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

Transportation Statistics Annual Report

2022

Free Copy
Not Meant for Sale

Transportation Statistics Annual Report 2022

Free Copy
Not Meant for Sale

To obtain free copies of the *Transportation Statistics Annual Report 2022* and other BTS publications, please refer to the following resources:

Mail	U.S. Department of Transportation Bureau of Transportation Statistics Attn: Product Orders 1200 New Jersey Avenue Washington, DC 20590
Internet	https://www.bts.gov/tsar

BTS Information Service

Ask-A-Librarian	http://transportation.libanswers.com/
Phone	202-366-DATA (3282)

Recommended Citation

U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation Statistics Annual Report 2022* (Washington, DC: 2022). https://doi.org/10.21949/1528354

Acknowledgments

Bureau of Transportation Statistics
Patricia Hu
Director

Rolf R. Schmitt
Deputy Director

Produced under the direction of:
Ramond Robinson
Director, Office of Transportation Analysis

Project Manager
Long Nguyen

Editor
William H. Moore

Visual Information Specialists
Aaron Baunee
Kalle Culotta
Hannah Hocevar
Sari Kimmel
Mikki Stacey
Alpha Wingfield

Major Contributors
Michael Bronzini
Bingsong Fang
Theresa Firestine
Wendell Fletcher
John Fuller
David Greene
Paul Kent
Alan Pisarski
Steve Polzin
Christopher Rick
Joanne Sedor

Other Contributors
Justina Beard
Stacey Bricka
Matthew Chambers
Taylor Daily
Mitchell Fisher
Mindy Liu
Robert Nazareth
Daniel Palumbo
Xiaoyuan Sun
Hoa Thai
Miles Weule Chandler

Special thanks to all our colleagues throughout the U.S. Department of Transportation who provided data used in this report and critical review of the narrative.

Quality Assurance Statement

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

Notice

Introduction

Transportation is fundamental to the vibrancy of the Nation and creates both the economy and the quality of life. It enables people to engage in productive pursuits, carry out commerce, and experience the social interactions that are fundamental to people's happiness and success. Transportation affects and is affected by a full spectrum of societal elements:

- The built and natural environment,
- The economy,
- People's health and safety, and
- The social interactions that underpin our culture, all of which are impacted by transportation and the infrastructure and services that provide it.

Recognizing the importance of transportation and the importance of objective statistics for transportation decision-making, Congress requires the Director of the Bureau of Transportation Statistics (BTS) of the U.S. Department of Transportation (USDOT) to provide the *Transportation Statistics Annual Report* (TSAR) each year to Congress and the President.[1] BTS published the first TSAR in 1994. This 28th TSAR edition documents the conduct of the duties of BTS as called out in the statute.

Historically, transportation trends generally change unassumingly from year to year. However, the COVID-19 pandemic, first recognized as a national emergency in March 2020, produced unprecedented changes in transportation supply, demand, and performance in a matter of months. At the same time, ongoing technological change, shifting national priorities, and cultural, demographic, and economic challenges have altered expectations of what is important to report to transportation stakeholders. To adjust to the colossal changes, data needs have become more foundational to decision-making. Emerging patterns, such as a better understanding of the impact of telework and eCommerce on transportation; identifying the roles of ride-hailing services, E-scooters, and E-bikes in providing mobility; measuring supply chain performance; and reporting on equity, sustainability, and climate are critical concerns identified in the FY 2022-26 USDOT Strategic Plan and are among the current challenges of providing data to support transportation decision-making.

The U.S. Department of Transportation and many other organizations, such as the Transportation Research Board of the National Academy of Sciences, Engineering, and Medicine and the University Transportation Centers program overseen by USDOT, are actively exploring new measures and methods of gathering data to support transportation. More frequent and timely data collection, more geographic detail, and leveraging digital communications and data tools to speed the collection and processing of data are supporting the advancements in data reporting.

[1] 49 U.S. Code § 6302.

This report is organized into 7 chapters that reflect the topics in BTS's legislative mandate, including some new data items. Aside from this Introduction, the report components are Chapter 1 - State of the System, Chapter 2 - Passenger Travel and Equity, Chapter 3 - Freight and Supply Chain, Chapter 4 - Transportation Economics, Chapter 5 - Transportation Safety, Chapter 6 - Energy and Sustainability and Chapter 7 - State of Transportation Statistics. The report also provides an update to the State of Transportation Statistics and Recent BTS Accomplishments. The box to the right displays examples of the new data items in this report.

The concluding chapter on the state of transportation statistics documents lessons BTS and its partners have learned from measuring fast-evolving events and highlights changing data needs in response to new legislation.

A notable addition to this report is the coverage of the effects that the Coronavirus (COVID-19) pandemic has had on all modes of transportation—effects that BTS closely monitors. BTS provides a wide range of transportation statistics online, showing the pandemic's effects on passenger travel and freight shipments. These measures are available at https://www.bts.gov/covid-19.

BTS welcomes comment on the *Transportation Statistics Annual Report* (TSAR) and the Bureau's other products. Comments, questions, and requests for printed copies should be sent to bts@dot.gov or to the Bureau of Transportation Statistics, U.S. Department of Transportation, 1200 New Jersey Avenue SE, Washington DC, 20590.

Example of New Data Items Included in TSAR 2022

Chapter 2 - Passenger Travel and Equity:

- Consumer Expenditure Survey analysis of time spent in travel, adding insight on spending on intercity/international travel.
- Extensive treatment of race and ethnicity aspects of travel.
- New public and private sources providing insight on telework.

Chapter 6 - Transportation Safety:

- NHTSA collected data on crashes involving advanced or automated driving systems that were deployed within 30 seconds of a crash.
- Consumer Products Safety Commission (CPSC) information on injury, fatality, and hazard patterns for e-scooters, e-bikes, and hoverboards.
- Information on harassment and crime on passengers and operators.

Previous editions of the TSAR are available at www.bts.gov/tsar.

Table of Contents

List of Figures

List of Tables

CHAPTER 3
Freight and Supply Chain

Introduction

U.S. economic competitiveness is dependent on efficient freight movement. Manufacturers procure raw materials and intermediate goods, process them in the production operation, and ship their products to customers, all thanks to logistics activities. Companies rely on goods being hauled from their suppliers to their business establishments and from their establishments to their customers; they handle a myriad of paperwork that governs freight flows; they package, store, and ship their products as a key part of managing their supply chains. It is the transport and logistics industry that links all supply chain actors together.

COVID-19 caused extensive pandemic-related consumer purchases and supply chain disruptions, drawing public attention to supply chain issues. More recent global changes, such as the war in Ukraine, drought-induced

Highlights

- Thirty-eight percent of U.S. gross output in 2020, equivalent to $12.44 trillion, depended on the Nation's Transportation and Logistics sector, which itself contributed an output of $565 billion.
- After the COVID-19-year of 2020, U.S. trade surged to $4.6 trillion, a 22 percent increase from 2020 to 2021.
- In 2021, Canada reemerged as the United States' leading trade partner in terms of trade value, with Mexico and China ranked second and third, respectively.
- In 2020, over 17 billion tons of domestic freight worth $14.5 trillion moved through about $7 trillion of assets consisting of ports, highways, rail systems, airports, and pipelines.
- Trucks transported 12 billion tons in 2019, or 67 percent of total domestic freight volume — about 10 times more than that of rail, the United States' third-ranked mode by freight volume.
- In 2020, e-commerce's share of total retail sales increased to 14.6 percent from 10.5 percent in the previous year.
- In terms of freight value, John F. Kennedy International Airport and Chicago airports were ranked as the top two international freight gateways in 2020. Ranked 3rd and 4th were the U.S.-Mexico land border post in Laredo and the Port of Los Angeles.
- Improved U.S. East Coast connectivity to liner shipping networks have enabled the diversion of some Asian trade volumes from the U.S. West Coast to U.S. East Coast ports; in 2021 U.S. East Coast Asian container volumes exceeded U.S. West Coast Asian freight volumes.

Continued »

Highlights Continued

- Pipelines dominated U.S.-Canada trade in 2021, carrying about 37 percent of total freight weight. Carrying 35 percent of freight weight, trucking is the dominant mode in U.S.-Mexico trade. Vessels are the second mode of choice for U.S.-Mexico trade, carrying nearly 30 percent of freight weight.
- In 2019 and 2020, the container port average dwell time was 28.2 and 28.1 hours, respectively; this increased to an average of 32.1 hours in 2021 and to 35.5 hours for the first half of 2022, reflecting increasing congestion from COVID-induced demand.
- Substantial foreign direct investment in Mexico in 2022, particularly from the nearshoring of U.S. companies, will likely mean an increase in cross border trade flows, with trucking continuing its modal dominance. This will likely mean a shifting of freight flows from U.S. coastal ports to the U.S.-Mexico border.

navigation constraints on the Ohio and Upper Mississippi River systems, and labor unrest in significant parts of the freight transportation system, have underscored the impact supply chains have on day-to-day life.

This chapter first describes U.S. production, referred to as gross output, and international trade as principal factors affecting transportation demand. Sectors that rely most on transportation and warehousing are identified and the value of their gross output provided, as is the gross output for the transportation and warehousing sector. The dominance of China, Mexico, and Canada among U.S. top 10 trading partners in terms of value is then described.

The chapter then addresses the characteristics of the U.S. freight transportation system that enables the movement of U.S. gross output between domestic origins and destinations as well as international trade. The chapter also explores domestic freight demand and highlights the dominance of trucking in the freight markets, including the top 10 domestic commodity markets. The distribution of gateway trade to other states is then addressed, using Texas and Michigan as examples, and notes the U.S. Asian trade supply chain shift from the U.S. West Coast to U.S. East Coast ports. Data on U.S. container port performance are presented, and the chapter concludes with the identification of data that, when made available, can be useful for planning and performance monitoring purposes.

Much of the data reported were based on the Freight Analysis Framework (Box 3-A), which integrates data from a variety of sources in downloadable formats and visualizations.

Low Water on the Mississippi Slows Critical Freight Flows

The Mississippi River provides a vital link for freight movement in the United States. In 2020, the river carried more than half of the 165.5 million tons of freight that moved between the 12 states touching the Upper

Mississippi System[1] and Louisiana (Figure 3-1). The percentage of freight carried by the river to Louisiana is notably higher for some states: 92 percent for Indiana, 81 percent for Missouri, 80 percent for Illinois, and 75 percent for Kentucky. Today, that flow of freight has been hampered by low water levels on the Lower River.

Agricultural Product Movement by Water

Of the 12 states, Illinois shipped the most freight to Louisiana in total (55 million tons) and by water (44 million tons) in 2020 (Figure 3-2). Cereal grain accounted for 43 percent of the total tonnage between Illinois and Louisiana, and other agricultural products accounted for 26 percent. The river carried 93 percent of the cereal grain between Illinois and Louisiana, compared to 6 percent by rail, and it carried 82 percent of "other agricultural products"[2] between those two states, compared to 15 percent by rail and 3 percent by truck.

Effect of Low River Levels

The ability to move freight on the Mississippi River is affected by extreme water levels, whether too much due to flooding or too little due to drought. Currently, low water levels in the Lower Mississippi River due to scant rainfall have severely hampered fall 2022 barge shipments, especially on the vital stretch between Cairo, IL, and Memphis, TN (Figure 3-2). Groundings and the need for dredging have closed sections of the river and halted barge movements for intermittent periods. U.S. Coast Guard District 8 (New Orleans) reported a backup of more than 2,000 barges on the Lower Mississippi in early October. Low water also restricts the loads each barge can carry, and the narrower channel restricts the number of barges in a single tow.

Rain from Hurricane Roselyn eased the problem slightly in late October, but long-term weather forecasts do not anticipate enough rain to restore full river operations for at least several months.

[1] These include Minnesota, Wisconsin, Iowa, Illinois, and Missouri along the Mississippi north of its confluence with the Ohio River; Kansas and Nebraska along the navigable portion of the Missouri River; and Indiana, Ohio, Kentucky, West Virginia, and Pennsylvania along the Ohio River.

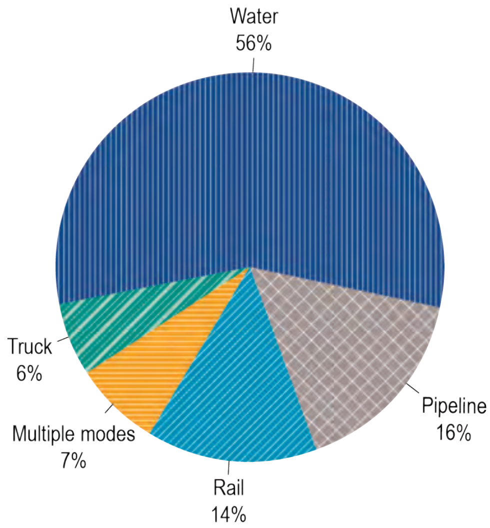
[2] The category of "other agricultural products" excludes cereal grains, live animals and seafood, milled grain, and foodstuffs.

Box 3-A Freight Analysis Framework

The Freight Analysis Framework (FAF), produced through a partnership between the Bureau of Transportation Statistics and the Federal Highway Administration, integrates data from a variety of sources to create a comprehensive picture of freight movement among states and major metropolitan areas by major commodity groups and by all modes of transportation. Primarily based on data from the Commodity Flow Survey (CFS), FAF incorporates data from international trade, agriculture, extraction, utility, construction, service, and other sectors.

FAF version 5 (FAF5) provides estimates for tonnage, value, and ton-miles by regions of origin and destination, commodity type, and mode. Data are available for the base year (currently 2017), the recent years (2018–2020), and forecast year estimates through 2050. Data may be accessed through the FAF Data Tabulation Tool.

Figure 3-1 Percent Tonnage by Mode Between States on the Upper Mississippi River System and Louisiana



NOTE: Percentages do not sum to 100 due to rounding.

SOURCE: FHWA/BTS Freight Analysis Framework version 5.4 at www.bts.gov/faf available as of December 2022.

Rail shipment is the normal alternative to barges, but the rail system can have difficulty absorbing such a massive short-term shift. Moreover, concerns over a possible rail strike in 2022 made shippers hesitant to rely on a rail option.

