8 VALUE OF AND INVESTMENT IN TRANSPORTATION INFRASTRUCTURE AND OTHER ASSETS

Transportation infrastructure and other transportation assets constitute one of the most important economic resources of the United States. *Transportation infrastructure*, known also 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, other private firms, and governments. For example, people and goods are moved by using 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).

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

- *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, private sector, and households all invest in transportation capital stock.
- *Investment in Transportation Assets* from BEA, which measures investment in new transportation assets as well as household purchases of transportation assets, such as personal motor vehicles and parts.
- The *Value of Construction Put in Place* survey measured by the U.S. Census Bureau, which also measures transportation investment. Both BEA and Census estimate the value of transportation infrastructure in terms of the resources used to construct it. Construction costs affect the amount that governments invest in highways, roads, bridges, airport terminals and runways, transit facilities, water transportation facilities, and pedestrian and bicycling infrastructure.
- 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 the implicit benefits that society derives from using transportation assets. Estimating the value of transportation assets in terms of the benefits

derived, such as mobility to businesses and individuals, is more difficult and is the subject of ongoing research.

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

Assets, according to the United Nation's System of National Accounts, are entities owned by some unit, or units, from which the owner(s) derive economic benefits by holding or using them over a period of time.

Fixed transportation assets includes 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 1 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 1 year. Assets expected to remain in service for less than a year are categorized as *consumption goods* and are 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. The Bureau of Economic Analysis (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).

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

Value of Transportation Capital Stock

BEA measures the value of transportation assets (transportation infrastructure and equipment) 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 is the net value (the value after depreciation) 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).

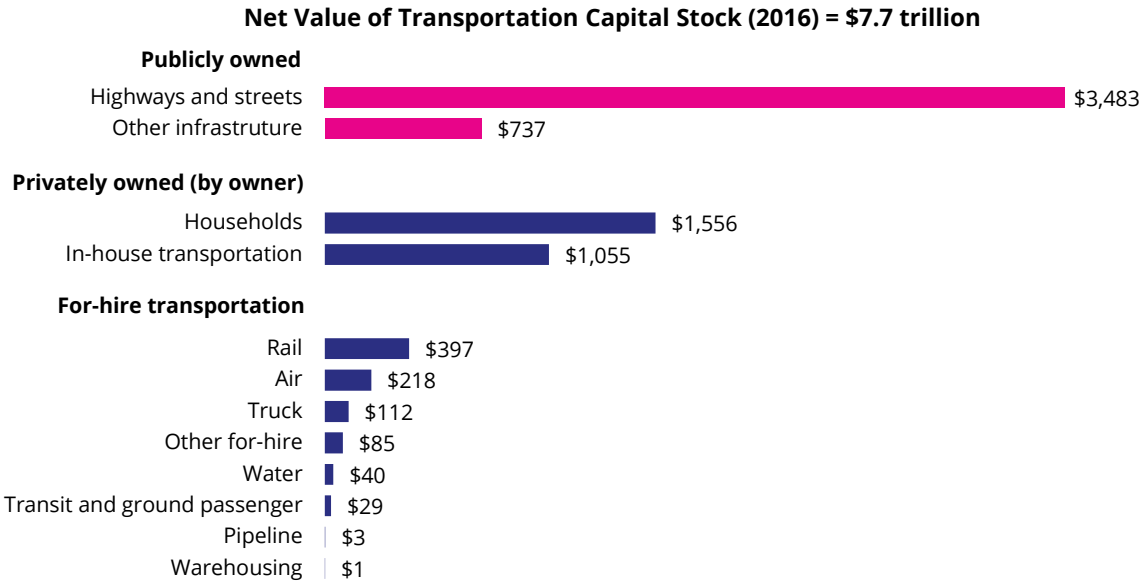
Transportation capital stock is owned by both the public and private sectors. In 2016, the public sector owned $4.2 trillion (54.7 percent), while the private sector owned $3.5 trillion (45.3 percent) (figure 8-1). Public highways and streets accounted for the largest share of publicly owned transportation capital stock ($3.5 trillion 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 trillion 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 are for privately-owned capital stock only 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. *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 BTS' 2016 Transportation Statistics Annual Report (TSAR) 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 www.bea.gov.

