8 Value of and Investment in Transportation Infrastructure and Other Assets

Key Takeaways

- The net value of U.S. transportation capital stock was estimated at $7.7 trillion in 2016.
- In 2017, state and local governments accounted for 99.0 percent of public investment in transportation, although they received a significant amount of that funding from the Federal Government.
- The National Highway Cost Construction Index has increased by 58.9 percent from the first quarter of 2004 to the last quarter of 2017.

Introduction

Transportation infrastructure and other transportation assets constitute some of the most important economic resources of the United States. *Transportation infrastructure*, also known as *transportation structures* in national data, includes highways and streets, bridges, railroads, and other transportation structures. *Transportation assets* include transportation infrastructure along with vehicles and other transportation equipment used to move people and goods (box 8-1).

Transportation assets support the economic activities of households, transportation companies, private firms, and governments. For example, people and goods move via the transportation infrastructure built, owned, maintained, and operated by federal and local governments (e.g., streets, highways, airports, and transit systems), as well as by the private sector (e.g., toll facilities, railroads, pipelines, and support infrastructure, such as terminals).

Box 8-1 Terminologies Used in Measuring the Value of and Investment in Transportation Infrastructure and Equipment

The United Nations' System of National Accounts defines *assets* as entities owned by some unit or units from which the owners derive economic benefits by holding or using them over time.

Fixed transportation assets include transportation infrastructure as well as motor vehicles and other equipment, such as aircraft, ships, and boats used to move people and goods. They are assets because they last more than one year and are used to produce goods and services, e.g., to move flour to a bakery. *Fixed investment in transportation assets* is spending on fixed transportation assets.

Capital stock refers to assets in existence on a certain date. To be classified as capital, an asset must be durable (i.e., storable and have an average life of at least 3 years) and expected to remain in service for at least one year. Assets expected to remain in service for less than a year are *consumption goods* and excluded. Capital stock for transportation includes fixed structures, such as railroad tracks, airports, transit stations, bus shelters, and locks and dams as well as equipment like automobiles, aircraft, and ships.

BEA measures the value of capital stock by cumulating investment in transportation assets and deducting the cumulated loss in value due to wear and tear, obsolescence, accidental damage, and aging known as depreciation. The resulting value is the *net value* of transportation capital stock, i.e., the value of the stock less depreciation. The depreciation estimates assume that a fixed percentage of the assets loses value each year. BEA bases its depreciation patterns on empirical evidence of used asset prices in resale markets. For most assets, the value of economic depreciation generates a net (of depreciation) value that is a proxy for the value of economic replacement (what must be spent to maintain the volume of capital services at the existing level).

Transportation infrastructure consists of the structures that support the movement of goods and people, such as highways and streets, bridges, railroads, airports, and ports. It does not include transportation equipment like motor vehicles, aircraft, and ships. BEA estimates the value of, and investment in, new transportation infrastructure referred to as new transportation structures in the National Income and Product Accounts (NIPA).

This chapter presents national data measuring the value of, and investment in, transportation assets (transportation infrastructure, vehicles, and other transportation equipment). The data include:

1. *Transportation Capital Stock* from the Bureau of Economic Analysis (BEA), which measures the explicit value of all transportation assets in existence as of a certain date (known as capital stock). Government, the private sector, and households all invest in transportation capital stock. This measure is depreciated.

2. *Investment in Transportation Assets* from BEA, which measures investment in new transportation assets such as government spending on highway construction and household purchases of personal motor vehicles and parts.

3. The *Value of Construction Put in Place* survey conducted by the U.S. Census Bureau, which measures investment in transportation infrastructure. Both BEA and Census estimate the value of transportation infrastructure in terms of the resources used to construct it.

4. The *National Highway Construction Cost Index (NHCCI)*, which measures the prices that state transportation departments pay for roadway construction, materials, and services.

The chapter also discusses, qualitatively, the implicit benefits that society derives from using transportation assets, such as mobility to businesses and individuals. Estimating the value of transportation assets in terms of these benefits quantitatively is more difficult and the subject of ongoing research.

Value of Transportation Capital Stock

BEA measures the value of transportation assets through its estimate of *transportation capital stock* (box 8-1). Transportation capital stock is the value of transportation infrastructure (e.g., roadways, bridges, and stations) and equipment (e.g., automobiles, aircraft, and ships) in existence as of a specific date. Economists deduct depreciation to account for the decline in value of the assets due to wear and tear, obsolescence, accidental damage, and aging. The resulting value after depreciation is the net value of U.S. transportation capital stock. The net value of U.S. transportation capital stock was estimated at $7.7 trillion in 2016 (figure 8-1).

