0.2
1980	37.5	22.3	16.4	23.6	0.2
1990	37.7	25.4	16.4	20.2	0.3
2000	35.7	27.6	14.9	21.4	0.4
2007	39.5	28.6	12.0	19.6	0.3

Sources: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, National Transportation Statistics, table 1-46b, available at http://www.bts.gov/publications/national_transportation_statistics/ as of December 2009. Data for 1960–1980 from Association of American Railroads, *Railroad Facts*.

mode shares, and their combined patronage for work trips, have diminished considerably (table 2). It is unclear whether—and under what regulatory conditions—private bus and rail transit would have performed better. In any case, the nation's large investment in the road system, and rising incomes, and growth in the number of suburban workplaces and residences—and the inability of transit operations to respond to those changes—have increased commuters' preferences for traveling in their automobiles, causing auto's share of work trips to climb to 90 percent as of 2009.

Periodic surveys of domestic intercity travel summarized in table 3 indicate, as expected, that automobiles and increasingly airplanes are mainly used for those trips and that bus

and rail's combined share of domestic intercity travel is less than 5 percent. The decline in rail's patronage has continued under Amtrak, which took over private rail's unprofitable passenger operations in 1970. As noted later, bus service, which did not increase its traffic share for more than two decades after it was deregulated in 1980, has recently been expanding nationwide as new operators have entered the industry, so its share of domestic intercity travel is expected to increase.

Given the economic and regulatory conditions at the time, the private sector had little choice but to sell its urban bus and rail and intercity passenger rail operations to the public sector, which has not turned those modes around. As their shares have declined, bus

TABLE 2
MEANS OF TRANSPORTATION TO WORK, 1960–2009

<i>Item and mode</i>	1960	1970	1980	1990	2000	2009
Primary means of commuting (millions of workers)						
Privately owned vehicle	41.3	59.7	81.2	99.5	112.7	119.4
Bus	5.3	4.2	3.9	3.5	3.3	3.7
Subway/rail	2.4	2.3	2.1	2.3	2.5	3.1
Walk	6.4	5.6	5.4	4.5	3.8	3.9
Other	1.6	1.9	1.6	1.7	1.8	2.4
Commuting (percent of workers)						
Privately owned vehicle	72.5	81.0	86.2	89.2	90.8	90.1
Bus	9.3	5.7	4.1	3.1	2.7	2.8
Subway/rail	4.2	3.1	2.2	2.1	2.0	2.3
Walk	11.2	7.6	5.7	4.0	3.1	2.9
Other	2.8	2.6	1.7	1.5	1.5	1.8

Notes: Privately owned vehicle includes solo drivers and carpoolers. The “other” category includes ferryboat, taxi, motorcycle, and bicycle.

Sources: 1960–1990 data—Provided by the Journey-to-Work and Migration Statistics Branch, Population Division, U.S. Bureau of the Census. 2000 data—U.S. Bureau of the Census, Journey to Work: 2000, tables 1 and 2, 1990–2000, March 2004 (www.census.gov/population/www/socdemo/journey.html). 2009 data—U.S. Bureau of the Census, 2009 American Community Survey, tables B08301 and S0802. (Additional resources: www.census.gov)

and rail transit have required ever-greater subsidies to cover their operating deficits, not to mention their capital costs (figure 1). Subsidies may be justified for public enterprises with scale economies, but I argue later that transit’s growing subsidies reflect persistent inefficiencies. Amtrak’s annual subsidies have also grown as its share has declined, currently exceeding \$1 billion.

At the same time, the growth of auto, truck, and plane traffic is placing great strains on highway and airport infrastructure, contributing to budgetary problems and system delays. When the Highway Trust Fund was created in 1956, it was expected to pay obligations for road maintenance and capital improvements that were incurred by the states. Although

highway traffic has grown causing, for example, road pavement to deteriorate more than proportionally, the federal gasoline tax, which is the primary source of user fee revenues, has not been raised since 1993 and by 2007, total user fee revenue accounted for only 65 percent of all funds for highways—down from 84 percent ten years earlier—with non-user fees and bonds providing the rest of the funding. In fact, Congress has recently added general funds to the Trust Fund to close what would otherwise be a deficit. Projections by the Congressional Budget Office indicate a deficit for the foreseeable future under the assumption that such general funds will not be provided, meaning that the U.S. Department of Transportation would have to ration the

TABLE 3
DOMESTIC INTERCITY PASSENGER-MILES BY MODE

(Billions of Passenger-Miles)	1970	1980	1990	2000	2004
Item and mode					
Primary means of travel					
Privately owned vehicle	1,026	1210	1,452	1,513	1,629
Air	110	204	346	516	558
Bus	25	27.4	23	64	61
Rail	11	11	13	6	6
Travel Share (percent of miles traveled)					
Privately owned vehicle	86.9	82.5	78.6	71.8	71.9
Air	9.3	13.9	18.7	24.5	24.7
Bus	2.1	1.9	1.2	3.1	2.7
Rail	0.9	0.7	0.7	0.3	0.3

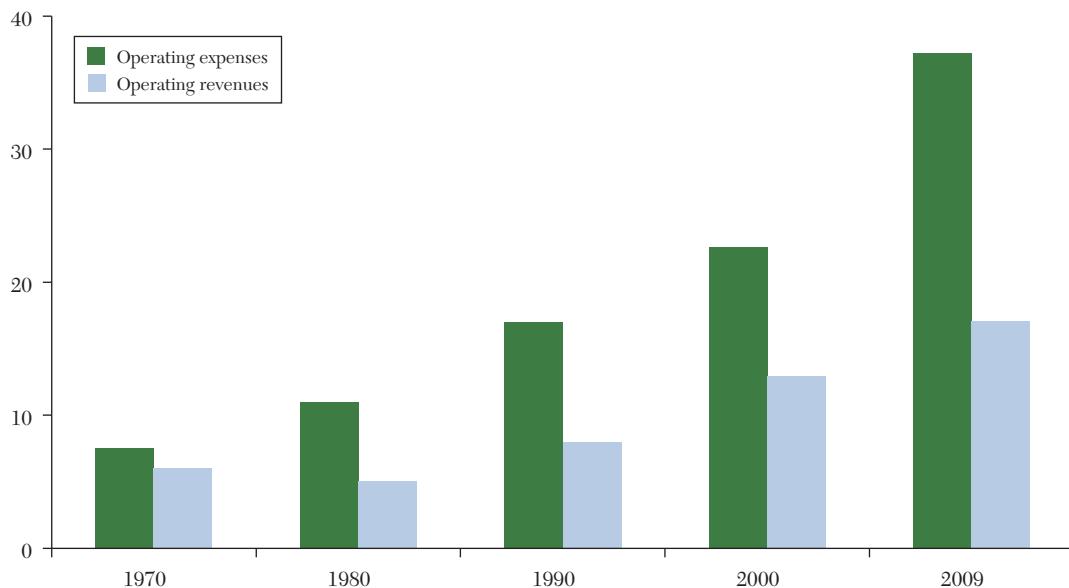
Sources: Data for 1970–1980 from *Transportation in America*, eighteenth edition. Data for 1990–2004 are from *Transportation in America*, twentieth edition.

amount it reimburses to states by statute (figure 2). Highway performance has been affected as road capacity has fallen further behind demand and delays have increased. Figure 3 shows that the average annual traffic delay endured by motorists in urban areas has more than doubled during the past three decades. The Texas Transportation Institute reports in its *Urban Mobility Report* that the annual cost of congestion, accounting for travel delays and expenditures on fuel, currently exceeds \$100 billion. In addition, despite frustratingly frequent lane closures for road repairs, highway crews cannot seem to outpace the rate of pavement deterioration. Data from the Federal Highway Administration, *Highway Statistics*, indicate that although the condition of the nation's highways and bridges varies with general economic conditions, as much as one-third of the nation's highways may be in poor or mediocre condition, and one-quarter of the

nation's bridges may be functionally obsolete or structurally deficient for several years.

Airports are experiencing similar problems. Since 2000, the aviation trust fund has been running annual deficits of \$3 billion–\$5 billion that have been covered by general taxpayer funds (figure 4), and travel times by air, due to greater airport and airspace congestion, have steadily increased since airlines were deregulated in 1978 (figure 5). Ball et al. (2010) estimate that in 2007 the cost of air transportation delays to air carriers was \$8.3 billion and the cost to passengers, accounting for flight cancellations and missed connections, was another \$16.7 billion.⁵

⁵Domestic air cargo flights that can operate outside of congested time windows suffer little delay. But domestic air cargo that is carried in passenger aircraft and international air cargo, which have a combined value of roughly \$500 billion, is delayed. Thus, the cost of delays would be even larger if the cost to shippers of air freight were included.



*Figure 1. Public Transit Industry Operating Revenues and Expenses 1970–2009
(Billions of dollars)*

Source: APTA, *Public Transit Fact Book 2011* and previous years
<http://www.apta.com/resources/statistics/Documents/FactBook>

3. Some Methodological Considerations for Assessing Transportation Policies

The appropriate role of the public and private sector has been analyzed more in transportation than in any other economic activity (McFadden 2011), resulting in a long tradition of empirical policy studies beginning with the classic assessments of intercity transportation regulation by administrative agencies (Meyer et al. 1959 and Caves 1962) and estimates of the economic effects of reforming price and entry regulations of the various modes (Winston 1985, 1998) and of implementing efficient infrastructure pricing and investment policies (Small and Verhoef 2007).

A careful assessment of a government transportation policy should account for

the essential features of transportation: the role of space, the importance of time, and the multiplicity of users' decisions. Users demand and firms supply transportation—namely, passenger and freight trips defined by origin and destination pairs—because activities are spatially separated. Small and Winston (1999) and McFadden (2001a) survey the literature that has developed the tools for analyzing transportation demand and Braeutigam (1999) and McCullough and Heerman (2010) survey the literature that has developed the tools for analyzing transportation costs and supply.

Spatial separation means that travelers and goods take time to reach their destinations. Of course, time is an attribute of all consumption (Becker 1965), but it is especially important in transportation because it

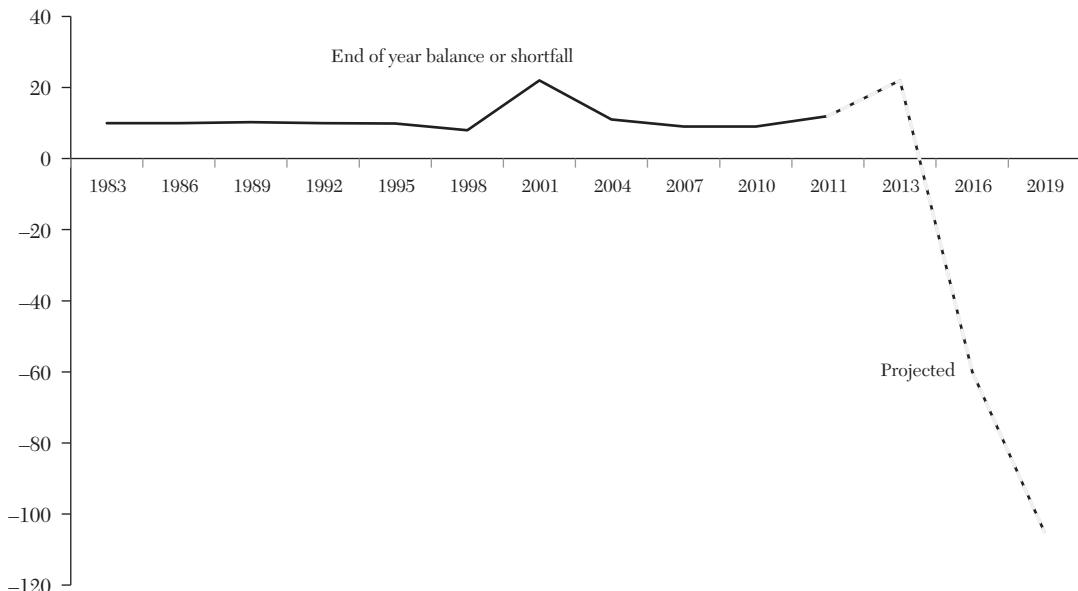


Figure 2. Budgetary Status of Highway Account of the Highway Trust Fund*
(Billions of dollars)

Source: Congressional Budget Office <http://www.cbo.gov/ftpdocs/121xx/doc12173/05-17-HighwayFunding.pdf>

*The projected loss assumes that general funds will not be provided to close the deficit.

encompasses many aspects of a trip, including its timing and reliability, and because individuals differ in their value of travel time and reliability (Small, Winston, and Yan 2005). Hensher (2011) surveys the literature that measures the value of travel time. Time also interacts with efficient pricing decisions, such as yield management to price scarce aircraft seating capacity and time-of-day pricing to allocate scarce (high-occupancy-toll) lane capacity. Efficient pricing of transport capacity subject to time-varying demand guides efficient investment decisions, which are independently affected by time because infrastructure (e.g., road pavement) has finite durability and demand is uncertain. Thus efficient investment involves tradeoffs of initial and ongoing expenditures to minimize total lifecycle costs.