Investment in Transportation Assets

Government, 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 one 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 (infrastructure and equipment) that last more than one year (e.g., highways and streets, railroad lines, trucks, buses, and railcars). The estimates cover all public and private investments in transportation, except pipeline. Investment in pipeline infrastructure is embedded in mining infrastructure investment. All public and private investment estimates are for 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 considered transportation assets because they last more than one year. Personal motor vehicle maintenance and repair is not considered an asset. 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 2016, public and private investment in transportation infrastructure and equipment totaled $412.7 billion, or 15.4 percent of all public and private investment of $2,680.2 billion (figure 8-2). Public and private investment in new transportation infrastructure accounted for $126.0 billion, or 4.7 percent of all public and private investment. Private transportation equipment accounted for $286.7 billion, or 10.7 percent of all public and private investment. Data are not available for public investment in transportation equipment.

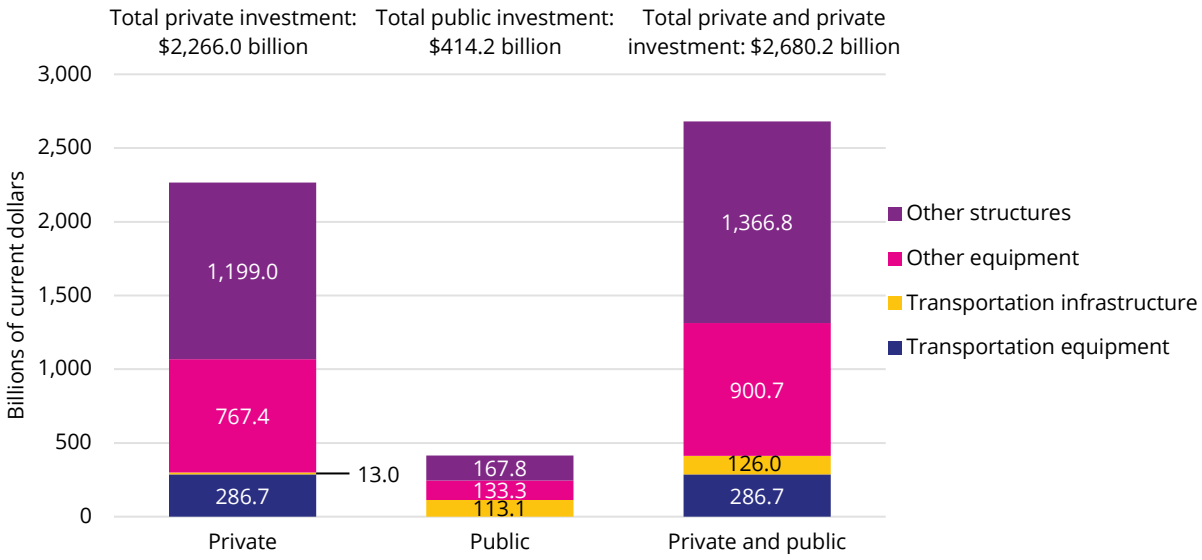
Box 8-2: Sources of Highway Investment Estimates

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 are 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, while the BEA estimates exclude it. In addition, FHWA's definition of construction includes "all expenditures for construction, relocation, resurfacing, restoration, rehabilitation and reconstruction (3R/4R), widening, safety and capacity improvements, restoration of failed components, additions and betterments of roads and bridges," a large portion of which the Census Bureau does not count as investment in their Value of Construction Put in Place survey. Finally, the FHWA data comes from states which may report on a calendar or state fiscal year basis. FHWA does not annualize the data into a calendar year period. Because of these methodological differences, BEA and FHWA estimates are not comparable.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

Figure 8-2: Public and Private Fixed Investment, 2016



Note: Private investment excludes intellectual property products, such as software and research and development.

