Introduction to Summary Indicators

Transportation is a service industry, moving people and goods for the benefit of businesses and households. Whether it is a vacation trip, a shipment of raw inputs to a manufacturer, or final product delivery to a consumer, transportation services are a key barometer of economic activity.

The U.S. Department of Transportation’s (DOT) Bureau of Transportation Statistics (BTS) developed and currently produces the Transportation Services Index (TSI) to measure the volume of services provided monthly by the for-hire transportation sector (box 1-1).

1For-hire transportation consists of the services provided by transportation firms to industries and the public on a fee basis. Airlines, railroads, transit agencies, common carrier trucking companies, and pipelines are examples of for-hire transportation. Other types of transportation are discussed in Chapter 2 in the context of the Transportation Satellite Accounts.

Box 1-1 Transportation Services Index

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


Transportation Services Index

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, while 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 March 2016. Overall, the combined TSI increased by 19.0 percent, the freight TSI increased by 13.9 percent, and the passenger TSI increased by 30.9 percent. However, all three measures declined in the wake of the September 2001 terrorist attacks. The passenger TSI dropped especially sharply—19.3 percent from August 2001 to September 2001. All three indexes also decreased sharply during the recession from December 2007 to June 2009. The combined TSI decreased by 19.3 percent, the passenger TSI decreased by 6.6 percent, and the freight TSI decreased by 11.4 percent. However, they have all since recovered to prerecession levels.

**TSI and the Economy**

The TSI has a strong relationship with the economy, and the TSI has increased as the

**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 numerous 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 due to an effect known as “substitution bias.” In other words, keeping the base year fixed introduces a new problem.

One method to address these issues is chaining, a technique that uses values from the current year and the fixed year to calculate values. Chaining is more computationally difficult, but more accurate because it can account for substitution bias. For the Transportation Services Index, the Bureau of Transportation Services uses the Fisher Ideal Index formula to chain the data. Technical details are available at [http://1.usa.gov/1PWbN8T](http://1.usa.gov/1PWbN8T).

**SOURCE:** Bureau of Transportation Statistics, 2016.
economy has grown. BTS research shows that changes in the TSI occur before changes in the economy, making the TSI useful for predicting economic trends.\(^2\) Figure 1-3 illustrates the relationship between the freight TSI and the national economy from 1979 to 2015. The dashed blue line shows the freight TSI detrended to remove long-term changes. The red line shows the freight TSI detrended and smoothed to eliminate month-to-month volatility as well. The shaded areas represent economic slowdowns, or periods when economic growth slows below normal rates and unemployment rises as a result. 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.


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

**Gross Domestic Product (GDP) and Foreign Trade**

Gross Domestic Product (GDP) is the broadest measure of the economy. The U.S. GDP includes the monetary value of all goods and services produced within the United States. Between the first quarters of 2000 and 2016, real GDP increased 33.4 percent, and the freight TSI increased by 17.8 percent (figure 1-4). However, due to the recession, GDP decreased 3.6 percent from the first quarter of 2008 to the second quarter of 2009, and the freight TSI decreased 14.6 percent. Both measures have since recovered to prerecession levels. GDP includes

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

**SOURCE:** U.S. Department of Transportation, Bureau of Transportation Statistics, Transportation Services Index, available at www.bts.gov as of May 2016.
many sectors besides transportation, so the magnitude of changes in GDP and the TSI cannot be directly compared.

In addition to domestic value shown by GDP, figure 1-4 includes the real foreign trade index to capture import and export activity. Real foreign trade increased 64.9 percent between the first quarters of 2000 and 2016, outpacing GDP growth. During the recession, foreign trade declined 15.9 percent from the first quarter of 2008 to the second quarter of 2009.