Critical Timing of Seasonal Products

Many major barge commodities, such as coal, chemicals, and petroleum, move at similar volumes year-round. Grain and other farm products, however, are seasonal. In 2022, downbound (southbound) grain shipments from the Upper Mississippi through Lock 27, the southernmost lock on the river, followed the 2021 pattern through October (Figure 3-3), but many of those shipments have stalled or been on the Lower River.

Unfortunately, disruptions to freight flow caused by low water have coincided with the peak shipping season for U.S. corn and soybeans, the Nation's largest export crops. The October downbound grain and agricultural product shipments on the Lower Mississippi below Lock and Dam 27 were predominately soybeans and corn, leaving those major export commodities most vulnerable to the Lower River disruption (Figure 3-4).

The implications of stalled shipments are apparent in barge shipping rates. By early September, barge rates were already at record highs. As Figure 3-5 shows, downbound grain rates on the Mississippi in October 2022 rose to more than double the 2021 peak and remained high in early November.

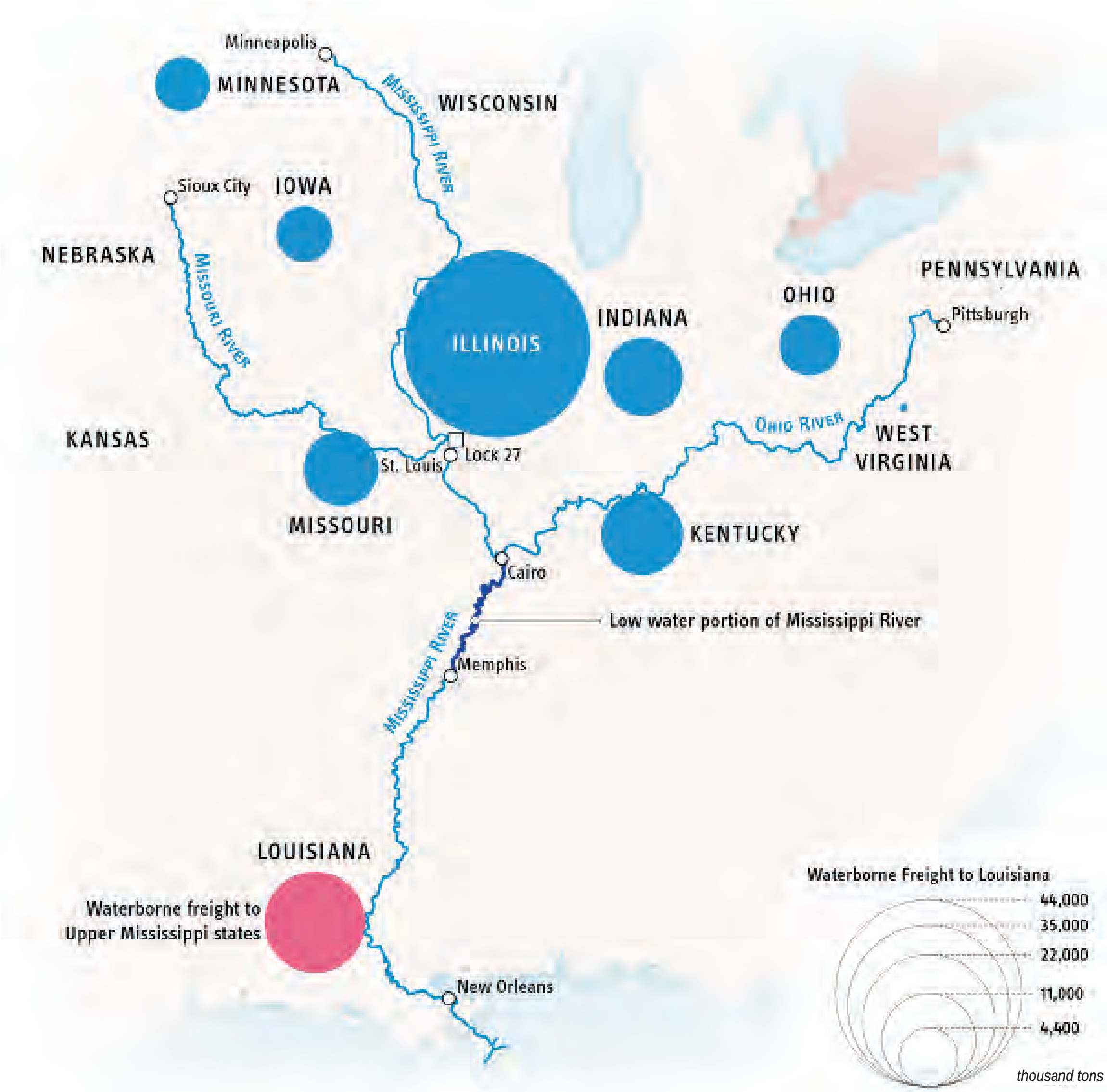
World Events and Freight Shipments

World demand and prices for grain have been rising due to Russia's invasion of Ukraine, drought in other producing areas, and increased consumption in China and elsewhere. Yet, despite the demand, U.S. grain and soybean exports are down due in part to the higher U.S. dollar and in part to the delivery delays caused by the compounded impact of low water and disruption to the supply chain. While domestic grain prices remain low, bid prices for U.S. export corn peaked in mid-October as the river delays were at their worst.

The Soy Transportation Coalition estimates that barge transportation accounts for about 6 percent of the delivered cost for soybeans shipped from Davenport, IA, to Shanghai, China. As Figure 3-5 indicates, October barge rates were as much as 400 percent above average, which would raise the delivered price of soybeans by about 24 percent, placing U.S. producers at a cost disadvantage compared to those in Brazil and other competitors.

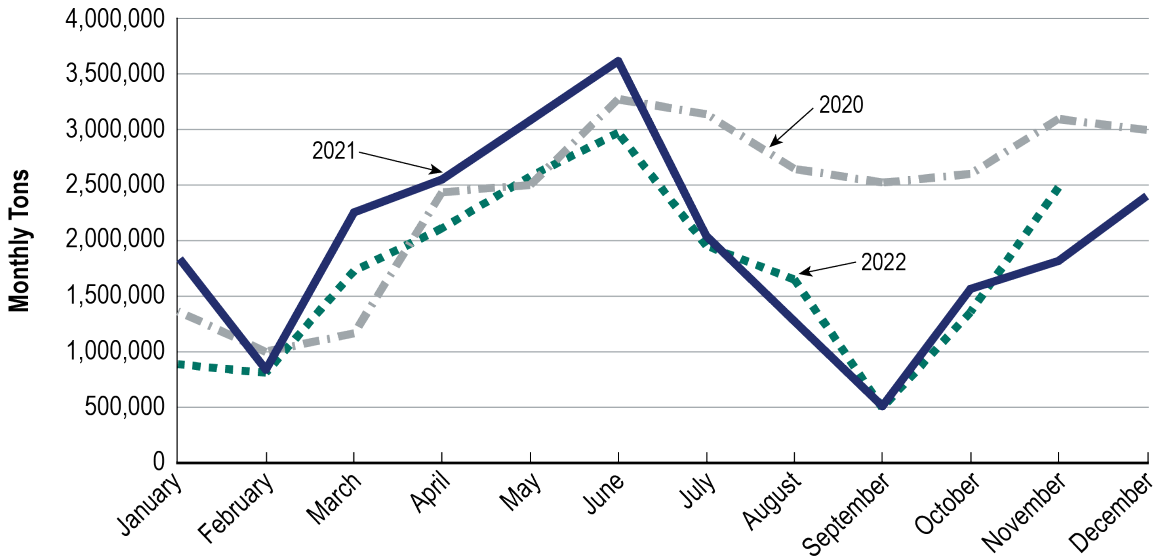
Grain is not the only commodity affected. The Waterways Council noted that the low water has also delayed coal shipments that are "very much

Figure 3-2 Waterborne Tonnage between States on the Upper Mississippi River System and Louisiana



SOURCES: FHWA/BTS Freight Analysis Framework version 5.4 at www.bts.gov/faf available as of December 2022.

Figure 3-3 Downbound Barge Grain Shipments



SOURCE: U.S. Department of Agriculture. Barge Dashboard at https://agtransport.usda.gov/stories/s/Barge-Dashboard/965a-yzgy/ available as of December 2022.

needed in Europe" due to the Russian invasion of Ukraine.

Besides delaying loaded downbound barge tows moving from producing areas to destination ports, such as Memphis, South Louisiana, and New Orleans, the low water also delays upbound tows moving fertilizer and cement for spring planting and construction, which also cuts the supply of empty barges for subsequent downbound trips.

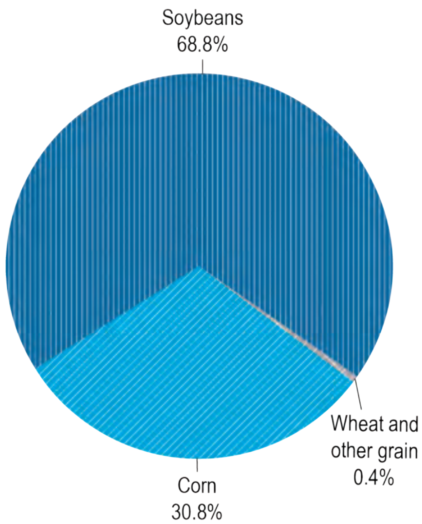
Factors That Affect Freight Transportation Demand

Domestic production and international trade are major drivers of freight transport demand. Production and trade growth affect the utilization of the Nation's highway, marine, and air freight transport systems and their ability to accommodate freight transport demand. U.S. gross domestic product (GDP) drives domestic and international freight transport demand through its influence on the scale of consumer demand and on the sectoral structure of the economy. U.S. economic sectors generate outputs given expected GDP growth, consumer demand, and markets for exports. Consumer demand has three elements: size, variety, and geographic concentration of consumers. The size and the variety of commodities consumers demand and the value of consumer purchases are major drivers of the number of freight shipments. The geographic concentration of consumers is an important driver of trip lengths, load factors, and mode choice.

U.S. Production of Goods and Services

U.S. manufacturing, mining, construction, agriculture, and wholesale and retail trade sectors are especially dependent on freight transport and logistics systems. In 2021, the economic activity on the goods and services produced by these sectors, referred to as gross output, had a value of $12.8 trillion (Table 3-1) [USDOC BEA 2022a]. The total gross output of these sectors shows a decline from 2019 to 2020, when the economy was most impacted by COVID-19, but construction, agriculture, and

Figure 3-4 October 2022 Downbound Grain and Agricultural Product Shares

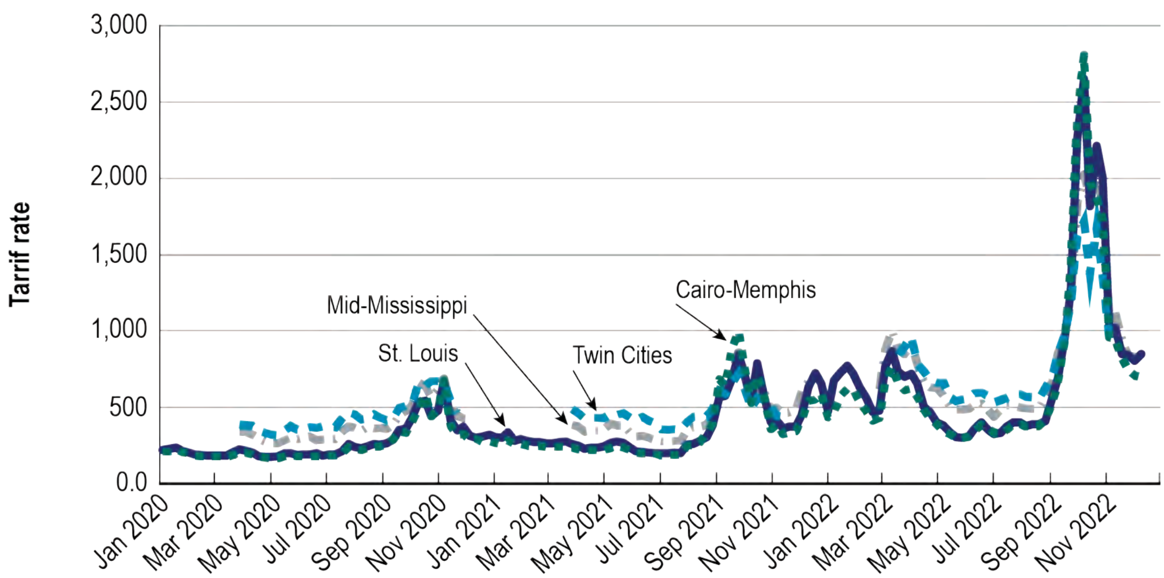


SOURCE: U.S. Department of Agriculture. Barge Dashboard https://agtransport.usda.gov/stories/s/Barge-Dashboard/965a-yzgy/ available as of December 2022.

retail trade increased their output from 2019 to 2020. Moreover, in 2021, the construction and retail trade sectors experienced their highest outputs during the 2016–2021 period. Transportation and Warehousing, which provides the freight services these sectors depend on, contributed an output of about $623.7 billion in 2021, its highest output during the 2016–2021 period.

Table 3-1 also shows that the output for freight services increases or decreases in accordance with the ebbs and flows of the output of these sectors. For each year demonstrating output growth for these sectors, Transportation and Warehousing output also grew. Transportation and Warehousing output's decline from 2019 to 2020 was in accord with the output decrease of the freight system-dependent sectors for the same year. As these sectors increase outputs, then there will be more truck, rail, maritime, and

Figure 3-5 Grain Barge Shipping Rates



SOURCE: U.S. Department of Agriculture. Barge Dashboard at https://agtransport.usda.gov/stories/s/Barge-Dashboard/965a-yzgy/ available as of December 2022.