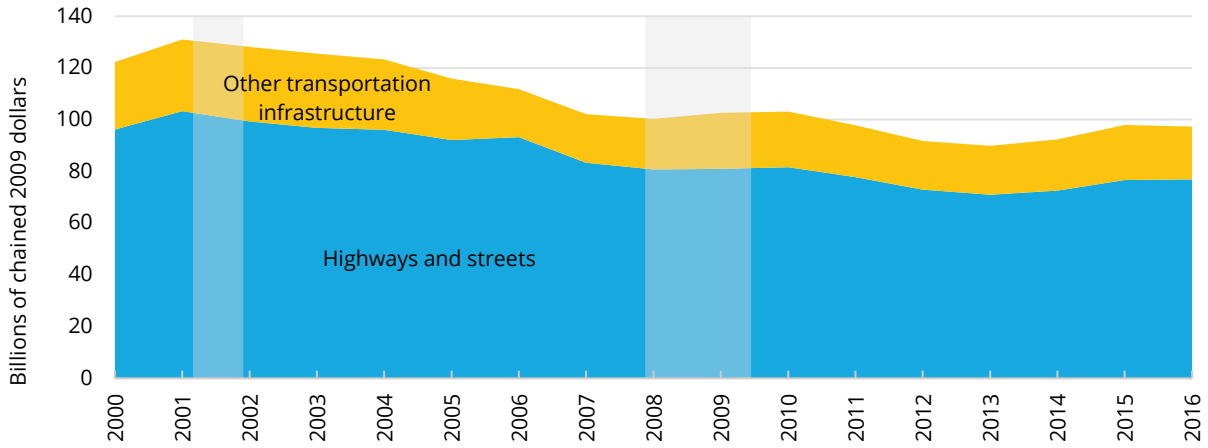
Source: U.S. Department of Commerce, Bureau of Economic Analysis, Private Fixed Investment in Structures by Type (Table 5.4.5) and Gross Government Fixed Investment by Type, Chained Dollars (Table 5.9.5B), available at www.bea.gov/iTable/index_nipa.cfm as of October 2017.

Public Investment in Transportation

Public spending on highways and streets dominates public investment in new transportation infrastructure. In 2016, the public sector invested $89.5 billion in constructing new highways and streets, which accounted for 79.2 percent of the $113.1 billion invested in new public transportation infrastructure (current dollars). The public sector accounts for almost all investment in new transportation infrastructure, accounting for 71.0 percent of all public and private investment in new transportation infrastructure in 2016 (figure 8-2). A majority of investment in new public transportation infrastructure overwhelmingly was by state and local governments. In 2016, 99.1 percent of investment was from state and local governments, although they received a significant amount of that funding from the Federal Government.

Figure 8-3 shows public investment in new transportation infrastructure from 2000 to 2016 (in chained 2009 dollars). Investment in new transportation infrastructure peaked in 2001 at $131.0 billion then fell continuously through 2008. During this period, investment declined 23.4 percent to a low of $100.3 billion in 2008. Transportation infrastructure investment increased in 2009 and 2010 as a result of 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, and investment fell from 2011 through 2013 to $89.9 billion before increasing to $97.3 billion in 2016. This decline left investment in new transportation infrastructure at 25.7 percent below its 2001 peak.

Figure 8-3: Public Investment in New Transportation Infrastructure (billions of chained 2009 dollars)



Note: Data on public investment in transportation equipment (e.g., buses and transit railcars) not available. Shaded areas indicate economic recessions.

