





Transportation Economic Trends 2018

U.S. Department of Transportation
Office of the Secretary of Transportation
Bureau of Transportation Statistics

TRANSPORTATION ECONOMIC TRENDS
2018

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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 2018* highlights important trends in transportation and the economy, and explains related economic concepts and data sources for a general audience. The 2018 edition builds on the 2017 edition with updated data and new content.

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.

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1 Summary Indicators

Key Takeaways

- Freight movement and passenger travel, as measured by the Transportation Services Index (TSI) (a monthly measure of transportation activity), recovered from the December 2007 through June 2009 Great Recession at different rates. Passenger travel took longer to recover despite declining less during the recession.
- Manufacturers' shipments and industrial production grew from early 2016 through mid-2018 (the latest available data) creating increased demand for freight transportation services that saw U.S. freight shipments climb to record levels in 2017. Growth in the TSI during this time period reflects this demand.
- All freight transportation modes, except rail, moved record volumes in 2017, resulting in the freight TSI reaching multiple monthly record highs.
- Air freight volumes declined from early 2011 to early 2014—a period when air freight traffic stagnated worldwide due to weak global trade. Air freight grew from early 2014 to an all-time high in June 2018 before declining slightly and remaining below the June peak as of August 2018 (the latest available data).
- Passenger transportation also reached record levels. Air travel reached an all-time high in August 2018 (the latest available data).

Introduction

Transportation not only makes economic activity possible by enabling the production of goods and services—for instance, carrying the raw materials needed to manufacture goods—but also serves as a major economic activity in and of 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 activity in the economy, while Chapter 2 measures the indirect and direct contribution of transportation to the economy.

Transportation Services Index (TSI)

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*[1] in the United States (box 1-1).

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 1-2 illustrates trends in the TSI from January 2000 to August 2018. Overall, the combined TSI increased by 31.8 percent, the freight TSI increased by 28.5 percent, and the passenger TSI increased by 39.1 percent. However, all three measures declined in the wake of the September 2001 terrorist attacks. The passenger

[1] For-hire transportation consists of the services provided by transportation firms to industries and the public on a fee basis. Examples of for-hire transportation include airlines, railroads, transit agencies, common carrier trucking companies, and pipelines. Chapter 2 discusses other types of transportation.

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. The TSI includes only domestic "for-hire" transportation operated on behalf of or by a company that provides freight or passenger transport services to external customers for a fee. Not included in for-hire passenger transportation are taxi, paid ride services in personal motor vehicles (e.g., Uber, Lyft, etc.), intercity bus services, and noncommercial passenger travel (e.g., trips in the household car). For-hire transportation also does not include transportation services carried out by firms for their own purposes, known as in-house transportation (e.g., goods moved by trucks owned and operated by a firm). The for-hire transportation services covered in the TSI constitutes slightly more than half of all transportation services (excluding noncommercial passenger travel).[1]

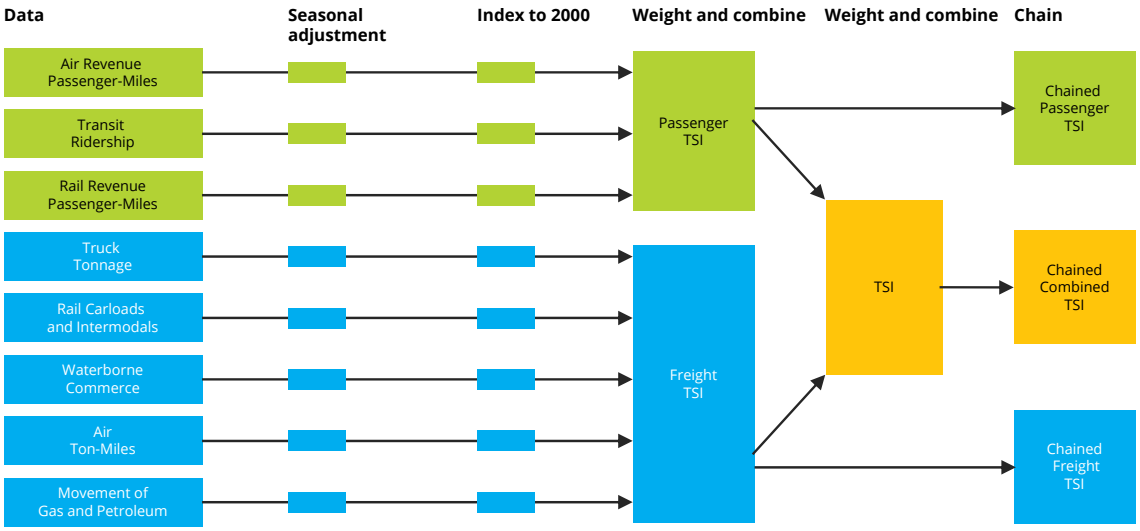
[1] Calculated from industry output shown in the U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts 2016, available at www.bts.gov as of August 2018.

Each TSI index shows the month-to-month change in for-hire transportation services. BTS seasonally adjusts the monthly data for each transportation mode and then combines to produce 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 passenger and freight modes. These indexes serve both as multimodal monthly measures of the state of transportation and as indicators of the U.S. economic future.

BTS research shows that changes in the freight TSI occur before changes in the economy, making the freight TSI a potentially useful economic indicator.[2]

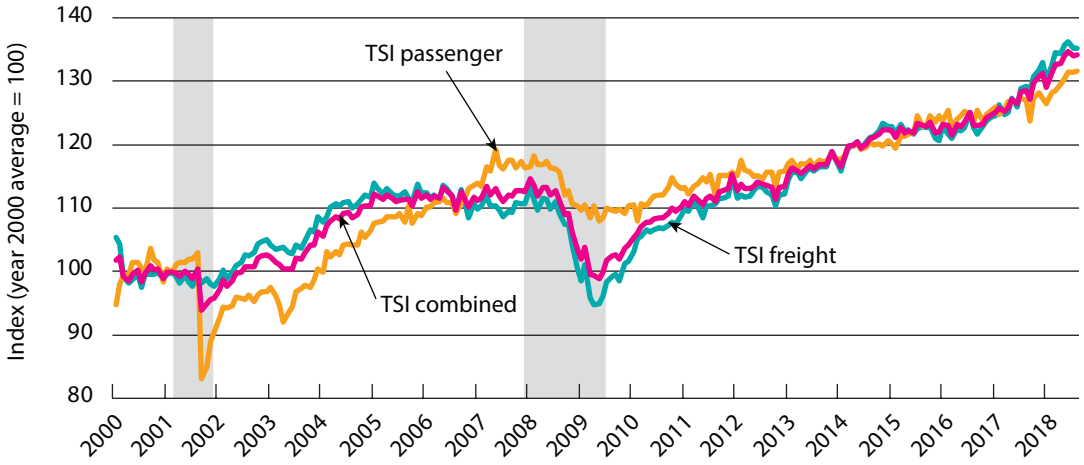
[2] See U.S. Department of Transportation, Bureau of Transportation Statistics, "TSI and the Economy Revisited," December 2014, available at https://www.bts.gov/archive/publications/special_reports_and_issue_briefs/special_report/2014_12_10/entire.

Figure 1-1 Transportation Services Index (TSI) Components



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

Figure 1-2 Transportation Services Index (TSI), January 2000 to August 2018



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 as of November 2018.

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, however, 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.

Chained indexing addresses these issues by employing 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 https://www.bts.gov/archive/publications/special_reports_and_issue_briefs/special_report/2014_12_10/entire.

TSI dropped sharply—19.4 percent in September 2001 from the previous month due to significant declines in passenger air travel. The indexes also decreased sharply during the Great Recession from December 2007 to June 2009. Declines in freight activity began 1 month after the onset of the Great Recession, with the freight TSI falling 16.2 percent from January 2008 through May 2009.[2] Passenger activity began to decline 7 months prior to the Great Recession (in May 2007), with the passenger TSI falling from May 2007 to May 2009 by 9.5 percent. The freight TSI rose above its pre-recession (January 2008) peak in June 2012, declined, and then rose to a consistent level about its June 2012 peak in January 2013. The passenger TSI rose above its pre-recession (May 2007) peak in March 2014 – taking longer to recover than the freight TSI despite declining less during the recession.

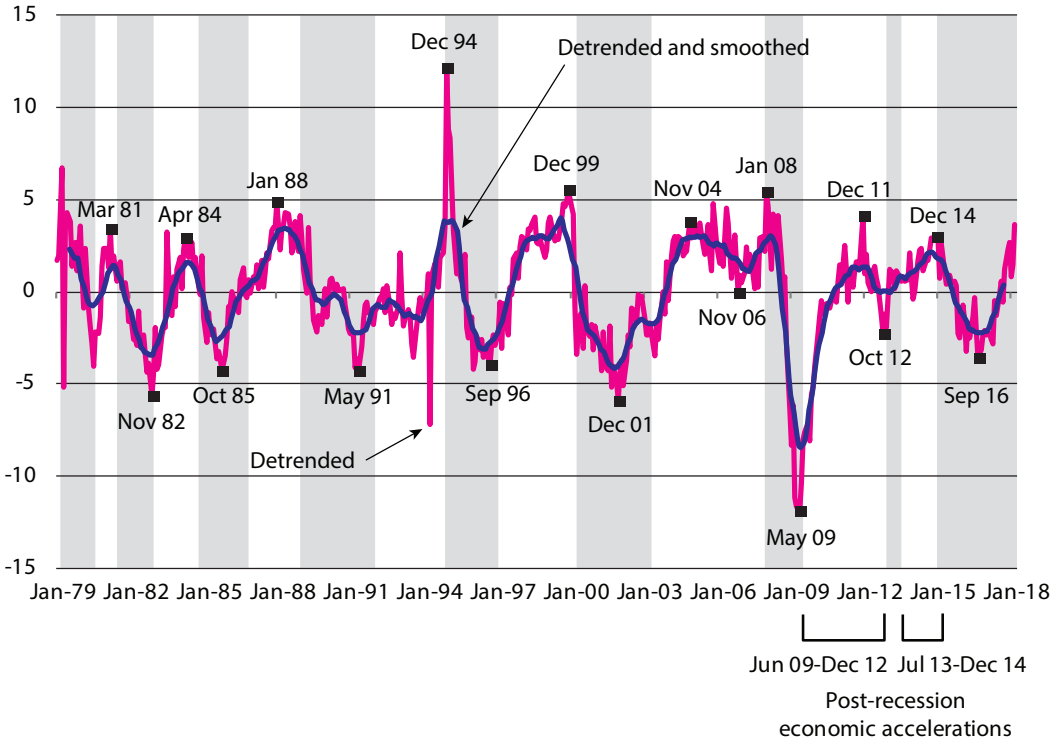
TSI and the Economy

BTS research shows that changes in the TSI occur before changes in the economy, making the TSI a potentially useful economic indicator.[3] Figure 1-3 illustrates the relationship between

[2] For more information on the relationship of the TSI to economic recessions, see U.S. Department of Transportation, Bureau of Transportation Statistics, "TSI and the Economy Revisited," December 2014, available at https://www.bts.gov/archive/publications/special_reports_and_issue_briefs/special_report/2014_12_10/entire.

[3] See U.S. Department of Transportation, Bureau of Transportation Statistics, "TSI and the Economy Revisited," December 2014, available at https://www.bts.gov/archive/publications/special_reports_and_issue_briefs/special_report/2014_12_10/entire.

Figure 1-3 Freight Transportation Services Index and the Economic Growth Cycle, January 1979 to March 2018



NOTES: Shaded areas indicate decelerations in the economy, and areas between are accelerations in the economy (growth cycles). Endpoint for deceleration begun in December 2014 has not been determined. 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 removes 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 as of May 2018.

the freight TSI and the national economy from January 1979 to March 2018. The dashed red line shows the freight TSI detrended to remove long-term changes. The solid blue line shows the freight TSI detrended and smoothed to remove 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 marked in figure 1-3 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 (marking the end of the recession) to December 2012, and the second from July 2013 to December 2014. BTS research shows that, as before, the freight TSI led both accelerations; however, the relationship between the freight TSI and these growth cycles changed somewhat.[4] The freight TSI reached a peak in December 2011 and then turned downward 12 months before the economic deceleration began in December 2012. The freight TSI then turned a second time before the December 2012 economic deceleration. Historically, the freight TSI had not turned twice

[4] See U.S. Department of Transportation, Bureau of Transportation Statistics, "Long Term Growth in Freight Transportation Services: Methods and Findings," available at https://www.bts.gov/topics/transportation-and-economy/long-term-growth-freight-transportation-services-0 as of July 2018.

Box 1-3 Expansions, Recessions, and Growth Cycles

In an economic expansion, the economy grows in real terms, as shown by increases in statistics like employment, industrial production, sales, and personal incomes. In a recession, the economy contracts, as shown by decreases in those statistics. In the United States, the National Bureau of Economic Research (NBER) decides 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. Economists measure an expansion from the trough (or bottom) of the previous business cycle to the peak of the current cycle, while a recession 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.

before 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 economic deceleration. Freight activity began to grow in September 2016, marked by the freight TSI turning upwards. As of March 2018, freight activity continues to increase.

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. BTS presents other economic measures as indexes for comparability with the TSI.

Gross Domestic Product

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. After accounting for inflation, increases in GDP reflect increases in the production and demand for goods and services. To produce more goods and deliver them to consumers, industries require additional freight transportation services. Thus, GDP and freight activity, as measured by the freight TSI, tend to rise and fall at the same time. The magnitude of growth and decline, however, may be different. For example, if the sectors requiring the least freight transportation services drive the growth in GDP, then the demand for additional freight transportation services may grow more slowly than GDP.

Between the first quarter of 2000 and the second quarter of 2018, real GDP increased 43.2 percent, and the freight TSI increased by 31.5 percent (figure 1-4). This growth hides the extended period of decline during the Great Recession. From the fourth quarter of 2007 to the second quarter of 2009, GDP decreased 4.0 percent, and the freight TSI decreased 13.9 percent. Both measures have since recovered to prerecession levels. The freight TSI, however, recovered more slowly than GDP after the Great Recession. This difference may be explained by slow post-recession growth in manufacturing and retail sales, both of which are major sources of demand for freight transportation.[5]

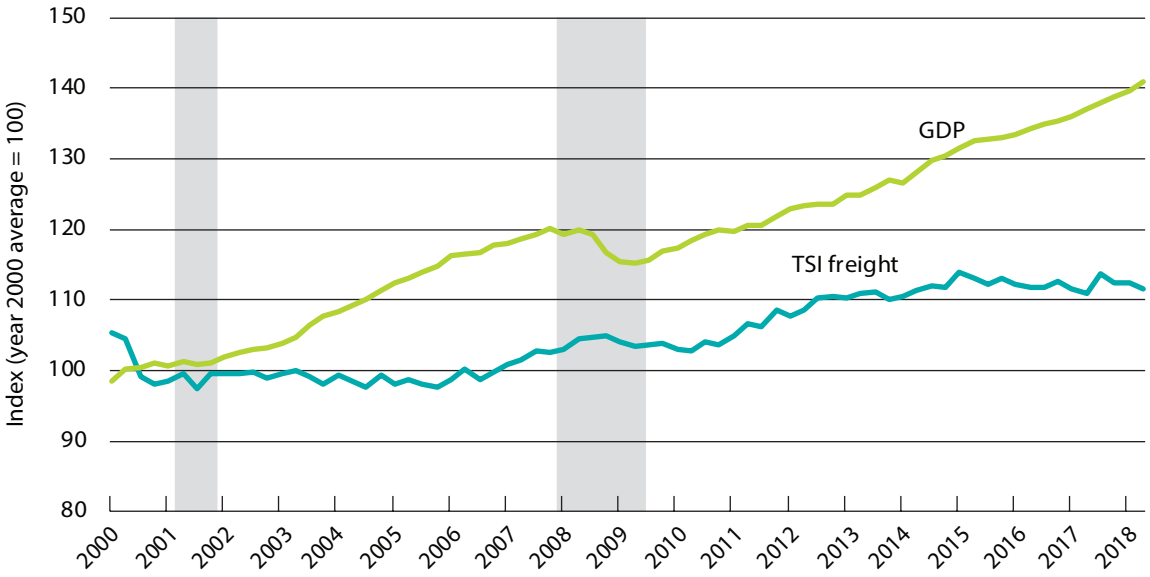
Industrial Production and Manufacturers' Shipments

Industrial production and manufacturers' shipments generate major sources of demand for freight transportation services (box 1-4). When these shipments declined during the Great Recession, the freight TSI declined as well (figure 1-5). From December 2007 to June 2009, industrial production declined by 17.4 percent, manufacturers' shipments declined by 21.5 percent, and the freight TSI declined by 13.2 percent.

Industrial production and manufacturers' shipments both grew after the Great Recession, generating renewed demand for freight

[5] See U.S. Department of Transportation, Bureau of Transportation Statistics, "Long Term Growth in Freight Transportation Services: Methods and Findings," available at https://www.bts.gov/topics/transportation-and-economy/long-term-growth-freight-transportation-services-0 as of July 2018.

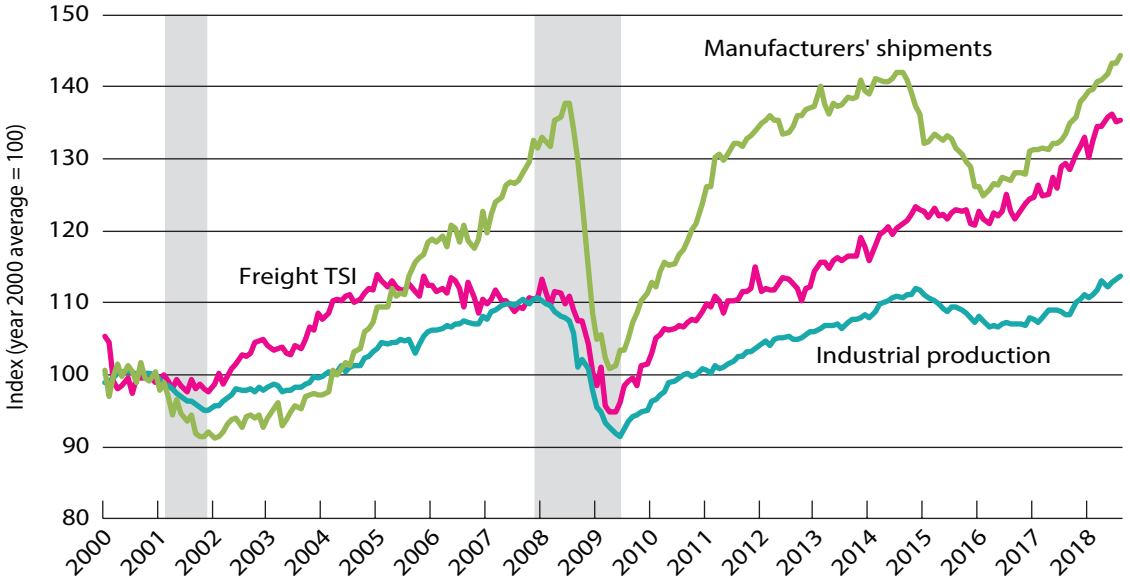
Figure 1-4 Real Quarterly Gross Domestic Product and Freight Transportation Services Index (TSI) (seasonally adjusted), Q1 2000 to Q2 2018



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 apps.bea.gov/iTable/index_nipa.cfm as of November 2018. **Freight TSI**: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI as of November 2018.

Figure 1-5 Monthly Industrial Production, Manufacturers' Shipments, and Freight Transportation Services Index (TSI) (seasonally adjusted), January 2000 to August 2018



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/ as of November 2018. **Manufacturers' Shipments**: U.S. Bureau of the Census, Value of Manufacturers' Shipments for All Manufacturing Industries, available at www.census.gov/manufacturing/m3 as of November 2018. **Freight TSI**: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at https://www.transtats.bts.gov/OSEA/TSI as of November 2018.

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. The survey excludes freight charges and excise taxes.

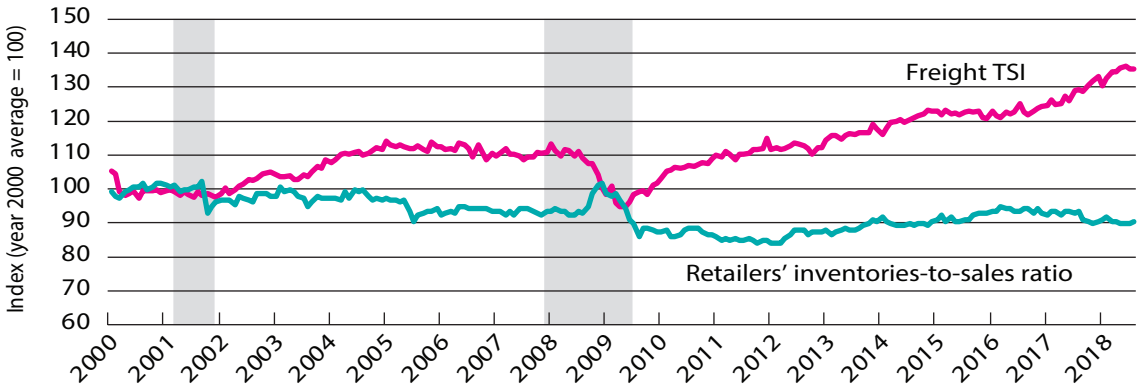
transportation services. The post-recession growth of the freight TSI reflects this renewed demand for freight transportation services. The freight TSI declined in early 2015, following a decline in manufacturers' shipments and a concurrent decline in industrial production. Manufacturers' shipments declined 12.0 percent from July 2014 through February 2016, and industrial production fell 4.8 percent from November 2014 through March 2016. Manufacturers' shipments and industrial production grew from early 2016 through mid-2018 (the latest available data), creating demand once again for freight transportation services. Growth in the freight TSI from mid-2016 through mid-2018 reflects this demand.

Inventories-to-Sales Ratio

When businesses keep greater amounts of inventory on hand, they use less freight transportation. *Inventories-to-sales ratio* measures this practice as the value of goods on shelves and warehouses divided by monthly sales. A ratio of 2.5, for example, indicates that a business warehouses 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 the 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 declined as businesses adopted just-in-time delivery and learned to manage their inventories more efficiently. From January 2000 to June 2008, the inventories-to-sales ratio for retailers declined by about 7.0 percent (figure 1-6). During the recession, however, the ratio rose 10.2 percent from June 2008 to December 2008, while the freight TSI declined 8.6

Figure 1-6 Monthly Freight Transportation Services Index (TSI) and Retailers' Inventory to Sales Ratio (seasonally adjusted), January 2000 to August 2018



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: **Retailers' Inventories-to-Sales Ratio**: U.S. Bureau of the Census, Manufacturing and Trade Inventories and Sales [RETAILIRSA], retrieved from FRED, Federal Reserve Bank of St. Louis https://fred.stlouisfed.org/series/RETAILIRSA, November 2018. **Freight TSI**: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.transtats.bts.gov/OSEA/TSI as of November 2018.

percent – indicative of a stockpiling of unmoved inventories that subsequently reduced demand for freight transportation. From December 2008 to August 2018, the inventories-to-sales ratio for retailers declined 11.1 percent, and the freight TSI increased 34.8 percent. The freight TSI grew by more than the decline in retailers' inventories-to-sales ratio because more than retail inventory affects the demand for freight transportation services, e.g., industrial production and manufacturing shipments also affect the demand for freight transportation services.

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 summer vacations. 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 removes movement in a time series caused by regular seasonal variation in activity, e.g., an increase in air travel during summer months. Removal of this seasonal variation allows measurement of real monthly changes, short- and long-term patterns of growth, or decline and turning points.

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 traffic (shipping containers and truck trailers moved on rail cars), pipeline movement, natural gas consumption, U.S. waterway tonnage, air transportation revenue passenger miles, rail passenger-miles, and public transit ridership.[6] 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

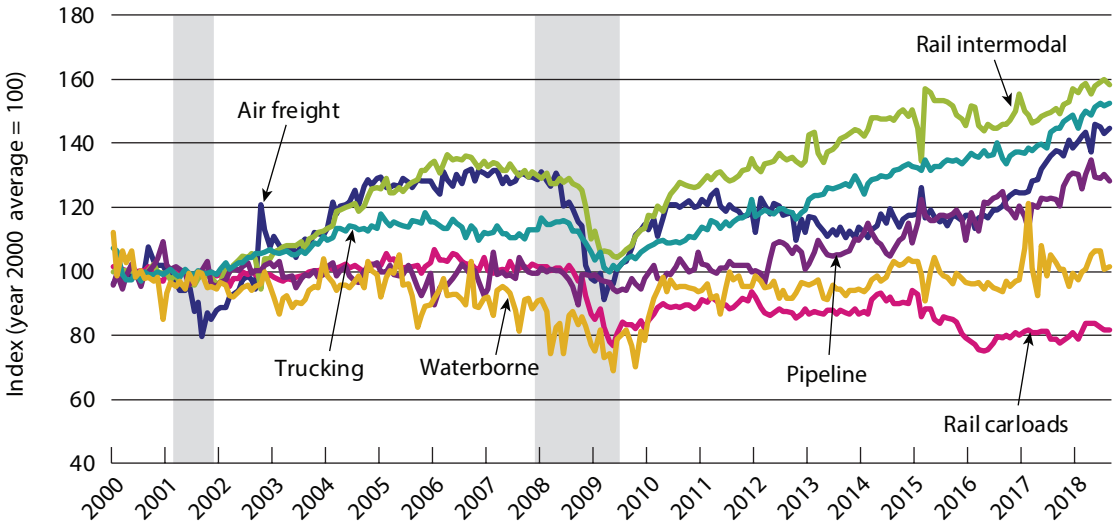
Rail intermodal grew the fastest among the freight modes in the TSI, rising 51.9 percent from June 2009 (the end of the economic recession) to August 2018 (figure 1-7). Competitive pricing, track upgrades, and investment in rail intermodal terminals and other infrastructure contributed to the rapid growth of rail intermodal traffic.[7] Trucking grew the second fastest at 51.7 percent, followed by air freight at 43.6 percent, pipeline at 37.1 percent, waterborne at 29.0 percent, and rail carloads at 1.2 percent. Rail intermodal, trucking, and pipeline all have grown steadily since June 2009, while waterborne shows little growth after initial recovery. Air freight grew 24.3 percent from June 2009 to April 2011 and then declined 11.6 percent from April 2011 to February 2014. Data from the International Air Transport Association shows that air freight traffic stagnated worldwide due to weak global trade during this period and rose after global trade picked up in 2014. Air freight, as measured in the TSI, grew 31.9 percent from February 2014 to May 2018, reaching an all-time high in May 2018 before a slight decline in June and July 2018. As of August 2018 (the latest available data), air freight remains below the May 2018 peak.

Rail carloads declined 7.0 percent from June 2009 to April 2016, falling below the May 2009 recession low in March 2016. Rail carloads grew 12.0 percent from April 2016 to May 2018 before declining 2.9 percent from May to August 2018 (the latest available data). Data from the Association of American Railroads suggest that the decline in rail carload shipments from 2008 to early 2016 is due to reductions in coal shipments and recent increases in coal shipments contributed to growth in rail carloads in 2016 and

[6] 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.

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

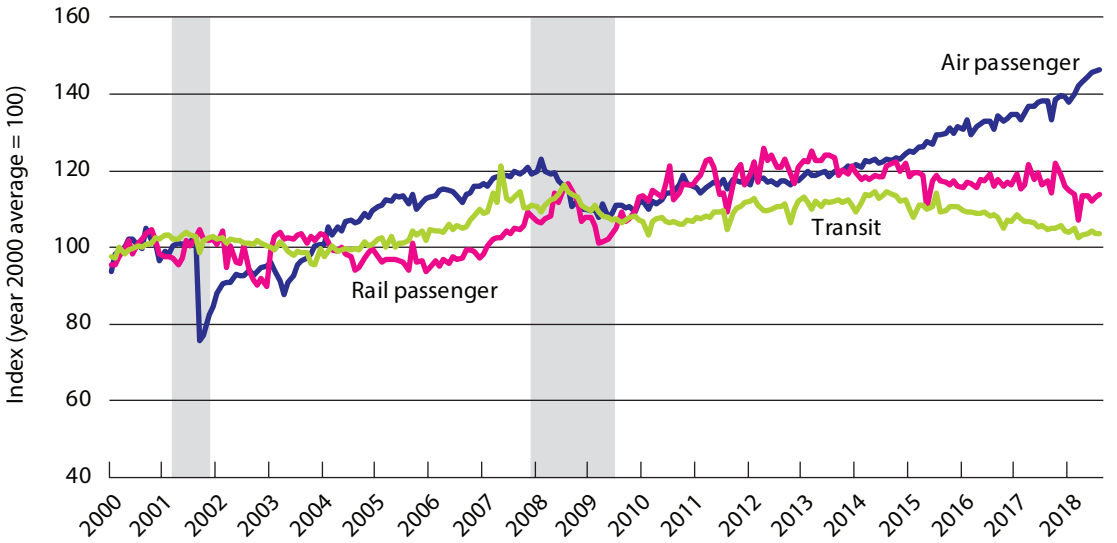
Figure 1-7 Modal Data (seasonally adjusted) Included in Freight Transportation Services Index, January 2000 to August 2018



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

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, seasonally adjusted transportation data, available at www.transtats.bts.gov/osea/seasonaladjustment/ as of November 2018.

Figure 1-8 Modal Data (seasonally adjusted) Included in Passenger Transportation Services Index, January 2000 to August 2018



NOTE: Shaded areas indicate economic recessions.

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, seasonally adjusted transportation data, available at www.transtats.bts.gov/osea/seasonaladjustment/ as of November 2018.

2017.[8] Total coal shipped by U.S. Class I railroads dropped 40.5 percent from the all-time high of 878.6 million tons in 2008 to 522.5 million tons in 2017, but coal shipments in 2017 increased 6.3 percent from the 491.7 million tons shipped in 2016.[9] Data from the Energy Information Administration, though compiled differently, show the same trend in coal shipments.

All freight modes in the TSI (except rail) reached all-time highs in 2017, contributing to the overall freight TSI reaching multiple monthly all-time highs in 2017.[10] Waterborne transportation reached a record high during 2017, while trucking reached a record high by the end of 2017. Air freight and pipeline reached record highs during the year and remained near the all-time highs at the end of 2017. Intermodal rail freight grew 4.9 percent from January to December 2017, growing by more than the 0.7 percent decline in rail carloads. Rail carloads remain below the all-time high reached in January 2006 due to reductions in coal shipments from 2008 to early 2016. Air freight, rail intermodal, trucking, and pipeline continued to grow in the first two quarters of 2018, surpassing 2017 levels and reaching a new all-time highs. These record highs contributed to the freight TSI reaching an all-time high in June 2018.

Seasonally Adjusted Passenger Transportation

Among the passenger modes included in the TSI, seasonally adjusted air passenger-miles increased the most, at 56.3 percent, from January 2000 to August 2018 (figure 1-8). Air passenger-miles reached their lowest point in September 2001 following the September 11, 2001 terrorist attacks but increased by 93.6 percent since that point despite declining 9.5 percent from the onset of the Great Recession to May 2009 (the lowest point reached during the recession). Following the Great Recession, air passenger-miles grew steadily and then sharply increased in roughly the last quarter of 2014 through the second quarter of 2018. Air passenger-miles reached an all-time high in August 2018 (the latest available data).

Seasonally adjusted rail passenger-miles have increased by 19.1 percent since January 2000. They reached their highest level in April 2012 and have since declined 9.5 percent, although remaining relatively unchanged since the end of 2015 (figure 1-8).

Seasonally adjusted transit ridership increased by 6.3 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).

Seasonally Adjusted Highway Vehicle-Miles Traveled

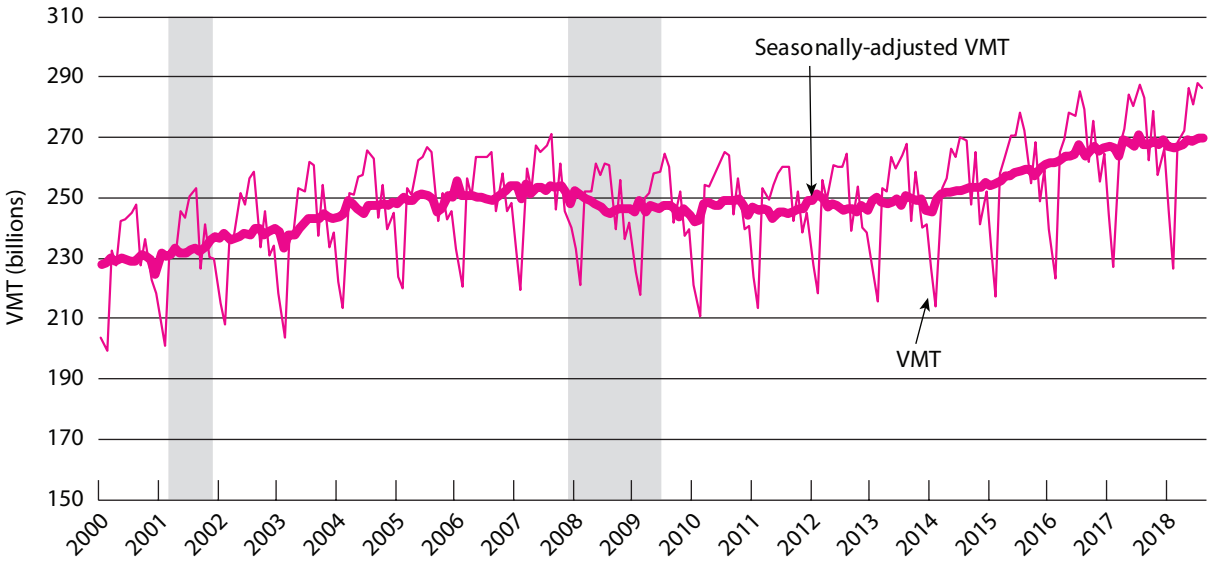
While the TSI measures for-hire transportation services, BTS also seasonally adjusts data for highway vehicle-miles traveled (VMT) to show trends in travel volumes. Seasonally adjusted VMT grew by 18.4 percent from January 2000 to August 2018 (figure 1-9). VMT remained stable after a marginal decline at the onset of the recession and then began to steadily rise in early 2014. VMT grew 9.9 percent from January 2014 to August 2018. More highway driving took place in 2017 than in any previous year, topping 3.2 trillion vehicle miles (unadjusted). VMT remained near its end of 2017 level through the first two quarters of 2018.

[8] See "Railroads and Coal," May 2018, available at https://www.aar.org/wp-content/uploads/2018/05/AAR-Railroads-Coal.pdf.

