

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

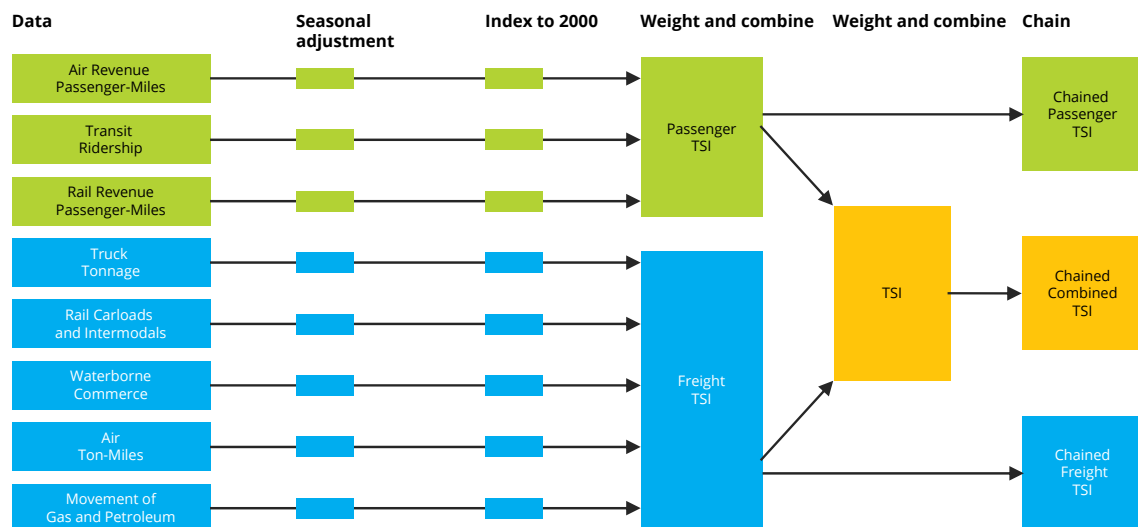
¹ Calculated from industry output shown in the U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Satellite Accounts 2016, available at www.bts.gov as of August 2018.

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.

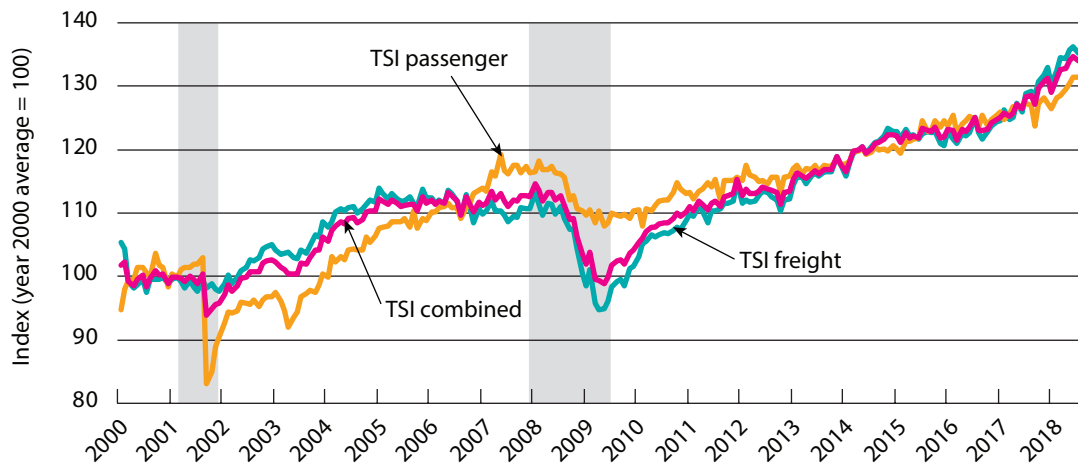
Figure 1-1 Transportation Services Index (TSI) Components



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

1-2 Transportation Economic Trends

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.