Table 3-1 Gross Output of Freight System-Dependent Industry Sectors: 2016–2021 (Billions of 2012 Chained Dollars)

Industry sector	2016	2017	2018	2019	2020	2021
Total of sectors highly dependent on transportation and warehousing	12,384.0	12,562.2	12,920.0	12,927.6	12,361.1	12,788.5
Sectors highly dependent on transportation and warehousing						
Agriculture, forestry, fishing, and hunting	524.7	535.3	532.9	519.8	543.3	528.4
Mining	570.8	633.5	721.7	757.2	647.0	632.0
Utilities	490.0	481.6	505.0	500.7	487.4	498.3
Construction	1,355.9	1,378.2	1,387.6	1,401.6	1,426.9	1,440.5
Manufacturing	6,010.3	5,984.0	6,112.8	6,093.1	5,658.3	5,773.2
Wholesale trade	1,776.4	1,841.1	1,885.6	1,864.0	1,787.4	1,988.5
Retail trade	1,655.9	1,708.5	1,774.4	1,791.2	1,810.8	1,927.6
Transportation and warehousing	546.7	572.6	591.0	595.3	573.7	623.7

NOTES: Chain dollars adjusts for inflation over time allowing for equitable comparisons among dollar amounts. Transportation and Warehousing includes warehousing and stroage, water, truck, and pipeline transportation only; rail and air transportation are excluded due to a mix of freight and passenger output. Transit and ground transportation and other transportation and support activities are also excluded due to their focus on passenger transportation.

SOURCE: Bureau of Economic Analysis, Gross Output by Industry (billions of 2012 chain dollars), available at https://apps.bea.gov/iTable/iTable.cfm?reqid=150&step=2&isuri=1&categories=ugdpxind as of October 2022.

air transport services needed to deliver their products.

International Trade

As discussed later, the movement of international trade is accommodated through a system of trade gateways consisting of ports, airports, and land-border crossings. In 2021, imports and exports valued at $4.6 trillion moved through these gateways, representing about 25 percent of U.S. GDP [USDOC BEA 2022b]. The value for 2021 marks the highest annual U.S. trade value during the 2012–2021 period and experienced a relatively sharp rise from $3.8 trillion in 2020 (Figure 3-6).

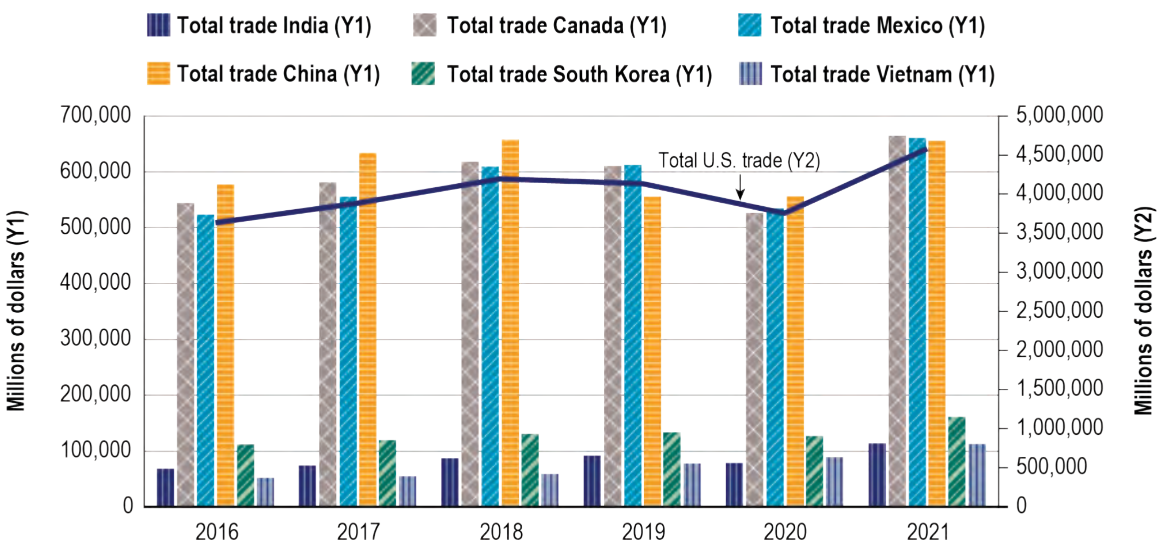
Canada for the first time emerged as the United States' largest trading partner in 2021 (Figure 3-6). U.S.-Canada trade was valued at nearly $666 billion in 2021. U.S. trades with Mexico and China were valued at $661 billion and $656 billion, respectively. Mexico's trade grew substantially during the 2016–2021 period, with both Mexico and Canada exceeding China in trade value in 2019 due to trade friction in 2018. Though China was the United States' leading trade partner in 2020 with the onrush of pandemic-related consumer purchases, Canada and Mexico reestablished their historic U.S. trade dominance in 2021, assuming the top 2 trading partner positions, with China moving to third in the top 10 trade partner list.

Both Mexico and Canada are likely to benefit from companies seeking to nearshore their production to reduce supply chain risk as well as to take advantage of the U.S.-Mexico-Canada trade agreement. As discussed later, Mexico has been the recipient of substantial foreign direct investment, which will have important implications for land border freight and U.S. port throughput volumes.

Total Freight Movement

In 2020, the U.S. freight transportation system moved more than 19 billion tons of freight worth

Figure 3-6 Trade Growth with Selected Top-Ten Trading Partners: 2016–2021 (Millions of Dollars).



SOURCE: Bureau of Census, U.S. Department of Commerce, "Top Trading Partners – December 2021", available at https://www.census.gov/foreign-trade/statistics/highlights/top/top2112yr.html, as of September 2022.

about $18.0 trillion (Table 3-2) through capital assets valued at about $7 trillion [USDOT BTS and FHWA 2022] consisting of ports, highways, rail systems, airports, and pipelines. Trucking by far was the most relied on freight transport mode; trucks transported 12.5 billion tons of freight valued at more than $13.1 trillion, about 65 percent and 73 percent of total freight weight and value, respectively. Trucking's freight volume was about 8.5 times higher than that of railed freight volume, the third-ranked freight mode. In 2020, pipelines transported 19.2 percent of total freight tons, moving 3.7 billion tons valued at close to $1 trillion. Except for two categories of modes, all the other modes experienced drops in freight weight from 2017 to 2020. Freight moved by air and air & truck increased in weight from 2017 to 2020. Only freight moved via pipeline showed an increase in both weight and value from 2017 to 2020.

Distance of Freight Movement and Modes of Transportation Used

A high percentage of freight in terms of both value and weight is moved over relatively short distances. In 2020, for example, freight moved by all modes below 100 miles represented about 30 percent of the total freight value and 35 percent of total weight (Figure 3-7), or $5.4 trillion and 6.8 billion tons. The proportion of the total value and weight increases to 56 and 74 percent, respectively, for shipment distances up to 249 miles, raising value and weight to $10.2 trillion and 14.2 billion tons.

Modal shares of freight vary considerably by distance. Trucks carry the largest shares by value,tons, and ton-miles of all goods shipped in the United States. As Figure 3-7 shows, trucking was the leading transport mode for all distances in 2020 by value, even for distances greater

Table 3-2 Freight Mode Weight and Value: 2017 and 2020

	Weight							
	2017				2020			
Millions of tons	Total	Domestic	Exports[1]	Imports[1]	Total	Domestic	Exports[1]	Imports[1]
TOTAL	19,578	17,478	1,115	985	19,211	17,015	1,228	969
Truck	12,805	11,848	513	443	12,520	11,558	492	471
Rail	1,610	1,202	243	165	1,459	1,034	258	167
Water	915	662	160	93	784	601	130	52
Air, air and truck	6	2	2	2	8	2	3	3
Multiple modes and mail	688	536	89	63	645	512	75	58
Pipeline	3,451	3,133	100	218	3,716	3,232	267	217
Other and unknown	102	94	8	1	79	75	3	1

	Value							
	2017				2020			
Billions of 2017 dollars	Total	Domestic	Exports[1]	Imports[1]	Total	Domestic	Exports[1]	Imports[1]
TOTAL	18,839	15,082	1,555	2,203	18,024	14,463	1,413	2,148
Truck	13,690	11,297	960	1,433	13,148	10,829	853	1,466
Rail	553	227	126	201	537	213	127	197
Water	293	184	55	53	242	166	43	34
Air, air and truck	654	159	246	249	599	140	226	232
Multiple modes and mail	2,658	2,362	108	188	2,489	2,262	70	157
Pipeline	946	851	29	66	998	851	86	61
Other and unknown	45	2	31	12	12	2	8	3

[1] Data do not include imports and exports that pass through the United States from a foreign origin to a foreign destination by any mode.

NOTES: Numbers may not add to totals due to rounding. The 2016 data are provisional estimates based on selected modal and economic trend data. Data in this table are not comparable to similar data in previous years because of updates to the Freight Analysis Framework. All truck, rail, water, and pipeline movements that involve more than one mode, including exports and imports that change mode at international gateways, are included in multiple modes & mail to avoid double counting. As a consequence, rail and water totals in this table are less than other published sources.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, Freight Analysis Framework, version 5.4, September 2022.

Figure 3-7 Domestic Shipment Value and Weight by Mode and Distance Bands: 2020

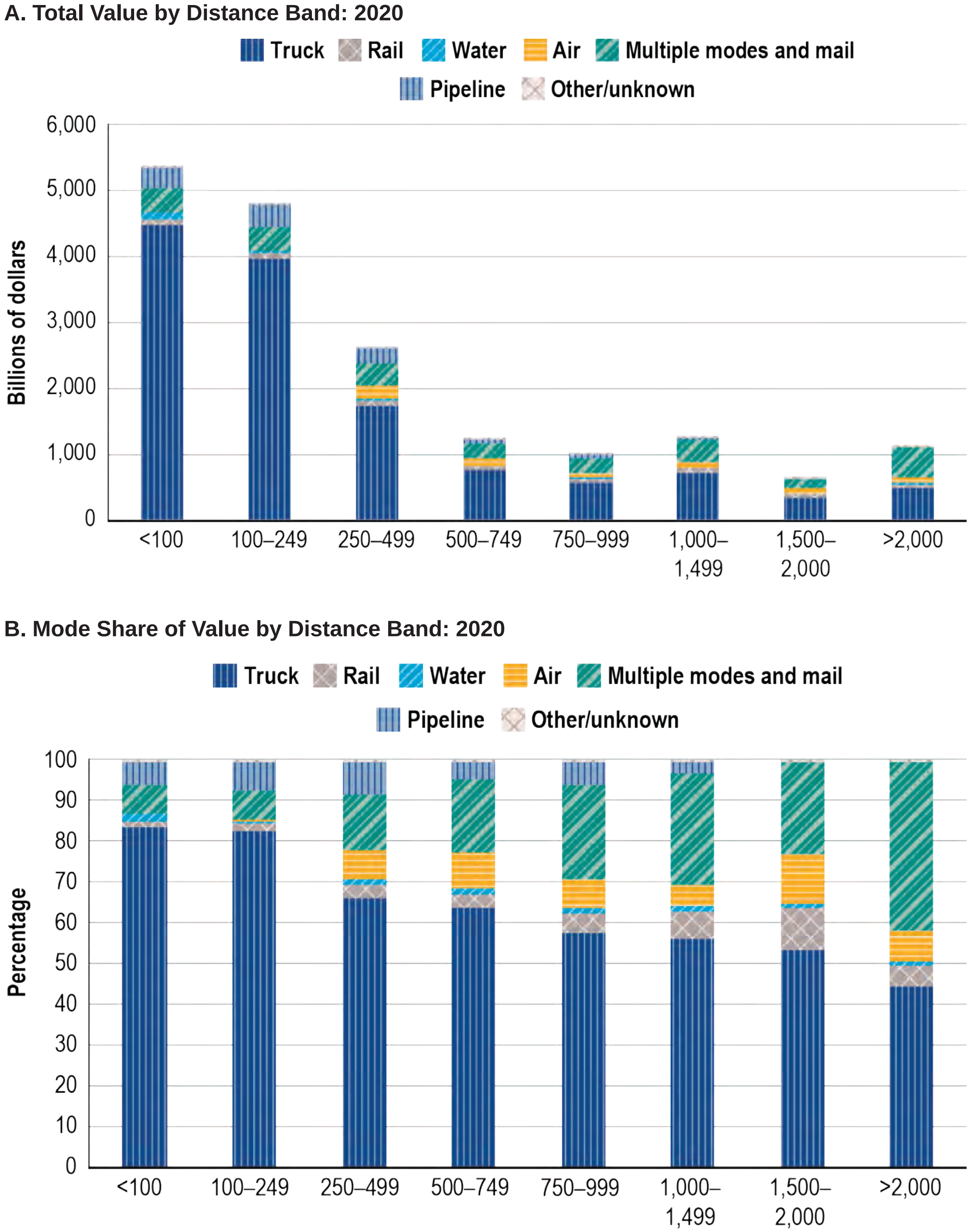
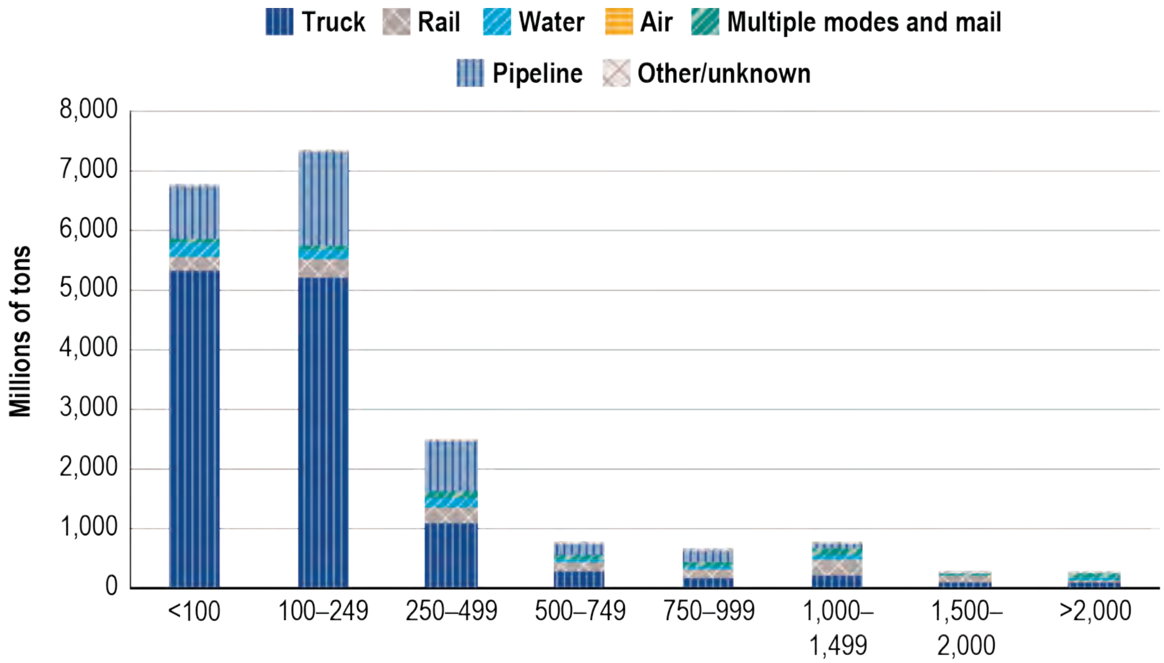