**Industrial Production and Manufacturers’ Shipments**

Industrial production and manufacturers’ shipments are major sources of demand for freight transportation services (box 1-3). When these shipments declined during the recession, the freight TSI declined as well (figure 1-5). From December 2007 to July 2009, industrial production declined by 16 percent, and manufacturers’ shipments declined by 21 percent. After the recession, industrial production increased by 17 percent, and manufacturers’ shipments increased by 28 percent. However, manufacturers’ shipments recently declined 8.6 percent from July 2014 to March 2016.

**Box 1-3 Industrial Production and Manufacturers’ Shipments**

The Industrial Production Index is published monthly by the Federal Reserve Board and 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, which provides monthly data on economic conditions in the domestic manufacturing sector. The survey measures the dollar value of products sold by manufacturing establishments and is based on net selling values after discounts and allowances are excluded. Freight charges and excise taxes are also excluded.

**SOURCE:** Bureau of Transportation Statistics, 2016.
Inventories/Sales Ratio

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

The U.S. Census Bureau produces a national inventories/sales ratio for businesses in the United States. This ratio has generally declined as businesses adopt just-in-time delivery and learn to manage their inventory more efficiently. From January 2000 to June 2008, the ratio declined by about 9 percent from 1.38 to 1.25 (figure 1-6). During the recession, however, the ratio rose to 1.48 in January 2009—an increase of 18 percent in less than a year. Correspondingly, the freight TSI declined 10.1 percent from June 2008 to January 2009.

Seasonally Adjusted Transportation Data

The monthly data used to create the TSI are highly seasonal, reflecting trends such as stores increasing inventory for the holiday season and households taking vacations in the summer. Seasonal trends make it difficult to observe underlying long-term changes in the data, as well as monthly shifts and short term trends, which are best viewed using seasonally adjusted data (box 1-4).
To portray real changes in the TSI, BTS seasonally adjusts, indexes, and weights the data based on economic value added\(^3\) for all transportation modes including truck tonnage, rail freight carloads, rail freight intermodal, pipeline, natural gas, U.S. waterway tonnage, passenger air transportation, rail passenger-miles, and public transit ridership. Figures 1-7 through 1-17 show the raw and seasonally adjusted data for each of the modes included in the TSI, except for truck tonnage, which shows only the seasonally adjusted data.\(^4\)

**Seasonally Adjusted Freight Transportation**

Seasonally adjusted truck tonnage increased by 25.4 percent between January 2000 and March 2016 (figure 1-7). After reaching a recession-related low in April 2009, the index has increased by 35.1 percent.

Seasonally adjusted rail carloads decreased by 26.1 percent from January 2000 to March 2016 (figure 1-8). Carloads declined by the greatest amount during the 2007 to 2009 recession, and never recovered to prerecession levels. Moreover, carloads began to decline again in December 2014. In March 2016 carloads dropped to 1.05 million—the lowest amount in the last 16 years, and the

---

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

\(^4\) Seasonally adjusted truck tonnage - is calculated from the American Trucking Association Monthly Truck Tonnage Report. For unadjusted truck tonnage data, contact the American Trucking Association.
Figure 1-7  Truck Tonnage Index, 2000 to 2016

NOTES: Shaded areas indicate economic recessions. The unadjusted truck tonnage data are available from the American Trucking Association’s (ATA) Monthly Truck Tonnage Report. Under agreement with the ATA, BTS does not publish the unadjusted series.


Figure 1-8  Rail Freight Carloads, 2000 to 2016

NOTES: Shaded areas indicate economic recessions. Monthly rail carloads and intermodals are estimated by dividing the weekly sum by 7 (7 days in a week) and then summing for the number of days in the month (31 days for May, 30 days for June, etc.).

NOTES: Shaded areas indicate economic recessions. Monthly rail carloads and intermodals are estimated by dividing the weekly sum by 7 (7 days in a week) and then summing for the number of days in the month.