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

[10] The freight TSI reached an all-time high in July and August 2017 and in October, November, and December 2017.

Figure 1-9 Highway Vehicle-Miles Traveled (VMT), January 2000 to August 2018



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 as of May 2018.
Seasonally-adjusted VMT: U.S. Department of Transportation, Bureau of Transportation Statistics, seasonally adjusted transportation data, available at www.transtats.bts.gov/osea/seasonaladjustment/ as of November 2018.

2 Transportation's Contribution to the Economy

Key Takeaways

- When measured by value-added to gross domestic product (GDP), transportation services contributed $1,066.9 billion, or 5.6 percent, to U.S. GDP in 2016. Specifically, for-hire transportation services contributed $562.4 billion (3.0 percent), in-house transportation contributed $172.3 billion (0.9 percent), and household transportation contributed $332.2 billion (1.8 percent).
- Transportation's contribution to the economy also can be measured as the share of all expenditures on transportation-related final goods and services (known as the final demand for transportation). In this perspective, transportation contributed $1,489.7 billion, or 8.9 percent, to U.S. GDP.
- Transportation-related final demand fell 15.6 percent during the 2007 to 2009 recession, effectively erasing 10 years of growth. It recovered in 2014 when final demand rose above the pre-recession high and then grew slowly (0.2 percent) from 2015 to 2016 (latest available data). The slow growth between 2015 and 2016 resulted from a 7.3 percent decline in private investment — the first year of decline in private investment since steadily rising from the 2009 low.
- Transportation indirectly contributes to the economy by enabling the production of goods and services. In 2016 wholesale and retail trade used the most transportation services at $277.9 billion and required 9.0 cents of transportation services to produce one dollar of output.

Introduction

Transportation's contribution to the economy can be measured by its contribution to gross domestic product (GDP).[1] GDP is an economic measure of all goods and services produced and consumed in the country. GDP can be measured from three different approaches: (1) expenditure, (2) production (known as value-added), and (3) income.[2] With regards to transportation, the expenditure approach identifies the final (finished) transportation goods and services purchased by persons, businesses, governments, and foreigners. The production (value-added) approach measures the contribution of transportation services to the economy. Finally, the income approach measures the contribution of transportation services produced by transportation industries to the economy.

The Bureau of Economic Analysis' (BEA's) national income and product accounts and the Bureau of Transportation Statistics' (BTS') Transportation Satellite Accounts (TSAs) are used to measure transportation's contribution to GDP using the first two approaches:

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

The expenditure approach captures the contribution of transportation services as well

[1] Unless otherwise noted, GDP refers to the U.S. GDP.

[2] For a more detailed explanation, also see *Measuring the Economy: A Primer on GDP and the National Income and Product Accounts*, U.S. Department of Commerce, Bureau of Economic Analysis, December 2015. Available at: https://www.bea.gov/sites/default/files/methodologies/nipa_primer.pdf as of September 2018.

as transportation-related goods, such as motor vehicles and fuels used for transportation. In contrast, the production (value-added) approach captures only the contribution of transportation industries to GDP, because data exist for only the total value-added by an industry, i.e., for all output. With regards to the income approach, data are not detailed enough to measure the contribution of transportation to GDP.

This chapter explains and highlights trends in the final demand for transportation and the value-added by transportation industries.

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. This measure includes (see box 2-1):

- 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;
- net exports (exports minus imports) of transportation goods and services (e.g., motor vehicles and freight charges for moving goods from and to the United States); and

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.

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. It can be measured from 3 perspectives:
  - Expenditure approach: Sum of personal consumption, investment, government expenditures, and exports less imports.
  - Production (value-added) approach: Total industry output (sales and other operating income) less the cost of inputs used in production. Alternatively, the sum of employee compensation, taxes on production and imports less subsidies, and gross operating surplus.
  - Income approach: Income earned by households (wages, health retirement benefits, interest income, etc.) and firms (profits including royalties from intellectual property rights, etc.)
- GDD is like GDP but excludes net exports, thereby showing only domestic demand.

What are transportation-related final demand, transportation value-added, and income attributed to transportation?

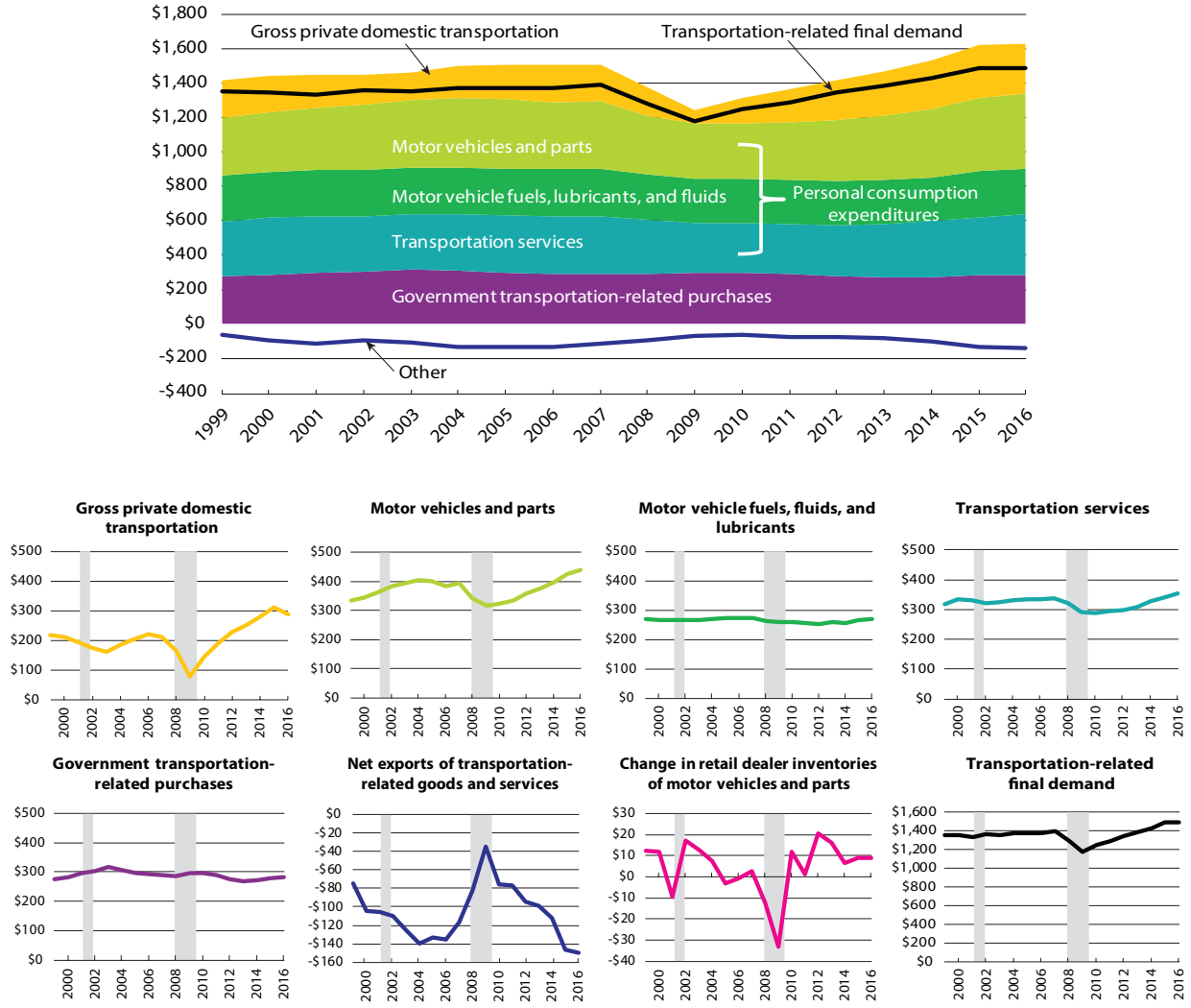
- *Transportation-Related Final Demand* measures the contribution of transportation services to the economy using the expenditure approach. It is the sum of:
  - personal consumption expenditures on transportation-related goods and services (motor vehicles and parts; motor vehicle fuels, lubricants, and fluids; and transportation services);
  - private domestic investment in transportation structures and equipment;
  - government purchases of transportation goods and services;
  - net exports (exports minus imports) related to transportation goods and services; and
  - change in retailers' inventories of motor vehicles and parts.
- *Transportation Value-Added* measures the contribution of transportation services to the economy using the production (value-added) approach. It equals sales, or receipts, and other operating income from transportation services (gross output) less the goods and services used in production (intermediate inputs). Data in this chapter are total value-added.
- *Income attributed to transportation* measures the income generated from the production of transportation goods and services. Data are not available in sufficient detail to measure the contribution of transportation to the economy using this approach.

- change in retailer dealers' inventories of finished goods, such as motor vehicles and parts.

In 2016 the demand for transportation ($1,489.7 billion) accounted for 8.9 percent of U.S. GDP (as measured in chained 2009 dollars) (figure 2-1). The demand included:

- personal consumption expenditures of transportation, such as vehicle and motor fuel purchases ($1,059.5 billion, or 71.1 percent of transportation-related final demand);
- private domestic investment in transportation structures and equipment ($289.0 billion, or 19.4 percent);
- government purchases of transportation goods and services ($282.3 billion, or 19.0 percent);

Figure 2-1 GDP Components of Transportation-Related Final Demand, 1999–2016 (billions, chained 2009 dollars)



NOTES: "Other" is the sum of the change in retail dealer inventories of motor vehicles and parts and net exports of transportation-related goods and services. 2016 data are latest available. Shaded areas indicate economic recessions.

SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts Tables, tables 1.1.6, 2.4.6, 3.11.6, 3.15.6, 4.2.6, 5.4.6, 5.5.6 and 5.7.6B, available at https://www.bea.gov/iTable/index_nipa.cfm as of June 2018.

- net exports (exports minus imports) related to transportation goods and services (-$149.9 billion, or -10.1 percent); and
- the change in retailers' inventories of motor vehicles and parts ($8.8 billion, or 0.6 percent).

Transportation-related final demand grew from 1999 (first year for which data are available) through 2016 by 10.0 percent (from $1,354.4 to $1,489.7 billion chained 2009 dollars) despite a significant decline during the December 2007 to June 2009 Great Recession (figure 2-1). Transportation-related final demand fell 15.6 percent (from $1,392.6 billion to $1,175.6 billion chained 2009 dollars) during the 2007 to 2009 recession, falling to its lowest level since 1999 in 2009. The sharp decline during that recession effectively erased 10 years of growth in final demand. Transportation-related final demand recovered in 2014 when it rose above the pre-recession high.

The decline in transportation-related final demand during the recession affected private investment and personal consumption expenditures more than other categories. Imports often decrease during economic declines, and in 2009 they decreased to the point that exports of transportation goods and services nearly equaled imports. After 2009 imports rose and, once again, exceeded the value of exports. 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.

Total transportation-related final demand increased following the recession, surpassing the 2007 peak in 2014 and continued to climb through 2016. However, transportation-related final demand grew only slightly (0.2 percent) from 2015 to 2016. The 0.2 percent growth from 2015 to 2016 marked a sharp contrast to the growth of 2.9 percent or more following the 2007 to 2009 recession. The slow growth between 2015 and 2016 resulted from a 7.3 percent decline in private investment — the first year of decline in private investment since steadily rising from the 2009 low.

Demand for Transportation Compared to Other Goods and Services

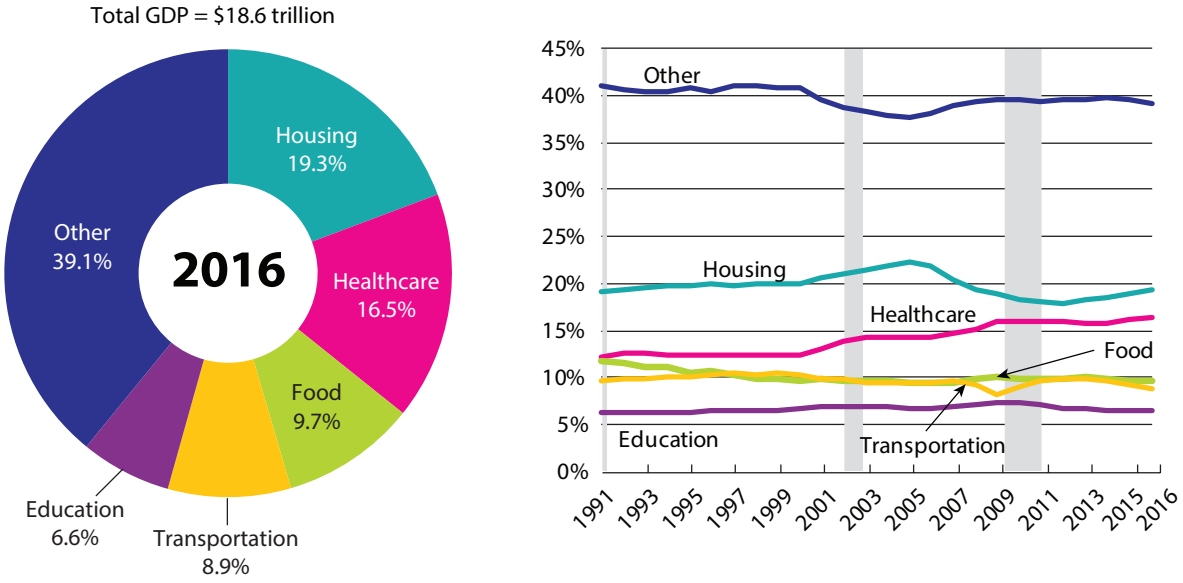
Transportation-related final demand can be compared to the demand for other goods and services, such as housing and healthcare. Figure 2-2 compares transportation-related final demand to the demand for five other categories of goods and services (healthcare, housing, food, education, and all other goods and services).[3] In 2016 transportation continued to be the fourth largest expenditure category, amounting to $1,662 billion, or 8.9 percent, of total U.S. GDP. Housing is the largest expenditure category at 19.3 percent of final demand, slightly more than twice the size of transportation.

The right side of figure 2-2 shows the expenditures for goods and services by category from 1991 to 2016. Transportation-related final demand decreased during the recession from 9.6 percent of total final demand in 2007 to 8.3 percent in 2009, grew from 2009 to 9.8 percent in 2012, and remained at 9.8 percent in 2013. The share of transportation expenditures fell from 2013 to 2016 due to a larger rise in the demand for housing. In absolute dollars, transportation expenditures grew 38.0 percent from 2009 (the lowest level reached during the Great Recession) to 2013 and then by 1.0 percent from 2013 to 2016.

The demand for goods and services does not provide a full picture of the contribution of transportation to the economy. The data allow us to measure demand as expenditures on goods and services. Expenditures may increase due to a greater quantity purchased and/or an increase in the price of the purchased good or service. The two effects cannot be separated to determine the underlying reason for an increase in expenditures

[3] "Other" includes expenditures on entertainment, personal care, and payments to pension plans.

Figure 2-2 Final Demand for Goods and Services by Category, 2016



NOTES: 2016 data are latest available. 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.

— whether due to an increase in price for the same amount of goods and services or from an increase in the quantity purchased. Additionally, demand, as measured by expenditures, does not adequately measure the amount needed to support economic activity. For example, if spending on transportation infrastructure falls below the level needed to maintain the system, then the measure underestimates the amount of spending needed.

Contribution of Transportation Services Produced: Value-Added

The production approach, also known as the value-added approach, captures the role of transportation in producing goods and services and the contribution of each industry to the economy as measured by GDP. *Value-added* (box 2-1) is the contribution of an industry to GDP, as measured by total output (i.e., industry revenue) less the cost of inputs, such as fuel and other materials used in production. The value-added by all industries sum to the total GDP. While the previously described method measures how much end users spend on transportation goods and services, the production approach measures the contribution of transportation services produced by transportation industries to the economy. It does not include the contribution of transportation-related goods, such as fuel used for transportation, due to a lack of available data.

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. The contribution of for-hire transportation to GDP can be measured using the production, also known as the value-added, approach (box 2-1).

Figure 2-3 shows how much for-hire transportation services and other industries contribute to GDP. Transportation ranks as the 13th largest contributor to GDP among the 18 industries in 2016.

Figure 2-3 Contribution to Gross Domestic Product (GDP) by Industry, 2017



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 for-hire transportation services' contribution (value-added) to GDP by transportation industries from 1997 to 2017. In 2017 the three transportation industries with the largest contributions were trucking ($155.5 billion, 0.80 percent of GDP), other transportation and support activities ($129.9 billion, 0.67 percent), and air ($108 billion, 0.56 percent).[4] The transportation industries that grew as a percentage of GDP from 1997 to 2017 include warehousing and storage (from 0.24 to 0.33 percent), pipelines (from 0.08 to 0.15 percent, with peaks of 0.15 percent in 2001 and 2017), water (0.08 to 0.09 percent), and transit and ground passenger (from 0.18 to 0.20 percent). However, the industries with a larger share of GDP decreased, including trucking (from 0.90 to 0.80 percent) and air (from 0.62 to 0.56 percent). Rail contributed the same percent in 2017 as in 1997 (0.23 percent), a slight decline from its peak contribution of 0.27 percent in 2014.

Production of For-Hire Transportation Services by State

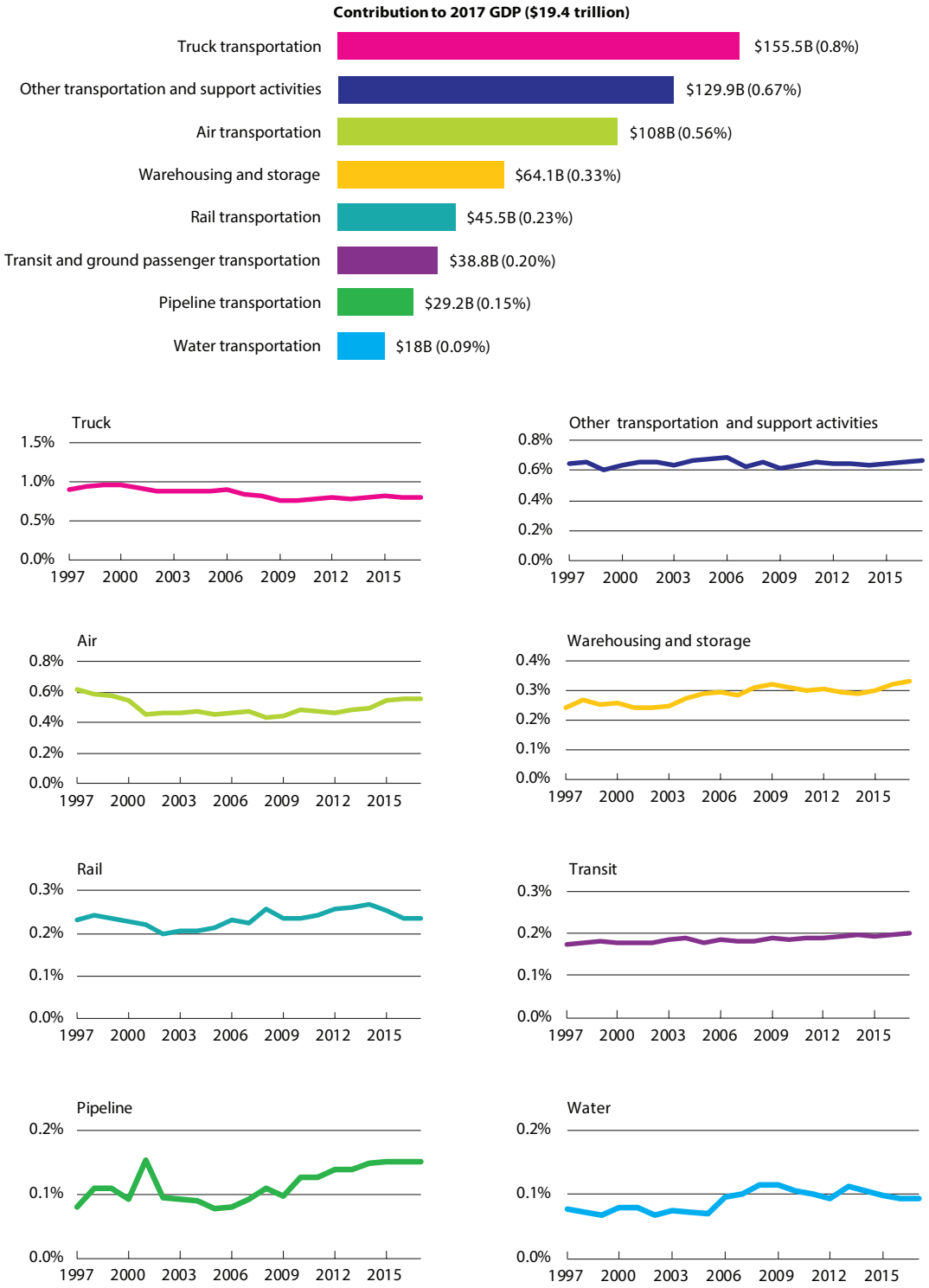
The amount produced by the for-hire transportation industry and its contribution to a state GDP depends on the state's geography, population density, mix of industries, and location of transportation hubs. For example, Nebraska has a major national rail hub in Omaha, and the third-highest percentage of GDP from transportation and warehousing of any state in the country (7.2 percent of Nebraska's GDP in 2017). States with larger total GDPs, such as California ($2.7 trillion) and Texas ($1.70 trillion), also have large transportation and warehousing activities—$69.2 and $60.0 billion, respectively. Because other economic activities are larger in California and Texas, transportation and warehousing services represent a small share of their total GDP (figure 2-5).

In-house Transportation and Household Services Produced in the Economy

Measuring only for-hire transportation services understates the transportation component of GDP. Many industries produce transportation services for their own use and these services, with few exceptions, are not included in for-hire measure. The transportation services produced by non-transportation industries for their own use are known as in-house transportation, for instance, a grocery chains operating its own truck fleet to move food from distribution centers to stores.

[4] Other transportation and support activities includes scenic and sightseeing transportation and support activities for transportation and couriers and messengers.

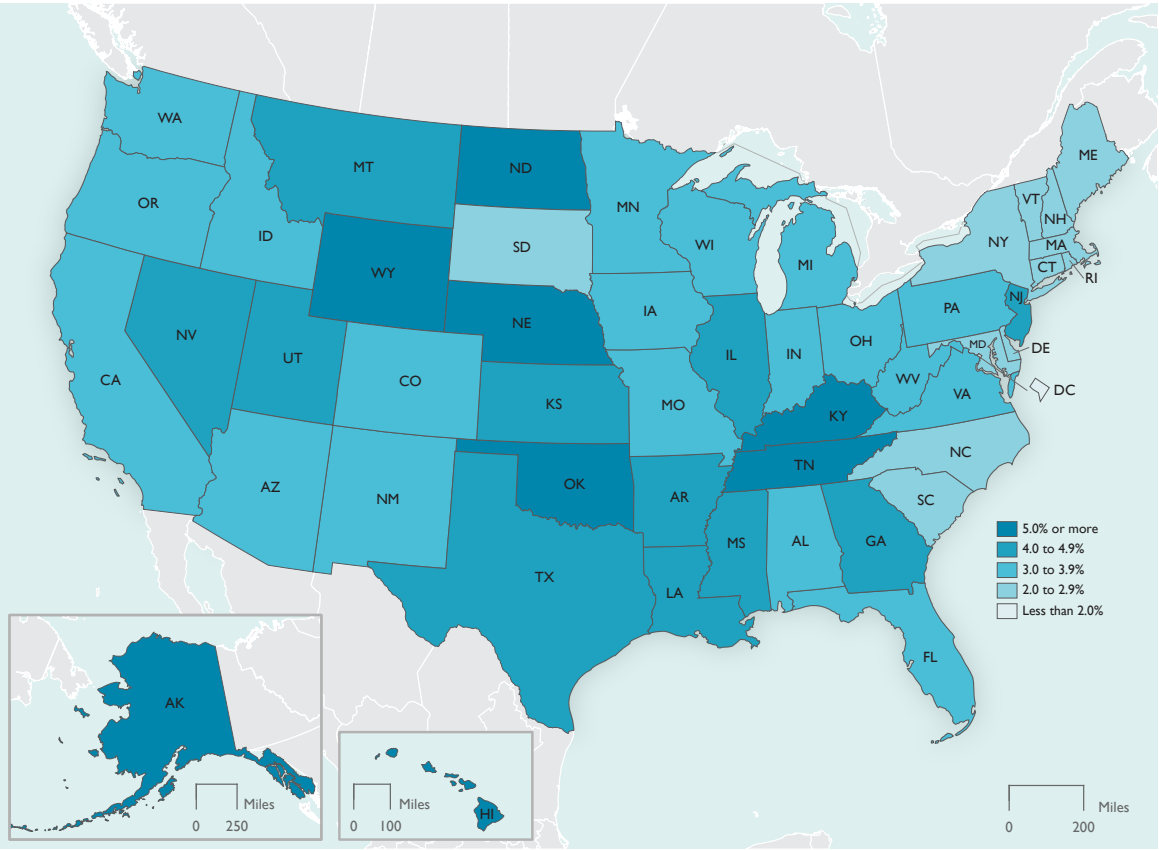
Figure 2-4 For-Hire Transportation and Warehousing's Contribution to GDP by Industry (percent)



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

SOURCE: U.S. Department of Commerce, Bureau of Economic Analysis, GDP by Industry, Value-Added by Industry Table (April 19, 2018 release), available at www.bea.gov as of June 2018.

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.

BTS developed the Transportation Satellite Accounts (TSAs, see box 2-2) to estimate the contribution of in-house transportation services to the economy. The TSAs also show the contribution of transportation carried out by households using household vehicles. The TSAs thereby provide a more comprehensive measure of the size and role of transportation services in the economy than measures that capture only the contribution of for-hire transportation.

In 2016, the latest year for which comprehensive data are available, BTS estimates transportation (for-hire, in-house, and household) services' total GDP contribution at $1,066.9 billion (figure 2-6). The pie chart in figure 2-6 represents total GDP, and the tri-colored slice shows the portion contributed by transportation services 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 (1.8 percent) transportation's contribution to the total GDP in 2016. That year for-hire transportation services contributed $562.4 billion (3.0 percent) to a GDP of $19.0 trillion.[5] Transportation services (air, rail, truck, and water) provided by non-transportation industries for their own use contributed an additional $172.3 billion (0.9 percent) to GDP.[6]

[5] 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 household vehicles.

[6] Large retailers, such as Walmart and Target, are captured in for-hire transportation services even though these are actually in-house transportation services provided by a non-transportation industry for their own use.

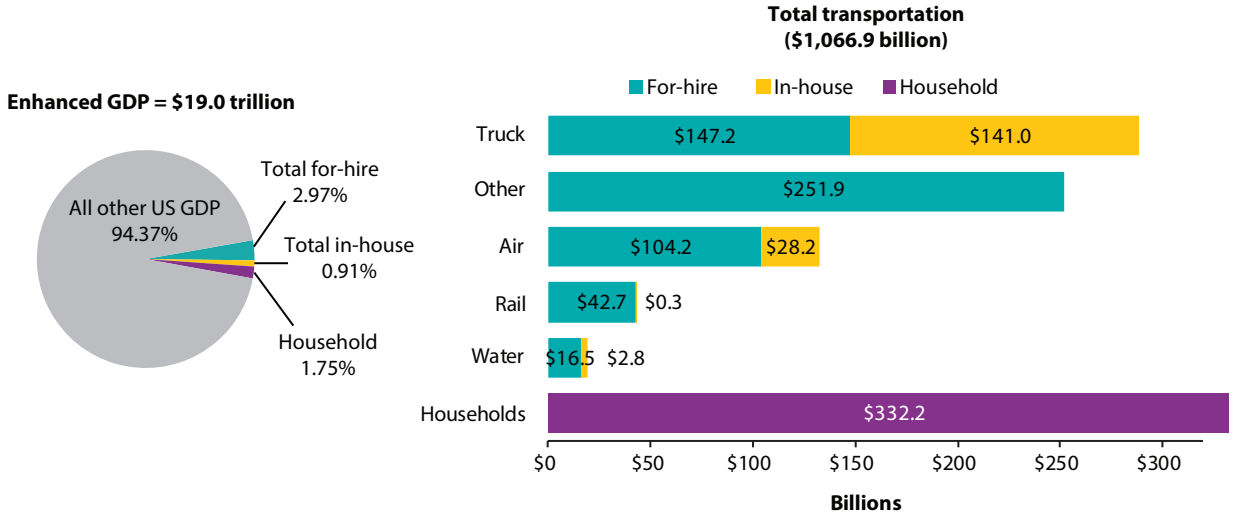
Box 2-2 What are the Transportation Satellite Accounts (TSAs)?

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 a household vehicle.

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, 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—for example, a baker's delivery truck. 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.
- *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, by design, do not include unpaid labor, volunteer work, and other non-market production.

Figure 2-6 Gross Domestic Product (GDP) Attributed to Transportation Types and Modes, 2016



NOTE: For information on the methodology behind the Transportation Satellite Accounts (TSAs) see box 2-5. The GDP value in the TSAs (referred to as enhanced GDP) 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. "Other" includes: pipeline, transit, and ground passenger transportation, including State and local government passenger transit; sightseeing transportation and transportation support; courier and messenger services; and warehousing and storage). 2016 data are latest available.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at https://www.bts.gov/satellite-accounts.

Household transportation (i.e., the depreciation cost associated with households owning motor vehicles) contributed $332.2 billion (1.8 percent) to GDP. [7]

The bars in figure 2-6 show transportation's contribution to GDP by type (for-hire, in-house, or household transportation) and by mode. Total household transportation's contribution to GDP was larger, at $332.2 billion, than any of the other transportation modes. Trucking contributed the second largest amount, at $288.2 billion. In-house truck transportation operations contributed $141.0 billion, while for-hire truck transportation services contributed $147.2 billion. Air contributed a total of $132.4 billion, comprising $104.2 billion of for-hire services and $28.2 billion of in-house services; rail contributed $42.9 billion, comprising $42.7 billion of for-hire services and $0.3 billion of in-house services; and water contributed $19.2 billion, comprising $16.5 billion of for-hire services and $2.8 billion of in-house services.

Use of Transportation Services by Industries

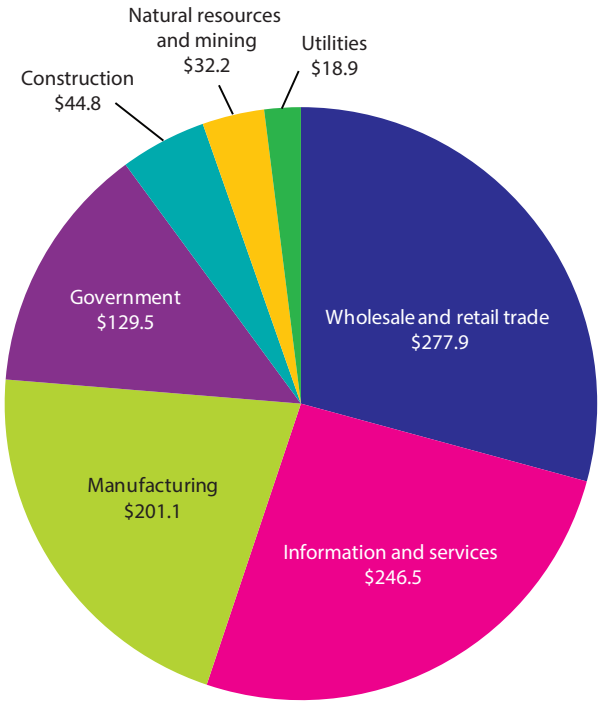
Transportation services indirectly contribute to the economy by enabling the production of goods and services by non-transportation industries. Specifically, industries rely on transportation services as well as transportation infrastructure, such as roadways, shipping channels, and rail lines, to access supplies and customers. Additionally, workers in each industry use transportation to reach their workplace. This section presents data on the amount of transportation used by non-transportation industries and the amount required by these industries to produce a dollar of goods and/or services.

[7] In the TSAs, BTS measures the contribution of household transportation to GDP as the depreciation of automobiles and does not include the value of time spent driving because it is out of scope of the U.S. Input-Output (I-O) accounts on which the TSAs are built. The I-O accounts, by design, do not include unpaid labor, volunteer work, and other non-market production.

Transportation Used by Industries

The TSAs show the amount of transportation services required by non-transportation industries to produce various goods and services. Figure 2-7 shows the value of for-hire and in-house transportation services used by seven major industries. Wholesale and retail trade uses the largest amount of transportation services at $277.9 billion, followed by information and services at $246.5 billion and manufacturing at $201.1 billion.

Figure 2-7 Use of For-Hire and In-House Transportation by Industry Sector, 2016 (billions of dollars)

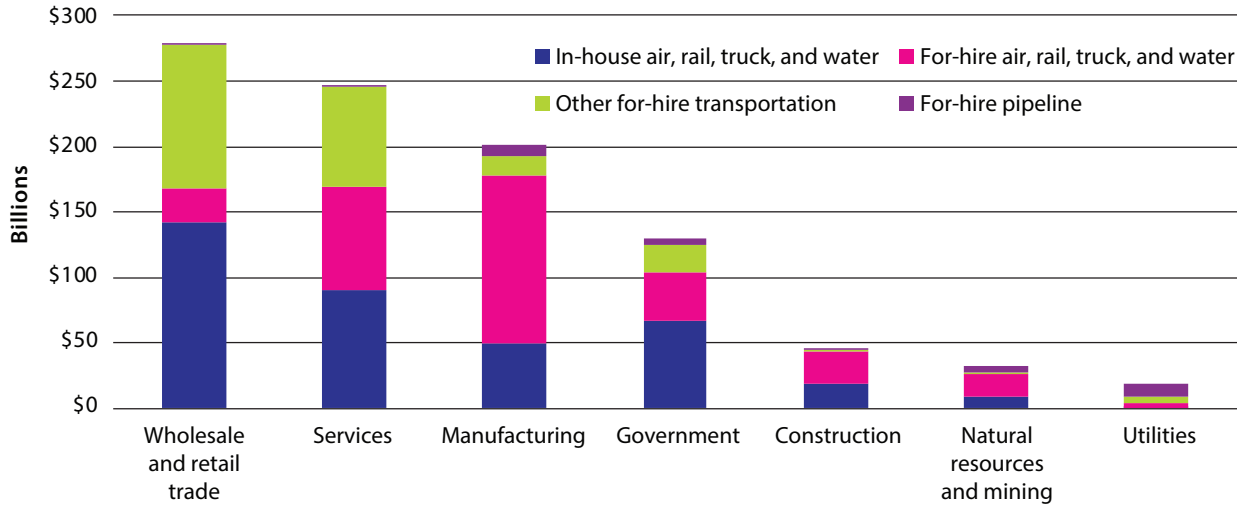


NOTE: 2016 data are latest available.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at https://www.bts.gov/satellite-accounts.