Finally, transportation often involves a multiplicity of users' decisions, including the choice of mode, carrier, destination, routing, and departure time as well as non-transport choices, such as shipment size, and long-run decisions, such as residential location, workplace, and vehicle ownership. Those are often discrete decisions that can be analyzed by qualitative choice models that preferably are estimated with disaggregated data to avoid aggregation biases.⁶

⁶McFadden (2001b) recounts his famous example of estimating a disaggregated multinomial logit model with data on individuals' mode choices to predict that a new mode in the San Francisco Bay Area, BART, would attract 6.3 percent of work trips, which stood up very well to its actual share of 6.2 percent. In contrast, a conventional (aggregate) gravity model using data on market mode shares predicted that BART's share of work trips would be

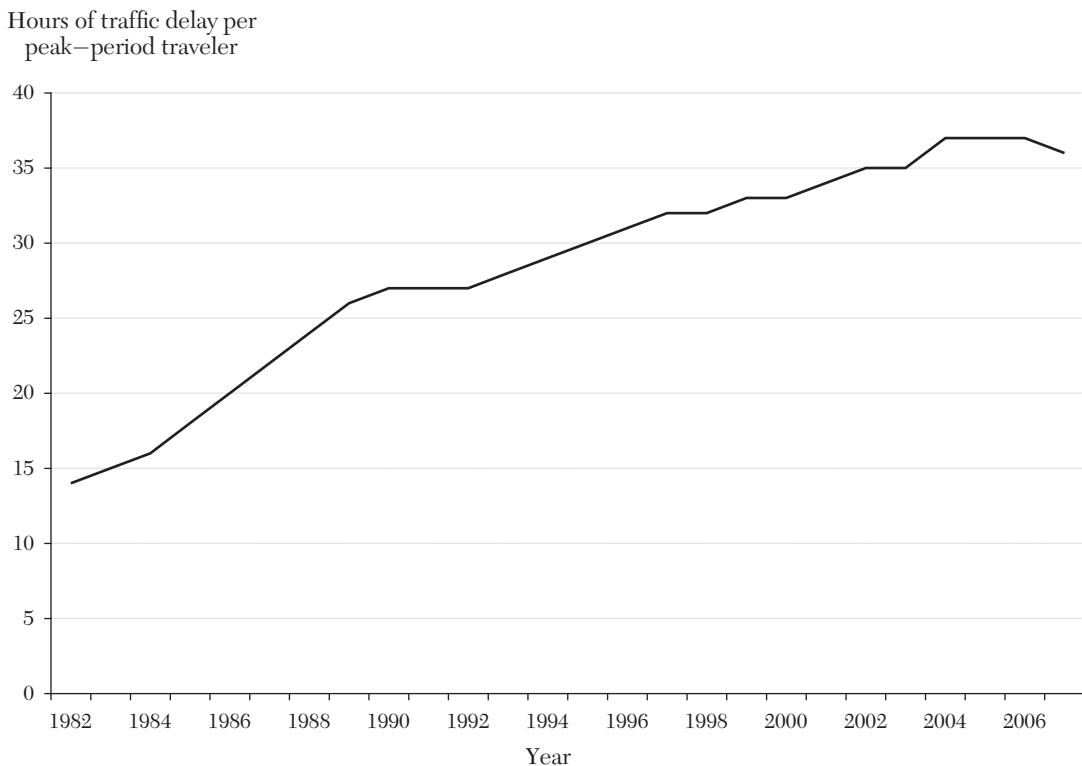


Figure 3. Average Annual Traffic Delay in Urban Areas, 1982–2007

Source: Texas A&M University Transportation Institute.

A transportation policy can be assessed by constructing a counterfactual benchmark policy and comparing the welfare generated by the two policies. The benchmark policy may be a hypothetical optimal policy or an alternative policy under consideration. For example, the public sector's infrastructure pricing and investment policies have often been

evaluated by comparing economic welfare under current pricing and investment policies with what it would be if prices were set at marginal cost, accounting for congestion and other externalities as appropriate, and investments that equalized costs and benefits at the margin. In other words, current policies are compared with first-best welfare-maximizing policies. The estimate of aggregate welfare under the counterfactual policy should account for all the relevant responses by users and suppliers, which may affect prices, travel times, and other service attributes, and include the welfare of all members of society who are affected by the policy.

15 percent. The use of disaggregated data also facilitates models that capture unobserved influences on travelers' preferences, such as tastes, which vary among travelers. Those models include the mixed logit model developed by Brownstone and Train (1999) and McFadden and Train (2000) and models of travelers' choices among differentiated products (Anderson, de Palma, and Thisse 1992).

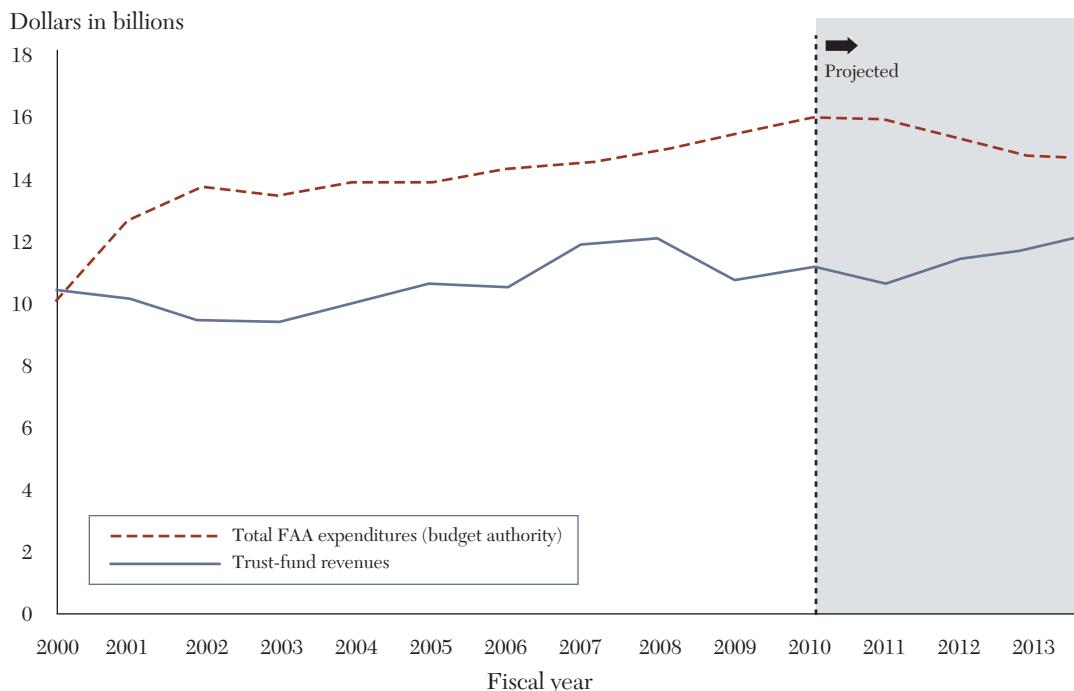


Figure 4. Actual and Forecast Trust-Fund Revenues and FAA Expenditures, Fiscal Years 2000 through 2013
Source: U.S. Government Accountability Office, 2012a.

The public sector's regulatory policies have also been assessed by a counterfactual benchmark policy. For example, Morrison and Winston (1990, 1995) assessed the effects of airline fare deregulation by comparing actual deregulated fares with what fares would have been if the Civil Aeronautics Board continued to regulate fares by updating its formula, called the Standard Industry Fare Level.

The choice to use an ideal welfare standard (for example, marginal cost pricing) as a counterfactual could lead to findings that reveal that a current transportation policy is causing significant inefficiencies and could motivate interest in some type of policy reform. Or the choice could be used to support a specific policy reform because that reform is assumed to produce results

that are consistent with the counterfactual benchmark. For example, initial studies that supported trucking deregulation compared trucking regulation with the first-best benchmark of marginal cost pricing on the grounds that deregulation was assumed to produce that outcome.

The empirical studies that I report on the efficacy of the public sector's provision of infrastructure and urban transit generally use a plausible (counterfactual) welfare standard; however, I do not draw immediate policy conclusions from them because it is inappropriate to unconditionally assume that any significant inefficiencies could be remedied by either public sector policy reforms that are currently under consideration or by private deregulated provision of transportation.

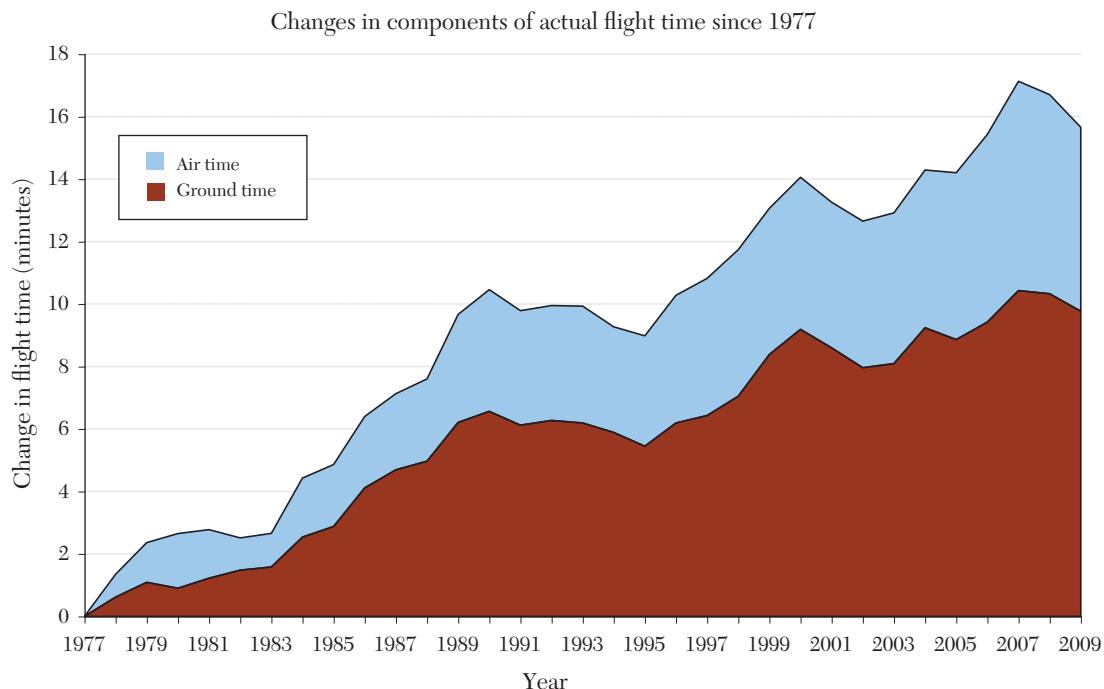


Figure 5. Air Travel Delays

Source: U.S. Department of Transportation, Service Segment Data and Schedule T-100, Data Bank 28DS, Domestic Segment Data. Data for 2009 are through October.

I discuss the possible effects of those alternative approaches later. Empirical studies of certain transportation economic regulations use limited experiences with deregulation (or cases where the regulation is not binding) as a counterfactual and imply that full deregulation would generate effects that are consistent with the counterfactual.

4. *Empirical Evidence on the Efficacy of Public Sector Provision of Transportation*

The public sector's prominent role in providing and regulating transportation in the United States significantly influences the performance of the entire system. I therefore survey and synthesize the empirical

evidence on the welfare effects of policies that the government has enacted to manage public infrastructure and services, regulate private sector competition, ameliorate congestion, safety, and emissions externalities, and subsidize travelers and private carriers. I indicate how those policies have affected the efficiency of the transportation sector and how some of them have also affected the efficiency of labor markets, urban economies, international trade, and industry competition.

4.1 *Managing Infrastructure and Services*

For now, I take as given that it is socially desirable for the public sector to own and

manage virtually the nation's entire surface, air, and water transportation infrastructure that is used for commercial purposes and for it to provide urban transit service. Given that responsibility, it is appropriate to assess whether the government is pricing, investing in, and operating those components of the transportation system efficiently.

4.1.1 Pricing Public Facilities

Travel occurs over a finite space, such as a roadway, airway, runway, or waterway. Public authorities should allocate that space efficiently to travelers and shippers by setting prices that reflect the social marginal costs of using it during a particular time of day.

Roads consist of two important characteristics: capacity (lanes and a shoulder) to provide space for different vehicles, including passenger cars, buses, and heavy trucks to travel simultaneously, as well as park; and durability (pavement thickness and bridge strength) to bear the weight of different vehicles, particularly heavy trucks, and to resist surface wear and structural damage to pavements and bridges. Motorists and truckers are charged the gasoline tax for their use of highway lanes, which is an inefficient charge because it does not account for their contribution to congestion. Vehicles should be charged for their use of lane capacity that contributes to congestion by paying efficient (marginal cost) congestion tolls, which can be assessed using modern technology without disrupting motorists' and truckers' journeys or invading their privacy. By substantially reducing—but not eliminating—delays and reducing residential sprawl because the out-of-pocket cost of commuting would no longer be underpriced, such tolls could generate annual gains of \$40 billion, accounting for the travel time savings for commuters, savings for taxpayers from lower costs of public services from greater residential density, and greater revenues to the government (Langer and Winston 2008).

For the vast majority of their trips, including work trips, motorists face sub-market prices for on-street parking; thus, they incur search costs themselves when looking for parking spaces while also imposing significant costs on other drivers by adding to congestion on surrounding local streets. Field studies suggest that as much as one-third of traffic in some parts of San Francisco and Los Angeles is attributable to drivers circling as they hunt for spaces. Extrapolations from those studies suggest that nationwide costs are in the billions of dollars.⁷ In response, some motorists fraudulently use disabled placards to eliminate search and park for free.⁸ An efficient congestion-based pricing policy, which is currently being tested in San Francisco, sets real time prices at parking meters to raise the price of parking on the city's most crowded blocks and to lower it on its emptiest blocks. Evidence on the effects of that experiment on overall parking charges and search costs would be useful.⁹ Fosgerau and de Palma (2011) also point out

⁷As reported in *Time*, "The New Science of Parking," July 9, 2007, Transportation Alternatives, a New York advocacy group, conducted a 2006 field study of fifteen blocks in the upper west side of New York City and Professor Donald Shoup of UCLA conducted a study of Westwood Village in Los Angeles. The studies estimated that motorists' search for on-street parking over a one year period in those locations respectively generated 366,000 and 950,000 additional vehicle miles traveled. Given the thousands of locations throughout U.S. metropolitan areas where such search occurs and applying Small and Verhoef's (2007) estimate of the social marginal cost of a vehicle mile of \$1.08, suggests a national estimate of parking search costs in the billions of dollars.

⁸Shoup (2011) describes field studies where many drivers with disabled placards were seen carrying heavy loads between their cars and adjacent businesses and where police interviews found that 90 percent of the placards that were checked were being used illegally. Consequently, disabled people often have difficulty gaining access to spots that are set aside for them.

⁹Chicago has recently sold its parking-meter concession to a private firm and allowed it to set prices for on-street parking. It would also be useful to document the economic effects of that reform.

that peak-period parking charges would help mitigate road congestion.

The gasoline tax that truckers are charged for highway travel does not adequately account for their damage to pavements because that damage depends on a truck's weight per axle (for a given weight, trucks with more axles inflict less pavement damage) and for their stress on bridges, which depends on a truck's total weight. Small, Winston, and Evans (1989) estimate that replacing the fuel tax with an axle-weight (marginal cost) charge would encourage truckers to shift to vehicles with more axles that do less damage to road pavement, thereby reducing maintenance expenditures and producing an annual welfare gain exceeding \$10 billion.