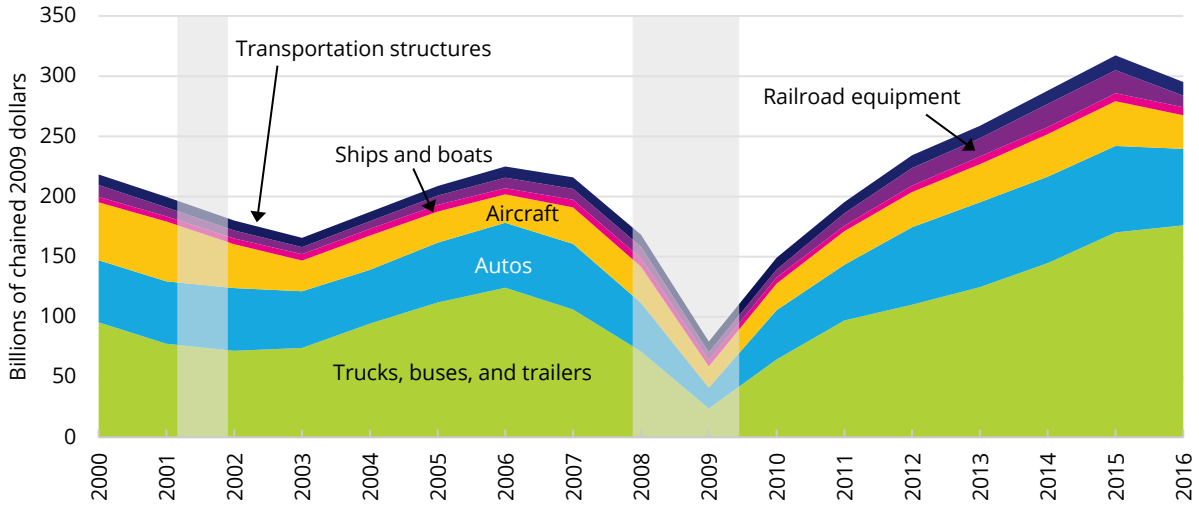
Source: U.S. Department of Commerce, Bureau of Economic Analysis, Real Gross Government Fixed Investment by Type, Chained Dollars (table 5.9.6B), available at www.bea.gov/iTable/index_nipa.cfm as of October 2017.

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 (e.g., tires). Household spending on motor vehicle fuel and public transportation is not considered an investment because they are consumed upon purchase. For a good to be considered an investment, it must be storable and have an average life of at least three years (known as a durable good).

Private investment in new transportation infrastructure consists of investment in new private airport infrastructure and land infrastructure (primarily railroad infrastructure). While public investment in new transportation infrastructure has declined since 2001, private investment in new transportation infrastructure increased by 31.8 percent from 2001 to 2016, reaching $11.4 billion (in chained 2009 dollars) in 2016 (figure 8-4). Private investment in new transportation infrastructure hit a low point in 2003 at $7.7 billion (in chained 2009 dollars). All private investment in transportation reached a low during the Great Recession at $79.6 billion in 2009 and then climbed to $289.0 billion in 2016 (in chained 2009 dollars) (figure 8-4). Private spending on motor vehicles (trucks, buses, truck trailers, and autos purchased by businesses) accounts for the largest portion (over three-quarters of current dollar share) of this investment.

Figure 8-4: Private (Business) Investment in Transportation New Infrastructure and Equipment (billions of chained 2009 dollars)