FIGURE 3-7 Continued

C. Total Tonnage by Distance Band: 2020



D. Mode Share of Tonnage by Distance Band: 2020

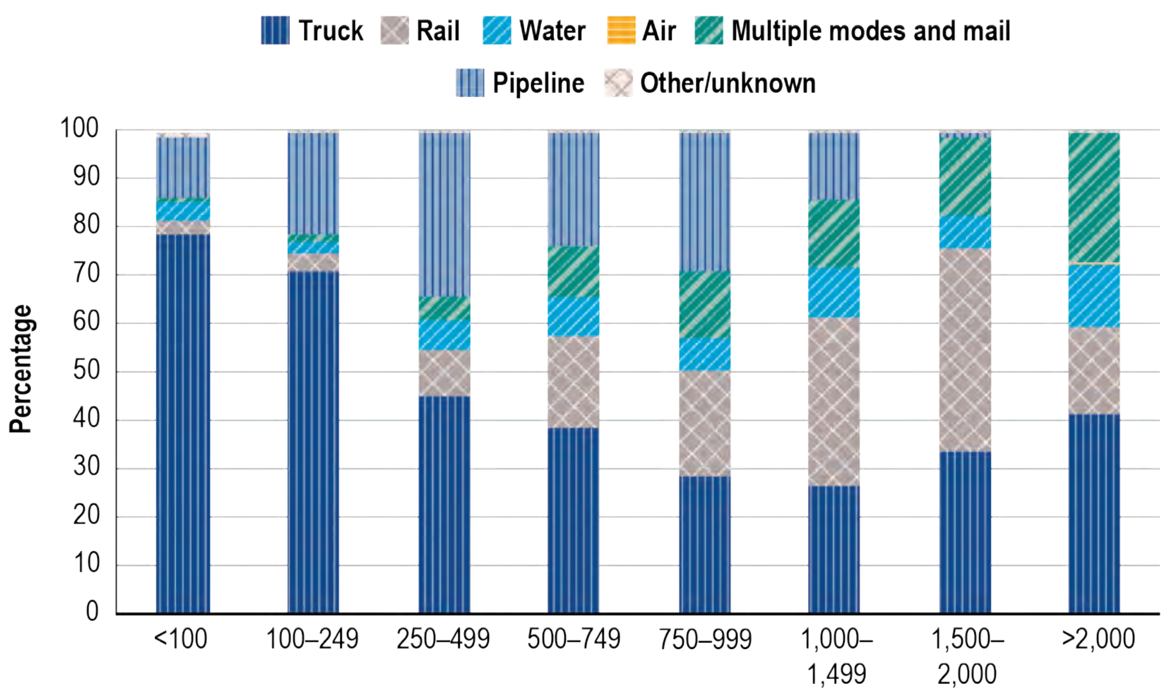
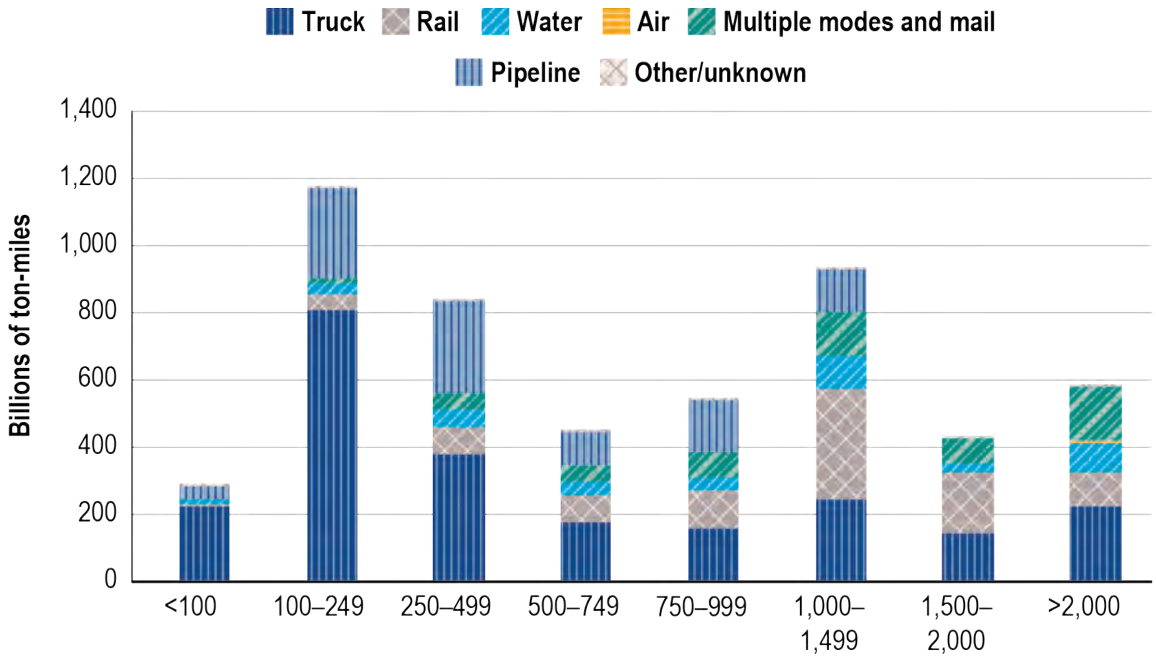
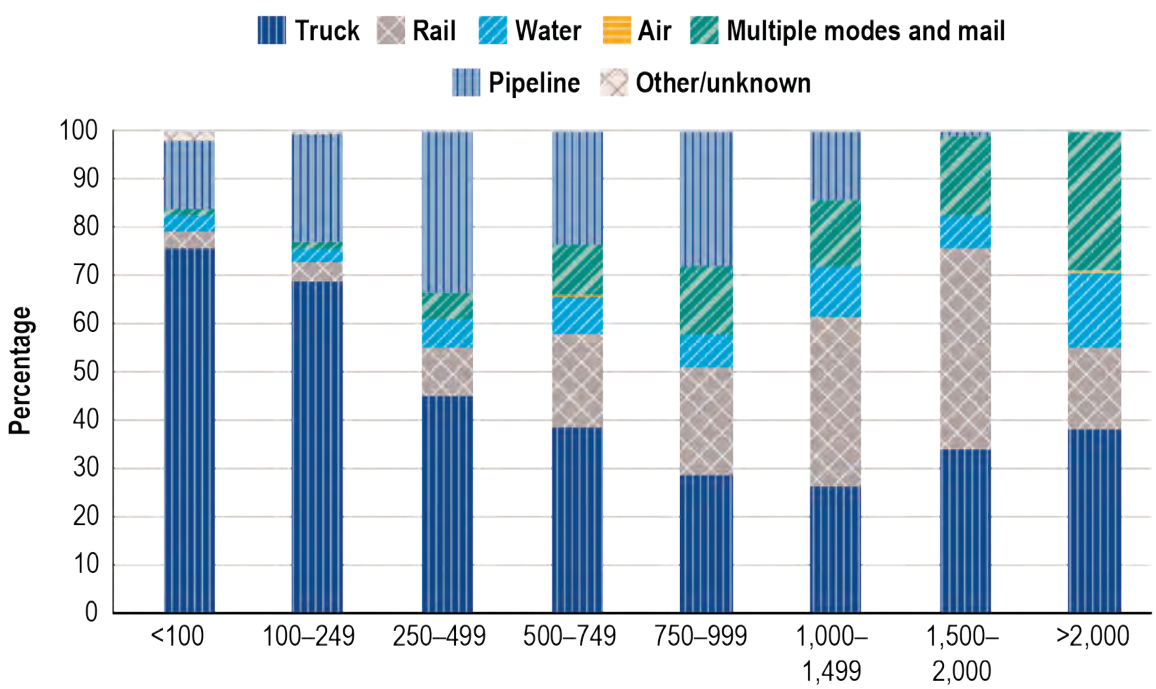


FIGURE 3-7 Continued

E. Total Ton-Miles by Distance Band: 2020



F. Mode Share of Ton-Miles by Distance Band: 2020



Source: U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, Freight Analysis Framework, version 5.5, October 2022.

than 2,000 miles. In terms of tons, trucking was the preferred mode to destinations from below 100 miles and up to 749 miles. Rail leads in tonnage and ton-miles for goods shipped from 1,000 to 2,000 miles with heavy commodities. Air and multiple modes accounted for more than half of the value of high-value shipments moving over 2,000 miles.

Top 10 Commodities

Table 3-3 and Figure 3-8 present the top 10 domestic commodities by weight and mode, and by value and mode, respectively, in 2020. With nearly 13 million tons, the top 10 commodities together represent 66.7 percent of all domestic commodities by weight (Table 3-3). Most of the commodities may be characterized as bulk freight (note the absence of manufactured goods) and all of the commodities are transported by multiple modes, including in some cases nominal amounts by air. Bulk commodities shipped by air are likely relatively higher value specialty products that are transported in breakbulk form (e.g., sacks and barrels on pallets in air freight). The greatest single commodity by weight is coal and petroleum products-n.e.c. (“not elsewhere classified”), where pipelines convey nearly 2.3 billion tons (79 percent) of the total of about 2.9 billion tons for that commodity. Gravel, cereal grains, and non-metallic mineral products, the second-, third-, and fourth-ranked commodities by weight, are largely moved by truck.

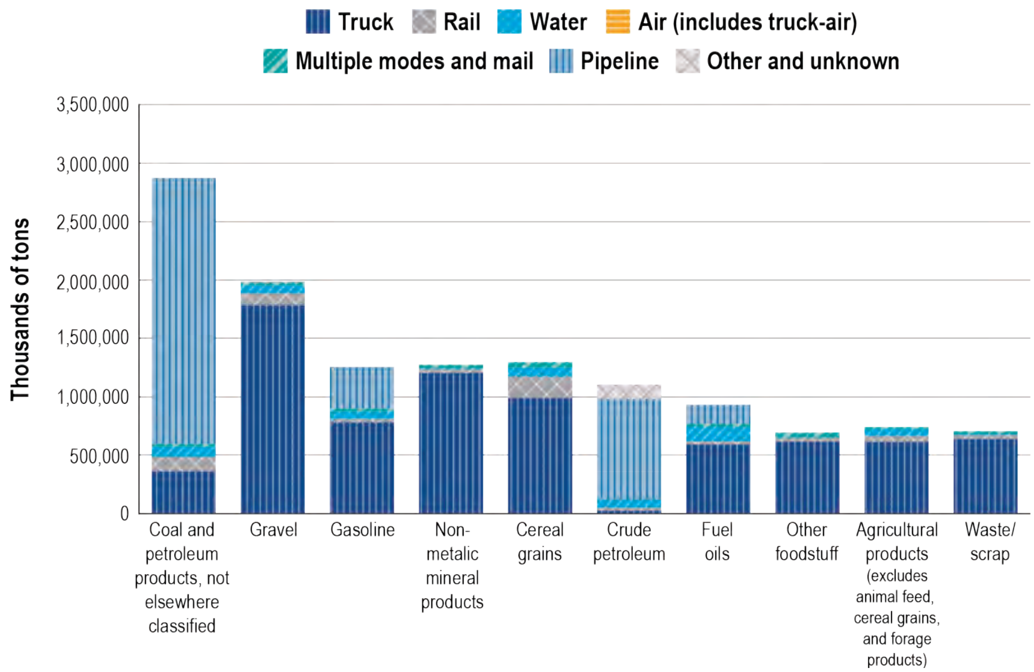
The top 10 commodities by value represent about 70 percent of the total value of all commodities. The top 10 by value list is in stark contrast with the top 10 by weight list, as manufactured goods predominate the top 10 commodities by value (Table 3-3). Trucks carry $7.7 billion of freight, or 71 percent of the total top 10 freight value of about $10.8 billion. The “Multiple modes and mail” category carries 15.7 percent of the total value of the top 10 commodities (Figure 3-9).

Table 3-3 Top 10 Commodities by Weight and Value: 2020

Commodities by Weight	Thousands of tons	Commodities by Value	Billions of 2020 dollars
Coal and petroleum products, not elsewhere classified	2,878,389	Electronics	1,723,397
Gravel	1,988,558	Mixed freight	1,533,025
Gasoline	1,258,338	Motorized vehicles	1,377,615
Non-metallic mineral products	1,276,869	Pharmaceuticals	1,218,496
Cereal grains	1,299,820	Machinery	1,105,044
Crude petroleum	1,106,424	Miscellaneous manufactured products	868,119
Fuel oils	935,526	Plastics/rubber	825,823
Other foodstuffs	693,902	Other foodstuffs	718,350
Agricultural products (excludes animal feed, cereal grains, and forage products)	741,036	Coal and petroleum products, not elsewhere classified	692,807
Waste/scrap	708,158	Gasoline	669,841
Top 10 Total	12,887,021	Top 10 Total	10,732,517
Total of all Commodities	19,331,315	Total of all Commodities	18,062,704
Top 10 Share of Total	66.7%	Top 10 Share of Total	59.4%

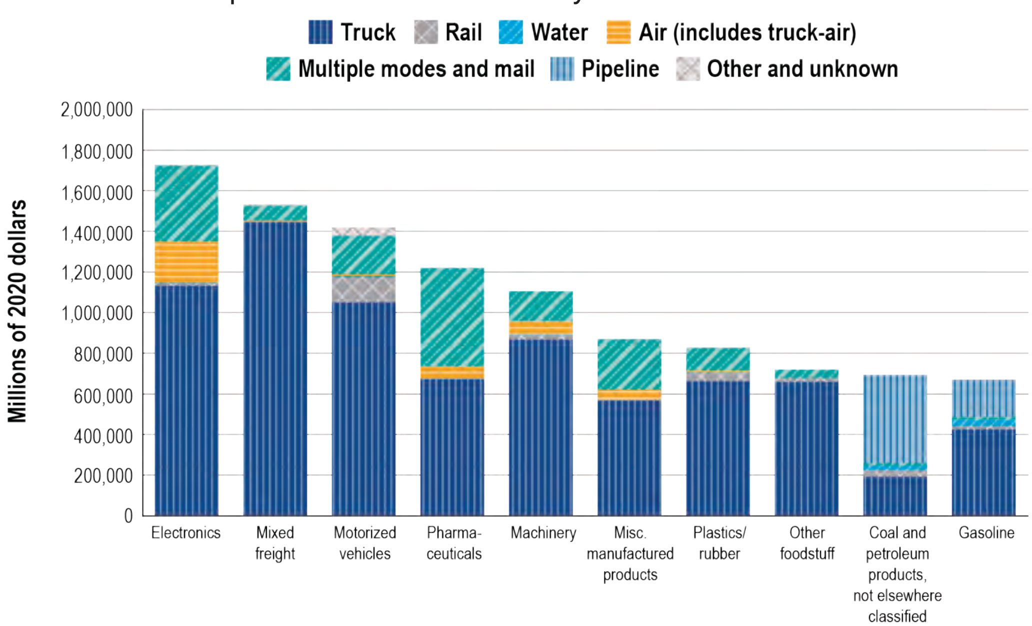
SOURCE: U.S. Department of Transportation (USDOT), Bureau of Transportation Statistics, and USDOT, Federal Highway Administration, Office of Freight Management and Operations, Freight Analysis Framework, version 5.4, October 2022.