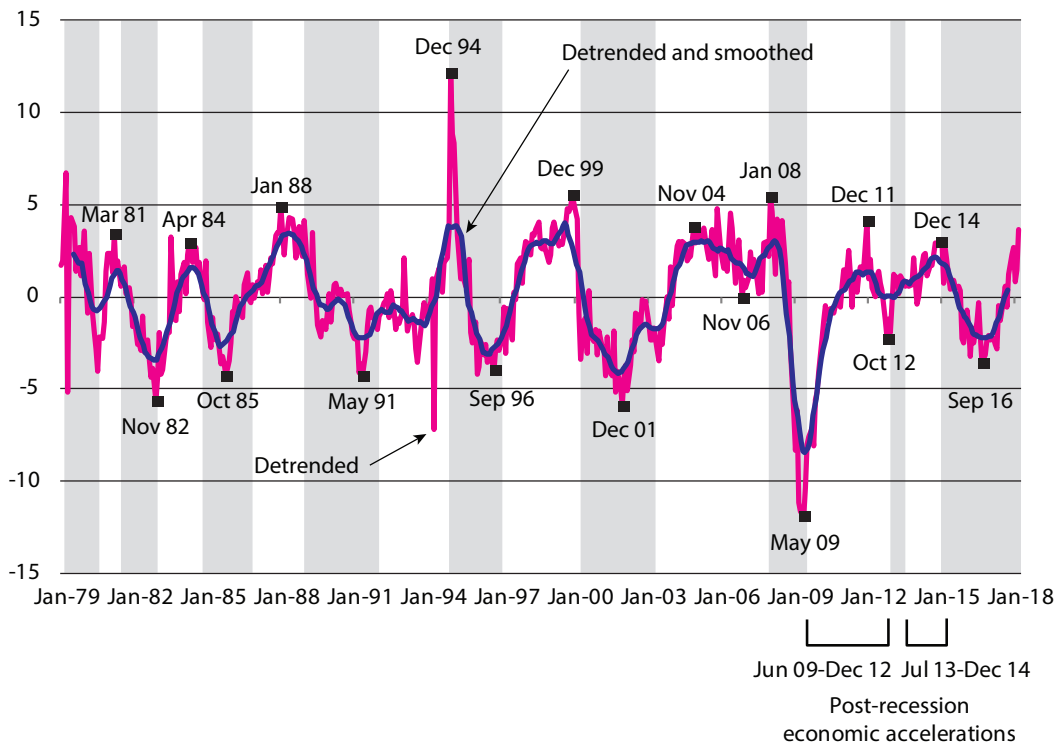
TSI and the Economy

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

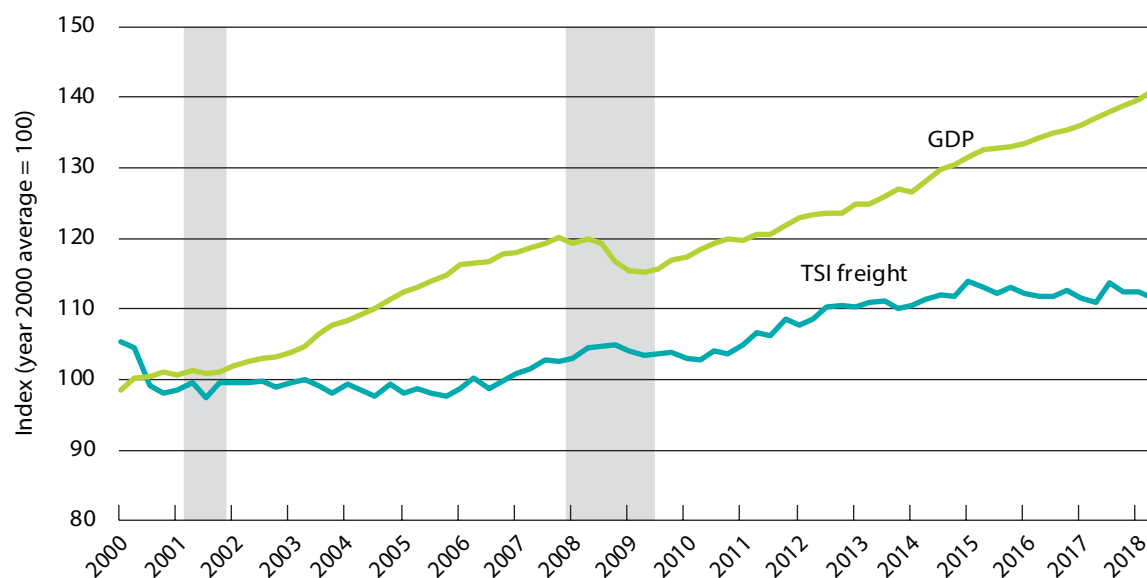
Industrial Production and Manufacturers' Shipments

