

TRANSPORTATION ECONOMIC TRENDS 2017

U.S. Department of Transportation
Bureau of Transportation Statistics

TRANSPORTATION ECONOMIC TRENDS 2017

U.S. Department of Transportation
Bureau of Transportation Statistics

ACKNOWLEDGEMENTS

U.S. Department of Transportation
Elaine L. Chao
Secretary of Transportation

Jeffrey A. Rosen
Deputy Secretary of Transportation

Bureau of Transportation Statistics
Patricia Hu
Director

Rolf Schmitt
Deputy Director

Produced Under
Ed Strocko
Director, Office of Spatial Analysis and Visualization

Project Manager
Stephen Brumbaugh

Major Contributors
Theresa Firestine

Ken Notis

Other Contributors
Simon Randrianarivelo

Editor
William H. Moore

QUALITY ASSURANCE STATEMENT

The Bureau of Transportation Statistics (BTS) provides high quality information to serve government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. BTS reviews quality issues on a regular basis and adjusts its programs and processes to ensure continuous quality improvement.

Notice

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for its contents or use thereof.

ABOUT THIS REPORT

Transportation plays a vital role in the American economy: it makes economic activity possible, and serves as a major economic activity itself. *Transportation Economic Trends 2017* highlights important trends in transportation and the economy, and explains related economic concepts and data sources for a general audience.

Organization

The report has eight chapters:

- Chapter 1 introduces the Transportation Services Index, a monthly summary of freight and passenger movement.
- Chapter 2 explains what transportation contributes to the American economy.
- Chapter 3 examines the costs that households and businesses pay for transportation.
- Chapter 4 analyzes transportation-related employment.
- Chapter 5 explains and examines trends in transportation productivity.
- Chapter 6 analyzes household spending on transportation goods and services.
- Chapter 7 examines government transportation spending and revenue.
- Chapter 8 discusses transportation assets and infrastructure.

Each chapter uses the latest data available as of June 15, 2017 unless otherwise noted.

Improvements to the 2017 Edition

Transportation Economic Trends 2017 builds on the 2016 edition with updated data and new content, including:

- An expanded discussion of transportation productivity measures and how the transportation sector has contributed to economic growth in the United States (chapter 5);
- National data measuring the value of and investment in transportation assets (chapter 8);
- Additional explanations of economic concepts and data sources;
- A glossary of economic and transportation terms.

TABLE OF CONTENTS

1 SUMMARY INDICATORS

Transportation makes economic activity possible by enabling the production of goods and services—for instance, in carrying the raw materials needed to manufacture goods. Transportation also serves as a major economic activity itself. Households, businesses, and the government directly consume transportation goods (e.g., vehicles and motor fuel) and services (e.g., public transit and commercial airline transportation) to meet their travel needs. This chapter shows transportation's relationship to the economy, while Chapter 2 measures the indirect and direct contribution of transportation to the economy.

Transportation Services Index

Transportation activities have a strong relationship to the economy. The Bureau of Transportation Statistics (BTS) developed the Transportation Services Index (TSI) to measure the volume of freight and passenger transportation services provided monthly by the *for-hire transportation sector* in the United States (box 1-1). For-hire transportation consists of the services provided by transportation firms to industries and the public on a fee basis. Airlines, railroads, transit agencies, common carrier trucking companies, and pipelines are examples of for-hire transportation. Other types of transportation are discussed in Chapter 2.

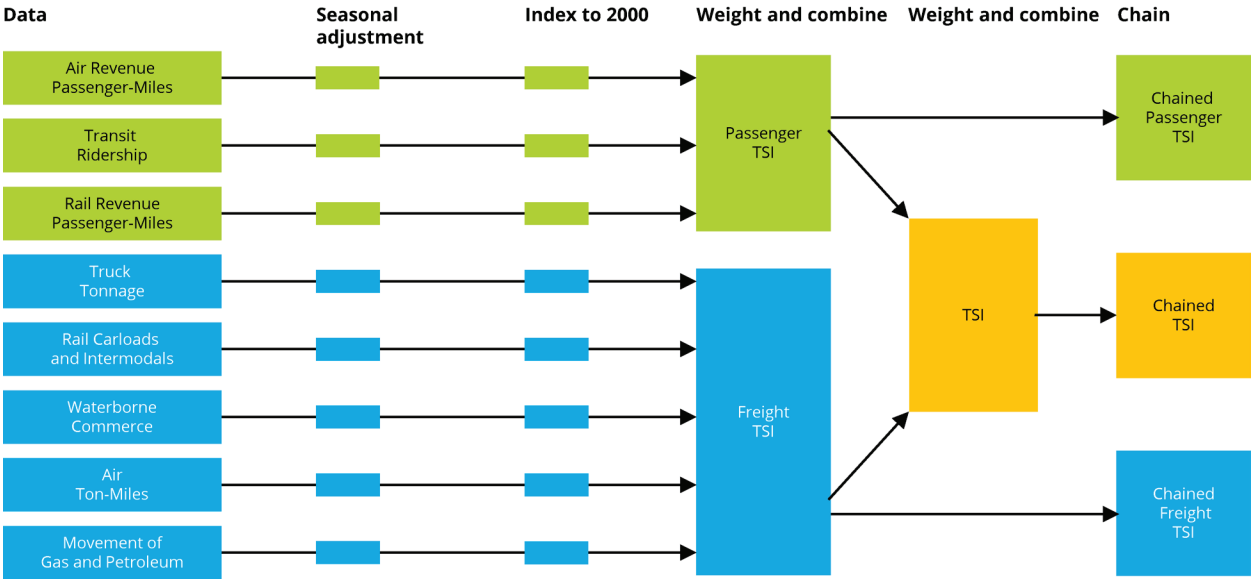
Box 1-1: Transportation Services Index

The Bureau of Transportation Statistics' (BTS) Transportation Services Index (TSI) measures the volume of freight and passengers moved. BTS produces three indexes: a freight index, a passenger index, and a combined index. The indexes incorporate monthly data from multiple for-hire transportation modes. Each index shows the month-to-month change in for-hire transportation services. Monthly data on each mode of transportation is seasonally adjusted, then combined into the three indexes. The passenger index is a weighted average of data for passenger aviation, transit, and passenger rail. The freight index is a weighted average of data for trucking, freight rail, waterborne, pipeline, and air freight. The combined index is a weighted average of all these modes. These indexes serve both as multimodal monthly measures of the state of transportation and as indicators of the U.S. economic future.

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

Figure 1-1 shows the steps used to create the TSI, from collecting raw data, through seasonally adjusting and indexing the data, to combining them into summary chained indexes (box 1-2). The green boxes in figure 1-1 highlight the data input and process for the passenger TSI, and the blue boxes highlight the data input and process for the freight TSI. The two indexes are then appropriately weighted to create the combined TSI.

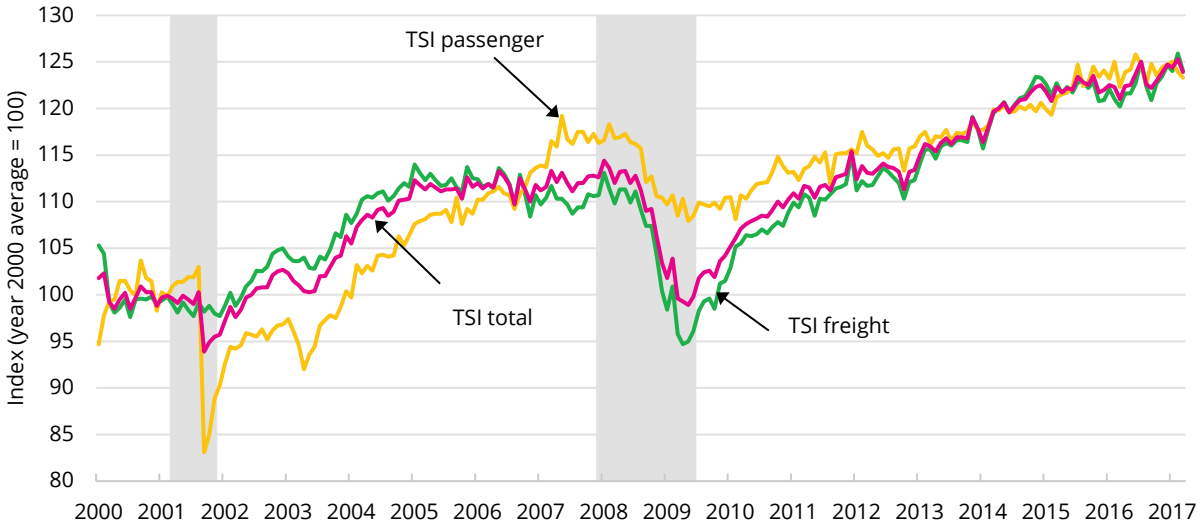
Figure 1-1: Transportation Services Index (TSI) Production Process



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI.

Figure 1-2 illustrates trends in the TSI from January 2000 to March 2017. Overall, the combined TSI increased by 21.7 percent, the freight TSI increased by 17.8 percent, and the passenger TSI increased by 30.2 percent. However, all three measures declined in the wake of the September 2001 terrorist attacks. The passenger TSI dropped sharply—19.3 percent from August 2001 to September 2001 due to significant declines in passenger air travel. The indexes also decreased sharply during the Great Recession from December 2007 to June 2009. The combined TSI decreased by 11.4 percent, the passenger TSI decreased by 6.7 percent, and the freight TSI decreased by 13.2 percent. All three indexes have since recovered to pre-recession levels.

Figure 1-2: Transportation Services Index (TSI), January 2000 to March 2017



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI.

Box 1-2: Chained Indexing

Many economic measures use a fixed base year to allow comparisons over time. However, the measures are highly sensitive to the base year chosen, and choosing a new base year can change the measure's history dramatically. In the past, when government economists changed the base year for calculating GDP, the revised growth calculations sparked many debates about the true state of the economy. At the same time, these measures become less accurate the further one moves away from the base year. In other words, keeping the base year fixed introduces a new problem.

One method to address these issues is chained indexing, a technique that uses values from the current year and the fixed year to calculate values. For the Transportation Services Index, the Bureau of Transportation Statistics uses the Fisher Ideal Index formula to chain the data. Technical details are available at go.usa.gov/xNpGK.

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

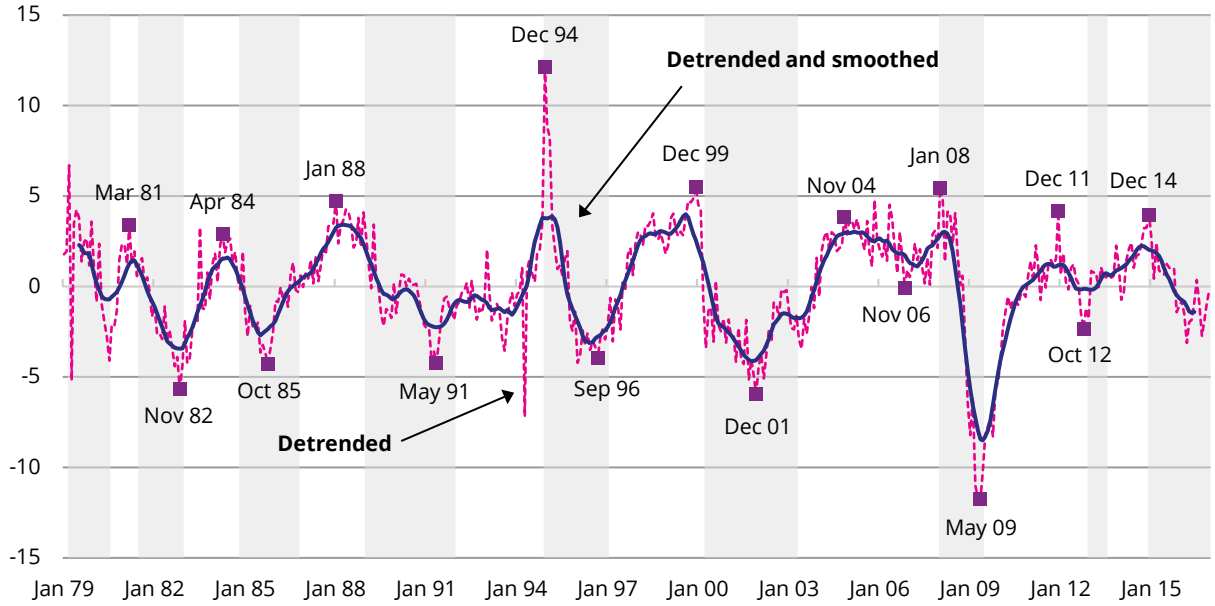
TSI and the Economy

BTS research shows that changes in the TSI occur before changes in the economy, making the TSI a potentially useful economic indicator.[1] Figure 1-3 illustrates the relationship between the freight TSI and the national economy from January 1979 to December 2016. The dashed blue line shows the freight TSI detrended to remove long-term changes. The red line shows the freight TSI detrended and smoothed to eliminate month-to-month volatility as well. The shaded areas represent *economic slowdowns*, or periods when economic growth slows below normal rates and unemployment tends to rise as a result of the slowdown. The peaks and troughs show that the freight TSI usually peaks before a growth slowdown begins and hits a trough before a growth slowdown ends (box 1-3).

Two economic accelerations followed the Great Recession: the first from June 2009 to December 2012, and the second from July 2013 to December 2014. BTS research shows that the freight TSI led both accelerations; however, the relationship between the freight TSI and growth cycles changed somewhat.[2] The freight TSI reached a peak in December 2011 and turned downward. This occurred 12 months before the economic deceleration that began in December 2012. The freight TSI turned a second time before December 2012, hitting a trough in October 2012 and turning upward. Historically, the freight TSI has not hit a trough and turned upwards before the onset of an economic deceleration. The economic deceleration begun in December 2012 ended in July 2013. The freight TSI peaked in December 2014 and turned downwards at the same time as the growth cycle.

[1] See U.S. Department of Transportation, Bureau of Transportation Statistics, "TSI and the Economy Revisited," December 2014, available at go.usa.gov/xnEP3.
[2] See U.S. Department of Transportation, Bureau of Transportation Statistics, "Long Term Growth in Freight Transportation Services: Methods and Findings," December 2017, available at go.usa.gov/xnPst.

Figure 1-3: Freight Transportation Services Index and the Economic Growth Cycle, January 1979 to December 2016



Notes: Shaded areas indicate decelerations in the economy (growth cycles). Detrending and smoothing refer to statistical procedures that make it easier to observe changes in upturns and downturns of the data. Detrending removes the long-term growth trend and smoothing eliminates month-to-month volatility.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI.

Box 1-3: Expansions, Recessions, and Growth Cycles

In an economic expansion, the economy is growing in real terms, as shown by increases in statistics like employment, industrial production, sales, and personal incomes. In a recession, the economy is contracting, as shown by decreases in those statistics. In the United States, the National Bureau of Economic Research (NBER) determines the official dates for expansions and recessions, which together make up business cycles. A business cycle has four phases: an expansion, a peak, a recession, and a trough. An expansion is measured from the trough (or bottom) of the previous business cycle to the peak of the current cycle, while recession is measured from the peak to the trough.

Growth cycles occur within a business cycle, and represent the cyclical changes in the economy that are evident once the long-term trend and seasonality have been removed. Growth cycles therefore highlight accelerations and decelerations in the economy.

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

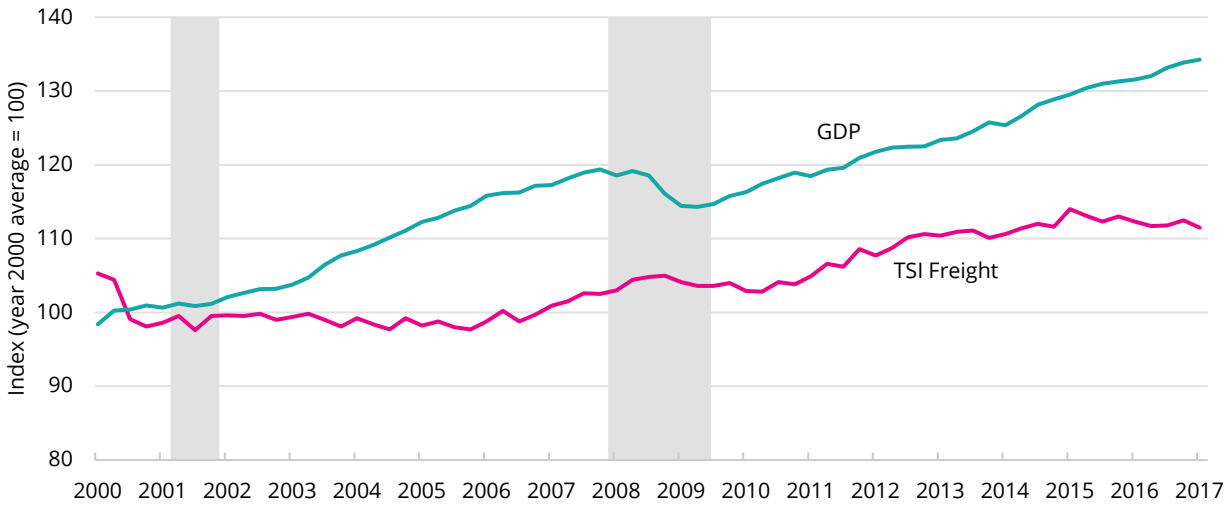
TSI and Other Economic Indicators

To understand the relationships between transportation and the rest of the economy, one can compare trends in the TSI with trends in other economic measures. The economic measures are presented as indexes for comparability with the TSI.

Gross Domestic Product (GDP)

Gross Domestic Product (GDP) is the broadest measure of the economy. The U.S. GDP includes the monetary value of all goods and services produced within the United States. Between the first quarters of 2000 and 2017, real GDP increased 36.4 percent, and the freight TSI increased by 21.1 percent (figure 1-4). This growth hides the extended period of decline during the recession. From the fourth quarter of 2007 to the second quarter of 2009, GDP decreased 4.2 percent, and the freight TSI decreased 13.9 percent. Both measures have since recovered to pre-recession levels. GDP includes many sectors besides transportation, so the magnitude of changes in GDP and the TSI cannot be directly compared.

Figure 1-4: Quarterly Gross Domestic Product and Freight Transportation Services Index (seasonally adjusted), Q12000 to Q1 2017



Note: Shaded areas indicate economic recessions.

Sources: GDP: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts, table 1.1.6, available at www.bea.gov/iTable/index_nipa.cfm. **Freight TSI**: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI.

Industrial Production and Manufacturers' Shipments

Industrial production and manufacturers' shipments are major sources of demand for freight transportation services (box 1-4). When these shipments declined during the 2007 to 2009 recession, the freight TSI declined as well. From December 2007 to June 2009, industrial production declined by 17.3 percent, and manufacturers' shipments declined by 21.6 percent (figure 1-5). After the recession, industrial production increased by 18.3 percent and manufacturers' shipments increased by 29.9 percent. However, manufacturers' shipments recently declined 10.1 percent from September 2014 to February 2016.

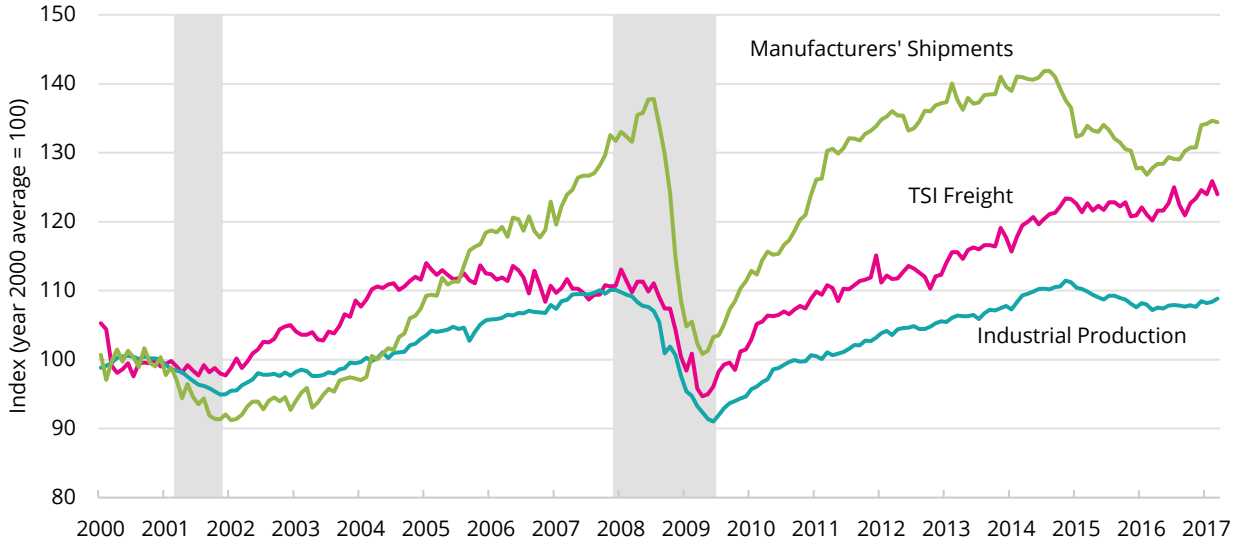
Box 1-4: Industrial Production and Manufacturers' Shipments Data

Data on industrial production come from the Industrial Production Index, published monthly by the Federal Reserve Board. It measures real output in the U.S. industrial sector, which includes manufacturing, mining, and electric and gas utilities.

Data on manufacturers' shipments come from the Census Bureau's Manufacturers' Shipments, Inventories, and Orders (M3) survey. This survey provides monthly data on economic conditions in the domestic manufacturing sector, and measures the dollar value of products sold by manufacturing establishments and is based on net selling values after discounts and allowances are excluded. Freight charges and excise taxes are excluded.

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

Figure 1-5: Monthly Industrial Production, Manufacturers' Shipments, and Freight TSI (seasonally adjusted), January 2000 to March 2017



Note: Shaded areas indicate economic recessions.

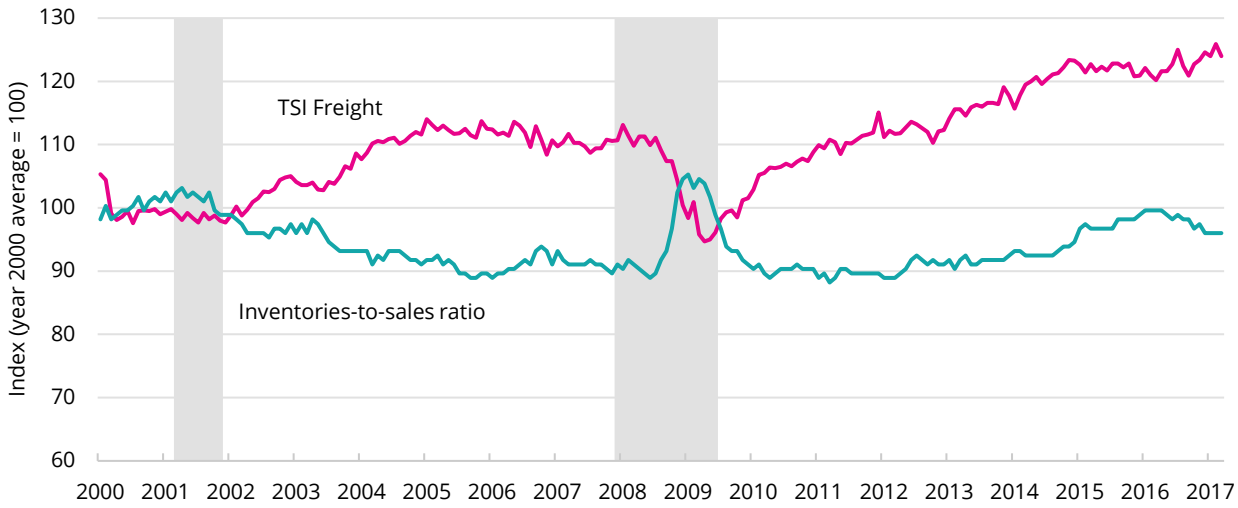
Sources: Industrial Production: Board of Governors of the Federal Reserve System, Industrial Production Index, available at www.federalreserve.gov/releases/g17/current. **Manufacturers' Shipments**: U.S. Bureau of the Census, Value of Manufacturers' Shipments for All Manufacturing Industries, available at www.census.gov/manufacturing/m3. **Freight TSI**: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI.

Inventories-to-Sales Ratio

When businesses keep greater amounts of inventory on hand, they use less freight transportation. One measure of inventory on hand is the *inventories-to-sales ratio*, or the value of goods on shelves and warehouses divided by monthly sales. A ratio of 2.5, for example, would indicate that a business has enough goods to cover sales for 2.5 months. When the inventories-to-sales ratio increases, the freight TSI tends to decrease at the same time or soon after. Conversely, when businesses move greater amounts of inventory and inventories to sales ratio falls, the freight TSI tends to increase.

The U.S. Census Bureau produces a national inventories-to-sales ratio for businesses in the United States. This ratio has generally declined as businesses adopt just-in-time delivery and learn to manage their inventory more efficiently. From January 2000 to June 2008, the inventories-to-sales ratio declined by about 9.4 percent (figure 1-6). During the recession, however, the ratio rose 18.4 percent from June 2008 to January 2009, while the freight TSI declined 10.5 percent. From January 2009 to March 2017, the inventories-to-sales ratio declined 8.8 percent, and the freight TSI increased 26.0 percent.

Figure 1-6: Monthly Freight Transportation Services Index and Inventory to Retail Sales Ratio (seasonally adjusted), January 2000 to March 2017



Notes: The inventories-to-sales ratio is indexed to the year 2000 for ease of comparison with the TSI. Shaded areas indicate economic recessions.

Sources: Inventories-to-Sales Ratio: U.S. Bureau of the Census, Manufacturing and Trade Inventories and Sales, available at www.census.gov/mtis. **Freight TSI**: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI.

Seasonally Adjusted Transportation Data

The monthly data used to create the TSI are highly seasonal, reflecting trends such as stores increasing inventory for the holiday season and households taking vacations in the summer. Seasonal trends make it difficult to observe underlying long-term changes in the data, as well as monthly shifts and short-term trends, which are best viewed using seasonally adjusted data (box 1-5).

Box 1-5: Seasonal Adjustment

Seasonal adjustment is the process of estimating and removing seasonal movement. Seasonal adjustment decomposes a time series into a seasonal part and an irregular part. The goal is to remove changes in the data happening at the same time and with the same magnitude and direction every year. Controlling these predictable influences allows measurement of real monthly changes, short- and long-term patterns of growth, or decline and turning points.

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

To portray real changes in the TSI, BTS seasonally adjusts, indexes, and weights the data based on economic value added for all transportation modes including truck tonnage, rail freight carloads, rail freight intermodal, pipeline, natural gas, U.S. waterway tonnage, passenger air transportation, rail passenger-miles, and public transit ridership.[3] Figures 1-7 and 1-8 show the seasonally adjusted modal data included in the freight and the passenger TSI as indexes.

Seasonally Adjusted Freight Transportation

Rail intermodal grew the fastest among the freight modes in the TSI, rising 50.6 percent from June 2009 (the end of the economic recession) to December 2016 (figure 1-7). Competitive pricing, track upgrades, and investment in rail intermodal terminals and other infrastructure contributed to the rapid growth of rail intermodal traffic.[4] Trucking grew the second fastest at 37.8 percent, followed by pipeline at 29.6 percent, waterborne at 23.2 percent, and air freight at 21.7 percent. Rail intermodal, trucking, and pipeline all have grown steadily since June 2009, while air freight and waterborne show little growth after initial recovery. Rail carloads declined 0.8 percent from June 2008 to December 2016. Data from the Association of American Railroads suggest that the decline in rail carload shipments is due to reductions in coal shipments.[5] The total coal shipped by Class I

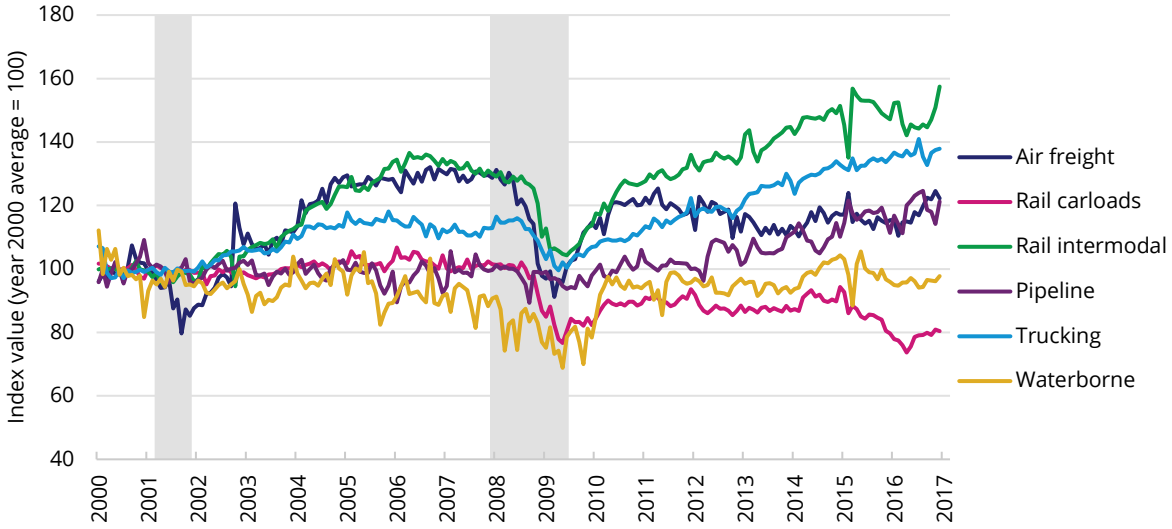
[3] Value added is defined as industry gross output less purchased materials and purchased services. This is a measure of the size of an industry sector used by economists. Value added for all industries sums to Gross Domestic Product.

[4] See "Railroad Intermodal Keeps America Moving," May 2016, available at www.aar.org/BackgroundPapers/Rail%20Intermodal.pdf.

[5] See "Railroads and Coal," July 2016, available at www.aar.org/BackgroundPapers/Railroads%20and%20Coal.pdf.

railroads peaked in 2008 at 878.6 million tons, dropped to 787.6 million tons in 2009, and continued to fall to 491.7 million tons in 2016.[6]

Figure 1-7: Modal Data (seasonally adjusted), Included in Freight Transportation Services Index, January 2000 to March 2017



Note: Shaded areas indicate economic recessions. Pipeline is a weighted average of petroleum pipeline and natural gas movement.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, seasonally adjusted transportation data, available at www.transtats.bts.gov/osea/seasonaladjustment.

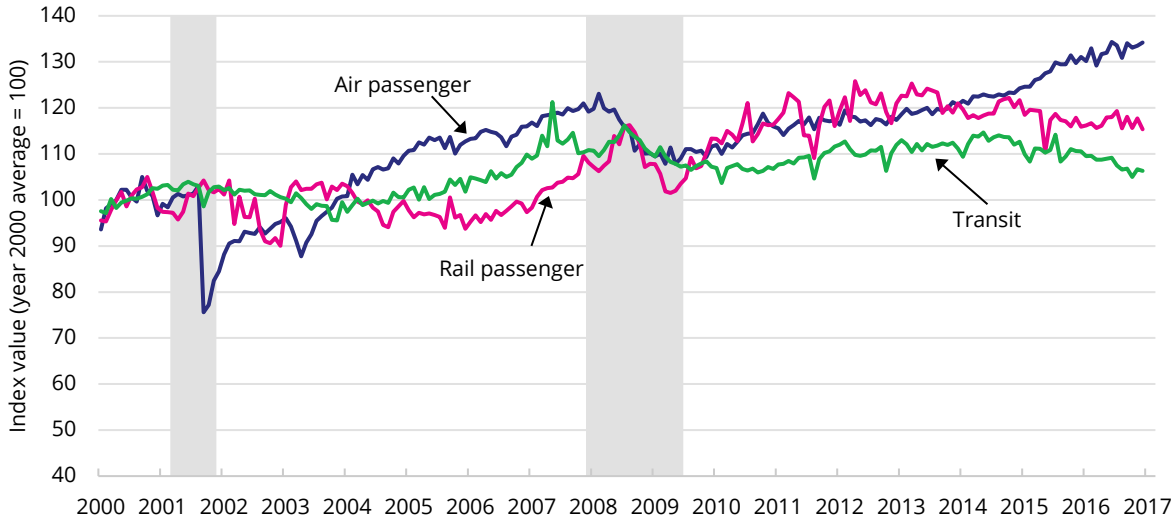
Seasonally Adjusted Passenger Transportation

Among the passenger modes included in the TSI, seasonally adjusted air passenger-miles increased the most, at 40.5 percent, from January 2000 to March 2017 (figure 1-8). Air passenger-miles reached their lowest point in September 2001 following the September 11, 2001 terrorist attacks, but have increased by 73.9 percent since that point.

[6] See Class I Railroad Statistics, May 2009, 2010, and 2017, available at www.aar.org/Documents/Railroad-Statistics.pdf.

Seasonally adjusted rail passenger-miles have increased by 20.7 percent since January 2000. They reached their highest level in April 2012 and since have declined 8.3 percent (figure 1-8). Seasonally adjusted transit ridership has increased by 10.1 percent since January 2000. Transit ridership fell after reaching a peak in July 2008 and then began to grow after February 2010. Transit ridership did not recover to the July 2008 high point before beginning a steady decline once again in late 2014 through the present (figure 1-8).

Figure 1-8: Modal Data (seasonally adjusted), Included in Passenger Transportation Services Index, January 2000 to March 2017



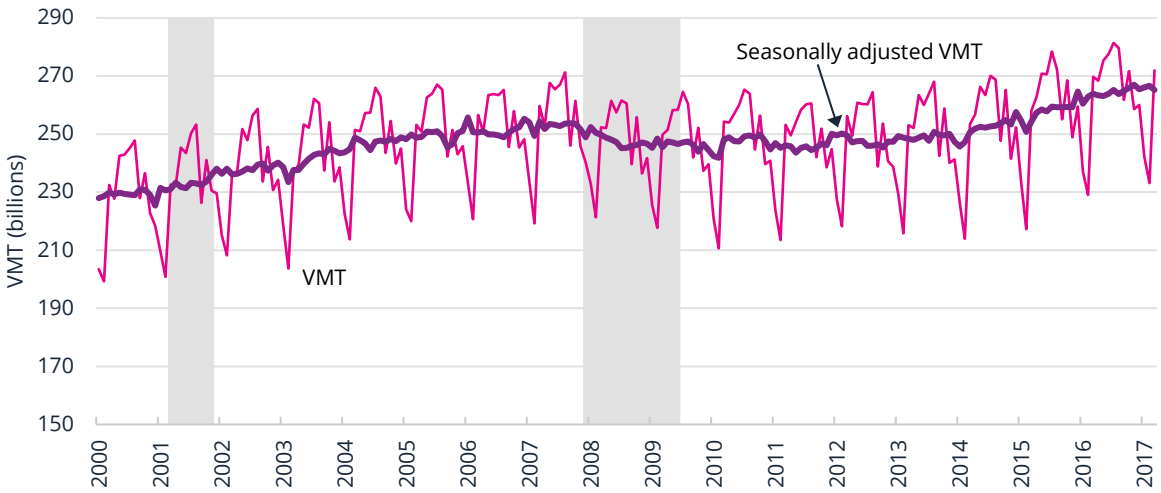
Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, seasonally adjusted transportation data, available at www.transtats.bts.gov/osea/seasonaladjustment.