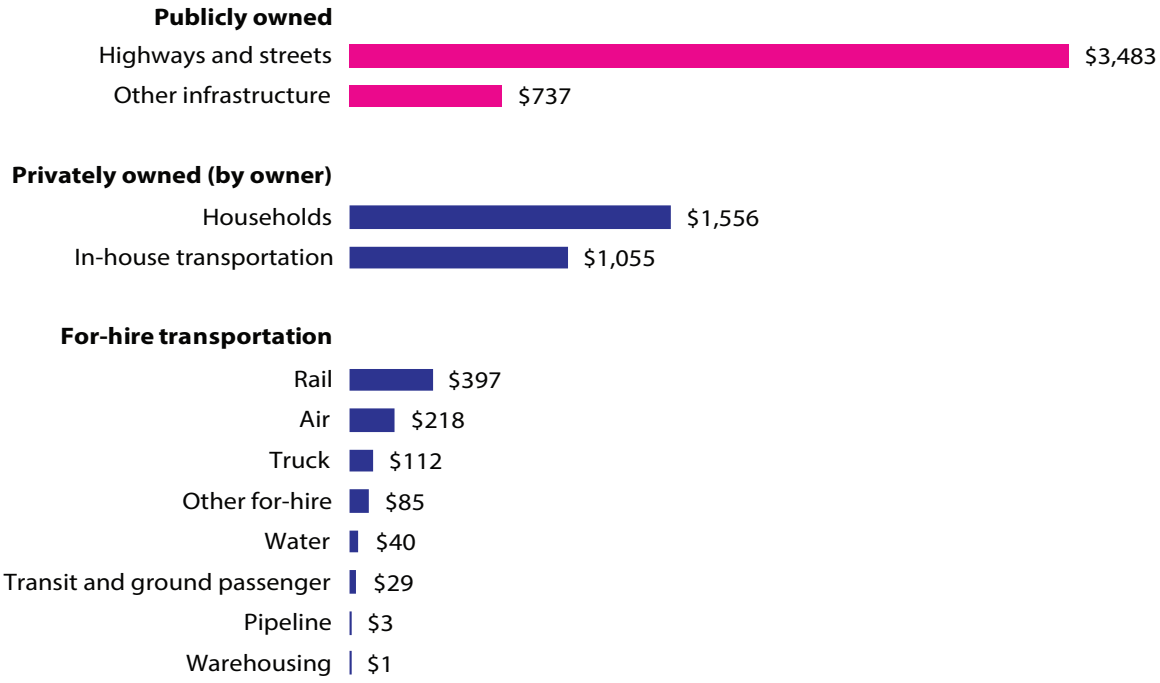
The public and private sector both own transportation capital stock. In 2016, the public sector owned $4.2 trillion (54.7 percent), while the private sector owned $3.5 trillion (45.3 percent) (figure 8-1). Public highways and streets accounted for the largest share of publicly owned transportation capital stock ($3.5 of $4.2 trillion), while other publicly owned transportation, such as airports, seaports, and transit structures, accounted for the remaining share ($737 billion).

Transportation capital stock owned by the private transportation sector includes the transportation capital stock owned by:

- households (personal motor vehicles and parts),
- non-transportation industries to carry out their own transportation operations (known as in-house transportation), and
- for-hire transportation industries.

In 2016 personal motor vehicles and parts owned by households, some of which are used for business purposes, accounted for the largest amount of privately owned transportation capital stock ($1.6 of $3.5 trillion) (figure 8-1). Non-transportation industries owned the second largest amount ($1.1 trillion) of privately owned transportation capital stock, most of which was highway related, such as truck fleets owned by grocery chains. For-hire rail owned the next largest amount, accounting for $397 billion of transportation capital stock, followed by for-hire air at $218 billion.