Efficient pricing could also reduce the likelihood of catastrophic bridge failure, expensive repairs, and the possible loss of life. Congestion pricing would reduce the stress inflicted by the simultaneous and slow passage of heavy vehicles by spreading the traffic flow over time and place, and an efficient truck tax should include a bridge charge related to vehicle weight to encourage truckers to reduce their loads on trips that include bridge crossings or to take alternative routes to avoid higher-priced bridge crossings.

Airport runways become congested—that is, they reach capacity—when planes that take off or land force other aircraft to wait on taxiways and tarmacs to take off or force them to wait in the air by reducing their speeds or circling the airport before they can land. The charge that an aircraft pays public airports to land (they are not charged to take off) is based on its weight and generally does not vary by time of day. But the volume of aircraft traffic, which determines the length of time that a plane must wait on the ground or in the air, does. Efficient takeoff and landing (marginal cost) congestion charges that vary by time of day could significantly reduce air travel delays, generating a \$6.3 billion annual

welfare gain, accounting for the time savings to travelers and reduced operating costs to airlines (Morrison and Winston 1989).¹⁰

Air traffic control services manage aircraft operations in the airspace near airports, which can become congested, and en route. Travelers currently pay for those services at a fixed rate of \$3.90 per flight segment and a 7.5 percent tax on the fares for a given flight that may or may not vary with the time of day or with air space congestion. The ticket tax should be replaced by a marginal-cost user fee that accounts for an aircraft's contribution to congested airspace near airports and to the demand on air traffic control services, thus reducing delays and traffic control's workload by inducing airlines to schedule flights to use the available airspace more efficiently.

Users of waterways and ports that develop and maintain the shoreside facilities for the intermodal transfer of cargo between ships, barges, trucks and railroads are charged a tax on barge fuel, but they generally do not pay congestion charges that would discourage peak-period use. Setting marginal cost congestion charges at ports, which was initially advocated by Lave and DeSalvo (1968), would undoubtedly reduce delays that have grown with the increasing volume of import and export cargo (Fan, Wilson, and Tolliver 2010) and would reduce industry operating costs.

¹⁰Brueckner (2002) and Mayer and Sinai (2003) point out that an airline carrier has an incentive to take account of the delay it causes to its own flights. They argue that optimal congestion tolls would charge a carrier only for the delay it causes to flights by other carriers. Such charges at congested airports would raise equity concerns because carriers with smaller market shares would pay higher charges than carriers with larger market shares would pay. However, those issues appear to be moot because Morrison and Winston (2007) found only small welfare improvements from setting optimal charges along the lines suggested by Brueckner and Mayer and Sinai instead of charging carriers for delaying any flight.

Finally, users of urban bus and rail transit pay fares that are set by transit authorities below marginal cost (Winston and Shirley 1998), some even ride at discounts from those fares, and some federal employees ride free. As pointed out later, such subsidies are hard to justify on distributional grounds because transit users generally live in households with incomes that are above the national average.

4.1.2 Investments and Operations

Public investments in transportation infrastructure and transit should be chosen to maximize the present value of users' benefits, net of capital and maintenance costs; operating costs should be minimized to reduce the burden on taxpayers to cover the deficits that may be incurred by those services.

Investments in highway capacity have been distorted by prices that have been set below marginal cost (Duranton and Turner 2011). Duranton and Turner (2012) conclude from a study covering the period 1983 to 2003 that, at the margin, the benefits from additional roads have fallen short of the costs and that increasing the provision of roads is unlikely to relieve congestion. Winston and Langer (2006) found that in a given year, one dollar of highway spending—a large share of which is used for maintenance rather than capacity expansion—reduces users' congestion costs only eleven cents in that year (cost reductions quickly dissipate in subsequent years because the road depreciates).

Ng and Small (2012) point out that existing highway capacity could be used more effectively to reduce delays by improving highway design. Most highways in major metropolitan areas operate under congested conditions during much of the day, yet highway design standards are based on free-flow travel speeds. Policymakers could therefore reduce the cost of delays by expanding the range of alternative highway designs that, for example, could raise speeds during peak

travel periods by increasing the number of lanes, although speeds during off-peak travel periods may be slower because lanes and shoulder widths would be narrower. Technology exists to install lane dividers that can be illuminated so that they are visible to motorists and that can be adjusted to increase or decrease the number of lanes that are available in response to traffic volume.

Small, Winston, and Evans (1989) have argued that investments in highway durability—that is, pavement thickness—should minimize the sum of initial capital and ongoing maintenance costs. They determined that building roads with thicker pavement at an annualized cost of \$3.7 billion would generate an annualized maintenance saving of almost 4 times as much—\$14.4 billion—for a net annual welfare gain of \$10.7 billion. Roads could also be made more durable by implementing innovations such as tack coats between pavement levels and thicker bottom layers of asphalt to avoid buckling, both of which can extend the functional life of a highway at little extra cost. But state departments of transportation award construction contracts on the basis of the minimum bid, not on the technological sophistication of the contractor. Gillen et al. (2001) estimated that California alone could generate annual maintenance savings of nearly \$900 million by using improved methods for laying asphalt.

Improving the durability of the nation's roads is also important because it would reduce the wear and tear on motorists' and truckers' vehicles. Driving on damaged roads is estimated to cost U.S. motorists \$67 billion in additional annual operating costs and repairs (The Road Information Program 2010) and also to damage trucks and increase their operating costs.

Policymakers have wasted resources by investing in highway projects that have not been selected on the basis of careful cost-benefit analysis. As exemplified by Boston's

“Big Dig,” originally forecast in 1984 to cost \$2.3 billion to depress the central arteries beneath the city and to build another tunnel to Logan Airport, highway officials are notorious for underestimating and subsequently inflating expenditures on proposed projects—the project ultimately cost \$15 billion, over 6 times the initial estimate. Inefficient highway investments are also a by-product of earmarked projects that have become a growing political cost of ensuring that multiyear federal transportation bills are passed. The most recent comprehensive surface transportation act, passed in 2005, contained some 6000 earmarked projects amounting to \$24 billion.¹¹ Money from the Highway Trust Fund for highway projects is distributed among states based on formulas that produce inefficient allocations because they include factors, such as a state’s size, that are not accurate indicators of road congestion. Thus, Winston and Langer (2006) found that holding the level of spending constant, highway officials could reduce highway costs \$13.8 billion per year, accounting for users’ congestion costs and states’ highway expenditures, if expenditures were explicitly targeted to those areas of the country with the greatest congestion.

Finally, inefficient regulations have raised highway-operating costs by increasing wages and by expanding the labor force that is hired to manage and complete highway projects—federal and state transportation departments employ nearly 200,000 workers in part just to ensure that projects meet all regulations. The annual cost of Davis–Bacon regulations that stipulate that “prevailing wages”—interpreted in practice as “union wages”—be paid on any construction project receiving federal funds was initially found by Allen (1983)

to be as high as \$600 million. Similar state regulations were found by Kessler and Katz (2001) to increase highway wages as much as 4 percent. Recently, Sherk (2011) calculated that the inflated wages attributable to Davis–Bacon regulations increase the cost of federal construction projects 9.9 percent and that repealing the regulations and paying market wages would have saved taxpayers \$10.9 billion in 2010. The savings are not solely transfers because the inflated wage payments are funded by taxation.

Social welfare could be substantially raised by investments in airport runway capacity that would reduce delays and airlines’ operating costs. Morrison and Winston (1989) estimated that the annual gain from combining efficient runway pricing with efficient runway investments was \$16 billion. But in practice, the cost of constructing runways has turned into a task that is measured in billions of dollars because it takes decades to meet regulations, especially Environmental Protection Agency environmental impact standards. Even without runway investments, Simaiakis et al. (2011) showed that basic improvements in airports’ “pushback” rates could reduce travel delays. For example, they found at Boston Logan Airport that holding planes for an average of four minutes longer at the gate instead of having them line up on the runway significantly reduced taxi times and cut jet fuel consumption.

Inefficiencies arise from airports’ investments that are funded by the Airport Improvement Program (AIP) because those federal funds are not allocated to the airports that could make the best use of them to reduce delays. Instead, only 37 percent of AIP funds in fiscal year 2009 went to the 100 largest metropolitan airports, which account for 84 percent of airline passengers, while roughly 30 percent of the funds went to small airports that do not offer commercial service by regularly scheduled carriers.

¹¹ Subsequently, a series of one-year extensions, and in 2012 a two-year extension, have been passed instead of a multiyear bill, but earmarked projects are still included by lawmakers.

Air traffic control facilities in airport towers are supported by the U.S. Airport and Airways Trust fund. Compared with the current allocation of funds, Morrison and Winston (2008) estimated that allocating expenditures to towers that serve the most congested airports would generate more than \$1 billion in annual time savings to air travelers and cost savings to airlines.¹²

The major problem with investments in air traffic control has been the extraordinary time that the FAA has taken to implement the latest technological advances that could improve safety and increase the speed of air travel. In the early 1980s, the FAA announced plans to develop an advanced automated system that was scheduled to be completed by 1991 at a cost of \$12 billion. As of 2012, the fully upgraded system is more than two decades late, billions of dollars over budget, and still nowhere in sight. Instead, the FAA has turned its attention to expediting the transition from the current radar-based system that uses imprecise, decades-old technology to a next generation satellite-based system known, appropriately, as NextGen. Radar updates aircraft positions only every 5 to 10 seconds and forces controllers to separate aircraft by several miles to provide a safety buffer and avoid collisions. In contrast, the automatic dependent surveillance broadcast (a key component of NextGen) updates positions every second. By enabling pilots to be less dependent on controllers, to choose the most efficient altitude, routing, and speed for their trip, and to operate in cloudy and foggy weather much as they do on clear days, a NextGen satellite-based system could reduce travel times,

¹² Oster (2006) points out that when the Air Traffic Organization proposed to save money in February 2005 by closing control towers between midnight and 5:00 a.m. at forty-eight lightly used airports, U.S. legislators from the airports' districts strongly opposed the action without considering whether the tower services were needed or even used.

carrier operating costs, and airplane emissions throughout the system while improving safety.¹³ Unfortunately, government officials expect NextGen to take much longer and cost billions of dollars more than they originally projected.¹⁴

Water transportation infrastructure has not been studied much by academic economists but waterway investments by the Army Corps' of Engineers have attracted the attention of government watchdogs. Thus the U.S. Department of Defense requested that the National Academies (2001) review the feasibility of the Corps' draft report on the costs and benefits of extending several locks on the lower portion of the Upper Mississippi River–Illinois Waterway to relieve waterway congestion, particularly for grain moving to New Orleans for export. The Academies concluded that because of flawed assumptions and data, the Corps should not use its key spatial equilibrium model to forecast barge traffic and it recommended that the Corps collect an extensive database of shipments and develop a more conceptually satisfactory model. Moreover, it recommended that the Corps investigate nonstructural options, such as better barge scheduling and congestion fees, to relieve congestion and review the costs and benefits of those options before considering lock extensions.

¹³ Europe is modernizing its air traffic control system through a program known as Single European Sky ATM Research (SESAR). NextGen and SESAR could optimize their technologies to make trans-Atlantic flights safer and faster.

¹⁴ NextGen infrastructure and equipage is estimated to cost about \$40 billion with expected completion by 2025 according to official testimony at the Hearings on the Reauthorization and Reform of the Federal Aviation Administration and the Airport Improvement Program, February 8, 2011. It would be expected that a multi-billion dollar project like NextGen would be financed by, for example, government-issued bonds. Instead, Congress is micromanaging the project and passing annual legislation to provide funds for it.

Beginning with a series of articles that ran in the 2000 *Washington Post*, Michael Grunwald underscored the Academies' concerns by reporting the most egregious examples of the Army Corps' inefficiencies, including consultants' estimates that benefit–cost ratios of recent Corps' projects were consistently and unequivocally below one and documentation that the Corps had adjusted cost–benefit calculations to justify projects on the Mississippi and Illinois rivers.¹⁵ Most waterway projects not only have questionable social desirability, but barge companies have been charged only a small fraction of the costs of operating, maintaining, and renovating the system.¹⁶

The efficiency of investments in transit, especially for new light and heavy rail systems, has long been questioned because new rail systems are notorious for exceeding cost estimates, while ridership levels tend to be much lower than anticipated (Pickrell 1990, Flyvbjerg, Holm, and Buhl 2006). Flyvbjerg, Holm, and Buhl estimate that the average cost escalation for rail projects is roughly 40 percent.

Regulations and operating inefficiencies then proceed to inflate the cost of service. "Buy American" provisions mandate that transit agencies first offer contracts to domestic producers instead of seeking the most efficient supplier of capital equipment (Hughes 1994); federal subsidies of rolling capital encourage transit agencies to replace their capital stock prematurely rather than to maintain it efficiently (Cromwell 1991); and restrictions within Section 13 (c) of the 1964 Federal Transit Act on firing an employee may result in severance packages that approach \$400,000.

¹⁵See, for example, Michael Grunwald, "Army Corps Delays Study over Flawed Forecasts," *Washington Post*, October 5, 2000, p. A33.

¹⁶Michael Grunwald, "Corps' Taming of Waterways Doesn't Pay Off," *Washington Post*, January 9, 2000, p. A1.

Extrapolating from data that transit companies were required to report to the Federal Transit Administration during the 1990s and previous decades, on average, only about 20 percent of seats are filled with paying passengers, suggesting that transit service frequency during off-peak periods is excessive in many metropolitan areas and that vehicle sizes may not be aligned with demand throughout the day. Winston and Shirley (1998) estimate that setting bus and rail service frequencies to maximize net benefits and charging fares equal to marginal cost reduced transit deficits and service frequencies and resulted in an annual welfare gain of \$10.6 billion. Cutting frequencies generates benefits because deficits are reduced by more than the value that travelers place on the lost service. Another problem with transit's operations is that its route coverage fails to respond to changes in commuting patterns and residential locations. Baum-Snow and Kahn (2005) provide evidence that in those cities where rail systems have not changed their networks, rail's share has declined as former patrons and jobs have moved beyond rail's catchment areas.