Seasonally Adjusted Highway Vehicle-Miles Traveled

While the TSI measures for-hire transportation services, BTS also seasonally adjusts data for highway vehicle-miles traveled (VMT) to show trends in travel volumes. Seasonally adjusted VMT has grown by 16.3 percent since January 2000 (figure 1-9). VMT remained stable after a marginal decline at the onset of the recession and then began to steadily rise in early 2014. VMT grew 7.9 percent from January 2014 to March 2017.

Figure 1-9: Highway Vehicle-Miles Traveled (VMT), 2000 to 2017



Note: Shaded areas indicate economic recessions.

Sources: Unadjusted VMT: U.S. Department of Transportation, Federal Highway Administration, Traffic Volumes and Trends, available at www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm. **Seasonally-adjusted VMT**: U.S. Department of Transportation, Bureau of Transportation Statistics, seasonally adjusted transportation data, available at www.transtats.bts.gov/osea/seasonaladjustment.

2 TRANSPORTATION'S CONTRIBUTION TO THE ECONOMY

Transportation's contribution to the economy can be measured by its contribution to gross domestic product (GDP). GDP is an economic measure of all goods and services produced and consumed in the country. The transportation component of GDP can be measured as either:

- the share of all expenditures (by households, private firms, and the government) on final goods and services that are related to transportation (collectively known as the final demand for transportation), or
- the contribution of transportation services produced (known as value added) to GDP.

This chapter uses data from the Bureau of Economic Analysis' national income and product accounts and from the Bureau of Transportation Statistics' Transportation Satellite Accounts to explain and highlight trends in transportation's contribution to the economy.

Transportation-Related Final Demand

Transportation-related final demand (box 2-1) is a measure of the expenditures by households, private firms, and the government on final goods and services related to transportation. It is the sum of the following:

- personal consumption expenditures on transportation-related goods and services (motor vehicles and parts; motor vehicle fuels, lubricants, and fluids; and transportation services);
- private domestic investment in transportation structures and equipment;
- government purchases of transportation goods and services; and
- net exports (exports minus imports) related to transportation goods and services.

The first three expenditures (personal consumption expenditures, private investment, and government purchases of transportation related goods and services) sum to the domestic demand for transportation. If export and import values of transportation-related goods and services were equal—in other words, if net exports (exports minus imports) equaled zero—then the total transportation-related GDP would equal the sum of domestic demand for transportation. However, transportation-related imports tend to exceed exports, which results in net exports being negative. Negative net exports reduce the total for transportation-related final demand and result in transportation-related final demand being less than the sum of domestic sources of demand.

Transportation-related final demand is useful for comparing the amount spent on transportation to the amount spent on other economic activities, such as healthcare and

housing. It is not, however, a perfect measure of the transportation needed to support economic activity. For example, if investment in transportation infrastructure is below the level needed to maintain the system, then the measure will underestimate demand.

Box 2-1: National Income Account Terminology

The national income and product accounts use several related terms when discussing the size of the economy and sectors within the economy, such as transportation. These terms are used in the figures in this chapter and in other discussions of transportation economics.

What is Gross Domestic Product (GDP) and Gross Domestic Demand (GDD)?

- GDP is the sum of the value of all goods and services produced in the economy.
- GDD is like GDP but excludes net exports, thereby showing only domestic demand.

What are the differences among transportation value added, total transportation expenditures, and value of shipments?

Transportation value added is the contribution of transportation to the economy. It is equal to sales, or receipts, and other operating income from transportation services (gross output) less the goods and services used in production (intermediate inputs). Value added by transportation also can be measured as the sum of employee compensation, taxes on production and imports less subsidies, and gross operating surplus.

Transportation-related final demand is a measure of expenditures by households, private firms, and the government on final goods and services related to transportation. It is the sum of the following:

- personal consumption expenditures on transportation-related goods and services (motor vehicles and parts; motor vehicle fuels, lubricants, and fluids; and transportation services);
- private domestic investment in transportation structures and equipment;
- government purchases of transportation goods and services; and
- net exports (exports minus imports) related to transportation goods and services.

Value of shipments is the value of the goods transported by the freight transportation sector, which is different from the value of the service used to transport them.

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

Transportation-Related Final Demand by GDP Component

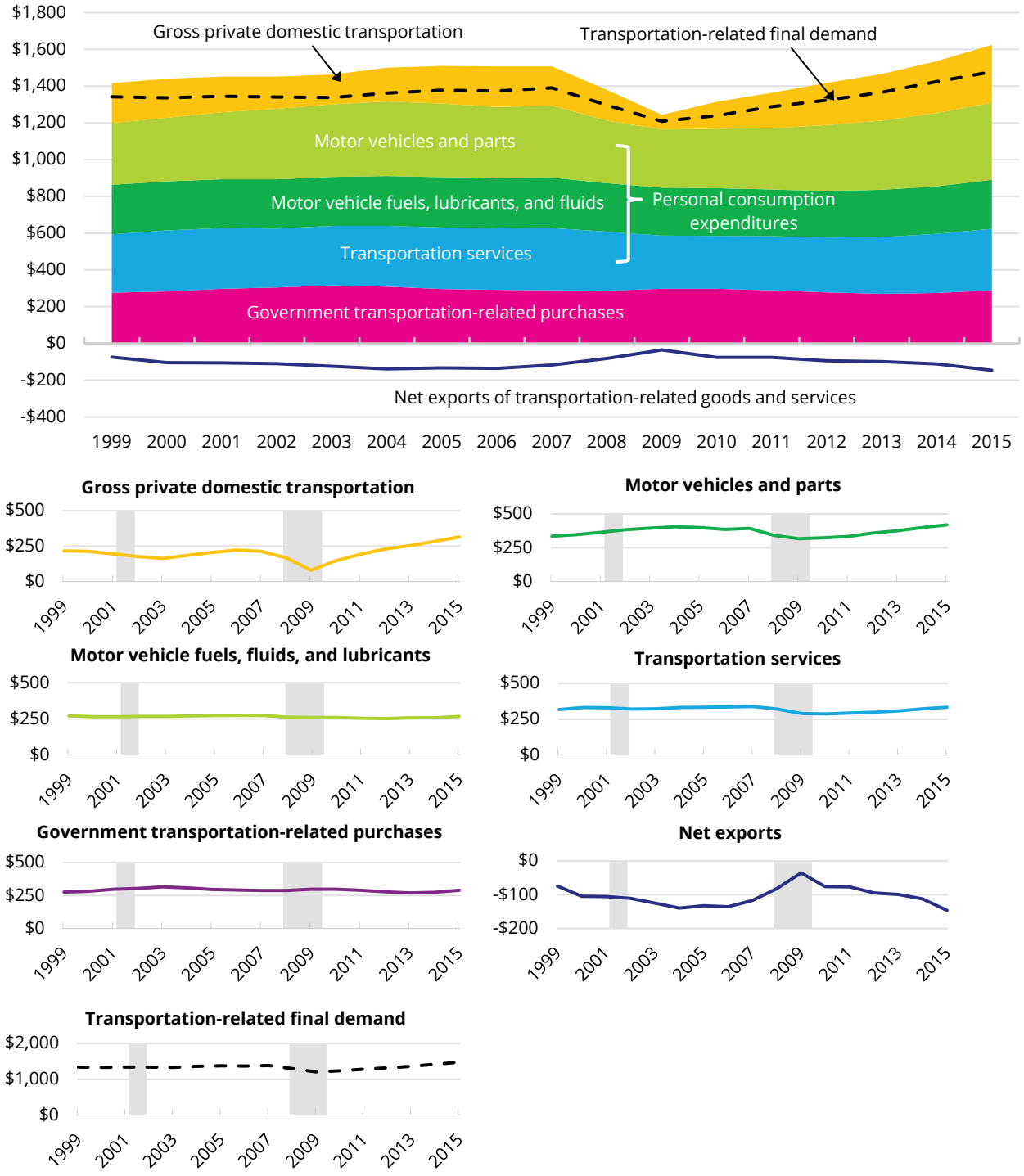
Figure 2-1 shows total transportation-related final demand from 1999 to 2015 (in chained 2009 dollars) and trends for each of its components (see box 2-1). Transportation-related final demand grew 3.5 percent from 1999 to 2007, peaking at $1,389.7 billion in 2007. It then fell 13.0 percent from 2007 to 2009 due to the recession, hitting an all-time low ($1,208.5 billion) in 2009. The sharp decline during the recession effectively removed over 10 years of growth in final demand. Transportation-related final demand has increased since the

recession, surpassing the 2007 peak in 2014 and continuing to climb in 2015. The average annual growth in transportation-related final demand was 3.4 percent between 2010 and 2015, compared to 0.4 percent between 2000 and 2007 (before the recession).

The decline in transportation-related final demand during the recession was most evident in private investment and in personal consumption expenditures (purchases of motor vehicle fuels, lubricants, and fluids; motor vehicles and parts; and transportation services). Exports of transportation goods and services came close to balancing imports in 2009—imports often decrease during economic declines—but returned to their larger negative balance in later years. Government transportation-related purchases peaked in 2003, and then declined steadily to $287.4 billion (in chained 2009 dollars) in 2008. They then rose in 2009 and 2010, as the government increased spending in response to the recession and to declines in private sector investment.

In 2015 the final demand for transportation ($1,477.9 billion) accounted for 9.0 percent of U.S. GDP (as measured in chained 2009 dollars). The demand included personal consumption expenditures of transportation ($1,020.7 billion, 69.1 percent of transportation demand), private domestic investment in transportation structures and equipment ($314.4 billion, 21.3 percent), government purchases of transportation goods and services ($289.1 billion, 19.6 percent), and net exports (exports minus imports) related to transportation goods and services (-$146.3 billion, -9.9 percent).

Figure 2-1: Gross Domestic Product (GDP) Components of Transportation-Related Final Demand, 1999 to 2015 (billions, chained 2009 dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics, Table 3-4, available at www.bts.gov. Current dollar data can be found in U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics, Table 3-3, available at www.bts.gov.

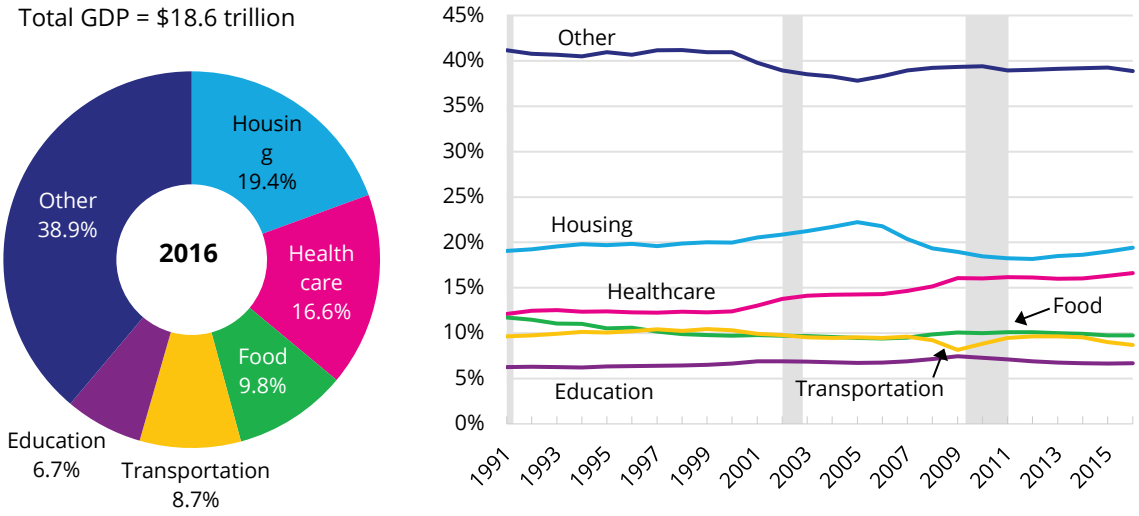
Gross Domestic Product (GDP) by Major Social Function

GDP by major social function shows expenditures (total final demand) on broad economic activities, such as housing, transportation, and healthcare. The major social functions—housing, healthcare, food, transportation, and education—comprise 60 percent of expenditures, while the 40 percent "other" category includes entertainment, personal care, and payments to pension plans.

Figure 2-2 shows that transportation was the fourth largest expenditure category in 2016 after healthcare, housing, and food (excluding "other expenditures"), representing 8.7 percent of total final demand. Housing is the largest source of final demand at 19.4 percent, slightly more than twice the size of transportation.

The right side of figure 2-2 shows expenditures by major social function from 1991 to 2016. Expenditures on transportation (transportation-related final demand) decreased during the recession from 9.6 percent of GDP in 2007 to 8.2 percent in 2009, and then increased slowly. Expenditures on transportation grew from 2009 to 2016, but the share of expenditures fell from 2012 to 2016 due to housing expenditures rising more rapidly.

Figure 2-2: Final Demand for Goods and Services by Major Social Function, 2016



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-9, available at www.bts.gov.

Contribution of Transportation Services Produced: Value Added

For-Hire Transportation Services Produced in the Economy

For-hire transportation services consist of air, rail, truck, passenger and ground transportation, pipeline, and other support services that transportation firms (e.g., transit

agencies and common carrier trucking companies) provide to industries and the public on a fee basis. Calculating the contribution of for-hire transportation to GDP uses a *value-added* approach that subtracts the cost of inputs (e.g., fuel and equipment costs) from total output (measured by industry revenue, e.g., airline fares).

Figure 2-3 shows how much transportation contributes to GDP relative to other industries. Each industry has an estimated contribution to GDP based on its *value added* (box 2-2). The value added by all industries sum to GDP. Since GDP is a measure of all economic activity, looking at industry value added shows where the most and least economic activity occurred. Transportation ranks 13th among the 17 industries in its contribution to GDP.

This ranking, however, understates the importance of transportation for two reasons. First, it includes only the contribution of for-hire transportation to GDP. In addition to purchasing for-hire transportation services, many industries produce transportation services for their own use. The services produced by non-transportation industries are known as in-house transportation. The *Transportation Satellite Accounts*, discussed later in this chapter, show the contribution of in-house transportation performed by non-transportation industries. Second, the ranking does not capture the extent to which industries rely on transportation. Each industry uses roadways, shipping channels, rail lines, and other transportation infrastructure to access supplies and customers, and workers in each industry use transportation to reach their workplace. The value of these transportation assets are discussed in Chapter 8.

Box 2-2: What is Transportation Value Added?

Transportation Value Added is a measure of the contribution of the transportation sector to gross domestic product (GDP) based on the difference between the value of the transportation services sold and the goods and services used to produce transportation. The Bureau of Economic Analysis (BEA) considers industry value added to be a measure of an industry's contribution to GDP.

The value of transportation sector outputs is estimated using data on the sales of transportation sector services to other parts of the economy. That shows what other parts of the economy are willing to pay for those services. Inputs purchased by the transportation sector, such as fuel and equipment, are valued based on what the transportation sector pays for them. The difference is the value added by the transportation sector, which is the transportation sector's contribution to GDP.

The contribution of the inputs to transportation includes the value added by the sector that produces them. For example, the contribution of the fuel purchased by for-hire carriers is included in the value added by the energy sector, which produced the fuel. If fuel purchased by for-hire transportation was not subtracted from the value added by transportation, it would be double-counting the value added by fuel. Other examples of excluded inputs include equipment, spare parts, lubricants, and other materials. This approach allows BEA to compute total GDP as the sum of the contributions of all sectors of the economy.

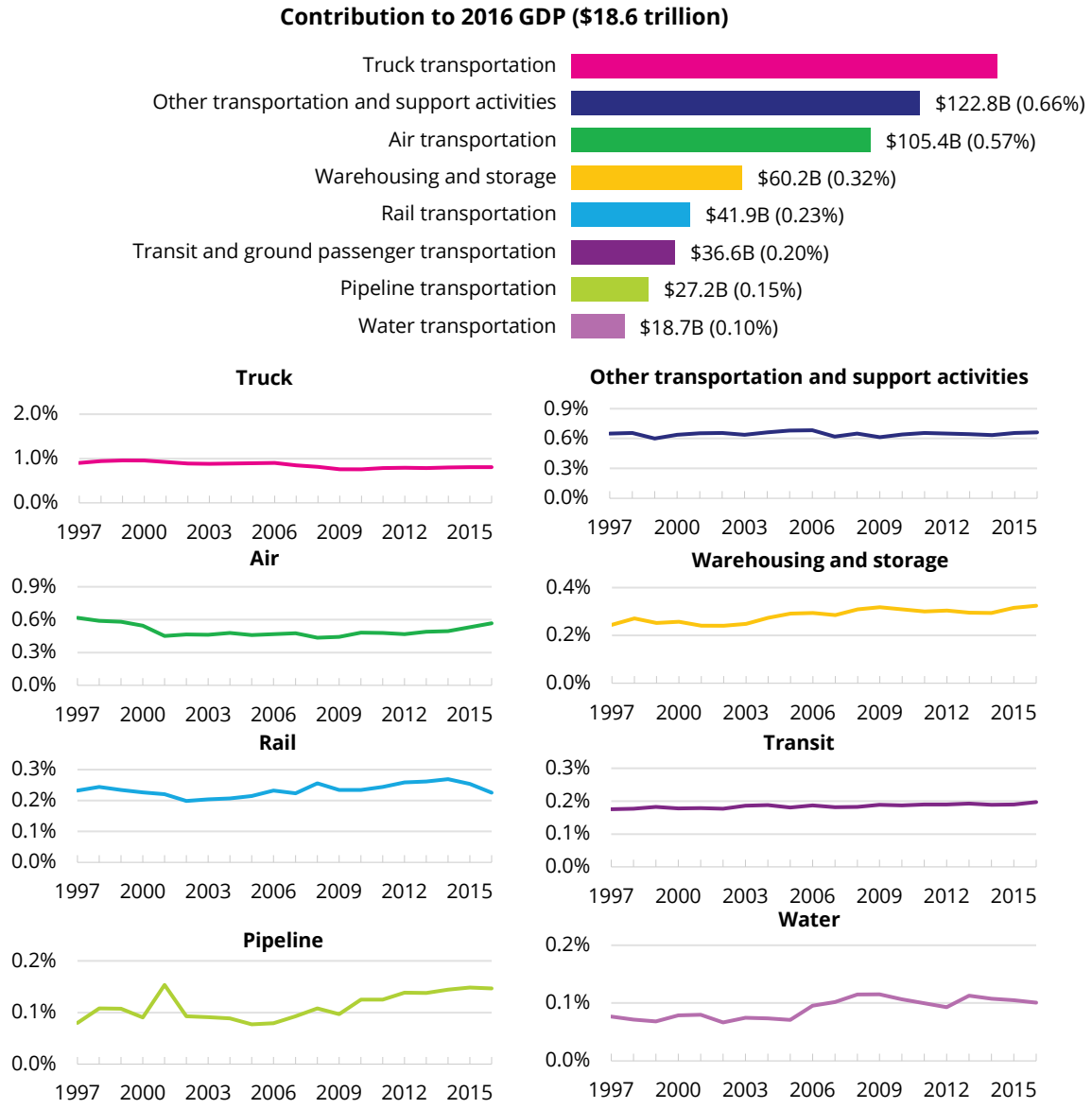
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

Figure 2-3: Contribution to Gross Domestic Product (GDP) by Industry, 2016

Source: U.S. Department of Commerce, Bureau of Economic Analysis, GDP by Industry table "Real Value Added by Industry (A) (Q)," available at www.bea.gov/iTable/index_industry_gdpIndy.cfm.

Figure 2-4 shows transportation's contribution to GDP by mode from 1997 to 2016. In 2016 the three modes with the largest contributions were trucking ($150.1 billion, 0.81 percent of GDP), other transportation and support activities ($122.8 billion, 0.66 percent), and air ($105.4 billion, 0.57 percent). The modes that grew as a percentage of GDP from 1997 to 2016 were warehousing and storage (from 0.24 percent to 0.32 percent), pipelines (from 0.08 percent to 0.15 percent, with peaks of 0.15 percent in 2001 and 2016), water (0.08 percent to 0.10 percent), and transit and ground passenger (from 0.18 percent to 0.20 percent). However, most modes decreased relative to GDP, including trucking (from 0.90 percent to 0.81 percent) and air (from 0.62 percent to 0.57 percent). Rail contributed the same percent in 2016 as in 1997 (0.23 percent), a slight decline from its peak contribution of 0.27 percent in 2014.

Figure 2-4: For-Hire Transportation Industry's Contribution to Gross Domestic Product (GDP) by Mode



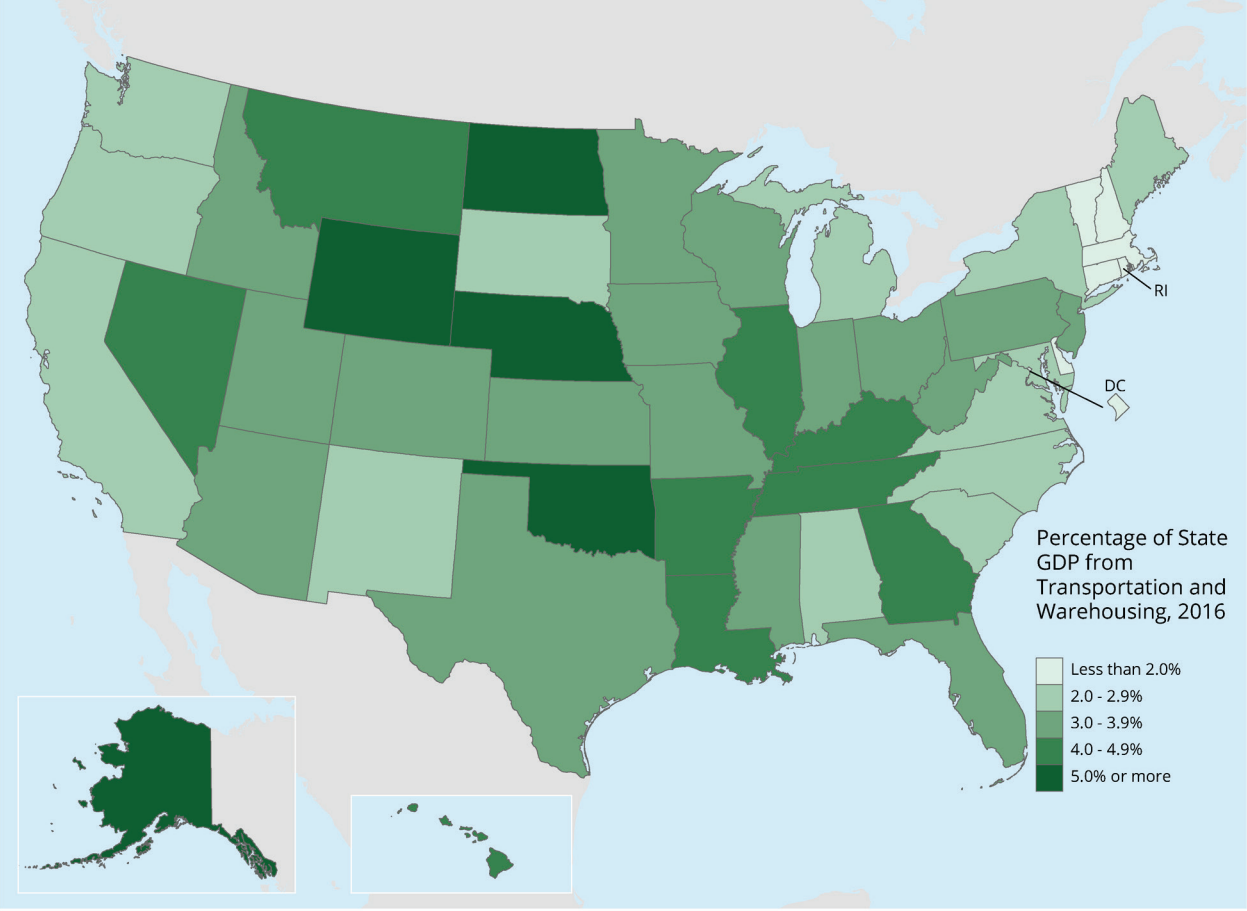
Notes: Data are from the value added by industry table of the BEA Industry Economic Accounts. Line 40 has data for Transportation and Warehousing, and Lines 41 through 48 have data for individual modes. Current dollar data can be found in *National Transportation Statistics,* table 3-1.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-2, available at www.bts.gov.

State Gross Domestic Product from Transportation and Warehousing

The percentage that transportation and warehousing contributes to a state's GDP depends on the state's geography, population density, mix of industries, and location of transportation hubs. For example, Nebraska has a major national rail hub in Omaha, and has the second-highest percentage of GDP from transportation and warehousing of any state in the country (7.8% of Nebraska's GDP in 2016). States with larger total GDPs, such as California ($2.6 trillion) and Texas ($1.62 trillion), also have large transportation and warehousing activities—$63.3 billion and $55.6 billion, respectively. Because other economic activities are so much larger in California and Texas, however, transportation and warehousing is a small share of their total GDP (figure 2-5).

Figure 2-5: State Gross Domestic Product from Transportation and Warehousing as a Percent of State Total Gross Domestic Product, 2016



Source: U.S. Department of Commerce, Bureau of Economic Analysis, "Regional GDP & Personal Income," available at www.bea.gov/iTable/index_regional.cfm.

Transportation Satellite Accounts

The Bureau of Economic Analysis (BEA) measures the value added by for-hire transportation using the Economic Census Survey. *For-hire transportation services* are produced by transportation firms (trucking companies, railroads, and airlines) and sold to transportation users. In addition to for-hire transportation services, non-transportation industries also produce transportation services for their own purposes. For instance, grocery stores may operate a truck fleet to move food from distribution centers to stores. BEA embeds the value of these services, known as *in-house transportation*, within the value of the goods purchased by non-transportation industries to carry out in-house transportation operations.

BTS developed the *Transportation Satellite Accounts* (TSAs, box 2-3*)* to extract the commodities used to carry out in-house transportation operations and estimate the contribution of in-house transportation to the economy. The TSAs also show the contribution of transportation carried out by households using automobiles. The TSAs thus give a more comprehensive measure of the size and role of transportation in the economy.

Box 2-3: What are the Transportation Satellite Accounts (TSAs)?

Satellite industry accounts expand on the national income and product accounts and the input-output accounts, and supplement these accounts by focusing on one aspect of economic activity. The TSAs capture transportation activities carried out by non-transportation industries for their own purposes and transportation activities carried out by households using an automobile.

The TSAs show the contribution of for-hire, in-house, and household transportation services:

- *For-hire transportation* consists of the air, rail, truck, passenger and ground transportation, pipeline, and other support services provided by transportation firms such as railroads, transit agencies, common carrier trucking companies, and pipelines to industries and the public on a fee basis.
- *In-house transportation* consists of air, rail, water, and truck services produced by businesses for their own use. Business in-house transportation includes privately owned and operated vehicles of all body types, used primarily on public rights of way, and the support services to store, maintain, and operate those vehicles. A baker's delivery truck is an example of in-house transportation.
- *Household transportation* covers transportation provided by households for their own use using a vehicle, measured by the depreciation cost associated with household ownership of motor vehicles. Air passenger travel is included in for-hire air transportation. The time that households spend operating a private motor vehicle for personal use is not included, because it is outside the scope of the U.S. Input-Output (I-O) accounts on which the TSAs are built.

The I-O accounts do not include unpaid labor, volunteer work, and other non-market production.

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

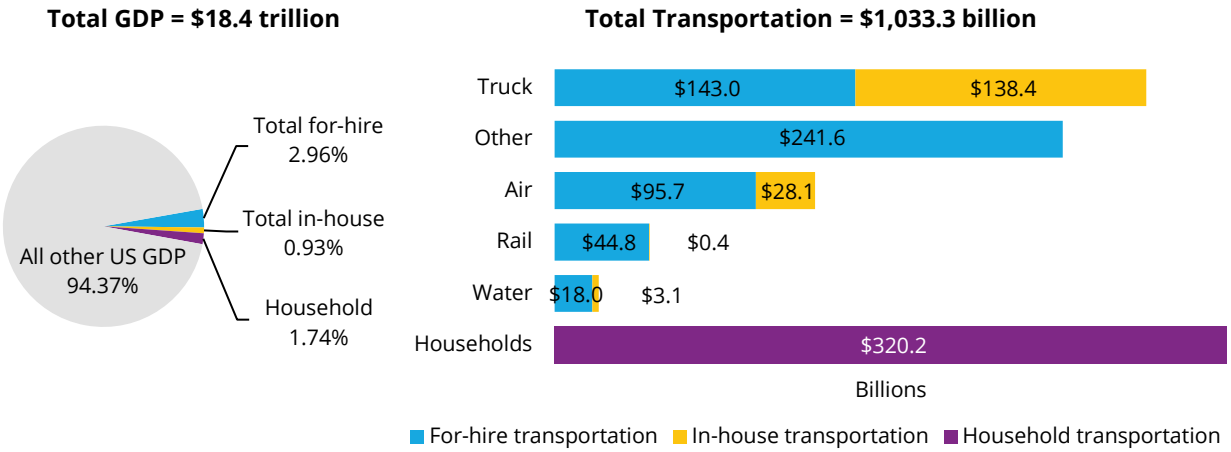
Transportation Satellite Account Results

The TSAs compute transportation's GDP contribution attributed to all transportation modes. In 2015, the latest year for which comprehensive data are available, transportation's total GDP contribution was estimated at $1,033.3 billion (figure 2-6). The pie chart in figure 2-6 represents total U.S. GDP, and the slice shows the portion contributed by transportation, based on the TSAs. The colors within the slice show the relative shares of for-hire (3.0 percent), in-house (0.9 percent), and household (1.7 percent) transportation's contribution to GDP. For-hire transportation contributed $543.2 billion (3.0 percent) to U.S. GDP of $18.4 trillion.[1] Transportation services (air, rail, truck, and water) provided by non-transportation industries for their own use (called in-house transportation) contributed an additional $169.9 billion (0.9 percent) to U.S. GDP.[2] Household transportation (i.e., the depreciation cost associated with households owning motor vehicles)[3] contributed $320.2 billion (1.7 percent) to U.S. GDP.

[1] The GDP value in the TSAs is larger than the GDP value published in the national income and product accounts because it includes the contribution of household transportation. Household transportation covers transportation provided by households for their own use with an automobile.
[2] Large retailers, such as Walmart and Target, are captured by BEA in the for-hire transportation sector, but smaller retailers are subsumed into the BTS in-house estimate.
[3] In the TSAs, BTS measures the contribution of household transportation to GDP as the depreciation of automobiles. The measure does not include the value of time spent driving because it is not within the scope of the U.S. Input-Output accounts on which the TSAs are built. The I-O accounts, by design, do not include unpaid labor, volunteer work, or other non-market production.

The bars in figure 2-6 show transportation's contribution to GDP by type (for-hire, in-house, or household transportation) and by mode for for-hire and in-house transportation. Total household transportation's contribution to GDP was larger, at $320.2 billion, than any of the other transportation modes. Trucking contributed the second largest amount, at $281.4 billion. In-house truck transportation operations (such as a grocery chain operating its own trucks) contributed $138.4 billion, while for-hire truck transportation services contributed $143.0 billion. Air contributed a total of $123.8 billion, comprised of $95.7 billion of for-hire services and $28.1 billion of in-house services; rail contributed $45.2 billion, comprised of $44.8 billion of for-hire services and $0.4 billion of in-house services; and water contributed $21.0 billion, comprised of $18.0 billion of for-hire services and $3.1 billion of in-house services.

Figure 2-6: Gross Domestic Product (GDP) Attributed to Transportation Types and Modes, 2015



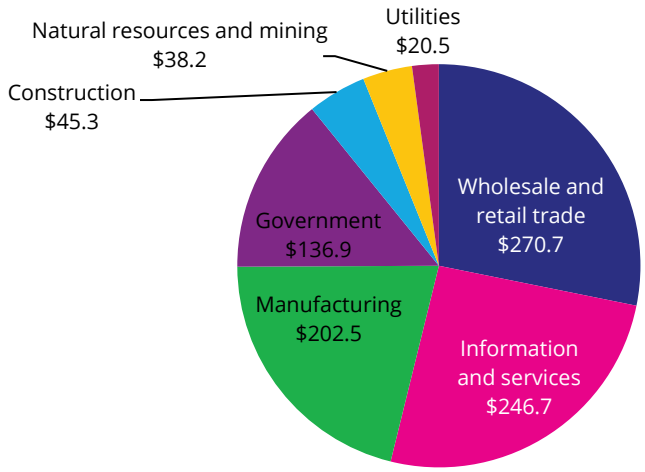
Note: For information on the methodology behind the Transportation Satellite Accounts see box 2-3. The GDP value in the TSAs is larger than the GDP value published in the National Accounts because it includes the contribution of household transportation. "Household transportation" covers transportation that households provide for themselves with vehicles.

Sources: U.S. Department of Commerce, Bureau of Economic Analysis, "Regional GDP & Personal Income," available at www.bea.gov/iTable/index_regional.cfm. U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.

Use of For-Hire and In-House Transportation by Industry

The TSAs can also compute the extent of transportation services required to produce various goods and services. Figure 2-7 compares the value of for-hire and in-house transportation services used by seven major industries to produce their goods and services. When in-house transportation is included, wholesale and retail trade is the largest user of transportation services at $270.7 billion, followed by information and services at $246.7 billion and manufacturing at $202.5 billion.

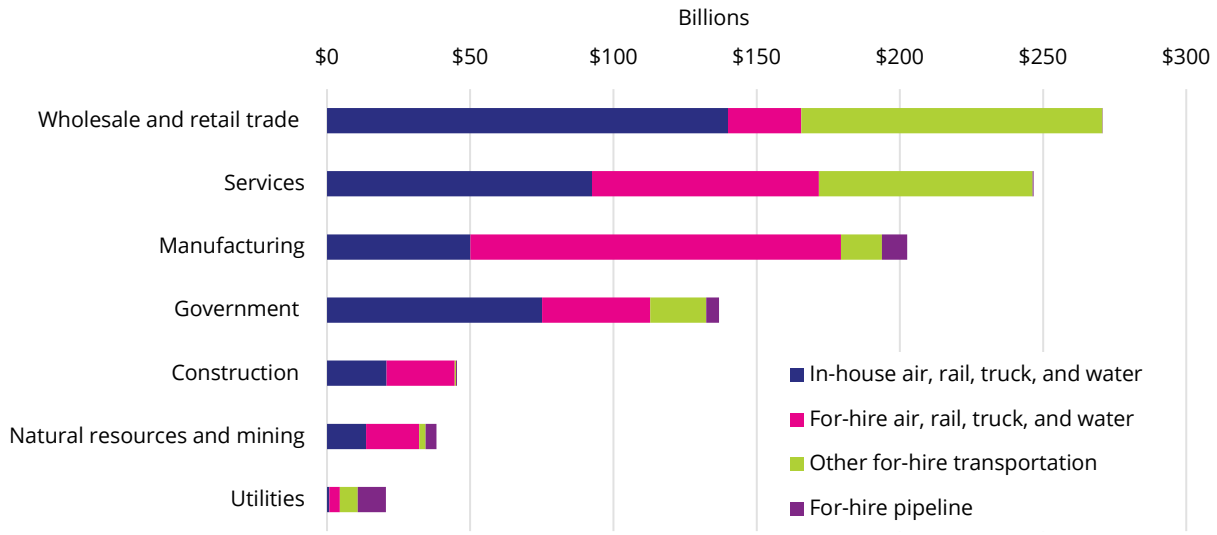
Figure 2-7: Use of For-Hire and In-House Transportation by Industry Sector, 2015 (billions of dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.