Figure 8-1 Estimated Value of Transportation Capital Stock by Owner, 2016 (billions)



NOTES: Estimates for only privately owned capital stock except otherwise noted. Capital stock estimates are reported after deducting depreciation. *Other publicly owned transportation* includes publicly owned airway, waterway, and transit structures but does not include associated equipment. *Locks and dams* may be included under *Other publicly owned transportation*. *Household* includes personal vehicles, which are considered consumer durable goods. *In-house transportation* includes transportation services provided within a firm whose main business is not transportation. For example, grocery companies often use their own truck fleets to move goods from their warehouses to their retail outlets. *In-house transportation and for-hire transportation* figures cover the current cost net capital stock for fixed assets (transportation-related equipment including light trucks; other trucks, buses and truck trailers; autos; aircraft; ships and boats; and railroad equipment as well as transportation-related structures including air, rail, transit, and other transportation structures and track replacement) owned by a firm. *Other privately owned transportation* includes sightseeing, couriers and messengers, and transportation support activities, such as freight transportation brokers. Details may not add to totals due to rounding. Estimates may differ from those published in the Bureau of Transportation Statistics' 2016 *Transportation Statistics Annual Report* due to revisions in source data.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, Fixed Asset Tables, tables 3.1ESI, 7.1B, 8.1; and Nonresidential Detailed Estimates, net stocks, current cost table. Available at apps.bea.gov/iTable/index_FA.cfm.

Investment in Transportation Assets

Government, the private sector, and households all invest in transportation assets. *Transportation investment* is defined as spending on transportation assets that take more than a year to consume. Because the assets last more than 1 year, this type of investment is known as a *fixed investment* in transportation assets (box 8-1). The investment may be in transportation infrastructure (referred to as structures in national data on investment) like highways and streets, which have a fixed location; or in transportation equipment like motor vehicles, aircraft, ships, and boats.

BEA estimates public and private investment in new transportation assets that last more than 1 year (e.g., highways and streets, railroad lines, trucks, buses, and railcars). The BEA estimates of investment in new transportation assets cover all public and private investments in transportation, except pipelines, which BEA includes in mining infrastructure investment. All public and private investment estimates include only new structures and equipment and exclude maintenance and repair of existing structures or equipment. BEA also estimates household purchases of new and used motor vehicles, motorcycles, and other sports and recreational vehicles, such as bicycles,

all of which are transportation assets because they last more than 1 year. The Federal Highway Administration also estimates investment in highways and streets (box 8-2).

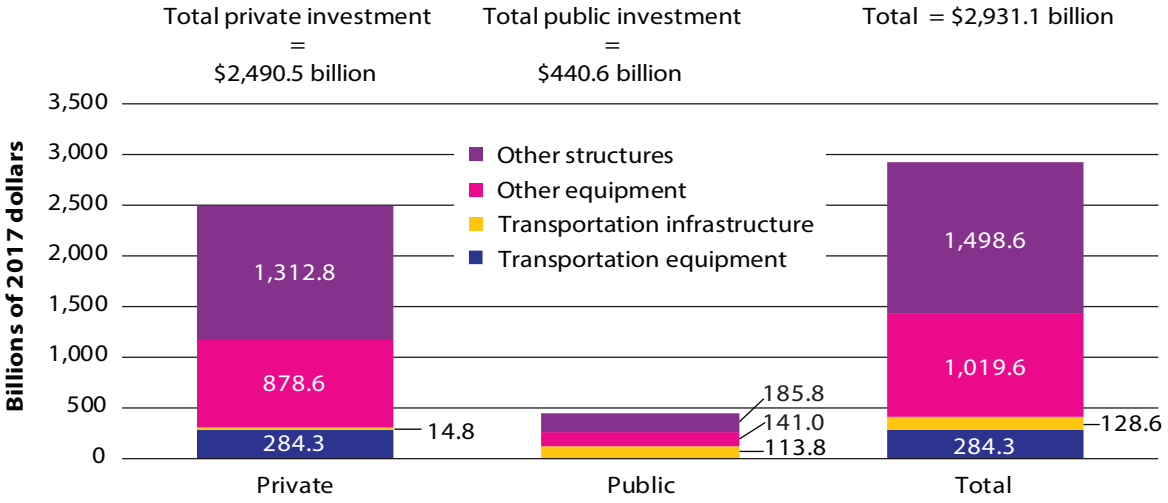
Transportation assets represent a small but important share of total public and private investment in the United States. In 2017, public and private investment in transportation infrastructure and equipment totaled $412.9 billion, or 14.1 percent of the $2,931.1 billion in investment in all infrastructure and equipment (figure 8-2). Public and private investment in new transportation infrastructure accounted for $128.6 billion (4.4 percent), and private transportation equipment accounted for $284.3 billion (9.7 percent). Data for public investment in transportation equipment are not available.