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.

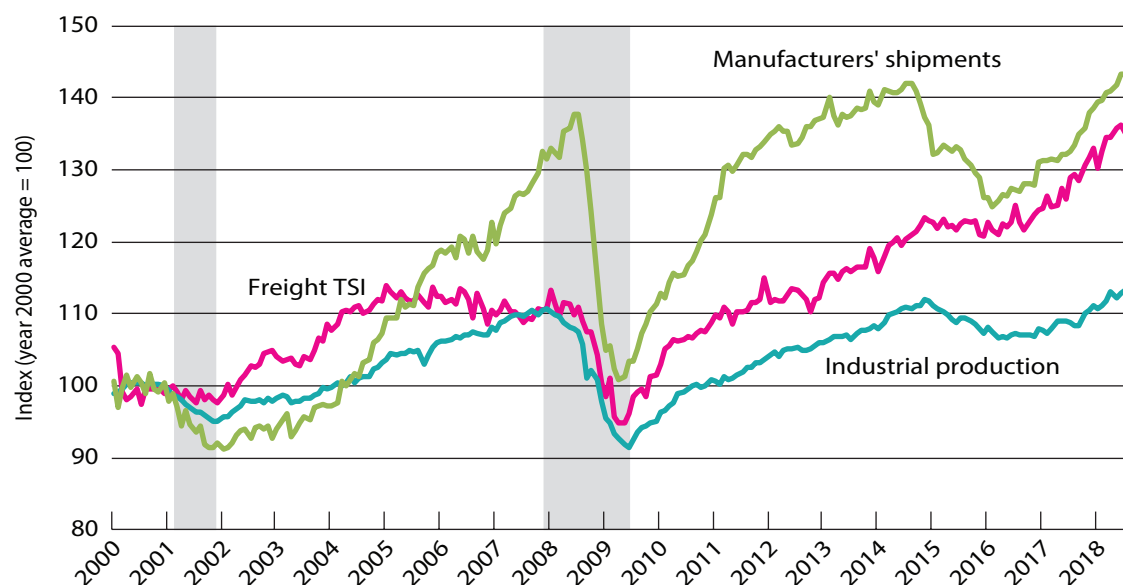
Figure 1-4 Real Quarterly Gross Domestic Product and Freight Transportation Services Index (TSI) (seasonally adjusted), Q1 2000 to Q2 2018



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.