In the wholesale and retail trade industry, in-house transportation accounts for 51.7 percent of the $270.7 billion total transportation services used (figure 2-8). In-house transportation also represents a large portion of transportation services used in natural resources/mining (35.5 percent of $38.2 billion), construction (45.8 percent of $45.3 billion), and government (54.9 percent of $136.9 billion). Other sectors, like manufacturing, rely more on for-hire transportation. In the manufacturing sector, for-hire transportation accounts for 75.3 percent of the $202.5 billion total transportation services used.

Figure 2-8: Use of For-hire and In-house Transportation by Industry Sector and Mode, 2015 (billions of dollars)



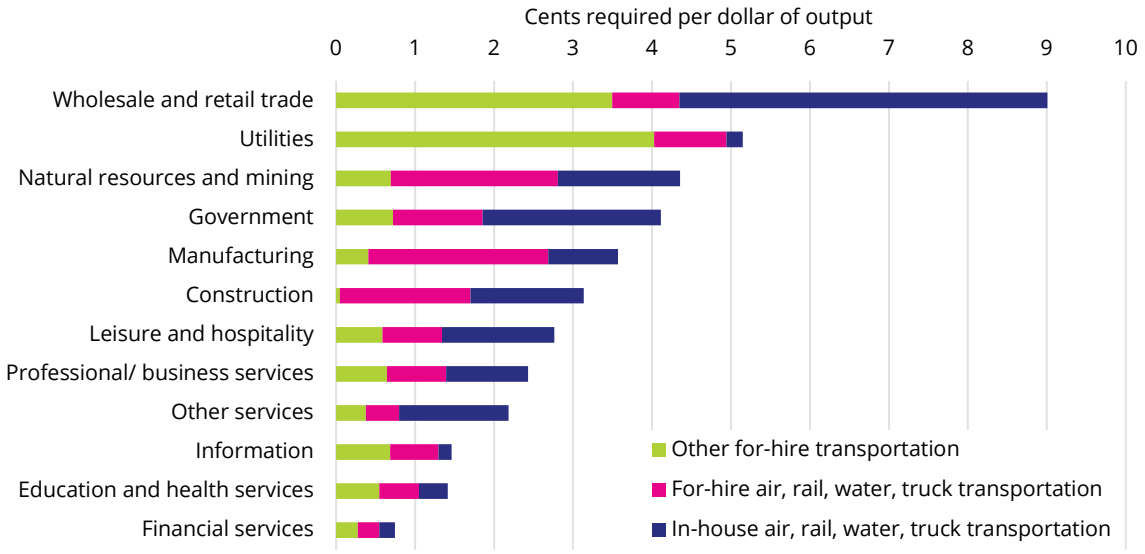
Notes: Pipeline transportation is shown separately only for the natural resources and mining and the utilities industries. It accounts for less than 5 percent of total transportation used by other industries. Services includes: information, financial services, professional and business services, education and health services, leisure and hospitality, and all other services.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.

Transportation Required Per Dollar of Output by Sector

Looking at the amount of transportation required to produce each dollar of output shows how much a sector depends on transportation (figure 2-9). In 2015 the wholesale and retail trade sector required more transportation services to produce one dollar of output than any other sector. It required 9.0 cents of transportation services to produce one dollar of output—4.7 cents of in-house transportation operations, and 4.4 cents of for-hire transportation services. BTS fully discusses transportation's role in the seven major industry sectors in Industry Snapshots: Transportation's Role in the U.S. Economy, available at www.bts.gov.

Figure 2-9: Transportation Required Per Dollar of Output by Sector, 2015



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at www.bts.gov.

3 HOW MUCH DOES TRANSPORTATION COST?

The cost of transportation stems from the resources it requires—labor, equipment, fuel, and infrastructure. Many resources are purchased by firms that provide transportation services, such as labor purchased by a railroad or fuel bought by a trucking company. Other resources are purchased directly by the users of transportation, such as fuel purchased by households for automobile travel. In addition, federal, state, and local governments provide most of the transportation infrastructure, such as highways.

The prices that transportation companies charge for transportation services become out-of-pocket costs to travelers and freight shippers, and influence their transportation choices. Because transportation is an input to the production of almost all goods and services, transportation price changes can influence the cost of other goods and services as well. Transportation prices themselves are affected by the prices of inputs, such as labor costs, fuel costs, and the costs of transportation parts.

This chapter discusses costs for three segments of the transportation market:

1. businesses that use transportation to produce and deliver non-transportation goods, such as retail and grocery;
2. producers of transportation services, such as railroads, airlines, or trucking companies; and
3. business and household travelers.

When disaggregate data are not available for business and household travelers, statistics that combine business and household travelers will be used. This chapter also contains a special section on fuel because fuel is a key input to all transportation industries and households.

The prices paid for transportation do not fully account for air pollution, traffic congestion, or other negative effects of transportation. These unaccounted effects represent costs to society, and are known as *negative externalities*. While negative externalities are an important part of economic analysis, this chapter covers only prices paid.

Costs to Use Transportation Services

This section presents data on transportation costs from two perspectives: (1) the *Producer Price Index* (PPI) (box 3-1); and (2) the *Consumer Price Index for all Urban Consumers* (CPI-U) (box 3-2). The PPI for a mode of transportation measures the average change in the selling prices received by producers of transportation services. Prices are from the viewpoint of the seller, and thus exclude items like sales and excise taxes. The CPI-U, on the other hand, is from the viewpoint of the consumer. The CPI-U is a measure of the average change over

time in the prices paid by urban consumers for a market basket of goods and services.[1] The CPI-U also includes user fees (e.g., water and sewer service) and sales and excise taxes paid by the consumer.

Box 3-1: Producer Price Indices

The Producer Price Index (PPI) is the weighted average of wholesale or producer prices. These are the prices charged by producers of transportation services. The PPI for a mode of transportation measures the average change in the selling prices received by producers. For example, the rail producer price index is based on a survey of railroad prices charged to shippers. The PPI for trucking services measures the average change over time in the selling price for trucking services. The PPI is different from the Consumer Price Index, which shows changes in prices from the viewpoint of the consumer or purchaser of the transportation services.

The PPI, published by the Bureau of Labor Statistics (BLS), is one of the most widely used measures of price changes for the transportation sector. BLS surveys a sample of individual business establishments. Because prices are from the point of view of the producer of transportation services, they exclude items like sales and excise taxes. Prices are weighted by the size of establishment's revenue to create indexes for narrowly defined services (e.g., local specialized freight trucking excluding used goods) and are then combined by BLS into aggregated indexes (e.g., all trucking) using value of shipments data from economic censuses of the Bureau of the Census. BLS publishes data for both broad and more narrowly defined services and costs.

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

Producer Price Index

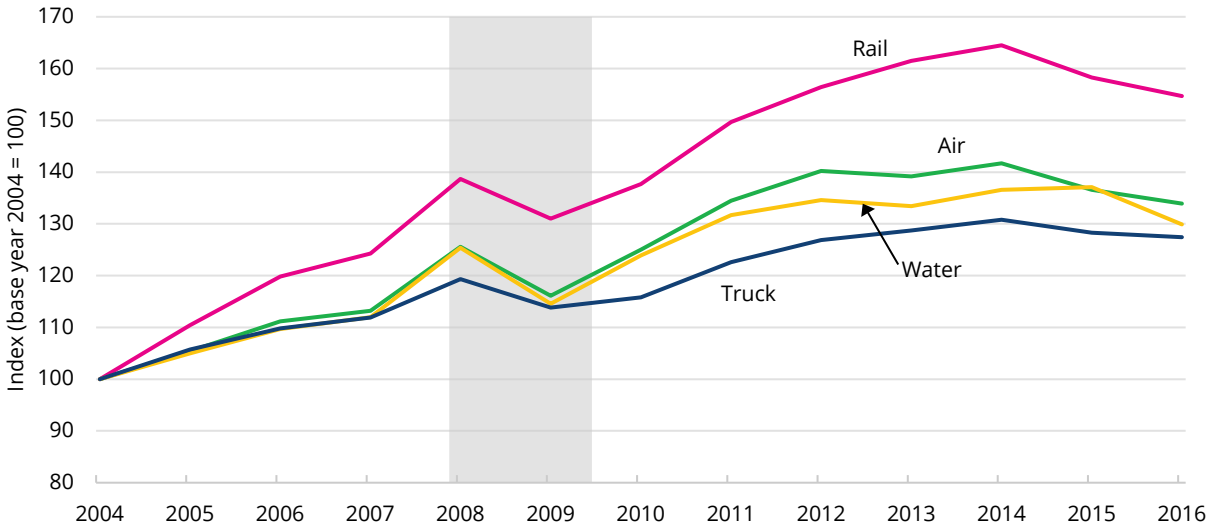
The *Producer Price Index* (PPI) shows the weighted average of wholesale or producer prices. Figure 3-1 shows PPIs in the transportation industry by mode from 2004 to 2016. Despite periods of modest decline from 2007 to 2009 (during the recession) and from 2014 to 2016, businesses purchasing transportation services saw an overall increase in the relative prices for air, rail, truck, water, and pipeline transportation services. The costs faced by businesses purchasing rail transportation services grew by 54.7 percent, more rapidly than any other transportation mode. The costs faced to purchase truck, water, and air transportation services also increased, with trucking services growing at a slightly slower rate (27.4 percent) than water (29.9 percent) and air (33.9 percent) transportation services.

[1] The CPI-U excludes rural consumers to avoid statistical sampling issues.

More research is needed to better understand the reasons PPIs change differently by mode.

The PPIs show a peak across modes in 2008. The 2008 peak occurred at the end of a period of economic growth accompanied by increasing fuel prices. After a decline during the economic downturn in 2009, prices rose and surpassed the 2008 peak in 2011, Prices reached their all-time highest level in 2014 (except for water producer prices, which rose to their highest level in 2015) and have since declined modestly.

Figure 3-1: Producer Price Indices for Providers of Selected Transportation and Warehousing Services, 2004 to 2016



Notes: Transportation Warehousing Services are defined using the North American Industry Classification System (NAICS). Shaded bars indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-13, available at www.bts.gov.

Table 3-1 shows changes in producer prices for selected transportation industry subsectors. While transportation PPIs have often moved together, some subsectors show exceptions. For example, the prices faced by businesses purchasing transportation services declined for all transportation modes during the recession, except for the pipeline transportation subsectors, postal service, and the household and office moving subsector of the trucking industry, which increased modestly (6.0 percent or less) between 2008 and 2009.

Table 3-1: Detailed Producer Price Indices by Transportation Modes, 2004 to 2016

Mode	2004	2016	2004-2016
Air transportation (NAICS 481)[1]	100.0	133.5	
Scheduled air transportation (NAICS 4811)[2]	100.0	134.0	
Scheduled freight air transportation (NAICS 481112)	100.0	151.2	
Nonscheduled air transportation (NAICS 4812)[3]	100.0	138.3	
Rail transportation (NAICS 482)[3]	100.0	154.8	
Line -haul railroads (NAICS 482111)[4]	100.0	154.7	
Water transportation (NAICS 483)	100.0	130.0	
Deep sea freight transportation (NAICS 483111)[5]	100.0	106.9	
Coastal and great lakes freight transportation (NAICS 483113)	100.0	164.0	
Inland water freight transportation (NAICS 483211)[6]	100.0	164.5	
Truck transportation (NAICS 484)	100.0	127.4	
General freight trucking (NAICS 4841)	100.0	129.4	
General freight trucking, local (NAICS 48411)	100.0	123.9	
General freight trucking, long distance (NAICS 48412)	100.0	130.6	
Specialized freight trucking (NAICS 4842)	100.0	123.4	
Used household and office goods moving (NAICS 48421)	100.0	121.4	
Specialized freight (except used goods) trucking, local (NAICS 48422)	100.0	128.8	
Specialized freight (except used goods) trucking, long distance (NAICS 48423)	100.0	118.7	
Pipeline transportation (NAICS 486)	NA	NA	
Pipeline transportation of crude oil (NAICS 4861)	100.0	228.1	
Other pipeline transportation (NAICS 4869)	100.0	169.4	
Support activities for transportation (NAICS 488)	100.0	117.9	
Support activities for water transportation (NAICS 4883)	100.0	134.0	
Postal service (NAICS 491)[2]	100.0	138.8	
Couriers and messengers (NAICS 492)	100.0	191.7	

Notes: Blue dots on the sparkline charts indicate high values; red dots indicate low values.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-13, available at www.bts.gov.

Consumer Price Index for Urban Consumers

The *Consumer Price Index for Urban Consumers* (CPI-U, box 3-2) is a measure of the average change over time in the prices paid by urban consumers for a market basket of consumer goods and services. Economists often use the CPI-U as an indicator of general price trends. Consumer Price Indexes for goods and services, such as ones related to transportation, show changes in prices for those goods and services.

Table 3-2 shows price changes in private and public transportation from 2015 to 2016.[2] On average, transportation cost less in 2016 than in 2015 (table 3-2). The CPI-U for both private and public transportation declined from 2015 to 2016 (table 3-2). Costs for private transportation declined by 2.2 percent, resulting primarily from a 11.5 percent decrease in gasoline cost as well as decreases in the cost of other fuels and tires. These decreases were partially offset by increases in the cost of insurance (6.2 percent), parking fees and tolls (2.8 percent), and vehicle maintenance and repairs (1.7 percent).

Public transportation costs overall declined by 1.2 percent due to a 3.3 percent decline in air fares. Not all public transportation prices declined. Ship fares increased 7.4 percent, intracity transportation costs increased by 1.7 percent, and intracity mass transit costs increased by 1.8 percent.

[2] In this discussion, "public transportation" refers to common carrier for-hire passenger transportation, including intracity mass transit.

Table 3-2: Consumer Price Indexes for All Urban Consumers, Transportation-Related Goods and Services

Goods and Services	2015 Average	2016 Average	2015–2016 Change
Overall transportation	199.1	194.9	-2.1%
Private transportation	193.7	189.5	-2.2%
New and used motor vehicles [1]	100.8	100.2	-0.5%
New vehicles	147.1	147.4	0.2%
Used cars and trucks [1 2]	147.1	143.5	-2.5%
Motor fuel	213.1	188.4	-11.6%
Gasoline (all types)	212.0	187.6	-11.5%
Other motor fuels [1]	197.5	165.8	-16.0%
Motor vehicle parts and equipment	144.2	143.6	-0.5%
Tires	126.5	125.4	-0.9%
Motor vehicle maintenance and repair	270.7	275.4	1.7%
Motor vehicle insurance	460.6	489.1	6.2%
Motor vehicle fees [1]	178.9	182.6	2.1%
Parking fees and tolls [1 2]	215.9	221.9	2.8%
Public transportation	268.7	265.4	-1.2%
Airline fare	292.2	282.6	-3.3%
Other intercity	152.9	158.3	3.6%
Intercity train fare [2 3]	110.0	112.4	2.2%
Ship fare [1 2]	61.8	66.3	7.4%
Intracity transportation	303.9	308.9	1.7%
Intracity mass transit [2 4]	120.2	122.3	1.8%

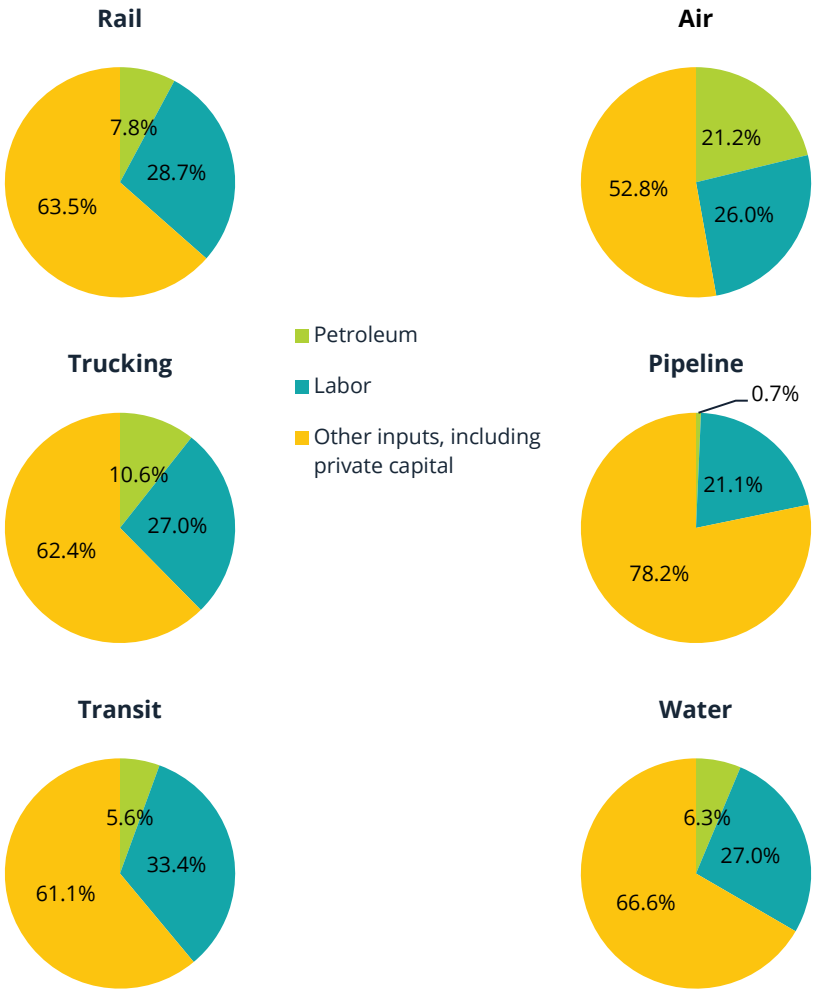
Notes: "New and used motor vehicles" includes all purchased consumer vehicles. "Public transportation" includes all common carrier for-hire passenger transportation, including intracity mass transit. Taxis are included in "intracity transportation." The bases for indexes are as follows: (1) Indexes on a December 1997=100 base. (2) Special index based on a smaller sample. (3) Indexes on a December 2007=100 base. (4) Indexes on a December 2009=100 base. (All others) Average of 1982 to 1984=100.

Source: U.S. Department of Labor, Bureau of Labor Statistics, All Urban Consumers (Current Series), Not Seasonally Adjusted, US City Average, available at www.bls.gov/cpi/data.htm.

Fuel Prices

Fuel prices are a cost to transportation industries and a direct cost to consumers. The cost of petroleum products is a large share of the total value of the output of for-hire transportation services, ranging as high as 21.2 percent for aviation (figure 3-2). Gasoline and motor oil also account for 22.0 percent of household spending on transportation, as discussed in chapter 6 (figure 6-6). Fuel cost is very visible to households, as news reports focus on changes in fuel prices and gas stations must post prices by law, making fuel prices salient to consumers in ways other prices are not.

Figure 3-2: Input Cost Shares by Mode, 2015



Notes: Chapter 4 discusses labor costs in more detail. Percentages may not add to 100 due to rounding.

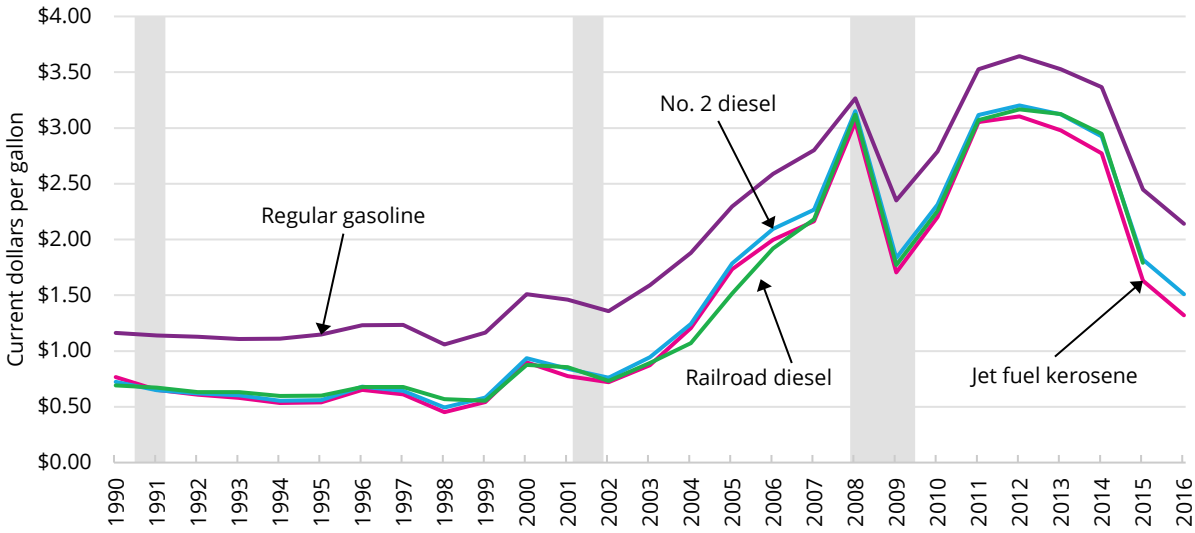
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *2015 Transportation Satellite Accounts*, available at www.bts.gov.

Sales Price of Transportation Fuel

Prices for regular gasoline, No. 2 diesel (used by automobiles and trucks), jet fuel kerosene, and railroad diesel typically move together with slight variations (figure 3-3). This reflects the underlying price of crude oil from which they are all refined.

Following a decade of relatively stable fuel prices in the 1990s, fuel prices began to increase. Gasoline, No. 2 diesel fuel, and kerosene spiked to over $3.00 per gallon in 2008. While declining sharply during the 2007 to 2009 recession, fuel prices began to rise again, rising above the 2008 price just after 2011. Since peaking in 2012, prices declined in 2013 through 2016. In 2015 prices declined below the 2009 low for kerosene and diesel fuel, while prices declined below the 2009 low for regular gasoline in 2016. Railroad diesel fell to about its 2009 level in 2015.

Figure 3-3: Sales Price of Transportation Fuel to End-Users, Excluding Taxes, 1990 to 2016



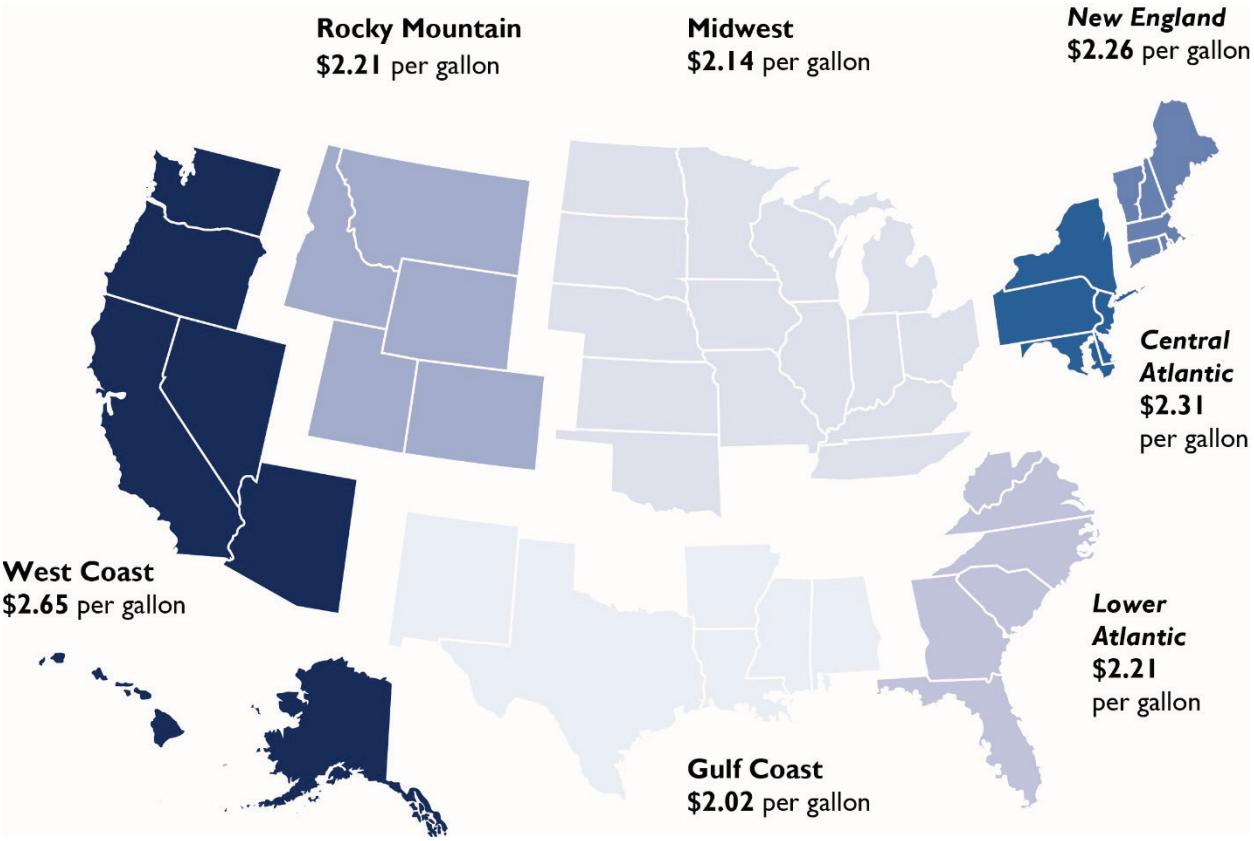
Notes: Data on the cost of railroad diesel fuel come from the Association of American Railroads. All other fuel cost data come from the Energy Information Administration. Gasoline costs are average retail prices. Highway diesel fuel and jet fuel prices are based on sales to end-users (sales made directly to the ultimate consumer, including bulk customers in agriculture, industry, and utility). Shaded bars indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-11, available at www.bts.gov.

Average Motor Gasoline Prices by Region

Gasoline prices vary substantially across the United States. Prices can vary because of state and local taxes, refinery locations, fuel supplies, retail competition, and fuel regulations. Figure 3-4 illustrates average regional gasoline prices in 2016 using data from the Energy Information Administration (EIA). The averages include all grades and blends of regular gasoline. In 2016 the average gasoline price in the United States was $2.25 per gallon. The West coast had the highest gasoline prices in the country at $2.65 per gallon—$0.33 more than the Central Atlantic, which had the second-highest prices at $2.31 per gallon. Prices were highest in California, at $2.78 per gallon, because California requires a unique blend of gasoline to meet environmental regulations. Meanwhile, the Gulf coast had the lowest gasoline prices at $2.02 per gallon, or $0.12 lower than the Midwest, which had the second-lowest prices at $2.14 per gallon.

Figure 3-4: Average Retail Gasoline Prices by Region, 2016



Note: Average prices include all grades and formulations of regular gasoline.

Source: U.S. Department of Energy, Energy Information Administration, available at www.eia.gov/dnav/pet/pet_pri_gnd_a_epmo_ pte_dpgal_a.htm.

Costs to Deliver Transportation Services

There are two types of transportation services: freight transportation services provided to producers of goods and services (e.g., trucking and air freight); and passenger transportation services provided to both producers and household consumers. The price of freight transportation services is a cost to producers of many goods and services, and thus affects the prices of those goods and services. The cost of passenger transportation services directly affects consumers as well as the prices of goods and services because producers also use passenger transportation services to conduct business.

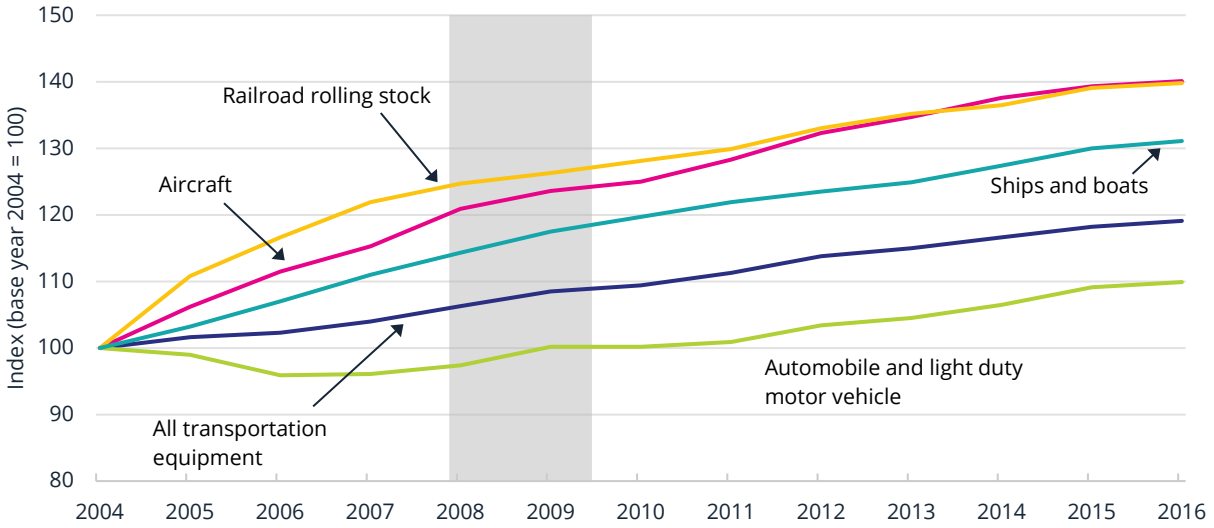
The major inputs to produce transportation services are labor, fuel, materials, and supplies as well as the depreciation of items like airplanes, trucks, railroad locomotives and freight cars, trucking terminals, railroad tracks, and other infrastructure. The depreciation represents the reduction in an asset's value attributable to wear and tear, accidental damage, obsolescence, and aging. The depreciation and input prices affect the price of freight and passenger transportation. The next subsection presents a measure of equipment costs to the producers of transportation services. Measures of labor costs are presented in chapter 4.

Equipment Costs

Different modes of transportation use different equipment. This equipment is primarily privately owned by the transportation service providers. The Producer Price Index (PPI) shows how the costs faced by producers of transportation services change over time (figure 3-5). The PPI includes indexes for equipment used by transportation industries, such as aircraft, railroad cars, and heavy trucks, as well as equipment used by consumers, such as vehicles owned by households. The PPI shows the trends in transportation equipment manufacturing prices and reflect their potential effect on the cost of delivering transportation services—the higher the equipment cost, the higher the cost of delivery transportation services. The PPI for transportation equipment is different from the PPIs for transportation services.

The prices for transportation equipment, as measured by the PPI, continuously increased between 2004 and 2016, except for automobiles and light-duty motor vehicles. In contrast, the prices for automobiles and light-duty vehicles declined between 2004 and 2008, leveled off from 2009 to 2010, and finally increased between 2011 and 2016. The prices for railroad, aircraft, and ships and boats showed a growth greater than that for all transportation equipment combined. This increase in equipment prices may have affected the profitability and purchase decisions of transportation sectors, the costs for transportation users, and prices along the economic supply chain in other sectors that use transportation services, such as wholesale, retail, and warehousing and storage industries.

Figure 3-5: Producer Price Indices for Select Transportation Equipment Manufacturing, 2004 to 2016



Note: Producer Price Index data come from the U.S. Bureau of Labor Statistics. Shaded bars indicate economic recessions.

Sources: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-14, available at www.bts.gov.

Costs of For-Hire Travel

Households pay for travel in two ways. First, they pay to own and operate passenger vehicles for their own use, as discussed in chapter 6 on household transportation expenditures. Second, they pay fares to use for-hire passenger transportation services for their *intercity* and *intracity* travel, as discussed in this chapter.

For-hire intercity passenger transportation consists of three modes: aviation, rail, and scheduled bus service other than that provided by transit agencies (e.g., Greyhound, Bolt Bus, and Megabus) (box 3-3).[3] For-hire intracity travel includes local transit and commuter rail. Local and commuter passengers typically travel much shorter distances than intercity passengers. For example, the average trip length for intercity rail was 39.5 miles, according to the 2009 National Household Travel Survey (NHTS), while the average trip length for transit was 7.2 miles.

Box 3-3: Average Fares

Providers of for-hire passenger transportation services, such as airlines, railroads, and transit agencies, charge a variety of fares for different services. The average fare for a mode is defined as the sum of all fare revenue received by the service providers in that mode, divided by the number of one-way trips.

Data on revenue and trips for air come from the U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information. Revenue is divided by trips. Baggage fees are not included in passenger revenue, and free flights (e.g., frequent-flyer reward trips) are not included in trips.

Data on revenue and trips for rail come from Amtrak's Annual Report. The annual report gives ticket revenue per passenger mile, which is multiplied by average trip length of passengers.

Data on commuter rail and transit come from the Federal Transit Administration's National Transit Database. For transit the revenue is divided by unlinked trips. Trips on transit often involve transfers between two buses, or a bus and rail transit. Many transit systems are only able to capture the number of boardings, and cannot link the segments into a complete one-way trip, so unlinked trips (i.e., the number of times a passenger boards a transit vehicle) are used instead. If data on complete one-way trips were available, it would show higher average fares for transit.

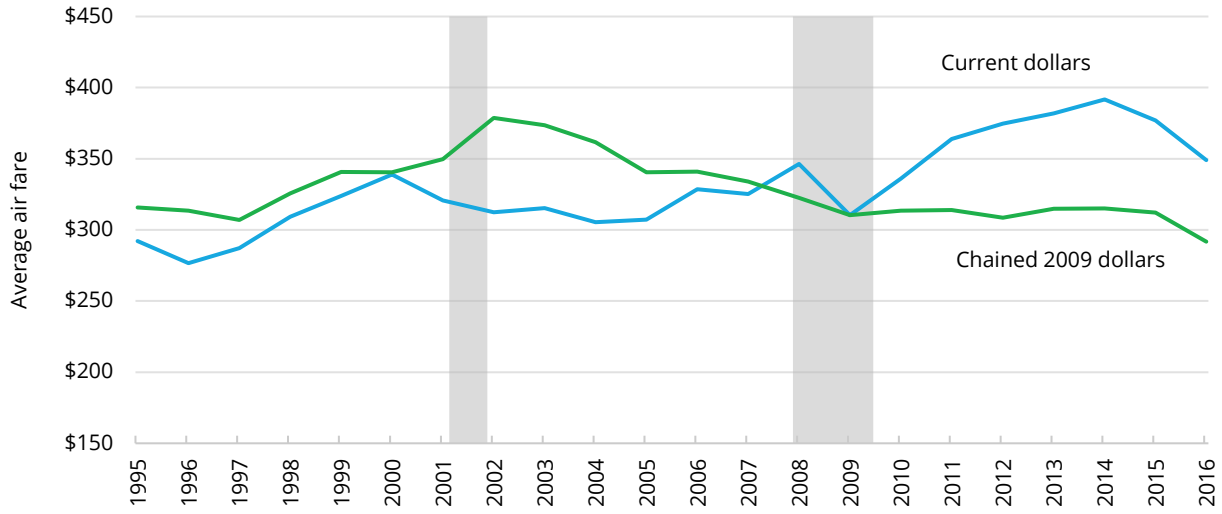
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 2017.