4.1.3 Effects on Other Economic Activities

A growing body of economic theory indicates that the policies that I have discussed are likely to affect the efficiency of other sectors besides transportation. Urban and regional economists have motivated interest in transportation policies that enable agglomeration economies to be realized by reducing travel costs and travel times (Fujita and Ogawa 1982, Graham 2007), thereby raising productivity, innovation, and wages in various cities and regions (Fujita and Thisse 2002, Venables 2007). For example, improvements in air transportation service have spurred the growth of the banking sector in Charlotte, North Carolina, and backroom supporting service in Reno, Nevada

and North Dakota. Giroud (2013) finds that new airline routes that reduce the travel time between headquarters and plants lead to increases in plant-level investment and in plants' total factor productivity. The new economic geography literature (Krugman 1991, 1998) shows that by reducing the cost of shipping goods between locations—which decreases the effective distance between two points—transportation improvements promote trade, increase product competition and variety, and facilitate specialization in economic activities.

Empirical research on how public provision and regulation of transportation has affected the broader economy is in its infancy, but is suggestive of economic effects that additional research could clarify. The failure to adopt congestion pricing on the nation's highways has increased commute times and reduced the area over which workers search for and have access to jobs and over which firms search for employees, thus reducing employment, productivity, and urban growth. Hymel (2009) estimated that Los Angeles would have had 100,000 additional jobs in 2003 if congestion were 50 percent less in the preceding decade. Black, Kolesnikova, and Taylor (2007) found that metropolitan areas that experienced relatively large increases in average commuting time also had slower growth of labor force participation of married women. Light's (2007) analysis based on the American Time Use Survey documents that workers' productivity and income is reduced by highway congestion. His findings suggest that individuals spend less time at work and suffer as much as a 3 percent loss in income because of the sharp growth in congestion and delays. Behavioral economics suggests that congestion's adverse effect on productivity and wages may be even greater. If, as Kahneman and Krueger (2006) report, the morning commute to work is particularly unpleasant compared with other activities, workers' job

performance may suffer long past the time that they arrive at work.¹⁷ Improvements in the transportation system that resulted in a faster and less-congested commute would increase workers' happiness and productivity throughout the day and produce benefits in addition to the more easily measured travel time savings. Graham (2007) concludes that the failure to price congestion efficiently has also reduced the densities of metropolitan areas, increased sprawl, and significantly hampered agglomeration.

Many researchers have documented that transportation has a quantitatively important impact on trade flows (Limao and Venables 2001, Anderson and van Wincoop 2004). Thus inefficient port and highway pricing policies that have failed to reduce congestion and have compromised the speed and reliability of water and truck transportation—the latter is used predominantly to move goods to and from ports—have increased trade costs and reduced trade flows.

Investments in highway capacity should increase employment by expanding the area over which workers search for and have access to jobs and over which firms search for employees. Duranton and Turner (2012) documented that from 1983 to 2003, a 10 percent increase in a city's initial highway stock caused a 1.5 percent increase in its employment level. Michaels (2008) showed that by increasing inter-regional trade, the interstate highway system raised the relative demand for skilled manufacturing workers in counties with a high endowment of human capital and reduced it elsewhere. And because highways increase the demand for labor and enhance firms' productivity, they also raise wages (Baum-Snow 2010).

¹⁷Calfee and Winston (1998) found that motorists attach much less disutility to a commute in *uncongested* conditions because it may enable them to relax before work and decompress after work.

I am not aware of estimates of the effect of transportation infrastructure investments on U.S. trade flows, but trade and development economists have indicated that such investments have significantly increased trade for developing countries (World Bank 2007, Donaldson 2010).

4.2 Regulating Private Sector Competition

The potential for market failure due to scale economies has been the primary economic justification for federal government regulation of market prices, entry, and exit of many transportation services. However, in the late 1970s, the federal government recognized that economic regulation was creating rather than eliminating inefficiencies and it proceeded to partially deregulate domestic intercity transportation—freight railroads, motor carriers, airlines, and buses. (I discuss the salient economic effects of partial deregulation later when I consider privatization.) But the government still plays an active role in regulating competition in the transportation industries by enforcing maximum rate regulations for railroads, regulating pipeline rates, and maintaining policies that affect airlines' ability to serve certain airports; by determining the extent of deregulation of international air service, ocean shipping, and taxi service; and by trying to prevent anti-competitive behavior, especially in the airline industry. The desirability of those actions can also be determined by whether they are eliminating or creating inefficiencies.

4.2.1 Price and Entry Regulations

Policymakers enacted maximum railroad rate regulations because they were concerned that freight railroads could exercise market power for shipments of certain bulk commodities such as coal and grain. Under those regulations, shippers could challenge a rate if it exceeded 180 percent of variable costs and if the railroad in question had no effective competition. In practice, maximum

rate regulations have resulted in a lobbying tug-of-war where so-called captive shippers, who are served directly by one railroad and ship bulk commodities that cannot move easily by truck or barge over long distances, press for regulations to reduce rates while railroad industry executives attempt to fend off those regulations. Grimm and Winston (2000) found that the aggregate welfare loss from elevated rail rates to captive shippers, as compared with the rates paid by noncaptive shippers, was small and had modest redistribution effects. Recently, shippers and railroads have taken steps to work out their differences bilaterally. Shippers are challenging fewer rates and the railroads are settling the challenges that shippers file rather than putting them through costly and protracted litigation.

In 1992, the Federal Energy Regulatory Commission's Final Restructuring Rule effectively unbundled natural gas pipelines to promote competition, but FERC still regulates rates. Shippers can obtain discounts by opting for "interruptible" service (that is, a pipeline owner can stop service to a customer when demand is high under conditions specified by a contract). However, MacAvoy (2000) pointed out that the presence of rate regulation still imposes rigidities that prevent capacity from being used efficiently.

Public policies have reduced competition and raised fares at certain airports by creating entry barriers. The most costly policy—a legacy of airline–airport contractual arrangements established during the 1950s and 1960s—enables incumbent air carriers to have exclusive use of certain gates, thus potentially preventing new entrants from providing service or from providing it at convenient times. In principle a public airport has a legal obligation to provide airlines reasonable access to the facility, but policymakers have yet to define precisely what *reasonable* means. Hence, incumbents

may even prevent competitors from accessing gates that are little used. Morrison and Winston (2000) estimated that the prevalence of exclusive-use gates cost travelers some \$4.4 billion annually in higher fares. Ciliberto and Williams (2010) also found that limiting carriers' access to gates has raised fares.¹⁸

In an effort to encourage pleasure and long-distance travelers to use New York JFK and Newark airports, "perimeter" rules have restricted entry and raised fares by prohibiting airlines from offering flights that exceed 1,500 miles at LaGuardia and to promote growth at Dulles Airport just outside Washington by prohibiting airlines from offering flights from all but six select cities that exceed 1,250 miles at Reagan National. Given that Dulles now serves far more passengers than Reagan National serves, and that JFK has become the busiest airport in the New York metropolitan area, those rules are unjustified.

Bilateral agreements have provided the framework under which air fares and service frequency between two countries are determined. During the 1970s, the Carter administration promoted the idea of "open skies," liberal bilateral agreements between countries that enabled market forces to be the most important determinant of fares and capacity. Beginning with a successful agreement with the Netherlands in 1992 and a recent one with Japan in late 2010, the United States has pressed for open skies one country at a time and the results have been encouraging. Cristea and Hummels (2011) found for a limited sample that was based only on tickets from U.S. carriers that the agreements caused fares to drop 5 percent, on average. Winston and Yan (2013) found for a sample of the 500 most heavily traveled

international routes, including tickets from all international carriers, that the agreements have generated at least \$5 billion in annual welfare gains to travelers. They also found that equally large gains—roughly \$5 billion annually—could be obtained if the United States eliminated remaining international airline economic regulations by negotiating open skies agreements with the countries with which they have not done so. And U.S. policymakers could take a major step toward creating a fully deregulated global airline industry that would benefit travelers still further by eliminating regulations that prevent foreign airlines from providing service on any U.S. route they wish to serve.

Micco and Serebrisky (2006) found that Open Skies agreements that have been negotiated between 1990 and 2003 caused a 9 percent drop in the cost of shipping freight by air. Because international air cargo and passenger transportation are governed by the same regulatory environment, full deregulation of international air travel would cause air cargo rates to decline further.

As discussed by Sagers (2006), over its 140-year history, ocean liner shipping has enjoyed an antitrust exemption permitting ocean carriers to fix rates at shipping conferences on the grounds that destructive competition would result without the exemption and bankrupt the industry. Containerization, introduced in the 1960s, enabled ocean container ships to reduce excess capacity and to operate and compete in an intermodal environment without shipping conferences by interchanging containers with railroads and motor carriers.¹⁹ The Ocean Shipping Reform Act of 1998 took a first step toward ending conferences by allowing shippers to

¹⁸"Majority in interest" clauses enable incumbent carriers to block construction of new terminals and gates that would allow new entrants to serve an airport.

¹⁹Levinson (2006) noted that stacking containers—and therefore containerization—was facilitated by the development of a lock connected to the corners of containers that crane operators could mechanically open and close from their seats.

enter into contracts with carriers, causing rates to decline on certain routes (Reitzes and Sheran 2002). Disbanding all ocean liner rate conferences would effectively end the remaining price-fixing arrangements and could cut ocean-shipping rates at least 30 percent (Fink, Mattoo, and Neagu 2002).

Entry into ocean shipping is regulated by the 1920 Jones Act, which decreed that the only ships allowed to call at two consecutive American ports must be built in the United States, owned by American companies, fly the American flag, and be operated by American crews. Because cruises that allow passengers to disembark in Alaska must often begin their cruise in a different country, the tourist industry in Vancouver, Canada is just one example of an unintended beneficiary of the Act. Data collected by Seasnake LLC indicate that the price of ships built in the United States, including containerships, tankers, and dry bulkers, is nearly twice the price of comparable ships built overseas. The 2010 Open America's Waters Act indicated that repealing the Jones Act would, according to a U.S. International Trade Commission study, generate a \$1 billion efficiency gain by reducing the costs of ocean shipping, but the Act was not passed by Congress.

Deregulating price and entry regulations of international air cargo and ocean shipping could provide the additional benefit of reducing trade costs, which would expand the volume of international trade and increase competition in U.S. markets (Hummels and Schaur 2012). And the decrease in international airline passenger fares could generate more business travel that promotes trade by transferring information among highly skilled professionals (Poole forthcoming).

Finally, private for-hire transportation within cities is usually controlled by fare and entry regulations of taxis and by regulations that prohibit private transit companies from offering service. It is widely believed that those regulations raise the cost of intracity

transportation but I am not aware of systematic evidence to support that belief. Moore and Balaker (2006) conclude from the limited evidence that is available that travelers would benefit from deregulating taxi service. And the positive experiences that travelers in New York City and Atlanta have had from private van service that is allowed to serve selected routes in those cities, suggest that travelers in urban areas throughout the country could benefit from similar service.

4.2.2 Addressing Anti-Competitive Behavior

Policymakers have periodically become concerned that airlines are increasing fares by engaging in anticompetitive behavior, especially by monopolizing airport hubs.²⁰ For a given fare class, the major determinant of a passenger's fare is the distance of a flight. But even if two routes are of equal distance, one may have a much higher fare if it is composed of an airport hub at one of the endpoints. A common explanation is that an airline that offers many flights throughout the day at a given airport will

²⁰ Other alleged anticompetitive actions by airlines include certain mergers, which were opposed by the U.S. Department of Justice but approved by the U.S. Department of Transportation, instances of predatory pricing, and collusion. Morrison (1996) concluded that the mergers approved by the Transportation Department did not decrease travelers' welfare; Morrison and Winston (2000) cast doubt that airlines have engaged in predatory pricing; and Miller (2010) found that an antitrust case in response to the claim that the Airline Tariff Publishing Company enabled airlines to coordinate fares failed to produce a lasting reduction in fares or to yield any benefits to travelers. Policymakers have also raised concerns about competition in the rail freight industry. For example, Senator Jay Rockefeller indicated that because railroad consolidations have reduced competition, Congress plans to maintain a stronger regulatory presence. Winston, Maheshri, and Dennis (2011) found that the two recent major railroad mergers in the western United States (Burlington Northern–Atchison–Topeka–Santa Fe and Union Pacific–Southern Pacific) had negligible long-run effects on grain transportation prices and consumer welfare.

discourage entry and be able to raise fares (Fruhan 1972).

The GAO (1990) initiated an empirical debate by approaching the problem from the travelers' perspective and asking whether fares for trips that originate at dominant hub airports are high enough relative to fares for trips that originate at other airports to justify policy intervention. To determine the *hub premium*, fares from the dominant airports, including, for example, Minneapolis, should be compared with fares from the control group of airports, including, for example, Milwaukee. Care must be taken to isolate several relevant influences on fares at both types of airports, including route distance, number of plane changes, traffic mix, carrier(s) identity, frequent flier tickets, gate availability, and the like.

Indeed, the hub premium can change dramatically depending on the influences that are isolated. For example, Morrison and Winston (2000) found that the hub premium was 23 percent if the control group of non-dominated airports was served by Southwest Airlines, but the premium was eliminated if the control group of airports was not served by Southwest.

Does the hub premium reflect higher fares that should be addressed by a policy? One attempt to reduce hub premiums was the 2000 Wendell H. Ford Aviation Investment and Reform Act, which included a condition that a dominated hub must provide a competition plan for how new entrants can be included in the airport facility. Or rather, do hub premiums reflect the fact that Southwest has slowly expanded its network to include operations at hub airports? The latter interpretation appears more consistent with the data as the hub premium began to decline in the late 1990s (Borenstein and Rose forthcoming) because low-cost carriers—Southwest and others—increased their market shares and presence at hub airports following cuts in capacity by the legacy

carriers that experienced financial distress before and especially after the September 11 terrorist attacks.