In the wholesale and retail trade industry, in-house transportation accounts for 51.1 percent of the $277.9 billion total transportation services used (figure 2-8). In-house transportation also represents a large portion of transportation services used in natural resources/mining (30.4

Figure 2-8 Use of For-hire and In-house Transportation by Industry Sector and Mode, 2016 (billions of dollars)



NOTES: "Services" includes information, financial services, professional and business services, education and health services, leisure and hospitality, and all other services. Other for-hire transportation includes pipeline, transit, and ground passenger transportation, including State and local government passenger transit; sightseeing transportation and transportation support; courier and messenger services; and warehousing and storage). 2016 data are latest available.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at https://www.bts.gov/satellite-accounts.

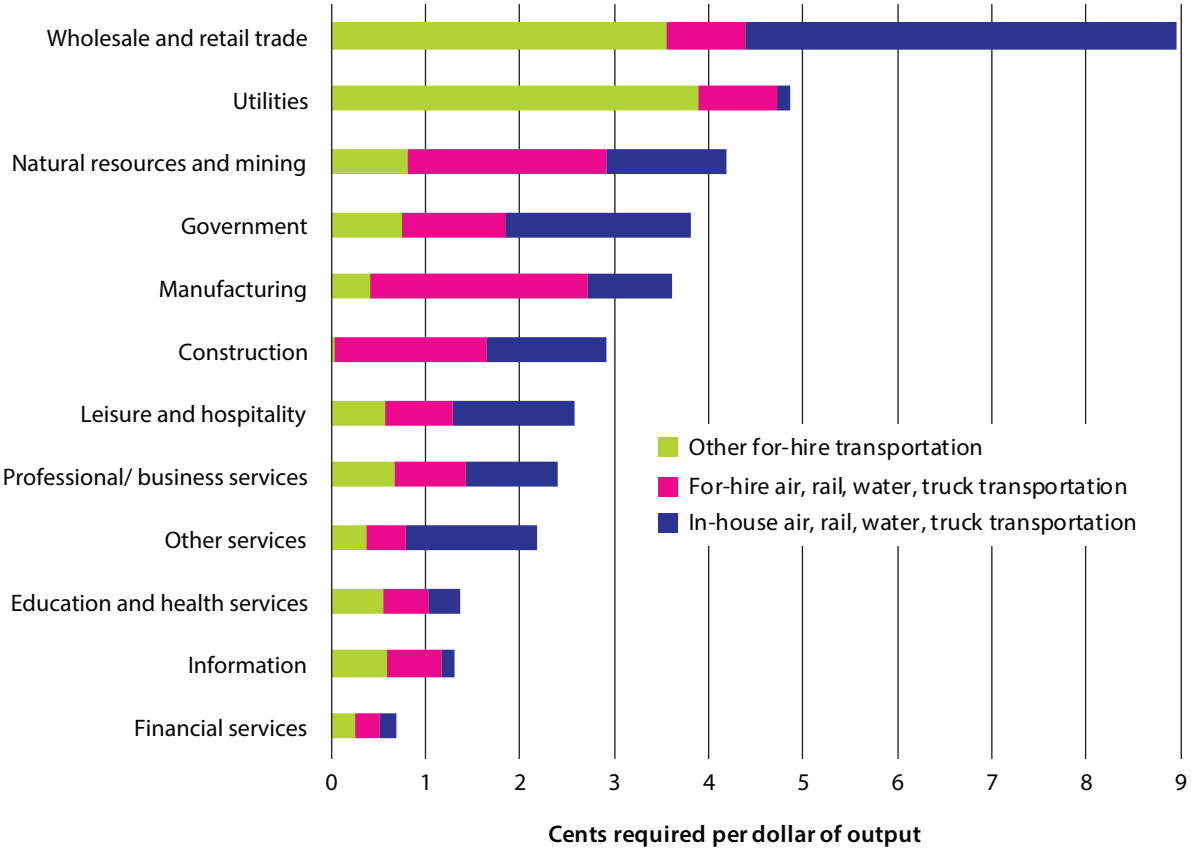
percent of $32.2 billion), construction (43.7 percent of $44.8 billion), and government (51.5 percent of $129. 5 billion). Other sectors, like manufacturing, rely more on for-hire transportation services. In the manufacturing sector, for-hire transportation accounts for 75.4 percent of the $201.1 billion total transportation services used.

Transportation Required Per Dollar of Output by Sector

Looking at the amount of transportation services required to produce each dollar of output shows how much a sector depends on transportation services (figure 2-9). In 2016 the wholesale and retail trade sector continues to require 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—4.6 cents of in-house transportation operations, and 4.4 cents of for-hire transportation services.

BTS further discusses transportation's role in the seven major industry sectors in *Industry Snapshots: Uses of Transportation 2017*, available at https://www.bts.gov/product/industry-snapshots.

Figure 2-9 Transportation Required Per Dollar of Output by Sector, 2016



NOTES: Other for-hire transportation includes: pipeline, transit and ground passenger transportation, including State and local government passenger transit; sightseeing transportation and transportation support; courier and messenger services; and warehousing and storage). 2016 data are latest available.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts, available at https://www.bts.gov/satellite-accounts.

3 How Much Does Transportation Cost?

Key Takeaways

- The *cost* of transportation stems from the resources it requires—labor, equipment, fuel, and infrastructure. Fuel prices are the most widely discussed resource cost. Fuel prices peaked in 2012, then declined in 2013 through 2016 before rising once again in 2017 as the price of crude oil rose.
- The prices received for transportation services (e.g., by airlines for air freight and passenger services) are an indicator of the prices businesses pay when purchasing transportation services. They reached an all-time high in 2014 (except for the prices received for water transportation services, which rose to their highest level in 2015). Prices then declined before increasing in 2017.
- From 2004 to 2017, the price received by the rail transportation industry (an indicator of the prices faced by purchasers of rail transportation services) grew by more than the prices received by all other modes.
- On average, except for air, consumers faced higher transportation costs in 2017 than in 2016.
- Average airfares dropped to an all-time low of $293 (chained 2009 dollars) in 2017.
- Local transit fares (adjusted for inflation) have remained relatively unchanged over the past two decades. Transit fares were the same in 2016 as in 1995, while commuter rail fares (adjusted for inflation) have grown since their 2002 low.

Introduction

This chapter shows the costs to produce transportation services and the *prices* paid by users to use those services. *Producers* are the firms that carry out transportation operations to move people and goods. The producers may not necessarily be the *providers*. For example, freight forwarders provide transportation services by arranging the shipping of merchandise with a for-hire transportation firm that produces the transportation services (e.g., trucking services) requested by purchasers. *Purchasers* are users, who may be either households—known as consumers—or businesses.

The *cost* to produce transportation services stems from the resources it requires—labor, equipment, fuel, and infrastructure. Firms purchase these resources to produce transportation services. For example, airlines pay for pilots, commercial jets, and jet fuel to produce air transportation services. In addition, federal, state, and local governments purchase labor, equipment, and material to build, operate, and maintain transportation infrastructure, such as highways.

The cost of the resources used by producers of transportation services influences the prices they charge. The *price* reflects the cost of the resources plus mark-up and tax (box 3-1). 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 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.

Box 3-1 Transportation Cost and Price Terminology

The following defines the cost and price terms used in this chapter.

Cost refers to the monetary value of the resources used to produce transportation services—labor, equipment, fuel, and infrastructure. The cost of the resources used by producers of transportation services influences the prices they charge.

Price is the sum of the cost of the resources used plus mark-up and tax.

Users are *purchasers*, who may be either households—known as consumers—or businesses.

Producers are the firms that carry out transportation operations to move people and goods. For example, trucking companies that haul merchandise to stores and air carriers that transport freight and passengers. The producers may not necessarily be the *providers*. For example, freight forwarders and freight brokers provide transportation services by arranging the shipping of merchandise with a for-hire transportation firm that produces the transportation services (e.g., trucking services) needed to move the merchandise.

This chapter discusses fuel and equipment costs faced by producers of transportation services, such as railroads, airlines, or trucking companies. This chapter also discusses the prices faced by two segments of the transportation market:

1. businesses that use transportation to produce and deliver goods, such as retail and grocery, and
2. 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 Produce Transportation Services

The major inputs to produce transportation services include labor, equipment, fuel, and infrastructure. This section discusses fuel and equipment prices. The prices are a cost to producers of transportation services, as they are resources that must be purchased to produce transportation services. Chapter 4 examines the number employed in transportation and transportation-related industries as well as their wages and compensation. Chapter 7 presents data on the value of and investment in transportation infrastructure.

Fuel prices are a cost to firms that carry out their own transportation operations and industries that sell transportation services. These industries embed the costs in the price they charge businesses and households—for the transportation services they provide for a fee (for-hire transportation) or for the goods they produce with the transportation services. Looking at for-hire transportation services, the cost of petroleum products is a large share of the total cost of inputs used to produce for-hire transportation services, ranging as high as 36.7 percent for aviation (figure 3-1).

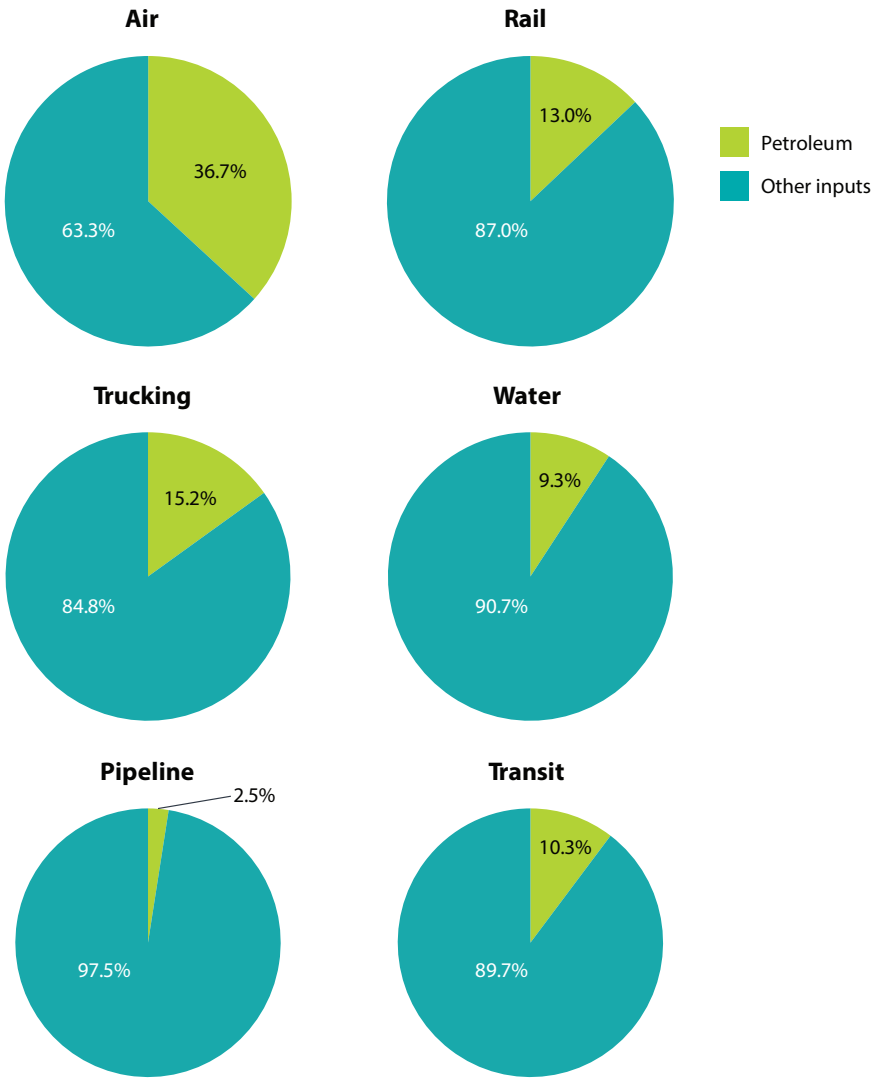
While this section looks at costs to produce transportation services, fuel prices also are a cost to households to operate motor vehicles for their own use. Gasoline and motor oil account for 22.0 percent of household spending on transportation, as discussed in chapter 6 (figure 6-6). Fuel cost is readily 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.

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 3-2). This reflects the underlying price of crude oil from which they are all refined (figure 3-3).

Following a decade of relatively stable fuel prices in the 1990s, fuel prices began to increase (figure 3-2). Gasoline, No. 2 diesel fuel, and kerosene spiked

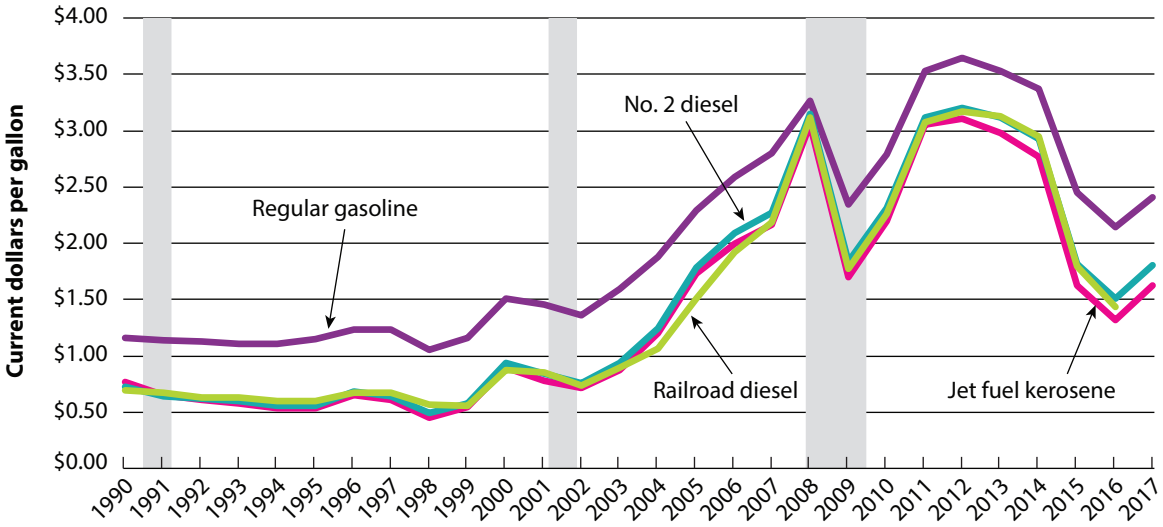
Figure 3-1 Input Cost Shares for For-hire Transportation by Mode, 2016



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

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, *2016 Transportation Satellite Accounts*, available at www.bts.gov as of June 2018.

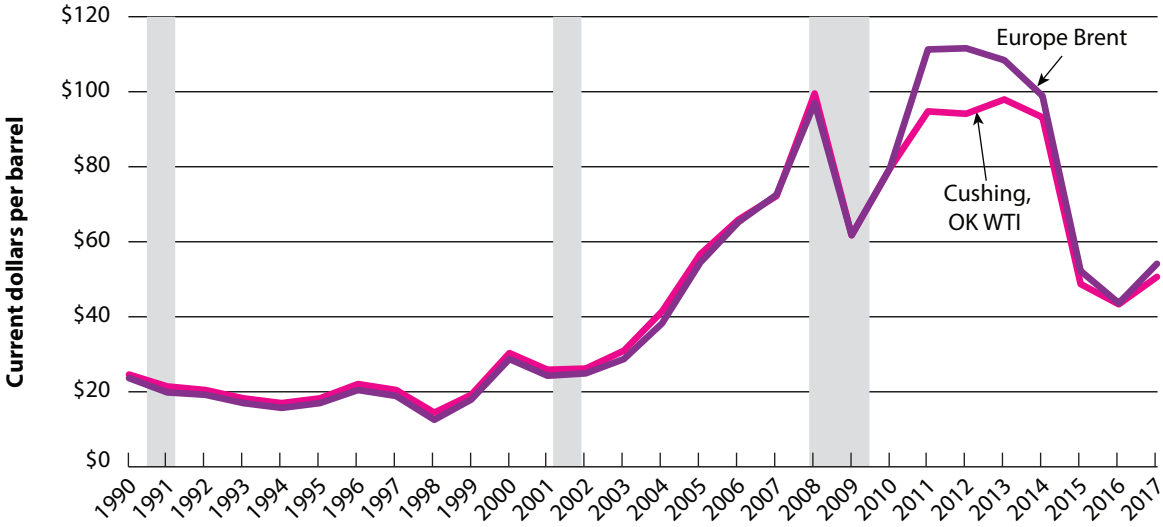
Figure 3-2 Sales Price of Transportation Fuel to End-Users, Excluding Taxes, 1990–2017 (current dollars per gallon)



NOTES: 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.

SOURCES: *All data except railroad fuel*: U.S. Department of Energy, Energy Information Administration, Monthly Energy Review, tables 9.4 and 9.7, available at www.eia.doe.gov/emeu/mer/prices.html as of June 18, 2018; *Railroad fuel*: Association of American Railroads, Railroad Facts (Washington, DC: Annual Issues), p. 62.

Figure 3-3 Price of Crude Oil (current dollars per gallon)



NOTES: *Cushing, OK WTI*—A crude stream produced in Texas and southern Oklahoma that serves as a reference or "marker" for pricing a number of other crude streams that are traded in the domestic spot market at Cushing, Oklahoma. *Europe Brent*—A blended crude stream produced in the North Sea region that serves as a reference or "marker" for pricing a number of other crude streams. Shaded bars indicate economic recessions.

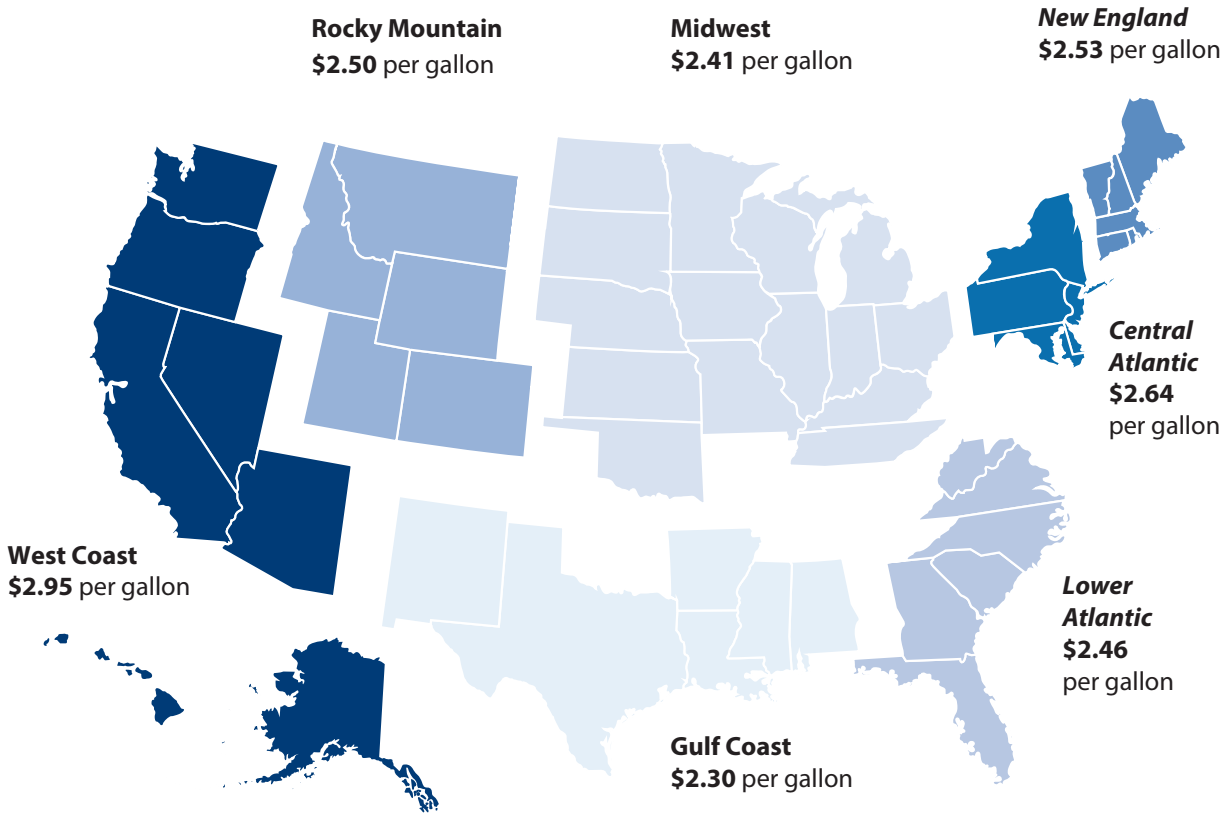
SOURCES: U.S. Department of Energy, Energy Information Administration, Spot Prices for Crude Oil, available at www.eia.gov/dnav/pet/pet_pri_spt_s1_a.htm as of August 2018.

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 before rising once again in 2017. In 2015 prices declined below the 2009 low for kerosene and diesel fuel. The prices for kerosene and diesel fuel remained below the 2009 low despite rising in 2017. In contrast, the price for regular gasoline declined below the 2009 low in 2016 before rising above it in 2017 due to an increase in crude oil prices. Railroad diesel fell to about its 2005 level in 2016.

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 2017 using data from the Energy Information Administration (EIA). The averages include all grades and blends of regular gasoline. In 2017 the average gasoline price in the United States was $2.53 per gallon. The West Coast had the highest gasoline prices in the country at $2.95 per gallon—$0.31 more than the Central Atlantic, which had the second-highest prices at $2.64 per gallon. Among West Coast states, prices were highest in California, at $3.08 per gallon, because California requires a unique blend of gasoline to meet environmental regulations. Meanwhile, the Gulf Coast states had the lowest gasoline prices at $2.30 per gallon, or $0.11 lower than the Midwest states, which had the second-lowest prices at $2.41 per gallon.

Figure 3-4 Average Retail Gasoline Prices by Region, 2017



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_dcus_nus_a.htm as of August 2018.

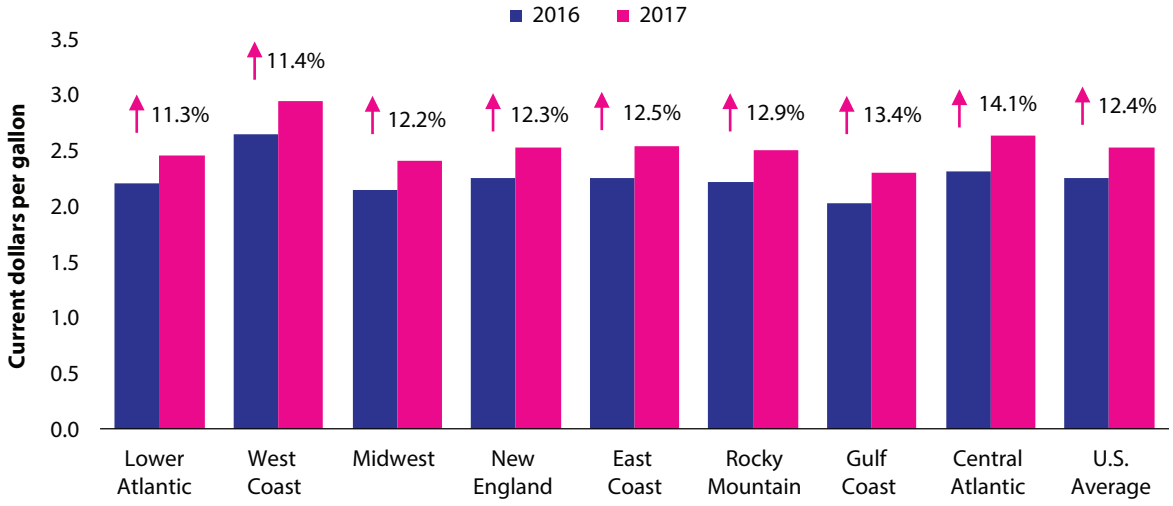
The average gasoline price in the United States increased 12.4 percent from 2016 to 2017 (figure 3-5). The Central Atlantic states experienced the greatest increase in gasoline prices, rising 14.1 percent from $2.31 to $2.64. Gasoline prices increased the least in the Lower Atlantic states—rising 11.3 percent from $2.21 to $2.46.

Equipment Costs

Different modes of transportation purchase and use different equipment, for example, airlines use aircraft to move people and goods, while households primarily use motor vehicles to travel. This section looks at the cost of transportation equipment used to produce transportation services. Data are not available on the prices transportation providers pay for transportation equipment like railcars; however, data on the prices received by firms producing transportation equipment are available. The prices firms receive for producing transportation equipment differ from the prices purchasers pay, in that they do not include sales and other excise taxes that purchasers face when buying transportation equipment. For example, the price purchasers pay for a new car at an auto-dealership includes State sales tax, which the State receives. This means that the automobile manufacturer receives less than what purchasers pay. The prices that firms receive for producing transportation equipment are an indicator of the prices faced by purchasers, for example, if the prices firms receive rise, the prices faced by purchasers likely increase—making transportation equipment a larger cost in producing transportation services.

The *Producer Price Index (PPI)* (box 3-2) shows the average change over time in the prices received by producers of transportation equipment, for example, prices received by aircraft manufacturers (figure 3-6). The PPI includes indexes for equipment used by transportation industries, such as aircraft, railroad cars, and heavy trucks, as well as motor vehicles used by businesses and households. The PPI shows the trends in transportation equipment manufacturing prices and reflect their potential effect on the cost of producing transportation services—the higher the equipment cost, the higher the cost of producing transportation

Figure 3-5 Change in Average Retail Price of Gasoline, 2016–2017



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

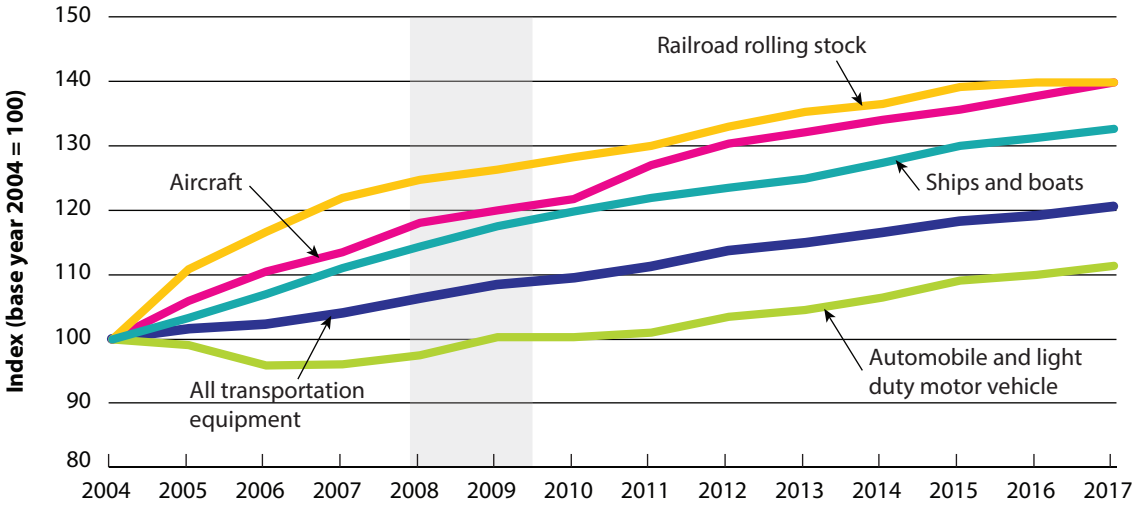
SOURCE: U.S. Department of Energy, Energy Information Administration, available at www.eia.gov/dnav/pet/pet_pri_gnd_dcus_nus_a.htm as of August 2018.

Box 3-2 Producer Price Indexes

The Producer Price Index (PPI) captures the weighted average of wholesale or producer prices that producers of transportation services (e.g., air carriers and trucking companies) receive. The PPI for a mode of transportation measures the average change in the prices received by producers. For example, the rail producer price index uses a survey of railroad prices charged to shippers. The PPI for trucking services measures the average change over time in the price received for trucking services. The PPI differs from the Consumer Price Index (box 3-3), which shows changes in prices from the viewpoint of households purchasing 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. BLS weights prices by the size of establishment's revenue to create indexes for narrowly defined services (e.g., local specialized freight trucking excluding used goods) and then combines them into aggregated indexes (e.g., all trucking) using value-of-shipments data from the economic censuses of the Bureau of the Census. BLS publishes data for both broad and more narrowly defined services and costs.

Figure 3-6 Producer Price Indexes for Select Transportation Equipment Manufacturing, 2004–2017



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

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Index Industry Data, available at www.bls.gov/ppi/ as of June 2018.

services. The PPI for transportation equipment differs from the PPIs for transportation services discussed later in this chapter.

The prices for transportation equipment, as measured by the PPI, continuously increased between 2004 and 2017, 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 2017. 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.

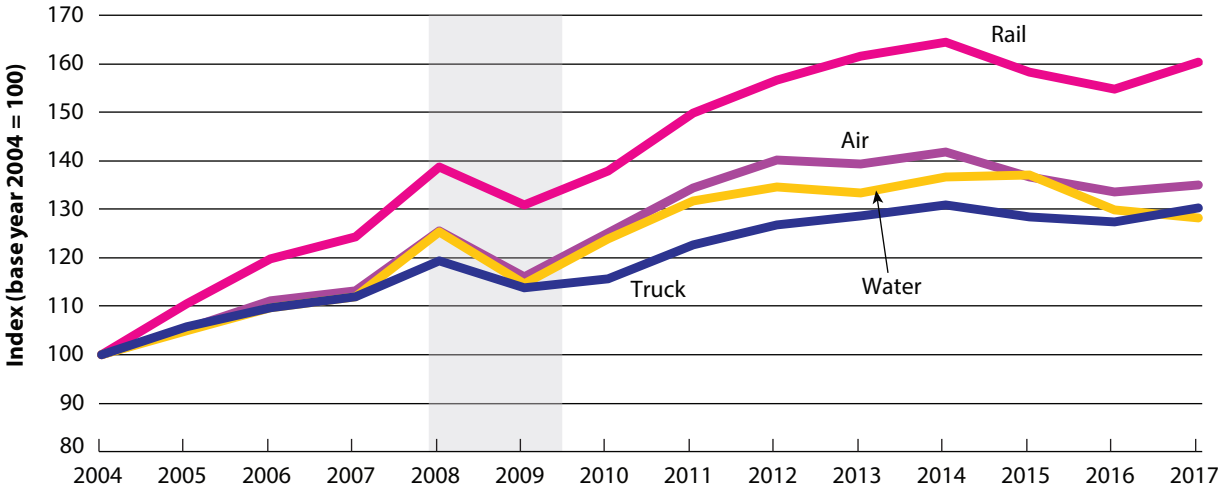
Prices Faced by Businesses Purchasing Transportation Services

The PPI for producing transportation services measures the average change over time in the prices received by producers for selling their transportation services, for example, airfare. The PPIs are not the cost to purchase transportation services, because they do not include sales and excises taxes that businesses and households pay for the services. Nonetheless, the PPIs are an indicator of the prices faced by businesses purchasing transportation services. Some of the services, for example, airfare, may be purchased by households as well.

Figure 3-7 shows PPIs for transportation service producers by mode from 2004 to 2017. Despite periods of modest decline from 2007 to 2009 (during the recession) and from 2014 to 2016, the prices received by producers of air, rail, truck, water, and pipeline transportation services increased. This means that purchasers of transportation services saw an overall increase in prices for transportation services. From 2004 to 2017, the price received for producing rail transportation services grew by 60.4 percent, more rapidly than any other transportation mode. The prices received for producing truck, water, and air transportation services (and hence faced by purchasers of the services) also increased. The price received for producing water transportation services grew at a slightly slower rate (28.1 percent) than truck (30.3 percent) and air (35.0 percent) transportation services, because the price received for producing water transportation services declined from 2014 to 2017. More research is needed to better understand the reasons PPIs change differently by mode.

The historic trends in the PPI 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 prices received for producing water transportation services, which rose to their highest level in 2015) and have since declined modestly before increasing in 2017 (except for prices received for water transportation services, which declined in 2017).

Figure 3-7 Producer Price Indices for Producers of Selected Transportation and Warehousing Services, 2004–2017



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

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Index Industry Data, available at www.bls.gov/ppi as of May 2018.

Table 3-1 shows changes in the prices received by selected transportation producers. While transportation PPIs have often moved together, some subsectors show exceptions. For example, the prices received for producing transportation services (and hence faced by purchasers of 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.

Prices Faced by Households

Households pay for travel in two ways. First, they pay to own and operate passenger vehicles for their own use. Second, they pay fares to use for-hire passenger transportation services (e.g.,

Table 3-1 Detailed Producer Price Indexes by Transportation Modes, 2004–2016 (2004 = 100)

Mode	2004	2017	2004-2017
Air transportation (NAICS 481)[1]	100.0	135.0	
Scheduled air transportation (NAICS 4811)[2]	100.0	135.4	
Scheduled freight air transportation (NAICS 481112)	100.0	150.1	
Nonscheduled air transportation (NAICS 4812)[3]	100.0	140.5	
Rail transportation (NAICS 482)[3]	100.0	160.3	
Line -haul railroads (NAICS 482111)[4]	100.0	160.3	
Water transportation (NAICS 483)	100.0	128.1	
Deep sea freight transportation (NAICS 483111)[5]	100.0	116.3	
Coastal and great lakes freight transportation (NAICS 483113)	100.0	147.6	
Inland water freight transportation (NAICS 483211)[6]	100.0	159.0	
Truck transportation (NAICS 484)	100.0	130.4	
General freight trucking (NAICS 4841)	100.0	132.7	
General freight trucking, local (NAICS 48411)	100.0	123.6	
General freight trucking, long distance (NAICS 48412)	100.0	134.7	
Specialized freight trucking (NAICS 4842)	100.0	125.2	
Used household and office goods moving (NAICS 48421)	100.0	124.1	
Specialized freight (except used goods) trucking, local (NAICS 48422)	100.0	129.8	
Specialized freight (except used goods) trucking, long distance (NAICS 48423)	100.0	120.8	
Pipeline transportation (NAICS 486)	NA	NA	
Pipeline transportation of crude oil (NAICS 4861)	100.0	224.1	
Other pipeline transportation (NAICS 4869)	100.0	170.8	
Support activities for transportation (NAICS 488)	100.0	120.0	
Support activities for water transportation (NAICS 4883)	100.0	137.6	
Postal service (NAICS 491)[2]	100.0	140.1	
Couriers and messengers (NAICS 492)	100.0	198.3	

NOTES: Blue dots on the sparkline charts indicate high values; red dots indicate low values. Transportation Mode defined by the North American Industry Classification System (NAICS). Indexes rebased, year 2004 = 100.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Index, available at www.bls.gov/ppi as of June 2018.

air, transit bus, and rail services) for their intercity and intracity travel. This section presents data on prices from the Consumer Price Index (CPI) (box 3-3) as well as average fare data for three for-hire intercity passenger transportation modes: aviation, Amtrak (rail), and scheduled bus service other than that provided by transit agencies (e.g., Greyhound, Bolt Bus, and Megabus) (box 3-4).[1] This section also presents average-fare data for two for-hire intracity modes: local transit and commuter rail. While not presented in this chapter due to a lack of available data on fares, other forms of for-hire intracity travel include ride-hailing services (taxis and rideshare services like Uber and Lyft), limousine services, and bikeshare. Chapter 6 provides detail on total household transportation expenditures and how it compares to other household expenditures.