[3] Intercity rail service provided by Amtrak (commuter rail service) is included with other intracity modes in intracity passenger fares. Recent intercity bus fare data are currently not available.

Aviation Fares

Adjusted for inflation, passenger airfares increased 20.0 percent from 1995 to 2002, then fell 23.0 percent between 2002 to 2016 (figure 3-6). Average airfares were $316 in 1995 and increased to $379 in 2002 before falling to $310 in 2009. Average airfares then remained around $310 from 2009 to 2015 before dropping to an all-time low of $292 in 2016. All changes are shown in real chained dollars, which account for inflation and substitutions within market baskets. Fares do not include baggage or reservation fees, which airlines began to charge in 2008.

Figure 3-6: Domestic Average Air Fares (scheduled service), 1995 to 2016

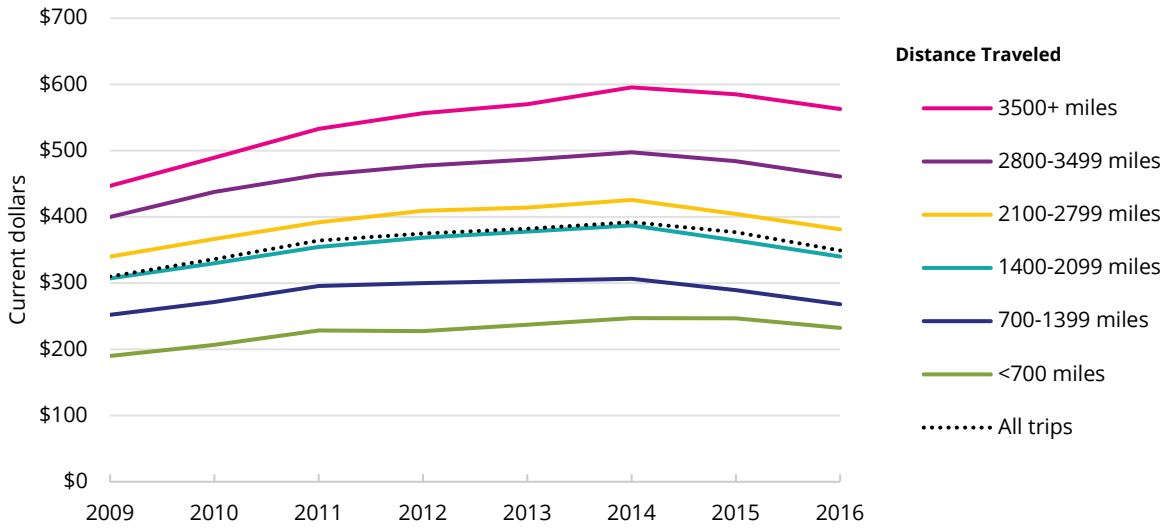


Notes: BTS reports average fares based on domestic itinerary fares. Itinerary fares consist of round-trip fares, unless the customer does not purchase a return trip. In that case, the one-way fare is included. Fares are based on the total ticket value, which consists of the price charged by the airlines plus any additional taxes and fees levied by an outside entity at the time of purchase. Fares include only the price paid at the time of the ticket purchase and do not include fees for optional services, such as baggage fees. Averages do not include frequent-flyer or "zero fares."

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Annual U.S. Domestic Average Itinerary Fare, available at www.rita.dot.gov/bts/airfares/programs/economics_and_finance/air_travel_price_index/html/AnnualFares.html.

Domestic air travel includes shorter trips of less than 700 miles and trips as long as 3500 miles. Figure 3-7 shows that air fares between 2009 and 2016 have been related to distance traveled, and that air fares by different distances have had similar patterns over time. Changes in air fares between 2009 and 2016 ranged from a 6.3 percent increase for trips between 700 and 1,400 miles to a 26 percent increase for trips over 3,500 miles. Fares peaked in 2014 for all distance categories, then declined in 2015 due to lower fuel prices for carriers and competition from low-cost carriers.

Figure 3-7: Domestic Average Air Fares by Distance Traveled, 2009 to 2016



Notes: Domestic average air fares are determined by taking the revenue and dividing by the number of passengers. Airfare includes base fare plus taxes paid by the passenger at the time of ticket purchase. The data represent a 10% sampling of tickets obtained upon the passenger's first traveled segment. The fare does not include any additional items, such as baggage fees, airline lounge access, or seat upgrades.

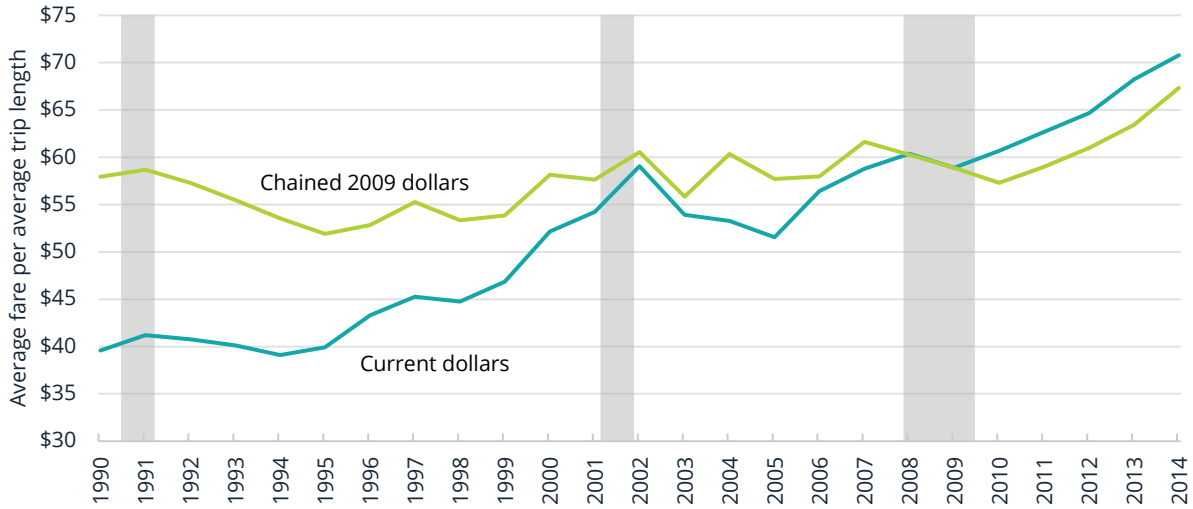
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information, 2017.

Intercity Railroad Fares

Amtrak intercity railroad fares represent a complex interaction of demand, operating costs, government subsidies, and regulation. Amtrak fares (in chained 2009 dollars) fluctuated within a narrow band from 1990 to 2014 (figure 3-8). The fares represent ticket revenue per passenger mile multiplied by average trip length of passengers except for years before 1997, where fares are calculated from total transportation revenues.

Amtrak fares fell from about $59 per passenger in 1991 to $52 in 1995 and fluctuated between $52 and $61 from 1995 through 2003. Passenger fares began to rise again in 2004, hitting a peak of about $62 in 2007. Fares declined during the recession but rose above the 2007 peak in 2013. Fares continued to climb, reaching an all-time high of $67 in 2014.

Figure 3-8: Average Amtrak Rail Fares per Average Trip Length, 1990 to 2014



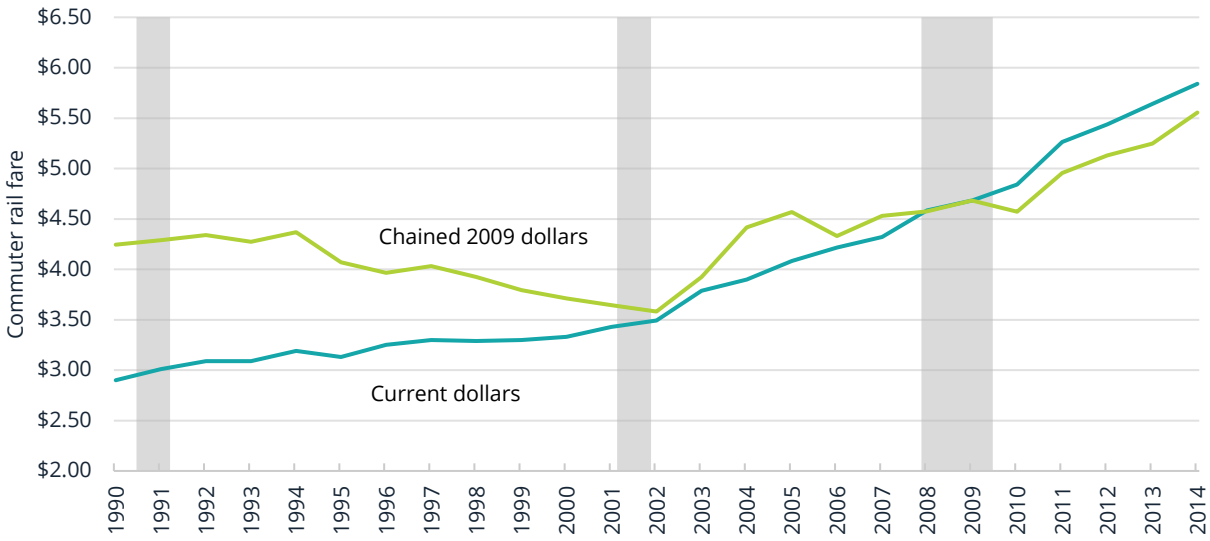
Notes: Fares for years after 1997 are from National Passenger Rail Corporation (Amtrak), *Amtrak Annual Report*, and calculated as ticket revenue per passenger mile multiplied by average trip length of passengers. Fares for years before 1997 are from National Passenger Rail Corporation (Amtrak), *Amtrak Annual Report*, Statistical Appendix, and calculated as total transportation revenues divided by Amtrak system passenger trips. Shaded bars indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-19, available at www.bts.gov.

Commuter Railroad Fares

Commuter rail is railway passenger service that operates between a central city and adjacent suburbs. Intercity rail service, such as Amtrak, is excluded, except for the part of service operated by or under contract with a public transit agency for predominantly commuter services. "Predominantly commuter service" means that, for any given trip segment between two stations, more than 50 percent of the average daily ridership makes a return trip on the same day. Commuter rail does not include heavy rail rapid transit or light rail/streetcar transit service. Figure 3-9 shows that commuter rail fares peaked at just over $5.56 (in chained 2009 dollars) in 2014, following a decade of increases after a low point in 2002.

Figure 3-9: Commuter Rail Fares, 1990 to 2014



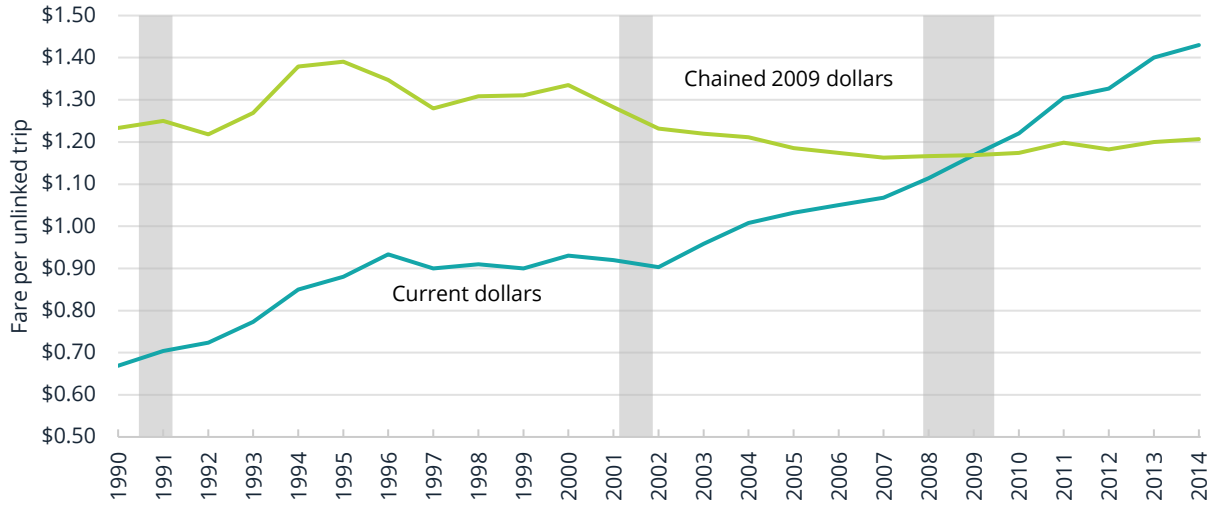
Note: Shaded bars indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-18, available at www.bts.gov.

Transit Fares

Over the past two decades, average fares for all local transit modes have fluctuated between $1.16 and $1.39 per unlinked trip (in chained 2009 dollars), and have declined 2.1 percent overall (figure 3-10). Transit modes include heavy rail (subway or metro), light rail, bus, and trolley car. Transit fares are based on average fares per unlinked trip. For example, if a passenger takes a bus with a fare of $1 and transfers to a subway with a fare of $2, the journey would count as two unlinked trips with an average fare of $1.50. Many transit agencies are unable to account for transfers in counting trips.

Figure 3-10: Fares for all Transit Modes per Unlinked Trip, 1990 to 2014



Notes: Data for the year 2006 are under review by the Federal Transit Administration. An average of data for 2005 and 2007 has been substituted for the missing data. Shaded bars indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-18, available at www.bts.gov.

4 TRANSPORTATION EMPLOYMENT

The transportation and warehousing sector and related industries employ over 13.0 million people in a variety of roles, from driving buses to manufacturing cars to building and maintaining ports and railroads (box 4-1). This chapter explores transportation employment by industry, occupation, mode, and state, and highlights the significant role that transportation employment plays in the Nation's job profile.

Box 4-1: Sectors, Subsectors, and Industries

Terms like "sector" and "industry" are often used interchangeably. For precision, this chapter uses the terms in the same manner as the North American Industry Classification System (NAICS). In NAICS, sectors contain subsectors, subsectors contain industry groups, and industry groups contain industries, as shown in the following example:

Sector: Transportation and warehousing (NAICS 48-49)

Subsector: Truck transportation (NAICS 484)

Industry group: General freight trucking (NAICS 4841)

Industry: General freight trucking, long-distance (NAICS 48412)

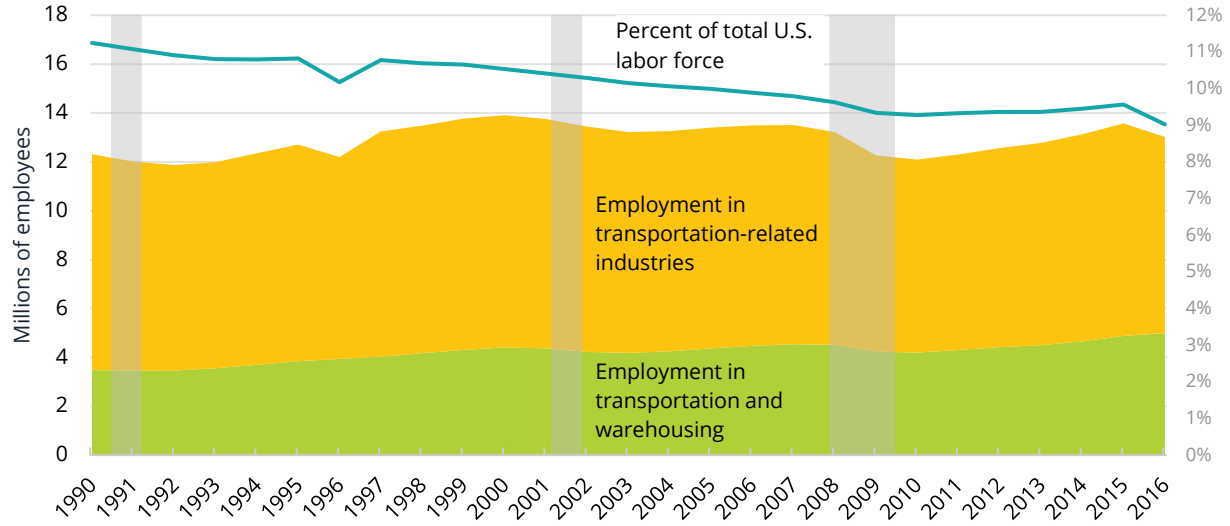
Industry detail: General freight trucking, long-distance, less than truckload (NAICS 484122)

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

Transportation-Related Employment in the United States

Figure 4-1 shows the number and percent of workers in transportation and transportation-related industries from 1990 to 2016. "Transportation-related industries" includes all industries in the transportation and warehousing sector (e.g., air, rail, water, and truck transportation), as well as related industries like motor vehicle parts manufacturing. In 1990, 12.3 million workers were employed in these industries. Employment rose to a high of 13.9 million workers in 2000 but declined to 13.2 million by 2003 following the 2001 recession. Employment declined further to a low of 12.1 million in 2010 due to the 2007 to 2009 recession. Employment rose steadily from 2011 to 2015, reaching 13.6 million in 2015 and exceeding the pre-recession level of 13.5 million in 2007 for the first time. In 2016, employment declined to 13.0 million. Employment increased for industries in the transportation and warehousing sector, but this increase was more than offset by a decline in employment for transportation-related industries. The percentage of American workers in transportation-related employment has continued to decline from 11.3 percent in 1990 to 9.0 percent in 2016.

Figure 4-1: Transportation-Related Labor Force Employment in the United States, 1990 to 2016



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-23, available at www.bts.gov.

Transportation Employment by Industry and Occupation

Employment in the For-Hire Transportation and Warehousing Sector

The for-hire transportation and warehousing sector (NAICS 48-49; box 4-2) directly employed 5.0 million workers in the United States in 2016—3.5 percent of the Nation's total labor force. Employment in this sector includes both transportation and non-transportation occupations, and covers a diverse set of skills. Figure 4-2 shows for-hire transportation and warehousing employment from 1990 to 2016 by subsector (box 4-3). Each subsector shows different patterns of employment because they have different mixes of job skills and occupations, as well as different economic environments.

Truck transportation is the largest subsector, employing 29.2 percent of the 4.9 million for-hire transportation employees in 2016. Truck transportation employment grew by 29.5 percent between 1990 and 2016, from 1.1 million to 1.5 million employees, with significant fluctuations related to major economic events such as September 11, 2001, the Great Recession, and other economic recessions. Warehousing and storage employment grew by 125.1 percent, from 406,600 to 915,100 employees, to become the second-largest subsector, overtaking air transportation in 2004. The "support activities for transportation" subsector (which includes establishments like air traffic control services, marine cargo handling, and motor vehicle towing) is the third-largest subsector, growing 81.3 percent from 364,100 to 660,100 employees from 1990 to 2016.

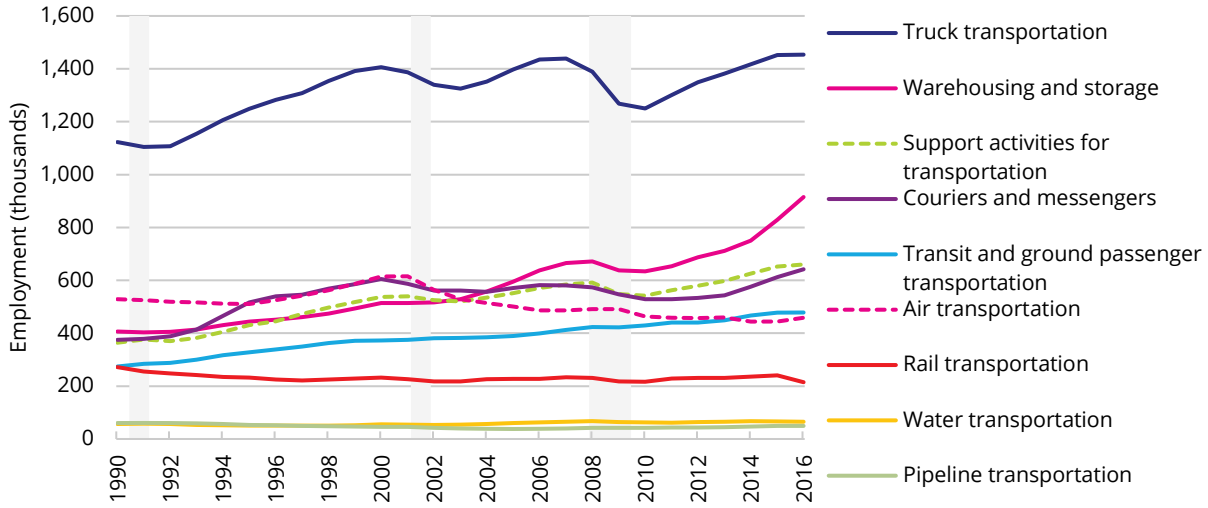
Box 4-2: For-Hire and In-House Transportation

For-hire transportation consists of transportation services provided on a fee basis to industries and the public. These services are provided by businesses such as railroads, transit agencies, common-carrier trucking providers, airlines, and pipeline companies.

In-house transportation consists of the services provided by non-transportation industries for their own use. It includes privately owned and operated vehicles used primarily on public rights of way, as well as the supportive services to store, maintain, and operate those vehicles.

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

Figure 4-2: Employment in For-Hire Transportation by Subsector, 1990 to 2016 (thousands)



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-23, available at www.bts.gov.

Not all for-hire transportation subsectors experienced employment increases from 1990 to 2016. Employment in air transportation increased from 1995 to 2001, but declined after 2001, leading to an overall decrease in employment of 13.3 percent between 1990 and 2016, from 529,200 to 458,600 employees. In addition, rail transportation employment declined by 21.0 percent from 1990 to 2016 (from 271,800 to 214,700 employees) and pipeline transportation employment declined 17.2 percent from 1990 to 2016 (from 59,800 to 49,500 employees).

Box 4-3: Employment in the Transportation and Warehousing Sector

The **transportation and warehousing** sector (North American Industrial Classification System (NAICS 48-49) includes air transportation, water transportation, truck transportation, transit and ground passenger transportation, pipeline transportation, scenic and sightseeing transportation, support activities for transportation (e.g., air traffic control and marine cargo handling), postal service, couriers and messengers, and warehousing and storage. It does not include government, railroad transportation, or self-employed persons.

Air transportation (NAICS 481) includes industries providing air transportation of passengers and cargo using aircraft, such as airplanes and helicopters. It does not include scenic and sightseeing air transportation, support activities for air transportation, or air courier services.

Water transportation (NAICS 483) includes industries providing water transportation of passengers and cargo using water craft, such as ships, barges, and boats. It does not include scenic and sightseeing water transportation services or support activities for water transportation.

Truck transportation (NAICS 484) includes industries providing over-the-road transportation of cargo using motor vehicles, such as trucks and tractor trailers. It does not include support activities for road transportation, freight transportation arrangement services, the Postal Service (covered in NAICS 491), or courier services.

Transit and ground passenger transportation (NAICS 485) includes industries providing a variety of passenger transportation activities, such as urban transit systems; chartered bus, school bus, and interurban bus transportation; and taxis. It does not include scenic and sightseeing transportation, support activities for road transportation, or arrangement for car pools and vanpools.

Pipeline transportation (NAICS 486) includes industries using transmission pipelines to transport products, such as crude oil, natural gas, refined petroleum products, and slurry. It does not include activities classified as utilities, such as natural gas distribution or water and air distribution and collection.

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

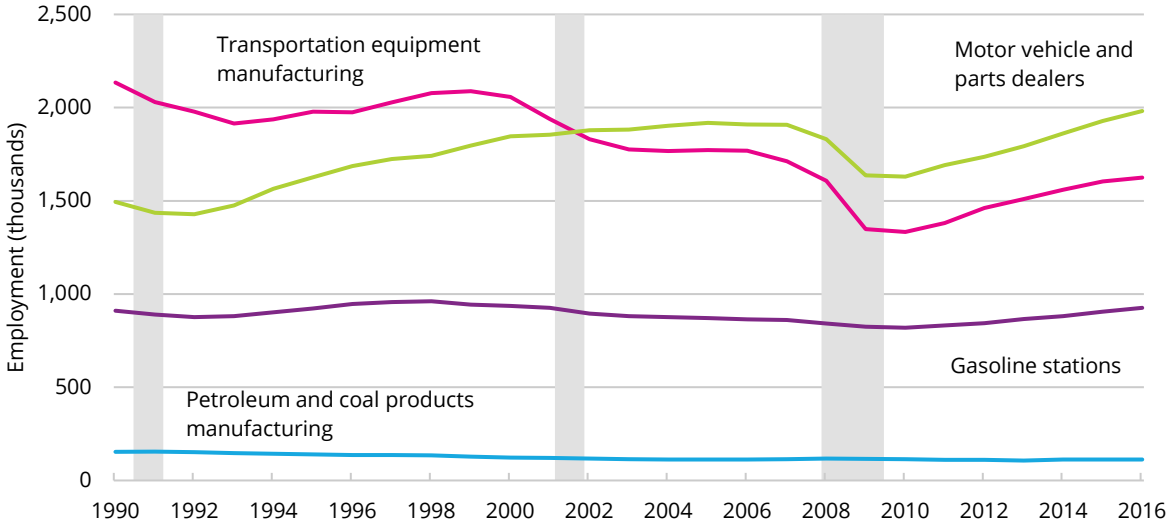
Employment in Selected Transportation-Related Industries

Transportation also leads to employment in related industries that provide the goods and services needed to produce transportation. For example, transportation companies purchase transportation equipment (as do other companies engaged in in-house transportation), motor vehicle dealers and gas stations provide services that support household and business transportation, and a significant portion of the output of the petroleum industry is used for transportation.

A notable shift in transportation-related employment occurred between 1990 and 2016. From 1990 through 2001, transportation equipment manufacturing was the largest transportation-related industry (figure 4-3). However, as employment in transportation equipment manufacturing experienced a prolonged decline, motor vehicle and parts

dealers became the largest industry in 2002. Employment in motor vehicle and parts dealers grew by 32.6 percent from 1990 to 2016, while employment in transportation equipment manufacturing declined 23.9 percent.

Figure 4-3: Employment in Selected Transportation-Related Industries, 1990 to 2014 (thousands)



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-23, available at www.bts.gov.

Transportation Employment by Occupation

Many workers in transportation-related jobs are not included in employment data for transportation industries because they work for non-transportation firms. Table 4-1 highlights the variety of positions available in various industries using the Standard Occupational Classification (SOC) system. Understanding the full range of transportation jobs and skills in the economy requires examination of employment data at the occupational level.

The largest transportation-related occupation is heavy-duty truck drivers; in 2016, 1.7 million people worked as heavy-duty truck drivers. Four of the six largest transportation-related occupations involve driving, and account for 38.5 percent of total employment:

- Heavy-duty truck drivers (1,704,520 employees)
- Light-duty and delivery truck drivers (858,710 employees)
- School bus drivers (515,020 employees)
- Driver/sales workers (426,310 employees)

Table 4-1: Transportation-Related Occupations

Vehicle operators, pipeline operators, and primary support occupations

- Airline pilots, copilots, and flight engineers
- Commercial pilots
- Air traffic controllers
- Airfield operations specialists
- Ambulance drivers and attendants, except emergency medical technicians
- Bus drivers, transit and intercity
- Bus drivers, school
- Driver/sales workers
- Truck drivers, heavy and tractor-trailer
- Truck drivers, light or delivery services
- Taxi drivers and chauffeurs
- Locomotive engineers
- Locomotive firers
- Rail yard engineers, dinkey operators, and hostlers
- Railroad brake, signal, and switch operators
- Railroad conductors and yardmasters
- Subway and street car operators
- Sailors and marine oilers
- Captains, mates, and pilots of water vessels
- Motorboat operators
- Ship engineers
- Bridge and lock tenders
- Gas compressor and gas pumping station operators
- Pump operators, except wellhead pumpers

Secondary support service occupations

- Insurance appraisers, auto damage
- Parking enforcement workers
- Transit and railroad police
- Crossing guards
- Travel guides
- Flight attendants
- Transportation attendants, except flight attendants and baggage porters
- Travel agents
- Reservation and transportation ticket agents and travel clerks
- Couriers and messengers
- Dispatchers, except police, fire, and ambulance
- Postal service mail carriers
- Shipping, receiving, and traffic clerks
- Parking lot attendants
- Traffic technicians
- Transportation inspectors
- Refuse and recyclable material collectors
- Tank car, truck, and ship loaders

Transportation equipment manufacturing and maintenance occupations

- Aerospace engineers
- Marine engineers and naval architects
- Aerospace engineering and operations technicians
- Avionics technicians
- Electrical and electronics installers and repairers, transportation equipment
- Electronic equipment installers and repairers, motor vehicles
- Aircraft mechanics and service technicians
- Automotive body and related repairers
- Automotive glass installers and repairers
- Automotive service technicians and mechanics
- Bus and truck mechanics and diesel engine specialists
- Rail car repairers
- Motorboat mechanics
- Motorcycle mechanics
- Bicycle repairers
- Recreational vehicle service technicians
- Tire repairers and changers
- Aircraft structure, surfaces, rigging, and systems assemblers
- Painters, transportation equipment
- Tire builders
- Automotive and watercraft service attendants
- Cleaners of vehicles and equipment

Transportation infrastructure construction and maintenance occupations

- Paving, surfacing, and tamping equipment operators
- Highway maintenance workers
- Rail-track laying and maintenance equipment operators
- Signal and track switch repairers
- Dredge operators

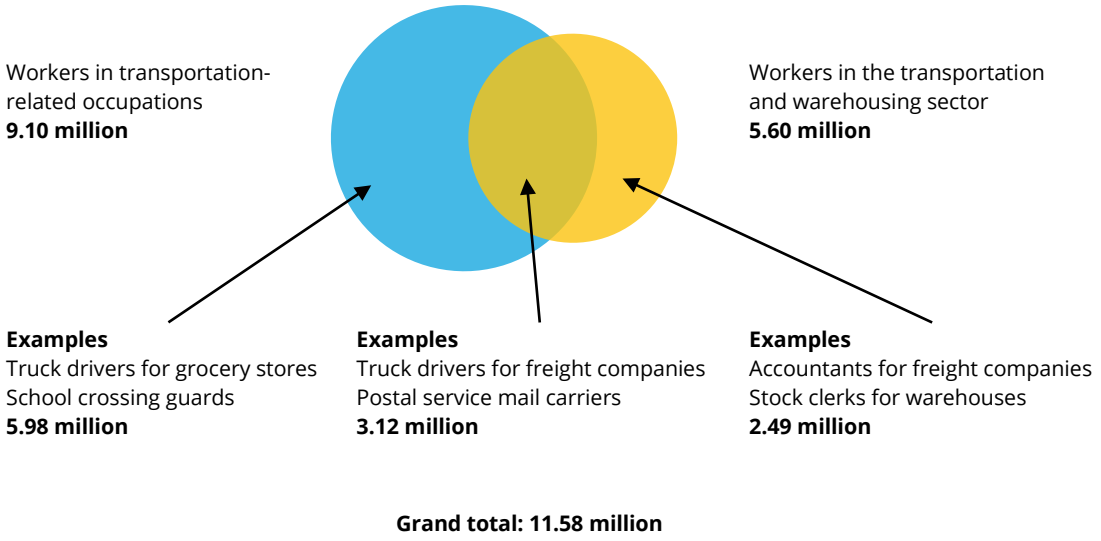
Other occupations

- Transportation, storage, and distribution managers
- Aircraft cargo handling supervisors
- First-line supervisors/managers of helpers, laborers, and material movers, hand
- First-line supervisors/managers of transportation and material-moving machine and vehicle operators

From 2000 to 2016, employment in transportation and transportation-related occupations decreased by 1.1 percent. Some of the declines in employment are likely due to the December 2007 to June 2009 recession, but other declines in employment—for example, declines for postal service mail carriers and for couriers and messengers—portend structural changes in transportation employment.

Many employees of transportation companies, such as accountants and computer programmers, work in occupations that are not considered transportation occupations. Conversely, many workers in transportation occupations are employed in other industries, such as truck drivers working for retail chains. Figure 4-4 illustrates this difference using employment estimates produced by the Bureau of Labor Statistics (BLS) for the Occupational Employment Statistics program (box 4-4). While total employment in the transportation and warehousing sector and total employment in transportation occupations measure the role of transportation in employment, they are different measures and may not move in tandem.

Figure 4-4: Relationship Between the Transportation and Warehousing Sector and Transportation-Related Occupations, May 2016



Note: Totals may differ from other totals in chapter because occupational statistics available at the sector level differ from occupational statistics available at the national level.

Source: Bureau of Labor Statistics, Occupational Employment Statistics, available at bls.gov/oes.

Box 4-4: Occupational Employment Statistics

The Bureau of Labor Statistics (BLS) produces annual occupational employment and wage estimates as part of the Occupational Employment Statistics (OES) program. BLS conducts a semi-annual survey of establishments to produce estimates for over 800 industries in the United States. The survey covers all full-time and part-time paid workers in non-farm industries, but does not include the self-employed or unpaid workers.

"Transportation occupations" includes the following worker types:

- Workers directly employed by a transportation company
- Workers engaged in in-house transportation
- Workers providing services to the transportation industry
- Workers providing transportation for non-transportation government agencies such as school districts

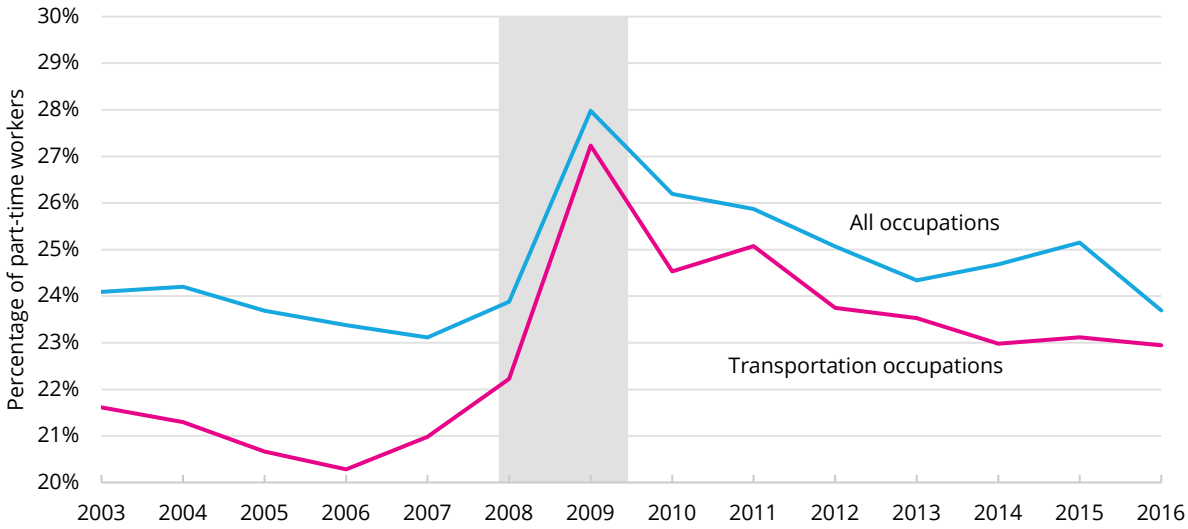
The occupations were selected based on a broad definition of transportation and transportation-related occupations found in Sen, B. and M. Rossetti, "A Complete Count of the U.S. Transportation Workforce," Transportation Research Record 1719: 2000, pp 259–266.