4.3 Regulating Externalities

Congestion, fatalities, injuries, property damage, and pollution associated with transportation generate substantial social costs. As noted, the cost to motorists and air travelers from congestion is in the hundreds of billions of dollars. The roughly 33,000 highway traffic fatalities alone during the past few years roughly amount to a \$200 billion annual loss assuming a conventional \$6 million value of life. Muller, Mendelsohn, and Nordhaus (2011) estimate that in 2002 emissions from light duty cars and trucks produced \$37 billion in air pollution costs. The fundamental economic question is whether government policies that have been implemented to curb those externalities are doing so at minimum social costs.²¹

4.3.1 Congestion

I have stressed that policymakers have not used the price mechanism to efficiently charge roadway, waterway, and airway users for contributing to congestion. Instead, they have used various "quantity-based" policies

²¹ Parry, Walls, and Harrington (2007) discuss per-mile adjustments to the fuel tax that seek to simultaneously reduce local pollution, congestion, and accidents. But the fuel tax is an imprecise charge for those externalities because it does not vary much with traffic volume and it does not vary with vehicle emissions and with the riskiness of a driver. Corporate Average Fuel Economy (CAFE) standards, which went into effect in 1975, have attempted to improve the fuel efficiency of U.S. passenger vehicles. Considerable debate exists about whether those standards can and have improved social welfare (Parry, Walls, and Harrington 2007, Anderson et al. 2011) and because the standards encourage consumers not to drive heavier less fuel-efficient vehicles that are safer than lighter vehicles, whether they conflict with other goals such as safety (Crandall and Graham 1989, Small 2012). Moreover, researchers have often concluded that CAFE is much less efficient than raising the gasoline tax to reduce gasoline consumption by a given amount (for example, Jacobsen forthcoming).

to either restrict passenger traffic or in the case of parking to require developers to build new facilities.

Land use policies, such as zoning and regulations that establish minimum lot sizes, attempt to limit traffic congestion on local streets and excess demand for parking spaces. But Glaeser (2011) and Glaeser and Ward (2009) point out those policies increase housing prices and promote sprawl by reducing residential density. Since the 1950s, American cities have tried to ensure the availability of parking at commercial establishments, prevent overflow parking from generating excess demand for parking on residential streets, and reduce congestion created by motorists searching for available spaces by requiring commercial developers to satisfy minimum parking requirements (MPRs). In practice, MPRs cause an oversupply of parking spaces, lower the density of commercial and residential development, and increase housing costs. Cutter and Franco (2011) found that MPRs distorted land use decisions by forcing developers in Los Angeles to provide more parking than they otherwise would; McDonnell, Madar, and Been (2011) reached a similar conclusion about the effect of MPRs in the New York metropolitan area. Manville (2010) evaluated a 1999 experiment in Los Angeles that exempted vacant commercial and industrial buildings from MPRs if they were converted into housing and found that developers provided more housing and less parking than they would have provided if MPRs were in place.

The Federal Aviation Administration has instituted slot controls (quotas) on the number of takeoffs and landings per hour in an attempt to reduce congestion at New York LaGuardia, New York JFK, Washington, D.C. Reagan National, Chicago O'Hare, and Newark Liberty Airport. But in practice, slots have been found to reduce competition and raise fares (Morrison and

Winston 2000) and to have minimal effects on nationwide airline delays (GAO 2012b). The U.S. Department of Transportation has tried to reduce air travel delays by publishing on-time performance ratings and establishing tarmac rules. Forbes, Lederman, and Tombe (2012) revealed that carriers "game" the ratings by introducing bonus programs to incentivize front-line employees, such as ground crew, to make sure that flights that may be a few minutes late are on time. Carriers also pad their schedules, which increases the variability of arrival times and sometimes causes carriers to wait before they can deplane passengers at their gates because they have arrived too early. The goal of the "tarmac rule," introduced in April 2010, was to reduce long delays by imposing large fines on carriers that spend more than three hours on the tarmac. Those delays do occur less frequently but the rule has also led to a significant increase in flight cancellations that may delay some travelers even more because today's high load factors may force them to wait at least a day before they can reschedule a cancelled flight (GAO 2011). Thus, the net effect of the rule on the cost of travel delays is not clear.

4.3.2 Safety

Although transportation safety continues to command the attention of policymakers and the public, figures 6–8 show that automobile, trucking, airline, and railroad fatalities have declined during the past few decades. In fact, the past decade was the safest decade in the history of air travel. Researchers, however, have not generally determined how much government policy has improved transportation safety compared with the incentives for safe operations that are provided by market competition. For example, in contrast to some predictions, airline and trucking accidents did not increase—in fact, they declined—following

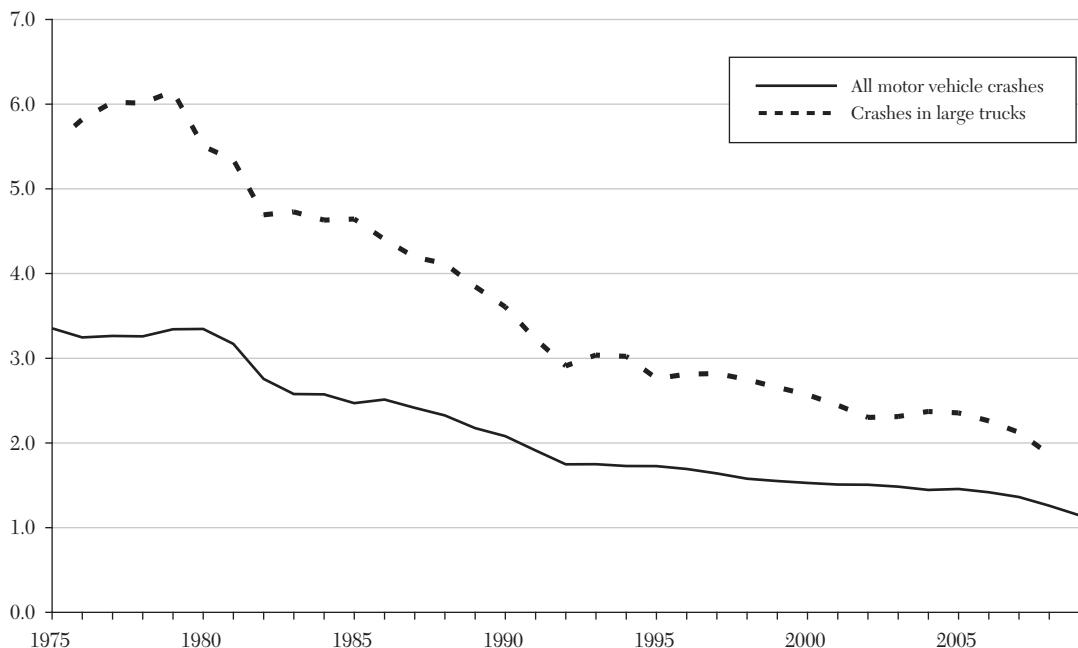


Figure 6. Fatality Rates for All Motor Vehicles per 100 Million Vehicle Miles Traveled 1975–2007

Source: Savage (2013).

deregulation because managers did not find it profitable to compromise safety.²²

Government could improve airline safety even more by expediting adoption of the NextGen satellite-based air traffic control system. And recent work indicates that governments can prevent automobile accidents and fatalities from increasing by keeping the minimum legal drinking age at 21 instead of lowering it to 18 (Carpenter and Dobkin 2011, Kaestner and Yarnoff 2011). Edlin and Karaca-Mandic's (2006) proposed per-mile tax to improve safety is questionable because it does not explicitly account for the riskiness of different drivers. For example,

compared with employed adults, male teenagers drive far fewer miles per year, but their probability of being involved in an accident is much greater on a per-mile basis. An efficient safety pricing or quantity-based policy should encourage the most dangerous drivers to drive less and not take risks while driving.

Finally, it is important for the government to minimize the cost of policies that appear to contribute to safety. For example, because some roads cannot accommodate the largest trucks, size and weight limits have been established to keep trucks that might jeopardize safety off of certain roads. But those limits may also increase shippers' costs by forcing smaller trucks to make additional trips to move the nation's freight. More flexible size and weight limits could spur technical change that improves vehicle design,

²²Rail freight operations have become safer because carriers have developed new software that improves their ability to predict certain kinds of derailments before they are likely to occur.

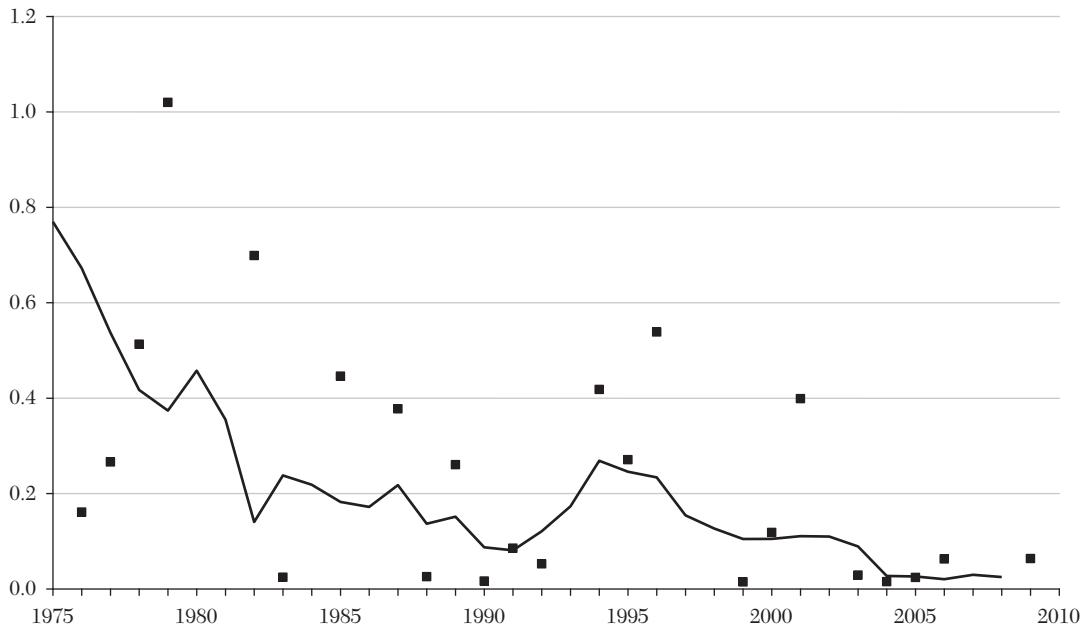


Figure 7. Aviation Passenger Fatalities per Million Passenger Enplanements with 5-Year Moving Average for Part 121 Scheduled Service 1975–2010

Source: Savage (2013).

such as stronger brakes and additional axles. And improvements in highway design, such as thicker pavements and stronger bridges, could allow trucking companies to use larger trucks without compromising safety.²³

4.3.3 Emissions

Gasoline vehicles emit carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxides (NOx), and particulate matter (PM-10), which are detrimental to human health. Table 4 shows that vehicles travelling on highways in metropolitan areas have emitted much less of those pollutants from

1970 to 2007. This outcome can be largely attributed to the Clean Air Act of 1970 that set emissions standards for CO, VOC, and NOx for new passenger vehicles and light-trucks, and to subsequent amendments to the Act that tightened the standards. But the Acts also substantially raised the price of a new car; hence, Crandall et al. (1986) argued that any benefits from the standards could have been achieved at much lower cost by imposing a (marginal cost) emissions tax that would have been paid by drivers of all (new and used) vehicles.

An efficient emissions tax would generate an optimal level of vehicle emissions by ensuring that consumers' willingness to pay for a marginal reduction in the probability of death (from the injurious effects of vehicle emissions on health) is equal to the marginal

²³ States continue to experiment with speed limits on highways that balance safety and travel times. A private toll road in Texas has recently established an 85 mph limit, whose effects bear watching.

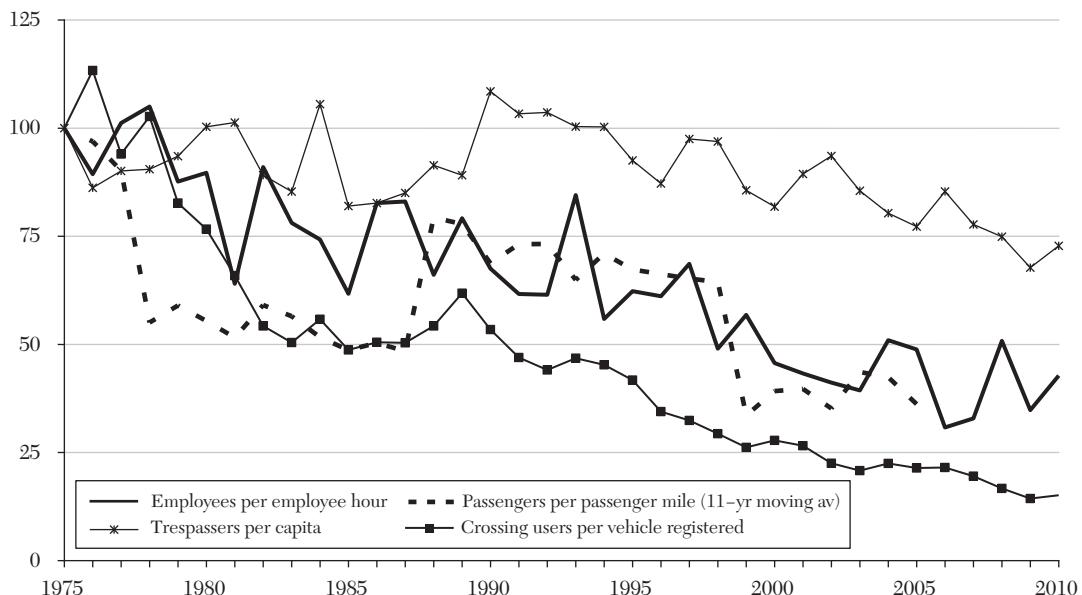


Figure 8. Indices of Railroad Fatality Rates 1975–2010 with 1975 = 100

Source: Savage (2013).

cost of supplying the improvement in vehicle emissions. Future work should take up the challenge of incorporating the benefits of reduced vehicle emissions on climate change.²⁴

Given that highway congestion creates stop and go traffic that produces greater emissions (Pozdena 2009) that are harmful to children's health (Currie and Walker

2011) and runway congestion contributes significantly to local pollution levels and adversely affects the health of residents living nearby and downwind from airports (Schlenker and Walker 2011), policymakers have missed an opportunity to use highway and airport congestion pricing to efficiently improve the environment and reduce those threats to health. Instead, some policymakers have tried to reduce transportation's overall contribution to pollution by inducing shifts from cars to urban transit. Winston and Shirley (1998) found that policies to induce those shifts were not effective because transit also produces pollution and operates with a low load factor and small mode share. Chen and Whalley (2012) used the opening of a new metro station in Taipei as an exogenous event to estimate the effect of urban rail transit on air quality and found that it reduced one key tailpipe pollutant, carbon

²⁴Assessing the transportation system's effect on climate change and policies to reduce that effect is beyond the scope of this survey. It is worth noting here that such policies could have unintended consequences. For example, Winchester et al. (2011) evaluated the impact of an economy-wide cap and trade policy on U.S. aviation and found that although aviation emissions declined, average fleet efficiency was reduced because a much higher fuel bill raised fares, reduced demand, and slowed the introduction of new aircraft. That is, the impact of reduced demand for aviation on new aircraft purchase decisions dominated incentives to purchase more efficient aircraft in the face of rising fuel costs.