Figure 3-8 Tonnage of Top 10 Domestic Commodities by Mode: 2020



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, Freight Analysis Framework, version 5.4, October 2022.

Figure 3-9 Value of Top 10 Domestic Commodities by Mode: 2020



NOTE: "Other foodstuffs" and "Other agricultural products" do not include foodstuff and agricultural categories too small to make this top-ten list.

SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, Freight Analysis Framework, version 5.4, October 2022.

International Freight

International freight, valued at $3,561 billion in 2020 (Table 3-2), holds a relatively small share of total U.S. freight value of $18 trillion in the same year, but the small share is a misleading indicator of its importance. Because international freight is handled in the Nation's maritime ports, land borders, and airports, there is a high concentration of logistics activities in these areas. This is especially true for the maritime ports of Los Angeles and Long Beach, both of which are physically located in the same metropolitan area.

Table 3-4 shows total U.S.-International freight by geography and mode. Vessels transported $1,045,619 million (58.3 percent) between the United States and Asia, whereas air transported $671,964 million (37.5 percent). More comparable dollar amounts were transported by vessel and air (42.7 vs. 50.5 percent) between the United States and Europe.

Table 3-5 presents the United States' top 25 gateways out of 328 international points of entry in the United States [U.S. Customs and Border Protection 2022]. The number one- and number two-ranked gateways relative to the value of imported and exported freight are airports, while the Laredo-Texas land border holds the number three position. Maritime gateways overall accounted for 40 percent of all gateways freight value, compared to 38 and 22 percent for airports and land border posts, respectively.

Figure 3-10 shows the value of the Nation's top 25 gateways in 2020, 19 of them handling more imports than exports. As the number one gateway, John F. Kennedy International Airport, NY, handled freight exports and imports valued at $215.5 billion, about $1 billion more than Chicago, IL. Laredo, TX, as the number one land border gateway, handled freight valued at $201.4 billion, while the number one maritime gateway, the Port of Los Angeles, handled export and import freight valued at $196.9 billion. The Port of Los Angeles was also the number one out of the top 25 import gateways, handling imports valued at $169.1 billion, about $7.5 billion ahead of the Chicago gateway. Laredo was United States' number one export gateway, with an export value of about $80 billion, followed closely by John F. Kennedy International Airport at about $79 billion.

U.S. North American Freight

Canada and Mexico, as U.S. border countries and the number one and two U.S. trade partners in 2021 (Figure 3-6), respectively, rely heavily on trucking, pipeline, and rail modes (Figure 3-11). In 2021, U.S.-Canada freight flow totaled $664.2 billion, an increase of 26.4 percent from $525.5 billion in 2020. On the southern border, U.S.-Mexico freight flow totaled $661.2 billion in 2021, an increase of 22.9 percent from $538.1 billion in 2020.

Because of the heavy reliance on pipeline to move crude oil, natural gas, and refined petroleum products, pipelines dominated U.S.-Canada trade, carrying 37 percent of freight weight in 2021—15 percent greater than each of the 22 percent shares carried by truck and rail (Figure 3-11). U.S.-Mexican trade tells a different story for 2021, with trucking dominating trade at 34 percent, followed by the 30 percent share of trade carried aboard vessels. Rail's market share of about one-fifth of total trade is similar for both countries. The air mode carries a relatively negligible share of the weight of both trades.

Laredo, TX, and Detroit, MI, were the third and eighth largest U.S. gateways in terms of freight value in 2020 (Figure 3-10), with trucks representing 22 and 36 percent of total freight trade in Canada and Mexico, respectively. In 2020, Texas's border crossings alone had about 4.4 million inbound trucks and nearly 9.2 thousand inbound trains. In contrast, Michigan had about half as many inbound

Table 3-4 Value of U.S.-International Freight Flows by Geography and Transportation Mode: 2021 (Millions of Dollars)

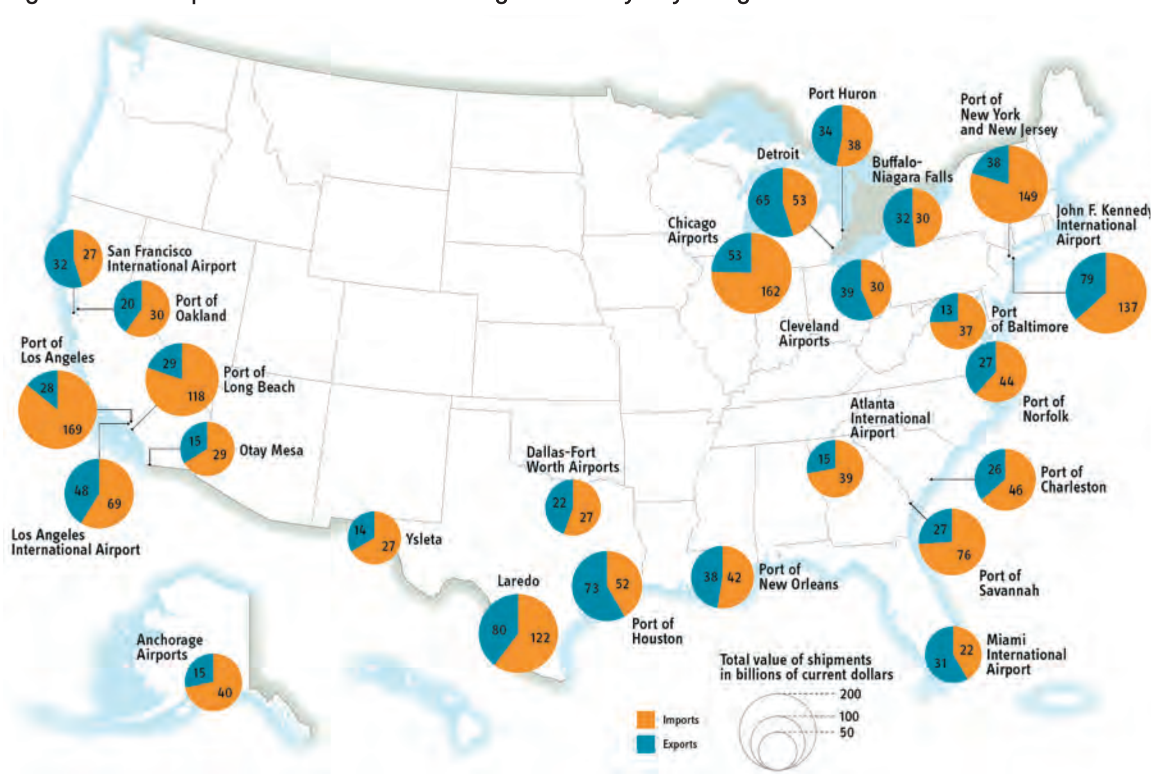
Geography	Mode						
	Truck	Rail	Pipeline	Air	Vessel	Other	TOTAL
Canada	367,039	102,241	86,192	34,941	30,584	44,549	665,546
Mexico	460,850	84,217	12,026	17,921	66,887	19,239	661,140
Asia	NA	NA	NA	671,964	1,045,619	76,694	1,794,277
Europe	NA	NA	NA	532,754	450,396	72,124	1,055,274
Other	NA	NA	NA	98,591	292,312	18,216	409,119

KEY: NA = not applicable.

NOTES: Transportation mode in this table represents the mode by which freight arrived to or departed from the United States, therefore truck, rail, and pipeline are only available for U.S. freight flows with Canada and Mexico.

SOURCE: Truck, Rail, and Pipeline: U.S. Department of Transportation, Bureau of Transportation Statistics, TransBorder Freight Data, available at www.bts.gov/transborder; Air, Vessel, and Other: U.S. Department of Commerce, Census Bureau, *USA Trade Online*, https://usatrade.census.gov/ as of August 2022.

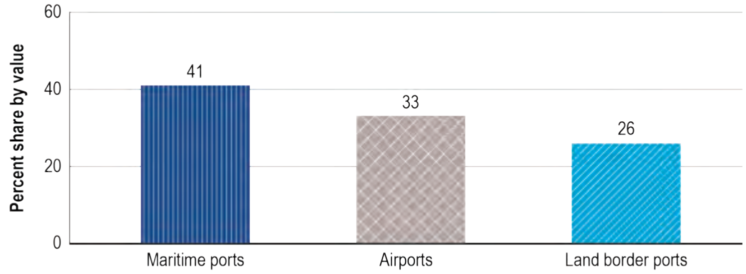
Figure 3-10 Top 25 U.S. International Freight Gateways by Freight Value: 2020



SOURCES: Air: U.S. Department of Commerce, U.S. Census Bureau, Foreign Trade Division, USA Trade Online, available at https://ustrade.census.gov as of January 7, 2022. Land: U.S. Department of Transportation, Bureau of Transportation Statistics, North American Transborder Freight Data, available at https://www.bts.gov/transborder as of March 7, 2022. Water: U.S. Army Corps of Engineers, Navigation Data Center, personal communication, special tabulation, November 12, 2020, and November 2, 2021.

Table 3-5 International Freight Gateways and Their 2020 Rankings by Value (Billions of Dollars)

Maritime Ports	Gateway Rank	Airports	Gateway Rank	Land Border Ports	Gateway Rank
Los Angeles, CA	4	John F. Kennedy International Airport, NY	1	Laredo - Texas	3
New York, NY	5	Chicago, IL (Port)	2	Detroit - Michigan	8
Long Beach, CA	6	Los Angeles International Airport, CA (Port)	9	Port Huron - Michigan	13
Houston, TX	7	New Orleans, LA (Port)	11	Buffalo-Niagara Falls - New York	16
Savannah, GA	10	Cleveland, OH (Port)	15	Otay Mesa - California	24
Charleston, SC	12	San Francisco International Airport, CA (Port)	17	Ysleta Port of Entry	25
Norfolk, VA	14	Anchorage, AK (Port)	18	Hidalgo - Texas	29
Oakland, CA	21	Atlanta, GA (Port)	19	El Paso - Texas	30
Baltimore, MD	22	Miami International Airport, FL (Port)	20	Eagle Pass - Texas	32
Tacoma, WA	26	Dallas-Fort Worth, TX (Port)	23	Santa Teresa - New Mexico	33
Corpus Christi, TX	28	Newark, NJ (Port)	27	Pembina - North Dakota	35
New Orleans, LA	31	Seattle-Tacoma International Airport, WA (Port)	48	New Orleans Customs District n.e.c.	37
Seattle, WA	34			Nogales - Arizona	38
Miami, FL	36			Champlain-Rouses Point - New York	40
Jacksonville, FL	39			Blaine - Washington	41
Brunswick, GA	42			Chicago Customs District n.e.c.	45
Port Everglades, FL	43			Brownsville - Texas	49
Philadelphia, PA	44			Calexico-East - California	50
Mobile, AL	46				
Gramercy, LA	47				
TOTAL value (billions of dollars)	$1,263.2		$1,017.2		$807.1
Share of the Top-50 TOTAL	41%		33%		26%

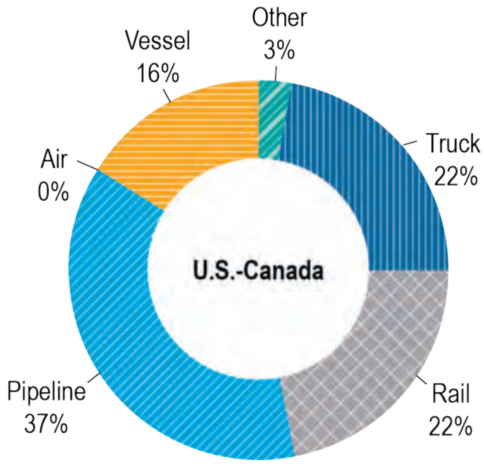


NOTES: **All data:** Trade levels reflect the mode of transportation as a shipment enters or exits at a border port. Flows through individual ports are based on reported data collected from U.S. trade documents. Trade does not include low-value shipments. (In general, these are imports valued at less than $1,250 and exports that are valued at less than $2,500). Air: Data for all air gateways are reported at the port level and include a low level (generally less than 2%-3% of the total value) of small user-fee airports located in the same region. Air gateways not identified by airport name (e.g., Chicago, IL and others) include major airport(s) in that geographic area in addition to small regional airports. In addition, due to Bureau of Census confidentiality regulations, data for courier operations are included in the airport totals for JFK International Airport, Chicago, Los Angeles, Miami, New Orleans, Anchorage, and Cleveland.