Box 8-2 Sources of Highway Investment Estimates

Both the Bureau of Economic Analysis (BEA) and the Federal Highway Administration (FHWA) publish estimates of capital outlays on highways and streets. The BEA estimates come from the Census Bureau's Value of Construction Put in Place survey, which covers construction costs for new structures and improvements that extend the life or add value to existing structures in the private and public sectors. BEA releases their estimates in their fixed asset tables, which are part of the National Income and Product Accounts (see box 8-1). All data are in terms of fiscal year. BEA converts the data to calendar year and uses the estimates to measure investment in new transportation infrastructure.

FHWA also estimates investment in highways and streets. The FHWA estimates differ from the BEA estimates because they include the value of land, whereas the BEA estimates exclude it. In addition, FHWA's definition of construction includes "all expenditures for construction, relocation, resurfacing, restoration, rehabilitation and reconstruction …, widening, safety and capacity improvements, restoration of failed components, additions and betterments of roads and bridges." The Census Bureau does not count a large portion of this construction as investment in their Value of Construction Put in Place survey. Finally, the FHWA data differ from BEA estimates because they come from states which may report on a calendar or state fiscal year basis. Unlike BEA, the FHWA does not annualize the data into a calendar year period. Because of these methodological differences, BEA and FHWA estimates are not comparable.

Figure 8-2 Public and Private Fixed Investment, 2017



NOTE: Intellectual property products, such as software and research and development, not included in public investment total.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Account Tables, Private Fixed Investment in Structures by Type (Table 5.4.5 millions) and Gross Government Fixed Investment by Type, Chained Dollars (Table 5.9.5B millions), available at apps.bea.gov/iTable/index_nipa.cfm as of August 2018.

Public Investment in Transportation

In 2017 the public sector accounted for almost all investment in new transportation infrastructure ($113.8 of $128.6 billion, 88.5 percent) (figure 8-2). The public sector invested nearly three quarters of that amount ($83.9 of $113.8 billion, 73.8 percent) in constructing new highways and streets. State and local governments engaged in an overwhelming majority of the investment: in 2017, state and local governments accounted for 99.0 percent of that investment, although they received a significant amount of that funding from the Federal Government.

Figure 8-3 shows public investment in new transportation infrastructure from 2002 to 2017 (in chained 2012 dollars). Investment in new transportation infrastructure declined from $142.2 billion in 2002 to a low of $113.4 billion in 2008 as investment declined 19.7 percent. Transportation infrastructure investment increased in 2009 and 2010 due to the *American Recovery and Reinvestment Act of 2009* (Pub. L. 111–5), which authorized $48.1 billion in transportation stimulus spending. The end of the stimulus spending caused investment in new transportation infrastructure to decline again in 2011, falling through 2013 to $103.3 billion before increasing to $113.8 billion in 2016. Public investment in new transportation infrastructure declined in 2017 to $105.5 billion—25.5 percent below the 2002 level.