[1] 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.

Consumer Price Index for Urban Consumers (CPI)

The CPI (box 3-3) measures transportation costs from the households' (also known as consumers') perspective. The CPI is a measure of the average change over time in the prices paid by urban consumers for a market basket of goods and

Box 3-3 Consumer Price Index for All Urban Consumers (CPI)

The Consumer Price Index for all Urban Consumers (CPI) measures the average change over time in the prices urban consumers paid for a market basket of consumer goods and services. The CPI covers the spending by 93 percent of the total U.S. population. It includes expenditures made by residents of urban or metropolitan areas. It does not include spending patterns of people living in rural nonmetropolitan areas, those in farm households, people in the Armed Forces, and those in institutions, such as prisons and mental hospitals.

The CPI for goods and services, such as ones related to transportation, show changes in prices paid by consumers for transportation related goods and services. Comparing the CPI for all goods and services to the CPI for transportation shows which transportation items are contributing to changes in the consumer cost of living. Comparing mode-specific CPIs shows which modes of transportation are becoming more expensive relative to other modes of transportation.

Box 3-4 Average Fares

Providers of for-hire passenger transportation services, such as airlines, railroads, and transit agencies, charge a variety of fares for different services. BTS defines the average fare for a mode 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. BTS divides revenue by trips. Passenger revenue does not include baggage fees, and BTS does not include free flights (e.g., frequent-flyer reward trips) in trip estimates.

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, BTS divided the revenue by unlinked trips. Trips on transit often involve transfers between two buses, or a bus and rail transit. Many transit systems only capture the number of boardings and cannot link the segments into a complete one-way trip, so BTS only uses unlinked trips (i.e., the number of times a passenger boards a transit vehicle). If data on complete one-way trips were available, they would show higher average fares for transit.

services.[2] The CPI also includes user fees (e.g., water and sewer service) and sales and excise taxes paid by the consumer. Economists often use the CPI as an indicator of general price trends. CPIs 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 2016 to 2017.[3] On average, transportation cost more in 2017 than in 2016 (table 3-2). The CPI for private transportation increased (3.8 percent), while the CPI for public transportation declined modestly (0.9 percent) from 2016 to 2017 (table 3-2). Costs for private transportation rose by 3.8 percent, resulting primarily from a 12.9 percent increase in the cost

[2] The CPI covers the spending by 93 percent of the total U.S. population. It includes expenditures made by residents of urban or metropolitan areas. It does not include spending patterns of people living in rural nonmetropolitan areas, those in farm households, people in the Armed Forces, and those in institutions, such as prisons and mental hospitals.

[3] In this discussion, "public transportation" includes fares for mass transit, buses, trains, airlines, taxis, school buses for which a fee is charged, and boats.

Table 3-2 Consumer Price Indexes for All Urban Consumers, Transportation Related Goods and Services, 2016 and 2017

Goods and Services	2016 average	2017 average	Change from 2016 to 2017
Overall transportation	**194.9**	**201.6**	**3.4%**
Private transportation	**189.5**	**196.6**	**3.8%**
New and used motor vehicles [1]	100.2	98.9	-1.3%
New vehicles	147.4	147.0	-0.2%
Used cars and trucks [1 2]	143.5	138.3	-3.6%
Motor fuel	188.4	212.7	12.9%
Gasoline (all types)	187.6	211.8	12.9%
Other motor fuels [1]	165.8	191.0	15.1%
Motor vehicle parts and equipment	143.6	143.0	-0.4%
Tires	125.4	124.0	-1.1%
Motor vehicle maint. and repair	275.4	280.8	2.0%
Motor vehicle insurance	489.1	526.9	7.7%
Motor vehicle fees [1]	182.6	185.0	1.3%
Parking fees and tolls [1 2]	198.3	200.2	1.0%
Public transportation	**265.4**	**263.1**	**-0.9%**
Airline Fare	282.6	275.8	-2.4%
Other intercity	158.3	159.6	0.9%
Intercity train fare [2 3]	112.4	116.1	3.3%
Ship fare [1 2]	66.3	66.0	-0.5%
Intracity transportation	308.9	314.3	1.7%
Intracity mass transit [2 4]	122.3	124.5	1.8%

NOTES: "New and used motor vehicles" includes all purchased consumer vehicles. "Private transportation" includes purchases made by households on new and used motor vehicles; motor fuel; motor vehicle parts and equipment; motor vehicle insurance; and motor vehicle fees. "Public transportation" includes fares for mass transit, buses, trains, airlines, taxis, school buses for which a fee is charged, and boats. 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, U.S. City Average, available at www.bls.gov/cpi/data.htm as of June 2018.

of gasoline, a 15.1 percent increase in the cost of other motor fuels, and a 7.7 percent increase in the cost of motor vehicle insurance. These increases were partially offset by decreases in the cost of new and used motor vehicles (1.3 percent), motor vehicle parts and equipment (0.4 percent), and tires (1.1 percent).

Overall public transportation costs declined by 0.9 percent due to a 2.4 percent drop in air fares. Not all public transportation prices declined. Intercity train fare increased 3.3 percent, intracity transportation increased 1.7 percent, and intracity mass transit costs increased by 1.8 percent.

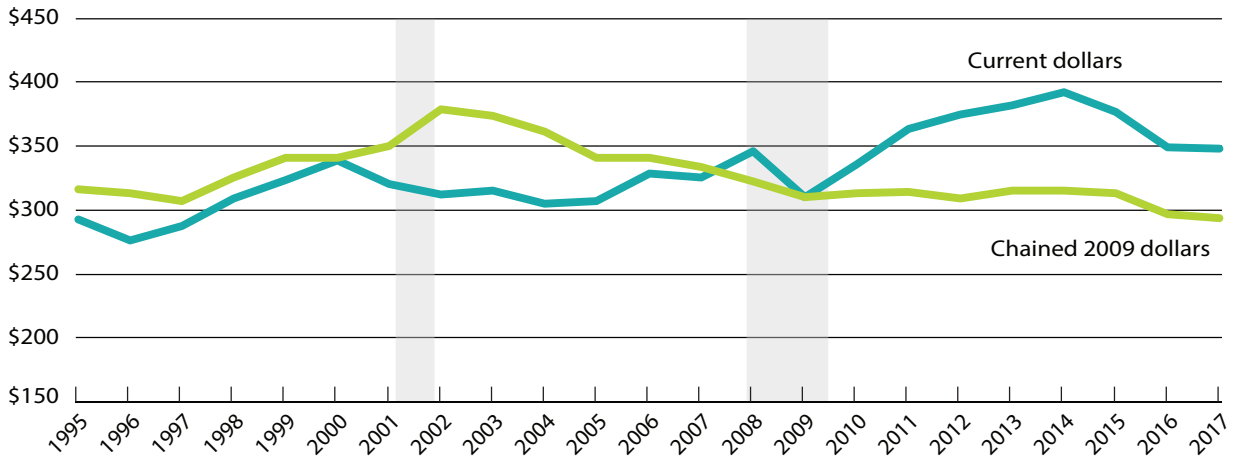
The CPI provides a picture of the relative change in the price households pay for transportation. Fare data, presented in the following sections, show the actual price paid.

Aviation Fares

Adjusted for inflation, passenger airfares increased 20.0 percent from 1995 to 2002, then fell 22.6 percent from 2002 to 2017 (figure 3-8). 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 for the period of $293 in 2017. 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.

Domestic air travel includes shorter trips of less than 700 miles and trips as long as 3,500 miles. Figure 3-9 shows air fares between 2009 and 2017 by distance traveled. Air fares by different distances show similar patterns over time. Changes in air fares between 2009 and 2017 ranged from a 7.8 percent increase for trips between 700 and 1,400 miles to a 28.3 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. Average fares

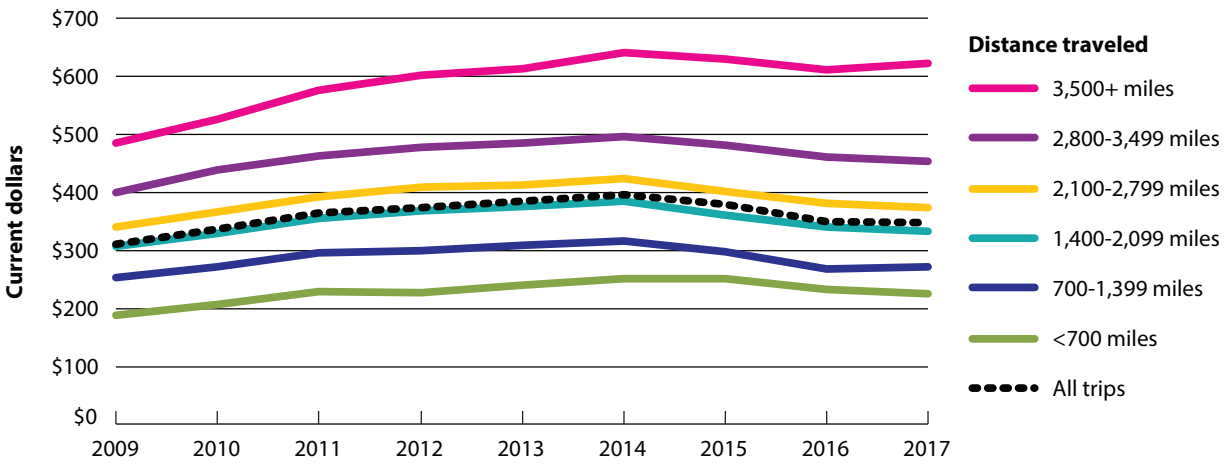
Figure 3-8 Domestic Average Air Fares (scheduled service), 1995–2017



NOTES: BTS reports average fares based on domestic itinerary fares. Domestic includes itineraries within or between the 50 U.S. States and the District of Columbia. Itinerary fares consist of round-trip fares, unless the customer does not purchase a return trip. In that case, BTS included the one-way fare. BTS based fares 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."
Shaded bars indicate economic recessions.

SOURCES: *Current dollars*: U.S. Department of Transportation, Bureau of Transportation Statistics, Annual U.S. Domestic Average Itinerary Fare, available at www.bts.gov/content/annual-us-domestic-average-itinerary-fare-current-and-constant-dollars as of June 2018. *Chained 2009 dollars*: calculated using chain-type quantity index from Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts tables, Price Indexes for Personal Consumption Expenditures by Type of Product, table 2.4.4U, line 203.

Figure 3-9 Domestic Average Air Fares by Distance Traveled, 2009–2017



NOTES: BTS reports average fares based on domestic itinerary fares. Domestic includes itineraries within or between the 50 U.S. States and the District of Columbia. BTS determines domestic average air fares 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 percent 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.

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, Airline Origin & Destination Survey (10 percent sample), DB1B_Ticket where bulk fare equals zero, itinerary fare is greater than or equal to $50 and itinerary yield is less than or equal to $3 except Hawaii. For Hawaii, DB1B_Ticket where bulk fare equals zero, itinerary fare is greater than or equal to $25 and itinerary yield is less than or equal to $3.

for trips between 700 and 1,400 miles as well as trips over 3,500 miles increased slightly in 2017, while the average fare for all other trips continued to decline from the 2014 peak.

Intercity Railroad Fares

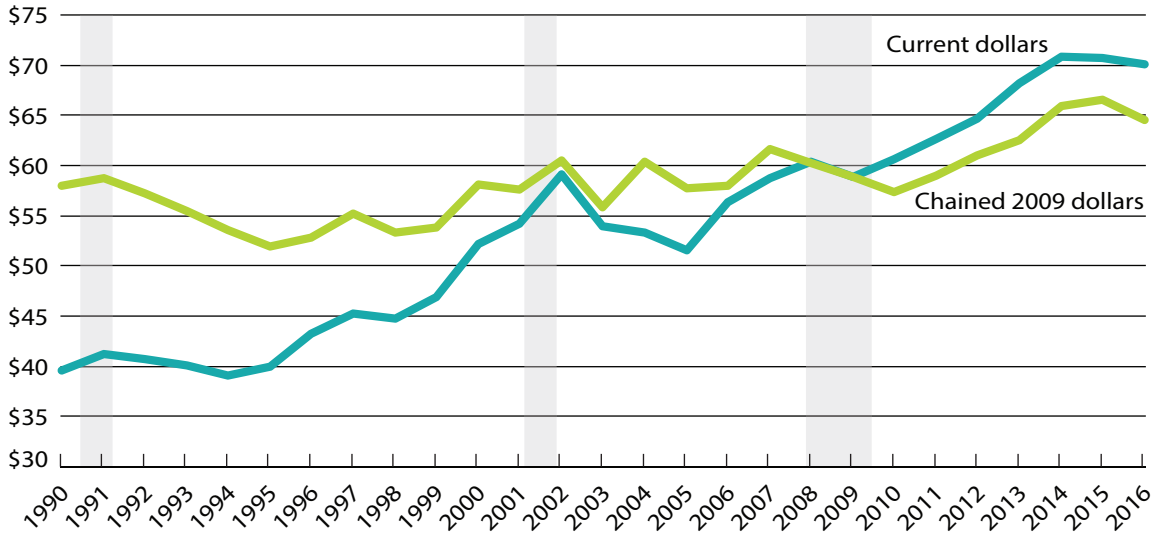
Amtrak intercity railroad fares represent a complex interaction of demand, operating costs, government subsidies, and regulation. Amtrak fares (in chained 2009 dollars) fluctuated within a narrow band from 1990 to 2016 (figure 3-10). The fares represent ticket revenue per passenger-mile multiplied by average trip length of passengers except for years prior to 1997, where BTS calculated fares 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 2015 before declining to $65 in 2016.

Commuter Railroad Fares

Commuter rail includes 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 3-11 shows that commuter rail fares grew steadily from 2002 to 2016, rising to $5.70 (in chained 2009 dollars) in 2016.

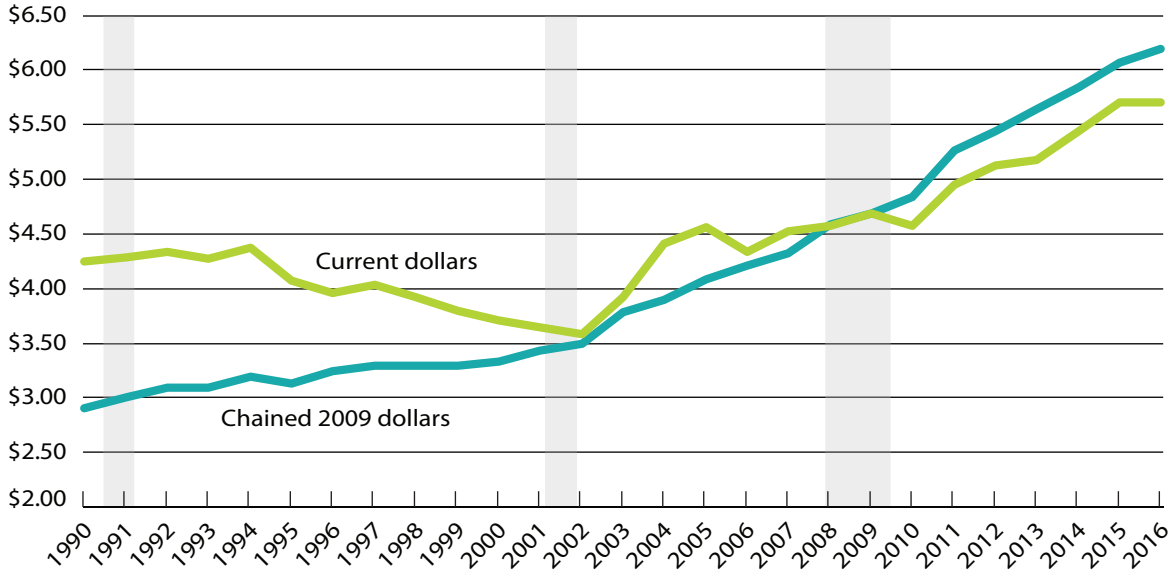
Figure 3-10 Average Amtrak Rail Fares per Average Trip Length, 1990–2016



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.

SOURCES: *Intercity Rail/Amtrak*: U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics, Average Passenger Fares (current dollars) (table 3-18) and Average Passenger Fares (chained 2009 dollars) (table 3-19), available at www.bts.gov as of June 2018.

Figure 3-11 Commuter Rail Fares, 1990–2016



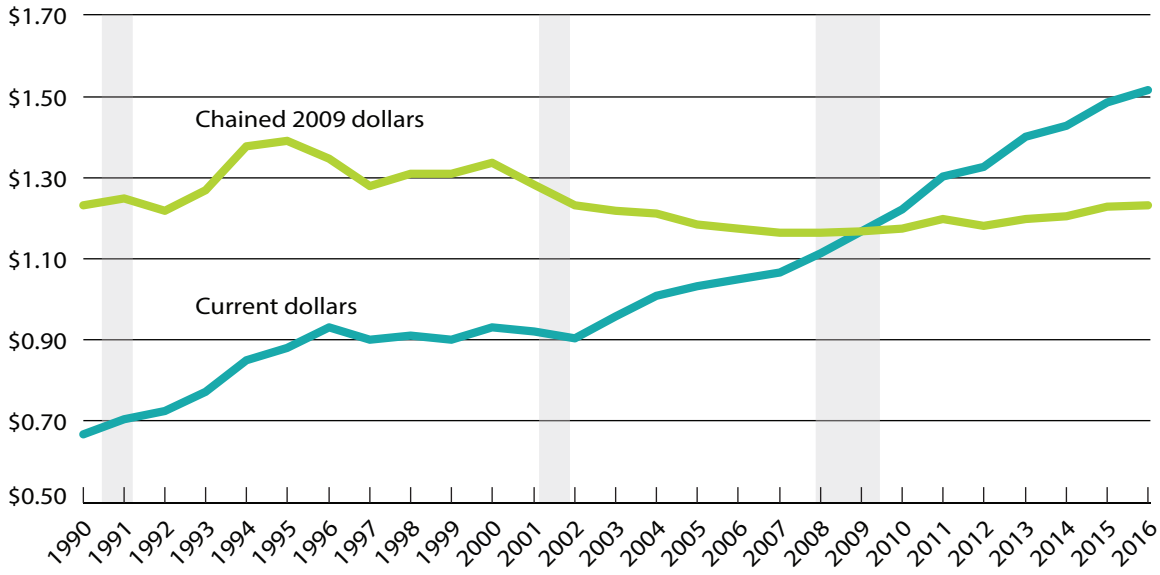
NOTE: Shaded bars indicate economic recessions.

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics, Average Passenger Fares (current dollars) (table 3-18) and Average Passenger Fares (chained 2009 dollars) (table 3-19), available at www.bts.gov as of June 2018.

Transit Fares

Over the past two decades, average fares for all local transit modes have fluctuated between $1.16 and $1.40 per unlinked trip (in chained 2009 dollars), and were the same in 2016 as in 1990 (figure 3-12). Transit modes include heavy rail (subway or metro), light rail, bus, and trolley car. For the years 1995 to 2001, BTS calculates average transit fare per trip as total passenger fares by total passenger trips collected by the American Public Transportation Association. For the years since 2001, data come from the National Transit Database, which presents average transit fares per unlinked trip. This means that 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 cannot account for transfers in counting trips.

Figure 3-12 Fares for all Transit Modes per Unlinked Trip, 1990–2016



NOTES: An average of data for 2005 and 2007 substituted for 2006 data, because the 2006 data are a suspected outlier. Shaded bars indicate economic recessions.

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, National Transportation Statistics, Average Passenger Fares (current dollars) (table 3-18) and Average Passenger Fares (chained 2009 dollars) (table 3-19), available at www.bts.gov as of June 2018.

4 Transportation Employment

Key Takeaways

- Transportation and transportation-related industries employ over 13.3 million people, accounting for 9.1 percent of workers in the United States. Employment in these industries rose steadily from 2011 to 2015 to 13.6 million, exceeding prerecession levels, then declined to 13.3 million in 2017.
- Four of the five largest transportation-related occupations involve driving. These four occupations (heavy-duty, light-duty, and delivery truck drivers; school bus drivers; and driver/sales workers) employ 3.6 million workers and account for 35.7 percent of total transportation-related employment.
- The average compensation for transportation-related occupations, including wages and benefits, was $6.43 dollars per hour less than the average for all occupations ($29.89 versus $36.32) in 2017.

Introduction

Industries in the transportation and warehousing sector and related industries outside the sector employed over 13.3 million people in 2017 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.

Transportation and Transportation-Related Industry Employment in the United States

Figure 4-1 shows the number and percentage of workers in transportation and transportation-related industries from 1990 to 2017. "Transportation industries" refers to industries in the transportation and warehousing sector such as air, rail, water, and truck transportation. "Transportation-related industries" refers to related industries outside the sector such as motor vehicle parts manufacturing.

The percentage of American workers in transportation and transportation-related industries declined from 11.3 percent in 1990 to 9.1 percent in 2017 (figure 4-1). In 1990, transportation and transportation-related industries employed 12.3 million workers. 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 Great Recession from December 2007 to June 2009. Employment rose steadily from 2011 to 2015, reaching 13.6 million in 2015 and exceeding the prerecession level of 13.5 million in 2007 for the first time, then declined to 13.3 million in 2017. Employment increased for transportation industries from 2015 to 2017, but a

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)

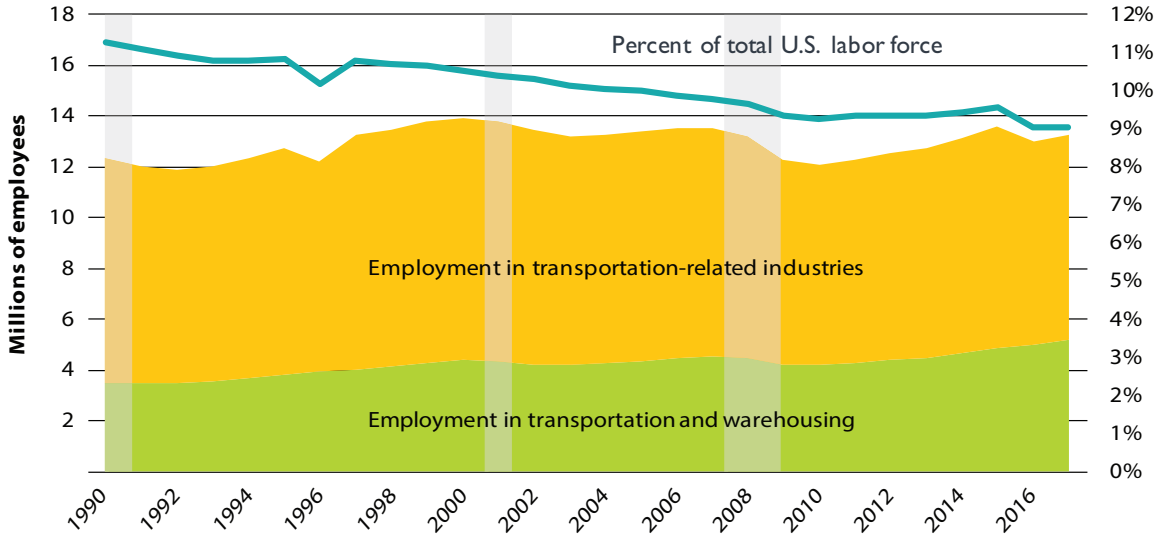
Subsector: Truck transportation (NAICS 484)

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)

Figure 4-1 Transportation-Related Labor Force Employment in the United States, 1990–2017



NOTE: Shaded areas indicate economic recessions.

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics*, table 3-23, available at www.bts.gov as of July 2018.

decline in employment for transportation-related industries offset this increase.

Transportation Employment by Industry and Occupation

Employment in the Transportation and Warehousing Sector

The transportation and warehousing sector (NAICS 48-49; box 4-2) directly employed 5.2 million workers in the United States in 2017—3.5 percent of the Nation's labor force. Transportation-related industries outside the sector employed 8.1 million workers. Employment in this sector includes transportation and non-transportation occupations and covers a diverse set of skills.

Figure 4-2 shows employment in the transportation and warehousing sector from 1990 to 2017 by subsector (box 4-2). Each subsector shows different patterns of employment because they face different economic environments and require different mixes of job skills and occupations. Truck transportation, the largest subsector, employed 28.2 percent of the 5.2 million employees in 2017. Truck transportation employment grew by 29.5 percent between 1990 and 2017, from 1.1 to 1.5 million employees, with significant fluctuations related to major economic events, such as September 11, 2001, the Great Recession, and other recessions. Warehousing and storage employment grew by 144.1 percent (from 406,600 in 1990 to 992,700 employees in 2017) to become the second-largest subsector, overtaking air transportation in 2004. The "support activities for transportation" subsector, the third-largest subsector, provides services like air traffic control, marine cargo handling, and motor vehicle towing. It grew 89.5 percent from 364,100 in 1990 to 690,100 employees in 2017.

Not all subsectors experienced employment increases from 1990 to 2017. Employment in air transportation increased from 1995 to 2001, but declined after 2001, leading to a 9.8 percent decline in employment between 1990 and 2017 (from 529,200 to 477,500 employees). In addition, rail transportation employment declined by 20.9 percent from 1990 to 2017 (from 271,800 to 215,000 employees) and pipeline transportation employment declined 19.2 percent (from 59,800 to 48,300 employees).

Box 4-2 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.

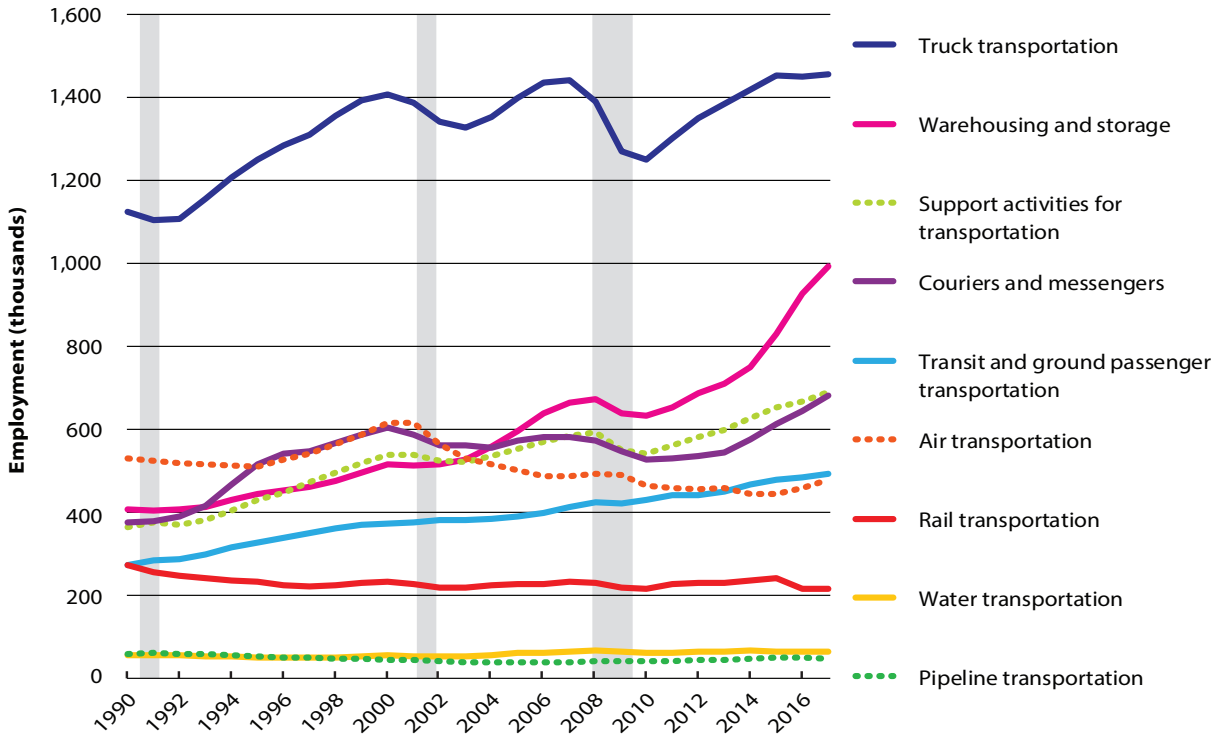
Water transportation (NAICS 483) includes industries providing water transportation of passengers and cargo using water craft, such as ships, barges, and boats. It does not include scenic and sightseeing water transportation services or support activities for water transportation.

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.

Figure 4-2 Employment in the Transportation and Warehousing Sector by Subsector, 1990–2017 (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 as of July 2018.

Employment in Selected Transportation-Related Industries

Transportation leads to employment in related industries that provide the goods and services needed to produce transportation. For example, the manufacturing sector produces transportation equipment, and gas stations provide services that support household and business transportation. Additionally, transportation uses a substantial portion of the output of the petroleum industry. In 2017 transportation used an estimated 14.0 million barrels of the 19.9 million barrels of petroleum supplied daily in the United States.[1]

A notable shift in transportation-related employment occurred between 1990 and 2017. From 1990 through 2001, transportation equipment manufacturing employed the most people of all transportation-related industries (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 34.4 percent from 1990 to 2017 (from 1.5 to 2.0 million employees), while employment in transportation equipment manufacturing declined 23.6 percent (from 2.1 to 1.6 million employees).

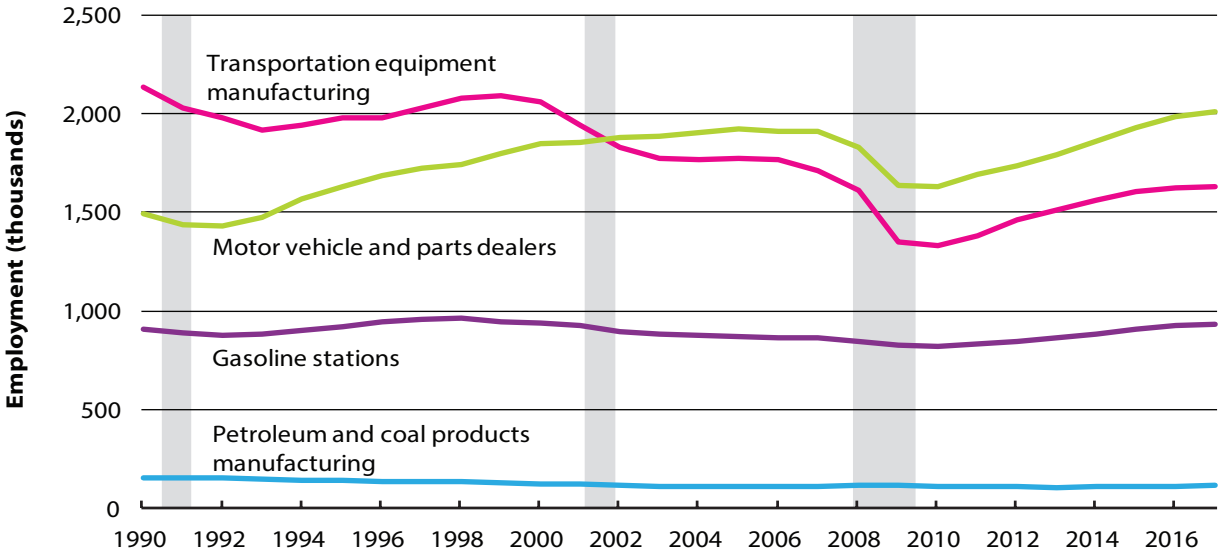
Transportation Employment by Occupation

Transportation industry employment data does not include many workers in transportation-related jobs who work for non-transportation firms. Table 4-1 lists transportation-related positions using the Standard Occupational Classification (SOC) system and highlights the variety of positions.[2] It is necessary to understand employment data at the occupational level to understand the full range of transportation jobs and skills in the economy.

[1] U.S. Energy Information Administration (EIA), Monthly Energy Review, tables 3.1 and 3.7c, available at https://www.eia.gov/totalenergy/data/monthly/ as of August 2018.

[2] BLS maintains a list of SOC occupations and related materials at https://www.bls.gov/soc/.

Figure 4-3 Employment in Selected Transportation-Related Industries, 1990–2017 (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 as of July 2018.

Table 4-1 All 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

NOTE: BTS selected these occupations 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.

In 2017 an estimated 8.9 million people worked in transportation-related occupations as defined by the Bureau of Transportation Statistics (BTS) (table 4-1; figure 4-4). The occupation employing the most workers was heavy-duty truck drivers; 1.8 million people worked as heavy-duty truck drivers in 2017 (figure 4-5). Four of the five transportation-related occupations that employ the largest number of workers involve driving and account for 35.7 percent (3.6 million employees) of transportation and material moving workers (figure 4-5):

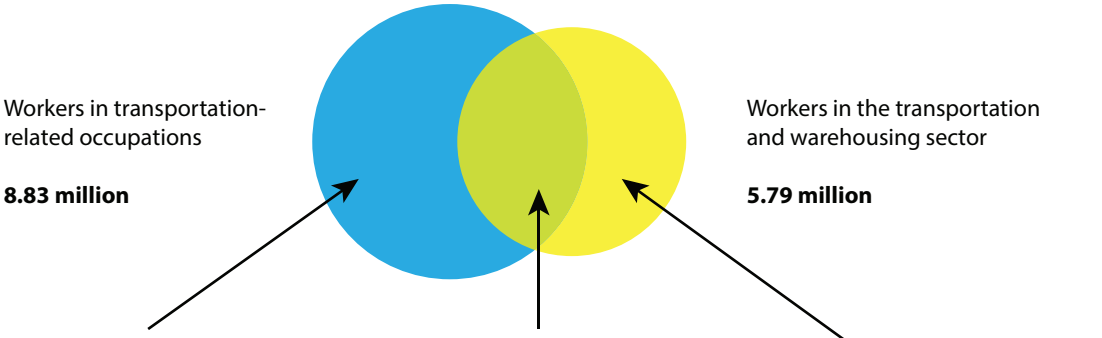
- Heavy-duty truck drivers (1.8 million; 19.7 percent)
- Light-duty and delivery truck drivers (878,000; 9.9 percent)
- School bus drivers (507,000; 5.7 percent)
- Driver/sales workers (427,000; 4.8 percent)

Many employees in the transportation and warehousing sector work in occupations that are not transportation occupations, such as accountants and computer programmers. Conversely, many workers in transportation occupations work in other sectors, 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 4-3). While employment in the transportation and warehousing sector and employment in transportation occupations measure the role of transportation in employment, they measure different things and may not move in tandem.