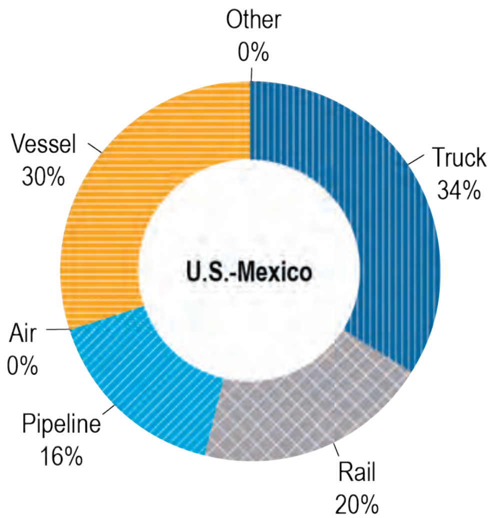
SOURCE: **Airports:** U.S. Department of Commerce, U.S. Census Bureau, Foreign Trade Division, USA Trade Online, available at https://usatrade.census.gov as of Jan. 7, 2022. **Land Border Posts:** U.S. Department of Transportation, Bureau of Transportation Statistics, North American Transborder Freight Data, available at https://www.bts.gov/transborder as of Mar. 7, 2022. **Maritime:** U.S. Army Corps of Engineers, Navigation Data Center, personal communication, special tabulation, Nov. 12, 2020, and Nov. 2, 2021.

Figure 3-11 Modal Shares of U.S. Trade with Canada and Mexico: 2021

A. Modal Shares in U.S.-Canada Trade in Tons, 2021; Tons = 573.7 Million



B. Modal Shares in U.S.-Mexico Trade in Tons, 2021; Tons = 400.3 Million



SOURCE: U.S. Department of Transportation, Bureau of Transportation Statistics, TransBorder Freight Data, available at www.bts.gov/transborder as of May 2022.

trucks as Mexico did (about 2.1 million) and a little more than half as many inbound trains with 4.9 thousand [USDOT BTS 2022a].

Inbound trucks and trains crossing the Texas border in 2020 moved about 37 billion and 14 billion tons, respectively. Eight states—Texas, California, Georgia, Illinois, Kentucky, Michigan, New Jersey, and Ohio—accounted for 79 percent of all freight moved. Forty-one percent of the freight volume crossing the Texas-Mexico border remained for distribution in Texas, while 38 percent was distributed to the other seven states [FAF, USDOT BTS and FHWA 2022]. In 2020, about 22.7 million and 15.9 million tons were moved on inbound trucks and trains, respectively, across the Michigan border. In addition to Michigan, this freight was destined to eight other states: Ohio, Indiana, Texas, Wisconsin, California, Kentucky, Georgia, and Tennessee [FAF, USDOT BTS and FHWA 2022]. Illinois is the largest inbound freight recipient among these nine states, with trucking the leading mode choice.

Shifts in Containerized Freight

A review of Middle Eastern and Asian countries[3] containerized imports and exports indicates a supply chain shift from the U.S. West Coast ports to the U.S. East Coast ports during the period 2011–2021. Improvements to the Panama and Suez Canals, along with advances in the capability of U.S. East Coast ports to accommodate larger vessels, increased the options liner carriers[4] have for freight delivery. With these improvements, U.S. East Coast ports have benefited from greater connectivity to liner shipping networks.

[3] The U.S. Census Bureau includes the following countries as part of Asia: Asia Near East includes Bahrain, Gaza Strip, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, West Bank Administered by Israel, and Yemen; Asia-South includes Afghanistan, Bangladesh, India, Nepal, Pakistan, and Sri Lanka; Asia-Other includes Bhutan, Brunei, Burma, Cambodia, China, Hong Kong, Indonesia, Japan, Korea-North, Korea-South, Laos, Macau, Malaysia, Maldives, Mongolia, Philippines, Singapore, Syria, Taiwan, Thailand, Timor-Leste, and Vietnam.

[4] A liner carrier is a service that operates on a schedule with a fixed port rotation and published dates at the advertised ports

Figure 3-12 shows that U.S. West Coast ports have historically served as the gateway for imported containerized Asian cargoes, despite the larger U.S. East Coast populations. However, the U.S. East Coast has shown continuous growth of Asian import trades over the past 10 years, approaching a near-even split in 2021, with U.S. East Coast port import throughput of 62 million metric tons versus the West Coast ports' 64.3 million tons. When U.S.-China trade frictions materialized in 2018, the U.S. West Coast ports showed a precipitous decline (8.6 percent) in Asian imports, with growth stalled in U.S. East Coast ports in 2018 and a decline in 2019–2020 of 1.1 percent.

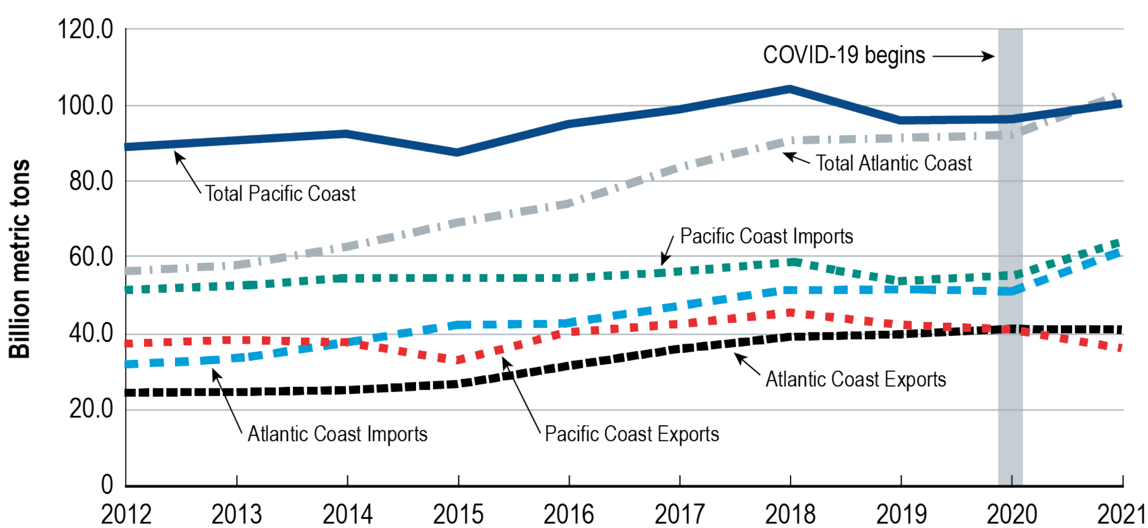
Figure 3-12 also reflects the pandemic-related surge of Asian imports from 2020–2021, with the U.S. East Coast ports showing 21.4 percent growth versus the West Coast ports' growth of 16.2 percent. U.S. East Coast average annual growth rates, referred to as CAGR,[5] over the period 2011–2021 are higher at 7.4 percent than the West Coast's average annual growth rate of 3.5 percent.

U.S.-Asia export performance on the U.S. West Coast also shows a significant loss of Asian export market share to the U.S. East Coast ports, as Figure 3-12 shows. Overall, the average annual growth rate in U.S. East Coast exports with Asia for the years 2011–2021 was 5.1 percent, compared with a 0.6 percent decline for the West Coast ports. Interestingly, the West Coast port containerized volumes have declined continuously since 2018 when U.S.-China trade friction began. While both U.S. East Coast and West Coast ports experienced declines since COVID-19 in 2020, the U.S. West Coast ports experienced an 11.7 percent drop in Asian exports, while the U.S. East Coast ports had a negligible decline of 0.2 percent.

With the U.S. East Coast port growth in U.S. containerized export volumes and near-equilibrium market share between U.S. West Coast and East Coast ports for imports, it is

[5] CAGR is the Compound Annual Growth Rate, which is the average annual growth rate over a period longer than one year; here, we determine the CAGR for the period 2011–2021

Figure 3-12 U.S. East Coast and West Coast Asian Containerized Freight Volumes: 2012–2021



SOURCES: U.S. Department of Commerce, Census Bureau, Economic Indicators Division, available at http://usatrade.census.gov as of September 2022.

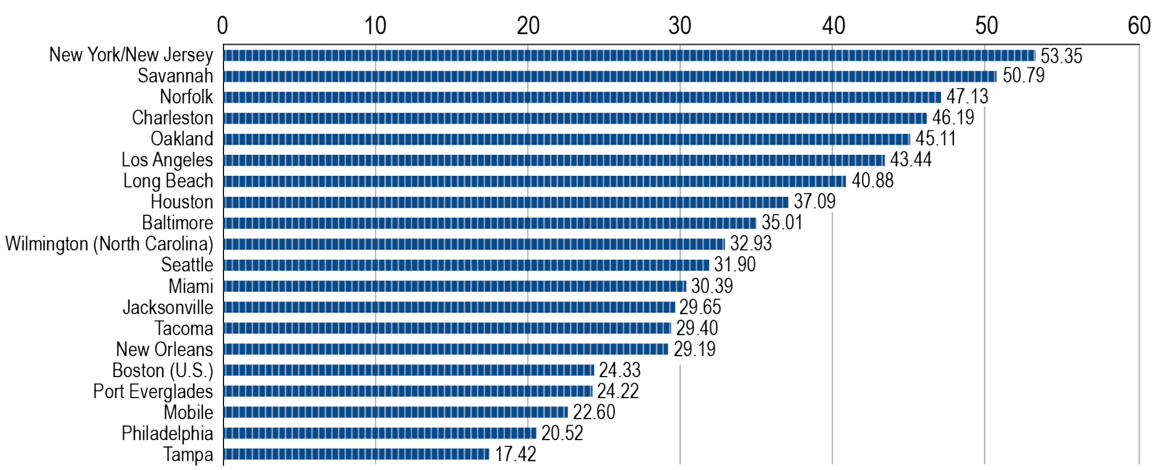
not surprising that U.S. East Coast ports have overtaken the U.S. West Coast ports as the containerized cargo gateway for Asian trades. Combining both containerized imports and exports, the U.S. East Coast ports for the first time surpassed West Coast port container freight weight in 2021 (Figure 3-12), handling nearly three million tons more than West Coast ports. The 2011–2021 CAGR of the total Asian containerized freight volume for U.S. East Coast ports was 6.4 percent versus 1.2 percent for West Coast ports.

The United Nations Conference on Trade and Development created the Liner Shipping Connectivity Index (LSCI) in 2004 as a measure of how well countries and ports are connected to the global shipping network.[6] Figure 3-13 presents the top 20 LSCIs for U.S. ports. The U.S. East Coast Port's success in capturing greater Asian market share is enabled in part by the ports' ability to connect with global shipping networks; ports with a high degree of network connectivity allows them to offer a wider range of shipping options than ports with lower connectivity.

The U.S. East Coast port of New York/New Jersey, Savannah, Norfolk, and Charleston are ranked as the top four most connected ports, with five other U.S. East Coast ports among the top 20. Oakland, Los Angeles, and Long Beach rank fifth, sixth, and seventh, respectively, with only one other U.S. West Coast port finding itself in the top 20. This largely explains the supply chain shifts from the U.S. West Coast to the U.S. East Coast as U.S. East Coast ports expanded their capacity and capabilities. Importantly, U.S. Gulf Coast ports also invested in port improvements; the ports of Tampa, New Orleans, and Houston also appear in the U.S. top 20 most-connected ports.

[6] UNCTAD's connectivity indexes are published quarterly available at https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=170026, and https://unctad.org/system/files/official-document/rmt2017_en.pdf as of 18 October 2022.

Figure 3-13 U.S. Top 20 Container Port Liner Shipping Connectivity Index: 2021



SOURCES: United Nations Conference on Trade and Development, Liner Shipping Connectivity Index, 2021, available at https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92 as of October 2022.

Shortening Supply Chains: Nearshoring, Reshoring, and Foreign Direct Investment[7]

Nearshoring, reshoring, and foreign direct investment (FDI) have important implications for trade flows and hence the facilities used to accommodate these flows. A U.S. plant nearshoring to a country on the Nation's borders, for example, means a likely shift of its supply chain from U.S. coastal ports to land border crossings, which are largely shipped by truck. Production and labor costs, tax policy and incentives, and the state of trade relationships, among other factors, can affect factory location decisions, where countries source their imports, and how they route their exports.

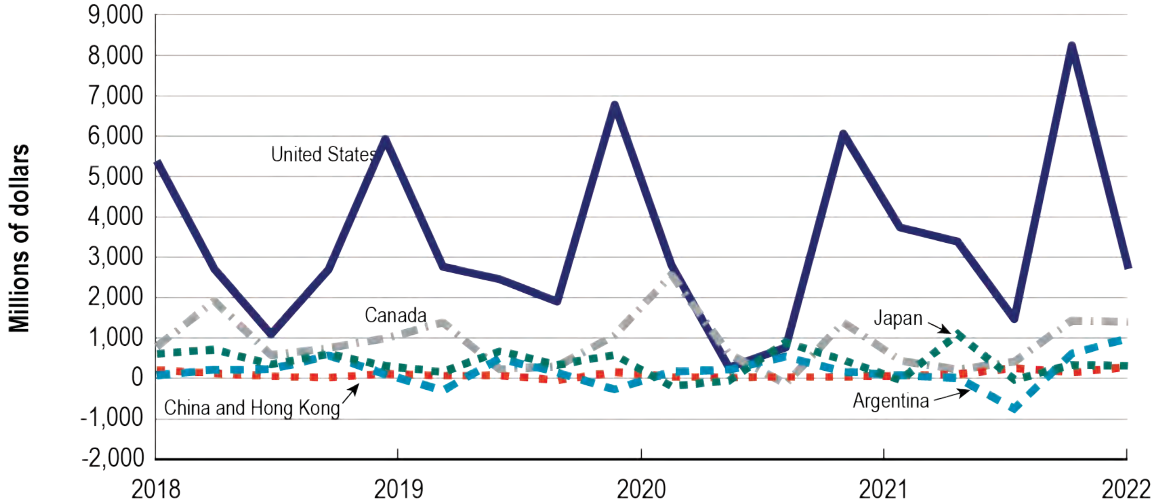
U.S.-China trade friction in 2018 caused some U.S. and Chinese manufacturers in China to relocate production capacity to other countries around them [Rapoza 2020 and WSJ 2019]. The recent supply chain constraints can also encourage U.S. companies to bring production closer to home, where shorter supply chains can be more readily managed for risk. Some companies, under the rubric of the United States-Mexico-Canada trade agreement (USMCA), have relocated production capacity to Mexico, where hard (e.g., rail and road accesses) and soft (e.g., trade and regulatory frameworks) have been long-established.