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

Part-Time and Full-Time Employment

BTS compiles statistics for a group of transportation and transportation-related occupations in *National Transportation Statistics*, which includes occupations in the SOC "transportation and material moving" occupation group. The percentage of workers employed part-time in transportation and material moving occupations is slightly lower than the percentage of workers employed part-time in all occupations as a whole (figure 4-5). The percentage of part-time workers in transportation and material moving occupations increased from a low of 20.3 percent in 2006 to a high of 27.2 percent in 2009 due to the 2007 to 2009 economic recession but has decreased to 22.9 percent as of 2016.

Figure 4-5: Percentage of Part-Time Workers, 2003 to 2016



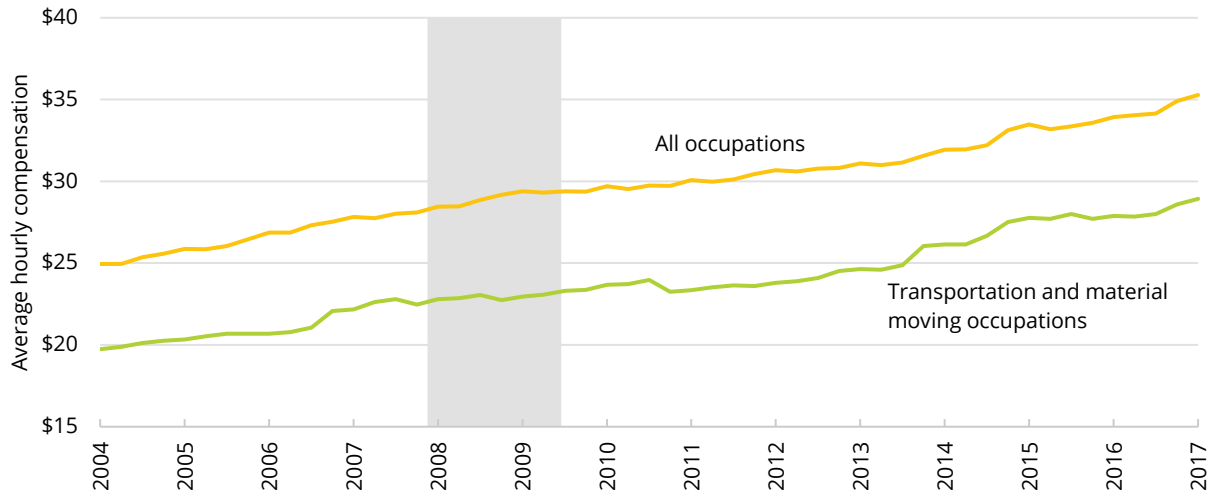
Note: Shaded areas indicate economic recessions.

Source: Bureau of Labor Statistics, Current Population Survey, available at www.census.gov/programs-surveys/cps.html.

Wages and Compensation

Figure 4-6 compares compensation for workers in transportation and material moving occupations and workers in all occupations from 2004 to 2017. Compensation includes wages and benefits. In current dollars, compensation for workers in transportation and material moving occupations increased 46.6 percent from the first quarter of 2004 to the first quarter of 2017 (from $19.74 to $28.93). In comparison, wages for all occupations increased 41.4 percent (from $24.95 to $35.28). Low-wage transportation occupations, like truck drivers and household movers, account for a much larger share of the transportation workforce than high-wage occupations like airline pilots. As a result, the average compensation for transportation-related occupations is $6.35 dollars per hour less than the average for all occupations as of the first quarter of 2017.

Figure 4-6: Average Hourly Compensation (wages and benefits), 2004 to 2017



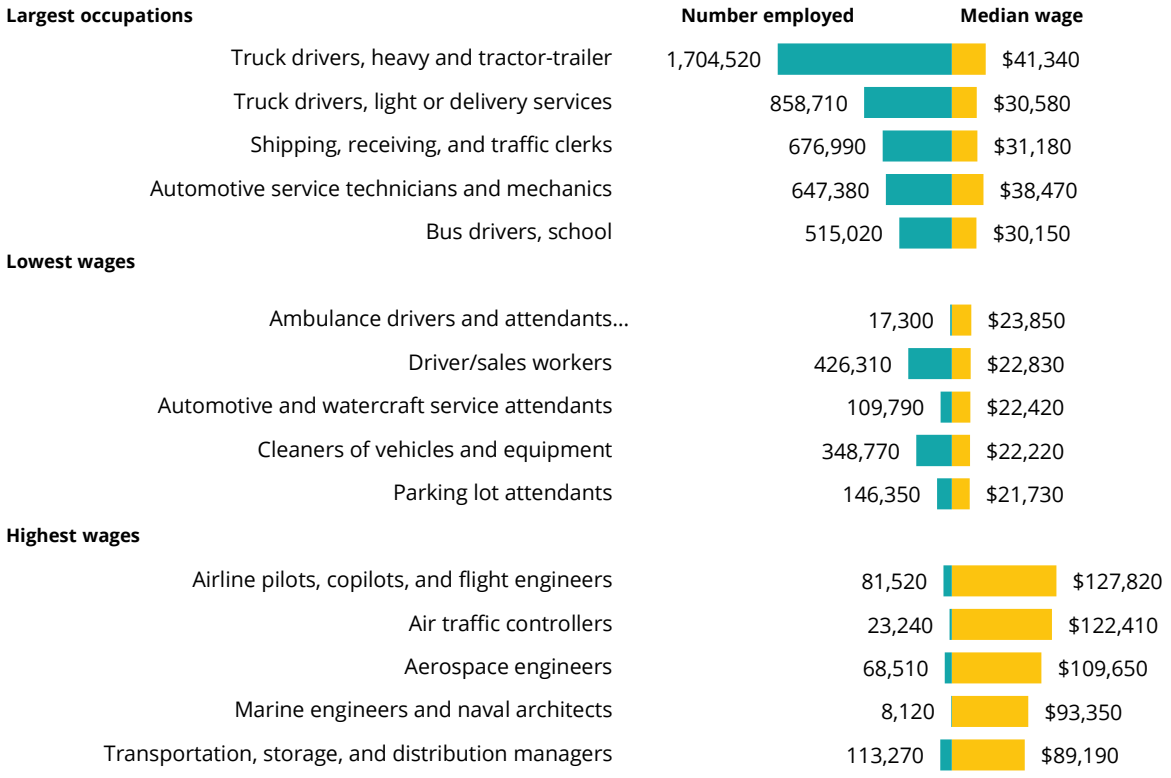
Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Employer Costs for Employee Compensation, available at www.bls.gov/ncs/ect/#tables.

Figure 4-7 illustrates annual wages for the largest, lowest-paid, and highest-paid transportation occupations in the United States in 2016. Because some occupations are more seasonal, analysts use annual wage data instead of the average hourly compensation used in figure 4-6 to compare industry employment categories. Annual wages vary widely, from an average of over $100,000 for airline pilots to an average of $21,730 for parking lot attendants. The five lowest-paid transportation-related occupations collectively employ 1.0 million workers, while the five highest-paid occupations employ 294,660 workers.

BTS compiles employment and financial data submitted by airlines to provide a detailed picture of airline labor. In 2016, approximately 282,000 employees worked in aircraft and traffic handling—for example, as baggage handlers, as flight dispatchers, or as reservations clerks. Approximately 82,000 employees worked as in-flight personnel (including pilots), 51,000 worked in maintenance, 11,000 worked in general management, and 204,000 worked in other occupations.

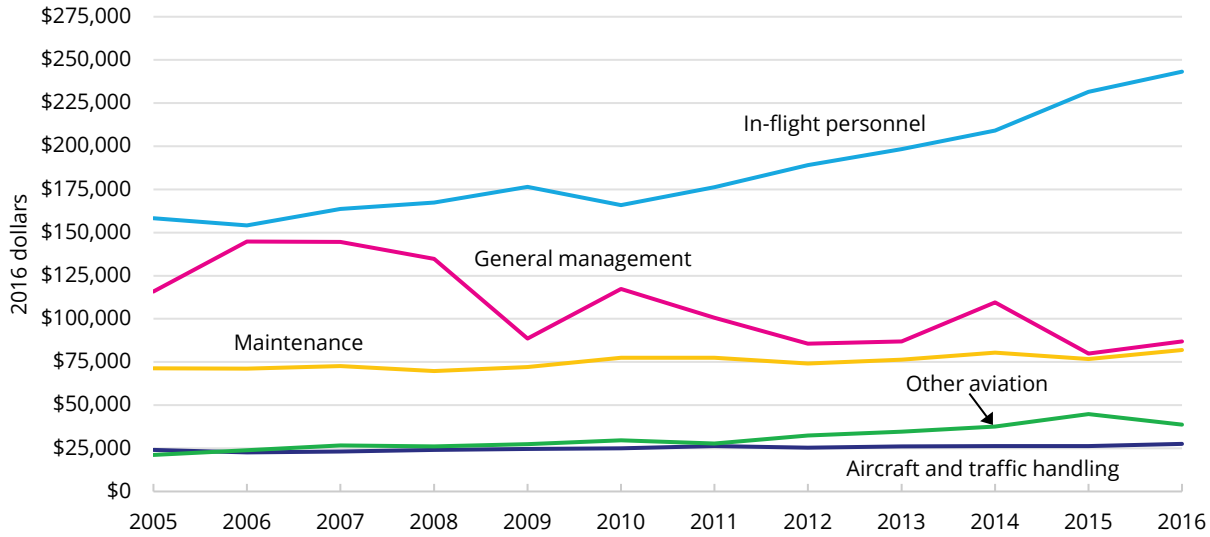
Figure 4-7: Employment and Wages for Select Transportation Occupations, 2016



Source: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment and Wages, available at www.bls.gov/oes.

Figure 4-8 uses airline data to show trends in average annual salaries for airline labor, adjusted for inflation. Salaries for in-flight personnel experienced the largest absolute growth, increasing by 53.7 percent from $158,236 in 2005 to $243,187 in 2016. Salaries for employees in "other aviation occupations" experienced the largest relative growth, increasing by 83.2 percent from $21,170 to $38,789 in the same period. Salaries rose for all groups except general management, whose salaries declined 39.9 percent from their peak of $144,784 in 2006 to $86,962 in 2016.

Figure 4-8: Average Annual Salary by Aviation Occupation, 2005 to 2016 (2016 dollars)



Sources: U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information, Form 42 Schedule P-6 and P-10, available at transtats.bts.gov.

Transportation Employment by State

Transportation Establishments, Employees, and Payroll

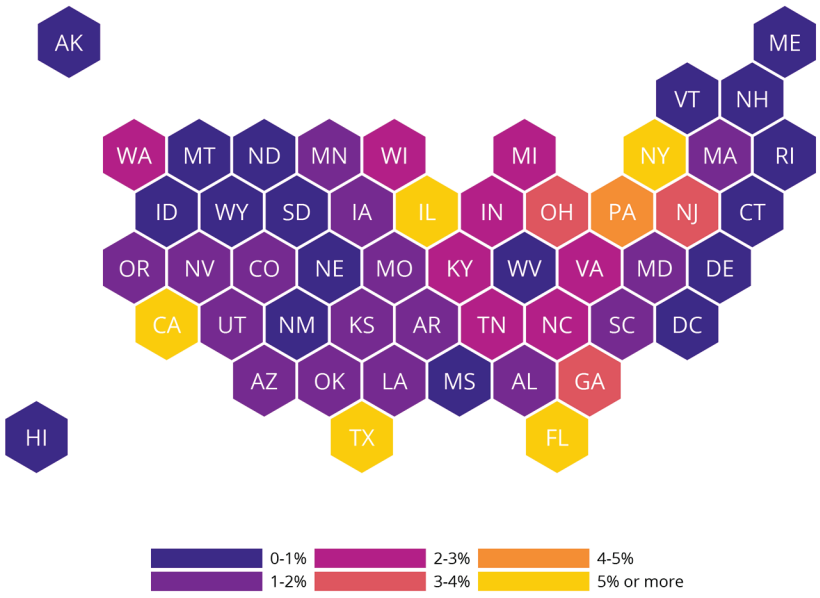
Transportation establishments and firms employ people throughout the United States.[1] Figure 4-9 shows the relative share of employees in each state in 2016, and table 4-2 shows information about transportation establishments, employees, and total employee payroll

[1] BLS defines an establishment as a single location where one predominant activity occurs, and a firm as an establishment or a combination of establishments.

for each state. Self-employed workers, freight railroad employees, and government employees are not included. State transportation employment is highly related to population and locations of transportation hubs. The five most populated states—California, Texas, Florida, New York, and Illinois—have the greatest number of establishments and employees, both because they have a large employment pool and because they have national large transportation hubs like railroad interchanges or major ports.

Transportation establishments collectively account for 3.7 percent of total employees and 3.6 percent of total payroll in the United States. Transportation establishments employ anywhere from 0.6 percent of total state employees in the District of Columbia to 7.0 percent of employees in Alaska. Accordingly, the share of total state payroll ranges from 0.6 percent in the District of Columbia to 8.7 percent in Alaska. Many transportation establishments are small businesses: the national average establishment size is 20 employees.

Figure 4-9: State Share of National Transportation Employment, 2015



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *State Transportation Statistics*, table 6-1, available at www.bts.gov.

Table 4-2: Transportation Establishments, Employment, and Payroll by State, 2015

State	Transportation establishments	Paid employees	Percent of state employees	Average employees per establishment	Annual payroll (thousands)	Percent of state payroll
Alabama	2,903	58,578	3.6%	20	2,593,509	3.8%
Alaska	1,144	18,736	7.0%	16	1,356,522	8.7%
Arizona	3,318	87,151	3.8%	26	4,220,738	4.1%
Arkansas	2,359	52,637	5.2%	22	2,331,009	5.9%
California	23,153	486,149	3.4%	21	24,835,936	2.9%
Colorado	3,779	69,739	3.1%	18	3,439,205	2.9%
Connecticut	1,708	41,807	2.8%	24	1,922,079	2.1%
Delaware	684	14,153	3.6%	21	601,900	2.8%
District of Columbia	164	3,076	0.6%	19	220,211	0.6%
Florida	14,576	238,271	3.1%	16	11,808,123	3.5%
Georgia	6,597	176,600	4.8%	27	8,499,267	4.9%
Hawaii	885	29,911	5.7%	34	1,427,670	6.5%
Idaho	1,751	18,419	3.4%	11	698,096	3.3%
Illinois	15,486	242,399	4.5%	16	11,811,330	4.1%
Indiana	5,294	123,332	4.6%	23	5,384,598	4.8%
Iowa	3,535	55,985	4.2%	16	2,329,398	4.2%
Kansas	2,554	52,669	4.4%	21	2,190,072	4.3%
Kentucky	2,938	92,858	5.9%	32	4,612,591	7.2%
Louisiana	3,924	72,841	4.2%	19	4,188,004	5.5%
Maine	1,209	15,160	3.0%	13	628,506	3.1%
Maryland	3,499	69,414	3.1%	20	3,365,189	2.8%
Massachusetts	3,779	82,451	2.6%	22	3,900,496	2.0%
Michigan	6,227	112,260	3.0%	18	5,493,944	3.1%
Minnesota	4,699	80,299	3.1%	17	3,642,073	2.7%
Mississippi	2,065	37,193	4.0%	18	1,607,579	4.7%
Missouri	4,757	81,944	3.4%	17	3,488,184	3.2%
Montana	1,381	13,838	3.7%	10	642,043	4.5%
Nebraska	2,390	29,602	3.4%	12	1,341,149	3.6%
Nevada	1,565	51,562	4.6%	33	2,108,810	4.5%
New Hampshire	804	12,825	2.2%	16	527,324	1.9%
New Jersey	7,482	165,343	4.6%	22	8,469,774	4.1%
New Mexico	1,402	18,516	3.0%	13	792,214	3.2%
New York	12,811	238,524	3.0%	19	11,157,629	2.2%
North Carolina	5,766	119,570	3.3%	21	5,361,773	3.3%
North Dakota	1,651	19,664	5.4%	12	1,057,919	6.2%
Ohio	7,448	171,286	3.6%	23	8,103,911	3.8%
Oklahoma	2,758	49,395	3.6%	18	2,648,747	4.5%
Oregon	3,097	56,730	3.8%	18	2,586,497	3.6%
Pennsylvania	8,660	218,687	4.1%	25	9,338,739	3.6%
Rhode Island	647	10,524	2.5%	16	421,946	2.1%
South Carolina	2,628	57,916	3.5%	22	2,399,757	3.6%
South Dakota	1,190	10,861	3.1%	9	441,301	3.2%
Tennessee	4,146	135,090	5.4%	33	6,003,431	5.4%

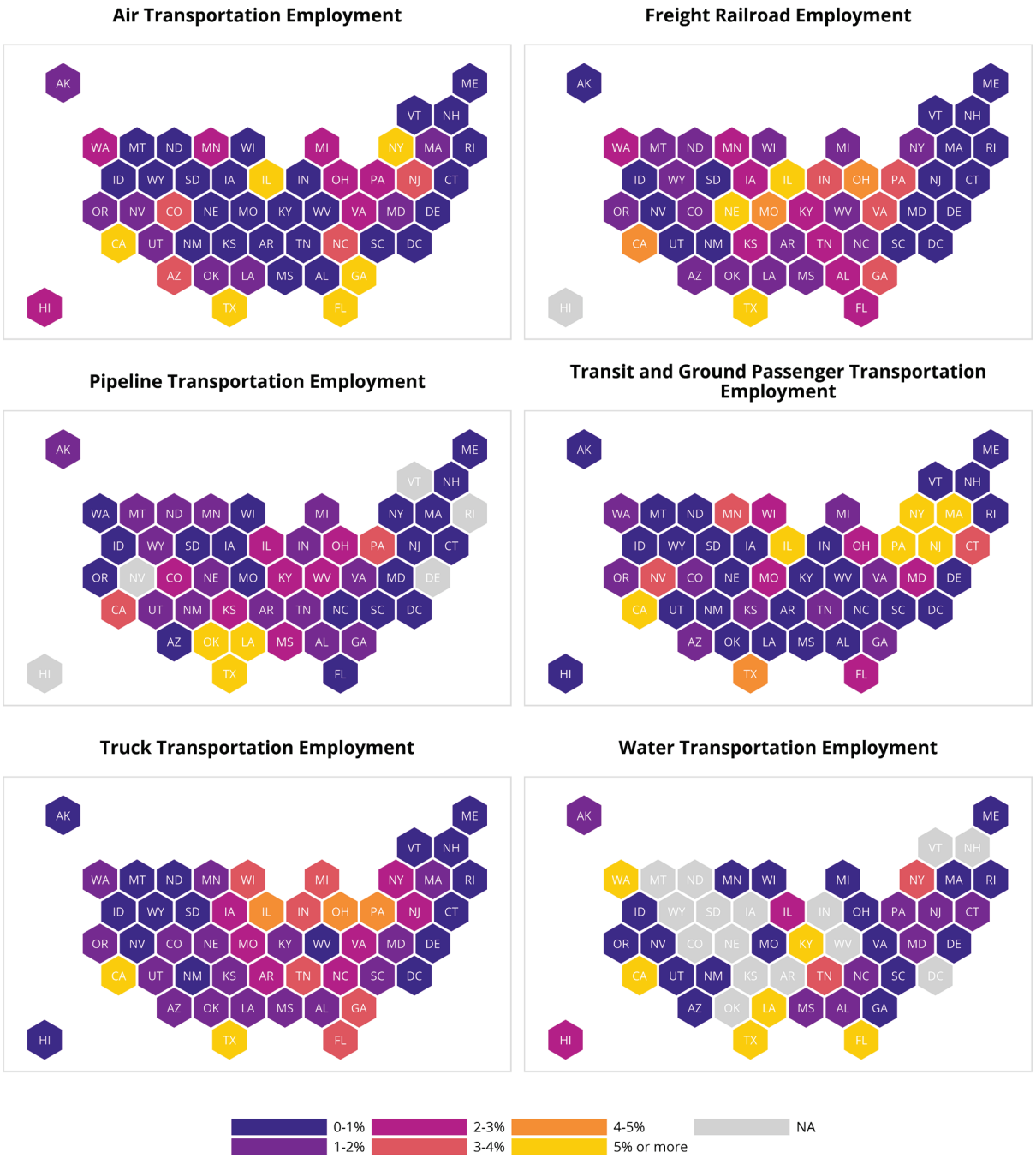
State	Transportation establishments	Paid employees	Percent of state employees	Average employees per establishment	Annual payroll (thousands)	Percent of state payroll
Texas	19,139	432,156	4.2%	23	23,867,978	4.6%
Utah	2,305	58,453	4.9%	25	2,580,488	5.0%
Vermont	485	5,744	2.2%	12	227,381	2.1%
Virginia	4,888	102,124	3.2%	21	4,672,267	2.8%
Washington	5,177	97,081	3.7%	19	5,196,995	3.5%
West Virginia	1,196	14,144	2.5%	12	637,959	2.9%
Wisconsin	5,415	101,754	4.1%	19	4,304,516	3.8%
Wyoming	964	11,147	5.1%	12	531,532	5.3%
United States, total	**228,382**	**4,616,568**	**3.7%**	**20**	**222,018,309**	**3.6%**

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *State Transportation Statistics*, table 6-1, available at www.bts.gov.

Employment by Mode

Figure 4-10 illustrates the state distribution of modal employment. While transportation employment remains related to population, there is some variation by mode. For example, Texas, Louisiana, and Oklahoma have the largest number of pipeline establishments, even though Louisiana and Oklahoma are the 25th and 28th most populated states. In contrast, while Florida is the third most populated state, it has few pipeline establishments and ranks 31st. For freight railroad, Nebraska has the third largest number of employees, despite being the 37th most populated state, because it contains the headquarters of a major railroad corporation.

Figure 4-10: State Share of National Transportation Industry Employment by Mode, 2015



Note: Data for states in light gray were withheld to prevent disclosure.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *State Transportation Statistics*, tables 6-2 to 6-7, available at www.bts.gov.

5 TRANSPORTATION PRODUCTIVITY

This chapter highlights trends in transportation productivity by exploring three measures of productivity: labor productivity; multifactor productivity; and revenue per passenger-mile or freight ton-mile. The chapter also uses productivity measures to illustrate how the transportation sector has contributed to economic growth in the United States.

What is Productivity?

In the general sense, "productivity" refers to the rate at which workers produce goods or complete work. *Economic productivity* has a more precise definition: it is the ratio of total output to the inputs used in the production process. Inputs may include capital, labor, energy, materials, and services. Productivity increases when a business produces the same output using fewer (or lower-cost) inputs. The business may then choose to produce more output, lower prices, invest in the business, or return income to shareholders.

Productivity may increase for several reasons. For example, new technology or training classes may help workers produce more goods in the same amount of time or with the same amount of resources. Likewise, policy changes may allow firms to operate more efficiently.

Productivity growth increases national income and improves the standard of living. One classic example is the Ford Motor Company's Model T automobile, produced in the early 1900s. Ford greatly increased productivity by using interchangeable parts and a moving assembly line. Ford chose to use the increased productivity to sell the Model T for a lower price than competing vehicles. As a result, more people could afford an automobile.

Increases in productivity may not lead to lower prices for consumers or increases in output. For example, demand for a business' products may decline despite an increase in productivity, which in turn may make the business unable to profitably increase output and lower its prices. Productivity increases achieved through automation may also lead to worker layoffs and overall reductions in employment. In other words, productivity growth is necessary but not sufficient for increases in total economic activity and economic well-being.

Productivity Measurements

Productivity measures provide answers to important questions about the transportation sector—for example, how efficiently transportation providers move people and goods, and whether the value of their services has grown more rapidly than the costs of the inputs they use. There are two main measures of transportation productivity: *labor (single-factor) productivity* and *multifactor productivity*. Labor productivity measures the output per unit of labor input, while multifactor productivity measures the output per unit as a weighted average of multiple factors, such as fuel, equipment, and materials. While multifactor

productivity is a more comprehensive measure of economic performance, labor productivity is easier to measure and continues to have a broad appeal.

In the United States, the Bureau of Labor Statistics (BLS) produces labor and multifactor productivity measures for industries and sectors as defined by the North American Industry Classification System (NAICS) (box 5-1). These measures show industry and sector changes in inputs, outputs, and productivity.

Box 5-1: BLS Productivity Programs

The Bureau of Labor Statistics (BLS) produces productivity statistics through its Major Sector Productivity (MSP) Program and its Industry Productivity Studies (IPS). The MSP program generally produces productivity measures at the North American Industry Classification (NAICS) sector (2-digit) and subsector (3-digit) level, while IPS publishes productivity statistics at the 4-digit NAICS industry level. Sometimes a 3-digit subsector is the same as a 4-digit industry in the NAICS system, and as a result, both MSP and IPS produce measures for the same NAICS industry. However, these measures will not be the same due to methodological differences between the two programs. The largest difference is in the measurement of output. The MSP program takes an aggregate approach and uses real gross output (less the portion consumed in the same industry) obtained from BLS. IPS takes a micro-level approach and uses deflated sales, values, or physical quantities for output.

BLS also produces statistics for private business and private non-farm business as a whole and uses *value-added output* as a measure of output. Value-added output is gross output less all purchased intermediate inputs. Productivity statistics based on real gross output, as for 3-digit and 4-digit NAICS industries in the MSP program, tend to be preferred because they show the impact of changes in the quality of nonlabor inputs. BLS' productivity statistics presented in this chapter are from the MSP program.

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

The Bureau of Economic Analysis (BEA) also produces labor and multifactor productivity measures in the BEA/BLS Integrated Industry-Level Production Accounts (box 5-2). The Integrated Accounts take the BLS measures a step further by measuring the contribution of labor, capital, and other factors of production to the economy by industry.

Box 5-2: BEA/BLS Integrated Industry-Level Production Accounts

The Bureau of Economic Analysis (BEA) and the Bureau of Labor Statistics (BLS) collaborate to produce industry-level production accounts for the United States. To produce the accounts, BEA and BLS combine data on industry-level outputs and intermediate inputs from BEA's GDP by industry accounts with data on capital inputs and labor hours from the BLS Productivity Programs. The integrated accounts show the contribution of labor, capital, and multifactor productivity to economic growth. For more information, please see "A Prototype BEA/BLS Industry-Level Production Account for the United States," available at www.bls.gov/mfp/bea_bls_industry_product_account.pdf.

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

Labor Productivity

BLS produces the official labor productivity measures for the UNITED STATES To measure *labor productivity*, BLS measures outputs by industry and divides the output by paid labor hours. When an industry has multiple products or services, the outputs are weighted by value. BLS indexes the ratios to a common base year to allow for comparisons over time. BLS measures show industry responses to regulations and policies, changes in labor costs, and competitive pressures; the measures also enable comparisons across industries.

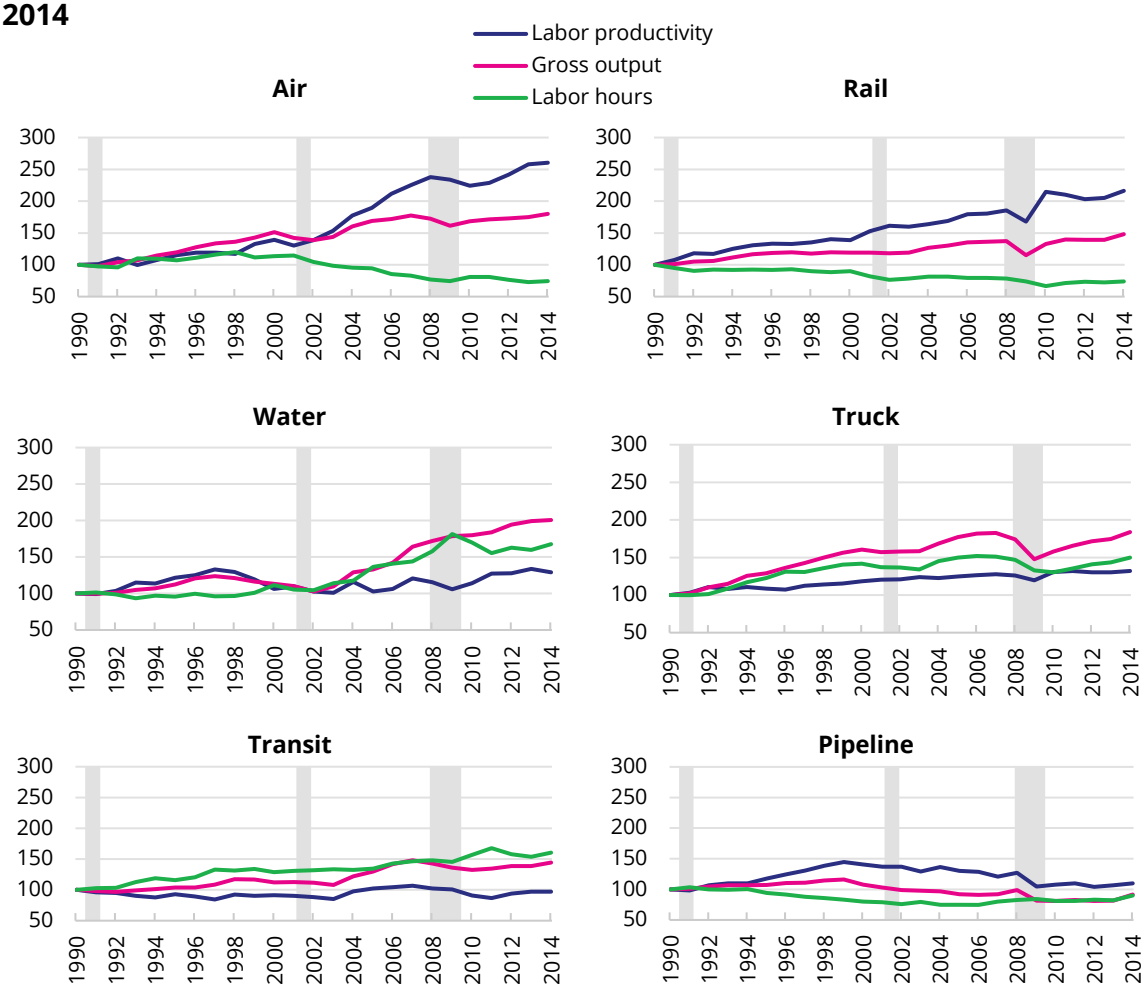
Figure 5-1 illustrates changes in labor productivity for selected transportation sectors from 1990 to 2014. Air transportation experienced the largest increase in labor productivity among all transportation modes, growing 160.5 percent from 1990 to 2014. Air transportation's labor productivity grew most notably between 2001 and 2008. The gains during this period come from legacy carriers adopting aggressive labor-saving initiatives and from large output gains among low-cost carriers.[1] Rail transportation experienced the second largest gains in labor productivity, increasing by 116.3 percent. These gains are the result of labor-saving technologies automating operational and administrative tasks.[2] Labor-saving initiatives in air and rail resulted in a decline in labor hours with continued

[1] See Russell, Matthew. "Economic productivity in the air transportation industry: multifactor and labor productivity trends, 1990–2014," *Monthly Labor Review*, U.S. Department of Labor, Bureau of Labor Statistics, March 2017. Available at www.bls.gov/opub/mlr/2017/article/economic-productivity-in-the-air-transportation-industry.htm as of May 2017.

[2] See Kriem, Youseff. The Productivity of the U.S. Freight Rail Industry 1979-2009. U.S. Transportation Productivity Study, Massachusetts Institute of Technology, available at transportation.mit.edu/sites/default/files/documents/MIT_Rail_Freight_Report.pdf as of June 2017.

growth in output over the 1990 to 2014 period. During the same period, smaller labor productivity increases occurred in truck (32.1 percent) and water (28.9 percent) transportation. Labor productivity in pipeline transportation grew 9.5 percent despite declining from 2000 through 2014. Labor productivity in transit transportation declined 3.0 percent due to the total amount of hours required to produce output (labor hours) rising faster than output.

Figure 5-1: Labor Productivity Indexes for Selected Transportation Sectors, 1990 to 2014



Notes: Data in these graphs are not comparable to data in previous editions due to a change in the data used. Shaded areas indicate economic recessions. Labor hours is the total number of number of hours worked by all workers in a sector to produce gross output. Gross output is the total value of goods and services produced by the sector. Gross output includes the value of the goods and services used to produce the sector output. Labor productivity measures a sector's output per unit of labor input.

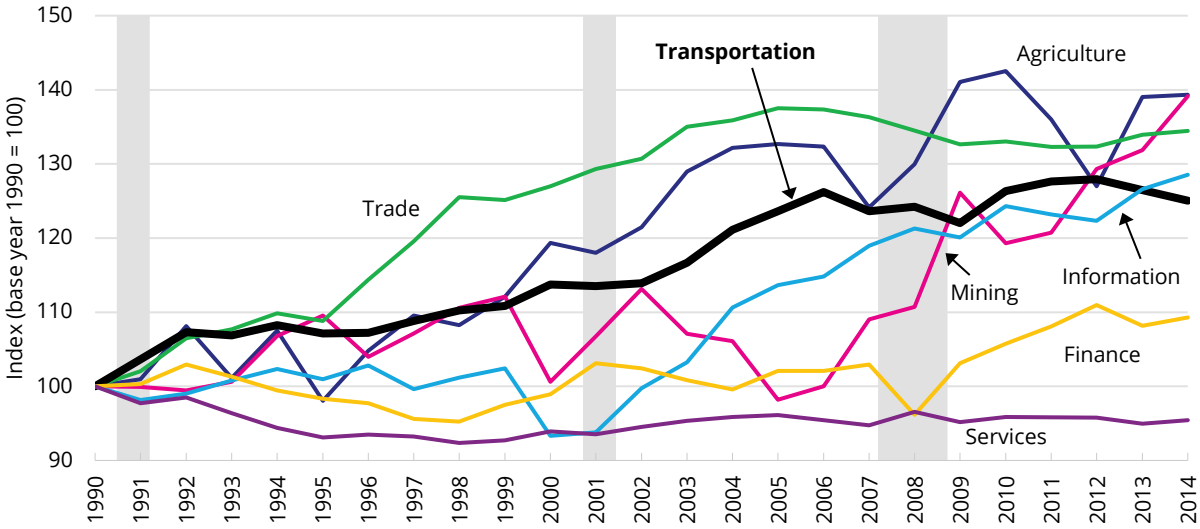
Source: U.S. Department of Labor, Bureau of Labor Statistics, Major Sector Productivity, available at www.bls.gov.

Multifactor Productivity

To measure *multifactor productivity (MFP)*, BLS divides output by a weighted set of inputs, including capital (e.g., equipment), labor, energy (e.g., fuel), materials, and purchased services. MFP measures the change in output relative to the change in inputs used to produce that output. Changes in multifactor productivity reflect the combined effects of factors, such as new technologies, new regulations, or organizational changes, after accounting for changes in inputs.

From 1990 to 2014, MFP for the transportation sector grew, at 25.0 percent, more modestly than all other sectors except the finance and service sector (figure 5-2). MFP gains in the transportation sector reflect an 81.5 percent increase in output and a 45.2 percent increase in combined inputs (figure 5-3). Capital services grew by 44.6 percent and labor input, which is the combined effect of hours worked and labor composition, grew 44.4 percent. Intermediate inputs grew by 46.4 percent.