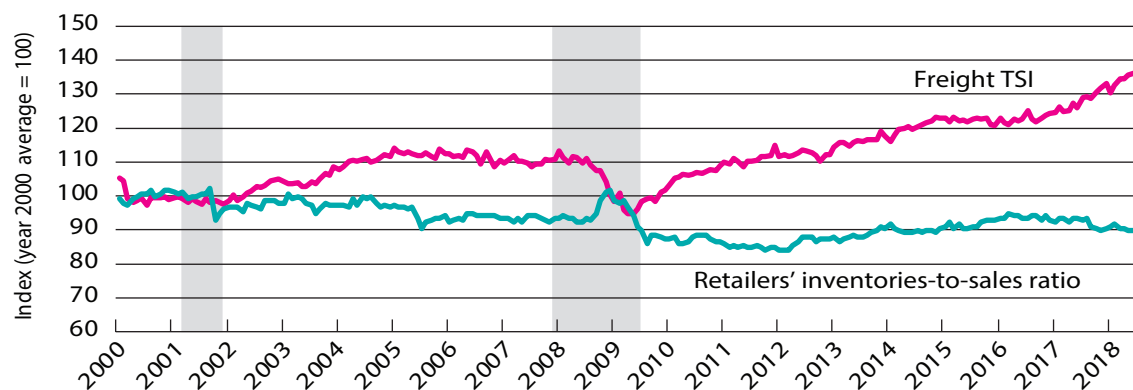
Growth in the freight TSI from mid-2016 through mid-2018 reflects this demand.

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/OSFA/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

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.

seasonally adjusted modal data included in the freight and the passenger TSI as indexes.

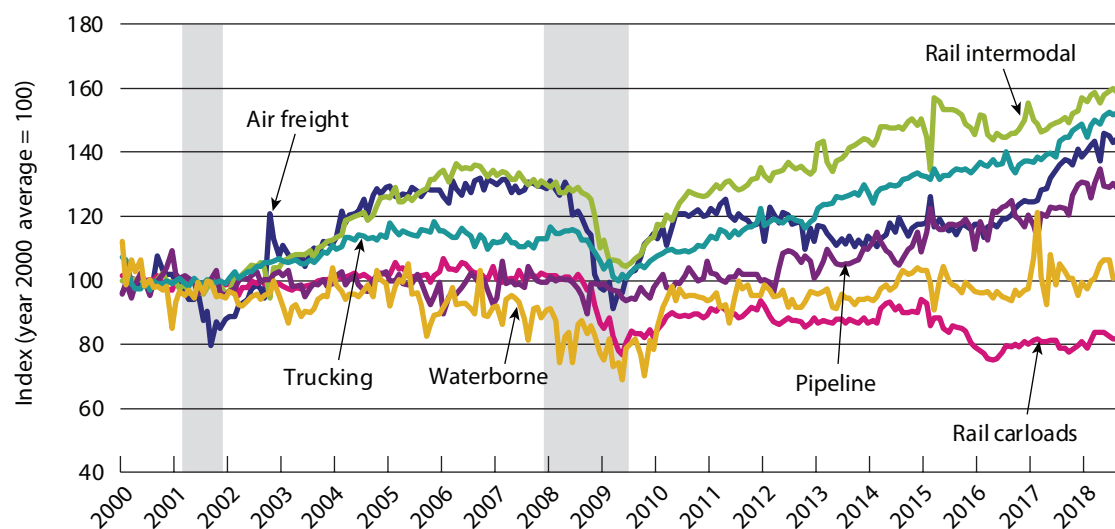
Seasonally Adjusted Freight Transportation