There are also indications that U.S. companies are reshoring some production capacity and that foreign direct investments (FDI) are being made in new plant operations, though the former is not necessarily a recent phenomenon. For example, the National Institute of Standards and Technology estimates that one million jobs were reshored to the United State during the period 2010–2020 [NIST 2022], with recent data indicating the addition of more than 600,000 jobs since 2020 [Reshoring Initiative 2022]. Largely encouraged by the new U.S. CHIPS and Science Act, U.S. semiconductor manufacturers Intel, GlobalFoundries, and Micron have announced plans to reshore fabrication plants in the United States [Moser 2022]. For FDI in 2021, foreign companies invested more than $333 billion in acquiring, establishing, or expanding U.S. businesses, an increase from $141 billion from COVID year 2020, with $121 billion of the 2021 amount invested in manufacturing [USDOC BEA 2021]. The recent decision by a major textile goods supplier to relocate some of its production capacity to California from Jordan exemplifies the FDI trend in the United States [Sousa 2022].

FDI in a country at the Nation's borders can also induce a shift in supply chains. Mexico, for example, has received $11.5 billion from its top 5 FDI countries in the first quarter of 2022 alone, as shown in Figure 3-14, which also presents the quarterly FDI flows to Mexico for the top 5 countries during the period 2018 through the first two quarters of 2022. FDI flows from the United States are far and above the investments made by the other four countries—exceeding their combined investments. An upward trend in U.S. FDI can be observed around the timeframe of the USMCA's signing and implementation in 2020. A sharp decline is also observed in the third quarter of 2020 with the advent of COVID-19, with another surge observed in 2022 as U.S. manufacturers sought to shorten their supply chains; the U.S. investments reported for the first two quarters in 2022 have already surpassed the U.S. companies' entire 2020 investments. Note that the other four countries, though showing a far lower scale of FDI, will also benefit from proximity to U.S. markets under USMCA's rubric. This will largely impact truck flows in U.S.-Mexican cross-border trades given its predominance over other modes.

[7] Foreign direct investment occurs when a foreign company invests in another country for purposes of acquiring, establishing, or expanding business activity.

Figure 3-14 Foreign Direct Investment in Mexico by Top-5 Countries, 2016 Through Second Quarter of 2022



SOURCES: Gobierno de México, "Información Estadística de la Inversión Extranjera Directa", Información estadística general de flujos de IED hacia México desde 1999, available at https://www.datos.gob.mx/busca/dataset/informacion-estadistica-de-la-inversion-extranjera-directa as of 26 September 2022.

Changing Freight Distribution Practices and the Impact of e-Commerce

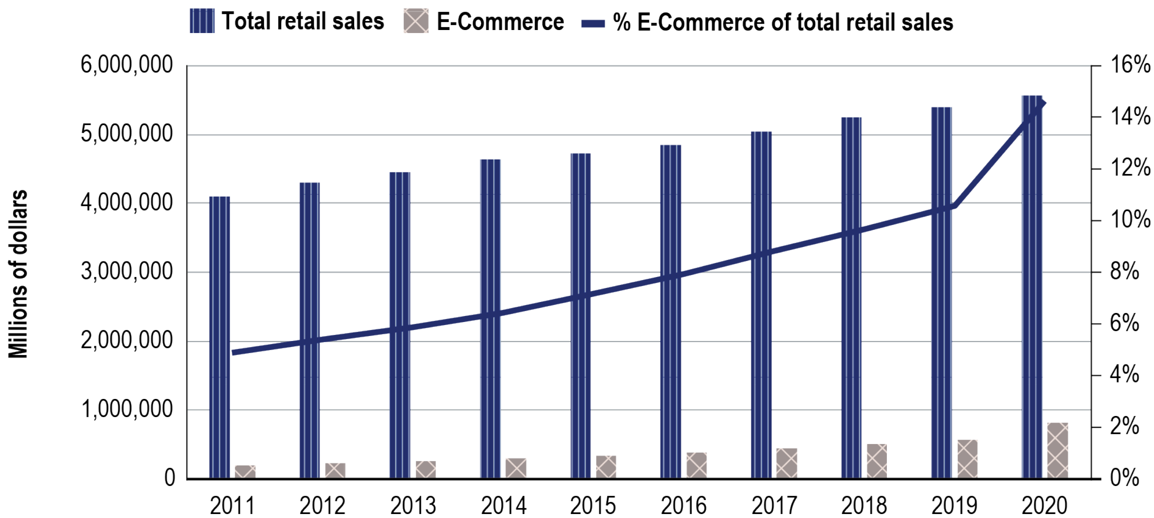
In recent years, large nationwide retailers created distribution centers in coastal port areas; after clearance from U.S. Customs, marine containers would move from ports to these centers or at cross-docking facilities[8] in distribution centers, sorted in accord with the store to where the products were assigned, and then loaded onto trailers for final delivery. While these retailers still rely on distribution centers near ports, the increased use of e-commerce platforms means that retail goods inventory is now forward-positioned in intermediate locations in suburbs and in closer proximity to urban centers, and even within cities, to meet customer demands for quick-order delivery of goods.

Figure 3-15 illustrates how e-commerce retail sales have steeply risen in recent years, especially during the COVID-19 year 2020, when e-commerce accounted for 14.6 percent of all retail sales, up nearly three times its 4.9 percent share in 2011. In contrast, total retail sales in 2020 are only 3 percent higher than that in 2019. The year 2016 saw for the first time shoppers spending more than 50 percent of their purchases online [UPS 2016]. With retailers focused now on customer online and ship-to-store experiences, e-commerce sales can be expected to continue to rise.

Increasing e-commerce sales as a proportion of retail sales will have the effect of decreasing shipment distances, creating greater challenges for mitigating traffic, especially in the approaches to urban areas. This can change trucking operations as an increasing number of trucks will be deployed for shorter hauls and last-mile deliveries.

[8] Cross-docking facilities enable the direct transfer of goods from inbound trucks to outbound trucks for delivery to multiple locations without interim storage and hence eliminate storage fees and storage time.

Figure 3-15 Growth of Retail and E-Commerce Share of Total Retail Sales, 2011–2020



SOURCES: U.S. Census Bureau, Annual Retail Trade Survey: 2020, Estimated Annual U.S. Retail Trade Sales - Total and E-Commerce: 1998-2020, available at https://www.census.gov/data/tables/2020/econ/arts/annual-report.html as of September 2022.

Supply Chain Disruption and Freight Transportation Performance

The Nation's freight transportation network consists of many nodes and links, each of which may become a bottleneck and affect the overall freight transportation performance. The COVID-19 pandemic has heightened the awareness of such supply chain bottlenecks. Marine containers provide a good example as they are moved through various links (when the container moves, such as ships, roads, rail, and barges) and nodes (where the container is processed or stored, such as marine terminals, customs, border posts, free zones, and distribution centers). Links and nodes also exist in the port areas as container ships move between the port's entrance buoy to a berth and containers are loaded and discharged, stored, and moved through gate processing. Supply chain disruptions experienced over the past several years put significant stresses on many of these nodes and links throughout the network, which are captured by some of the BTS freight performance measures.

Container Port Performance

In the port area, there is a range of indicators that can be generated to gauge the performance of marine terminal operations. The ability to collect data related to the time a vessel spends in a port is enabled using the Automatic Identification System (AIS), which identifies the vessel and tracks its speed, direction, and location. The AIS can identify the port or terminal the vessel is calling. BTS uses AIS data for the time the vessel spends at the berth, referred to as container vessel dwell time.

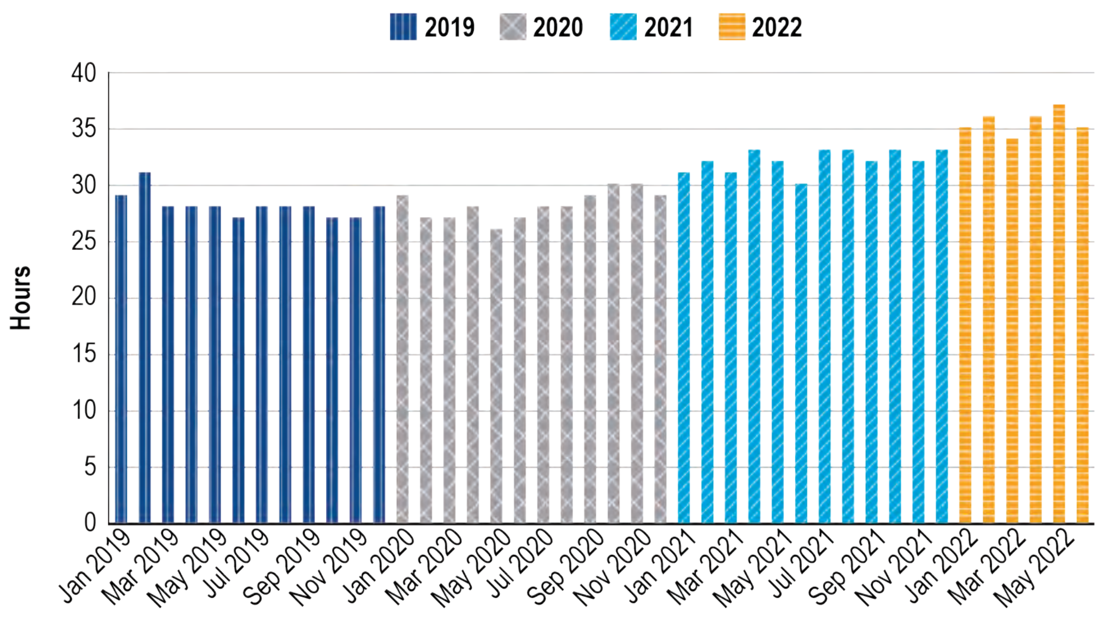
Figure 3-16 shows the average vessel dwell time for the top 25 U.S. container ports. In 2019, 2020, and 2021, the average dwell time was 28.1 hours, 28.2 hours, and 32.1, respectively. The average dwell time continued to increase in the first half of 2022 reaching 35.5 hours, altogether showing a gradual increase due to COVID-related demand [USDOT BTS 2022b]. The impact of COVID-related demand notwithstanding, dwell time can be affected by the vessel's size and the call size. For container ships, size is indicated by the capacity of the vessel, usually in twenty-foot equivalent units (TEU). Call size refers to the container volume that is loaded onto or discharged from the vessel, also reported in TEU.

Figure 3-17 illustrates the impact larger vessels have had at the United States' largest container port complex in San Pedro Bay, which includes the ports of Los Angeles and Long Beach.

The figure shows a general decline in the number of ship calls from 2005 to 2015, from 2,817 ship calls in 2005 to 2,070 ship calls in 2015. However, container volume per call, reflected in TEUs, increased from an average of 5,039 TEUs per call in 2005 to 7,420 TEUs per call in 2015 as vessel calls decreased and ship size increased. Given shipping alliance efforts to maximize capacity utilization, and the likelihood of even larger vessels increasing their share of total port calls since 2015, it is probable that the average volume per call has since increased in Los Angeles and Long Beach.

The World Bank ranks container ports on an annual basis according to their performance as measured by vessel waiting time (at anchor) and vessel berth time [WBG 2022]. The World Bank collects vessel AIS data and a carrier's operational time stamps for 370 container ports worldwide. A performance index that incorporates call size and ship size (TEU capacity) is calculated as they have a bearing on berth time, as the above noted vessel call trends of the San Pedro Bay ports suggest. An index is calculated for each port and reported by both total score and scores by ship size category. The index represents the time the (1) vessel waits at anchor, (2) the vessel's buoy-to-berth transit time, and (3) vessel's total berth time. Port performance overall is thus measured by the vessel's total time in port, from arrival to

Figure 3-16 Average Container Vessel Dwell Time for Top 25 U.S. Container Ports: 2019–June 2022



NOTES: Vessel calls of less than 4 hours or more than 120 hours were excluded as representing calls either too short for significant cargo handling or too long for normal operations.

SOURCES: U.S. Department of Transportation, Bureau of Transportation Statistics, calculated using AIS data from the U.S. Coast Guard's Nationwide Automatic Identification System (NAIS) archive, processed by the U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory, through the AIS Analysis Package (AISAP) software application, as of December 2021.

the entrance buoy to berth departure, and thus considers more broadly port performance than indicated by container vessel (berth) dwell time alone.

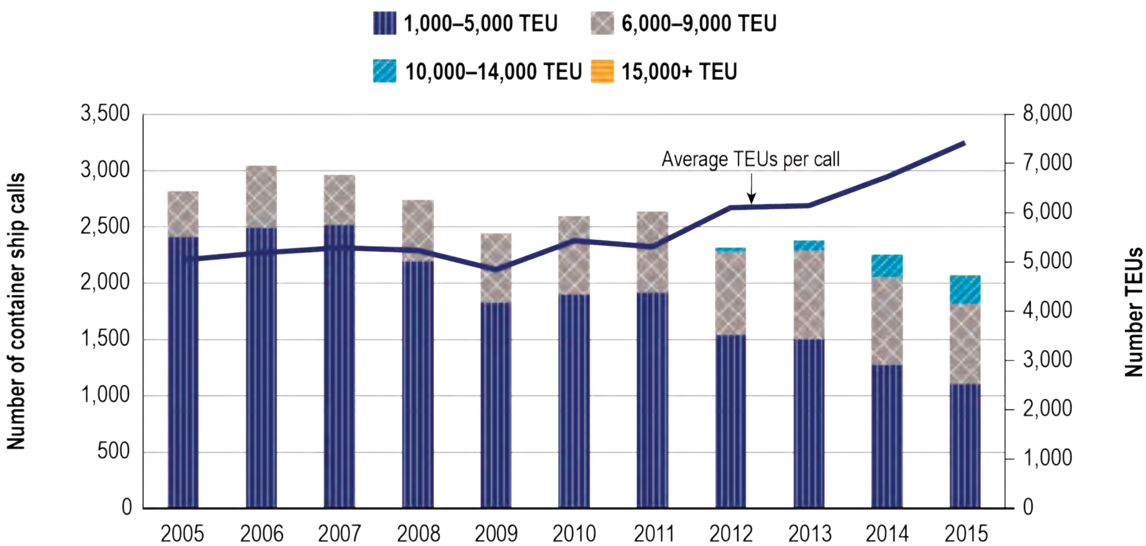
Figure 3-18 identifies the U.S. top 25 container ports based on TEU, with the ports of Los Angeles, Long Beach, and New York numbering among the top 3. Only the port of New Orleans, on the lower end of the top 25, handles more exports than imports. Honolulu handles the highest number of domestic containers. Table 3-6 presents the World Bank's global rankings of these ports for each port's overall rank by vessel size category.