TABLE 4
CHANGE IN HIGHWAY-VEHICLE EMISSIONS

Pollutant	1970	2007	Percent change
Carbon Monoxide (CO)*	88.0	41.6	-53
Volatile Organic Compounds (VOC)*	13.0	3.6	-72
Nitrogen Oxides (Nox)*	7.4	5.6	-24
Particulate Matter (PM-10)*	0.4	0.2	-61
Lead**	172.0	0.0	

Notes: *millions of tons

**thousands of tons

Sources: Viton (2011); Small and Kazimi (1995).

monoxide, 5–15 percent, but it had no effect on ground level ozone pollution.

4.4 Subsidizing Travelers and Carriers

Public policies that subsidize certain travelers and carriers to pursue social goals, such as improving the mobility of low-income households, may be justified if the goals are supported by the public and the subsidies are provided at minimum social cost. Subsidies are not warranted when they amount to inefficient income transfers that primarily benefit travelers with incomes above the national average.

I noted that fares paid by all urban transit riders, not just those with low-incomes, are heavily subsidized. Certain commuters also receive tax breaks from employer-provided benefits of free parking and transit passes. Recent estimates of the revenue foregone to the government are nearly \$4 billion from free parking and \$0.5 billion from transit passes.²⁵ Of course, private sector employees' wages may be reduced to offset some of those benefits. But federal government

employees who obtain free monthly payments (not included in the preceding total) for commuting on public transportation do not experience wage offsets because Congress fully covers their subsidies.²⁶

Policymakers also subsidize air carriers that serve small communities and Amtrak. Although airline deregulation revealed that profitable air service without the need for subsidies could be provided in the long run to small communities (Morrison and Winston 1986), the Essential Air Services program continues to provide annual subsidies that approach \$200 million to air carriers that offer at least two flights a day to the 145 airports in the program.²⁷ The highest per-passenger subsidy in 2011 was more than \$1,000 at the airport in Ely, Nevada (population 4,255 according to the 2010 census). The median subsidy per passenger is roughly \$100 (GAO 2007). Amtrak, which was

²⁵The source for those figures is *Analytical Perspectives, President's Fiscal Year Budget, 2000–2010*.

²⁶Public rail transit subsidies for federal government employees benefit auto commuters by reducing congestion to some extent.

²⁷The FAA reauthorization bill passed in 2012 calls for government funding for the program to be slightly cut to \$190 million and for roughly a dozen communities to lose subsidized service.

expected to operate its rail passenger service as a private entity without federal subsidies within a few years of its inception in 1970, is still federally supported four decades later. It has received more than \$30 billion in federal operating and capital subsidies and has obtained additional funding from state and local governments to subsidize routes operating within their jurisdiction (GAO 2006).

5. Synthesizing and Assessing the Evidence

The nation's transportation system is a vital part of the economy that has significantly raised living standards for Americans while gradually becoming safer and less harmful to the environment. But the public sector's extensive involvement in the system has resulted in policies that have generated large costs. Its provision and management of infrastructure and urban transit has not been guided by basic economic principles: prices do not reflect social marginal costs, especially a user's contribution to congestion and delays; investments are not based on cost-benefit analysis and have failed to maximize net benefits; and operating costs are inflated by regulations. Economic regulations of transportation operations have not promoted efficiency and, in some cases, they have hurt consumers; consumer welfare would clearly improve if international airline and ocean shipping services were fully deregulated. Finally, the effect of government policy on transportation safety has not been empirically determined while its policies to reduce congestion and pollution have imposed excessive costs.

Table 5 summarizes the inefficiencies I discussed in the previous section and, where available, reports the estimated annual welfare costs. Total costs exceed \$100 billion (in 2005 dollars), which is an extreme lower bound estimate because it does not include the cost of inefficiencies that have not been

quantified and the substantial cost of transportation policy inefficiencies on other economic sectors. In addition, as I discuss in the context of privatization, it does not include the potentially large cost of government policies that may have stifled innovation and technological advances in several areas of transportation. An accurate—and undoubtedly much higher—estimate of the total welfare costs of public provision and regulation of transportation awaits further research to quantify the omitted costs.

5.1 Distributional Considerations

Federal transportation spending funded by the traveling public, such as highway bills' wasteful earmarks and highway and aviation trust fund allocations to locales with relatively little traffic, have undesirable distributional features. Other policies explicitly subsidize bus commuters who, according to the *National Household Travel Survey*, live in households with average incomes of \$42,550 (2008 dollars), rail commuters who live in households with average incomes of \$85,100 (2008 dollars), and users of Amtrak and airlines that serve small communities who also live in households with incomes above the national average.

Taxpayer-provided subsidies to cover transit deficits have become so large that they may be exceeding the social benefits provided by urban bus (Winston and Shirley 1998) and urban rail (Winston and Maheshri 2007). Parry and Small (2009) conclude that subsidies may be justified for some urban rail systems but they qualify that conclusion by noting it is most applicable to a transit agency with strong incentives to minimize costs—*incentives that judging by the evidence on cost inefficiencies most, if not all, transit agencies appear to lack*. Morrison (1990) estimated that Amtrak's heavily-trafficked northeastern routes are cross-subsidizing routes with lower traffic in the rest of the United States resulting in negligible social

TABLE 5
INEFFICIENCIES AND WELFARE COSTS (2005 DOLLARS) FROM TRANSPORTATION POLICIES
Public Provision of Infrastructure and Urban Transit

Item	Aggregate Welfare Cost
Increasing travel delays for motorists, truckers, and shippers	Cars and trucks are not charged for contributing to congestion (\$45 billion excluding loss to truckers and shippers) ^a
Search costs for parking spaces	n/a
Excessive damage to highway pavements	Truckers are not charged efficient pavement-wear taxes for road use (\$10.8 billion) ^b
Excessive structural stress on bridges	n/a
Increasing delays for air travelers and cargo during takeoffs and landings	Runway capacity is suboptimal and congestion tolls are not charged for takeoffs and landings (\$16 billion); ^c welfare costs do not include cargo
Increasing delays for air travelers in congested airspace near airports	n/a
Increasing delays on waterways	n/a
Highways require excessive repairs and repaving	Road thickness thinner than optimal (\$12.5 billion) ^d Inferior materials are used to lay asphalt (\$1 billion just for California) ^e
Damage to cars and trucks from roads in poor condition	Total damage costs to cars are estimated to be \$64 billion; ^f welfare cost n/a
Highway labor costs are inflated	Federal and state regulations raise wages (welfare cost n/a)
The allocation of highway funds is inefficient	Funds are not allocated to the most congested cities to minimize the cost of delays (\$13.8 billion) ^g
The cost of investments in airport runway capacity and air traffic control technology is increased by delays in project completion	Regulations and mismanagement increase the costs of runway and air traffic control investments (n/a)
The allocation of funds for airports and air traffic control is inefficient	Funds are not allocated to the most congested airports (ATC facilities \$1.1 billion ^h ; airports n/a)
Army Corps' of Engineers waterway investments are inefficient	Investments do not satisfy a cost-benefit test (n/a)
Urban transit requires excessive subsidies	Fares are set below marginal cost and frequencies are excessive (\$10.6 billion) ⁱ "Buy American" regulations; Capital subsidies; Restrictions on releasing employees (n/a)
<i>Economic Regulations</i>	
Reductions in airline competition at airports	Limited availability of gates (\$4.4 billion) ^j Slots and perimeter rules n/a
Foreign carriers cannot enter U.S. routes; economic regulations on certain international routes for passengers and cargo service	Travelers' international fares are raised (\$3 billion) ^k

(Continued)

TABLE 5
INEFFICIENCIES AND WELFARE COSTS (2005 DOLLARS) FROM TRANSPORTATION POLICIES
Public Provision of Infrastructure and Urban Transit (Continued)

Item	Aggregate Welfare Cost
Jones Act restrictions and ocean shipping liner conferences	n/a
Regulation of taxi fares and prohibition of entry by private transit	n/a
Federal truck size and weight limits	n/a
Land use regulations and minimum parking requirements	n/a

Sources:

- ^a Langer and Winston (2008)
- ^b Small, Winston, and Evans (1989)
- ^c Morrison and Winston (1989)
- ^d Small, Winston, and Evans (1989)
- ^e Gillen (2001)
- ^f The Road Information Program (2010)
- ^g Winston and Langer (2006)
- ^h Morrison and Winston (2008)
- ⁱ Winston and Shirley (1998)
- ^j Morrison and Winston (2000)
- ^k Winston and Yan (2013)

benefits overall. Amtrak's patronage in the northeast has grown in the past decade but so have its costs and it requires billions of dollars to address deferred maintenance (GAO 2006).

To be sure, transit subsidies are providing some benefits to low-income households, but they appear to be modest. According to data from the American Community Survey, 2006–2010, low-income commuters, defined as earning less than \$15,000 per year, use transit for only 9.6 percent of their work trips (Cox 2012), in all likelihood because transit only enables them to reach less than one-third of metro-wide jobs within 90 minutes (Tomer 2012) while the automobile enables them to reach all jobs in the 51 largest metropolitan areas within 60 minutes (Levinson 2013).

5.2 Causes of Inefficient Policies

Agency limitations, regulatory constraints, and political forces combine to maintain inefficient transportation policies and to impede efficient reforms. For example, the Federal Aviation Administration is at the heart of airport and air traffic control inefficiencies because it lacks organizational independence and is prevented to a significant extent by both the U.S. Department of Transportation and Congress from using its resources—and from encouraging airports to use theirs—more efficiently. Given that it faces opposition from two powerful branches of government, it is not surprising that the FAA finds it so difficult to reform its policies.

Constructive reforms must also overcome various regulations. For example, I noted the

regulatory hurdles that delay airport runway investments and the “majority in interest” clauses that permit incumbent airlines to block new construction of gates and terminals that would enable new entrants to serve an airport. Levine (2007) points out that wide-spread adoption of runway congestion pricing would require airline tenants and their airport landlords to abrogate their existing residual and compensatory contracts and to develop an acceptable framework for determining all airport charges.

Regulations of, and expenditures on, transportation systems are likely to benefit particular stakeholders, especially those who effectively pressure members of Congress and regulatory officials to support their agenda and to oppose efficient reforms. For example, Stiglitz (1998) described his efforts, as part of the Clinton administration, to institute peak-period pricing for air traffic control only to find reform blocked by owners of corporate jets and small planes who had a vested interest in inefficiently-low user fees.

Indeed, special interest politics is transparent in several areas of transportation policy. Dilger (2009) points out that through their public interest groups, state and local government officials have lobbied for increased federal assistance for surface transportation grants and increased flexibility in how they use those funds; the American Automobile Association and the American Trucking Association have opposed efficient congestion tolls and axle-weight charges that are likely to cause many of their members to pay more for using the road system while they have supported more government highway spending; labor unions have opposed removing Davis-Bacon regulations because thousands of construction workers would see their wages fall; and urban transit subsidies have largely been accrued by powerful interests—higher wages to labor and higher profits to suppliers of transit capital. The current debate about funding a national high-speed-rail

system has attracted powerful interest groups who support and oppose the idea.

Finally, because federal transportation legislation reauthorizes hundreds of billions of dollars for aviation and surface transportation spending that has the potential to benefit certain stakeholders at the expense of others, members of Congress must continually engage in contentious negotiations to craft the legislation. Compromises broadly apportion federal highway funds to states and federal aviation funds to air traffic control facilities, instead of allocating those funds efficiently to specific locales based on a cost–benefit approach to alleviate the country’s most congested highways and air travel corridors.

Although the public sector has greatly contributed to building the nation’s invaluable transportation system, its costly policies cannot be ignored, especially because more efficient policies could significantly improve the system. I now consider two alternative approaches for initiating constructive change: public sector policy reforms and privatization.

6. Public and Private Sector Approaches for Improving the U.S. Transportation System

The existence of extensive inefficient transportation policies per se does not necessarily imply that the public sector should reduce its involvement in the system, but it does indicate that policymakers should be motivated to explore reforms that would improve efficiency. If the public sector is going to maintain the status quo and not make constructive reforms, then privatization merits serious consideration.

6.1 Public Sector Policy Reforms

Policymakers could improve performance in transportation and other sectors by implementing efficient pricing and investment

policies. Former secretary of transportation Mary Peters, who served in President George W. Bush's cabinet from 2006 to 2009, showed that I am not making naïve policy recommendations that are unappealing to policymakers and that have no possibility of being implemented.

Secretary Peters supported congestion pricing as a way to improve the nation's highway infrastructure without significantly increasing federal spending, and she hoped to disburse funds to encourage metropolitan areas to conduct congestion pricing experiments, especially Mayor Michael Bloomberg's plan to charge motorists and trucks to enter Midtown and Lower Manhattan during the busiest weekday travel hours. Bloomberg's proposal passed several political hurdles, gaining approval from the governor, city council, and one house of the state legislature, before it failed to be approved by the other house (Schaller 2010).²⁸

Secretary Peters also tried to decrease airline delays in New York area airspace by calling for the federal government to conduct auctions that would enable up to 10 percent of the takeoff and landing slots at the three major New York-area airports, Kennedy, LaGuardia, and Newark Liberty, to be claimed by the highest bidder. Because airlines would reduce the cost of the slots per passenger by using larger planes to haul more passengers per flight, they would use fewer small (regional) planes and reduce the total number of flights and delays (Whalen

et al. 2008). But with the incumbent carriers, JetBlue and Delta, and the New York Port Authority, which wanted to maintain its control of airport operations, lobbying against the plan and New York's then-Governor David Paterson and Senator Charles Schumer claiming that the Department of Transportation had exceeded its authority, the new secretary of transportation under President Obama, Ray LaHood, scrapped the slot auction proposal.

Given that broad transportation policy approaches that are grounded in microeconomic efficiency appear to be indefinitely on hold, the major options that policymakers are currently considering to improve the system are to secure additional financing and to increase spending on infrastructure.