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

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

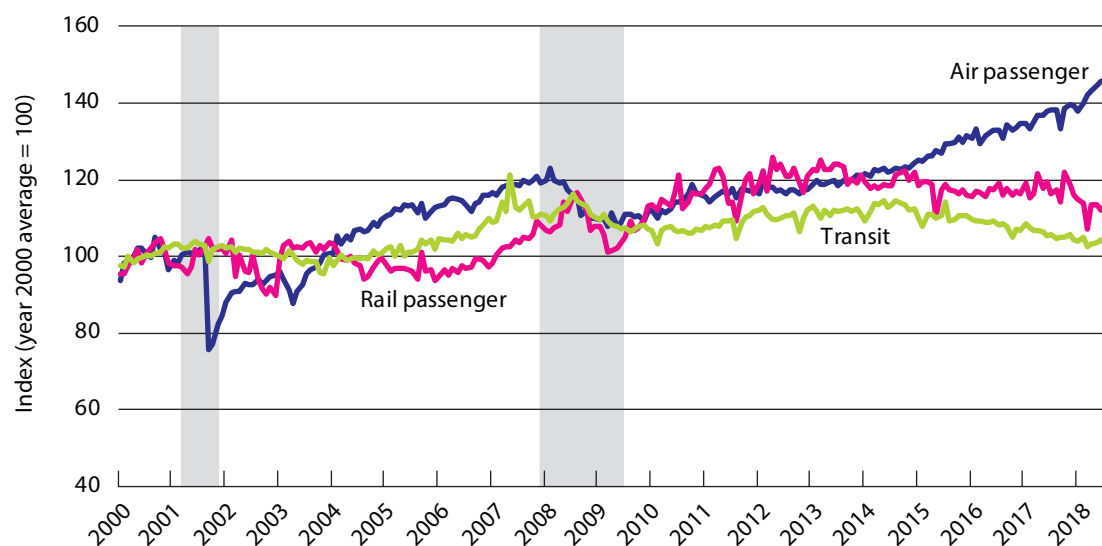
Figure 1-7 Modal Data (seasonally adjusted) Included in Freight Transportation Services Index, January 2000 to August 2018



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

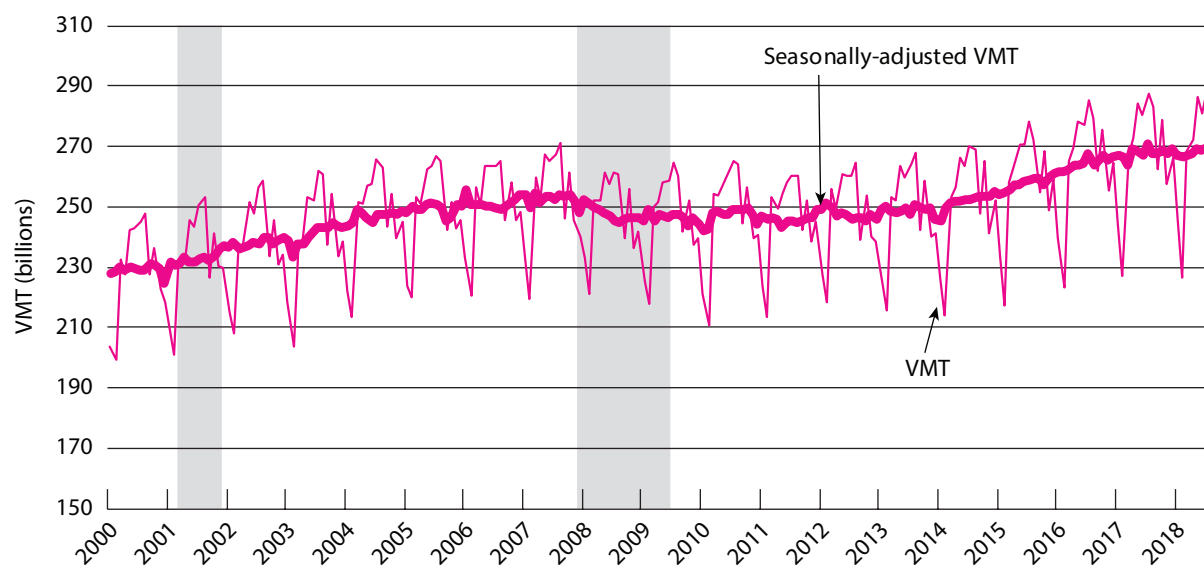
While the TSI measures for-hire transportation services, BTS also seasonally adjusts data for highway vehicle-miles traveled (VMT) to show trends in travel volumes. Seasonally adjusted VMT grew by 18.4 percent from January 2000 to August 2018 (figure 1-9). VMT remained stable after a marginal decline 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.