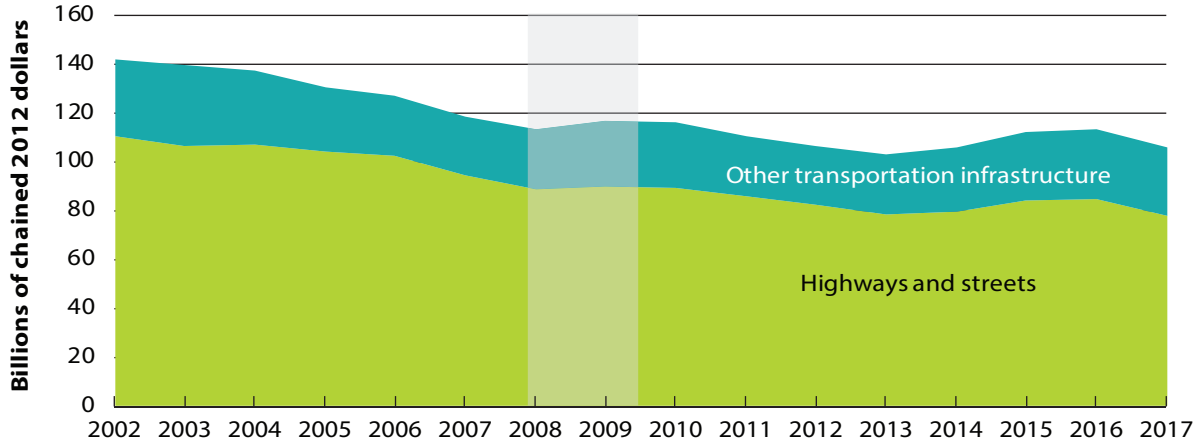
Private Investment in Transportation

Private investment in transportation includes investment by private businesses in transportation infrastructure and equipment as well as spending by households on vehicles (automobiles, light trucks, motorcycles, and other recreational vehicles, such as bicycles) and motor vehicle parts and accessories, such as tires. Investment includes only spending on durable goods, or storable goods with an average life of at least 1 year.[1] Household spending on motor vehicle fuel and public transportation is therefore not an investment because the goods are consumed upon purchase.

Private investment in new transportation infrastructure consists of investment in new private airport infrastructure and land infrastructure (primarily railroad infrastructure).

[1] This definition differs from the definition used by BEA for capital investment by firms and governments.

Figure 8-3 Public Investment in New Transportation Infrastructure, 2002–2017 (billions of chained 2012 dollars)



NOTE: Data not available on public investment in transportation equipment (e.g., buses and transit railcars not available). Shaded vertical bar indicates economic recession.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Account Tables, Real Gross Government Fixed Investment by Type, Chained Dollars (table 5.9.6 millions), available at apps.bea.gov/iTable/index_nipa.cfm as of August 2018.

While public investment in new transportation infrastructure has declined since 2002, private investment in new transportation infrastructure increased from $8.5 billion in 2002 to $13.3 in 2017, or 56.3 percent (in chained 2012 dollars) in 2017 (figure 8-4). Private investment in new transportation infrastructure hit a low point in 2003 at $8.0 billion (in chained 2012 dollars).

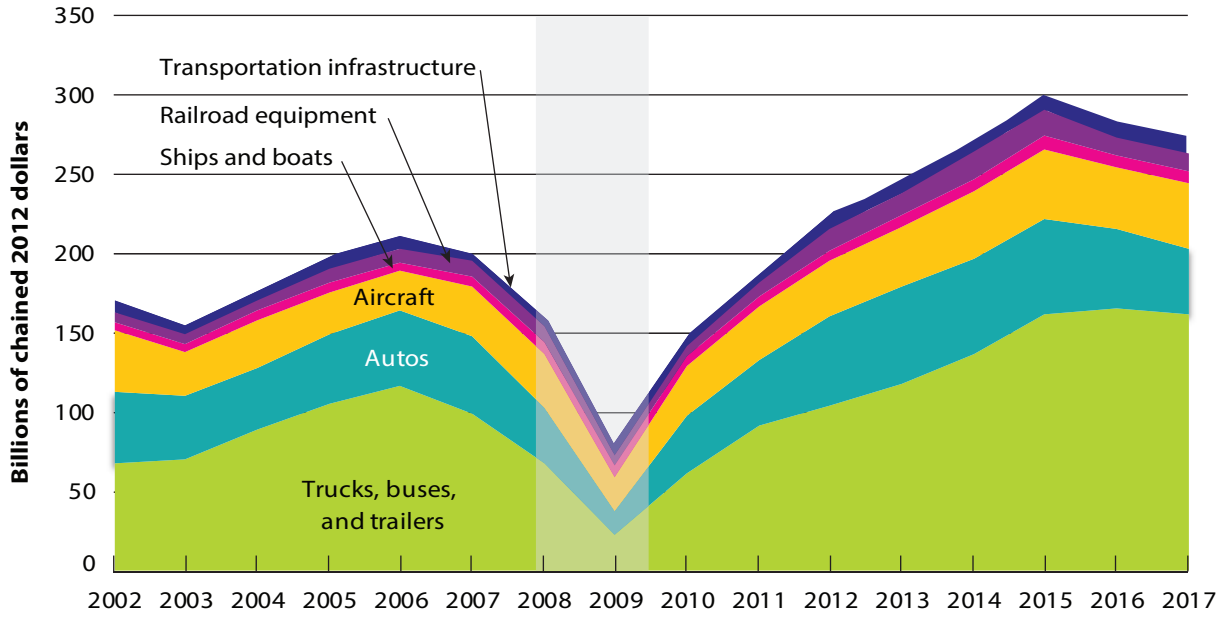
Private investment in transportation infrastructure and equipment reached a low of $82.0 billion in 2009 during the Great Recession (December 2007 to June 2009) and then climbed to $304.2 billion in 2015 before declining through 2017 to $277.4 billion (in chained 2012 dollars) (figure 8-4). Private spending on motor vehicles (trucks, buses, truck trailers, and autos purchased by businesses) accounts for the largest portion (73 percent) of this investment.