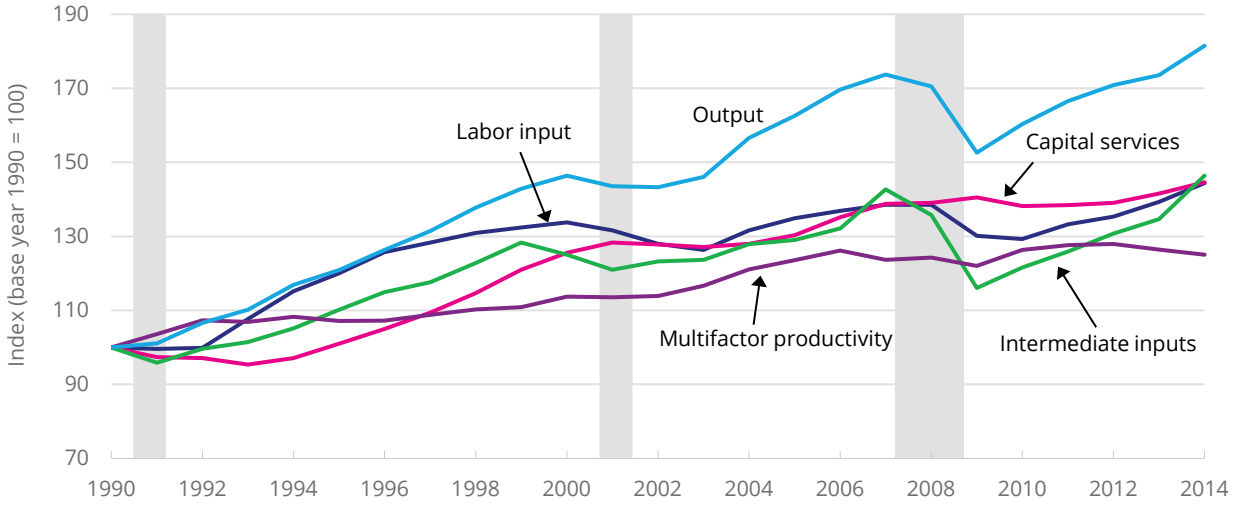
Figure 5-2: Multifactor Productivity Indexes for Selected Sectors, 1990 to 2014



Notes: Finance includes finance and insurance and real estate rental and leasing. The service sector includes professional and business services; education and health services; leisure and hospitality; and other services (NAICS 54–81). Shaded areas indicated economic recessions.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Major Sector Productivity, available at www.bls.gov.

Figure 5-3: Productivity of the Transportation Sector, 1990 to 2014



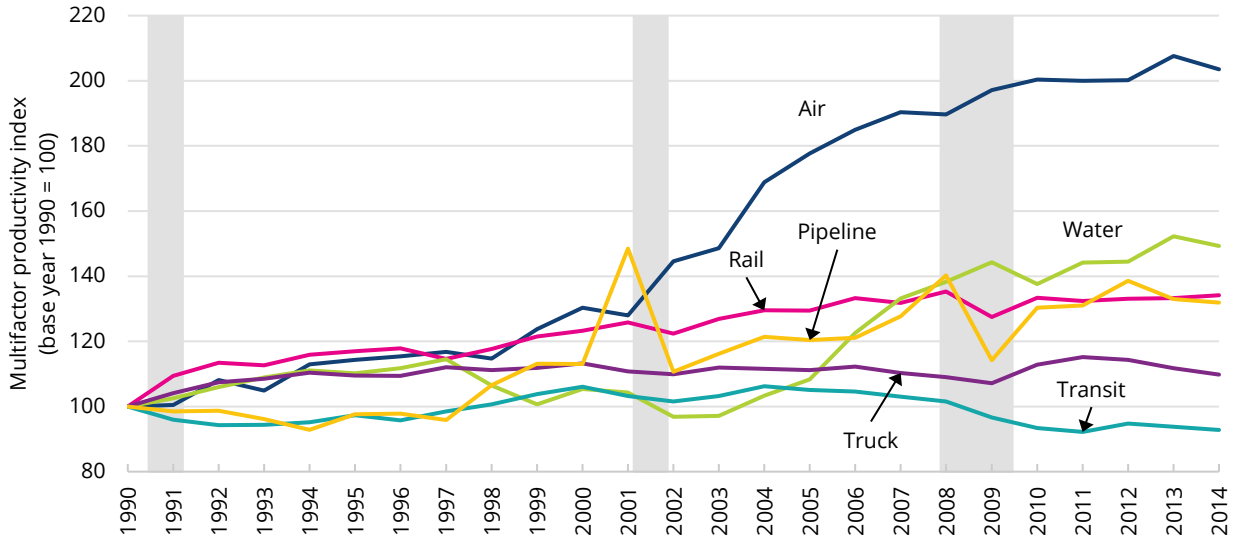
Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Major Sector Productivity, available at www.bls.gov.

From 1990 through 2014, air transportation had the largest increase in MFP, growing at 103.5 percent (figure 5-4). The gain in air transportation reflects an 80.1 increase in output and an 11.5 percent decline in combined inputs. Combined inputs fell, despite an increase in capital services, because of declines in labor inputs and intermediate inputs. The increase in capital services and the decline in labor follow from the air transportation sector adopting labor-saving technologies, such as self-service kiosks.

Water transportation experienced the second largest increase in MFP, growing 49.3 percent from 1990 to 2014, despite declining 15.2 percent from 1997 to 2003. The MFP of rail transportation grew steadily over the entire period but more slowly, increasing 34.2 percent. MFP in pipeline transportation had a smaller increase of 31.9 percent over the same period and showed more year-to-year variation than other modes. Truck transportation's MFP grew marginally at 9.8 percent, while the transit sector experienced a decline of 7.2 percent.

Figure 5-4: Multifactor Productivity Indexes for Selected Transportation Sectors, 1990 to 2014



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Major Sector Productivity, available at www.bls.gov.

Sources of Economic Growth

The BEA/BLS Integrated Production Accounts show the contribution of labor, capital, and MFP to economic growth. Based on the accounts, transportation's contribution has been smaller than other sectors. Between 2003 and 2007, transportation, with an average annual growth rate of 0.14 percent, contributed significantly less than the manufacturing, service, and finance, which all had average annual growth rates in excess of 0.50 percent (table 5-1). Almost all sectors, including transportation, experienced negative growth during the 2007 to 2009 economic recession. Since 2009, transportation has contributed positively to economic growth. However, transportation's average annual contribution to economic growth from 2009 to 2014 (the latest available year) is below its pre-recession level at 0.06 percent.

Table 5-1: Sources of Economic Growth (average annual growth rate), 2003 to 2014

Industry	2003–2007	2007–2009 (Recession)	2009–2014
All	2.73%	-1.56%	1.79%
Finance	0.58%	0.03%	0.31%
Services	0.56%	-0.12%	0.59%
Manufacturing	0.51%	-0.66%	0.20%
Information	0.32%	0.03%	0.14%
Government	0.28%	0.17%	0.07%
Trade	0.28%	-0.61%	0.26%
Transportation	**0.14%**	**-0.11%**	**0.06%**
Mining	0.07%	0.17%	0.11%
Utilities	0.02%	-0.05%	0.02%
Agriculture	0.00%	0.09%	0.02%
Construction	-0.03%	-0.48%	0.01%

Notes: Finance includes finance and insurance and real estate rental and leasing. The service sector includes professional and business services; education and health services; leisure and hospitality; and other services (NAICS 54-81).

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Integrated Industry-Level Productivity Account, available at www.bea.gov.

Per-Mile Revenue Measures

Another way to look at transportation productivity is to examine what users pay for transportation. This can be seen as an economic measure of the value of transportation. For for-hire passenger transportation, the unit of output is passenger-miles. The measure of what travelers pay is *average revenue per passenger-mile*. For for-hire freight transportation, the unit of output is ton-miles. The measure of what freight shippers pay is *average freight revenue per ton-mile*. For modes where users do not typically pay per use, like driving a personal vehicle, complete data are difficult to obtain.

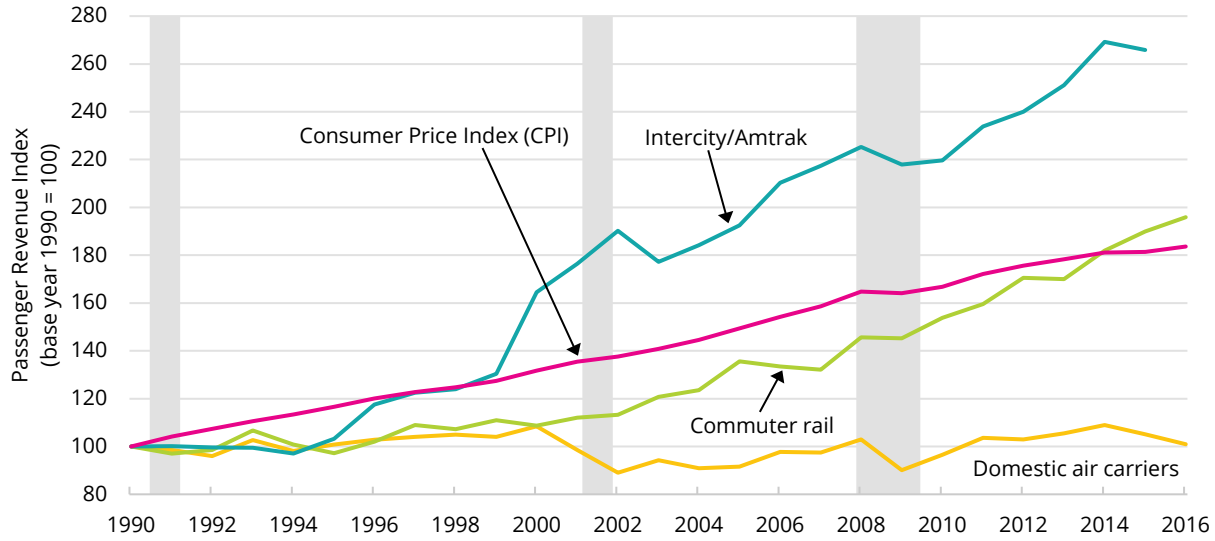
Revenue per Passenger-Mile

While nominal revenue per passenger-mile has increased since 1990, only Amtrak/intercity rail and commuter rail experienced real (inflation-adjusted) passenger revenue growth. Figure 5-5 shows nominal changes in revenue per passenger-mile relative to the Consumer Price Index (CPI) for three industries: domestic air carriers, commuter rail, and Amtrak/intercity rail. Amtrak/intercity rail experienced the largest growth in revenue per passenger-mile, increasing 165.8 percent between 1990 and 2015 (latest available year), and commuter rail increased 95.9 percent between 1990 and 2016. Both Amtrak/intercity rail and commuter rail experienced steady growth. In contrast, domestic air carrier revenue per passenger-mile fell after the September 2001 terrorist attacks, began to rise after

reaching a low in 2002, and then fell again during the Great Recession (December 2007 to June 2009) to its 2002 level in 2009. Between 2009 and 2014, domestic air carrier revenue per passenger-mile rose 21.0 percent but then fell 7.3 percent between 2014 and 2016.

The increases in revenue per passenger-mile are partly due to an increase in the overall price of goods and services. The CPI, which measures overall changes in prices, increased by 83.6 percent from 1990 to 2016, indicating that Amtrak/intercity rail and commuter rail were the only industries with real increasing revenue per passenger-mile during the period. Domestic air carriers, meanwhile, suffered a decrease in real revenue per passenger-mile.

Figure 5-5: Average Passenger Revenue per Passenger-Mile Indices, 1990 to 2016



Notes: Domestic air carrier revenue includes baggage fees and reservation change fees. Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-20, available at www.bts.gov.

Domestic Air Carrier Revenues

Two developments have affected domestic air carrier revenues from 1990 to the present. First, average inflation-adjusted domestic air fares declined 22.0 percent between the

fourth quarter of 1995 and the fourth quarter of 2016.[3] As a result, fares have accounted for a lower percentage of operating revenues. In the 1990s, domestic air carriers received slightly below 90 percent of their revenues from passenger fares. In the 2000s, however, the percentage declined from 88.9 percent in 2000 to 73.7 percent in 2009, and has remained near the same percentage since then. Second, airlines began increasing baggage fees and reservation change fees in 2008. In 2016, passenger airlines collected $3.3 billion from baggage fees and $1.9 billion from reservation change fees; these fees accounted for 2.6 and 1.5 percent of total operating revenue, respectively.

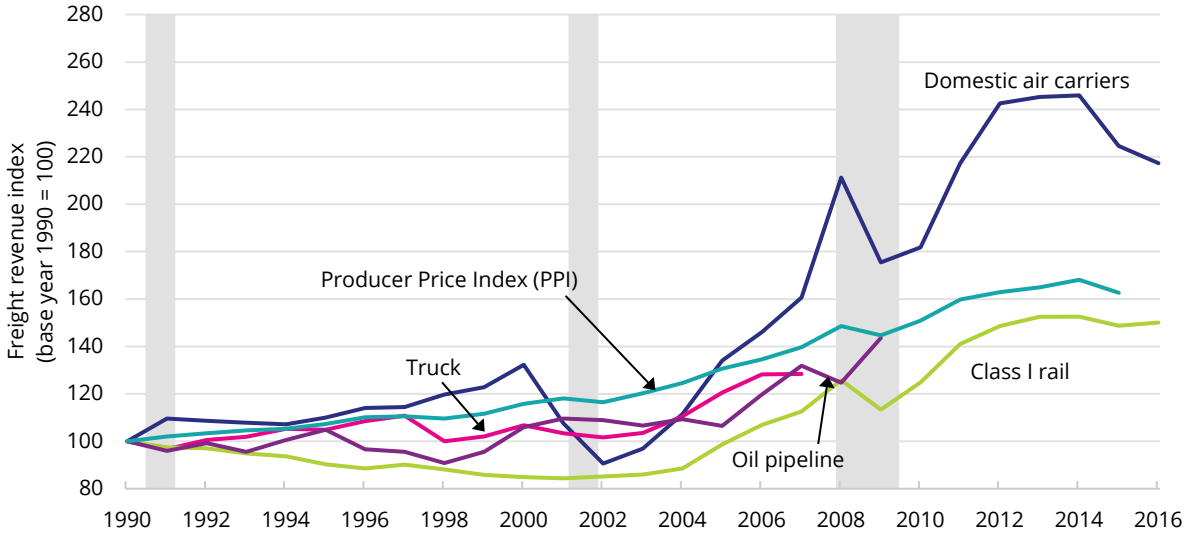
Freight Revenue per Ton-Mile

Figure 5-6 shows the average freight revenue per ton-mile for air, truck, rail, and pipeline compared to the Producer Price Index (PPI). Data for pipelines after 2009 and for trucks after 2007 are unavailable. The PPI measures overall changes in the selling prices received by transportation service providers for their services.

Nominal freight revenue per ton-mile increased for all freight modes; however, revenue increases exceeded producer price increases only for domestic air. Domestic air carriers experienced the largest increase in revenue per ton-mile, increasing 117.3 percent from 1990 to 2016. The largest gains in air revenue per ton-mile occurred between 2002 and 2014, despite a slight decline during the 2007 to 2009 recession. Air revenue per ton-mile remained virtually unchanged between 2012 and 2014 and declined in 2015 and 2016 from its 2014 level. Class I railroads, defined as line-haul freight railroads with annual operating revenues of $457.91 million or more as of 2015,[4] experienced a smaller increase in revenue per ton-mile of 50.1 percent in the same period due to an initial decline. Rail revenue per ton-mile declined 15.6 percent from 1990 to 2001 but then grew 77.9 percent from 2001 to 2016 with only a slight decline during the 2007 to 2009 recession and in 2015. Oil pipelines experienced an increase of 43.6 percent from 1990 to 2009, and trucks experienced the smallest increase of 28.4 percent from 1990 to 2007.

[3] For more information on domestic air carrier revenues, please see the BTS airline financial data press releases at www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/press_releases/airline_financial_data.html.
[4] See "Class I Railroad Statistics", Association of American Railroads, May 2017, available at www.aar.org/Documents/Railroad-Statistics.pdf as of June 2017.

Figure 5-6: Average Freight Revenue per Ton-Mile Indices, 1990 to 2016



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-21, available at www.bts.gov.

6 HOUSEHOLD SPENDING ON TRANSPORTATION

Household spending on transportation is a large expense for American households. It influences many of their personal decisions, including where they live and work. This chapter explores three national measures of household spending on transportation:

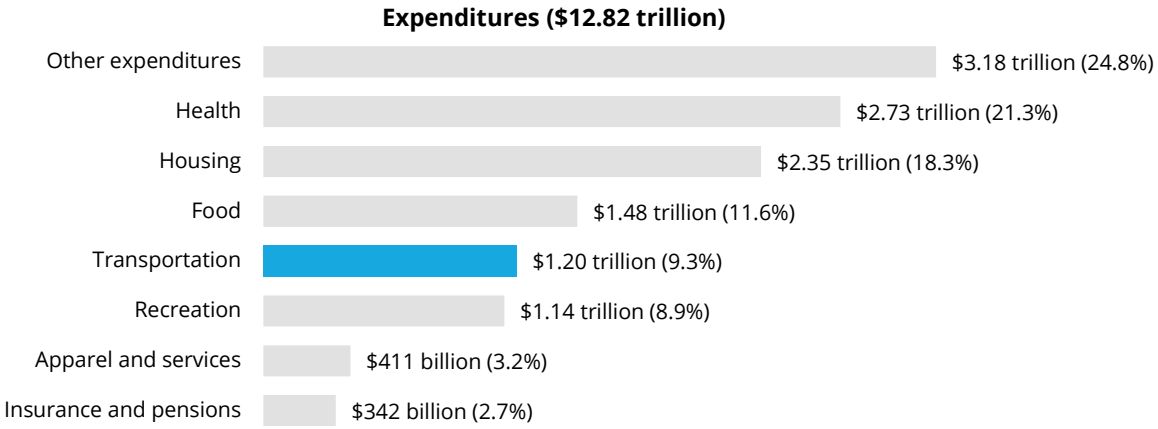
1. *Personal Consumption Expenditures*, which measure total national household spending on transportation;
2. The *Consumer Expenditure Survey*, which measures individual household spending on transportation; and
3. American Automobile Association (AAA) per-mile operating costs for new vehicles.

Personal Consumption Expenditures

Personal Consumption Expenditures (PCE) is the broadest measure of consumer spending in the American economy. It measures total national household spending on transportation-related goods and services, such as vehicles, fuel, and for-hire transportation. It also measures total national transportation spending by governments, employers, and other organizations on behalf of households—for example, employee transit subsidies. The Bureau of Economic Analysis (BEA) produces PCE using data from a range of sources, including trade organizations, the Census Bureau, the Bureau of Labor Statistics, and the Centers for Medicare & Medicaid Services. PCE measures national aggregate spending only; it does not measure differences in spending among individual households.

Transportation expenditures accounted for $1.20 trillion (9.3 percent) of PCE in 2016, making transportation the fourth largest category (excluding "other expenditures") after healthcare, housing, and food (figure 6-1). Transportation expenditures increased 42.7 percent, from $838 billion in 2000 to $1.20 trillion in 2016 (figure 6-2). The growth in total expenditures outpaced the growth in transportation expenditures, increasing 88.8 percent from $6.79 trillion to $12.82 trillion over the same period. Expenditure growth for healthcare (145.6 percent), housing (93.5 percent), and food (83.5 percent) also outpaced expenditure growth for transportation. As a result, the percentage of total expenditures for transportation declined from 12.3 percent in 2000 to 9.3 percent in 2016.

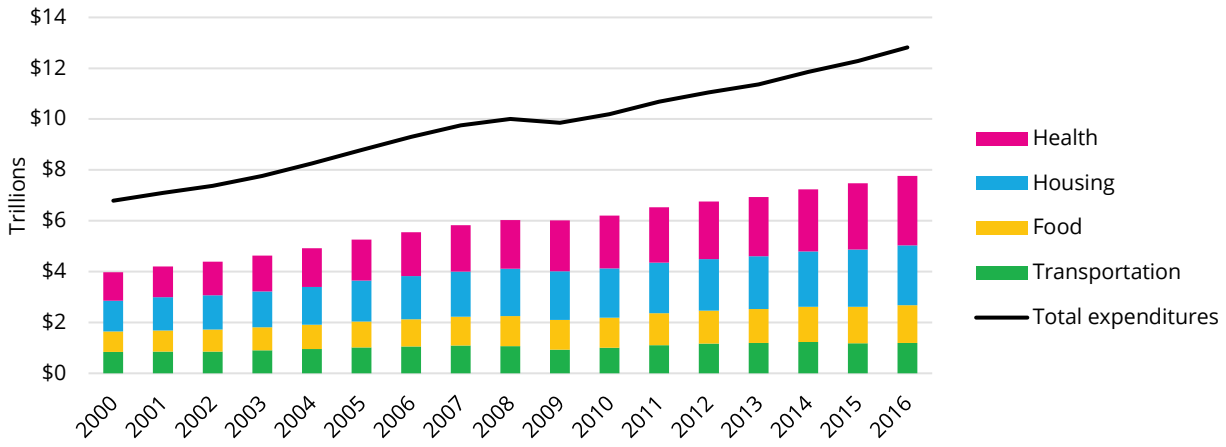
Figure 6-1: Total National Household Expenditures (Major Categories), 2016



Notes: "Other expenditures" include alcoholic beverages purchased for off-premises consumption; furnishings, household equipment, and routine household maintenance; education; accommodations; financial services (excluding pension funds); other goods and services; net foreign travel and expenditures abroad by U.S. residents; and final consumption expenditures of nonprofit institutions serving households.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts Tables, table 2.5.5, 2.4.5U, available at www.bea.gov/iTable/index_nipa.cfm.

Figure 6-2: Total National Household Expenditures (Four Largest Categories), 2000 to 2016



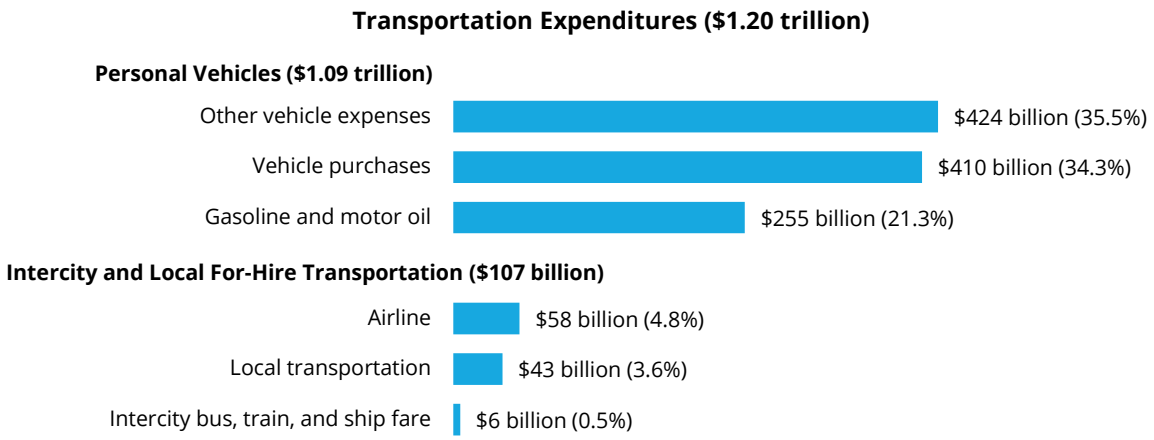
Source: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts Tables, table 2.5.5, 2.4.5U, available at www.bea.gov/iTable/index_nipa.cfm.

Expenditures on Personal Vehicles

Personal vehicles account for the majority of transportation expenditures in the PCE—$1.09 trillion in 2016, or 91.1 percent of total transportation expenditures (figure 6-3). This amount includes costs for purchasing, operating, and maintaining personal vehicles.

New and used vehicle purchases account for $410 billion in expenditures, or one-third of total transportation expenditures (34.3 percent). Gasoline and motor oil purchases account for $255 billion (21.3 percent) in transportation expenditures. World oil markets and national and regional refinery prices directly affect the cost of gasoline and motor oil. Vehicle gas mileage and congestion, which limits achievable mileage, also affect the cost. Finally, other vehicle expenses, such as repair costs and insurance, account for $424 billion (35.5 percent) of transportation expenditures. Vehicle age, vehicle reliability, pavement conditions, prices of parts, and local market conditions affect the amount spent on repair.

Figure 6-3: Total National Household Transportation Expenditures, 2016



Note: "Other vehicle expenses" include vehicle insurance, vehicle parts, and maintenance and repair costs.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts Tables, table 2.5.5, 2.4.5U, available at www.bea.gov/iTable/index_nipa.cfm.

Expenditures on Intercity and Local For-Hire Transportation

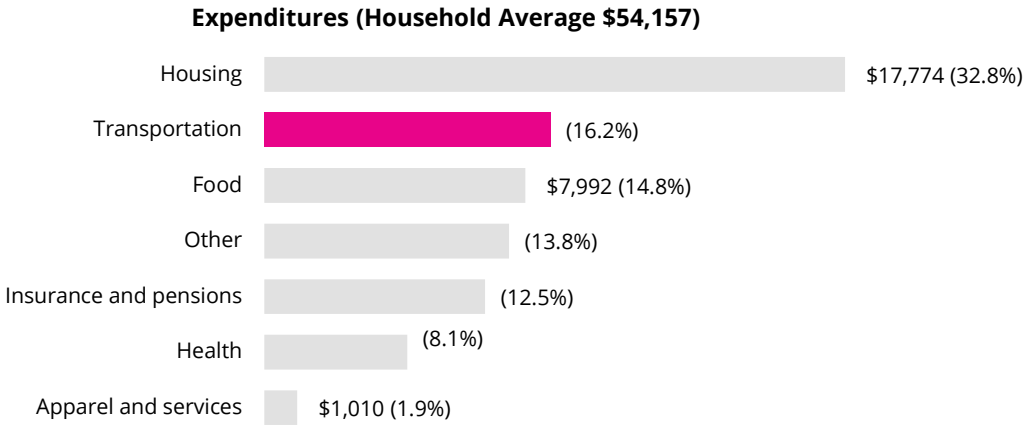
Air passenger travel spending accounted for $58 billion (4.8 percent) of transportation expenditures; intercity bus, train, and ship fares accounted for $6 billion (0.5 percent). Local for-hire transportation services account for $43 billion (3.6 percent) of transportation expenditures. Further disaggregating local for-hire transportation shows that mass transit represents 49.2 percent of expenditures on local for-hire transportation ($21 billion), taxis represent 14.3 percent ($6 billion), and other services, such as sightseeing buses, account for the remaining 36.5 percent ($16 billion).

Household Transportation Expenditures

The *Consumer Expenditure Survey* (CE), administered by the Bureau of Labor Statistics (BLS), measures individual household spending in the United States. A nationally representative sample of households provides detailed information on expenditures, income, and household characteristics. The CE is the only Federal survey that has information on the complete range of expenditures for individual households, including transportation.

The CE shows that households in the United States spent an average of $8,755 on transportation in 2016, making transportation the second largest household expenditure category (representing 16.2 percent of total expenditures) after housing (figure 6-4). Transportation accounts for a greater percentage of the CE than the PCE because the CE includes only direct household expenditures, while the PCE includes expenditures on behalf of households (box 6-1).

Figure 6-4: Average Individual Household Expenditures (major categories), 2016



Note: Amounts are calculated by BTS using public-use microdata, and may differ slightly from amounts calculated using original data.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey 2016 Microdata, available at www.bls.gov/cex.

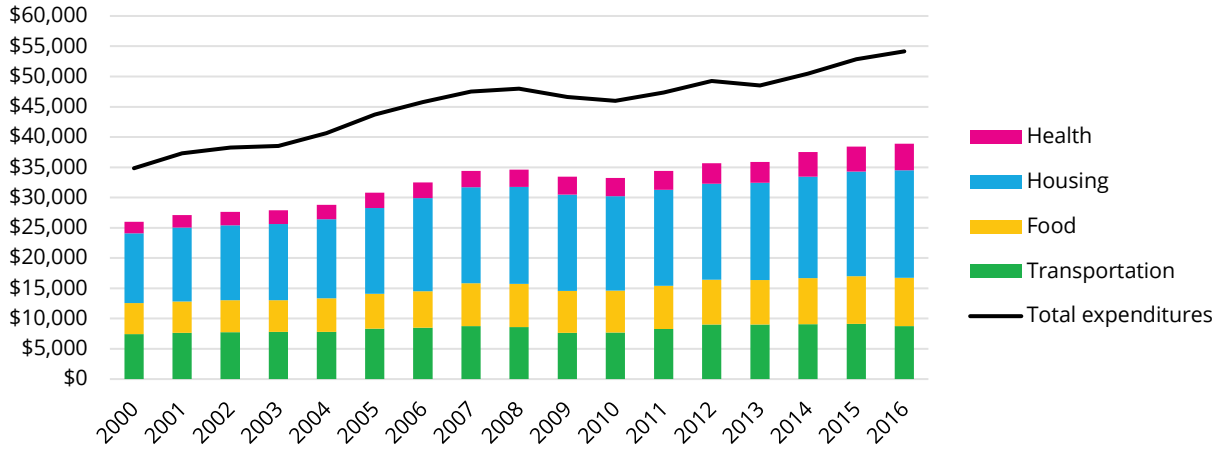
Box 6-1: Personal Consumption Expenditures and the Consumer Expenditure Survey

Personal Consumption Expenditures includes expenditures made on behalf of households, such as healthcare premiums paid by businesses and housing assistance from non-profits and the government. As a result, healthcare and housing expenditures are larger and account for a larger share of total expenditures than in the Consumer Expenditure Survey, which only examines direct household expenditures. Transportation as a percentage of personal consumption expenditures is the most useful measure for discussions about household needs because it includes all expenditures that society makes to meet household needs. At the same time, transportation as a percentage of household expenditures is the most useful measure for discussions about household budgets.

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

Average annual household transportation expenditures have increased more slowly than other major expenditures (figure 6-5). From 2000 to 2016, transportation expenditures increased by 18.0 percent, from $7,417 to $8,755, while total expenditures increased by 55.5 percent, from $34,839 to $54,157. As a result, the share of transportation expenditures declined from 21.3 percent in 2000 to 16.2 percent in 2016. In contrast, housing expenditures increased by 54.6 percent (from $11,494 to $17,774), food expenditures increased by 54.8 percent (from $5,164 to $7,992), and health expenditures increased by 125.6 percent (from $1,938 to $4,373) in the same period.

Figure 6-5: Average Individual Household Expenditures (four largest categories), 2000 to 2016



Note: Amounts are calculated by BTS using public-use microdata, and may differ slightly from amounts calculated using original data.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey 2016 Microdata, available at www.bls.gov/cex.

Household transportation expenditures vary by household characteristics. For example, rural households spent more on transportation ($10,299) than urban households ($8,768) in 2016, in part because rural households have higher rates of vehicle ownership and lower levels of access to public transit.[1] Drivers in rural areas also drove 47.9 percent more miles per capita in 2009 than drivers in urban areas—34.2 miles versus 23.1 miles per day, respectively. Finally, households without vehicles spend lower amounts on transportation.

Average annual expenditures are a useful measure of household spending on transportation; at the same time, however, spending for an individual household can vary greatly from year to year. For example, households have much higher expenditures in years that they purchase vehicles. Year-to-year changes in gasoline prices and vehicle insurance premiums can also affect expenditures for an individual household. The CE does not capture these changes for households, because it is a cross-sectional survey and samples a different group of households each year.

Expenditures on Personal Vehicles

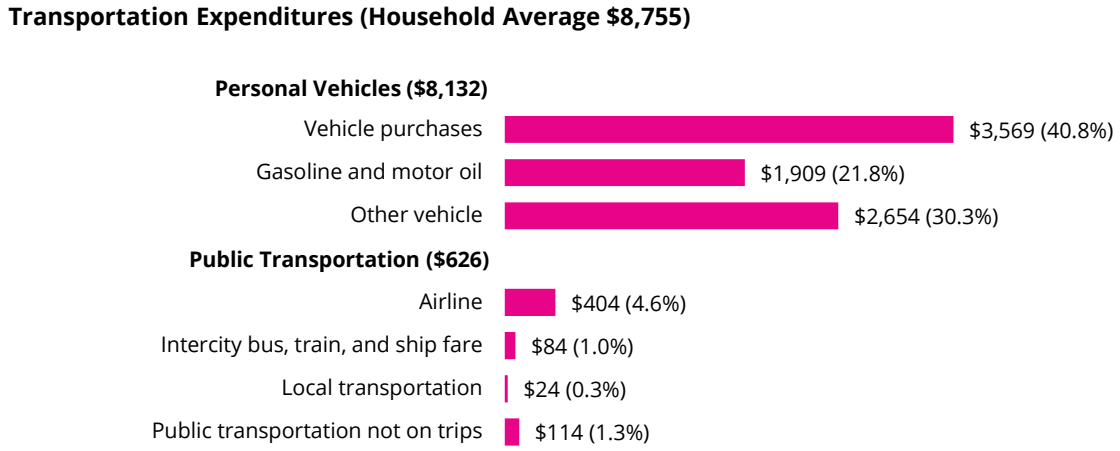
The average household devotes most of its transportation budget ($8,132 of $8,755, or 92.9 percent) to purchasing, operating, and maintaining private vehicles (figure 6-6). Vehicle purchases account for 40.8 percent ($3,569) of transportation expenditures, gasoline and motor oil account for 21.8 percent ($1,909), and other vehicle expenses, such as repairs and insurance, account for 30.3 percent ($2,654).

[1] For more information on travel behavior and demographics, please see U.S. Department of Transportation Federal Highway Administration, *Summary of Travel Trends: 2009 National Household Travel Survey*, available at nhts.ornl.gov/2009/pub/stt.pdf.

Expenditures on Intercity and Local For-Hire Transportation

Public transportation accounts for the remaining 7.1 percent ($626) of household transportation expenditures. Looking at public transportation expenditures on trips, intercity travel represents 78.0 percent ($488) of expenditures—64.5 percent ($404) for airline fares and 13.4 percent ($84) for bus, train, and ship fares—and local transportation accounts for 3.8 percent ($24). Public transportation not on trips accounts for the remaining 18.2 percent ($114) of public transportation expenditures.

Figure 6-6: Average Individual Household Transportation Expenditures, 2016



Notes: Amounts are calculated by BTS using public-use microdata, and may differ slightly from amounts calculated using original data. Transportation expenditures include vehicle insurance.

Source: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey 2016 Microdata, available at www.bls.gov/cex.

Transportation Expenditures and Income

Households spend similar percentages on transportation across all income categories (table 6-1), with the percentage ranging from 14.4 to 17.8 percent in 2016. While the percentages remain relatively similar, households in the top income quintile spent over four times as much as households in the bottom income quintile in 2016—$16,114 versus $3,767.

Higher income households spend more on transportation because they are more likely to own vehicles: in 2016, 97.0 percent of households on the top income quintile had at least one vehicle, compared with 64.0 percent in the bottom income quintile. Moreover, higher income households have greater numbers of vehicles. Households in the top income quintile owned an average of 2.7 vehicles per household in 2016, while households in the bottom income quintile owned 0.9 vehicles per household.