Part-Time and Full-Time Employment

BTS compiles statistics for a group of transportation and transportation-related occupations in *National Transportation Statistics*,

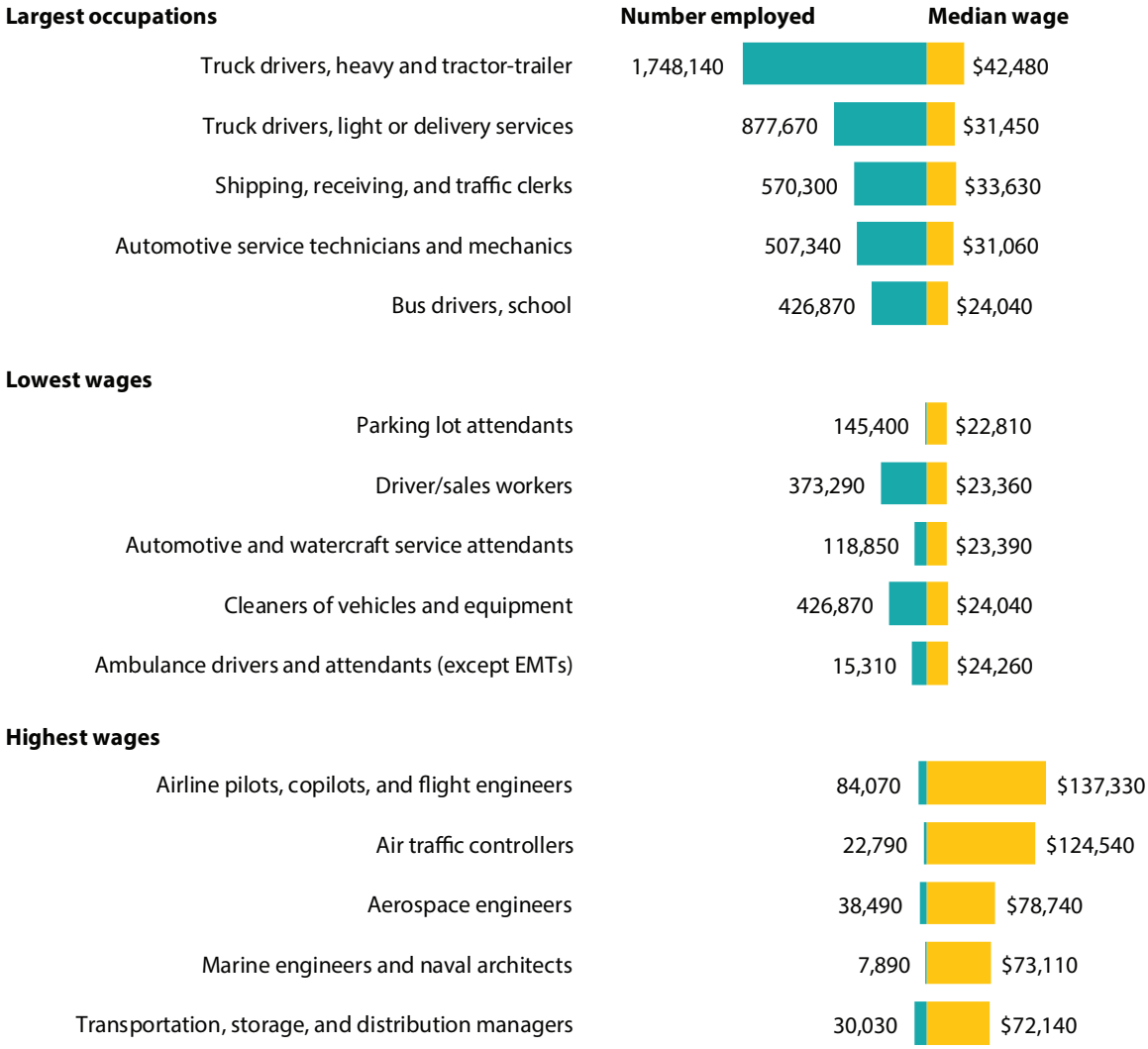
Figure 4-4 Relationship Between the Transportation and Warehousing Sector and Transportation-Related Occupations, May 2017



NOTES: 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. "Transportation-related occupations" refers to occupations selected by BTS as listed in table 4-1.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment Statistics, available at http://bls.gov/oes as of August 2018.

Figure 4-5 Employment and Wages for Select Transportation Occupations, 2017



NOTE: Airline pilots typically fly on scheduled air carrier routes to transport passengers and cargo, while commercial pilots fly on non-scheduled air carrier routes. "Commercial pilots" includes charter pilots, air ambulance pilots, and air tour pilots.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Occupational Employment and Wages, available at http://bls.gov/oes as of July 2018.

Box 4-3 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 semiannual 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

BTS selected these occupations 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.

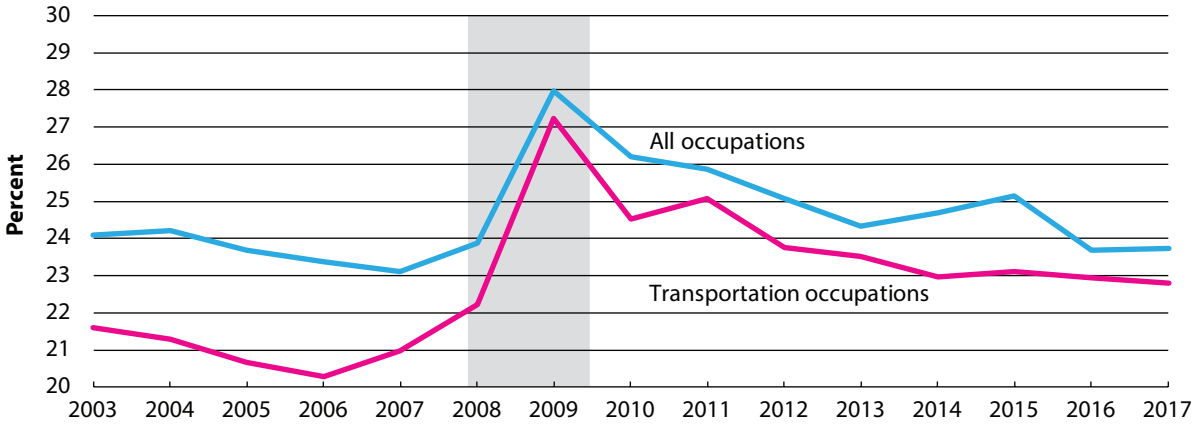
which includes occupations in the SOC "transportation and material moving" occupation group.[3] The percentage of workers employed part-time in transportation and material moving occupations is slightly lower than the percentage of workers employed part-time in all occupations (figure 4-6). The percentage 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 22.8 percent as of 2017.

[3] This group includes household movers.

Wages and Compensation

Figure 4-7 compares compensation for workers in transportation and material moving occupations and workers in all occupations from 2004 to 2018. Compensation includes wages and benefits. In current dollars, hourly compensation for workers in transportation and material moving occupations increased 51.4 percent from the first

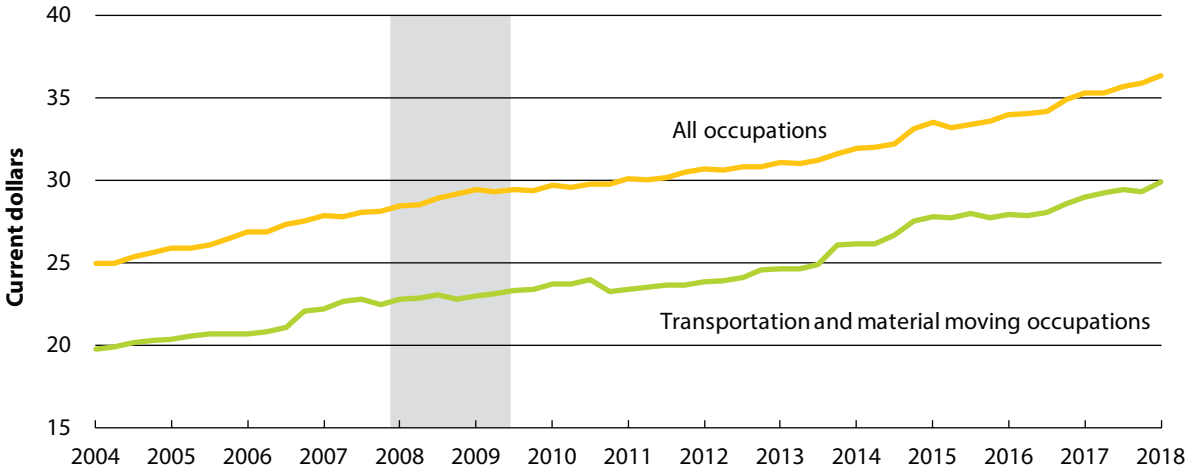
Figure 4-6 Percentage of Part-Time Workers, 2003–2017



NOTE: Shaded areas indicate economic recessions.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Employer Costs for Employee Compensation, available at www.census.gov/programs-surveys/cps.html as of July 2018.

Figure 4-7 Average Hourly Compensation (wages and benefits), 2004–2018 (current dollars)



NOTE: Shaded areas indicate economic recessions.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Employer Costs for Employee Compensation, available at www.census.gov/programs-surveys/cps.html as of July 2018.

quarter of 2004 to the first quarter of 2018 (from $19.74 to $29.89). In comparison, wages for all occupations increased 45.6 percent (from $24.95 to $36.32). 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 $6.43 dollars per hour less than the average for all occupations as of the first quarter of 2018.

Annual wages for the largest, lowest-paid, and highest-paid transportation occupations in the United States in 2017 are illustrated in figure 4-5. Because some occupations are more seasonal, analysts use annual wage data instead of the average hourly compensation used in figure 4-7 to compare industry employment categories. Annual wages vary widely, from an average of over $100,000 for airline pilots and air traffic controllers to an average of $22,810 for parking lot attendants. The five lowest-wage transportation-related occupations collectively employ 1.08 million workers, while the five highest-wage occupations employ 183,270 workers.

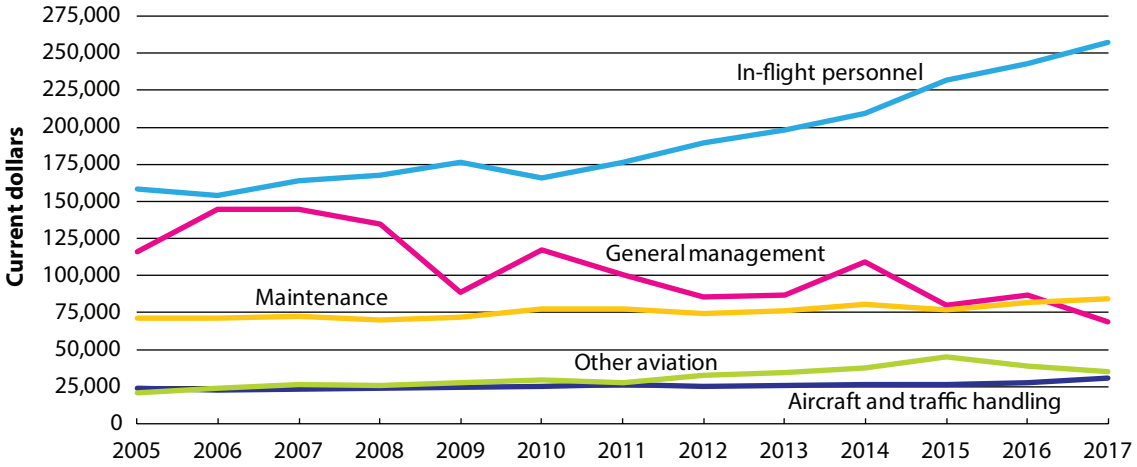
Wages and Compensation for Airline Occupations

BTS has a Congressional mandate to collect and disseminate data on airlines, including data on finances and employment; these data offer a detailed picture of airline labor. In 2017 an estimated 287,500 employees worked in aircraft and traffic handling—for example, as baggage handlers, flight dispatchers, or reservations clerks.[4] Approximately 84,900 employees worked as in-flight personnel (including pilots), 54,500 worked in maintenance, 12,300 worked in general management, and 227,600 worked in other occupations.

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 62.5 percent from $158,236 in 2005 to $257,121 in 2017. Salaries for employees in "other aviation occupations" (e.g., recordkeeping and statistical personnel, traffic solicitors, and

[4] 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 as of July 2018.

Figure 4-8 Average Annual Salary by Aviation Occupation, 2005–2017 (thousands of 2017 dollars)



NOTE: Shaded area indicates economic recession.

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 as of July 2018.

trainees and instructors) experienced the largest relative growth, increasing by 66.0 percent from $21,170 to $35,147 in the same period. Salaries rose for all groups except general management, whose salaries declined 52.3 percent from their peak of $144,784 in 2006 to $69,048 in 2017.

Transportation Employment by State

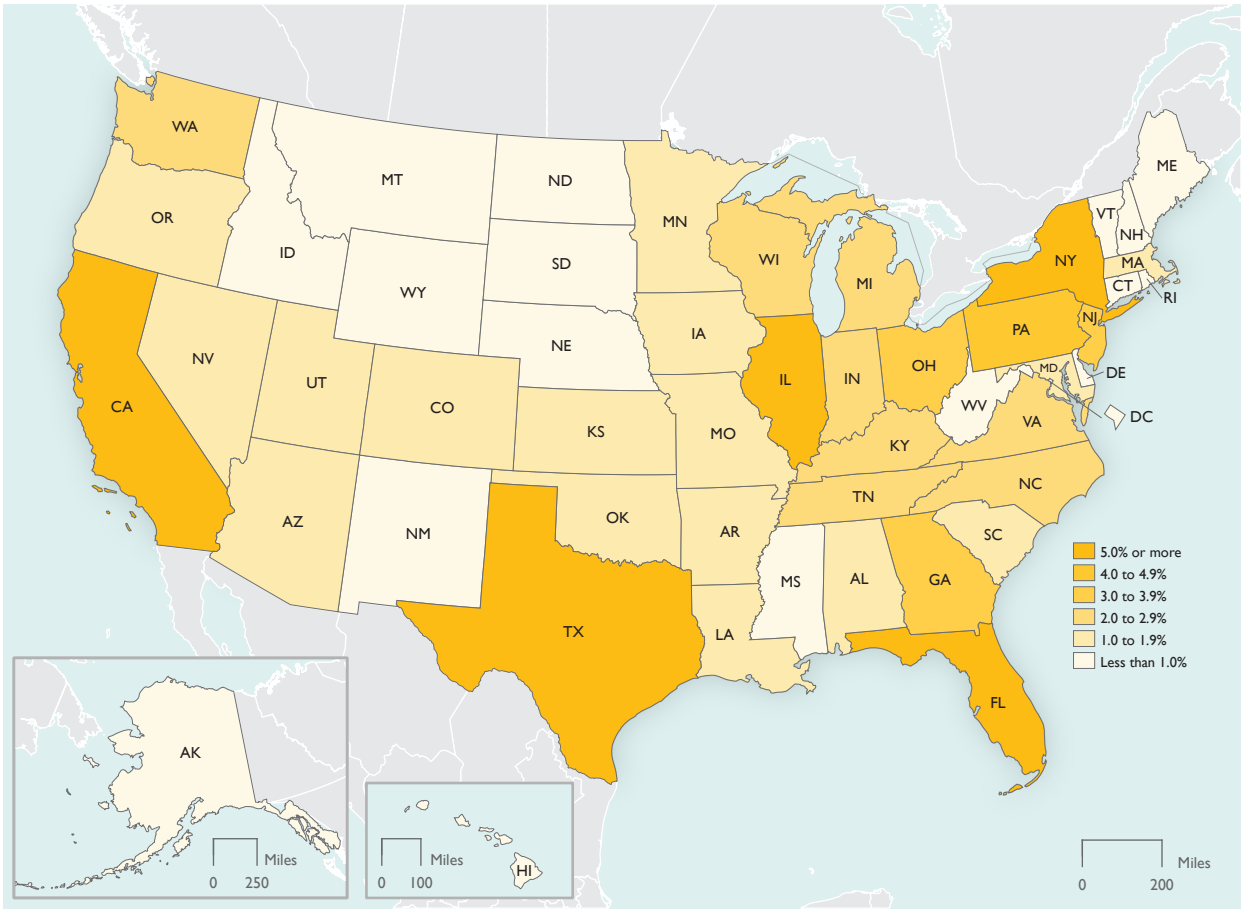
Transportation Establishments, Employees, and Payroll

Transportation establishments and firms employ people throughout the United States.[5] Table 4-2 shows information about transportation establishments, employees, and total employee payroll for each state in 2016; figure 4-9 shows the relative share of employees in each state. The data do not include freight railroad employees (because recent data are unavailable), self-employed workers, and government employees. State transportation employment corresponds with population levels and the locations of transportation hubs. The four most populated states (California, Texas, Florida, and New York) have the greatest number of establishments and employees (table 4-2). These states have a large employment pool and 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 (table 4-2). Transportation establishments

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

Figure 4-9 State Share of National Transportation Employment, 2016



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, 2016

State	Transportation establishments	Paid employees	Percent of total employees in state	Average employees per establishment	Annual payroll ($ thousands)	Percent of total payroll in state
Alabama	2,960	59,000	3.5%	20	2,633,446	3.8%
Alaska	1,145	18,655	7.0%	16	1,356,732	8.9%
Arizona	3,367	89,655	3.8%	27	4,438,953	4.2%
Arkansas	2,386	53,468	5.2%	22	2,327,513	5.7%
California	23,852	505,066	3.5%	21	26,685,162	3.0%
Colorado	3,742	67,489	2.9%	18	3,581,602	3.0%
Connecticut	1,678	43,315	2.8%	26	1,950,929	2.1%
Delaware	707	14,338	3.6%	20	622,262	2.9%
District of Columbia	165	3,875	0.7%	23	264,347	0.7%
Florida	14,942	248,639	3.0%	17	12,354,061	3.4%
Georgia	6,783	182,614	4.8%	27	8,896,717	4.9%
Hawaii	904	30,155	5.7%	33	1,544,994	6.7%
Idaho	1,796	18,457	3.3%	10	724,877	3.3%
Illinois	15,817	244,615	4.4%	15	11,989,961	4.1%
Indiana	5,291	124,985	4.6%	24	5,433,375	4.6%
Iowa	3,564	57,434	4.2%	16	2,411,969	4.2%
Kansas	2,567	55,850	4.7%	22	2,202,859	4.3%
Kentucky	2,904	96,476	6.0%	33	4,831,730	7.4%
Louisiana	3,882	68,693	4.0%	18	3,876,328	5.2%
Maine	1,230	15,695	3.1%	13	649,026	3.0%
Maryland	3,477	71,679	3.1%	21	3,533,204	2.9%
Massachusetts	3,874	84,681	2.6%	22	4,066,006	2.0%
Michigan	6,378	114,357	3.0%	18	5,595,473	3.1%
Minnesota	4,724	83,446	3.1%	18	3,776,249	2.8%
Mississippi	2,054	38,944	4.1%	19	1,649,336	4.8%
Missouri	4,723	87,182	3.5%	18	3,677,032	3.3%
Montana	1,353	13,412	3.5%	10	646,749	4.4%
Nebraska	2,415	30,505	3.4%	13	1,348,387	3.6%
Nevada	1,557	52,399	4.5%	34	2,286,290	4.6%
New Hampshire	808	13,870	2.3%	17	567,567	1.9%
New Jersey	7,516	164,419	4.5%	22	8,637,592	4.0%
New Mexico	1,334	17,226	2.7%	13	716,857	2.9%
New York	12,886	252,127	3.1%	20	11,835,007	2.3%
North Carolina	5,888	123,215	3.2%	21	5,527,453	3.2%
North Dakota	1,489	15,806	4.6%	11	808,372	5.1%
Ohio	7,497	176,312	3.7%	24	8,372,644	3.8%
Oklahoma	2,738	47,463	3.5%	17	2,401,612	4.2%
Oregon	3,148	57,040	3.7%	18	2,705,958	3.7%
Pennsylvania	8,725	222,332	4.2%	25	9,496,828	3.6%
Rhode Island	696	11,503	2.6%	17	451,279	2.2%
South Carolina	2,718	60,392	3.5%	22	2,509,918	3.6%
South Dakota	1,214	10,672	3.0%	9	447,277	3.2%
Tennessee	4,193	141,880	5.5%	34	6,342,180	5.5%
Texas	19,228	445,428	4.3%	23	24,307,189	4.6%
Utah	2,294	56,433	4.6%	25	2,535,214	4.7%
Vermont	495	5,893	2.2%	12	234,303	2.2%
Virginia	4,991	104,296	3.2%	21	4,904,673	2.9%
Washington	5,283	99,199	3.7%	19	5,449,518	3.5%
West Virginia	1,173	14,882	2.7%	13	651,541	3.0%
Wisconsin	5,525	103,910	4.1%	19	4,414,351	3.8%
Wyoming	918	10,332	5.0%	11	489,652	5.3%
United States, total	**230,994**	**4,729,709**	**3.7%**	**20**	**229,162,554**	**3.6%**

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

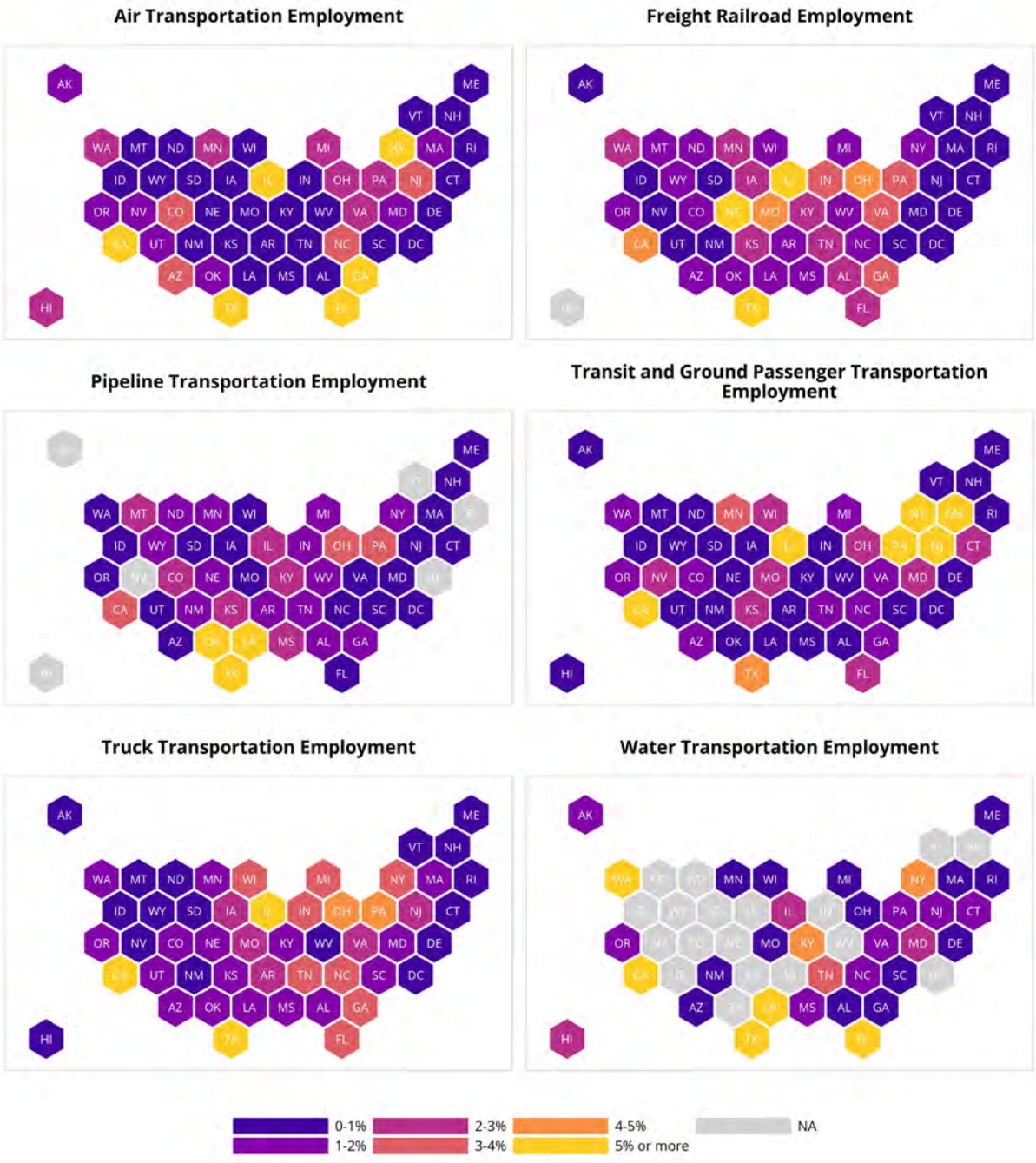
employ anywhere from 0.7 percent of total state employees in the District of Columbia to 7.0 percent of employees in Alaska. Accordingly, the share of total state payroll ranges from 0.7 percent in the District of Columbia to 8.9 percent in Alaska. Many transportation establishments fall into the small business classification: the national average establishment size is 20 employees.[6]

Employment by Mode

Figure 4-10 illustrates state transportation employment by mode in 2016. While transportation employment remains related to population, it also relates to the extent of transportation infrastructure and assets in a given state. For example, Texas, Louisiana, and Oklahoma have the largest number of pipeline establishments, even though Louisiana and Oklahoma were the 25th and 28th most populated states in 2017. 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.

[6] The Small Business Administration classifies "small businesses" as those with less than 1,500 employees (Business Credit and Assistance, 13 CFR 121.201).

Figure 4-10 State Share of National Transportation Industry Employment by Mode, 2016 (2015 for Freight Railroad)



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

Key Takeaways

- Labor productivity measures output per unit of labor input. From 1990 to 2016, air transportation experienced the largest increase (159.2 percent) in labor productivity among all transportation modes. Rail transportation experienced the second largest gains (100.9 percent), followed by trucking (33.6 percent), water transportation (26.2 percent), and pipeline transportation (5.7 percent). Transit transportation labor productivity declined by 15.2 percent from 1990 to 2016.
- Multifactor productivity (MFP) measures output per unit of weighted average of multiple factors, such as fuel, equipment, and materials. From 1990 through 2016, air transportation MFP increased the most across transportation categories, growing 107.3 percent. Rail and water transportation MFP grew 33.7 and 33.0 percent, respectively; pipeline and truck transportation had smaller increases of 27.6 and 10.2 percent, respectively; and the transit sector experienced a decline of 11.5 percent.
- Another measure of transportation productivity examines average revenue per passenger-mile and average freight revenue per ton-mile, both of which measure how much users are willing to pay for transportation services. Between 1990 and 2016, Amtrak/intercity rail average revenue per passenger-mile grew the most at 172.1 percent, while domestic air carrier average revenue per passenger-mile grew marginally at 1.8 percent from 1990 to 2017. In contrast, domestic air carriers average freight revenue per ton-mile increased 126.7 percent.

Introduction

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

What is Productivity?

Productivity measures 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 more efficiently by using fewer (or lower-cost) inputs. The reverse is also true. Productivity decreases when a business produces the same output using more (or higher cost) inputs. In instances of productivity increases, the business may 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 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. Decreases in productivity could result from factors that impact inputs, such as changes in wage rates or the cost of intermediate goods. Temporary decreases in productivity may also occur when businesses expand faster than their output increases or businesses do not adjust to declining output.

Productivity growth can lead to increases in national income and improvements in 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 do not always lead to lower prices for consumers or increases in output. For example, demand for a business' products may decline independent of an increase in productivity, which in turn may make the business unable to profitably increase output and lower its prices. Also, increases in productivity may not always lead to increases in total economic activity. For example, productivity increases achieved through automation may 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.

Productivity Measurements

Productivity measures answer important questions about the performance of the transportation sector—for example, how efficiently transportation providers move people and goods, and whether the value of their services grew more rapidly than the costs of the inputs they use. The two main measures of transportation productivity include: *labor (single-factor) productivity* and *multifactor productivity (MFP)*. 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. The multifactor productivity ratio provides a more comprehensive measure of economic performance but is complex and difficult to isolate specific factor impacts on output. Labor productivity measures continue to have broad appeal because they are both simple to understand and, in many instances, labor is the major driver in changes to productivity.

In the United States, the Bureau of Labor Statistics (BLS) produces labor and multifactor productivity measures for industries (through its Industry Productivity Studies) as well as sectors and selected sub-sectors (in its Major Sector Productivity (MSP) program) 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. This chapter presents transportation productivity data from BLS' MSP program.

Box 5-1 BLS Productivity Measures

The Bureau of Labor Statistics (BLS) produces productivity statistics through its Major Sector Productivity (MSP) Program, its Industry Productivity Studies (IPS), and its value-added studies. 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. BLS produces a productivity statistic for all industries aggregated in its value-added studies.

The three sets of productivity statistics differ due to methodological differences between the 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 the Bureau of Economic Analysis. IPS takes a micro-level approach and uses deflated sales, values, or physical quantities for output. The value-added approach subtracts the value of the inputs used during the production process (e.g., fuel and materials) from gross output.

BLS' productivity statistics presented in this chapter come from the MSP program because the MSP program produces statistics for all transportation sectors, whereas the ISP program produces statistics for only a few transportation industries.

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 economic growth.

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, multifactor productivity to economic growth. For more information, please see "A Prototype BEA/BLS Industry-Level Production Account for the United States," available at https://www.bls.gov/mfp/bea_bls_industry_product_account.pdf.

These productivity measures assume that the quality of output does not change. For example, output measures, such as ton-miles and passenger-miles, measure the quantity of output but do not measure the quality of output. If the industry produced less to improve quality, productivity would appear to be declining due to less output being produced per unit of input.

Labor Productivity

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 2016. Air transportation experienced the largest increase in labor productivity among all transportation modes, growing 159.2 percent from 1990 to 2016. 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 100.9 percent. These gains resulted from 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 growth in output over the 1990 to 2016 period. During the same period, smaller labor productivity increases occurred in truck (33.6 percent) and water (26.2 percent) transportation. Labor productivity in pipeline transportation grew 5.7 percent despite declining output and labor hours from 2000 through 2016. Both transit transportation output and the amount of labor hours required to produce that output increased from 1990 to 2016, but labor productivity declined 15.2 percent due to labor hours rising faster (76.6 percent) than output (49.8 percent).

Multifactor Productivity (MFP)

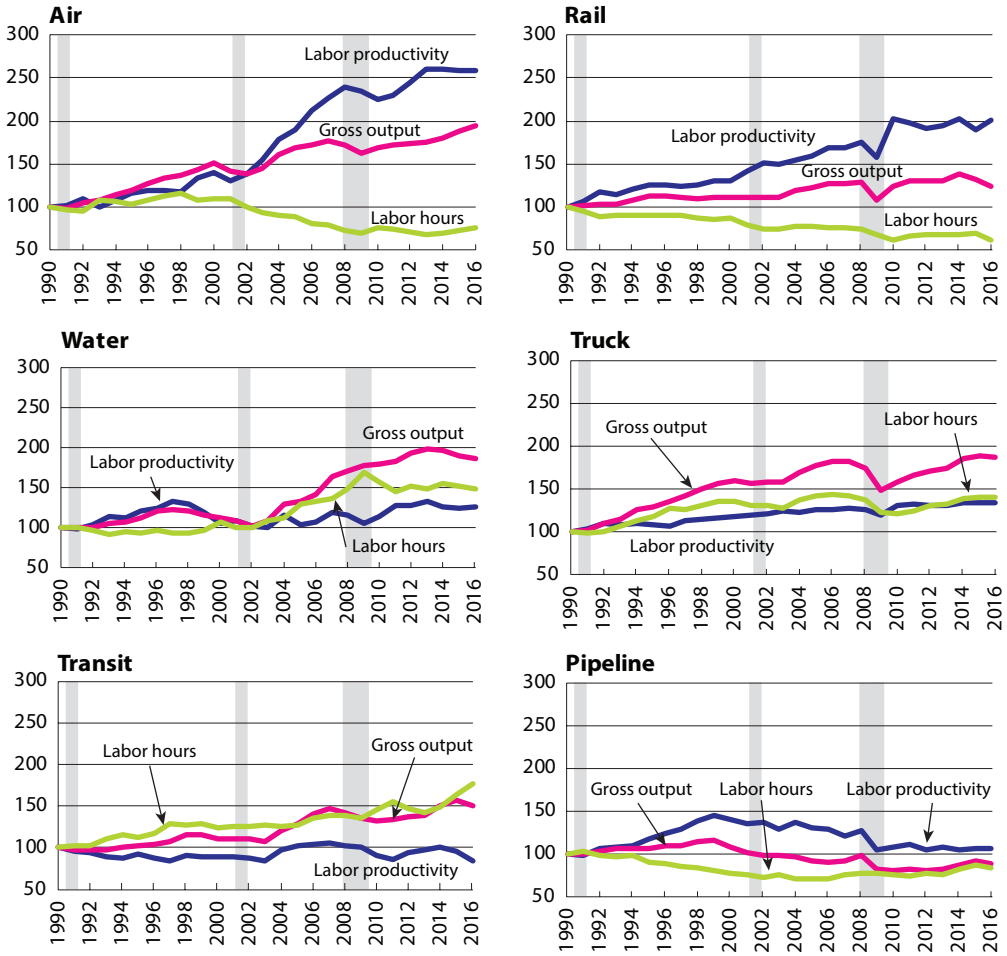
To measure MFP, BLS divides output by a weighted set of inputs, including capital (e.g., equipment), labor, energy (e.g., fuel), materials, and purchased services. Unlike labor productivity, which is a single-factor measure of productivity, changes in MFP reflect the combined effect of multiple inputs. MFP more effectively captures the effect of new technologies, new regulations, or organizational changes if these changes influence other means of production besides labor.

From 1990 to 2016, MFP for the transportation sector grew 23.0 percent, a more modest increase than all other sectors except the finance and

[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 https://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 http://transportation.mit.edu/sites/default/files/documents/MIT_Rail_Freight_Report.pdf as of June 2017.

Figure 5-1 Labor Productivity Indexes of Transportation Sectors, 1990–2016 (index 1990 = 100)



NOTES: 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. Shaded areas indicate economic recessions.