NOTE: Shaded areas indicate economic recessions.

first time that carloads have dropped below the recession-era low of May 2009. Rail carloads have declined in large part because demand for coal, the main freight railroad commodity, has decreased. In 2014 Class I railroads originated 18.8 percent fewer tons of coal than in 2008.\(^5\)

In contrast to rail carloads, seasonally adjusted rail intermodal traffic has increased by 46.0 percent from January 2000 to March 2016 (figure 1-9). It has increased by 39.6 percent from its recession-era low in June 2009, which was still higher than its level in January 2000.

Seasonally adjusted aviation freight ton-miles have increased by 13.1 percent in the last 16 years and by 19.0 percent since their recession-era low in March 2009 but have still not returned to their pre-recession levels (figure 1-10).


Seasonally adjusted waterway tonnage declined by 13.4 percent from January 2000 to March 2016. It has recovered by 41.3 percent since its low in October 2009, though its March 2016 level is below the high it reached in later 2014 (figure 1-11).

Seasonally adjusted petroleum pipeline shipments increased from 212 million barrels of crude oil in January 2000 to 248 million barrels in March 2016, fueled largely by an increase in shipments from August 2014 to the present (figure 1-12). Unlike other transportation measures, which declined noticeably during the 2007 to 2009 recession, pipeline shipments declined steadily over a longer period from late 2004 to late 2009.

Seasonally adjusted natural gas consumption, which measures transportation of natural gas by pipeline, has increased by 17.9 percent since 2000 and is highly seasonal (figure 1-13).

---

**Figure 1-11  Waterways Tonnage, 2000 to 2016**

---

**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 May 2016.


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 May 2016. Pipeline movement - U.S. Energy Information Administration (EIA) available at: www.eia.gov/petroleum/supply/monthly/ (Table 5B); tonto.eia.doe.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm (Alaska). Seasonally-adjusted pipeline movement - U.S. Department of Transportation, Bureau of Transportation Statistics (BTS) calculation from data collected by U.S. Energy Information Administration (EIA) available at: www.eia.gov/petroleum/supply/monthly/ (Table 5B); tonto.eia.doe.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm (Alaska).

NOTE: Shaded areas indicate economic recessions.

**Figure 1-14  Air Revenue Passenger-Miles (RPMs), 2000 to 2016**

![Graph showing Air Revenue Passenger-Miles (RPMs), 2000 to 2016](image)

**NOTE:** Shaded areas indicate economic recessions.


Unadjusted RPMs - U.S. Department of Transportation, Bureau of Transportation Statistics (BTS), Office of Airline Information, T-1 data. Seasonally adjusted RPMs - U.S. Department of Transportation, Bureau of Transportation Statistics (BTS).

---

**Seasonally Adjusted Passenger Transportation**

Seasonally adjusted air passenger-miles have increased by 40.9 percent in the last 16 years (figure 1-14). They reached their lowest point in September 2001 following the 9/11 terrorist attacks, but have increased by 74.0 percent since that point.

Seasonally adjusted transit ridership has increased by 10.2 percent in the last 16 years, but has not yet recovered to the high points reached in July 2008, just before the recession, and the even earlier May 2007 peak (figure 1-15).

Seasonally adjusted rail passenger-miles have increased by 21.3 percent since 2000. They reached their highest level in April 2012 (figure 1-16).

While the TSI measures for-hire transportation services, BTS also seasonally adjusts data for highway vehicle-miles traveled (VMT) to show trends in travel volumes. Seasonally adjusted VMT has grown by 16.7 percent since January 2000 (figure 1-17).
Figure I-15  Public Transit Ridership, 2000 to 2016

NOTE: Shaded areas indicate economic recessions.


Figure I-16  Rail Passenger-Miles, 2000 to 2016

NOTES: Shaded areas indicate economic recessions. “Rail” includes Amtrak and Alaska Railroad Corporation, but not commuter rail.

Figure I-17  Highway Vehicle-Miles Traveled (VMT), 2000 to 2016

NOTE: Shaded areas indicate economic recessions.