Virginia, ranked 23rd of 370 ports, has the highest ranking of the U.S. top 25 ports while also ranking 19th for the 8,501–13,500-TEU vessel size category. Virginia's rank, however, is far lower for vessels of less than 1,500-TEU capacity, at 168. Miami ranks 29th overall and 19th for the 1,501–5,000-vessel size category, but 133rd for the 5,001–8,500 vessel size category. The rankings overall indicate that not all vessel size categories are receiving the same level of service, demonstrating the constant challenges that port operators face in balancing berth and equipment allocation with often multiple vessel calls of different capacity vessels.

Truck and Rail Performance

The earlier-noted shift of Asian container trades to U.S. East Coast ports encouraged a shift from intermodal rail transport to truck transport because distances from the East Coast are shorter to Mid-west markets. Consequently, the average dwell time at major terminals increased for all major terminals for the eastern railroads while that for the western railroads did not increase as much or even decreased, reflecting the relative changes in the congestion level at the rail terminals in different locations. For

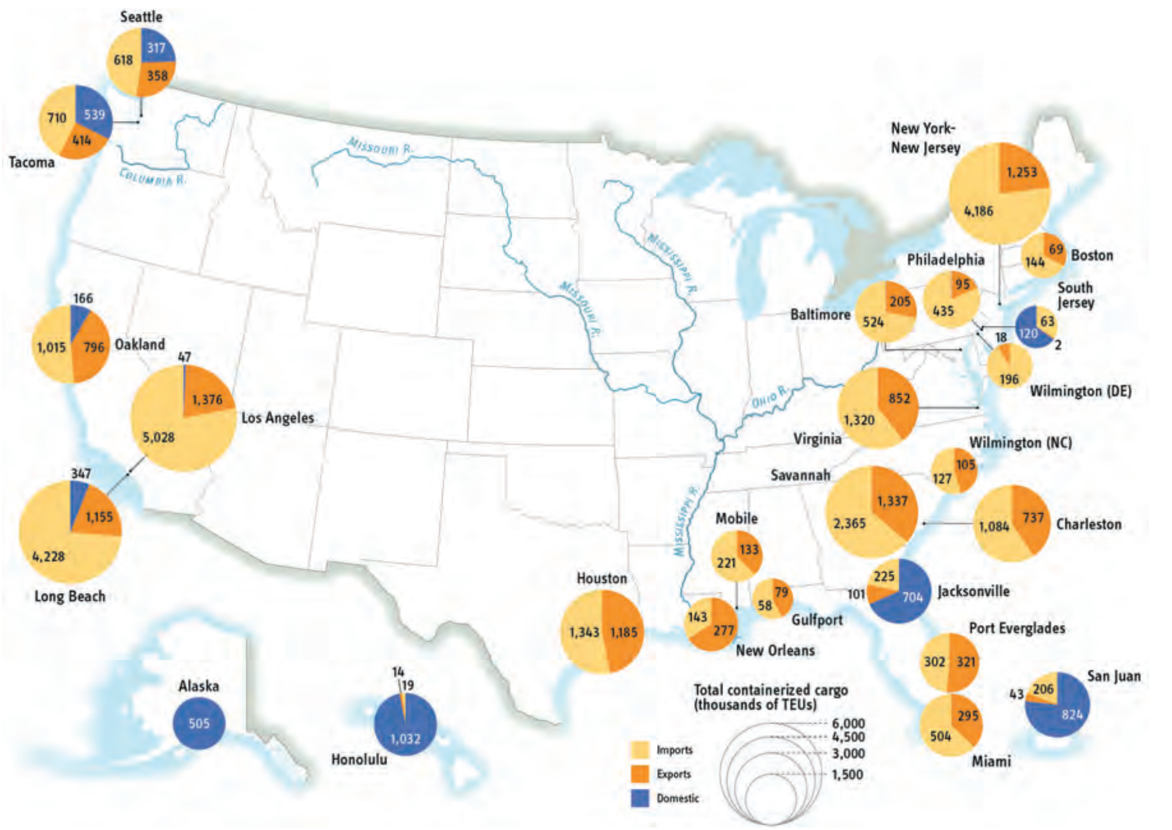
Figure 3-17 Vessel Size and Call Trends and Average Container Throughput per Call, Ports of Los Angeles and Long Beach: 2005–2015



KEY: TEU = twenty-foot equivalent unit.

SOURCE: Vessel call data and size category from San Pedro Bay Ports Clean Air Action Plan, Bay Wide Ocean-Going Vessel International Maritime Organization Tier Forecast 2015-2050, July 2017, p. 3; TEU volume data from the Port of Los Angeles, Annual Container Statistics, available at https://www.portoflosangeles.org/business/statistics/container-statistics and Port of Long Beach, TEUs Archive: 1995 to Present by Year, available at https://polb.com/business/port-statistics#yearly-teus; data at both ports available as of October 20221.

Figure 3-18 U.S. Top 25 Container Ports Based on Twenty-Foot Equivalent Units (TEUs)



SOURCE: U.S. Army Corps of Engineers, Navigation Data Center, personal communication, special tabulation, Nov. 12, 2020, and Nov. 2, 2021.

Table 3-6 World Bank Container Port Performance Index Rankings of Top-Ten U.S. Container Ports: 2021

Port	Overall Rank	Rank by vessel size ranges				
		<1,500 TEU	1,501–5,000 TEU	5,001–8,500 TEU	8,501–13,500 TEU	>13,500 TEU
Los Angeles	370	0	346	224	181	103
Long Beach	369	258	348	227	175	102
NY/NJ	251	160	226	138	121	75
Savannah	367	268	336	214	179	100
Houston	119	119	173	113	101	0
Virginia	23	168	60	44	19	40
Oakland	359	206	229	186	167	96
Charleston	130	79	102	102	75	80
Tacoma	345	0	276	196	173	0
Seattle	322	0	268	190	170	0

KEY: TEU = twenty-foot equivalent unit.

SOURCE: World Bank, Container Port Performance Index 2021, available at https://openknowledge.worldbank.org/handle/10986/37542 as of October 2022.

example, according to the BTS Supply Chain Indicators (www.bts.gov/freight-indicators), the western railroad's (BSNF's) average dwell time was 26.62 hours in 2020, 25.30 hours in 2021, and 27.10 hours in 2022. While the corresponding indicator for the eastern railroad (CSX) was 18.20, 21.60, and 23.60, respectively, showing a steady increase every year. CSX experienced some dramatic increases at terminals like Louisville, KY (52.3 percent from 2021 to 2022) and Toledo, OH (32.5 percent from 2021 to 2022). The average dwell time by another eastern railroad, NS, at Macon, GA, increased from 28.50 hours in 2021 to 37.90 hours in 2022. No western railroads experienced such dramatic increases in the same period [BTS Supply Chain Indicators 2022].

It is interesting to note that this increase does not seem to have as much to do with railroads as with terminals. For example, the average dwell time by the Central railroad CP went from 17.7 hours in 2021 to 26.6 hours in 2022 at Albany, NY. The same railroad experienced similar large increases at Glenwood, MD and Harvey, IL. No terminals on the West Coast experienced such increases, regardless of railroads [BTS Supply Chain Indicators 2022].

A consistent pattern is seen in average truck speed in the vicinity of ports. For example, the average truck speed around the port of Los Angeles-Long Beach generally increased from 2019 through 2022, particularly in the second half of each year, while that around the port of New York-New Jersey is generally lower in 2022 than in 2020 and 2021. Take as an example Octobers of 2020, 2021, and 2022 for which the latest data is available, the average truck speed around the port of Los Angeles-Long Beach was 19.7 mph, 20.2 mph, and 20.6 mph, respectively, while that around the port of New York-New Jersey was 19.0 mph, 18.9 mph, and 18.8 mph, respectively. One increased annually and the other the opposite [BTS Supply Chain Indicators 2022].

Additional Data Needs

Previous editions of the Transportation Statistics Annual Report highlighted long-standing needs for more timely and granular data on freight flows; more complete data on the domestic transportation of U.S. foreign trade, costs of shipping freight, and last-mile movements of freight; and better data on the performance of the freight transportation system. As noted in the last chapter of this report, BTS is undertaking several activities to address these long-standing needs for improved freight statistics. Among the actions are initiatives for improved measurement of the volume, availability, and performance of containerized freight, the detailed needs for which are described in this section.

In response, the Ocean Shipping Reform Act (OSRA) of 2022 (P.L. 117-146) was signed into law on June 15, 2022. Section 16 of the OSRA included mandates for BTS to produce statistics on the total street dwell times (the amount of time an empty or loaded container or a bare or loaded chassis spent between exiting the gate and returning to the terminal) for intermodal shipping containers and chassis. In addition, BTS is required to measure the average out-of-service percentage for chassis. The data that BTS is obtaining will include chassis and container operators, location, fleet availability, and usage.

The Freight Logistics Optimization Works (FLOW) initiative is a joint effort between the USDOT and the freight industry. The initiative will allow industry partners to make better-informed decisions to move goods efficiently through data sharing. BTS is the independent steward of this data-sharing initiative across a privately operated enterprise that spans from shipping lines, ports, terminal operators, truckers, railroads, warehouses, and beneficial cargo owners.

BTS has identified several important freight data gaps through a recent effort in developing the Section 25003 report. For example, the report recognizes that small-area freight origin and destination data and tools are needed for local decision-making. Likewise, support is required to measure freight trip ends (last-mile) and trips from warehouses to retail and office establishments (middle-mile).

A long-existing challenge to freight analysis in general and freight economic analysis in particular is the lack of the freight cost data. None of the Commodity Flow Survey (CFS), Freight Analysis Framework (FAF), and other minor freight data sources provide systematic and system-wide cost information on a per ton, per mile, per ton-mile basis. Information on cost details by commodity, by mode, by route, by region, etc. will greatly benefit all freight analysis

References

Lower Mississippi River Forecast Center (LMRFC), River Observations, Nov. 13, 2022. Available at https://www.weather.gov/lmrfc/ as of November 2022.

Moser, Harry, "Record-Breaking Reshoring," *FABShop Magazine Direct*, November 2022, p. 6. Available at https://magazine.fsmdirect.com/2022/nov/d/#page1 as of November 2022.

National Institute of Science and Technology, Manufacturing Extension Partnership, "Reshoring and the Pandemic: Bringing Manufacturing Back to America," Mar. 31, 2022. Available at https://www.nist.gov/mep/manufacturing-infographics/reshoring-and-pandemic-bringing-manufacturing-back-america as of November 2022.

Rapoza, Kenneth, Forbes, "Chinese Companies Shifting to Other Countries to Avoid US Tariffs," *Forbes*, April 7, 2020. Available at https://www.forbes.com/sites/kenrapoza/2020/04/07/new-data-shows-us-companies-are-definitely-leaving-china/#23ec06ad40fe as of September 2022; *The Wall Street Journal*, "Manufacturers Move Supply Chains Out of China." Available at https://www.wsj.com/articles/manufacturers-move-supply-chains-out-of-china-11563096601 as of September 2022.

Reshoring Initiative, *IH 2022 Data Report – Multiple Supply Chain Risks Accelerate Reshoring*, p. 2. Available at https://reshorenow.org/content/pdf/2022_1H_data_report-final5.5.pdf as of November 2022.

Sousa, Kim, "The Supply Side: Walmart Apparel Supplier Onshores Garment Production," Nov. 5, 2022. Available at https://talkbusiness.net/2022/11/the-supply-side-walmart-apparel-supplier-onshores-garment-production/ as of November 2022.

U.S. Army Corps of Engineers, Institute for Water Resources, 2022. *Waterborne Commerce of the United States*, Calendar Year 2020. Available at file:///C:/Users/pkent/Downloads/d9f5c91d-31a2-47f1-aa9f-3a3c4133d54f___wcusmvgc20.pdf as of November 2022.

U.S. Customs and Border Protection 2022. Ports of Entry. Available at https://www.cbp.gov/border-security/ports-entry

U.S. Department of Commerce (USDOC), Bureau of Economic Analysis (BEA):

—2022a. Gross Output by Industry (billions of 1012 chain dollars). Available at https://apps.bea.gov/iTable/iTable.cfm?reqid=150&step=2&isuri=1&categories=ugdpxind as of September 2022.

—2022b. GDP by Industry, Table 5. Gross Domestic Product: Level and Change from Preceding Period. Available at https://www.bea.gov/data/gdp/gdp-industry as of September 2022.

—2021. New Foreign Investment in the United States. Available at https://www.bea.gov/data/intl-trade-investment/new-foreign-direct-investment-united-states as of November 2022.

U.S. Department of Commerce (USDOC), CENSUS. 2022. U.S. International Trade in Goods and Services, Annual Revision," Release Number: CB 22-92, BEA 22-23, June 7, 2022. Available at https://www.census.gov/foreign-trade/Press-Release/ft900/final_2021.pdf as of September 2022.

U.S. Department of Labor (USDOL), Bureau of Labor Statistics (BLS). 2022. Occupational Employment and Wage Statistics, Occupational Employment and Wages, May 2021. Available at https://www.bls.gov/oes/current/oes537051.htm as of September 2022.

U.S. Department of Transportation (USDOT), Bureau of Transportation Statistics (BTS), and Federal Highway Administration (FHWA). 2022. Freight Analysis Framework, version 5.4, September 2022. Available at www.bts.gov as of October 2022.

U.S. Department of Transportation (USDOT), Bureau of Transportation Statistics (BTS):

—2022a. Border Crossing/Entry Data. Available at www.bts.gov/content/border-crossing entry-data as of September 2022.

—2022b. Container Vessel Dwell Times. Available at https://data.bts.gov/stories/s/Container-Vessel-Dwell-Times/pbag-pyes as of September 2022.

—2022c. Freight Indicators.

United Parcel Service (UPS). 2016. *UPS Pulse of the Online Supper: Tech-Savvy Shoppers Transforming Retail*. Available at https://pressroom.ups.com/pressroom/ContentDetailsViewer.page?ConceptType=FactSheets&id=1465325363052862 as of September 2022.

World Bank Group (WBG). 2022. *The Container Port Performance Index 2021*. Available at https://openknowledge.worldbank.org/handle/10986/37542 as of October 2022.











Printed on paper containing recycled post-consumer waste paper

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