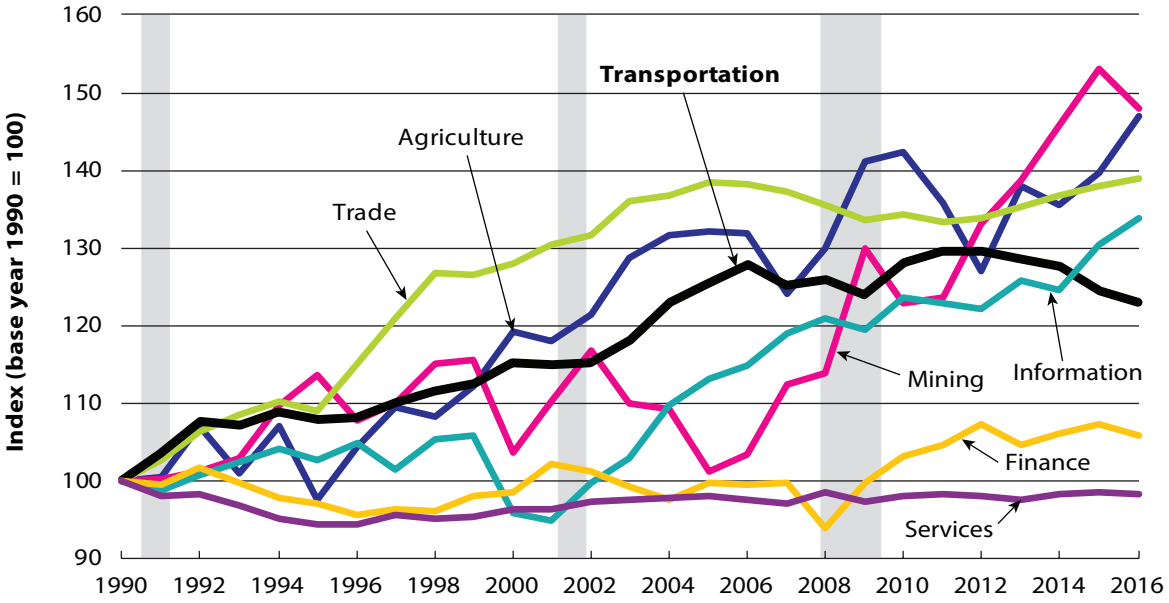
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Major Sector Productivity, available at www.bls.gov.

services sectors (figure 5-2).[3] MFP gains in the transportation sector resulted from the sector producing more per unit of combined inputs over time (figure 5-3). Of the inputs used, capital services (the cumulative value of the services rendered from the use of physical assets such as equipment, structures, and software over time) grew the most at 58.5 percent. Labor input, which is the combined effect of hours worked and the effort and skills of workers, grew 54.5 percent. Intermediate inputs, such as fuel, materials (e.g., tires), and purchased services, grew the least at 40.9 percent. Combined, capital services, labor, and intermediate inputs grew 49.0 percent, while output grew 83.0 percent. The greater growth in output led to an increase in MFP.

From 1990 through 2016, air transportation MFP increased the most across transportation categories, growing 107.3 percent (figure 5-4). The gain in air transportation reflects a 94.5 percent increase in output and a 6.2 percent decline in

[3] The services sector includes professional and business services, education and health services, leisure and hospitality, and other services (NAICS 54–81).

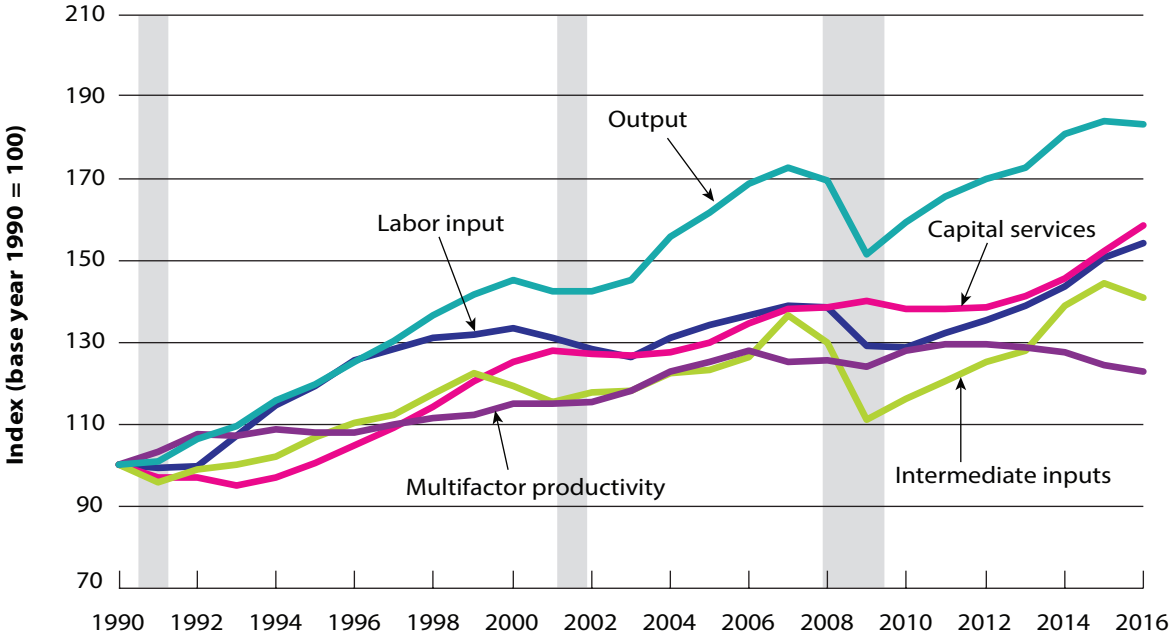
Figure 5-2 Multifactor Productivity Indexes of Selected Sectors, 1990–2016 (index 1990 = 100)



NOTES: Finance includes finance and insurance and real estate rental and leasing. The services sector include 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, http://www.bls.gov.

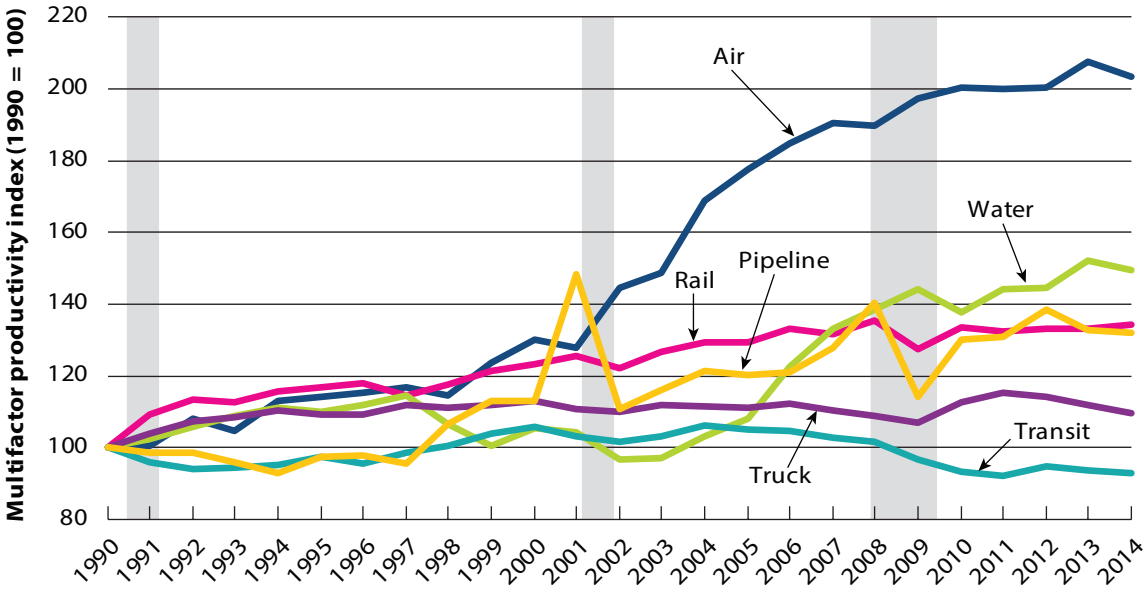
Figure 5-3 Transportation Multifactor Productivity and its Components, 1990–2016 (index 1990 = 100)



NOTE: Shaded areas indicate economic recessions.

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

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



NOTE: Scenic and sightseeing transportation (NAICS 487), support activities for transportation (NAICS 488), postal Services (NAICS 491), couriers and messengers (NAICS 492), and warehousing and storage (NAICS 493) are not included in this figure. Shaded areas indicate economic recessions.

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

combined inputs. Combined inputs fell, despite an increase in capital services, because of declines in labor inputs (18.5 percent) and intermediate inputs (10.7 percent), such as fuel and materials. The increase in capital services and the decline in labor result from the air transportation sector adopting labor-saving technologies, such as self-service kiosks.

Rail and water transportation experienced the next largest increases in MFP, growing 33.7 and 33.0 percent from 1990 to 2016, respectively. The gains suggest an adoption of practices to more efficiently produce transportation services but ones less impactful than those adopted by the air transportation sector. Unlike air and rail transportation MFP, the MFP of water transportation declined from 1997 to 2003—due to a decline in the output of water transportation services—and then began to rise.

MFP in pipeline transportation had a smaller increase of 27.6 percent from 1990 to 2016 and showed more year-to-year variation than other modes. Pipeline MFP had large spikes in 2001, 2008, and 2012. The largest spike in pipeline MFP resulted from the 2001 recession. During the 2001 recession, inputs to the production of pipeline transportation services (e.g., fabricated metal) declined faster than output (e.g., oil carried by pipeline), causing MFP to rise significantly. Likewise, a larger decline in inputs than output caused another spike in 2008 during the Great Recession (December 2007 to June 2009).

Sources of Economic Growth

The BEA/BLS Integrated Production Accounts show the contribution of labor, capital, and MFP to economic growth (box 5-2). 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, services, 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

Table 5-1 Sources of Economic Growth
(Average annual growth rate)

Industry	2003-2007	2007-2009	2009-2016
All	**2.71%**	**-1.56%**	**1.91%**
Finance	0.58%	0.03%	0.34%
Services	0.56%	-0.12%	0.60%
Manufacturing	0.51%	-0.66%	0.17%
Information	0.32%	0.03%	0.17%
Government	0.26%	0.17%	0.09%
Trade	0.28%	-0.61%	0.29%
Transportation	0.14%	-0.11%	0.05%
Mining	0.07%	0.17%	0.08%
Utilities	0.02%	-0.05%	0.02%
Agriculture	0.00%	0.09%	0.03%
Construction	-0.03%	-0.48%	0.06%

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, http://www.bea.gov as of September 2018.

has contributed positively to economic growth. However, transportation's average annual contribution to economic growth from 2009 to 2016 (the latest available year) is below its pre-recession level at 0.05 percent.

Per-Mile Revenue Measures

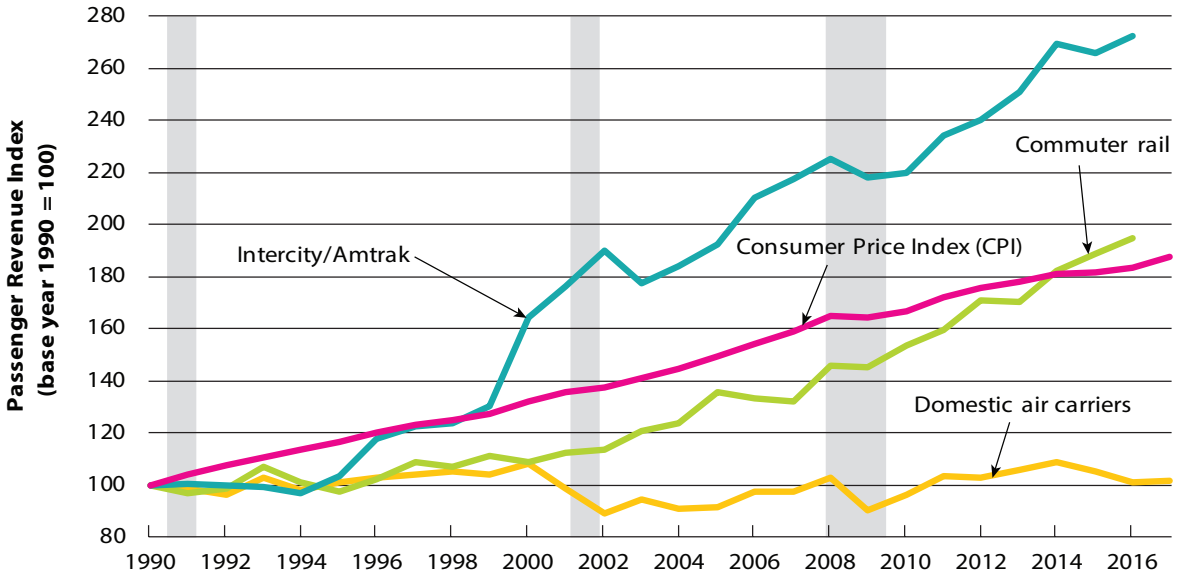
Labor productivity and MFP measure productivity from the industry perspective, namely, the ratio of total output to the inputs used in the production process (a measure of the rate of production). What users pay for each unit of the produced services can be thought of as a productivity measure from the user perspective—how much users are willing to pay for the produced services. For for-hire passenger transportation, the *average revenue per passenger-mile* measures what travelers pay per mile of purchased transport services. For for-hire freight transportation, the *average freight revenue per ton-mile* measures what freight shippers pay per ton mile of purchased transport. For modes where users do not typically pay per use, like driving a personal vehicle, data are difficult to obtain. These metrics differ from labor productivity and MFP because they incorporate revenue and thus capture price and quantity. By using revenue that incorporates prices for the service, this metric deals more effectively with outputs that have different levels of quality. For example, if two flights have the same origin and destination in which one flight is direct while the other includes layovers, revenue per mile would capture the difference in flight quality (time) through the difference in prices. However, quality is one of many determinates of price and can be difficult to isolate.

Revenue per Passenger-Mile

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 172.1 percent between 1990 and 2016 while commuter rail increased 94.7 percent. Both Amtrak/intercity rail and commuter rail experienced steady growth during that time period. 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 to its 2002 level in 2009. Between 2009 and 2014, domestic air carrier revenue per passenger-mile rose 21.0 percent but then fell 6.6 percent between 2014 and 2017.

The price of goods and services generally increases over time. This is often referred to as inflation. Because revenue is price multiplied by quantity, all else being equal, revenue increases over time due to these rising prices. The CPI measures overall changes in prices paid by households. Comparing revenue per passenger-mile to the CPI shows whether revenue per passenger-mile is rising slower or faster than rising prices. If revenue per mile trends similarly to the CPI, these trends can typically be attributed to inflation. When these trends diverge from the CPI,

Figure 5-5 Average Revenue per Passenger-Mile Indexes, 1990–2017 (Index 1990 = 100)



NOTES: Domestic air carrier revenue includes baggage fees and reservation change fees. Data for commuter rail and intercity/Amtrak available only through 2016. 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.

it implies that other factors may influence revenue per passenger-mile. The CPI increased by 87.5 percent from 1990 to 2017 while during that time period air revenue per passenger-mile grew more slowly, suggesting air carriers received less revenue per passenger-mile over time after accounting for inflation. In contrast, revenue per passenger-mile of Amtrak/intercity rail grew faster than the CPI, suggesting Amtrak/intercity rail received increasing revenue per passenger-mile over time after accounting for inflation. There are several possible explanations. Purchasers may have been willing to pay higher prices for Amtrak/intercity rail but possibly not for air transportation, which prevented air carriers from raising prices at the same rate that all goods and services increased. This does not indicate a preference for Amtrak/intercity rail; it only indicates a possibly greater tolerance toward price increases. It also may reflect differences in the cost to produce passenger transportation across modes. Rising costs may cause a transportation provider to increase their prices at a faster rate to boost revenue. There are additional possible explanations. More research is needed to explain divergences of revenue per passenger-mile from the CPI.

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 27.4 percent between 1995 and the first quarter of 2018.[4] As a result, fares have accounted for a lower percentage of operating revenues. In the 1990s domestic air carriers received around 90 percent of their revenues from passenger fares. In the 2000s, however, the percentage declined from 91.0 percent in 2000 to 72.9 percent in 2009, and has remained near the same percentage since then. Second, airlines began charging baggage fees and reservation change fees in 2008. In 2017 passenger airlines collected $3.6 billion from baggage fees and $1.9 billion from reservation change fees; these fees accounted for 2.7 and 1.4 percent of total operating revenue, respectively.[5]

[4] For U.S. domestic average air fares in current and constant dollars, please see https://www.bts.gov/content/annual-us-domestic-average-itinerary-fare-current-and-constant-dollars.

[5] For more information on domestic air carrier revenues, please see the BTS airline financial data press releases at https://www.bts.dot.gov/statistical-releases.

Freight Revenue per Ton-Mile

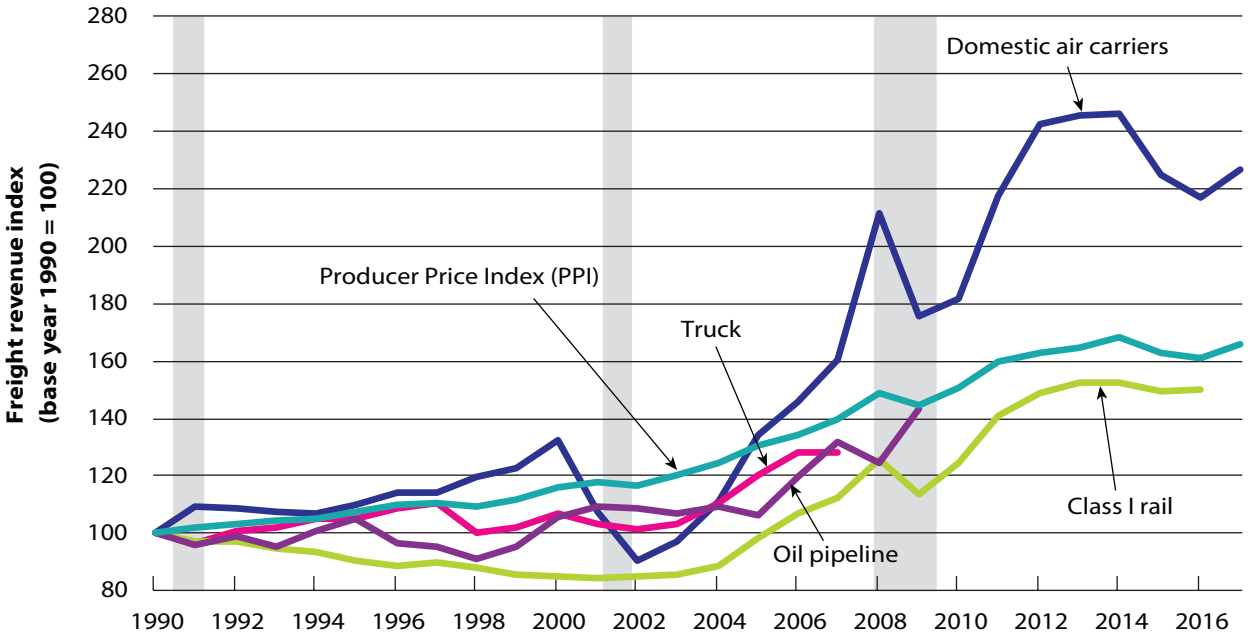
Figure 5-6 shows the average freight revenue per ton-mile for air, truck, rail, and pipeline compared to the Producer Price Index (PPI). The PPI measures overall changes in the selling prices received by transportation service providers for their services.

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. Unlike on the passenger side, domestic air carriers saw a significant increase in revenue from carrying freight but a smaller increase in ton-miles. This caused revenue per ton-mile to increase significantly (126.7 percent) from 1990 to 2017, whereas revenue per passenger mile grew marginally (1.8 percent). 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, declined in 2015 and 2016 from its 2014 level, and increased 9.8 percent from 2016 to 2017.

Class I railroads, defined as line-haul freight railroads with annual operating revenues of $457.91 million or more as of 2015, experienced a smaller increase in revenue per ton-mile, at 50.1 percent, than domestic air carriers from 1990 to 2016 (latest year rail revenue per ton-mile data are available) due to an initial decline.[6] 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 an increase of 28.4 percent from 1990 to 2007. Data for pipelines after 2009 and for trucks after 2007 are unavailable.

[6] See "Class I Railroad Statistics", Association of American Railroads, May 2017, available at https://www.aar.org/Documents/Railroad-Statistics.pdf as of June 2017.

Figure 5-6 Average Freight Revenue per Ton-Mile Indexes, 1990–2017 (Index 1990 = 100)



NOTE: Data for Class I rail available only through 2016. Data for truck available only through 2007. Data for oil pipeline available only through 2009. 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

Key Takeaways

- Transportation accounted for $1.2 trillion (9.2 percent) of total national household spending (including spending on behalf of households such as employee transit subsidies) in 2017, making transportation the fourth largest household expenditure category after healthcare, housing, and food.
- Households spent an average of $9,737 on transportation in 2017. By this measure, transportation is the second largest household expenditure category after housing because it does not include spending on behalf of households. This expenditure has increased more slowly than housing, food, and health expenditures.
- Household transportation expenditures vary by household characteristics. In 2017, rural households spent more on transportation than urban households ($10,293 versus $9,511). Households in the top fifth of income spent over five times as much on transportation as households in the bottom fifth of income ($18,190 versus $3,497).
- On average, it costs $0.59 per mile to operate and maintain a new vehicle in 2018, assuming the owner drives it 15,000 miles per year.

Introduction

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

1. *Personal Consumption Expenditures (PCE)*, which measures 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.

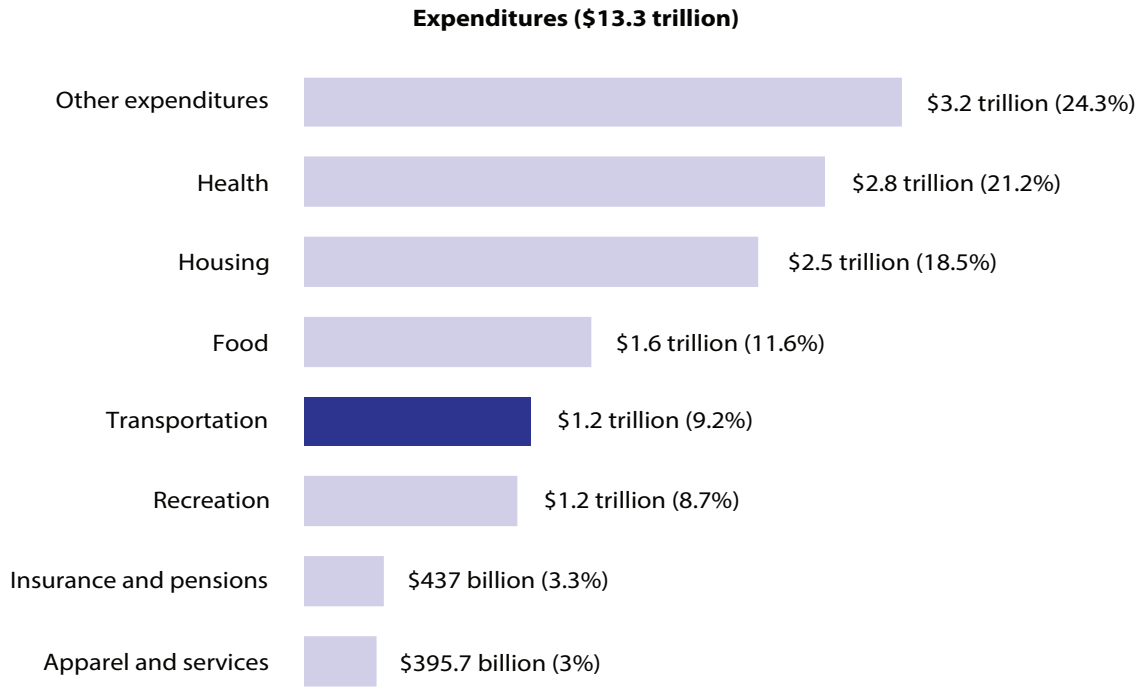
Personal Consumption Expenditures

Personal Consumption Expenditures (PCE), produced by the Bureau of Economic Analysis (BEA), is the broadest measure of consumer spending in the American economy. It measures total national household spending on goods and services. In the realm of transportation, it measures total household spending on durable goods, such as vehicles; nondurable goods, such as fuel; and services, such as for-hire transportation. PCE also measures total national transportation spending by governments, employers, and other organizations on behalf of households—for example, employee transit subsidies. The 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 total national spending only; it does not measure differences in household spending by income or social group.

Transportation expenditures accounted for $1.2 trillion (9.2 percent) of PCE in 2017, making transportation the fourth largest spending category (excluding "other expenditures") after healthcare, housing, and food (figure 6-1). Transportation expenditures increased 54.6 percent, from $794.8 billion in 2000 to $1.2 trillion in 2017 (figure 6-2).[1] Total household expenditures increased 97.0 percent from $6.8 to $13.3 trillion

[1] The latest version of PCE includes data revisions going back to 2000. Dollar amounts in TET 2018 will therefore differ from dollar amounts in TET 2017.

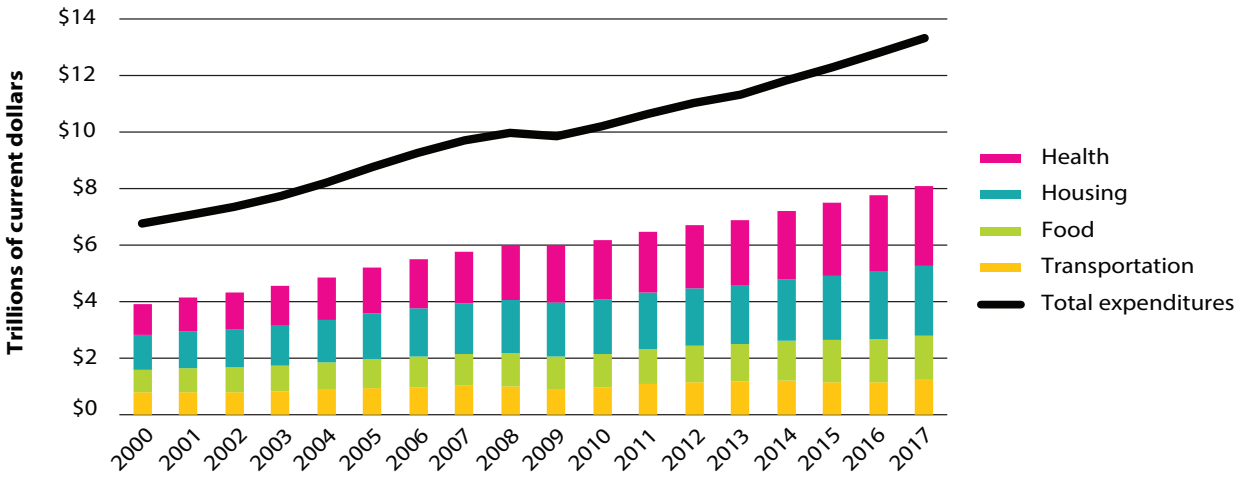
Figure 6-1 Total National Household Expenditures (Major Categories), 2017



NOTE: "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 as of September 2018.

Figure 6-2 Total National Household Expenditures, 2000–2017 (four largest categories, current dollars)



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 as of September 2018.

over the same period, outpacing growth in transportation expenditures. Expenditure growth for healthcare (155.0 percent), housing (102.9 percent), and food (93.3 percent) also outpaced expenditure growth for transportation. As a result, transportation expenditures declined from 11.8 percent of total PCE in 2000 to 9.2 percent of total PCE in 2017.

Expenditures on Personal Vehicles

Personal vehicles accounted for most of the transportation expenditures in the PCE—$1.1 trillion in 2017, or 87.8 percent of total transportation expenditures (figure 6-3).[2] This amount includes costs for purchasing, operating, and maintaining personal vehicles.

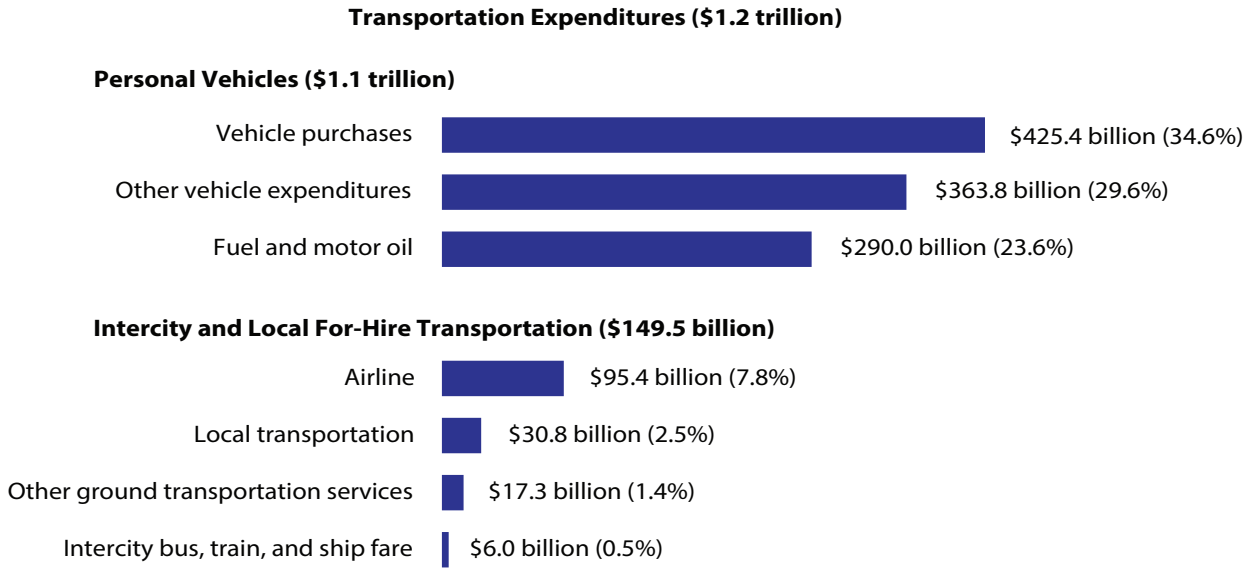
New and used vehicle purchases accounted for $425.4 billion in expenditures, or one-third of total transportation expenditures (34.6 percent) in 2017. Fuel and motor oil purchases accounted for $290.0 billion (23.6 percent) of transportation expenditures. World oil markets and national and regional refinery prices directly affect the cost of fuel and motor oil. Finally, other vehicle expenses, such as repair costs and insurance, accounted for $363.8 billion (29.6 percent) of transportation expenditures. Vehicle age, vehicle reliability, pavement conditions, prices of parts, and local market conditions affect the amount spent on repair.

Expenditures on Intercity and Local For-Hire Transportation

Expenditures on intercity for-hire transportation (between cities) and local for-hire transportation (within the same city) accounted for $149.4 billion (12.2 percent) of total transportation expenditures in 2017. Spending on air passenger travel accounted for $95.4 billion, nearly two-thirds (63.9 percent) of the $149.4 billion spent on for-hire transportation. Local for-hire transportation services accounted for $30.8 billion (20.6 percent); this category includes intracity mass transit ($20.1 billion) and local for-hire taxicabs and ride-hailing

[2] The percentages in this chapter are calculated using unrounded data and may therefore differ from percentages calculated using the rounded figures presented in this chapter.

Figure 6-3 Total National Household Transportation Expenditures, 2017



NOTE: "Other vehicle expenditures" include vehicle insurance, vehicle parts, and maintenance and repair costs. "Local transportation" includes intracity mass transit and local for-hire taxicabs and ride-hailing services.

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 as of September 2018.

services, such as Uber and Lyft ($10.7 billion). Expenditures for other ground transportation services, such as sightseeing buses, accounted for $17.3 billion (11.6 percent). Finally, intercity bus, train, and ship fares accounted for $5.9 billion (3.9 percent) of the total.

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 contains 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 $9,737 on transportation in 2017, making transportation the second largest household expenditure category (representing 17.4 percent of total expenditures) after housing (figure 6-4). The CE ranked transportation the second largest household expenditure category because the CE includes only direct household expenditures, whereas the PCE includes expenditures on behalf of households, e.g., healthcare paid by insurance (box 6-1).

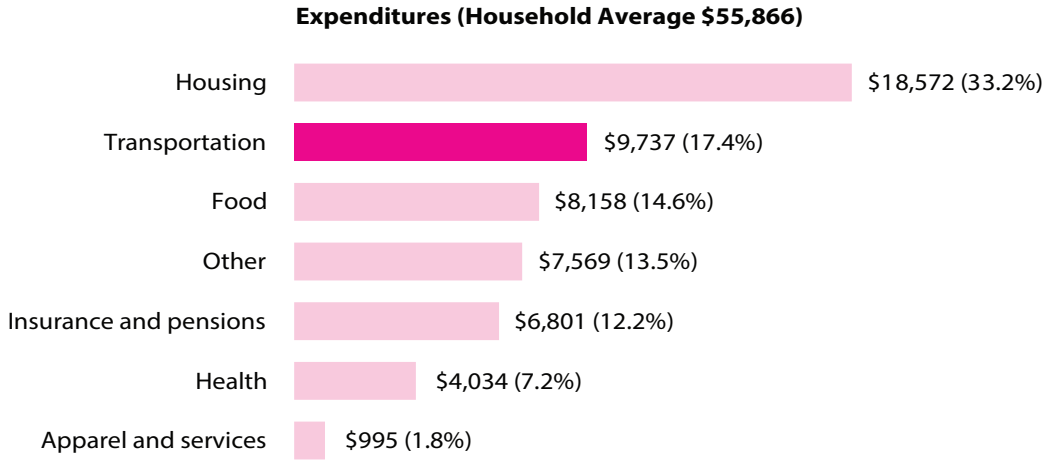
Box 6-1 Personal Consumption Expenditures and the Consumer Expenditure Survey

Personal Consumption Expenditures (PCE) includes expenditures made on behalf of households, such as healthcare premiums paid by businesses and housing assistance from nonprofits 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 (CE), which only examines direct household expenditures.

For discussions about household expenditures, transportation as a percentage of *personal consumption* expenditures is the most useful measure because it includes all expenditures that society makes to meet household needs. For discussions about household budgets, transportation as a percentage of *household* expenditures is the most useful measure.