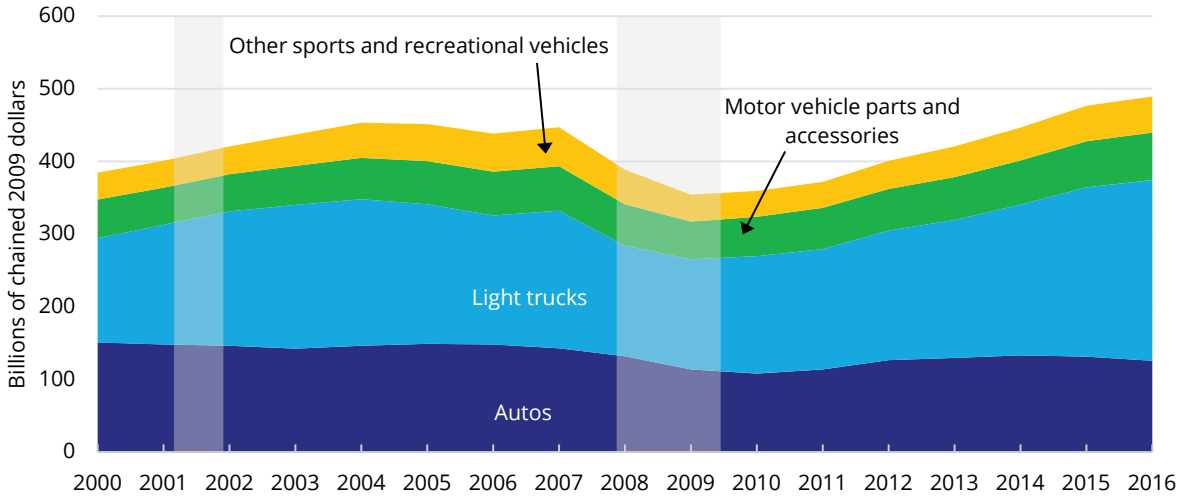


Note: Includes net purchase of used vehicles. Shaded areas indicate economic recessions.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Real Private Fixed Investment in Structures by Type, Chained Dollars (table 5.4.6) and Private Fixed Investment in Equipment by Type (table 5.5.6), available at www.bea.gov/iTable/index_nipa.cfm as of October 2017.

Household spending on transportation assets likewise declined during the Great Recession, reaching a low of $354.0 billion in 2009 and climbing to $489.4 billion in 2016 (in chained 2009 dollars) (figure 8-5). Household spending on transportation assets accounts for a declining share of spending on durable goods by households. In 2000, transportation assets accounted for 43.6 percent of household spending on durable goods and gradually declined through 2016 (based on current dollar shares) to 37.8 percent.

Figure 8-5: Household Purchase of Transportation Assets (billions of chained 2009 dollars)



Notes: Value for trucks, buses, and truck trailers and autos includes net purchases of used vehicles. Other sports and recreational vehicles includes: motorcycles; bicycles and accessories; pleasure boats and aircraft; and other recreational vehicles. Shaded areas indicate economic recessions.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Real Personal Consumption Expenditures by Type of Product, Chained Dollars (table 2.4.6U) available at www.bea.gov/iTable/index_nipa.cfm as of October 2017.

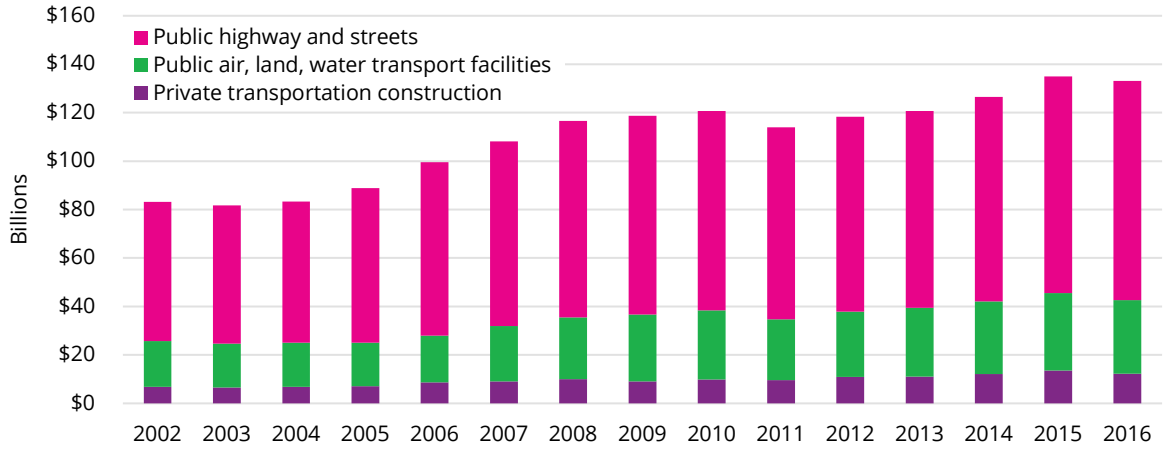
Value of Construction Put in Place

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 for improvements that either extend the life or add value to existing structures in the private and public

sectors.[1] Construction costs include labor, materials, equipment rental, architectural and engineering work, overhead, interest and taxes, contractor profits, and miscellaneous overhead and office charges.