Household spending on transportation assets likewise declined during the Great Recession, reaching a low of $384.4 billion in 2009 before climbing to $572.4 billion in 2017 (in chained 2012 dollars) (figure 8-5). Household spending on transportation assets accounts for a declining share of spending on durable goods by households. In 2002 transportation assets accounted for 55.4 percent of household spending on durable goods and gradually declined through 2017 (based on current dollar shares) to 36.3 percent.

Value of Construction Put in Place

The Value of Construction Put in Place survey program, administered by the U.S. Census Bureau, provides monthly estimates of the value of construction work done in the United States. These estimates cover costs for constructing new structures and making improvements that extend the life or add value to existing structures

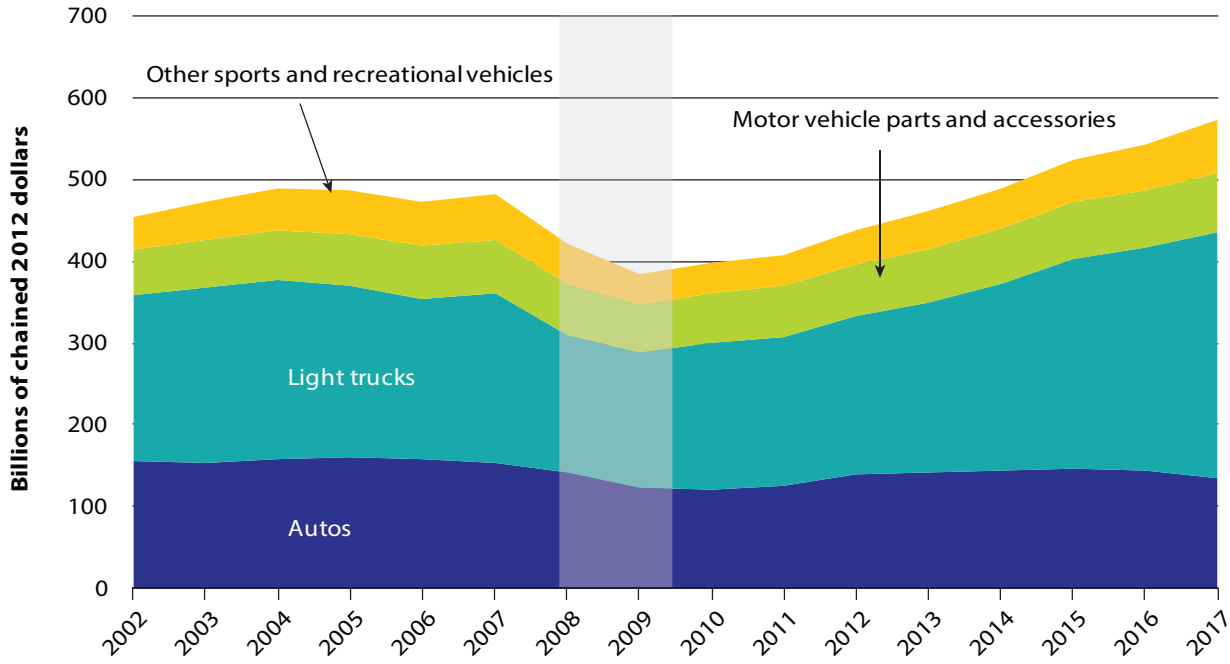
Figure 8-4 Private (Business) Investment in New Transportation Infrastructure and Equipment, 2002–2017 (billions of chained 2012 dollars)



NOTE: Includes net purchase of used vehicles, which measures net purchases from other sectors through dealers and include dealer margins. Shaded vertical bar indicates economic recession.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Account Tables, Real Private Fixed Investment in Structures by Type, Chained Dollars (table 5.4.6 millions) and Private Fixed Investment in Equipment by Type (table 5.5.6 millions), available at apps.bea.gov/iTable/index_nipa.cfm as of August 2018.