Average annual household transportation expenditures have increased more slowly than other major expenditures (figure 6-5). From 2000

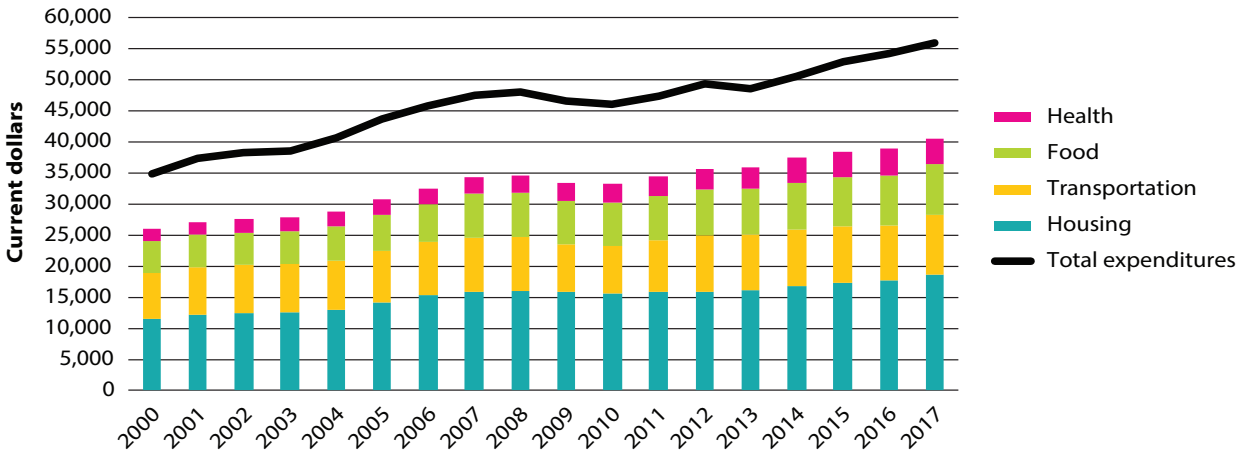
Figure 6-4 Average Individual Household Expenditures (major categories), 2017



NOTE: Amounts are calculated by the Bureau of Transportation Statistics using public-use microdata and may differ slightly from amounts calculated by the Bureau of Labor Statistics using original data.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey 2017 Microdata, available at www.bls.gov/cex as of September 2018.

Figure 6-5 Average Individual Household Expenditures, 2000–2017 (four largest categories, current dollars)



NOTE: Amounts are calculated by the Bureau of Transportation Statistics using public-use microdata and may differ slightly from amounts calculated by the Bureau of Labor Statistics using original data.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey 2017 Microdata, available at www.bls.gov/cex as of September 2018.

to 2017, transportation expenditures increased 31.3 percent, from $7,417 to $9,737, while total expenditures increased by 60.4 percent, from $34,839 to $55,866. As a result, the share of transportation expenditures declined from 21.3 percent in 2000 to 17.4 percent in 2017. In contrast, housing expenditures increased by 61.6 percent (from $11,494 to $18,572), food expenditures increased by 58.0 percent (from $5,164 to $8,158), and health expenditures increased by 108.1 percent (from $1,938 to $4,034) in the same period.

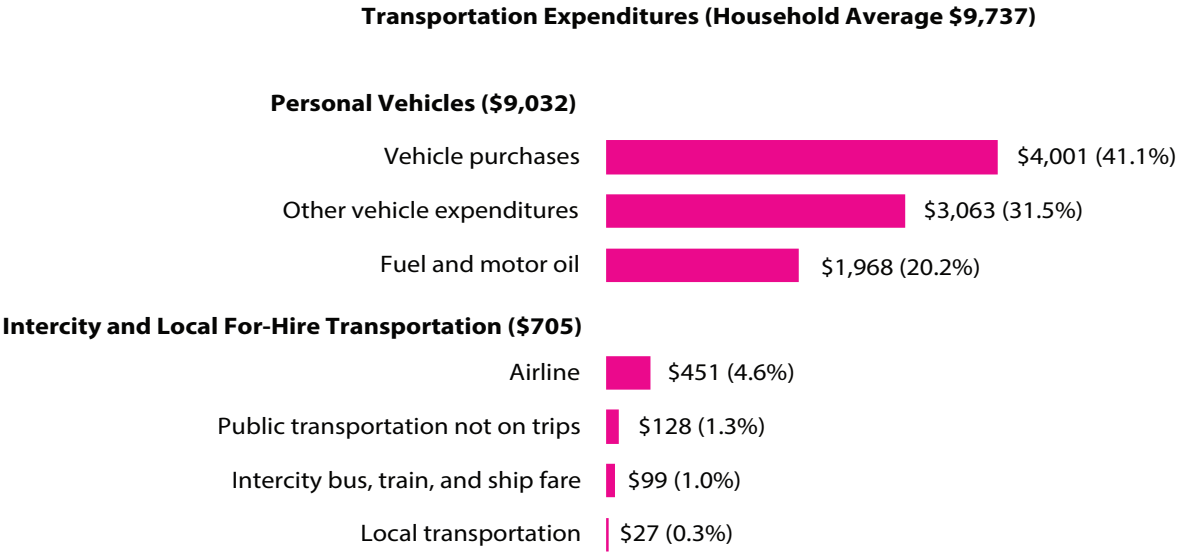
Household transportation expenditures vary by household characteristics. For example, rural households spent more on transportation ($10,293) than urban households ($9,511) in 2017, in part because rural households have higher rates of vehicle ownership and lower levels of access to public transit.[3] In 2017, rural households owned an average of 2.5 vehicles per household versus 1.8 vehicles per household for urban households. Residents of rural areas also drove 45.6 percent more miles per capita than residents in urban areas—32.2 miles versus 22.1 miles per day in 2017, respectively. In addition, households without vehicles spend lower amounts on transportation. In 2017, households without vehicles spent an average of $2,338 on transportation versus $10,157 for households with at least one vehicle. At the same time, transportation expenditures vary among households in the same socioeconomic group—namely because households have much higher expenditures in years that they purchase vehicles—and average annual expenditures cannot capture these variations.

Expenditures on Personal Vehicles

The average household devoted most of its transportation budget ($9,032 of $9,737, or 92.8 percent) in 2017 to purchasing, operating, and maintaining private vehicles (figure 6-6). Vehicle purchases accounted for 41.1 percent ($4,001) of transportation expenditures, fuel and motor oil accounted for 20.2 percent ($1,968), and other vehicle expenses, such as repairs and insurance, accounted for 31.5 percent ($3,063).

[3] For more information on travel behavior and demographics, please see U.S. Department of Transportation Federal Highway Administration, *Summary of Travel Trends: 2017 National Household Travel Survey*, available at https://nhts.ornl.gov/assets/2017_nhts_summary_travel_trends.pdf.

Figure 6-6 Average Individual Household Transportation Expenditures, 2017



NOTES: "Other vehicle expenditures" include vehicle insurance, vehicle parts, and maintenance and repair costs. "Public transportation not on trips" includes public transportation not taken as part of a trip or vacation. A trip or vacation includes trips to visit relatives or friends, business trips, recreational trips, other trips overnight or longer, and day trips of at least 75 miles away from home. "Local transportation" includes intracity mass transit and local for-hire taxicabs and ride-hailing services.
Amounts are calculated by the Bureau of Transportation Statistics 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 2017 Microdata, available at www.bls.gov/cex as of September 2018.

Expenditures on Intercity and Local For-Hire Transportation

Intercity and local for-hire transportation accounted for the remaining 7.2 percent ($705) of household transportation expenditures in 2017 (figure 6-6). Expenditures on trips and vacations accounted for 81.8 percent ($577) of the total:

- airline fares ($451);
- bus, train, and ship fares ($99); and
- local transportation taken during trips ($27).

Trips and vacations include trips to visit relatives or friends, business trips, recreational trips, other trips overnight or longer, and day trips of at least 75 miles away from home.

Intercity and local for-hire transportation taken while not on trips or vacations accounted for the remaining 18.2 percent ($128).

Transportation Expenditures and Income

Households spend similar percentages on transportation across all income categories except for the bottom income quintile, or the bottom fifth of households by income. In 2017 the top four income quintiles spent between 15.5 and 16.9 percent of total expenditures on transportation, while the bottom quintile spent 13.4 percent (table 6-1). Households in the top income quintile spent over five times as much as households in the bottom income quintile in 2017—$18,190 versus $3,497.

Higher income households spend more on transportation because they are more likely to own vehicles and more of them. In 2017 97.0 percent of households in the top income quintile had at least one vehicle, compared with 67.0 percent in the bottom income quintile. Households in the top income quintile owned an average of 2.8 vehicles per household in 2017, while households in the bottom income quintile owned 1.0 vehicles per household.

Table 6-1 Average Individual Household Expenditures by Income Quintile, 2017

Income range by quintile	Total annual spending	Vehicles per household	Households without any vehicles	Households with at least one vehicle	Transportation spending per household	Percentage of total spending
All quintiles	**$60,060**	**1.9**	**12%**	**88%**	**$9,576**	**15.9%**
First quintile ($0–$20,738)	$26,019	1	33%	67%	$3,497	13.4%
Second quintile ($20,739–$39,608)	$39,300	1.6	11%	89%	$6,572	16.7%
Third quintile ($39,609–$66,897)	$50,470	1.9	6%	94%	$8,532	16.9%
Fourth quintile ($66,898–$109,742)	$67,604	2.3	4%	96%	$11,099	16.4%
Fifth quintile ($109,733+)	$116,988	2.8	3%	97%	$18,190	15.5%

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Consumer Expenditure Survey, available at www.bls.gov/cex as of September 2018.

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). On average, it costs $0.59 per mile to own and operate a new vehicle in 2018.[4] The largest expense is fixed ownership costs, which represent 67.8 percent of the total cost ($0.40 per mile). Fixed ownership costs include depreciation, vehicle insurance, license and registration fees, and finance charges. Operating costs account for the remaining 32.2 percent of the total cost ($0.19 per mile). Fuel, a highly salient cost to consumers because they see prices posted at every filling station, is the largest operating cost, representing 18.6 percent ($0.11 per mile) of the total cost. Maintenance, repair, and tires account for the remaining 13.6 percent ($0.08 per mile) of the total cost.

[4] Operating costs in TET 2018 are not comparable to operating costs in earlier editions because AAA revised its methodology in 2017.

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 using estimated driving costs for nine vehicle types (small, medium, and large sedans; small and medium SUVs; minivans; pickup trucks; hybrid and electric cars) weighted by sales. AAA revised its methodology for estimating costs and added new vehicle types in 2017; as a result, estimates from previous years are not comparable. 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.

7 Government Transportation Revenues And Expenditures

Key Takeaways

- Transportation revenues grew at a faster rate than that of transportation expenditures in 2013, increasing 4.5 percent compared to transportation expenditure's 2.7 percent.
- While total transportation revenues exceeded transportation expenditures by 9.8 percent in 2014, 48.4 percent of the revenues were funds raised from non-transportation sources, such as local sales taxes dedicated to transportation.
- Most (90 percent) transportation expenditures occur at the state and local level, and most (64 percent) go to highways.
- There is considerable variation among states in transportation expenditure levels and how that money is distributed among modes.

Introduction

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, transportation related taxes, and general revenues.

The latest available data for revenue and expenditure data is for 2014, state and local government transportation expenditure data by state is for 2015, and federal and state funding of public transit data by state is for 2016.

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

1. *Government Transportation Financial Statistics* (GTFS) (box 7-1) examines transportation revenue and spending at the federal, state, and local levels.
2. *Census of State and Local Government* from the Census Bureau examines revenue and spending in individual states. It is a survey of state and local financial officers that gathers financial information on all areas of government.
3. The Survey of State Funding for Public Transportation from the American Association of State Highway and Transportation Officials (AASHTO) examines transportation revenue and spending in individual states. It is a survey of state departments of transportation. This data may differ from that derived from the Census of State and Local Governments due to differences in sources and methods.
4. The National Transit Database from the Federal Transit Administration examines data on transit provided by local transit agencies.

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 here are not comparable to the GTFS data presented in TET 2016 due to slight changes in the items selected and summed from the data sources.

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.

In 2014 federal, state, and local revenue collected and dedicated to transportation programs totaled $355.7 billion (in 2014 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 that support 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).

Federal Government Revenue Sources

Highway and aviation, which have trust funds supported by dedicated taxes, accounted for 97.6 percent of the $54.2 billion in 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.

In real 2009 dollars, Federal Highway Trust Fund revenues decreased by 16.9 percent from 2007 to 2014 (figure 7-3). Real revenues have declined in part 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 for diesel—since October 1997. Revenues also declined because vehicle gas mileage improved by 13.8 percent from 2007 to 2014 for 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.

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 into two categories:

1. Own source revenue
2. Supporting revenue *minus* transportation revenue directed to other uses

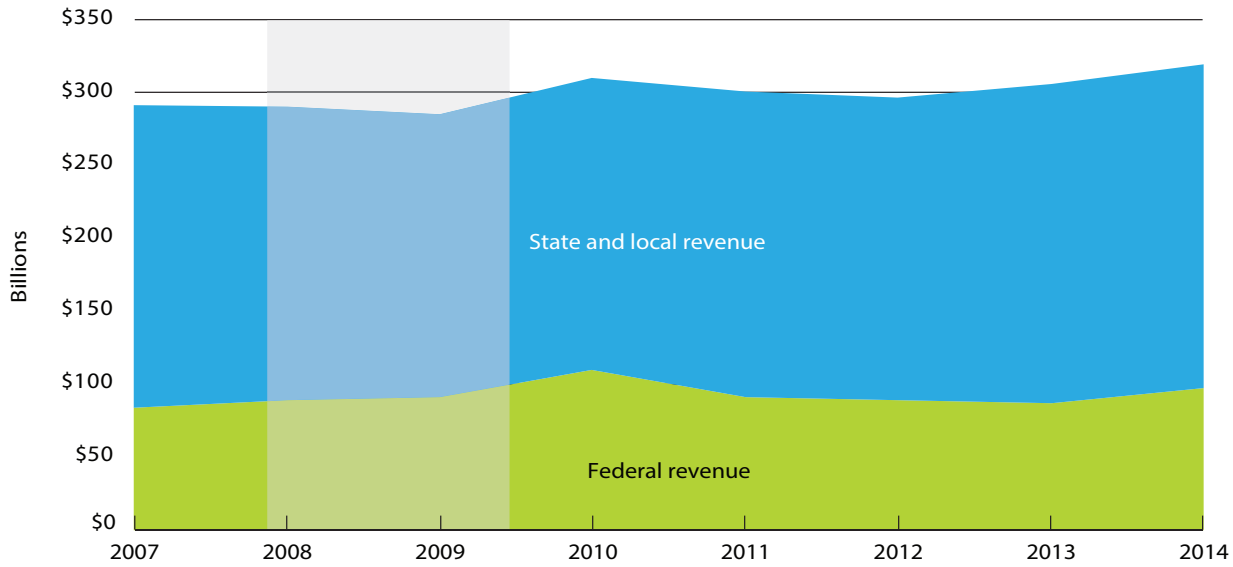
Own-source revenue refers to taxes and charges levied on transportation-related activities and used specifically for transportation. Most of these revenue sources are user fees charged to users of the transportation system. Examples include the following:

- Excise taxes, such as motor fuel taxes and aviation taxes
- Property taxes, such as motor vehicle taxes
- 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
- Concession income, such as that received by airport authorities

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 directed to the general fund for other uses.

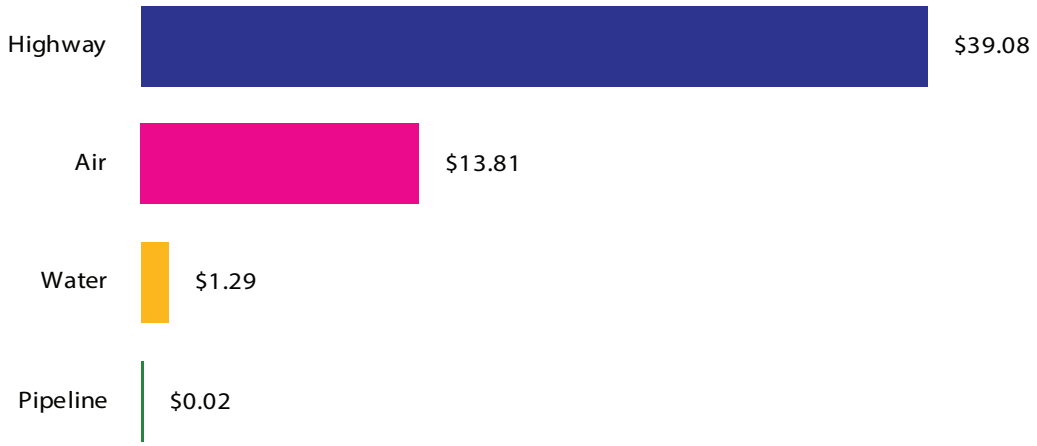
Figure 7-1 Federal, State, and Local Government Revenues, 2007 to 2014 (billions of chained 2009 dollars)



NOTES: Revenue includes own-source revenue and supporting revenue, but does not include revenue diverted to other uses. Shaded vertical bar indicates economic recession.

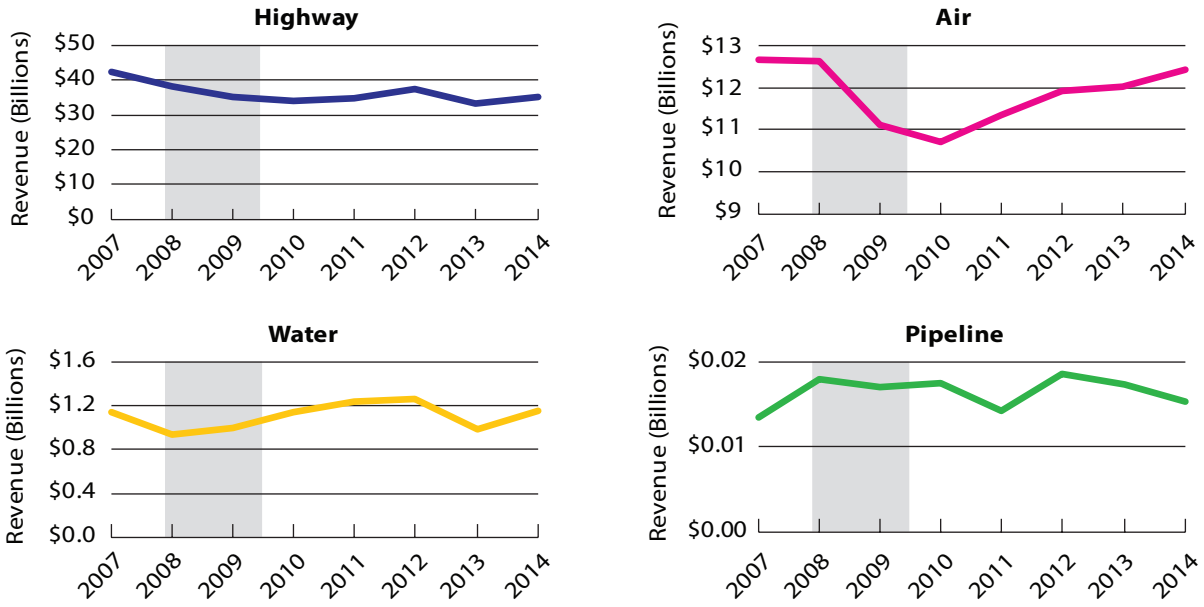
SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics*, available at www.bts.gov.

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



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

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



NOTE: Graph scales are not comparable. 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 Government Revenue Sources

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 came from the following:

- $86.7 billion, (67.0 percent of transportation revenue in 2014) went to highways and came from transportation related activities such as fuel taxes, motor vehicle taxes, tolls and other sources (figure 7-4).
- $19.1 billion (14.8 percent) went to air and came from landing fees, terminal area rentals, and several other sources.
- $18.8 billion (14.6 percent) went to transit and is almost entirely from fares.

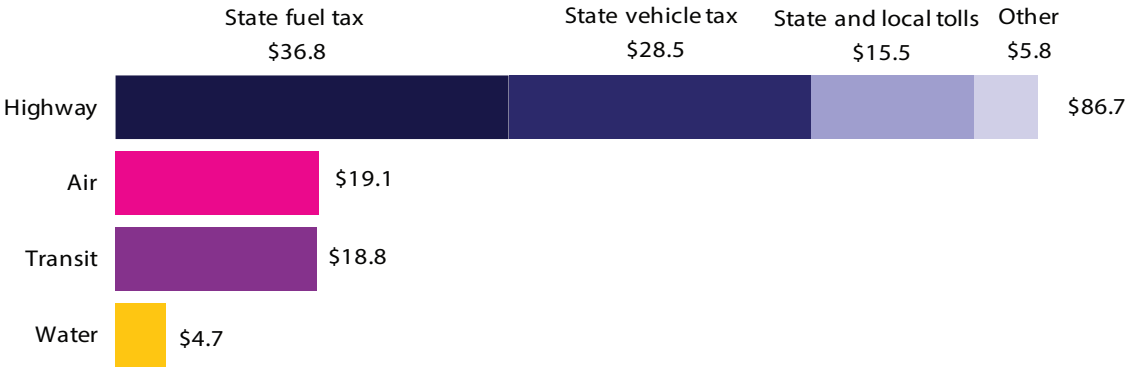
In inflation-adjusted dollars, highway, aviation, and water revenues all declined during the Great Recession (December 2007 to June 2009), although highway and water revenues have since exceeded pre-recession levels (figure 7-5).

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 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. The Federal Government spent $32.8 billion directly on transportation, excluding federal transfers to states.

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 11.2 percent (from $26.5 billion to $29.5 billion). Real federal transfers to states increased 6.8 percent (from $49.5 billion to $52.8 billion), while real state and

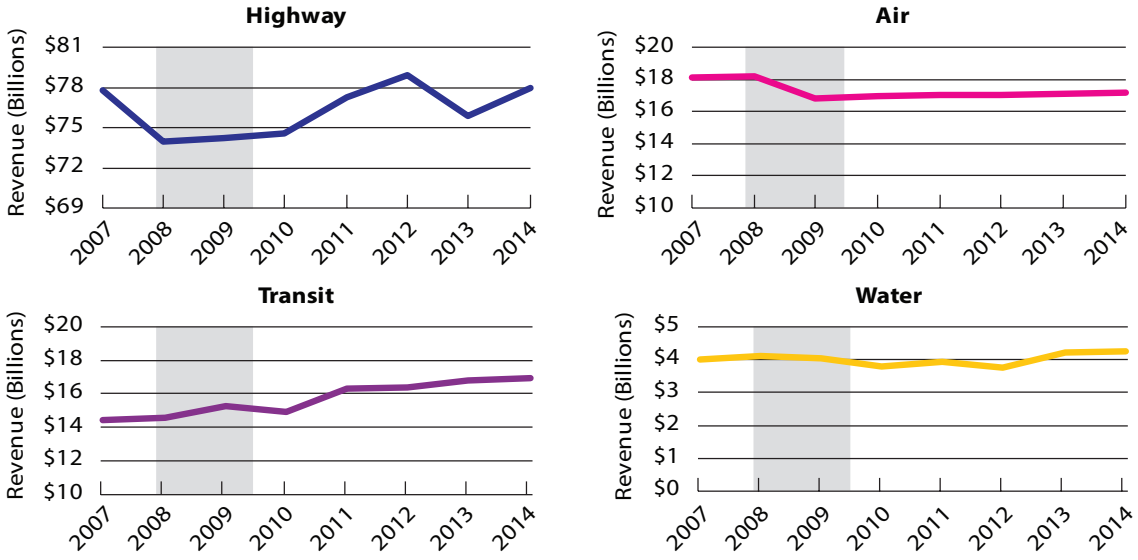
Figure 7-4 State and Local Own Source Revenue by Mode, 2014 (billions of 2014 dollars)



NOTE: Totals may not sum due to rounding.

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 area indicates economic recession. Graph scales are not comparable.

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

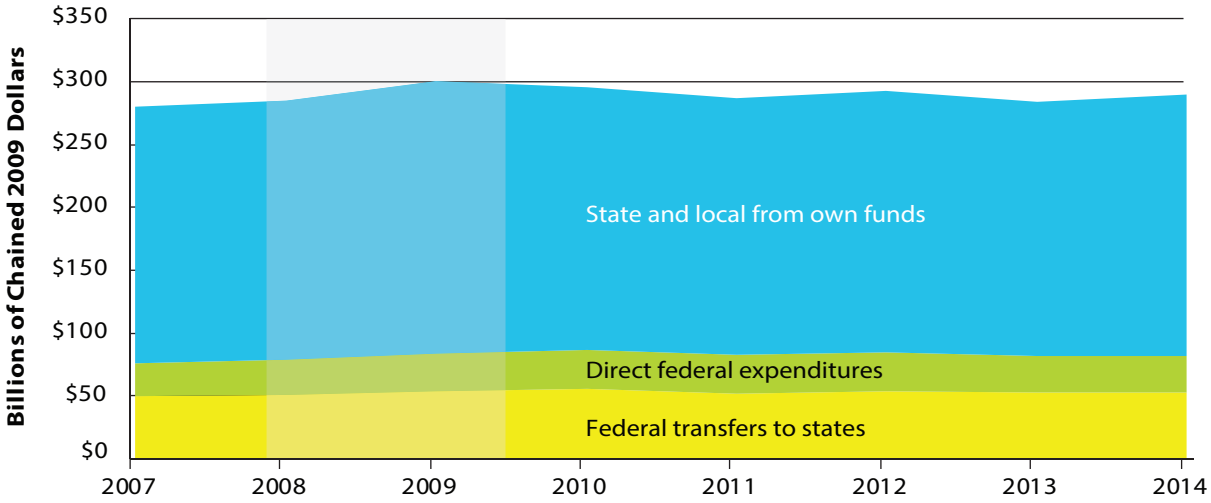
Box 7-3 Government Transportation Expenditures

Transportation expenditures are outlays that the government pays to provide an efficient and safe transportation system, regardless of the sources of funding and regardless of 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.

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



NOTE: Shaded vertical bar indicates economic recession.

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

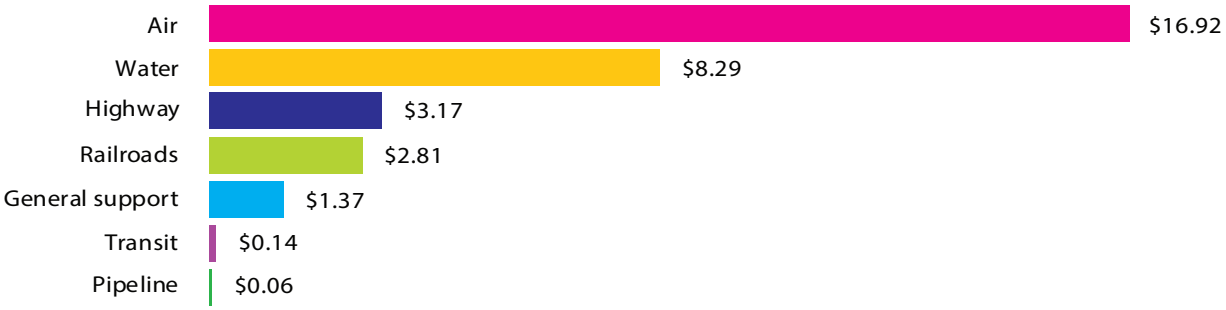
local expenditures (excluding expenditures paid for with federal funds) increased by 1.7 percent (from $204.3 billion to $207.8 billion).

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 (ARRA) 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 $86.7 billion (in chained 2009 dollars). By 2014 ARRA spending was substantially complete and no longer impacted the pattern of growth in transportation spending.

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).

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



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

In real 2009 dollars, federal highway spending peaked in 2011 with the recession stimulus spending, and then declined (figure 7-8).

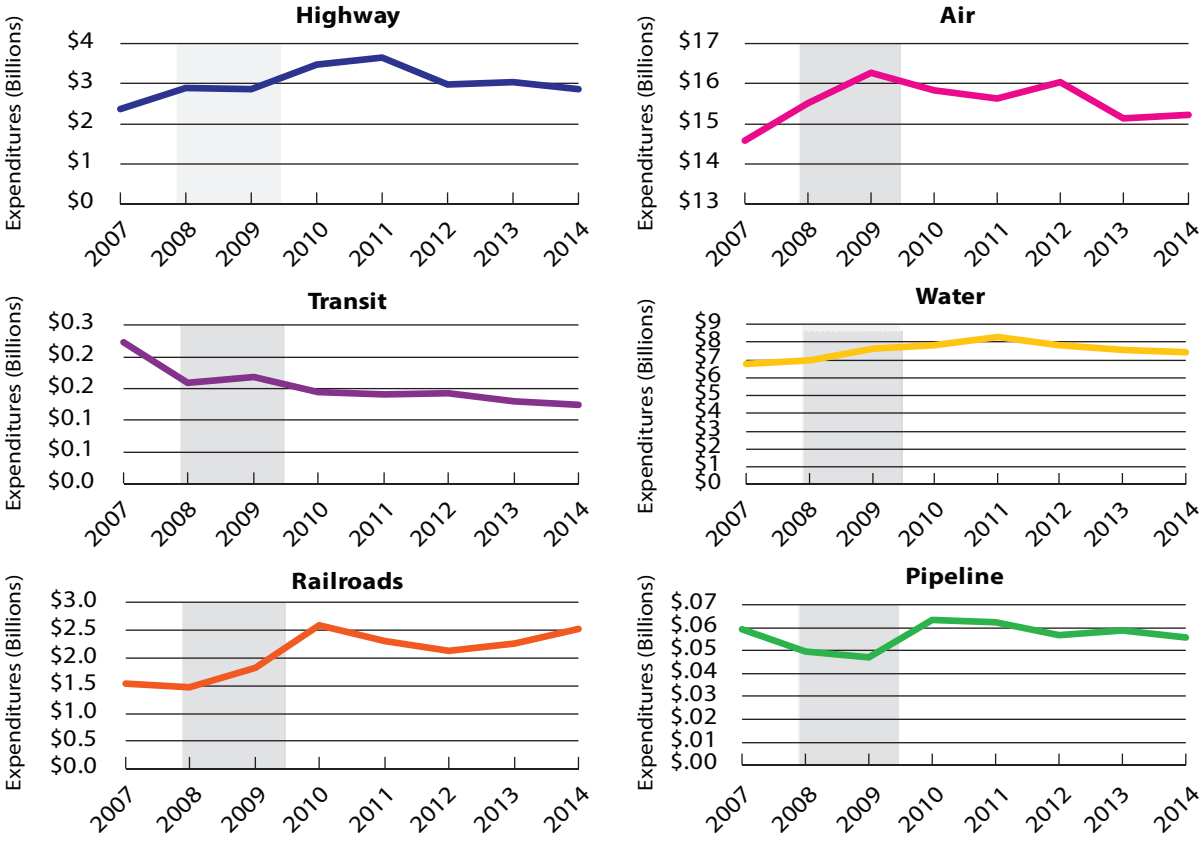
State and Local Transportation Spending by Mode

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).

This paragraph discusses total expenditures in each state for which the latest survey data is from the 2015 Census of State and Local Governments. Figure 7-11 shows the percentage of total expenditures that each state and its local governments spent on transportation in 2015 (box 7-4). A regional pattern emerges with relatively high expenditures in resource-rich states in the northern Great Plains. Despite relatively low population densities, these states have considerable demand for transportation to support industries that rely on heavy, high bulk transportation-intensive products such as oil, coal, and minerals.

States and local governments also allocate funds among transportation modes differently because

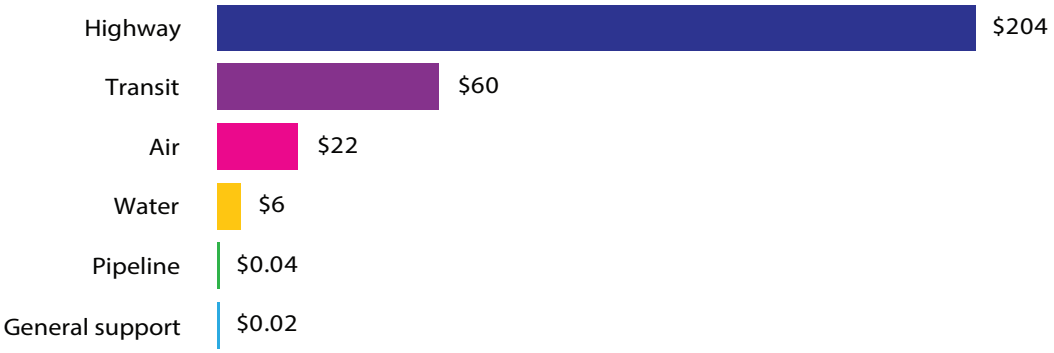
Figure 7-8 Trends in Federal Transportation Expenditures by Mode, 2007 to 2014 (billions of chained 2009 dollars)



NOTE: Shaded areas indicate economic recessions. Graph scales are not comparable.

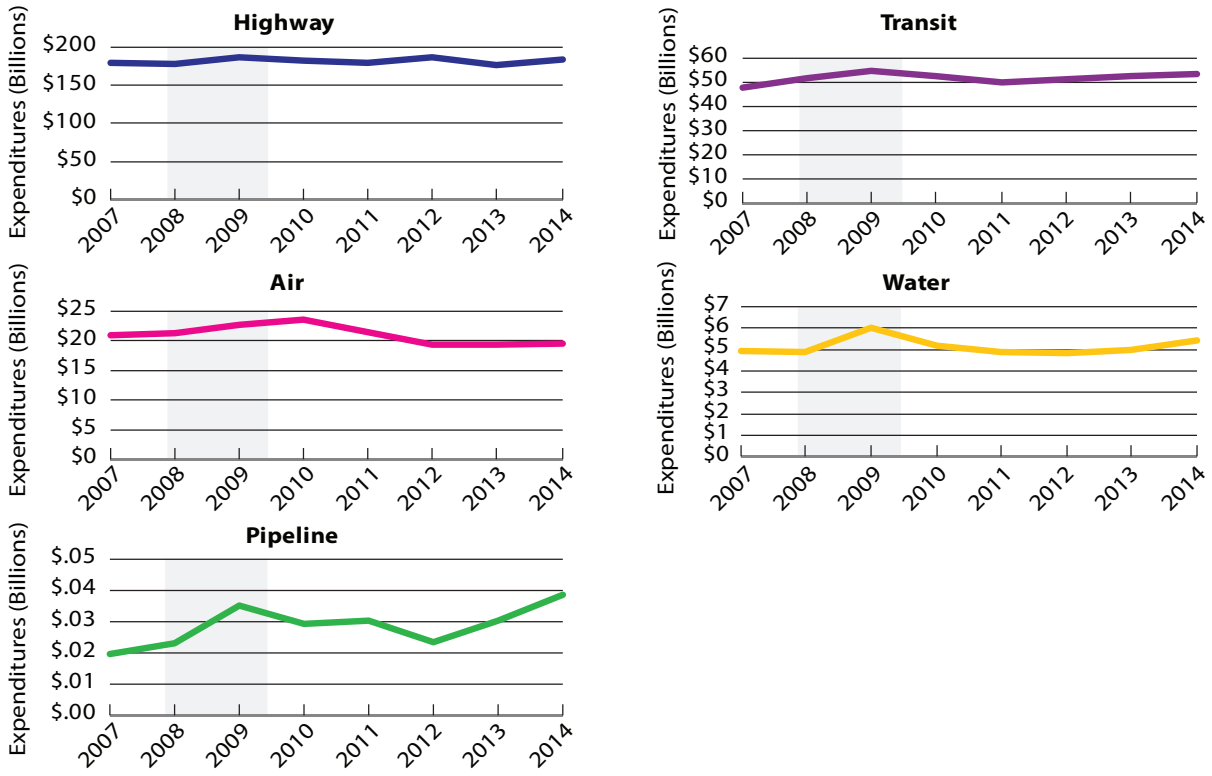
SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, *Government Transportation Financial Statistics*, available at www.bts.gov.