In 2016 private and public spending on new transportation construction and improvements totaled $133.2 billion (figure 8-6). Public transportation construction accounted for 90.8 percent of that amount ($120.9 billion), and private transportation construction accounted for the remaining 9.2 percent ($12.2 billion). Highway and street construction accounted for 74.9 percent of public spending on transportation construction ($90.5 billion), and construction for air, land, and water transportation facilities accounted for the remaining 25.1 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 4 percent per year since 2002, dropping slightly in 2011 (when transportation stimulus funding in the American Recovery and Reinvestment Act of 2009 ended) and in 2016.

Figure 8-6: Value of Construction Put in Place, 2002 to 2016 (billions of current dollars)



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

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

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 different 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 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.

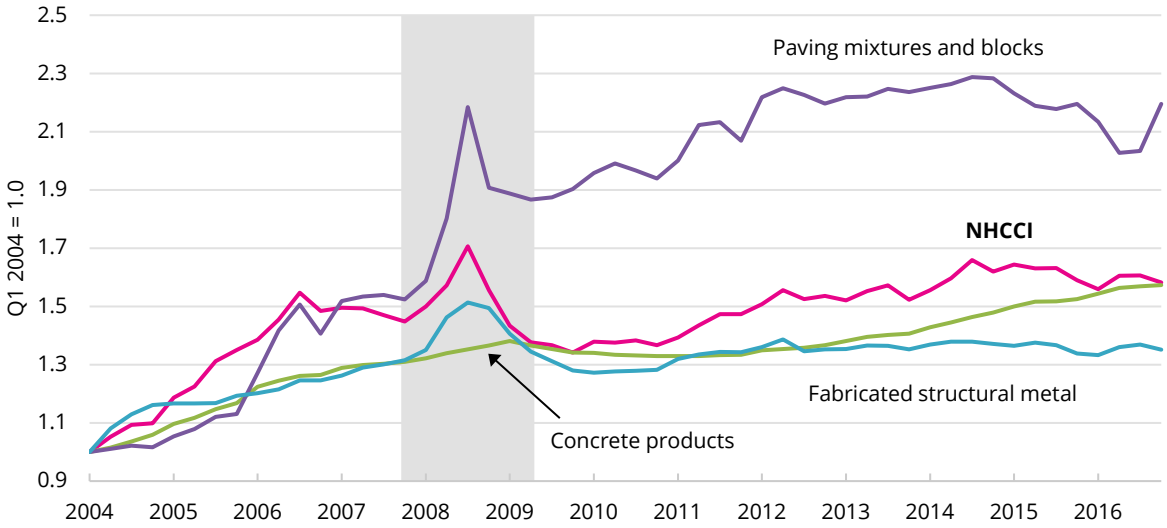
Box 8-3: National Highway Cost Construction Index

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 that comprise 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.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

In recent years, the NHCCI has shown a trend similar to the broader economy. Figure 8-7 shows that the NHCCI increased by 58.3 percent from the first quarter of 2004 to the last quarter of 2016. 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 6.9 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 but, as of the last quarter of 2016, has yet to reach 2008 peak.

Figure 8-7: National Highway Construction Cost Index (NHCCI) and Producer Price Index for Major Construction Materials, Q1 2004 to Q4 2016



Note: Shaded areas indicate economic recessions. Rebased to Q1 2004 = 1.

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 2017; *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 as of September 2017.

Construction costs are part of the total cost to move goods and people. 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 6-7).

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 which result from connecting businesses and individuals to jobs, markets, and social functions. Two approaches are typically taken 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, 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 benefits beyond the project zone. At the same time, however, the project-level analysis will include freight shipments which 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 GDP 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.

To measure the accessibility benefits of transportation, more research is needed to link transportation accessibility to wages, consumer prices, and individual well-being. The Texas Transportation Institute, Federal Aviation Administration, and others have developed and refined methodologies to estimate the *cost* of reduced accessibility from travel delays, but individuals also receive *benefits* when they reach 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.