Figure 8-5 Household Purchase of Transportation Assets, 2002–2017 (billions of chained 2012 dollars)



NOTES: Value for trucks, buses, and truck trailers and autos includes net purchases of used vehicles. "Other sports and recreational vehicles" include motorcycles; bicycles and accessories; pleasure boats and aircraft; and other recreational vehicles. Shaded vertical bar indicates economic recession.

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Account Tables, Real Personal Consumption Expenditures by Type of Product, Chained Dollars (table 2.4.6U) available at apps.bea.gov/iTable/index_nipa.cfm as of August 2018.

in the private and public sectors.[2] Construction costs include labor, materials, equipment rental, architectural and engineering work, overhead, interest and taxes, contractor profits, and miscellaneous overhead and office charges.

In 2017 private and public spending on new transportation construction and improvements totaled $134.0 billion (figure 8-6). Public transportation construction accounted for 89.0 percent of that amount ($119.3 billion), and private transportation construction accounted for the remaining 11.0 percent ($14.8 billion). Highway and street construction accounted for 74.5 percent of public spending on transportation construction ($88.9 billion), and construction for air, land, and water transportation facilities accounted for the remaining 24.5 percent ($30.4 billion). Although the amount and composition of construction varies from year to year, the value of new transportation construction and improvements put in place has increased an average of 3.3 percent per year since 2002, dropping slightly in 2011 when transportation stimulus funding from the American Recovery and Reinvestment Act of 2009 ended.

Highway Construction Costs

Construction costs affect the amount that governments invest on new roads, highways, and bridges. These costs depend on the prices of many inputs, including materials like steel and asphalt, labor costs, and overhead costs. Construction cost indexes measure the change in the prices for these materials over time. Because

[2] Maintenance and repair to keep existing structures in an ordinarily efficient operating condition that do not materially extend the life of the structure (e.g., painting, patching, refurbishing, and reconditioning) are not counted.

Figure 8-6 Value of Construction Put in Place, 2002–2017 (billions of current dollars)

SOURCE: U.S. Department of Commerce, Census Bureau, Construction Spending Survey, available at www.census.gov/construction/c30/c30index.html as of August 2018.

transportation modes require different inputs, construction costs are mode-specific.

The U.S. Department of Transportation's Federal Highway Administration produces the *National Highway Cost Construction Index (NHCCI)*, which measures the average change over time in the prices paid by State transportation departments for roadway construction materials and services (box 8-3). It can be used to track price changes in highway construction.

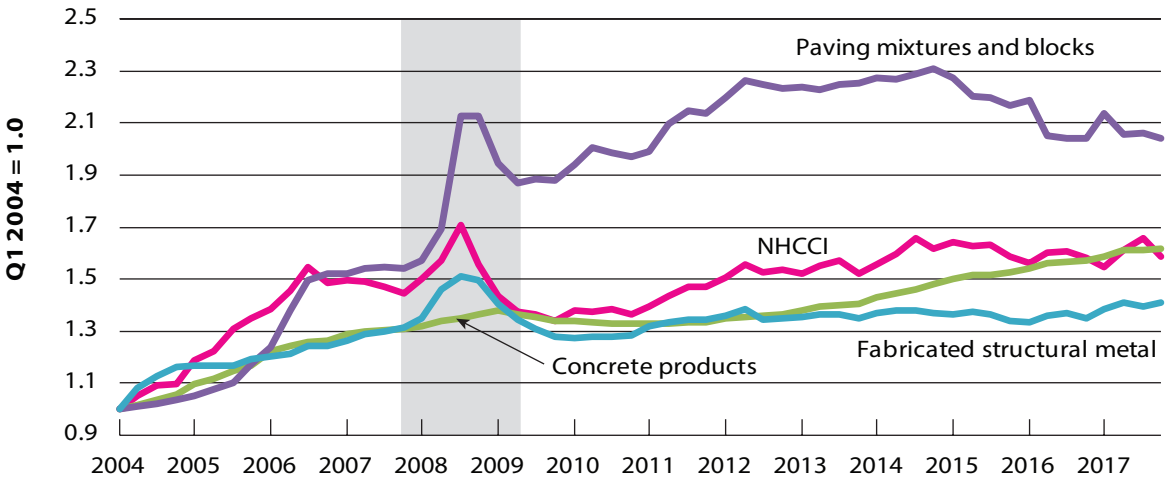
Box 8-3 National Highway Cost Construction Index

The National Highway Construction Cost Index (NHCCI), published quarterly since the first quarter of 2003, uses a database of successful bids on state highway projects that includes quotes on the specific items in the projects. The NHCCI measures from the perspective of the buyer, e.g., the state. It includes the costs of material and labor as well as profit and overhead. The average price charged is calculated for each item in each state, and these price changes are then combined into a national index based on a market basket of items.