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



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

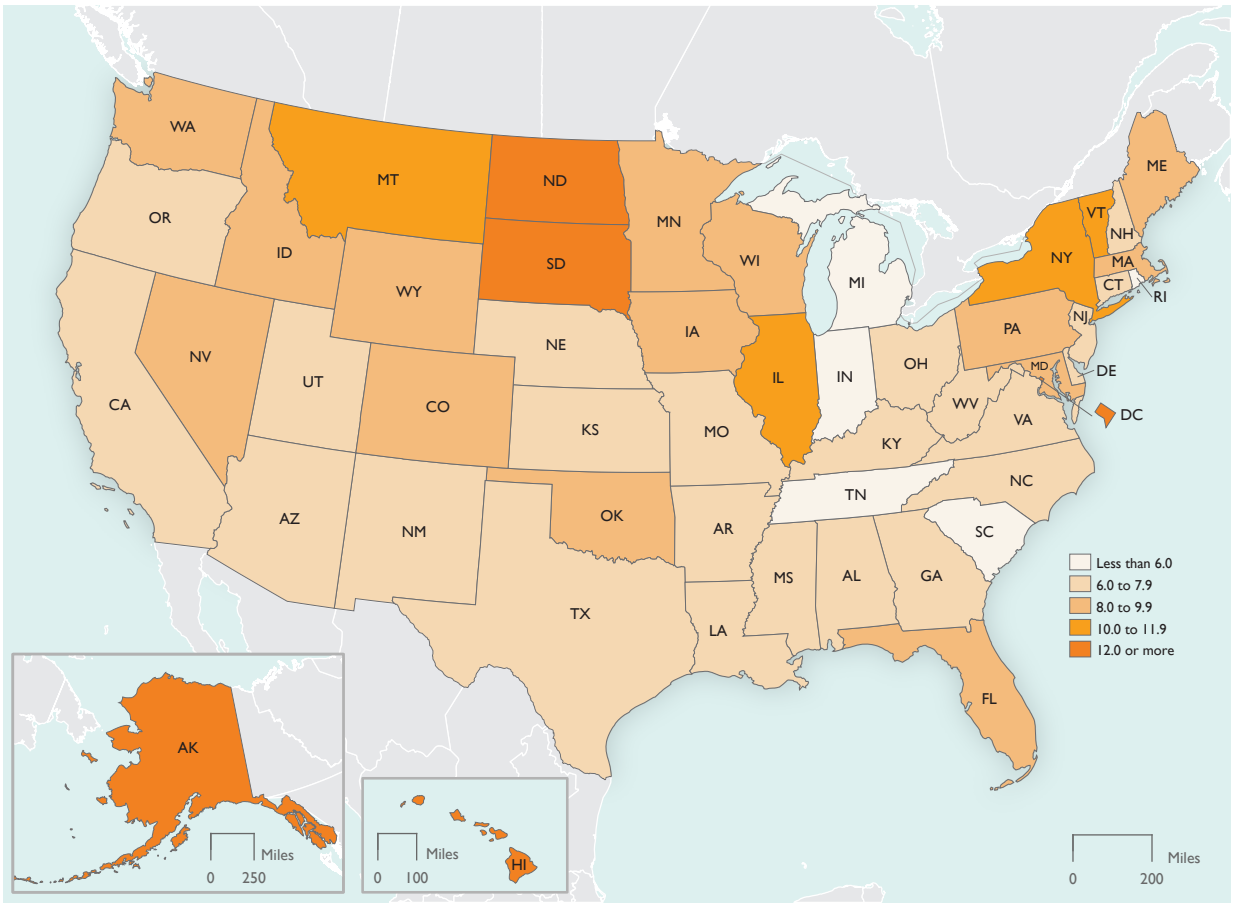
Figure 7-10 Trends in State and Local Expenditures by Mode, 2007 to 2014 (billions of chained 2009 dollars)



NOTE: Shaded areas indicate economic recessions. Graph scales are not comparable.

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

Figure 7-11 Proportion of State and Local Government Expenditures Spent on Transportation, 2015



SOURCE: U.S. Department of Commerce, Census Bureau, *Census of State and Local Governments,* 2015, available at www.census.gov as of May 2018.

Box 7-4 State Transportation Finance

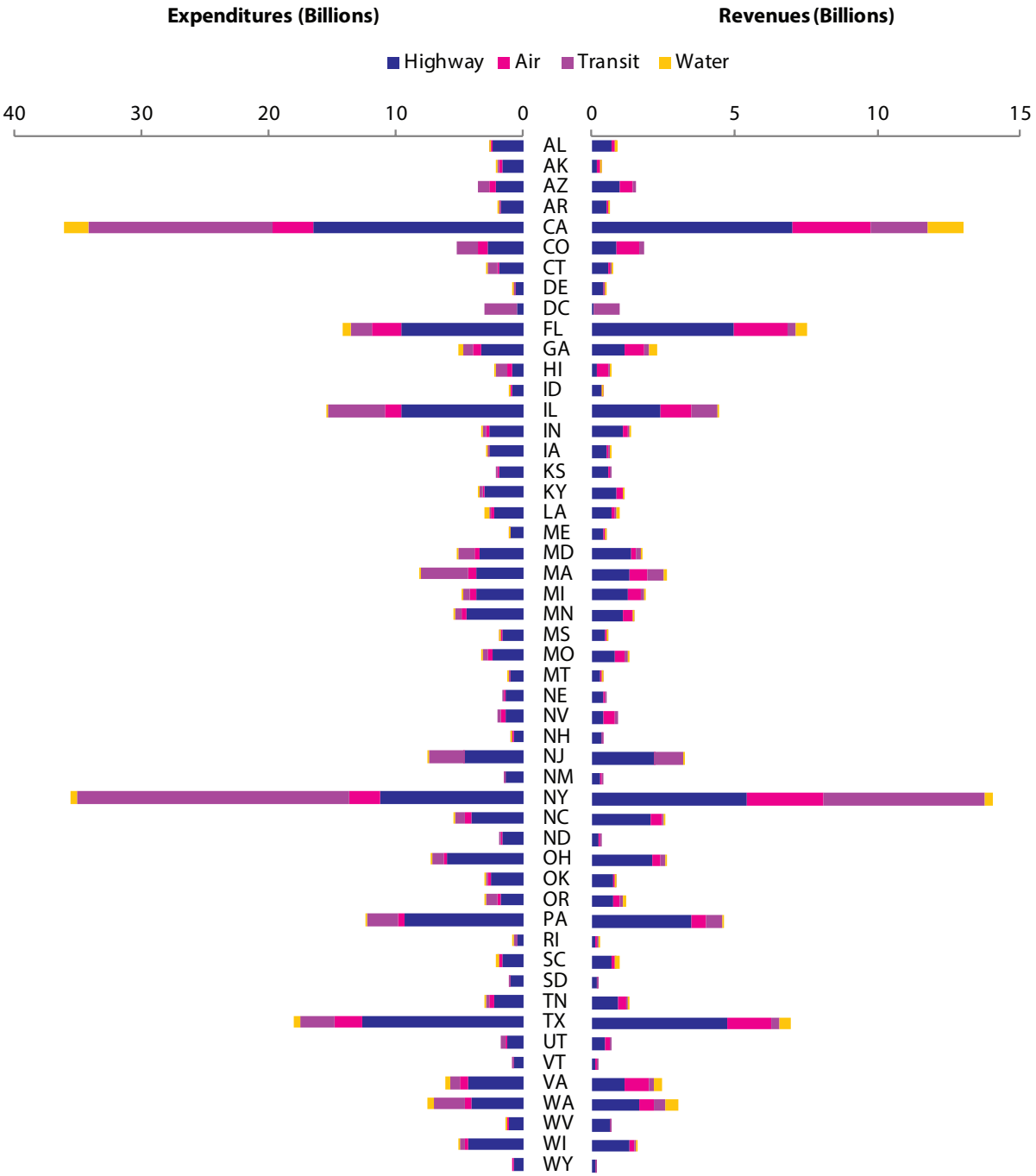
State transportation expenditure data come from the U.S. Census Bureau's State and Local Government Finances, which conducts a full census of state and local governments every 5 years and a sample survey in the intervening years. Federal and state transit spending data come from a survey of state transportation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

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 (84.3 percent and 60.5 percent, respectively) in 2015 (figure 7-12). In contrast, inland low-density states in the Great Plains, like North Dakota and Kansas spent 90 percent or more of their transportation expenditures on highways. Hawaii and Nevada spent approximately 20 percent (19.5 percent and 17.9 percent, respectively) on aviation. Finally, Louisiana and South Carolina, which have economically significant ports, spent greater percentages on water transportation (10.5 percent and 8.6 percent) than other states spent.

Public-Private Partnerships

Public-private partnerships (PPPs) (box 7-5) are another method to finance, build, and operate transportation projects, such as highway toll lanes or airport terminals. Most of the data in this chapter come from the U.S. Census Bureau's *State*

Figure 7-12 Transportation Expenditures and Revenues by State and Local Governments, 2015



SOURCE: U.S. Department of Commerce, U.S. Census Bureau, *State and Local Government Finance*, 2015, available at https://www.census.gov/programs-surveys/gov-finances.html as of May 2018.

and Local Government Finances or similar sources of government spending data. 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, they do not capture the private portion of the investment. 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. The agency usually retains ownership in the facility or system.

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 2016 New York had the highest state and federal transit expenditure at $6.33 billion, with the state government contributing $5.04 billion (79.6 percent) and the Federal Government contributing $1.29 billion in transfers to states (20.4 percent) (figure 7-13).

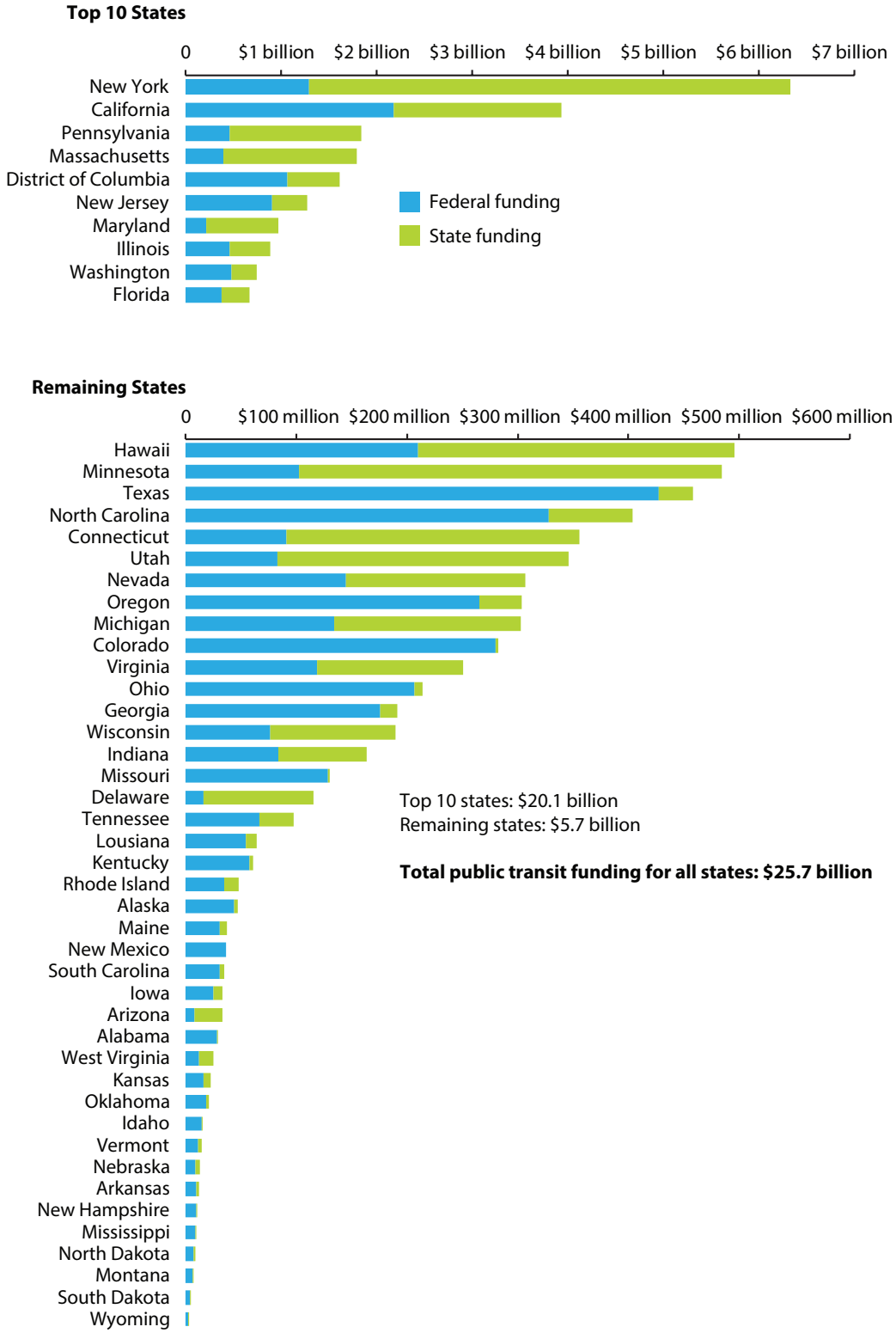
Figure 7-13 shows that 10 states, including the District of Columbia, account for $20.06 billion of the $25.74 billion spent on public transportation, or over three-quarters of all transit expenditures (77.9 percent). Within the top 10 states, the proportion of the total state transportation spending on transit ranges from a low of 28.5 percent in New Jersey to a high of 79.6 percent in New York. While the top 10 states have average expenditures of $2.01 billion, the remaining states have average expenditures of $142 million.

Government Transportation Revenue and Expenditures

Revenue collected from transportation-related activity and dedicated to transportation programs falls short of government transportation expenditures, an issue of long standing. 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 revenues do not cover expenditures, general tax receipts (e.g., from sales and property taxes), trust fund balances, and borrowing cover shortages.

Figure 7-14 illustrates transportation revenue relative to transportation expenditures for all levels of government from 2007 to 2014 in chained 2009 dollars. Transportation revenue includes the revenue collected from transportation activity (that is, own source revenues) as well as supporting revenue from other sources like general funds. In 2014 supporting revenues represented 48.4 percent of total revenues. 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.

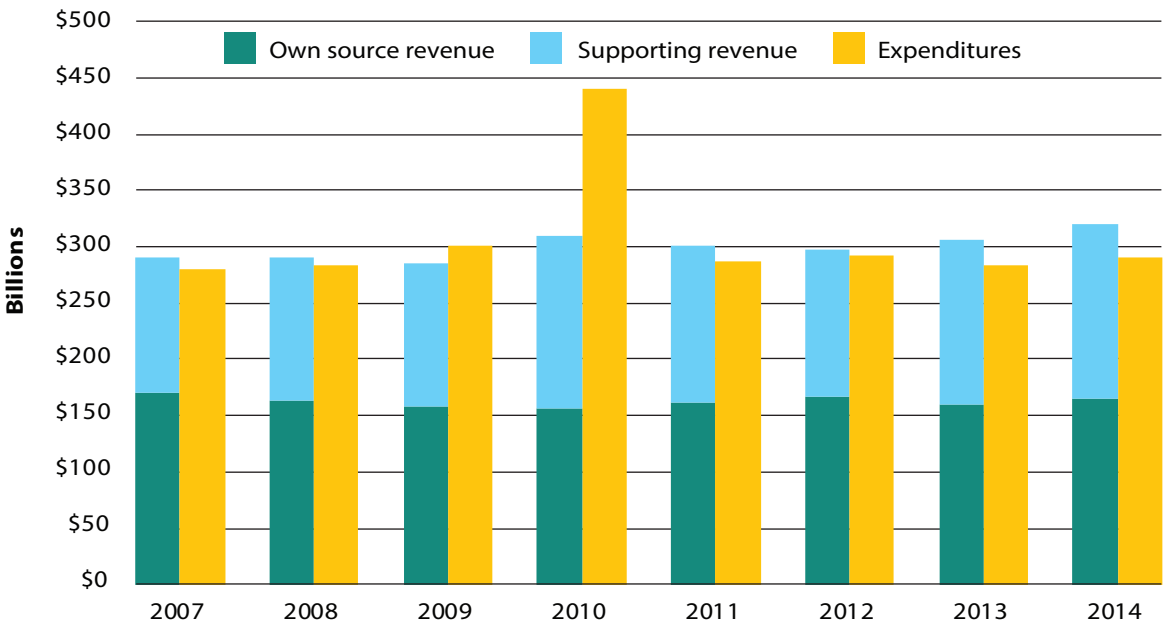
Figure 7-13 Federal and State Funding of Public Transit, 2016



NOTE: Top 10 states includes the District of Columbia.

SOURCE: U.S. Department of Transportation, Federal Transit Administration, National Transit Database, 2016 Funding Sources, available at https://www.transit.dot.gov/ntd as of May 2018.

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

Key Takeaways

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

Introduction

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Value of Transportation Capital Stock

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

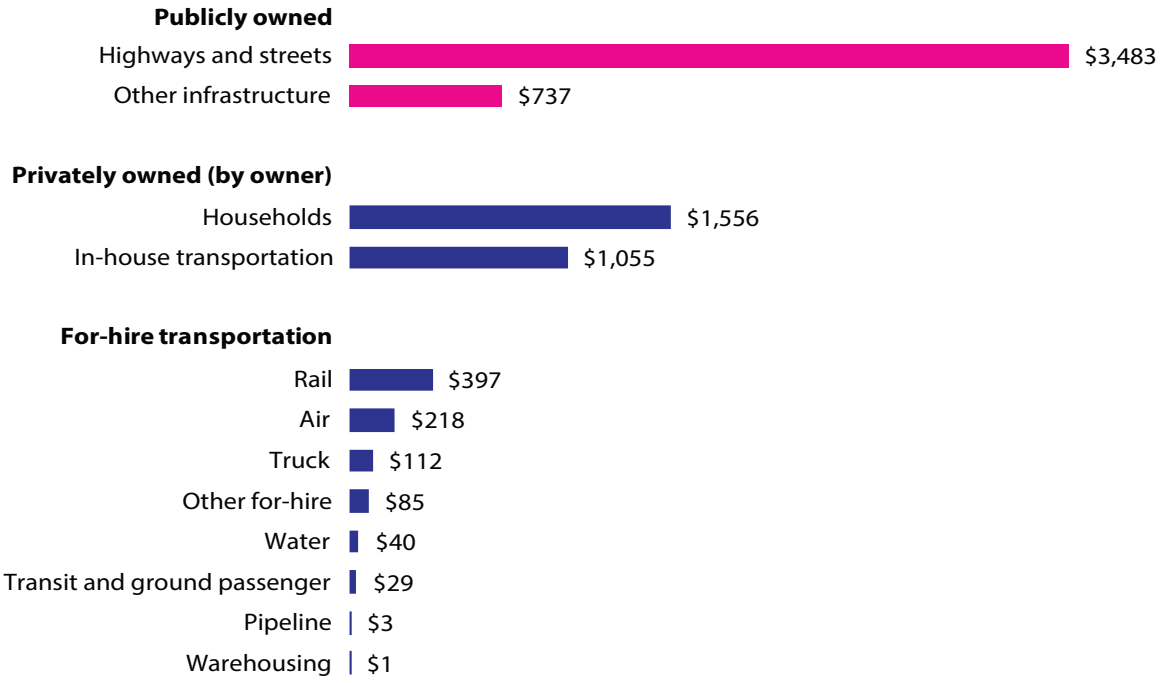
The public and private sector both own transportation capital stock. In 2016, the public sector owned $4.2 trillion (54.7 percent), while the private sector owned $3.5 trillion (45.3 percent) (figure 8-1). Public highways and streets accounted for the largest share of publicly owned transportation capital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

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

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

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

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



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

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

Investment in Transportation Assets

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

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

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

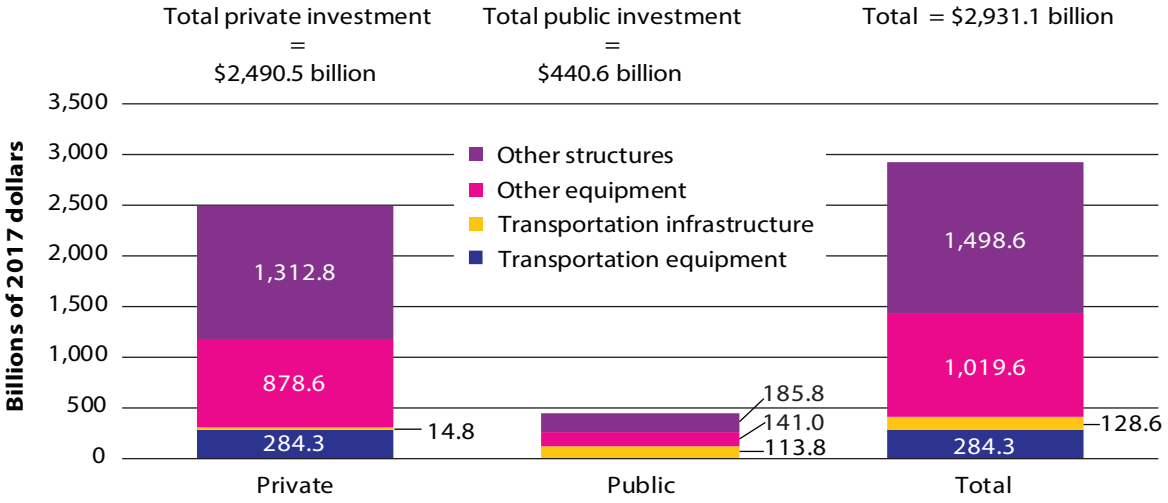
Transportation assets represent a small but important share of total public and private investment in the United States. In 2017, public and private investment in transportation infrastructure and equipment totaled $412.9 billion, or 14.1 percent of the $2,931.1 billion in investment in all infrastructure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

Box 8-2 Sources of Highway Investment Estimates

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

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

Figure 8-2 Public and Private Fixed Investment, 2017



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

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

Public Investment in Transportation

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

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

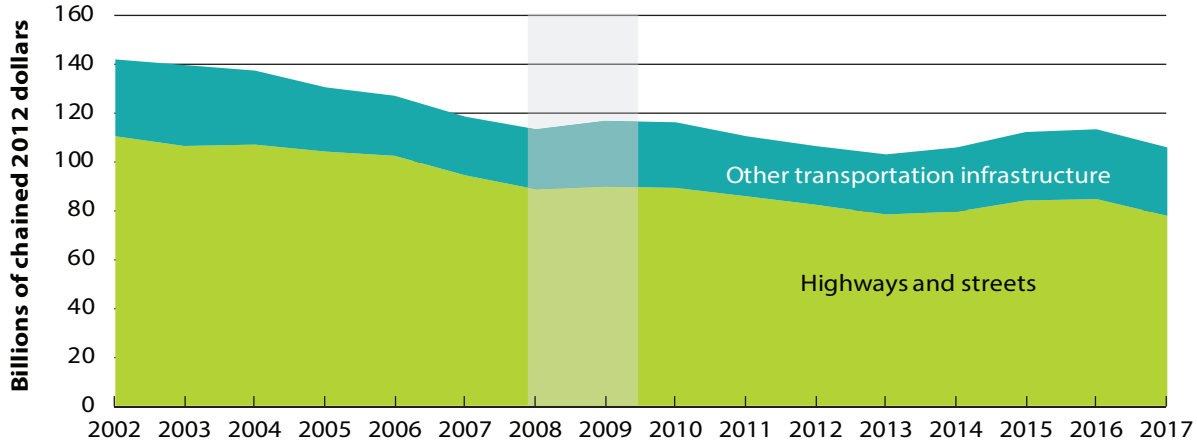
Private Investment in Transportation

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

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

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

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



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

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

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

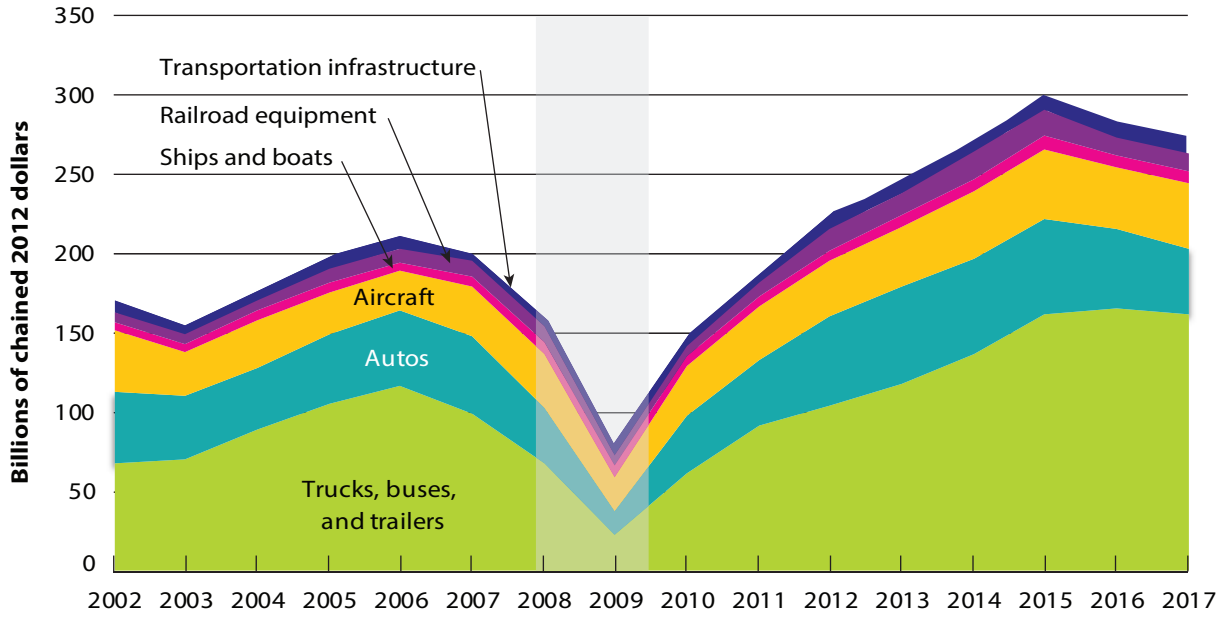
Private investment in transportation infrastructure and equipment reached a low of $82.0 billion in 2009 during the Great Recession (December 2007 to June 2009) and then climbed to $304.2 billion in 2015 before declining through 2017 to $277.4 billion (in chained 2012 dollars) (figure 8-4). Private spending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

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

Value of Construction Put in Place

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

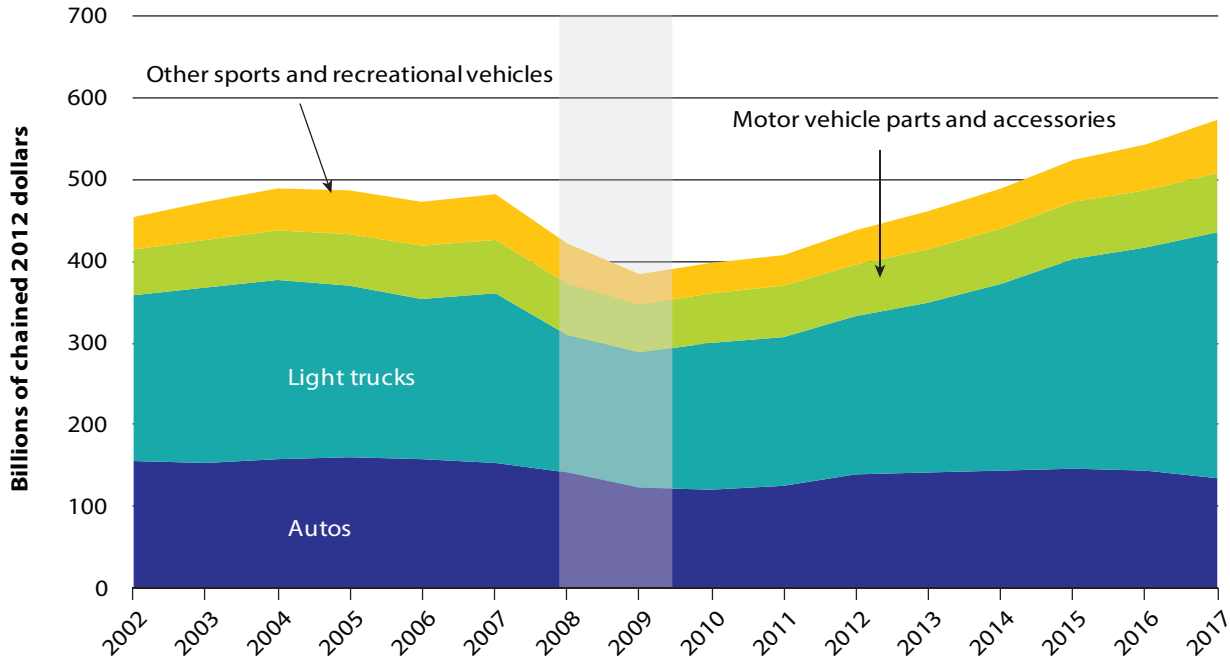
Figure 8-4 Private (Business) Investment in New Transportation Infrastructure and Equipment, 2002–2017 (billions of chained 2012 dollars)



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

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

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



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

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

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

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

Highway Construction Costs

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

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

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



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

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

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

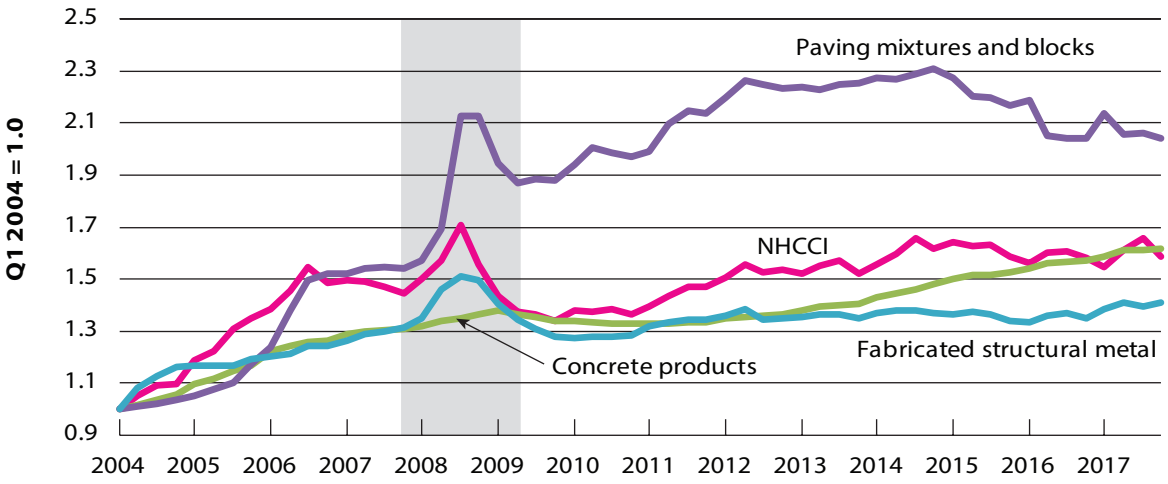
Box 8-3 National Highway Cost Construction Index

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

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

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

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



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

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

Estimating the Benefits of Transportation Infrastructure

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

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

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

Accessibility Benefits

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

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

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

Glossary

Assets

Entities owned by a unit or units from which the owners derive economic benefits by holding or using them.

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.

Consumers

Households.

Consumer Price Index (CPI)

Measure of changes in the prices paid by urban consumers for a representative basket of goods and services.

Cost of transportation

Monetary value of resources used to produce transportation services, including labor, equipment, fuel, and infrastructure.

Economic slowdown (deceleration)

Period when growth slows below normal rates.

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.

Fixed investment

Investment in assets that take more than a year to consume.

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 in-house 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.

Household transportation

Transportation provided by households for their own use using a personal vehicle.

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.

Intercity

Existing or traveling between cities.

Intracity

Existing or traveling within the same city.

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.

Labor productivity

Measure of economic performance that compares the amount of goods and services produced (output) to the amount of labor input used to produce those goods and services.

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.

Negative externality

Negative effects on others that occur when people use transportation. Examples include traffic congestion and air pollution.

Nominal dollars (current 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.

Price of transportation-related goods and services

Reflects the cost of resources used to produce the transportation-related good or service plus mark-up and tax.

Producers of transportation services

Firms that carry out transportation operations to move people and goods. May not necessarily be the providers.

Producer Price Index (PPI)

Measure of the average change over time in the prices received by domestic producers for their output. Prices are from the point of view of the producer and therefore exclude items like sales and excise taxes.

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.

Providers of transportation services

Firms that carry out transportation operations to move people and goods or arrange transportation services to move people and goods (e.g., freight forwarders and freight brokers).

Public-private partnership (PPP)

Contractual agreement formed between public and private sector partners.

Purchasers

Users, who may be either households—known as consumers—or businesses.

Real dollars

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

Seasonal adjustment

Statistical method for estimating and removing seasonal movement (regular calendar effects) 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 capital stock

Value of transportation infrastructure and equipment in existence as of a specific date.

Transportation infrastructure (transportation structures)

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 investment

Spending on transportation assets that take more than a year to consume.

Transportation output

Quantity of transportation goods and services produced. Measures of transportation output include passenger-miles for passenger travel and ton-miles for freight.

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 moved 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.

Users of transportation services

Purchasers of transportation. May be households (consumers) or businesses.

Value added

Contribution of industry to GDP, measured by total output (industry revenue) less the costs of inputs.

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







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