6.1.1 Improving Financing

Policymakers are rightly concerned that they lack the funds to adequately repair and maintain existing roads and to expand road capacity. A funding gap exists because highway revenues are largely based on the gasoline tax, which fails to cover the costs of motorists' and truckers' road use and has been falling relative to total miles traveled as vehicle fuel efficiency has improved. Proposed strategies include raising the fuel tax on cars and trucks and introducing a tax on vehicle-miles-traveled (Congressional Budget Office 2011, Parry 2008). Both policies fall short of efficient marginal cost pricing, but either alone or in combination, they appear to be justifiable on second-best grounds and could increase highway revenues. Of course, they would still encounter congressional resistance to increasing transportation taxes.

Public-private partnerships (PPPs) can potentially help governments facing budgetary pressures by substituting private for public spending on transportation infrastructure and by improving project efficiency because the private partner builds, operates, and

²⁸GAO (2012c) summarizes the conventional economic arguments—that is, equity concerns—for opposing congestion pricing. However, Taylor (2010) points out that revenue from congestion pricing could reduce or replace the regressive sales taxes that are increasingly used to fund transportation. Altshuler (2010) points out that from a political perspective a policy like congestion pricing is difficult to pass in the United States because our legislative system effectively gives a long list of interest groups the opportunity to oppose a major policy change that could do any harm to their interests.

maintains the project and therefore has incentives to provide durable construction and efficient maintenance and operations, unlike with pure public provision (Engel, Fischer, and Galetovic 2011b, Auriol and Picard 2011).

PPPs have a limited history in the United States. In recent years, investments have amounted to \$20 billion to \$40 billion and the gains have been small (Engel, Fischer, and Galetovic 2011a).²⁹ One problem is that roughly 30 percent of the original contracts have been renegotiated because they were incorrectly designed. For example, the Dulles Greenway toll road initially went into default because the private owner significantly overestimated motorists' demand, but it is now heavily used and financially viable.

Finally, some policymakers have proposed that infrastructure projects could attract additional financing and could be more efficient if the nation created an infrastructure bank, which would consist of a board who made independent decisions and issued direct loans and loan guarantees that would be backed primarily by private money to finance public works projects (Kahn and Levinson 2011). Such a bank would potentially eliminate congressional pork barrel projects, but it is not clear whether the board would be insulated from political influences, whether project selection and social rates of return would significantly improve, and whether the private sector would be interested in investing in the bank unless it envisioned highly favorable rates of return.³⁰

²⁹CBO (2012) shows that the costs of operating and maintaining the Chicago Skyway and Indiana toll road slightly declined after those roads were taken over by private firms, but other factors may have contributed to the lower costs.

³⁰Many state governments have established infrastructure banks to support surface transportation projects, but I am not aware of any assessments of the performance of those banks.

6.1.2 Increasing Infrastructure Spending

A concomitant of government strategies to increase transportation funding is to increase infrastructure spending; but because other policies such as pricing would not necessarily be reformed, the returns from additional spending could be compromised.³¹ Ironically, the existence of federal-aid highways has enabled states to spend less on highways than they otherwise would; thus, the federal government could increase infrastructure spending simply by requiring states to increase their matching funds or to maintain certain levels of investment (Knight 2002, GAO 2004).

Aschauer (1989) and Munnell (1990) provided the initial empirical support for increasing infrastructure spending by analyzing national time series data and finding that such spending generated returns exceeding 100 percent. A heated debate ensued that questioned those returns with Shatz et al. (2011) concluding in a recent survey of the literature that the economic effects of highway infrastructure spending are context-specific and vary greatly. For example, the construction of the U.S. interstate highway system had positive and large effects on the nation's productivity; but following the completion of the system in the early 1970s, spending has primarily been used to maintain the road network and it has had much smaller effects on productivity (e.g., Fernald 1999, Shirley and Winston 2004).

³¹That concern also applies to the transportation component of the 2009 American Reinvestment and Recovery Act (aka the \$787 billion stimulus program). To be sure, the effects of the stimulus program are controversial because it is difficult to execute a persuasive counterfactual of what productivity and employment would have been in the absence of transportation spending to compare with their actual levels. Moreover, only 8 percent of total spending went to transportation and waterway systems (Feyrer and Sacerdote 2011). In any case, I maintain that the potential improvements in productivity and employment were lessened by transportation policy inefficiencies.

The Obama administration envisions a 17,000-mile national high-speed passenger rail network as a transformative investment in the transportation system that could simultaneously reduce highway and air travel delays and generate employment and economic growth. Of course, such an investment would entail at least \$600 billion in initial construction costs and billions in operating costs, which must be weighed against the investment's benefits to determine if it is socially desirable.

Glaeser (2009) performed a series of back-of-the-envelope cost-benefit calculations and consistently found that building a high-speed rail network would not be socially desirable, even accounting for the reductions in highway congestion, carbon emissions, and traffic fatalities. Evidence drawn from international experience with high-speed rail appears to be consistent with Glaeser's conclusion. Nickelsburg and Ahluwalia (2012) studied the Japanese Shinkansen high-speed rail system and found that it did not provide evidence of inducing aggregate growth. De Rus (2011) considered trip distances of 500 kilometers and found that high-speed-rail in Europe produced welfare gains only for corridors that have at least 10 million annual passengers. Nash (2009) concluded that, even under favorable economic conditions, at least 9 million annual passengers were needed to justify a new high-speed rail line. Acela, Amtrak's high-speed service, which began operating in 2000 in the most densely populated corridor in the United States, carries less than half of that total annually. Thus the reduction in travel times offered by high-speed rail would have to more than double Acela's ridership to potentially justify the service.

The administration's plans to build a national high-speed-rail network are increasingly drawing opposition from the public and elected officials—in fact, some states such

as Florida have refused federal subsidies for high-speed-rail projects that they have deemed uneconomic. Although California has passed legislation to spend some \$8 billion in federal and state money to begin constructing its network, farm bureaus in the state's Central Valley have immediately brought lawsuits to stop construction and have promised a long legal battle. Moreover, California officials expect the federal government to provide another \$42 billion to complete the system's network. Hence, it appears to be unlikely and fortunate on economic efficiency grounds that the Administration will not successfully introduce a new rail passenger transportation option in the United States in the foreseeable future.

Instead of developing a broad thematic strategy to improve the transportation system's performance based on efficiency criteria, policymakers are considering a piecemeal combination of options that seek to increase transportation funding and infrastructure spending. Some policies may improve transportation efficiency, others may not; but none offer the potential to rid the system of decades of inefficient practices and to spur innovations in operations and technology that may substantially benefit the traveling public and other economic sectors.³² Those objectives were largely achieved when policymakers took a bold step and partially deregulated the intercity transportation modes. I now consider whether policymakers should go further and deregulate and privatize entire parts of the transportation system to improve its performance.

³²Another transportation policy that would not promote efficiency is building urban streetcar systems. Cities are increasingly indicating an interest in spending funds, with federal support, on streetcars to revitalize their downtowns. But that form of transportation, which was abandoned decades ago because it was uneconomic, is likely to require large subsidies and increase the strain on local government budgets.

6.2 Privatization and Deregulation

The absence of evidence that extensive and costly government failure in transportation policy is likely to be corrected by efficient reforms in the near future motivates serious consideration of privatization. The available theory identifies the conditions under which privatization would raise welfare over public provision but the available empirical evidence does not resolve the uncertainties about whether those conditions are likely to materialize in practice in the United States. Thus, I believe that a critical step of the evaluation process should be that policymakers carefully design and conduct modest, localized privatization experiments to produce credible empirical evidence of economic effects that either support or reject broader adoption of privatization.

6.2.1 Theory

Whether privatization is superior to public ownership on economic grounds depends on the extent of market power that private firms possess, the extent to which incentives influence whether firms achieve their goals, and whether consumers have any recourse for applying competitive pressure on the private firms (Vickers and Yarrow 1991, Roland 2008). A further consideration is the method that state-owned assets are sold or distributed to private firms and the government's implied "welfare weights" for consumers and producers (Megginson and Netter 2001, Laffont and Tirole 1993).

Armstrong and Sappington (2006), among others, point out that even if an industry is privatized, it may be appropriate to regulate it. I have stressed that government regulations in the transportation sector have not tended to improve welfare, so I assume privatization here refers to a transparent, well-structured agreement in which the government sells, not leases, transportation assets to a private firm(s) for a one-time payment to the

government with all risk transferred to the firm(s) and with the firm(s) subject only to general business laws (Small 2010).

Theoretical studies of various components of the transportation system suggest it is possible that privatization would not result in serious market failures and that it could increase travelers' and society's welfare. Highway privatization could succeed by resulting in some form of congestion pricing that accounts for travelers' heterogeneous preferences for speedy and reliable travel, a competitive alternative to the private road, and a gas tax rebate for private road users (de Palma and Lindsey 2000, 2002, Calcott and Yao 2005).

In response to those who claim that urban bus and rail service both exhibit economies of traffic density and economies of waiting time (Mohring 1972), Walters (1982) argues that the extent of those economies indicates that public transit's inefficient operating environment creates excess capacity. Such capacity, Walters argues, could be substantially eliminated in a private market because operators would have the incentive and ability to improve their operations by, for example, adjusting vehicle sizes and frequencies to demand. At the same time, intermodal competition—especially from the automobile—would limit the ability of bus and rail companies to exercise market power.

U.S. airports are not natural monopolies (Morrison 1983); in fact, airport competition frequently arises when multiple airports serve a metropolitan area because catchment areas are likely to overlap (Starkie 2008b) and because travelers choose among airports based on the carriers that serve an airport and the service quality that the carriers offer (Ishii, Jun, and Van Dender 2009, Pels, Nijkamp, and Rietveld 2001). Effective private airport competition could potentially develop in several of the large U.S. metropolitan areas that are served by multiple airports, such as New York, Washington, D.C., Chicago, Los Angeles, and San Francisco.

Of course, many cities are served by only one airport. In that situation, Starkie (2012) argues that airlines could reduce charges by playing off one airport against another as their national network evolves.

6.2.2 Empirical Evidence

The only recent experience that the United States has had with privatizing any part of its transportation system was transferring the northeast freight rail system, Conrail, back to the private sector—a positive action because Conrail was subsequently purchased by CSX and Norfolk Southern railroads without raising antitrust objections. Circumstantial evidence on the potential effects of privatization can be obtained from experiences abroad, partial deregulation of U.S. intercity transportation, and evidence from simulations of possible privatization scenarios.

6.2.3 International Experience

Outside of the United States, the policy of converting state-owned assets into privately managed assets gained worldwide attention following the United Kingdom's privatization program that was initiated by the Thatcher government in the early 1980s. Highway privatization has been active in developed and developing countries (Gomez-Ibanez and Meyer 1993). Australia's Macquarie Bank Ltd. and Spain's Cintra Concesiones have amassed large infrastructure funds and have been leading investors in private highways throughout the world, but I am not aware of economic assessments of their or any other investors' privatization projects.

Karlaftis (2006) surveyed the empirical evidence of the effects of privatizing transit systems in various cities of the United Kingdom, continental Europe, Australia, Latin America, and Asia and concluded that privatization reduced costs and increased operating efficiency, primarily through more efficient use of labor. For example, cost savings were obtained by replacing regular buses

with mini-buses, whose drivers are paid lower rates. At the same time, minibuses operate at higher speeds and offer greater frequencies than conventional buses do and, because of their maneuverability, are able to stop at any point on the route to pick up and discharge passengers. Winston and Mahesri (2007) pointed out that recently privatized rail transit systems in foreign cities, notably Tokyo and Hong Kong, have been able to eliminate deficits by reducing labor and capital costs and by introducing more comfortable cars and remote payment mechanisms, among other innovations, that have reduced operating costs and expanded ridership. Finally, many Latin American, Asian, and Middle East cities rely on private jitney operations as their chief mode of urban transportation.

In contrast to U.S. cities, many cities throughout the world, such as London, New Delhi, Rome, Sydney, and Tokyo, have privatized their airports subject to varying degrees of regulation. Case studies find that privatization has improved airport efficiency in Australia (Forsyth 2008) and the United Kingdom (Graham 2008, Starkie 2008a). In a worldwide comparison of airports, Oum, Yan, and Yu (2008) found that airport privatization has reduced costs by promoting competition. An exception is that competition was not promoted when the three London airports, Heathrow, Gatwick, and Stansted, were initially privatized by allowing one company, Ferrovial SA, to purchase them. Subsequently, the UK Competition Commission appropriately required the owner to sell Gatwick and Stansted airports. Finally, Bilotkach et al. (2012) studied sixty-one European airports over an eighteen-year period and found that privatization has reduced aeronautical charges to airlines.³³

³³ Similarly, in contrast to U.S. cities, many cities throughout the world have privatized their ports and some evidence exists that privatization has led to efficiency improvements (Tongzon and Heng 2005).

Many countries have also restructured their air traffic control providers by granting them managerial and financial autonomy. Comparisons of the U.S. Air Traffic Control Organization with Nav Canada, a private sector air traffic control organization established in 1996 and financed by publicly traded debt, have found that under privatization modernization of technology was greatly improved, air travel became safer, and users benefited from improved service quality (Oster 2006, McDougall and Roberts 2008).

Privatization of rail transportation throughout the world has had mixed results. As summarized in Gomez-Ibanez (2006), some privatized railway operations have been successful, but unbundling train operations and track infrastructure maintenance turned out to create coordination problems in the important case of the United Kingdom, where the train operators, the infrastructure company, Railtrack, and the regulator often disagreed about the design of the improvements needed to expand track capacity, how much they should cost, and how those costs should be shared. Congestion on the system made maintenance more difficult and contributed to accidents that helped bankrupt Railtrack in 2001. Nash (2006) and Glaister (2006) argued that the U.K. government deserves considerable blame for Railtrack's collapse because it implemented the unbundling policy hastily and carelessly. Indeed, vertical unbundling did not cause serious problems in the rest of Europe and Australia, but that may be because the rail infrastructure companies were in public rather than private hands or because infrastructure capacity was far less strained.

Finally, airline market reforms have generally been successful, especially the transformation of European aviation from a series of bilateral agreements between governments and their national airlines to a single European market, which led to significant

reductions in fares and improvements in productivity (Barrett 2009).³⁴

6.2.4 U.S. Experience with Transportation Deregulation

Deregulating intercity transportation lead to efficiency improvements in three key steps: first, new entrants, including low-cost airlines and less-than-truckload carriers, advanced truckload carriers, and recently a plethora of modern intercity bus carriers, provided new competition;³⁵ second, incumbent carriers began to shed the inefficiencies that they accumulated while they were regulated; third, carriers redesigned their networks to improve transit times, reliability, and service frequency, adopted information technologies to manage their operations more efficiently, and tailored their services to cater to travelers' and shippers' varied preferences.