Table 6-1: Average Individual Household Expenditures by Income Quintile, 2016

Income range by quintile	Household spending	Vehicles per household	Households with at least one vehicle	Transportation spending	Percentage of total spending
All quintiles	$57,311	1.9	87.0%	$9,049	15.8%
First quintile ($0-$19,868)	$25,138	0.9	64.0%	$3,767	15.0%
Second quintile ($19,869-$38,163)	$36,770	1.5	86.0%	$5,992	16.3%
Third quintile ($38,164-$64,418)	$47,664	1.9	93.0%	$8,464	17.8%
Fourth quintile ($64,419-$103,040)	$64,910	2.4	97.0%	$10,931	16.8%
Fifth quintile ($103,041+)	$112,221	2.7	97.0%	$16,114	14.4%

Source: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey, available at www.bls.gov/cex.

Per-Mile Vehicle Operating Costs

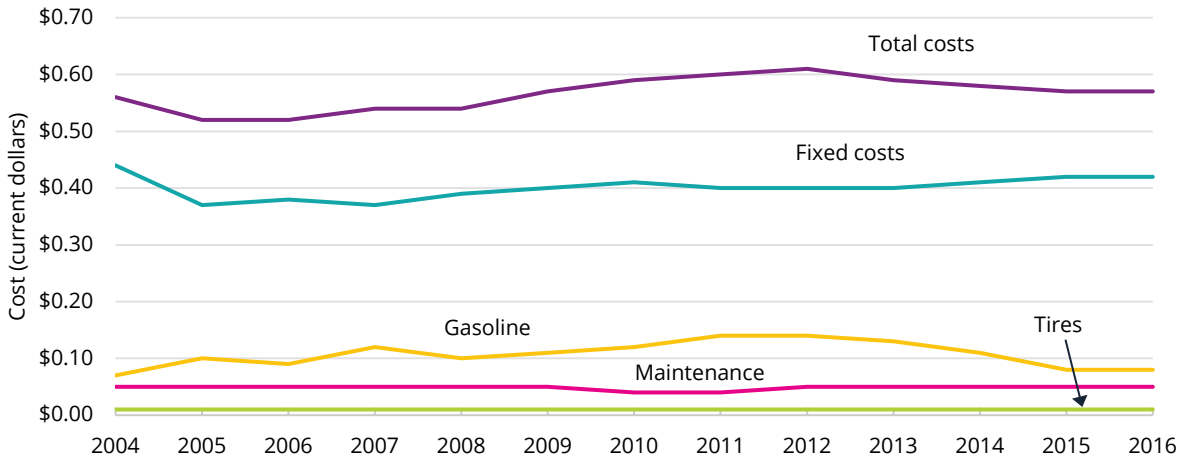
The American Automobile Association (AAA) collects data on automobile operating costs annually and publishes per-mile cost estimates for new vehicles driven 15,000 miles a year for 5 years (box 6-2). Figure 6-7 shows the costs to own and operate a new vehicle on a per-mile basis from 2004 to 2016. On average, it costs $0.56 per mile to own and operate a new vehicle in 2016. The largest expense is fixed ownership costs, which represent 73.7 percent of the total cost ($0.42 per mile). Fixed ownership costs include depreciation, vehicle insurance, license and registration fees, and finance charges. Operating costs account for the remaining 26.3 percent of the total cost ($0.14 per mile). Gasoline, a highly salient cost to consumers because they see prices posted at every gas station, is the largest operating cost, representing 14.0 percent ($0.08 per mile) of the total cost. Maintenance and tires account for the remaining 10.5 percent ($0.06 per mile) of the total cost.

Box 6-2: Per-Mile Vehicle Operating Expenses

The American Automobile Association (AAA) publishes per-mile vehicle operating cost estimates in *Your Driving Costs*. To calculate the costs, AAA estimates annual costs for small, medium, and large sedans using data from five top-selling current-year vehicles for each group. AAA's estimates assume that drivers drive 15,000 miles a year and trade in vehicles after 5 years. Fixed costs include depreciation, insurance, licensing, registration, taxes, and finance charges.

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

Figure 6-7: Per-Mile Costs of Owning and Operating an Automobile, 2004 to 2016 (current dollars)



Note: Fixed costs include depreciation, insurance, licensing, registration, taxes, and finance charges.

Source: American Automobile Association, *Your Driving Costs*, as cited in U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, Table 3-17, available at www.bts.gov.

7 GOVERNMENT TRANSPORTATION REVENUES AND EXPENDITURES

Federal, state, and local governments play a major role in providing transportation services and infrastructure in the United States. Governments spend funds on critical activities like building highways, operating the nation's air traffic control system, and maintaining transit facilities. These funds come from several government revenue sources, including user fees, taxes, bonds, and grants.

This chapter presents data on government transportation revenue and spending from two data sources:

1. Government Transportation Financial Statistics (GTFS) (box 7-1), which examines transportation revenue and spending at the federal, state, and local levels. The GTFS data presented in this chapter are not comparable to the GTFS data presented in *Transportation Economic Trends 2016* due to slight revisions in the methodology.

2. *State Transportation Statistics* (STS) and the Survey of State Funding for Public Transportation from the American Association of State Highway and Transportation Officials (AASHTO), which examine transportation revenue and spending in individual states.

Box 7-1: Government Transportation Financial Statistics

Government Transportation Financial Statistics (GTFS), a publication of the Bureau of Transportation Statistics, provides information on transportation-related revenue and expenditures for all levels of government and for all modes of transportation. It aggregates data from a variety of sources, including the Office of Management and Budget's Public Budget Database, the Federal Highway Administration's *Highway Statistics Report*, the National Transit Database, the FAA's *Airport Financial Report*, tax data from the Bureau of Economic Analysis, and the U.S. Census Bureau's *Survey of State and Local Government Finances*. The GTFS data presented in this chapter are not comparable to the GTFS data presented in TET 2016 due to slight changes in the items selected and summed from the aforementioned data sources.

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

Government Transportation Revenue

Government transportation revenue comes from user taxes and fees, such as gasoline taxes and tolls, air ticket taxes, and general revenues, as well as income from investing transportation funds and receipts from fines and penalties (box 7-2). Borrowing is not considered transportation revenue, so it is not included in the totals.

Box 7-2: Government Transportation Revenue

Transportation revenue includes taxes, charges, and fees collected by governments from transportation and non-transportation activities and allocated to transportation programs. Income from investing transportation funds and receipts from fines and penalties are also treated as transportation revenue. For reporting, transportation revenue is classified and grouped into two categories: *own source revenue* and *supporting revenue*, minus *transportation revenue directed to other uses*.

Own-source revenue refers to taxes and charges levied on transportation-related activities and used specifically for transportation. Most of these revenue sources are user fees charged to users of the transportation system. Examples include:

- Excise taxes, such as motor fuel taxes and aviation taxes
- Property taxes, such as motor vehicle taxes
- Income taxes, such as corporate taxes paid by transportation companies
- Charges, such as tolls and motor vehicle license fees
- Fines and penalties, such as speeding and parking violation tickets
- Investment income, such as interest income from the Highway Trust Fund balance
- Income from concession agreements where a private company operates a publicly owned transportation infrastructure on a concession basis

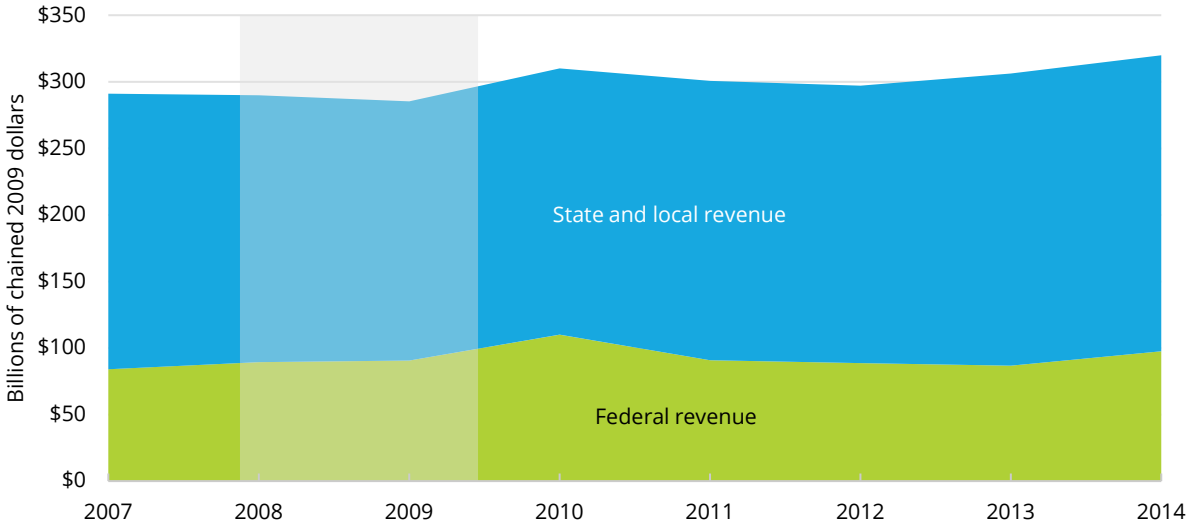
Supporting revenue includes funds collected from non-transportation-related activities but dedicated to support transportation programs. Examples include receipts received by state and local governments from sales or property taxes to finance transportation projects.

Revenue directed to other uses includes funds raised from transportation-related activities but used to finance programs other than transportation. One example is receipts generated from motor fuel taxes that are directed to the general fund for other uses.

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

In 2014 revenue collected and dedicated to transportation programs totaled $355.7 billion (current dollars). Slightly over half of the revenue ($183.6 billion, or 51.6 percent) came from taxes and charges levied on transportation-related activities. The remaining $172.1 billion (48.4 percent) came from non-transportation-related activities but supports transportation programs, such as state or local sales or property taxes used to finance transportation projects. In inflation-adjusted dollars, total revenue collected and dedicated to transportation programs increased by 9.9 percent from $291 billion in 2007 to $320 billion in 2014 (figure 7-1).

Figure 7-1: Federal, State, and Local Government Revenues, 2007 to 2014 (billions of chained 2009 dollars)



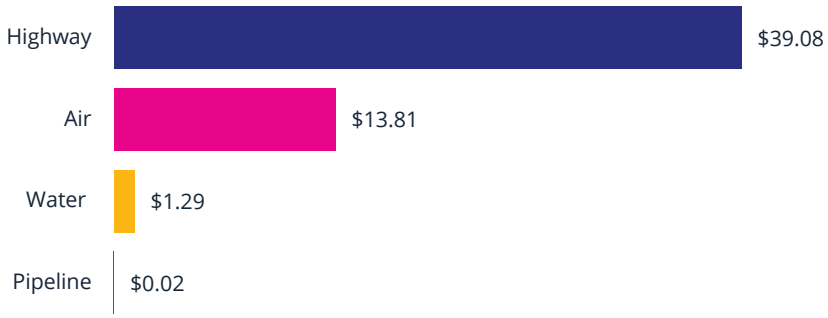
Note: Revenue includes own-source revenue and supporting revenue, but does not include revenue diverted to other uses. Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

Sources of Government Transportation Revenue

Highway and aviation, which have trust funds supported by dedicated taxes, accounted for 97.6 percent of federal transportation revenue in 2014 (figure 7-2). The Federal Government collected $39.1 billion (72.1 percent) in highway revenues and $13.8 billion (25.5 percent) in aviation revenues, as well as $1.3 billion (2.4 percent) in water transportation revenues and $0.02 billion (0.03 percent) in pipeline revenues.

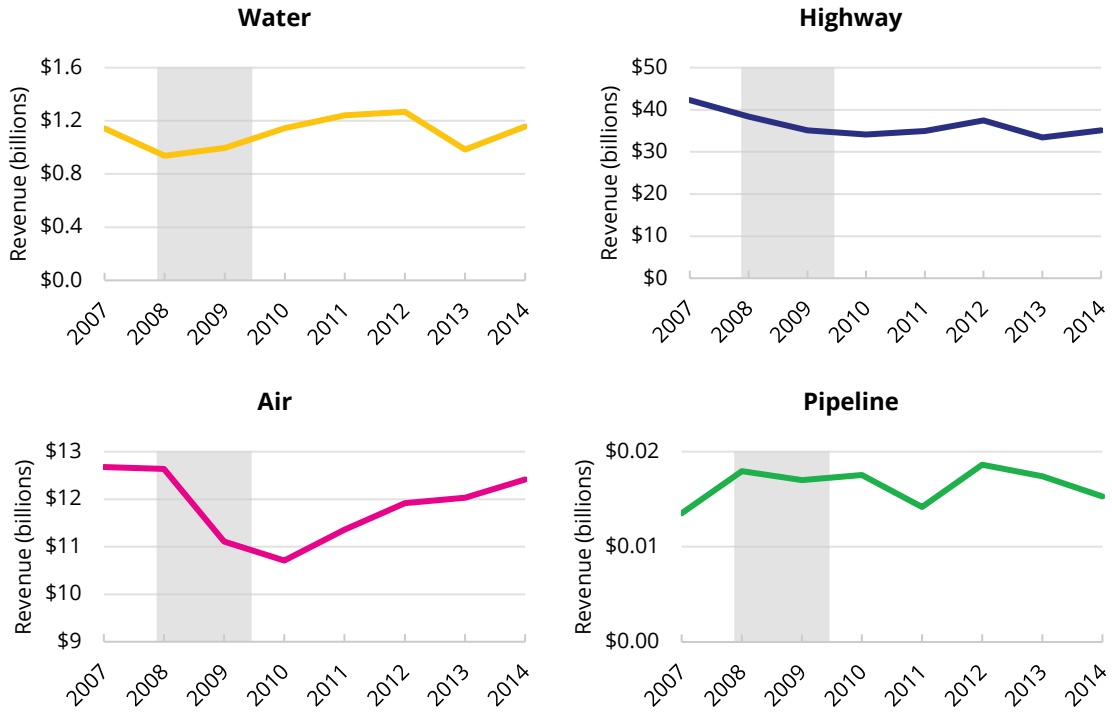
Figure 7-2: Federal Own-Source Revenue by Mode, 2014 (billions of current dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

In real 2009 dollars, highway trust fund revenues decreased by 16.9 percent from 2007 to 2014 (figure 7-3). Real revenues have declined because the Federal Government has not increased the federal taxes for gasoline and diesel—18.4 cents per gallon for gasoline and 24.4 cents per gallon—since October 1997. Revenues also declined because vehicle gas mileage improved by 13.8 percent from 2007 to 2014 among new passenger cars and because vehicle miles traveled declined by 2.7 percent from 2007 to 2011 due to the 2007 to 2009 recession. Highway revenues have been stable since the recession.

Figure 7-3: Trends in Federal Own-Source Revenue by Mode, 2007 to 2014 (billions of chained 2009 dollars)

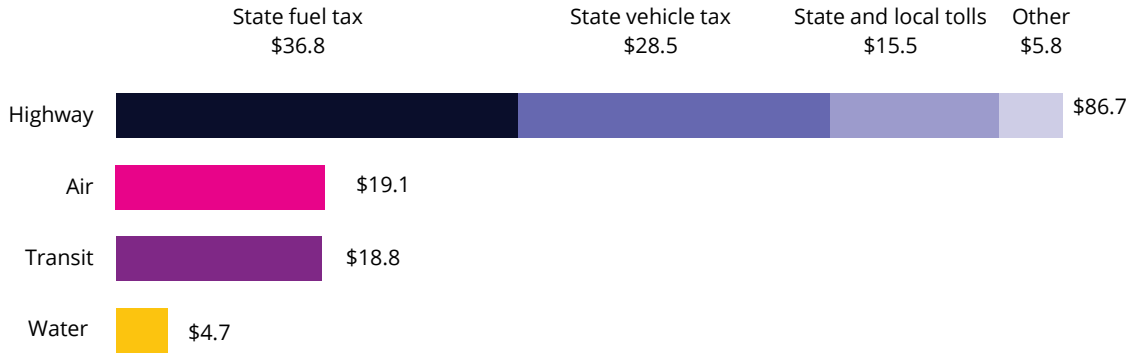


Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

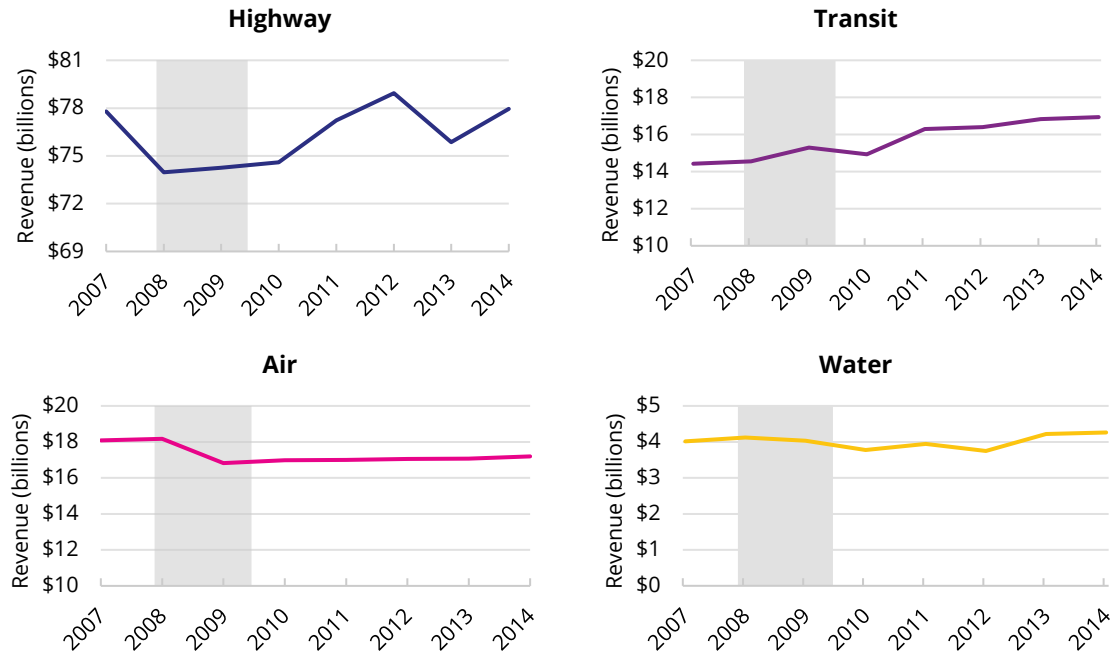
State and local governments collected $247.3 billion of the $355.7 billion (69.5 percent) in government revenues. Of this revenue, the state and local governments collected $129.4 billion from transportation-related activities, most of which is from highway revenue sources ($86.7 billion, or 67.0 percent of transportation revenue in 2014), which include fuel taxes, motor vehicle taxes, and tolls (figure 7-4). Aviation-related revenue ($19.1 billion, 14.8 percent) comes from landing fees, terminal area rentals, and several other sources. Transit revenue ($18.8 billion, 14.6 percent) is almost entirely from fares. In inflation-adjusted dollars, highway, aviation, and water revenues all declined during the recession, although highway and water revenue has since exceeded pre-recession levels (figure 7-5).

Figure 7-4: State and Local Own Source Revenue by Mode, 2014 (billions of current dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

Figure 7-5: Trends in State and Local Own Source Revenue by Mode, 2007 to 2014 (billions of chained 2009 dollars)



Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

Government Transportation Spending

Most government spending on transportation takes place at the state and local levels, although state and local capital expenditures are often paid for in part with federal funds (box 7-3). In 2014, the Federal Government spent $32.8 billion on transportation (excluding federal transfers to states), and state and local governments spent $291.2 billion (including expenditures paid for with federal transfers, such as the Federal-Aid Highway Program and the Airport and Airway Trust Fund).

Box 7-3: Government Transportation Expenditures

Transportation expenditures are outlays the government pays to provide an efficient and safe transportation system, regardless of the sources of funding and which agencies make the payments. Expenditures include both capital investments and money spent to maintain and operate the transportation system. Government expenditures on transportation that do not support the transportation system, such as paying for military shipments, are not included.

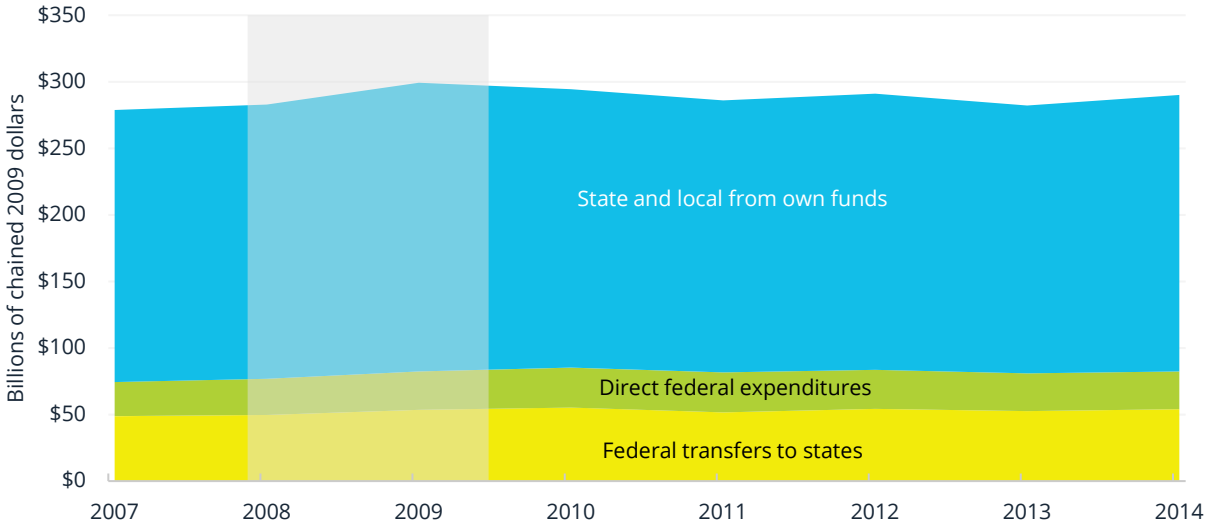
Federal expenditure data come from several sources, including the Office of Management and Budget's *Analytical Perspective* and the Federal Highway Administration's *Highway Statistics*. State and local expenditure data come primarily from the U.S. Census Bureau's *State and Local Government Finances* and from the National Transit Database.

This chapter shows state and local expenditure financed by federal funding separately. This makes it possible to see federal expenditures (including funding provided to state and local governments) and state and local expenditures (including federal funds received) without double-counting the federal funds provided to state and local governments.

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

In real 2009 dollars, transportation expenditures at all levels of government have increased since 2007 (figure 7-6). From 2007 to 2014, real direct federal expenditures increased by 10.4 percent (from $25.6 billion to $28.2 billion). Real federal transfers to states increased 10.7 percent (from $48.8 billion to $54.1 billion), while real state and local expenditures (excluding expenditures paid for with federal funds) increased by only 1.7 percent (from $204.3 billion to $207.8 billion). Governments increased transportation spending following the 2007 to 2009 recession to stimulate the economy. In 2009 the Federal Government enacted the American Recovery and Reinvestment Act of 2009, which authorized $48.1 billion in transportation stimulus spending. As a result, transportation expenditures by the Federal Government (direct federal expenditures and federal transfers to states) reached a peak in 2010 at $85.2 billion.

Figure 7-6: Federal, State, and Local Government Expenditures, 2007 to 2014 (billions of chained 2009 dollars)



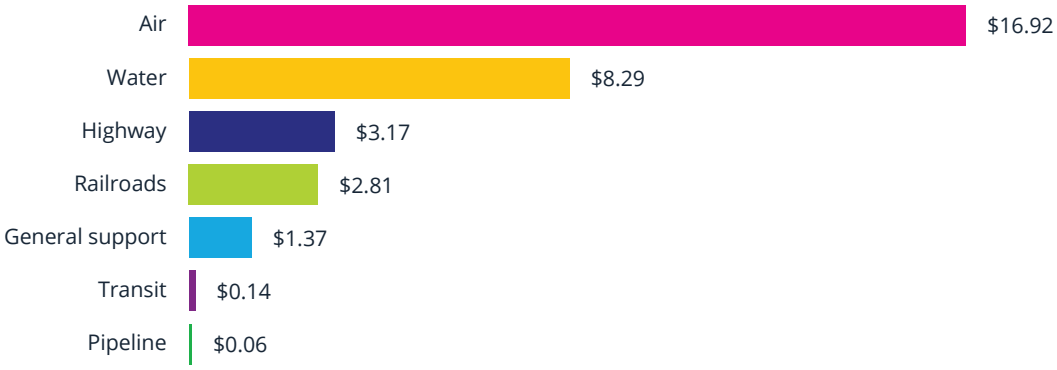
Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

Federal Transportation Spending by Mode

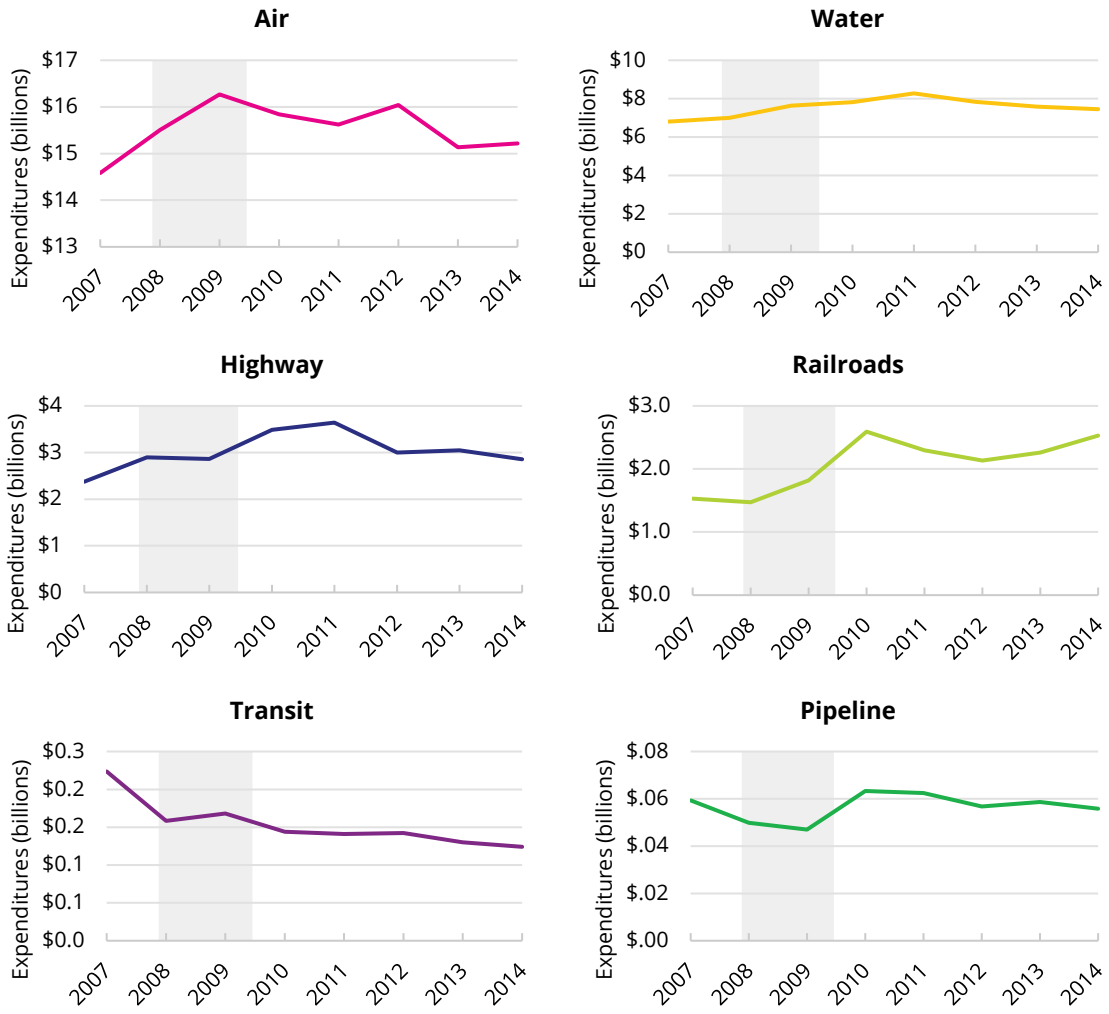
Most federal transportation spending (excluding federal transfers to states) is for aviation ($16.9 billion in 2014, or 51.7 percent) followed by water ($8.3 billion, or 25.3 percent) and highways ($3.2 billion, or 9.7 percent) (figure 7-7 and box 7-3). In real 2009 dollars, federal highway spending peaked in 2011 with the recession stimulus spending, and then declined (figure 7-8).

Figure 7-7: Federal Transportation Expenditures by Mode, 2014 (billions of current dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

Figure 7-8: Trends in Federal Transportation Expenditures by Mode, 2007 to 2014 (billions of chained 2009 dollars)



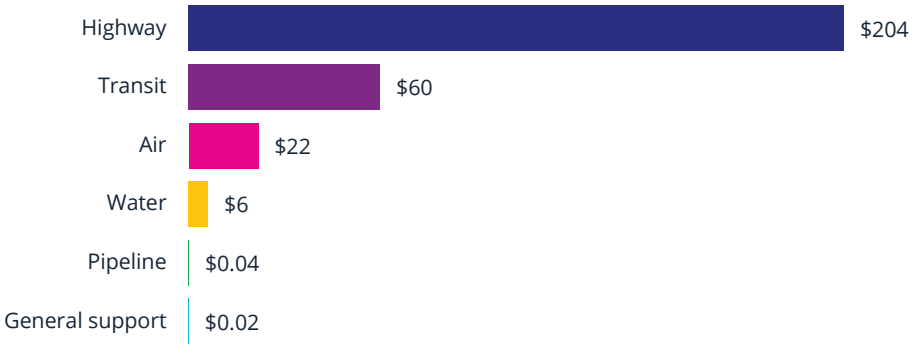
Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

State and Local Transportation Spending by Mode

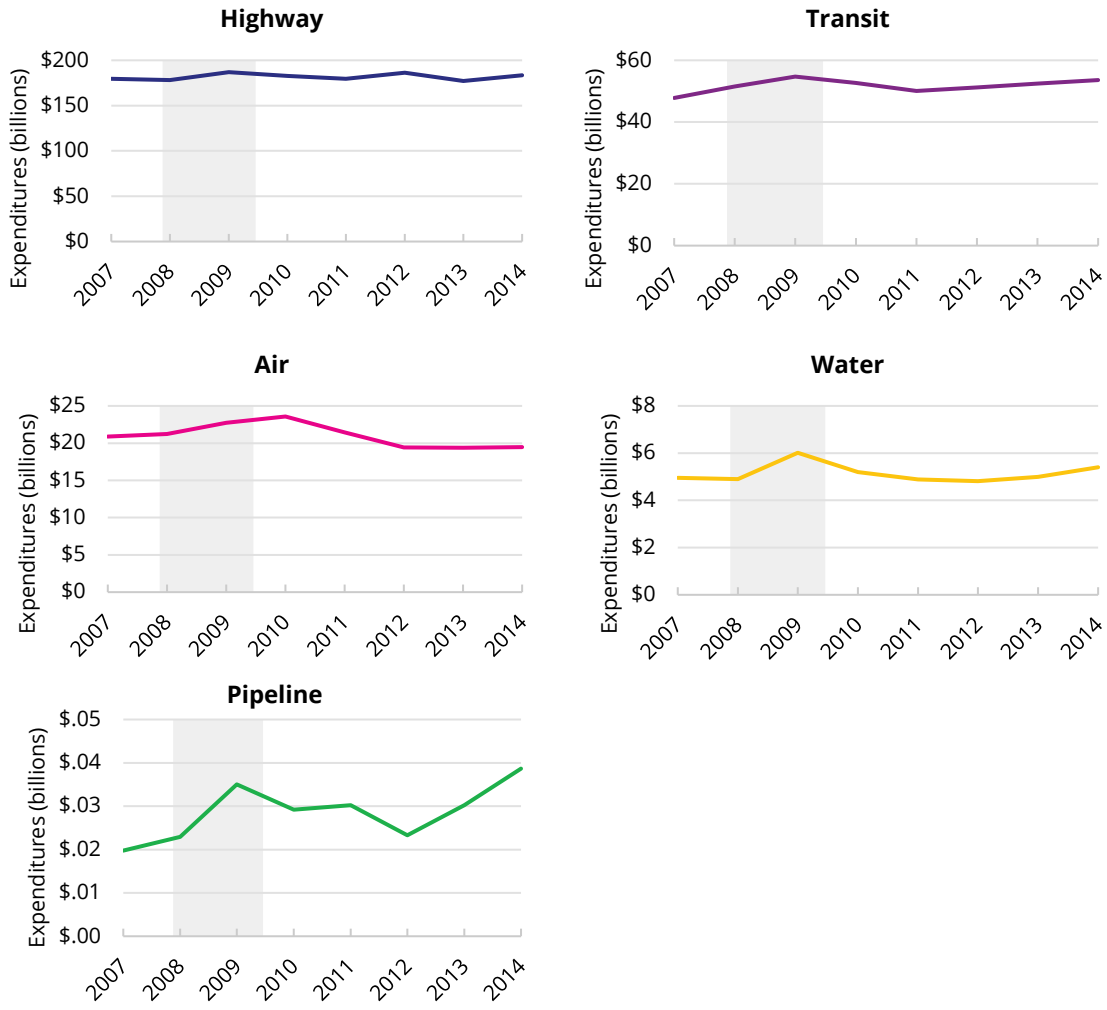
In 2014, 70.0 percent ($203.9 billion) of state and local spending on transportation (including expenditures paid for with federal grants) went to highways, and 20.5 percent ($59.6 billion) went to transit (figure 7-9). The remaining amount went to air ($21.7 billion, 7.4 percent), water ($6.0 billion, 2.1 percent), pipeline ($.04 billion, 0.01 percent), and general support ($0.02 billion, 0.01 percent) (figure 7-10).