The NHCCI has shown a trend similar to the broader economy, peaking just before the Lehman Brothers bankruptcy during the 2008 financial crisis. Figure 8-7 shows that the NHCCI increased by 58.9 percent from the first quarter of 2004 to the last quarter of 2017. The NHCCI increased 54.7 percent between the first quarter of 2004 and the third quarter of 2006 when housing construction boomed and global raw material prices, including highway materials (cement, steel, and asphalt), increased. However, this increase was followed by a decline of 6.4 percent from the third quarter peak in 2006 to the last quarter of 2007. An increase in the cost of highway materials caused the NHCCI to rise 17.9 percent from the last quarter of 2007 through the third quarter of 2008. The NHCCI fell from the third quarter of 2008 peak through the fourth quarter of 2009, falling 21.4 percent, as the cost of highway materials declined. The NHCCI has risen slowly since the last quarter of 2009.

Construction costs are one part of the total cost to move goods and people; other sections of this report discuss additional costs. Chapter 3 discusses the transportation costs businesses face in producing non-transportation goods and the costs business and households face in purchasing for-hire transportation services, such as air travel. Chapter 6 discusses household spending on transportation, including the cost of owning and operating a motor vehicle.

Figure 8-7 National Highway Construction Cost Index (NHCCI) and Producer Price Index for Major Construction Materials, Q1 2004 to Q4 2017



NOTE: Rebased to Q1 2004 = 1. Shaded vertical bar indicates economic recession.

SOURCE: *NHCCI*: U.S. Department of Transportation, Federal Highway Administration, National Highway Construction Cost Index, available at www.fhwa.dot.gov/policyinformation/nhcci.cfm as of August 2018; *Concrete products* (series id PCU3273--3273--), *Paving mixtures and blocks* (series id PCU3241213241210), and *Fabricated structural metal* (series id PCU332312332312): U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Index, available at www.bls.gov/ppi as of August 2018.

Estimating the Benefits of Transportation Infrastructure

National statistics measuring the value of, and investment in, transportation infrastructure do not capture the value of the transportation infrastructure to society. For example, constructing a new bridge might cost $100 million, but the *value* of the bridge comes from the benefits that result from connecting businesses and individuals to jobs, markets, and social functions. Economists typically take two approaches to estimate the benefits that society derives from using transportation. One approach is bottom-up from the project level (a microeconomic approach); the other is top-down from the national account level (a macroeconomic approach).

In theory, the two approaches should yield similar estimates of transportation benefits, but the approaches do not completely overlap. Project-level analysis may understate the effects that a project will have on the national economy. For example, a new interchange near an international port may attract more international trade, creating national economic impacts beyond the project zone. At the same time, the project-level analysis might include freight shipments that shift from other U.S. ports to the upgraded port facility and therefore have no net effect on the national economy. Both sets of shipments would need to be measured accurately to estimate the national economic benefits of the interchange.

The macroeconomic approach, in contrast, uses the BEA's National Income and Product Accounts (NIPA), which provide aggregate measures of the Nation's economic output at the national, regional, and industry levels. Econometric analysis links project-level effects to changes in gross domestic product or changes in the net value of capital stock. However, the analysis is complicated and measures only large transportation investments, such as the Interstate Highway System.

Accessibility Benefits

The government and the private sector invest in transportation assets by building, maintaining, and expanding existing infrastructure to improve

connectivity and address congestion. These investments offer individuals and businesses access to jobs, markets, and other opportunities. Measuring the accessibility benefits requires a different approach from measuring the value of the capital stock and the value of the investment.

Linking transportation accessibility to wages, consumer prices, and individual well-being is necessary to measure the accessibility benefits of transportation. The Texas Transportation Institute, Federal Aviation Administration, and others have developed methodologies to estimate the cost of reduced accessibility from travel delays, but individuals also receive benefits from accessing their destination. Data sources like the National Household Travel Survey, the American Community Survey, and the Longitudinal Employer-Household Dynamics allow researchers to measure these benefits by matching household locations to the locations of employment, consumer markets, and social connections. More research will yield better measurements of accessibility benefits.