The U.S. deregulation experience gives cause for both optimism and caution about the potential effects of privatization. Optimism appears warranted when I compare public authorities' operations with deregulated carriers' operations. For example, deregulated intercity freight railroads

³⁴ It is commonly believed that the United States should take note of how certain transportation policies in Europe, namely higher gas taxes and restrictions on driving, have contributed to the higher densities of European cities. However, Gordon and Cox (2012) conclude that cities on both sides of the Atlantic are Americanizing—U.S. cities are not becoming denser, rather European cities are continuing to decentralize. Getting Europeans out of transit into cars has turned out to be much easier than getting Americans out of cars and into transit.

³⁵ Schwieterman et al. (2007) points out that regulatory reform of intercity bus transportation in 1982 did not immediately reverse the mode's long-term decline. But in 2006 the intercity bus sector began to reassert itself and has been expanding service nationwide at a fast rate with the emergence and growth of Megabus, a new low-cost operator owned by the successful British company Stagecoach Ltd. and new East Coast and West Coast operators. New services have also emerged including Greyhound's Bolt Bus and the so-called Chinatown buses that connect Washington, D.C., and New York City and other origin-destination pairs.

dropped roughly one-third of their track miles to reduce excess capacity and airlines significantly accelerated hub-and-spoke operations to increase load factors, while public transit authorities have done little to improve the efficiency of their networks during the past three decades. Privatized and deregulated bus and rail transit companies are likely to redesign their networks to make them more efficient.

Generally, much of the success of intercity transportation deregulation is attributable to carriers' innovations in operations and technology that were suppressed by regulation (Morrison and Winston 1999, Gallamore 1999). Privatization could improve infrastructure provision and urban transportation for the same reason. For example, a new generation of communications technologies—known as telematics—could enable highway infrastructure providers to set accurate congestion tolls and could enable motorists' to optimize their route choices to reduce delays with on-board computers that use satellite information in conjunction with real-time highway travel conditions and computerized road maps. Some motorists have shown that telematics can expedite their trips by improving route choices. But because highway authorities have not implemented any form of real-time road pricing, motorists have little reason to adopt telematics to consider alternative price and travel time options for their journeys. Information technology could also be used to reduce search for available parking places and to set charges that vary by location according to demand. One approach would be to embed sensors in the asphalt to allow motorists to access information on the Internet that indicates a parking spot's availability, price, and location.

Bus systems could use telematics when circumstances arise to identify alternative less-congested routes that would be faster but still enable passengers to get off close to their regular stops. Recently, in San

Francisco an Apple iPad app was created that uses Global Positioning System technology to track all the city's buses in real time, allowing transit managers and passengers to monitor problems and delays. But the app has not been used because the San Francisco transit agency, MUNI, is over budget and cannot afford to purchase the iPads required to run the software.

It is possible that other innovations that could greatly improve transportation are being stifled by the public sector and that they could be adopted more quickly under privatization: from the mundane, such as longer lived pavements and technologies that enable highway operators to identify potholes more quickly, to the sublime, such as driverless cars and fully-automated freight shuttles that operate on guideways in metropolitan areas.³⁶

A major caution is that private firms would either be new U.S. firms or foreign firms that have little if any experience competing in infrastructure and transportation services in the United States. And in contrast to new entrants in deregulated intercity markets, those firms would inherit and then have to shed the public sector's inefficient operations, investments, technologies, and to some extent its labor force.

Thus the challenges facing firms in a privatized and deregulated environment of adjusting to unregulated competition over the business cycle, shedding bequeathed

³⁶Neil Jenkins, the Chairman of a manufacturer of amphibious automobiles, claims that a conflict between regulations impedes the introduction of such a vehicle in the United States. Air-bag sensors must be set according to National Highway Traffic Safety Administration guidelines for the car to be approved for highway travel. But on the water, the settings are too sensitive because waves that crash on the vehicle deploy the air bags. In addition, an Environmental Protection Agency rule requires that a car be equipped with a catalyst, which can heat up to several hundred degrees, to control emissions. But the Coast Guard bars watercraft from operating with anything even half that hot in its engine compartment.

inefficiencies, improving their networks, adopting the most effective management strategies and latest technologies, and catering to customers' preferences would be much greater than they were for firms in a deregulated environment.³⁷

6.2.5 Simulations

By drawing on evidence from deregulated intrastate airline markets in California and Texas, and from freight transport markets where certain agricultural commodities were deregulated and comparing them with regulated prices in comparable markets, academics offered predictions of the economic effects of deregulation that helped influence policymakers to adopt regulatory reform (Derthick and Quirk 1985). It is difficult to perform similar studies to predict the economic effects of privatizing and deregulating U.S. public infrastructure and transportation services because no private services in the United States that could be used for a counterfactual exist.

Some studies, however, have characterized possible competitive environments under privatization and deregulation and performed simulations to predict travelers' and social welfare in those environments. Winston and Yan (2011) analyzed highway privatization based on motorists' travel on State Route 91 in California, which currently consists of high-occupancy toll lanes and regular lanes. The authors characterized

a competitive environment by assuming the highway takes the form of two routes with equal lane capacities and that both routes could be operated by a private monopolist, each route could be operated by a different private firm generating duopoly competition, or one route could be operated by a private firm and the other by the government generating public-private competition. They also assumed motorists, represented by a third party, and private providers negotiated tolls and capacity that generated a contract equilibrium (Meyer and Tye 1988) and that motorists would be refunded gasoline taxes that currently go into the highway trust fund because the private provider(s) would be solely responsible for financing the highway.

Winston and Yan found that highway privatization could benefit road users and increase welfare by reducing the inefficiencies associated with current (public sector) road pricing and capacity allocation, even if the highway were owned and operated by a monopolist. Motorists were able to gain in certain bargaining situations where they were given a choice of paying a high toll to use lanes with little congestion or paying a low toll to use lanes that are highly congested. Motorists failed to gain when a private owner set monopoly charges or when negotiations did not lead to price and lane capacity allocations that were aligned with their preferences.

Winston and Shirley (1998) simulated the economic effects of privatizing and deregulating transit by constructing a model in which bus and rail companies in a metropolitan area competed with one another, as well as with private automobiles, and set prices and service frequency to maximize profits. They found that the public's gains from eliminating transit deficits (and taxpayer subsidies) would substantially exceed travelers' losses from higher fares and reduced service, and that private bus and rail operators would be profitable. Those findings, however, greatly

³⁷I am not aware of systematic evidence of the effects of cities' efforts to privatize certain services. Levin and Tadelis (2010) study the determinants of privatization and find that economic efficiency concerns affect this choice; services for which it is harder to write and administer performance contracts are less likely to be privatized; services that are less likely to inflame residents' sensitivity to quality are more likely to be privatized—perhaps because city officials focus more on reducing costs and can provide less expensive levels of service to achieve cost reductions without irritating constituents. Cities in the West are more likely to contract for service provision and large cities make the greatest use of privatization.

overstated the potential losses to travelers because they do not reflect the improvements in operations, marketing, and service that could be achieved by private transit and the impact that new entrants, such as private vans, jitneys, and deregulated taxis, would have on fares and service.³⁸

Finally, Yan and Winston (2012) develop a model where privatized airports in the San Francisco Bay Area with separate owners compete for airline operations by setting profit-maximizing runway charges that reduce delays and airlines compete for passengers; runway charges are determined through separate negotiations between airlines organized as a bargaining unit and each of the three Bay Area airports, Oakland, San Jose, and San Francisco.

The authors found that it was essential for the Bay Area airports to be sold to different owners to prevent carriers from facing monopoly charges that would be passed on to travelers. They also found that by setting different charges for different classifications of airport users, scheduled commercial carriers and general aviation, the Bay Area airports would gain from privatization, as would commercial travelers and carriers. Commercial air travelers would pay higher fares because airport charges to airlines would increase, but the time-savings from less-congested air travel would more than offset that cost. General aviation would face higher charges but their losses would be softened if policymakers expanded airport privatization to encourage (smaller) private airports to compete for (smaller) aircraft operations by, for example, taking advantage of advances in

GPS technology that have improved access to smaller airports, by upgrading runways and gates, and by offering van and rental car service to improve travelers' access to the central city and other parts of the metropolitan area. By having more flight alternatives, travelers in low-density markets could especially benefit if private airports nationwide offered commercial service.

6.2.6 Privatization Experiments and Evaluations

Although much of the circumstantial evidence is encouraging, I cannot ignore the fact that some foreign privatization experiences, such as the United Kingdom's rail track and certain highway concessions, have resulted in financial failure; that travelers' and firms' adjustment to privatization in the United States would be far more turbulent than it was to deregulation, possibly leading to adverse outcomes; and that the evidence based on simulations also includes monopolization scenarios where travelers' welfare would be significantly reduced under privatization. Thus the available evidence does not preclude the possibility that privatization and deregulation of the U.S. transportation system could result in market failure attributable to the abuse of monopoly power or inadequate management of uncertainty in demand, costs, and the like that could lead to a financial collapse.

In addition, many questions can be raised about how privatization and deregulation should proceed. For example, what is the most efficient way for the government to transfer public assets to private firms? What should the sale prices be for those assets? What role, if any, should the public sector have in the privatized system? How much time will be needed for effective competition to develop in privatized and deregulated transportation markets? Should regulations be implemented during the transition to effective competition? What contingency

³⁸ Uber, a San Francisco technology company, has facilitated new urban transportation service by providing a smartphone application that allows consumers to directly hail private livery service and some taxicabs on demand without having to go through a dispatcher. Not surprisingly, city governments are proposing regulations that would constrain this service and protect incumbent taxi companies from a new source of competition.

plans should be developed in the event that privatization results in a financial collapse of a significant part of the system or in a monopoly provider that faces no competitive discipline?

At the same time, policymakers can draw on experiences from different sectors that have relied on private investment and utility service for decades, such as, electricity, water, gas, and so on, and that have addressed concerns about monopoly power, service quality, risk management, and maintaining assets. Practical experiences also exist from privatization of city-owned parking garages and parking meter concessions and from public-sector contracting with private firms to build and repair roads. Privatizing public transportation infrastructure and services does not raise unique insurmountable issues.

Accordingly, it is important for policymakers, in collaboration with scholars, practitioners, and users, to carefully design and execute experiments in selected parts of the country to obtain some hard evidence of the effects of privatization before considering nationwide adoption. In fact, Congressional legislation for airports and highways has included funding and tax breaks to explore privatization to a limited extent, so the idea of transportation privatization experiments in the United States is not new. Certain cities, such as Chicago and Sandy Springs, Georgia, are exploring privatization of many of their public services, including transportation infrastructure. And at least one private company has expressed interest in developing a high-speed rail network in the northeast corridor and other private companies have expressed interest in offering high-speed rail service between Miami and Orlando and between Dallas and Houston.

Considerable thought should go into identifying contexts for the experiments that would enhance their value. For example, Winston (2010) suggests motivating factors (e.g., congestion and delays), characteristics

of suitable locations (e.g., a congested travel corridor that is unlikely to receive substantial government funding), and potential benefits to travelers (e.g., reduced travel times) from conducting highway, transit, airport, and air traffic control privatization experiments. Effective competition could develop for those transportation services and the experiments should be designed to maximize the likelihood it does. Observers should understand that private firms will need considerable time to raise capital, develop a business plan, and to replace the public sector's capital structure with their own more efficient capital structure. An advantage of privatization is that a contract exists, so clear, enforceable performance standards can be set for project costs, completion, operation, and the like.

As experiments evolve, analysts should evaluate their economic outcomes and, if necessary, propose supplemental policies that could enhance the transportation system's performance. The evaluations should take the counterfactual approach that I discussed previously. For example, if a city privatizes its bus transit system, then public officials should commission a comprehensive survey to collect disaggregated data on travelers' behavior, including their work and non-work trips, choice of mode, origin and destination, socioeconomic characteristics, and the price and non-price attributes of the available modes during the period that bus was privatized, allowing private bus operators and travelers to have sufficient time to adjust to the new economic environment. Using this data set, analysts could estimate an urban mode choice model and measure the social welfare effects of bus privatization by comparing what travelers' welfare would have been without privatization, based on public bus transit's and other modes' price and nonprice attributes during a representative period, with travelers' welfare under privatization, based on the price and nonprice attributes of private bus

and the other modes, and by calculating the change in the government's budget balance, labor's earnings and employment, and bus operators' profit.

7. Conclusion

Transportation, as a distinct sector and through its interaction with other sectors, is a vital part of the U.S. economy. And as commuters' blood pressure readings would attest, it also greatly affects everyone's quality of life. Unfortunately, our transportation system has been steadily raising the nation's blood pressure—a problem that calls for more than health care reform. Improvements in communications that, for example, facilitate telecommuting and online meetings are a modest short-run response to certain passenger transportation inefficiencies, but they are not an effective long-run strategy because they limit face to face contact, personal interactions, and the exchange of ideas that promote innovation and growth (Jones and Romer 2010).

Economists' research in the 1960s and 1970s helped spur regulatory reform of the intercity transportation system that greatly benefited the economy. The research priorities today have the potential to result in even greater benefits. First, the time has come for the United States to determine the socially optimal mix of public and private provision of transportation; the policies that should govern that transition; and the policies that could promote the highest level of system performance while overcoming political and institutional constraints. Second, notwithstanding its social benefits, transportation still contributes significant negative externalities. Research that could identify effective ways to improve transportation safety, especially on highways, develop more efficient approaches to reduce the transport sector's consumption of energy and its contribution to harmful emissions, and propose

and evaluate pricing and investment policies that could ameliorate congestion in a socially desirable manner would be valuable.

Finally, transportation economics could greatly advance its standing among economists and with the engaged public by broadening its perspective and cross-fertilizing with other fields to explain more fully how transportation affects labor markets, urban and regional economies, international trade patterns, and industry competition. Given the vast importance of transportation in our daily lives and its absorption of trillions of dollars in users', providers', and governments' money and time, it is certainly reasonable that the field's ultimate ambition should be to explain how resources devoted to transportation contribute to an entire economy's performance and growth. A framework that could successfully address that question could then be exported to countries around the world to improve their transportation systems.

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