Figure 7-9: State and Local Expenditures by Mode, 2014 (billions of current dollars)



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

Figure 7-10: Trends in State and Local Expenditures by Mode, 2007 to 2014 (billions of chained 2009 dollars)

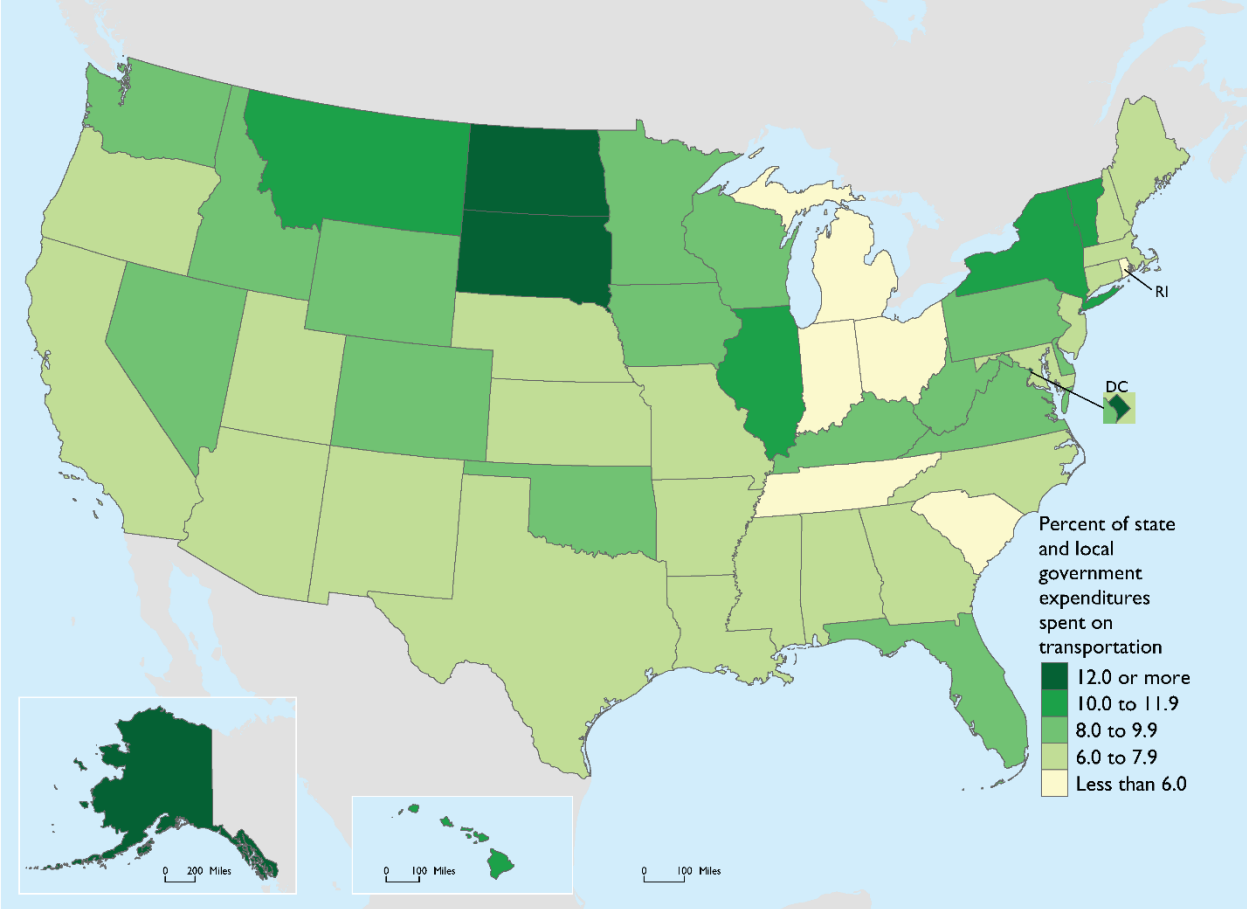


Note: Shaded areas indicate economic recessions.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

Figure 7-11 shows the percentage of total expenditures that each state and its local governments spent on transportation in 2014 (box 7-4). There is a regional pattern with higher expenditures in low-density, resource-rich states in the northern Great Plains. These states have considerable demand for transportation to support industries that rely on bulky, transportation-intensive products, such as oil, coal, and minerals.

Figure 7-11: Proportion of State and Local Government Expenditures Spent on Transportation, 2014



Source: U.S. Department of Commerce, Census Bureau, *Census of State and Local Governments*, 2014, available at www.census.gov.

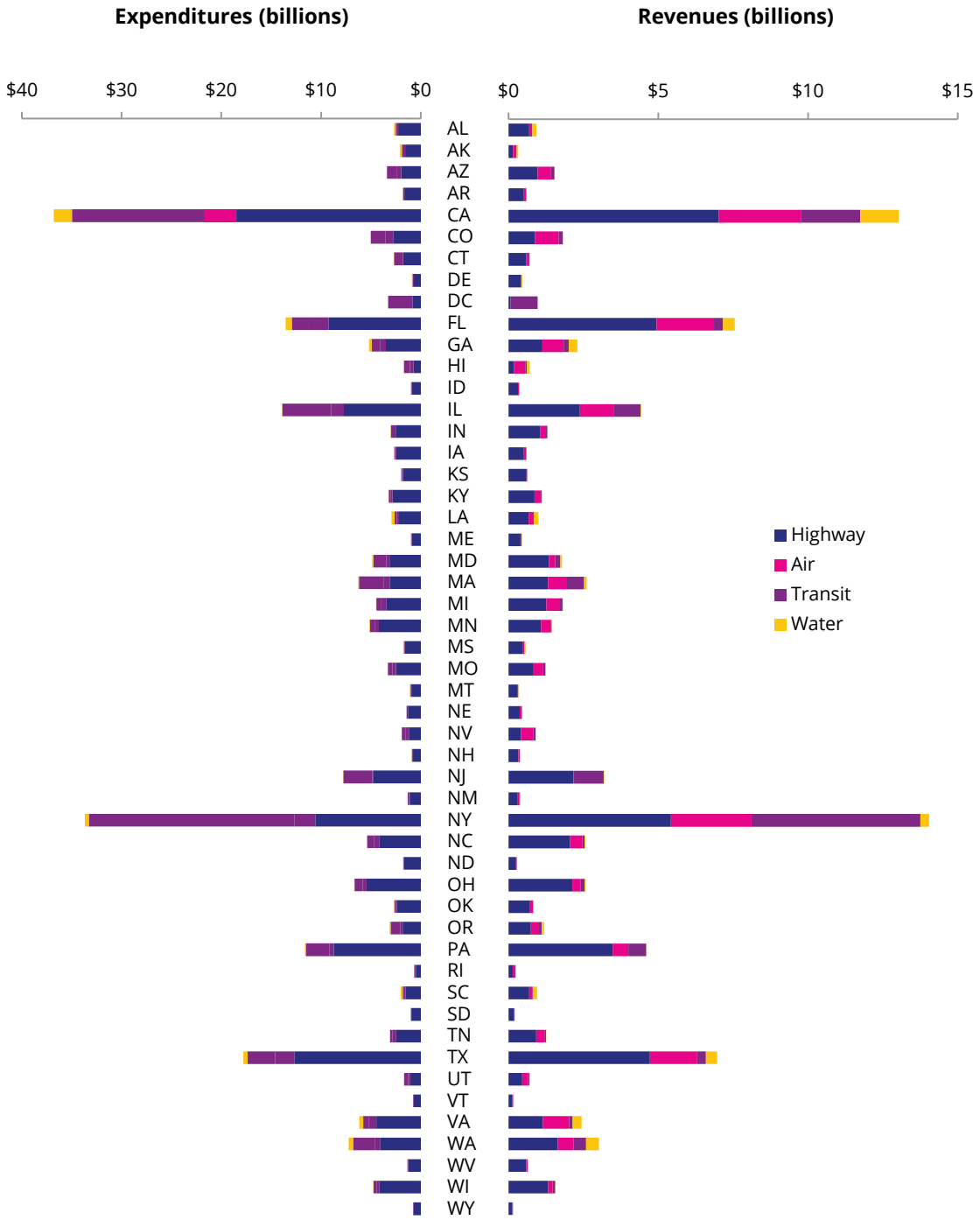
Box 7-4: State Transportation Finance

State transportation expenditure data come from the U.S. Census Bureau's *State and Local Government Finances*, which conducts a full census of state and local governments every 5 years and a sample survey in the intervening years. Federal and state transit spending data come from a survey of state transportation departments conducted by the American Association of State Highway and Transportation Officials. The data do not include local government expenditures on transit.

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

States and local governments also allocate funds among transportation modes differently because they have different geographies and economies, which lead to different transportation needs. For example, state and local governments in the District of Columbia and New York devoted over half of their transportation expenditures to transit (75.7 and 61.2 percent, respectively) in 2014 (figure 7-12). In contrast, inland low-density states in the Great Plains like North Dakota and Kansas spent over 90 percent of their transportation expenditures on highways. Hawaii and Nevada spent just over 20 percent (20.3 and 20.2 percent, respectively) on aviation. Finally, Louisiana and South Carolina, which have economically significant ports, spent greater percentages on water transportation (10.9 and 10.1 percent) than other states spent.

Figure 7-12: Transportation Expenditures and Revenues by State and Local Governments, 2014



Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *State Transportation Statistics*, Table 6-8, available at www.bts.gov.

Public-Private Partnerships

Public-private partnerships (PPPs) (box 7-5) are another method to finance, build, and operate transportation projects, such as public transportation networks. Most of the data presented in this chapter on state and local government revenue and spending comes from the U.S. Census Bureau's *State and Local Government Finances* or similar sources of government spending. Investment by a local government in a PPP is captured as a local government expenditure in these sources. Because these sources capture only government spending, the private portion of the investment would not be captured. Toll revenues accruing to state and local governments are included in U.S. Census Bureau's *State and Local Government Finances*, but toll revenues to PPPs that do not go to local governments are not included.

Box 7-5: Public-Private Partnership (PPP)

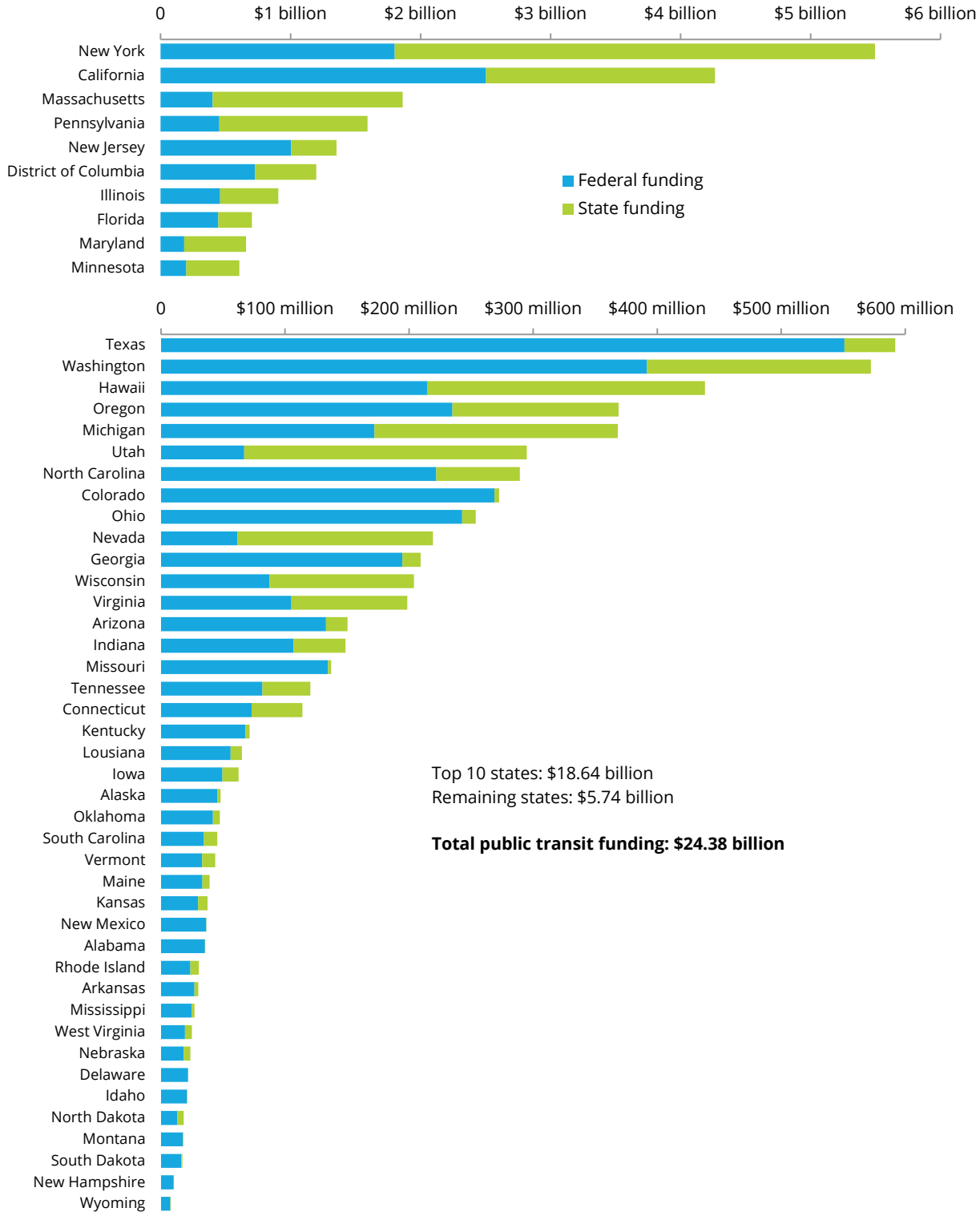
A *public-private partnership (PPP)* is a contractual agreement formed between public and private sector partners. The agreements usually involve a government agency contracting with a private company to renovate, construct, operate, maintain, or manage a facility or system. While the agency usually retains ownership in the facility or system, the private company will be given additional decision rights to determine how the project or task will be completed.

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

State and Federal Funding of Public Transit

The amount that states spend on public transit varies by state, as does the relative share of state and Federal Government spending on transit (box 7-4). In 2015 New York had the highest state and federal transit expenditure at $5.50 billion, with the state government contributing $3.70 billion, or 67.2 percent, and the Federal Government contributing $1.80 billion, or 32.8 percent (figure 7-13). Figure 7-13 shows that 10 states (including the District of Columbia) account for $18.64 billion of the $24.38 billion spent on public transportation, or over three-quarters of all transit expenditures (76.5 percent). Within the top 10 states, the proportion of state spending on transit ranges from a low of 25.7 percent in New Jersey to a high of 78.5 percent in Massachusetts. While the top 10 states have average expenditures of $1.86 billion, the remaining states have average expenditures of $140 million.

Figure 7-13: Federal and State Funding of Public Transit, 2015



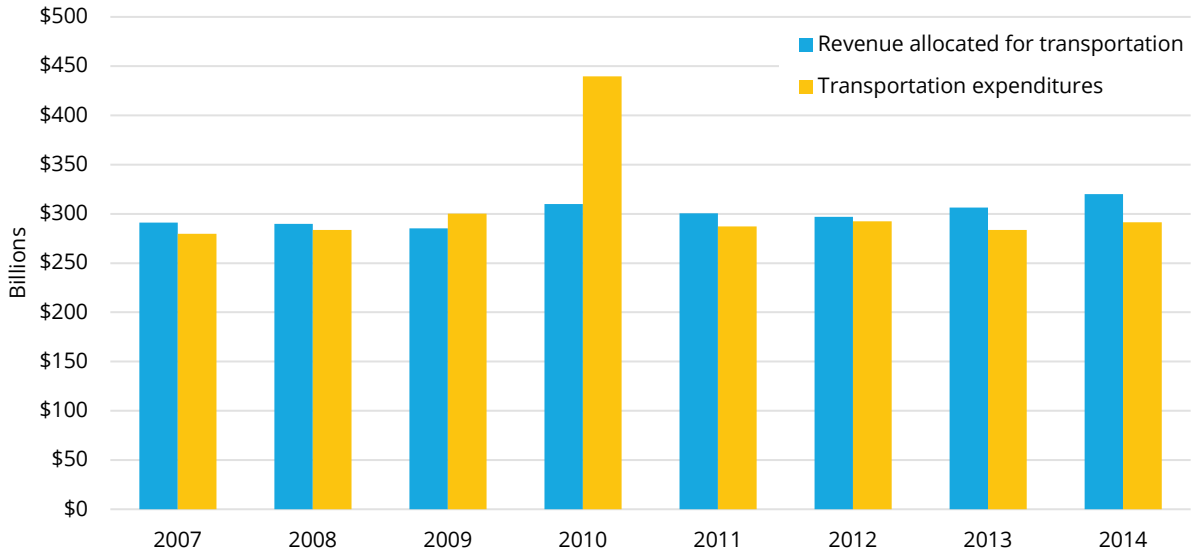
Source: U.S. Department of Transportation, Federal Transit Administration, National Transportation Database, 2015 Funding Sources, available at www.transit.dot.gov/ntd.

Government Transportation Revenue and Expenditures

Revenue from transportation-related activity and dedicated to transportation programs falls short of government transportation expenditures. In 2014 transportation revenues covered 56.7 percent of expenditures. The gap between transportation revenues and expenditures has declined since 2009, when revenues covered 52.5 percent of expenditures. When transportation revenues do not cover expenditures, general tax receipts (e.g., from sales and property taxes), trust fund balances, and borrowing are needed to cover shortages.

Figure 7-14 illustrates transportation revenue and transportation expenditures for all levels of government from 2007 to 2014 in chained 2009 dollars. Transportation revenue includes the revenue collected from transportation activity as well as supporting revenue from other sources like general funds. Transportation expenditures exceeded revenues in 2009 and 2010, when the American Recovery and Reinvestment Act of 2009 increased transportation stimulus spending. In 2010, transportation expenditures peaked at $440 billion, exceeding transportation revenue by $130 billion.

Figure 7-14: Government Transportation Revenue and Expenditures, 2007 to 2014 (billions of chained 2009 dollars)



Note: Revenue includes own-source revenue and supporting revenue.

Source: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics,* available at www.bts.gov.

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).

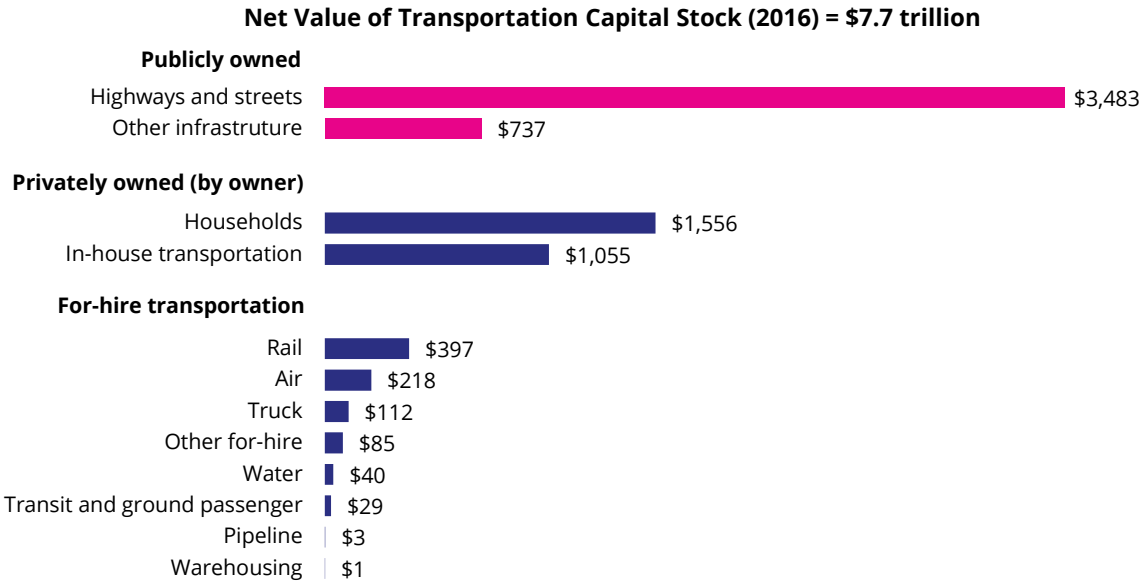
Transportation capital stock is owned by both the public and private sectors. In 2016, the public sector owned $4.2 trillion (54.7 percent), while the private sector owned $3.5 trillion (45.3 percent) (figure 8-1). Public highways and streets accounted for the largest share of publicly owned transportation 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.

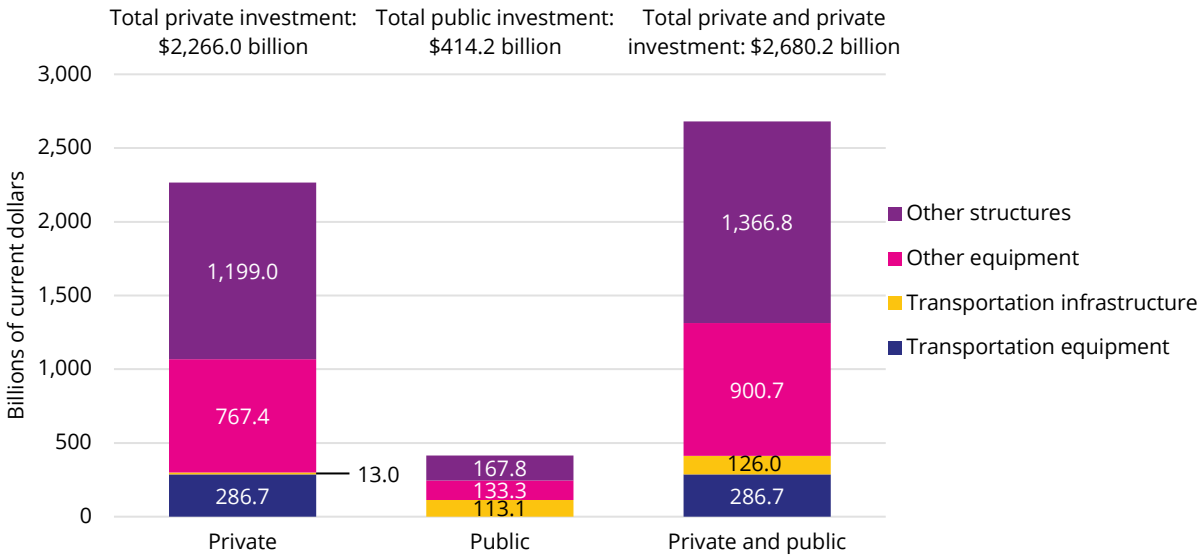
Box 8-2: Sources of Highway Investment Estimates

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.

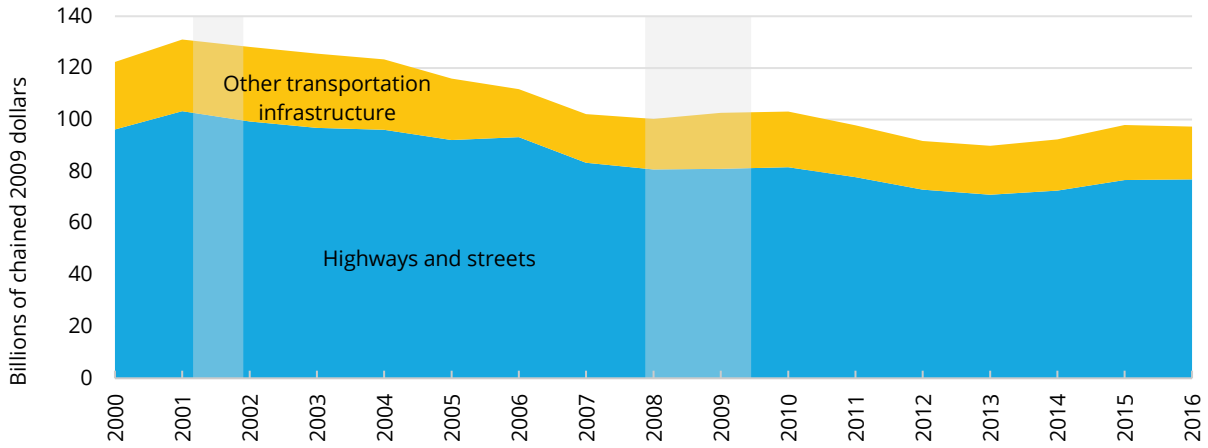
Source: U.S. Department of Commerce, Bureau of Economic Analysis, Private Fixed Investment in Structures by Type (Table 5.4.5) and Gross Government Fixed Investment by Type, Chained Dollars (Table 5.9.5B), available at www.bea.gov/iTable/index_nipa.cfm as of October 2017.

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.

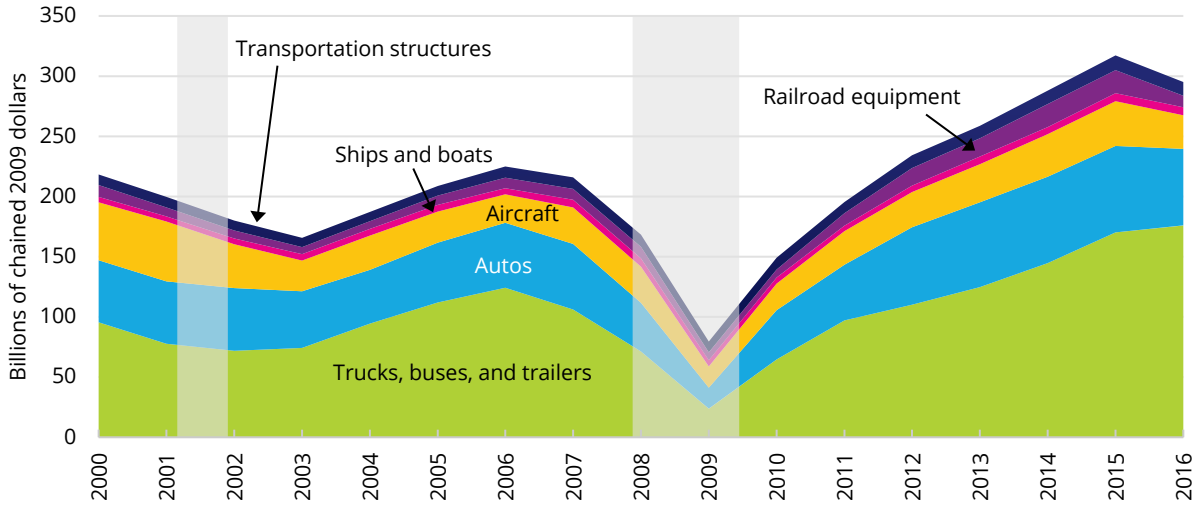
Source: U.S. Department of Commerce, Bureau of Economic Analysis, Real Gross Government Fixed Investment by Type, Chained Dollars (table 5.9.6B), available at www.bea.gov/iTable/index_nipa.cfm as of October 2017.

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)

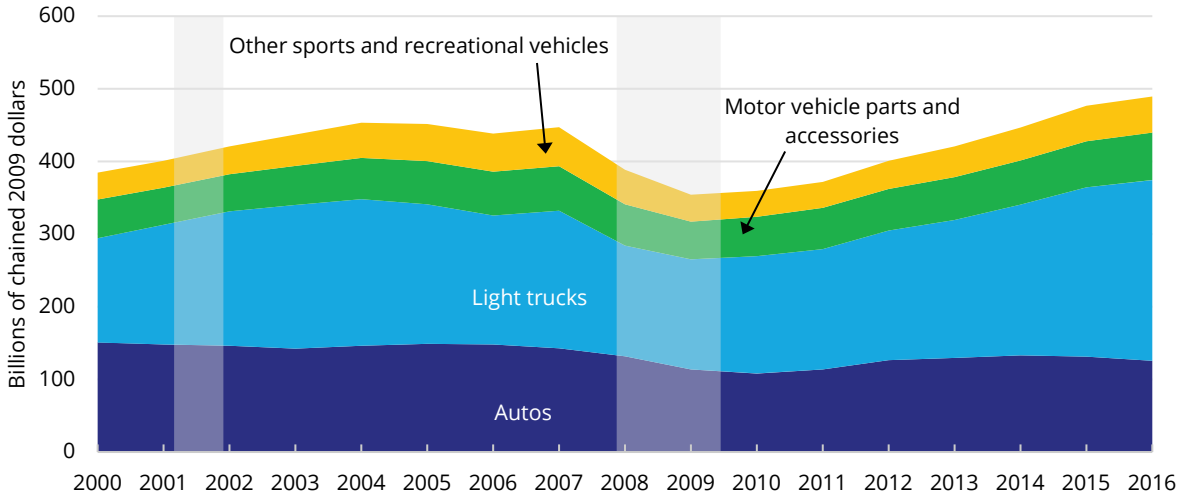


Note: Includes net purchase of used vehicles. Shaded areas indicate economic recessions.

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.

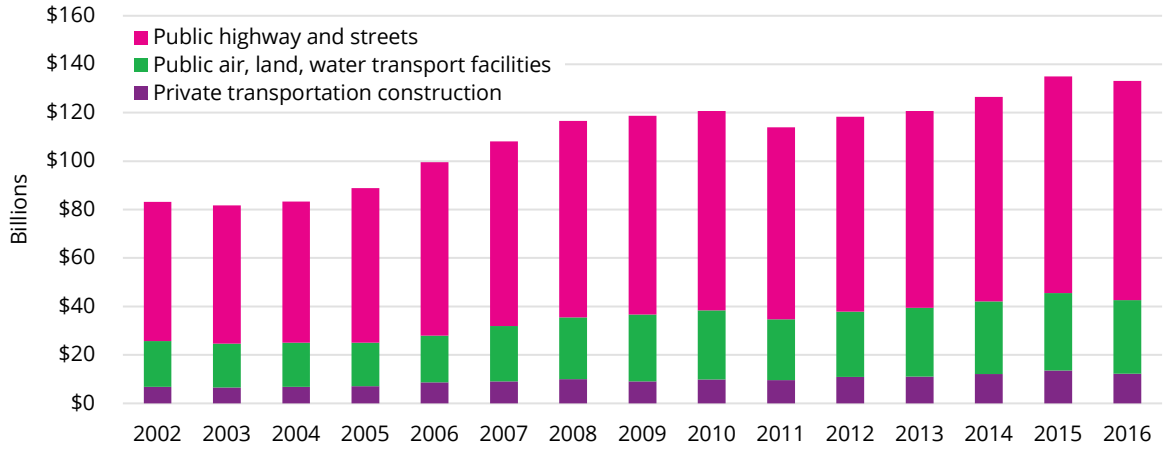
Value of Construction Put in Place

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.

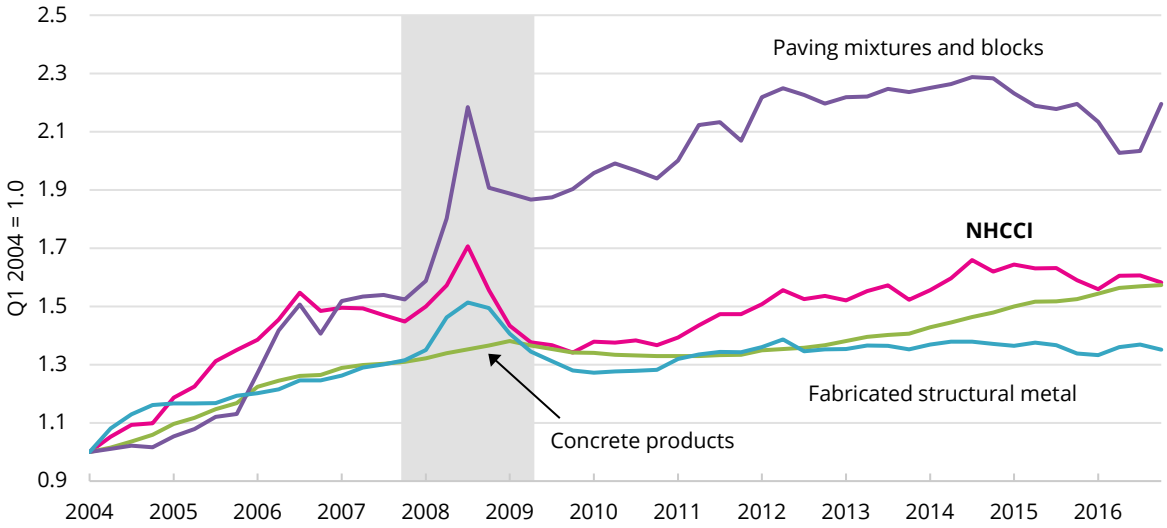
Box 8-3: National Highway Cost Construction Index

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.

GLOSSARY

Capital stock
Assets that are durable and expected to remain in service for at least one year. Examples of transportation capital stock include bridges, stations, highways, streets, and ports; and equipment such as automobiles, aircraft, and ships.

Chaining (chained dollars)
Method of inflation adjustment that allows for comparing dollar value changes between years.

Consumption goods
Assets that are expected to remain in service for less than a year.

Consumer Price Index (CPI)
Measure of changes in the prices paid by urban consumers for a representative basket of goods and services.

Fixed assets
Produced assets used to produce other goods or services, including other fixed assets, for more than one year. Fixed transportation assets include transportation structures, motor vehicles, and equipment such as aircraft, ships, and boats.

For-hire transportation
Transportation operated on behalf of or by a company that provides services to external customers for a fee. For-hire transportation differs from private transportation services in which a firm transports its own freight and does not offer its transportation services to other shippers.

Gross Domestic Product (GDP)
The total value of goods and services produced by labor and property in the United States. As long as the labor and property are located in the United States, the suppliers may be United States or foreign residents.

In-house transportation
Transportation services provided within a firm whose main business is not transportation, such as a grocery store using its own truck fleet to move goods from warehouses to retail outlets.

Inventories-to-sales ratio
The value of goods on shelves and warehouses divided by monthly sales. For example, a ratio of 2.5 would show that a business has enough goods to cover sales for 2.5 months

Multifactor productivity
Measure of economic performance that compares the amount of goods and services produced (output) to the amount of combined inputs used to produce those goods and services. Inputs can include labor, capital, energy, materials, and purchased services.

Nominal dollars
Dollar amount that reflects current prices and quantities current at the time the measure was taken, and does not take inflation into account.

Own-source revenue
Taxes and charges levied on transportation-related activities and used specifically for transportation.

Passenger mile
One passenger transported one mile. For example, one vehicle traveling 3 miles carrying 5 passengers generates 15 passenger-miles.

Producer Price Index (PPI)
Measure of the average change over time in the selling prices received by domestic producers for their output.

Productivity
Measure of economic performance that equals the ratio of total output to the inputs used in the production process. Inputs may include capital, labor, energy, materials, and services.

Real dollars
Dollar amount adjusted for changes in prices over time due to inflation.

Seasonal adjustment
Statistical method for estimating and removing seasonal movement from a time series.

Supporting revenue
Funds collected from non-transportation-related activities but dedicated to support transportation programs.

Ton-mile
Unit of measure equal to movement of 1 ton over 1 mile.

Transportation infrastructure
Structures that support a transportation system, including highways and streets, bridges, railroads, and other transportation structures. It does not include transportation equipment like motor vehicles, aircraft, and ships.

Transportation-related final demand
Measure of the expenditures by households, private firms, and the government on final goods and services related to transportation. It includes personal consumption expenditures, private investment, government purchases, and net exports related to transportation goods and services.

Transportation Services Index (TSI)
Monthly measure showing the relative change in the volume of services over time performed by the for-hire transportation sector. The TSI covers the activities of for-hire freight carriers, for-hire passenger carriers, and a combination of the two.

Unlinked trips
Number of passengers boarding public transportation vehicles. Passengers are counted each time they board vehicles, no matter how many vehicles they use to travel from their origin to their destination.

ACRONYMS AND INITIALISMS

Acronym or Initialism	Term
AAA	American Automobile Association
AASHTO	American Association of State Highway and Transportation Officials
BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
BTS	Bureau of Transportation Statistics
CE	Consumer Expenditure Survey
CPI	Consumer Price Index
CPI-U	Consumer Price Index for all Urban Consumers
EIA	Energy Information Administration
FHWA	Federal Highway Administration
GDD	Gross Domestic Demand
GDP	Gross Domestic Product
IPS	Industry Productivity Studies
MFP	Multifactor Productivity
MSP	Major Sector Productivity
NAICS	North American Industry Classification System
NHCCI	National Highway Construction Cost Index
NHTS	National Household Travel Survey
NIPA	National Income and Product Accounts
OES	Occupational Employment Statistics
PCE	Personal Consumption Expenditures
PPI	Producer Price Index
SOC	Standard Occupational Classification
STS	State Transportation Statistics
TSAR	Transportation Statistics Annual Report
TSAs	Transportation Satellite Accounts
TSI	Transportation Services Index
VMT	Vehicle Miles Traveled

Printed on paper containing recycled post-consumer waste paper